



Cell structure: practice questions

8 questions • 25 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 25

1 PAPER 1A STYLE [1 mark]

Which cell normally has no nucleus when it is mature?

- A. ☐ Skeletal muscle fibre
- B. ☐ Aseptate fungal hypha
- C. ☐ Phloem sieve tube element
- D. ☐ Phloem companion cell

2 PAPER 1A STYLE [1 mark]

Which structure in Paramecium is mainly involved in homeostasis?

- A. ☐ Cilia
- B. ☐ Contractile vacuole
- C. ☐ Food vacuole
- D. ☐ Oral groove

3 PAPER 1A STYLE [1 mark]

HL only

What is the basis of cell differentiation in a multicellular organism?

- A. ☐ Loss of the genes that a cell does not need
- B. ☐ Different patterns of gene expression
- C. ☐ Mutations that occur during development
- D. ☐ Different numbers of chromosomes in each cell type

4 PAPER 1B STYLE

[5 marks]

A student made a temporary mount of human cheek cells stained with methylene blue. At $\times 400$, 40 eyepiece units lined up exactly with 10 divisions of a stage micrometer. Each stage micrometer division is $10\text{ }\mu\text{m}$. The student then measured the diameter of five cells. The data are for practice. (a) Calculate the length of one eyepiece unit at $\times 400$. [1] (b) Calculate the mean diameter of the cells in μm . Show your working. [2] (c) Explain why the graticule must be calibrated again if the student changes to a total magnification of $\times 100$. [1] (d) Suggest why the student measured five cells rather than one. [1]

Diameters of five cheek cells (practice data)

Cell	Diameter / eyepiece units
1	22
2	25
3	24
4	26
5	23

Answer =

5 PAPER 2A STYLE

[3 marks]

An electron micrograph of a mitochondrion has a scale bar 20 mm long labelled $0.5\text{ }\mu\text{m}$. The mitochondrion is 60 mm long on the micrograph. (a) Calculate the magnification of the micrograph. [2] (b) Calculate the actual length of the mitochondrion in μm . [1]

Answer =

6 PAPER 2A STYLE

[4 marks]

Distinguish between the structure of a Gram-positive bacterium, such as Staphylococcus, and an animal cell. [4]

7 PAPER 2A STYLE

[4 marks]

Outline the advantages of cryogenic electron microscopy and of immunofluorescence for studying cells. [4]

8 PAPER 2B STYLE

[6 marks]

HL only

Explain the evidence that mitochondria and chloroplasts originated by endosymbiosis. [6]

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

C C [1]

2. [1]

B B [1]

3. [1] **HL only**

B B [1]

4. [5]

- (a) $100\text{ }\mu\text{m} \div 40 = 2.5\text{ }\mu\text{m}$ [1]
- (b) mean = $(22 + 25 + 24 + 26 + 23) \div 5 = 24$ eyepiece units [1]
- (b) $24 \times 2.5 = 60\text{ }\mu\text{m}$ [1] ECF from (a)
- (c) the eyepiece scale does not change size but the specimen is magnified less, so one eyepiece unit represents a different (larger) length of specimen OWTTE [1] Accept $10\text{ }\mu\text{m}$ at $\times 100$
- (d) cells vary in size, so a mean is more representative / reduces the effect of one unusual cell / random error [1]

5. [3]

- (a) $20\text{ mm} = 20\text{ }000\text{ }\mu\text{m}$ [1]
- (a) $20\text{ }000 \div 0.5 = \times 40\text{ }000$ [1]
- (b) $60\text{ }000\text{ }\mu\text{m} \div 40\text{ }000 = 1.5\text{ }\mu\text{m}$ [1] ECF from (a)

6. [4]

- bacterium has no nucleus / DNA in a nucleoid region, whereas the animal cell has a nucleus with a double membrane and pores [1]
- bacterial DNA is naked / not bound to histones, whereas eukaryotic DNA is bound to histones [1]
- bacterial DNA is a single loop / circular, whereas eukaryotic chromosomes are linear [1]
- 70S ribosomes in the bacterium, 80S ribosomes in the animal cell cytoplasm [1]
- bacterium has a cell wall (of peptidoglycan); the animal cell has none [1]
- no membrane-bound organelles in the bacterium; the animal cell has mitochondria / ER / Golgi apparatus / lysosomes [1]
- bacterial cytoplasm is not compartmentalised [1]
- bacterium is smaller [1]
- max 4. Do not accept 'bacteria have no DNA'.

7. [4]

- cryo-EM: rapid freezing preserves molecules in their natural shape / without ice crystals [1]
- cryo-EM: many images are combined by computer to give a 3D structure [1]
- cryo-EM: near-atomic resolution / proteins need not be crystallised / used for membrane proteins or virus capsids [1]
- immunofluorescence: fluorescently tagged antibodies bind specific proteins / antigens [1]
- immunofluorescence: shows the location of a specific protein within the cell [1]
- immunofluorescence: several proteins can be labelled in different colours at once / used with a light microscope [1]
- max 4, with at least one point for each technique

8. [6] HL only

- mitochondria and chloroplasts descended from prokaryotes taken into a larger cell by endocytosis [1]
- all eukaryotes descend from a common ancestor with a nucleus, which then gained mitochondria [1]
- chloroplasts were gained later, in some eukaryotes only (algae and plants) [1]
- they have 70S ribosomes, like prokaryotes [1]
- unlike the 80S ribosomes in the eukaryotic cytoplasm [1]
- they have naked circular DNA, like prokaryotes [1]
- not linear chromosomes bound to histones [1]
- they can replicate / divide by a process like binary fission [1]
- the cell cannot make them from scratch [1]
- they have a double membrane, consistent with being taken in by a host cell / inner membrane resembles a prokaryote membrane [1]
- their gene sequences are most similar to aerobic bacteria (mitochondria) / cyanobacteria (chloroplasts) [1]
- the theory explains a wide range of observations, which makes it strong [1]
- max 6