Question number	Acceptable answer	Additional guidance	Mark
1 (a) (i)	**C** R		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
1 (a) (ii)	**D** S		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
1 (a) (iii)	**B** Q		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
1 (b)	An explanation that makes reference to three of the following: • slow twitch fibres have more mitochondria (1) • slow twitch fibres have more capillaries (1) • slow twitch fibres have more myoglobin (1) • slow twitch fibres respire aerobically and fast twitch respire anaerobically (1)	Answers expressed as the converse for fast twitch fibres are acceptable.	**(3)**

(Total for Question 1 = 6 marks)

Question number	Acceptable answer	Additional guidance	Mark
2 (a)	**D** transcription factor		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
2 (b)	A description that makes reference to three of the following points: • binding of {protein complex / transcription factor} to { template / antisense } strand of DNA (for HGF gene) (1) • binding of RNA polymerase to { complex / transcription factor } (1) • complementary base pairing of RNA nucleotides (1) • RNA polymerase joins the nucleotides together to form a molecule of mRNA (1)		**(3)**

Question number	Acceptable answer	Additional guidance	Mark
2 (c)	An explanation that makes reference to the following points: • control the dose of rapamycin (1) • HGF production requires rapamycin to form the transcription factor (1)		**(2)**

(Total for Question 2 = 6 marks)

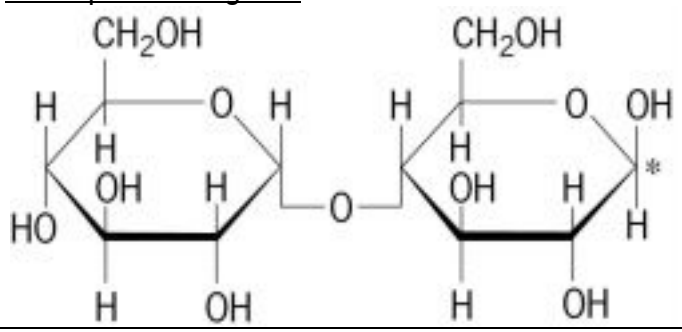
Question number	Acceptable answer	Additional guidance	Mark
3 (a)	An explanation that makes reference to the following points: • prevention of serotonin reuptake (1) • increased serotonin release (1) • increased depolarisation of postsynaptic membrane (1)		**(3)**

Question number	Acceptable answer	Additional guidance	Mark
3 (b) (i)	An explanation that makes reference to the following points: • a mechanism for preventing depolarisation (1) • prevention of depolarisation of postsynaptic membrane (1)	e.g. prevention of neurotransmitter release, breakdown of neurotransmitter, inhibition of postsynaptic receptors	**(2)**

Question number	Acceptable answer	Additional guidance	Mark
3 (b) (ii)	An explanation that makes reference to the following points: • a mechanism for causing depolarisation (1) • constant depolarisation of postsynaptic membrane (1)	e.g. stimulation of neurotransmitter release, inhibition of enzyme, binding to postsynaptic receptor	**(2)**

(Total for Question 3 = 7 marks)

Question number	Answer	Additional guidance	Mark
4 (a) (i)	D hydrolysis		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
4 (a) (ii)	carbons joined by bonds to oxygen and hydrogen atoms present	<u>Example of diagram</u> 	**(1)**

Question number	Answer	Additional guidance	Mark
4 (a) (iii)	B glycosidic		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
4 (b) (i)	An explanation that makes reference to the following: • carbon dioxide produced is absorbed by the potassium hydroxide solution (1) • oxygen removal from the air will cause { the volume to fall / the fluid to move up on the right hand side of the capillary tube } (1)		**(2)**

<table>
<tr><th>Question number</th><th colspan="2">Acceptable answer</th></tr>
<tr><td>4 (b) (ii)</td><td colspan="2">Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.

The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.

• removal of oxygen from the apparatus
• to produce anaerobic conditions
• remove the potassium hydroxide
• so that carbon dioxide is not absorbed
• measure the movement of fluid over a period of time
• use scale to measure increase in volume of gas in apparatus
• calculate volume by multiplying the distance moved by the capillary's cross-sectional area</td></tr>
<tr><td>Level</td><td>Mark</td><td>Descriptor</td></tr>
<tr><td>0</td><td>0</td><td>No awardable content</td></tr>
<tr><td>1</td><td>1-2</td><td>An explanation of how the investigation should be modified may be attempted but with limited analysis, interpretation and / or evaluation of the scientific information. Generalised comments made.

The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.</td></tr>
<tr><td>2</td><td>3-4</td><td>An explanation of how the investigation should be modified will be given with occasional evidence of analysis, interpretation and / or evaluation of the scientific

The explanation shows some linkages and lines of scientific reasoning with some structure.</td></tr>
<tr><td>3</td><td>5-6</td><td>An explanation of how the investigation should be modified is given which is supported throughout by evidence from the analysis, interpretation and / or evaluation of the scientific information.

The explanation shows a well-developed and sustained line of scientific reasoning which is clear, coherent and logically structured</td></tr>
</table>

(Total for Question 4 = 11 marks)

Question number	Acceptable answer	Additional guidance	Mark
5 (a)	• correct answer for wheat plant (1) • correct answer for bacterium (1)	<u>Example of calculation:</u> (27.3 + 27.2) ÷ (22.8 + 22.7) = 1.20 (24.6 + 24.3) ÷ (25.6 + 25.5) = 0.96	**(2)**

<table>
<tr><th>Question number</th><th colspan="2">Acceptable answer</th></tr>
<tr><td>5 (b)</td><td colspan="2">Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.
The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.
all the organisms possess DNA containing the same four bases
the ratio of A + G : C + T is close to 1 for all species studied
similar percentages for A & T and C & G support complementary base pairings in all organisms
A + T : C + G varies between species as gene sequences will differ
no indication of sequence of bases therefore genomes cannot be compared
sequence of complementary base pairs reflects differences in protein structure according to genetic code</td></tr>
<tr><td>Level</td><td>Mark</td><td>Descriptor</td></tr>
<tr><td>0</td><td>0</td><td>No awardable content</td></tr>
<tr><td>1</td><td>1-2</td><td>Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified.

A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.</td></tr>
<tr><td>2</td><td>3-4</td><td>A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified.

A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.</td></tr>
<tr><td>3</td><td>5-6</td><td>A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information.

A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.</td></tr>
</table>

(Total for Question 5 = 8 marks)

Question number	Acceptable answer	Additional guidance	Mark
6 (a) (i)	B 0.91 µm		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
6 (a) (ii)	C (Y)		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
6 (a)(iii)	An answer that makes reference to the following points: • double membrane (1) • cristae (1)		**(2)**

Question number	Acceptable answer	Additional guidance	Mark
6 (b) (i)	An explanation that makes reference to the following points: • nitrogen maintains anaerobic conditions (1) • to show that the procedure is not the cause of a change in pH (1)	Allow the idea that any changes in pH are due to oxygen	**(2)**

Question number	Acceptable answer	Additional guidance	Mark
6 (b) (ii)	An answer that makes reference to three of the following points: • fall in pH is due to an increase in hydrogen ion concentration (1) • when oxygen is present the electron transport chain passes hydrogen ions into the intermembrane space (1) • hydrogen ions move across the membrane into the matrix by chemiosmosis (1) • (once oxygen has been used up) the pH rises as hydrogen ions cross the inner membrane into the matrix (1)		**(3)**

Question number	Acceptable answer	Additional guidance	Mark
6 (c)	An explanation that makes reference to the following points: • the inner membrane establishes a hydrogen ion concentration gradient (1) • in treated mitochondria the concentration gradient for hydrogen ions required for ATP production will not be present (1) • proteins in the inner membrane use a flow of hydrogen ions to produce ATP (1)		**(3)**

(Total for Question 6 = 12 marks)

Question number	Acceptable answer	Additional guidance	Mark
7 (a)	An explanation that makes reference to the following points: • the allele for red eye is dominant over scarlet eye (1) • all offspring inherit one red allele from the homozygous parent (1)		**(2)**

Question number	Acceptable answer	Additional guidance	Mark
7 (b)	B heterozygous		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
7 (c) (i)	An explanation that makes reference to the following: • F1 flies shown to be heterozygous for both genes (1) • four types of gamete shown for F1 flies, the scarlet curly flies produce only gametes with recessive alleles (1) • four offspring genotypes correctly shown (1)	e.g RrSs e.g RS Rs rS rs x rs <u>Example of offspring genotypes:</u> RrSs, Rrss, rrSs, rrss,	**(3)**

Question number	Acceptable answer	Additional guidance	Mark
7 (c) (ii)	An answer that makes reference to the following points: • there are three degrees of freedom in the data (1) • the critical value at $p < 0.05$ is 7.81 (1) • since 10.64 is greater than 7.81 there is a significance difference from expected (1)		**(3)**

Question number	Acceptable answer	Additional guidance	Mark
7 (c) (iii)	An answer that makes reference to the following points: • phenotypes of the original parents are more common than new combinations of characteristics (1) • the two genes are likely to be linked (1) • new combinations are the result of crossing over (1)		**(3)**

(Total for Question 7 = 12 marks)

Question number	Acceptable answer	Additional guidance	Mark
8 (a)	An explanation that makes reference to the following points: • ions carry a charge (1) • ions cannot pass through the non-polar region of fatty acid tails (1)		**(2)**

Question number	Acceptable answer	Additional guidance	Mark
8 (b)	An explanation that makes reference to the following points: • protein provides a pore to allow ions to pass through (1) • region surrounding the pore has hydrophilic properties (1) • allowing facilitated diffusion of ions (1)		**(3)**

Question number	Acceptable answer	Additional guidance	Mark
8 (c)(i)	<table><tr><td>Voltage-dependent potassium channels</td><td>×</td><td>✓</td><td>×</td></tr><tr><td>Voltage-dependent sodium channels</td><td>✓</td><td>×</td><td>×</td></tr><tr><td>Passive potassium channel</td><td>✓</td><td>✓</td><td>✓</td></tr><tr><td>Sodium-potassium pump</td><td>✓</td><td>✓</td><td>✓</td></tr></table> (1) (1) (1)	One mark for each correct row	**(3)**

Question number	Acceptable answer	Additional guidance	Mark
8 (c)(ii)	An explanation that makes reference to the following points: • passive channels allow potassium ions to move down a diffusion gradient (1) • potassium ions move from inside the axon to outside (1) • movement through the passive channels is reduced by a negative charge inside the axon (1) • no net movement of potassium ions through these channels (at the resting potential) (1)	There is a high concentration of potassium ions inside the axon, due to the action of the Na/K pump. The ions diffuse out of the axon via the passive potassium channels, moving down their concentration gradient. Movement down the concentration gradient is opposed by the positive charges outside the axon and the negative charge inside the axon. Eventually these forces reach equilibrium , at which time there is no net movement of potassium ions across the membrane.	**(4)**

(Total for Question 8 = 12 marks)

Question number	Acceptable answer	Additional guidance	Mark
9 (a)	An answer that makes reference to the following points: Either • number of different species (1) • in {an area / a community / an ecosystem / a habitat } (1) OR • { genetic diversity / number of different alleles } (1) • within a species (1)		**(2)**

Question number	Acceptable answer	Additional guidance	Mark
9 (b)	• N(N-1) correctly calculated (1) • ∑n(n-1) correctly calculated (1) • value for D correctly calculated (1)	<u>Example of calculation:</u> N = 720 so (N(N-1) = 517680 (1) ∑ n(n-1) = 203314 (1) D = 517680 ÷ 203314 D = 2.5 Correct answer with no working scores full marks	**(3)**

Question number	Acceptable answer	Additional guidance	Mark
9 (c)	An explanation that makes reference to the following points: • some species have adaptations that allow them to survive in changed conditions (1) • some species cannot tolerate changed conditions (1) • fewer species reduces interspecific competition allowing increased numbers of species remaining (1)		**(3)**

(Total for Question 9 = 8 marks)

Question number	Acceptable answer	Additional guidance	Mark
10 (a)	D (to show the variability in the data)		**(1)**

Question number	Acceptable answer	Additional guidance	Mark
10 (b)	An answer that makes reference to the following points: • statins reduce the proportion of people with FH that die of CVD (1) • blood LDL lower with statins (1) • high blood LDL is associated with atherosclerosis (1) • statins reduce development of atherosclerosis (and hence CVD) (1)		**(4)**

Question number	Acceptable answer	Additional guidance	Mark
10 (c)	A description that makes reference to the following points: • make sample sizes comparable (1) • include information on gender (1) • include information on other risk factors e.g. life style choices, other health conditions (1)	Allow larger sample size	**(3)**

(Total for Question 10 = 8 marks)

Question number	Acceptable answer	Additional guidance	Mark
11 (a)(i)	critical period (1)	Allow critical window	**(1)**

Question number	Acceptable answer	Additional guidance	Mark
11 (a)(ii)	An explanation that makes reference to the following points: • to act as a control (1) • to ensure that the procedure does not affect vision (1)		**(2)**

Question number	Acceptable answer	Additional guidance	Mark
11 (a)(iii)	An answer that makes reference to three of the following points: • without light stimulus during critical period cortex fails to develop (1) • neurone growth is limited in regions without stimulus (1) • NGF stimulates normal neurone growth without light stimulus (1) • visual cortex development with NGF appears normal (1)		**(3)**

Question number	Acceptable answer	Additional guidance	Mark
11 (b)	An answer that makes reference to the following points: • with stimulation brain response improves more than in the mice without stimulation (1) • response of covered eye in stimulated mice increases to normal at 14 days (1) • stimulation causes visual cortex to develop (1) • may involve production of NGF as a result of stimulation (1)		**(4)**

(Total for Question 11 = 10 marks)