The Carpe Diem
SEIZE THE SEMESTER

# The Carpe Diem Cell Structure — Question Bank

KNUST — College of Health Sciences · HESA

Cell Structure · BIOL 151 · slides 1 to 562

**1,120 questions** · 6 modules · 96 sections · Easy / Medium / Hard / Devil

Format 2 · Answer after every section

# Module 1 — What is a cell? → Putting the organelles together

slides 1 to 100 · 200 questions · 19 sections · bank: BIOL151_Question_Bank_Slides1-100.docx
Difficulty: 80 Easy · 81 Medium · 31 Hard · 8 Devil

## What is a cell? · Q1–8

**Q1** · Easy · *codex, slides 20 to 25*

**What is an organism called if it consists of a single cell?**

1. Multicellular, such as a human or an oak tree
2. Acellular, meaning it has no cells at all
3. Unicellular, such as an amoeba or a bacterium
4. Polycellular, meaning it has two or three cells

**Q2** · Easy · *codex, slide 25*

**Which description best defines a cell?**

1. The smallest structure that always has a membrane-bound nucleus
2. The smallest unit able to perform life functions on its own
3. A group of different tissues cooperating to perform one task
4. A structure found only in organisms made of many cells

**Q3** · Easy · *codex, slide 21*

**Which of these is among the abilities that define life in a cell?**

1. Possessing a rigid cell wall of cellulose
2. Responding to stimuli in its surroundings
3. Containing a membrane-bound nucleus at all times
4. Measuring more than 200 micrometres across

**Q4** · Medium · *codex, slides 20 to 25*

**Which statement about multicellular organisms such as humans is correct?**

1. They consist of one very large cell with many nuclei
2. They contain billions of cells in complex structures
3. They contain only a few hundred cells that work independently
4. They contain no cells that are able to reproduce

**Q5** · Medium · *codex, slides 20 to 25*

**Which of the following is NOT listed among the abilities that define life in cells?**

1. Photosynthesising in sunlight
2. Growing and reproducing
3. Processing information
4. Carrying out chemical reactions

**Q6** · Medium · *codex, slides 20 to 25*

**A bacterium swims toward a nutrient-rich region. Which defining property of life does this show?**

1. Reproducing by cell division
2. Responding to stimuli
3. Growing in overall size
4. Carrying out chemical reactions

**Q7** · Hard · *codex, slides 20 to 25*

**A student argues that a mitochondrion is a cell because it contains DNA and makes ATP. Which part of the definition of a cell shows she is wrong?**

1. A cell must perform life functions on its own, and a mitochondrion cannot outside its host
2. A cell must be larger than 200 micrometres, and mitochondria are much smaller than that
3. A cell must contain a nucleus, and mitochondria have none of their own
4. A cell must be multicellular, and a mitochondrion is a single unit

**Q8** · Hard · *codex, slide 22*

**Which observation best supports the idea that the cell is the fundamental unit of life?**

1. Multicellular organisms contain trillions of cells arranged in complex structures
2. Even simple single-celled organisms show all the major properties of life
3. Cells can be seen under a light microscope using suitable preparation
4. All cells share exactly the same shape and size in every organism

### Answers — What is a cell? · Q1–8

**Q1 — C** · An organism made of one cell is unicellular.

**Q2 — B** · A cell is the smallest unit able to perform life functions independently, which is why it is the basic unit of life.

**Q3 — B** · Responding to stimuli is one of the abilities, along with growth, reproduction, processing information and chemical reactions.

**Q4 — B** · Humans and other multicellular organisms are built from vast numbers of cells in complex structures.

**Q5 — A** · Correct choice.

**Q6 — B** · Moving toward nutrients is a response to a stimulus in the environment.

**Q7 — A** · A cell is the smallest unit able to perform life functions independently.

**Q8 — B** · A single-celled organism shows every major property of life, so the cell is the fundamental unit.

## History of the cell · Q9–20

**Q9** · Easy · *codex, slides 26 to 32*

**In which year did Robert Hooke introduce the term cell?**

1. 1595
2. 1674
3. 1665
4. 1855

**Q10** · Easy · *codex, slides 26 to 32*

**Who was the first person to witness a live cell under a microscope?**

1. Robert Hooke
2. Antony van Leeuwenhoek
3. Robert Brown
4. Rudolf Virchow

**Q11** · Easy · *codex, slide 26*

**In 1665 Robert Hooke named the cell after comparing cork compartments to what?**

1. The honey chambers of a beehive
2. Small rooms that monks lived in
3. Tiny beads strung along a thread
4. Seeds packed inside a fruit

**Q12** · Easy · *codex, slide 26*

**In which publication did Robert Hooke describe his cork observations?**

1. Cellular Pathology, a book on cell origins
2. On the Origin of Species, a work on evolution
3. Micrographia, a book of microscope drawings
4. De Humani Corporis Fabrica, a text on anatomy

**Q13** · Easy · *codex, slide 32*

**Who is credited with building the first compound microscope in 1595?**

1. Zacharias Janssen
2. Robert Hooke
3. Antonie van Leeuwenhoek
4. Ernst Ruska

**Q14** · Medium · *codex, slides 26 to 32*

**What did Hooke actually see when he examined cork under his microscope?**

1. The dead cell walls of plant cells
2. Living cells with visible nuclei
3. Bacteria swimming in a drop of water
4. Protozoa moving among algae

**Q15** · Medium · *codex, slides 26 to 32*

**Besides algae, what did Leeuwenhoek probably see through his microscope?**

1. Mitochondria
2. Ribosomes
3. Chromosomes
4. Bacteria

**Q16** · Medium · *codex, slides 26 to 32*

**Which person and year pairing is correct?**

1. Janssen, 1665
2. Leeuwenhoek, 1595
3. Hooke, 1665
4. Brown, 1674

**Q17** · Medium · *codex, slides 26 to 32*

**How many years after Hooke named the cell (1665) did Leeuwenhoek describe the alga Spirogyra (1674)?**

1. 19 years
2. 29 years
3. 90 years
4. 9 years

**Q18** · Medium · *codex, slides 26 to 32*

**Leeuwenhoek lived from 1632 to 1723. About how old was he when he described the alga Spirogyra in 1674?**

1. 32 years old
2. 52 years old
3. 42 years old
4. 91 years old

**Q19** · Medium · *codex, slide 29*

**Which organism did Leeuwenhoek describe in 1674 when he first saw living cells?**

1. Thin slices of dead cork seen through a lens
2. The green alga Spirogyra under his lens
3. Orchid cells showing a clear central nucleus
4. Red cells drawn from a drop of human blood

**Q20** · Hard · *codex, slide 32*

**Which statement about early microscopists is supported by the lecture timeline?**

1. Hooke described bacteria in 1665, before Leeuwenhoek's microscopes existed
2. Leeuwenhoek had described bacteria by 1683, after Hooke named cells in 1665
3. Janssen described bacteria in 1595 with the first compound microscope
4. Brown described bacteria in 1831 before he identified the nucleus

### Answers — History of the cell · Q9–20

**Q9 — C** · Hooke named the cell in 1665 after viewing cork.
**Q10 — B** · Leeuwenhoek was the first to witness a live cell, in 1674.
**Q11 — B** · Hooke likened the cork compartments to the little rooms (cellulae) monks lived in, which gave us the word cell.
**Q12 — C** · Hooke published his cork observations and drawings in Micrographia.
**Q13 — A** · Janssen is credited with the first compound microscope in 1595.
**Q14 — A** · Hooke saw the walls of dead plant cells, which looked like small rooms.
**Q15 — D** · The lecture says Leeuwenhoek probably also saw bacteria.
**Q16 — C** · Hooke introduced the term cell in 1665.
**Q17 — D** · 1674 minus 1665 is 9 years.
**Q18 — C** · 1674 minus 1632 is 42.
**Q19 — B** · In 1674 Leeuwenhoek described the alga Spirogyra, the first living cells seen.
**Q20 — B** · Hooke named cells in 1665, and Leeuwenhoek had described bacteria by 1683.

## Milestones in cell biology · Q21–34

**Q21** · Easy · *codex, slides 33 to 35*

**Who developed the polymerase chain reaction (PCR) in 1983?**

1. Shinya Yamanaka
2. Ernst Ruska
3. Camillo Golgi
4. Kary Mullis

**Q22** · Easy · *codex, slides 33 to 35*

**Which genome-editing technology emerged in 2012?**

1. Polymerase chain reaction
2. CRISPR-Cas9
3. Super-resolution microscopy
4. The electron microscope

**Q23** · Easy · *codex, slides 33 to 35*

**Who generated induced pluripotent stem cells (iPSCs) in 2006?**

1. Kary Mullis
2. Shinya Yamanaka
3. Friedrich Miescher
4. Max Knoll

**Q24** · Easy · *codex, slides 33 to 35*

**What did Singer and Nicolson propose in 1972?**

1. The chromosome theory of inheritance
2. The double helix structure of DNA
3. The existence of introns in genes
4. The fluid mosaic model of the cell membrane

**Q25** · Easy · *codex, slides 33 to 35*

**Which structure did Watson and Crick describe in 1953?**

1. The double helix of DNA
2. The fluid mosaic membrane
3. The Golgi apparatus
4. The nucleus of orchid cells

**Q26** · Medium · *codex, slide 32*

**Which structure did Robert Brown describe in orchid cells between 1831 and 1833?**

1. The Golgi apparatus
2. The ribosome
3. The cell nucleus
4. The cork cell wall

**Q27** · Medium · *codex, slide 33*

**In 1869 Friedrich Miescher isolated nuclein from cell nuclei. What molecule is this material?**

1. Messenger RNA from active genes
2. Deoxyribonucleic acid (DNA)
3. Ribosomal protein from the cytoplasm
4. Glycogen stored in the nucleus

**Q28** · Medium · *codex, slide 33*

**Which cell structure did Camillo Golgi identify in 1898?**

1. The Golgi apparatus
2. The endoplasmic reticulum
3. The ribosomes
4. The chromosomes

**Q29** · Medium · *codex, slide 33*

**What did Sutton and Boveri propose in 1902 and 1903?**

1. That nuclein is made of a double helix of DNA strands
2. That membranes are a fluid mosaic of lipids and proteins
3. That cells arise only from pre-existing cells
4. That chromosomes carry inherited information

**Q30** · Medium · *codex, slide 34*

**Which scientists made key contributions alongside Watson and Crick to the 1953 double helix model?**

1. Friedrich Miescher and Camillo Golgi
2. Kary Mullis and Shinya Yamanaka
3. Rosalind Franklin and Maurice Wilkins
4. Singer and Nicolson in membrane research

**Q31** · Medium · *codex, slide 34*

**Which gene structure discovery was made in 1977?**

1. The deciphered genetic code
2. The double helix of DNA
3. Introns and RNA splicing
4. The polymerase chain reaction

**Q32** · Hard · *codex, slide 35*

**A lab must amplify pathogen DNA from a patient sample, reprogramme adult cells into pluripotent cells, and edit a gene. Which technologies fit these tasks, in that order?**

1. CRISPR-Cas9, PCR, induced pluripotent stem cells
2. Induced pluripotent stem cells, CRISPR-Cas9, PCR
3. PCR, induced pluripotent stem cells, CRISPR-Cas9
4. PCR, CRISPR-Cas9, induced pluripotent stem cells

**Q33** · Hard · *codex, slides 32 to 35*

**Which scientist and discovery pairing is INCORRECT?**

1. Miescher: the double helix structure of DNA
2. Mullis: the polymerase chain reaction (PCR)
3. Sutton and Boveri: the chromosome theory of inheritance
4. Singer and Nicolson: the fluid mosaic model of the membrane

**Q34** · Devil · *codex, slides 33, 35*

**Which advance is correctly matched to what it made possible?**

1. PCR (1983): revealing the double helix structure of DNA through amplification of samples
2. iPSC generation (2006): leading to the discovery of introns and RNA splicing in genes
3. Electron microscope (1931): showing ultrastructure, leading to descriptions of the ER and ribosomes
4. CRISPR-Cas9 (2012): enabling the first isolation of nuclein from nuclei of human cells

### Answers — Milestones in cell biology · Q21–34

**Q21 — D** · Kary Mullis developed PCR in 1983.

**Q22 — B** · CRISPR-Cas9 emerged in 2012 as a powerful genome-editing technology.

**Q23 — B** · Yamanaka generated iPSCs in 2006.

**Q24 — D** · In 1972 they proposed the fluid mosaic model.

**Q25 — A** · Watson and Crick described the double helix, with contributions from Franklin and Wilkins.

**Q26 — C** · Brown identified and described the nucleus in plant (orchid) cells.

**Q27 — B** · Miescher's nuclein, isolated from nuclei in 1869, was DNA.

**Q28 — A** · Golgi identified the structure that now bears his name in 1898.

**Q29 — D** · Their chromosome theory of inheritance tied heredity to chromosomes.

**Q30 — C** · Franklin and Wilkins made key contributions to the 1953 double helix model.

**Q31 — C** · Introns and RNA splicing were discovered in 1977.

**Q32 — C** · PCR amplifies DNA, iPSC technology reprogrammes cells, and CRISPR-Cas9 edits genes.

**Q33 — A** · Correct choice.

**Q34 — C** · The 1931 electron microscope revealed ultrastructure, and the ER and ribosomes were described by electron microscopy in the 1940s and 1950s.

## Cell theory · Q35–50

**Q35** · Easy · *codex, slides 36 to 39*

**According to the classical tenets, all living things are made up of what?**

1. Organs
2. Tissues
3. Organelles
4. Cells

**Q36** · Easy · *codex, slides 36 to 39*

**Who completed the classical cell theory in 1855?**

1. Theodor Schwann
2. Matthias Schleiden
3. Rudolf Virchow
4. Robert Brown

**Q37** · Easy · *codex, slides 36 to 39*

**Who proposed in 1838 that all plants are composed of cells?**

1. Theodor Schwann
2. Rudolf Virchow
3. Matthias Schleiden
4. Robert Hooke

**Q38** · Easy · *codex, slides 36 to 39*

**Who extended the idea that organisms are made of cells to animals in 1839?**

1. Matthias Schleiden
2. Rudolf Virchow
3. Antony van Leeuwenhoek
4. Theodor Schwann

**Q39** · Easy · *codex, slides 36 to 39*

**What name did Schleiden give to his proposed process of spontaneous crystallization?**

1. Free cell formation
2. Binary fission
3. Cell differentiation
4. Cell fusion

**Q40** · Easy · *codex, slides 36 to 39*

**The classical tenets say cells are the smallest what of all living things?**

1. Storage units
2. Working units
3. Genetic units
4. Chemical units

**Q41** · Medium · *codex, slides 36 to 39*

**Which scientist had already proposed that all cells come from pre-existing cells before Virchow?**

1. Robert Remak
2. Matthias Schleiden
3. Theodor Schwann
4. Robert Brown

**Q42** · Medium · *codex, slides 36 to 39*

**Which statement is part of the modern cell theory?**

1. Energy flow (metabolism) occurs within cells
2. Cells arise by spontaneous crystallization
3. Only plants are composed of cells
4. Cells are not the smallest working units

**Q43** · Medium · *codex, slides 36 to 39*

**Modern cell theory says hereditary information is passed from cell to cell during which process?**

1. Photosynthesis
2. Protein synthesis
3. Phagocytosis
4. Cell division

**Q44** · Medium · *codex, slides 36 to 39*

**In 1839, Schwann and Schleiden suggested what about cells?**

1. That all cells come from pre-existing cells
2. That cells contain hereditary DNA
3. That cells are the basic unit of life
4. That energy flow occurs outside cells

**Q45** · Medium · *codex, slides 36 to 39*

**How many classical tenets of cell theory are listed in the lecture?**

1. Two
2. Four
3. Three
4. Five

**Q46** · Medium · *codex, slides 32, 37*

**A pathologist explains that a tumour enlarges because its cells keep dividing. Which principle, stated by Virchow in 1855, does this illustrate?**

1. Cells form spontaneously by crystallising out of fluid
2. Every cell must contain a prominent nucleus
3. All plants are composed of cells
4. All cells arise from pre-existing cells

**Q47** · Hard · *codex, slides 38, 39*

**Modern cell theory adds statements to the classical version. Which of these are additions rather than classical tenets? 1. Metabolism takes place within cells. 2. Cells carry hereditary DNA that is passed on during division. 3. All living things are made of cells. 4. All cells come from pre-existing cells.**

1. 1 and 2 only
2. 1, 2 and 3 only
3. 3 and 4 only
4. 2, 3 and 4 only

**Q48** · Hard · *codex, slides 36, 37*

**Which point shows that the 1839 Schwann and Schleiden theory was still incomplete?**

1. It lacked the idea that cells arise from existing cells, and Schleiden proposed spontaneous free cell formation
2. It rejected the idea of cells as the basic unit of life and treated whole tissues as the fundamental unit
3. It applied only to plants, because Schwann had not yet shown that animal tissues are also made of cells
4. It required every cell to contain a nucleus, a condition that red blood cells later showed to be false

**Q49** · Hard · *codex, slides 32, 36, 37*

**Which statement correctly gives who proposed classical cell theory and when it was completed?**

1. Schwann and Virchow proposed it by 1839, and Schleiden completed it in 1855
2. Hooke and Brown proposed it by 1665, and Virchow completed it in 1831
3. Schleiden and Schwann proposed it by 1839, and Virchow completed it in 1855
4. Schleiden and Schwann proposed it by 1855, and Virchow completed it in 1839

**Q50** · Devil · *codex, slide 39*

**Which statement would a supporter of modern cell theory reject?**

1. An organism's activity reflects the total activity of its cells
2. Metabolism occurs mainly in body fluid outside all cells
3. DNA carried in cells is passed on during cell division
4. Cells of similar species share basic chemical composition

### Answers — Cell theory · Q35–50

**Q35 — D** · The first tenet says all living things are made up of cells.
**Q36 — C** · Virchow concluded in 1855 that all cells come from pre-existing cells.
**Q37 — C** · Schleiden proposed this in 1838.
**Q38 — D** · Schwann extended Schleiden's idea to animals in 1839.
**Q39 — A** · Schleiden called it free cell formation, and it differs from modern theory.
**Q40 — B** · Cells are the smallest working units of all living things.
**Q41 — A** · Remak had proposed it, and it has been suggested Virchow plagiarized him.
**Q42 — A** · Modern theory places metabolism within cells.
**Q43 — D** · DNA is passed from cell to cell during cell division.
**Q44 — C** · They suggested that cells were the basic unit of life.
**Q45 — C** · The lecture lists three classical tenets.
**Q46 — D** · Virchow's omnis cellula e cellula says new cells come from division of existing cells, as in tumour growth.
**Q47 — A** · Metabolism inside cells and DNA-based heredity are the modern additions; statements 3 and 4 are classical tenets.
**Q48 — A** · Cell origin from existing cells was missing, and Schleiden's free cell formation was later replaced by Virchow's principle.
**Q49 — C** · Schleiden (1838) and Schwann (1839) established it, and Virchow completed it in 1855.
**Q50 — B** · Correct choice.

## Diversity of cells · Q51–68

**Q51** · Easy · *codex, slides 41 to 49*

**Which blood cells are part of the immune system?**

1. White blood cells
2. Red blood cells
3. Platelets
4. Osteocytes

**Q52** · Easy · *codex, slides 41 to 49*

**Gametes are haploid. What do they form when they fuse?**

1. A stem cell line
2. A muscle fibre
3. A red blood cell
4. A zygote

**Q53** · Easy · *codex, slides 41 to 49*

**What are stem cells capable of?**

1. Self-renewal and specialization
2. Only carrying oxygen in the blood
3. Only transmitting signals along axons
4. Only contracting to cause movement

**Q54** · Easy · *codex, slides 41 to 49*

**Roughly how many distinct cell types does the human body contain?**

1. About 20
2. Over 200
3. About 50
4. Over 2,000

**Q55** · Easy · *codex, slide 44*

**Which feature distinguishes a mature human red blood cell from most other human cells?**

1. It contains two nuclei and divides quickly to repair tissue
2. It lacks a nucleus and is specialised to carry oxygen
3. It sits in lacunae and maintains the bone matrix
4. It is haploid and fuses with another cell to form a zygote

**Q56** · Easy · *codex, slide 43*

**Which cell type extends axons and dendrites to transmit signals?**

1. Osteocytes of bone tissue
2. Red blood cells of the circulation
3. Neurons of the nervous system
4. Gametes such as sperm and egg

**Q57** · Easy · *codex, slide 44*

**Which cell type is packed with contractile proteins?**

1. Red blood cells that carry oxygen
2. Osteocytes that maintain bone matrix
3. Muscle cells that generate movement
4. Neurons that transmit electrical signals

**Q58** · Medium · *codex, slides 41 to 49*

**Which statement about oxygen and cells is supported?**

1. Oxygen is essential for every cell of every organism
2. Oxygen kills every cell that is exposed to it
3. Oxygen has no effect on any cell at all
4. Oxygen kills some cells but is essential for others

**Q59** · Medium · *codex, slides 41 to 49*

**Which example shows a unicellular organism living in close association with another organism?**

1. A lone amoeba living freely in a drop of pond water
2. Bacteria that help plants extract nitrogen from the air
3. A neuron forming connections in the cerebellum
4. A red blood cell carrying oxygen through the blood

**Q60** · Medium · *codex, slides 41 to 49*

**About how large is the human egg cell?**

1. About 2 micrometres
2. About 200 micrometres
3. About 20 micrometres
4. About 2 millimetres

**Q61** · Medium · *codex, slides 41 to 49*

**Where do osteocytes reside, and what do they do?**

1. They float in the blood and carry oxygen
2. They sit in the cerebellum and form synapses
3. They line the muscles and contain contractile proteins
4. They reside in lacunae and maintain the bone matrix

**Q62** · Medium · *codex, slides 41 to 49*

**Which statements about unicellular organisms are correct? 1. Some live in isolation. 2. Others form colonies. 3. All of them lack DNA. 4. None of them respond to stimuli.**

1. 1 and 2 only
2. 1, 2 and 3 only
3. 2 and 4 only
4. 3 and 4 only

**Q63** · Medium · *codex, slides 41 to 49*

**Which statement about the human egg and sperm cells is correct?**

1. Both are multicellular structures that divide before fusing
2. Both are single cells, and their union starts the development of the body
3. Only the egg is a cell, and sperm is a non-living particle
4. Both are diploid cells that contain 92 chromosomes each

**Q64** · Medium · *codex, slide 48*

**Which blood element provides substances that let blood clot at a wound?**

1. The platelets circulating in blood
2. The red cells circulating in blood
3. The white cells circulating in blood
4. The osteocytes embedded in bone

**Q65** · Hard · *codex, slide 47*

**A microbiologist finds a microbe in cattle rumen that converts carbon dioxide and water into methane, around 150 litres of gas a day per animal. Which group does it belong to?**

1. Archaebacteria such as Methanosarcina
2. Filamentous algae such as Spirogyra
3. Rotifers that move rapidly in water
4. Bacteria that help plants obtain nitrogen

**Q66** · Hard · *codex, slides 42, 49*

**A Purkinje neuron in the cerebellum can form over 100,000 connections through its dendrites. Which idea about cells does this best illustrate?**

1. All human cell types share one identical structure
2. Cells with more connections must contain several nuclei
3. Nerve cells are not true cells but extensions of tissue
4. Cell shape and structure are specialised for function

**Q67** · Hard · *codex, slide 41*

**A lecture lists amoebae and rotifers as organisms that move rapidly, while others stay largely stationary. Which idea about living things does this illustrate?**

1. Movement is what separates living cells from non-living material
2. Rapid movement is required before an organism counts as single-celled
3. Cells that stay in place cannot reproduce or respond to stimuli
4. Cells and organisms show great diversity, including differences in movement

**Q68** · Devil · *codex, slide 43*

**Which statement correctly distinguishes human gametes from stem cells?**

1. Gametes can self-renew and specialise, while stem cells are haploid and fuse to form a zygote
2. Both cell types are haploid, but only stem cells can fuse with another cell to form a zygote
3. Gametes are haploid and fuse to form a zygote, while stem cells can self-renew and specialise
4. Both self-renew without limit, but only gametes can specialise into different kinds of tissue

### Answers — Diversity of cells · Q51–68

**Q51 — A** · White blood cells are part of the immune system.
**Q52 — D** · Gametes fuse to form a zygote.
**Q53 — A** · Stem cells are undifferentiated and can self-renew and specialise.
**Q54 — B** · The human body has over 200 distinct cell types.
**Q55 — B** · Red blood cells have no nucleus, which suits their job of transporting oxygen.
**Q56 — C** · Neurons extend axons and dendrites to transmit signals.
**Q57 — C** · Muscle cells are packed with contractile proteins that generate movement.
**Q58 — D** · Cells vary in their need for oxygen.
**Q59 — B** · Such bacteria live in association with plants.
**Q60 — B** · The human egg is about 200 micrometres.
**Q61 — D** · Osteocytes sit in lacunae and maintain bone matrix.
**Q62 — A** · Some unicellular organisms live in isolation, and others form colonies or live in association.
**Q63 — B** · The egg and sperm are single cells whose union begins development.
**Q64 — A** · Platelets provide the substances that allow blood to clot at a wound.
**Q65 — A** · Methanosarcina is an archaebacterium that makes methane from CO2 and water, and some live in cattle rumen.
**Q66 — D** · A cell's shape and structure reflect its specialised role, as a neuron's extensive dendrites show.
**Q67 — D** · The examples illustrate the variety of living things, including differences in movement.
**Q68 — C** · Gametes are haploid and fuse into a zygote; stem cells are undifferentiated and can renew themselves and specialise.

## The nucleus: envelope and pores · Q69–82

**Q69** · Easy · *codex, slides 54 to 62*

**What is the gap between the two membranes of the nuclear envelope called?**

1. The perinuclear space
2. The nucleoplasm
3. The cytosol
4. The annulus

**Q70** · Easy · *codex, slides 54 to 62*

**How many protein granules surround each nuclear pore?**

1. Four
2. Six
3. Twelve
4. Eight

**Q71** · Easy · *codex, slides 54 to 62*

**Where are nuclear pores found?**

1. Where the outer and inner membranes fuse
2. Only on the surface of the nucleolus
3. On the inner membrane alone
4. Where the envelope meets the Golgi

**Q72** · Easy · *codex, slides 54 to 62*

**The nuclear pores are described as being filled with what?**

1. Lipid
2. Water
3. DNA
4. Glycogen

**Q73** · Easy · *codex, slide 59*

**Which organelle is described as the control centre of the cell and holds its DNA?**

1. The ribosome, built from rRNA and protein
2. The lysosome, filled with hydrolytic enzymes
3. The Golgi apparatus, a stack of flattened sacs
4. The nucleus, enclosed by a double membrane

**Q74** · Easy · *codex, slides 54, 61*

**How many membranes surround the nucleus?**

1. One membrane, forming a single boundary layer
2. Two membranes, together forming the nuclear envelope
3. None, because the nucleus is only a free region
4. Three, with an extra membrane around the nucleolus

**Q75** · Medium · *codex, slides 54 to 62*

**What kind of symmetry does the annulus around a nuclear pore show?**

1. Fourfold (square) symmetry
2. Sixfold (hexagonal) symmetry
3. Eightfold (octagonal) symmetry
4. No symmetry at all

**Q76** · Medium · *codex, slides 54 to 62*

**The proteins that assemble the nuclear pore complex are mainly called what?**

1. Nucleoporins
2. Histones
3. Tubulins
4. Lamins

**Q77** · Medium · *codex, slides 54 to 62*

**Which statement about the nuclear pore complex is correct?**

1. It synthesises ribosomal RNA for the nucleolus
2. It condenses chromosomes before cell division
3. It regulates transport of RNA and proteins
4. It stores calcium ions for the cell

**Q78** · Medium · *codex, slides 54 to 62*

**All of the following are true of the nuclear envelope EXCEPT which one?**

1. It is a double membrane with a gap between
2. It is perforated by water-filled nuclear pores
3. Its outer membrane is continuous with the rough ER
4. Its inner membrane is continuous with the rough ER

**Q79** · Medium · *codex, slides 54, 85*

**Which feature links the nuclear envelope to the endomembrane system?**

1. Its inner membrane is continuous with the Golgi apparatus
2. Its outer membrane is continuous with the rough ER
3. Its pores fuse directly with the lysosome membrane
4. Its perinuclear space is shared with the plasma membrane

**Q80** · Hard · *codex, slides 61, 62*

**Which description of the nuclear pore complex is accurate?**

1. Six histone subunits in hexagonal symmetry regulate transport of RNA and proteins into the nucleus
2. Eight protein subunits in octagonal symmetry, mainly nucleoporins, regulate transport of RNA and proteins
3. Eight protein subunits in octagonal symmetry form a fixed open hole that lets all molecules pass
4. Four nucleoporin subunits in square symmetry, found only on the inner membrane, move DNA out

**Q81** · Hard · *codex, slide 61*

**On an electron micrograph the two nuclear membranes are separated by a gap but meet at certain points. What are the gap and the meeting points?**

1. The perinuclear space, and sites where pores form
2. The nucleoplasm, and sites where nucleoli attach
3. The perinuclear space, and sites where ribosomes dock
4. The annulus, and sites where histones bind

**Q82** · Devil · *codex, slides 54, 58*

**Which statement correctly contrasts the nucleus with the nucleolus?**

1. The nucleus has a double membrane envelope, whereas the nucleolus has no membrane and assembles ribosomal subunits
2. The nucleolus has a double membrane envelope, whereas the nucleus has none and assembles ribosomal subunits
3. Both have a double membrane envelope, but only the nucleolus is involved in assembling ribosomal subunits
4. Both lack a surrounding membrane, but only the nucleus contains DNA and is perforated by nuclear pores

### Answers — The nucleus: envelope and pores · Q69–82

**Q69 — A** · The two membranes are separated by the perinuclear space.
**Q70 — D** · Eight protein granules are arranged symmetrically around each pore.
**Q71 — A** · Pores sit at regions where the two membranes fuse.
**Q72 — B** · The nuclear pores are water-filled.
**Q73 — D** · The nucleus is the control centre of the cell and contains its DNA.
**Q74 — B** · The nuclear envelope is a double membrane separated by the perinuclear space.
**Q75 — C** · Eight protein subunits give octagonal symmetry.
**Q76 — A** · Nucleoporins assemble into the nuclear pore complex.
**Q77 — C** · The complex regulates transport between nucleus and cytoplasm.
**Q78 — D** · Correct choice.
**Q79 — B** · The outer nuclear membrane is continuous with the rough ER.
**Q80 — B** · The annulus has eightfold symmetry and is built mainly of nucleoporins that regulate transport.
**Q81 — A** · The gap is the perinuclear space, and pores form where the membranes fuse.
**Q82 — A** · The nucleus has a double membrane envelope, while the nucleolus lacks a membrane and assembles ribosomal subunits.

## Nuclear transport and contents · Q83–90

**Q83** · Easy · *codex, slides 62 to 71*

**Where are nuclear proteins produced?**

1. Inside the nucleolus
2. In the perinuclear space
3. In the nuclear pores
4. In the cytosol

**Q84** · Easy · *codex, slides 62 to 71*

**What do the nuclear pores regulate?**

1. The folding of chromatin into nucleosomes inside the nucleus
2. The assembly of ribosomal subunits in the nucleolus
3. The passage of molecules between the nucleus and cytoplasm
4. The doubling of DNA before the cell divides

**Q85** · Easy · *codex, slides 62 to 71*

**Glycoproteins at the nuclear pore appear to regulate what?**

1. The transcription of rRNA in the nucleolus
2. The doubling of DNA before cell division
3. The entry of material into the nucleus
4. The size of the nucleolus in the nucleus

**Q86** · Medium · *codex, slides 62 to 71*

**Some molecules much bigger than nuclear pores pass freely, while some far smaller are blocked. What does this show about nuclear entry?**

1. It depends only on the size of the molecule
2. It is selective and does not depend on size alone
3. It is completely random
4. It depends only on whether a molecule is charged

**Q87** · Medium · *codex, slides 62 to 71*

**Which materials are allowed into the nucleus to build DNA and RNA?**

1. Fully assembled lysosomes from the cytoplasm
2. Building blocks and molecules that provide energy
3. Complete finished chromosomes from the cytoplasm
4. Intact mitochondria from the cytoplasm

**Q88** · Medium · *codex, slides 62 to 71*

**Chromatin material embedded in the nucleoplasm is the precursor of what?**

1. Ribosomes
2. Lysosomes
3. Chromosomes
4. Nuclear pores

**Q89** · Medium · *codex, slides 62 to 71*

**Which two structures are contained within the nucleus?**

1. The nucleolus and the nucleoplasm
2. The Golgi cisternae and the nucleolus
3. The cristae and the nucleoplasm
4. The thylakoids and the nucleolus

**Q90** · Hard · *codex, slide 66*

**Nuclear proteins are made on ribosomes in the cytosol. Which feature lets them accumulate selectively in the nucleus?**

1. Their synthesis on ribosomes located inside the nucleolus
2. Their small size, which lets only nuclear proteins slip through pores
3. Packaging into lysosomes that deliver them across the envelope
4. Amino acid sequences that act as signals directing them to the nucleus

### Answers — Nuclear transport and contents · Q83–90

**Q83 — D** · Nuclear proteins, like all proteins, are produced in the cytosol.
**Q84 — C** · The pores permit some molecules to pass and block others.
**Q85 — C** · Glycoproteins appear to regulate entry into the nucleus.
**Q86 — B** · Entry is regulated and selective, not purely a size filter.
**Q87 — B** · Building blocks for DNA and RNA and energy molecules are allowed in.
**Q88 — C** · Chromatin is the precursor of chromosomes.
**Q89 — A** · The nucleus contains the nucleolus and the nucleoplasm.
**Q90 — D** · Signal sequences of amino acids concentrate these proteins in the nucleus.

## Chromatin and chromosomes · Q91–102

**Q91** · Easy · *codex, slides 64 to 69*

**What is the complex of DNA and protein in chromosomes called?**

1. Chromatin
2. Cytosol
3. Nucleoid
4. Cytoskeleton

**Q92** · Easy · *codex, slides 64 to 69*

**Chromatin is made up of repeating structural units called what?**

1. Nucleosomes
2. Nucleoporins
3. Cisternae
4. Cristae

**Q93** · Easy · *codex, slides 64 to 69*

**On which structures are genes found?**

1. Ribosomes
2. Nucleoli
3. Lysosomes
4. Chromosomes

**Q94** · Easy · *codex, slides 64 to 69*

**What does each gene direct the synthesis of?**

1. A specific lipid
2. A specific ribosome
3. A specific organelle
4. A specific protein

**Q95** · Easy · *codex, slide 64*

**How many DNA chromosomes does a human cell contain?**

1. 23 chromosomes
2. 48 chromosomes
3. 46 chromosomes
4. 92 chromosomes

**Q96** · Medium · *codex, slides 64 to 69*

**What form do the chromosomes take in dividing cells?**

1. Loosely dispersed chromatin
2. Free RNA strands
3. Tightly packed DNA
4. Membrane-bound vesicles

**Q97** · Medium · *codex, slides 64 to 69*

**A nucleoprotein is best described as what?**

1. A protein made entirely of histones
2. A complex of nucleic acid and protein
3. A lipid bound to DNA in the nucleus
4. A carbohydrate bound to RNA in the cytosol

**Q98** · Medium · *codex, slides 64 to 69*

**By mass, which component makes up about two-thirds of a eukaryotic chromosome?**

1. Protein
2. DNA
3. RNA
4. Lipid

**Q99** · Medium · *codex, slides 64 to 69*

**All of the following describe chromatin EXCEPT which one?**

1. It is a complex of DNA and protein
2. It makes up chromosomes
3. It is built from repeating nucleosomes
4. It is enclosed by its own double membrane

**Q100** · Medium · *codex, slide 69*

**By mass, how is a eukaryotic chromosome divided between DNA and protein?**

1. About one-third DNA and two-thirds protein
2. About two-thirds DNA and one-third protein
3. About equal parts DNA and protein by mass
4. Almost entirely DNA, with only traces of protein

**Q101** · Medium · *codex, slide 69*

**Histones, the main proteins of chromatin, are best described as what?**

1. Small, basic proteins that associate with DNA
2. Large, acidic enzymes that copy DNA
3. Lipid molecules that form the nuclear envelope
4. RNA molecules that assemble ribosomal subunits

**Q102** · Hard · *codex, slide 64*

**A human cell is about to divide. Which sequence of events for its chromosomal DNA is correct?**

1. The chromosomes condense first, then the DNA doubles itself in packed form
2. The DNA doubles itself, then the chromosomes condense into tightly packed forms
3. The DNA doubles itself, then it leaves the nucleus through the pores
4. The DNA is degraded, then rebuilt from histone proteins alone

### Answers — Chromatin and chromosomes · Q91–102

**Q91 — A** · The nucleoprotein complex of DNA and protein is chromatin.
**Q92 — A** · Chromatin is made up of repeating nucleosomes.
**Q93 — D** · Genes are found on chromosomes.
**Q94 — D** · Each gene directs the synthesis of a specific protein.
**Q95 — C** · A human cell contains 46 chromosomes.
**Q96 — C** · Chromosomes in dividing cells are tightly packed DNA.
**Q97 — B** · Chromatin is a nucleoprotein, a complex of DNA and protein.
**Q98 — A** · Chromosomes are about one-third DNA and two-thirds protein.
**Q99 — D** · Correct choice.
**Q100 — A** · Eukaryotic chromosomes are about one-third DNA and two-thirds protein.
**Q101 — A** · Histones are small, basic proteins that form chromatin with DNA.
**Q102 — B** · DNA doubles itself before it condenses into tightly packed chromosomes.

## Ribosomes and protein synthesis · Q103–118

**Q103** · Easy · *codex, slides 72 to 79*

**What is the function of ribosomes?**

1. Lipid synthesis
2. ATP production
3. Photosynthesis
4. Protein synthesis

**Q104** · Easy · *codex, slides 72 to 79*

**Where do free ribosomes float?**

1. Inside the nucleolus
2. In the cytosol
3. In the perinuclear space
4. Inside the thylakoids

**Q105** · Easy · *codex, slides 72 to 79*

**What carries the instructions for making a protein from DNA?**

1. A ribosomal protein
2. Messenger RNA
3. A phospholipid
4. Glycogen

**Q106** · Easy · *codex, slides 72 to 79*

**What are the two subunits of a ribosome called?**

1. The cis subunit and the trans subunit
2. The inner subunit and the outer subunit
3. The large subunit and the small subunit
4. The alpha subunit and the beta subunit

**Q107** · Easy · *codex, slides 72 to 79*

**What does the nucleolus make?**

1. Ribosomal subunits
2. Lysosomal enzymes
3. Chlorophyll for the chloroplast
4. Cell wall cellulose

**Q108** · Easy · *codex, slide 79*

**Ribosomes are composed of which two components?**

1. DNA and histone protein
2. Ribosomal RNA and protein
3. Phospholipid and cholesterol
4. Messenger RNA and glycogen

**Q109** · Medium · *codex, slides 72 to 79*

**Which proteins do free ribosomes produce?**

1. Proteins exported from the cell
2. Only membrane lipids
3. Proteins used within the cell
4. Only DNA polymerase

**Q110** · Medium · *codex, slides 72 to 79*

**Which proteins are made by ribosomes attached to the ER?**

1. Proteins used only in the cytosol
2. Ribosomal RNA for new subunits
3. Proteins for export from the cell
4. Chlorophyll for the chloroplast

**Q111** · Medium · *codex, slides 72 to 79*

**What happens during translation?**

1. DNA is copied onto messenger RNA in the nucleus
2. Ribosomal subunits are assembled in the nucleolus
3. The message is translated into a sequence of amino acids
4. Chromosomes condense before the cell divides

**Q112** · Medium · *codex, slides 72 to 79*

**What happens during transcription?**

1. DNA information is copied onto a messenger RNA
2. The mRNA message is turned into amino acids
3. Ribosomal proteins are made in the nucleolus
4. DNA is degraded and then rebuilt from histones

**Q113** · Medium · *codex, slides 72 to 79*

**Where are rRNA molecules synthesised?**

1. In the rough ER
2. In the nucleolus
3. In the Golgi cisternae
4. In the perinuclear space

**Q114** · Medium · *codex, slides 54, 58*

**Where are ribosomal subunits assembled?**

1. In the perinuclear space of the envelope
2. In the lumen of the rough endoplasmic reticulum
3. In the cisternae of the Golgi apparatus
4. In the nucleolus, a region inside the nucleus

**Q115** · Hard · *codex, slide 72*

**Which sequence correctly shows how a gene directs protein synthesis?**

1. mRNA is translated into DNA, then DNA is transcribed into amino acids
2. Amino acids are transcribed into mRNA, then mRNA is translated into DNA
3. DNA is translated into amino acids, then amino acids are transcribed into mRNA
4. DNA is transcribed into mRNA, then mRNA is translated into amino acids

**Q116** · Hard · *codex, slide 75*

**Which statement about assembly of ribosomal subunits in the nucleolus is correct?**

1. rRNA made from ribosomal genes combines with ribosomal proteins that were produced in the cytoplasm
2. Ribosomal proteins are made inside the nucleolus, using the rRNA transcripts as their template
3. Messenger RNA and histone proteins assemble directly into the large and small subunits there
4. Complete ribosomes form in the cytosol and are then imported into the nucleolus for storage

**Q117** · Hard · *codex, slides 79, 85*

**A pancreatic cell secretes digestive enzymes. Which ribosomes make those enzymes?**

1. Free ribosomes floating throughout the cytosol only
2. Ribosomal subunits stored inside the nucleolus
3. Bound ribosomes attached to the endoplasmic reticulum
4. Ribosomes embedded in the nuclear pore annulus

**Q118** · Devil · *codex, slide 75*

**A drug destroys the nucleoli in a cell. What is the ultimate effect on protein production?**

1. No mRNA can be transcribed from any gene, so proteins stop at once
2. Free ribosomes convert into bound ribosomes, so secretion rises
3. Fewer ribosomal subunits form, so overall protein synthesis declines
4. DNA can no longer double, so chromosomes cannot condense before division

### Answers — Ribosomes and protein synthesis · Q103–118

**Q103 — D** · Ribosomes make proteins.
**Q104 — B** · Free ribosomes float in the cytosol.
**Q105 — B** · DNA is transcribed onto a messenger RNA molecule.
**Q106 — C** · A ribosome has a large and a small subunit.
**Q107 — A** · The nucleolus makes ribosomal subunits from rRNA and proteins.
**Q108 — B** · Ribosomes are built from rRNA and protein, arranged as a large and a small subunit.
**Q109 — C** · Free ribosomes make proteins used within the cell.
**Q110 — C** · Bound ribosomes attached to the ER make proteins for export.
**Q111 — C** · Translation builds a protein from the mRNA message.
**Q112 — A** · Transcription copies a gene's instructions onto mRNA.
**Q113 — B** · Nucleoli are sites of synthesis of rRNA molecules.
**Q114 — D** · The nucleolus is the site where rRNA and proteins form ribosomal subunits.
**Q115 — D** · DNA is transcribed to messenger RNA, which is translated into an amino acid sequence.
**Q116 — A** · rRNA transcripts combine with ribosomal proteins made in the cytoplasm.
**Q117 — C** · Bound ribosomes on the ER make proteins for export from the cell.
**Q118 — C** · Without nucleoli, ribosomal subunits cannot be made, so protein synthesis falls.

## The endomembrane system · Q119–126

**Q119** · Easy · *codex, slides 81 to 85*

**What does the prefix endo mean in endomembrane?**

1. Outside
2. Between
3. Within
4. Around

**Q120** · Easy · *codex, slides 81 to 85*

**Which organelle is part of the endomembrane system?**

1. Mitochondria
2. Chloroplasts
3. Ribosomes
4. Lysosomes

**Q121** · Easy · *codex, slides 81 to 85*

**Which pair belongs to the endomembrane system together with the nuclear envelope?**

1. The mitochondria and the chloroplasts
2. The ribosomes and the centrioles
3. The nucleoli and the chromosomes
4. The ER and the Golgi apparatus

**Q122** · Medium · *codex, slides 81 to 85*

**Why is the plasma membrane counted as part of the endomembrane system?**

1. It produces ribosomal subunits for the other organelles of the system
2. It is continuous with the nuclear pores and the nucleolus
3. It carries out cellular respiration with its inner cristae
4. It interacts with other endomembrane organelles and exports secreted proteins

**Q123** · Medium · *codex, slides 81 to 85*

**What does the endomembrane system regulate?**

1. Light capture and carbon fixation
2. Protein traffic and metabolic functions
3. Storage of hereditary information
4. Construction of the cell wall

**Q124** · Medium · *codex, slides 81 to 85*

**Besides lysosomes, which membranes does the endomembrane system include?**

1. Mitochondrial, chloroplast and peroxisome membranes only
2. Peroxisome, ribosome and centriole membranes only
3. Cell wall, extracellular matrix and cytoskeleton
4. Nuclear envelope, ER, Golgi apparatus and plasma membrane

**Q125** · Medium · *codex, slide 85*

**Which statement best describes the shared job of the endomembrane system?**

1. It generates ATP through oxidative reactions in cristae
2. It modifies, packages and transports lipids and proteins
3. It stores the genetic instructions in chromosomes
4. It anchors the cell to its neighbours and matrix

**Q126** · Hard · *codex, slides 81 to 85*

**A secreted protein is made on bound ribosomes. Which sequence of structures does it pass through before export?**

1. Golgi apparatus, then rough ER, then plasma membrane
2. Rough ER, then lysosome, then plasma membrane
3. Rough ER, then Golgi apparatus, then plasma membrane
4. Nucleolus, then Golgi apparatus, then plasma membrane

### Answers — The endomembrane system · Q119–126

**Q119 — C** · Endo means within.
**Q120 — D** · Lysosomes are part of the endomembrane system.
**Q121 — D** · The ER and Golgi are core endomembrane organelles.
**Q122 — D** · It interacts with the other organelles and is the export site for secreted proteins.
**Q123 — B** · The system regulates protein traffic and performs metabolic functions.
**Q124 — D** · These are the membranes listed in the endomembrane system.
**Q125 — B** · Endomembrane organelles work together to modify, package and transport lipids and proteins.
**Q126 — C** · Secreted proteins pass from rough ER to the Golgi and then to the plasma membrane.

## Endoplasmic reticulum · Q127–136

**Q127** · Easy · *codex, slide 86*

**Which type of ER has ribosomes on its surface?**

1. Smooth ER
2. Neither type has ribosomes
3. Rough ER
4. Only the nuclear envelope

**Q128** · Easy · *codex, slide 86*

**Which type of ER synthesises lipids?**

1. Rough ER
2. The Golgi cisternae
3. The nuclear pores
4. Smooth ER

**Q129** · Easy · *codex, slide 86*

**Which ion is stored in the smooth ER?**

1. Sodium ($Na^{+}$)
2. Calcium ($Ca^{2+}$)
3. Chloride ($Cl^{-}$)
4. Iron ($Fe^{2+}$)

**Q130** · Easy · *codex, slide 86*

**Where do transport vesicles from the rough ER go?**

1. To the nucleolus
2. To the mitochondria
3. To the Golgi apparatus
4. Directly to the chloroplast

**Q131** · Easy · *codex, slide 86*

**The endoplasmic reticulum is best described as a network of what?**

1. Protein filaments
2. Cellulose fibres
3. Membranes and sacs
4. Hydrolytic enzymes

**Q132** · Medium · *codex, slide 86*

**What does the rough ER do with proteins?**

1. It digests them with hydrolytic enzymes
2. It decomposes them with catalase
3. It stores them as pigments
4. It packages them for secretion

**Q133** · Medium · *codex, slide 86*

**Liver cells exposed to the barbiturate phenobarbital expand which organelle to detoxify the drug?**

1. Rough ER
2. Chloroplasts
3. Nucleoli
4. Smooth ER

**Q134** · Medium · *codex, slide 86*

**What else does the rough ER make besides packaging proteins?**

1. Chlorophyll for the chloroplast
2. ATP in its cristae
3. Replacement membrane
4. Ribosomal RNA for new subunits

**Q135** · Medium · *codex, slide 86*

**All of the following are functions of the smooth ER EXCEPT which one?**

1. Synthesising lipids for new membranes
2. Packaging proteins into transport vesicles
3. Storing calcium ions inside the lumen
4. Detoxifying drugs and poisons in liver cells

**Q136** · Hard · *codex, slide 86*

**Cell A stores calcium and detoxifies alcohol, while cell B secretes large amounts of antibody. Which ER type dominates in each?**

1. A: rough ER; B: smooth ER
2. A: smooth ER; B: smooth ER
3. A: rough ER; B: rough ER
4. A: smooth ER; B: rough ER

### Answers — Endoplasmic reticulum · Q127–136

**Q127 — C** · Rough ER has ribosomes on its surface.
**Q128 — D** · Smooth ER synthesises lipids.
**Q129 — B** · The smooth ER stores $Ca^{2+}$.
**Q130 — C** · The rough ER sends transport vesicles to the Golgi.
**Q131 — C** · The ER is a network of membranes and sacs.
**Q132 — D** · Rough ER packages proteins for secretion.
**Q133 — D** · The smooth ER detoxifies drugs and poisons.
**Q134 — C** · Rough ER makes replacement membrane.
**Q135 — B** · Correct choice.
**Q136 — D** · Smooth ER stores $Ca^{2+}$ and detoxifies, while rough ER packages secreted proteins.

## Golgi apparatus · Q137–144

**Q137** · Easy · *codex, slides 88 to 90*

**What are the flattened membrane sacs of the Golgi apparatus called?**

1. Cristae
2. Cisternae
3. Thylakoids
4. Lacunae

**Q138** · Easy · *codex, slides 88 to 90*

**Which face of the Golgi apparatus receives vesicles from the ER?**

1. The cis face
2. The trans face
3. The outer face
4. The nuclear face

**Q139** · Easy · *codex, slides 88 to 90*

**From which face do vesicles leave the Golgi apparatus?**

1. The cis face
2. The inner face
3. The matrix face
4. The trans face

**Q140** · Easy · *codex, slides 88 to 90*

**Which organelles does the Golgi apparatus produce?**

1. Lysosomes
2. Mitochondria
3. Ribosomes
4. Chloroplasts

**Q141** · Medium · *codex, slides 88 to 90*

**What is the function of the Golgi apparatus?**

1. Photosynthesis in its thylakoid disks
2. Packaging materials for transport in vesicles
3. Cellular respiration in its folded cristae
4. Storage of calcium ions in its lumen

**Q142** · Medium · *codex, slides 88 to 90*

**Which statement describes vesicle traffic through the Golgi apparatus?**

1. Vesicles arrive at the trans face and leave from the cis face
2. Vesicles arrive at the cis face and are shipped from the trans face
3. Vesicles arrive and leave only at the cis face
4. Vesicles pass through the nucleolus before the trans face

**Q143** · Medium · *codex, slides 88 to 90*

**All of the following are functions of the Golgi apparatus EXCEPT which one?**

1. Packaging materials in vesicles
2. Producing lysosomes
3. Assembling ribosomal subunits
4. Synthesising small molecules for transport

**Q144** · Hard · *codex, slides 88 to 90*

**A vesicle carrying a secretory protein buds from the rough ER. Which statement describes its next steps?**

1. It fuses at the cis face, and contents leave from the trans face
2. It fuses at the trans face, and contents leave from the cis face
3. It bypasses the Golgi and is exported directly by the nucleolus
4. It enters the nucleolus first and then the cis face

### Answers — Golgi apparatus · Q137–144

**Q137 — B** · The Golgi is a series of flattened sacs called cisternae.
**Q138 — A** · The cis face receives vesicles.
**Q139 — D** · The trans face ships vesicles.
**Q140 — A** · The Golgi produces lysosomes.
**Q141 — B** · The Golgi synthesises and packages small molecules for transport.
**Q142 — B** · The cis face receives and the trans face ships vesicles.
**Q143 — C** · Correct choice.
**Q144 — A** · Vesicles arrive at the cis face and are shipped from the trans face.

## Lysosomes and vacuoles · Q145–154

**Q145** · Easy · *codex, slides 91 to 92*

**Which type of enzymes do lysosomes contain?**

1. Photosynthetic enzymes
2. Respiratory enzymes of the cristae
3. Hydrolytic enzymes
4. DNA polymerase enzymes

**Q146** · Easy · *codex, slides 91 to 92*

**Lysosomes carry out which process?**

1. Photosynthesis
2. Protein synthesis
3. ATP production by cristae
4. Intracellular digestion

**Q147** · Easy · *codex, slides 91 to 92*

**What do vacuoles store?**

1. Only chromosomes and ribosomal subunits
2. Food, water, minerals, pigments and poisons
3. Only ribosomal subunits and rRNA molecules
4. Only hydrogen peroxide and catalase

**Q148** · Easy · *codex, slides 91 to 92*

**Which vacuole stores water and ions in plant cells?**

1. The large central vacuole
2. The food vacuole
3. The contractile vacuole
4. The peroxisome

**Q149** · Medium · *codex, slides 91 to 92*

**Which process involving lysosomes is a form of programmed cell death?**

1. Photosynthesis
2. Transcription
3. Cytokinesis
4. Apoptosis

**Q150** · Medium · *codex, slides 91 to 92*

**Which pair are examples of vacuoles?**

1. Cisternae of the Golgi and cristae
2. Thylakoids and grana of chloroplasts
3. Lacunae of bone and annuli of pores
4. Food vacuoles and contractile vacuoles

**Q151** · Medium · *codex, slides 91 to 92*

**Which organelle produces lysosomes?**

1. The nucleolus
2. The mitochondrion
3. The chloroplast in leaf cells
4. The Golgi apparatus

**Q152** · Medium · *codex, slides 91 to 92*

**Why are lysosomes described as recycling centres of the cell?**

1. They convert light into chemical energy for reuse
2. They copy DNA so the cell can reuse its genes
3. Hydrolytic enzymes break down materials for reuse
4. They store water for reuse by the cell

**Q153** · Medium · *codex, slides 91 to 92*

**All of the following are functions of lysosomes EXCEPT which one?**

1. Decomposing hydrogen peroxide with catalase
2. Intracellular digestion of materials
3. Recycling the cell's worn-out materials
4. Programmed cell death (apoptosis)

**Q154** · Hard · *codex, slides 91 to 92*

**A macrophage engulfs a bacterium. Which organelle supplies the enzymes to digest it?**

1. A peroxisome, using catalase to digest it
2. The central vacuole, storing it as a pigment
3. The smooth ER, detoxifying it as a drug
4. A lysosome from the Golgi, using hydrolytic enzymes

### Answers — Lysosomes and vacuoles · Q145–154

**Q145 — C** · Lysosomes contain hydrolytic enzymes.
**Q146 — D** · Lysosomes carry out intracellular digestion.
**Q147 — B** · Vacuoles store these materials.
**Q148 — A** · Plants have a large central vacuole that stores water and ions.
**Q149 — D** · Lysosomes participate in programmed cell death (apoptosis).
**Q150 — D** · These are the examples of vacuoles listed.
**Q151 — D** · The Golgi apparatus produces lysosomes.
**Q152 — C** · Hydrolytic enzymes digest materials, recycling the cell's components.
**Q153 — A** · Correct choice.
**Q154 — D** · Lysosomes made by the Golgi digest engulfed material with hydrolytic enzymes.

## Peroxisomes · Q155–162

**Q155** · Easy · *codex, slides 89, 98*

**Which enzyme in peroxisomes decomposes hydrogen peroxide?**

1. Amylase
2. Catalase
3. Pepsin
4. DNA polymerase

**Q156** · Easy · *codex, slides 89, 98*

**Peroxisomes take part in the breakdown of which pair of molecules?**

1. Amino acids and fatty acids
2. Starch and cellulose
3. Nucleotides and ATP
4. Chlorophyll and phospholipids

**Q157** · Easy · *codex, slides 89, 98*

**How do peroxisomes form?**

1. By division of pre-existing peroxisomes
2. By budding from the nuclear envelope
3. By budding from the plasma membrane
4. By fusion of several lysosomes

**Q158** · Medium · *codex, slides 89, 98*

**Which toxic substances do peroxisomes oxidise?**

1. Glucose and glycogen
2. Alcohol and formaldehyde
3. Chlorophyll and cellulose
4. Calcium and sodium ions

**Q159** · Medium · *codex, slides 89, 98*

**How do peroxisomes compare in size with lysosomes?**

1. They are larger than lysosomes
2. They are the same size as lysosomes
3. They are smaller than lysosomes
4. They are larger than mitochondria

**Q160** · Medium · *codex, slides 89, 98*

**Which toxic compound is produced during peroxisomal oxidation reactions?**

1. Chlorophyll for the chloroplast
2. Glycogen
3. Lactic acid
4. Hydrogen peroxide ($H_2O_2$)

**Q161** · Hard · *codex, slides 89, 98*

**Why must peroxisomes contain catalase?**

1. Oxidation produces toxic hydrogen peroxide, which catalase decomposes
2. Catalase makes the hydrogen peroxide that oxidises fatty acids
3. Catalase digests worn-out organelles so the cell can recycle them
4. Catalase builds new peroxisomes by dividing existing ones

**Q162** · Devil · *codex, slides 89, 98*

**After heavy alcohol intake, which organelle oxidises alcohol in liver cells, and which enzyme then handles the toxic by-product?**

1. Lysosomes oxidise it, and hydrolytic enzymes decompose the product
2. Peroxisomes oxidise it, and catalase decomposes the hydrogen peroxide produced
3. The Golgi apparatus oxidises it, and cisternae store the product
4. Chloroplasts oxidise it, and chlorophyll decomposes the product

### Answers — Peroxisomes · Q155–162

**Q155 — B** · Peroxisomes contain catalase, which decomposes $H_2O_2$.
**Q156 — A** · Peroxisomes help break down amino acids and fatty acids.
**Q157 — A** · Peroxisomes form by division of pre-existing peroxisomes.
**Q158 — B** · Peroxisomes oxidise alcohol and formaldehyde.
**Q159 — C** · Peroxisomes are described as smaller than lysosomes.
**Q160 — D** · Oxidation in peroxisomes produces hydrogen peroxide.
**Q161 — A** · Catalase decomposes the hydrogen peroxide produced.
**Q162 — B** · Peroxisomes oxidise alcohol and catalase decomposes hydrogen peroxide.

## Plant and animal cells · Q163–170

**Q163** · Easy · *codex, slides 93 to 96*

**Which organelle is found in plant cells only?**

1. Lysosomes
2. Centrioles
3. Desmosomes
4. Chloroplasts

**Q164** · Easy · *codex, slides 93 to 96*

**The cell wall of plant cells is made of what?**

1. Peptidoglycan
2. Cellulose
3. Chitin
4. Collagen

**Q165** · Easy · *codex, slides 93 to 96*

**Which pair of structures is found in animal cells only?**

1. Central vacuoles and chloroplasts
2. Cellulose walls and plasmodesmata
3. Mitochondria and ribosomes
4. Lysosomes and centrioles

**Q166** · Medium · *codex, slides 93 to 96*

**Which structure connects neighbouring plant cells?**

1. Desmosomes
2. Gap junctions
3. Tight junctions
4. Plasmodesmata

**Q167** · Medium · *codex, slides 93 to 96*

**Which structure is found in animal cells only?**

1. The large central vacuole
2. The chloroplast in leaf cells
3. The extracellular matrix (ECM)
4. The cellulose cell wall

**Q168** · Medium · *codex, slides 93 to 96*

**All of the following are found in plant cells only EXCEPT which one?**

1. Central vacuoles
2. Chloroplasts
3. Centrioles
4. Plasmodesmata

**Q169** · Hard · *codex, slides 93 to 96*

**A student sees a cell with a large central vacuole, chloroplasts and a cellulose wall. Which features should she NOT expect to find in it?**

1. Centrioles and desmosomes
2. Plasmodesmata and a cellulose wall
3. A central vacuole and chloroplasts
4. Mitochondria and ribosomes

**Q170** · Devil · *codex, slides 93 to 96*

**Which structures are found in BOTH plant and animal cells? 1. Mitochondria 2. Central vacuole 3. Golgi apparatus 4. Lysosomes**

1. 1, 2 and 3 only
2. 1 and 3 only
3. 2 and 4 only
4. 1, 3 and 4 only

### Answers — Plant and animal cells · Q163–170

**Q163 — D** · Chloroplasts are listed as plant cells only.
**Q164 — B** · The plant cell wall is made of cellulose.
**Q165 — D** · Lysosomes and centrioles are listed as animal cells only.
**Q166 — D** · Plasmodesmata are listed as plant cells only.
**Q167 — C** · The ECM is listed as animal cells only.
**Q168 — C** · Correct choice.
**Q169 — A** · These are listed as animal cell features.
**Q170 — B** · Mitochondria and the Golgi apparatus are in both; the central vacuole is plant only and lysosomes are listed as animal only.

## Mitochondria · Q171–178

**Q171** · Easy · *codex, slide 97*

**What is the function of mitochondria?**

1. They are the site of cellular respiration
2. They are the site of photosynthesis
3. They are the site of protein export
4. They detoxify drugs and poisons

**Q172** · Easy · *codex, slide 97*

**How many membranes surround a mitochondrion?**

1. One, a single outer membrane
2. Three, including a thylakoid membrane
3. None, since they are free in the cytosol
4. Two, an outer and an inner membrane

**Q173** · Easy · *codex, slide 97*

**What are the folds of the inner mitochondrial membrane called?**

1. Cisternae
2. Grana
3. Cristae
4. Lacunae

**Q174** · Medium · *codex, slide 97*

**What is the mitochondrial matrix?**

1. The folds of the inner membrane
2. The outer membrane of the organelle
3. The fluid-filled inner compartment
4. The stack of thylakoid disks

**Q175** · Medium · *codex, slide 97*

**Why do cristae increase the ATP made by a mitochondrion?**

1. They make the outer membrane thicker so ATP leaks out
2. They increase the surface area holding ATP enzymes
3. They store chlorophyll to capture sunlight
4. They divide the matrix into many separate cells

**Q176** · Medium · *codex, slide 97*

**All of the following are true of mitochondria EXCEPT which one?**

1. They capture sunlight using chlorophyll
2. They have a double membrane
3. Cristae are folds of the inner membrane
4. They are the site of cellular respiration

**Q177** · Hard · *codex, slide 97*

**A heart muscle cell needs large amounts of ATP. Which mitochondrial feature would you expect to be extensive?**

1. Cristae, which enlarge the inner membrane surface
2. Thylakoid stacks, which capture sunlight energy
3. Cisternae, which package proteins for secretion
4. A single smooth membrane, which stores calcium

**Q178** · Hard · *codex, slide 97*

**Which description lists mitochondrial structure from the outside inwards?**

1. Outer membrane, thylakoid disks, then stroma
2. Outer membrane, cristae-folded inner membrane, matrix
3. Matrix, cristae, then a single outer membrane
4. Cis face, cisternae of the stack, then trans face

### Answers — Mitochondria · Q171–178

**Q171 — A** · Mitochondria are the site of cellular respiration.
**Q172 — D** · Mitochondria have an outer and an inner membrane.
**Q173 — C** · Cristae are folds of the inner membrane.
**Q174 — C** · The matrix is the fluid-filled inner compartment.
**Q175 — B** · Cristae contain enzymes for ATP production and increase surface area.
**Q176 — A** · Correct choice.
**Q177 — A** · More cristae mean more surface for ATP-producing enzymes.
**Q178 — B** · The organelle has outer and inner membranes with cristae, and the matrix inside.

## Chloroplasts · Q179–184

**Q179** · Easy · *codex, slide 99*

**Which process takes place in chloroplasts?**

1. They are the site of photosynthesis
2. They are the site of cellular respiration
3. They are the site of protein secretion
4. They store calcium ions

**Q180** · Easy · *codex, slide 99*

**Which pigments capture sunlight in chloroplasts?**

1. Chlorophylls
2. Catalase
3. Histones
4. Hydrolases

**Q181** · Easy · *codex, slide 99*

**How many membranes surround a chloroplast?**

1. One
2. Three
3. None
4. Two

**Q182** · Medium · *codex, slide 99*

**What are the stacks of thylakoid disks in a chloroplast called?**

1. Grana
2. Cristae
3. Cisternae
4. Lacunae

**Q183** · Medium · *codex, slide 99*

**What is the fluid inside a chloroplast called?**

1. The matrix
2. The nucleoplasm
3. The stroma
4. The cytosol

**Q184** · Hard · *codex, slide 99*

**A leaf cell loses its chlorophyll. Which process fails, and where is the pigment normally held?**

1. Cellular respiration fails, and the pigment is in the cristae
2. Protein secretion fails, and the pigment is in the Golgi cisternae
3. Photosynthesis fails, and the pigment is in the thylakoid disks of the grana
4. DNA doubling fails, and the pigment is in the nucleolus

### Answers — Chloroplasts · Q179–184

**Q179 — A** · Chloroplasts are the site of photosynthesis.
**Q180 — A** · Chloroplasts contain chlorophylls for capturing sunlight energy.
**Q181 — D** · Chloroplasts have a double membrane.
**Q182 — A** · Thylakoid disks are in stacks called grana.
**Q183 — C** · The fluid of the chloroplast is the stroma.
**Q184 — C** · Chlorophylls capture sunlight in the thylakoids of chloroplasts.

## Endosymbiont theory · Q185–190

**Q185** · Easy · *codex, slide 100*

**Which two organelles are thought to share a similar origin according to the endosymbiont theory?**

1. Mitochondria and chloroplasts
2. Lysosomes and peroxisomes
3. Golgi and ER
4. Ribosomes and nucleoli

**Q186** · Easy · *codex, slide 100*

**According to the endosymbiont theory, what engulfed the prokaryotic cells?**

1. Ancestors of viruses
2. Early lysosomes
3. Early peroxisomes
4. Ancestors of eukaryotic cells

**Q187** · Easy · *codex, slide 100*

**Which structural feature of mitochondria and chloroplasts is evidence for the endosymbiont theory?**

1. A single flat membrane
2. A double-membrane structure
3. A ring of nuclear pores
4. A cellulose wall

**Q188** · Medium · *codex, slide 100*

**Which other evidence supports the endosymbiont theory?**

1. They have no DNA at all
2. They are produced by the Golgi apparatus
3. They are made of only protein
4. They have their own ribosomes and DNA

**Q189** · Medium · *codex, slide 100*

**Which behaviour of mitochondria and chloroplasts supports the endosymbiont theory?**

1. They reproduce independently within the cell
2. They only form when the nucleus divides
3. They are assembled in the nucleolus
4. They are made by the rough ER

**Q190** · Hard · *codex, slide 100*

**All of the following support the endosymbiont theory EXCEPT which one?**

1. They have a double-membrane structure
2. They have a single membrane like the ER
3. They have their own ribosomes and DNA
4. They reproduce independently within the cell

### Answers — Endosymbiont theory · Q185–190

**Q185 — A** · Mitochondria and chloroplasts are thought to share a similar origin.
**Q186 — D** · Prokaryotic cells were engulfed by ancestors of eukaryotic cells.
**Q187 — B** · A double membrane is listed as evidence.
**Q188 — D** · Own ribosomes and DNA are listed as evidence.
**Q189 — A** · Independent reproduction is listed as evidence.
**Q190 — B** · Correct choice.

## Putting the organelles together · Q191–200

**Q191** · Easy · *codex, slides 85 to 100*

**Which organelle is the site of photosynthesis?**

1. The mitochondrion
2. The lysosome
3. The peroxisome
4. The chloroplast in leaf cells

**Q192** · Easy · *codex, slides 85 to 100*

**Which organelle carries out intracellular digestion?**

1. The Golgi apparatus
2. The mitochondrion
3. The nucleolus
4. The lysosome

**Q193** · Easy · *codex, slides 89, 98*

**Which organelle decomposes hydrogen peroxide using catalase?**

1. The lysosome
2. The peroxisome
3. The mitochondrion
4. The Golgi apparatus

**Q194** · Medium · *codex, slides 85 to 100*

**Which pairing of organelle and function is correct?**

1. Rough ER: site of photosynthesis in leaf cells
2. Peroxisome: intracellular digestion with hydrolytic enzymes
3. Golgi apparatus: packaging materials for transport
4. Mitochondrion: assembly of ribosomal subunits

**Q195** · Medium · *codex, slides 85 to 100*

**Which pair of organelles works together to prepare a secreted protein for export?**

1. The nucleolus and the chloroplast
2. The mitochondrion and the peroxisome
3. The rough ER and the Golgi apparatus
4. The lysosome and the central vacuole

**Q196** · Medium · *codex, slides 85 to 100*

**Pick the odd one out among these organelles.**

1. The rough ER
2. The Golgi apparatus
3. The lysosome
4. The chloroplast in leaf cells

**Q197** · Hard · *codex, slides 85 to 100*

**Which sequence correctly traces a secreted protein from gene to export?**

1. Gene in the nucleus, mRNA, bound ribosome on rough ER, Golgi apparatus, plasma membrane
2. Gene in the nucleus, mRNA, free ribosome in the cytosol, Golgi apparatus, plasma membrane
3. Gene in the nucleus, mRNA, bound ribosome on rough ER, lysosome, plasma membrane
4. Gene in the nucleolus, rRNA, bound ribosome on rough ER, Golgi apparatus, plasma membrane

**Q198** · Hard · *codex, slides 85 to 100*

**Which organelles contain their own DNA and ribosomes? I. Mitochondria II. Chloroplasts III. Lysosomes IV. Peroxisomes**

1. I, II and III only
2. II and IV only
3. I and II only
4. I, III and IV only

**Q199** · Hard · *codex, slides 85 to 100*

**Which structure is NOT enclosed by a double membrane?**

1. The nucleus
2. The lysosome
3. The mitochondrion
4. The chloroplast in leaf cells

**Q200** · Devil · *codex, slide 85*

**Which structure is NOT part of the endomembrane system as described in the lecture?**

1. The mitochondrion, bounded by outer and inner membranes
2. The plasma membrane, where secreted proteins are exported
3. The nuclear envelope, continuous with the rough ER
4. The lysosome, which holds hydrolytic enzymes

### Answers — Putting the organelles together · Q191–200

**Q191 — D** · Chloroplasts are the site of photosynthesis.

**Q192 — D** · Lysosomes carry out intracellular digestion.

**Q193 — B** · Peroxisomes contain catalase, which decomposes hydrogen peroxide.

**Q194 — C** · The Golgi synthesises and packages materials for transport in vesicles.

**Q195 — C** · The rough ER packages proteins and the Golgi ships them onward.

**Q196 — D** · Correct choice.

**Q197 — A** · The gene is transcribed, and the protein is made on bound ribosomes, then passes to the Golgi and the plasma membrane.

**Q198 — C** · Mitochondria and chloroplasts have their own ribosomes and DNA, as the endosymbiont theory notes.

**Q199 — B** · Correct choice.

**Q200 — A** · The lecture lists the nuclear envelope, ER, Golgi, lysosomes and plasma membrane; mitochondria are not included.

# Module 2 — Microbodies → Intermediate filaments

slides 101 to 200 · 200 questions · 21 sections · bank: BIOL151_Question_Bank_Slides101-200.docx
Difficulty: 80 Easy · 80 Medium · 32 Hard · 8 Devil

## Microbodies · Q201–208

**Q201** · Easy · *codex, slides 101 to 102*

**Which three organelles make up the microbodies?**

1. Peroxisomes, glyoxysomes and hydrogenosomes
2. Lysosomes, ribosomes and central vacuoles
3. Mitochondria, chloroplasts and the nucleus
4. Golgi bodies, ER and transport vesicles

**Q202** · Easy · *codex, slides 101 to 102*

**How many membranes bound a microbody?**

1. A single membrane
2. A double membrane
3. Three membranes
4. No membrane at all

**Q203** · Easy · *codex, slides 101 to 102*

**Microbodies are concerned largely with which process?**

1. Oxidation
2. Photosynthesis
3. Translation
4. DNA replication

**Q204** · Medium · *codex, slides 101 to 102*

**In which vertebrate organs are microbodies found?**

1. The liver and kidneys
2. The skin and hair follicles
3. The bones and cartilage
4. The heart and lungs

**Q205** · Medium · *codex, slides 101 to 102*

**Which description fits microbodies?**

1. Large uniform organelles bounded by a double membrane
2. Small vesicle-like organelles bounded by a single membrane
3. Membraneless granules that assemble ribosomal subunits
4. Flattened sacs that package and ship proteins for secretion

**Q206** · Medium · *codex, slides 101 to 102*

**Microbodies are found in all of the following EXCEPT which one?**

1. The leaves and seeds of plants
2. The cell wall of bacteria
3. Protozoa and yeasts
4. The liver of vertebrates

**Q207** · Hard · *codex, slides 101 to 102*

**Which feature distinguishes microbodies from mitochondria and chloroplasts?**

1. They produce ATP by photosynthesis in light
2. They have a single bounding membrane
3. They contain cristae and a matrix inside
4. They are found only in bacteria and archaea

**Q208** · Hard · *codex, slides 101 to 102*

**A cell biologist isolates small, oval, single-membrane vesicles from liver tissue that mainly carry out oxidation. Which group do they belong to?**

1. Mitochondria
2. Microbodies
3. Chloroplasts
4. Golgi cisternae

### Answers — Microbodies · Q201–208

**Q201 — A** · Microbodies consist of peroxisomes, glyoxysomes and hydrogenosomes.
**Q202 — A** · Microbodies are bounded by a single membrane.
**Q203 — A** · Microbodies are concerned largely with oxidation.
**Q204 — A** · Microbodies are found in the liver and kidneys of vertebrates.
**Q205 — B** · They are a heterogeneous group of small vesicle-like organelles with one membrane.
**Q206 — B** · Correct choice.
**Q207 — B** · Microbodies are single-membrane vesicle-like organelles.
**Q208 — B** · Microbodies are small oxidative vesicles found in liver and kidney.

## Peroxisomes: enzymes and reactions · Q209–220

**Q209** · Easy · *codex, slides 103 to 105*

**About how many enzymes do peroxisomes contain, according to the lecture?**

1. About 50
2. About 5
3. About 500
4. About 5,000

**Q210** · Easy · *codex, slides 103 to 105*

**Peroxisomes are morphologically similar to which other organelle?**

1. Mitochondria
2. Lysosomes
3. Chloroplasts
4. The nucleus

**Q211** · Easy · *codex, slides 103 to 105*

**Which substrate is broken down by oxidative reactions in peroxisomes?**

1. Uric acid
2. Starch
3. Cellulose
4. Chlorophyll

**Q212** · Easy · *codex, slides 103 to 105*

**Which enzyme converts urate into allantoin, $CO_2$ and $H_2O_2$?**

1. Urate oxidase
2. Catalase
3. Pepsin
4. Amylase

**Q213** · Medium · *codex, slides 103 to 105*

**Which three enzymes are named as peroxisome enzymes in the lecture?**

1. Pepsin, amylase and lipase of the gut
2. DNA polymerase, helicase and DNA ligase
3. Urate oxidase, D-amino acid oxidase and catalase
4. ATP synthase, cytochrome c and NADH dehydrogenase

**Q214** · Medium · *codex, slides 103 to 105*

**What can catalase convert hydrogen peroxide into?**

1. Glucose
2. Methane
3. Hydrogen gas
4. Water

**Q215** · Medium · *codex, slides 103 to 105*

**Which peroxisomal process provides a major source of metabolic energy?**

1. Photosynthesis in thylakoids
2. Digestion by hydrolases
3. Oxidation of fatty acids
4. Transcription of rRNA

**Q216** · Medium · *codex, slides 103 to 105*

**Where are fatty acids oxidised in animal cells?**

1. Only in peroxisomes of the cell
2. In both peroxisomes and mitochondria
3. Only in the mitochondria of the cell
4. Only in lysosomes of the cell

**Q217** · Medium · *codex, slides 103 to 105*

**In which organisms is fatty acid oxidation restricted to peroxisomes?**

1. Humans and mice
2. Bacteria and archaea
3. Yeasts and plants
4. Birds and fish

**Q218** · Medium · *codex, slides 103 to 105*

**All of the following are substrates broken down by peroxisomal oxidation EXCEPT which one?**

1. Uric acid from purine breakdown
2. Amino acids such as D-amino acids
3. Cellulose from plant cell walls
4. Fatty acids from stored lipids

**Q219** · Hard · *codex, slides 103 to 105*

**Which statement correctly links each peroxisomal enzyme to its role?**

1. Catalase breaks down urate, urate oxidase acts on amino acids, and D-amino acid oxidase disposes of hydrogen peroxide
2. D-amino acid oxidase breaks down urate, catalase acts on amino acids, and urate oxidase disposes of hydrogen peroxide
3. Urate oxidase disposes of hydrogen peroxide, catalase acts on amino acids, and D-amino acid oxidase breaks down urate
4. Urate oxidase breaks down urate, D-amino acid oxidase acts on amino acids, and catalase disposes of hydrogen peroxide

**Q220** · Hard · *codex, slides 103 to 105*

**A yeast cell with defective peroxisomes cannot grow on fatty acids as its only fuel. Why?**

1. Yeasts oxidise fatty acids equally in mitochondria, so a defect would not matter
2. Fatty acids are digested only by lysosomes in yeasts
3. Fatty acid oxidation is restricted to peroxisomes in yeasts
4. Catalase is the only enzyme that can oxidise fatty acids

### Answers — Peroxisomes: enzymes and reactions · Q209–220

**Q209 — A** · The lecture says peroxisomes contain about 50 enzymes.
**Q210 — B** · Peroxisomes look similar to lysosomes.
**Q211 — A** · Uric acid is among the substrates oxidised in peroxisomes.
**Q212 — A** · Urate oxidase catabolises urate to allantoin, $CO_2$ and $H_2O_2$.
**Q213 — C** · These three enzymes are named in peroxisomes.
**Q214 — D** · Catalase converts hydrogen peroxide to water, or uses it to oxidise another compound.
**Q215 — C** · Fatty acid oxidation is a major source of metabolic energy.
**Q216 — B** · In animal cells fatty acids are oxidised in both organelles.
**Q217 — C** · In yeasts and plants fatty acid oxidation is restricted to peroxisomes.
**Q218 — C** · Correct choice.
**Q219 — D** · Each enzyme has the role stated.
**Q220 — C** · Without peroxisomes the yeast cannot oxidise fatty acids.

## Glyoxysomes · Q221–228

**Q221** · Easy · *codex, slides 106 to 107*

**In which kind of cells are glyoxysomes found?**

1. Human liver cells
2. Bacterial cells
3. Animal muscle cells
4. Some plant cells

**Q222** · Easy · *codex, slides 106 to 107*

**A glyoxysome is a specialised form of which organelle?**

1. Lysosome
2. Mitochondrion
3. Golgi apparatus
4. Peroxisome

**Q223** · Easy · *codex, slides 106 to 107*

**Glyoxysomes are notably found in the cells of what?**

1. Mature leaves
2. Germinating seeds
3. Root hairs
4. Dead cork tissue

**Q224** · Medium · *codex, slides 106 to 107*

**Glyoxysomes contain the enzymes of which cycle?**

1. The glyoxylate cycle
2. The Calvin cycle
3. The urea cycle
4. The cell cycle

**Q225** · Medium · *codex, slides 106 to 107*

**The glyoxylate cycle is a variant of which cycle?**

1. The Calvin cycle
2. The urea cycle
3. The cell cycle
4. The citric acid cycle

**Q226** · Medium · *codex, slides 106 to 107*

**What does the glyoxylate cycle allow plants to convert?**

1. Stored lipids into carbohydrates
2. Stored carbohydrates into lipids
3. Stored proteins into new DNA strands
4. Light energy into ATP in thylakoids

**Q227** · Hard · *codex, slides 106 to 107*

**A germinating seed must move energy from fat reserves to growing tissues. How do glyoxysomes help?**

1. They convert sugars into immobile fats for later storage
2. They digest the seed coat with hydrolytic enzymes
3. They convert immobile fat reserves into transportable sugars
4. They capture sunlight to make sugars inside the seed

**Q228** · Devil · *codex, slides 106 to 107*

**Which sequence describes what happens to seed fats in glyoxysomes?**

1. Fats form succinate, the cycle gives acetyl CoA, and acetyl CoA goes to mitochondria for gluconeogenesis
2. Fats form acetyl CoA, the glyoxylate cycle gives succinate, and succinate goes to mitochondria for gluconeogenesis
3. Fats form glucose, glucose gives acetyl CoA, and acetyl CoA is stored in the nucleus
4. Fats form acetyl CoA, which goes straight to chloroplasts for photosynthesis

### Answers — Glyoxysomes · Q221–228

**Q221 — D** · Glyoxysomes are found in some plant cells.
**Q222 — D** · A glyoxysome is a specialised form of peroxisome.
**Q223 — B** · Glyoxysomes are notable in germinating seeds.
**Q224 — A** · Glyoxysomes contain the enzymes of the glyoxylate cycle.
**Q225 — D** · It is a variant of the citric acid cycle.
**Q226 — A** · Stored lipids are converted to carbohydrates.
**Q227 — C** · Fat reserves become sugars that can be transported to growing tissues.
**Q228 — B** · This is the sequence given in the lecture.

## Hydrogenosomes · Q229–233

**Q229** · Easy · *codex, slide 108*

**Which gas does a hydrogenosome release as a by-product?**

1. Molecular hydrogen ($H_2$)
2. Oxygen
3. Methane
4. Nitrogen

**Q230** · Easy · *codex, slide 108*

**Hydrogenosomes are found in which kind of cells?**

1. All aerobic bacterial cells
2. Some anaerobic eukaryotic cells
3. Only plant leaf mesophyll cells
4. Only mature red blood cells

**Q231** · Medium · *codex, slide 108*

**Under which condition do hydrogenosomes release hydrogen during energy generation?**

1. Bright light and high temperatures
2. High oxygen levels and abundant air
3. Freezing temperatures and darkness
4. Anaerobic, oxygen-deficient conditions

**Q232** · Medium · *codex, slide 108*

**Which groups are listed as having hydrogenosomes?**

1. Cyanobacteria, archaea and spirochetes
2. Ciliates, trichomonads, fungi and animals
3. Mosses, ferns and flowering plants
4. Viruses, prions, viroids and phages

**Q233** · Hard · *codex, slide 108*

**Which statement about hydrogenosomes is correct?**

1. They are double-membrane organelles that release $O_2$ during photosynthesis
2. They are membrane-enclosed organelles that release $H_2$ under anaerobic conditions
3. They are membraneless granules that store nutrients in bacteria
4. They are single-membrane organelles that digest cell debris at pH 5

### Answers — Hydrogenosomes · Q229–233

**Q229 — A** · Hydrogenosomes release molecular hydrogen.
**Q230 — B** · They occur in some anaerobic eukaryotes.
**Q231 — D** · Hydrogen release occurs under anaerobic conditions.
**Q232 — B** · Hydrogenosomes occur in some of each group.
**Q233 — B** · This summarises the lecture definition.

## Lysosomes: formation, enzymes and pH · Q234–247

**Q234** · Easy · *codex, slides 109 to 111*

**Where are lysosomes formed?**

1. In the Golgi complex
2. In the nucleolus
3. In the mitochondrion
4. In the chloroplast

**Q235** · Easy · *codex, slides 109 to 111*

**What are lysosomes filled with?**

1. Chlorophyll
2. Ribosomal RNA
3. Digestive enzymes
4. Hydrogen gas

**Q236** · Easy · *codex, slides 109 to 111*

**What internal pH do lysosomes reach?**

1. About 7.0
2. About 9.0
3. About 2.0
4. About 5.0

**Q237** · Easy · *codex, slides 109 to 111*

**Roughly how many hydrolytic enzymes do lysosomes contain?**

1. About 6
2. About 600
3. About 60
4. About 6,000

**Q238** · Easy · *codex, slides 109 to 111*

**Which ions do lysosomes pump in to reach their internal pH?**

1. $Na^+$ ions
2. $Ca^{2+}$ ions
3. $Cl^-$ ions
4. $H^+$ ions

**Q239** · Easy · *codex, slides 109 to 111*

**What do lysosomes do to foreign substances?**

1. They store them as pigments
2. They oxidise them using catalase
3. They digest them
4. They export them from the cell

**Q240** · Medium · *codex, slides 109 to 111*

**Which pump moves protons into the lysosome?**

1. A porin in the outer membrane
2. A calcium channel in the smooth ER
3. A nucleoporin in the nuclear pore
4. An $H^+$-ATPase in the lysosome membrane

**Q241** · Medium · *codex, slides 109 to 111*

**What does the internal pH of about 5.0 do?**

1. It destroys the lysosomal membrane
2. It activates the lysosomal enzymes
3. It stops hydrolysis completely
4. It makes the lysosome permeable to enzymes

**Q242** · Medium · *codex, slides 109 to 111*

**What does autolysis mean for lysosomes?**

1. They digest bacteria taken in by phagocytes
2. They are formed by the Golgi complex
3. They release hydrogen under anaerobic conditions
4. They recycle the cell's own organelles

**Q243** · Medium · *codex, slides 109 to 111*

**What does the lecture say happens to lysosomes after cell death?**

1. Lysosomal damage occurs after death
2. Lysosomes multiply after death
3. Lysosomes turn into peroxisomes
4. Lysosomes remain unchanged

**Q244** · Medium · *codex, slides 109 to 111*

**Lysosomes are described as what kind of structures?**

1. Membrane-bound vesicles
2. Membraneless granules
3. Double-membrane organelles
4. Protein filaments

**Q245** · Medium · *codex, slides 109 to 111*

**All of the following are true of lysosomes EXCEPT which one?**

1. They are formed in the Golgi complex
2. They are filled with digestive enzymes
3. They are formed in the nucleolus
4. They pump $H^+$ ions until the pH reaches 5.0

**Q246** · Hard · *codex, slides 109 to 111*

**A lysosome has a defective $H^+$-ATPase. Why would it fail to digest material?**

1. Without proton pumping the lysosome membrane dissolves in its own enzymes
2. Without proton pumping the lysosome cannot form in the Golgi complex
3. Without proton pumping the pH does not fall to about 5.0, so the enzymes stay inactive
4. Without proton pumping the hydrolases move out into the cytosol

**Q247** · Hard · *codex, slides 109 to 111*

**Which sequence is correct for a lysosome?**

1. The hydrolases become active, the $H^+$-ATPase acidifies it, and the Golgi then forms it
2. The nucleolus forms it, catalase acidifies it, and the hydrolases become active
3. The Golgi forms it, the $H^+$-ATPase acidifies it to about pH 5, and the hydrolases become active
4. The ER forms it, the porins acidify it, and the hydrolases become active

### Answers — Lysosomes: formation, enzymes and pH · Q234–247

**Q234 — A** · Lysosomes are formed in the Golgi complex.
**Q235 — C** · Lysosomes are filled with digestive enzymes.
**Q236 — D** · Lysosomes pump in $H^+$ until the internal pH reaches about 5.0.
**Q237 — C** · Lysosomes contain about 60 hydrolytic enzymes.
**Q238 — D** · Protons are pumped in until the pH is about 5.0.
**Q239 — C** · Lysosomes digest foreign substances.
**Q240 — D** · The $H^+$-ATPase pumps protons into the lysosome.
**Q241 — B** · The acidic pH activates the lysosomal enzymes.
**Q242 — D** · Autolysis is the recycling of the cell's own organelles.
**Q243 — A** · The lecture notes lysosomal damage after death.
**Q244 — A** · Lysosomes are membrane-bound vesicles.
**Q245 — C** · Correct choice.
**Q246 — C** · The enzymes are activated by the acidic pH.
**Q247 — C** · Formation, acidification and enzyme activation follow this order.

## Lysosomal digestion pathways · Q248–257

**Q248** · Easy · *codex, slides 110 to 112*

**Digestion of material that enters from outside the cell is called what?**

1. Autophagy
2. Apoptosis
3. Heterophagy
4. Endocytosis

**Q249** · Easy · *codex, slides 110 to 112*

**What is it called when lysosomes break down the cell's own components?**

1. Autophagy
2. Heterophagy
3. Transcription
4. Exocytosis

**Q250** · Easy · *codex, slides 110 to 112*

**What does an endosome fuse with to form a secondary lysosome?**

1. A peroxisome
2. A mitochondrion
3. A primary lysosome
4. A chloroplast

**Q251** · Medium · *codex, slides 110 to 112*

**What are phagocytic vesicles also called?**

1. Phagosomes
2. Endosomes
3. Cisternae
4. Thylakoids

**Q252** · Medium · *codex, slides 110 to 112*

**Coated vesicles from receptor-mediated endocytosis deliver their contents to which vesicle?**

1. A glyoxysome
2. An endosome
3. A hydrogenosome
4. A nucleolus

**Q253** · Medium · *codex, slides 110 to 112*

**Which intracellular materials can lysosomes degrade?**

1. Only chromosomes
2. Only the nuclear envelope
3. Only the cell wall
4. Mitochondria and ribosomes

**Q254** · Medium · *codex, slides 110 to 112*

**The lysosomal membrane is freely permeable to which molecules?**

1. The hydrolytic enzymes themselves
2. Low molecular weight products of hydrolysis
3. The large substrates awaiting digestion
4. All large proteins of the cytosol

**Q255** · Hard · *codex, slides 110 to 112*

**Which statement about the lysosomal membrane is NOT true?**

1. It is readily digested by the hydrolases inside the lysosome
2. It is normally impermeable to the enzymes and their substrates
3. It is freely permeable to low molecular weight products of hydrolysis
4. It resists digestion by the lysosomal hydrolases

**Q256** · Hard · *codex, slides 110 to 112*

**A phagocytic vesicle fuses with a primary lysosome. What forms, and what does it allow?**

1. A primary lysosome, allowing synthesis of new enzymes
2. A secondary lysosome, allowing digestion of the ingested material
3. A glyoxysome, allowing conversion of fats into sugars
4. A hydrogenosome, allowing release of hydrogen

**Q257** · Devil · *codex, slides 110 to 112*

**Which pathway describes digestion after receptor-mediated endocytosis?**

1. Coated vesicle, endosome, fusion to a secondary lysosome, then products enter the cytosol
2. Coated vesicle, secondary lysosome, endosome, then fusion with a primary lysosome
3. Endosome, coated vesicle, peroxisome, then absorption into the nucleus
4. Phagosome, glyoxysome, hydrogenosome, then release from the cell

### Answers — Lysosomal digestion pathways · Q248–257

**Q248 — C** · Digestion of extracellular material is heterophagy.
**Q249 — A** · Degradation of intracellular material is autophagy.
**Q250 — C** · An endosome fuses with a primary lysosome.
**Q251 — A** · Phagocytic vesicles are also called phagosomes.
**Q252 — B** · Coated vesicles deliver contents to an endosome.
**Q253 — D** · Lysosomes can degrade mitochondria and ribosomes.
**Q254 — B** · The small products can leave the lysosome.
**Q255 — A** · Correct choice.
**Q256 — B** · Fusion forms a secondary lysosome where digestion occurs.
**Q257 — A** · This is the pathway in the lecture.

## Lysosomes in disease · Q258–269

**Q258** · Easy · *codex, slides 113 to 116*

**Which condition results from inhaling silica particles into the lungs?**

1. Asbestosis
2. Black lung disease
3. Silicosis
4. Tay-Sachs disease

**Q259** · Easy · *codex, slides 113 to 116*

**Asbestosis is caused by breathing in what?**

1. Silica particles
2. Coal dust
3. Pollen grains
4. Asbestos fibres

**Q260** · Easy · *codex, slides 113 to 116*

**Black lung disease is caused by breathing in what?**

1. Asbestos fibres
2. Coal dust
3. Silica particles
4. Smoke from wood fires

**Q261** · Easy · *codex, slides 113 to 116*

**Which cells take up inhaled silica particles?**

1. Phagocytes
2. Fibroblasts
3. Red blood cells
4. Osteocytes

**Q262** · Easy · *codex, slides 113 to 116*

**Tay-Sachs disease is caused by the absence of what?**

1. A single lysosomal enzyme
2. A mitochondrial membrane
3. A nuclear pore protein
4. A ribosomal subunit

**Q263** · Medium · *codex, slides 113 to 116*

**What does inhaled silica do to lysosomal membranes in phagocytes?**

1. It strengthens them against digestion
2. It converts them into peroxisomes
3. It reacts with them, rupturing them
4. It has no effect on them at all

**Q264** · Medium · *codex, slides 113 to 116*

**Which cells deposit collagen fibres in silicosis?**

1. Phagocytes
2. Fibroblasts
3. Red blood cells
4. Neurons

**Q265** · Medium · *codex, slides 113 to 116*

**What does collagen deposition do to the lung in silicosis?**

1. It reduces lung elasticity and impairs breathing
2. It increases lung elasticity and breathing
3. It makes the lung produce more silica
4. It removes the silica from the lung tissue

**Q266** · Medium · *codex, slides 113 to 116*

**Which substance accumulates in nerve cells in Tay-Sachs disease?**

1. Starch granules
2. Hydrogen peroxide
3. Cellulose
4. Glycolipids

**Q267** · Medium · *codex, slides 113 to 116*

**What happens when a specific hydrolase is absent from lysosomes?**

1. The substrate is digested by catalase instead
2. The lysosome becomes a peroxisome
3. Its substrate accumulates inside the lysosomes
4. The substrate is exported by the Golgi

**Q268** · Hard · *codex, slides 113 to 116*

**Which sequence describes how silicosis develops?**

1. Fibroblasts deposit collagen, phagocytes take up silica, and lysosomal membranes rupture
2. Lysosomal membranes rupture, silica enters the blood, and phagocytes deposit collagen
3. Phagocytes die, silica reacts with lysosomes, and collagen is digested
4. Phagocytes take up silica, lysosomal membranes rupture, phagocytes die, and fibroblasts deposit collagen

**Q269** · Devil · *codex, slides 113 to 116*

**Which statement correctly contrasts silicosis with Tay-Sachs disease?**

1. Silicosis follows lysosomal rupture, and Tay-Sachs follows a missing lysosomal enzyme
2. Silicosis follows absence of one lysosomal enzyme, whereas Tay-Sachs follows silica uptake
3. Both follow rupture of the nuclear envelope after particle uptake
4. Both follow loss of catalase from the peroxisomes of liver cells

### Answers — Lysosomes in disease · Q258–269

**Q258 — C** · Silicosis results from inhaling silica particles.
**Q259 — D** · Asbestosis is caused by breathing in asbestos fibres.
**Q260 — B** · Black lung disease is caused by breathing in coal dust.
**Q261 — A** · Phagocytes take up the silica particles.
**Q262 — A** · It is caused by absence of a single lysosomal enzyme.
**Q263 — C** · Silica reacts with the lysosomal membranes, which then rupture.
**Q264 — B** · Fibroblasts are stimulated to deposit collagen.
**Q265 — A** · Elasticity falls and breathing is impaired.
**Q266 — D** · Glycolipids accumulate in nerve cells.
**Q267 — C** · The substrate accumulates, often with severe medical consequences.
**Q268 — D** · This is the sequence given in the lecture.
**Q269 — A** · These are the two mechanisms described.

## Prokaryotes and eukaryotes compared · Q270–283

**Q270** · Easy · *codex, slides 126 to 128*

**Where is DNA located in a prokaryotic cell?**

1. In a double-membrane nucleus
2. In the nucleolus
3. In the nucleoid region
4. In the Golgi apparatus

**Q271** · Easy · *codex, slides 126 to 128*

**Which organism is cited as an example of a prokaryote?**

1. E. coli
2. Amoeba
3. Yeast
4. Spirogyra

**Q272** · Easy · *codex, slides 126 to 128*

**Which structure do prokaryotic cells lack?**

1. A cell membrane
2. Ribosomes
3. DNA
4. A membrane-bound nucleus

**Q273** · Easy · *codex, slides 126 to 128*

**Which type of cells make up animals, plants, fungi and protists?**

1. Prokaryotic cells
2. Archaeal cells only
3. Eukaryotic cells
4. Viral cells

**Q274** · Easy · *codex, slides 126 to 128*

**How do eukaryotic cells compare in size with prokaryotic cells?**

1. They are smaller
2. They are the same size
3. They are always microscopic only
4. They are larger

**Q275** · Easy · *codex, slides 126 to 128*

**The genome of a eukaryotic cell is enclosed in what?**

1. A cell wall
2. A capsule
3. A double-membrane nucleus
4. A lysosome

**Q276** · Medium · *codex, slides 126 to 128*

**How is prokaryotic DNA packaged compared with eukaryotic DNA?**

1. It is wrapped around histones in a nucleus
2. It is packaged inside a double-membrane nucleus
3. It is packaged into nucleoli
4. It is not wrapped around histones

**Q277** · Medium · *codex, slides 126 to 128*

**What makes up the cell wall of bacteria?**

1. Cellulose
2. Collagen
3. Chitin
4. Peptidoglycan

**Q278** · Medium · *codex, slides 126 to 128*

**How does the archaeal cell wall differ from the bacterial wall?**

1. It is made of peptidoglycan like bacteria
2. It is tough and made of other chemicals
3. It is made of cellulose like plants
4. It is absent in all archaeal cells

**Q279** · Medium · *codex, slides 126 to 128*

**Which internal structures are absent from prokaryotes?**

1. Ribosomes that make proteins
2. Cytoplasm filling the cell
3. Complex membrane-bound organelles
4. A cell membrane around the cell

**Q280** · Medium · *codex, slides 126 to 128*

**Which type of prokaryote inhabits extreme environments?**

1. Amoebae
2. Algae
3. Fungi
4. Archaea

**Q281** · Medium · *codex, slides 126 to 128*

**Which of these is NOT a feature of prokaryotic cells?**

1. DNA in a nucleoid region
2. A cell wall for protection
3. A double-membrane nucleus
4. Some capsules and flagella

**Q282** · Hard · *codex, slides 126 to 128*

**A hot spring sample contains a single-celled organism with a wall, no nucleus and no peptidoglycan. How is it classified?**

1. Bacteria
2. Archaea
3. Fungi
4. Protista

**Q283** · Hard · *codex, slides 126 to 128*

**Which statement correctly compares prokaryotes and eukaryotes?**

1. Prokaryotes enclose DNA in a nucleus, while eukaryotes have a nucleoid
2. Prokaryotes have nucleoid DNA without histones, eukaryotes have a nucleus
3. Both enclose all their DNA in a double-membrane nucleus
4. Both wrap their DNA around histones inside nucleoli

### Answers — Prokaryotes and eukaryotes compared · Q270–283

**Q270 — C** · Prokaryotic DNA is located in the nucleoid region.
**Q271 — A** · Bacteria such as E.
**Q272 — D** · Prokaryotic cells lack a nucleus.
**Q273 — C** · These organisms are made of eukaryotic cells.
**Q274 — D** · Eukaryotic cells are larger cells.
**Q275 — C** · The genome is enclosed in a double-membrane nucleus.
**Q276 — D** · Prokaryotic DNA is not wrapped around histones.
**Q277 — D** · Bacterial walls are made of peptidoglycan.
**Q278 — B** · Archaeal walls are made of other distinct chemicals.
**Q279 — C** · Prokaryotes lack complex membrane-bound organelles.
**Q280 — D** · Archaea inhabit extreme environments.
**Q281 — C** · Correct choice.
**Q282 — B** · Archaea are prokaryotes without peptidoglycan that live in extreme places.
**Q283 — B** · This matches the lecture comparison.

## Inside the bacterial cell · Q284–295

**Q284** · Easy · *codex, slides 130 to 135*

**Which structure is common to all bacterial cells?**

1. Capsules
2. Ribosomes
3. Endospores
4. Flagella

**Q285** · Easy · *codex, slides 130 to 135*

**What is the shape of the bacterial chromosome?**

1. Several linear strands of DNA
2. A single circular strand of DNA
3. A set of 46 rod-shaped chromosomes
4. A ring of histone proteins only

**Q286** · Easy · *codex, slides 130 to 135*

**What is the dense area where bacterial DNA aggregates called?**

1. The nucleolus
2. The nuclear envelope
3. The nucleoid
4. The matrix

**Q287** · Easy · *codex, slides 130 to 135*

**About how much of bacterial cytoplasm is water?**

1. 7 to 8 percent
2. About 20 percent
3. Nearly 100 percent
4. 70 to 80 percent

**Q288** · Easy · *codex, slides 130 to 135*

**Plasmids are small circles of what?**

1. Protein
2. DNA
3. Lipid
4. Cellulose

**Q289** · Medium · *codex, slides 130 to 135*

**Plasmids often confer which protective trait?**

1. A nucleus
2. Photosynthesis in chloroplasts
3. Drug resistance
4. A double membrane

**Q290** · Medium · *codex, slides 130 to 135*

**How are plasmids passed from one bacterium to another?**

1. In mitosis
2. By osmosis
3. By photosynthesis
4. In conjugation

**Q291** · Medium · *codex, slides 130 to 135*

**What is the role of inclusion bodies in bacteria?**

1. They make ATP using their cristae
2. They assemble ribosomal subunits
3. They hold the chromosome inside a nucleus
4. They store nutrients for times of depletion

**Q292** · Medium · *codex, slides 130 to 135*

**Which statement about granules is correct?**

1. They are membrane-bound organelles with hydrolytic enzymes
2. They are circular DNA that confers resistance
3. They are inclusions of inorganic crystals with no membrane
4. They are thick coats of polysaccharide on the cell

**Q293** · Medium · *codex, slides 130 to 135*

**Which statements about bacterial plasmids are correct? 1. They are circles of DNA. 2. They carry about 5 to 100 genes. 3. They are essential for the survival of every bacterium. 4. They can be passed on in conjugation.**

1. 1 and 2 only
2. 1, 2 and 4 only
3. 2, 3 and 4 only
4. 1, 3 and 4 only

**Q294** · Hard · *codex, slides 130 to 135*

**All of the following are found in only SOME bacteria EXCEPT which one?**

1. Flagella
2. Ribosomes
3. Capsules
4. Endospores

**Q295** · Hard · *codex, slides 130 to 135*

**Some aquatic bacteria float near the surface. Which structure explains this?**

1. Granules of inorganic crystals, which add weight
2. Plasmids carrying drug resistance
3. Capsules that anchor the cell to rocks
4. Gas vesicles in inclusions, which provide buoyancy

### Answers — Inside the bacterial cell · Q284–295

**Q284 — B** · Ribosomes are common to all bacterial cells.
**Q285 — B** · The bacterial chromosome is a single circular strand.
**Q286 — C** · Bacterial DNA aggregates in the nucleoid.
**Q287 — D** · Cytoplasm is 70 to 80 percent water.
**Q288 — B** · Plasmids are circles of DNA.
**Q289 — C** · Plasmids often confer drug resistance.
**Q290 — D** · Plasmids are passed on in conjugation.
**Q291 — D** · Inclusions act as a storehouse.
**Q292 — C** · Granules are not enclosed by membranes.
**Q293 — B** · Statements 1, 2 and 4 are true; plasmids are nonessential, so statement 3 is false.
**Q294 — B** · Correct choice.
**Q295 — D** · Gas vesicles provide buoyancy and flotation.

## Glycocalyx, capsule and slime layer · Q296–305

**Q296** · Easy · *codex, slides 136 to 138*

**What is a glycocalyx?**

1. A ring of DNA that carries drug resistance
2. A dormant tough structure made in soil bacteria
3. A tube used to transfer DNA between cells
4. A coating of repeating polysaccharide, protein, or both

**Q297** · Easy · *codex, slides 136 to 138*

**A loose shield that protects bacteria from loss of water and nutrients is called what?**

1. A slime layer
2. A capsule
3. An endospore
4. A flagellum

**Q298** · Easy · *codex, slides 136 to 138*

**A dense, thick glycocalyx tightly bound to the bacterial cell is called what?**

1. A slime layer
2. A plasmid
3. A capsule
4. A granule

**Q299** · Easy · *codex, slides 136 to 138*

**Which bacterium's slime layer helps it accumulate on tooth enamel?**

1. Escherichia coli
2. Mycoplasma
3. Streptococcus mutans
4. Corynebacterium diphtheriae

**Q300** · Medium · *codex, slides 136 to 138*

**Glycocalyces are important in the formation of what?**

1. Chloroplasts
2. Nuclear pores
3. Biofilms
4. Lysosomes

**Q301** · Medium · *codex, slides 136 to 138*

**Streptococcus mutans slime on tooth enamel contributes to which condition?**

1. Silicosis
2. Tay-Sachs disease
3. Dental plaque and cavities
4. Black lung disease

**Q302** · Medium · *codex, slides 136 to 138*

**What is a bacterial capsule composed of?**

1. Phospholipids embedded with porin proteins
2. Circular DNA carrying 5 to 100 genes
3. Hollow tubes made of flagellin protein
4. Polysaccharides firmly attached to the cell wall

**Q303** · Medium · *codex, slides 136 to 138*

**Which are roles of a bacterial capsule? 1. Protection from phagocytosis. 2. Adhesion to surfaces. 3. Transfer of plasmids. 4. Formation of endospores.**

1. 1 and 3 only
2. 2 and 4 only
3. 3 and 4 only
4. 1 and 2 only

**Q304** · Hard · *codex, slides 136 to 138*

**How do a slime layer and a capsule differ?**

1. The capsule is a loose shield, while the slime layer is tightly bound and thick
2. The slime layer contains DNA, while the capsule contains only lipid
3. The slime layer is found only in archaea, while the capsule is found in humans
4. The slime layer is a loose shield, while the capsule is more tightly bound, denser and thicker

**Q305** · Devil · *codex, slides 136 to 138*

**A capsule-deficient mutant is cleared faster by phagocytes and adheres poorly to surfaces. Which pair of capsule roles explains both observations?**

1. Storage of nutrients and release of hydrogen
2. Transfer of plasmids and swimming movement
3. Protection from phagocytosis and adhesion to surfaces
4. Formation of spores and digestion of waste

### Answers — Glycocalyx, capsule and slime layer · Q296–305

**Q296 — D** · A glycocalyx is a coating of polysaccharide, protein or both.
**Q297 — A** · A loose shield is a slime layer.
**Q298 — C** · A tightly bound dense glycocalyx is a capsule.
**Q299 — C** · S.
**Q300 — C** · Glycocalyces take part in biofilm formation.
**Q301 — C** · The slime builds plaque that contributes to cavities.
**Q302 — D** · A capsule is composed of polysaccharides attached to the wall.
**Q303 — D** · Capsules protect against phagocytosis and help bacteria adhere to surfaces.
**Q304 — D** · This is the distinction in the lecture.
**Q305 — C** · Capsules protect from phagocytes and help bacteria adhere.

## Endospores · Q306–311

**Q306** · Easy · *codex, slide 139*

**What is an endospore?**

1. A circular piece of extra bacterial DNA
2. A dormant, tough, non-reproductive structure
3. A tube that transfers DNA between cells
4. A coating of repeating polysaccharide

**Q307** · Easy · *codex, slide 139*

**Endospores are produced by what?**

1. All bacteria
2. A small number of bacteria
3. Only archaea
4. Only fungi

**Q308** · Easy · *codex, slide 139*

**Where are endospores commonly found?**

1. Only inside lysosomes
2. Only inside the nucleus
3. In soil and water
4. Only in germinating seeds

**Q309** · Medium · *codex, slide 139*

**Endospores are resistant to which enzyme?**

1. Catalase
2. Amylase
3. Pepsin
4. Lysozyme

**Q310** · Medium · *codex, slide 139*

**Why are endospores called non-reproductive?**

1. A dormant survival form, not a way to make cells
2. They always produce two cells at once
3. They transfer DNA to other living cells
4. They are made only by dead bacterial cells

**Q311** · Hard · *codex, slide 139*

**A food sample treated with a chemical disinfectant still contains viable bacteria after heating. Which structure best explains survival?**

1. Endospores
2. Slime layers
3. Plasmids
4. Fimbriae

### Answers — Endospores · Q306–311

**Q306 — B** · An endospore is a dormant tough structure that does not reproduce.
**Q307 — B** · Only a small number of bacteria make endospores.
**Q308 — C** · Endospores are found in soil and water.
**Q309 — D** · Endospores resist lysozyme.
**Q310 — A** · They allow survival, not reproduction.
**Q311 — A** · Endospores resist disinfectants, heat and starvation.

## Prokaryotic cytoskeleton and ribosomes · Q312–317

**Q312** · Easy · *codex, slides 140 to 141*

**What do bacterial ribosomes make?**

1. Proteins
2. Lipids
3. Cellulose
4. DNA

**Q313** · Easy · *codex, slides 140 to 141*

**How many subunits make up a prokaryotic ribosome?**

1. One
2. Three
3. Two
4. Four

**Q314** · Easy · *codex, slides 140 to 141*

**Prokaryotic ribosomes are made of protein and what else?**

1. Phospholipid
2. Peptidoglycan
3. rRNA
4. Glycogen

**Q315** · Medium · *codex, slides 140 to 141*

**Where may prokaryotic ribosomes be found?**

1. Inside a nucleus or inside a nucleolus
2. In the cytoplasm or on the plasma membrane
3. Inside mitochondria and inside chloroplasts
4. On the rough ER and the Golgi only

**Q316** · Medium · *codex, slides 140 to 141*

**Until recently, the cytoskeleton was thought to occur in which cells only?**

1. Archaeal cells
2. Viral particles
3. Bacterial spores
4. Eukaryotic cells

**Q317** · Hard · *codex, slides 140 to 141*

**Which statement about the prokaryotic cytoskeleton is correct?**

1. It is a double membrane around the chromosome
2. It is a cell wall made of peptidoglycan
3. It is absent from all prokaryotic cells
4. It is a scaffold in the cytoplasm

### Answers — Prokaryotic cytoskeleton and ribosomes · Q312–317

**Q312 — A** · Ribosomes carry out protein synthesis.
**Q313 — C** · A prokaryotic ribosome has two subunits.
**Q314 — C** · Ribosomes contain protein and rRNA.
**Q315 — B** · They may be free or attached to the plasma membrane.
**Q316 — D** · It was thought to be only eukaryotic.
**Q317 — D** · The lecture calls it a major advance.

## Cell envelope and plasma membrane · Q318–325

**Q318** · Easy · *codex, slides 142 to 145*

**Which layers can make up the bacterial cell envelope?**

1. Membrane, wall and sometimes an outer membrane
2. Nuclear envelope, ER and Golgi apparatus
3. Capsule, plasmid and granule inclusions
4. Cristae, matrix and ribosome subunits

**Q319** · Easy · *codex, slides 142 to 145*

**The bacterial plasma membrane is made of what type of structure?**

1. A phospholipid bilayer with proteins
2. A thick layer of pure cellulose
3. A coat of silica around the cell
4. A single layer of lipid and sugar

**Q320** · Easy · *codex, slides 142 to 145*

**Where does the cell envelope lie relative to the cytoplasm?**

1. Inside it
2. Within the nucleus
3. Outside it
4. Within the nucleoid

**Q321** · Medium · *codex, slides 142 to 145*

**Which function does the bacterial plasma membrane provide?**

1. Photosynthesis in chloroplasts of the cell
2. Storage of DNA inside a true nucleus
3. Attachment of the cell to a tooth surface
4. A site for energy reactions and synthesis

**Q322** · Medium · *codex, slides 142 to 145*

**The plasma membrane is selectively permeable. What does this mean?**

1. It lets all materials pass in and out freely
2. It regulates which materials move in and out
3. It lets nothing pass in or out at all
4. It lets only water pass in and out

**Q323** · Medium · *codex, slides 142 to 145*

**How many layers does the Gram-positive envelope have?**

1. Two
2. One
3. Three
4. Four

**Q324** · Hard · *codex, slides 142 to 145*

**How many layers does the Gram-negative envelope have, and which are they?**

1. Two: cell wall and cytoplasmic membrane
2. Three: capsule, nucleus and cell wall
3. Four: outer membrane, wall, plasma membrane and nucleoid
4. Three: outer membrane, cell wall and cytoplasmic membrane

**Q325** · Hard · *codex, slides 142 to 145*

**All of the following are functions of the bacterial plasma membrane EXCEPT which one?**

1. Regulating the transport of materials
2. Storing the chromosome inside a nucleus
3. Hosting energy reactions for the cell
4. Secreting some substances outward

### Answers — Cell envelope and plasma membrane · Q318–325

**Q318 — A** · The envelope has two or three layers.
**Q319 — A** · It is a phospholipid bilayer with proteins.
**Q320 — C** · The envelope lies outside the cytoplasm.
**Q321 — D** · These are listed functions.
**Q322 — B** · It regulates transport.
**Q323 — A** · Gram-positive bacteria have two layers.
**Q324 — D** · Gram-negative envelopes have three layers.
**Q325 — B** · Correct choice.

## Bacterial cell walls · Q326–341

**Q326** · Easy · *codex, slides 146 to 156*

**What is the main polymer of the bacterial cell wall?**

1. Peptidoglycan
2. Cellulose
3. Collagen
4. Chitin

**Q327** · Easy · *codex, slides 146 to 156*

**What does the bacterial cell wall provide?**

1. Photosynthesis using chlorophyll
2. Protein synthesis on ribosomes
3. Motility through the environment
4. Shape and strong structural support

**Q328** · Easy · *codex, slides 146 to 156*

**Which bacteria have a thick peptidoglycan layer?**

1. Gram-positive bacteria
2. Gram-negative bacteria
3. Mycoplasmas
4. Archaea

**Q329** · Easy · *codex, slides 146 to 156*

**Which bacteria have an outer membrane?**

1. Gram-positive bacteria
2. Mycoplasmas
3. Gram-negative bacteria
4. Endospores

**Q330** · Easy · *codex, slides 146 to 156*

**Which molecule is in the outermost layer of the Gram-negative outer membrane?**

1. Cellulose
2. Lipopolysaccharide (LPS)
3. Teichoic acid
4. Histone

**Q331** · Easy · *codex, slides 146 to 156*

**What is absent from archaeal cell walls?**

1. Any protective layer
2. Ribosomes
3. Peptidoglycan
4. DNA

**Q332** · Medium · *codex, slides 146 to 156*

**What connects the glycan strands of peptidoglycan?**

1. Phosphodiester bonds
2. Interlocking peptide bridges
3. Disulfide loops in histones
4. Hydrogen peroxide bridges

**Q333** · Medium · *codex, slides 146 to 156*

**How thick is the peptidoglycan wall of Gram-positive bacteria?**

1. About 1 to 3 nm
2. About 20 to 80 nm
3. About 2 mm
4. About 200 μm

**Q334** · Medium · *codex, slides 146 to 156*

**Gram-negative bacteria have a single peptidoglycan sheet. How thin is it?**

1. About 20 to 80 nm
2. About 1 mm
3. About 1 to 3 nm
4. About 3 cm

**Q335** · Medium · *codex, slides 146 to 156*

**What forms the channels that let small molecules cross the Gram-negative outer membrane?**

1. Nucleoporins
2. Histone rings
3. Aquaporin granules
4. Porin proteins

**Q336** · Medium · *codex, slides 146 to 156*

**Which bacteria lack a cell wall entirely?**

1. Mycobacterium
2. Mycoplasmas
3. Nocardia
4. Escherichia coli

**Q337** · Medium · *codex, slides 146 to 156*

**Which are features of Gram-negative bacteria? 1. An outer membrane. 2. A single thin peptidoglycan sheet. 3. Lipopolysaccharide in the outer layer. 4. A thick peptidoglycan wall of 20 to 80 nm.**

1. 1 and 4 only
2. 2 and 3 only
3. 1, 2 and 3 only
4. 1, 3 and 4 only

**Q338** · Hard · *codex, slides 146 to 156*

**Why are Gram-negative bacteria generally harder to inhibit or kill?**

1. Their outer membrane is an extra barrier to some chemicals
2. They have a thicker peptidoglycan layer than Gram-positive bacteria
3. They make endospores in all of their cells
4. They have a nucleus that shields the DNA

**Q339** · Hard · *codex, slides 146 to 156*

**Mycobacterium and Nocardia are called acid-fast because of which feature?**

1. A thick coat of cellulose
2. A double-membrane nucleus
3. A layer of teichoic acids only
4. Unique lipids in their cell walls

**Q340** · Hard · *codex, slides 146 to 156*

**All of the following are true of peptidoglycan EXCEPT which one?**

1. It provides rigid support to the bacterial wall
2. It has a backbone of NAG and NAM
3. It is freely permeable to solutes
4. It is found in the walls of archaea

**Q341** · Devil · *codex, slides 146 to 156*

**A penicillin-class antibiotic damages the cell wall. Why would Mycoplasma be unaffected?**

1. They have a thicker outer membrane
2. They form endospores
3. They have a nucleus
4. They lack a cell wall entirely

### Answers — Bacterial cell walls · Q326–341

**Q326 — A** · Peptidoglycan gives the wall its rigidity.
**Q327 — D** · The wall gives shape and strength.
**Q328 — A** · Gram-positive walls are thick.
**Q329 — C** · Gram-negative bacteria have an outer membrane.
**Q330 — B** · LPS is in the outermost layer.
**Q331 — C** · Archaea have no peptidoglycan.
**Q332 — B** · Peptide bridges connect strands.
**Q333 — B** · The wall is about 20 to 80 nm.
**Q334 — C** · It is a single thin sheet of 1 to 3 nm.
**Q335 — D** · Porin channels admit small molecules.
**Q336 — B** · Mycoplasmas lack a wall.
**Q337 — C** · Gram-negative bacteria have an outer membrane, a thin peptidoglycan sheet and LPS; the thick wall is Gram-positive.
**Q338 — A** · The outer membrane is impervious to some chemicals.
**Q339 — D** · Their walls contain unique lipids.
**Q340 — D** · Correct choice.
**Q341 — D** · Without a wall there is nothing for the drug to act on.

## Surface appendages · Q342–349

**Q342** · Easy · *codex, slides 157 to 158*

**Which appendages provide bacterial motility?**

1. Fimbriae
2. Capsules
3. Flagella
4. Plasmids

**Q343** · Easy · *codex, slides 157 to 158*

**Which appendages help bacteria attach to surfaces and mate?**

1. Pili and fimbriae
2. Flagella and axial filaments
3. Capsules and slime layers
4. Granules and inclusions

**Q344** · Easy · *codex, slides 157 to 158*

**Do fimbriae play a role in bacterial motility?**

1. No, they help bacteria adhere to solid surfaces
2. Yes, they act as the main swimming organs
3. Yes, they transfer plasmids by contact
4. Yes, they pump protons into lysosomes

**Q345** · Medium · *codex, slides 157 to 158*

**Which bacteria typically have fimbriae?**

1. Most Gram-negative bacteria
2. Most Gram-positive bacteria
3. Only archaea
4. Only endospore formers

**Q346** · Medium · *codex, slides 157 to 158*

**How do pili compare in length with other appendages?**

1. They are shorter than fimbriae and longer than flagella
2. They are the same length as the fimbriae
3. They are longer than the flagella of the cell
4. They are longer than fimbriae and shorter than flagella

**Q347** · Medium · *codex, slides 157 to 158*

**What do conjugation pili transfer between cells?**

1. Ribosomes
2. Plasmids
3. Mitochondria
4. Capsules

**Q348** · Hard · *codex, slides 157 to 158*

**Which statement about fimbriae and disease is correct?**

1. They synthesise toxins on their ribosomes
2. They help bacteria adhere and are a virulence factor
3. They prevent bacteria from sticking to tissue
4. They store energy in granules for the cell

**Q349** · Devil · *codex, slides 157 to 158*

**Which pairing of appendage and role is correct?**

1. Fimbriae: grappling-hook movement; pili: adhesion without motility
2. Flagella: DNA transfer; pili: swimming movement
3. Fimbriae: adhesion; pili: grappling-hook movement and conjugation
4. Pili: nutrient storage; fimbriae: gas buoyancy in water

### Answers — Surface appendages · Q342–349

**Q342 — C** · Flagella provide motility.
**Q343 — A** · Pili and fimbriae are used for attachment and mating.
**Q344 — A** · Fimbriae have no role in motility.
**Q345 — A** · Most Gram-negative bacteria have fimbriae.
**Q346 — D** · Pili are intermediate in length.
**Q347 — B** · Conjugation pili transfer plasmids.
**Q348 — B** · Adhesion makes fimbriae a virulence factor.
**Q349 — C** · These are the roles described.

## Bacterial shapes and arrangements · Q350–359

**Q350** · Easy · *codex, slides 159 to 162*

**A bacterium shaped like a rod is called what?**

1. A bacillus
2. A coccus
3. A spirillum
4. A vibrio

**Q351** · Easy · *codex, slides 159 to 162*

**What is the name for a spherical bacterium?**

1. A bacillus
2. A spirochete
3. A coccus
4. A vibrio

**Q352** · Easy · *codex, slides 159 to 162*

**Cocci arranged in chains are called what?**

1. Staphylococci
2. Streptococci
3. Diplococci
4. Tetrads

**Q353** · Easy · *codex, slides 159 to 162*

**What do we call cocci grouped in irregular clusters?**

1. Streptococci
2. Diplococci
3. Staphylococci
4. Sarcinae

**Q354** · Medium · *codex, slides 159 to 162*

**Which spiral bacterium has a flexible wall and an axial filament?**

1. Spirillum
2. Bacillus
3. Spirochete
4. Coccus

**Q355** · Medium · *codex, slides 159 to 162*

**What does pleomorphism mean?**

1. Cells of one species always form chains
2. Cells of one species make endospores
3. Cells of one species lack a cell wall
4. Cells of one species vary in shape and size

**Q356** · Medium · *codex, slides 159 to 162*

**What is a short, slightly curved rod called?**

1. A spirillum
2. A vibrio
3. A coccus
4. A fusiform

**Q357** · Medium · *codex, slides 159 to 162*

**Which of these bacterial shapes are spiral? 1. Spirillum. 2. Spirochete. 3. Vibrio. 4. Coccus.**

1. 1 and 2 only
2. 1, 2 and 3 only
3. 2 and 4 only
4. 3 and 4 only

**Q358** · Hard · *codex, slides 159 to 162*

**Why do bacilli appear only singly, in pairs or in chains, while cocci can also form clusters and packets?**

1. Bacilli divide on a single axis, cocci on one or more planes
2. Bacilli have no cell wall, whereas cocci have a thick wall
3. Bacilli lack ribosomes, whereas cocci have many of them
4. Bacilli make endospores, whereas cocci make capsules

**Q359** · Hard · *codex, slides 159 to 162*

**A Gram stain shows spheres in cubical packets. Which arrangement is this?**

1. Sarcina
2. Staphylococci
3. Diplococci
4. Streptobacilli

### Answers — Bacterial shapes and arrangements · Q350–359

**Q350 — A** · A rod is a bacillus.
**Q351 — C** · A sphere is a coccus.
**Q352 — B** · Chains of cocci are streptococci.
**Q353 — C** · Irregular clusters are staphylococci.
**Q354 — C** · A spirochete has a flexible wall and axial filament.
**Q355 — D** · Pleomorphism means variable shape and size.
**Q356 — B** · A vibrio is a short curved rod.
**Q357 — A** · Spirilla and spirochetes are spiral; a vibrio is a curved rod and a coccus is spherical.
**Q358 — A** · The division planes determine the arrangement.
**Q359 — A** · A cubical packet is a sarcina.

## Prokaryotic reproduction · Q360–365

**Q360** · Easy · *codex, slide 163*

**What is the asexual way prokaryotes reproduce?**

1. Binary fission
2. Mitosis
3. Meiosis
4. Budding of the nucleus

**Q361** · Easy · *codex, slide 163*

**In conjugation, DNA is transferred by means of what?**

1. A phage
2. The environment
3. A pilus
4. A spore

**Q362** · Easy · *codex, slide 163*

**Transduction uses which agents to move DNA?**

1. Pili
2. Capsules
3. Bacteriophages
4. Plasmid rings only

**Q363** · Medium · *codex, slide 163*

**In transformation, a prokaryote takes up what?**

1. Proteins from lysosomes
2. Chloroplasts from plants
3. DNA from its environment
4. Phages from the soil

**Q364** · Medium · *codex, slide 163*

**What happens during binary fission?**

1. Two cells fuse to make one larger cell
2. A cell forms an endospore for survival
3. Genes are transferred through a pilus
4. The chromosome is copied and the cell divides

**Q365** · Hard · *codex, slide 163*

**Which matching of mechanism and source of DNA is correct?**

1. Transformation: DNA through a pilus; transduction: environmental DNA; conjugation: phage DNA
2. Transformation: environmental DNA; transduction: phage DNA; conjugation: pilus DNA
3. Transformation: phage DNA; transduction: pilus DNA; conjugation: environmental DNA
4. All three move DNA only by binary fission of cells

### Answers — Prokaryotic reproduction · Q360–365

**Q360 — A** · Binary fission separates one cell into two.
**Q361 — C** · DNA moves through a pilus.
**Q362 — C** · Bacteriophages move DNA in transduction.
**Q363 — C** · It takes up DNA shed by other prokaryotes.
**Q364 — D** · This is binary fission.
**Q365 — B** · These are the three mechanisms.

## Cell size, shape and surface area · Q366–371

**Q366** · Easy · *codex, slides 166 to 171*

**What does a large surface area-to-volume ratio help a cell do?**

1. Exchange materials with its environment
2. Store more DNA in a small space
3. Divide without a cell membrane
4. Avoid needing ATP for transport

**Q367** · Easy · *codex, slides 166 to 171*

**Which factor influences cell shape?**

1. The colour of the cytoplasm
2. The number of ribosomes only
3. The age of the nucleolus
4. The rigidity of the membrane

**Q368** · Medium · *codex, slides 166 to 171*

**Which list names factors that determine cell size and shape?**

1. Cytoplasm viscosity, neighbour pressure, membrane rigidity and function
2. Wavelength of light, numerical aperture and refractive index
3. Peptidoglycan, outer membrane and teichoic acid layers
4. Histones, nucleosomes and chromatin fibres in the nucleus

**Q369** · Medium · *codex, slides 166 to 171*

**Why are red blood cells not simply spherical?**

1. An internal cytoskeleton shapes them
2. They contain a large central nucleus
3. They contain chloroplasts for photosynthesis
4. They are surrounded by a cellulose wall

**Q370** · Medium · *codex, slides 166 to 171*

**Which factor depends on neighbouring cells?**

1. The rate of photosynthesis in the cell
2. The mechanical action of adjoining cells
3. The number of plasmids in the cell
4. The presence of pili on the surface

**Q371** · Hard · *codex, slides 166 to 171*

**A spherical cell doubles its diameter. What happens to its surface area-to-volume ratio?**

1. It doubles
2. It stays the same
3. It halves
4. It rises fourfold

### Answers — Cell size, shape and surface area · Q366–371

**Q366 — A** · It aids exchange of materials.
**Q367 — D** · Membrane rigidity is a factor.
**Q368 — A** · These factors are listed in the lecture.
**Q369 — A** · The cytoskeleton helps maintain the shape.
**Q370 — B** · Neighbours exert mechanical action on shape.
**Q371 — C** · Surface area rises fourfold and volume eightfold, so the ratio halves.

## The cytoskeleton: overview · Q372–383

**Q372** · Easy · *codex, slides 174 to 183*

**Which three kinds of fibres make up the cytoskeleton?**

1. Cristae, grana and cisternae of organelles
2. Histones, nucleosomes and chromatin fibres
3. Pili, fimbriae and flagella of bacterial cells
4. Microtubules, microfilaments and intermediate filaments

**Q373** · Easy · *codex, slides 174 to 183*

**Microtubules are made from which protein?**

1. Actin
2. Keratin
3. Histone
4. Tubulin

**Q374** · Easy · *codex, slides 174 to 183*

**Microfilaments are made from which protein?**

1. Tubulin
2. Actin
3. Vimentin
4. Collagen

**Q375** · Easy · *codex, slides 174 to 183*

**Intermediate filament proteins are similar to which protein of hair?**

1. Actin
2. Tubulin
3. Myosin
4. Keratin

**Q376** · Easy · *codex, slides 174 to 183*

**What does the cytoskeleton act like in the cell?**

1. A skeleton that supports its shape
2. A wall of peptidoglycan around it
3. A sac of digestive enzymes inside it
4. A storage vacuole for water

**Q377** · Medium · *codex, slides 174 to 183*

**How wide is a microfilament?**

1. About 25 nm
2. About 10 nm
3. About 70 nm
4. About 7 nm

**Q378** · Medium · *codex, slides 174 to 183*

**What is the diameter of the tubes that form microtubules?**

1. About 7 nm
2. About 12 nm
3. About 25 nm
4. About 250 nm

**Q379** · Medium · *codex, slides 174 to 183*

**What is the diameter range of intermediate filaments?**

1. 25 nm
2. 7 nm
3. 100 to 200 nm
4. 8 to 12 nm

**Q380** · Medium · *codex, slides 174 to 183*

**Which proteins form intermediate filaments?**

1. Alpha and beta tubulin dimers
2. G-actin and F-actin monomers
3. Kinesin and dynein motor proteins
4. Lamins and cell-specific proteins

**Q381** · Medium · *codex, slides 174 to 183*

**Which two categories describe the roles of the cytoskeleton?**

1. Digestive and photosynthetic
2. Structural and transport
3. Genetic and hereditary
4. Detoxifying and storing

**Q382** · Hard · *codex, slides 174 to 183*

**Which function of the cytoskeleton operates at the tissue level?**

1. Muscle movement
2. Anchoring organelles
3. Chromosome movement
4. Vesicle movement

**Q383** · Devil · *codex, slides 174 to 183*

**Which order ranks the three filaments from thinnest to thickest?**

1. Microfilaments, intermediate filaments, then microtubules
2. Microtubules, intermediate filaments, then microfilaments
3. Intermediate filaments, microfilaments, then microtubules
4. Microfilaments, microtubules, then intermediate filaments

### Answers — The cytoskeleton: overview · Q372–383

**Q372 — D** · These are the three components.
**Q373 — D** · Microtubules are made of tubulin.
**Q374 — B** · Microfilaments are made of actin.
**Q375 — D** · They are similar to keratin.
**Q376 — A** · It supports cell shape like a skeleton.
**Q377 — D** · Microfilaments are about 7 nm.
**Q378 — C** · Microtubules are about 25 nm.
**Q379 — D** · Intermediate filaments are 8 to 12 nm.
**Q380 — D** · These form intermediate filaments.
**Q381 — B** · The cytoskeleton has structural and transport roles.
**Q382 — A** · Muscle movement is a tissue-level function.
**Q383 — A** · The diameters are 7 nm, 8 to 12 nm and 25 nm.

## Actin filaments · Q384–392

**Q384** · Easy · *codex, slides 184 to 195*

**What does G-actin stand for?**

1. Gel actin
2. Globular actin
3. Granular actin
4. Golgi actin

**Q385** · Easy · *codex, slides 184 to 195*

**What does F-actin stand for?**

1. Free actin
2. Fibrous actin
3. Filamentous actin
4. Fat actin

**Q386** · Easy · *codex, slides 184 to 195*

**Actin filaments have which structural property?**

1. A hollow core
2. Polarity
3. A double membrane
4. A nucleus

**Q387** · Easy · *codex, slides 184 to 195*

**Which nucleotide is bound to G-actin?**

1. GTP
2. ATP
3. dATP
4. UTP

**Q388** · Medium · *codex, slides 184 to 195*

**What does F-actin do to its bound ATP?**

1. It makes more ATP for the cell
2. It hydrolyses it to ADP and Pi
3. It stores it as glycogen granules
4. It exports it through nuclear pores

**Q389** · Medium · *codex, slides 184 to 195*

**Why does ADP not leave the actin filament?**

1. The opening of the cleft is blocked
2. The filament contains no ATP at all
3. ADP is too large to leave it
4. The filament is made of lipid molecules

**Q390** · Medium · *codex, slides 184 to 195*

**Why does free G-actin rebind ATP rather than ADP?**

1. ATP outnumbers ADP in the cytosol
2. ADP cannot bind to actin at all
3. ATP is made inside the actin cleft
4. G-actin has no cleft to bind either

**Q391** · Hard · *codex, slides 184 to 195*

**Which statement describes actin monomer orientation?**

1. The cleft faces the same end, called the minus end
2. Monomers orient randomly, so there is no polarity
3. Monomers orient the cleft toward the plus end of a microtubule
4. Monomers form a hollow tube with a lumen

**Q392** · Hard · *codex, slides 184 to 195*

**Which sequence describes the actin cycle?**

1. F-actin hydrolyses ATP, G-actin polymerises, and ATP is exchanged for ADP
2. G-actin hydrolyses ATP first, then it forms microtubules in the cell
3. F-actin releases ADP directly through its cleft
4. G-actin-ATP polymerises, F-actin hydrolyses ATP, and G-actin swaps ADP for ATP

### Answers — Actin filaments · Q384–392

**Q384 — B** · G-actin is globular actin.
**Q385 — C** · F-actin is filamentous actin.
**Q386 — B** · Actin filaments have polarity.
**Q387 — B** · G-actin binds ATP.
**Q388 — B** · ATP is hydrolysed to ADP and Pi.
**Q389 — A** · The cleft opening is blocked.
**Q390 — A** · ATP is more abundant than ADP.
**Q391 — A** · The cleft faces the minus end.
**Q392 — D** · This is the cycle in the lecture.

## Intermediate filaments · Q393–400

**Q393** · Easy · *codex, slides 197 to 200*

**Intermediate filaments are found in most what?**

1. Plants and fungi only
2. Animals, not plants and fungi
3. Bacteria only
4. Viruses

**Q394** · Easy · *codex, slides 197 to 200*

**What are the subunits of intermediate filaments?**

1. Globular actin units
2. α-helical rods
3. Tubulin dimers
4. Plasmid circles

**Q395** · Easy · *codex, slides 197 to 200*

**Intermediate filaments resist which kind of force?**

1. Stretching forces
2. Light forces
3. Osmotic forces only
4. Gravitational forces

**Q396** · Medium · *codex, slides 197 to 200*

**Unlike microfilaments, intermediate filaments do not contribute to what?**

1. Mechanical strength
2. Cell shape
3. Support of the membrane
4. Cell motility

**Q397** · Medium · *codex, slides 197 to 200*

**Intermediate filaments provide mechanical support for what?**

1. The nuclear pore complex only
2. The lysosome membrane around enzymes
3. The plasma membrane at cell contacts
4. The chloroplast thylakoid disks

**Q398** · Medium · *codex, slides 197 to 200*

**How stable are intermediate filaments after extraction with detergents and high salt?**

1. Completely destroyed
2. Extremely stable
3. Converted to microtubules
4. Converted to actin

**Q399** · Hard · *codex, slides 197 to 200*

**Which statement about intermediate filament diameter is correct?**

1. They are larger than microtubules but smaller than microfilaments
2. They are thinner than microtubules but thicker than microfilaments
3. They are the same size as microtubules in cells
4. They are the thinnest of the three filaments in cells

**Q400** · Devil · *codex, slides 197 to 200*

**Which feature makes intermediate filaments suited to resisting stretch in skin?**

1. Hollow tubes of tubulin give tracks for motor proteins
2. Thin globular actin chains drive muscle contraction
3. A double membrane gives physical protection
4. Ropelike α-helical filaments give tensile strength

### Answers — Intermediate filaments · Q393–400

**Q393 — B** · They are found in animals.
**Q394 — B** · α-helical rods assemble into the filaments.
**Q395 — A** · They resist stretching.
**Q396 — D** · They do not contribute to motility.
**Q397 — C** · They support these contact sites.
**Q398 — B** · They remain extremely stable.
**Q399 — B** · They are intermediate in size.
**Q400 — D** · The rope-like structure provides strength.

# Module 3 — Intermediate filament types → Parts of the compound microscope

slides 201 to 300 · 200 questions · 17 sections · bank: BIOL151_Question_Bank_Slides201-300.docx
Difficulty: 80 Easy · 80 Medium · 32 Hard · 8 Devil

## Intermediate filament types · Q401–410

**Q401** · Easy · *codex, slides 201 to 202*

**Which group of intermediate filaments is found in the nucleus?**

1. Keratins
2. Vimentin
3. Neurofilaments
4. Lamins

**Q402** · Easy · *codex, slides 201 to 202*

**Which intermediate filament proteins are found in epithelia?**

1. Lamins
2. Vimentin
3. Neurofilaments
4. Keratins (cytokeratins)

**Q403** · Easy · *codex, slides 201 to 202*

**Which type III intermediate filament protein is the most abundant type?**

1. Keratin
2. Lamin
3. Vimentin
4. Neurofilament protein

**Q404** · Easy · *codex, slides 201 to 202*

**Which intermediate filaments are found in neuronal axons?**

1. Lamins
2. Cytokeratins
3. Neurofilaments
4. Vimentin

**Q405** · Medium · *codex, slides 201 to 202*

**Into how many groups are intermediate filaments broken down in the lecture?**

1. Four
2. Two
3. Three
4. Six

**Q406** · Medium · *codex, slides 201 to 202*

**Keratins form which hard epithelial structures?**

1. Bone, cartilage and tendon
2. Blood, lymph and plasma
3. Muscle, heart and nerve
4. Nails, hair and wool

**Q407** · Medium · *codex, slides 201 to 202*

**In which cells is vimentin found?**

1. Neurons, hepatocytes and sperm cells
2. Plant cells, fungal cells and bacteria
3. Leukocytes and endothelial cells
4. Osteocytes, platelets and red cells

**Q408** · Medium · *codex, slides 201 to 202*

**What do neurofilaments do in axons and dendrites?**

1. They carry vesicles toward the plus end using ATP
2. They generate force for contraction with myosin
3. They nucleate new microtubules at the minus end
4. They reach the axon tips and give structural support

**Q409** · Hard · *codex, slides 201 to 202*

**All of the following are groups of intermediate filaments EXCEPT which one?**

1. Lamins
2. Keratins
3. Tubulins
4. Neurofilaments

**Q410** · Hard · *codex, slides 201 to 202*

**Which pairing of filament group and location is correct?**

1. Lamins: epithelia; keratins: axons; neurofilaments: nucleus
2. Lamins: axons; keratins: nucleus; neurofilaments: epithelia
3. Lamins: nucleus; keratins: epithelia; neurofilaments: axons
4. Lamins: epithelia; keratins: nucleus; neurofilaments: leukocytes

### Answers — Intermediate filament types · Q401–410

**Q401 — D** · Lamins are the intermediate filaments of the nucleus.
**Q402 — D** · Keratins are found in epithelial tissues.
**Q403 — C** · Vimentin is the most abundant type III protein.
**Q404 — C** · Neurofilaments are found in neuronal axons.
**Q405 — A** · The lecture lists four groups.
**Q406 — D** · Hard epithelial tissues include nails, hair and wool.
**Q407 — C** · Vimentin is found in these cells.
**Q408 — D** · Neurofilaments extend from the cell body and provide structural support.
**Q409 — C** · Correct choice.
**Q410 — C** · This matches the lecture.

## Intermediate filament assembly · Q411–415

**Q411** · Easy · *codex, slide 204*

**Intermediate filament assembly begins with a pair of helical monomers twisting into what?**

1. Protofilaments of 13 units
2. Coiled-coil dimers
3. G-actin chains
4. Tubulin rings

**Q412** · Easy · *codex, slide 204*

**Is the basic assembly unit of an intermediate filament polarized?**

1. Yes, it has a plus and minus end
2. Yes, it has a cis and trans face
3. Yes, it has a head and a tail like kinesin
4. No, it is a non-polarized unit

**Q413** · Medium · *codex, slide 204*

**What forms when two coiled-coil dimers twist around each other?**

1. A trimer
2. A protofilament
3. A nucleosome
4. A tetramer

**Q414** · Medium · *codex, slide 204*

**How do intermediate filaments differ from microfilaments in polarity?**

1. Intermediate filaments are polarized, whereas microfilaments are not
2. Both are polarized in exactly the same way
3. They are non-polarized, but microfilaments are polarized
4. Both are non-polarized in all cells

**Q415** · Hard · *codex, slide 204*

**Which sequence describes intermediate filament assembly?**

1. Two tetramers form a dimer, which twists into helical monomers
2. Tubulin dimers form protofilaments, which form a 13-member tube
3. G-actin binds ATP, then polymerises into a polarized filament
4. Monomers form coiled-coil dimers, then two dimers form a tetramer

### Answers — Intermediate filament assembly · Q411–415

**Q411 — B** · Two helical monomers form a coiled-coil dimer.
**Q412 — D** · The unit is non-polarized.
**Q413 — D** · The result is a tetramer of two coiled-coil dimers.
**Q414 — C** · The lecture contrasts the two.
**Q415 — D** · This is the assembly sequence in the lecture.

## Diseases of intermediate filaments · Q416–425

**Q416** · Easy · *codex, slide 205*

**Which skin disease results from lack of normal bundles of keratin filaments?**

1. Silicosis
2. Tay-Sachs disease
3. Epidermolysis bullosa simplex
4. Alzheimer's disease

**Q417** · Easy · *codex, slide 205*

**What forms in the skin of a person with epidermolysis bullosa simplex?**

1. Blisters
2. Tumours
3. Scales of collagen
4. Pigment patches

**Q418** · Easy · *codex, slide 205*

**What are the keratin inclusions seen in alcoholic liver cirrhosis called?**

1. Barr bodies
2. Mallory bodies
3. Nissl bodies
4. Lamellar bodies

**Q419** · Easy · *codex, slide 205*

**Changes in which filaments are linked to Alzheimer's disease on this slide?**

1. Keratin filaments
2. Lamins
3. Actin filaments
4. Neurofilaments

**Q420** · Medium · *codex, slide 205*

**Which intermediate filament protein is defective in epidermolysis bullosa simplex?**

1. Vimentin
2. Keratin
3. Lamin
4. Neurofilament protein

**Q421** · Medium · *codex, slide 205*

**In which organ do Mallory bodies accumulate?**

1. The brain
2. The liver
3. The skin
4. The lung

**Q422** · Medium · *codex, slide 205*

**Which disease involves accumulation of keratin filaments into inclusions?**

1. Epidermolysis bullosa simplex
2. Alcoholic liver cirrhosis
3. Alzheimer's disease
4. Black lung disease

**Q423** · Medium · *codex, slide 205*

**In which tissue do neurofilament changes occur in Alzheimer's disease?**

1. The brain
2. The liver
3. The skin
4. The lung

**Q424** · Hard · *codex, slide 205*

**A patient's skin blisters because normal keratin bundles are lacking. Which cellular function has failed?**

1. Resistance to mechanical stress
2. Transport of vesicles along microtubules
3. Contraction by actin and myosin
4. Spindle formation during mitosis

**Q425** · Devil · *codex, slide 205*

**Which statement correctly pairs each disease with its filament change?**

1. Epidermolysis bullosa simplex: keratin inclusions; Alzheimer's: lack of keratin bundles; alcoholic cirrhosis: neurofilament changes
2. Epidermolysis bullosa simplex: neurofilament changes; Alzheimer's: keratin inclusions; alcoholic cirrhosis: lack of bundles
3. All three involve loss of lamins from the nucleus
4. Epidermolysis bullosa simplex: lack of keratin bundles; Alzheimer's: neurofilament changes; alcoholic cirrhosis: keratin inclusions

### Answers — Diseases of intermediate filaments · Q416–425

**Q416 — C** · Lack of keratin bundles causes this blistering disease.
**Q417 — A** · Blisters form because normal keratin bundles are lacking.
**Q418 — B** · Keratin filaments accumulate as Mallory bodies.
**Q419 — D** · Changes in neurofilaments in the brain are described.
**Q420 — B** · Keratin filament bundles are lacking.
**Q421 — B** · Mallory bodies accumulate in the liver.
**Q422 — B** · Keratin inclusions form in alcoholic cirrhosis.
**Q423 — A** · The changes occur within the brain.
**Q424 — A** · Intermediate filaments give tensile strength against mechanical stress.
**Q425 — D** · Each pairing matches the lecture.

## Microtubule structure · Q426–441

**Q426** · Easy · *codex, slides 208, 209, 218, 219*

**What is the approximate diameter of a microtubule?**

1. About 7 nm
2. About 25 nm
3. About 12 nm
4. About 250 nm

**Q427** · Easy · *codex, slides 208, 209, 218, 219*

**What shape are microtubules?**

1. Solid rods
2. Flat sheets
3. Hollow tubes
4. Branched cables

**Q428** · Easy · *codex, slides 176, 182*

**Which of the three cytoskeletal filaments is the widest?**

1. Microtubules
2. Microfilaments
3. Intermediate filaments
4. Lamin filaments

**Q429** · Easy · *codex, slides 208, 209, 218, 219*

**Tubulin dimers consist of which two subunits?**

1. Alpha and beta tubulin
2. Actin and myosin
3. Kinesin and dynein
4. Lamin A and lamin B

**Q430** · Easy · *codex, slides 208, 209, 218, 219*

**How many protofilaments make up a microtubule?**

1. Seven
2. Thirteen
3. Eight
4. Twenty-five

**Q431** · Easy · *codex, slides 208, 209, 218, 219*

**Tubulin dimers joined end to end form a linear polymer called what?**

1. A nucleosome
2. A tetramer
3. A protofilament
4. A cisterna

**Q432** · Medium · *codex, slides 208, 209, 218, 219*

**How are the thirteen protofilaments arranged in a microtubule?**

1. Wound as a single rope with no central duct
2. Stacked as flat disks like thylakoids
3. Twisted into coiled-coil dimers
4. In parallel, around a central duct

**Q433** · Medium · *codex, slides 208, 209, 218, 219*

**In humans, how long can axonal paths carrying cargo along microtubules be?**

1. About a millimetre
2. About 25 nm
3. More than a metre
4. Exactly 7 micrometres

**Q434** · Medium · *codex, slides 208, 209, 218, 219*

**What must exceed a critical level for microtubule assembly to occur?**

1. The temperature of the cell
2. The number of motor proteins
3. The concentration of tubulin
4. The thickness of the cell wall

**Q435** · Medium · *codex, slides 208, 209, 218, 219*

**What does it mean that tubulin building blocks are polar?**

1. Their ends have different shapes
2. They carry equal charges at both ends
3. They dissolve only in water
4. They contain two identical halves

**Q436** · Medium · *codex, slides 208, 209, 218, 219*

**What are the two ends of a microtubule called?**

1. The cis end and the trans end
2. The head end and the tail end
3. The inner end and the outer end
4. The plus end and the minus end

**Q437** · Medium · *codex, slides 208, 209, 218, 219*

**Which nucleotide is bound by tubulin in microtubule assembly?**

1. ATP
2. UTP
3. cAMP
4. GTP

**Q438** · Medium · *codex, slides 208, 209, 218, 219*

**What is a tubulin dimer?**

1. A pair of actin monomers
2. One alpha and one beta tubulin
3. Two coiled-coil keratin chains
4. A pair of kinesin heads

**Q439** · Hard · *codex, slides 208, 209, 218, 219*

**Which description of microtubule structure is correct?**

1. A hollow tube of 13 parallel protofilaments
2. A solid rope of coiled-coil keratin dimers and tetramers
3. A polarized double helix of globular actin monomers
4. A stack of flat tubulin disks surrounded by a membrane

**Q440** · Hard · *codex, slides 208, 209, 218, 219*

**All of the following are true of microtubules EXCEPT which one?**

1. They are hollow tubes about 25 nm wide
2. They have thirteen protofilaments
3. They are made of actin monomers
4. They have a plus and a minus end

**Q441** · Hard · *codex, slides 208, 209, 218, 219*

**A nerve cell must move a vesicle over more than a metre to the axon tip. Which structure provides the track?**

1. Lamins
2. Keratin filaments
3. Microtubules
4. Mallory bodies

### Answers — Microtubule structure · Q426–441

**Q426 — B** · Microtubules are about 25 nm across.
**Q427 — C** · Microtubules are hollow tubes of variable length.
**Q428 — A** · Microtubules, at about 25 nm, are the widest of the three filaments.
**Q429 — A** · Each dimer is an α and a β tubulin pair.
**Q430 — B** · A microtubule has thirteen protofilaments.
**Q431 — C** · The linear polymer is a protofilament.
**Q432 — D** · They lie in parallel around a central duct.
**Q433 — C** · Axons can exceed a metre in length.
**Q434 — C** · Tubulin concentration must exceed a critical level.
**Q435 — A** · This gives microtubules a plus and a minus end.
**Q436 — D** · Microtubules have plus and minus ends.
**Q437 — D** · GTP binds tubulin and drives growth and retraction.
**Q438 — B** · The dimer is an α–β pair.
**Q439 — A** · This summarises the lecture.
**Q440 — C** · Correct choice.
**Q441 — C** · Microtubules carry cargoes along axons.

## Tubulin polymerisation and drugs · Q442–455

**Q442** · Easy · *codex, slides 210 to 212, 220, 221*

**Which drug acts as a microtubule stabiliser?**

1. Colchicine
2. Taxol
3. Colcemid
4. Vincristine

**Q443** · Easy · *codex, slides 210 to 212, 220, 221*

**Which drugs inhibit microtubule polymerisation by binding the subunit?**

1. Taxol and paclitaxel
2. Penicillin and lysozyme
3. Colchicine and colcemid
4. Catalase and urate oxidase

**Q444** · Easy · *codex, slides 210 to 212, 220, 221*

**Which type of tubulin nucleates microtubules at the minus end?**

1. α-tubulin
2. β-tubulin
3. γ-tubulin
4. Actin

**Q445** · Easy · *codex, slides 210 to 212, 220, 221*

**Which nucleotide's binding, hydrolysis and release explain microtubule growth and retraction?**

1. ATP
2. GTP
3. cAMP
4. UTP

**Q446** · Easy · *codex, slides 210 to 212, 220, 221*

**Which behaviour describes the alternating growth and shrinkage of microtubules?**

1. Dynamic instability
2. Treadmilling of actin only
3. Autolysis
4. Binary fission

**Q447** · Easy · *codex, slides 210 to 212, 220, 221*

**What does colchicine do to microtubules?**

1. It stabilises assembled microtubules
2. It inhibits their polymerisation
3. It converts them into actin filaments
4. It nucleates them at the minus end

**Q448** · Medium · *codex, slides 210 to 212, 220, 221*

**What does taxol do to microtubules?**

1. It blocks their assembly by binding subunits
2. It stabilises them against disassembly
3. It cuts them into protofilaments
4. It builds them from actin

**Q449** · Medium · *codex, slides 210 to 212, 220, 221*

**Colcemid is listed alongside which drug as an inhibitor of polymerisation?**

1. Colchicine
2. Taxol
3. Kinesin
4. Mallory

**Q450** · Medium · *codex, slides 210 to 212, 220, 221*

**At which end of the microtubule does γ-tubulin nucleate growth?**

1. The plus end
2. The middle of the tube
3. The minus end
4. The cell membrane

**Q451** · Medium · *codex, slides 210 to 212, 220, 221*

**Which statement describes the mechanism of microtubule growth and retraction?**

1. Binding, hydrolysis and release of GTP
2. Binding, hydrolysis and release of ATP
3. Fusion of lysosomes with endosomes
4. Division of pre-existing peroxisomes

**Q452** · Medium · *codex, slides 210 to 212, 220, 221*

**Which processes are named as part of the mechanism of microtubule growth and retraction?**

1. ATP hydrolysis alone with no capping
2. GTP binding and hydrolysis, plus capping
3. Methylation of keratin and capping at the nucleus
4. Digestion by hydrolases and capping at the Golgi

**Q453** · Hard · *codex, slides 210 to 212, 220, 221*

**How do colchicine and taxol differ in their action?**

1. Colchicine stabilises microtubules, while taxol blocks assembly
2. Both stabilise the assembled microtubules in cells
3. Colchicine blocks assembly, while taxol stabilises microtubules
4. Both depolymerise actin filaments in cells

**Q454** · Hard · *codex, slides 210 to 212, 220, 221*

**Which pairing of drug and effect is correct?**

1. Colchicine: stabilises microtubules; taxol: inhibits polymerisation
2. Colchicine: inhibits polymerisation; taxol: stabilises microtubules
3. Colchicine: nucleates at the minus end; taxol: cuts protofilaments
4. Colchicine: motor protein; taxol: tubulin subunit

**Q455** · Devil · *codex, slides 210 to 212, 220, 221*

**A drug locks microtubules so they cannot disassemble, and cells stall in mitosis. Which drug is this, and why do the cells stall?**

1. Colchicine, because it stabilises spindle microtubules
2. Taxol, because it inhibits tubulin polymerisation
3. Taxol, because stabilised microtubules cannot shorten
4. Colchicine, because it inhibits the nuclear envelope

### Answers — Tubulin polymerisation and drugs · Q442–455

**Q442 — B** · Taxol stabilises microtubules.
**Q443 — C** · Both bind the subunit and inhibit polymerisation.
**Q444 — C** · γ-tubulin nucleates microtubules at the minus end.
**Q445 — B** · GTP binding, hydrolysis and release drive growth and retraction.
**Q446 — A** · Microtubules show dynamic instability.
**Q447 — B** · Colchicine inhibits assembly.
**Q448 — B** · Taxol inhibits disassembly.
**Q449 — A** · Colchicine and colcemid inhibit polymerisation.
**Q450 — C** · γ-tubulin nucleates at the minus end.
**Q451 — A** · GTP binding, hydrolysis and release is the mechanism.
**Q452 — B** · These are listed in the lecture.
**Q453 — C** · They act in opposite ways.
**Q454 — B** · This matches the lecture.
**Q455 — C** · Spindle fibres must grow and shorten to pull and position chromosomes.

## Motor proteins · Q456–471

**Q456** · Easy · *codex, slides 213 to 216, 224, 236*

**Which motor protein moves toward the plus end of a microtubule?**

1. Dynein
2. Tubulin
3. Kinesin
4. Keratin

**Q457** · Easy · *codex, slides 213 to 216, 224, 236*

**Which motor protein moves toward the minus end of a microtubule?**

1. Kinesin
2. Actin
3. Dynein
4. Vimentin

**Q458** · Easy · *codex, slides 213 to 216, 224, 236*

**Which three motor proteins are shown in the lecture?**

1. Kinesin, myosin and dynein
2. Tubulin, actin and keratin
3. Lamin, vimentin and keratin
4. Catalase, urate oxidase and amylase

**Q459** · Easy · *codex, slides 213 to 216, 224, 236*

**On which side of a microtubule do motor proteins travel?**

1. Along the outside
2. Along the inside
3. Through the central duct
4. Only at the minus end

**Q460** · Easy · *codex, slides 213 to 216, 224, 236*

**Which molecule do motor proteins use as fuel?**

1. ATP
2. GTP only
3. cAMP
4. Glycogen

**Q461** · Easy · *codex, slides 213 to 216, 224, 236*

**Each motor protein has a motor domain and what other region?**

1. A stalk
2. A nucleus
3. A cell wall
4. A thylakoid

**Q462** · Medium · *codex, slides 213 to 216, 224, 236*

**Besides microtubules, which other filaments are used as trackways by motor proteins?**

1. Lamin filaments
2. Actin filaments
3. Keratin filaments
4. Neurofilaments

**Q463** · Medium · *codex, slides 213 to 216, 224, 236*

**In pigment cells, kinesin and dynein move pigment in response to which signal?**

1. cAMP
2. GTP
3. Mallory bodies
4. Tau protein

**Q464** · Medium · *codex, slides 213 to 216, 224, 236*

**Do motor proteins of different models all move in the same direction along microtubules?**

1. Yes, all of them move toward the plus end
2. Yes, all of them move toward the minus end
3. No, they travel in different directions
4. No, they do not move along microtubules

**Q465** · Medium · *codex, slides 213 to 216, 224, 236*

**How many models of motor proteins does the lecture list?**

1. Two
2. Three
3. Five
4. Eight

**Q466** · Medium · *codex, slides 213 to 216, 224, 236*

**What can link microtubules and actin filaments as trackways?**

1. Phosphodiester bonds
2. Peptidoglycan strands
3. Proteins that bridge the two
4. Cellulose fibres

**Q467** · Medium · *codex, slides 213 to 216, 224, 236*

**All of the following are motor proteins EXCEPT which one?**

1. Tubulin
2. Kinesin
3. Dynein
4. Myosin

**Q468** · Medium · *codex, slides 213 to 216, 224, 236*

**Which statement about motor protein structure is correct?**

1. Only kinesin has a motor domain
2. Motor proteins have no associated polypeptides
3. Motor proteins are made entirely of lipid
4. All three have a motor domain and a stalk

**Q469** · Hard · *codex, slides 213 to 216, 224, 236*

**Which statement correctly matches motor proteins with direction on microtubules?**

1. Kinesin moves to the plus end, dynein to the minus end
2. Kinesin moves toward the minus end, and dynein toward the plus end
3. Both move toward the plus end of the tube
4. Both move toward the minus end of the tube

**Q470** · Hard · *codex, slides 213 to 216, 224, 236*

**A neuron must send a vesicle out to the axon tip and return old material. Which motors suit these two trips?**

1. Dynein outward and kinesin back to the nucleus
2. Lamins outward and keratin back again
3. Kinesin outward, dynein back toward the cell body
4. Tubulin outward and actin back again

**Q471** · Devil · *codex, slides 213 to 216, 224, 236*

**A drug blocks dynein only. Which axonal transport is most affected?**

1. Movement of cargo back toward the cell body
2. Movement of cargo toward the plus end, out to the axon tip
3. Assembly of microtubules by GTP
4. Formation of keratin tetramers

### Answers — Motor proteins · Q456–471

**Q456 — C** · Kinesin moves toward the plus end.
**Q457 — C** · Dynein moves toward the minus end.
**Q458 — A** · These three are shown.
**Q459 — A** · They travel along the outside, not inside.
**Q460 — A** · Motor proteins hydrolyse ATP as they move.
**Q461 — A** · Motor proteins have a motor domain and a stalk.
**Q462 — B** · Actin filaments are also used as trackways.
**Q463 — A** · The lecture links this movement to cAMP.
**Q464 — C** · Kinesin and dynein travel in opposite directions.
**Q465 — B** · Motor proteins come in three models.
**Q466 — C** · Proteins can link microtubules and actin filaments.
**Q467 — A** · Correct choice.
**Q468 — D** · The lecture shows this shared layout.
**Q469 — A** · These are the directions given.
**Q470 — C** · The two motors move in opposite directions.
**Q471 — A** · Dynein moves cargo toward the minus end.

## Microtubule systems and functions · Q472–485

**Q472** · Easy · *codex, slides 217, 225 to 227*

**Which structure organises the microtubules of an interphase cell?**

1. The centrosome
2. The nucleolus
3. The Golgi apparatus
4. The peroxisome

**Q473** · Easy · *codex, slides 217, 225 to 227*

**Microtubules are the central structural supports of which two structures?**

1. Microvilli and desmosomes
2. Cilia and flagella
3. Nuclear pores and lamins
4. Plasmodesmata and walls

**Q474** · Easy · *codex, slides 217, 225 to 227*

**What do microtubules move during cell division?**

1. Chromosomes
2. Ribosomes
3. Lysosomes
4. Plasmids

**Q475** · Easy · *codex, slides 217, 225 to 227*

**What do cilia in the lungs sweep along?**

1. Air bubbles trapped in plasma
2. Collagen fibres from fibroblasts
3. Silica crystals only
4. Mucus carrying trapped debris

**Q476** · Easy · *codex, slides 217, 225 to 227*

**What anchors a cilium or flagellum at the cell?**

1. A centriole-free nucleus
2. A basal body
3. A plasmodesma
4. A glycocalyx

**Q477** · Easy · *codex, slides 217, 225 to 227*

**What kind of movement does a flagellum have?**

1. Sliding like a piston
2. Rolling like a wheel
3. Rotation of the nucleus
4. Undulatory movement

**Q478** · Medium · *codex, slides 217, 225 to 227*

**Relative to the flagellum's axis, in which direction is force generated?**

1. At right angles to the axis
2. Only at the tip, away from the axis
3. Opposite to its movement
4. Parallel to the axis

**Q479** · Medium · *codex, slides 217, 225 to 227*

**What do microtubules guide as tracks?**

1. Ribosomal subunits across the nuclear pores
2. Motor proteins carrying organelles
3. Peptidoglycan across the cell wall
4. Hydrogen peroxide into the peroxisome

**Q480** · Medium · *codex, slides 217, 225 to 227*

**Which microtubule system appears in a dividing cell?**

1. The basal body
2. The mitotic spindle
3. The centrosome in interphase
4. The nuclear lamina

**Q481** · Medium · *codex, slides 217, 225 to 227*

**How do cilia and flagella move unicellular organisms?**

1. By pumping protons across membranes
2. By digesting food in lysosomes
3. By propelling water past the organism
4. By contracting actin rings

**Q482** · Medium · *codex, slides 217, 225 to 227*

**Microtubules take part in all of the following EXCEPT which one?**

1. Moving chromosomes during division
2. Supporting cilia and flagella
3. Guiding vesicle transport
4. Resisting stretching forces

**Q483** · Hard · *codex, slides 217, 225 to 227*

**Which pairing of structure and role is correct?**

1. Centrosome: anchors cilia; basal body: moves chromosomes; spindle: organises interphase microtubules
2. Centrosome: organises interphase microtubules; basal body: anchors cilia; spindle: moves chromosomes
3. Centrosome: makes ribosomes; basal body: stores calcium; spindle: digests debris
4. Centrosome: resists stretch; basal body: carries vesicles; spindle: nucleates actin

**Q484** · Hard · *codex, slides 217, 225 to 227*

**A smoker's airway cilia stop beating. What is the direct consequence?**

1. Chromosomes fail to separate in lung cells
2. Lung cells lose their intermediate filaments
3. Alveolar lysosomes stop making enzymes
4. Mucus and trapped debris are not swept out

**Q485** · Devil · *codex, slides 217, 225 to 227*

**Which statement correctly contrasts anchored cilia with a free-swimming flagellate?**

1. Anchored cilia move fluid, whereas flagella propel the organism
2. Anchored cilia propel the organism, whereas flagella move fluid over a surface
3. Both are supported by actin filaments only
4. Neither of them contains microtubules

### Answers — Microtubule systems and functions · Q472–485

**Q472 — A** · The centrosome is the microtubule organizing centre in interphase.
**Q473 — B** · Microtubules support cilia and flagella.
**Q474 — A** · Microtubules move chromosomes during cell division.
**Q475 — D** · Cilia sweep mucus carrying trapped debris from the lungs.
**Q476 — B** · The basal body anchors cilia and flagella.
**Q477 — D** · A flagellum has an undulatory movement.
**Q478 — D** · Force is generated parallel to the flagellum's axis.
**Q479 — B** · Motor proteins carry organelles along microtubule tracks.
**Q480 — B** · The mitotic system forms the spindle.
**Q481 — C** · They propel water past the organism.
**Q482 — D** · Correct choice.
**Q483 — B** · Each pairing is right.
**Q484 — D** · Ciliary sweeping removes mucus and debris.
**Q485 — A** · Anchoring makes the fluid move instead of the cell.

## Microtubules and Alzheimer's disease · Q486–495

**Q486** · Easy · *codex, slides 228 to 230*

**Which protein is a microtubule associated protein found in nerve cells?**

1. Keratin
2. Catalase
3. Tau protein
4. Histone

**Q487** · Easy · *codex, slides 228 to 230*

**Where are MAPs attached on a healthy microtubule?**

1. On the outside of the microtubule
2. Inside the central duct of the tube
3. Only at the minus end of the tube
4. Within the nuclear pore complex

**Q488** · Easy · *codex, slides 228 to 230*

**What is lost from axons in Alzheimer's disease?**

1. Mitochondria
2. Lysosomes
3. Ribosomes
4. Microtubules

**Q489** · Easy · *codex, slides 228 to 230*

**What increases in nerve cells in Alzheimer's disease?**

1. Keratin bundles
2. Colchicine crystals
3. Lamin sheets
4. Unorganised tangles of tau

**Q490** · Medium · *codex, slides 228 to 230*

**What do MAPs do for microtubules in healthy cells?**

1. They dissolve them and increase flexibility
2. They convert them into actin filaments
3. They regulate them and increase their stability
4. They nucleate them at the minus end

**Q491** · Medium · *codex, slides 228 to 230*

**Which transport service is lost when axonal microtubules are lost?**

1. Transport across the nuclear pores
2. Transport of oxygen in blood
3. Transport of ATP into mitochondria
4. Transport up and down the nerve axon

**Q492** · Medium · *codex, slides 228 to 230*

**What happens to a nerve cell without movement of biochemicals and organelles along its axon?**

1. The cell gains extra microtubules
2. The cell turns into a muscle cell
3. The nerve cell loses function
4. The axon becomes a cilium

**Q493** · Medium · *codex, slides 228 to 230*

**What does the lecture say about the causes of microtubule loss and increased tau?**

1. They are fully explained by silica
2. They are caused by keratin defects
3. They are not yet known
4. They are caused by taxol

**Q494** · Hard · *codex, slides 228 to 230*

**Which statement about tau is correct?**

1. Tau forms the wall of microtubules from α and β subunits
2. Tau is a motor protein that walks toward the minus end
3. Tau nucleates microtubules at the centrosome
4. Tau attaches to the outside of microtubules and stabilises them

**Q495** · Hard · *codex, slides 228 to 230*

**Why does loss of axonal microtubules impair a neuron?**

1. The nucleus can no longer divide normally
2. Intermediate filaments cannot assemble at all
3. Keratin cannot form liver inclusions
4. Cargo can no longer be moved along the axon

### Answers — Microtubules and Alzheimer's disease · Q486–495

**Q486 — C** · Tau is a MAP in nerve cells.
**Q487 — A** · MAPs attach to the outside of microtubules.
**Q488 — D** · Microtubules are lost from the axons.
**Q489 — D** · Unorganised tangles increase as microtubules are lost.
**Q490 — C** · These are the effects listed.
**Q491 — D** · The transport service up and down the axon is lost.
**Q492 — C** · Without transport the neuron loses function.
**Q493 — C** · The causes are not yet known.
**Q494 — D** · This matches the lecture.
**Q495 — D** · Microtubule tracks carry the cargo.

## Microtubules and cancer treatment · Q496–509

**Q496** · Easy · *codex, slides 231 to 234*

**Which drug locks microtubules by inhibiting their disassembly?**

1. Colchicine
2. Taxol
3. Nocodazole
4. Vincristine

**Q497** · Easy · *codex, slides 231 to 234*

**Which drug has been used in cancer chemotherapy, according to the lecture?**

1. Penicillin
2. Lysozyme
3. Catalase
4. Vincristine

**Q498** · Easy · *codex, slides 231 to 234*

**Cancer is best described as what?**

1. Failure of cells to divide
2. Abnormal proliferation of cells
3. Loss of the cell wall
4. Collapse of the Golgi apparatus

**Q499** · Easy · *codex, slides 231 to 234*

**Which structures pull chromosomes apart during mitosis?**

1. Spindle fibres
2. Mallory bodies
3. Cilia
4. Lamins

**Q500** · Easy · *codex, slides 231 to 234*

**Which phase of the cell cycle is named as one where microtubules play a vital role?**

1. The nucleolar phase
2. The Golgi phase
3. M-phase
4. The stationary phase of bacteria

**Q501** · Medium · *codex, slides 231 to 234*

**Besides being effective, what must an anticancer drug avoid?**

1. Binding any protein at all
2. Disrupting non-cancerous cells
3. Acting on dividing cells
4. Entering the bloodstream

**Q502** · Medium · *codex, slides 231 to 234*

**What does taxol do to a cell's microtubules?**

1. It dissolves them into tubulin
2. It locks them so they become static
3. It cuts them at the minus end
4. It converts them into actin

**Q503** · Medium · *codex, slides 231 to 234*

**Which drugs inhibit microtubule assembly by blocking polymerisation and promoting depolymerisation?**

1. Taxol, paclitaxel and docetaxel
2. Kinesin, dynein and myosin motors
3. Colchicine, nocodazole and vincristine
4. Catalase, urate oxidase and amylase

**Q504** · Medium · *codex, slides 231 to 234*

**What do spindle fibres do during mitosis?**

1. They digest the nuclear envelope entirely
2. They align, pull and position chromosomes
3. They synthesise new ribosomes in the cell
4. They pump protons into lysosomes

**Q505** · Medium · *codex, slides 231 to 234*

**Which two strategies could target microtubules to stop cancer cell division?**

1. Disrupt assembly or stabilise assembled microtubules
2. Disrupt keratin assembly or stabilise lamins
3. Block the Golgi or stabilise the nucleolus
4. Starve the cell or stabilise the capsule

**Q506** · Medium · *codex, slides 231 to 234*

**Which drug is listed with colchicine and vincristine as an inhibitor of microtubule assembly?**

1. Taxol
2. Penicillin
3. Lysozyme
4. Nocodazole

**Q507** · Hard · *codex, slides 231 to 234*

**How do taxol and vincristine differ?**

1. Taxol blocks polymerisation, while vincristine stabilises microtubules
2. Both stabilise microtubules in cells
3. Both inhibit actin filaments in cells
4. Taxol stabilises microtubules, vincristine blocks assembly

**Q508** · Hard · *codex, slides 231 to 234*

**All of the following are microtubule-targeting drugs EXCEPT which one?**

1. Taxol
2. Penicillin
3. Vincristine
4. Nocodazole

**Q509** · Devil · *codex, slides 231 to 234*

**Why can drugs acting on microtubules stop a cancer cell from dividing?**

1. Spindle microtubules must grow and shorten, so blocking either halts division
2. Microtubules make the cell wall, so blocking them stops wall formation
3. Microtubules copy DNA, so blocking them stops replication
4. Microtubules make ribosomes, so blocking them stops translation

### Answers — Microtubules and cancer treatment · Q496–509

**Q496 — B** · Taxol inhibits microtubule disassembly.
**Q497 — D** · Vincristine has particularly been used in chemotherapy.
**Q498 — B** · Cancer is uncontrolled cell division.
**Q499 — A** · Spindle fibres align, pull and position chromosomes.
**Q500 — C** · Microtubules are important during M-phase.
**Q501 — B** · It should have minimal effects on normal cells.
**Q502 — B** · Taxol locks microtubules and they become static.
**Q503 — C** · These three inhibit assembly.
**Q504 — B** · These are the spindle's actions.
**Q505 — A** · These are the two options in the lecture.
**Q506 — D** · Nocodazole inhibits assembly like colchicine and vincristine.
**Q507 — D** · They act in opposite ways.
**Q508 — B** · Correct choice.
**Q509 — A** · Both growth and shortening are needed.

## Comparing the three filaments · Q510–519

**Q510** · Easy · *codex, slides 206, 229, 235*

**Which cytoskeletal filament provides tensile strength?**

1. Intermediate filaments
2. Microtubules
3. Microfilaments
4. Actin monomers

**Q511** · Easy · *codex, slides 206, 229, 235*

**Which protein is common in the intermediate filaments of epithelial cells?**

1. Actin
2. Keratin
3. Tubulin
4. Myosin

**Q512** · Easy · *codex, slides 206, 229, 235*

**Which structure is the main microtubule-organizing centre in animal cells?**

1. The Golgi apparatus
2. The nucleus
3. The endoplasmic reticulum
4. The centrosome

**Q513** · Easy · *codex, slides 206, 229, 235*

**Microtubules are primarily composed of which dimers?**

1. Actin and myosin
2. α- and β-tubulin
3. Keratin and vimentin
4. Lamin A and B

**Q514** · Medium · *codex, slides 206, 229, 235*

**What is the main function of intermediate filaments?**

1. To enable cell movement
2. To resist mechanical stress
3. To transport vesicles
4. To separate chromosomes

**Q515** · Medium · *codex, slides 206, 229, 235*

**What is a key function of microtubules?**

1. Chromosome movement during mitosis
2. Muscle contraction in muscle cells
3. Cell surface tension control
4. Protein folding in the cytosol

**Q516** · Medium · *codex, slides 206, 229, 235*

**Intermediate filaments differ from actin filaments and microtubules because they do what?**

1. Provide tensile strength
2. Are made of tubulin
3. Are highly dynamic
4. Require ATP for motor movement

**Q517** · Medium · *codex, slides 206, 229, 235*

**Which cytoskeletal filament is used for muscle contraction and cell movement?**

1. Actin filaments
2. Intermediate filaments
3. Microtubules
4. Lamins

**Q518** · Hard · *codex, slides 206, 229, 235*

**Which row correctly matches each filament with its protein and main role?**

1. Microfilaments: tubulin, strength; intermediate filaments: actin, spindle; microtubules: keratin, movement
2. Microfilaments: keratin, spindle; intermediate filaments: tubulin, movement; microtubules: actin, strength
3. Microfilaments: actin, movement; intermediate: keratin, strength; microtubules: tubulin, transport
4. All three filaments are made of actin and drive contraction

**Q519** · Devil · *codex, slides 206, 229, 235*

**One drug disrupts mitosis, a second weakens skin strength and a third stops muscle contraction. Which filaments do they target, in that order?**

1. Actin filaments, microtubules and intermediate filaments
2. Microtubules, intermediate filaments and actin filaments
3. Intermediate filaments, actin filaments and microtubules
4. Microtubules, actin filaments and intermediate filaments

### Answers — Comparing the three filaments · Q510–519

**Q510 — A** · Intermediate filaments give tensile strength.
**Q511 — B** · Keratin is common in epithelial intermediate filaments.
**Q512 — D** · The centrosome is the main MTOC.
**Q513 — B** · Microtubules are made of α- and β-tubulin dimers.
**Q514 — B** · They provide strength against mechanical stress.
**Q515 — A** · Microtubules form the spindle.
**Q516 — A** · Tensile strength is their distinguishing role.
**Q517 — A** · Actin filaments drive movement and contraction.
**Q518 — C** · Each row is right.
**Q519 — B** · Spindle, strength and contraction map to these filaments.

## Units of measurement · Q520–529

**Q520** · Easy · *codex, slides 240 to 246*

**How many micrometres are there in a millimetre?**

1. 1,000
2. 10
3. 100
4. 10,000

**Q521** · Easy · *codex, slide 245*

**A nanometre is equal to which part of a metre?**

1. $10^{-6}$ m
2. $10^{-9}$ m
3. $10^{-3}$ m
4. $10^{-10}$ m

**Q522** · Easy · *codex, slide 240*

**What is the smallest object the unaided human eye can distinguish?**

1. About 1 µm (0.001 mm)
2. About 10 µm (0.01 mm)
3. About 1 mm (1,000 µm)
4. About 0.1 mm (100 µm)

**Q523** · Easy · *codex, slide 246*

**How many angstroms (Å) make up 1 nanometre?**

1. 0.1 Å
2. 10 Å
3. 100 Å
4. 1,000 Å

**Q524** · Medium · *codex, slides 240 to 246*

**Convert 1 µm into nanometres.**

1. 10
2. 100
3. 1,000
4. 1,000,000

**Q525** · Medium · *codex, slides 240 to 246*

**A structure is 0.5 µm wide. What is its width in nanometres?**

1. 500 nm
2. 50 nm
3. 5 nm
4. 5,000 nm

**Q526** · Medium · *codex, slides 240 to 246*

**A micrometre equals how many metres?**

1. $10^{-6}$ m
2. $10^{-3}$ m
3. $10^{-9}$ m
4. $10^{-10}$ m

**Q527** · Medium · *codex, slides 240 to 246*

**Old texts sometimes used the angstrom, which was compared with the diameter of what?**

1. A red blood cell
2. A hydrogen atom
3. A bacterium
4. A mitochondrion

**Q528** · Hard · *codex, slides 240 to 246*

**A structure is 50 Å wide. How many nanometres is this?**

1. 50 nm
2. 0.5 nm
3. 5 nm
4. 500 nm

**Q529** · Hard · *codex, slides 240 to 246*

**A cell measures 0.1 mm across. How many nanometres is this?**

1. 1,000 nm
2. 100,000 nm
3. 10,000 nm
4. 1,000,000 nm

### Answers — Units of measurement · Q520–529

**Q520 — A** · 1,000 µm equal 1 mm.
**Q521 — B** · A nanometre is 0.000000001 m, written $10^{-9}$ m.
**Q522 — D** · The unaided eye cannot distinguish objects smaller than about 0.1 mm.
**Q523 — B** · 10 Å equal 1 nm, since 1 Å is 0.1 nm.
**Q524 — C** · 1,000 nm equal 1 µm.
**Q525 — A** · 0.5 µm times 1,000 gives 500 nm.
**Q526 — A** · A micrometre is 0.000001 m.
**Q527 — B** · The angstrom is about the diameter of a hydrogen atom.
**Q528 — C** · 10 Å equal 1 nm, so 50 Å is 5 nm.
**Q529 — B** · 0.1 mm is 100 µm, which is 100,000 nm.

## Simple microscopes · Q530–539

**Q530** · Easy · *codex, slides 249 to 254*

**Which two devices are well-known examples of simple microscopes?**

1. Magnifying glasses and loupes
2. Electron microscopes and loupes
3. Compound microscopes and stereo microscopes
4. Phase contrast microscopes and magnifying glasses

**Q531** · Easy · *codex, slides 249 to 254*

**How are modern simple microscopes usually used?**

1. Fixed to a bench with a condenser lens
2. Housed in a vacuum column with coils
3. Cooled with liquid nitrogen at night
4. Hand held, for field work or quick viewing

**Q532** · Easy · *codex, slide 252*

**Which description defines a simple microscope?**

1. A microscope that uses an objective and an eyepiece lens
2. A microscope that forms its image with a beam of electrons
3. A microscope that uses only a single lens
4. A microscope that views opaque objects through two light paths

**Q533** · Easy · *codex, slide 253*

**How does a loupe differ from an ordinary magnifying glass?**

1. It has two lenses, an objective and an eyepiece, set in a tube
2. It uses an electron beam to enlarge very small details
3. It has no attached handle, and its lens sits in a protective housing
4. It must be clamped to a stage and focused with a coarse knob

**Q534** · Medium · *codex, slides 249 to 254*

**How many lenses did the user of a historical simple microscope look through?**

1. Only one
2. Two
3. Three
4. A series of lenses

**Q535** · Medium · *codex, slides 249 to 254*

**What do the lecture's two types of light microscope consist of?**

1. Phase and dark-field microscopes
2. Simple microscopes and compound microscopes
3. Electron and ultraviolet microscopes
4. Scanning and transmission microscopes

**Q536** · Medium · *codex, slides 249 to 254*

**What do simple microscopes lack compared with compound microscopes?**

1. A lens of any kind
2. A light source of any kind
3. A way of magnifying objects
4. A series of lenses

**Q537** · Medium · *codex, slides 249 to 254*

**Historical simple microscope designs resembled modern microscopes in which way?**

1. They used the same electron beams
2. They had the same series of lenses
3. They produced three-dimensional images
4. Their mounts looked like modern mounts

**Q538** · Hard · *codex, slides 249 to 254*

**All of the following are true of simple microscopes EXCEPT which one?**

1. They have only one lens
2. A loupe is an example
3. Modern versions are usually hand held
4. They use two lenses in series

**Q539** · Hard · *codex, slides 249 to 254*

**A geologist wants to inspect a rock quickly in the field. Which instrument fits best?**

1. A hand-held simple microscope such as a loupe
2. A bench compound microscope with a condenser
3. A transmission electron microscope
4. A stereo microscope with two eyepieces on a stand

### Answers — Simple microscopes · Q530–539

**Q530 — A** · These are the two well-known examples.
**Q531 — D** · They are designed to be hand held.
**Q532 — C** · A simple microscope has only one lens, as in a magnifying glass or loupe.
**Q533 — C** · A loupe has no attached handle and its lenses sit in an opaque cylinder or housing.
**Q534 — A** · The user had only one lens.
**Q535 — B** · These are the two types.
**Q536 — D** · Compound microscopes use a series of lenses.
**Q537 — D** · Mounts resembled those used with modern microscopes.
**Q538 — D** · Correct choice.
**Q539 — A** · Simple microscopes are designed for field work.

## Spherical aberration · Q540–555

**Q540** · Easy · *codex, slides 255 to 270*

**How many inherent optical defects are associated with simple microscopes?**

1. Two
2. One
3. Three
4. Four

**Q541** · Easy · *codex, slides 255 to 270*

**Which defect forms blurred images because light rays are not brought to a simultaneous focus?**

1. Chromatic aberration
2. Parfocal error
3. Airy disc
4. Spherical aberration

**Q542** · Easy · *codex, slides 255 to 270*

**Spherical aberration can affect which two image qualities?**

1. Resolution and clarity
2. Colour and brightness
3. Magnification and working distance
4. Contrast and polarity

**Q543** · Easy · *codex, slides 255 to 270*

**Which lens shape is the best choice for focusing parallel rays to a single point?**

1. Biconcave
2. Concavo-convex
3. Flat glass plate
4. Plano-convex

**Q544** · Easy · *codex, slides 255 to 270*

**Which lens fills the space between the specimen and the lens with a medium of the same refractive index?**

1. A plano-convex lens
2. An aspherical lens
3. An achromatic doublet
4. An oil immersion lens

**Q545** · Easy · *codex, slides 255 to 270*

**What does aspherical mean?**

1. Non-spherical
2. Perfectly spherical
3. Coloured
4. Opaque

**Q546** · Easy · *codex, slides 255 to 270*

**Rays passing near a lens's horizontal axis are refracted how, compared with rays near its edge?**

1. Less
2. More
3. The same amount
4. Not at all

**Q547** · Medium · *codex, slides 255 to 270*

**Where do rays near the edge of a lens focus relative to rays near its axis?**

1. At exactly the same point of the axis
2. Behind the eyepiece of the microscope
3. Inside the specimen on the slide
4. At different points along the optical axis

**Q548** · Medium · *codex, slides 255 to 270*

**What does an aspherical lens surface do?**

1. Converges rays to a single focus
2. Splits white light into colours
3. Blocks the outer rays of light
4. Adds immersion oil to the gap

**Q549** · Medium · *codex, slides 255 to 270*

**Why do materials of different refractive index between specimen and lens worsen spherical aberration?**

1. They absorb all the blue light
2. They bend rays at different angles
3. They make the lens heavier
4. They change the colour of the specimen

**Q550** · Medium · *codex, slides 255 to 270*

**What does coating the periphery of a lens with opaque material do?**

1. It blocks the outer rays
2. It adds colour correction
3. It fills the gap with oil
4. It focuses rays at infinity

**Q551** · Medium · *codex, slides 255 to 270*

**Why does the plano-convex shape minimise spherical aberration?**

1. It is perfectly symmetrical about its axis
2. It removes all colours from the image
3. It is made of crown glass only
4. Its asymmetry suits unequal distances

**Q552** · Medium · *codex, slides 255, 258*

**Which description matches spherical aberration?**

1. Different colours of light focus at different positions, giving colour fringes
2. The specimen stays in focus when the objective is changed to another power
3. Rays near the lens edge focus at different points from rays near the axis, blurring the image
4. Only scattered light enters the objective, giving a bright image on a dark background

**Q553** · Hard · *codex, slides 255 to 270*

**In which situation is a plano-convex lens optimal?**

1. The object touches the lens and the rays diverge
2. The object and image are at equal distances
3. Object at infinity, image a focused point
4. The light is white and the lens is thick

**Q554** · Hard · *codex, slides 255 to 270*

**Which two measures reduce spherical aberration by matching refractive indices and by blocking edge rays?**

1. An achromatic doublet and oil immersion
2. Oil immersion and an opaque coating on the periphery
3. An aspherical surface and a crown–flint pair
4. A plano-convex lens and a colour filter

**Q555** · Hard · *codex, slides 266, 267, 280*

**All of the following reduce spherical aberration EXCEPT which one?**

1. Using a specialised aspherical lens surface curved to converge rays
2. Coating the periphery of the lens with opaque material
3. Bonding crown glass and flint glass into an achromatic doublet
4. Using oil immersion so one refractive index fills the gap

### Answers — Spherical aberration · Q540–555

**Q540 — A** · Spherical and chromatic aberration are the two defects.
**Q541 — D** · This is spherical aberration.
**Q542 — A** · It affects resolution and clarity.
**Q543 — D** · Plano-convex lenses focus parallel rays to a single point.
**Q544 — D** · Oil immersion removes the refractive index mismatch.
**Q545 — A** · An aspherical surface is not spherical.
**Q546 — A** · Rays near the axis are refracted less than rays near the edge.
**Q547 — D** · They end up in different spots across the optical axis.
**Q548 — A** · Its curvature brings rays to one focal point.
**Q549 — B** · Repeated bending at different angles causes the problem.
**Q550 — A** · Edge rays are removed.
**Q551 — D** · The asymmetry minimises aberration in that case.
**Q552 — C** · Rays are not brought to a simultaneous focus, so the image is blurred.
**Q553 — C** · This is the optimum case.
**Q554 — B** · These are the two measures.
**Q555 — C** · Correct choice.

## Chromatic aberration · Q556–569

**Q556** · Easy · *codex, slides 273 to 285*

**Chromatic aberration is also known as what?**

1. Colour fringing, or purple fringing
2. Spherical fringing, or oil fringing
3. Airy fringing, or ring fringing
4. Parfocal fringing, or focus fringing

**Q557** · Easy · *codex, slides 273 to 285*

**What causes chromatic aberration?**

1. Dirt on the lens surface
2. The size of the stage plate
3. Dispersion of the lens material
4. A damaged illuminator bulb

**Q558** · Easy · *codex, slides 273 to 285*

**How does chromatic aberration appear in an image?**

1. As a grey haze across the centre
2. As a bright dot with rings
3. As a black circle at the edge
4. As fringes of colour around the image

**Q559** · Easy · *codex, slides 273 to 285*

**Which lens combination is used to reduce chromatic aberration?**

1. An aspherical singlet
2. An oil film
3. An achromatic doublet
4. A coated periphery

**Q560** · Easy · *codex, slides 273 to 285*

**What are bonded together in an achromatic doublet?**

1. Two identical glass pieces together
2. A lens and an opaque ring around it
3. A lens and a mirror below it
4. Two materials with differing dispersion

**Q561** · Medium · *codex, slides 273 to 285*

**What varies with wavelength to cause chromatic aberration?**

1. The thickness of the slide
2. The number of lenses
3. The refractive index of the glass
4. The working distance of the eyepiece

**Q562** · Medium · *codex, slides 273 to 285*

**Does an achromatic doublet correct chromatic aberration perfectly?**

1. Yes, it removes all colour error
2. No, it makes it much worse
3. No, it reduces it over a range
4. Yes, but only for blue light

**Q563** · Medium · *codex, slides 273 to 285*

**Which edge colours can appear with chromatic aberration?**

1. Only black and white fringes
2. Only grey and brown fringes
3. Only infrared and ultraviolet
4. Red, green, blue, yellow or purple

**Q564** · Medium · *codex, slides 273 to 285*

**What is a simple way to partly correct residual chromatic aberration after the image is taken?**

1. Add immersion oil to the image
2. Scale the red, green and blue channels
3. Coat the edge of the image in black
4. Double the magnification afterwards

**Q565** · Medium · *codex, slides 263, 273 to 275, 258*

**Which of these is NOT a feature of chromatic aberration?**

1. Rays near the lens axis are refracted less than rays near the periphery
2. Coloured fringes appear around the edges of the image
3. Dispersion in the glass makes focal length vary with wavelength
4. Different colours of light are focused at different positions

**Q566** · Medium · *codex, slides 280, 282*

**Which pair of materials, bonded together as an achromatic doublet, reduces chromatic aberration?**

1. Quartz glass and fused silica
2. Crown glass and flint glass
3. Crown glass and fused quartz
4. Flint glass and clear plastic

**Q567** · Hard · *codex, slides 273 to 285*

**Which statement about correcting chromatic aberration is correct?**

1. Crown and flint glass bonded as a doublet remove it completely at all wavelengths
2. Oil immersion removes it by matching refractive indices
3. An opaque coating on the lens edge removes it
4. A crown–flint doublet reduces it over a range, not perfectly

**Q568** · Hard · *codex, slides 258, 263, 273 to 282*

**Which statements describe chromatic aberration? I. Colour fringes appear near the edges of the image. II. Rays near the lens axis are refracted less than rays at the periphery. III. Focal length varies with the wavelength of light because of dispersion. IV. It can be reduced by combining different kinds of glass.**

1. I and II only
2. I, III and IV only
3. II, III and IV only
4. I, II and IV only

**Q569** · Devil · *codex, slides 273 to 285*

**A photograph shows purple fringes at high-contrast edges. Which cause and fix fit?**

1. Dispersion in the glass, fixed by multi-glass lens systems
2. Different refractive indices in the gap, fixed by oil immersion
3. Rays near the axis refracting less, fixed by an aspherical lens
4. Poor working distance, fixed by moving the stage

### Answers — Chromatic aberration · Q556–569

**Q556 — A** · These are alternative names.
**Q557 — C** · Dispersion varies refractive index with wavelength.
**Q558 — D** · Colour fringes appear around the image.
**Q559 — C** · An achromat bonds two materials of differing dispersion.
**Q560 — D** · They form a single lens.
**Q561 — C** · Focal length varies with wavelength.
**Q562 — C** · It does not give perfect correction.
**Q563 — D** · These coloured edges can appear.
**Q564 — B** · This is the simple after-the-fact fix.
**Q565 — A** · Correct choice.
**Q566 — B** · Crown and flint glass, with differing dispersion, are bonded to reduce chromatic aberration.
**Q567 — D** · This matches the lecture.
**Q568 — B** · Statements I, III and IV describe chromatic aberration; statement II describes spherical aberration.
**Q569 — A** · Both are described in the lecture.

## Light and the electromagnetic spectrum · Q570–577

**Q570** · Easy · *codex, slides 286 to 288*

**Light is what kind of radiation?**

1. Sound radiation
2. Ionic radiation
3. Thermal particles
4. Electromagnetic radiation

**Q571** · Easy · *codex, slides 286 to 288*

**Which elementary particle defines light?**

1. The photon
2. The electron
3. The proton
4. The neutron

**Q572** · Easy · *codex, slides 286 to 288*

**Between which wavelengths does visible light lie, according to the lecture?**

1. 100 nm and 300 nm
2. 700 nm and 1000 nm
3. 200 nm and 600 nm
4. 400 nm and 700 nm

**Q573** · Medium · *codex, slides 286 to 288*

**What does the mnemonic ROYGBIV list?**

1. The lens aberrations listed
2. The parts of the microscope
3. The colours of the visible spectrum
4. The types of light microscope

**Q574** · Medium · *codex, slides 286 to 288*

**What does light microscopy refer to?**

1. Any microscope using electron beams
2. Any microscope that uses visible light
3. Any microscope using sound waves
4. Any microscope using X-rays

**Q575** · Medium · *codex, slides 286 to 288*

**Lens curvature and composition are designed to minimise what?**

1. Distortion of image shapes and colours
2. Magnification of the specimen image
3. The wavelength of visible light
4. The working distance of the stage

**Q576** · Hard · *codex, slides 286 to 288*

**Which statement about visible light is correct?**

1. It is the whole electromagnetic spectrum
2. It is particulate matter without waves
3. It has wavelengths of 100 to 300 nm
4. It is part of the electromagnetic spectrum

**Q577** · Hard · *codex, slides 286 to 288*

**All of the following describe light EXCEPT which one?**

1. Its elementary particle is the electron
2. It is electromagnetic radiation
3. Its visible range is 400 to 700 nm
4. Its elementary particle is the photon

### Answers — Light and the electromagnetic spectrum · Q570–577

**Q570 — D** · Light is electromagnetic radiation.
**Q571 — A** · The photon defines light.
**Q572 — D** · Visible light lies between 400 and 700 nm.
**Q573 — C** · It lists red to violet.
**Q574 — B** · This is the definition in the lecture.
**Q575 — A** · Lenses are designed to minimise this distortion.
**Q576 — D** · Visible light is a small part of the spectrum.
**Q577 — A** · Correct choice.

## Types of light microscope · Q578–585

**Q578** · Easy · *codex, slides 289 to 290*

**How many basic types of light microscope does the lecture describe in this section?**

1. Three, including electron
2. One, the compound only
3. Two, compound and dissecting
4. Five, including confocal

**Q579** · Easy · *codex, slides 289 to 290*

**Which light microscope needs specimens sliced thinly enough for light to pass through?**

1. The dissecting microscope
2. The loupe
3. The compound microscope
4. The magnifying glass

**Q580** · Easy · *codex, slides 289 to 290*

**Which light microscope permits opaque specimens to be viewed?**

1. The compound microscope
2. The transmission electron microscope
3. The dissecting (stereo) microscope
4. The ultraviolet microscope

**Q581** · Easy · *codex, slides 289 to 290*

**What is another name for the stereo microscope?**

1. The compound microscope
2. The dissecting microscope
3. The simple microscope
4. The scanning microscope

**Q582** · Medium · *codex, slides 289 to 290*

**What kind of light does a dissecting microscope typically use?**

1. Light reflected from the surface
2. Light transmitted through a thin section
3. A beam of electrons
4. Ultraviolet laser light

**Q583** · Medium · *codex, slides 289 to 290*

**How does the stereo microscope produce a three-dimensional view?**

1. A single lens flips the image upside down
2. An opaque disc blocks the centre of the beam
3. Oil fills the gap under the lens
4. Two optical paths give each eye its own view

**Q584** · Medium · *codex, slides 289, 290, 308*

**Which statement about the dissecting (stereo) microscope is NOT true?**

1. It gives a three-dimensional view using two optical paths
2. It needs specimens cut thin enough for light to pass through
3. It typically uses light reflected from the specimen surface
4. It permits viewing of opaque specimens at low magnification

**Q585** · Hard · *codex, slides 289 to 290*

**Which microscope would you choose to examine the surface of an insect, and why?**

1. A compound microscope, because it needs a thick opaque specimen
2. A loupe on a stage, because it has two optical paths
3. A compound microscope, because it gives a stereo view
4. A dissecting microscope, because it views opaque specimens in 3D

### Answers — Types of light microscope · Q578–585

**Q578 — C** · Compound and dissecting microscopes are the two.
**Q579 — C** · Compound microscopes need thin specimens.
**Q580 — C** · It permits opaque specimens to be viewed.
**Q581 — B** · It is also called the dissecting or stereoscopic microscope.
**Q582 — A** · It typically uses reflected light.
**Q583 — D** · Two objectives and eyepieces give different angles.
**Q584 — B** · Correct choice.
**Q585 — D** · It suits opaque specimens.

## Parts of the compound microscope · Q586–600

**Q586** · Easy · *codex, slides 293 to 300*

**Which part holds the eyepiece and connects it to the objective?**

1. The arm
2. The body tube
3. The stage
4. The condenser

**Q587** · Easy · *codex, slides 293 to 300*

**Which part is the flat surface on which the slide is placed?**

1. The base
2. The diaphragm
3. The eyepiece
4. The stage

**Q588** · Easy · *codex, slide 298*

**What is the function of the condenser lens in a compound microscope?**

1. It collects light from the illuminator and focuses it on the specimen
2. It magnifies the image of the specimen for the observer's eye
3. It controls the amount of light by opening and closing an iris
4. It holds the slide in position over the stage aperture

**Q589** · Easy · *codex, slide 297*

**Which part controls the amount of light reaching the specimen?**

1. The revolving nosepiece, also called the turret
2. The coarse adjustment knob on the arm
3. The diaphragm, also called the iris
4. The body tube joining eyepiece and objective

**Q590** · Easy · *codex, slides 294, 297*

**A 10× eyepiece is used with a 45× objective lens. What is the total magnification?**

1. 55×
2. 4,500×
3. 450×
4. 0.45×

**Q591** · Easy · *codex, slide 295*

**Which part supports the body tube, connects it to the base and is used to carry the microscope?**

1. The stage
2. The condenser
3. The arm
4. The turret

**Q592** · Medium · *codex, slides 293 to 300*

**Why is the low power objective used first when viewing a slide?**

1. It gives the highest resolution of detail
2. Its short length avoids breaking the slide
3. It uses far less light than the others
4. It needs no focusing

**Q593** · Medium · *codex, slides 293 to 300*

**What power do eyepieces usually have?**

1. 4× or 6×
2. 40× or 100×
3. 1000× or 2000×
4. 10× or 15×

**Q594** · Medium · *codex, slides 293 to 300*

**What does the revolving nosepiece do?**

1. It focuses the light on the specimen below
2. It holds the objectives and rotates them
3. It controls the amount of light entering
4. It switches the illuminator off

**Q595** · Medium · *codex, slides 293 to 300*

**Which three objective powers are usual in a standard microscope?**

1. 2×, 5× and 8×
2. 10×, 40× and 100×
3. 15×, 50× and 500×
4. 20×, 30× and 60×

**Q596** · Medium · *codex, slides 293 to 300*

**What are the dimensions of a typical glass slide?**

1. 25 × 50 mm and 10 mm thick
2. 75 × 26 mm and about 1 mm thick
3. 100 × 50 mm and 5 mm thick
4. 10 × 10 mm and 0.1 mm thick

**Q597** · Medium · *codex, slides 293 to 300*

**What is the cover slip for?**

1. It magnifies the specimen image
2. It controls the amount of light
3. It holds the slide on the stage
4. It stops the specimen spilling

**Q598** · Hard · *codex, slides 293 to 300*

**Which sequence correctly follows light through a standard transmitted-light compound microscope?**

1. Eyepiece, objective, specimen, condenser, illuminator
2. Illuminator, objective, condenser, eyepiece, specimen
3. Condenser, illuminator, eyepiece, specimen, objective
4. Illuminator, condenser, specimen, objective, eyepiece

**Q599** · Hard · *codex, slides 293 to 300*

**All of the following are involved in controlling or focusing the light reaching the specimen EXCEPT which one?**

1. The diaphragm
2. The revolving nosepiece
3. The condenser lens
4. The illuminator

**Q600** · Devil · *codex, slides 293 to 300*

**A student sees a dim, blurry image with the bulb on, the high power objective selected and the condenser removed. Which change most directly sharpens the image?**

1. Replacing the cover slip, which magnifies the specimen
2. Switching off the illuminator to reduce glare
3. Replacing the condenser, which focuses light on the specimen
4. Moving the arm to the other side of the base

### Answers — Parts of the compound microscope · Q586–600

**Q586 — B** · The body tube holds the eyepiece and connects it to the objective.
**Q587 — D** · The stage is the flat surface that holds the slide.
**Q588 — A** · The condenser collects light and focuses it on the specimen, giving a sharper image.
**Q589 — C** · The diaphragm (iris) controls the amount of light reaching the specimen.
**Q590 — C** · Total magnification is eyepiece power times objective power, so 10 × 45 = 450×.
**Q591 — C** · The arm supports the tube, connects it to the base and is held when carrying.
**Q592 — B** · The short objective protects the slide.
**Q593 — D** · Eyepieces are usually 10× or 15×.
**Q594 — B** · This is the role of the nosepiece.
**Q595 — B** · These are the usual three objectives.
**Q596 — B** · This is the typical size and thickness.
**Q597 — D** · It keeps the specimen in place.
**Q598 — D** · Light passes in this order to the eye.
**Q599 — B** · Correct choice.
**Q600 — C** · A condenser gives a sharper, clearer image.

# Module 4 — Coarse and fine adjustment → Fluorescence microscopy

slides 301 to 400 · 200 questions · 14 sections · bank: BIOL151_Question_Bank_Slides301-400.docx
Difficulty: 80 Easy · 79 Medium · 33 Hard · 8 Devil

## Coarse and fine adjustment · Q601–608

**Q601** · Easy · *codex, slides 301 to 304*

**Which knob moves the specimen to bring the slide to approximate focus?**

1. The fine adjustment knob
2. The coarse adjustment knob
3. The condenser knob
4. The diaphragm lever

**Q602** · Easy · *codex, slides 301 to 304*

**Which knob brings the specimen into sharp final focus?**

1. The coarse adjustment knob
2. The nosepiece
3. The fine adjustment knob
4. The power switch

**Q603** · Easy · *codex, slides 301 to 304*

**Where is the coarse adjustment knob located?**

1. On the eyepiece
2. On the stage aperture
3. On the illuminator lamp
4. On the arm of the microscope

**Q604** · Easy · *codex, slides 301 to 304*

**What should be done carefully when focusing?**

1. Switching off the illuminator lamp
2. Moving and adjusting the coarse knob
3. Removing the coverslip first
4. Rotating the eyepiece tube

**Q605** · Medium · *codex, slides 301 to 304*

**How is the fine adjustment knob related to the coarse adjustment knob?**

1. It is a sub part of the coarse knob system
2. It is a separate unit on the base
3. It is the same knob used for light control
4. It is a part of the objective lens

**Q606** · Medium · *codex, slides 301 to 304*

**What does the coarse knob do to the slide?**

1. It rotates the objective turret
2. It dims the lamp slowly
3. It stains the specimen lightly
4. It moves it to bring it into focus

**Q607** · Medium · *codex, slides 301 to 304*

**After finding a roughly focused image, which knob should a student use first, and then to finish?**

1. Fine knob first, then coarse knob
2. Condenser first, then diaphragm
3. Coarse knob first, then fine knob
4. Nosepiece first, then base

**Q608** · Hard · *codex, slides 301 to 304*

**An image is roughly in focus but still blurry. Which step best improves it?**

1. Turning the coarse adjustment knob fully
2. Removing the condenser lens
3. Switching to the dissecting microscope
4. Turning the fine adjustment knob slightly

### Answers — Coarse and fine adjustment · Q601–608

**Q601 — B** · The coarse knob moves the specimen toward approximate focus.
**Q602 — C** · The fine knob gives sharp focus.
**Q603 — D** · It is present on the arm.
**Q604 — B** · The lecture says the coarse adjustment must be moved carefully.
**Q605 — A** · The fine knob is described as a sub part of the coarse knob.
**Q606 — D** · The knob moves the specimen to focus.
**Q607 — C** · Coarse gives approximate focus and fine gives sharp focus.
**Q608 — D** · The fine knob brings the specimen into sharp focus.

## Functions of the microscope · Q609–616

**Q609** · Easy · *codex, slides 305 to 307*

**Which two functions does microscopy serve?**

1. Fixation and staining
2. Magnification and resolution
3. Heating and cooling
4. Sectioning and embedding

**Q610** · Easy · *codex, slides 305 to 307*

**Resolution is the rendering of two objects as what?**

1. A single blurred spot
2. The same colour
3. A larger image
4. Separate entities

**Q611** · Easy · *codex, slides 305 to 307*

**What is enlargement of the specimen image called?**

1. Resolution
2. Magnification
3. Contrast
4. Aperture

**Q612** · Medium · *codex, slides 305 to 307*

**What is the use of increasing magnification without better detail?**

1. Great, since larger is clearer
2. Little or none
3. Equal to improving resolution
4. Useful only for dissecting microscopes

**Q613** · Medium · *codex, slides 305 to 307*

**What are the two basic aims of all microscopes?**

1. To stain the specimen and to preserve it
2. To magnify and to show greater detail
3. To heat the specimen and to dry it
4. To section the specimen and to embed it

**Q614** · Hard · *codex, slides 305 to 307*

**Why are magnification and resolution described as interdependent?**

1. Resolution always equals magnification
2. Magnification replaces the need for resolution
3. Each is of little use without the other
4. Resolution works only in dissecting microscopes

**Q615** · Hard · *codex, slides 305 to 307*

**All of the following are aims of microscopes EXCEPT which one?**

1. Magnifying the specimen
2. Displaying greater detail
3. Improving resolution
4. Digesting the specimen

**Q616** · Devil · *codex, slides 305 to 307*

**A student doubles the magnification and the image becomes bigger but no more detailed. What does this show?**

1. The microscope has no condenser
2. Extra magnification alone adds little
3. The specimen has been fixed
4. The wavelength has become shorter

### Answers — Functions of the microscope · Q609–616

**Q609 — B** · Microscopy serves magnification and improved resolution.
**Q610 — D** · Resolution renders two objects as separate entities.
**Q611 — B** · Enlargement is magnification.
**Q612 — B** · It is of little or no use.
**Q613 — B** · These are the two aims.
**Q614 — C** · The aims depend on each other.
**Q615 — D** · Correct choice.
**Q616 — B** · This is empty magnification.

## Magnification and focal length · Q617–630

**Q617** · Easy · *codex, slides 308 to 310*

**What is the usual magnification range of an ordinary class microscope?**

1. 25× to 1500×
2. 1× to 10×
3. 250× to 15,000×
4. 2000× to 20,000×

**Q618** · Easy · *codex, slides 308 to 310*

**Up to what magnification do most dissecting microscopes magnify?**

1. 300×
2. 3×
3. 3000×
4. 30×

**Q619** · Easy · *codex, slides 308 to 310*

**What useful magnification can some compound microscopes reach with the oil immersion lens?**

1. 200×
2. 2000×
3. 20,000×
4. 20×

**Q620** · Easy · *codex, slides 308 to 310*

**The magnification of an optical system depends on what?**

1. The colour of the glass slide
2. Focal length and the lens arrangement
3. The thickness of the metal stage
4. The size of the lamp housing

**Q621** · Easy · *codex, slides 308 to 310*

**Focal length is the distance over which what are brought to a focus?**

1. Scattered rays
2. Diverging rays
3. Parallel rays
4. Reflected rays

**Q622** · Easy · *codex, slide 308*

**The ratio of the length of the final image to the length of the specimen is called what?**

1. Resolution
2. Contrast
3. Specimen stage
4. Magnification

**Q623** · Medium · *codex, slides 308 to 310*

**Magnification above what value is considered empty for compound microscopes?**

1. Above 2000×
2. Above 25×
3. Above 100×
4. Above 1500× only

**Q624** · Medium · *codex, slides 308 to 310*

**What does focal length measure?**

1. How bright the lamp bulb is
2. How strongly light is converged
3. How thick the specimen slice is
4. How fast the stage moves up

**Q625** · Medium · *codex, slides 308 to 310*

**Which statement about magnification is NOT true?**

1. It is the ratio of image length to specimen length
2. It always improves resolution
3. It depends on the focal length of the lenses
4. It is called empty above 2000× for compound microscopes

**Q626** · Medium · *codex, slides 308, 317*

**A student draws an ant 8 cm long, and its real length is 2 mm. What is the magnification of the drawing?**

1. 4×
2. 40×
3. 400×
4. 0.025×

**Q627** · Medium · *codex, slide 309*

**What does a shorter focal length mean for a lens?**

1. Lower optical power, because it bends rays less sharply
2. No change in optical power, because only aperture matters
3. Greater optical power, because it bends rays more sharply
4. A longer working distance, because rays focus farther away

**Q628** · Medium · *codex, slide 308*

**Why is magnification beyond about 2000× in a compound light microscope called empty?**

1. The illuminator cannot supply enough light above that value
2. The working distance becomes zero once that value is reached
3. Resolution stops improving, so no extra detail appears
4. The image becomes inverted and can no longer be focused

**Q629** · Hard · *codex, slides 308, 347*

**A red blood cell is 7 µm wide. What is the width of its image at a total magnification of 450×?**

1. 3.15 mm
2. 0.315 mm
3. 31.5 mm
4. 3.15 µm

**Q630** · Devil · *codex, slides 308 to 310*

**A student uses a 20× eyepiece with a 100× oil objective. What is the total magnification, and how does it compare with the useful limit?**

1. 200×, well below the useful limit
2. 120×, well below the useful limit
3. 2000×, at the useful limit for oil immersion
4. 20,000×, far beyond the useful limit

### Answers — Magnification and focal length · Q617–630

**Q617 — A** · The ordinary class microscope magnifies 25× to 1500×.
**Q618 — D** · Most dissecting microscopes magnify up to 30×.
**Q619 — B** · Some reach a useful 2000× with oil.
**Q620 — B** · Both focal length and arrangement matter.
**Q621 — C** · Parallel rays are brought to a focus over the focal length.
**Q622 — D** · Magnification is the ratio of the final image length to the specimen length.
**Q623 — A** · Beyond 2000× resolution no longer improves.
**Q624 — B** · Focal length measures how strongly light is converged.
**Q625 — B** · Correct choice.
**Q626 — B** · 8 cm is 80 mm, and 80 mm divided by 2 mm gives 40×.
**Q627 — C** · A shorter focal length gives greater optical power by bringing rays to a focus over a shorter distance.
**Q628 — C** · Past about 2000× resolution does not improve, so the image is bigger but shows no more detail.
**Q629 — A** · 7 µm × 450 = 3,150 µm, which is 3.15 mm.
**Q630 — C** · 20 × 100 = 2000×, the useful limit.

## Working distance and parfocal objectives · Q631–644

**Q631** · Easy · *codex, slides 311 to 316*

**How long is the working distance at low magnification?**

1. Zero
2. Relatively long
3. Exactly 1 mm
4. Equal to the focal length

**Q632** · Easy · *codex, slides 311 to 316*

**What happens to working distance as magnification increases?**

1. It increases
2. It stays constant
3. It decreases considerably
4. It doubles

**Q633** · Easy · *codex, slides 311 to 316*

**Which lenses practically touch the specimen?**

1. Low-power objectives
2. Eyepiece lenses
3. Condenser lenses
4. Oil immersion lenses

**Q634** · Easy · *codex, slides 311 to 316*

**Parfocal objectives can be changed with what?**

1. Complete refocusing each time
2. A change of illuminator
3. A change of slide
4. Minimal or no refocusing

**Q635** · Easy · *codex, slides 311 to 316*

**If a parfocal microscope is switched from 10× to 40×, what happens to the object?**

1. It stays in focus
2. It disappears
3. It turns upside down
4. It changes colour

**Q636** · Medium · *codex, slides 311 to 316*

**In most compound microscopes, how is the lens moved to increase magnification?**

1. Farther away from the specimen
2. Sideways across the whole stage
3. Physically closer to the specimen
4. Up into the narrow body tube

**Q637** · Medium · *codex, slides 311 to 316*

**What does parfocalling objectives do?**

1. Removes the need for a stage
2. Makes all objectives the same power
3. Adjusts each objective to stay in focus
4. Shortens the working distance to zero

**Q638** · Medium · *codex, slides 311 to 316*

**Why should users be aware of working distance changes with magnification?**

1. To increase the lamp brightness
2. To change the immersion oil often
3. To reduce the staining time needed
4. To prevent damage to the lens and slides

**Q639** · Medium · *codex, slides 311 to 316*

**How large is the focus error in parfocal objectives?**

1. There is some, but it is insignificant
2. None at all in any microscope
3. So large it needs refocusing always
4. Always larger at low power

**Q640** · Medium · *codex, slides 311, 316*

**All of the following are true about working distance EXCEPT which one?**

1. It is relatively long when the objective has low magnification
2. It decreases considerably as the magnification is increased
3. It is the distance between the eyepiece and the objective lens
4. Oil immersion objectives practically touch the specimen

**Q641** · Medium · *codex, slides 313, 314*

**What does it mean when a microscope's objectives are described as parfocal?**

1. The specimen stays in focus when the objective is changed to another magnification
2. The specimen stays in focus when the working distance is changed
3. The specimen stays in focus when the slide is shifted sideways
4. The specimen stays in focus when an opaque disc is placed in the diaphragm

**Q642** · Hard · *codex, slides 311 to 316*

**Which statement distinguishes working distance from parfocal distance?**

1. Working distance is the eyepiece-to-objective gap, while parfocal is the specimen thickness
2. Both describe the distance between condenser and lamp
3. Working distance is objective-to-specimen, parfocal means staying in focus
4. Working distance is the focal length, while parfocal is magnification

**Q643** · Hard · *codex, slides 311 to 316*

**A student switches from a 40× objective to the 100× oil lens and sees the slide nearly touching the lens. Which fact explains this?**

1. Parfocal objectives increase the working distance at high power
2. Working distance falls at high power, and oil lenses nearly touch
3. The condenser moved far away from the stage
4. The fine knob doubles the working distance of the lens

**Q644** · Hard · *codex, slides 311, 313, 316*

**A student focuses sharply at 10×, then moves to the 40× objective and the 100× oil lens, using only the coarse knob. Why is this risky?**

1. Parfocal objectives lose focus entirely at higher power, so the image is destroyed for good
2. Working distance increases sharply at high power, so the slide may fall off the stage
3. Working distance falls considerably and the oil lens nearly touches the specimen, so lens or slide may be damaged
4. Chromatic aberration increases with the coarse knob, so the colours are permanently lost

### Answers — Working distance and parfocal objectives · Q631–644

**Q631 — B** · Working distance is relatively long at low magnification.
**Q632 — C** · Working distance falls considerably.
**Q633 — D** · Oil immersion lenses practically touch the specimen.
**Q634 — D** · Parfocal objectives need little or no refocusing.
**Q635 — A** · It stays in focus.
**Q636 — C** · The lens is moved closer to the specimen.
**Q637 — C** · Parfocalling aligns the objectives' focus.
**Q638 — D** · Short distances risk damage.
**Q639 — A** · There is inevitably some small error.
**Q640 — C** · Correct choice.
**Q641 — A** · Parfocal objectives stay in focus, with little or no refocusing, when magnification is changed.
**Q642 — C** · These are different ideas.
**Q643 — B** · The oil lens has almost no working distance.
**Q644 — C** · Working distance decreases with magnification, and oil immersion lenses practically touch the specimen.

## Magnification versus resolution · Q645–660

**Q645** · Easy · *codex, slides 317 to 325*

**Magnification enlarges what about the specimen?**

1. Its appearance, not its physical size
2. Its physical size permanently in the cell
3. Its refractive index in the lens
4. Its wavelength of light

**Q646** · Easy · *codex, slides 317 to 325*

**Which term describes the ability of an imaging system to show detail?**

1. Magnification
2. Resolution
3. Contrast
4. Aperture

**Q647** · Easy · *codex, slides 317 to 325*

**Which term is often confused with magnification?**

1. Resolution
2. Fixation
3. Parfocal
4. Dispersion

**Q648** · Easy · *codex, slides 317 to 325*

**What effect limits a microscope's ability to resolve fine details?**

1. Evaporation
2. Absorption by glass
3. Diffraction
4. Gravity

**Q649** · Easy · *codex, slides 317 to 325*

**Two micrographs at the same magnification differ in clarity. What differs?**

1. Magnification
2. Slide length
3. Resolution
4. Eyepiece colour

**Q650** · Easy · *codex, slides 317 to 325*

**What is the finite limit beyond which separate points cannot be resolved called?**

1. The resolution limit
2. The focal limit
3. The working limit
4. The parfocal limit

**Q651** · Medium · *codex, slides 317 to 325*

**Which do microbiologists depend on more, magnification or resolution?**

1. Resolution, to tell microbes apart
2. Magnification, to make microbes large
3. Neither one of them
4. Working distance of the lens

**Q652** · Medium · *codex, slides 317 to 325*

**Resolving power is the ability to distinguish between two closely spaced what?**

1. Cover slips
2. Condensers
3. Airy disks
4. Eyepieces

**Q653** · Medium · *codex, slides 317 to 325*

**Which three factors affect the size of diffraction patterns?**

1. Slide thickness, stage size and lamp power
2. Wavelength, refractive index and numerical aperture
3. Fixative, stain and embedding medium
4. Magnification, working distance and parfocal distance

**Q654** · Medium · *codex, slides 317 to 325*

**Why must a viewer first magnify to a point where resolution becomes relevant?**

1. Resolution is created by the eyepiece colour
2. Magnification replaces the lens aperture
3. Detail needs enough enlargement first
4. Staining can only occur above 1000×

**Q655** · Medium · *codex, slides 317 to 325*

**What happens as two small specimens are moved closer and closer together?**

1. They become brighter and larger
2. They turn into a single new cell
3. They can no longer be seen as distinct
4. They always stay distinct however close

**Q656** · Medium · *codex, slide 322*

**At very high magnification with transmitted light, point objects appear as fuzzy discs ringed by diffraction rings. What are these discs called?**

1. Deflected electrons
2. Airy discs
3. Cones of light
4. Positive phase rings

**Q657** · Hard · *codex, slides 317 to 325*

**The right micrograph shows more detail at the same magnification as the left. Why?**

1. It has higher resolution
2. It has a higher magnification
3. It has a longer working distance
4. It is stained with heavy metal

**Q658** · Hard · *codex, slides 317 to 325*

**Two points lie 100 nm apart, and the microscope's limit of resolution is 240 nm. What happens?**

1. They appear as two because magnification is high
2. They appear as two because 100 is smaller than 240
3. They disappear because of diffraction rings
4. They appear as one because they are closer than the limit

**Q659** · Hard · *codex, slides 317 to 325*

**All of the following affect the extent of diffraction patterns EXCEPT which one?**

1. The wavelength of light
2. The refractive index of the lens materials
3. The thickness of the glass slide
4. The numerical aperture

**Q660** · Devil · *codex, slides 317 to 325*

**A student says raising magnification alone will separate two structures 100 nm apart in a light microscope with a 240 nm limit. How should this be judged?**

1. It is right, because enough magnification always separates them
2. It is wrong, since resolution sets the limit and 100 nm is below 240 nm
3. It is right, because Airy discs shrink with magnification
4. It is wrong only if the stage is perfectly flat

### Answers — Magnification versus resolution · Q645–660

**Q645 — A** · Magnification enlarges appearance, not physical size.
**Q646 — B** · Resolution describes the ability to show detail.
**Q647 — A** · Resolution is often confused with magnification.
**Q648 — C** · Diffraction limits resolution.
**Q649 — C** · Resolution differs while magnification is the same.
**Q650 — A** · This is the resolution limit.
**Q651 — A** · They depend on resolution to see differences.
**Q652 — C** · Resolving power is the ability to distinguish adjacent Airy disks.
**Q653 — B** · These are the three listed.
**Q654 — C** · Enlargement must reach the point where detail matters.
**Q655 — C** · Beyond the resolution limit they merge.
**Q656 — B** · Point objects appear as fuzzy Airy discs surrounded by diffraction rings.
**Q657 — A** · Higher resolution gives more detail at the same magnification.
**Q658 — D** · 100 nm is below the 240 nm limit.
**Q659 — C** · Correct choice.
**Q660 — B** · Resolution limits separation.

## Parameters that affect resolution · Q661–670

**Q661** · Easy · *codex, slides 326 to 330*

**Which colour gives better resolution, blue or red light?**

1. Blue light, because its wavelength is shorter
2. Red light, because its wavelength is longer
3. Both are the same, as wavelength is irrelevant
4. Neither, because colour has no effect

**Q662** · Easy · *codex, slides 326 to 330*

**Which illumination method optimises light distribution?**

1. Köhler illumination
2. Oil illumination
3. Parfocal illumination
4. Spherical illumination

**Q663** · Easy · *codex, slides 326 to 330*

**Which high-quality lenses minimise distortions and improve resolution?**

1. Plan apochromats
2. Simple plano lenses
3. Opaque lenses
4. Dispersive lenses

**Q664** · Easy · *codex, slides 326 to 330*

**About what refractive index does immersion oil have?**

1. 1.51
2. 1.00
3. 0.51
4. 5.1

**Q665** · Medium · *codex, slides 326 to 330*

**Blue light has about what wavelength in the lecture?**

1. About 700 nm
2. About 450 nm
3. About 180 nm
4. About 1500 nm

**Q666** · Medium · *codex, slides 326 to 330*

**In the lecture, red light lies at about what wavelength?**

1. About 700 nm
2. About 450 nm
3. About 200 nm
4. About 1000 nm

**Q667** · Medium · *codex, slides 326 to 330*

**Why do some microscopes use ultraviolet light?**

1. It is much brighter than white light
2. It stains the specimen automatically
3. It removes the need for all lenses
4. Its wavelength is shorter than visible

**Q668** · Medium · *codex, slides 326 to 330*

**What do lens aberrations do to image quality?**

1. They increase resolution
2. They improve contrast always
3. They shorten the working distance
4. They reduce clarity

**Q669** · Hard · *codex, slides 326 to 330*

**Which list names the factors that affect resolution?**

1. Wavelength, NA, optical quality, illumination, contrast and medium index
2. Slide thickness, stage size, lamp colour and arm length
3. Fixative, stain, embedding, sectioning and mounting
4. Magnification, working distance, parfocal distance and focal length

**Q670** · Hard · *codex, slides 326 to 330*

**All of the following affect the resolution of a light microscope EXCEPT which one?**

1. The wavelength of light
2. The numerical aperture
3. The medium's refractive index
4. The colour of the slide label

### Answers — Parameters that affect resolution · Q661–670

**Q661 — A** · Shorter wavelength gives better resolution.
**Q662 — A** · Köhler illumination optimises light distribution.
**Q663 — A** · Plan apochromatic lenses minimise distortions.
**Q664 — A** · Immersion oil has n of about 1.51.
**Q665 — B** · Blue light is about 450 nm.
**Q666 — A** · Red light is about 700 nm.
**Q667 — D** · UV has a shorter wavelength.
**Q668 — D** · Aberrations reduce clarity.
**Q669 — A** · These are the factors in the lecture.
**Q670 — D** · Correct choice.

## Numerical aperture · Q671–690

**Q671** · Easy · *codex, slides 331 to 339*

**What is the equation for numerical aperture?**

1. NA = n(sin μ)
2. NA = n / sin μ
3. NA = sin μ / n
4. NA = n(cos μ)

**Q672** · Easy · *codex, slides 331 to 339*

**What does n stand for in the numerical aperture equation?**

1. The number of lenses
2. The wavelength of light
3. The medium's refractive index
4. The magnification

**Q673** · Easy · *codex, slides 331 to 339*

**What is the refractive index of air in the NA equation?**

1. 1.00
2. 1.51
3. 0.50
4. 2.00

**Q674** · Easy · *codex, slides 331 to 339*

**What refractive index do specialised immersion oils reach?**

1. About 1.51
2. About 1.00
3. About 3.0
4. About 0.5

**Q675** · Easy · *codex, slides 331 to 339*

**What is the maximum value of the angle μ?**

1. 45°
2. 90°
3. 180°
4. 30°

**Q676** · Easy · *codex, slides 331 to 339*

**What is the value of sin 90°?**

1. 1
2. 0
3. 0.5
4. 90

**Q677** · Easy · *codex, slides 331 to 339*

**A lens with a larger NA can do what?**

1. Visualise coarser detail with a dimmer image
2. Increase the working distance only
3. See finer detail with a brighter image
4. Remove the need for light

**Q678** · Easy · *codex, slides 331 to 339*

**What does μ represent in the NA equation?**

1. The full angular aperture
2. The wavelength of light
3. The refractive index
4. Half of the angular aperture

**Q679** · Medium · *codex, slides 331 to 339*

**What shape is the cone of image-forming light entering the objective?**

1. A flat sheet
2. A cylinder
3. An inverted cone
4. A sphere

**Q680** · Medium · *codex, slides 331 to 339*

**What is the practical upper limit of NA for dry objectives?**

1. About 1.51
2. About 2.5
3. About 0.1
4. About 0.95

**Q681** · Medium · *codex, slides 331 to 339*

**Which factor is the limit for achieving NA above 1.0?**

1. The colour of the lens
2. The medium's refractive index
3. The size of the stage
4. The thickness of the slide

**Q682** · Medium · *codex, slides 331 to 339*

**How is a working NA greater than 1.0 achieved?**

1. By using a much thicker cover slip
2. By raising the medium's index
3. By dimming the lamp a little
4. By using a much longer eyepiece

**Q683** · Medium · *codex, slides 331 to 339*

**How does NA relate to aberration correction in objectives?**

1. Corrected objectives have smaller NA
2. NA is unrelated to correction
3. Highly corrected objectives have larger NA
4. Only uncorrected objectives reach 1.0

**Q684** · Medium · *codex, slides 331 to 339*

**What is the NA of a 10× plan apochromat objective in the lecture table?**

1. 0.25
2. 0.45
3. 0.30
4. 0.95

**Q685** · Medium · *codex, slides 331 to 339*

**What is the NA of the 40× oil objective in the table?**

1. 0.65
2. 0.95
3. 1.3
4. 2.5

**Q686** · Medium · *codex, slides 331 to 339*

**What happens to NA as the angle μ rises from 7° to 60° in air?**

1. It falls from 0.87 to 0.12
2. It stays fixed at about 1.0
3. It rises from about 0.12 to 0.87
4. It rises from about 1.0 to 2.0

**Q687** · Hard · *codex, slides 331 to 339*

**What is the NA of a dry objective (air, n = 1.00) whose angle μ is 30°?**

1. 0.50
2. 0.30
3. 1.00
4. 0.87

**Q688** · Hard · *codex, slides 331 to 339*

**Why can an air objective not exceed an NA of 1.0?**

1. Air blocks all rays above 1.0
2. The lens glass melts above 1.0
3. The eyepiece cannot read above 1.0
4. n is 1.00 and sin μ never exceeds 1

**Q689** · Hard · *codex, slides 331 to 339*

**Which objective in the table has the highest NA among dry 40× lenses?**

1. Plan apochromat, NA 0.95
2. Plan achromat, NA 0.65
3. Plan fluorite, NA 0.75
4. Plan apochromat, NA 1.3

**Q690** · Devil · *codex, slides 331 to 339*

**An oil objective has n = 1.51 and μ = 60°. What is its NA?**

1. About 0.87
2. About 1.51
3. About 2.60
4. About 1.31

### Answers — Numerical aperture · Q671–690

**Q671 — A** · NA equals n times sin μ.
**Q672 — C** · n is the refractive index.
**Q673 — A** · Air has a refractive index of 1.00.
**Q674 — A** · Immersion oils reach about 1.51.
**Q675 — B** · The maximum value is 90°.
**Q676 — A** · The sine of 90° is 1.
**Q677 — C** · A larger NA gives finer detail and brightness.
**Q678 — D** · μ is one-half the angular aperture.
**Q679 — C** · Light enters in an inverted cone.
**Q680 — D** · Dry objectives rarely exceed 0.95.
**Q681 — B** · The refractive index limits NA.
**Q682 — B** · A denser medium raises NA.
**Q683 — C** · Correction allows larger NA.
**Q684 — B** · The 10× plan apochromat has NA 0.45.
**Q685 — C** · The 40× oil objective has NA 1.3.
**Q686 — C** · NA rises from 0.12 to 0.87.
**Q687 — A** · NA = 1.00 × sin 30° = 0.50.
**Q688 — D** · n = 1.00 and sin μ ≤ 1 cap NA at 1.0.
**Q689 — A** · The plan apochromat has NA 0.95.
**Q690 — D** · 1.51 × sin 60° ≈ 1.31.

## Refractive index and immersion oil · Q691–702

**Q691** · Easy · *codex, slides 329, 341, 342*

**Which medium lies between low-power objectives and the specimen in a conventional microscope?**

1. Oil
2. Water
3. Glycerol
4. Air

**Q692** · Easy · *codex, slides 329, 341, 342*

**What refractive index does air have in the conventional microscope?**

1. 1.5
2. 0.5
3. 2
4. 1

**Q693** · Easy · *codex, slides 329, 341, 342*

**About what refractive index do immersion oils used with glass-covered slides have?**

1. About 1.00
2. About 3.00
3. About 0.50
4. About 1.50

**Q694** · Easy · *codex, slides 329, 341, 342*

**Which objectives use air as the medium, according to the lecture?**

1. Only the ×100 objectives
2. Only the dissecting lenses
3. None of the objectives
4. The low power ones, below ×100

**Q695** · Easy · *codex, slides 329, 341, 342*

**What does using immersion oil do to the numerical aperture?**

1. It decreases it
2. It sets it to zero
3. It increases it
4. It has no effect

**Q696** · Medium · *codex, slides 329, 341, 342*

**Why do fewer light rays get lost with immersion oil?**

1. The oil absorbs the stray rays
2. The oil blocks the outer rays
3. The oil makes the lens bigger
4. Less light is lost to refraction

**Q697** · Medium · *codex, slides 329, 341, 342*

**What is the refractive index of the coverslip and glass slide in the lecture figure?**

1. 1.0
2. 0.5
3. 3.0
4. 1.5

**Q698** · Medium · *codex, slides 329, 341, 342*

**How does immersion oil improve resolution?**

1. It shortens the wavelength of the light
2. It raises NA and fewer rays are lost
3. It increases the magnification of the eyepiece
4. It stains the specimen lightly

**Q699** · Medium · *codex, slides 329, 341, 342*

**How does the refractive index of immersion oil compare with air?**

1. It is lower
2. It is the same
3. It is zero for most samples
4. It is higher

**Q700** · Medium · *codex, slides 329, 341, 342*

**Which materials in the lecture figure have a refractive index of 1.5?**

1. Air, the coverslip and the glass slide
2. Oil, the coverslip and the glass slide
3. Air and the oil immersion only
4. Only the glass slide itself

**Q701** · Hard · *codex, slides 329, 341, 342*

**Why is the refractive index of the immersion oil matched to that of the glass?**

1. Light is not bent away, so more rays enter
2. The oil then shortens the light wavelength
3. The oil then acts as a kind of stain
4. The oil then reduces the NA of the lens

**Q702** · Hard · *codex, slides 329, 341, 342*

**A dry 100× lens gives a poor image. Which change best improves it?**

1. Switching to red light instead
2. Removing the condenser lens fully
3. Adding immersion oil
4. Dimming the lamp further

### Answers — Refractive index and immersion oil · Q691–702

**Q691 — D** · The medium is air.
**Q692 — D** · Air has a refractive index of 1.
**Q693 — D** · The optimum value is about 1.50.
**Q694 — D** · Objectives below ×100 use air.
**Q695 — C** · The oil increases NA.
**Q696 — D** · Fewer rays are lost due to refraction.
**Q697 — D** · They are shown as n = 1.5.
**Q698 — B** · Higher NA means better resolution.
**Q699 — D** · Oil is about 1.5 and air is 1.0.
**Q700 — B** · All three are shown at n = 1.5.
**Q701 — A** · Matching the index avoids refraction losses.
**Q702 — C** · Oil raises NA and cuts refraction losses.

## Wavelength and the limit of resolution · Q703–720

**Q703** · Easy · *codex, slides 343 to 349*

**What is the formula for the limit of resolution?**

1. $r = 0.61\ NA / \lambda$
2. $r = 0.61\lambda / NA$
3. $r = \lambda \times NA$
4. $r = NA / 0.61\lambda$

**Q704** · Easy · *codex, slides 343 to 349*

**How does a shorter wavelength change resolution?**

1. It gives poorer resolution
2. It gives better resolution
3. It has no effect
4. It removes the diffraction limit

**Q705** · Easy · *codex, slides 343 to 349*

**About what is the maximum NA of light microscope objectives in practice?**

1. About 0.14
2. About 14
3. About 1.4
4. About 4.1

**Q706** · Easy · *codex, slides 343 to 349*

**To which component of white light is the human eye most sensitive?**

1. Violet light
2. Red light
3. Green light
4. Blue light

**Q707** · Easy · *codex, slides 343 to 349*

**What is the best resolution limit obtainable with white light?**

1. About 240 nm
2. About 24 nm
3. About 2.4 μm
4. About 240 μm

**Q708** · Easy · *codex, slides 343 to 349*

**About how wide is a red blood cell?**

1. About 7 nm
2. About 70 μm
3. About 7 μm
4. About 7 mm

**Q709** · Easy · *codex, slides 343 to 349*

**What does the limit of resolution r represent?**

1. The maximum magnification possible
2. The brightness of the image
3. The focal length of the objective
4. The minimum resolvable distance

**Q710** · Medium · *codex, slides 343 to 349*

**Green light spans which wavelength range?**

1. 400 to 450 nm
2. 560 to 600 nm
3. 650 to 700 nm
4. 180 to 400 nm

**Q711** · Medium · *codex, slides 343 to 349*

**What upper limit does the lecture give for the refractive index n?**

1. About 1.7, usually 1.5
2. About 3.0, usually 2.0
3. About 1.0, always
4. About 0.7, usually 0.5

**Q712** · Medium · *codex, slides 343 to 349*

**Using λ = 560 nm and NA = 1.4, what limit of resolution results?**

1. About 244 nm
2. About 24 nm
3. About 2,440 nm
4. About 400 nm

**Q713** · Medium · *codex, slides 343 to 349*

**Light of 600 nm with an NA of 1.5 gives what limit?**

1. About 366 nm
2. About 244 nm
3. About 24 nm
4. About 400 nm

**Q714** · Medium · *codex, slides 343 to 349*

**If the NA doubles and the wavelength is unchanged, what happens to r?**

1. It doubles
2. It stays the same
3. It halves
4. It becomes zero

**Q715** · Medium · *codex, slides 343 to 349*

**If the wavelength is halved and the NA is unchanged, what happens to r?**

1. It doubles
2. It halves
3. It stays the same
4. It quadruples

**Q716** · Medium · *codex, slides 343 to 349*

**Why does the maximal resolving power depend mainly on the wavelength?**

1. The eyepiece power fixes the NA
2. sin μ stays below 1, and n is limited
3. The lamp power fixes the NA
4. The stage height fixes the NA

**Q717** · Hard · *codex, slides 343 to 349*

**A microscope has a 180 nm limit of resolution. Can it effectively resolve a 20 μm specimen?**

1. Yes, because 20 μm is far larger than 180 nm
2. No, because 20 μm is below the limit
3. No, because the limit must exceed 20 μm
4. Only with ultraviolet light

**Q718** · Hard · *codex, slides 343 to 349*

**An oil lens with n = 1.51 has an angle μ of 90°. What is its NA?**

1. 1.51
2. 0.90
3. 90
4. 2.40

**Q719** · Hard · *codex, slides 343 to 349*

**Which pair of changes gives the best resolution?**

1. Shorter wavelength and larger NA
2. Longer wavelength and larger NA
3. Shorter wavelength and smaller NA
4. Longer wavelength and smaller NA

**Q720** · Devil · *codex, slides 308, 346, 347*

**The best limit of resolution of a light microscope with white light is about 240 nm. Roughly how many such points could fit side by side across a red blood cell 7 μm wide?**

1. About 2.9
2. About 290
3. About 0.034
4. About 29

### Answers — Wavelength and the limit of resolution · Q703–720

**Q703 — B** · The limit of resolution is 0.61 λ divided by NA.
**Q704 — B** · The shorter the wavelength, the better the resolution.
**Q705 — C** · The maximum is about 1.4.
**Q706 — C** · The eye is most sensitive to green.
**Q707 — A** · The best limit is about 240 nm.
**Q708 — C** · A red blood cell is about 7 µm.
**Q709 — D** · It is the minimum distance rendered separate.
**Q710 — B** · Green is about 560 to 600 nm.
**Q711 — A** · n cannot rise above 1.7, and is usually 1.5.
**Q712 — A** · 0.61 × 560 ÷ 1.4 ≈ 244 nm.
**Q713 — B** · 0.61 × 600 ÷ 1.5 = 244 nm.
**Q714 — C** · r is inversely proportional to NA.
**Q715 — B** · r is directly proportional to λ.
**Q716 — B** · NA is capped, leaving wavelength as the main variable.
**Q717 — A** · The specimen is much bigger than the limit.
**Q718 — A** · NA = 1.51 × sin 90° = 1.51.
**Q719 — A** · Both lower r.
**Q720 — D** · 7 µm is 7,000 nm, and 7,000 divided by 240 is about 29.

## Bright-field microscopy · Q721–732

**Q721** · Easy · *codex, slides 351 to 353*

**Where is the apex of the light cone focused in a bright-field microscope?**

1. At the eyepiece
2. At the plane of the specimen
3. At the lamp
4. At the objective rear

**Q722** · Easy · *codex, slides 351 to 353*

**What gathers the lamp light in a standard bright-field microscope?**

1. The substage condenser
2. The eyepiece
3. The stage clip
4. The nosepiece

**Q723** · Easy · *codex, slides 351 to 353*

**How are specimens seen in a bright-field microscope?**

1. By emitting their own bright light
2. By changing the speed and path of light
3. By absorbing UV and then glowing
4. By blocking all of the light

**Q724** · Easy · *codex, slides 351 to 353*

**Differences in light intensity that build an image are called what?**

1. Resolution
2. Magnification
3. Aperture
4. Contrast

**Q725** · Easy · *codex, slides 351 to 353*

**Which specimens cannot be adequately visualised with bright-field microscopy?**

1. Heavily stained thick sections
2. Transparent unstained living cells
3. Opaque rocks and mineral grains
4. Metal alloys and polished ores

**Q726** · Medium · *codex, slides 351 to 353*

**On which two properties of a specimen does its ability to change light depend?**

1. Its overall colour and temperature
2. Its total volume and its weight
3. Its refractive index and its opacity
4. Its age and its place of origin

**Q727** · Medium · *codex, slides 351 to 353*

**What happens if a specimen's refractive index is too similar to the surrounding medium?**

1. It will not be seen
2. It will appear brighter
3. It will appear coloured
4. It will appear larger

**Q728** · Medium · *codex, slides 351 to 353*

**How can contrast be enhanced in bright-field microscopy?**

1. By removing the condenser
2. By staining the specimen
3. By dimming the lamp a little
4. By raising the stage

**Q729** · Medium · *codex, slides 351 to 353*

**What is a drawback of staining for contrast?**

1. It shortens the working distance a lot
2. It adds extra magnification to it
3. It often requires killing the specimen
4. It changes the wavelength of light

**Q730** · Medium · *codex, slides 351 to 353*

**What produces contrast in bright-field microscopy?**

1. Light rays that travel without interacting
2. Light rays changed enough to interfere
3. Light rays blocked entirely
4. Light rays turned into electrons

**Q731** · Hard · *codex, slides 351 to 353*

**Why can unstained living cells not be seen well in bright-field microscopy?**

1. Their index matches the medium closely
2. They produce far too much contrast
3. They emit far too much fluorescence
4. They are far too opaque to light

**Q732** · Hard · *codex, slides 351 to 353*

**All of the following are true of bright-field microscopy EXCEPT which one?**

1. The condenser focuses a light cone on the specimen
2. Contrast can be enhanced by staining
3. Staining often requires killing the cells
4. It is ideal for transparent living specimens

### Answers — Bright-field microscopy · Q721–732

**Q721 — B** · The apex is focused at the specimen plane.
**Q722 — A** · The substage condenser gathers the light.
**Q723 — B** · They change light speed and path.
**Q724 — D** · Differences in light intensity are contrast.
**Q725 — B** · These lack contrast.
**Q726 — C** · These two properties matter.
**Q727 — A** · It will not be seen.
**Q728 — B** · Staining enhances contrast.
**Q729 — C** · Staining often kills cells.
**Q730 — B** · Interference produces contrast.
**Q731 — A** · Little contrast is produced.
**Q732 — D** · Correct choice.

## Dark-field microscopy · Q733–748

**Q733** · Easy · *codex, slides 361 to 369*

**What blocks the main light beam in a dark-field microscope?**

1. A filter in the eyepiece
2. A mirror under the stage
3. A dark disk in the condenser
4. A coat on the slide

**Q734** · Easy · *codex, slides 361 to 369*

**How does the specimen appear in dark-field microscopy?**

1. Dark against a bright background
2. Coloured against a white background
3. Light against a dark background
4. Invisible

**Q735** · Easy · *codex, slides 361 to 369*

**For which samples is dark-field microscopy well suited?**

1. Live and unstained biological samples
2. Fixed and stained sections only
3. Dried metal films and foils
4. Frozen sections of tissue only

**Q736** · Easy · *codex, slides 361 to 369*

**Which spiral organisms are cited as visible with dark-field microscopy?**

1. Amoebae
2. Spirochetes
3. Diatoms
4. Algae

**Q737** · Easy · *codex, slides 361 to 369*

**What is the disadvantage of dark-field microscopy listed in the lecture?**

1. Objects look smaller than they are
2. It cannot show living cells at all
3. It needs electron beams to work
4. Objects look bigger than they actually are

**Q738** · Easy · *codex, slides 361 to 369*

**Which light enters the objective in dark-field microscopy?**

1. Only direct light from the lamp
2. Only ultraviolet light of the lamp
3. Only transmitted direct light
4. Only light scattered by the specimen

**Q739** · Medium · *codex, slides 361 to 369*

**In which three situations is a dark-field microscope used for live microorganisms?**

1. When fluorescent, opaque or deep frozen
2. When dry, thick, fixed or stained
3. When large, heavy, hot or opaque
4. When unseen, unstainable or distorted by dye

**Q740** · Medium · *codex, slides 361 to 369*

**At what angle does light strike the sample in dark-field microscopy?**

1. Obliquely
2. Straight down
3. Straight up
4. Parallel to the axis

**Q741** · Medium · *codex, slides 361 to 369*

**Which gold particle size can be seen with dark-field because it is below the diffraction limit?**

1. 40 nm gold
2. 400 nm gold
3. 4 µm gold
4. 40 µm gold

**Q742** · Medium · *codex, slides 361 to 369*

**For which kind of object is dark-field poorly suited?**

1. Small particles
2. Unstained microorganisms
3. Water-borne cells
4. Large objects

**Q743** · Medium · *codex, slides 361 to 369*

**Where is the opaque disc placed in a dark-field microscope?**

1. Underneath the condenser lens
2. On top of the eyepiece
3. Inside the objective
4. On the slide

**Q744** · Medium · *codex, slides 361 to 369*

**In which kind of suspension does the lecture say dark-field is frequently used to examine unstained microorganisms?**

1. Bacteria in dry powder
2. Algae in solid rock
3. Fungal spores on glass
4. Yeast cells in liquid

**Q745** · Hard · *codex, slides 361 to 369*

**Why does the specimen appear bright on a dark background?**

1. The sample emits its own bright light
2. The sample absorbs UV and glows
3. The background is stained black
4. Only scattered light reaches the objective

**Q746** · Hard · *codex, slides 361 to 369*

**A dark-field microscope is used to examine all of the following EXCEPT which one?**

1. Inherently fluorescent specimens
2. Specimens invisible in ordinary light
3. Specimens that cannot be stained
4. Tiny living cells in a fluid

**Q747** · Hard · *codex, slides 361 to 369*

**A clinician wants to see live spirochetes in a fluid smear. Which technique suits this?**

1. Dark-field microscopy
2. Transmission electron microscopy
3. Bright-field with no stain
4. Fixation and sectioning

**Q748** · Devil · *codex, slides 361 to 369*

**Which statement correctly contrasts bright-field and dark-field microscopy?**

1. Bright-field shows a bright specimen on a dark background, whereas dark-field shows a dark one on a bright background
2. Both show bright specimens on dark backgrounds
3. Both need a disc in the condenser
4. Bright-field gives a bright background, dark-field a dark one

### Answers — Dark-field microscopy · Q733–748

**Q733 — C** · A dark disk stops the main beam.
**Q734 — C** · The specimen is bright on a dark background.
**Q735 — A** · It suits live unstained samples.
**Q736 — B** · Spirochetes are seen with dark-field.
**Q737 — D** · Objects appear larger than they are.
**Q738 — D** · Only scattered light enters.
**Q739 — D** · These three situations are listed.
**Q740 — A** · Light strikes at an oblique angle.
**Q741 — A** · Sub-diffraction 40 nm gold particles are visible.
**Q742 — D** · It is not good for large objects.
**Q743 — A** · The disc is under the condenser lens.
**Q744 — D** · Unstained microorganisms in liquid such as yeast cells are named.
**Q745 — D** · Direct light is blocked.
**Q746 — A** · Correct choice.
**Q747 — A** · It suits live spirochetes.
**Q748 — D** · The backgrounds differ.

## Phase-contrast microscopy · Q749–772

**Q749** · Easy · *codex, slides 370 to 388*

**Which microscope makes colourless living cells visible without staining?**

1. The phase-contrast microscope
2. The bright-field microscope
3. The transmission electron microscope
4. The ultraviolet microscope

**Q750** · Easy · *codex, slides 370 to 388*

**What does the wavelength of light measure?**

1. Brightness
2. Colour
3. Speed
4. Contrast

**Q751** · Easy · *codex, slides 370 to 388*

**What does the amplitude of light measure?**

1. Brightness
2. Colour
3. Phase
4. Resolution

**Q752** · Easy · *codex, slides 370 to 388*

**What does the phase-contrast microscope do to the diffracted rays?**

1. It blocks them completely
2. It speeds them up
3. It turns them into electrons
4. It further retards them

**Q753** · Easy · *codex, slides 370 to 388*

**For which specimens is phase-contrast widely used?**

1. Dried powders
2. Heavily stained slides
3. Living cells and tissues
4. Frozen blocks

**Q754** · Easy · *codex, slides 370 to 388*

**Which diaphragm in phase-contrast makes light waves become in phase?**

1. The iris diaphragm
2. The field diaphragm
3. The annular diaphragm
4. The opaque disc

**Q755** · Easy · *codex, slides 370 to 388*

**Phase contrast is the most commonly used contrasting technique where, according to the lecture?**

1. In electron microscopy
2. In our labs
3. In field geology
4. In astronomy

**Q756** · Easy · *codex, slides 370 to 388*

**What makes living cells hard to see with ordinary light?**

1. They are too opaque for light to pass
2. They emit too much light of their own
3. They are colourless and fairly transparent
4. They are too large to fit under the lens

**Q757** · Easy · *codex, slides 370 to 388*

**What does staining with dyes usually do to cells?**

1. Results in their death or disruption
2. Keeps them alive and moving
3. Makes them fluoresce at once
4. Doubles their size in the dye

**Q758** · Easy · *codex, slides 370 to 388*

**In bright-field images of cultured cells, which regions are visible?**

1. All of the regions equally well
2. Only the cytoplasm of the cell
3. Refractive regions like the nucleus
4. Only the mitochondria inside it

**Q759** · Medium · *codex, slides 370 to 388*

**Which plate retards the light that passes through the specimen in phase-contrast?**

1. The negative filter plate
2. The glass slide
3. The coverslip
4. The positive phase plate

**Q760** · Medium · *codex, slides 370 to 388*

**What limit does phase-contrast microscopy not overcome?**

1. The limit of staining quality
2. The limit of slide size used
3. The wavelength limit of visible light
4. The limit of lamp power output

**Q761** · Medium · *codex, slides 370 to 388*

**Which kind of photography has phase-contrast been particularly useful with?**

1. Aerial photography
2. X-ray photography
3. Flash photography
4. Time-lapse motion photography

**Q762** · Medium · *codex, slides 370 to 388*

**How do the diffracted rays behave relative to the undiffracted rays?**

1. They are advanced
2. They are unchanged
3. They are retarded
4. They are absorbed fully

**Q763** · Medium · *codex, slides 370 to 388*

**Which details of living cells have been observed with phase-contrast?**

1. Atomic structure and electron clouds
2. Only dead cell walls and cork
3. Cell movement, nuclei changes and flow
4. Only DNA sequences in genes

**Q764** · Medium · *codex, slides 370 to 388*

**What does a greater degree of diffraction do to the image?**

1. It makes the image brighter
2. It makes the image coloured
3. It has no effect
4. It makes the image darker

**Q765** · Medium · *codex, slides 370 to 388*

**Which light passes through the thicker portion of the positive phase plate?**

1. Light from the background only
2. Light that passed through the specimen
3. Light from the lamp directly above
4. Light from the eyepiece lens

**Q766** · Medium · *codex, slides 370 to 388*

**What is the effect of the thicker part of the positive phase plate on specimen light?**

1. More retardation, so more contrast
2. Less retardation, so contrast is reduced
3. No effect on the specimen light
4. It turns the light into pure UV

**Q767** · Medium · *codex, slides 370 to 388*

**Which illumination method is compared with phase contrast in the cell culture figure?**

1. Dark-field illumination
2. Bright-field illumination
3. Fluorescence illumination
4. Electron illumination

**Q768** · Hard · *codex, slides 370 to 388*

**All of the following are true of the phase-contrast microscope EXCEPT which one?**

1. It is used to observe living cells
2. It improves contrast
3. It uses both transmitted and scattered light
4. It overcomes the wavelength limit of light

**Q769** · Hard · *codex, slides 370 to 388*

**Which sequence describes how phase contrast creates contrast?**

1. Diffracted rays are retarded more, interfere, and contrast rises
2. Undiffracted rays are blocked, and diffracted rays are brightened
3. The specimen is stained, and dye absorbs the rays
4. The lamp is dimmed, and the image darkens

**Q770** · Hard · *codex, slides 370 to 388*

**Which microscope is best for viewing the internal structures of a living amoeba?**

1. The bright-field microscope with a stain
2. The dark-field microscope
3. The transmission electron microscope
4. The phase-contrast microscope

**Q771** · Hard · *codex, slides 370 to 388*

**Why is staining unsuitable for studying cell movement?**

1. It usually kills or disrupts the cells
2. It makes the cells much larger
3. It changes the wavelength of light
4. It removes the nucleus entirely

**Q772** · Devil · *codex, slides 370 to 388*

**A researcher wants to film cytoplasmic flow in a cell over many hours. Which technique and reason fit best?**

1. Transmission electron microscopy, because it gives the highest resolution
2. Bright-field with a stain, because staining shows movement
3. UV microscopy, because UV is safe for living cells
4. Phase contrast with time-lapse, since living unstained cells can be followed

### Answers — Phase-contrast microscopy · Q749–772

**Q749 — A** · It is used to see unstained living cells.
**Q750 — B** · Wavelength is a measure of colour.
**Q751 — A** · Amplitude is a measure of brightness.
**Q752 — D** · It further retards the diffracted rays.
**Q753 — C** · It is widely used for living cells and tissues.
**Q754 — C** · Light passes through an annular diaphragm.
**Q755 — B** · It is the most used technique in the labs.
**Q756 — C** · Living cells are colourless and transparent.
**Q757 — A** · Staining usually kills or disrupts cells.
**Q758 — C** · Only highly refractive regions are visible.
**Q759 — D** · The positive phase plate retards the light.
**Q760 — C** · Resolution is still limited by wavelength.
**Q761 — D** · It works well with time-lapse photography of living cells.
**Q762 — C** · Diffracted rays are retarded.
**Q763 — C** · These details have been observed.
**Q764 — D** · Greater diffraction gives a darker image.
**Q765 — B** · Specimen light passes through the thicker portion.
**Q766 — A** · The thicker portion enhances the phase difference and contrast.
**Q767 — B** · The figure compares phase contrast with bright-field.
**Q768 — D** · Correct choice.
**Q769 — A** · Further retardation enhances interference.
**Q770 — D** · It reveals internal details of living, unstained cells.
**Q771 — A** · Staining usually kills cells.
**Q772 — D** · This matches the lecture.

## Ultraviolet microscopy · Q773–788

**Q773** · Easy · *codex, slides 390 to 396*

**By how much does UV light increase resolution compared with white light?**

1. Ten-fold
2. Five-fold
3. Two-fold
4. One hundred-fold

**Q774** · Easy · *codex, slides 390 to 396*

**Over which range do ultraviolet wavelengths extend?**

1. 400 to 700 nm
2. 180 to 400 nm
3. 700 to 1000 nm
4. 18 to 40 nm

**Q775** · Easy · *codex, slides 390 to 396*

**Which lens material replaces glass in UV microscopes?**

1. Quartz
2. Plastic
3. Crown glass
4. Flint glass

**Q776** · Easy · *codex, slides 390 to 396*

**Why can UV light not be viewed directly through the eyepiece?**

1. It is far too bright to look at
2. It is too slow to reach the eye
3. It has no wavelength to measure
4. It is not visible to the human eye

**Q777** · Easy · *codex, slides 390 to 396*

**What can UV light damage?**

1. The eye
2. The glass slide
3. The immersion oil
4. The condenser

**Q778** · Easy · *codex, slides 390 to 396*

**Which two advantages does UV microscopy offer?**

1. Lower cost and much easier use
2. Live imaging and no damage at all
3. Better resolution and higher contrast
4. Wider field and thicker sections

**Q779** · Medium · *codex, slides 390 to 396*

**Why does UV light improve resolution?**

1. Its wavelength is longer than visible light
2. It has a higher refractive index
3. Its wavelength is shorter than visible
4. It bends less in immersion oil

**Q780** · Medium · *codex, slides 390 to 396*

**How is the UV image made visible to the viewer?**

1. With a coloured eyepiece tube
2. With a thicker glass lens
3. With a camera or screen
4. With a stain on the glass slide

**Q781** · Medium · *codex, slides 390 to 396*

**Why cannot glass lenses be used in a UV microscope?**

1. Glass absorbs only red light
2. UV cannot pass through glass
3. Glass is too heavy
4. Glass is too expensive

**Q782** · Medium · *codex, slides 390 to 396*

**Which specimens are suited to UV microscopy?**

1. Those that absorb UV and re-emit longer light
2. Only those that reflect all of the light
3. Only those that have no refractive index
4. Only those that are dried in air

**Q783** · Medium · *codex, slides 390 to 396*

**Who has benefited recently from UV microscopes that give high-resolution images of fresh tissue?**

1. Astronomers mapping the stars
2. Geologists studying the rocks
3. Chemists making new dyes
4. Pathologists assessing biopsies

**Q784** · Medium · *codex, slides 390 to 396*

**A microscope has a 240 nm limit with white light. If UV doubles resolution, what is the new limit?**

1. About 480 nm
2. About 120 nm
3. About 24 nm
4. About 360 nm

**Q785** · Medium · *codex, slides 390 to 396*

**How does a sample's response to UV light compare with its response to white light?**

1. It is smaller, which lowers contrast
2. It is identical to white light
3. It is zero for most samples
4. It is greater, which increases contrast

**Q786** · Hard · *codex, slides 390 to 396*

**Which statement lists the disadvantages of the UV microscope?**

1. It needs cheap glass lenses, the image is too bright, and UV is safe
2. It needs costly quartz lenses, and UV can damage the eye
3. It needs oil, the image is inverted, and UV cools the slide
4. It has no resolution gain, no contrast gain, and needs no lens

**Q787** · Hard · *codex, slides 390 to 396*

**All of the following are disadvantages of the UV microscope EXCEPT which one?**

1. It needs quartz lenses
2. The image is not visible to the eye
3. UV may damage the eye
4. It cannot improve resolution

**Q788** · Devil · *codex, slides 390 to 396*

**Using a 240 nm baseline, can a UV microscope resolve two points 150 nm apart, and what is needed to view them?**

1. Yes, since its limit is about 120 nm, and a camera or screen is needed
2. No, since its limit is about 480 nm, and a glass lens is enough
3. Yes, since its limit is about 480 nm, and the eye can see it directly
4. No, since UV gives no gain in resolution, and oil is needed

### Answers — Ultraviolet microscopy · Q773–788

**Q773 — C** · UV increases resolution two-fold.
**Q774 — B** · UV is 180 to 400 nm.
**Q775 — A** · Quartz lenses must be used.
**Q776 — D** · The UV image is not visible.
**Q777 — A** · UV tends to damage the eye.
**Q778 — C** · These are the two advantages.
**Q779 — C** · The shorter wavelength improves resolution.
**Q780 — C** · The image is recorded or projected.
**Q781 — B** · UV cannot pass through glass lenses.
**Q782 — A** · These specimens are suited.
**Q783 — D** · Pathologists use it for biopsies.
**Q784 — B** · Doubling resolution halves the limit.
**Q785 — D** · A greater response gives increased contrast.
**Q786 — B** · These are the disadvantages listed.
**Q787 — D** · Correct choice.
**Q788 — A** · 150 nm exceeds a 120 nm limit, and the image is invisible.

## Fluorescence microscopy · Q789–800

**Q789** · Easy · *codex, slides 398 to 399*

**What is the emission of visible light by substances illuminated with UV light called?**

1. Refraction
2. Dispersion
3. Fluorescence
4. Diffraction

**Q790** · Easy · *codex, slides 398 to 399*

**What are fluorescent dyes called?**

1. Chromatophores
2. Chromosomes
3. Fluorochromes
4. Pigment granules

**Q791** · Easy · *codex, slides 398 to 399*

**Which cell components can be naturally fluorescent?**

1. Cell walls and capsules
2. Ribosomes and plasmids
3. Chromosomes and nuclei
4. Lipid droplets and glycogen

**Q792** · Easy · *codex, slides 398 to 399*

**Which light is focused on the specimen in fluorescence microscopy?**

1. Infrared rays
2. Ultraviolet light rays
3. A beam of electrons
4. X-rays

**Q793** · Easy · *codex, slides 398 to 399*

**How can non-fluorescing structures be made to fluoresce?**

1. By heating them to high temperatures
2. By drying them completely in air
3. By fixing them with osmium tetroxide
4. By staining them with fluorochromes

**Q794** · Medium · *codex, slides 398 to 399*

**What kind of light do fluorescent substances emit?**

1. Infrared only
2. Visible light
3. Electrons
4. Sound

**Q795** · Medium · *codex, slides 398 to 399*

**In what way do naturally fluorescent components appear?**

1. Always black
2. In various colours
3. Always white
4. Invisible

**Q796** · Medium · *codex, slides 398 to 399*

**Why are fluorochromes used on structures that do not fluoresce naturally?**

1. They remove the need for UV light
2. They make those structures glow under UV
3. They block UV from the specimen
4. They convert UV into electrons

**Q797** · Medium · *codex, slides 398 to 399*

**Which type of radiation excites the substances in fluorescence microscopy?**

1. Visible green light only
2. Infrared
3. Radio waves
4. Ultraviolet

**Q798** · Medium · *codex, slides 398 to 399*

**Which statement about fluorescence is correct?**

1. All substances emit visible light under any light
2. Only stained structures ever fluoresce
3. Fluorescence needs electron beams
4. Some substances emit visible light under UV

**Q799** · Hard · *codex, slides 398 to 399*

**Why does a fluorescent stain make a structure visible?**

1. It reflects all white light equally
2. It absorbs UV light and re-emits visible light
3. It blocks visible light from the background
4. It increases the refractive index of the medium

**Q800** · Hard · *codex, slides 398 to 399*

**All of the following are true of fluorescence microscopy EXCEPT which one?**

1. UV rays are focused on the specimen
2. Some components fluoresce naturally
3. It uses a beam of electrons to illuminate the specimen
4. Non-fluorescing structures can be stained with fluorochromes

### Answers — Fluorescence microscopy · Q789–800

**Q789 — C** · The effect is called fluorescence.
**Q790 — C** · Fluorescent dyes are fluorochromes.
**Q791 — C** · Chromosomes and nuclei can fluoresce naturally.
**Q792 — B** · UV rays are focused on the specimen.
**Q793 — D** · They are stained with fluorescent dyes.
**Q794 — B** · They emit visible light.
**Q795 — B** · They appear in various colours.
**Q796 — B** · The dye makes them fluoresce.
**Q797 — D** · UV excites the substances.
**Q798 — D** · This is the definition given.
**Q799 — B** · The stain converts UV into visible emission.
**Q800 — C** · Correct choice.

# Module 5 — Principles of fluorescence → Cell lysis and homogenisation

slides 401 to 500 · 200 questions · 15 sections · bank: BIOL151_Question_Bank_Slides401-500.docx
Difficulty: 79 Easy · 80 Medium · 33 Hard · 8 Devil

## Principles of fluorescence · Q801–812

**Q801** · Easy · *codex, slides 401 to 407*

**What rises to a higher energy level when a fluorescent molecule absorbs light?**

1. A proton in the atomic nucleus
2. An electron in a given orbital
3. A whole chromosome of the cell
4. A hydrogen bond in the water

**Q802** · Easy · *codex, slides 401 to 407*

**How does the excitation wavelength compare with the emission wavelength?**

1. It is longer
2. It is the same
3. It is shorter
4. It is zero

**Q803** · Easy · *codex, slides 401 to 407*

**How does the energy of the emitted light compare with the excitation light?**

1. It is more
2. It is less
3. It is the same
4. It is infinite

**Q804** · Easy · *codex, slides 401 to 407*

**Which fluorescent dye is shown with its excitation and emission spectra?**

1. Eosin
2. Fluorescein
3. Hematoxylin
4. Crystal violet

**Q805** · Easy · *codex, slides 401 to 407*

**What state is an electron in right after it absorbs the light?**

1. An unstable excited state
2. The ground state
3. A stable permanent state in this case
4. A bonded state

**Q806** · Medium · *codex, slides 401 to 407*

**What happens to electrons in the excited state?**

1. They stay excited and never release energy
2. They leave the atom and form a beam
3. They turn into protons inside the nucleus
4. They return to the ground state, giving off light

**Q807** · Medium · *codex, slides 401 to 407*

**What is the release of energy as light from excited electrons called?**

1. Refraction
2. Diffraction in practice
3. Fluorescence
4. Dispersion

**Q808** · Medium · *codex, slides 401 to 407*

**Fluorescent molecules absorb light at one wavelength and emit it at what?**

1. A shorter wavelength
2. The same wavelength
3. A longer wavelength
4. No wavelength

**Q809** · Medium · *codex, slides 401 to 407*

**Which transition in the electron's energy produces the emitted light?**

1. Rise from the ground state to the excited state
2. Loss of the electron from the atom
3. Splitting of the atomic nucleus
4. Return from the excited to the ground state

**Q810** · Medium · *codex, slides 401 to 407*

**Why is the emitted light of lower energy than the absorbed light?**

1. The molecule absorbs extra energy from the lamp
2. The wavelength gets shorter
3. Some energy is released as heat
4. The dye converts it to electrons

**Q811** · Hard · *codex, slides 401 to 407*

**Which statement about wavelengths in fluorescence is correct?**

1. Emission wavelength is shorter than excitation wavelength
2. Emission wavelength is longer than excitation wavelength
3. Both wavelengths are always exactly equal
4. Emission wavelength is close to zero

**Q812** · Hard · *codex, slides 401 to 407*

**All of the following are true of fluorescence EXCEPT which one?**

1. Electrons rise to a higher energy level
2. Excited electrons return to the ground state
3. Energy is released as light and heat
4. Emitted light has a shorter wavelength

### Answers — Principles of fluorescence · Q801–812

**Q801 — B** · The absorbed energy raises an electron to a higher energy level.
**Q802 — C** · Excitation uses the shorter wavelength.
**Q803 — B** · Emission has a longer wavelength and less energy.
**Q804 — B** · The spectra of fluorescein are shown.
**Q805 — A** · The excited state is unstable.
**Q806 — D** · This release produces fluorescence.
**Q807 — C** · The emission of energy is fluorescence.
**Q808 — C** · Emission is at a longer wavelength.
**Q809 — D** · This return releases the light.
**Q810 — C** · Energy is lost as light and heat.
**Q811 — B** · Emission is at a longer wavelength.
**Q812 — D** · Correct choice.

## Fluorescence microscopy in use · Q813–820

**Q813** · Easy · *codex, slides 403, 404, 406*

**One of the most popular uses of fluorescence microscopy involves preparing what?**

1. Slides coated in paraffin wax
2. Cut sections of epoxy resin
3. Glass slides with copper grids in this case
4. Antibodies for specific proteins

**Q814** · Easy · *codex, slides 403, 404, 406*

**Which fluorescent dye is complexed with the antibody in the lecture's example?**

1. Eosin
2. Nigrosin
3. Fluorescein
4. Safranin

**Q815** · Easy · *codex, slides 403, 404, 406*

**What is fluorescence microscopy used to detect within a cell?**

1. Only the cell wall of the cell
2. Only the temperature inside it
3. Only the pH of the cytoplasm
4. Structures, molecules or proteins

**Q816** · Medium · *codex, slides 403, 404, 406*

**How is the dye illuminated in fluorescence microscopy?**

1. With unfiltered white light only
2. With a focused beam of electrons
3. With filtered light at the dye's peak
4. With high frequency sound waves

**Q817** · Medium · *codex, slides 403, 404, 406*

**What does the filter before the eyepiece allow through?**

1. Only the emitted wavelength
2. Only the excitation wavelength
3. All wavelengths equally
4. No light at all

**Q818** · Medium · *codex, slides 403, 404, 406*

**Why does the dye glow brightly against a dark background?**

1. The slide is stained completely black in practice
2. Only emitted light reaches the eyepiece
3. The condenser blocks all light
4. The lamp is switched off

**Q819** · Hard · *codex, slides 403, 404, 406*

**After a fluorescein-labelled antibody is applied, which structures fluoresce?**

1. All of the structures equally
2. Only the cell wall of the cell
3. Only the stain-free background
4. Those containing the specific protein

**Q820** · Devil · *codex, slides 403, 404, 406*

**A lab wants to show where one protein sits in cells. Which sequence of steps is correct?**

1. Stain with eosin, fix in paraffin, then image with electrons
2. Add DNase, sonicate, then spin in a centrifuge
3. Label an antibody with fluorescein, apply it, then image
4. Freeze the cells, thaw them, then image with a loupe

### Answers — Fluorescence microscopy in use · Q813–820

**Q813 — D** · Antibodies are prepared to bind specific proteins.
**Q814 — C** · The antibodies are complexed with fluorescein.
**Q815 — D** · It detects structures, molecules or proteins.
**Q816 — C** · Filtered light at the absorbing wavelength is used.
**Q817 — A** · Only the emitted wavelength is seen.
**Q818 — B** · Background excitation light is filtered out.
**Q819 — D** · Only structures with the protein bind the antibody.
**Q820 — C** · This is the described method.

## Optics of the fluorescence microscope · Q821–830

**Q821** · Easy · *codex, slides 410 to 414*

**A fluorescence microscope is basically which kind of microscope with added features?**

1. A transmission electron microscope
2. A scanning electron microscope
3. A conventional light microscope
4. A dissecting microscope

**Q822** · Easy · *codex, slides 410 to 414*

**Which component separates the excitation and emission light paths?**

1. The eyepiece
2. The dichroic mirror
3. The diaphragm
4. The nosepiece

**Q823** · Easy · *codex, slides 410 to 414*

**Which lens performs two functions in a fluorescence microscope?**

1. The objective lens
2. The eyepiece lens
3. The condenser lens
4. The field lens

**Q824** · Easy · *codex, slides 410 to 414*

**What is the configuration called in which excitation and emission both travel through the objective?**

1. Epifluorescence
2. Transillumination
3. Dark-field
4. Phase contrast

**Q825** · Medium · *codex, slides 410 to 414*

**What is the first function of the objective in a fluorescence microscope?**

1. To collect electrons from the sample
2. To stain the specimen with dye
3. To focus the excitation light
4. To cool the lamp housing down

**Q826** · Medium · *codex, slides 410 to 414*

**What is the second function of the objective in a fluorescence microscope?**

1. To filter out all of the light
2. To collect the emitted fluorescence
3. To rotate the slide slowly
4. To heat the specimen gently

**Q827** · Medium · *codex, slides 410 to 414*

**Why must excitation light be focused more strongly than by a simple condenser?**

1. To make the image much bigger
2. To shorten the light wavelength as a rule
3. To excite the fluorescent species
4. To cool the sample slightly

**Q828** · Medium · *codex, slides 410 to 414*

**Within the objective, what do the excitation and emission light share?**

1. The same optics
2. Separate lenses
3. A dichroic mirror only
4. A beam of electrons

**Q829** · Hard · *codex, slides 410 to 414*

**Why must the elements that separate excitation from emission be very efficient?**

1. To limit the background light
2. To raise the NA of the objective
3. To shorten the working distance
4. To reduce the refractive index

**Q830** · Hard · *codex, slides 410 to 414*

**Which statement describes the key to epifluorescence optics?**

1. Using a longer working distance
2. Separating excitation from emission
3. Staining the whole slide black
4. Increasing the magnification used at that stage

### Answers — Optics of the fluorescence microscope · Q821–830

**Q821 — C** · It is a conventional light microscope with added components.
**Q822 — B** · A dichroic mirror separates the paths.
**Q823 — A** · The objective focuses excitation and collects emission.
**Q824 — A** · This configuration is epifluorescence.
**Q825 — C** · It focuses the excitation light.
**Q826 — B** · It collects the emitted fluorescence.
**Q827 — C** · Strong focus excites the species.
**Q828 — A** · They share the same optics.
**Q829 — A** · Efficient separation reduces background.
**Q830 — B** · This is the key to the optics.

## Electron microscopy: principles · Q831–842

**Q831** · Easy · *codex, slides 416 to 423*

**What dual nature do electrons have?**

1. Only particle-like behaviour
2. Only wave-like behaviour
3. Neither of the two behaviours
4. Both particle-like and wave-like

**Q832** · Easy · *codex, slides 416 to 423*

**The wavelength of an electron depends on what?**

1. The colour of the lamp
2. The speed at which it is moving
3. The size of the specimen
4. The thickness of the slide

**Q833** · Easy · *codex, slides 416 to 423*

**What are the two types of electron microscope?**

1. Simple and compound
2. Bright-field and dark-field
3. Transmission and scanning
4. Phase and fluorescence

**Q834** · Easy · *codex, slides 416 to 423*

**What is the apparent wavelength of electrons at 60 kV?**

1. 5 nm
2. 0.5 nm in this case
3. 0.005 nm
4. 560 nm

**Q835** · Easy · *codex, slides 416 to 423*

**What replaces the light source in an electron microscope?**

1. A source of electrons
2. A tungsten lamp
3. A mercury arc lamp source
4. A quartz lens

**Q836** · Medium · *codex, slides 416 to 423*

**Which equation approximates the wavelength of electrons?**

1. $\lambda = 0.61\ NA / r$
2. $\lambda = n \sin \mu$
3. $\lambda = \sqrt{(1.5/V)}$ nm
4. $\lambda = 1.5\ V$ nm

**Q837** · Medium · *codex, slides 416 to 423*

**Why is the theoretical resolving power of electron microscopy not realised?**

1. Electrons have no real wavelength as a rule
2. The beam cannot be focused at all
3. Contrast and lens defects limit it
4. The vacuum absorbs all electrons

**Q838** · Medium · *codex, slides 416 to 423*

**Using λ = √(1.5/V) nm, what is the approximate wavelength at 100,000 V?**

1. About 0.4 nm
2. About 0.004 nm
3. About 0.04 nm at that stage
4. About 4 nm

**Q839** · Medium · *codex, slides 416 to 423*

**What replaces the glass lenses of a light microscope in an electron microscope?**

1. Magnetic lenses
2. Quartz lenses
3. Plastic lenses in this case
4. Glass prisms

**Q840** · Medium · *codex, slides 416 to 423*

**What replaces the eyepiece in the scanning electron microscope design?**

1. A fluorescent mercury lamp
2. A condenser lens
3. A glass slide
4. A cathode ray tube

**Q841** · Hard · *codex, slides 416 to 423*

**Why can electron microscopy in principle resolve far finer detail than light microscopy?**

1. The electron beam is brighter than a lamp
2. Electron wavelength is much shorter than light
3. Electrons have a larger NA than glass
4. Electron lenses are made of glass

**Q842** · Hard · *codex, slides 416 to 423*

**How many times shorter is a 0.005 nm electron wavelength than 560 nm green light?**

1. About 1,120 times
2. About 112,000 times
3. About 11,200 times
4. About 1,120,000 times

### Answers — Electron microscopy: principles · Q831–842

**Q831 — D** · Electrons are both particulate and wave-like.
**Q832 — B** · Wavelength depends on the electron's speed.
**Q833 — C** · TEM and SEM are the two types.
**Q834 — C** · At 60 kV the wavelength is 0.005 nm.
**Q835 — A** · A source of electrons replaces the light source.
**Q836 — C** · This is the equation in the lecture.
**Q837 — C** · These are the limits stated.
**Q838 — B** · √(1.5/100,000) is about 0.0039 nm.
**Q839 — A** · Magnetic lenses focus the electron beam.
**Q840 — D** · The SEM uses a cathode ray tube.
**Q841 — B** · Shorter wavelength gives better resolution.
**Q842 — B** · 560 divided by 0.005 is 112,000.

## Transmission electron microscopy · Q843–858

**Q843** · Easy · *codex, slides 424 to 429*

**What produces the electron ray in a TEM?**

1. A tungsten halogen lamp bulb
2. A mercury arc lamp source
3. A heated pin-shaped cathode
4. A fluorescent screen coating

**Q844** · Easy · *codex, slides 424 to 429*

**What acceleration voltage range is typical for a TEM?**

1. 5 to 15 V
2. 500 to 1500 kV
3. 50 to 150 kV
4. 1 to 5 kV

**Q845** · Easy · *codex, slides 424 to 429*

**Which kind of section does the TEM beam pass through?**

1. A thick block of wax
2. An ultrathin prepared section
3. A living culture dish
4. A whole insect

**Q846** · Easy · *codex, slides 424 to 429*

**What do the lens systems of an electron microscope consist of?**

1. Electromagnetic coils
2. Polished quartz glass discs
3. Plastic domes and rings
4. Glass spheres in a tube

**Q847** · Easy · *codex, slides 424 to 429*

**On what is the TEM image made visible?**

1. A glass eyepiece only
2. A sheet of wax
3. A paraffin block
4. A fluorescent screen or film

**Q848** · Easy · *codex, slides 424 to 429*

**Biological objects give weak contrast in TEM because they consist mainly of what?**

1. Heavy metals such as gold
2. Low atomic number elements
3. Elements with high atomic numbers
4. Radioactive isotopes of carbon

**Q849** · Medium · *codex, slides 424 to 429*

**What does the degree of electron deflection depend on?**

1. The object's electron density
2. The colour of the object
3. The temperature of the lamp in practice
4. The thickness of the slide

**Q850** · Medium · *codex, slides 424 to 429*

**Which atoms deflect electrons more?**

1. Atoms of smaller mass
2. Atoms of any mass equally
3. Only hydrogen atoms
4. Atoms of greater mass

**Q851** · Medium · *codex, slides 424 to 429*

**What does the projective lens do in a TEM?**

1. It enlarges the objective's image
2. It stains the specimen slightly as a rule
3. It controls the lamp output
4. It cuts the section thinly

**Q852** · Medium · *codex, slides 424 to 429*

**What power of resolution do modern TEMs reach?**

1. 20 to 30 nm at that stage
2. 0.2 to 0.3 nm
3. 2 to 3 nm
4. 240 nm

**Q853** · Medium · *codex, slides 424 to 429*

**What usually restrains the power of resolution of electron microscopy?**

1. The wavelength of the electrons only
2. The colour of the stain
3. The age of the microscope
4. Lens quality and preparation

**Q854** · Medium · *codex, slides 424 to 429*

**The useful resolution of TEM corresponds to about what magnification?**

1. About 3,000×
2. About 30,000,000×
3. About 300×
4. About 300,000×

**Q855** · Hard · *codex, slides 424 to 429*

**Raising the acceleration voltage shortens the electron waves. Why is this hardly ever limiting?**

1. Electrons cannot be accelerated above 50 kV
2. Shorter waves would reduce resolution
3. Lens quality and preparation limit it first
4. The anode absorbs all the electrons

**Q856** · Hard · *codex, slides 424 to 429*

**All of the following are true of the TEM EXCEPT which one?**

1. The beam passes through an ultrathin section
2. Electrons are deflected according to electron density
3. The beam is scanned across the surface of a solid specimen
4. The image is formed on a fluorescent screen

**Q857** · Hard · *codex, slides 424 to 429*

**An unstained biological section gives a faint, low-contrast TEM image. Why?**

1. Its high atomic number elements absorb all electrons
2. The section is too thin to scatter any electrons
3. The anode is far too cold to work
4. Its low atomic numbers deflect electrons weakly

**Q858** · Devil · *codex, slides 424 to 429*

**Which order correctly follows the electrons through a TEM?**

1. Electron gun, condenser, specimen, objective, projective lens, screen
2. Screen, projective lens, objective, specimen, condenser, gun
3. Gun, objective, specimen, condenser, screen, projective lens
4. Condenser, gun, specimen, projective lens, objective, screen

### Answers — Transmission electron microscopy · Q843–858

**Q843 — C** · A heated pin-shaped cathode produces the electron ray.
**Q844 — C** · TEM voltages are 50 to 150 kV.
**Q845 — B** · The beam passes through an ultrathin section.
**Q846 — A** · Coils generate the field.
**Q847 — D** · The image is shown on a screen or film.
**Q848 — B** · These deflect electrons weakly.
**Q849 — A** · Deflection depends on electron density.
**Q850 — D** · The greater the mass, the greater the deflection.
**Q851 — A** · The projective system enlarges the image.
**Q852 — B** · Modern gadgets reach 0.2 to 0.3 nm.
**Q853 — D** · These restrain it more than voltage.
**Q854 — D** · Useful resolution is around 300,000×.
**Q855 — C** · These factors usually restrain resolution.
**Q856 — C** · Correct choice.
**Q857 — D** · C, H, N and O give weak contrast.
**Q858 — A** · This is the path of the beam.

## Scanning electron microscopy · Q859–874

**Q859** · Easy · *codex, slides 432 to 434*

**What is the SEM used to look at?**

1. The surface of a solid specimen
2. The inside of an ultrathin section
3. Living cells in water
4. The colour of a dye

**Q860** · Easy · *codex, slides 432 to 434*

**Up to what magnification can an SEM reach, according to the lecture?**

1. 100,000×
2. 1,000×
3. 10,000,000×
4. 30×

**Q861** · Easy · *codex, slides 432 to 434*

**What does the large depth of field in SEM produce?**

1. Attractive 3D-looking images
2. Flat two-dimensional images only
3. Coloured images
4. Dark blank images

**Q862** · Easy · *codex, slides 432 to 434*

**What does the SEM use instead of light to form an image?**

1. Electrons
2. Ultraviolet rays
3. Sound waves
4. X-rays

**Q863** · Easy · *codex, slides 432 to 434*

**About what magnification does conventional light microscopy reach, according to the lecture?**

1. About 20×
2. About 2,000×
3. About 200,000×
4. About 20,000×

**Q864** · Easy · *codex, slides 432 to 434*

**What does the SEM image of pollen show?**

1. A flat stained thin section
2. A very attractive 3D-looking image
3. A set of green fluorescent dots
4. A blank dark field of view

**Q865** · Medium · *codex, slides 432 to 434*

**What is the usual resolution of the SEM in the lecture?**

1. About 0.2 nm
2. About 10 nm
3. About 240 nm
4. About 10 µm

**Q866** · Medium · *codex, slides 432 to 434*

**At what magnification is the 10 nm resolution quoted?**

1. 20,000×
2. 2,000×
3. 200×
4. 200,000×

**Q867** · Medium · *codex, slides 432 to 434*

**What does a large field of focus allow in SEM?**

1. Only a tiny spot to be in focus
2. The whole sample to be stained
3. Much of the sample in focus at once
4. The beam to be turned off at once in this case

**Q868** · Medium · *codex, slides 432 to 434*

**Why can SEM reveal details that light microscopy cannot resolve?**

1. Electrons have a much shorter wavelength
2. Electrons are heavier than light
3. The SEM uses a much larger lamp
4. The SEM uses much thicker sections

**Q869** · Medium · *codex, slides 432 to 434*

**Why is the SEM one of the most heavily used instruments in research?**

1. It is cheap, portable and simple to run
2. It needs no vacuum in its column at all
3. It shows living cells in true colour
4. It combines magnification, depth and resolution

**Q870** · Medium · *codex, slides 432 to 434*

**What happens to complex three-dimensional objects in an SEM?**

1. They remain sharp and in focus
2. They appear flat
3. They are destroyed instantly in practice
4. They are turned inside out

**Q871** · Hard · *codex, slides 432 to 434*

**Which is a stated advantage of the SEM over the light microscope?**

1. A greater depth of field
2. A longer wavelength of illumination
3. A glass lens system
4. A lower magnification limit

**Q872** · Hard · *codex, slides 432 to 434*

**All of the following are advantages of the SEM over the light microscope EXCEPT which one?**

1. It has a larger depth of field
2. It views living specimens in water
3. It reaches higher magnification
4. It resolves finer detail

**Q873** · Hard · *codex, slides 432 to 434*

**Which statement correctly contrasts TEM and SEM?**

1. TEM images ultrathin sections, SEM images solid surfaces
2. TEM images solid surfaces, whereas SEM images ultrathin sections
3. Both image living cells in a water drop
4. Both use glass lenses and a bright lamp

**Q874** · Devil · *codex, slides 432 to 434*

**The SEM reaches 100,000× and the light microscope about 2,000×. How many times greater is the SEM limit?**

1. 5 times
2. 500 times
3. 50 times
4. 200 times

### Answers — Scanning electron microscopy · Q859–874

**Q859 — A** · The SEM looks at the surface of a solid specimen.
**Q860 — A** · SEM magnifications reach up to 100,000×.
**Q861 — A** · It gives three-dimensional-looking images.
**Q862 — A** · The SEM uses electrons.
**Q863 — B** · It reaches about 2,000×.
**Q864 — B** · The image looks three-dimensional.
**Q865 — B** · The resolution is usually about 10 nm.
**Q866 — A** · It is quoted with 20,000× magnification.
**Q867 — C** · Much of the sample is sharp together.
**Q868 — A** · Shorter wavelength improves resolution.
**Q869 — D** · These advantages are listed.
**Q870 — A** · The depth of field keeps them in focus.
**Q871 — A** · SEM gives greater depth of field.
**Q872 — B** · Correct choice.
**Q873 — A** · These are their uses.
**Q874 — C** · 100,000 divided by 2,000 is 50.

## The magnetic lens system · Q875–882

**Q875** · Easy · *codex, slides 439 to 440*

**What does the condenser lens control in the electron microscope?**

1. The colour of the electrons
2. The thickness of the section
3. The intensity of the electron beam
4. The vacuum level in the column

**Q876** · Easy · *codex, slides 439 to 440*

**What do the scanning coils do?**

1. Heat the specimen to dryness
2. Cut thin sections of tissue
3. Stain the sample with dye
4. Deflect the beam in x and y

**Q877** · Easy · *codex, slides 439 to 440*

**What is the objective lens aperture used for?**

1. To add colour to the image
2. To cool the specimen down
3. To raise the voltage applied
4. To exclude scattered electrons

**Q878** · Medium · *codex, slides 439 to 440*

**What does the objective lens do to the electron beam?**

1. It stains the specimen slightly
2. It focuses it on the specimen
3. It deflects it in the x and y axes
4. It controls its intensity

**Q879** · Medium · *codex, slides 439 to 440*

**Where are the scanning coils found?**

1. Above the electron gun
2. Below the condenser lens
3. Inside the specimen
4. At the screen

**Q880** · Medium · *codex, slides 439 to 440*

**How does the beam move across the sample?**

1. As a single fixed spot of light
2. As a flood over the whole stage
3. As lines of dwell times across an area
4. As rotating rings of electrons

**Q881** · Hard · *codex, slides 439 to 440*

**Which parts form the magnetic lens system of the electron microscope?**

1. Eyepiece, stage, diaphragm and clip
2. Cathode, anode, screen and a coil
3. Glass slide, coverslip, oil and clip
4. Condenser lens, objective lens and coils

**Q882** · Hard · *codex, slides 439 to 440*

**All of the following are functions of the magnetic lens system EXCEPT which one?**

1. The condenser lens controls beam intensity
2. The objective lens focuses the beam on the specimen
3. The aperture excludes scattered electrons
4. The condenser lens deflects the beam in the x and y axes

### Answers — The magnetic lens system · Q875–882

**Q875 — C** · It controls the beam intensity.
**Q876 — D** · They deflect the beam in x and y.
**Q877 — D** · It excludes extraneous electrons.
**Q878 — B** · It focuses (de-magnifies) the beam on the specimen.
**Q879 — B** · They are below the condenser system.
**Q880 — C** · The beam spot moves in lines across the area.
**Q881 — D** · These are the parts listed.
**Q882 — D** · Correct choice.

## Light versus electron microscope · Q883–892

**Q883** · Easy · *codex, slides 442, 474*

**Air fills the interior of which instrument?**

1. The electron microscope
2. The scanning electron microscope
3. The transmission electron microscope
4. The light microscope

**Q884** · Easy · *codex, slides 442, 474*

**Which microscope uses glass lenses?**

1. The light microscope
2. The electron microscope
3. The TEM
4. The SEM

**Q885** · Easy · *codex, slides 442, 474*

**Which instrument works with its interior under vacuum?**

1. The light microscope
2. The dissecting microscope
3. The dark-field microscope
4. The electron microscope

**Q886** · Easy · *codex, slides 442, 474*

**Which microscope gives monochrome images?**

1. The electron microscope
2. The light microscope
3. The phase-contrast microscope
4. The stereo microscope

**Q887** · Medium · *codex, slides 442, 474*

**What are the maximum resolving powers of the light and electron microscopes?**

1. About 0.2 nm and 240 nm
2. About 24 nm and 2 nm
3. About 240 nm and 0.2 nm
4. About 2400 nm and 20 nm

**Q888** · Medium · *codex, slides 442, 474*

**What magnification range does the electron microscope offer?**

1. ×30 to ×1,500
2. ×3 to ×30
3. ×1,000 to ×1,500
4. ×300 to ×500,000

**Q889** · Medium · *codex, slides 442, 474*

**What radiation source does the electron microscope use?**

1. A quartz halogen lamp bulb
2. A mercury arc lamp source
3. A high-voltage tungsten source
4. A xenon flash tube lamp

**Q890** · Medium · *codex, slides 442, 474*

**How can specimens be prepared for the light microscope?**

1. Only as dehydrated dead tissue
2. Only as ultrathin resin sections
3. Only as deeply frozen blocks
4. As temporary mounts, living or dead

**Q891** · Hard · *codex, slides 442, 474*

**Which row correctly compares light and electron microscope preparation?**

1. Fixation: $OsO_4$ versus alcohol; embedding: resin versus wax
2. Fixation: none versus alcohol; embedding: wax versus gelatin
3. Fixation: alcohol versus $OsO_4$ or $KMnO_4$; embedding: wax versus resin
4. Fixation: alcohol versus alcohol; embedding: wax versus wax

**Q892** · Hard · *codex, slides 442, 474*

**All of the following distinguish the electron microscope from the light microscope EXCEPT which one?**

1. It uses a vacuum interior
2. It has a fluorescent screen for viewing
3. It uses a glass lens system
4. It has far greater resolving power

### Answers — Light versus electron microscope · Q883–892

**Q883 — D** · The light microscope is air-filled.
**Q884 — A** · It uses glass lenses.
**Q885 — D** · It operates under vacuum.
**Q886 — A** · Colours are not visible in EM.
**Q887 — C** · These are the maximum resolving powers.
**Q888 — D** · This is the stated range.
**Q889 — C** · It uses a high-voltage tungsten source.
**Q890 — D** · Living or dead specimens can be mounted.
**Q891 — C** · These are the stated differences.
**Q892 — C** · Correct choice.

## Fixation · Q893–906

**Q893** · Easy · *codex, slides 445 to 449*

**How many steps does fixation consist of?**

1. One
2. Three
3. Four
4. Two

**Q894** · Easy · *codex, slides 445 to 449*

**Which agent fixes tissue by freezing it very rapidly?**

1. Formaldehyde
2. Xylene
3. Paraffin wax
4. Liquid nitrogen

**Q895** · Easy · *codex, slides 445 to 449*

**What is the temperature of liquid nitrogen?**

1. −20 °C in practice
2. −196 °C
3. 0 °C
4. 37 °C

**Q896** · Easy · *codex, slides 445 to 449*

**Which chemicals fix proteins for electron microscopy?**

1. Osmium tetroxide and permanganate
2. Acetic acid and chromic acid
3. Xylene and ethanol
4. Formaldehyde and glutaraldehyde

**Q897** · Easy · *codex, slides 445 to 449*

**Which chemicals fix lipids for electron microscopy?**

1. Formaldehyde and glutaraldehyde
2. Osmium tetroxide and permanganate
3. Acetone, alcohol and acetic acid as a rule
4. Xylene, ethanol and paraffin wax

**Q898** · Medium · *codex, slides 445 to 449*

**What does fixation prevent in the tissue?**

1. Autolysis
2. Staining
3. Sectioning
4. Dehydration

**Q899** · Medium · *codex, slides 445 to 449*

**What else must tissue be protected from during fixation?**

1. Exposure to light
2. Contact with glass
3. Bacterial or fungal attack
4. Staining dyes

**Q900** · Medium · *codex, slides 445 to 449*

**Why does physical fixation freeze the tissue so rapidly?**

1. So that the tissue turns to paraffin
2. So that the stain sticks better
3. So disruptive ice crystals do not form
4. So that the tissue becomes transparent

**Q901** · Medium · *codex, slides 445 to 449*

**What happens to frozen tissue if it is brought to room temperature?**

1. It becomes permanently fixed
2. It rapidly undergoes autolysis
3. It turns into hard wax
4. It becomes stained blue

**Q902** · Medium · *codex, slides 445 to 449*

**What must be done to keep permanent preparations of frozen sections?**

1. They must be heated
2. They must be dried in air
3. They must be chemically fixed
4. They must be embedded in xylene

**Q903** · Medium · *codex, slides 445 to 449*

**Which components do chemical fixatives stabilise?**

1. Only water
2. Proteins and lipids
3. Only ions
4. Only dyes

**Q904** · Hard · *codex, slides 445 to 449*

**All of the following are fixatives used for light microscopy EXCEPT which one?**

1. Osmium tetroxide
2. Acetic acid
3. Mercuric chloride
4. Formaldehyde

**Q905** · Hard · *codex, slides 445 to 449*

**Which are fixatives used for electron microscopy? 1. Glutaraldehyde. 2. Osmium tetroxide. 3. Acetic acid. 4. Potassium permanganate.**

1. 1 and 2 only
2. 1, 2 and 4 only
3. 2, 3 and 4 only
4. 1, 3 and 4 only

**Q906** · Devil · *codex, slides 445 to 449*

**A researcher freezes tissue in liquid nitrogen and cuts frozen sections, but wants permanent slides for next year. What must be done?**

1. Leave them at room temperature, because freezing has fixed them permanently
2. Embed them in dry ice, because ice is a permanent fixative
3. Chemically fix the sections, because frozen tissue is fixed only while frozen
4. Soak them in xylene, because xylene is a fixative

### Answers — Fixation · Q893–906

**Q893 — D** · Fixation has two steps.
**Q894 — D** · Liquid nitrogen is a physical fixative.
**Q895 — B** · Liquid nitrogen is at −196 °C.
**Q896 — D** · They fix proteins.
**Q897 — B** · They fix lipids.
**Q898 — A** · Fixation prevents autolysis.
**Q899 — C** · Fixation protects against microbes.
**Q900 — C** · Rapid freezing avoids ice crystals.
**Q901 — B** · It is fixed only while frozen.
**Q902 — C** · Permanent preparations need chemical fixation.
**Q903 — B** · These are the major structural components.
**Q904 — A** · Correct choice.
**Q905 — B** · Glutaraldehyde, osmium tetroxide and potassium permanganate are used; acetic acid is a light microscopy fixative.
**Q906 — C** · Permanent preparations need chemical fixation.

## Embedding · Q907–924

**Q907** · Easy · *codex, slides 450 to 458*

**What is the most frequently used embedding matrix for light microscopy?**

1. Epoxy resin at that stage
2. Agar jelly
3. Gelatin
4. Paraffin wax

**Q908** · Easy · *codex, slides 450 to 458*

**Why must tissue be dehydrated before paraffin embedding?**

1. Paraffin is far too thick
2. Paraffin and water do not mix
3. Tissue is too transparent
4. Water is itself a stain

**Q909** · Easy · *codex, slides 450 to 458*

**Which clearing agent removes the ethanol?**

1. Xylene
2. Propylene oxide
3. Formaldehyde
4. Osmium tetroxide

**Q910** · Easy · *codex, slides 450 to 458*

**What is the typical thickness of paraffin sections for light microscopy?**

1. 5 nm
2. 50 µm
3. 5 µm
4. 5 mm

**Q911** · Easy · *codex, slides 450 to 458*

**Typical electron microscopy sections measure how thick?**

1. 5 µm
2. 80 to 100 nm
3. 80 to 100 µm
4. 8 to 10 nm

**Q912** · Easy · *codex, slides 450 to 458*

**Which materials are used to embed specimens for electron microscopy?**

1. Paraffin wax
2. Raw carrot
3. Agar plates
4. Epoxy or acrylic resins

**Q913** · Easy · *codex, slides 450 to 458*

**What does xylene replace during embedding?**

1. The paraffin
2. The ethanol
3. The fixative
4. The stain

**Q914** · Medium · *codex, slides 450 to 458*

**How is the tissue dehydrated before embedding?**

1. With a single pure water bath
2. With stronger and stronger ethanol
3. With dry heat in an oven only
4. With acetone vapour in a jar only in this case

**Q915** · Medium · *codex, slides 450 to 458*

**What replaces the xylene in the sample?**

1. Molten paraffin wax
2. Propylene oxide
3. Absolute ethanol
4. Liquid nitrogen

**Q916** · Medium · *codex, slides 450 to 458*

**Which solvent replaces xylene in epoxy resin embedding?**

1. Propylene oxide
2. Ethanol
3. Acetic acid
4. Formaldehyde

**Q917** · Medium · *codex, slides 450 to 458*

**How is the resin-impregnated specimen polymerised?**

1. By baking it in an oven
2. By freezing it in liquid nitrogen
3. By soaking it in xylene
4. By staining it with eosin

**Q918** · Medium · *codex, slides 450 to 458*

**Why does too thick a section give a poor electron micrograph?**

1. Electrons pass through without any scatter
2. The section turns into wax
3. Electrons scatter, giving poor contrast
4. The vacuum absorbs the beam

**Q919** · Medium · *codex, slides 450 to 458*

**What are raw carrot and unripe pawpaw used for?**

1. Staining thin animal sections
2. Supporting thick plant sections
3. Fixing tissue in the cold
4. Cutting ultrathin resin sections

**Q920** · Medium · *codex, slides 450 to 458*

**Why are samples embedded in a matrix?**

1. To solidify them for fine sectioning
2. To make them strongly magnetic
3. To dissolve them in warm water
4. To turn them into resin only

**Q921** · Hard · *codex, slides 450 to 458*

**Which sequence is correct for preparing a paraffin section?**

1. Clearing, fixation, dehydration, then infiltration
2. Fixation, dehydration, clearing, then infiltration with wax
3. Infiltration, clearing, dehydration, then fixation
4. Dehydration, infiltration, fixation, then clearing

**Q922** · Hard · *codex, slides 450 to 458*

**Why is paraffin unsuitable for electron microscopy sections?**

1. It is far too expensive to use
2. It is too transparent to electrons
3. It dissolves in the epoxy resin
4. It is not hard enough for 80 nm slices

**Q923** · Hard · *codex, slides 450 to 458*

**All of the following are used in the embedding procedure for light microscopy EXCEPT which one?**

1. Ethanol
2. Propylene oxide
3. Xylene
4. Molten paraffin wax

**Q924** · Devil · *codex, slides 450 to 458*

**A light microscopy section is 5 µm thick and an electron microscopy section is 50 nm. How many times thicker is the light microscopy section?**

1. 10 times
2. 1,000 times
3. 100 times
4. 50 times

### Answers — Embedding · Q907–924

**Q907 — D** · Paraffin wax is the most frequently used matrix.
**Q908 — B** · Paraffin does not mix with water.
**Q909 — A** · Xylene is the usual clearing agent.
**Q910 — C** · Paraffin sections are typically 5 µm.
**Q911 — B** · EM sections are typically 80 to 100 nm.
**Q912 — D** · Resins provide a harder matrix.
**Q913 — B** · Xylene replaces the ethanol.
**Q914 — B** · Increasing ethanol concentrations are used.
**Q915 — A** · Molten paraffin infiltrates the sample.
**Q916 — A** · Propylene oxide is the resin solvent.
**Q917 — A** · The specimen is baked in an oven.
**Q918 — C** · Thick sections scatter all electrons.
**Q919 — B** · They sandwich thick plant specimens.
**Q920 — A** · Thin slices improve access and reduce overlay.
**Q921 — B** · This is the processing order.
**Q922 — D** · It does not provide a sufficiently hard matrix.
**Q923 — B** · Correct choice.
**Q924 — C** · 5,000 nm divided by 50 nm is 100.

## Sectioning · Q925–934

**Q925** · Easy · *codex, slides 459 to 460*

**Which instrument is used to cut thin sections?**

1. A microtome
2. A centrifuge
3. A homogenizer
4. A spectrophotometer

**Q926** · Easy · *codex, slides 459 to 460*

**Which cutting edge is used for wax-embedded specimens?**

1. A steel razor
2. A diamond knife
3. A glass knife
4. A laser blade

**Q927** · Easy · *codex, slides 459 to 460*

**Which cutting edges are used for araldite-embedded specimens?**

1. Steel razors
2. Glass or diamond knives
3. Plastic blades
4. Wooden blades

**Q928** · Easy · *codex, slides 459 to 460*

**What supports sections for electron microscopy?**

1. A grid of fine copper strands
2. A glass slide
3. A wax block
4. A cover glass only

**Q929** · Medium · *codex, slides 459 to 460*

**Which three parts does every microtome have?**

1. A lamp, a lens, a stage and a clip
2. Holder, cutting edge and thickness regulator
3. A gun, an anode, a screen and a coil
4. A pestle, a tube, a piston and a seal

**Q930** · Medium · *codex, slides 459 to 460*

**At what temperature is a freezing microtome maintained?**

1. −20 °C
2. −196 °C
3. 0 °C
4. 37 °C

**Q931** · Medium · *codex, slides 459 to 460*

**Light microscopy sections lie within what thickness range?**

1. 50 to 100 nm
2. 10 to 20 nm
3. 1 to 2 mm
4. 1000 to 20,000 nm

**Q932** · Medium · *codex, slides 459 to 460*

**How thin are sections cut for electron microscopy?**

1. 1000 to 20,000 nm
2. 5 to 10 nm
3. 50 to 100 nm
4. 5 to 10 µm

**Q933** · Hard · *codex, slides 459 to 460*

**Which pairing of embedding medium and cutting edge is correct?**

1. Wax: steel razor; araldite: glass or diamond
2. Wax: diamond knife; araldite: steel razor
3. Wax: glass knife; araldite: plastic knife
4. Wax and araldite both: a steel razor

**Q934** · Hard · *codex, slides 459 to 460*

**All of the following are used to mount sections EXCEPT which one?**

1. A glass slide
2. A paraffin block
3. A copper grid
4. A grid of fine copper strands

### Answers — Sectioning · Q925–934

**Q925 — A** · A microtome cuts sections.
**Q926 — A** · A steel razor cuts wax-embedded specimens.
**Q927 — B** · Glass or diamond knives cut araldite.
**Q928 — A** · Sections are mounted on copper grids.
**Q929 — B** · These are the parts of all microtomes.
**Q930 — A** · Frozen specimens are cut at −20 °C.
**Q931 — D** · Light microscopy sections are 1000 to 20,000 nm.
**Q932 — C** · EM sections are 50 to 100 nm.
**Q933 — A** · These pairings are given.
**Q934 — B** · Correct choice.

## Staining for light microscopy · Q935–954

**Q935** · Easy · *codex, slides 463 to 467, 470*

**Why must thin sections usually be stained before examination?**

1. They are too thick to stain
2. They are too dry to cut
3. They are too small to see
4. They are nearly transparent

**Q936** · Easy · *codex, slides 463 to 467, 470*

**Dyes with a negative charge are called what?**

1. Basic dyes
2. Neutral dyes
3. Fixative dyes
4. Acidic dyes

**Q937** · Easy · *codex, slides 463 to 467, 470*

**Which group of dyes carries a positive charge?**

1. Acidic dyes
2. Neutral dyes
3. Fixative dyes
4. Basic dyes

**Q938** · Easy · *codex, slides 463 to 467, 470*

**Which of these is an acidic dye?**

1. Eosin
2. Crystal violet
3. Methylene blue
4. Safranin

**Q939** · Easy · *codex, slides 463 to 467, 470*

**Which of these is a basic dye?**

1. Crystal violet
2. Eosin
3. Nigrosine
4. India ink

**Q940** · Easy · *codex, slides 463 to 467, 470*

**Which stain colours cell nuclei blue in H&E?**

1. Eosin
2. Giemsa
3. Safranin
4. Hematoxylin

**Q941** · Easy · *codex, slides 463 to 467, 470*

**What colour does eosin give the cytoplasm?**

1. Red or shades of pink
2. Blue
3. Green
4. Yellow

**Q942** · Easy · *codex, slides 463 to 467, 470*

**Giemsa stain is which kind of dye?**

1. An acidic dye
2. A basic dye
3. A fluorescent dye
4. A neutral dye

**Q943** · Medium · *codex, slides 463 to 467, 470*

**Why are basic dyes most commonly used in bacteriology?**

1. Bacterial cells are positively charged
2. Bacterial cells are electrically neutral in practice
3. Basic dyes are cheaper to buy
4. Bacterial surfaces are negatively charged

**Q944** · Medium · *codex, slides 463 to 467, 470*

**What do acidic dyes bind to?**

1. Positively charged proteins
2. Negatively charged nucleic acids
3. Only to lipids in the membrane
4. Only to water in the cell

**Q945** · Medium · *codex, slides 463 to 467, 470*

**What does hematoxylin react with primarily?**

1. Negatively charged nucleic acids
2. Positively charged membrane lipids
3. Neutral sugars in the cytoplasm
4. Free water in the cytoplasm

**Q946** · Medium · *codex, slides 463 to 467, 470*

**What does eosin react with largely?**

1. Nucleic acids in the nucleus
2. Cell wall cellulose fibres
3. Lipid droplets in the cytoplasm only as a rule
4. Basic groups present in the cytoplasm

**Q947** · Medium · *codex, slides 463 to 467, 470*

**Where did most commonly used light microscopy stains originate?**

1. Aromatic dyes made for textiles
2. Mineral dyes from ground rocks
3. Dyes made for electron microscopy
4. Plant pigments from leaves only

**Q948** · Medium · *codex, slides 463 to 467, 470*

**What are acidic dyes used for in the microbiology laboratory?**

1. Staining nucleic acids in the nucleus
2. Background staining (capsules)
3. Fixing bacteria to the slide
4. Embedding tissue in the wax

**Q949** · Medium · *codex, slides 463 to 467, 470*

**What do neutral dyes stain?**

1. Nucleic acids and cytoplasm
2. Only lipids
3. Only cell walls
4. Only the nucleolus

**Q950** · Medium · *codex, slides 463 to 467, 470*

**Which stains are routine for most animal tissues?**

1. Crystal violet and safranin
2. Giemsa and methylene blue
3. India ink and nigrosine
4. Hematoxylin and eosin (H&E)

**Q951** · Hard · *codex, slides 463 to 467, 470*

**Which dye is NOT a basic dye?**

1. Crystal violet
2. Methylene blue
3. Eosin
4. Safranin

**Q952** · Hard · *codex, slides 463 to 467, 470*

**Which statements about staining are correct? 1. Hematoxylin stains nuclei blue. 2. Eosin colours cytoplasm pink. 3. Acidic dyes are positively charged. 4. Basic dyes bind negatively charged molecules.**

1. 1 and 2 only
2. 2, 3 and 4 only
3. 1, 2 and 4 only
4. 1, 3 and 4 only

**Q953** · Hard · *codex, slides 463 to 467, 470*

**Why is H&E used as a starting point in histopathology?**

1. It is the only dye that works on tissue
2. It makes all cells fluoresce brightly
3. It gives essential structural information
4. It fixes the tissue at the same time

**Q954** · Devil · *codex, slides 463 to 467, 470*

**A pathologist sees blue nuclei and pink cytoplasm in a skin section. Which dyes and which binding logic fit?**

1. Eosin binds nucleic acids, and hematoxylin binds basic cytoplasmic groups
2. Hematoxylin binds nucleic acids, and eosin binds cytoplasm
3. Both dyes bind only lipids and fats
4. Both dyes bind only cellulose fibres

### Answers — Staining for light microscopy · Q935–954

**Q935 — D** · Thin sections are almost transparent.
**Q936 — D** · Acidic dyes carry a negative charge.
**Q937 — D** · Basic dyes carry a positive charge.
**Q938 — A** · Eosin is an acidic dye.
**Q939 — A** · Crystal violet is a basic dye.
**Q940 — D** · Hematoxylin stains nuclei blue.
**Q941 — A** · Eosin stains cytoplasm red or pink.
**Q942 — D** · Giemsa is a neutral dye.
**Q943 — D** · Basic dyes bind negative charges.
**Q944 — A** · Acidic dyes bind positive structures.
**Q945 — A** · It reacts with nucleic acids in the nucleus.
**Q946 — D** · Eosin stains basic groups in the cytoplasm.
**Q947 — A** · They were first produced for textiles.
**Q948 — B** · They provide background staining.
**Q949 — A** · Neutral dyes stain both.
**Q950 — D** · H&E is the routine stain for most animal tissues.
**Q951 — C** · Correct choice.
**Q952 — C** · Statements 1, 2 and 4 are true; acidic dyes are negatively charged, so statement 3 is false.
**Q953 — C** · This is the stated reason.
**Q954 — B** · This matches the staining mechanism.

## Staining for electron microscopy · Q955–968

**Q955** · Easy · *codex, slides 471 to 473*

**What must stains impart to sections in electron microscopy instead of colour?**

1. Fluorescence
2. A pink tint
3. Contrast
4. Heat

**Q956** · Easy · *codex, slides 471 to 473*

**Which two elements are used as stains in electron microscopy?**

1. Lead and uranium
2. Carbon and hydrogen
3. Sodium and potassium
4. Oxygen and nitrogen

**Q957** · Easy · *codex, slides 471 to 473*

**Uranium binds preferentially to which molecules?**

1. Lipids and membranes
2. Water and ions
3. Nucleic acids and proteins
4. Cellulose

**Q958** · Easy · *codex, slides 471 to 473*

**Lead binds preferentially to which components?**

1. Nucleic acids and proteins
2. Water
3. Glycogen
4. Lipids and membranes

**Q959** · Easy · *codex, slides 471 to 473*

**Which stain imparts electron density to membranes and lipids?**

1. Eosin
2. Hematoxylin
3. Osmium
4. Xylene

**Q960** · Easy · *codex, slides 471 to 473*

**What kind of background does negative staining produce?**

1. A transparent background
2. A coloured background
3. A fluorescent background
4. An electron-dense background

**Q961** · Medium · *codex, slides 471 to 473*

**Why do unstained sections give faint, low-contrast images in EM?**

1. Electrons are all absorbed by the resin
2. The resin is completely opaque
3. Electrons pass through unstained tissue
4. The beam is switched off midway

**Q962** · Medium · *codex, slides 471 to 473*

**Why do lead and uranium increase contrast?**

1. They add colour to the final image
2. They cool the electron beam
3. High atomic number raises density
4. They shorten the wavelength

**Q963** · Medium · *codex, slides 471 to 473*

**The double staining of uranium and lead is to electron microscopy as which stain pair is to light microscopy?**

1. Crystal violet and safranin
2. Giemsa and eosin
3. Nigrosin and India ink
4. Hematoxylin and eosin

**Q964** · Medium · *codex, slides 471 to 473*

**Which are examples of negative stains?**

1. Hematoxylin, eosin, Giemsa and safranin
2. Phosphotungstate, uranyl acetate and molybdate
3. Osmium, lead, uranium and glutaraldehyde
4. Crystal violet, safranin and nigrosin

**Q965** · Medium · *codex, slides 471 to 473*

**How does the specimen appear in negative staining?**

1. Bright on a dark background
2. Dark on a bright background
3. Coloured on a white background
4. Invisible

**Q966** · Hard · *codex, slides 471 to 473*

**Which statement correctly pairs EM stains with their targets?**

1. Uranium: lipids; lead: nucleic acids; osmium: proteins at that stage
2. Uranium: nucleic acids; lead: lipids; osmium: membranes
3. Uranium: water; lead: sugars; osmium: salts
4. All three bind only cellulose and salts

**Q967** · Hard · *codex, slides 471 to 473*

**All of the following are true of positive staining in EM EXCEPT which one?**

1. It is used for isolated organelles and membranes
2. It is used for small particles such as viruses and ribosomes
3. Lipid-rich and nucleic acid-rich parts appear dark
4. It produces an electron-dense background

**Q968** · Devil · *codex, slides 471 to 473*

**Which statement correctly contrasts positive and negative staining?**

1. Positive staining darkens parts, negative gives a bright specimen
2. Positive staining gives a bright background, whereas negative staining darkens components
3. Both give a bright specimen on a bright background
4. Both add colour to the sections

### Answers — Staining for electron microscopy · Q955–968

**Q955 — C** · EM stains impart contrast.
**Q956 — A** · Pb and uranium are used.
**Q957 — C** · Uranium binds nucleic acids and proteins.
**Q958 — D** · Lead binds lipids and membranes.
**Q959 — C** · Osmium imparts electron density to membranes and lipids.
**Q960 — D** · The background is electron dense.
**Q961 — C** · Little contrast results.
**Q962 — C** · High atomic number increases electron density.
**Q963 — D** · This analogy is given in the lecture.
**Q964 — B** · These are listed negative stains.
**Q965 — A** · The specimen appears bright.
**Q966 — B** · These are the targets.
**Q967 — D** · Correct choice.
**Q968 — A** · These are the two effects.

## Cell fractionation · Q969–976

**Q969** · Easy · *codex, slides 475 to 477*

**What is the process of disrupting cells and separating their components called?**

1. Cell fixation
2. Cell embedding
3. Cell staining
4. Cell fractionation

**Q970** · Easy · *codex, slides 475 to 477*

**In what kind of medium are cells usually homogenised?**

1. Pure distilled water in this case
2. An iso-osmotic medium
3. Pure ethanol
4. Liquid nitrogen

**Q971** · Easy · *codex, slides 475 to 477*

**What is the first step in cell fractionation?**

1. Chromatography
2. Spectrophotometry
3. Autoradiography
4. Cell lysis

**Q972** · Medium · *codex, slides 475 to 477*

**Which three steps are listed before analysis?**

1. Fixation, embedding and staining
2. Sectioning, mounting and viewing
3. Lysis, homogenisation and separation
4. Freezing, thawing and drying out

**Q973** · Medium · *codex, slides 475 to 477*

**Which three techniques are listed for analysing the fractions?**

1. Fixation, embedding, sectioning and mounting
2. Spectrophotometry, autoradiography and chromatography
3. Sonication, lysis, blending, grinding and mixing
4. Staining, mounting, drying, sealing and labelling

**Q974** · Medium · *codex, slides 475 to 477*

**What is the product of homogenising cells called?**

1. A homogenate
2. A pellet
3. A section
4. A fixative

**Q975** · Medium · *codex, slides 475 to 477*

**What is the aim of separating cell fragments and organelles in the homogenate?**

1. To stain them all the same colour
2. To embed them in resin
3. To destroy them completely
4. To analyse each fragment

**Q976** · Hard · *codex, slides 475 to 477*

**Which sequence correctly describes cell fractionation followed by analysis?**

1. Lysis, homogenisation, separation, then analysis
2. Separation, lysis, homogenisation, then fixation and staining
3. Fixation, embedding, sectioning, then centrifugation
4. Analysis, lysis, separation, then homogenisation

### Answers — Cell fractionation · Q969–976

**Q969 — D** · This process is cell fractionation.
**Q970 — B** · An iso-osmotic medium is used.
**Q971 — D** · Cell lysis is the first step.
**Q972 — C** · These are the three steps listed.
**Q973 — B** · These are the analysis techniques.
**Q974 — A** · Homogenisation gives a homogenate.
**Q975 — D** · This allows each fragment to be studied.
**Q976 — A** · This is the sequence in the lecture.

## Cell lysis and homogenisation · Q977–1000

**Q977** · Easy · *codex, slides 485 to 499*

**Before proteins can be purified, which step must come first?**

1. Staining
2. Centrifugation
3. Cell lysis
4. Embedding

**Q978** · Easy · *codex, slides 485 to 499*

**Which two devices use rotating blades to grind tissue such as liver or muscle?**

1. The Dounce and the Potter-Elvehjem in practice
2. The French press and the sonicator
3. The Waring blender and the Polytron
4. The microtome and the centrifuge

**Q979** · Easy · *codex, slides 485 to 499*

**Which homogenizer has a round glass pestle driven into a glass tube?**

1. The Potter-Elvehjem
2. The French press
3. The Dounce homogenizer
4. The Polytron

**Q980** · Easy · *codex, slides 485 to 499*

**Which homogenizer has a Teflon pestle shaped to fit a rounded or conical vessel?**

1. The Dounce
2. The Potter-Elvehjem
3. The French press
4. The Waring blender as a rule

**Q981** · Easy · *codex, slides 485 to 499*

**Which device forces a sample through a tiny hole under high pressure?**

1. The French press
2. The Dounce
3. The Polytron
4. The sonicator

**Q982** · Easy · *codex, slides 485 to 499*

**What does sonication use to lyse cells?**

1. Rotating blades
2. A glass pestle
3. Liquid nitrogen
4. High frequency sound waves

**Q983** · Easy · *codex, slides 485 to 499*

**Which method is most common for disrupting plant cells?**

1. Sonication
2. Mortar and pestle grinding
3. The French press
4. Freeze and thaw

**Q984** · Easy · *codex, slides 485 to 499*

**In what is plant tissue frozen before grinding with a mortar and pestle?**

1. Distilled water
2. Pure ethanol
3. Paraffin wax
4. Liquid nitrogen

**Q985** · Easy · *codex, slides 485 to 499*

**Which enzyme can be added to reduce viscosity caused by released DNA?**

1. Catalase
2. DNase
3. Amylase
4. Pepsin

**Q986** · Easy · *codex, slides 485 to 499*

**What do protease inhibitors prevent during lysis?**

1. DNA copying by polymerases
2. Lipid oxidation in membranes
3. Cell swelling in the buffer
4. Proteolysis (protein degradation)

**Q987** · Medium · *codex, slides 485 to 499*

**Which homogenisation method is most widely used for small volumes and cultured cells?**

1. Liquid homogenisation
2. Mortar and pestle
3. Sonication
4. The Waring blender

**Q988** · Medium · *codex, slides 485 to 499*

**How do liquid homogenizers lyse cells?**

1. By heating the suspension to boiling
2. By adding a chemical fixative
3. By forcing cells through a gap
4. By drying the cells in air

**Q989** · Medium · *codex, slides 485 to 499*

**What do the microscopic vapour bubbles do in sonication?**

1. They stain the cells and nuclei
2. They cool the sample quickly
3. They implode, sending shock waves
4. They dissolve all the DNA there

**Q990** · Medium · *codex, slides 485 to 499*

**How is overheating prevented during sonication?**

1. By running it continuously
2. By adding paraffin wax first
3. By short bursts in an ice bath
4. By using a glass pestle too

**Q991** · Medium · *codex, slides 485 to 499*

**Sonication is best suited to what sample volumes?**

1. Volumes above 100 litres
2. Volumes below 100 ml
3. Volumes of exactly 1 litre
4. Volumes between 250 and 500 ml

**Q992** · Medium · *codex, slides 485 to 499*

**How does the freeze and thaw method break cells?**

1. Heating melts the membranes at 100 °C
2. Dehydration by strong alcohol baths
3. Shearing through very narrow tubes
4. Ice crystals break the cells

**Q993** · Medium · *codex, slides 485 to 499*

**Why is mortar and pestle the fastest method for plant cells?**

1. Plant cells have no membrane at all
2. The wall is strong cellulose
3. Plant cells are very small indeed
4. Plant cells contain very much DNase

**Q994** · Medium · *codex, slides 485 to 499*

**What does suspending cells in a hypotonic buffer do?**

1. It fixes them firmly in place
2. It swells them so they burst
3. It stains all of them blue
4. It freezes them solid fast

**Q995** · Medium · *codex, slides 485 to 499*

**Which additive helps crush the cell walls of yeast cells?**

1. Dry ice
2. Glass beads
3. Paraffin
4. Xylene

**Q996** · Medium · *codex, slides 485 to 499*

**Why is nuclease treatment not needed for sonicated material?**

1. Sonicated samples contain no DNA at that stage
2. Sonication raises viscosity
3. Nucleases are destroyed by cold
4. Sonication shears the chromosomes

**Q997** · Hard · *codex, slides 485 to 499*

**All of the following are traditional (non-detergent) lysis methods EXCEPT which one?**

1. Sonication
2. Freeze and thaw
3. Mortar and pestle
4. Treatment with a detergent

**Q998** · Hard · *codex, slides 485 to 499*

**Which are physical (non-detergent) lysis methods? 1. Sonication. 2. Freeze and thaw. 3. Detergent treatment. 4. Mortar and pestle.**

1. 1, 2 and 4 only
2. 1 and 3 only
3. 2, 3 and 4 only
4. 1, 3 and 4 only

**Q999** · Hard · *codex, slides 485 to 499*

**A yeast suspension resists lysis in a blender. Which two additives could help?**

1. Liquid nitrogen to freeze the cells, or paraffin
2. A lytic enzyme for the wall, or glass beads
3. Formaldehyde to fix the cells, or xylene
4. Eosin to stain the wall, or glycerol

**Q1000** · Devil · *codex, slides 485 to 499*

**Which statement is correct about viscosity after lysis?**

1. It falls as nucleic acids are released, and nuclease is always required
2. It rises, and only protease inhibitors reduce it
3. It rises, DNase and RNase reduce it, and sonicated samples need none
4. It is unchanged, so no additive is ever needed

## Answers — Cell lysis and homogenisation · Q977–1000

**Q977 — C** · Cell lysis is the first step.

**Q978 — C** · These are the mechanical disruption tools.

**Q979 — C** · A Dounce has a glass pestle.

**Q980 — B** · It uses a Teflon pestle.

**Q981 — A** · A piston applies high pressure.

**Q982 — D** · Sonication uses sound waves.

**Q983 — B** · This is the most common method.

**Q984 — D** · Tissue is frozen in liquid nitrogen.

**Q985 — B** · DNase reduces viscosity.

**Q986 — D** · They prevent proteolysis.

**Q987 — A** · It is the most widely used for small volumes.

**Q988 — C** · They shear the membranes.

**Q989 — C** · The implosion causes shock waves.

**Q990 — C** · Multiple short bursts on ice are used.

**Q991 — B** · It suits volumes under 100 ml.

**Q992 — D** · This describes the mechanism.

**Q993 — B** · The tough wall needs crushing.

**Q994 — B** · Hypotonic buffer helps lysis.

**Q995 — B** · Glass beads help crush the walls.

**Q996 — D** · Sonication shears chromosomes.

**Q997 — D** · Correct choice.

**Q998 — A** · Sonication, freeze and thaw and mortar and pestle are physical methods; detergent treatment is a separate class.

**Q999 — B** · These are the listed facilitators.

**Q1000 — C** · This summarises the lecture.

# Module 6 — Differential centrifugation → Rf values and interpreting data

slides 501 to 562 · 120 questions · 10 sections · bank: BIOL151_Question_Bank_Slides501-562.docx
Difficulty: 48 Easy · 47 Medium · 20 Hard · 5 Devil

## Differential centrifugation · Q1001–1020

**Q1001** · Easy · *codex, slides 502 to 506*

**What is the use of increased gravity to speed up the sedimentation of substances called?**

1. Chromatography
2. Homogenisation
3. Autoradiography
4. Centrifugation

**Q1002** · Easy · *codex, slides 502 to 506*

**Which instrument spins samples at various speeds to separate cell parts?**

1. The microtome
2. The centrifuge
3. The spectrophotometer
4. The cuvette

**Q1003** · Easy · *codex, slides 502 to 506*

**What name is given to the large cell structures that settle at the bottom of the tube?**

1. Supernatant
2. Homogenate
3. Gradient
4. Pellets

**Q1004** · Easy · *codex, slides 502 to 506*

**What is the liquid left above the pellet called?**

1. The pellet
2. The homogenate
3. The supernatant
4. The fraction

**Q1005** · Easy · *codex, slides 502 to 506*

**On what is separation in differential centrifugation based primarily?**

1. The colour of the particles
2. The charge of the particles
3. The solubility of the particles
4. The size of the particles

**Q1006** · Easy · *codex, slides 502 to 506*

**What pellets after 1000 × g for 10 minutes?**

1. Unbroken cells and heavy nuclei
2. Mitochondria and some lysosomes
3. Ribosomes and small vesicles
4. Soluble proteins and ions

**Q1007** · Easy · *codex, slides 502 to 506*

**Which organelles pellet after 10,000 × g for 20 minutes?**

1. Unbroken cells and heavy nuclei
2. Chromosomes and nucleoli only
3. Mitochondria, lysosomes, microbodies
4. Plasma membrane sheets and ER

**Q1008** · Easy · *codex, slides 502 to 506*

**How does the centrifugal force change between successive spins in differential centrifugation?**

1. It is decreased each time
2. It is increased each time
3. It stays constant
4. It is varied at random

**Q1009** · Medium · *codex, slides 502 to 506*

**What is done with the supernatant after the first spin?**

1. It is decanted and spun again
2. It is discarded at once
3. It is stained blue and dried
4. It is embedded in hot wax

**Q1010** · Medium · *codex, slides 502 to 506*

**What do successively higher speeds collect?**

1. Successively larger parts
2. The same parts every time
3. Only soluble molecules
4. Successively smaller parts

**Q1011** · Medium · *codex, slides 502 to 506*

**Why are organelle pellets only partially pure?**

1. They are made of one type of organelle
2. They are dissolved in the supernatant
3. They are contaminated with other particles
4. They are stained with dye

**Q1012** · Medium · *codex, slides 502 to 506*

**How can contaminants smaller in size be removed from a pellet?**

1. Resuspend and re-pellet it
2. Heat it to boiling point
3. Dry it in warm air
4. Add xylene to it

**Q1013** · Medium · *codex, slides 502 to 506*

**In which kind of solvents are pellets washed?**

1. Hypotonic solvents only
2. Isotonic solvents
3. Pure ethanol
4. Liquid nitrogen

**Q1014** · Medium · *codex, slides 502 to 506*

**What is differential centrifugation commonly used for?**

1. Producing fully pure single molecules
2. Staining organelles for the microscope
3. Cutting thin sections of tissue
4. Simple pelleting and partial purification

**Q1015** · Medium · *codex, slides 502 to 506*

**What does partial purification by differential centrifugation serve as?**

1. The final step of any purification
2. A replacement for homogenisation
3. A preliminary step before a gradient
4. A fixation method for tissue

**Q1016** · Medium · *codex, slides 502 to 506*

**Which statement about differential centrifugation is NOT true?**

1. It uses progressively increasing force
2. It generates pellets and supernatants
3. It gives partially pure organelles
4. It separates particles mainly by their density

**Q1017** · Hard · *codex, slides 502 to 506*

**Which order of pelleting is expected as the force increases?**

1. Mitochondria first, then nuclei at higher force of spinning
2. All organelles together at 1000 × g in one pellet
3. Nuclei at low force, then mitochondria at higher force
4. Lysosomes first, then unbroken cells at higher force

**Q1018** · Hard · *codex, slides 502 to 506*

**A student's next spin is ten times the force of the 1000 × g spin that pelleted nuclei. Which force is this?**

1. 100 × g
2. 1,000,000 × g
3. 100,000 × g
4. 10,000 × g

**Q1019** · Hard · *codex, slides 502 to 506*

**A 10,000 × g pellet of mitochondria is still contaminated. Which step comes next?**

1. Discard the pellet and start again with distilled water
2. Wash in isotonic solvent and re-pellet, then use a gradient
3. Add detergent to dissolve the contaminants
4. Stain the pellet and view it directly under a lens

**Q1020** · Devil · *codex, slides 502 to 506*

**Which workflow correctly purifies mitochondria?**

1. Homogenise, spin high first, then low for nuclei, then stain the pellet
2. Spin the intact cells, then homogenise, then use a density gradient
3. Stain the cells, spin once at 1000 × g, then embed in hot wax
4. Homogenise, spin low for nuclei, spin higher for mitochondria, then use a gradient

### Answers — Differential centrifugation · Q1001–1020

**Q1001 — D** · Centrifugation uses increased gravity to speed sedimentation.
**Q1002 — B** · The centrifuge spins at various speeds.
**Q1003 — D** · The large structures settle as pellets.
**Q1004 — C** · The supernatant holds the smaller parts in liquid.
**Q1005 — D** · Size is the main basis of separation.
**Q1006 — A** · These pellet at 1000 × g for 10 minutes.
**Q1007 — C** · These pellet at 10,000 × g for 20 minutes.
**Q1008 — B** · The speed increases with each trial.
**Q1009 — A** · The supernatant is spun again faster.
**Q1010 — D** · Higher speeds collect smaller parts.
**Q1011 — C** · Pellets are typically contaminated.
**Q1012 — A** · Repeated washing removes smaller contaminants.
**Q1013 — B** · Isotonic solvents are used for washing.
**Q1014 — D** · These are its common uses.
**Q1015 — C** · It prepares for further purification.
**Q1016 — D** · Correct choice.
**Q1017 — C** · Larger structures pellet first.
**Q1018 — D** · Ten times 1000 × g is 10,000 × g.
**Q1019 — B** · Washing then gradient purification follows.
**Q1020 — D** · This follows the lecture sequence.

## Density gradient centrifugation · Q1021–1032

**Q1021** · Easy · *codex, slides 509 to 513*

**Which method is preferred to purify subcellular organelles and macromolecules?**

1. Density gradient centrifugation
2. Differential centrifugation alone
3. Paper chromatography alone
4. Sonication of the cells

**Q1022** · Easy · *codex, slides 509 to 513*

**Which medium is named as an example for generating a density gradient?**

1. Paraffin wax
2. Sucrose
3. Xylene
4. Eosin

**Q1023** · Easy · *codex, slides 509 to 513*

**Where is the heaviest layer placed in a density gradient tube?**

1. At the bottom
2. At the top
3. In the middle only
4. Outside the tube

**Q1024** · Easy · *codex, slides 509 to 513*

**Where is the cell suspension added to the gradient?**

1. At the bottom of the tube
2. Into the middle layer
3. On top of the gradient
4. Beside the tube

**Q1025** · Easy · *codex, slides 509 to 513*

**Into which two categories is density gradient centrifugation classified?**

1. Differential and analytical
2. Simple and compound
3. Paper and thin layer
4. Rate-zonal and isopycnic

**Q1026** · Medium · *codex, slides 509 to 513*

**In which two modes can a density gradient be generated?**

1. Hot or cold
2. Wet or dry
3. Discontinuous or continuous
4. Fast or slow

**Q1027** · Medium · *codex, slides 509 to 513*

**What density do viruses have in the buoyant density example?**

1. 11 to 12 g/cm³
2. 0.1 to 0.2 g/cm³
3. 5 to 6 g/cm³
4. 1.1 to 1.2 g/cm³

**Q1028** · Medium · *codex, slides 509 to 513*

**Which components move fastest down the tube in buoyant density centrifugation?**

1. The lightest components
2. The smallest components
3. The coloured components
4. The densest components

**Q1029** · Medium · *codex, slides 509 to 513*

**Where does a component stop in the gradient?**

1. At its own sucrose density
2. At the very bottom always
3. At the top always
4. Wherever the tube ends

**Q1030** · Medium · *codex, slides 509 to 513*

**What do the bands at the bottom of the gradient contain?**

1. High buoyant density components
2. Components with low buoyant densities
3. Only water and buffer
4. Only dissolved salts and ions

**Q1031** · Hard · *codex, slides 509 to 513*

**Why do components with high buoyant density band lower in the gradient than those with low buoyant density?**

1. Dense components are lighter, so they sink more slowly
2. Each stops where the density matches its own
3. The gradient is lightest at the bottom of the tube
4. All components stop at the same point in the gradient

**Q1032** · Hard · *codex, slides 509 to 513*

**All of the following are true of a density gradient EXCEPT which one?**

1. The suspension is added on top
2. It can be continuous or discontinuous
3. The lightest layer is at the bottom
4. Sucrose can be used as a medium

### Answers — Density gradient centrifugation · Q1021–1032

**Q1021 — A** · It is the preferred purification method.
**Q1022 — B** · Sucrose is a gradient medium.
**Q1023 — A** · The heaviest layer is at the bottom.
**Q1024 — C** · The suspension is added to the top.
**Q1025 — D** · These are the two categories.
**Q1026 — C** · Gradients can be discontinuous or continuous.
**Q1027 — D** · The viruses have densities of 1.1 to 1.2 g/cm³.
**Q1028 — D** · The densest components move fastest.
**Q1029 — A** · It stops where the density matches its own.
**Q1030 — A** · Dense components lie at the bottom.
**Q1031 — B** · The matching point is deeper for denser particles.
**Q1032 — C** · Correct choice.

## Rate-zonal and isopycnic separation · Q1033–1044

**Q1033** · Easy · *codex, slides 513 to 518*

**Which separation uses particle size and mass rather than density?**

1. Rate-zonal separation
2. Isopycnic separation
3. Differential pelleting
4. Analytical separation

**Q1034** · Easy · *codex, slides 513 to 518*

**Which separation uses particle density?**

1. Rate-zonal separation
2. Paper chromatography alone
3. Autoradiography
4. Isopycnic separation

**Q1035** · Easy · *codex, slides 513 to 518*

**Which common example uses a CsCl gradient?**

1. Separation of nucleic acids
2. Separation of antibody classes
3. Separation of pigments
4. Separation of whole cells

**Q1036** · Easy · *codex, slides 513 to 518*

**In isopycnic separation, a particle sinks until what is reached?**

1. The bottom of the tube
2. Where the densities are equal
3. The top of the tube
4. The edge of the cuvette

**Q1037** · Easy · *codex, slides 513 to 518*

**Which common example is separated by rate-zonal separation?**

1. Nucleic acids in CsCl
2. Whole nuclei
3. Plant cell walls
4. Antibody classes

**Q1038** · Medium · *codex, slides 513 to 518*

**Why can antibody classes be separated by mass but not by density?**

1. They have different densities and the same mass
2. Similar densities but different masses
3. They have no real mass at all
4. They are too large to centrifuge

**Q1039** · Medium · *codex, slides 513 to 518*

**Once isopycnic quasi-equilibrium is reached, what does more centrifugation do?**

1. It has no influence on migration
2. It pushes the particle to the bottom
3. It pushes the particle to the top
4. It dissolves the particle

**Q1040** · Medium · *codex, slides 513 to 518*

**Which cellular organelles are cited as an example for rate-zonal separation?**

1. Chloroplasts only
2. Cell walls
3. Plasmids
4. Endosomes

**Q1041** · Medium · *codex, slides 513 to 518*

**All of the following are true of isopycnic separation EXCEPT which one?**

1. Separation depends on particle density
2. Particles stop where the solution density equals their own
3. The duration always changes the final position
4. A CsCl gradient can separate nucleic acids

**Q1042** · Hard · *codex, slides 513 to 518*

**A mixture contains particles of the same density but different masses. Which separation should be used?**

1. Isopycnic, because it separates by density
2. Neither, because they cannot be separated
3. Rate-zonal, because it separates by size and mass
4. Paper chromatography, because it uses density

**Q1043** · Hard · *codex, slides 513 to 518*

**Which statement correctly describes rate-zonal separation?**

1. It exploits particle size and mass
2. It exploits only the colour of the particles
3. It requires the particles to reach equilibrium
4. It uses a single layer without a gradient

**Q1044** · Devil · *codex, slides 513 to 518*

**Which statement correctly contrasts rate-zonal with isopycnic separation?**

1. Rate-zonal depends on density, whereas isopycnic depends on size and mass
2. Both depend only on the colour of particles
3. Both continue until particles reach the bottom
4. Rate-zonal uses size and mass, isopycnic uses density

### Answers — Rate-zonal and isopycnic separation · Q1033–1044

**Q1033 — A** · Rate-zonal separation uses size and mass.
**Q1034 — D** · Isopycnic separation uses density.
**Q1035 — A** · Nucleic acids are separated in CsCl.
**Q1036 — B** · It stops where the densities match.
**Q1037 — D** · Antibody classes are an example.
**Q1038 — B** · Mass differs while density is similar.
**Q1039 — A** · Further spinning does not change the position.
**Q1040 — D** · Endosomes are an example.
**Q1041 — C** · Correct choice.
**Q1042 — C** · Mass differences are exploited.
**Q1043 — A** · This is the description in the lecture.
**Q1044 — D** · These are the differences.

## The analytical ultracentrifuge · Q1045–1052

**Q1045** · Easy · *codex, slides 519 to 521*

**What maximum force can an analytical ultracentrifuge generate?**

1. Up to 5,000 g
2. Up to 50 g
3. Up to 5,000,000 g
4. Up to 500,000 g

**Q1046** · Easy · *codex, slides 519 to 521*

**What is the centrifuge cell of an analytical ultracentrifuge made of?**

1. Paraffin
2. Cellulose
3. Quartz
4. Teflon

**Q1047** · Easy · *codex, slides 519 to 521*

**With which media is the specimen mixed in the analytical ultracentrifuge?**

1. Xylene or ethanol
2. Eosin or hematoxylin
3. Water or oil only
4. Sucrose or caesium chloride

**Q1048** · Medium · *codex, slides 519 to 521*

**On which fundamental property does analytical ultracentrifugation rely?**

1. Colour and light refraction
2. Mass and gravitation
3. Charge and magnetism
4. Heat and pressure

**Q1049** · Medium · *codex, slides 519 to 521*

**Does analytical ultracentrifugation need standards for comparison?**

1. Yes, it always needs standards
2. No, it is a primary technique
3. Yes, but only with sucrose
4. Only when using caesium chloride

**Q1050** · Medium · *codex, slides 519 to 521*

**What forms at the top of the cell during analytical ultracentrifugation?**

1. A solid pellet of particles only
2. A layer of coloured dye
3. Pure solvent, sharply bounded
4. A layer of paraffin wax

**Q1051** · Hard · *codex, slides 519 to 521*

**Which kinds of molecules can the analytical ultracentrifuge separate and characterise?**

1. Very small molecules and macromolecules
2. Only whole living cells in water
3. Only large tissue blocks of organs
4. Only dried powders of minerals

**Q1052** · Hard · *codex, slides 519 to 521*

**How does an analytical ultracentrifuge differ from a preparative centrifuge?**

1. It is a simpler device that only pellets cells at 1000 g
2. It uses no centrifugal force at all
3. A refinement that analyses solution behaviour
4. It is used only for staining

### Answers — The analytical ultracentrifuge · Q1045–1052

**Q1045 — D** · It generates forces of up to 500,000 g.
**Q1046 — C** · The cell is made of quartz.
**Q1047 — D** · Sucrose or CsCl is used.
**Q1048 — B** · It relies on mass and gravitation.
**Q1049 — B** · It is a primary technique requiring no standards.
**Q1050 — C** · Particles sediment and leave pure solvent at the top.
**Q1051 — A** · It can characterise these molecules.
**Q1052 — C** · It refines preparative centrifuges for analysis.

## Principles of spectrophotometry · Q1053–1064

**Q1053** · Easy · *codex, slides 524 to 526*

**What does the spectrometer part of a spectrophotometer produce?**

1. A focused beam of electrons
2. A short flash of heat
3. A cloud of coloured dye
4. Light of a selected wavelength

**Q1054** · Easy · *codex, slides 524 to 526*

**What does the photometer measure?**

1. The intensity of light
2. The colour of the sample only
3. The temperature of the tube
4. The mass of the sample

**Q1055** · Easy · *codex, slides 524 to 526*

**What holds the liquid sample in a spectrophotometer?**

1. A microscope slide
2. A cuvette
3. A paper strip
4. A copper grid

**Q1056** · Easy · *codex, slides 524 to 526*

**Where is the cuvette placed?**

1. Between the beam and the photometer
2. Before the lamp of the machine
3. Behind the photometer and display
4. Inside the galvanometer housing

**Q1057** · Easy · *codex, slides 524 to 526*

**Which display device is normally used to show the photometer signal?**

1. A microscope
2. A thermometer
3. A galvanometer
4. A microtome

**Q1058** · Medium · *codex, slides 524 to 526*

**What does the photometer deliver to the display device?**

1. A focused beam of electrons
2. A flash of light
3. A voltage signal
4. A cloud of steam

**Q1059** · Medium · *codex, slides 524 to 526*

**What makes the display signal change?**

1. The colour of the plastic cuvette
2. The light absorbed by the liquid
3. The size of the laboratory room
4. The age of the sample tube

**Q1060** · Medium · *codex, slides 524 to 526*

**How many instruments make up a spectrophotometer?**

1. One
2. Three
3. Two
4. Four

**Q1061** · Medium · *codex, slides 524 to 526*

**What does the lecture mean by the colour of light produced by the spectrometer?**

1. The brightness
2. The wavelength
3. The speed
4. The temperature

**Q1062** · Medium · *codex, slides 524 to 526*

**Which part measures the amount of light passing through the tube?**

1. The photometer
2. The spectrometer
3. The cuvette
4. The galvanometer

**Q1063** · Hard · *codex, slides 524 to 526*

**Which sequence correctly follows the light in a spectrophotometer?**

1. Photometer, cuvette, spectrometer, then display device
2. Spectrometer, cuvette with sample, photometer, then display device
3. Cuvette, display device, spectrometer, then photometer
4. Display device, photometer, cuvette, then spectrometer

**Q1064** · Hard · *codex, slides 524 to 526*

**All of the following are parts of a spectrophotometer set-up EXCEPT which one?**

1. A microtome
2. A spectrometer
3. A photometer
4. A cuvette

### Answers — Principles of spectrophotometry · Q1053–1064

**Q1053 — D** · It produces light of any selected colour.
**Q1054 — A** · The photometer measures light intensity.
**Q1055 — B** · The liquid sits in a cuvette.
**Q1056 — A** · It sits between the beam and the photometer.
**Q1057 — C** · A galvanometer is normally used.
**Q1058 — C** · It delivers a voltage signal.
**Q1059 — B** · The signal changes as absorption changes.
**Q1060 — C** · A spectrometer and a photometer.
**Q1061 — B** · Colour is wavelength.
**Q1062 — A** · The photometer measures the light.
**Q1063 — B** · This is the light path and signal path.
**Q1064 — A** · Correct choice.

## Colour, absorbance and concentration · Q1065–1080

**Q1065** · Easy · *codex, slides 532 to 535*

**If a material absorbs violet light, what colour does it appear?**

1. Orange
2. Red
3. Blue
4. Yellow

**Q1066** · Easy · *codex, slides 532 to 535*

**If a material absorbs blue light, what colour does it appear?**

1. Yellow
2. Orange
3. Red
4. Violet

**Q1067** · Easy · *codex, slides 532 to 535*

**If a material absorbs yellow light, what colour does it appear?**

1. Orange
2. Green
3. Blue
4. Violet

**Q1068** · Easy · *codex, slides 532 to 535*

**What colour does haemoglobin appear?**

1. Blue
2. Green
3. Red
4. Violet

**Q1069** · Easy · *codex, slides 532 to 535*

**In the equation A = εcl, what does ε represent?**

1. The molar absorptivity
2. The path length
3. The concentration
4. The absorbance

**Q1070** · Easy · *codex, slides 532 to 535*

**Absorbance is proportional to what?**

1. The percentage transmittance
2. The path of the sunlight
3. The temperature of the lamp
4. The concentration of the analyte

**Q1071** · Medium · *codex, slides 532 to 535*

**Which light does haemoglobin absorb much more effectively than red?**

1. Red light
2. Infrared light
3. Blue and green light
4. Ultraviolet light only

**Q1072** · Medium · *codex, slides 532 to 535*

**What is proportional to the haemoglobin concentration in solution?**

1. The amount of red light transmitted only
2. The viscosity of the solution
3. The absorbance of blue or green light
4. The size of the cuvette

**Q1073** · Medium · *codex, slides 532 to 535*

**Why is absorbance generally preferred over % transmittance?**

1. Absorbance is proportional to concentration
2. %T cannot be measured at all by any instrument
3. %T needs no light source at all
4. Absorbance is always larger in value

**Q1074** · Medium · *codex, slides 532 to 535*

**Which relationship between absorbance and % transmittance is correct?**

1. $A = 2 + \log_{10} \%T$
2. $A = \%T / 100$
3. $A = \log_{10} \%T$ only
4. $A = 2 - \log_{10} \%T$

**Q1075** · Medium · *codex, slides 532 to 535*

**In $A = \varepsilon cl$, what do c and l stand for?**

1. Colour and light
2. Cuvette and lens
3. Charge and length
4. Concentration and path length

**Q1076** · Medium · *codex, slides 532 to 535*

**If colour development is linked to concentration, how can concentration be measured?**

1. By counting the cuvettes used
2. By measuring light absorption
3. By measuring the room temperature
4. By weighing the light beam

**Q1077** · Hard · *codex, slides 532 to 535*

**A sample transmits 10% of the light. What is its absorbance?**

1. 2
2. 0.1
3. 1
4. 10

**Q1078** · Hard · *codex, slides 532 to 535*

**A sample transmits 1% of the light. What is its absorbance?**

1. 2
2. 1
3. 0
4. 0.01

**Q1079** · Hard · *codex, slides 532 to 535*

**If the concentration of a coloured solution doubles at a fixed path length, what happens to its absorbance?**

1. It halves
2. It doubles
3. It stays the same
4. It falls to zero

**Q1080** · Devil · *codex, slides 532 to 535*

**A solution has an absorbance of 1 at a wavelength it absorbs as blue light. What colour does it look, and what is its %T?**

1. Yellow, with a %T of 1%
2. Orange, with a %T of 100%
3. Orange, with a %T of 10%
4. Violet, with a %T of 10%

### Answers — Colour, absorbance and concentration · Q1065–1080

**Q1065 — D** · Violet absorbed gives yellow.
**Q1066 — B** · Blue absorbed gives orange.
**Q1067 — D** · Yellow absorbed gives violet.
**Q1068 — C** · Haemoglobin appears red.
**Q1069 — A** · ε is the molar absorptivity.
**Q1070 — D** · Absorbance is proportional to concentration.
**Q1071 — C** · It absorbs blue and green more effectively.
**Q1072 — C** · This is the proportional measurement.
**Q1073 — A** · This is the stated reason.
**Q1074 — D** · This is the correct relationship.
**Q1075 — D** · c is concentration and l is path length.
**Q1076 — B** · Absorption measures concentration.
**Q1077 — C** · $A = 2 - \log_{10} 10 = 1$.
**Q1078 — A** · $A = 2 - \log_{10} 1 = 2$.
**Q1079 — B** · Absorbance is proportional to concentration.
**Q1080 — C** · Blue absorbed looks orange, and A = 1 gives %T = 10.

## Autoradiography: principle and procedure · Q1081–1092

**Q1081** · Easy · *codex, slides 536 to 539*

**What does autoradiography visualise?**

1. The colour of a stain dye
2. The temperature of a sample
3. The weight of a single cell
4. Distribution of radioactive label

**Q1082** · Easy · *codex, slides 536 to 539*

**What is the radioactive sample covered with in autoradiography?**

1. Paraffin wax
2. Epoxy resin
3. Immersion oil
4. Photographic emulsion

**Q1083** · Easy · *codex, slides 536 to 539*

**Which ions are reduced to atoms in the emulsion?**

1. $Na^{+}$ ions
2. $Ca^{2+}$ ions
3. $Ag^{+}$ ions
4. $Cl^{-}$ ions

**Q1084** · Easy · *codex, slides 536 to 539*

**Which isotope is among those most widely used in biological research?**

1. Uranium-235
2. Iodine-131 only
3. Radon-222
4. Tritium ($^{3}H$)

**Q1085** · Easy · *codex, slides 536 to 539*

**What forms the dark bands in an autoradiogram?**

1. Dye molecules
2. Wax crystals
3. Silver atoms
4. Salt crystals

**Q1086** · Medium · *codex, slides 536 to 539*

**Which particles from the radioactive salts activate the silver in the emulsion?**

1. Negatively charged beta particles
2. Positively charged alpha particles
3. Neutral photons only, no charge
4. Positively charged protons only

**Q1087** · Medium · *codex, slides 536 to 539*

**What does washing with fixers leave on the slide?**

1. All the silver halide
2. Only the dye
3. Insoluble silver atoms only
4. Only the wax

**Q1088** · Medium · *codex, slides 536 to 539*

**Which instrument can be used to quantify an autoradiogram?**

1. A microtome
2. A densitometer
3. A centrifuge
4. A galvanometer

**Q1089** · Medium · *codex, slides 536 to 539*

**What does preflashing the film do?**

1. It destroys the silver crystals
2. It makes the film thicker
3. It increases sensitivity
4. It removes the emulsion

**Q1090** · Hard · *codex, slides 536 to 539*

**Which sequence correctly describes the autoradiography procedure?**

1. Wash with fixer, cover with emulsion, reduce $Ag^{+}$, then view
2. View first, then cover with emulsion, then reduce $Ag^{+}$
3. Reduce $Ag^{+}$, cover with emulsion, wash, then activate silver
4. Emulsion, silver activated, $Ag^{+}$ reduced, fixer wash, then viewing

**Q1091** · Hard · *codex, slides 536 to 539*

**All of the following are isotopes named for biological autoradiography EXCEPT which one?**

1. Tritium ($^{3}H$)
2. Carbon-14
3. Uranium-235
4. Phosphorus-32

**Q1092** · Devil · *codex, slides 536 to 539*

**A researcher incubates tissue with $^{35}S$-labelled amino acids to see where proteins are made. How does the method reveal the sites?**

1. It is incorporated and its beta particles darken the silver halide
2. The label dyes the proteins blue, which is then photographed
3. The label makes proteins fluoresce under UV and is photographed
4. The label is separated from the proteins by a centrifuge

### Answers — Autoradiography: principle and procedure · Q1081–1092

**Q1081 — D** · It visualises radioactive label distribution.
**Q1082 — D** · The sample is covered with emulsion.
**Q1083 — C** · Silver ions are reduced to silver atoms.
**Q1084 — D** · Tritium is widely used.
**Q1085 — C** · Reduced silver forms the dark bands.
**Q1086 — A** · Beta particles activate silver.
**Q1087 — C** · Only insoluble silver remains.
**Q1088 — B** · A densitometer gives quantitative estimates.
**Q1089 — C** · Preflashing improves sensitivity.
**Q1090 — D** · This follows the lecture steps.
**Q1091 — C** · Correct choice.
**Q1092 — A** · This matches the described mechanism.

## Autoradiography with tritiated thymidine · Q1093–1098

**Q1093** · Easy · *codex, slides 543, 544*

**Which labelled nucleoside is used to label DNA in the lecture's example?**

1. Tritiated uridine
2. Radioactive glucose
3. Tritiated thymidine
4. Radioactive glycine

**Q1094** · Easy · *codex, slides 543, 544*

**Into which molecule is tritiated thymidine incorporated?**

1. Messenger RNA
2. Plasma membrane lipids
3. Chromosomal DNA
4. Ribosomal proteins

**Q1095** · Medium · *codex, slides 543, 544*

**Why does tritiated thymidine label DNA and not RNA?**

1. Thymidine is not present in RNA
2. Thymidine is too large for RNA
3. RNA is destroyed by the emulsion
4. RNA never contains any isotopes

**Q1096** · Medium · *codex, slides 543, 544*

**Which silver salt is in the emulsion used for chromosome labelling?**

1. Silver nitrate
2. Silver bromide (AgBr)
3. Sodium chloride
4. Calcium carbonate

**Q1097** · Medium · *codex, slides 543, 544*

**How do the silver grains appear after the radiation converts $Ag^{+}$ to metal?**

1. As blue patches
2. As small black dots
3. As glowing green rings
4. As transparent crystals

**Q1098** · Hard · *codex, slides 543, 544*

**Which sequence correctly describes labelling of chromosomes with tritiated thymidine?**

1. Grow cells with label, fix chromosomes, immerse in emulsion, wash off excess AgBr
2. Immerse in emulsion first, then grow cells with the label, then lyse
3. Wash away AgBr first, then fix the chromosomes, then grow cells
4. Lyse the cells, wash them, then grow them with the label

### Answers — Autoradiography with tritiated thymidine · Q1093–1098

**Q1093 — C** · Cells are grown with tritiated thymidine.
**Q1094 — C** · It is incorporated into chromosomal DNA.
**Q1095 — A** · Thymidine is found only in DNA.
**Q1096 — B** · The emulsion contains silver bromide.
**Q1097 — B** · The grains look like small black dots.
**Q1098 — A** · This follows the lecture.

## Chromatography and the paper technique · Q1099–1110

**Q1099** · Easy · *codex, slides 546 to 552*

**What is the stationary phase in partition chromatography?**

1. A liquid
2. A solid
3. A gas
4. A vacuum

**Q1100** · Easy · *codex, slides 546 to 552*

**Adsorption chromatography uses which kind of stationary phase?**

1. A liquid
2. A gas
3. A solid
4. A plasma

**Q1101** · Easy · *codex, slides 546 to 552*

**Which technique has largely replaced paper chromatography?**

1. Autoradiography
2. Thin layer chromatography
3. Spectrophotometry
4. Differential centrifugation

**Q1102** · Easy · *codex, slides 546 to 552*

**How is the sample applied to the paper?**

1. As a thick coat of paraffin wax
2. As a small capillary spot
3. As a stream from a water hose
4. As a block of hard resin

**Q1103** · Easy · *codex, slides 546 to 552*

**About how far above the base of the paper is the sample spot placed?**

1. About 2 cm
2. About 20 cm
3. About 2 mm
4. About 12 cm

**Q1104** · Medium · *codex, slides 546 to 552*

**What drives the solvent up the paper?**

1. Gravity pulling it down
2. Capillary action
3. An electric field
4. Centrifugal force

**Q1105** · Medium · *codex, slides 546 to 552*

**Where must the sample spot be relative to the solvent surface?**

1. Below the solvent surface
2. Dissolved in the solvent
3. Above the solvent surface
4. Outside the container

**Q1106** · Medium · *codex, slides 546 to 552*

**Which solvents are named for paper chromatography?**

1. Ethanol, water or acetone
2. Xylene, paraffin or resin
3. Eosin, safranin or crystal violet
4. Sucrose, CsCl or glycerol

**Q1107** · Medium · *codex, slides 546 to 552*

**Which two factors make compounds travel at different rates on paper?**

1. Colour and brightness of the spot
2. Weight and height of the paper strip
3. Age and temperature of the lamp
4. Solubility and attraction to the paper

**Q1108** · Medium · *codex, slides 546 to 552*

**What is two-way chromatography used for?**

1. Measuring absorbance of spots
2. Separating spots that overlap
3. Staining the paper
4. Embedding the spots in wax

**Q1109** · Hard · *codex, slides 546 to 552*

**How is two-way chromatography carried out?**

1. The paper is run twice in the same solvent in the same direction
2. The paper is turned 90° and run in a different solvent
3. The paper is cut in two and stained
4. The paper is dried and burned

**Q1110** · Hard · *codex, slides 546 to 552*

**All of the following are true of paper chromatography EXCEPT which one?**

1. It can measure any substance on the paper
2. Compounds move at different rates
3. The solvent rises by capillary action
4. The sample is placed as a small spot

### Answers — Chromatography and the paper technique · Q1099–1110

**Q1099 — A** · The stationary phase is a liquid.
**Q1100 — C** · The stationary phase is a solid.
**Q1101 — B** · TLC has largely replaced it.
**Q1102 — B** · A small spot is placed with a capillary tube.
**Q1103 — A** · The spot is about 2 cm from the base.
**Q1104 — B** · Capillary action moves the solvent.
**Q1105 — C** · The spot must be above the solvent.
**Q1106 — A** · These are the named solvents.
**Q1107 — D** · These two factors decide the rate.
**Q1108 — B** · A second run separates unresolved spots.
**Q1109 — B** · A second solvent separates overlapping spots.
**Q1110 — A** · Correct choice.

## Rf values and interpreting data · Q1111–1120

**Q1111** · Easy · *codex, slides 554 to 560*

**What does Rf stand for?**

1. Rate of flow
2. Ratio of fronts
3. Relative frequency
4. Radius of fixation

**Q1112** · Easy · *codex, slides 554 to 560*

**How is the Rf value calculated?**

1. Distance of the solvent front divided by distance of the spot
2. Width of the spot divided by the paper width
3. Time taken divided by distance travelled
4. Spot distance divided by solvent front distance

**Q1113** · Easy · *codex, slides 554 to 560*

**Is the Rf value characteristic for a given substance?**

1. No, it varies at random each run
2. Yes, unique under the same conditions
3. No, it is the same for all substances
4. Only for coloured substances

**Q1114** · Easy · *codex, slides 554 to 560*

**When will a compound give the same Rf value?**

1. When run in any solvent at all
2. When run under identical conditions
3. When stained after running
4. When dried in the sun first

**Q1115** · Medium · *codex, slides 554 to 560*

**The solvent front travelled 10 cm and a spot travelled 4 cm. What is the Rf?**

1. 0.4
2. 2.5
3. 0.04
4. 14

**Q1116** · Medium · *codex, slides 554 to 560*

**The solvent front travelled 12 cm and a spot travelled 9 cm. What is the Rf?**

1. 1.33
2. 0.75
3. 0.25
4. 21

**Q1117** · Medium · *codex, slides 554 to 560*

**To which part of the spot is the distance travelled measured?**

1. The top edge of the spot
2. The centre of the spot
3. The bottom edge of the spot
4. The edge of the paper

**Q1118** · Medium · *codex, slides 554 to 560*

**Which of these Rf values is impossible?**

1. 0.5
2. 0.8
3. 0.1
4. 1.2

**Q1119** · Hard · *codex, slides 554 to 560*

**A spot travelled 5.2 cm while the solvent front travelled 13 cm. What is its Rf?**

1. 0.4
2. 2.5
3. 0.52
4. 7.8

**Q1120** · Devil · *codex, slides 554 to 560*

**A spot has an Rf of 0.60 and the solvent front travelled 15 cm. How far did the spot travel?**

1. 9 cm
2. 25 cm
3. 0.9 cm
4. 15.6 cm

### Answers — Rf values and interpreting data · Q1111–1120

**Q1111 — B** · Rf stands for ratio of fronts.
**Q1112 — D** · This is the definition.
**Q1113 — B** · It is characteristic of the substance.
**Q1114 — B** · Identical conditions give the same Rf.
**Q1115 — A** · 4 divided by 10 is 0.4.
**Q1116 — B** · 9 divided by 12 is 0.75.
**Q1117 — B** · Distance is measured to the centre.
**Q1118 — D** · Correct choice.
**Q1119 — A** · 5.2 divided by 13 is 0.4.
**Q1120 — A** · 0.60 multiplied by 15 is 9.