GCE

Biology B

H422/01: Fundamentals of 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	Marks	AO element	Guidance
1	D	**1**	AO1.2	
2	A	**1**	AO1.1	
3	C	**1**	AO2.3	
4	C	**1**	AO1.1	
5	D	**1**	AO2.1	
6	A	**1**	AO1.2	
7	C	**1**	AO2.2	
8	C	**1**	AO1.1	
9	D	**1**	AO1.1	
10	B	**1**	AO1.1	
11	B	**1**	AO2.8	
12	D	**1**	AO1.1	
13	B	**1**	AO1.2	
14	D	**1**	AO2.7	
15	A	**1**	AO1.1	
16	C	**1**	AO2.1	
17	C	**1**	AO1.1	
18	B	**1**	AO2.2	
19	C	**1**	AO2.6	
20	D	**1**	AO2.5	
21	C	**1**	AO2.6	((150x60)x20))/9000
22	A	**1**	AO1.1	
23	B	**1**	AO1.2	
24	A	**1**	AO1.1	
25	D	**1**	AO1.2	
26	A	**1**	AO1.2	

27	D	**1**	AO1.1	
28	B	**1**	AO2.8	
29	C	**1**	AO1.1	
30	C	**1**	AO2.7	
	Total	**30**		

Question			Answer	Mark	AO element	Guidance
31	(a)		*head* (contains) haploid nucleus **AND** to ensure diploid number of chromosomes is maintained on fertilisation ✓ (has) acrosome **AND** contains hydrolytic enzymes to digest zona pellucida ✓ ***max 1*** *midpiece* (contains) mitochondria **AND** (provide) energy for movement / tail (of spermatozoa) ✓ *tail* (contains) contractile fibres / microtubules / flagellum **AND** creates whip-like movements / enable swimming action ✓	**3 max**	AO1.1	Structure **AND** function required for 1 mark in each section **ALLOW** for fertilisation of haploid secondary oocyte / to donate DNA (to zygote formed) at fertilisation **DO NOT ALLOW** to create / make energy
31	(b)	(i)	DNA has phosphate (groups) in the backbone ✓ phosphate (group) is charged ✓ *idea that* forces of attraction occurs between opposite charges on phosphate and arginine ✓	**2 max**	AO2.1	**ALLOW** has sugar-phosphate backbone
31	(b)	(ii)	enables sperm nucleus to be small ✓ greater protection of DNA molecules ✓	**1 max**	AO2.1	**ALLOW** enables the head of the sperm to be small
31	(c)	(i)	similar age men used in all study groups ✓ no significant difference in (mean) age of men in study ✓	**2**	AO3.2	
31	(c)	(ii)	control (group)	**1**	AO3.3	

Question			Answer		Mark	AO element	Guidance
31	(c)	(iii)	1	group 1 / men with normal sperm count and motility had lowest percentage of sperm with protamine deficiency ✓	4 max	AO3.1	
			2	group 4 / men with low sperm count and motility had highest percentage of sperm with protamine deficiency ✓			
			3	(group 3 and 4 shows) protamine deficiency affects sperm motility more than sperm count / AW ✓			
			4	percentage of sperm with protamine deficiency is higher in men with , low fertility / infertility ✓			
			5	difference between , groups 1 and 2 / groups 2 and 3 / groups 3 and 4 , is not statistically significant ✓			
			6	difference between , groups 1 and 3 / groups 2 and 4 / groups 1 and 4 is statistically significant ✓			
			7	AVP ✓			e.g. overlap of error bars group 2 and 3 e.g. no overlap of error bars

Question			Answer	Mark	AO element	Guidance
31	(d)*		***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):* ○ *award the higher mark where the Communication Statement has been met.* ○ *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) There are statements showing similarities **and** differences between spermatogenesis and oogenesis. Role of hormones included in similarities and differences. *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)** There are statements showing similarities **and** differences between spermatogenesis and oogenesis. Role of hormones is unclear or not linked to similarities / differences. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** There are statements showing **either** similarities **or** differences between spermatogenesis and oogenesis. Role of hormones is unclear or not linked to similarities / differences. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	**6**	AO2.5	**Indicative scientific points may include** *Similarities* • meiotic division • mitotic divisions • primordial germ cells • haploid gametes produced • multiplication phase • growth phase • maturation phase • initiated by gonadotrophin releasing hormone / GnRH • both affected by luteinising hormone / LH and follicle stimulating hormone / FSH *Differences* **spermatogenesis** • second meiotic division is completed immediately after the first • spermatozoa are smaller than ova • primary spermatocytes form secondary spermatocytes of even size • no polar bodies formed • FSH causes cells in testes to be more receptive to testosterone

			0 marks *No response or no response worthy of credit.*			• LH causes cells in testes to release testosterone • continuous process **oogenesis** • second meiotic division only occurs after fertilisation • primary oocyte has uneven division • primary oocyte forms secondary oocyte and polar body • one large ovum and smaller polar bodies formed • FSH / LH cause maturation of follicles in ovary • FSH / LH cause release of oestrogen • surge of LH causes release of secondary oocyte • staggered process

Question			Answer	Mark	AO element	Guidance
32	(a)		differential (staining technique) ✓ different tissues / cell structures , stained different colours ✓ allows identification of cell nuclei ✓	2 max	AO2.7	**ALLOW** gives an indication of tissue location within an organ
32	(b)	(i)	contains collagen fibres ✓ protection / maintains shape , of the eye ✓ enables muscle / ligament attachment ✓	2 max	AO1.1 AO2.1	
32	(b)	(ii)	choroid ✓ prevents internal reflection ✓	2	AO1.1	
32	(c)	(i)	640 μm ✓✓	2	AO2.8	**ALLOW for 1 mark** 64 (mm) ÷ 100 **OR** 0.64 (mm)
32	(c)	(ii)	(+/-) 1.25 ✓✓	2	AO3.2	**ALLOW for 1 mark** (66-61) ÷ 2√4
32	(d)	(i)	cilia connect inner and outer segments of (cone) cell ✓ (mutated BBS genes cause) production of non-functional proteins in , cilia / microtubules ✓ less / no , transport of proteins between segments ✓	2 max	AO2.1	
32	(d)	(ii)	different (cone) cells have different type of iodopsin ✓ (so iodopsin) absorbs either red or green or blue light ✓ (so) cone cells differ in sensitivity to different wavelengths of light ✓ trichromatic vision ✓	3 max	AO1.1	**ALLOW** description
32	(d)	(iii)	widespread effects in the body ✓ affects , several organs / systems, in the body ✓	1 max	AO2.5	
32	(d)	(iv)	apoptosis ✓	1	AO1.1	**ALLOW** description

Question			Answer	Mark	AO element	Guidance
33	(a)		Any **two** from: sit person down in upright position with knees bent ✓ help them take their medicine for , heart problem / angina ✓ give an aspirin tablet / get them to chew aspirin tablet ✓ monitor breathing and pulse rates ✓	**2 max**	AO1.1	**ALLOW** sit in 'W' position
33	(b)	(i)	*idea that* in note 1 Daphnia would already have been in water so already acclimatised ✓ *idea that* in note 5 time is required for alcohol to be taken in by Daphnia ✓	**1 max**	AO3.4	
33	(b)	(ii)	Daphnia died so invalid results ✓ AVP ✓	**1 max**	AO3.4	e.g. ethical reason
33	(c)	(i)	(t =) 108.1 ✓✓✓	**3**	AO3.1	**ALLOW** 107.96 to 109.32 **ALLOW** 1 mark for $Sd = \sqrt{11.85} = 3.44$ **ALLOW** 1 mark for $t = (107.3 \sqrt{12}) \div$ (ANS)
33	(c)	(ii)	students are correct that alcohol lowers heart rate but incorrect because it is significantly lower ✓ (because) critical value for 11 degrees of freedom / 2.20 , is much lower than value for t ✓	**2**	AO3.2	**ALLOW** ECF **ALLOW** ORA e.g. t is much higher than 2.20

Question			Answer	Mark	AO element	Guidance
34	(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):* ○ *award the higher mark where the Communication Statement has been met.* ○ *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) Evaluation with **both** positive and negative impact statements using examples. *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)** Evaluation with either positive **or** negative impact statements using examples. *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)** Little evaluation with basic descriptive statement that may not include reference. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	**6**	AO3.2	**Indicative scientific points may include** **Must be about impact on biodiversity / ecosystem** *Positive impacts:* • bioreserve area will maintain biodiversity and habitats • protected areas and fish sanctuary could limit decline in fish stocks • city could provide ecotourism to encourage maintaining biodiversity • traditional ways of living in floating villages more sustainable • human waste from floating villages could provide nutrients for fish increase in certain species (could also be negative impact) *Negative impacts:* • clearance of flooded forests could lead to loss of tree-dwelling species • clearance of flooded forests could lead to change extent of flood plain area leading to change in biodiversity

			0 marks *No response or no response worthy of credit.*			• possible conflicts between fishermen and rice growers / over-fishing or over - planting could cause decline or loss of certain species • agricultural expansion leading to loss of habitats • illegal fishing causes decline of some species

Question			Answer	Mark	AO element	Guidance
34	(b)	(i)	least species in rice growing areas due to , disturbance / clearance of habitats , for , planting / harvesting ✓ most species in shrubland and forest due to more different types of habitat available ✓ abandoned rice fields more than existing rice fields due to repopulation of areas ✓	2 max	AO2.1	**ALLOW** *idea of* lack of different habitats / monoculture **ALLOW** *idea that* secondary succession is occurring
34	(b)	(ii)	Simpson's Diversity Index ✓ number of individuals in <u>each</u> species ✓	2	AO1.1	**ALLOW** species abundance
34	(c)	(i)	chance event occurs ✓ (causing) significant reduction in , population / number of individuals , in Tonle Sap Lake area ✓ surviving crocodile population have fewer alleles than original population ✓ decrease in genetic diversity ✓	3 max	AO2.1	
34	(c)	(ii)	habitat destruction ✓ over-hunting / over-poaching ✓ disease ✓ toxic chemicals in the lake ✓ loss of prey species ✓ named natural disaster ✓	1 max		**ALLOW** description Must be relevant to the lake e.g. drought **IGNORE** flooding
34	(d)	(i)	(*farm 1*) 20% ✓ (*farm 2*) 35% ✓	2	AO2.6	(28/35) x 100 = 80% monomorphic (26/40) x 100 = 65% monomorphic
34	(d)	(ii)	Farm 2 would be most suitable ✓ Farm 2 has greater genetic diversity ✓ Farm 1 has more individuals in the population so more options for breeding pairs ✓	2 max	AO2.5	**ALLOW** ECF from Q34di

Question			Answer	Mark	AO element	Guidance
35	(a)	(i)	carries , genetic information / code , from nucleus to ribosomes ✓	1	AO1.1	**ALLOW** a correct description of mRNA in a mitochondria or prokaryotic cell
35	(a)	(ii)	carries specific amino acid / forms complex with amino acid **AND** anticodon binds to codon on mRNA ✓	1	AO1.1	**ALLOW** descriptions of anticodon and codon
35	(b)	(ii)	genes ✓ three ✓ degenerate ✓ overlap ✓	4	AO1.1	
35	(c)		genetic modification ✓ *avidin* gene is identified and isolated from bird genome ✓ gene inserted into vector ✓ vector incorporated into plant cell ✓ gene inserted into genome / DNA , of wheat plant ✓ AVP ✓	3 max	AO1.2 AO2.1	**ALLOW** named vector e.g. plasmid e.g. gene 'gun' used to introduce gene e.g. tissue culturing
35	(d)	(i)	binds to biotin preventing absorption ✓ inhibits channels / carriers / enzymes in the membrane ✓ breaks down biotin before it can be used ✓	1 max	AO2.1	
35	(d)	(ii)	cofactor / biotin , required for enzyme activity ✓ lack of biotin stops specific (metabolic) reaction ✓ example of reaction e.g. could prevent weevils synthesising proteins ✓ weevils can't synthesise biotin ✓	2 max	AO2.1	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>36</td><td>(a)</td><td></td><td>
<table>
<tr><th>Statement</th><th>True (T) or False (F)</th></tr>
<tr><td>ATP is used to pump Na^+ into and K^+ out of the axon</td><td>F</td></tr>
<tr><td>The inside of the axon membrane has a positive charge relative to the outside.</td><td>F</td></tr>
<tr><td>The axon membrane is more permeable to K^+ than Na^+</td><td>T</td></tr>
</table>
✓✓
</td><td>2</td><td>AO1.1</td><td>All three rows correct 2 marks

Two rows correct 1 mark

One or no rows correct 0 marks</td></tr>
<tr><td>36</td><td>(b)</td><td></td><td>positive feedback ✓
Na^+ enter due to opening of voltage-gated Na^+ channels ✓
(causes) generator potential ✓
entry of Na^+ causes more channels to open
which leads to more Na^+ entering ✓</td><td>3 max</td><td>AO1.1</td><td></td></tr>
</table>

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