

Answers to self-assessment questions

1 Cell structure

1.1 Structures found in both animal and plant cells:

- nucleus with nucleolus and chromatin
- cytoplasm containing mitochondria, Golgi apparatus and other small structures
- cell surface membrane.

Structure found only in animal cells:

- centriole.

Structures found only in plant cells:

- chloroplasts
- large, permanent central vacuole
- cell wall with middle lamella and plasmodesmata.

1.2 a Actual diameter = 20 μm (see caption)

$$\text{Diameter on diagram} = 60 \text{ mm} = 60\,000 \mu\text{m}$$

$$\begin{aligned}\text{Magnification, } M &= \text{size of image, } I \div \text{actual size of specimen, } A \\ &= 60\,000 \div 20\end{aligned}$$

$$\text{Therefore magnification} = \times 3000$$

b Magnification = $\times 20\,000$ (see caption)

$$\text{Length on micrograph} = 65 \text{ mm} = 65\,000 \mu\text{m}$$

$$\begin{aligned}\text{Size of specimen, } A &= \text{size of image, } I \div \text{magnification, } M \\ &= 65\,000 \div 20\,000\end{aligned}$$

$$\text{Therefore actual size of chloroplast} = 3.25 \mu\text{m}$$

1.3 The resolution of a microscope is limited by the radiation used to view the specimen. Resolution equals half the wavelength of the radiation used. The shortest wavelength of light is 400 nm, therefore the resolution of a light microscope is 200 nm. The diameter of a ribosome is much smaller than this, namely 25 nm.

1.4 Detail seen with the electron microscope, but not apparent using a light microscope:

- in the **nucleus**, chromatin can be distinguished
- the nucleus is seen to be surrounded by a double membrane (**envelope**) with **pores** in it
- **mitochondria** have a surrounding double membrane (envelope), the inner layer forming finger-like folds pointing inwards

- **endoplasmic reticulum** is extensive throughout the cell, some with **ribosomes (rough)** and some without (**smooth**)
- small structures seen under the light microscope can be distinguished by the electron microscope as **lysosomes** and **vesicles**
- free **ribosomes** are seen throughout the cell
- the **centriole** is seen to be two separate centrioles
- finger-like extensions of the cell surface membrane, known as **microvilli**, are seen.

1.5 Detail seen with the electron microscope, but not apparent using a light microscope:

- in the **nucleus**, chromatin can be distinguished
- the **nuclear membrane** can be seen as a double structure (envelope), continuous with the rough endoplasmic reticulum, and with pores in it

- there is extensive **rough** and **smooth endoplasmic reticulum** throughout the cell
- free **ribosomes** in the cytoplasm
- the **mitochondria** have a double membrane (envelope), the inner layer having folds into the matrix
- **chloroplasts** have a double outer membrane (envelope)
- **grana** can be seen in the chloroplast, as stacks of sacs connected to other grana by longer sacs (**thylakoids**).

1.6 Cell surface membrane: essential because it forms a partially permeable barrier between the cell and its environment, regulating movement of materials into and out of the cell. This is necessary to maintain an environment inside the cell which is different from that outside the cell.

Cytoplasm: site of metabolic activity; contains biochemicals in solution.

Ribosomes: sites of protein synthesis, an essential activity of all cells. (DNA controls cells by controlling which proteins are made.) Protein synthesis is a complex process involving the interaction of many molecules; the ribosome provides a site where this can happen in an organised way.

DNA: the genetic material. Contains the information which controls the activities of the cell. Has the ability to replicate itself, enabling new cells to be formed.

Cell wall (absent in animal cells): prevents the cell from bursting as a result of osmosis if it is exposed to a solution of higher water potential.