



GCE

Biology A

H020/02: Depth in biology

Advanced Subsidiary GCE

Mark Scheme for November 2020

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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.

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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
	Benefit of Doubt
	Contradiction
	Cross
	Error Carried Forward
	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
	Benefit of the doubt not given
	Tick
	Omission Mark
	Blank Page
	Level 1 answer in Level of Response question
	Level 2 answer in Level of Response question
	Level 3 answer in Level of Response question

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			AO	Answer	Mark	Guidance
1	(a)	(i)	2.3 3.4	<i>label</i> ribosome ✓ <i>explanation</i> cannot see with, this / light, microscope / need EM to see ✓ (LM) <u>resolution</u>, not high enough / too low ✓ (LM) <u>magnification</u>, not high enough / too low ✓ it is a nucleus ✓ OR <i>label</i> (large permanent) vacuole ✓ <i>explanation</i> it is an air bubble ✓ it spans more than one cell ✓ a vacuole is inside one cell ✓	3 max	1 mark for identifying incorrect label. 2 max for matching explanation. IGNORE structure shown too large ALLOW not visible / cannot be, viewed / detected for ‘see’ ALLOW resolution not, sharp / clear / strong / detailed, enough
1	(a)	(ii)	3.4	<i>any three from:</i> label lines should not cross ✓ no arrowheads ✓ no, shading / colouring in ✓ give, magnification / scale ✓ give title ✓ draw <u>cell walls</u> as two lines ✓ draw organelles in proportion ✓	3 max	ALLOW must be parallel ALLOW give diagram a name ALLOW ref. nuclei /structures labelled as ribosomes, too big

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1	(b)		1.1	TEM has, better / higher, resolution ✓ <i>TEM</i> (resolution figure in range) 0.05 - 2 nm ✓ (shows) image of cell interior ✓ (shows) ultrastructure / (two named) cell organelles ✓ <i>SEM</i> (resolution figure in range) 5 - 50 nm ✓ (shows) 3D / three-dimensional, image ✓ (shows cell) surface / topography ✓	4 max	ALLOW ora SEM has, worse / lower resolution IGNORE magnification ALLOW 0.00005 - 0.002 μm / 50 – 2000 pm 'TEM has resolution of 0.5nm whereas SEM only has resolution of 3-10nm' gets mps 1, 2, 5 (as comparative implied by 'only') ALLOW 0.005 – 0.05 μm ALLOW see depth DO NOT ALLOW organelles in cell unless fracture explained
1	(c)	(i)	2.1	E1 (erythrocytes / neutrophils, formed in the) spleen C1 (formed in) bone marrow ✓ E2 (ciliated epithelial cells in) blood vessels C2 in, trachea / bronchi / bronchioles / airways / lungs / respiratory system / oviducts / central canal of spinal cord ✓ E3 cell wall thickest (on side furthest from stoma) C3 cell wall thin(ner) (on side furthest from stoma) ✓	3	E1 ALLOW erythrocytes / neutrophils (formed in the spleen) C1 ALLOW lymphocytes (are formed in spleen) E2 ALLOW ciliated (epithelial cells in blood vessels) C2 ALLOW squamous (epithelial / endothelial, cells in blood vessels) DO NOT ALLOW digestive system / ileum E3 ALLOW (cell wall thickest) on side furthest from stoma C3 ALLOW (cell wall thick(er)) on, inner side / side nearest stoma
1	(c)	(ii)	2.6	FIRST CHECK ANSWER ON ANSWER LINE <i>correct answer = 2 marks</i> 35.7 ✓ ✓ <i>1 mark for working if final answer wrong:</i> (normal production = $1.6 \times 73 \times 24$) = 2803.2 / 2803 ✓ or (difference = $3804 - 2803.2$) = 1000.8 / 1001 ✓	2	ALLOW figure in range 35.4 – 36 with up to 3 dp correct for working shown ALLOW (hospital production rate = $3804 \div (73 \times 24)$) = 2.17 or ALLOW (difference in rate = $2.17 - 1.6$) = 0.57

1	(c)	(iii)	1.1	For answers marked by levels of response: Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but 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 set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark. The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. In summary: • The science content determines the level. • The communication statement determines the mark within a level.		
				Level 3 (5–6 marks) Full and detailed description of how each cell's specialised structure is suited to function: erythrocytes, neutrophils, squamous (epithelial) cells and ciliated (epithelial) cells. Candidate demonstrates a good understanding of the specialised features in all of these cells, and how these features make the cells suited to their specific function. <i>There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.</i> Level 2 (3–4 marks) A correct feature for each type of cell stated and linked to function of cell. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i>	6 max	Indicative scientific points may include the following: <i>erythrocyte / red blood cell</i> biconcave / flattened, disc no nucleus contain haemoglobin flexible shape 7.5 µm diameter 2.0 µm thick ref. contain carbonic anhydrase transport oxygen transport carbon dioxide move / squeeze, through, blood vessels / capillaries space for, oxygen / haemoglobin, maximised large surface area to volume ratio short diffusion distance to, centre of cell / all haemoglobin <i>neutrophil / white blood cell</i> granular cytoplasm many lysosomes hydrolytic / digestive, enzymes multilobed nucleus

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				Level 1 (1–2 marks) Some features correctly linked to a cell type. The linking of structure to function in outline only. <i>The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.</i> 0 marks No response or no response worthy of credit.		can change shape / diapedesis / phagocytosis 10-14 µm diameter immune response innate / non-specific / inflammation destroy / engulf, (named) pathogens / bacteria move to site of infection / wound squamous (epithelial cells) flattened shape very thin / (form layer) one cell thick fit together, tightly / like a pavement for rapid diffusion / short diffusion distance of, oxygen / carbon dioxide / gases, at alveoli / lungs / blood vessels ciliated (epithelial cells) have cilia / 'hair like' structures which, move / beat in rhythm to move mucus and trapped, pathogens / dust / debris from, lungs / (named) airways to move, ovum / egg from ovary / to uterus / to site of fertilisation to move cerebrospinal fluid / ventricular fluid
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2	(c)	(ii)	1.1	reaction between / joins, (carboxylic) acid and alcohol ✓ reaction between / joins, fatty acid(s) and glycerol ✓ condensation reaction / removal of water (molecule) ✓	2 max	
2	(d)	(i)	2.4	FIRST CHECK ANSWER ON ANSWER LINE <i>correct answer = 2 marks</i> 0.00346×10^9 / 3.46×10^6 / 3,460,209 ✓ ✓ <i>1 mark for working stages or intermediate answer if final answer wrong:</i> <i>calculate 1.11% of 2018 population</i> $7.7 \times 10^9 \times 1.11 \div 100 = 0.08547 \times 10^9$ ✓ <i>or calculate 2019 population by adding 1.11% figure to original population</i> $7.7 \times 10^9 + 0.08547 \times 10^9 = 7.78547 \times 10^9$ / 7,785,470,000 ✓ <i>or calculate photosensitive lupus sufferers by dividing 2019 population figure by 1350 and finding 60% of this:</i> $(7.78547 \times 10^9 \div 1350) = 0.00577 \times 10^9$ / 5,767,014 $(5,767,014 \times 60 \div 100) = 3,460,208.8$ / 3,460,208 ✓	2	ALLOW rounding to 3.5×10^6 ALLOW first two steps combined: $7.7 \times 10^9 \times 101.11 \div 100 = 7.78547 \times 10^9$ (or $7.7 \times 10^9 \times 1.0111$) ALLOW find 0.074% i.e. $\times 0.074 \div 100$ instead of dividing by 1350
2	(d)	(ii)	2.1	ultraviolet / UV (light / rays / radiation / photons) AND skin rash ✓	1	
2	(d)	(iii)	1.2 2.5	<i>idea that</i> immune system, attacks / damages, own / self, cells / tissue / antigens ✓ <i>plus any one of:</i> genetic / passed down in genes / linked to certain alleles / ref. DNA ✓	2	ALLOW own cells, attacked / treated, as, foreign / non-self, by immune system / immune cells / antibodies DO NOT ALLOW attacks own, bacteria / molecules IGNORE hereditary / inherited

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Question			AO	Answer	Mark	Guidance								
3	(a)		1.1	<table><tr><th>Pathogen</th><th>Communicable Disease</th></tr><tr><td>bacterium</td><td>tuberculosis (TB)</td></tr><tr><td>prot(oct)ist(a) ✓</td><td>potato late blight</td></tr><tr><td>prot(oct)ist(a) ✓</td><td>malaria</td></tr></table>	Pathogen	Communicable Disease	bacterium	tuberculosis (TB)	prot(oct)ist(a) ✓	potato late blight	prot(oct)ist(a) ✓	malaria	2	ALLOW fungus / fungi for potato late blight IGNORE <i>Phytophthora</i> IGNORE <i>Plasmodium</i>
Pathogen	Communicable Disease													
bacterium	tuberculosis (TB)													
prot(oct)ist(a) ✓	potato late blight													
prot(oct)ist(a) ✓	malaria													
3	(b)	(i)	2.8	FIRST CHECK ANSWER ON ANSWER LINE <i>correct answer = 2 marks</i> 21 ✓ ✓ <i>1 mark for working stage or intermediate answer if final answer wrong:</i> (175 x 17 ÷ 100 or 175 x 0.17) = 29.75 / 30 ✓ or (29.75 x 70 ÷ 100 or 29.75 x 0.7) = 20.825 ✓	2	ALLOW 29 or 30 for 29.75 in second working step								
3	(b)	(ii)	3.3	sample size relatively small / only 175 children tested ✓ ages of children varied ✓ difficulties in interpreting the response of the dog ✓ socks could be different (in fabric) ✓ socks could have been, worn for different lengths of time / shared ✓ ref. different, soaps / washing powders, used (on feet / socks) ✓	1 max	ALLOW different, soaps / washing powders, have different smells								
3	(c)	(i)	1.2	clump / aggregate / join, pathogens ✓ stops pathogens, moving / reproducing ✓ (helps) phagocytes then engulf (multiple / clumped) pathogens / phagocytosis of (clumped) pathogens ✓	2 max									

Question		AO	Answer	Mark	Guidance																																																
4	(a)	3.1 3.2	1 data (as a whole) do not show, direct / positive / indirect / negative / any, <u>correlation</u> ✓ 2 direct / positive, correlation is opposite to, conclusion / trend, student describes ✓ 3 rest home time trend supports negative correlation / as % vaccination decreases number of flu cases increases in rest homes / when vaccination higher flu cases lower ✓ 4 schools trend supports positive correlation / as % vaccination decreases number of flu cases decreases in schools / when vaccination higher flu cases higher ✓ 5 hospitals / other, trends show no correlation / as % vaccination decreases number of flu cases may increase or decrease or stay the same ✓ 6 <i>idea that</i> need to plot % vaccination against number of flu cases to judge correlation / uptake and cases highest in rest homes ✓ 7 compare figures from 2 years for one group OR from 2 groups for one year OR rest homes and other both at 70% uptake ✓ 8 limitation of data ✓	4 max	max 3 if do not state mp1 ALLOW <i>ora</i> conclusion / trend, student describes is, indirect / negative correlation ALLOW ‘flu case figures + / – 20 for mp 7 <table><tr><td></td><th colspan="3">Number of ‘flu cases</th></tr><tr><td></td><th>2015-16</th><th>2016-17</th><th>2017-18</th></tr><tr><td>rest homes</td><td>240</td><td>890</td><td>1690</td></tr><tr><td>hospitals</td><td>120</td><td>170</td><td>240</td></tr><tr><td>schools</td><td>280</td><td>60</td><td>170</td></tr><tr><td>other</td><td>40</td><td>20</td><td>60</td></tr></table> <table><tr><td></td><th colspan="3">Percentage uptake of vaccine</th></tr><tr><td></td><th>2015-16</th><th>2016-17</th><th>2017-18</th></tr><tr><td>rest homes</td><td>77</td><td>75</td><td>70</td></tr><tr><td>hospitals</td><td>57</td><td>60</td><td>59</td></tr><tr><td>schools</td><td>42</td><td>36</td><td>38</td></tr><tr><td>other</td><td>70</td><td>67</td><td>50</td></tr></table> 8 only three years studied / small sample sizes / not a comparison of standardised groups / case numbers not per 100, 000 / percentages / age / gender / other health problems, not controlled		Number of ‘flu cases				2015-16	2016-17	2017-18	rest homes	240	890	1690	hospitals	120	170	240	schools	280	60	170	other	40	20	60		Percentage uptake of vaccine				2015-16	2016-17	2017-18	rest homes	77	75	70	hospitals	57	60	59	schools	42	36	38	other	70	67	50
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other	70	67	50																																																		

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4	(b)	1.2	<i>any three matched to steps in correct order:</i> <i>step 3</i> antigen presentation / antigen binds to specific, B / T, lymphocyte / cell ✓ <i>steps 3 or 4</i> clonal selection / clonal expansion / plasma cells produced / produce antibodies primary immune response ✓ <i>step 5</i> ref. memory cells / secondary immune response ✓	3	ALLOW two steps in correct order in any two step spaces if one step space left blank (e.g. if whole sequence written as 3 and 4 with no 5)
4	(c)	2.6	herd immunity ✓ fewer people can, catch / spread, virus / measles OR vaccinated individuals / most people, cannot catch / spread, virus / measles ✓ $R_{(0)}$ number reduced ✓	2 max	ALLOW less / slower / decreases, transmission / spread

Question			AO	Answer	Mark	Guidance
5	(a)	(i)	3.4	repeats and calculate mean (at each temperature) ✓ use a biosensor (to measure glucose concentration) ✓ (test at) more / smaller, temperature intervals ✓ (test at) more / smaller / shorter, time intervals ✓	1 max	IGNORE different temperatures
5	(a)	(ii)	3.4	concentration of glucose (solution in bag / tubing) ✓ volume of the glucose solution (in bag / tubing) ✓ volume of (distilled) water (in beaker) ✓ volume of sample, removed / tested ✓ volume of Benedict's reagent used ✓ length of, Visking tubing / artificial cell ✓ time in water bath for Benedict's test ✓	1 max	IGNORE amount for volume throughout ALLOW surface area to volume ratio of Visking tubing
5	(b)	(i)	3.4	<i>hypothesis:</i> as temperature increases, movement of glucose into the (distilled) water / concentration of glucose (in samples), increases ✓ <i>scientific process:</i> diffusion ✓	2	IGNORE null hypothesis ALLOW as temperature increases diffusion rate increases ALLOW particles, move faster / have more kinetic energy
5	(b)	(ii)	3.1 3.2	as temperature increases, more glucose is found in the water / diffusion rate is faster ✓ result for 60 seconds at 20°C, anomalous / does not support ✓	2	ECF from wrong hypothesis in 5 (b)(i). ALLOW 1 max for no when supported with a reference to the anomaly at 60 seconds at 20°C
5	(c)		3.4	use one / control, temperature ✓ use two / more, layers of, Visking / dialysis, tubing ✓	2	CREDIT keep temperature, the same / constant IGNORE make Visking tubing thicker ALLOW fold / layer, Visking tubing

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Question		AO	Answer	Mark	Guidance
6	(a)	2.2 3.1	surface area to volume ratio = 3 : 1 (small) and 1.5 : 1 (large) or large, cube / animal, has smaller <u>SA:vol</u> or small, cube / animal, has larger <u>SA:vol</u> ✓ <u>diffusion</u>, distance / pathway, long / deep, in large, cube / animal or <u>diffusion</u> time long in large, cube / animal ✓ relatively / proportionally, small(er) surface cannot supply large(r) volume of cells ✓ specialised exchange surfaces needed for, oxygen / carbon dioxide / gases / nutrients / waste products ✓	2 max	ALLOW SA : volume or SA : V for surface area to volume ratio ALLOW 3 : 2 for 1.5 : 1 DO NOT ALLOW reverse ratios 1 : 3 and 1 : 1.5 (unless volume : SA stated) IGNORE diffusion, easier / harder ALLOW ora diffusion, distance / pathway / time, shorter in small, cube / animal
6	(b)	2.1 2.3	For answers marked by levels of response: Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but 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 set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark. The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. In summary: • The science content determines the level. • The communication statement determines the mark within a level.		
			Level 3 (5–6 marks) Full and detailed description of respiratory system in both fish and insect, showing how both are adapted to maximise ventilation and gaseous exchange. Reference made to structures shown on both Fig. 6.2 and Fig. 6.3 shown in the insert.	6	Indicative scientific points may include the following: <i>bony fish ventilation</i> water enters mouth ref. volume / pressure, change in buccal cavity water, flows / pushed, over gills

				<i>There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.</i> Level 2 (3–4 marks) Candidate demonstrates some understanding of the two exchange surfaces shown in Fig. 6.2 and Fig. 6.3 in the Insert. Not clearly linked to both ventilation and gas exchange. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i> Level 1 (1–2 marks) A description of some of the features of the respiratory systems of both fish and insect but not clearly linked to ventilation or gaseous exchange. Very few references to structures shown on Fig. 6.2 and Fig. 6.3 on the insert. <i>The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.</i> 0 marks No response or no response worthy of credit.		water leaves via operculum throughflow system / one direction of flow bony fish gas exchange gill, filaments / lamellae (shown on Fig. 6.2) large surface area thin short diffusion distance good blood supply / blood vessels (shown on Fig. 6.2) steep concentration gradient counter current system (water and blood move in opposite directions) tips of gill filaments overlap to slow down water movement insect ventilation muscular movement abdominal, dorso-ventral flattening / telescoping / pumping ref. volume / pressure, change in abdomen thorax, movement / shape change, in flight air drawn in or forced out size of spiracle, changes / controlled external gills in aquatic insects small size / large SA:vol of insects, means diffusion may be sufficient insect gas exchange gas / oxygen / CO₂, diffuses along tracheae (shown on Fig. 6.3) oxygen dissolves in water at tracheoles diffuses into surrounding cells many tracheoles so large surface area spirals of chitin (shown on Fig. 6.3) hold tracheae open
6	(c)		1.1	cartilage stops, trachea / bronchus, from collapsing ✓	2	ALLOW for support of trachea / bronchi

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				<i>elastic fibres</i> recoil of, alveoli / air sacs ✓		
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