1.2 Cells: Origin & Ultrastructure

Mark Schemes

Course	DP IB Biology
Section	1. Cell Biology
Topic	1.2 Cells: Origin & Ultrastructure
Difficulty	Medium

To be used by all students preparing for DP IB Biology HL
Students of other boards may also find this useful

1

The correct answer is **C** because an electron microscope does not have a resolution as small as 0.05 nm.

All the other statements are correct descriptions of either a light microscope or an electron microscope.

2

The correct answer is **D** because:

- A micrometer (µm) is 1000 times smaller than 1 mm
- Alveoli and white blood cells are microscopic structures that would need to be measured in µm
- A nanometer (nm) is 1000 times smaller than 1 µm
- The width of cell walls would be measured in nm as this is a very thin structure that surrounds a cell

A and **B** are incorrect because alveoli are microscopic structures, so measuring in mm would not give high enough precision. **C** is incorrect because measuring the width of cell walls in µm would not provide a measurement with a high enough precision.

3

The correct answer is **C** because:

- The nucleus, chloroplast and mitochondrion all have a double membrane.

  A nucleus is surrounded by a double membrane, which connects directly with the lumen of the rough endoplasmic reticulum.
  A chloroplast has a double membrane: the outer and inner membrane.
  A mitochondrion has a double membrane. The inner membrane is folded to form structures called the cristae, which contains many of the structures needed to synthesise ATP.

A, **B** and **D** are incorrect because endoplasmic reticulum and lysosomes have single membranes.

4

The correct answer is **C** because this structure is the cell membrane, which is responsible for controlling the exchange of substances into and out of cells (including palisade mesophyll cells).

A is incorrect because this structure could either be the chloroplast itself or the chloroplast membrane (although in this case it is not clear whether the label is pointing at the inner or outer membrane). **B** is incorrect because this structure is the cell wall of the palisade mesophyll cell. **D** is incorrect because this structure is a thylakoid (multiple thylakoids form stacks of disks referred to as grana, several of which can be seen in the electron micrograph).

5

The correct answer is **C** because:

- Eukaryotic cells contain two types of endoplasmic reticulum in the cytoplasm: the rough endoplasmic reticulum (RER) and the smooth endoplasmic reticulum (SER).
- The DNA in eukaryotic cells is wound around proteins called **histones** to make chromatin that forms the chromosomes.
- No eukaryotic cells are less than 1 µm in diameter. They usually range between 10–100 µm in diameter, whilst prokaryotic cells usually range between 0.1–5 µm in diameter.

6

The correct answer is **D** because products of metabolism (such as enzymes) can work intracellularly (inside the cell) or extracellularly (outside the cell).

A is incorrect because lysosomes contain hydrolytic enzymes and are responsible for breaking down waste material in cells. **B** and **C** are incorrect because many products of metabolism (eg. enzymes) can work internally (eg. enzymes that catalyse intracellular reactions) or externally (eg. digestive enzymes like salivary amylase).

7

The correct answer is **D** because structure I is the cytoplasm and structure IV is the cell membrane. All cells, including prokaryotic cells, contain these structures.

A is incorrect because the cell membrane would also be present in prokaryotes. **B** is incorrect because structure II is likely to be a chloroplast. After the nucleus and vacuole, the chloroplast is the next biggest organelle. It could also be a mitochondrion, another membrane-bound organelle like the chloroplast. Prokaryotic cells do not contain membrane-bound organelles. **C** is incorrect for the same reason and because structure III is the vacuole. The vacuole stores the cell sap, it is surrounded by the tonoplast, which is a membrane.

8

The correct answer is **D** because Pasteur's experiments showed that cells can only be formed by division of pre-existing cells. The swan-necked flask used by Pasteur has a specially shaped entrance that stopped mould spores from entering the sterilised broth. As the broth was sterilised (by boiling) before being transferred to this flask, it contained no pre-existing cells.

A, **B** and **C** are all scientifically correct statements but were not findings of Pasteur's work.

9

The correct answer is **B** because this provides evidence that mitochondria were once free-living prokaryotic organisms, with their own genetic material. These prokaryotes had developed the process of aerobic cell respiration and larger prokaryotes (that could only respire anaerobically) must have, at some point, taken them in by endocytosis, allowing them to live inside their cytoplasm. This is the basis of the endosymbiotic theory.

A, **C** and **D** are all scientifically correct statements but do not provide evidence for the endosymbiotic theory.

10

The correct answer is **A**. The clue here is the **single circular chromosome**, a characteristic of **prokaryotic cells**. The chromosome is first replicated and each copy moves to a different end of the cell. The cell then divides into two genetically identical daughter cells. Cell division in all prokaryotic cells (e.g. bacteria) occurs via binary fission.

B is incorrect because cytokinesis only refers to the final stage of cell division in **eukaryotic cells** (after the replication and division of DNA) during which the cytoplasm of a single cell divides into two daughter cells. **C** and **D** are incorrect because these are two cell division processes that produce new cells (mitosis) and gametes (meiosis) in **eukaryotes**, so they must involve linear, not circular, chromosomes.