

# **OCR A GCSE BIOLOGY 9-1 PAPER 1 2022 EXAM**

## **Advance Information for Summer 2022**

**GCSE (9–1)**

**Biology A (Gateway Science)**

**J247**

We have produced this advance information to help support all teachers and students with revision for the Summer 2022 exams.

### **Information**

- The format/structure of the papers remains unchanged.
- This notice covers all examined components.
- For each paper, the main list shows the major focus of the content of the exam.
- Topics **not** assessed, either directly or synoptically, have also been listed.
- The information is presented in specification order, **not** in question order.
- Assessment of practical skills, maths skills, and Working Scientifically skills will occur throughout all of the papers.
- You are **not** permitted to take this notice into the exam.
- This document has **3** pages.

### **Advice**

- It is advised that teaching and learning should still cover the entire subject content in the specification, so that students are as well prepared as possible for progression.
- Topics not explicitly given in either list may appear in low tariff questions or via synoptic questions (e.g., questions where students are asked to bring together knowledge, skills and understanding from across the specification).
- Students will still be expected to apply their knowledge to unfamiliar contexts.

Advance Information Summer 2022

3

**J247/03**

- Section 1.2 What happens in cells (and what do cells need)?
- Section 2.1 Supplying the cell
- Section 2.2 The challenges of size
- Section 3.2 Coordination and control – the endocrine system

Required practical skills that **will be assessed**:

- Practical Activity Group 1: Use a microscope to make observations.
- Practical Activity Group 2: Testing for the presence of biological molecules.
- Practical Activity Group 4: Investigate the factors that can affect the rate of enzyme activity.
- Practical Activity Group 6: Investigate tropic responses in plant shoots.

There are **NO** topics that are **not assessed** in this paper.

**Higher Tier, grades 9 to 4**

Content is split into six teaching topics B1-B6 and a practical activity skills topic B7:

- Topic B1: Cell level systems
- Topic B2: Scaling up
- Topic B3: Organism level systems
- Topic B4: Community level systems
- Topic B5: Genes, inheritance and selection
- Topic B6: Global challenges
- Topic B7: Practical skills

Paper 3 assesses content from Topics B1–B3 and B7

Paper 4 assesses content from Topics B4–B6 and B7, with assumed knowledge of Topics B1–B3.

Paper 3

J247/03

90 marks

1 hour 45 minutes

Written paper

**50%**  
**of total**  
**GCSE**

Paper 4

J247/04

90 marks

1 hour 45 minutes

Written paper

**50%**  
**of total**  
**GCSE**

J247/02 and J247/04 include synoptic assessment.

Note:

This revision pack only covers the main content mentioned in the paper 1 of advance information for summer 2022 OCR A GCSE Biology exam. Students must still revise everything else in paper 1 as these can still come as low tariff questions. Everything in paper 1 will be assessed as usual.

# Mark scheme

Question		Answer/Indicative content	Marks	Guidance												
1	a	<table border="1"> <thead> <tr> <th>name</th> <th>part</th> </tr> </thead> <tbody> <tr> <td>aorta</td> <td>D</td> </tr> <tr> <td>left atrium</td> <td>E</td> </tr> <tr> <td>right ventricle</td> <td>C</td> </tr> <tr> <td>tricuspid valve</td> <td>B</td> </tr> <tr> <td>vena cava</td> <td>A</td> </tr> </tbody> </table>	name	part	aorta	D	left atrium	E	right ventricle	C	tricuspid valve	B	vena cava	A	2	<p>3 or 4 correct (1) less than 3 correct (0)</p> <p><b>Examiner's Comments</b></p> <p>The parts of the heart were quite well known but all combinations were seen. The most common error was to reverse boxes 1 and 5. This illustrates that many candidates are still not aware that diagrams are mirror images of the body to identify right and left sides.</p>
name	part															
aorta	D															
left atrium	E															
right ventricle	C															
tricuspid valve	B															
vena cava	A															
	b i	provides a large surface area to volume ratio (1)	1	<p><b>allow</b> large SA / V <b>allow</b> squeeze through capillaries <b>ignore</b> arteries / veins / vessels</p> <p><b>Examiner's Comments</b></p> <p>Many candidates gained credit for the idea that red blood cells can squeeze through capillaries. Only a very small number gained the mark for a large surface area to volume ratio. The most common errors were 'more of them can travel in blood vessels' or 'they can travel faster'.</p>												
	ii	<p><b>any two from:</b> DNA codes for mRNA (1) mRNA moves (from nucleus) to cytoplasm (1) (mRNA passed to) ribosomes in cytoplasm (to make haemoglobin / protein) (1)</p>	2	<p><b>Examiner's Comments</b></p> <p>This question did differentiate and only a few candidates knew about mRNA and the ribosomes in the cytoplasm. There were many vague, incorrect answers stating that 'the cytoplasm is where chemical reactions take place' or 'the nucleus is in the cytoplasm'.</p>												
	iii	(haemoglobin combines with oxygen to form) oxyhaemoglobin (in lungs) (1) reverse reaction / breakdown of oxyhaemoglobin happens in tissues / cells to release oxygen (1)	2	<p><b>allow</b> oxyhaemoglobin dissociates releasing oxygen</p> <p><b>Examiner's Comments</b></p> <p>The majority of answers failed to mention oxyhaemoglobin at all, even though candidates did</p>												

					state that oxygen combined with haemoglobin. Most attempts at the second marking point simply stated that, in the tissues, oxygen passed / diffused into the cells, with no reference to any reverse reaction or release from the combined molecule.
	c		(bone marrow) contains stem cells / undifferentiated cells (1)  (stem cells) have genes / have information to develop into different (red or white) cells (1)	2	<b>allow</b> have genes for either type of cell <b>allow</b> can turn genes on and off as required  <b>Examiner's Comments</b>  A reasonable number of candidates knew about stem cells, but few went on to gain a second mark. The most common error was to repeat the question and say 'and so they can produce both types of cell'. Other candidates said that stem cells had the potential to become red and white blood cells, without explaining how (e.g. by having the genes). Some candidates gave unrelated answers (e.g. bone marrow is for keeping the body healthy, essential for growth or helps fight off disease).
			<b>Total</b>	<b>9</b>	
2		i	(lack of oxygen causes) fewer / no (aerobic) bacteria / fungi (1)  (therefore) no / slow / less decay ( 1)	2	<b>allow</b> fewer / no decomposers / microorganisms <b>ignore</b> germs / viruses <b>ignore</b> fewer / no detritivores  <b>allow</b> no / slow / less breakdown of dead material  <b>allow for additional marking point:</b> less / no / slower respiration (by bacteria / fungi / decomposers) (1)  <b>allow</b> reverse arguments  <b>Examiner's Comments</b>  Only about a third of candidates appreciated that low oxygen levels would mean that few decomposers could survive and therefore the rate of decay would be low. Some candidates clearly thought that 'nutrients' were a type of organism that needed oxygen to survive. Some thought that a lack of oxygen would reduce photosynthesis.
		ii	(release) energy (1) to take in minerals / nutrients (1)	3	

		by active transport / movement against a concentration gradient (1)		<p><b>ignore</b> absorb minerals from the air</p> <p><b>Examiner's Comments</b></p> <p>Less than half the candidates knew that respiration was needed to release energy. Very few were able to link this to the context and explain that the energy would be needed to absorb minerals by active transport. Weaker answers commonly explained that respiration was needed to bring in oxygen, or that respiration was needed for photosynthesis.</p>
		<b>Total</b>	<b>5</b>	
3		<p><b>[Level 3]</b> Describes the results AND gives a detailed explanation of the experiment. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p><b>[Level 2]</b> Describes the results AND gives a limited explanation of the experiment. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b> Describes the results of the experiment OR gives a limited explanation of the experiment. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p><b>This question is targeted at grades up to A*</b></p> <p><b>Detailed explanation could include:</b></p> <ul style="list-style-type: none"> <li>air movement increases / maintains concentration gradient</li> <li>air movement increases / maintains diffusion gradient</li> <li>air movement lowers <b>concentration</b> of water outside plant</li> </ul> <p><b>ignore</b> references to osmosis</p> <p><b>Limited explanation could include:</b></p> <ul style="list-style-type: none"> <li>(increased) air movement / fan causes loss of water</li> <li>(water is lost by) evaporation / diffusion of water</li> </ul> <p><b>ignore</b> references to osmosis</p> <p><b>Description:</b></p> <ul style="list-style-type: none"> <li>loss of mass / water / readings go down in B / shoot</li> <li>no change in A (<b>allow</b> small decrease)</li> </ul> <p>To get full credit for description there needs to be a comparison between A and B. Description of only A or B limits mark to 1/3/5</p>

					<p><b>if no other marks, allow</b> air movement increases transpiration for L1, 1 mark</p> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p> <p><b>Examiner's Comments</b></p> <p>To gain full marks candidates must answer every part of a question, in this case by describing the expected results in both flasks and explaining each. Although all possible marks were frequently seen, the most common score was four, which was gained by correctly describing the results and giving a limited explanation, e.g. that water was being lost from the plant by evaporation. To gain full marks a more detailed explanation was needed in terms of the fan lowering the water concentration of the air, so increasing loss by the plant. A minority wrote about water loss from the leaves being by osmosis. Some candidates said that the readings would change, but did not go on to say how.</p>
			<b>Total</b>	<b>6</b>	
4	a	i	90 (%) (1)	1	<p><b>allow</b> 90.32258 or correct rounding</p> <p><b>Examiner's Comments</b></p> <p>About half the candidates correctly calculated the percentage drop in pressure as 90%. The common error was to convert 9/93 to a percentage.</p>
		ii	<p>vessel at A = capillary (1)</p> <p>vessel at B = vein (1)</p>	2	<p><b>allow</b> capillary bed / arteriole <b>ignore</b> small artery <b>allow</b> venule / named vein e.g. vena cava</p> <p><b>Examiner's Comments</b></p> <p>Many candidates could not identify either the vessel at A as a capillary, nor the one at B as a vein. A minority correctly identified both. The most common error was to identify A as an artery.</p>
	b		<p>reduces effective blood circulation / blood could fall back into heart / backflow would happen (1)</p>	2	<p><b>ignore</b> references to oxygenated / deoxygenated <b>ignore</b> less blood but <b>allow</b> less blood pumped around body <b>ignore</b> job of valves e.g. valves stop backflow</p> <p><b>allow</b> not enough pressure to push blood around <b>allow</b> oedema / idea of fluid building up in tissues /</p>

		pressure is not maintained / reduces pressure (1)		<p>lungs</p> <p><b>ignore</b> references to higher pressure e.g. inside heart</p> <p><b>Examiner's Comments</b></p> <p>Most candidates gained at least 1 mark, usually for explaining that damaged valves could lead to backflow. A small minority gained both marks, usually for adding that blood pressure would fall. Some candidates seemed to confuse damaged valves with a 'hole in the heart' and wrote about oxygenated and deoxygenated blood mixing.</p>
		<b>Total</b>	<b>5</b>	
5	i	<p>(water lost in) transpiration (1)</p> <p>idea that only a <b>small</b> proportion is used in photosynthesis (1)</p>	2	<p><b>allow</b> evaporation from plant</p> <p><b>Examiner's Comments</b></p> <p>About half the candidates explained that the plant lost water through transpiration or evaporation. Very few also explained that a small proportion of the water added was used in photosynthesis. Some candidates thought that water left the leaves by osmosis.</p>
	ii	<p>more transpiration (1)</p> <p>idea that wind moves away water <b>vapour</b> (1)</p>	2	<p><b>allow</b> more water lost through stomata</p> <p><b>allow</b> more evaporation / more diffusion (out of leaf)</p> <p><b>ignore</b> simply 'more water lost'</p> <p><b>Examiner's Comments</b></p> <p>About half the candidates correctly explained that transpiration increased on windy days. A minority explained this in terms of the wind moving away water vapour.</p>
		<b>Total</b>	<b>4</b>	
6		<p>(cells) have partially permeable membrane (1)</p> <p>potato / cells are more concentrated than the distilled water (1)</p>	2	<p><b>allow</b> semi-permeable membrane</p> <p>answer must be comparative</p> <p><b>allow</b> cells have lower water concentration (than distilled water)</p> <p><b>allow</b> correct ref. to concentration gradient</p> <p><b>allow</b> higher level answers relating to water potential</p> <p>assume unqualified references to concentration refer to solute</p> <p>e.g. water moves from high to low concentration = 0 but</p>

				<p>water moves from high water concentration to low water concentration = 1</p> <p><b>Examiner's Comments</b></p> <p>The common weakness in answers was to make unqualified references to concentration. To say that water would move from an area of high water concentration to an area of low water concentration would have gained a mark. However to say that water would move from a high concentration solution to a low concentration solution would not. Unqualified references to concentration were taken by markers to refer to solute concentration. The second mark was for reference to a partially permeable membrane. 'Semi-permeable membrane' was acceptable, but 'partially permeable wall' was not. Neither was 'permeable membrane'.</p>
<b>Total</b>			<b>2</b>	
7		<p>a by-pass operation <input checked="" type="checkbox"/></p> <p>a valve replacement <input type="checkbox"/></p> <p>inserting a pacemaker <input type="checkbox"/></p> <p>inserting a 'heart assist' device <input type="checkbox"/></p> <p>(1)</p>	1	<p><b>more than one tick negates mark</b></p> <p><b>Examiner's Comments</b></p> <p>The majority of candidates identified the need for a by-pass operation although a number of them thought a valve replacement was needed.</p>
<b>Total</b>			<b>1</b>	
8	a	<p><b>[Level 3]</b> <b>Explanation</b> of why rate of photosynthesis is reduced <b>AND</b> <b>Explanation</b> of how and why transpiration is affected. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p><b>[Level 2]</b> <b>Description</b> of reduced photosynthesis <b>AND</b> <b>Description</b> of effects on transpiration.</p> <p><b>OR</b></p> <p><b>Explanation</b> of why rate of photosynthesis is reduced</p>	6	<p><b>This question is targeted at grades up to A</b></p> <p><b>Indicative scientific points on explanations may include:</b></p> <p><b>Explanations of reduced photosynthesis</b></p> <ul style="list-style-type: none"> <li>• photosynthesis reduced because of fewer collisions</li> <li>• photosynthesis reduced because reduced enzyme activity</li> <li>• photosynthesis reduced because high winds cause stomata to close so less carbon dioxide taken in</li> </ul> <p><b>Explanation of effects on transpiration.</b></p> <ul style="list-style-type: none"> <li>• transpiration increased because of increased diffusion (gradient) or increased evaporation</li> <li>• transpiration increased because of decreased humidity</li> </ul>



		<p><b>OR explanation</b> of how and why transpiration is affected. Quality of written communication partly impedes communication of the science at this level.  (3 – 4 marks)</p> <p><b>[Level 1]</b> <b>Description</b> of reduced photosynthesis <b>OR</b> <b>Description</b> of effects on transpiration. <b>OR</b> <b>attempts one explanation</b> without stating if they are increased or decreased Quality of written communication impedes communication of the science at this level.  (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit.  (0 marks)</p>		<ul style="list-style-type: none"> <li>transpiration may be reduced by low temperatures reducing evaporation or diffusion</li> <li>transpiration decreased as dry soils means there is less water and the guard cells become flaccid</li> </ul> <p><b>Indicative scientific points on descriptions may include:</b> <b>Description of reduced photosynthesis</b></p> <ul style="list-style-type: none"> <li>lower temperatures or high winds decrease the rate of photosynthesis</li> <li>high winds close stomata</li> </ul> <p><b>ignore</b> effect of dry soil or sunlight on photosynthesis</p> <p><b>Description of effects on transpiration.</b></p> <ul style="list-style-type: none"> <li>high winds increase rate of transpiration</li> <li>high winds cause stomata to close so less transpiration</li> <li>dry soils may reduce transpiration</li> <li>low temperatures can reduce transpiration</li> </ul> <p><b>allow absolute ideas e.g. no photosynthesis when cold</b></p> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p> <p><b>Examiner's Comments</b></p> <p>This question discriminated the different levels well, the less able candidates would mention that transpiration and photosynthesis were affected by the different conditions but not actually say that the rates increased or decreased. Only the more able candidates used the correct terminology linked to evaporation from the leaves or enzyme activity. A large proportion of the candidates described the processes of photosynthesis and transpiration without actually linking them to the conditions.</p>
b			4	<p><b>Function mark is dependent on cell mark</b> <b>To gain full marks, functions must be clearly linked to correct cells</b> e.g. 'xylem and phloem transport water and sugar' (2) e.g. xylem transports water phloem transports sugar and minerals (3)</p> <p><b>allow</b> named mineral e.g. nitrate (1)</p>

		<p>xylem (1)</p> <p>(transports) water / minerals (1)</p> <p>phloem (1)</p> <p>(transports) food / sugar (1)</p>		<p><b>not</b> sugar / food / starch</p> <p>not phylum / phyllem</p> <p><b>allow</b> named food substances e.g. glucose / sucrose / amino acids (1)</p> <p><b>not</b> minerals or starch</p> <p><b>ignore</b> water for phloem</p> <p><b>ignore</b> nutrients for both</p> <p><b>ignore</b> direction of movement</p> <p><b>Examiner's Comments</b></p> <p>Most candidates identified xylem and phloem although the incorrect spelling of phloem (phylum or phyllem) meant that some lost this mark. A common misconception is that phloem transports minerals.</p>
		<b>Total</b>	<b>10</b>	
9		<p><b>any two from:</b></p> <p>movement from (an area of) low concentration to (an area of) high concentration (1)</p> <p>using energy or respiration (1)</p> <p>using carrier (1)</p>	2	<p><b>allow</b> moves from a <b>lower</b> concentration (into the root) (1)</p> <p><b>allow</b> against or up a concentration gradient (1)</p> <p><b>ignore</b> through or across a concentration gradient</p> <p><b>allow</b> using ATP (1)</p> <p><b>ignore</b> uses oxygen</p> <p><b>allow</b> uses membrane proteins (1)</p> <p><b>ignore</b> references to osmosis and diffusion</p> <p><b>Examiner's Comments</b></p> <p>Candidates often confused active transport with diffusion or osmosis. Only the more able candidates answered correctly in terms of concentration gradients and energy. Some managed to contradict their answer by stating that the movement was against a concentration gradient from an area high concentration to low concentration.</p>
		<b>Total</b>	<b>2</b>	
10	i	<p>D (1)</p> <p>it has a thick(er) wall / muscle</p> <p>OR</p> <p>it should be C but the heart is reversed (1)</p>	2	<p>2<sup>nd</sup> mark is dependent on the 1<sup>st</sup></p> <p><b>allow</b> more muscular</p> <p><b>Examiner's Comments</b></p>

					Many candidates made links between D and a thicker muscle wall. There was, however, still evidence of some confusion over what each part of the heart does.
		ii	idea that heart would need to be turned round / placed back to front (1)  to allow connection to the correct blood vessels (1)	2	<b>allow</b> put the heart in face down / flipped over / reversed / inverted  <b>allow</b> idea that would need to extend / reach the blood vessels to the heart (1) to allow them to reach the correct chambers (1) arteries / veins need to be swapped around (1)  <b>Examiner's Comments</b>  Some candidates struggled with the applied nature of this question. Most who scored did so for the idea of putting it in back to front. Fewer got the mark for linking up the correct blood vessels.
			<b>Total</b>	<b>4</b>	
11		i	0.08 (1)	1	<b>?Examiner's Comments??</b>  Most candidates correctly gave 0.08 seconds. Common incorrect answers included 0.04 and 0.16.
		ii	contraction of ventricles is longer / 0.24 v 0.08 (1)  need to pump blood further / to the body (1)	2	<b>allow</b> atria only need to pump the blood into the ventricles / do not need to pump as far (1) <b>ignore</b> to generate a higher pressure  <b>?Examiner's Comments??</b>  Most candidates gained at least one mark and many gained both. One common incorrect answer was that while the ventricles pump blood to the body, the atria pump it to the lungs.
			<b>Total</b>	<b>3</b>	
12			<b>[Level 3]</b> Gives a full explanation that pesticide movement is driven by transpiration and occurs through the xylem <b>and</b> explains why pesticide movement is greater on warm sunny days. Quality of written communication does not impede communication of the science at this level.  (5 – 6 marks)  <b>[Level 2]</b> Gives an explanation that pesticide movement is driven by transpiration and occurs through	6	<b>This question is targeted at grades up to A</b>  <b>Indicative scientific points at level 3 (HD) may include:</b>  <b>transpiration</b> is greater when it is warm / sunny because: <ul style="list-style-type: none"><li>• (higher temperatures) increase rate of evaporation / diffusion</li><li>• (on sunny days) stomata open (more widely)</li></ul> <b>Indicative scientific points at levels 1 and 2 (SD) may include:</b>

		<p>the xylem. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b> Gives a partial explanation explaining that pesticide movement is linked with transpiration <b>or</b> that it occurs through the xylem. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>		<ul style="list-style-type: none"> <li>• pesticide moves by transpiration</li> <li>• transpiration involves evaporation / diffusion</li> <li>• transpiration is greater when it is warm / sunny</li> <li>• movement through xylem</li> </ul> <p>if refer to stem / veins / vessels / phloem instead of xylem, limit to 5/3/1 marks if refer to just evaporation / diffusion instead of transpiration, limit to 5/3/1 marks if only give L3 indicative points, limit to L1</p> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p> <p><b>Examiner’s Comments</b></p> <p>This question was well answered with very few candidates gaining no marks and many gaining full marks, although the full range of marks was seen. Candidates usually addressed all parts of the question and attempted to use appropriate scientific terminology. All acceptable answers on the mark scheme were seen.</p>
		<b>Total</b>	<b>6</b>	
13		<p>idea that <b>all</b> the blood goes through the lungs (1)</p>	1	<p><b>allow</b> all the blood needs oxygenating</p> <p><b>?Examiner's Comments??</b></p> <p>Some candidates failed to realise that all blood has to go through the lungs. They reverted to more superficial responses.</p>
		<b>Total</b>	<b>1</b>	
14		<p><b>[Level 3]</b> gives an explanation of the effect of plant hormone <b>AND</b> correctly works out the concentration of the plant hormone solution. (5 – 6 marks)</p> <p><b>[Level 2]</b> correctly works out the concentration of the plant hormone solution <b>OR</b> gives an explanation of the effect of plant hormone <b>AND</b></p>	6	<p><b>This question is targeted up to grade A*</b></p> <p><b>Indicative scientific points about explaining the effect of plant hormone may include:</b></p> <ul style="list-style-type: none"> <li>• The plant hormone causes growth / stem gets longer / stem now 25mm</li> <li>• This is due to promoting cell elongation</li> <li>• as concentration of hormone increases so does % change in length</li> </ul>

		<p>makes a partial attempt at working out the concentration of the plant hormone solution</p> <p>Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p><b>[Level 1]</b></p> <p>gives an explanation of the effect of plant hormone</p> <p><b>OR</b></p> <p>makes a partial attempt at working out the concentration of the plant hormone solution (1 – 2 marks)</p> <p><b>[Level 0]</b></p> <p>Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>		<p><b>Indicative scientific points about the piece include:</b></p> <ul style="list-style-type: none"> <li>• Calculation to show that this is a 5mm increase</li> <li>• This corresponds to a 25% (increase)</li> <li>• This must have been caused by a plant hormone concentration of 28 (parts per million)</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>								
<b>Total</b>			<b>6</b>									
15	a i	<p><b>any two from:</b></p> <p>has a nucleus ora (1)</p> <p>has mitochondria ora (1)</p> <p>has chloroplasts ora (1)</p>	2	<p><b>not</b> cell wall</p> <p><b>not</b> cytoplasm</p> <p><b>not</b> cap</p>								
	ii	<table border="1"> <tr> <td>some genes can be lost from some cells</td> <td></td> </tr> <tr> <td>both aerobic and anaerobic respiration can occur</td> <td></td> </tr> <tr> <td>cells are able to differentiate and specialise</td> <td>✓</td> </tr> <tr> <td>organisms are able to clone themselves</td> <td></td> </tr> </table>	some genes can be lost from some cells		both aerobic and anaerobic respiration can occur		cells are able to differentiate and specialise	✓	organisms are able to clone themselves		1	more than one answer = 0
some genes can be lost from some cells												
both aerobic and anaerobic respiration can occur												
cells are able to differentiate and specialise	✓											
organisms are able to clone themselves												
	iii	<p>nervous or hormone system to communicate between cells /</p> <p>transport or circulation or cardiovascular system to carry nutrients / oxygen / blood / CO<sub>2</sub> around the organism</p> <p>excretory or gas exchange system to exchange materials with the surroundings (1)</p>	1	<p><b>ignore</b> named organs e.g. kidney / heart etc. for system</p> <p><b>allow</b> explained alternative systems e.g. respiratory system / reproductive / digestive</p>								
	b	<p><b>[Level 3]</b></p> <p>includes a correct description of protein synthesis</p>	6	<b>This question is targeted up to grade A*</b>								

		<p><b>AND</b> describes where proteins are made <b>AND</b> correctly links this to the change in shape of the cap over a period of time.</p> <p>Quality of written communication does not impede communication of the science at this level.  (5 – 6 marks)</p> <p><b>[Level 2]</b> includes a correct description of protein synthesis <b>AND</b> describes where proteins are made <b>OR</b> correctly links this to the change in shape of the cap over a period of time. Quality of written communication partly impedes communication of the science at this level.  (3 – 4 marks)</p> <p><b>[Level 1]</b> includes simple description of protein synthesis <b>OR</b> describes where proteins are made <b>OR</b> why it takes several weeks for the change in the cap.  (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit.  (0 marks)</p>		<p><b>Indicative scientific points about protein synthesis at level 2/3 may include:</b></p> <ul style="list-style-type: none"> <li>the order of bases codes for the order of amino acids</li> <li>mRNA carries the code from the DNA</li> <li>triplet base code read for amino acid</li> </ul> <p><b>Indicative scientific points about where proteins are made may include:</b></p> <ul style="list-style-type: none"> <li>proteins are made on the ribosomes</li> <li>in the cytoplasm</li> </ul> <p><b>Indicative scientific points about why it takes several weeks for the change in the cap:</b></p> <ul style="list-style-type: none"> <li>time taken for the proteins in the cap to be replaced / make different proteins</li> <li>mRNA from the old nucleus takes some time to be replaced by mRNA from new nucleus</li> </ul> <p><b>Indicative scientific points about protein synthesis at level 1 may include:</b></p> <ul style="list-style-type: none"> <li>proteins are coded for by DNA / genes</li> <li>sequence of bases that code for the protein</li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
		<b>Total</b>	<b>10</b>	
16	i	2.5 (1)	1	
	ii	the shrew needs / uses lots of oxygen (1)	3	

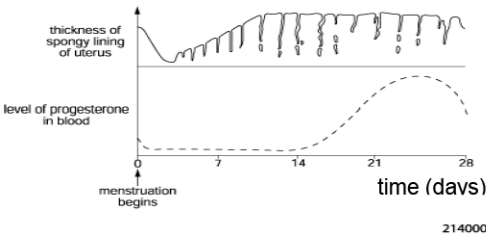
		<p>shrew red blood cell has a large surface area to volume ratio (1)</p> <p>this means that it can pick up / release oxygen <b>quickly</b> (1)</p>		<p><b>ignore</b> references to shrew's body surface area to volume ratio</p> <p><b>ignore</b> pick up more oxygen</p>
		<b>Total</b>	<b>4</b>	
17		<p><b>[Level 3]</b> States the effects are due to osmosis <b>AND</b> Explain the results in terms of direction of movement <b>AND</b> uses the terms lysis and crenation correctly Quality of written communication does not impede communication of the science at this level.  (5 – 6 marks)</p> <p><b>[Level 2]</b> States the effects are due to osmosis <b>and</b> attempts to explain the results in terms of direction of movement <b>OR</b> States the effects are due to osmosis <b>and</b> uses the terms lysis <b>and</b> crenation correctly Quality of written communication partly impedes communication of the science at this level.  (3 – 4 marks)</p> <p><b>[Level 1]</b> States the effects are due to osmosis. <b>OR</b> uses the terms lysis <b>or</b> crenation correctly  Quality of written communication impedes communication of the science at this level.  (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit.  (0marks)</p>	<b>6</b>	<p><b>This question is targeted at grades up to A*</b> <b>Indicative scientific points at that may be include:</b></p> <ul style="list-style-type: none"> <li>• effects are due to osmosis</li> <li>• at low concentrations / cells burst / liquid goes clear due to <b>lysis / haemolysis</b> <b>not turgid</b></li> <li>• high concentrations / cells shrivel / liquids remain cloudy due to <b>crenation</b> <b>not plasmolysis / flaccid</b></li> </ul> <p><b>direction of movement</b></p> <ul style="list-style-type: none"> <li>• at low concentrations / cells burst / liquid goes clear because water moves into cells when <b>salt</b> concentration of solution is <b>lower</b> (than <b>salt</b> concentration inside cells) <b>or</b> at low concentrations / cells burst / liquid goes clear because water moves into cells when <b>water</b> concentration of solution is <b>higher</b> (than <b>water</b> concentration inside cells) <b>or</b> at low concentrations / cells burst / liquid goes clear because water moves into cells when solution is <b>hypotonic</b></li> <li>• at high concentrations / cells do not burst / liquid stays cloudy because water moves out of cells when <b>salt</b> concentration of solution is <b>higher</b> (than <b>salt</b> concentration inside cells) <b>or</b> at high concentrations / cells do not burst / liquid stays cloudy because water moves out of cells when <b>water</b> concentration of solution is <b>lower</b> (than <b>water</b> concentration inside cells) <b>or</b> at high concentrations / cells do not burst / liquid stays cloudy because water moves out of cells when solution is <b>hypertonic</b></li> </ul> <p><b>allow</b> reverse arguments for each direction of movement</p>

					Use the L1, L2, L3 annotations in Scoris; do not use ticks.
			<b>Total</b>	<b>6</b>	
18		<p>as air movement increases so does the rate of transpiration / ora(1)</p> <p>(rate increases) due to increase in diffusion (through the stomata) /ora (1)</p> <p>identifies valid reason for not increasing further (1)</p>		<b>3</b>	<p><b>allow</b> idea that increasing speed of fan increases transpiration rate / ora (1)</p> <p><b>allow</b> idea that increasing wind speed increases transpiration rate / ora (1)</p> <p><b>allow</b> as air movement increases so does the uptake of water / ora (1)</p> <p><b>ignore</b> movement of air bubble</p> <p><b>allow</b> (rate increases) due to increase in evaporation / ora(1)</p> <p><b>allow</b> idea that increasing wind speed decreases humidity / ora (1)</p> <p><b>allow</b> more or faster water loss from diffusion / evaporation (1)</p> <p>e.g. limited by number of stomata / temperature / humidity (1)</p> <p><b>allow</b> limited by another factor / no longer the limiting factor (1)</p> <p><b>ignore</b> stomata close</p>
			<b>Total</b>	<b>3</b>	
19		<p><b>[Level 3]</b> Makes more than two comparison between the two graphs <b>AND</b> explains in detail how the pill prevents pregnancy Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p><b>[Level 2]</b> Makes at least two comparison between the two graphs <b>AND</b> attempts to explains in detail how the pill prevents pregnancy Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p>		<b>6</b>	<p><b>This question is targeted at grades up to A*</b> <b>Indicative scientific points that may be included</b> <b>detailed explanation</b></p> <ul style="list-style-type: none"> <li>the pill prevents the <b>release</b> of <b>FSH</b></li> <li><b>FSH</b> needed for egg development / no egg development as no or low levels of <b>FSH</b></li> <li>the pill <b>or</b> lack of <b>FSH</b> prevents the <b>release</b> of <b>LH</b></li> <li><b>LH</b> controls <b>ovulation</b> / no <b>ovulation</b> as no or low levels of <b>LH</b></li> <li>idea that <b>oestrogen</b> peak needed for ovulation / as there is no oestrogen peak there is no ovulation</li> <li><b>ignore</b> reference to uterus wall</li> </ul> <p><b>if no other explanation for FSH and LH identified then allow</b> FSH and LH are needed for egg development and ovulation as a single detailed explanation <b>simple explanation</b></p>



		<p><b>[Level 1]</b> Makes at least one comparisons between the two graphs <b>and</b> one simple explanation of how pill works <b>OR</b> Attempts to explains in detail how the pill prevents pregnancy Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p><b>[Level 0]</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>		<ul style="list-style-type: none"> <li>pill mimics pregnancy</li> <li>pill prevents ovulation / no egg develops/ no egg released</li> </ul> <p><b>comparing the graphs</b></p> <ul style="list-style-type: none"> <li><b>FSH</b> constant in graph <b>B</b> / peaks in <b>A</b></li> <li><b>FSH</b> levels low or no <b>FSH</b> in graph <b>B</b> / high in graph <b>A</b></li> <li><b>LH</b> constant in graph <b>B</b> / peaks in <b>A</b></li> <li><b>LH</b> levels low or no <b>LH</b> in graph <b>B</b> / high in graph <b>A</b></li> <li><b>progesterone</b> rises remains high then falls in <b>B</b> / fluctuates in <b>A</b> /<b>progesterone</b> level in <b>B</b> constant / varies in <b>A</b> /<b>progesterone</b> levels high in graph <b>B</b> / low in <b>A</b></li> <li><b>oestrogen</b> constant in <b>B</b> / fluctuates in <b>A</b> / <b>oestrogen</b> no peak in <b>B</b> / has (two) peaks in <b>A</b> allow pill for graph B and 'normal' for graph <b>A</b></li> </ul> <p><b>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</b></p>
		<b>Total</b>	<b>6</b>	
20	a	<p>amino acids are not proteins (1)</p> <p>they make up proteins (1)</p>	2	<p>no marks if they haven't identified amino acids <b>not</b> incorrect statements about collagen and insulin</p> <p><b>allow</b> amino acids make up proteins (2)</p>
	b	<p>the substrate is like a key (not the enzyme) (1)</p> <p>the substrate fits into the enzyme's active site (not the other way round) (1)</p>	2	<p><b>allow</b> the enzyme is like a lock (not a key) (1)</p> <p><b>allow</b> the enzyme has an active site not the substrate (1)</p> <p><b>allow</b> 'enzyme and the substrate are the wrong way round' (2)</p>
		<b>Total</b>	<b>4</b>	
21		B ✓	1 (AO 1.2)	
		<b>Total</b>	<b>1</b>	
22		B ✓	1 (AO 2.1)	
		<b>Total</b>	<b>1</b>	
23		C ✓	1 (AO 1.2)	
		<b>Total</b>	<b>1</b>	
24		D ✓	1 (AO 1.2)	

			<b>Total</b>	<b>1</b>	
25			D ✓	<b>1 (AO 2.1)</b>	
			<b>Total</b>	<b>1</b>	
26			A ✓	<b>1 (AO 1.1)</b>	
			<b>Total</b>	<b>1</b>	
27			D ✓	<b>1 (AO 2.2)</b>	
			<b>Total</b>	<b>1</b>	
28			C ✓	<b>1 (AO 1.1)</b>	<p><b><u>Examiner's Comments</u></b></p> <p>This question was the most accessible question in section A, with most candidates correctly answering C.</p>
			<b>Total</b>	<b>1</b>	
29			B ✓	<b>1 (AO 1.1)</b>	
			<b>Total</b>	<b>1</b>	
30			A ✓	<b>1 (AO 1.1)</b>	
			<b>Total</b>	<b>1</b>	
31	a		<p>adrenaline reduces blood flow to the skin ✓</p> <p>less blood lost (during time to clot/receive medical treatment) ✓</p>	<p><b>3</b></p> <p><b>(AO 1.1)</b></p> <p><b>(AO 2.1)</b></p>	<p><b>ALLOW</b> causes vasoconstriction <b>in skin</b></p> <p><b>IGNORE</b> stops bleeding</p> <p><b><u>Examiner's Comments</u></b></p> <p>Very few candidates appreciated that adrenaline would reduce the blood flow to the skin. Many assumed that it would simply increase heart rate and that this would somehow make the blood more likely to clot at the wound.</p>
	b	i	<p>corpus luteum / (empty) follicle / yellow body ✓</p>	<b>1 (AO 1.1)</b>	<p><b><u>Examiner's Comments</u></b></p> <p>There were a number of correct references to corpus luteum, yellow body or empty follicle.</p>

		ii	smooth curve drawn rising and falling ✓ fall must start on day 21 or after ✓	2 (AO 2 × 1.1)	 <p>if no fall in progesterone then award 0 marks</p> <p><b>Examiner's Comments</b></p> <p>Most candidates correctly appreciated that the line should increase, plateau and then fall.</p>
	c	i	<p><b>First check answer on answer line</b> <b>If answer = 19.98 (mm) award 3 marks</b></p> <p>20 - 0.025✓ but 19.975 (mm)✓ 19.98 (mm)✓</p>	3 (AO 2 × 2.2) (AO 1.2)	<p><b>Examiner's Comments</b></p> <p>The manipulation of standard form was often correct in this question.</p>
		ii	lining is not repaired correctly✓	1 (AO 1.1)	<p><b>ALLOW</b> lining will not thicken / not build up <b>IGNORE</b> lining will not be maintained / will become thinner</p> <p><b>Examiner's Comments</b></p> <p>There was some confusion in the answers between the roles of progesterone and oestrogen. Common incorrect answers referred to the breaking down of the uterus lining.</p>
		iii	<p><b>Any three from:</b> gonadotrophins used✓  FSH and LH used✓  FSH lead to ripening of follicle✓ and LH causes ovulation✓  human chorionic gonadotrophin✓  causes egg/ovum to mature inside follicle✓</p>	3 (AO 3 × 1.1)	<p><b>ALLOW</b> stimulate egg production/development</p> <p><b>Examiner's Comments</b></p> <p>Candidates often gave the hormones that might be given to women to treat infertility, i.e. LH and FSH but did not specifically link them to their function. This is illustrated in exemplar 7, which would only gain one mark for naming the two hormones.</p> <p><b>Exemplar 7</b></p>

				<p>(iii) Explain how hormones can be used to treat infertility in women.                  Drugs with menstrual hormones in - eg: FSH and LH complete negative feedback to produce more oestrogen and increase the number of eggs matured &amp; developed. [3]</p>
		iv	<p>order of bases is changed (in gene) ✓                  order of amino acids changed in protein / change in shape of the enzyme ✓</p>	<p><b>2</b>                  (AO 1.1)                  (AO 2.1)</p> <p><b>ALLOW</b> nucleotides  <b>ALLOW</b> mutation in base sequence</p> <p><b>ALLOW</b> different amino acids in protein  <b>IGNORE</b> codes for wrong amino acid to be made</p> <p><b>Examiner's Comments</b></p> <p>Many candidates correctly linked changes in the DNA base sequence to alterations in the amino acids in the protein or the shape of the protein molecule.</p>
			<b>Total</b>	<b>14</b>
32	a	i	<p>photosynthesis makes sugars in guard cells ✓                  epidermal cells (dont photosynthesise so) lower in sugar than guard cell ✓</p> <p><b>and any two from:</b>                  epidermal cells higher osmotic / water potential than guard cells ✓ ORA                  water enters guard cells (by osmosis) ✓ ORA                  increasing turgidity of guard cell opens stomata ✓ ORA                  due to thicker inner cell wall ✓                  opening / size of stoma affects transpiration rate ✓</p>	<p><b>4</b>                  (AO 2 x 1.1)                  (AO 2 x 2.1)</p> <p><b>ALLOW</b> correct description of transpiration linked to the size of stoma</p> <p><b>Examiner's Comments</b></p> <p>Candidates found this question one of the most challenging on the paper. Few candidates demonstrated a good knowledge of the mechanism of stomatal opening. Many candidates seemed to reverse the question and tried to explain how the rate of transpiration controlled photosynthesis in guard cells.</p>

		ii	<p>they have differentiated ✓</p> <p>have a <b>specific</b> job to do (in the leaf/plant) ✓</p>	<p><b>2</b> (AO 2 × 1.1)</p>	<p><b>ALLOW</b> they have adapted (to their function)</p> <p><b>ALLOW</b> no other cells do the same job</p> <p><b>ALLOW</b> they can open / close stomata</p> <p>they have adapted to a <b>specific</b> job / they are adapted to open and close stomata = 2 marks</p> <p><b>Examiner's Comments</b></p> <p>There were some good answers focussing on the structural differentiation of guard cells and the fact that they have a specific role.</p>
		b	<p>phloem is removed ✓</p> <p>swelling caused by a build-up of food/sugar ✓</p> <p>food/sugar produced in the leaves / moving downwards cannot get past (the ringed area)✓</p>	<p><b>3</b> (AO 3 × 3.2b)</p>	<p><b>ALLOW</b> phloem is on the outside</p> <p><b>IGNORE</b> nutrients / minerals / ions</p> <p><b>ALLOW</b> glucose / sucrose</p> <p><b>ALLOW</b> translocation to roots is prevented</p> <p><b>Examiner's Comments</b></p> <p>This was another challenging question for many candidates. They needed to observe from the transverse section, that it was the phloem that was removed from the stem. Candidates needed to apply that information to the build-up of sugar on the pathway down the stem. A number of candidates explained the swelling as a defence mechanism. Others such as exemplar 9, put the swelling change down to xylem and phloem and did not gain marks.</p> <p><b>Exemplar 9</b></p> <p>Bringing female vital parts of the xylem and phloem. The swelling is evidence of this as water and sucrose is being taken to the root hair cells below the ringed area, but can't pass beyond.</p>
			<b>Total</b>	<b>9</b>	
33	a		<p>can control temperature (easier)/ can be set to a specific / constant temperature ✓✓</p> <p>limited fire risk✓</p>	<p><b>2</b> (AO 2 × 2.2)</p>	<p><b>IGNORE</b> reference to ease of measurement</p> <p><b>ALLOW</b> less risk of burns</p> <p><b>ALLOW</b> ORA</p> <p><b>Examiner's Comments</b></p> <p>Many candidates correctly focussed on the fact that an electric water bath will maintain a constant temperature.</p>

				<p>Fewer candidates stated the need to prevent ethanol from being near a naked flame. Exemplar 1 contains both these points, therefore achieved both marks.</p> <p><b>Exemplar 1</b></p> <p>1 When you use an electric water bath it's easier to set the temperature and maintain the temperature ✓</p> <p>2 Electric water bath is safer than using bunsen burner especially when substance you are heating is flammable ✓</p> <p>[2]</p>
b		<p>for 60°C / high temperatures:</p> <p>idea that (membranes break down) at 60°C releasing more DNA / DNA is extracted easily ✓</p> <p>against 60°C / high temperatures:</p> <p>increased risk of DNA breaking down at 60°C / more DNA destroyed at 60°C / DNA not preserved at 60°C ✓</p>	<p><b>2</b> <b>(AO 2 x 2.2)</b></p>	<p><b>ALLOW</b> idea that enzymes destroying DNA are denatured so less DNA destroyed</p> <p>Answers must make it clear which temperature they are referring to. <b>ALLOW ORA</b></p>
c		<p>wear face mask / goggles to prevent protease/ethanol/chemicals being inhaled / entering eyes</p> <p>gloves / use tongs to prevent ethanol/protease/chemicals being in contact with skin ✓</p> <p>turn Bunsen off as ethanol is flammable ✓</p>	<p><b>2</b> <b>(AO 2 x 2.2)</b></p>	<p><b>ALLOW</b> use tongs as solution/ tube may be hot</p> <p><b>IGNORE</b> reference to lab coats / glass breakages</p> <p><b>Examiner's Comments</b></p> <p>Lower ability candidates did not gain marks in this question as they often gave vague answers such as references to being careful or not dropping equipment. An example of an answer that did not receive credit is seen in exemplar 2.</p> <p><b>Exemplar 2</b></p> <p>1 Safety precaution: Do not snare the test tube. Explanation: This may spill the mixture and DNA.</p> <p>2 Safety precaution: Do not place the test tube down. Explanation: This may break it.</p> <p>[2]</p>

	d	i	<p><b>First check answer on answer line</b> <b>If answer = 33.1 (mg) award 2 marks</b></p> <p><math>\frac{99.2}{3}</math> OR 33.067 / 33.07✓</p>	<p>2 (AO 1.2) (AO 2.2)</p>	<p><b>Examiner's Comments</b></p> <p>The majority of candidates could correctly calculate the mean mass and give the answer to one decimal place. A small but significant number only gained one mark as they quoted too many decimal places.</p>
		ii	<p>(yes because)</p> <p>idea that there is a greater mean / yield / mass produced (of DNA) ✓</p> <p>there is less range/variation in results ✓</p>	<p>2 (AO 2 x 3.1b)</p>	<p><b>ALLOW</b> ECF</p> <p><b>ALLOW</b> examples of data from table to indicate less range/variability</p> <p><b>Examiner's Comments</b></p> <p>There were many correct references to the differences in the ranges of readings, although in some cases the range for the water bath was incorrectly calculated. Fewer candidates commented on the differences between the mean mass of DNA obtained.</p>
			<b>Total</b>	<b>10</b>	
34		i	<p>(skin stem cell) differentiates into (motor) neurone ✓</p>	<p>1 (AO 2.2)</p>	<p><b>ALLOW</b> differentiates into MN (taken from abbreviation of motor neurone disease to MND in stem of question)</p> <p><b>Examiner's Comments</b></p> <p>This question was referring to the ability of stem cells to be able to produce nerve cells that could be used to measure the speed of impulses. Most candidates did not refer to nerve cells in their answers. This is shown in exemplar 6, which gained 1 mark.</p> <p><b>Exemplar 6</b></p> <p><i>Stem cells are undifferentiated</i></p> <p>..... [1]</p>
		ii	<p>cerebru ✓</p> <p>idea that area of brain controlling motor function / movement / conscious activities ✓</p>	<p>2 (AO 1.1) (AO 2.1)</p>	<p><b>ALLOW</b> cerebral cortex / motor cortex</p> <p><b>IGNORE</b> it is the area that coordinates reactions. <b>DO NOT ALLOW</b> a list of correct functions of the cerebrum without the importance of movement being highlighted</p> <p><b>Examiner's Comments</b></p>

					The region labelled Y was correctly identified by many candidates, although there was some confusion with the cerebellum. The explanation did not always gain marks, as many candidates simply listed all the functions of the cerebrum.
		iii	<p><b>Any two from:</b></p> <p>difficult to access brain (due to skull) ✓</p> <p>large number of neurones / large number of nerve impulses in the brain/</p> <p>difficult to follow a single neurone ✓</p> <p>ethical issues of researching on brain / risk of damage ✓</p>	<p>1 (AO 2 × 2.2)</p>	<p><b>IGNORE</b> difficult to take measurements in brain unless qualified</p> <p><b>Examiner's Comments</b></p> <p>There were many correct references to the difficulty of access to the brain and the risk of damage. Some candidates incorrectly referred to differences in conduction velocities in the two types of cell.</p>
			<b>Total</b>	<b>5</b>	
35		i	<p>stem cells are not differentiated/can still specialise ✓</p> <p>they could become rod cells ✓</p>	<p>1 (AO 1.2)</p> <p>1 (AO 2.1)</p>	<p><b>ALLOW</b> stem cells are unspecialised / can grow into any type of cell / have ability to differentiate</p> <p><b>Examiner's Comments</b></p> <p>Most candidates were able to describe what a stem cell is assessing AO1.1, and many had the AO2.1 idea that they could become rod cells. Some missed the AO2.1 mark by referring to damaged or mutated cells, instead of the rod cells.</p>
		ii	<p>idea it would not be detected as foreign cells (by the immune system/WBC) ✓</p> <p><b>OR</b></p> <p>idea it would not be rejected (by the body) ✓</p>	1 (AO2.2)	<p><b>ALLOW</b> accepted (by the body) / (body) more likely to accept</p> <p><b>Examiner's Comments</b></p> <p>This AO2 question was generally answered well. Lower ability candidates stated that stem cells from another person "wouldn't work". Marks are scored more frequently when candidates avoid general terms, and responses are specific to the question asked.</p>
			<b>Total</b>	<b>3</b>	
36			<p><b>Any two from:</b></p> <p>(small pieces means) there will be a larger surface area of dead plants ✓</p> <p>therefore, decomposers will be able to reproduce faster / feed faster ✓</p>	2 (AO 2 × 2.2)	<b>Examiner's Comments</b>



			therefore, decomposers will be able to respire faster ✓		In this AO2 question, few candidates linked size to area and a number incorrectly thought large pieces had large surface area. Very few candidates were able to link the size to rates of respiration or reproduction.
			<b>Total</b>	<b>2</b>	
37		i	mRNA carries the code for proteins ✓ more protein will be made ✓	<b>2 (AO 2 × 2.1)</b>	<b>ALLOW</b> protein will be made faster <b>Examiner's Comments</b> This question assessed AO2.1. Many candidates were able to link mRNA to either more or faster protein synthesis, but very few referred to the term 'code' to link mRNA and protein synthesis.
		ii	<b>First check answer on answer line</b> <b>If answer = 40 award 2 marks</b> $\frac{20 \times 200}{100}$ ✓ = 40 ✓	<b>2 (AO 2 × 2.2)</b>	<b>Examiner's Comments</b> Candidates found this AO2.2 mathematics skills question quite challenging. 240 was a common incorrect response. Candidates need to have more practice at similar questions using percentages to develop their mathematical skills in this area.
		iii	new method uses the plants <b>own</b> genes ✓ concern that plants with the insecticide/gene might be harmful to humans / might impact on food chains / might kill useful insects ✓	<b>2 (AO 2.2)</b>  <b>(AO3.2a)</b>	<b>ALLOW</b> might have side-effects <b>IGNORE</b> ideas about cultural or religious or ethical objections or that it is playing God <b>Examiner's Comments</b> This question assesses both AO2 and AO3. Candidates were most likely to score a mark for the AO3 marking point, but it was rare for them to gain the AO2 mark. Many candidates described the effect of the gene on the plant, not consumers, or did not pick up on the possible problems of the insecticide itself. There were several responses written about the concern about genetic modification not being a natural process. This is an idea that mark schemes are unlikely to credit, preferring instead to focus on the effects of GM food on all consumers. Candidates also frequently missed out writing about the plants own genes and just focused on

					the AO3 marking point of the bacterial gene so missed the AO2 marking point. It was common for candidates to write about general dangers of bacteria and infections and not specifically the gene.
			<b>Total</b>	<b>6</b>	
38			C	1 (AO 2.2)	<p><b><u>Examiner's Comments</u></b></p> <p>This is an AO2.2 question testing the ability to apply knowledge of osmosis to changes in volume, and was well answered by many candidates. Candidates clearly understood there would be no change in volume if put in the same sucrose concentration.</p>
			<b>Total</b>	<b>1</b>	
39	a		blood travels through pump/heart twice ✓ on full circuit around body ✓	2 (AO1.1)	<p><b>ALLOW</b> idea that there are two pumps / idea that blood is pumped twice</p> <p><b>ALLOW</b> idea that blood passes <b>separately</b> to lungs and body</p> <p><b><u>Examiner's Comments</u></b></p> <p>In this AO1.1 question many candidates described the diagram but got confused. Some wrote about blood vessels rather than the heart. Candidates that gained credit identified that blood passes through the heart twice but were often unable to identify that this happens on a complete full circuit of the body.</p>
	b		bird ✓ bird has 4 chambered heart ✓ bird has double circulation✓	3 (AO 2.1)	<p>If bird is not ticked or bird not selected in answer, then zero for question</p> <p><b>ALLOW</b> bird has heart with 4 sections/compartments/named four chambers</p> <p><b>ALLOW</b> description of double circulation</p> <p><b><u>Examiner's Comments</u></b></p> <p>In this AO2.1 question many candidates were identifying the bird, and some went on the justify their choice. However, most candidates often repeated similar descriptions to their previous answer, with few clearly identifying birds as having double circulation. It was very rare to see candidates who had recognised both birds and humans as having 4 chambers to the heart. Some did gain credit for this mark for correctly naming all 4 chambers.</p>
	c	i	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>	2	

		<p><b>If answer = 4 award 2 marks</b></p> <p><math>25\ 000 \div 5800 = 4.3 \checkmark</math>  <math>= 4</math> (nearest whole number) <math>\checkmark</math></p>	(AO 2.2) (AO 1.2)	<p><b>ALLOW</b> ECF mark for correct rounding if calculation is incorrect</p> <p><b>Examiner's Comments</b></p> <p>This question tested AO1.2 and AO2.2. Most candidates did this correctly although some stated 4.3 and did not gain the second marking point. There were a minority who just subtracted the two numbers.</p>
	ii	<p><b>Any two from:</b></p> <p>muscles need more energy / more ATP / more respiration <math>\checkmark</math></p> <p>muscles need more oxygen / more carbon dioxide to be removed / more glucose / to avoid anaerobic respiration / to avoid lactic acid production <math>\checkmark</math></p> <p>other organs not needed (in exercise) <math>\checkmark</math></p>	2 (AO 3.2a)	<p>need to include only one comparative word e.g. more, to be able to score the first two marking points, e.g. muscles need <b>more</b> oxygen for energy = 2 marks</p> <p><b>ALLOW</b> to remove more heat</p> <p><b>ALLOW</b> other organs not prioritised / blood diverted from other organs</p> <p><b>Examiner's Comments</b></p> <p>This AO3.2 question proved challenging. Most responses focused on increased blood flow but gave no indication of why this was needed. Marks were often gained for muscles needing 'more oxygen' or 'other organs not needed', with a few marks being given for the lactic acid/respiration ideas.</p>
		<b>Total</b>	<b>9</b>	
40		D	1 (AO 1.1)	<p><b>Examiner's Comments</b></p> <p>Recalling their knowledge in this AO1.1 question was answered well by higher ability candidates, less so by others. Lower ability candidates were frequently distracted by A.</p>
		<b>Total</b>	<b>1</b>	
41		C	1 (AO 2.2)	
		<b>Total</b>	<b>1</b>	
42		A	1 (AO 1.1)	<p><b>Examiner's Comments</b></p> <p>A very accessible question with the majority of candidates realising that DNA has a double helical structure.</p>
		<b>Total</b>	<b>1</b>	
43		C	1 (AO 1.1)	<p><b>Examiner's Comments</b></p>

				Another very accessible question which was answered correctly by most candidates.
			<b>Total</b>	<b>1</b>
44			C	1 (AO 1.1) <b>Examiner's Comments</b> This question proved to be challenging with a number of candidates choosing distractor A as the answer.
			<b>Total</b>	<b>1</b>
45			C	1 (AO 1.1)
			<b>Total</b>	<b>1</b>
46			B	1 (AO 2.1) <b>Examiner's Comments</b> Many candidates chose distractors C or D as their answers.
			<b>Total</b>	<b>1</b>
47	a		blood travels through pump/heart twice ✓  on full circuit around body ✓	2 (AO 1.1) <b>ALLOW</b> idea that there are two pumps / idea that blood is pumped twice  <b>ALLOW</b> idea that blood passes <b>separately</b> to lungs and body  <b>Examiner's Comments</b> There were many concise and correct answers, stating that the blood flows through the heart twice on each circuit. Some candidates tried to describe the flow of blood, but their answers did not differentiate between a single or a double system.
	b		bird ✓  bird has 4 chambered heart ✓  bird has double circulation ✓	3 (AO 2.1) If bird is not ticked or bird not selected in answer, then zero for question  <b>ALLOW</b> bird has heart with 4 sections/compartments/named four chambers  <b>ALLOW</b> description of double circulation  <b>Examiner's Comments</b> The majority of candidates chose the correct organism and stated that the fish had a double circulatory system and had a four-chambered heart. A description of the double system was accepted.
	c	i	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 4 award 2 marks</b>	2 (AO 2.2 1.2)

		<p>25 000 ÷ 5800 = 4.3 ✓ = 4 (nearest whole number) ✓</p>		<p><b>ALLOW</b> ECF mark for correct rounding if calculation is incorrect</p> <p><b>Examiner's Comments</b></p> <p>The majority of candidates extracted the correct numbers from the table, completed the calculation and gave their answer to the nearest whole number.</p>
	ii	<p><b>Any two from:</b></p> <p>muscles need more energy / more ATP / more respiration ✓</p> <p>muscles need more oxygen / more carbon dioxide to be removed / more glucose / to avoid anaerobic respiration / to avoid lactic acid production ✓</p> <p>other organs not needed (in exercise) ✓</p>	<p>2 (AO 3.2a)</p>	<p>need to include only one comparative word e.g. <b>more</b>, to be able to score the first two marking points, e.g. muscles need more oxygen for energy = 2 marks</p> <p><b>ALLOW</b> to remove more heat</p> <p><b>ALLOW</b> other organs not prioritised / blood diverted from other organs</p> <p><b>Examiner's Comments</b></p> <p>The main error here made by candidates was that they did not give a comparative answer. Exemplar 1 clearly states that more oxygen is required for more respiration and so scores both marks. Only one comparative statement was required but a number of candidates did not give any, simply stating that muscles need more blood because they need oxygen.</p> <p><b>Exemplar 1</b></p> <p><i>The blood flow to the muscles increases because they are contracting more and hence require more glucose and oxygen for more respiration. The increased blood flow provides the muscles with significant amounts of glucose and oxygen.</i></p>
		<b>Total</b>	<b>9</b>	
48	a	<p>iodine (molecules) moved into bag / through membrane ✓</p> <p>starch (molecules) cannot move through membrane / out of the bag ✓</p> <p>starch molecule are large / iodine molecule</p>	<p>3 (AO 2 x 3.2a) (AO 2.1)</p>	<p><b>ALLOW</b> iodine moved into starch solution <b>DO NOT ALLOW</b> iodine moved by osmosis through membrane</p> <p><b>ALLOW</b> starch cannot diffuse through membrane <b>DO NOT ALLOW</b> starch cannot move by osmosis through membrane</p> <p><b>ALLOW</b> iodine smaller than pores in membrane/OR✓</p>


			are small / starch molecules larger than iodine / ORA ✓		<p><b>Examiner's Comments</b></p> <p>Many of the candidates understood that the iodine molecules must have entered the bag. However, some of them put this down to osmosis rather than diffusion and therefore lost this mark. Few candidates commented on the fact that starch molecules could not leave the bag and did not explain this in terms of the size of the molecules.</p>
	b	i	suitable best-fit curve ✓	1 (AO 2.2)	<p><b>DO NOT ALLOW</b> obvious double lines or lines drawn with ruler</p> <p><b>Examiner's Comments</b></p> <p>The ability of candidates to draw a best fit curve seems to be improving and less double lines or sketched lines were seen.</p>
		ii	answer should match where curve of best fit crosses X axis on candidates own line of best fit	1 (AO 3.2a)	<p><b>ALLOW</b> +/- half a small square ie +/- 0.02 from intercept on candidates graph</p> <p><b>Examiner's Comments</b></p> <p>Some candidates had difficulties with the scale, but most could read off the intercept.</p>
		iii	0.6 (mol/dm <sup>3</sup> ) ✓	1 (AO 2.2)	
	c		meristem ✓	2 (AO 1.1)	<p><b>ALLOW</b> cambium</p> <p><b>Examiner's Comments</b></p> <p>Although some of the spellings varied, a number of candidates correctly identified meristems.</p>
			<b>Total</b>	<b>7</b>	
49	a	i	progesterone ✓	1 (AO 2.1)	
		ii	any two from oestrogen / FSH / LH ✓	1 (AO 1.1)	
	b		<p><b>Any four from:</b>                      treatment contains oestrogen / progesterone / both oestrogen and progesterone ✓                      inhibits LH ✓                      prevents ovulation ✓                      inhibits FSH ✓                      prevents egg maturing ✓</p>	4 (AO 1.1)	<p><b>ALLOW</b> inhibits LH which controls ovulation = 2 marks</p> <p><b>ALLOW</b> inhibits FSH which matures eggs = 2 marks</p>

		thickens mucus ✓		<p><b>ALLOW</b> produces mucus</p> <p><b>Examiner's Comments</b></p> <p>A small number of candidates confused fertility treatment with contraception and so referred to the use of FSH or LH. However, the majority could correctly explain why oestrogen and/or progesterone were used.</p>
	c	<p>embryonic stem cells are able to differentiate into any cell / totipotent / adult stem cells are limited / pluripotent ✓</p> <p><b>therefore insulin producing cells</b> are easier to develop from embryonic stem cells/adult stem cells are not ✓</p>	2 (AO 1.1) (AO 2.1)	<p><b>IGNORE</b> adult stem cells are already specialised</p> <p><b>ALLOW</b> difficult to locate adult stem cells</p> <p><b>IGNORE</b> embryonic stem cells can repair all parts</p> <p><b>Examiner's Comments</b></p> <p>The majority of candidates correctly explained the totipotent nature of embryonic stem cells but few candidates went on to explain the consequences of this in replacing pancreatic cells. Exemplar 6 shows an example of a common answer that only scores the first marking point.</p> <p><b>Exemplar 6</b></p> <p><i>.....embryonic stem cells can specialise to become any type of cell whereas adult stem cells can only specialise to become a cell from their own tissue..... [2]</i></p>
	d	<p>gibberellins breaks seed dormancy / elongation of shoots ✓</p> <p>ethene stimulates fruit ripening ✓</p>	2 (AO 1.1)	<p><b>ALLOW</b> stimulates flowering / fruit development / fruit growth / seed formation / germination / growth of shoots</p> <p><b>DO NOT ALLOW</b> fruit ripening</p> <p><b>ALLOW</b> dropping of leaves/fruit / stimulates fruit maturation</p> <p><b>Examiner's Comments</b></p> <p>Many answers correctly referred to the action of gibberellins in breaking seed dormancy and the action of ethene in controlling fruit ripening. A number of marks were lost through inaccurate answers such as the 'control of plant ripening'.</p>
		<b>Total</b>	<b>10</b>	
50	a	digital balance/scales / electronic balance/scales ✓	1 (AO 1.2)	<p><b>ALLOW</b> analytical balance/scales / scientific balance/scales ✓</p> <p><b>IGNORE</b> balance/scales unqualified / sensitive scales</p> <p><b>Examiner's Comments</b></p>

					Many candidates did not concentrate on the accuracy needed and just stated 'a mass balance'.
	b	i	no chloroplasts / no chlorophyll / no leaves ✓ they cannot photosynthesise ✓	2 (AO 2 x 2.1)	<b>DO NOT ALLOW</b> chlorophyll removed by alcohol  no chlorophyll/chloroplasts/leaves to allow photosynthesis = 2 marks  <b>Examiner's Comments</b>  There were many good answers seen here, with candidates linking the inability to photosynthesise to the absence of leaves or chlorophyll.
		ii	<b>Any two from:</b> include a thermostat ✓  keep the temperature constant/at optimum ✓  control the humidity ✓  circulate air inside the cabinet / keep well ventilated / give a supply of carbon dioxide ✓	2 (AO 3.3a)	<b>IGNORE</b> include insulation  <b>ALLOW</b> increase humidity/water vapour <b>IGNORE</b> water the plants  <b>ALLOW</b> give a supply of oxygen  <b>Examiner's Comments</b>  A common improvement was suggesting the provision of extra carbon dioxide, but a number of candidates concentrated on the heating or lighting rather than exploring 'further improvements'.
			<b>Total</b>	<b>5</b>	
51	a	i	<b>Any two from:</b> <u>transcription</u> ✓  DNA (template) used to code for/make mRNA ✓  mRNA nucleotides/bases used to synthesis a mRNA molecule / mRNA nucleotides/bases pair with DNA nucleotides/bases ✓	2 (AO 1.1)	<b>Examiner's Comments</b>  There were some correct references to transcription, but this question was intended as a high demand question and did prove to be quite challenging. Exemplar 8 shows an answer that does gain credit for referring to the pairing of DNA bases with mRNA bases.  <b>Exemplar 8</b>  <i>The DNA is unzipped to be read by the mRNA. The mRNA then reads the DNA template, matching each base with its complementary base pairing.</i> [2]
		ii	<b>Any two from:</b> <u>translation</u> ✓  mRNA attaches to ribosome ✓	2 (AO 1.1)	



		<p>tRNA is a carrier molecule for amino acids / tRNA/carrier molecule brings (correct) amino acids into place / tRNA reads the triplets on the mRNA ✓</p>		<p><b>ALLOW</b> each triplet code on tRNA/carrier molecule is specific for an amino acid. <b>DO NOT ALLOW</b> amino acids are made</p> <p><b>Examiner's Comments</b></p> <p>Again, there were some correct references to translation, but many answers confused the roles of ribosomes, mRNA and tRNA. Another common error was to refer to the making of amino acids, rather than proteins.</p>	
	b	i	<p><b>small traces</b> of DNA can now be replicated (using PCR) ✓ PCR <b>makes enough</b> DNA to profile / PCR <b>makes enough</b> DNA to match with suspects ✓</p>	<p>2 (AO 2.1)</p>	<p><b>IGNORE</b> single copy of DNA</p> <p>Small traces of DNA can be replicated using PCR so that it can match to suspects = 2 marks DNA can be replicated using PCR so that there is enough to match to suspects = 2 marks</p> <p><b>Examiner's Comments</b></p> <p>A number of candidates thought that the PCR process actually matched the DNA samples. Often the ability to copy small amounts of DNA to make enough for testing was not appreciated.</p>
		ii	<p>S phase / DNA replication ✓</p>	<p>1 (AO 2.1)</p>	<p><b>ALLOW</b> DNA duplication / <b>IGNORE</b> synthesis unless qualified</p> <p><b>Examiner's Comments</b></p> <p>S phase or DNA replication was stated by a number of candidates but more commonly there were references to mitosis or one of the stages of mitosis.</p>
	c	i	<p><b>Any two from:</b> check on heredity ✓ look for genetic disorders / identify health risk factors ✓ idea of choosing correct medication / genomics ✓ to confirm a person's identity ✓</p>	<p>2 (AO 2.1)</p>	<p><b>ALLOW</b> establish family tree / find relatives</p> <p><b>ALLOW</b> specified health risk factor</p> <p><b>Examiner's Comments</b></p> <p>There were many correct references to genetic conditions, making ancestral links or the identification of individuals.</p>
		ii	<p>avoid being identified for a crime / avoid high insurance costs /</p>	<p>1 (AO 3.1a)</p>	

		<p>reluctance of employers to offer jobs /</p> <p>remain unaware of family history/genetic disorders /</p> <p>idea of dislike of sharing personal details / privacy (reasons) ✓</p>		<p><b>ALLOW</b> do not want to be found by lost relatives</p> <p><b>ALLOW</b> against the Human Rights Act</p> <p><b>Examiner's Comments</b></p> <p>A number of candidates seemed to think that the database actually stored physical samples of DNA that could be used for cloning. The most common creditable answers referred to protection of privacy.</p>
		<b>Total</b>	<b>10</b>	
52	a	<p>platelets are needed for blood clotting ✓</p> <p>the rat would keep bleeding/bleed to death ✓</p>	2 (AO 2.1)	<p><b>Examiner's Comments</b></p> <p>Many candidates were able to score both marks on this AO2.1 question although some did not mention platelets. A significant number of candidates, however, linked the poison to clotting incorrectly, saying blood would clot too much or in the wrong place. In that type of response, there were references to heart attacks and strokes. Some candidates referred to wounds clotting.</p>
	b	<p>parents are Rr and Rr ✓</p> <p>offspring are RR, Rr, Rr, rr ✓</p> <p>rr identified as being non-resistant ✓</p>	3 (AO 2.2)	<p><b>ALLOW</b> all marks from a Punnett square</p> <p><b>ALLOW</b> ECF on offspring</p> <p><b>Examiner's Comments</b></p> <p>Many candidates scored on this AO2.2 question. The most frequent way candidates did not get maximum marks was by omitting to identify the correct offspring genotype.</p> <p>Candidates needed to annotate rr. A significant number of candidates only identified the non-resistant rate, not noticing that homozygous dominant rats were also present in that ratio; and therefore only stating 25% were homozygous. Candidates should be encouraged to routinely include the phenotypic ratio.</p> <div style="text-align: center;">  <p><b>AfL</b></p> </div> <p>Some candidates made errors on the Punnett square diagram. The main error was to cross R with r and derive RR. Candidates should be encouraged to check their answers for this type of error.</p>



60			B ✓	1 (AO2.1)	
			<b>Total</b>	<b>1</b>	
61	a	i	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 3 : 1 award 2 marks</b></p> <p>24 : 8 or 3 ✓</p> <p>3 : 1 ✓</p>	2 (AO2.2)	<b>ALLOW</b> answer in the table but answer on answer line takes preference
		ii	higher SA:V ratio faster rate of diffusion / ORA ✓	1 (AO3.2b)	<b>ALLOW</b> positive correlation <b>ALLOW</b> reference to less time instead of faster rate <b>IGNORE</b> they are directly proportional
		iii	<p>reduces (total) SA of alveoli/air sacs /  reduces SA : Vol ratio of alveoli/air sacs ✓</p> <p>so diffusion (of oxygen) reduced ✓</p>	2 (AO2 x 3.1a)	<b>ALLOW</b> harder for oxygen to diffuse <b>IGNORE</b> oxygen cannot diffuse into the blood in emphysema
	b		<p>sickle red blood cells release/take up/carry/deliver/transport less oxygen ✓</p> <p>sickle cells have a smaller surface area (to vol ratio) / tend to get stuck in blood vessels/capillaries / cannot pass through blood vessels/capillaries so easily ✓</p>	2 (AO1.1) (AO2.1)	<b>IGNORE</b> less oxygen binds to RBCs / sickle cells cannot carry oxygen  <b>IGNORE</b> references to smaller volume / less Hb / less space on the RBCs
			<b>Total</b>	<b>7</b>	
62	a		more accurate/precise measurement (of volume/amount of gas) ✓	1 (AO3.3b)	<b>ALLOW</b> gas could dissolve in water / less gas can escape  <b>IGNORE</b> gives exact measurement of gas release
	b	i	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b>  <b>If answer = 2.3 (cm<sup>3</sup> / min) award 3 marks</b></p> <p><math>\frac{25+23+22}{3} = 23.3333333</math> ✓</p> <p><math>\frac{23.3}{10} = 2.3333333</math> ✓</p>	3  (AO1 x 1.2)  (AO2 x 2.2)	<b>ALLOW</b> one mark for clear evidence of rounding incorrect answer correctly to one dp.

			= 2.3 (cm <sup>3</sup> / min) ✓		
		ii	increased movement of molecules / increased kinetic energy ✓  therefore, more chance of substrate colliding with enzymes/active sites ✓  more chance of substrate entering active site ✓	3 (AO2 x2.1)	increased KE of enzymes and substrates leads to more collisions = 2 marks  <b>ALLOW</b> more enzyme-substrate complexes forming
		c	(phenols) alter the shape of the active site/enzyme / block active site/enzyme ✓  so substrate no longer fits/binds with active site/enzyme ✓	2 (AO2.1)	<b>IGNORE</b> reference to denaturing  need reference to active site once only for 2 marks
			<b>Total</b>	<b>9</b>	
63	a	i	water evaporates (on surface of spongy mesophyll) ✓  water (vapour) passes/diffuses through the stomata/pores ✓	2 (AO1.1)	Need evaporate or a description of the process
		ii	measure distance gas bubble moves ✓  over certain time / specified time ✓  vary distance of lamp from potometer ✓	3 (AO1.2)	<b>ALLOW</b> measure position of bubble before and after  time taken for bubble to move a certain distance = 2 marks
		iii	absorbs heat/thermal energy (from lamp) / keeps (plants at) constant temperature ✓  heat/temperature would affect transpiration ✓	2 (AO2.2)	<b>IGNORE</b> references to photosynthesis
	b	i	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 57 (mm<sup>3</sup>) award 3 marks</b>  $\pi \times 0.5^2 \times 72$ ✓  = 56.52 ✓  = 57 (mm <sup>3</sup> ) ✓	3 (AO3 x 2.2)	<b>ALLOW</b> one mark for an answer of 226.08 and 2 marks for an answer of 230 (1.0 has been used as r) <b>ALLOW</b> one mark for clear evidence of incorrect answer correctly rounded to two sig figs.
		ii	42 (mm) / Trial 1 at 40cm ✓  reading taken too quickly after moving the lamp / error in measurement (distance bubble moved/time) / heat sink not in the way/radiating heat / change in room temp/air	2 (AO2 x 2.2)	

			movements / potometer/light not at correct distance ✓		
		iii	Idea that they should remove/ignore the anomalous result (before processing) ✓	1 (AO1.2)	<b>ALLOW</b> repeat that reading
		iv	the mean is 73 mm ✓ the range of values is 71 to 75 / range is 4 mm / 2mm is half the range ✓	2 (AO2 x 1.2)	<b>ALLOW</b> adding or subtracting 2 from 73 covers all the readings  this is the mean ± half the range = 2 marks
			<b>Total</b>	<b>15</b>	
64	a	i	<b>Any two from:</b> contains (plant) hormones ✓ causes excessive/rapid cell elongation/growth ✓ only affects broadleaved plants ✓	2 (AO2 x 1.1)	<b>ALLOW</b> auxins  <b>IGNORE</b> just plants grow faster  <b>ALLOW</b> effects some plants/weeds and not others/the crop
		ii	<b>B</b> because B causes highest percentage death of horsenettle ✓  A/C do not kill other broadleaved plants/weeds / A/C not suitable as field contains other weeds / A/C only kills horsenettle ✓  D does not kill roots / much less effective at killing horsenettle ✓  Spring treatment because buds just growing and flowering yet to happen ✓	4 (AO3.1b)	<b>No mark for B on its own.</b> <b>NEED a choice of B or D to score any marks</b> <b>Mark first choice</b>  Need reference to both buds and flowering  <b>ALLOW D</b> for three marks if B is not chosen first:  because D kills more species of weeds ✓  D much cheaper than B ✓  spring treatment because buds just growing and flowering yet to happen ✓
	b	i	breaks seed dormancy / elongation of shoots ✓	1 (AO1.1)	<b>ALLOW</b> (stimulates) flowering/ fruit development / fruit growth / seed formation / germination / growth of shoots / seedless fruits <b>DO NOT ALLOW</b> fruit ripening / seed growth

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		ii	<p>Idea that the ripeness colour scale can be used for comparison ✓</p> <p>idea that a numerical estimate/quantitative measure for level of ripeness is better / idea that it gives multiple measures and not just two/ripe or unripe / removes objectivity / allows reproducibility ✓</p>	<p>2 (AO2 x 3.3a)</p>	<p><b>ALLOW</b> can be used to choose from a selection of ripeness levels</p>
			<b>Total</b>	<b>9</b>	
65			<p><b>Any four from:</b></p> <p>DNA unwinds/unzips ✓</p> <p>during transcription mRNA is made ✓</p> <p>mRNA moves from the nucleus to the cytoplasm/ribosomes ✓</p> <p>translation on the ribosomes ✓</p> <p>carrier molecules/tRNA bring specific amino acids ✓</p> <p>amino acids joined to form a protein ✓</p>	<p>4 (AO4 x 1.1)</p>	<p><b>DO NOT ALLOW</b> amino acids are produced</p>
			<b>Total</b>	<b>4</b>	
66	a		<p><b>Any two from:</b></p> <p>anaemia / tiredness / lack of energy due to lack of red blood cells ✓</p> <p>inability to fight off infections / prone to infections due to lack of white blood cells/WBC ✓</p> <p>slow blood clotting due to lack of platelets ✓</p>	<p>2 (AO2 x 1.1)</p>	<p><b>DO NOT ALLOW</b> incorrectly matched symptom to blood cell type</p> <p><b>ALLOW</b> less immunity / reduced immune response / weakened immune system due to lack of white blood cells/WBC</p> <p><b>ALLOW</b> (recurring) nosebleeds / bruise easily due to lack of platelets</p>
	b	i	<p>people may be ill with infection / have a pathogen / just recovering from infection ✓</p> <p>therefore have produced more white blood cells to destroy the pathogen/produce antibodies ✓</p> <p><b>OR</b></p> <p>weakened immune system/cancer/cancer treatment reducing white blood cell number</p>	<p>2 (AO2 x 2.1)</p>	<p><b>IGNORE</b> fighting(off) pathogens</p>

		so less white blood cells to defend against pathogens/produce antibodies														
	ii	Area = $10 \times 10 = 100(\text{mm}^2)$ Volume = $100 \times 0.001 = 0.1 (\text{mm}^3) \checkmark$	1 (AO2.2)													
	iii	No (no mark) $1000 \div 0.1$ OR $1000 \times 10 \checkmark$ number of white blood cells/ $\text{mm}^3$ is $10 \times 10^3 / 1.0 \times 10^4 / 10000 \checkmark$  within the range of $6.0 - 16.0 \times 10^3 \checkmark$	3 (AO2 x 2.2) (AO3.2b)	<b>ALLOW</b> ECF from (ii) <b>ALLOW</b> number of white blood cells / $\text{mm}^3 = 10\ 000$ <b>ALLOW</b> within the normal white blood cell range/ 6000 – 16000												
	c	(Fanconi anaemia) (no mark)  ( $3 \times 10^6$ is a) low red blood cell count $\checkmark$  must be Fanconi anaemia because: caused by recessive allele $\checkmark$ obtained from heterozygous/carrier parents who don't have a blood disorder $\checkmark$  <b>OR</b>  cannot be D-B anaemia because: neither parents have a blood disorder $\checkmark$ it is caused by a dominant allele $\checkmark$	3 (AO3x3.2b)	<b>if incorrect disorder then no marks</b> <b>IGNORE</b> low numbers of all cells												
		<b>Total</b>	<b>11</b>													
67	a	smallest <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>nucleotide</td></tr><tr><td>allele</td></tr><tr><td>chromosome</td></tr><tr><td>genome</td></tr></table> largest	nucleotide	allele	chromosome	genome	1 (AO1.1)									
nucleotide																
allele																
chromosome																
genome																
	b	$66000000 \div 500 = 132\ 000 \checkmark$	1 (AO2.2)	<b>ALLOW</b> 0.132 million or 132 thousand												
	c	woman <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td colspan="2" style="text-align: center;">man</td></tr><tr><td></td><td style="text-align: center;">D</td><td style="text-align: center;">d</td></tr><tr><td style="text-align: center;">d</td><td style="text-align: center;">Dd</td><td style="text-align: center;">dd</td></tr><tr><td style="text-align: center;">d</td><td style="text-align: center;">Dd</td><td style="text-align: center;">dd</td></tr></table> $\checkmark$  $0.5 / 50(\%) \checkmark$		man			D	d	d	Dd	dd	d	Dd	dd	2 (AO2.2) (AO3.1a)	<b>ALLOW</b> appropriate use of other lower/upper case letters  <b>ALLOW</b> ECF <b>ALLOW</b> 1 in 2 / $\frac{1}{2}$ / 1:1 $\checkmark$ <b>DO NOT ALLOW</b> 1:2
	man															
	D	d														
d	Dd	dd														
d	Dd	dd														
	d	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 839 award 2 marks</b>  $2517/3 \checkmark$	2 (AO2 x 1.2)	<b>ALLOW</b> 840 or $2521/3 \checkmark$												



		<p>= 839 ✓</p>		
e		<p>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</p> <p><b>Level 3 (5–6 marks)</b> Demonstrates a knowledge of the importance of the blood supply to the heart. <b>AND</b> Applies knowledge to explain why a failure of this blood supply can lead to heart disease. <b>AND</b> Analyses the information to explain the link between a lack of LDL protein and heart disease.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b> Demonstrates a knowledge of the importance of the blood supply to the heart. <b>AND</b> Applies knowledge to explain why a failure of this blood supply can lead to heart disease.</p> <p><b>OR</b></p> <p>Demonstrates a knowledge of the importance of the blood supply to the heart. <b>AND</b> Analyses the information to explain the link between a lack of LDL protein and heart disease.</p> <p><b>OR</b></p> <p>Applies knowledge to explain why a failure of this blood supply can lead to heart disease. <b>AND</b> Analyses the information to explain the link between a lack of LDL protein and heart disease.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b></p>	<p>6 (AO2 x 1.1) (AO2 x 2.1) (AO2 x 3.1a)</p>	<p><b>AO1.1 Demonstrate knowledge and understanding of the importance of the blood supply to the heart muscle.</b></p> <ul style="list-style-type: none"> <li>• blood in the coronary artery supplies heart muscle</li> <li>• oxygen / glucose is supplied to the muscle</li> <li>• this is needed for the muscle to contract/for respiration</li> </ul> <p><b>AO2.1 Apply knowledge and understanding of the requirements of the heart muscle</b></p> <ul style="list-style-type: none"> <li>• without oxygen / glucose the heart muscle cannot <u>respire</u></li> <li>• <u>energy</u> from respiration is needed for the muscle to contract</li> </ul> <p><b>AO3.1a Analyse information and ideas to interpret the effects of lack of LDL receptor protein.</b></p> <ul style="list-style-type: none"> <li>• without LDL receptor protein there will be more cholesterol in the blood / cholesterol levels will be too high to be removed/broken down</li> <li>• increased build up of cholesterol in the coronary artery will increase the risk of heart disease / decrease blood flow to the heart muscle</li> </ul>

			<p>Demonstrates a knowledge of the importance of the blood supply to the heart.</p> <p><b>OR</b></p> <p>Applies knowledge to explain why a failure of this blood supply can lead to heart disease.</p> <p><b>OR</b></p> <p>Analyses the information to explain the link between a lack of LDL protein and heart disease.</p> <p><i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i></p> <p><b>0 marks</b> <i>No response or no response worthy of credit</i></p>		
			<b>Total</b>	<b>12</b>	
68	a	i	electric heater ✓	1 (AO2.2)	<b>ALLOW</b> electric incubator / <u>electric</u> (water) bath
		ii	wear goggles / tie (long) hair back / secure loose clothing ✓	1 (AO1.2)	<b>ALLOW</b> wear gloves / use gauze under flask / use heatproof mat <b>IGNORE</b> face mask / do not touch hot equipment
		iii	<p><b>Any two from:</b> difficult to keep constant/regulate temperature ✓</p> <p>uneven heating of flask creating hot/cold spots ✓</p> <p>human error in reading thermometer ✓</p>	2 (AO2.2)	<p><b>ALLOW</b> water may overheat</p> <p><b>ALLOW</b> may become hot and denature enzyme</p> <p><b>ALLOW</b> flask may have slightly raised temperature</p> <p><b>ALLOW</b> temperature in water bath may not reflect temperature in the flask</p>
	b	i	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 32 award 2 marks</b></p> <p><math>34 + 29 + 33 = 96</math> ✓</p> <p><math>96 \div 3 = 32</math> ✓</p>	2 (AO2.2)	<p><b>ALLOW</b> answer in the space under the table but answer on answer line in table takes preference</p> <p><b>ALLOW</b> ECF for mean calculation</p>
		ii	temperature ✓	1 (AO2.1)	
		iii	identifies variability in each point plot / gives an estimate of level of uncertainty ✓	1 (AO1.2)	<p><b>ALLOW</b> can plot range/error bars</p> <p><b>ALLOW</b> large error bars variability is high/ORA</p> <p><b>ALLOW</b> high variability then reliability is low/ORA</p> <p><b>ALLOW</b> idea of the spread of data at each point and</p>

				possibly identify/eliminate outlier/anomaly <b>ALLOW</b> ranges overlap the data at those 2 points isn't significantly different
		iv	<p><b>Any two from:</b> as temperature increases enzyme activity increases ✓</p> <p>optimum enzyme activity between 25°C and 35°C enzyme activity ✓</p> <p>but somewhere between 30°C and 35°C enzyme activity starts to decrease ✓</p> <p>idea decrease in rate (after 35°C) due to denaturing ✓</p>	<p>2 (AO3.1a)</p> <p><b>ALLOW</b> idea that as temperature increases/gets higher so does rate of (enzyme) reaction / gas release / ORA <b>ALLOW</b> higher temperature the faster the enzyme activity</p> <p><b>ALLOW</b> enzyme starts to denature above 30°C/between 30°C and 35°C</p>
			<b>Total</b>	<b>10</b>
69			<p>supports claim (that found in stomach) because it works best / optimum around pH 2 (1)</p> <p>does not support claim that it is a protease since there is no evidence (to support or reject claim) (1)</p>	<p>allow optimum pH matches stomach pH</p> <p>allow idea it could be another type of enzyme</p> <p><b>Examiner's Comments</b></p> <p>Most candidates explained that enzyme A had an optimum pH that matched that found in the stomach. Very few picked up on the fact that there was nothing in the scientists' results to support the claim that it was a protease, as opposed to another type of enzyme.</p>
			<b>Total</b>	<b>2</b>
70	a		at 20 °C: slower reaction (1)	1
			particles moving more slowly (1)	1
			less frequent collisions (1)	1
	b		At 80 °C: slower reaction (1)	1
			enzyme denatured (1)	1
			shape of active site changed / cannot bind to substrate (1)	1
	c	i	(optimum) could be either side of 40 °C / could be anywhere between 40 °C and 60 °C (1)	1
		ii	Do more repeats (1)	2
		ii	Idea of narrower intervals around 40 °C (1)	allow 30–50 °C

	d	<p><b>any two from</b> use a colorimeter – so it's objective / AW (1)</p> <p>have the same student doing all observations – so there is a consistent judgement / AW (1)</p> <p>repeat the experiment at each temperature – can take mean / average (1)</p>	2	<p><b>allow</b> light meter</p> <p><b>allow</b> colour chart / serial dilution</p>
		<b>Total</b>	<b>11</b>	
71	a	<p>at 20 °C: slower reaction (1)</p> <p>particles moving more slowly (1)</p> <p>less frequent collisions (1)</p>	<p>1</p> <p>1</p> <p>1</p>	<p><b>allow</b> reverse argument referring to 40 °C</p>
	b	<p>At 80 °C: slower reaction (1)</p> <p>enzyme denatured (1)</p> <p>shape of active site changed / can not bind to substrate (1)</p>	<p>1</p> <p>1</p> <p>1</p>	<p><b>allow</b> reverse argument referring to 40 °C</p>
		<b>Total</b>	<b>6</b>	