Cell biology

Eukaryotes and prokaryotes

1 a Nucleus – B; Cytoplasm – C.

   b *Any two from:* This cell has a nucleus, or prokaryotic cells do not have a nucleus; This cell has does not have a cell wall, or prokaryotic cells have a cell wall; This cell does not contain plasmids, or prokaryotic cells can contain plasmids; 'Prokaryotes can have flagella' is allowed.

   c $0.1 \times 1000 = 100 \, \mu m$

   d 0.6 mm

Animal and plant cells

1 Absorbs sunlight for photosynthesis – Chloroplasts; Provides strength to the cell – Cellulose cell wall; Filled with cell sap to keep the plant turgid – Permanent vacuole.

2 a A – cellulose cell wall; B – chloroplast; C – nucleus.

   b Cells near the top of a leaf have more chloroplasts to absorb more sunlight; for photosynthesis.

Cell specialisation and differentiation

1 a Many mitochondria

   b *Any two from:* Xylem cells; Phloem cells; Muscle cells.

   c To move mucus; out of the lungs OR To move an ovum; along the fallopian tube/oviduct.

2 a A cell that is undifferentiated and can become any type of cell.

   b Embryo

   c Take stem cells and grow them in a laboratory; Expose cells to chemicals/hormones to make them differentiate into a type of specialised cell; Grow the specialised cells on a Petri dish so that they form tissues; Use the tissues to form the new organ.

Microscopy

1 a The cells are not plant cells; There are no visible cellulose cell walls, permanent vacuole or chloroplasts.

   b Magnification $= \dfrac{5 \, cm}{0.5 \, \mu m} = \dfrac{50\,000 \, \mu m}{0.5 \, \mu m}$
   $= \times 100\,000$

2 Higher magnification/resolution; Able to see sub-cellular structures clearly/in detail.

3 Size of image = magnification $\times$ size of real object;
   $= 200 \times 10$;
   $= 2000 \, \mu m$ or 2 mm.

Using a light microscope

1 a Move the lowest magnification objective lens over the specimen; Move the stage by moving the course focus, until the cells are in focus; Move the objective lens to a higher magnification, and focus using the fine focus.

   b To see the cells/tissues more clearly; different stains can be used to identify tissues/organelles.

   c $\times 400$

2 a

	Number of cells after 12 hours			
	1	2	3	Mean
With mitotic inhibitor	12	10	**11**	11
Without mitotic inhibitor	108	110	106	**108**

   b *Any two from:* Type of cells; Starting number of cells; Temperature; Volume of nutrient broth/culture medium.

   c Use different concentrations of mitotic inhibitor.

Mitosis and the cell cycle

1 a G2 phase – Chromosomes are checked; S phase – Chromosomes are replicated; M phase – The cell divides into two daughter cells; Cytokinesis – Physical process of cell division.

   b So that when the cell divides during mitosis; each daughter cell has the correct number of sub-cellular structures.

2 i

cell membrane

chromosome

cytoplasm
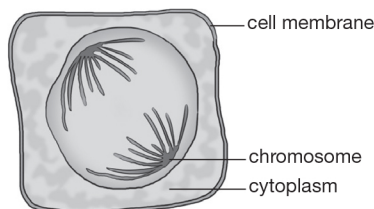
   ii The replicated chromosomes are separating; to the opposite sides of the cell.

3 26 (lb)

Stem cells

1 B

2 *Any two from:* Replacing/repair of cells; Growth; Used in medical research/treatments; Meristem used in plant cloning.

3 Meristem tissue; found in the shoots, roots and flowering parts of the plant.

4 Stem cells can be used to make organs for transplants, so there is no waiting time for organ donors; However, there is an ethical objection to using embryos, as they could potentially grow into humans/animals; Using stem cells in medical treatments means that the body will not reject the cells; but there is a risk of transfer of viral infection from putting stem cells into the body.

Diffusion

1 a Diffusion is the spreading out of the particles of any substance in solution, or particles of a gas; resulting in a net movement from an area of higher concentration to an area of lower concentration.

   b *Any one from:* In the lungs for exchange of oxygen/carbon dioxide; In the small intestines for the movement of the products of digestion.

2 a $24:8 = 3:1$;
   $96:64 = 3:2$
   $= 1.5:1$;
   Organism B has the smallest surface area to volume ratio.

   b They cannot get all the substances they need by diffusion alone; They need to increase the rate of diffusion; by increasing the surface area/providing a short diffusion pathway.

3 Extract solution from outside the Visking tubing; at regular intervals/named time interval; test for the presence of glucose. Factors – surface area, concentration gradient and diffusion thickness.

Osmosis

1 Osmosis is the diffusion of water from a dilute solution to a concentrated solution; through a partially permeable membrane.

2 From inside the cell to outside the cell.

3 Percentage increase $= \dfrac{(14 - 10)}{10} \times 100\%$
   $= 40\%$

4 a 3% sugar solution; because the plotted line crosses the x-axis at 3%.

   b The same volume of water left the cell as moved into the cell.

Investigating the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue

1 a In order, the percentage change is: 16.7; 0.0; –25.0; –34.1