OCR
Oxford Cambridge and RSA

GCE

Biology B

H422/02: Scientific literacy in biology

Advanced 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.

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

Subject-specific Marking Instructions

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.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>any two from:

(mtDNA is) circular ✓

(mtDNA is) not associated with , histones / proteins ✓

(mtDNA does) not contain (much / many) , introns / junk DNA ✓</td><td>2</td><td>2.1</td><td>ALLOW any of the differences described in the article, except for size / number of base pairs (this is excluded by the question stem)</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th>component</th><th>mtDNA</th><th>RNA</th><th>ATP</th></tr>
<tr><td>adenine</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>ribose</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>uracil</td><td></td><td>✓</td><td></td></tr>
<tr><td>pyrimidine</td><td>✓</td><td>✓</td><td></td></tr>
</table>
</td><td>3</td><td>1.1
2.1</td><td>1 mark per correct row</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>(mitochondrial) tRNA / rRNA ✓</td><td>1</td><td>2.1</td><td>DO NOT ALLOW ‘transcription factors’ unless it is made clear that these are RNA transcription factors.

IGNORE ‘transport’</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	(production of) two identical DNA molecules ✓ using each strand as a template / where half the genetic information is kept in the new DNA ✓	2	1.1	
		(ii)	mutation in catalytic region , prevents / AW , mtDNA replication ✓ mutation in exonuclease (domain) increases mutation rate ✓	2	2.1	**ALLOW** reduces accuracy of replication or causes damaged DNA to be replicated **DO NOT ALLOW** just mismatched base-pairs may not be removed
	(c)	(i)	(phosphorylated) nucleotides ✓ Taq / thermostable , (DNA) polymerase ✓ (DNA) primers ✓	3	1.1	**ALLOW** nucleotide triphosphates
		(ii)	**FIRST CHECK ON ANSWER LINE** **If answer = 7.69 OR $10^{7.69}$ award 2 marks** amplification factor = 2^{15} (= 32 768) ✓ $\log_{10}$ (1 500 × 32 768) = $\log_{10}$ 49 152 000 = 7.69 ✓	2	2.8	mark is for 2^{15} **ALLOW** $10^{7.69}$ **ALLOW** ECF from incorrect amplification factor
		(iii)	**(E) A D G B C F** ✓✓✓✓	4	1.2	If the order is incorrect, award one mark for each of the following: A first and F last A before G G before C

Question	Answer	Marks	AO element	Guidance
(d)	**any two from:** (because there will be) <u>more</u> anaerobic respiration if mitochondria are not functioning ✓ lactate formed in anaerobic respiration ✓ functioning mitochondria required to , convert reduced NAD to NAD / re-oxidise reduced NAD / regenerate NAD ✓	**2**	2.1	 **ALLOW** lactate accumulates in the absence of NAD **ALLOW** NADH for reduced NAD

Question			Answer	Marks	AO element	Guidance
2	(a)	(i)	*type 1 diabetes:* insulin (injection) ✓ *type 2 diabetes **any two** from:* controlled diet / reduced intake of refined sugars ✓ weight loss ✓ more / increased , exercise ✓ (named) drug treatment ✓	**3**	1.1	 **needs insulin for full marks** **DO NOT ALLOW** 'healthy diet' **DO NOT ALLOW** 'regular exercise' **ALLOW** medication
		(ii)	concentration of , glycosylated haemoglobin / HbA1c , increases with blood glucose concentration ✓ (gives indication of) average blood glucose concentration over several weeks ✓	**2**	1.1	**ALLOW** Hb_{A1c} / glycosylated haemoglobin concentration is proportional to glucose concentration
	(b)	**(i)**	sphygmomanometer ✓	**1**	1.1	**ALLOW** any non-ambiguous phonetic spelling.
		(ii)	**FIRST CHECK ON ANSWER LINE** **if answer = 2.4 % award 2 marks** (123 – 120) / 123 ✓ = 2.4 % ✓	**2**	2.2	 **ALLOW** 0.024 for 1 mark **ALLOW** calculator value 2.4390243 correctly rounded

Question	Answer	Marks	AO element	Guidance
(iii)*	***Summary of instructions to markers:*** *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.***			

Question	Answer	Marks	AO element	Guidance
	Level 3 (5–6 marks) An evaluation including pieces of evidence supporting **and** pieces of evidence not supporting the conclusions. There is more than one idea for additional information required. *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)** An evaluation including a piece of evidence supporting **and** a piece of evidence not supporting the conclusions. An idea for additional information is included. *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)** An evaluation including pieces of evidence either supporting **or** not supporting the conclusions. *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.	**6**	3.2	**Indicative scientific points may include** ***Evidence supporting conclusions*** • Retinopathy developed or got worse in fewer patients in test group • Retinopathy improved in more patients in test group • Blood pressure decreased in test group • calculation of % ***Evidence not supporting conclusions*** • No information provided about Hb_{A1c} • Small difference between the test and control groups in number of improvements • Numbers/sample size relatively small • Only small decrease in blood pressure • Blood pressure was in the normal range in both groups / no hypertension • 21 patients developed / worsened ***Additional information needed*** • Larger trial required • Statistical analysis • Information about severity of diabetes in two groups • Whether groups were age / sex matched • Need to correlate HB_{A1c} / control of diabetes with retinopathy • Other medication / pre-existing conditions

Question			Answer	Marks	AO element	Guidance
	(c)		**any three from:** increased blood pressure leads to increased , hydrostatic pressure / HP ✓ in capillaries in the eye ✓ HP is even greater than oncotic pressure (than normal) ✓ so more tissue fluid is formed (than normal) ✓	**3**	2.5	**ALLOW** reverse argument **ALLOW** answer based on less return of tissue fluid
	(d)	(i)	**any two from:** plot a scattergraph ✓ calculate (Spearman's rank) correlation coefficient ✓ look up / AW , p values (in a table) ✓	**2**	2.8	
		(ii)	**any two from:** correlation does not imply causation ✓ both diseases are , caused by / AW , obesity ✓ both diseases may be , caused by / linked to , another factor ✓	**2**	2.3 3.1	

Question			Answer	Marks	AO element	Guidance
3	(a)	(i)	X = oxygen / O_2 Y = carbon dioxide / CO_2 Z = adenosine triphosphate / ATP	**2**	1.1	All 3 correct = 2 marks 2 correct = 1 mark 1 or 0 correct = 0 marks
		(ii)	grana / granum ✓	**1**	1.1	**ALLOW** thylakoid (membrane) **DO NOT ALLOW** photosystems
		(iii)	**any two from:** contain , (named) pigment (molecules) / photosystems ✓ contain , (named) electron carriers / ETC / ATP synth(et)ase ✓ (has a) large surface area for , light absorption / light depended reactions / electron transport ✓ allows formation of electrochemical gradient ✓	**2**	2.1	**IGNORE** 'accessory' **IGNORE** enzymes unqualified **NOTE** mp 1 & 3 or mp 2 & 3 could be combined in a single sentence

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	**any one from:** (because the) spots / pigments , would continue to move ✓ (so) R_f values would not be correct ✓	1	2.7	**ALLOW** solvent would evaporate from end of paper / continue to move
		(ii)	**FIRST CHECK ON ANSWER LINE** **if answer = 0.44 award 2 marks (must be 2 sig figs)** distance moved by spot 5 = 52 mm **AND** distance moved by solvent = 119.0 mm ✓ correct use of $R_f = \frac{(distance\ moved\ by\ spot)}{(distance\ moved\ by\ solvent)}$ **OR** $R_f = \frac{(52)}{(119)} = 0.44$ ✓	2	2.8	**DO NOT ALLOW** any other distances **ALLOW** ECF from incorrect distances (must be ±2 mm of correct distances) maximum 1 mark if not to 2 sig figs maximum 1 mark if units given for R_f answer not to 2 sig figs and units given = 0 marks
		(iii)	(because) distance moved depends on <u>solubility</u> of pigment in solvent (mixture) ✓ (so) pigments would have different Rf values in different solvent (mixture) ✓	2	2.7	**DO NOT ALLOW** affinity for solvent **DO NOT ALLOW** 'interact with solvent' or 'interact with pigment'

Question			Answer	Marks	AO element	Guidance
	(c)	(i)	**any four from:** energy lost by electrons in redox reactions ✓ each , ETC component / electron carrier , is at a lower energy level ✓ energy released used to <u>pump</u> protons ✓ into the thylakoid space ✓ proton gradient , created / AW ✓ diffusion of <u>protons</u> through ATP synth(et)ase / chemiosmosis ✓ kinetic energy (of movement of protons) converted to chemical energy (of ATP) ✓	**4**	1.1 2.1	**IGNORE** kinetic energy (of electrons) **ALLOW** H^+ / hydrogen ions for 'protons' throughout **ALLOW** electrochemical gradient **DO NOT ALLOW** just electrical gradient **ALLOW** 'move back' for 'diffusion', 'proton motive force'
		(ii)	(because) energy (of electrons) lost as heat ✓ leakage of protons across membrane ✓	**2**	2.1	

Question			Answer	Marks	AO element	Guidance
4	(a)	(i)	**A** = neutrophil ✓ **B** = monocyte ✓ **C** = lymphoctye ✓	**3**	2.3	**ALLOW** granulocyte **ALLOW** agranulocyte or macrophage
		(ii)	does not have a nucleus / nucleolus / nuclear envelope / is anuclear ✓	**1**	2.3	**ALLOW** biconcave disc shape
	(b)	(i)	**any one from:** ensure thorough mixing ✓ use , isotonic / AW , diluent / solvent ✓	**1**	3.3	
		(ii)	**FIRST CHECK ANSWER LINE** **if answer = 5.6(3) × 10^9 award 4 marks** volume = 0.2 × 0.2 × 0.1 = 0.004 mm^3 ✓ cell density = 15 / 0.004 = 3750 mm^{-3} = 3.75 × 10^6 cm^{-3} ✓ dilution factor = 1.5 / 0.001 = 1 500 ✓ cell density = 1 500 × 3.75 × 10^6 cm^{-3} = 5.6(3) × 10^9 (cells cm^{-3}) ✓	**4**	2.4	**ECF** for evidence of 15 divided by candidate's volume

Question			Answer	Marks	AO element	Guidance
Question			Answer	Marks	AO element	Guidance
5	(a)	(i)	**any three from:** correct detail of colony morphology differences ✓ *agree because*… (there is) more than one type of <u>colony</u> ✓ (there is) more than one (colony) <u>morphology</u> ✓ *disagree because*… (there are) more than two , types of colony / morphologies ✓ (so there are) 3 / 4 / more than two , species present ✓	**3**	3.2	e.g. 'some colonies are orange, but some are light brown in colour'. 'Three colonies have rough edges, but the others are smooth'.

Question	Answer	Marks	AO element	Guidance
(ii)*	**Level 3 (5–6 marks)** A comprehensive description of a method that would produce pure cultures, including selection and culturing techniques, contamination avoidance, and purity confirmation. *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 description of a method that would produce pure cultures, including selection and culturing techniques, and either contamination avoidance or purity confirmation. *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)** An outline of a method that would produce a culture of bacteria, with proper aseptic technique but few other details. *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.	**6**	3.3	**Indicative scientific points may include** *Selection & culturing techniques*: • Select different colonies based on morphology • Culture on agar plates / in nutrient broth • Plate each colony on different plate / container of broth • Incubate at suitable temperature / 25ºC *Avoiding contamination*: • Use of sterile containers and media • Use aseptic technique to avoid contamination (e.g. disinfection of work surfaces; flaming of wire loops and bottle necks; limit exposure of samples; do not put lids or caps down on work surfaces) • Avoid selecting colonies that overlap *Confirming purity*: • Examine under microscope • Use of Gram or other staining An answer that just describes aseptic technique (no matter how detailed) will only achieve Level 1

Question			Answer	Marks	AO element	Guidance
	(b)	(i)	there are gram-negative and gram-positive bacteria present ✓ (because) some cells are stained pink and some are stained , purple / violet ✓	2	3.1	**ALLOW** at least 2 species / types of bacteria present **ALLOW** because they are stained differently
		(ii)	Gram positive bacteria have , thick /AW , peptidoglycan wall ✓ (that) takes up / binds to , crystal violet stain ✓ outer (stained) layer is not washed away by alcohol ✓	max 2	1.2	**ALLOW** 'they' for 'Gram positive bacteria' **ALLOW** Gram negative bacteria have thin wall **ALLOW** stain washed away in Gram negative allowing (named) counter stain to bind

Question			Answer	Marks	AO element	Guidance
	(c)	(i)	**any three from:** conclusions 1 & 2 are correct ✓ conclusion 3 & 4 may be incorrect (based on small zone of inhibition) ✓ *idea that* definitive conclusions cannot be made with small number of , strains / antibiotics ✓ conclusion 5 cannot be made based on this evidence ✓	**3**	3.2	
		(ii)	**any two from:** repeat with more plates **and** calculate mean ✓ (use) same / control , concentration of antibiotic ✓ (use) same / control , volume of antibiotic solution ✓	**2**	3.3	**ALLOW** use same area / diameter filter paper
		(iii)	(penicillin) destroys / disrupts assembly , of bacterial cell wall / peptidoglycan (in Gram-positive bacteria) ✓	**1**	2.5	**ALLOW** murein for peptidoglycan **ALLOW** just 'attacks the cell wall'
		(iv)	(polymyxin B) damages plasma membrane (in Gram-negative bacteria) ✓ polymyxin B disrupts another (named) process in (Gram-positive) bacteria ✓	**1**	2.5	**ALLOW** response based on differences in cell wall of Gram-positive and -negative bacteria.

Question			Answer	Marks	AO element	Guidance
		(v)	**any three from:** prepare bacterial , plate / culture / lawn ✓ add antibiotic and look for , zone of killing / evidence that bacteria have been killed ✓ only bactericidal antibiotics will show killing ✓ repeat with , different bacterial species / Gram-positive or Gram-negative bacteria ✓	**3**	3.3	**ALLOW** bacteriostatic antibiotic will not show killing

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark s</th><th>AO element</th><th>Guidance</th></tr>
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<tr><td>6</td><td>(a)</td><td>(i)</td><td>glycolysis ✓</td><td>1</td><td>1.1</td><td>ALLOW glycolytic pathway</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>cytoplasm ✓</td><td>1</td><td>1.1</td><td>ALLOW cytosol</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>
<table>
<tr><th></th><th>Substrate level phosphorylation</th><th>Hydrolysis</th><th>Dehydrogenase enzyme</th></tr>
<tr><td>1</td><td></td><td>✓</td><td></td></tr>
<tr><td>2</td><td></td><td>✓</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td>✓</td></tr>
<tr><td>4</td><td>✓</td><td></td><td></td></tr>
<tr><td>5</td><td>✓</td><td></td><td></td></tr>
</table>
</td><td>3</td><td>2.1</td><td>One mark for each correct column.</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>increases energy of glucose / reduces activation energy of reaction ✓</td><td>1</td><td>2.1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>pyruvate ✓
carbon dioxide ✓
reduced NAD / NADH ✓</td><td>4</td><td>1.1</td><td>ALLOW mp2 and 3 in either order.</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
			citrate ✓			

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