Oxford Cambridge and RSA

GCE

Biology B

H422/02: Scientific literacy in biology

Advanced 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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>virus enters (host) cell ✓

viral , DNA / RNA / genetic material , replicates ✓

viral proteins made using cell's mechanisms ✓</td><td>max 2</td><td>1.1

1.1

1.1</td><td>

ALLOW takes over host cell metabolism</td></tr>
<tr><td>1</td><td>(a)</td><td>(ii)</td><td>(because it was) not present in the (wild) population ✓

(because it was) only present in test sites ✓

was not present in the population at a baseline level ✓</td><td>max 1</td><td>2.1

2.1</td><td></td></tr>
<tr><td>1</td><td>(a)</td><td>(iii)</td><td>(because there was a) sudden increase in incidence ✓</td><td>1</td><td>2.1</td><td></td></tr>
<tr><td>1</td><td>(b)</td><td></td><td>
<table>
<tr><th></th><th>HIV</th><th>MYXV</th><th></th></tr>
<tr><td>genetic material is RNA</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>virus particle contains reverse transcriptase</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>virus has a capsid</td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>
</td><td>3</td><td>2 x 1.1
1 x 2.1</td><td></td></tr>
</table>

Question			Answer	Mark	AO element	Guidance
1	(c)		steep / AW , decrease from 1950 to 1955 **and** gradual / AW , increase to 1990 ✓ use of two pieces of correct data from graph e.g. 85% in 1950 / 35% in 1955 / 60% in 1990 ✓	**2**	2.1 2.1	
1	(d)	(i)	(surviving rabbits produce) memory (T/B) cells ✓ alleles for resistance (to MYXV) would be selected for ✓ (so the) allele frequency increases (in the population) ✓	**max 2**	2.2 2.2 2.2	**ALLOW** advantageous allele(s) passed on
1	(d)	(ii)	(vaccination involves) giving pathogen antigens ✓ (formation of) memory (T/B) cells ✓ exposure to pathogen leads to secondary immune response ✓ (which) destroys / kills , pathogen before it can cause , disease / death ✓	**max 3**	1.2 1.2 1.2 1.2	**ALLOW** any correct example of vaccine, e.g. live-attenuated, subunit vaccines, pathogen fragments **ALLOW** rapid production of antibodies
1	(d)	(iii)	vaccinated hosts can still transmit virus ✓ (so) unvaccinated , birds / flocks, could become infected ✓ **OR** (high) mutation rate leads to antigen variability ✓ so antibodies produced by vaccination no longer specific ✓	**2**	2.5 2.5 2.5 2.5	

Question			Answer	Mark	AO element	Guidance
1	(d)	(iv)	*for* susceptible birds would die before they could infect other birds ✓ resistant birds (are more likely to) encourage evolution of more virulent pathogens ✓ *against* (but) evolution of virulence may not matter for resistant birds ✓ hypervirulent pathogens could threaten , non-resistant / non-GMO , flocks ✓ ethical issues if industrial practices threaten organic producers ✓ susceptible birds may also be susceptible to , related / similar , pathogens	**max 4**	3.2 3.2 3.2 3.2 3.2 3.2	**ALLOW** other unambiguous term for birds throughout

Question			Answer	Mark	AO element	Guidance
2	(a)	(i)	(use) endoscopy / colonoscopy ✓ (to obtain a) biopsy sample ✓ observe cancerous cells in sample ✓ **OR** take a blood sample ✓ use flow cytometry with (monoclonal) antibodies to colorectal cancer (markers) ✓	**max 2**	2.5 2.5 2.5 2.5 2.5	**ALLOW** description of any valid method such as microscopy, histology, etc.
2	(a)	(ii)	(yes because) mortality rate is higher in the (FOBT) positive group ✓ (but there is) no evidence that this is linked to inflammation ✓	**2**	3.2 3.2	

Question			Answer	Mark	AO element	Guidance
2	(a)	(iii)	*for* (there is a) correlation between positive FOBT and risk of CRC ✓	max 4	3.2	
			the initial screening is non-invasive ✓		3.2	
			test can be done at home ✓		3.2	
			against (however, there is still) a need for confirmation by other means ✓		3.2	
			(there is a) risk of false , negatives / positives ✓		3.2	**ALLOW** the test does not identify all cases of CRC / test may not be performed correctly.
			(there could be a) high cost ✓		3.2	
			many people may not want to do the test ✓		3.2	
			people may not attend follow-up screening ✓		3.2	

Question			Answer	Mark	AO element	Guidance
2	(b)		***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.***			
2	(b)		**Level 3 (5–6 marks)** Description, with examples, of the action of tumour suppressor genes **and** proto-oncogenes, with no/few errors or omissions. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Description of the action of tumour suppressor genes **and** proto-oncogenes, with an example. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Description of the action of tumour suppressor genes **or** proto-oncogenes. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6**	**1.1** **1.2**	***Indicative scientific content:*** Tumour suppressor genes • slow the rate of cell division • stimulate apoptosis of cells with damaged / faulty DNA Examples • TP53 protein */ p53* gene • *BRCA1/BRCA2* • refer to list / TL Proto-oncogenes mutate to become oncogenes • stimulate cell division • activate DNA replication • control production of growth factors, cyclins and CDKs Examples • *Ras* • *c-Myc*

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td>
<table>
<tr><th>Statement</th><th>Letter(s)</th></tr>
<tr><td>fMRI shows these areas of the brain to be active when playing a musical instrument</td><td>A or F</td></tr>
<tr><td>Temperature-sensitive neurones are located in this area of the brain</td><td>C</td></tr>
<tr><td>Traumatic injury to either of these areas can lead to over- or under-production of sex hormones.</td><td>C or D</td></tr>
<tr><td>This region of the brain controls heart rate and breathing rate.</td><td>E</td></tr>
<tr><td>Stroke affecting part of this area of the brain could cause loss of control of muscles in the arms or legs.</td><td>A</td></tr>
</table>
✓✓✓✓

5 correct = 4 marks, 4 correct = 3 marks, 3 correct = 2 marks
2 correct = 1 mark</td><td>4</td><td>2.1
1.1
2.1
1.1
2.1</td><td></td></tr>
<tr><td>3</td><td>(b)</td><td>(i)</td><td>(use) tympanic / ear , method ✓

(because) eardrum shares its blood supply with the thermoregulatory centre ✓</td><td>2</td><td>1.1</td><td></td></tr>
</table>

Question			Answer	Mark	AO element	Guidance
3	(b)	(ii)	***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) A detailed description of the processes leading to hypothermia **and** a description of appropriate treatments, with no/minor errors or omissions. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A description of the processes leading to hypothermia, with some errors or omissions **and** a limited description of an appropriate treatment. **OR** a detailed description of the processes leading to hypothermia (treatment is missing). *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A description of the processes leading to hypothermia, with major errors or omissions **or** a description of an appropriate treatment. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	**6**	2 x AO1.1 4 x AO1.2	***Indicative scientific content:*** **Processes** • Hypothermia is lowering of body temperature outside normal range / below 35º C • Metabolic / enzyme reactions slow due to less kinetic energy. • So less metabolic heat is generated. • Positive feedback leads to body temperature falling further. **Treatment** Raise body temperature by: • Use of warm, dry blankets. • Move to a warm room. • Remove wet clothing. • Application of warm compresses to neck, groin and chest. • Warm, non-alcoholic drinks • Do not heat arms and legs as this forces cold blood back towards major organs. • Give expired air resuscitation if he stops breathing.

Question			Answer	Mark	AO element	Guidance
			0 marks *No response or no response worthy of credit.*			
3	(c)	(i)	*seasonal trend:* most cases of hypothermia in winter / most cases of hyperthermia in summer ✓ (because of) trends in seasonal temperatures ✓ incidence of hyperthermia is greater ✓ there is still some hypothermia in summer ✓	**Max 3**	2.2 2.2 2.2 2.2	**ALLOW** incidence of hypothermia is lower
3	(c)	(ii)	higher proportion of hypothermia patients required hospital admission ✓ (because) hypothermia is (usually) more life-threatening ✓ (because) hypothermia is more likely to affect , older / more vulnerable , patients ✓	**max 2**	2.2 2.2 2.2	**ALLOW** a response based on the suggestion that more hyperthermia patients die before they reach hospital
3	(c)	(iii)	increase in hyperthermia between 2004 and 2005 ✓ climate change / global heating , could increase incidence of hyperthermia ✓ no evidence about average (summer) temperatures ✓ only 2 years' data is not enough to draw valid conclusion ✓	**max 3**	3.2 3.2 3.2 3.2	**ALLOW** increased reporting

Question			Answer	Mark	AO element	Guidance
4	(a)	(i)	use a colorimeter to measure concentration of product ✓	max 3	2.7	
			(description of) use of standard curve to convert absorbance to concentration ✓		2.7	
			measure rate of appearance of product / description of plotting graph and use of tangent ✓		2.7	
			repeat at different concentrations of substrate ✓		2.7	
			keep all other , conditions / named condition , constant ✓		2.7	
4	(a)	(ii)	(so that) enzyme concentration is not a limiting factor ✓	1	2.7	
4	(a)	(iii)	**FIRST CHECK ON ANSWER LINE** **If answer = 1.55 mol dm^{-3} award 2 marks**	2		
			V_{max} = 9.8, so ½ V_{max} = 4.9			
			value for K_M in the range 1.50 – 1.60 ✓		2.8	
			(correct units =) mmol dm^{-3} ✓		2.8	
4	(a)	(iv)	(because the) curve never reaches V_{max} ✓	max 2	3.2	**ALLOW** *idea of* asymptotic curve
			(because it is) difficult / impossible , to reach high enough [S] ✓		3.2	**ALLOW** limited substrate solubility
			(so) V_{max} / maximum rate , will never be achieved ✓		3.2	

Question			Answer	Mark	AO element	Guidance
4	(b)	(i)	slope = 0.55 ✓	1	2.6	ALLOW answer in range 0.50 – 0.60
4	(b)	(ii)	slope = K_M/V_{max} ✓	1	2.6	**ALLOW** ECF from candidate's value for slope. **ALLOW** candidate's numerical value for slope.
4	(b)	(iii)	**FIRST CHECK ON ANSWER LINE** **If answer = 2.75 award 2 marks** K_M = slope × V_{max} ✓ correct value for K_M (units not required) ✓	2	2.6 2.6	**ALLOW** ECF from candidate's value for slope. MP2 does not require units as this has already been tested in MP2 of Q4(a)(iii)

Question			Answer	Mark	AO element	Guidance
5	(a)		transcribed / expressed ✓ histones ✓ methylation ✓ gametes ✓	4	1.1 1.1 1.1 1.1	**ALLOW** translated **ALLOW** (named) sex cells
5	(b)		mutation is unlikely to , have occurred in many parents / affect all offspring ✓ (whereas) DNA methylation / acetylation of histones , could have occurred in , many / all , parents (exposed to hypoxia) ✓ (which) activates / inhibits , expression of genes related to resistance to hypoxia ✓ lack of oxygen is a selective pressure ✓ (but biochemical) evidence of epigenetics in offspring is needed ✓	max 3	3.2 3.2 3.2 3.2 3.2	
5	(c)	(i)	prophase ✓	1		**ALLOW** mitosis
5	(c)	(ii)	(reference to) reproductive isolation ✓ epigenetic changes alter gene expression ✓ stops , meiosis / gamete formation ✓ (because) hybrids are <u>infertile</u> ✓ (so) species would diverge / remain separate ✓	max 3	3.2 3.2 3.2 3.2 3.2	

Question			Answer	Mark	AO element	Guidance
6	(a)	(i)	respirometer ✓	1	1.2	
6	(a)	(ii)	protein could be the respiratory substrate between 0 – 5 days / 10 – 25 days ✓ it is not the respiratory substrate at , start of germination / after 25 days ✓ RQ < 1.0 or >0.7(2) might be due to mixture of substrates ✓	max 2	3.2 3.2 3.2	
6	(a)	(iii)	measure protein content at different times ✓ e.g. using Biuret test / test strips ✓	2	3.3 3.3	
6	(a)	(iv)	at time zero / start of germination , (named) carbohydrate was being respired ✓ between 5 and 10 days , fats / oils , are being respired ✓ from ~25 days onwards carbohydrate is being respired ✓ between 0 – 5 days / 10 – 25 days , a mixture of substrates are being respired ✓	max 3	3.2 3.2 3.2 3.2	

Question			Answer	Mark	AO element	Guidance
6	(b)	(i)	**FIRST CHECK ON ANSWER LINE** **If answer = 0.72 award 2 marks** evidence of use of CO_2/O_2 (regardless of correct values) ✓ 18 / 25 = 0.72 ✓	**2**	2.2 2.2	Working: Balanced equation = $C_{18}H_{32}O_2 + 25O_2 \rightarrow 18CO_2 + 16H_2O$ calculation of RQ = 18 / 25 = 0.72 **ALLOW** ECF from incorrectly balanced equation
6	(b)	(ii)	RQ would increase ✓ because less oxygen would be used ✓	**2**	2.1	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td></td><td>
<table>
<tr><th>Example</th><th>Act.</th><th>Pass.</th><th>Nat.</th><th>Art.</th></tr>
<tr><td>Snake antivenoms consist of sheep or horse antibodies to snake venom proteins. They are given to treat snake bite.</td><td></td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>A mixture of proteins purified from the Haemophilus influenzae virus is used to reduce the risk of a person getting the ‘flu.</td><td>✓</td><td></td><td></td><td>✓</td></tr>
<tr><td>Following exposure to a pathogen, a person develops memory T and B cells.</td><td>✓</td><td></td><td>✓</td><td></td></tr>
<tr><td>A calf receives antibodies from its mother in colostrum.</td><td></td><td>✓</td><td>✓</td><td></td></tr>
</table>
</td><td>4</td><td>1.1</td><td>1 mark per correct row</td></tr>
</table>

Question			Answer	Mark	AO element	Guidance
7	(b)	(i)	(Student's) t-test ✓ (because they have) mean data / (are) testing the difference between means ✓	2	2.8 2.8	
7	(b)	(ii)	group I ✓ (because they had the) highest concentration of IgE / highest allergic response ✓	2	2.7 2.7	
7	(b)	(iii)	breastfeeding by mothers with AAD reduces degree of AAD in offspring ✓ something / antibodies , in breast milk must protect against allergic reactions ✓ (but) humans may not respond in the same way as mice ✓ results may only apply to allergic mothers passing on immunity to allergy ✓	max 3	2.7 2.7 2.7 2.7	**ALLOW** 'allergic mothers' for 'mothers with AAD'

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