Oxford Cambridge and RSA

GCE

Biology A

H420/01: Biological processes

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.

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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

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**.

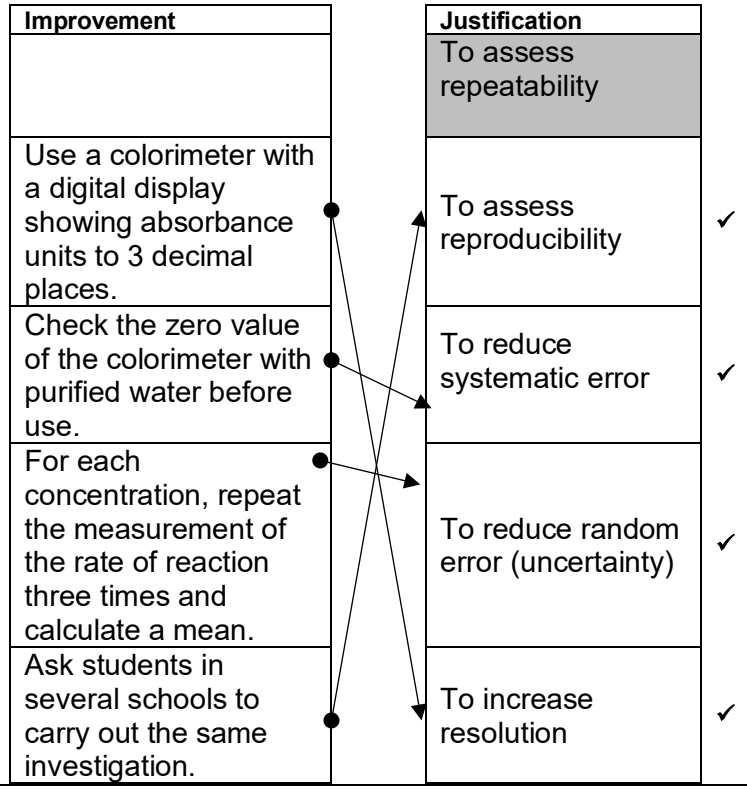
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	AO element	Guidance
1			D ✓	1	1.2	
2			B ✓	1	1.1	
3			A ✓	1	1.1	
4			A ✓	1	1.1	
5			B ✓	1	1.1	
6			B ✓	1	1.1	
7			B ✓	1	1.1	
8			B ✓	1	1.1	
9			A ✓	1	2.6	
10			A ✓	1	2.6	
11			C ✓	1	2.3	
12			C ✓	1	2.4	
13			B ✓	1	1.1	
14			C ✓	1	1.2	
15			B ✓	1	2.5	
			Total	15		

Question			Answer	Marks	AO element	Guidance
16	(a)	(i)	adenine ✓	1	2.1	**DO NOT ALLOW** adenosine **IGNORE** nitrogenous base / purine
	(a)	(ii)	hydrolysis ✓	1	2.1	**IGNORE** dephosphorylation
	(a)	(iii)	because ATP is , broken down / hydrolysed (to ADP) ✓ ATP is constantly recycled ✓ ATP used to provide energy for , (named) metabolic reactions / processes ✓ ATP is , not stored long term / used immediately ✓	max 2	2.1	**ALLOW** ATP is unstable **ALLOW** constant interconversion of ATP and ADP (+Pi) **ALLOW** ATP produced is coupled to metabolic reactions **IGNORE** used for respiration unqualified **ALLOW** ATP is used as fast as it is produced

Question			Answer	Marks	AO element	Guidance
16	(b)	(i)	*Substance A* **1** for (substance) **A** the , graph is a straight line / rate of uptake depends on concentration ✓ **2** (so substance) **A** is (absorbed by simple) diffusion ✓ *Substance B* **3** for (substance) **B** the curve , reaches a plateau **/** levels off ✓ **4** (so substance) **B** could be (absorbed by) , facilitated diffusion / active transport ✓ **5** (because) if facilitated diffusion channels / carrier proteins , become saturated **OR** (because) if active transport carrier proteins / carriers , become saturated ✓	**4 max**	3.1 3.2	**ALLOW** rate is (directly) proportional to concentration **ALLOW** as concentration increases rate increases **DO NOT ALLOW** facilitated diffusion **ALLOW** rate becomes constant **DO NOT ALLOW** rate slows **IGNORE** stops increasing **ALLOW** channels / carriers working at maximum capacity **ALLOW** transport proteins for either in **MP5** **DO NOT ALLOW** channel proteins for active transport

16	(b)	(ii)	***Substance A*** *effect* (uptake) unaffected / no change ✓ *explanation* (simple) diffusion , does not require ATP / is a passive process ✓ ***Substance B*** *effect if active transport* slower / little / reduced / no (uptake) ✓ *explanation* active transport , requires ATP / is an active process ✓ **OR** *effect if facilitated diffusion* (uptake) unaffected / no change ✓ *explanation* facilitated diffusion , does not require ATP / is a passive process ✓	**max 4**	3.1 2.5	**CHECK answer to (b)(i) ALLOW ECF** if answer to part (i) suggests candidate thinks substance A is taken up by active transport and Substance B is taken up entirely by diffusion. **ALLOW** does not require energy **ALLOW** does not require energy

Question			Answer	Marks	AO element	Guidance
16	(c)			4	2.3	**One mark per correct line** **DO NOT ALLOW** more than one line per box

Question			Answer	Marks	AO element	Guidance
17	(a)	(i)	R_f = 0.53 / 0.52 ✓ ✓ *pigment* = chlorophyll a ✓	3	2.4 3.2	If incorrect: **ALLOW for 1 mark for** correct use of $R_f = \frac{(distance\ moved\ by\ spot)}{(distance\ moved\ by\ solvent)}$ **e.g.** $R_f = \frac{(46)}{(86)}$ **OR** inappropriate use of sig. figs e.g. 0.533 / 0.5 **ALLOW ECF** if incorrect calculation **IGNORE** colour e.g. blue-green
	(a)	(ii)	grey ✓	1	2.4	**ALLOW ECF** from calculated R_f value in part (ii) (for ECF looking for a pigment next highest in value than calculated as spot 4 has travelled further from origin than spot 3) ECF list: 0.32-0.44 - prediction = green 0.49 - prediction= blue-green 0.65 -prediction = yellow-orange
	(a)	(iii)	spot 5 ✓ (because) is most soluble in , mobile phase / solvent ✓	2	2.3 2.4	**ALLOW** is less attracted to stationary phase / TLC plate

17	(b)	(i)	*hold TLC plate carefully* (so that) movement of spots not affected (by damage) **OR** (so that) plates are not contaminated (by fingerprints / oils from skin) ✓ *make sure plate doesn't touch sides of jar* (because) condensation / liquid / solvent , on walls of jar may affect movement of spots **OR** to avoid , solvent / spots , travelling in wrong direction ✓	**2**	1.2	**MUST be linked to appropriate precaution** **ALLOW** e.g. pigments for 'spots'
	(b)	**(ii)**	to , reduce / avoid / prevent , damage / degradation / contamination / AW , of the (photosynthetic) pigments ✓ to , reduce / avoid , evaporation of propanone / solvent ✓	**1 max**	1.2	
	(c)		***GP*** **1** (concentration of) GP decreases ✓ **2** (GP decreases) because less CO_2 available to react with RuBP to produce GP ✓ ***RuBP*** *(2 max)* **3** (concentration of) RuBP increases **AND** then decreases ✓ **4** RuBP increases because it is not converted to GP ✓ **5** RuBP increases as it is still being produced from TP ✓	**3 max**	2.3	**IGNORE** 6C intermediates **ALLOW** no / less , carbon (dioxide) fixation taking place **Max 2 from MPs 3,4, 5 and 6**

			6 RuBP decreases because less GP available to , regenerate / AW , RuBP ✓			

Question			Answer	Marks	AO element	Guidance
18	(a)		because it is , charged / polar / hydrophilic ✓ (so) cannot pass through the phospholipid bilayer / will need correct transport proteins✓ **OR** because it is (too) large ✓ (so) cannot pass through the phospholipid bilayer / will need correct transport proteins✓	**2 max**	2.1	**ALLOW** repelled by phospholipid bilayer **ALLOW** hydrophobic centre / fatty acid tails for phospholipid bilayer **IGNORE** cell membrane **IGNORE** cell membrane
	(b)	(i)	can be used with , living cells / thick samples ✓ AVP ✓	**1 max**	2.3	**Mark first response** e.g. high resolution e.g. can see distribution of molecules within cells e.g. can control depth of field e.g. sharper / less blurred image

18	(b)	(ii)	***conclusion is valid because:*** **1** concentration of Ca^{2+} is proportional to strength of stimulus ✓ **2** Ca^{2+} change from low to , medium / high , causes increase in (membrane) potential ✓ **3** action potential in , presynaptic neurone / synaptic bulb , leads to , opening of Ca^{2+} channels / entry of Ca^{2+} ✓ **4** Ca^{2+} , causes / AW , release of (named) neurotransmitter ✓ **5** (named) neurotransmitter causes , Na+ / sodium ion , channels to open in (post-synaptic) neurone ✓ **6** if threshold is exceeded this causes , action potential in (postsynaptic) neurone / depolarises (postsynaptic) membrane ✓ ***conclusion may not be valid because:*** **7** changes in Ca^{2+} concentration may not be the cause of (postsynaptic) action potential ✓ **8** Ca^{2+} change from medium to high but no change in (membrane) potential ✓	**4 max**	2.4 3.2	**ALLOW** calcium ions for Ca^{2+} throughout **DO NOT ALLOW** Ca^{+} / calcium but penalise once then ECF **ALLOW** reference to +40 mV as alternative to action potential throughout **IGNORE** ref to fluorescence / FURA-2 **MP 1 ALLOW e.g.** the greater the strength of stimulus the greater the Ca^{2+} concentration **MP2 ALLOW** figs go from -60 to +40mV **MP8 ALLOW** figs stay at + 40mV

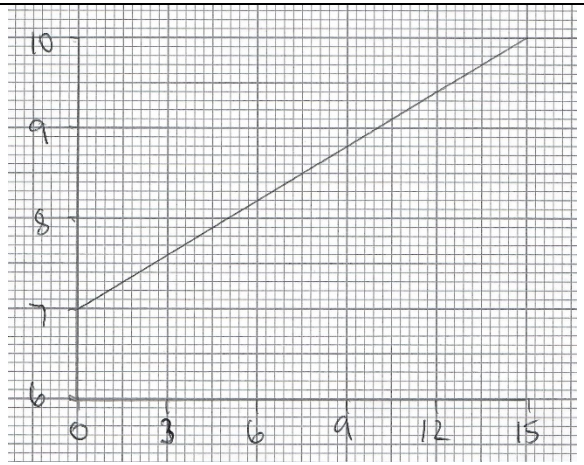
Question			Answer	Marks	AO element	Guidance
19	(a)	(i)	transmission electron (microscope) ✓	1	2.1	**ALLOW** TEM, 'microscopy' for 'microscope'
	(a)	(ii)	**M** = matrix ✓ **N** = crista(e) ✓	2	1.1	**ALLOW** inner membrane for **N**
	(b)		contain / location of , (named) electron carriers / ETC / ATP synth(et)ase / proton pumps ✓ (provide , site / location / surface) for , chemiosmosis / ATP synthesis / oxidative phosphorylation ✓ allow , formation / maintenance , of , H+ / proton / hydrogen ion , gradient ✓ outer membrane is highly permeable to allow movement of (named) molecules ✓	max 2	1.1	**Mark as continuous prose**
	(c)	(i)	length / size , similar to that of a bacterium ✓ contain (circular) DNA ✓ contain (70S / small / 20nm) ribosomes ✓ (may) have plasmids ✓ have double membrane ✓	max 2	3.2 2.1	**If more than two responses given:** mark **first** response on each prompt line. If responses on first prompt line and nothing on second line then mark first **two** on first prompt line
	(c)	(ii)	*cells with mitochondria / early eukaryotes* **1** would be able to respire aerobically ✓ **2** (this) produces more ATP ✓ **3** ATP needed for , active transport / cell division / protein synthesis / DNA replication ✓	3	2.1	**Assume for cells with mitochondria** **Only need to mention ATP once** **ALLOW ORA** for cells without mitochondria for **MPs 1, 2, 4** **ALLOW** releases more energy **DO NOT ALLOW** 'produces' energy **IGNORE** growth

Question			Answer	Marks	AO element	Guidance
			4 more ATP allows faster metabolic , processes / reactions ✓			**ALLOW** more ATP so can meet higher metabolic demand
20	**(a)**	**(i)**	rinse / change , flask / equipment ✓ stir yeast , (stock) solution / suspension ✓ (yeast stock solution made from) same type of yeast ✓ ensure connection to gas syringe is tight ✓ check temperature of , water bath / yeast (stock) solution , is 35 ºC ✓	**max 2**	3.3	**ALLOW** e.g. use different stirrer each time **ALLOW** ensure no leaks in gas syringe
		(ii)	boiled (and cooled) yeast / use buffer instead of yeast ✓	**1**	3.3	
	(b)	**(i)**	**1** rate of respiration is proportional to rate of gas production ✓ **2** use a tangent (on non linear part of curve) ✓ **3** measure / calculate , slope / gradient (of each line) ✓ **4** volume of gas (collected) divided by time ✓ **5** compare the same , time / period (between sugars) ✓	**max 3**	2.3 3.3	**ALLOW MPs 2, 3 and 5** from annotation of graph **ALLOW** seen as units e.g. $cm^3 min^{-1}$ **ALLOW** within prose / calculations

Question			Answer	Marks	AO element	Guidance
Summary of instructions to markers: *See instruction 10 on page 5 of this mark scheme.*						
20	**(b)**	**(ii)***	**Level 3 (5–6 marks)** An evaluation of **both** conclusions to include for **and** against statements *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)** An evaluation of **one** conclusion to include for **and** against statements. **OR** for **or** against statements for **both** conclusions. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence* **Level 1 (1–2 marks)** Incomplete evaluation e.g. for **or** against statements for **one** conclusion. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.*	**6**	3.2	**Indicative scientific points may include:** *Conclusion that rate of respiration of glucose, maltose and sucrose is similar* ***Supporting statements (correct because)*** • the slope of each curve is similar • values for overall / mean rates are similar • calculated values e.g. sucrose ~1.9cm^3 min^{-1}, glucose ~2.1cm^3min^{-1}, maltose ~2.4cm^3min^{-1} ***Against statements (incorrect because)*** • glucose respiration begins sooner than maltose / sucrose • glucose has more rapid increase at beginning • lag before respiration of maltose / sucrose begins • sucrose / maltose rate continues to increase as glucose is slowing down • maltose / sucrose may need to be hydrolysed before used in respiration *Conclusion that yeast could not hydrolyse disaccharides*

			0 marks *No response or no response worthy of credit.*			***Supporting statements (correct because)*** • little / no lactose respiration • lactose is disaccharide • lactose was not hydrolysed • yeast do not have the enzyme to hydrolyse lactose ***Against statements (incorrect because)*** • maltose / sucrose are disaccharides • maltose / sucrose are respired • may be that lactose could be hydrolysed but cannot be absorbed ***Either conclusion (against)*** • need statistical analysis to determine significance • e.g. t-test / standard deviation • measuring volume of gas over time only estimate of rate of respiration

Question			Answer	Marks	AO element	Guidance
20	(c)	(i)	**1** correct description of 1:10 dilution ✓ **2** need to make , a total of four 1:10 dilutions / three further 1:10 dilutions ✓ **3** correct values of dilutions given between stages e.g.1:10 to 1:100 ✓ **4** (ensure) mixing of yeast (suspension) at each stage ✓	**3 max**	2.4 3.3	**e.g.** take 1 cm^3 of culture and make up to 10 cm^3 **ALLOW** diagram showing serial dilution steps **DO NOT ALLOW** 1cm^3 + 10cm^3 **DO NOT ALLOW** add 0.1 cm^3 into 9.9cm^3 for **MP1** (due to measuring cylinders provided) but then ECF for **MPs 2 and 3** **ALLOW** values in standard form e.g. 1: 10^2 **ALLOW** e.g. stir thoroughly and repeat
		(ii)	eyepiece graticule ✓ stage micrometer ✓	**2**	2.3	**IGNORE** haemocytometer
		(iii)	1.25×10^8 ✓✓	**2**	2.4	**FIRST CHECK ON THE ANSWER LINE if answer = 1.25×10^8, award 2 marks** **If answer incorrect:** **ALLOW** 1 mark for answer not in standard form **OR** incorrect standard form e.g. 125 x 10^6 **OR** use of equation with correct figures $number\ of\ cells = \frac{2.5 \times 10^{-3}}{2.0 \times 10^{-11}}$

Question			Answer	Marks	AO element	Guidance
		(iv)	straight line ✓ starting at 0,7 ✓ ending at 15,10 ✓	3	2.4	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>21</td><td>(a)</td><td></td><td>
<table>
<tr><th rowspan="2">Structure</th><th colspan="3">Structural feature present</th></tr>
<tr><td>Cartilage</td><td>Elastic fibres</td><td>Goblet cells</td></tr>
<tr><td>Trachea</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Bronchi</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Bronchioles</td><td>× / ✓</td><td>✓</td><td>×</td></tr>
<tr><td>Alveoli</td><td>×</td><td>✓</td><td>×</td></tr>
</table>
</td><td>3</td><td>1.1</td><td>DO NOT ALLOW hybrid crosses

Trachea given in question, do not mark

1 mark for each correct row</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>spirometer ✓</td><td>1</td><td>1.1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>1.1 (dm^3) ✓</td><td>1</td><td>2.6</td><td>ALLOW range 1.0 to 1.2
(estimate 3.5 - 2.4)</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>4.5 (dm^3) ✓ ✓</td><td>2</td><td>2.6</td><td>FIRST CHECK ON ANSWER LINE if answer 4.5 , award 2 marks.
If answer incorrect:
ALLOW 1 mark for
calculation of maximum expiration - maximum inhalation i.e. 4.7 – 0.2</td></tr>
</table>

Question			Answer	Marks	AO element	Guidance
Summary of instructions to markers: *See instruction 10 on page 5 of this mark scheme.*						
21	(c)*		**Level 3 (5–6 marks)** A good description of normal expiration as passive process and comparison /contrast with forced expiration as an active process e.g. energy required / contraction of abdominal muscles. *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 sound description of normal expiration as passive process e.g. changes in volume or pressure due to muscles relaxing / elastic fibres recoiling. Some comparison / contrast with forced expiration. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence* **Level 1 (1–2 marks)** A basic description of normal expiration **OR** forced expiration. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** *No response or no response worthy of credit.*	**6**	1.2	**Indicative scientific points may include:** Normal expiration (provides some comparative statements for similarities) • passive • diaphragm muscles relax • diaphragm moves up / becomes dome shaped • external intercostal muscles relax • ribs move down and in • elastic fibres recoil • volume of thorax reduced • pressure in thorax increased • pressure in thorax greater than atmospheric pressure so air moves out of lungs Forced expiration (provides contrasting statements for differences) • active • requires energy • internal intercostal muscles contract • ribs pulled down hard • abdominal muscles contract forcing diaphragm up

21	**(d)**		surface area ✓ surface area to volume ratio ✓ circulatory system ✓ concentration gradient ✓ diffusion pathway ✓	**5**	1.1	

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