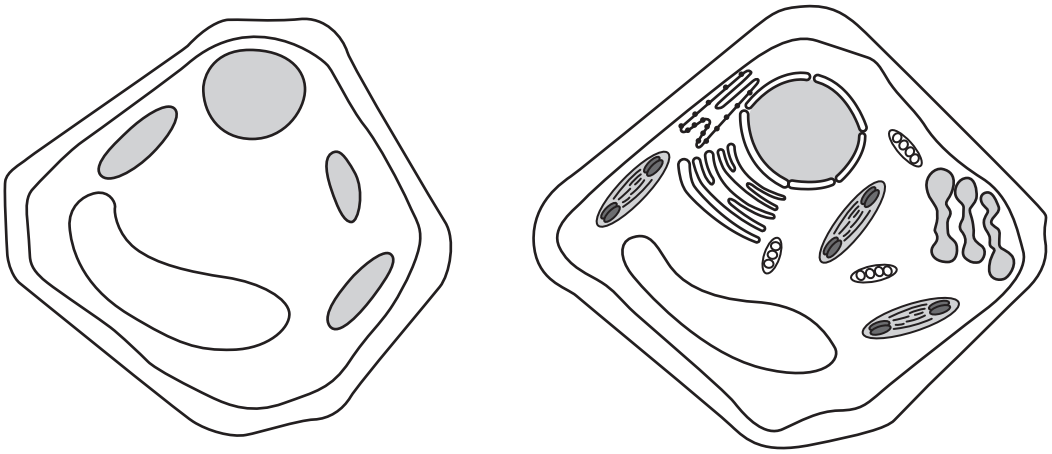
Answer **all** the questions.

1 Fig. 1.1 shows a student's diagrams of two plant cells. Each cell was observed using a different type of microscope. The cells are not drawn to scale.

(a)



Cell A **Cell B**

Fig. 1.1

(i) **Cell B** in Fig. 1.1 was observed using an electron microscope.

Give one piece of evidence from Fig. 1.1 that supports this.

.....

..... **[1]**

(ii) Give one way that an image produced by a laser scanning confocal microscope differs from that produced by an electron microscope.

.....

..... **[1]**

(b) Meiosis is a type of nuclear division.

Fig. 1.2 shows a photomicrograph of plant cells undergoing meiosis.

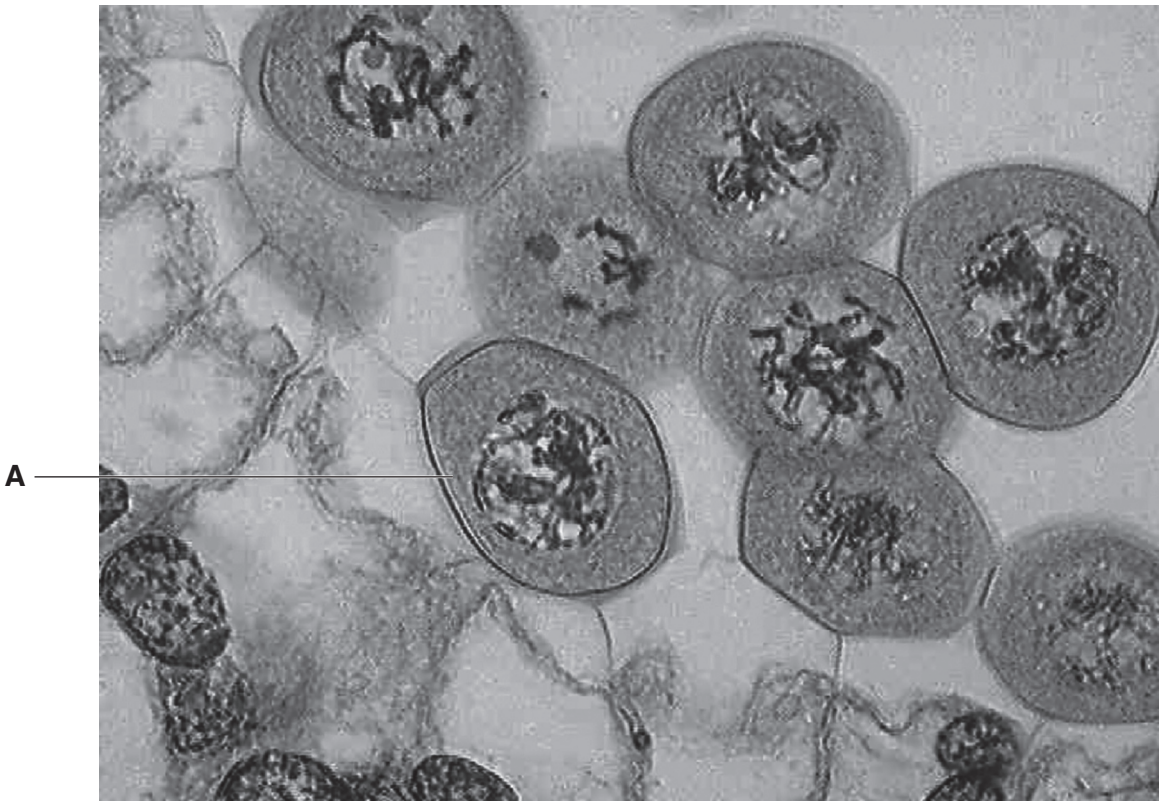


Fig. 1.2

(i) Identify the stage of meiosis 1 shown in the cell labelled **A**.

..... **[1]**

(ii) Based only on your observations of Fig. 1.2, state **two** reasons for your answer in **(b)(i)**.

.....

.....

.....

..... **[2]**

(iii) Another stage of meiosis is metaphase 1.

Explain how the organisation of homologous chromosomes during metaphase 1 increases genetic variation.

.....

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..... **[3]**

(c) The use of stem cells is being evaluated for the treatment of certain human diseases.

Name **two** potential sources of human stem cells and for **one** source, describe an ethical issue associated with the use of stem cells.

.....

.....

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.....

.....

..... **[4]**

22 Biological processes can be investigated using models.

The effect of cell size on diffusion can be investigated using cubes of agar jelly to represent cells of different sizes.

A student used cubes of agar jelly containing universal indicator, which changes colour at different pH.

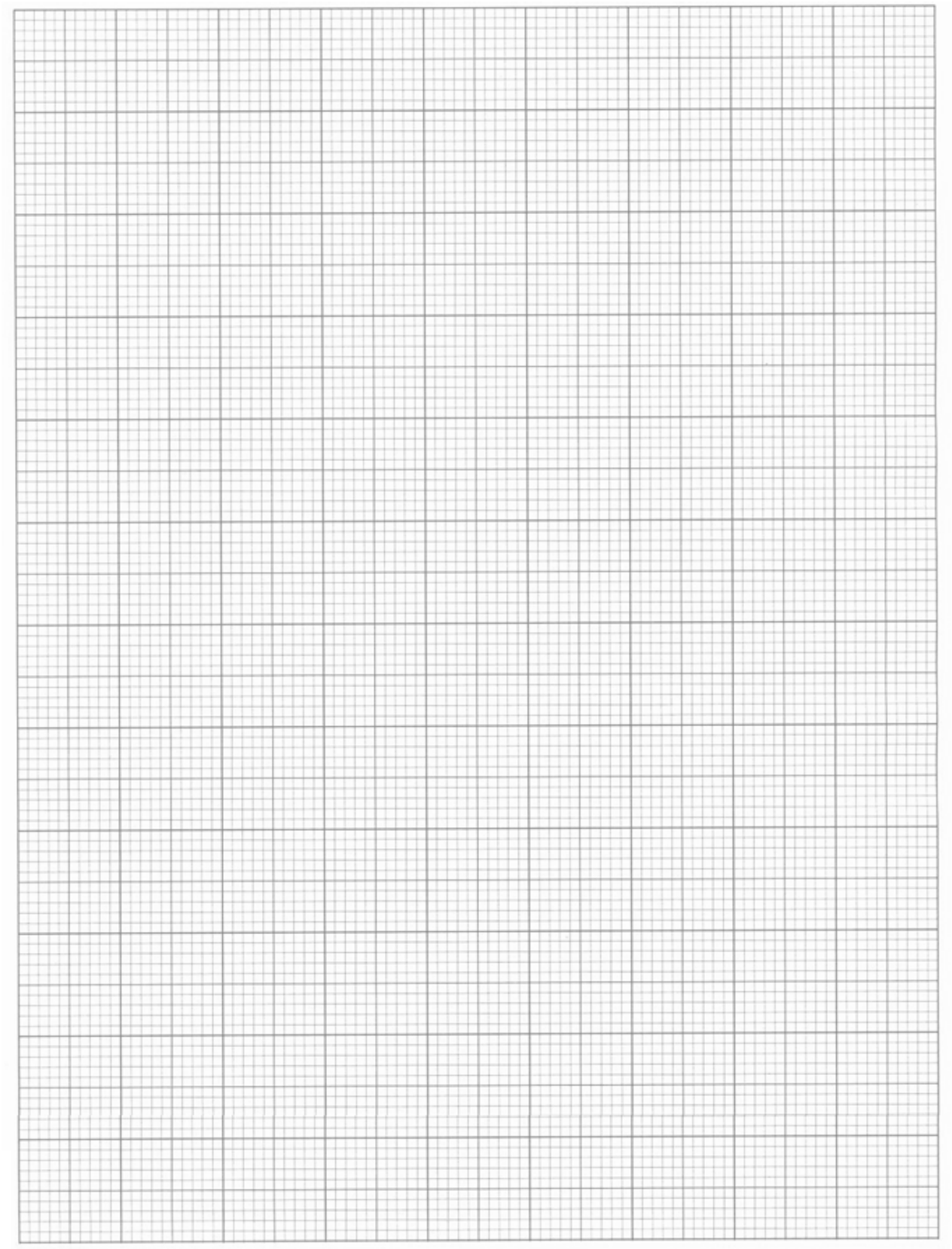
- Five different sizes of cubes were cut from a larger block using a scalpel.
- Cubes were placed in a beaker containing hydrochloric acid (enough to cover the cubes) and a stopwatch was started.
- After 2 minutes the cubes were removed, rinsed with distilled water and blotted dry.
- Acid absorbed at the outside continued diffusing towards the centre of the blocks.
- The time taken for the blocks to turn entirely red was recorded.

The results are shown in **Table 22.1 on the insert**.

(a) What was the role of the universal indicator in this experiment?

…… **[1]**

(b) **(i)** In the space provided **on page 16**, plot a graph of mean time taken to turn red against surface area to volume ratio. **[4]**



(ii) Describe the pattern shown by your graph.

……

……

…… **[1]**

(iii) An identical procedure was carried out on a cube of unknown size. This cube turned red after 21.5 min.

Use your graph to estimate the surface area to volume ratio of this unknown cube.

Answer…… **[1]**

(iv) Suggest how the original procedure could be modified in order to improve the accuracy of your answer to part **(iii)**.

……

……

…… **[1]**

(c) Use the data in **Table 22.1, on the insert**, to calculate the **rate** of diffusion of acid in **Cube C** from the outer surface to the centre of the cube.

Answer…… **[3]**

(d) **(i)** Explain which of the mean values, **A - E**, is likely to be the least accurate. You should process data from the table to support your answer.

……

……

……

…… **[2]**

(ii) Identify one limitation in the practical procedure that may have caused the results to be inaccurate **and** explain which cube's results are most likely to have been affected by this limitation.

Limitation **……**

……

……

Is more likely to affect cube **…..** because **……**

……

……

……

[3]

(e) The procedure described above involved the use of model cells. Hydrogen ions from the acid were able to travel freely to the centre of the agar jelly cubes.

The rate of movement of molecules from the plasma membrane towards the centre of **living** cells is often **greater** than that seen in the procedure the student carried out even if the cells are kept at the same temperature.

Suggest a reason for this observation.

……

……

…… **[1]**

SECTION B

Answer **all** the questions.

21 Fig. 21.1 shows some of the apparatus used in an experiment investigating water potential in potato tuber tissue.

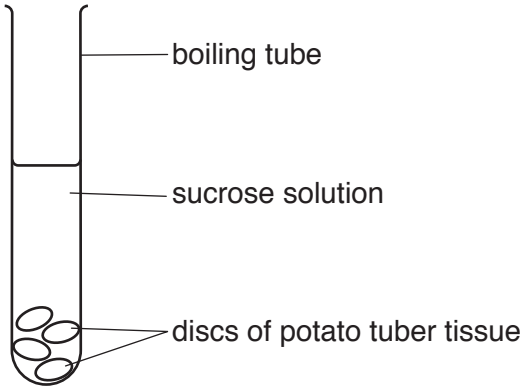


Fig. 21.1

The discs were placed in boiling tubes containing sucrose solutions of different concentrations for four hours. The percentage change of mass was then calculated.

The results are shown in Table 21.2.

Concentration of sucrose solution (mol dm^{-3})	Change in mass of potato discs (%)
0.00	+18.00
0.10	+12.50
0.20	+ 2.50
0.30	– 3.00
0.40	– 8.00
0.45	–11.50

Table 21.2

(a) (i) State **two** details of the procedure that must be followed to obtain valid results.

1 .....

.....

2 .....

.....

[2]

(ii) Explain how a student could use the data in Table 21.2 to determine the water potential of the potato tuber tissue.

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.....

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..... **[3]**

(b) Fig. 21.3 shows a diagram of a cell from a potato tuber disc that was placed in 0.45 mol dm^{-3} sucrose solution.

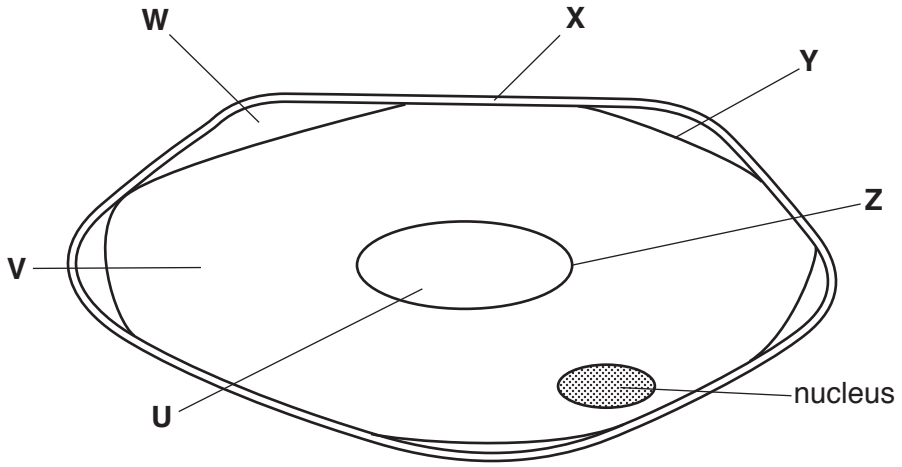

Fig. 21.3

(i) Identify the parts of the cell labelled **X**, **Y** and **Z**.

X .....

Y .....

Z .....

[3]

(ii) What will be found at **W** in the immersed cell?

..... **[1]**

(c) Halophytes are plants that have the ability to live in soils with a very low water potential. In the UK these plants form part of salt marsh communities.

Suggest **and** explain how the root hairs of halophytes are able to absorb water by osmosis from the soil of the salt marsh.

.....

.....

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.....

.....

..... **[2]**

22 Many multicellular organisms need to be able to convert monosaccharides into polysaccharides and back again.

Mammals convert the monosaccharide glucose into a highly branched polysaccharide called glycogen, which gets stored in liver cells.

(a) Explain why mammals store glycogen instead of glucose.

.....

.....

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.....

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.....

.....

..... **[3]**

(b) Humans use the enzyme α-amylase to break down polysaccharides in food for absorption into the blood.

The gene for human α-amylase is found on chromosome 1.

The gene is transcribed in the nucleus and translation occurs on the rough endoplasmic reticulum in cells of the salivary gland.

Describe how the molecule is prepared and secreted by cells of the salivary gland after translation has taken place.

.....

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.....

..... **[3]**

17 (a) Chromista are photosynthetic protoctists that live in water.

Chromista are different from other photosynthetic organisms because they contain the pigment chlorophyll *c*.

Chlorophyll *c* is not found in plants.

(i) Outline the importance of photosynthetic pigments in photosynthesis.

.....

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..... **[4]**

(ii) The wavelengths of light absorbed by chlorophyll *c* are different from those wavelengths absorbed by chlorophyll *a* and chlorophyll *b*.

Suggest why Chromista need pigments that are different from those of other photosynthetic organisms.

.....

.....

..... **[1]**

(b) Fig. 17.1 is a diagram of the chloroplast found in a Chromista cell.

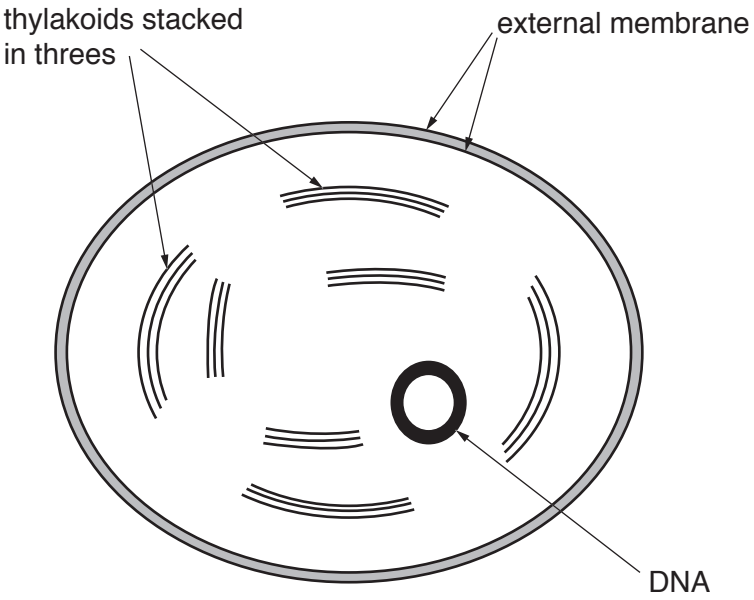

Fig. 17.1

Outline the structural differences between the Chromista chloroplast in Fig. 17.1 and the chloroplasts found in flowering plants.

.....

.....

.....

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..... **[2]**

(c) Fig. 17.2 is a diagram of part of the plasma membrane of a Chromista cell.

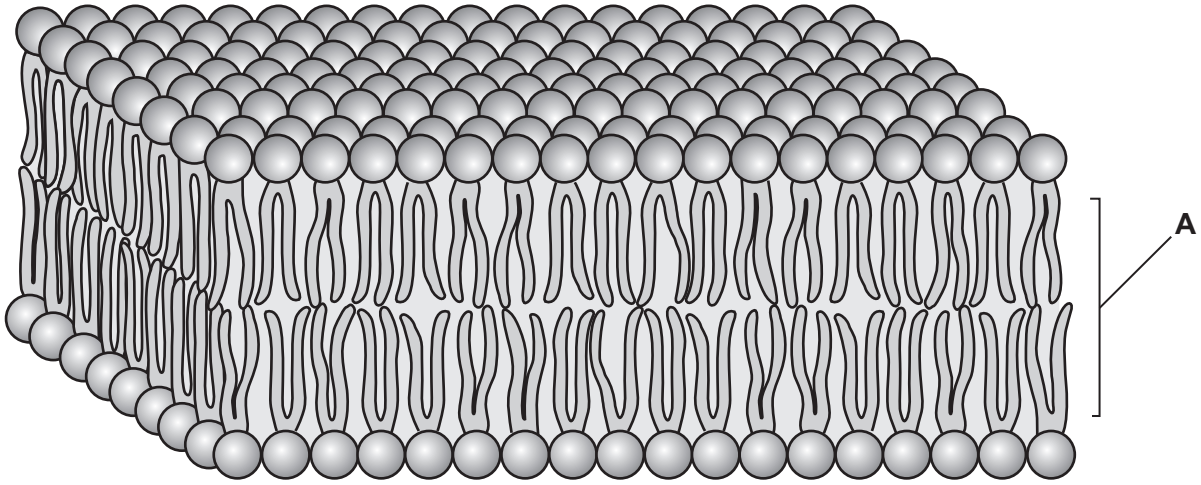

Fig. 17.2

(i) State and explain how **one** property of region **A** in Fig. 17.2 contributes to the stability of the plasma membrane.

.....

.....

.....

.....

..... **[2]**

(ii) There are differences between the plasma membrane and membranes within cells.

Outline the role of membranes **within** cells.

.....

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.....

.....

..... **[2]**

SECTION A

You should spend a maximum of 20 minutes on this section.

Answer **all** the questions.

1 Which statement explains the significance of mitosis in the development of whole organisms?

A Mitosis can be controlled at certain points in development, which will change body plans.

B Sex cells are produced by mitosis, which allows new organisms to be produced.

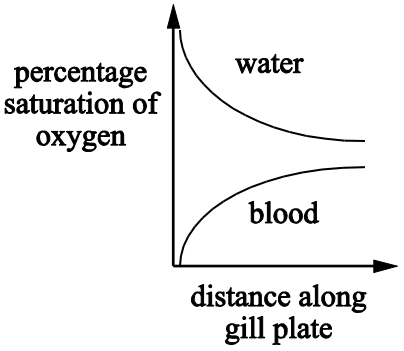
C Mitosis limits the total number of cells in an organism, which will change its shape.

D Budding in yeast is an example of mitosis, producing new multicellular organisms.

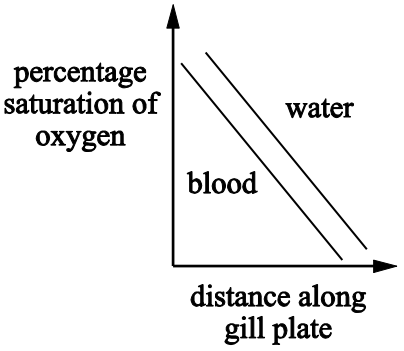
Your answer ☐ **[1]**

2 Which graph represents the counter-current exchange system in fish gills?

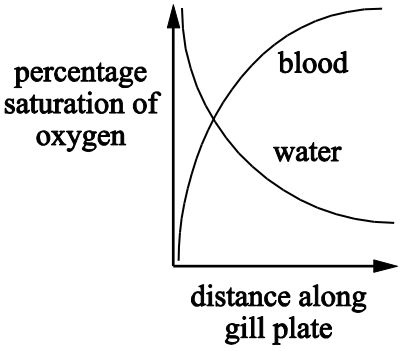
A



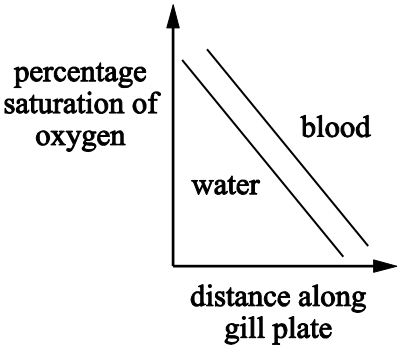
B



C



D



Your answer ☐ **[1]**

3 Cells require vitamins and minerals in order to function correctly. These vitamins and minerals need to cross the plasma membrane.

Vitamins are either fat soluble or water soluble. Vitamins A, D, E and K are fat soluble.

Which of the following combinations enter a cell by facilitated diffusion?

A vitamin A and calcium ions

B vitamin C and calcium atoms

C vitamin C and calcium ions

D vitamin A and calcium atoms

Your answer ☐ **[1]**

4 Animals receive different stimuli from their environment. Their synapses can manage multiple stimuli, often resulting in one response (such as a muscle twitching).

This action of the synapse is an example of

A spatial summation

B all or nothing response

C temporal summation

D cell signalling

Your answer ☐ **[1]**

5 The kidneys of a healthy individual filter 178 dm^3 day^{-1} of fluid from the glomeruli into the renal capsules. However, only 1.5 dm^3 day^{-1} of urine is produced.

What percentage of the filtrate is reabsorbed back into the blood?

A 176.5

B 0.8

C 11.8

D 99.2

Your answer ☐ **[1]**

6 The following mechanisms are used to move water through plants:

i) diffusion
ii) osmosis
iii) mass flow.

Which row correctly identifies the mechanism used at each point of the transpiration stream?

	Into root cells	**Across root via symplast pathway**	**Up the stem in the xylem**	**Across leaf via apoplast pathway**	**Out of leaf via stomata**
A	osmosis	osmosis	mass flow	mass flow	diffusion
B	diffusion	osmosis	osmosis	mass flow	diffusion
C	diffusion	osmosis	osmosis	mass flow	osmosis
D	osmosis	osmosis	mass flow	mass flow	osmosis

Your answer ☐ **[1]**

7 Citrate synthase catalyses the conversion of oxaloacetate into citric acid in the Krebs cycle. It exhibits product inhibition.

Which of the following is the correct description of citrate synthase?

	Type of respiration involved in	**Location of enzyme**	**Inhibitor**
A	anaerobic	cytoplasm	citric acid
B	aerobic	mitochondria	citric acid
C	aerobic	mitochondria	oxaloacetate
D	anaerobic	cytoplasm	oxaloacetate

Your answer ☐ **[1]**

8 Which of the following describes the process that happens during **repolarisation** of a neurone during the action potential?

	Sodium channels	Potassium channels	Membrane potential
A	closed	open	decreasing
B	open	closed	decreasing
C	open	closed	increasing
D	closed	open	increasing

Your answer ☐ **[1]**

9 An unknown solution of a single sugar was tested. The results were recorded in **Table 9.1**.

Colours observed after testing	
Benedict's test for reducing sugars	**Benedict's test for non-reducing sugars**
blue	brick red

Table 9.1

Identify the unknown sugar.

A fructose

B lactose

C sucrose

D glucose

Your answer ☐ **[1]**

10 An anticodon sequence of five successive tRNA molecules involved in protein synthesis was analysed and found to have the following percentage base composition.

Adenine 40; Cytosine 27; Guanine 13; Thymine 0; Uracil 20 %

Which row shows the percentage base composition of the template strand of the original DNA molecule?

	Adenine	Cytosine	Guanine	Thymine	Uracil
A	40	27	13	20	0
B	20	13	27	40	0
C	20	13	27	0	40
D	40	27	13	0	20

Your answer ☐ **[1]**

11 **Fig. 11.1** shows the heat flow through the skin of an athlete during vigorous exercise. Exercise starts at 400 seconds.

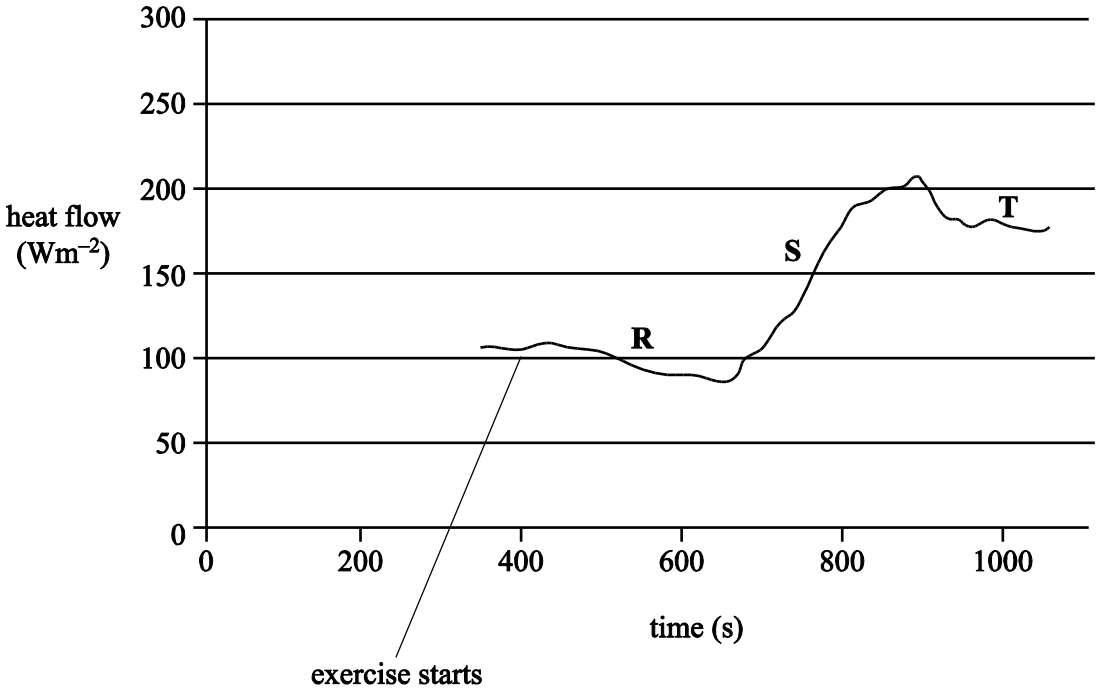


Fig. 11.1

Blood flow can be directed to those parts of the body that make the greatest demands.

Which row gives the best explanation of the stages in **Fig. 11.1**?

	R	S	T
A	Blood directed away from skin to avoid excess heat loss	Blood directed towards skin to release excess heat	Balance achieved between loss of excess heat and the need for oxygen in the muscles
B	Blood directed away from skin and towards the muscles to supply more oxygen for respiration	Blood directed towards skin to release excess heat	Balance achieved between heat loss and excess heat created in the muscles
C	Blood directed away from skin to avoid excess heat loss	Blood directed towards skin to gain heat from the environment	Balance achieved between heat loss and excess heat created in the muscles
D	Blood directed away from skin and towards the muscles to supply more oxygen for respiration	Blood directed towards skin to gain heat from the environment	Balance achieved between loss of excess heat and the need for oxygen in the muscles

Your answer ☐ **[1]**

12 Which of the following is/are interventions in the control of blood glucose concentration?

Statement 1: Insulin injection.

Statement 2: Regular cardiovascular exercise.

Statement 3: Glucagon injection.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

13 Which of the following statements is/are true?

Statement 1: Microtubules are part of the '9 + 2' formation in bacterial flagella.

Statement 2: Microtubules can be prevented from functioning by a respiratory inhibitor.

Statement 3: Microtubules are involved in moving chromosomes from the equator to the poles of the cell during mitosis.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

14 Blood vessels are adapted for their function.

Which of the following statements is/are true?

Statement 1: The walls of arteries near the heart contain a lot of elastic fibres so that they can stretch and recoil to maintain blood pressure.

Statement 2: The walls of the venules contain little muscle.

Statement 3: The walls of arteries contain a lot of muscle fibres to contract and generate pressure in the blood.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

15 Phospholipid bilayers play crucial roles within plant cells.
Which of the following statements linked to the importance of membranes in plant cells is/are true?

Statement 1: ATP synthase embedded in thylakoid membranes maintains chemiosmotic gradients.

Statement 2: Phospholipid bilayers within the chloroplast are impermeable to protons.

Statement 3: Thylakoid membranes contain electron transport chain proteins.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

3 **(a)** A cytoskeleton is present in all eukaryotic cells. One of its functions is to control the movement of organelles.

State how the cytoskeleton moves organelles around the cell.

.....

..... **[1]**

(b) Epithelial cells in the airways of mammals play an essential role in defences against pathogens.

Explain the function of epithelial cells in the airways of mammals in the defence against pathogens **and** suggest the importance of the cytoskeleton in carrying out this function.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(c) (i) Phagocytes defend the body by engulfing and destroying pathogens in a process called phagocytosis.

A student produced a summary of the stages of phagocytosis, which is shown in Fig. 3.1.

The student made two errors in their summary. Describe what **two** corrections the student should make.

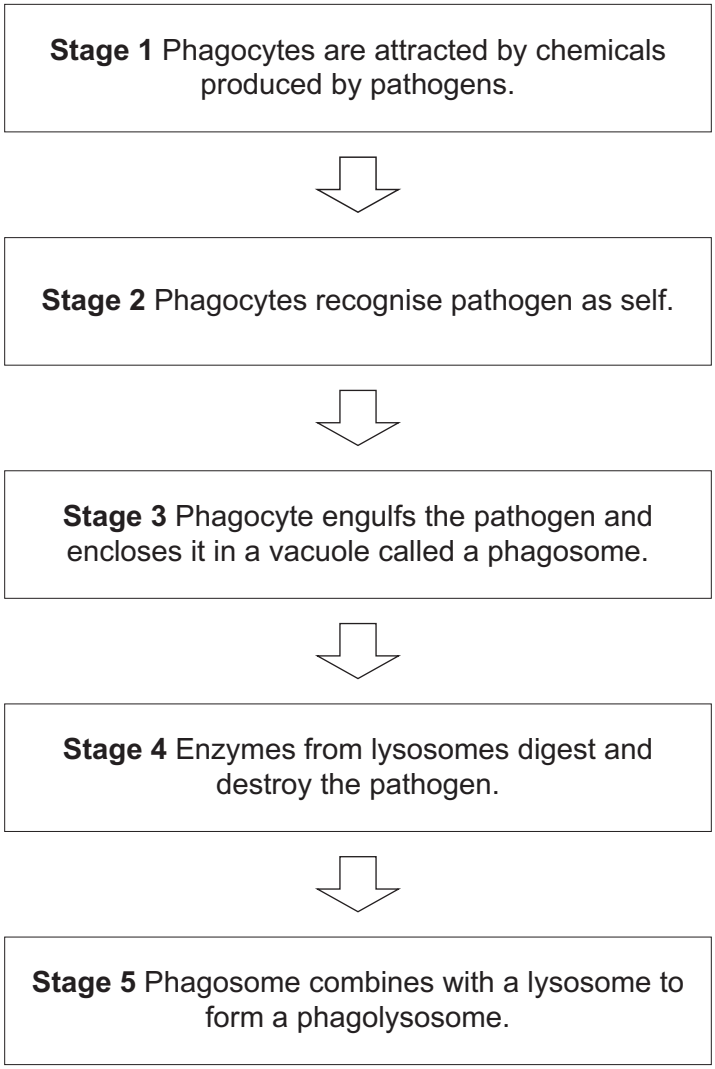


Fig. 3.1

Correction 1 .....

.....

.....

Correction 2 .....

.....

.....

[2]

(ii) Antibodies are defensive proteins carried in the bloodstream. Fig. 3.2 shows the simplified, incomplete structure of an antibody.

Complete Fig. 3.2 by **drawing and labelling** the missing part(s) of the antibody.

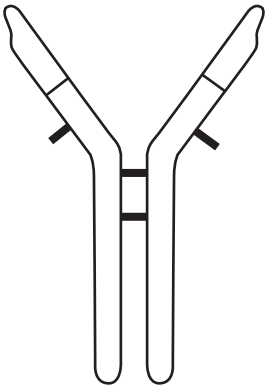


Fig. 3.2

[Answer on Fig. 3.2] **[1]**

24 In 1990, Carl Woese suggested a new top level taxon to the current system of classification of living organisms, which he termed a domain. He used his results from studying RNA to organise organisms into three distinct groups.

(a) (i) Name the cell component that appears in organisms of all three domains that Woese suggested.

..... **[1]**

(ii) One of the domains he suggested is called Eukarya.

Name the other **two** domains.

1 .....

2 .....

[2]

(iii) State **two** defining features of all members of the domain Eukarya.

.....

..... **[2]**

(b) Woese carried out a detailed study of RNA molecules in order to draw his conclusions.

Suggest **two** ways in which the scientific community are likely to have validated Woese's research.

.....

..... **[2]**

Question			Answer	Mark	Guidance
1	(a)	(i)	*you can now see* Golgi body / mitochondria / (smooth / rough) endoplasmic reticulum / ER / RER / SER / ribosomes **OR** organelles seen in more detail / grana (in chloroplast) / thylakoids (in chloroplast) / nuclear pore / cristae (in mitochondria) / membranes within organelles / double nuclear membrane / (double) nuclear envelope **OR** resolution is **,** higher / better ✓	1	**IGNORE** clarity **IGNORE** ref to size of organelles **DO NOT ACCEPT** chloroplast **IGNORE** ref to ultrastructure unqualified
1	(a)	(ii)	*LSCM image* has lower <u>resolution</u> (than EM) **OR** can have <u>fluorescen</u>t tag **OR** can see movement (as can be used on living cells) **OR** can see **,** different layers / at different depths (of the sample) ✓	1 max	**ORA** for electron microscope needs to be comparative **IGNORE** colour **IGNORE** ref to 2D / 3D / depth of field

Question			Answer	Mark	Guidance
1	(b)	(i)	prophase (1) ✓	1	**DO NOT ACCEPT** prophase II (as question states meiosis I)
1	(b)	(ii)	**1** chromosomes / chromatids , visible / condensed ✓ **2** chromosomes not **,** organised / yet aligned / arranged **OR** chromosomes not at **,** ends / equator ✓ **3** nuclear envelope (around chromosomes) / nuclear membrane is present / chromosomes separated from cytoplasm ✓ **4** no (visible) nucleolus ✓	2 max	**Mark the first 2 answers** **1** Needs to be a clear statement **2 ACCEPT** chromosomes , in different positions / scattered / spread out **3 ACCEPT** nuclear membrane starting to disappear **DO NOT ACCEPT** nuclear membrane has disappeared
1	(b)	(iii)	**1** independent / random **,** assortment ✓ **2** (homologous chromosomes) line up**,** across the centre of the cell / on the equator / on the metaphase plate ✓ **3** maternal or paternal chromosomes / either one of the homologous pair **,** can end up **,** facing either pole / in either (daughter) cell ✓ **4** each chromosome of the homologous pair **,** is genetically different / contains different alleles / contains different gene variant ✓	3 max	**4 ACCEPT** if described in terms of chromatids being genetically different

Question			Answer	Mark	Guidance
1	(c)		***2 max for sources*** embryonic / embryo ✓ fetus / fetal ✓ umbilical cord (blood) ✓ (adult) bone marrow (tissue) ✓ convert somatic cell into pluripotent cell ✓	**2 max**	**ACCEPT** e.g. breast milk / muscle / liver / placenta / etc. **ACCEPT** blastocyst
			ethical issue – must relate to one of their stated sources ethical issue identified – such as 1 from the list below ✓ *embryonic* **E1** embryo **,** destroyed / killed / discarded **E2** use of excess embryos from assisted fertilisation (IVF) **or** **or** **E3** debate about when life begins **or** **E4** embryo cannot give consent **or** *fetal* **F1** obtained from **,** miscarried / aborted **,** fetuses **or** *umbilical cord* **U1** detached from infant at birth anyway **or** *bone marrow* **B1** harvesting bone marrow is **,** painful **/** risky **or** **B2** donor babies / babies conceived specifically to provide a bone marrow transplant for a sibling (with a condition requiring the transplant) a statement indicating **,** judgement / opinion / understanding **,** of this ethical	**2**	**Note:** list of issues is not exhaustive – credit a well expressed issue **F1 IGNORE** ref to obtaining fetal stem cells by killing fetus but can still access the judgement mark Can only be awarded once the issue relating to one of their sources has been identified.

			issue ✓		**IGNORE** 'playing God' as an opinion

Question			Answer	Mark	Guidance
2	(a)			2	**IGNORE** any observations
			D1 put , (leaf) stalk(s) / petiole(s) , in , dye / stain / food colouring ✓		**D1 ACCEPT** 'stick' for 'stalk'
			D2 (then) cut , transversely / cross section ✓		**D2 ACCEPT** cut across , (leaf) stalk / petiole (with a sharp blade) a longitudinal , cut / section cut in half **IGNORE** **IGNORE**
			OR		
			M1 cut a (thin) , transverse / cross , section ✓		**M1 ACCEPT** cut a (thin) slice of (leaf) stalk / petiole (with a sharp blade) a longitudinal , cut / section cut in half **IGNORE** **IGNORE**
			M2 (then) add (named) stain / observe with microscope under low power ✓		

Question			Answer	Marks	Guidance
22	(a)		detect the presence of acid / H^+ ✓ measure end-point / dependent variable ✓	1	
	(b)	(i)	surface area to volume ratio on x-axis **and** time on y-axis ✓ plotted points occupy at least half of available area **and** linear scale on both axes **and** line of best fit drawn ✓ axes labelled time (min) **and** surface area to volume ratio / AW ✓ all points plotted correctly (to +/- half a 2 mm grid square) ✓	4	 **DO NOT ALLOW** if units given for x-axis **ALLOW** ecf for correctly plotted points on incorrectly-scaled graph
		(ii)	time taken for diffusion (to centre of cube) , increases as surface area to volume ratio decreases, ORA ✓	1	Answer must mention surface area to volume ratio **DO NOT ALLOW** if colour change is discussed in place of diffusion **IGNORE** rate **ALLOW** a description consistent with the graph the candidate has drawn
		(iii)	0.44 ✓	1	**ALLOW** answer in the range of 0.40 – 0.48 depending on candidate's plotted graph Answer must be reported to 2 decimal places
		(iv)	test cubes of (known) length between 10 and 20 mm ✓	1	
	(c)		0.35 / 0.347 ✓✓	3	**ALLOW** 0.69 / 0.694 for 1 mark **ALLOW** 0.3 or 0.3472 for 1 mark

Question			Answer	Marks	Guidance
			mm min^{-1} ✓		**ALLOW** mm/min
	(d)	**(i)**	*cube **A**, because…* time for test 2 different from others ✓ use of processed figures to support ✓	**2**	**ALLOW** calculated rates for cube **A** - **E** **ALLOW** calculated range compared with that of cubes **B** - **E**
		(ii)	*Limitation* inconsistency in surface area ✓ cube **A** ✓ *Because* It is the smallest cube so small error in cutting will have proportionately larger effect in a small cube / *idea that* error is a bigger proportion of total time ✓ *Limitation* using human eye and judgement to determine end point ✓ cube **E** ✓ *Because* largest cube so harder to see through 2cm of jelly / AW ✓	**3**	**ALLOW** mark only if one of the other two marks is awarded **ALLOW** mark only if one of the other two marks is awarded
	(e)		*idea of* involvement of cytoskeleton / vesicles ✓	**1**	**IGNORE** reference to different diffusion resistance
			Total	**17**	

SECTION B

Question			Answer	Marks	Guidance
21	(a)	(i)		max 2	*Mark first **two** answers only, ignoring the numbered sections* **IGNORE** mass / balance used / soak time / repeats **IGNORE** a list of variables unqualified
			1 discs same **,** size / thickness / surface area / surface area to volume ratio / diameter ✓		1 **ACCEPT** same cork borer used **ACCEPT** 'pieces of potato' etc. for 'discs' **ACCEPT** 'length' as equivalent to 'diameter' **IGNORE** same shape / similar size etc
			2 same (variety / part **,** of) potato ✓		
			3 no skin on potato ✓		
			4 *ref to* removing excess water before (re)weighing ✓		4 e.g. blotting / shaking
			5 same **,** number / amount **,** of discs (in each solution) ✓		
			6 same <u>volume</u> (sucrose) <u>solution</u> ✓		
			7 same temperature ✓		7 **ACCEPT** in context of room / environment / solution
			8 cover the tubes ✓		

Question			Answer	Marks	Guidance
21	(a)	(ii)	1 *idea that* no change of mass occurs when the water potential of (sucrose) solution = water potential of potato (tissue) ✓ 2 ref. to no change in mass (of potato) between 0.2 and 0.3 mol dm^{-3} ✓ 3 plot graph of concentration of **,** sucrose / solution **,** against (%) change in mass **and** find which (sucrose) concentration gives no change in mass of potato **OR** carry out the experiment again with more (sucrose) concentration intervals between 0.2 and 0.3 mol dm^{-3} ✓ 4 look up the water potential of the (sucrose) solution (e.g. on calibration curve or table) **,** of that concentration / of the concentration which gives no mass change ✓	max 3	**ACCEPT** Ψ for water potential throughout **IGNORE** ref to solute potential / isontonic 2 correct units must be stated once **ACCEPT** 'between 0.2 and 0.3 mol dm^{-3} the water potential of the solution and the potato will be the same' 3 x and y axes interchangeable When an axis has been identified it can be referred to by letter later. Needs some ref to the mass change being 0. If the change in mass axis has previously been identified, then ref to that axis value being 0 is equivalent to no change in mass e.g. '*Should draw a graph of sucrose concentration on the x axis and change in mass of potato discs on the y axis. The point where the line of best fit crosses the x axis (when the y axis = 0) is the concentration of sucrose in the potato discs.*' will get the mark '*Draw a graph with change in mass of potato discs on the y axis and concentration of sucrose solution on the x axis and draw a line of best fit. Where the line intercepts the x axis is where the change in mass of potato discs is zero.*' will get the mark 3 correct units must be stated once

Question			Answer	Marks	Guidance
21	(b)	(i)	X (cellulose) cell wall ✓ Y cell surface membrane / plasma membrane ✓ Z vacuole membrane / tonoplast ✓	max 3	*If additional incorrect answer given, then 0 marks* Y **ACCEPT** plasmalemma Z **IGNORE** vacuole
21	(b)	(ii)	sucrose solution ✓	1	*If additional incorrect answer given, then 0 marks* **ACCEPT** sugar solution / external solution / solution placed in **DO NOT CREDIT** 'solution' unqualified
21	(c)		there is a lower water potential inside root hair (cells) ✓ actively transport / pump , (mineral) ions / salts , into root hair(s) (cells) **or** root hair(s) (cells) store / contain , (mineral) ions / salts / solutes ✓	2	**IGNORE** ref to large surface area and short diffusion path **IGNORE** ref to solute potential / isotonic **ACCEPT** Ψ for water potential 'it' or 'they' = root hairs **IGNORE** ref to roots or root cells unqualified as hairs **ACCEPT** root hair , has / creates , a lower water potential (than soil) **ACCEPT** maintains / sets up / establishes , a (steep) water potential gradient Look for a comparison in water potential between the cell and the soil **IGNORE** solutes / sugars / hydrogen ions **ACCEPT** named ions **ACCEPT** named ions **ACCEPT** named solutes e.g. sugars
			Total	11	

Question			Answer	Marks	Guidance
22	(a)		*glycogen is* **1** insoluble **,** so has no effect on **,** water potential / Ψ (of cell) ✓ **2** <u>metabol</u>ically inactive ✓ **3** compact / lots can be stored in a small space ✓ **4** able to store **,** large amounts / lots **,** of <u>energy</u> ✓ **5** (highly branched so) has lots of ends for **,** adding / removing **,** <u>glucose</u> (when needed) **or** can be broken down **,** fast / quickly / rapidly **,** to release <u>glucose</u> ✓	**3**	**ACCEPT** ORA for glucose for **mps 1, 2 3 & 4 only** **1 ACCEPT** insoluble so has no osmotic effect (on cell) **5 IGNORE** ref to surface area **Note:** 'compact so can store large amounts of energy' = 2 marks (mps 3 & 4)

Question			Answer	Marks	Guidance
22	(b)			3 max	***NOTE*** *answers must be the in context of* ***protein*** *transport.* *Penalise once if a different material (e.g. gene) is transported* to max 2
			1 <u>transport</u> vesicle from RER ✓		
			2 modification / processing / folding ✓		**2** **ACCEPT** example of modification e.g. converted into a glycoprotein **ACCEPT** in context of RER or Golgi
			3 in / at , Golgi (body / apparatus) ✓		**3** **IGNORE** SER / smooth endoplasmic reticulum
			4 (packaged into) <u>secretory</u> vesicle ✓		
			5 vesicles move along the cytoskeleton ✓		**5** **ACCEPT** use of motor proteins / chaperones / microtubules
			6 (vesicle) fuses with , cell <u>surface</u> / plasma , membrane ✓		**6** **ACCEPT** merges with **DO NOT ACCEPT** binds / attaches / dissolves
			7 (secretion occurs by) <u>exocytosis</u> ✓		**7** **DO NOT ACCEPT** exocytosis in context of excretion (rather than secretion) **DO NOT ACCEPT** vesicle being released by exocytosis

Question			Answer	Marks	Guidance
17	(a)	(i)	(pigments) absorb , light / photons ✓ electrons , excited / raised to higher energy level ✓ accessory pigments pass energy to , reaction centres / primary pigments ✓ primary pigments , become oxidised / lose electrons / pass electrons to ETC ✓ for light dependent reaction / photophosphorylation ✓	4 max	**ALLOW** named accessory pigments e.g. chlorophyll b / xanthophyll / carotenoids **ALLOW** chlorophyll a for primary pigment **ALLOW** for making , ATP / reduced NADP
		(ii)	*idea that* they have to absorb light of short (er) wavelengths ✓ *idea that* some wavelengths (of light) don't reach , depths / them ✓	1 max	**ALLOW** blue / blue-violet light **ALLOW** wavelengths between 400 and 500nm **ALLOW** high(er) frequency e.g. some wavelengths of light may not reach *Chromista* if they are in deep water
	(b)		*Chromista* (chloroplast) has fewer thylakoids ✓ *Chromista* (chloroplast) has no , inter-granal lamellae / lamellae between thylakoids ✓ plants (chloroplasts) have thylakoids in groups of more than three ✓ plants (chloroplasts) have starch grains / *Chromista* (chloroplast) does not have starch grains ✓	2 max	**IGNORE** reference to external membrane **ALLOW** plants (chloroplasts) have more thylakoids **ALLOW** plant (chloroplasts) have lamellae between thylakoids **ALLOW** thylakoids in plant (chloroplasts) form grana **IGNORE** *Chromista* (chloroplast) has thylakoids in groups of three

Question			Answer	Marks	Guidance
	(c)	(i)	***property*** hydrophobic (region / fatty acid tails) ✓ ***explanation*** (helps to) form bilayer / separates two aqueous regions ✓ ***property*** (region) contains cholesterol ✓ ***explanation*** regulates (membrane) fluidity / AW✓	**2 max**	**IGNORE** stability for explanations ***property*** MUST be linked to its ***explanation***
	(c)	(ii)	compartmentalisation **OR** form / surround , (named) organelles ✓ purpose of / need for , compartments / separation ✓ sites of , chemical reactions / electron carriers / photophosphorylation / chemiosmosis / oxidative phosphorylation ✓ provide attachment sites for , enzymes / pigments ✓ allow formation of concentration gradients ✓	**2 max**	e.g. separating organelles from cytoplasm e.g. form vesicles for transport is **MP1** and **MP2** **ALLOW** ETC for electron carriers **ALLOW** correctly named enzyme e.g. ATP synthase
			Total	**11**	

Question			Answer/Indicative content	Marks	Guidance
1			A	1	
			Total	**1**	
2			B	1	
			Total	**1**	
3			C	1	
			Total	**1**	
4			A	1	
			Total	**1**	
5			D	1	
			Total	**1**	
6			A	1	
			Total	**1**	
7			B	1	
			Total	**1**	
8			A	1	
			Total	**1**	
9			C	1	
			Total	**1**	
10			A	1	
			Total	**1**	
11			B	1	
			Total	**1**	
12			D	1	
			Total	**1**	
13			C	1	
			Total	**1**	
14			B	1	

Question			Answer/Indicative content	Marks	Guidance
			Total	**1**	
15			C	1	
			Total	**1**	
16	a	i	*normal rate* 78.9 bpm (1) *rate for tachycardia* 125 bpm (1) *percentage increase* 58 (%) (1)(1)	4	**ALLOW** 1.3 bps. **ALLOW** 2.1 bps. **ALLOW 2 marks** for percentage increase correctly calculated using candidate's figures for rates and answer given to nearest whole number. **ALLOW 1 mark** for correct working [(125 – 78.9) ÷ 78.9 × 100 or correct use of candidate's figures for rates] **or** a correctly calculated but unrounded answer **DO NOT ALLOW** answers that divide by the rate for tachycardia as a percentage **increase** is asked for.
		ii	*two from* lower (Q)R(S) peak (1) P and T equal in height (1) width of T wave greater (1)	2	
	b		*three from* no distinct, P curve / atrial depolarisation (1) irregular / weak, atrial contraction (1) insufficient blood forced into ventricles (1) although ventricles contract there is less blood forced from the heart (1)	3	
			Total	**9**	

Question	Answer	Mark	Guidance
3(a)	(using) microtubules / tubulin / motor proteins ✓	1	**ALLOW** kinesins / dyneins / 'moto' proteins **IGNORE** spindle fibres, centrioles
3(b)	**1** goblet cells, secrete / release / make / produce / form, mucus ✓ **2** mucus traps, pathogens / microorganisms / bacteria ✓ **3** ref. phagocytes / neutrophils / macrophages / lysozyme ✓ **4** cilia / ciliated cells / ciliated epithelium, sweep / brush / waft / move / AW, mucus ✓ **5** cytoskeleton / microtubules / tubulin, move(s) / make(s) up, the cilia ✓	4 max	**IGNORE** excrete **ALLOW** named example of a lung pathogen **IGNORE** cilia trap, pathogens / microorganisms **ALLOW** 'cillia' / other spelling that looks and sounds same **DO NOT ALLOW** cilia cells

Question	Answer	Mark	Guidance
3(c)(i)	(stage) **2** (should say), non-self / not self / foreign ✓ (stage) **5** (should be) before **4 / 4** (should be) **after 5** ✓	2	**ALLOW** quote to replace stage number **2**, e.g. *'phagocytes recognise pathogens as non-self'* *'phagocytes do **not** recognise pathogens as **self**'* **IGNORE** non-body **ALLOW 4** and **5** are in wrong order / should be reversed / need swapping / should be the other way round / AW **ALLOW** quote to replace stage numbers, e.g. *'phagosome combines with a lysosome **before** stage 4'* *'enzymes from lysosomes digest pathogens **after** stage 5'* *'forms a phagolysosome and THEN destroys the pathogen'* *'phagosome and lysosome do not combine AFTER the pathogen is destroyed'*
3(c)(ii)	minimum of one light chain drawn on outside of heavy chain **and** label to, light (polypeptide) chain / variable region / antigen-binding site ✓	1	**GUIDELINES for drawing:** Light chain should start at tip of arm of Y and be 25–50% the length of the heavy chain. **ALLOW** label line not touching if label written near correct region

Question			Answer	Marks	Guidance
24	(a)	(i)	ribosome(s) ✓	1	***If additional incorrect answer given, then 0 marks***
24	(a)	(ii)	(Eu)bacteria ✓ Archaea(bacteria) ✓	2	*In either order* **DO NOT ACCEPT** bacterium **ACCEPT** phonetic spelling
24	(a)	(iii)	nucleus ✓ DNA with , histones / (associated) proteins ✓ linear DNA ✓ (named) membrane bound organelles ✓ 80s ribosomes ✓	2 max	***Mark the first two answers but*** **IGNORE** multicellular **DO NOT ACCEPT** microtubule / cytoskeleton / centriole **IGNORE** chromosome **IGNORE** chloroplast **ACCEPT** large(r) ribosomes
24	(b)		**1** scientific , conferences / meetings ✓ **2** peer review / approving the work for publication / publication in (reputable) scientific journal ✓ **3** replication of work (by others to see if the same results are obtained) ✓ **4** look for more (supporting) evidence (e.g. from other peoples' work / investigating other molecules) ✓	2 max	**2 ACCEPT** analysing the procedures and data of the investigation **3 ACCEPT (others)** repeat the experiments **4** Other molecules could include cytochrome C