GCE

Biology B

H422/03: Practical skills 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

Question			Answer	Mark	AO element	Guidance
1	(a)	(i)	age(ing) ✓	1	AO2.3	
1	(a)	(ii)	*variable* word list / 12 words ✓ *how it could have been controlled* same words read to each participant ✓ **OR** *variable* health (of participants) / (named) example of suitable disease / (named) example of suitable disorder ✓ *how it could have been controlled* medical check before tests were done / exclude subjects with disease or disorders / AW ✓ **OR** *variable* (duration of short) pause ✓ *how it could have been controlled* same time for (short) pause / AW ✓	2	AO2.3 AO3.3	**One mark** for variable and **one mark** for how it is controlled Variable must be linked correctly to how it is controlled for **two marks** **ALLOW one mark** for a correct variable even if how it is controlled is incorrect

Question			Answer	Mark	AO element	Guidance
1	(a)	(iii)	bar chart with bars of equal width **and** appropriate key for 'correct' and 'incorrectly' recalled words ✓ axes appropriately labelled **and** scale for mean number of words **and** plot area covers 50% of available space ✓ bars plotted correctly for 'correctly' and 'incorrectly recalled' words ✓ at least three error bars plotted correctly ✓	**4**	AO2.8	Error bar constructed as mean +/- 1SD
1	(b)	(i)	Any **one** from: family history ✓ genetic differences / mutation ✓ severe / traumatic / repeated, head / brain, injury ✓ stroke ✓ high / elevated, blood pressure ✓ high / elevated, blood cholesterol ✓ smoking ✓ low level of, intellectual activity / AW ✓	**1**	AO1.1	**IGNORE** ageing (as given in the question)

1	(b)	(ii)	*Relative risk* *Both calculated values should be given to the same number of decimal places:* (risk factor **G**) = 1.687 / 1.69 / 1.7 ✓ (risk factor **H**) = 1.599 / 1.60 / 1.6 ✓ **G** (has higher relative risk than **H**) ✓	**3**	AO2.4 AO3.1	**If both risk factor answers are incorrect ALLOW one mark for:** Correct incidence equation for either **G or H** e.g. for G = 85/6 **OR** for H = 94/7 **ALLOW** error carried forward for MP3 if calculations are incorrect
1	(c)		*Alzheimer's brain:* (has) small**er** / decreased, volume ✓ (is) **more**/ AW**,** deeply folded ✓ (has) wid**er,** gaps between folds ✓ (has) narrow**er**, folds ✓ (has) larger, ventricles / voids / AW ✓	**2 max**	AO2.5	**IGNORE** references to brain activity All marking points must be comparative **ALLOW** ora throughout
1	(d)		gingipain / protease, hydrolyses / AW, protein, in myelin sheath / myelin (in brain tissue) ✓ (which causes) damage / death, of neurones (in brain tissue) ✓ (could) lead to formation of, tau proteins (in neural cells) **OR** (could) lead to formation of, β-amyloid (proteins) / plaques (in extra cellular spaces) ✓	**2 max**	AO1.1 AO2.1	

1	(e)		*Statement is valid:* (statement is) valid, because brain tissue (of mice) treated with enzyme inhibitor, reduced the concentration / had low concentration, of bacterial DNA / AW ✓ (statement is) valid, because brain tissue (of mice) treated with enzyme inhibitor had similar concentration of bacterial DNA to brain tissue of non-exposed mice / AW ✓ *Statement is invalid:* *(statement is) invalid, because* investigation involved mice / not tested on humans ✓ *(statement is) invalid, because* small sample size of mice / AW ✓ *(statement is) invalid, because* not all AD symptoms are caused by, *P. gingivalis* / bacteria ✓	**4 max**	AO3.1 AO3.2	Maximum of 3 marks if there is no reference to the statement validity at least once within the answer.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>
<table>
<tr><th>Description</th><th>Haemoglobin</th><th>Myoglobin</th></tr>
<tr><td>Can bind with up to four oxygen molecules</td><td>✓</td><td></td></tr>
<tr><td>Has highest affinity for oxygen</td><td></td><td>✓</td></tr>
<tr><td>Located inside skeletal muscle</td><td></td><td>✓</td></tr>
</table>
</td><td>2</td><td>AO 1.1</td><td>3 correct = 2 marks
2 correct = 1 mark
1 correct = 0 mark</td></tr>
<tr><td>2</td><td>(b)</td><td>(i)</td><td>minimal disruption to lifestyle / AW ✓
fast results ✓
small volume of blood for sample ✓</td><td>1 max</td><td>AO3.2</td><td>IGNORE can be ‘carried out at home’ or ‘used by patient themselves’ or ‘easy to carry’ (as given in the question)</td></tr>
<tr><td>2</td><td>(b)</td><td>(ii)</td><td>monitor / AW, blood disorder / named blood disorder ✓

determine the severity of, blood disorder / named blood disorder ✓

monitor / AW, response to treatment ✓

monitor suitability / AW, to become a blood donor ✓</td><td>1 max</td><td>AO1.2</td><td>e.g. ‘monitor anaemia’</td></tr>
</table>

2	(b)	(iii)	low hydration levels increases concentration of solutes in plasma, leading to artificially high results / AW ✓	1	AO3.2	
2	(c)	(i)	sigmoid(al) ✓	1	AO1.1	**ALLOW** 's-shaped'
2	(c)	(ii)	*(alveolar capillaries)* 96 (%) **AND** *(venous blood)* 61 (%) ✓	1	AO 2.4	**BOTH** readings needed for **one** mark
2	(c)	(iii)	all points plotted correctly ✓ sigmoid shaped and smooth continuous curve drawn **and** trend line only drawn between data plots ✓	2	AO 2.8	i.e. trend line does not extend beyond last data plot
2	(c)	(iv)	fetus must / only, obtain(s) oxygen from mother's blood as it flows through placenta ✓ fetal haemoglobin has higher affinity for oxygen / AW, so the fetus can obtain oxygen even at (very) low partial pressures of oxygen ✓	2	AO1.1	**ALLOW** ORA throughout

Question			Answer	Mark	AO element	Guidance
3	(a)*		***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):* o *award the higher mark where the Communication Statement has been met.* o *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) Detailed explanation of how to use the potometer to obtain valid results to estimate the rate of transpiration with clear reference to control variables and how they will be taken into account **AND** how a suitable number of different light intensities are determined **AND** how the raw data will be collected **AND** how the raw data can be processed to estimate the rate of transpiration. *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)** Simple explanation of how to use the potometer to obtain valid results to estimate the rate of transpiration with reference to control variables and how some will be taken into account **AND** how different light intensities are determined **AND** how the raw data will be collected **OR** how the raw data can be processed to estimate the rate of transpiration.	**6**	AO1.2 AO3.4	**Indicative marking points e.g.** **Control variables** • control variables e.g. species / number of leaves / leaf surface area / humidity / temperature / light source (wattage) / windspeed • detail of how control variables taken into account e.g. same species / same number of leaves / measure leaf surface area (so rate can be calculated per unit of SA) / measure humidity / temperature controlled room to standardise room temperature / same light bulb which acts as source / fan used at same speed **Light intensity** • place light source at a suitable range of distance**s** from potometer • range of 5 distances stated for light source • use of light meter **OR** use of inverse

			Mentions measuring movement of air-water meniscus but no detail of calculation or further processing. May only give details of different positions of light source with no further detail of suitable range and number of positions. *There is a line of reasoning presented with some structure. The information presented is **mostly** relevant and supported by some evidence.* **Level 1 (1–2 marks)** Limited explanation of how to use the potometer to obtain valid results to estimate the rate of transpiration with reference to control variables **OR** how different light intensities are determined **OR** how the raw data will be collected **OR** how the raw data can be processed to estimate the rate of transpiration. *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.*			square law to determine LI (from distance between light source and potometer) **Dependent data** • measure distance moved by air-water meniscus over set time period • collection of repeats **Processing data** • calculation of distance moved over set time period • conversion of distance moved to volume (using formula for cylinder) • calculation of rate of water uptake i.e. volume ÷ time • calculate of mean rate of water uptake • further processing e.g. calculation of SD or appropriate statistical analysis e.g. use of unpaired t -test (to asses significant difference between 2 mean rates of water uptake at different light intensities)
3	**(b)**		**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer =** 10 (μm) ✓✓ 12mm ÷ 1200 **OR** 1.2cm ÷ 1200 ✓	**2**	AO2.4	

3	**(c)**	**(i)**	*Describe:* (as the leaf water potential decreases) rate of water loss decreases ✓ *Explain*: (because decreasing leaf water potential) lowers diffusion gradient (of water vapour), so less evaporation ✓	**2**	AO2.5	
3	**(c)**	**(ii)**	correct tangent drawn, in contact with trend line at 0.7MPa ✓ correctly calculated rate of change ✓	**2**	AO2.8	i.e. rate of change = change in y ÷ change in x

Question			Answer	Mark	AO element	Guidance
4	(a)		**Mark first answer** *acute disease* (has a) fast / rapid / AW, onset ✓ (has) fast, recovery time ✓	**1 max**	AO1.1	 **ALLOW** ORA for chronic
4	(b)	(i)	(the people chosen) reflect the distribution of, characteristics of the whole population / AW ✓	**1**	AO2.4	
4	(b)	(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer =** 70% ✓✓ (357 358 ÷ 511 670) x 100 ✓	**2**	AO2.4	**ALLOW** for **one** mark if calculated correctly but not recorded to 2sf 69.8% **OR** 69% **OR** 69.84%
4	(b)	(iii)	(may have) died ✓ (may have) emigrated / not traceable (for follow up questionnaire) AW ✓ (may have) withdrawn consent / AW ✓	**1 max**	AO3.2	

4	**(b)**	**(iv)**	a community setting more difficult to control variables than in laboratory / AW ✓ (individual exposure to pollutants was only estimated) so data collected was not accurate / AW ✓ people may have relocated so exposed to different levels of air pollutants / AW ✓ lifestyles may change due to length of study / thirty years is a long time for lifestyles to stay the same / AW ✓ people may not tell the truth on questionnaires / AW ✓ genetic predisposition to respiratory diseases will affect the data / AW ✓ other named / specified lifestyle factors, may be also raise risk (of respiratory disease) ✓	**3 max**	AO3.4	e.g. smoking

Question			Answer	Mark	AO element	Guidance
5	(a)*		***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):* o *award the higher mark where the Communication Statement has been met.* o *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) Detailed discussion that includes wide range of benefits of improved aerobic fitness **AND** addresses most F.I.T.T. factors **AND** several other factors. *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)** Discussion that includes some benefits of improved aerobic fitness **AND EITHER** at some F.I.T.T. factors **OR** other factors. *There is a line of reasoning presented with some structure. The information presented is* ***mostly*** *relevant and supported by some evidence.* **Level 1 (1–2 marks)** Brief discussion to include at least one benefit of improved aerobic fitness **AND EITHER** at least one of the F.I.T.T. factor **OR** at least one other factor.	**6**	AO1.2 AO3.3	**Indicative marking points e.g.** **Benefits of aerobic fitness:** • increased stroke volume • increased VO_2 max • decreased resting HR • increased capillary density in lungs and surrounding skeletal muscles • increased efficiency in lipid metabolism • increased glycogen stores in skeletal muscles • increase in number and size of mitochondria in muscle fibres • strengthening skeletal muscles • improving efficiency of circulatory system • reducing blood pressure • improving mental health e.g. reducing stress / lowering the incidence of depression • reducing risk of diabetes • reducing risk of osteoporosis

			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*			**'FITT' FACTORS to be taken into account** • frequency of exercise • intensity of exercise • time (duration) of exercise • type of exercise **Other factors to take into account** • Pre-existing medical conditions • Age • Previous level of fitness
5	**(b)**		**accurate** representation of the **tissue** in the micrograph drawn ✓ drawing made with clear continuous lines **AND** no shading **AND** label lines horizontal without arrow heads touching observable structures ✓ **two** observable structures of the tissue **labelled** correctly ✓ e.g. • muscle fibre • detail of sarcomere e.g. A band / I band / Z line • (myocyte) nucleus • capillary **two** of the labelled structures **annotated** ✓ e.g. • muscle fibre - multi nucleate / contains numerous myofibrils • A band / dark band - contains actin and myosin • I band / light band - contains only actin	**4**	AO2.3	**ALLOW** error carried forward for correct annotations if structures labelled incorrectly

			• Z line – marks length of a sarcomere / junction of actin filaments • nucleus - controls activity of myocyte / contains genetic material of the mycocyte • capillary – delivers nutrients to mycocytes / removes lactic acid from myocyte			

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