Oxford Cambridge and RSA

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
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

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	*label* ribosome ✓ *explanation* 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** *label* (large permanent) vacuole ✓ *explanation* 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	*any three from:* 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

1	(b)		1.1	TEM has, better / higher, resolution ✓ *TEM* (resolution figure in range) 0.05 - 2 nm ✓ (shows) image of cell interior ✓ (shows) ultrastructure / (two named) cell organelles ✓ *SEM* (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** *correct answer = 2 marks* 35.7 ✓ ✓ *1 mark for working if final answer wrong:* (normal production = 1.6 x 73 x 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 ÷ (73 x 24)) = 2.17 or **ALLOW** (difference in rate = 2.17 – 1.6) = 0.57

<table>
<tr><td>1</td><td>(c)</td><td>(iii)</td><td>1.1</td><td colspan="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.</td></tr>
<tr><td colspan="4"></td><td>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.

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.

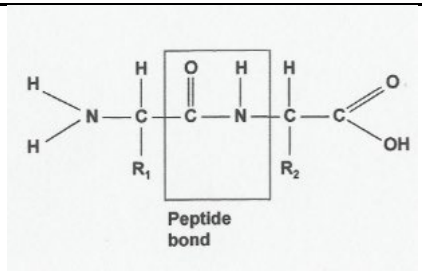
Level 2 (3–4 marks)
A correct feature for each type of cell stated and linked to function of cell.

There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</td><td>6 max</td><td>Indicative scientific points may include the following:

erythrocyte / red blood cell
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

neutrophil / white blood cell
granular cytoplasm
many lysosomes
hydrolytic / digestive, enzymes
multilobed nucleus</td></tr>
</table>

				Level 1 (1–2 marks) Some features correctly linked to a cell type. The linking of structure to function in outline only. *The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.* **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

Question			AO	Answer	Mark	Guidance
2	(a)	(i)	2.1	to provide, lots of / much, energy / ATP ✓	1	**DO NOT ALLOW** make / produce energy. **ALLOW** cell, needs / uses, lots of, energy / ATP
2	(a)	(ii)	2.1	Golgi apparatus ✓ to, modify / process / package, protein ✓ ref. vesicles / secretion (of mucus) / exocytosis ✓	2 max	**ALLOW** smooth endoplasmic reticulum / SER **ALLOW** lipid / triglyceride, synthesis (for smooth ER)
2	(b)	(i)	2.4	**FIRST CHECK ANSWER ON ANSWER LINE** *correct answer = 2 marks* 1,000,000 / 1 x 10^6 ✓ ✓ *1 mark for working if final answer wrong:* 40 x 500 = (20, 000cm^3) ✓ or 20 ms is 20/1000 = 0.02 s ✓	2	**ALLOW** calculation combined with wrong time figure e.g. 40 x 500 x 3 = 60, 000 **ALLOW** (1s ÷ 0.02 s / 1000 ms ÷ 20 ms) = 50
2	(b)	(ii)	2.1	(more) infections / irritation / coughing ✓	1	**ALLOW** bronchitis / pneumonia / bacterial disease / viral disease
2	(c)	(i)	2.1	line joins C to N and C=O drawn in (any side or angle) and N-H (any side or angle) ✓ peptide (bond) ✓	2	 **DO NOT ALLOW** dipeptide / peptic

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** *correct answer = 2 marks* 0.00346×10^9 / 3.46×10^6 / 3, 460, 209 ✓ ✓ *1 mark for working stages or intermediate answer if final answer wrong:* *calculate 1.11% of 2018 population* $7.7 \times 10^9 \times 1.11 \div 100 = 0.08547 \times 10^9$ ✓ *or calculate 2019 population by adding 1.11% figure to original population* $7.7 \times 10^9 + 0.08547 \times 10^9 = 7.78547 \times 10^9$ / 7, 785, 470, 000 ✓ *or calculate photosensitive lupus sufferers by dividing 2019 population figure by 1350* ***and*** *finding 60% of this:* $(7.78547 \times 10^9 \div 1350) = 0.00577 \times 10^9$ / 5, 767, 014 (5, 767, 014 x 60 ÷ 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. x 0.074 ÷ 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	*idea that* immune system, attacks / damages, own / self, cells / tissue / antigens ✓ *plus any one of:* 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

<table>
<tr><th colspan="3">Question</th><th>AO</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>1.1</td><td>
<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>
</td><td>2</td><td>ALLOW fungus / fungi for potato late blight
IGNORE Phytophthora

IGNORE Plasmodium</td></tr>
<tr><td>3</td><td>(b)</td><td>(i)</td><td>2.8</td><td>FIRST CHECK ANSWER ON ANSWER LINE
correct answer = 2 marks
21 ✓ ✓

1 mark for working stage or intermediate answer if final answer wrong:

(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 ✓</td><td>2</td><td>ALLOW 29 or 30 for 29.75 in second working step</td></tr>
<tr><td>3</td><td>(b)</td><td>(ii)</td><td>3.3</td><td>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) ✓</td><td>1 max</td><td>ALLOW different, soaps / washing powders, have different smells</td></tr>
<tr><td>3</td><td>(c)</td><td>(i)</td><td>1.2</td><td>clump / aggregate / join, pathogens ✓
stops pathogens, moving / reproducing ✓
(helps) phagocytes then engulf (multiple / clumped) pathogens / phagocytosis of (clumped) pathogens ✓</td><td>2 max</td><td></td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>AO</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>3.1
3.2</td><td>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 idea that 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 ✓</td><td>4
max</td><td>max 3 if do not state mp1

ALLOW ora conclusion / trend, student describes is, indirect / negative correlation

ALLOW ‘flu case figures + / – 20 for mp 7

<table>
<tr><th></th><th colspan="3">Number of ‘flu cases</th></tr>
<tr><th></th><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><th></th><th colspan="3">Percentage uptake of vaccine</th></tr>
<tr><th></th><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</td></tr>
</table>

4	(b)		1.2	*any three matched to steps in correct order:* *step 3* antigen presentation / antigen binds to specific, B / T, lymphocyte / cell ✓ *steps 3 or 4* clonal selection / clonal expansion / plasma cells produced / produce antibodies primary immune response ✓ *step 5* 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	*hypothesis:* as temperature increases, movement of glucose into the (distilled) water / concentration of glucose (in samples), increases ✓ *scientific process:* 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

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 SA:vol **or** small, cube / animal, has larger SA:vol ✓ diffusion, distance / pathway, long / deep, in large, cube / animal **or** diffusion 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:** ***bony fish ventilation*** water enters mouth ref. volume / pressure, change in buccal cavity water, flows / pushed, over gills

				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. **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. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.* **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. *The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.* **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 / CO_2, 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

				elastic fibres recoil of, alveoli / air sacs ✓		

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