OCR
Oxford Cambridge and RSA

GCE

Biology A

H420/03: Unified 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.

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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

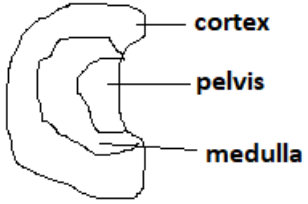
Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- 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	a		line drawing with clear continuous lines ✓ pelvis, medulla and cortex correctly labelled ✓	2	1.1 2.3	**ALLOW** a variety of shapes and sizes for the cortex medulla and pelvis (but they must be in the correct positions and clear) **ALLOW** any orientation of drawing e.g. pelvis on the left **DO NOT ALLOW** incomplete, overlapping or sketched lines **DO NOT ALLOW** shading or cross-hatching **DO NOT ALLOW** ureter or blood vessels shown **DO NOT ALLOW** if label lines incorrectly drawn (e.g. not straight or have arrowheads) or do not start exactly at the structure being labelled e.g. 2 marks for the answer below: 
	b	i	(re)absorption / regulation, of (named) ions ✓	1	1.1	Cl^- / K^+ / Na^+ / Ca^{2+}, reabsorption / regulation **ALLOW** words rather than formula (e.g. 'potassium ion' rather than 'K^+') **ALLOW** active transport of (named) mineral ions **ALLOW** (re)absorbs water **ALLOW** regulation of pH **IGNORE** 'changes / adjusts, salt concentrations' **IGNORE** 'creates a steep water potential gradient' **IGNORE** term 'selective'

Question			Answer	Marks	AO element	Guidance
		ii	increase(s) surface area for, (re)absorption/active transport ✓ has, cotransporters / membrane proteins, for, (re)absorption / active transport, of Na^+ / amino acid /glucose ✓	**1 max**	2.1	
		iii	B **AND** (because) <u>water,</u> is reabsorbed / removed, earlier in the nephron/AW ✓	**1**	2.1	**ALLOW** '<u>water</u> has exited by this point' **IGNORE** selective reabsorption has already occurred
	c		***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) Describes with some detail the roles of the nervous **and** endocrine systems in enabling water reabsorption. It is likely that the role of more than one hormone is included. *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)** Describes how the nervous system **and** endocrine system enable water reabsorption. *There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1-2 marks)** Describes how the nervous system **or** endocrine system enables water reabsorption **or** Outlines the role of both systems in water reabsorption. *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 2.5	**Indicative scientific points may include (but are not limited to):** *AO1.2 Demonstrate knowledge and understanding of scientific processes* *Endocrine system* • hypothalamus causes release of ADH from pituitary aldosterone released from adrenal cortex • ADH released from pituitary gland • ADH binds to receptors on the cell membranes of collecting duct cells … • … and this increases permeability to water (regulated by aquaporins) • role of cAMP *Nervous system*: • hypothalamus is part of nervous system • osmoreceptors in the hypothalamus … • … detect a low water potential in the blood • ADH is produced in the hypothalamus • posterior pituitary is extension of hypothalamus • correct reference to negative feedback *AO2.5 Apply knowledge and understanding of scientific processes in a theoretical context.* *Aldosterone*: • sodium ions pumped out of collecting duct cells (into tissue fluid) (and potassium ions pumped in) • lowers water potential in tissue fluid • concentration gradient established • sodium ions reabsorbed from the collecting duct lumen • water diffuses into collecting duct cells / out of lumen via osmosis.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td></td><td>d</td><td>i</td><td>Y
AND
idea of reduces blood volume the most ✓</td><td>1</td><td>3.2</td><td>e.g. ‘the concentration of water in the blood would be reduced more than with the other diuretics’
e.g. ‘more urine is produced’.
e.g. ‘less water is reabsorbed into the blood’.

ALLOW
X
AND
increases the (blood) potassium ion concentration the most
(as increased blood potassium linked to more sodium ion loss in urine and reduction in tension in blood vessel walls)</td></tr>
<tr><td></td><td></td><td>ii</td><td>X
AND
idea of does not raise (blood) <u>glucose</u> (concentration) ✓</td><td>1</td><td>3.2</td><td>e.g. ‘has no effect on (blood) <u>glucose</u>’
DO NOT ALLOW ‘raises (blood) glucose the least’</td></tr>
<tr><td>2</td><td>a</td><td></td><td>
<table>
<tr><th>Source of blood</th><th>Valve that controls blood flow</th><th>Destination of blood</th></tr>
<tr><td>right ventricle</td><td>right semilunar valve</td><td>pulmonary, artery/arteries</td></tr>
<tr><td>left atrium</td><td>left atrioventricular / bicuspid / mitral (valve)</td><td>left ventricle</td></tr>
</table>
✓ ✓
</td><td>2</td><td>1.1</td><td>IGNORE 'lungs'

ALLOW left atrial ventricular (valve)</td></tr>
</table>

	b		blood, leaks / AW, from left to right ventricle (during ventricular systole) ✓ (more) oxygenated blood delivered to lungs ✓ deoxygenated blood passes into left ventricle (during atrial systole) ✓ less oxygenated blood pumped, around the body / to tissues / to cells ✓ less oxygen available for (aerobic) respiration / ATP production ✓	**4 max**	2.1	**ALLOW** 'oxygenated and deoxygenated blood mix' **IGNORE** 'blood between the two ventricles is not separated' **ALLOW** 'less oxygen transported to, the body / tissues / cells' **ALLOW** 'less aerobic respiration takes place'
	c		(creatine kinase is an) intracellular (enzyme)/AW ✓ (presence in the blood indicates) damage to heart (cells / tissue / muscle)✓	**1 max**	2.1	e.g. 'creatine kinase should be within cells'
	d		*idea that* it ensures the same responses to treatment ✓ *idea that* no genetic variation to affect the results ✓ *idea that* no genetic variation so acts as control variable ✓	**1 max**	2.3	**IGNORE** 'improves validity' unqualified e.g. produces more valid results as no genetic variation' / 'reduces effect of genetic variation on results' **IGNORE** 'no genetic variation' unqualified **IGNORE** 'acts as a control variable' unqualified

<table>
<tr><td>3</td><td>a</td><td>i</td><td colspan="5">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.</td></tr>
<tr><td></td><td></td><td></td><td>Level 3 (5-6 marks)
Detailed description and linked explanation of results for both tables.

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)
Describes results for both tables with some explanation of at least one table.

There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.</td><td>6</td><td>2.3
2.4
3.1</td><td>Indicative scientific points may include (but are not limited to):

AO2.3 and 2.4 Apply knowledge and understanding of scientific ideas and techniques in a practical context when handling qualitative and quantitative data.

Descriptions:
<u>Table 3.1</u>:
• light increases length and mass of both roots and stems
• group A has less growth than group B

<u>Table 3.2:</u>
• stems grow towards the light (with a few exceptions)
• (almost) half the roots grow away from light
• some appear unaffected by light or grow towards light</td></tr>
</table>

			Level 1 (1-2 marks) Offers some description for both tables **or** describes and explains one table. *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.			*AO3.1 Analyse scientific information to make judgements and reach conclusions* *Explanations*: <u>Table 3.1:</u> • more carbohydrates produced during photosynthesis • light may trigger growth and germination (through phytochromes) <u>Table 3.2:</u> • details of phototropism (e.g. auxins produced in shoot tip moves to side away from light / auxins cause more cell elongation on side away from light) • light allows photosynthesis • positive phototropism in stems • geotropism more important than phototropism in roots • (some) negative phototropism in roots • other reasons for varied data, e.g. conditions not natural / measurement error / shading of stems / stems heavier than roots so tips
		ii	(unpaired) t-test ✓	**1**	2.8	**ALLOW** unrelated t-test **DO NOT ALLOW** paired/related, t-test
		iii	*idea of* comparing two <u>means</u> ✓	**1**	3.3	

		iv	8.10 is greater than 5.99 (at 2 degrees of freedom) ✓ (therefore) significant (difference) at (p =) 0.05 ✓ not significant at (p =)0.01 ✓ (indicates greater than 95% probability that) difference is not due to chance ✓ null hypothesis can be rejected (at p = 0.05) ✓	**3 max**	3.2	**ALLOW ECF for mp2 ,4 and 5 if 9.49 or 11.07 value used from table for max 2 marks** **ALLOW** 'students chi-squared value greater than critical value for 2 degrees of freedom' **ALLOW** 'there is a significant difference between the observed and expected results' **ALLOW** 'less than 5% probability that difference is due to chance'
	b		NO_3^- ✓ PO_4^{3-} ✓	**2**	1.1	**ALLOW** NH_4^+ **ALLOW** $H_2PO_4^-$
	c	**i**	auxin(s) / IAA ✓	**1**	1.1	**ALLOW** cytokinins
		ii	(soil/water) pH / species of plant / age of plant / size of plant / soil type / water availability ✓	**1**	3.3	**IGNORE** carbon dioxide concentration / wind movement / humidity **ALLOW** pre-treatment of seeds
	d		amyloplasts are, dense / heavy ✓ binding of amyloplasts with ER releases Ca^{2+} /AW ✓ *idea that* Ca^{2+} stimulates growth (factors) ✓ the root grows to the side of the, amyloplasts / Ca^{2+} release ✓	**2 max**	3.2	**ALLOW** amyloplasts fall in direction of gravity e.g. 'contact of amyloplasts with ER releases Ca^{2+}' **ALLOW** 'Ca^{2+} causes growth' **ALLOW** 'elongation' instead of 'growth'
4	**a**	**i**	cell division / cytokinesis ✓ *idea of* cell movement ✓	**1 max**	2.1	**ALLOW** binary fission / for replication **DO NOT ALLOW** mitosis e.g. 'allows flexibility' / 'allows it to bend'

		ii	*idea of* maintaining cell, shape / structure ✓	**1**	2.1	**ALLOW** to change cell shape / provide support
		iii	binds to, actin / cytoskeleton ✓ *idea that* actin might not function correctly ✓	**1 max**	3.2	e.g. stops muscle contraction / causes paralysis
	b		*Advantages* *idea of* less chance of resistance due to fewer years of use **OR** (slightly) more effective against MRSA / AW **OR** smaller chance of, nausea / constipation ✓ *Disadvantages* *idea of* long-term effects less certain (due to being used for only 4 years) **OR** (much) less effective against *Streptococcus* **OR** greater chance of, headache / diarrhoea ✓	**2**	3.2	**ORA** for vancomycin **IGNORE** ref to vomiting **IGNORE** ref to being less effective against *Staphylococcus* **IGNORE** ref to dizziness
	c	**i**	**X** <u>restriction</u> (endonuclease) ✓ **Y** (DNA) ligase ✓ **Z** electroporation / culture heating / heat shock / calcium salts ✓	**3**	1.2	**ALLOW** electric shock **ALLOW** calcium ions
		ii	(acts as) marker / reporter, gene ✓ *idea of* to indicate which bacteria have taken up the plasmid ✓	**1 max**	2.5	e.g. 'can identify transgenic bacteria'

		iii	0.00025 or 2.5 x 10^{-4} ✓✓	**2**	2.6	**FIRST CHECK ON ANSWER LINE** **If answer = 0.00025 or 2.5 x 10^{-4} award 2 marks** **If the answer is incorrect, award one mark for** 1/400 = 0.0025 or 2.5 x 10^{-3} **OR** 0.0025/1000 = 0.0000025 or 2,5 x 10^{-6} **OR** 0.0000025 x 100 (= 0.00025 or 2.5 x 10^{-4})
		iv	*idea of* extract DNA from cancerous liver and (named) healthy tissue ✓ choose primers for, E coli / β-galactosidase, DNA ✓ *idea of* comparing rate of DNA amplification ✓	**2 max**	3.4	e.g. 'compare amount of DNA after 30 cycles of PCR'
		v	*idea of* safety of genetic engineering (in bacteria) has been established ✓ *idea of* few animal rights issues to consider ✓	**1 max**	3.2	e.g. 'It's been done for many years without any problems' / 'genetic engineering is safe' e.g. 'bacteria do not have emotions like animals that can be engineered' / 'bacteria do not feel pain' / 'bacteria are not conscious'
5	**a**		stratified (sampling) ✓ detail of stratified sampling ✓ *correct calculation:* 40% (in farmland), 20% (in grassland), 40% (in peat bog) **OR** proportional numbers ✓	**3**	3.3 3.4	e.g. number of samples in each sector is proportional to the area or implied by correct calculation / random sampling within each sector e.g. 8, 4 and 8 samples
	b	**i**	large heath butterfly 1405 **and** 1153 ✓ bog hoverfly 30 **and** 20 ✓	**2**	2.8	**Answers must be rounded to nearest whole number**

		ii	*idea of* Chapman gives a lower estimate / Lincoln gives a higher estimate ✓ *idea that* difference between the estimates is (proportionally), greater for small populations / smaller for large populations ✓	**2**	3.1	***Read as prose*** **ALLOW ECF** from bi
	c		*preservation because* no visitors allowed **OR** human interference / peat extraction/ tree planting, restricted ✓ *not preservation / is conservation because* the habitat was being managed / example of management described (e.g. water levels raised / ditches blocked) **OR** the habitat had already been changed / was not the original habitat ✓	**2 max**	3.2	**DO NOT ALLOW** no human interference

	d		<table><tr><td>Name of conservation agreement</td><td>International agreement</td><td>Offers payments to farmers who conserve</td></tr><tr><td>Environmental (Countryside) stewardship scheme</td><td></td><td>✓</td></tr><tr><td>Convention on International Trade in Endangered Species</td><td>✓</td><td></td></tr><tr><td>Rio Convention on Biological Diversity</td><td>✓</td><td></td></tr></table> All correct = ✓✓ 1 or 2 rows correct = ✓	**2**	1.1	
6	**a**	**i**	low pO_2 in the <u>placenta</u> ✓ *idea of* O_2 transferred from adult to fetal <u>haemoglobin</u> (in the placenta) ✓ fetus receives (sufficient) oxygen for respiration ✓ maintains O_2 concentration gradient ✓	**2 max**	1.1	**ALLOW** 'low oxygen concentration in <u>placenta</u>' e.g. 'adult <u>haemoglobin</u> releases oxygen at low pO_2, but fetal <u>haemoglobin</u> will pick up oxygen at the same pO_2'.
		ii	initial straight line towards 80% and 10 mmHg (from the origin) ✓ curved line to 52 mmHg at 100% ✓	**2**	2.2	**ALLOW** straight line that stops short of 80% saturation as long as it passes through the 80% and 10 mmHg point if extrapolated **or** straight line that goes beyond this point

	b		*idea of* habitat is low(er) in oxygen ✓	**1**	3.1	
	c		(bilirubin is a) metabolic waste product / described ✓ as produced, from haem / during (red blood cell) breakdown ✓ (bilirubin) removed / AW, from the body ✓	**2**	1.2 2.5	**ALLOW** (bilirubin) removed into the digestive system
			Total	**70**		

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