Oxford Cambridge and RSA

GCE

Biology A

H020/02: Depth in biology

Advanced Subsidiary GCE

Mark Scheme for Autumn 2021

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

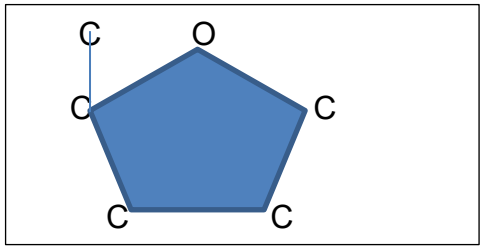
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Annotations

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Marking Annotations

Annotation	Use
BOD	Benefit of Doubt
CON	Contradiction
	Cross
ECF	Error Carried Forward
GM	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
I	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
NBOD	Benefit of the doubt not given
	Tick
^	Omission Mark
BP	Blank Page
L1	Level 1 answer in Level of Response question
L2	Level 2 answer in Level of Response question
L3	Level 3 answer in Level of Response question

Question			Answer	Mark	AO element	Guidance
1	(a)	(i)	soluble / polar ✓	1	AO1.1	
1	(a)	(ii)	*any three from:* *glycogen (compared to amylopectin)* more branched ✓ more coiled ✓ (so is) more compact / less space needed (for storage) ✓ (branching gives) many / more, free ends ✓ where glucose can be added or removed ✓ (so) speeds up glucose, release / hydrolysis ✓	3 max	AO2.1	*ORA for amylopectin throughout*
1	(a)	(iii)	OH / H, group on C1 is in opposite position to, beta glucose / Fig 1.1 OR in alpha glucose -H is at top and -OH is at bottom on C1 ✓	1	AO1.1	**ALLOW** C1 position to be shown on diagram
1	(b)		diagram completed to show correct position of all **5** carbon atoms in a pentose ✓	1	AO1.1	 **IGNORE** additional H, OH, H_2OH

Question			Answer	Mark	AO element	Guidance
2	(a)	(i)	reference to SA:V ratio ✓ SA:V jellyfish is 7:1 and sea bass is 1:3 ✓ correct explanation with ref. to <u>diffusion distance</u> ✓	3	AO3.2	**ALLOW** SA:V ratio for surface area to volume ratio **ALLOW** fish / larger organism, for sea bass **ALLOW** Latin names **ALLOW** SA:V ratio is (much / 21 times) larg<u>er</u> / high<u>er</u>, in jellyfish (than in sea bass) **ORA** **ALLOW** jellyfish is 7:1 and sea bass 0.3:1 e.g. more cells in sea bass so <u>distance</u> oxygen has to travel is too great for <u>diffusion</u> alone
2	(a)	(ii)	single (circulatory system / circulation) ✓	1	AO1.1	**IGNORE** closed **DO NOT ALLOW** open
2	(a)	(iii)	blood, stays in / is enclosed by / is transported in, (named) vessels ✓	1	AO1.1	
2	(a)	(iv)	*any two from:* sea bass single vs. mammal double ✓ sea bass blood goes through heart once vs. mammal twice ✓ sea bass 1 atrium and 1 ventricle vs. mammal 2 atria and 2 ventricles ✓	2 max	AO2.1	**ALLOW** mammal has pulmonary and systemic circulations **CREDIT** sea bass 2 chambers vs. mammal 4 chambers OR sea bass heart no septum vs. mammal heart has a septum
2	(b)	(i)	*any two from:* aorta ✓ pulmonary (artery) ✓ coronary (artery / arteries) ✓	2 max	AO1.1	
2	(b)	(ii)	septum ✓	1	AO1.1	

2	(b)	(iii)	*any three from:* left ventricle wall should be thicker than right (not same) ✓ label 'right ventricle' should be (left / right) atrium ✓ label 'tricuspid valve' should be semi-lunar valve ✓ idea that drawing is wrong way round so left ventricle should be on the right side of the page ✓	**3 max**	AO3.4	**IGNORE** drawing quality errors **IGNORE** structures omitted from drawing **ALLOW** RV should be at correct label location described **ALLOW** tricuspid valve should be at correct label location described **DO NOT ALLOW** left and right ventricles should be switched **ALLOW** LV should be labelled RV
2	(c)*		***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***			
			Level 3 (5–6 marks) *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* Full and detailed description of how the structure of the blood vessel is suited to its function for all three types of blood vessels (arteries, veins and capillaries) and correct reference to the data in Fig. 2.3.	**6**	AO2.3 AO2.4 AO3.1	For highest band need a **correct reference to Fig. 2.3** and explanation of how the **structure** of each blood vessel is suited to its **function** for each of the three blood vessels **(arteries, veins and capillaries).** **Indicative points can include:** *Correct reference to data in* ***Fig. 2.3*** Artery has: smaller lumen, smaller diameter, less collagen, more elastic tissue and more muscle (than vein) ORA. Correct use of figures from **Fig. 2.3** for comparisons.

			Level 2 (3–4 marks) *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* A fairly good description of how the structure of the blood vessel is suited to its function for all three types of blood vessels, arteries, veins and capillaries, and correct reference to the data in Fig. 2.3 **Level 1 (1–2 marks)** *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* Some description of how the structure of the blood vessel is suited to its function for all three types of blood vessels, arteries, veins and capillaries, and some reference to the data in Fig. 2.3. **0 marks** *No response or no response worthy of credit.*			Capillary has: no muscle, no elastic tissue, no collagen tissue, is only one cell thick. The lumen diameter of 9.5 μm is slightly bigger than the red blood cell diameter of 8 μm. <u>*Artery*</u> **Function:** carry blood away from the heart under high pressure (so they have to withstand this pressure and force). **Structure:** (Thicker) elastic layer / elastin, enables them to withstand, pressure / force. (Thicker) elastic layer / elastin, enables them to, stretch recoil. Ref. elastic layer evens out surges from the pumping of the heart and allows a continuous flow of blood (Windkessel effect). Collagen provides, structure / support. Collagen maintains shape and volume (limiting stretch). Smooth muscle contracts and relaxes to, change the size of the lumen / control blood pressure. Smooth muscle provides strength to withstand the pressure. <u>*Veins*</u> **Function:** Veins carry blood back to the heart. No, pulse / surge from heart. Blood in veins is under less pressure (than in arteries). Needs to move against gravity. **Structure:** Thinner elastic layer (no, stretch / recoil / pulse). Have valves to prevent backflow of blood. More collagen than arteries to give structural support as they carry large volumes of blood. <u>*Capillaries*</u> **Function:** Allow substances, to be exchanged / diffuse, between blood and, tissue fluid / surrounding cells. **Structure:** Walls are one cell thick. Short diffusion distance. Only large enough to allow red blood cells to travel through in single file (to increase contact of RBCs with capillary wall). Small enough to form network needed to exchange substances.

Question			Answer	Mark	AO element	Guidance
3	(a)	(i)	*any two from:* shake tube / mix contents ✓ remove 1cm^3 from tube 1 and add 9cm^3 of distilled water to tube 2 ✓ repeat process for tubes 3 and 4 ✓	**2 max**	AO2.8	**ALLOW** for any correct pair of tubes.
3	(a)	(ii)	0.0001% ✓	**1**	AO2.1	(tube1 0.1%, tube 2 0.01%, tube 3 0.001%) tube 4 = 0.0001%
3	(b)		acts / works, outside of the cell ✓	**1**	AO1.2	
3	(c)		*any two from:* trypsin / enzyme, denatures ✓ ref. change in, tertiary / 3D, structure of <u>active site</u> ✓ fewer, hydrogen ions / protons / H^+ ✓ changes charge on R groups ✓ alters, ionic / hydrogen, bonds ✓ substrate binds less efficiently / fewer ESCs ✓	**2 max**	AO2.5	**ALLOW** active site is no longer complementary due to tertiary shape change **ALLOW** ORA more, hydroxyl / OH^- **DO NOT ALLOW** no ESCs form
3	(d)	(i)	*any correct factor from list below and way of controlling this factor:* *Factor:* mass of liver OR surface area of liver OR volume of liver ✓ weigh with, balance / scales OR measure with, ruler / (laminated) graph paper OR measure water displaced / use Eureka can ✓ *Factor:* volume of, hydrogen peroxide / substrate ✓ use, measuring cylinder / syringe / pipette ✓	**2 max**	AO3.3	1st mark for factor. 2nd mark for way of controlling factor. The way of controlling the factor **must** match the factor stated.

			Factor: concentration of, hydrogen peroxide / substrate ✓ use, known / set / labelled, concentration / dilution ✓ *Factor:* pH of solution ✓ use buffer ✓			
3	**(d)**	**(ii)**	*any two from:* record starting meniscus / ensure measuring cylinder full of water ✓ method to add liver to hydrogen peroxide solution and start stopwatch ✓ read / check / record, meniscus / volume of water displaced / volume of gas / volume of oxygen, at 30 second intervals ✓	**2 max**	AO3.3	
3	**(d)**	**(iii)**	appropriate scale chosen, with *x* (horizontal) axis labelled **time (s)** **AND** *y* (vertical) axis labelled **volume of oxygen (cm^3)** ✓ points plotted correctly ± 1 square ✓ points joined with curved line ✓	**3**	AO2.4	**ALLOW** solidus for brackets round units **IGNORE** one error in the plotted points **ALLOW ECF** non-linear *x* axis data
3	**(d)**	**(iv)**	(volume taken from graph at 0s and) volume (from tangent) at time up to max 120 s ✓ (difference in) volume ÷ (difference in) time ✓ answer to two sig. figs. **0.23 cm^3 s^{-1}** ✓	**3**	AO2.4	**ECF** correct working with wrong fig(s) (e.g. not 0s or higher than 120s) **ECF** from mp2 *Sample working using tangent:* initial rate from tangent = 28 cm^3 ÷120 s = 0.233 = 0.23 cm^3 s^{-1} to two sig. figs.

3	(d)	(v)	2.09 ✓	1	AO2.2	**IGNORE** explanation of Q_{10} **ALLOW ECF** (0.48 ÷ fig from 3(b)(vi) = answer expressed to 2 sig. figs) At 20^0C initial rate of reaction = **0.23 cm^3 s^{-1}** At 30^0C initial rate of reaction is 0.48cm^3 s^{-1} 0.48 ÷ 0.23 = 2.086. To two sig. figs. this = 2.09
3	*(e)		***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***			
			Level 3 (5–6 marks) *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* Full and detailed account of how increasing the temperature affects enzyme activity, and of how increasing the enzyme concentration affects enzyme activity. **Level 2 (3–4 marks)** *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* A fairly good account of how increasing the temperature affects enzyme activity and of how increasing the enzyme concentration affects enzyme activity.	6	AO1.2 AO2.1	For highest band, need description of how varying the **temperature** affects activity of enzyme and how varying the **enzyme concentration** affects **activity of enzyme**. Responses may refer to movement of molecules, availability of active sites and likelihood of reaction due to formation of enzyme substrate complexes. **Indicative points include:** <u>*Temperature*</u> • As temperature increases from 0^oC to (stated) optimum the enzyme activity increases • Exponential rise as Q10 = 2 • As temperature increases above optimum temperature enzyme activity decreases

			Level 1 (1–2 marks) *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* An account giving some of the ways in which increasing the temperatures affect enzyme activity and of how increasing the enzyme concentration affects enzyme activity. **0 marks** *No response or no response worthy of credit.*			• Decrease above optimum is linear. • Different enzymes have different optimum temperatures • Detail of how optimum temperature of enzymes is an adaptation to organism's habitat e.g. thermophilic bacteria, deep sea fish. • As temperature increases kinetic energy increases • Particles move faster and collide more often • More enzyme-substrate complexes • Above optimum temperature enzymes denature • Detail e.g. 2^{o} and 3^{o} bonds break • Shape of active site is altered • No longer complementary to substrate <u>*Concentration of enzyme*</u> • As concentration of enzyme increases enzyme activity increases • Product of reaction levels off / activity of enzyme decreases, when substrate concentration limits reaction.

Question			Answer	Mark	AO element	Guidance
4	(a)		*any three from:* non-competitive ✓ PBO / inhibitor, binds to allosteric site ✓ substrate / permethrin, cannot bind / cannot fit into / is not complementary ✓ to, altered / changed, active site ✓	**3 max**	AO1.1	**ALLOW** description of allosteric site
4	(b)		*any two from:* eukaryotic (cells) ✓ detail of eukaryotic feature ✓ aquatic ✓ most are unicellular / few multicellular ✓ autotrophic or heterotrophic ✓	**2 max**	AO1.1	e.g. (named) membrane-bound organelle, 80S ribosomes, linear DNA, DNA with histones

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>5</td><td>(a)</td><td>(i)</td><td>any three from:
dig hole and place container in soil ✓
make top of container level with soil level ✓
cover to protect from, rain / scavengers ✓
leave overnight ✓
identify / count, (named) invertebrates ✓
sample both areas, randomly / at 5(+) sites ✓</td><td>3 max</td><td>AO1.1</td><td></td></tr>
<tr><td>5</td><td>(a)</td><td>(ii)</td><td>columns two and three of table correctly filled ✓
column four correctly filled (first 4 figures) ✓

correct value of D to two significant figures = 0.69 ✓

<table>
<tr><th>Species</th><th>n = Number of organisms</th><th>n/N</th><th>$(n/N)^2$</th></tr>
<tr><td>Common Woodlouse</td><td>9</td><td>0.429</td><td>0.184</td></tr>
<tr><td>Black sexton beetle</td><td>6</td><td>0.286</td><td>0.082</td></tr>
<tr><td>Spotted wolf spider</td><td>2</td><td>0.095</td><td>0.009</td></tr>
<tr><td>The woodlouse spider</td><td>4</td><td>0.190</td><td>0.036</td></tr>
<tr><td></td><td>N = 21</td><td></td><td>$\sum(n/N)^2$ = 0.311</td></tr>
<tr><td></td><td></td><td></td><td>1 - $\sum(n/N)^2$ = 0.689</td></tr>
</table>
</td><td>3</td><td>AO2.5</td><td>IGNORE final answer 0.689 / 0.69 in column 4 for mp 2

ALLOW ECF at any stage of calculation.
If no answer on answer line, ALLOW MP3 for correct answer given in table (column 4)</td></tr>
</table>

5	**(a)**	**(iii)**	area **B** more stable as has a higher, diversity (value) / Simpson's index ✓	**1**	AO1.2	**ALLOW ECF** from 5(a)(ii) e.g. if answer to 5(a)(ii) is greater than 0.84, **ALLOW ECF** for saying Area A has more stable community than area B due to greater diversity value
5	**(b)**	**(i)**	*any two from:* 1 use a tape measure to mark the line ✓ 2 at, fixed / 1m, intervals (along the tape) ✓ 3 use quadrat to measure percentage cover ✓ 4 identify with, key / field guide / app ✓ 5 repeat / use group data (not just your own results) ✓	**2 max**	AO3.3	
5	**(b)**	**(ii)**	*any four from:* statement true as only heather is present at, 4-6m / 8m ✓ statement true as only bracken is present at 9m ✓ statement false as bracken and heather both present at 0-4m / 7m ✓ comparative % (cover) figures for heather and bracken at one point with units ✓ only one of the two species present at 5 out of 9 points ✓	**4 max**	AO3.3 AO3.4	
5	**(c)**		*any four from:* give, area / red-listed species, protected status ✓ *in situ conservation:* education ✓ ref. restoration / habitat recovery ✓	**4 max**	AO2.1	e.g. SSSI / SPA (Special protection area) / SCA (Special conservation area) e.g. remove scrub / heather burning

			limit access / no hunting / no shooting (in breeding season) ✓ manage, deer / sheep / herbivore, populations ✓ cull / remove, (named) invasive species / egg predators ✓ *ex situ conservation:* remove seeds from endangered plants and store in seed bank ✓ (captive) breeding programme / species reintroduction ✓			e.g. fence off breeding grounds

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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