OCR
Oxford Cambridge and RSA

GCE

Biology A

Unit **H420A/03:** Unified biology

Advanced GCE

Mark Scheme for June 2018

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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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1. **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.

Annotation	Meaning
	Correct answer
	Incorrect response
BOD	Benefit of Doubt
NBOD	Not Benefit of Doubt
ECF	Error Carried Forward
GM	Given mark
	Underline (for ambiguous/contradictory wording)
^	Omission mark
I	Ignore
L1	Level 1
L2	Level 2
L3	Level 3
BP	Blank Page
CON	Response that contradicts previous correct response

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>a</td><td></td><td>
<table>
<tr><th>Statement about onion root cells</th><th>True</th><th>False</th></tr>
<tr><td>contain chloroplasts</td><td></td><td>✓</td></tr>
<tr><td>contain mitochondria</td><td>✓</td><td></td></tr>
<tr><td>contain 70S ribosomes in cytoplasm</td><td></td><td>✓</td></tr>
<tr><td>have pili</td><td></td><td>✓</td></tr>
<tr><td>have cellulose cell walls</td><td>✓</td><td></td></tr>
</table>
3 correct = ✓
all correct = ✓✓
</td><td>2</td><td>ALLOW use of crosses in place of ticks</td></tr>
<tr><td></td><td>b</td><td></td><td>M = xylem ✓
N = phloem ✓</td><td>2</td><td>DO NOT ALLOW xylem, vessels /elements
DO NOT ALLOW phloem, sieve tubes / companion cells
IGNORE vascular tissue</td></tr>
<tr><td></td><td>c</td><td>i</td><td>aaBB ✓
AAbb ✓
white / no pigment ✓</td><td>3</td><td>ALLOW BBaa / aBaB
ALLOW bbAA /AbAb
DO NOT ALLOW colourless</td></tr>
<tr><td></td><td></td><td>ii</td><td>(dominant) epistasis ✓</td><td>1</td><td>DO NOT ALLOW recessive epistasis
DO NOT ALLOW complementary epistasis
ALLOW antagonistic epistasis</td></tr>
<tr><td></td><td></td><td>iii</td><td>B, produces / codes for, repressor protein / repressor polypeptide / enzyme / transcription factor ✓

(protein / polypeptide / product of B) binds to, promoter (of A) / mRNA / ribosome ✓
(product of allele B) stops, transcription / translation (of allele A) / protein synthesis / described✓

product of B inhibits the enzyme (encoded by A) ✓</td><td>2 max</td><td>IGNORE ref to genes instead of alleles
IGNORE B is a regulatory gene

IGNORE binds to operator

IGNORE 'allele B turns off allele A'
ALLOW 'product of allele B stops production of (named) product of allele A'
DO NOT ALLOW 'B produces an enzyme which breaks down pigment produced by A'(as this is happening after expression of allele A)</td></tr>
<tr><td>2</td><td>a</td><td></td><td>2 (ATP molecules per glucose) from, glycolysis</td><td>4 max</td><td>ALLOW ‘4 ATP made from 2 TP’s’</td></tr>
</table>

Question			Answer	Marks	Guidance
			/ (breakdown of) triose (bis)phosphate ✓ (when) triose (bis)phosphate / TP, converted / broken down, to pyruvate ✓ *ref to* net yield of 2 (ATP) / 4 (ATP) made but 2 used up (in glycolysis) ✓ 1 ATP (produced) per, (turn of the) Krebs cycle / acetyl (coA) ✓ when 5-carbon compound is converted to, 4-carbon compound / oxaloacetate ✓		'net yield of 2 ATP's in glycolysis' = mp1 and 3 for 2 marks **ALLOW** 2ATP, per glucose in Krebs cycle / from every 2 acetyl (coA) **ALLOW** 'when citrate converted to oxaloacetate' **ALLOW** 'when succinyl CoA converted into succinate' **ALLOW** 'between (intermediate) 4C compounds'
	b		Phloem = B **AND** contains sucrose / non-reducing sugar ✓ non-reducing sugar / sucrose, hydrolysed / broken down, to monosaccharides ✓ Liver = A **AND** does not contain starch / gives negative result for iodine test ✓	**3**	**ALLOW** non-reducing sugars broken down to, reducing sugars / named monosaccharide **ALLOW** 'colour after iodine added was yellow'
	c	**i**	12.5 /13 (%) ✓	**1**	• 16 carbon atoms in the fatty acid • 2 carbon atoms in acetyl CoA (which enters the Krebs cycle) • 2/16 x 100 = 12.5%
		ii	67(%) **AND**	**1**	**ALLOW** 66.6̇ / 66.667 / 66.67 / 66.7 (%) **DO NOT ALLOW** 66.6 (incorrect rounding)

Question			Answer	Marks	Guidance
			(the link reaction is) more efficient✓		• acetyl CoA (2 carbon atoms) is produced from pyruvate (3 carbon atoms) in the link reaction • 2/3 x 100 = 67 % **ALLOW ECF** if the answer to (i) is greater than 66.7% and 'less efficient' has been written ***OR*** if the answer to (i) is 66.7% and 'equally efficient' has been written if NR or no answer given in (i) then 1 mark for correct efficiency calculation and **IGNORE** efficiency statement
		iii	(FAD/NAD) accepts / is reduced by/ transfers / AW, hydrogen (atoms) ✓	**1**	**DO NOT ALLOW** hydrogen, ions / molecules **ALLOW** 'carries / transports / picks up, hydrogens' **IGNORE** 'removes, hydrogens'
3	**a**	**i**	(anomaly is) 28 / (light intensity of) 32 and (temperature of) 40.5 / row 6 ✓ repeat test ✓	**2**	**ALLOW** highlighted row or 28 in the table **IGNORE** plot points on a graph
		ii			
			Level 3 (5-6 marks) Provides **detailed** descriptions of improvements to both presentation **and** experimental method.	**6**	**Indicative scientific points may include:** *(examples of the detailed descriptions required for level 3 are shown in **bold**)*

Question			Answer	Marks	Guidance
			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)** Provides correct description**s** of improvement**s** to both presentation **and** experimental method. *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)** Provides a correct description of an improvement to both the presentation **and** experimental method. *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.		*Improvements to presentation* • Units for light intensity should be shown **(e.g. AU or lux, etc.)** • The table should be presented to make comparisons of light intensity easier **(example of improvement – e.g. separate tables for temperature and light intensity)**. • The heading of column three could be improved **(e.g. 'rate of photosynthesis – bubbles min^{-1}')** • present data as a graph **(e.g. light intensity / temperature vs, number of bubbles)** *Improvements to method* • A more precise method for measuring photosynthetic rate (**e.g.** a (calibrated) **oxygen sensor** (rather than counting bubbles) **use of a photosynthometer / gas syringe / burette / measuring cylinder** (to measure volume of gas). • Control other variables in the experiment (**named control variables e.g. same, size/age, pondweed /** **same pH / change water surrounding**

Question			Answer	Marks	Guidance
					pondweed for each measurement / time to acclimatise / same wavelength of light) • Provide carbon dioxide source **(e.g. so carbon dioxide in excess / not limiting / add hydrogencarbonate)** • Smaller and more consistent intervals between light and temperature values should be used (**e.g. intervals of 50 light intensity units or 10°C**). • repeats should be used. **(e.g. to calculate mean or identify anomalies)**
	b		(light-independent stage is) controlled by (named) enzymes ✓ *idea that* higher temperature will increase, kinetic energy of enzyme molecules / number of successful collisions /ESCs formed / ora ✓ enzymes may be denatured at high temperatures / described ✓	**2 max**	**IGNORE** no enzymes in light dependent stage **ALLOW** fewer enzymes in light dependent stage **ALLOW** Rubisco as named enzyme
	c		shoot ✓ explant ✓ sterilise ✓ callus ✓	**4**	**ALLOW** root /stem **ALLOW** disinfect **DO NOT ALLOW** callose
4	**a**	**i**	*idea of* greater susceptibility to, infection / pathogens ✓	**2**	e.g. immune deficiency/ slower immune

Question			Answer	Marks	Guidance
			no / fewer, plasma cells / effector cells / antibodies ✓		response/weakened immune system / longer time to recover from infection **IGNORE** ref to illness / disease / immunological memory **ALLOW '**fewer lymphocytes to produce antibodies'
		ii	(allele is) recessive (because) ✓ healthy parents produce children with the disease ✓ 2 / 5 / 2 and 5 / mothers , heterozygous / carrier ✓ (likely to be) sex-linked / described ✓ (because) on the X chromosome / X linked ✓ only males have the disease/no females have the disease/AW ✓	**4 max**	**ALLOW** '3 has the disease, but 1and 2 / parents, do not ' **ALLOW** '7, or / and, 8, has the disease, but, 5 and 6 /parents, do not' **ALLOW** 'allele found on the sex chromosomes'
	b	**i**	*syndrome* 1 or 2 **and** *carriers* 3 ✓	**1**	**DO NOT ALLOW** 1.5 **IGNORE** 25% probability of a child having the syndrome and 50% probability of being a carrier.
		ii	0.25 / 25% / ¼ / 1 in 4 ✓	**1**	**IGNORE** 25 without % **IGNORE** 1:3 • Probability of each genotype in couple Z's offspring: VV = 0.25, Vv = 0.5, vv = 0.25. • Probability that mother is VV and child is vv = 0 x 0.25 = 0 • Probability that mother is Vv and child is vv =

Question			Answer	Marks	Guidance
					0.25 x 0.5 = 0.125 • Probability that mother is vv and child is vv = 0.5 x 0.25 = 0.125 • 0.125 + 0.125 = **0.25**
	c	**i**	(protease) digests / breaks down / hydrolyses, proteins associated with DNA / histones ✓	**1**	**IGNORE** digests / breaks down, enzymes / nucleases / contaminating proteins
		ii	$10^{3.61}$ ✓ ✓	**2**	**ALLOW** 4096 /3.61/ 3.612 for 1 mark **ALLOW** $10^{3.612}$ for 2 marks
		iii	temperature damage to, template / strand / fragment ✓ (sometimes, once separated) template / strands, may rejoin (rather than bonding to primers) ✓ lack of, primers / (free) nucleotides ✓ primers fail to, join / attach / anneal (to fragment) ✓	**1 max**	**IGNORE** 'temperature damage to DNA' **IGNORE** 'damage to fragment' **ALLOW** 'strands fail to separate' **IGNORE** lack of, enzymes / bases
		iv	(Taq DNA) polymerase ✓	**1**	**DO NOT ALLOW** RNA polymerase
		v	use, alkaline solution /buffer (solution) **AND** Solution carries charge / current (to separate fragments)✓ (use) Southern blotting / described **AND** to transfer fragments to a membrane ✓ use (radioactive / fluorescent) probes / tags / dyes / labels /stains **AND** to , visualise / AW , bands/ patterns ✓	**2 max**	**Mark first two changes described** **ALLOW** to see the position of the fragments

Question			Answer	Marks	Guidance
			idea of testing for longer than one minute **or** carrying out preliminary tests to assess the optimum run time **AND** *idea of* (ensures) separation (of DNA fragments / bands) ✓		
5	**a**	**i**	*Pinus resinosa* ✓	**1**	
		ii	*In the same domain because* (plants / pines, and, animals / humans) are both eukaryotes **or** description of similarity between plant and animal (eukaryotic) cells✓ *In different kingdoms because* description of difference between plants and animals ✓	**2**	**ALLOW** 'they are both eukaryotic' **ALLOW** 'all eukaryotes are classified in the same domain' e.g. 'both the pine and humans have cells with membrane-bound organelles' e.g. 'pines carry out photosynthesis but humans do not' 'plant cells have permanent vacuole but animal cells do not' 'difference is animal cells do not have cell wall'
	b		(Habitat B =) 0.61 ✓ Habitat with the greatest biodiversity = A ✓	**2**	**DO NOT ALLOW mp 2 if value of D not calculated** **ALLOW ECF** if B has been identified as the habitat with greatest biodiversity, (if value of D calculated for habitat B greater than 0.71)
	c	**i**	climax <u>community</u> ✓	**1**	
		ii	belt / line, transect / described **or** stratified sampling / described ✓ random selection of transect sites	**3**	e.g. ' lay tape from edge of lake and sample along it'

Question			Answer	Marks	Guidance
			or systematic sampling / place quadrats at, set / pre-determined, intervals along the transect **or** random sampling using quadrats in, selected areas / strata ✓ pooter / sweep nets / pitfall traps / light traps / tree-beating ✓		(N.B. only allow random sampling in context of stratified sampling) **ALLOW** any suitable method of trapping insects **IGNORE** capture mark recapture
		iii	Woodland = (k)g m^{-2} yr^{-1} / (k)J m^{-2} yr^{-1} **AND** Lake = (k)g m^{-3} yr^{-1} / (k)J m^{-3} yr^{-1} ✓	**1**	**ALLOW** (k)g h^{-1} yr^{-1} / (k)J h^{-1} yr^{-1} / tonnes h^{-1} yr^{-1} / (k)g (k)m^{-2} yr^{-1} / (k)J (k)m^{-2} yr^{-1} **ALLOW** (k)g (d)m^{-3} yr^{-1} / (k)J (d)m^{-3} yr^{-1} / (k)g (k)m^{-3} yr^{-1} / (k)J km^{-3} yr^{-1} **ALLOW** hectare $^{-1}$ for h^{-1} **ALLOW** y for yr **DO NOT ALLOW** 'per' **ALLOW** '/' instead of $^{-1}$
6	**a**		**Level 3 (5-6 marks)** Correctly describes similarities **and** differences between the processes *There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate*	**6**	**Indicative scientific points may include** *Similarities:* • Small molecules are filtered from/diffuse out of the blood.

Question			Answer	Marks	Guidance
			level. All the information presented is relevant and forms a continuous narrative. **Level 2 (3-4 marks)** Correctly describes a similarity **and** a difference between the processes *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)** Correctly describes similarities **or** differences between the processes *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.		• Both processes occur in capillaries. • Large molecules/proteins/ cells, remain in the blood. • High (hydrostatic) pressure in both processes. • Many molecules (e.g. water, sugars, ions) are reabsorbed back into capillaries. • Blood vessels become narrower to maintain (hydrostatic) pressure • Hydrostatic pressure greater than oncotic pressure in both • Neutrophils / lymphocytes, can pass through in both • Both involve basement membranes *Differences:* • Filtrate enters the Bowman's capsule and then the PCT in the kidney, but tissue fluid bathes cells/enters intercellular space. • Molecules that are not reabsorbed by capillaries form urine in the kidney, but molecules that are not reabsorbed from

Question			Answer	Marks	Guidance
					tissue fluid will, enter cells / form lymph. • Blood filtered through 3(named) layers in ultrafiltration, but only 1 (named) layer in formation of tissue fluid • knot of capillaries in ultrafiltration but a network of capillaries in formation of tissue fluid
6	b	i	age ✓ (because) GFR / kidney function , declines with age ✓ gender ✓ (because) men and women have different muscle mass ✓ exercise / muscle activity / muscle mass / fitness / pregnancy / body mass✓ (because this will) alter, metabolism of creatine (phosphate) / production of creatinine ✓ diet ✓ (because this will) affect levels of, creatine (phosphate) / creatinine (in the blood) ✓ ethnicity / genetic make up ✓ different alleles, affect metabolism of creatine (phosphate)	4 max	**Mark first two characteristics given** **Only award mark for explanation if correctly linked to characteristic** **IGNORE** chances of kidney failure increase with age **ALLOW** 'more / less, creatinine / product (in blood)' **ALLOW** 'more / less, creatine (in muscle) **ALLOW** use of creatine supplements

Question			Answer	Marks	Guidance
			/ production of creatinine ✓		
		ii	*idea that* large proteins, should remain in the blood / not enter, Bowman's capsule / nephron ✓	1	e.g. 'proteins / albumin, too large to cross the basement membrane' ' proteins are too large to be filtered and be present in the urine'
			Total	**70**	

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

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Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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