GCE A LEVEL MARKING SCHEME

SUMMER 2023

A LEVEL
BIOLOGY – UNIT 4
1400U40-1

INTRODUCTION

This marking scheme was used by WJEC for the 2023 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

WJEC GCE A LEVEL BIOLOGY

UNIT 4 – VARIATION, INHERITANCE AND OPTIONS

SUMMER 2023 MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement. Award the middle mark in the level if most of the content statements are given and the communication statement is partially met. Award the lower mark if only the content statements are matched.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		• Corpus luteum (1) • Progesterone secretion (1) Ignore oestrogen Reject FSH/ LH	2			2		2
		(ii)		provides materials for hormone {synthesis/secretion/ production} /so the hormones can be transported (1)		1		1		
	(b)	(i)		**Award 2 marks for** 0.0368 to 0.0380 Accept correct rounding 3.68×10^{-2} to 3.80×10^{-2} If incorrect award 1 mark for 150/4 x1/1000 Allow 147 to 150		2		2	2	
		(ii)		426 to 435 times larger Ecf from I 16/ answer from (i)		1		1	1	

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td></td><td>1 mark per row

<table><tr><th>Letter</th><th>Name of structure</th><th>Function during fertilisation</th></tr><tr><td>X</td><td>Acrosome</td><td>Secretes an enzyme to digest the {zona pellucida/jelly coat/outer layer of (2°) oocyte}
not corona radiata alone</td></tr><tr><td>Y</td><td>Nucleus/ head</td><td>carries {genetic material/ chromosomes/DNA}/
fuses with {female nucleus/ (2°) oocyte} to form {2n/zygote}</td></tr><tr><td>Z</td><td>Mito-chondrion/ia</td><td>provides ATP for {motility/movement}
Ignore energy</td></tr><tr><td>OR Z</td><td>Middle piece/ part</td><td>Contains mitochondria which provides ATP for {motility/movement}</td></tr></table>
If no marks awarded for correct rows award 1 mark for three correct structures.</td><td></td><td>3</td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>• 69 (1)
• Triploid/ Triploidy (1) Reject polyspermy/ polyploidy/ trisomy</td><td></td><td>1</td><td>1</td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>• Endosperm (1)
• as {food /starch/protein/lipid} (source) (1) ignore nutrients</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			**Any two (×1) from:** • has a large surface area + {diffusion/absorption/ gas exchange/ eq} (1) • {Good blood supply/many arteries/ many veins} **and** {to carry nutrients/waste} (1) • Umbilical cord + carries blood {to/ from} the {placenta/ embryo/ foetus/ baby}(1) • Acts as a barrier + to {mixing blood/different blood pressures/pathogen filter/ mother's immune system} **or** secretes hormones + to maintain pregnancy (1)	2			2		
				Question 1 total	**6**	**8**	**1**	**15**	**3**	**2**

<table>
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<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td></td><td>• Tile or cutting mat
• razor blade/scalpel
• needle/ seeker/ pins
• forceps/tweezers
• scissors
• hand lens/ microscope
Rej Lab coat/gloves/tongs/light/ruler eq/microscope slide/paper towels

3 for 1 mark</td><td>1</td><td></td><td></td><td>1</td><td></td><td>1</td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>
<table>
<tr><td>A</td><td>Petals/ corolla</td><td>Attract {insects/ pollinators} (1)</td></tr>
<tr><td>B</td><td>Anther/
stamen</td><td>{Produces/contains} {pollen/ male gamete} (1)</td></tr>
<tr><td>C</td><td>Calyx/ sepal</td><td>Protects {flower when in bud/ flower bud/ eq} (1)</td></tr>
<tr><td>D</td><td>Ovary</td><td>{Site of development of/ produces} {egg (cell)/ female gamete/ embryo}/
contains ovules/
site of fertilisation (1)</td></tr>
</table>

If no marks awarded for correct rows award 1 mark for any three correct structures.</td><td>4</td><td></td><td></td><td>4</td><td></td><td></td></tr>
</table>

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td></td><td>(c)</td><td></td><td></td><td>E – Wind pollinated flower
F – Insect pollinated flower
1 mark for both

Any three (x1) from

<table><tr><th><u>Wind pollinated</u></th><th><u>Insect pollinated</u></th></tr><tr><td>{smooth/no sculptured/ eq}</td><td>{rough/sculptured/ eq} to attach to insect
Reject sticky</td></tr><tr><td>is {small/ light} easily blown in the <u>wind</u></td><td>Large/ heavy</td></tr></table></td><td></td><td>3</td><td>1</td><td>4</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 2 total</td><td>5</td><td>3</td><td>1</td><td>9</td><td>0</td><td>1</td></tr>
</table>

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>3</td><td>(a)</td><td>(i)</td><td></td><td>Red variegated Red/white variegated
RRGA RWGA (1)
RG, RA RG, RA, WG, WA (1)</td><td></td><td>1
1</td><td></td><td>2</td><td></td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>
<table>
<tr><td>RRGG</td><td>RWGG</td><td>RRGA</td><td>RWGA</td><td>RRAA</td><td>RWAA</td></tr>
<tr><td>Red green</td><td>Red/white green</td><td>Red variegated</td><td>Red/white variegated</td><td>Red white</td><td>Red/white White</td></tr>
<tr><td>1
1/8
/12.5%</td><td>1
1/8
/12.5%</td><td>2
¼ /
25%</td><td>2
¼ /
25%</td><td>1
1/8
/12.5%</td><td>1
1/8
/12.5%</td></tr>
</table>
1 mark for correct genotypes
1 mark for corresponding phenotypes even if the genotypes are incorrect as long as they correspond
1 mark for ratios</td><td></td><td></td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>A. Seed can still germinate because of food stores/eq (1)

Any four (×1) from:
B. AA leads to white leaves/white leaved {plants/ phenotypes} do not grow (1)
C. so no {chlorophyll/chloroplasts} (1)
D. (so) no {photosynthesis/synthesis of carbohydrate} (1)
E Plant dies when food stores (in seed) run out/eq (1)
F. ¼ of the plants die/ white leaved plants not included in ratio/ 2: 2:1:1 ratio (, not 2:2:1:1:1:1 ratio) (1)</td><td></td><td></td><td>1

4</td><td>

5</td><td></td><td></td></tr>
</table>

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			• asexual reproduction (1) • Genetically identical/ same genetic make-up/clone/same DNA (1) • Produced by mitotic cell division/ no {meiosis/gametes/ crossing over} (1)		3		3		
				Question 3 total	**0**	**5**	**8**	**13**	**3**	**5**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		• More limpets on sheltered rocky shore/ fewer limpets on exposed shore (1) • Limpets on exposed (rocky) shores are longer / Limpets on sheltered (rocky) shores are shorter (1)			2	2		
		(ii)		Sheltered 54 Exposed 60		1		1	1	
	(b)	(i)		There is no <u>significant</u> difference in <u>mean</u> shell length between the {two populations (of *Patella vulgata)*/ two sets of data/ groups/ each site/ sheltered and exposed (rocky) shores/ two types of (rocky) shore} (1)		1		1		
		(ii)		38		1		1	1	1
		(iii)		**Any three (×1) from:** • 2.024 is the critical value (1) ecf from (ii) • Figure is {higher than critical value/ to the right of 0.05/5%} (1) • Reject null hypothesis (1) • (Over 95% confident that) there is a significant difference between the <u>means</u> / any difference is not due to chance (1)			3	3	2	3
	(c)			**Density independent** • Wave (action) **Density dependent** • (Supply of) food • (Presence /absence of) predators *<u>Ignore space</u>*		3		3		
				Question 4 total	**0**	**6**	**5**	**11**	**4**	**4**

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)	I	{is complimentary to/attaches to} the <u>start</u> of the sequence/ allows binding of {taq/DNA} polymerase	1			1		
			II	breaks hydrogen bonds between strands/ separating the two strands/ DNA becomes single stranded	1			1		
			III	to allow the primers to { bind / anneal} (to the DNA strands)	1			1		
		(ii)		thermally stable/can withstand {high temperatures/70^{o}C+}/ resistant to heat/eq	1			1		
	(b)			**Any two (×1) from:** • Populations are geographically isolated/ or description of (1) • Different environments select different alleles/ genetic drift / no gene flow (1) • (In each area) they can interbreed and so {remain genetically close/ gene pools remain similar}/ ORA (1)		2		2		
	(c)			Elephants with tusks would be (more likely to be) {poached/killed}/ greater <u>selection pressure</u> on tusked elephants/ ORA (1) {Poaching/killing} is selecting {for tuskless elephants/against tusked}/ tuskless elephants have a <u>selective</u> advantage/ ORA (1) so {pass on their {alleles/ mutation} (for no tusks)/ increased frequency of tuskless alleles in gene pool / ORA (1)		1	2	3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			Increased population size (1) because tusk-less animals are not {poached/killed} (for ivory) (1) **<u>OR</u>** **<u>Award two marks for:</u>** • Decreased population size because {elephants cannot defend against predators/feed as well} without tusks		2		2		
	(e)			**Any two (×1) from:** • Identify {where it has come from /population source / group} (1) • Ref to Anti-poaching action targeting populations at risk (1) • Identify recent illegal ivory (1)		2		2		
				Question 5 total	**4**	**7**	**2**	**13**	**0**	**0**

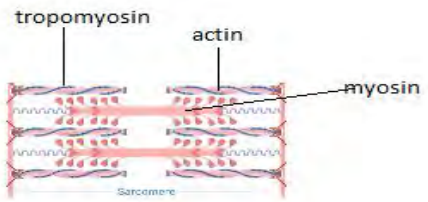
Question 6				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6				**Gene therapy techniques** A1 Insertion of a functional {gene/ DNA/ allele} (into cells)/ Replacement of a faulty {gene/ DNA/ allele} A2 Germ line {where (functional) gene added to embryo/ inherited} A3 **Somatic gene therapy** where functional gene is placed in body cells/ not inherited A4 Not permanent/needs re-treatment A5 Example of e.g.CF and CFTR gene inhaled into lungs/ Use of Restriction endonuclease/ligases/CRISPR/Cas9/stem cells/ Use of vectors/viruses/plasmids/liposomes **HGP link** B1 Aims of HGP: {sequence/ identify (position of)} {genes/ DNA} in the human genome/ improve understanding of genetic disorders/ improve the diagnosis and treatment of genetic disorders B2 {Prior to 2003/ before HGP sequenced} {very few/ fewer than 1,000} GT drug trials (per year). B3 {After 2003/ HGP sequenced} increase in GT trials B4 Reasons: (before 2003) Not all of human genome was sequenced/ (position of) {(faulty) genes/ mutations/ change in bases} was unknown/ ORA (for after 2003) B5 Up to 12,000 in 2017. **Use in gene therapy** C1 DMD is caused by a {mutation in the/ faulty} (dystrophin) gene **and** {failure to produce dystrophin/ protein too short/causes muscle wastage/weakness/ produces non-functional protein} C2 (Exon skipping introduces) a molecular patch over the exon with the {mutation/ fault} *Accept labelled diagram*	6	3		9		

Question 6	Marking details	Marks available					
		AO1	AO2	AO3	Total	Maths	Prac
	C3 Complementary RNA binds to the {mutated/ fault} section of the (dystrophin) mRNA / which makes the gene readable/ transcription can take place C4 A {shorter/ different} form of {dystrophin/ protein} is produced C5 which is functional **7-9 marks** Indicative content of this level is detail from all three sections *The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.* **4-6 marks** Indicative content of this level is detail from two sections or less detail from all three sections *The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.* **1-3 marks** Indicative content of this level is any detail from one section *The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.*						

Question 6				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				0 marks *The candidate does not make any attempt or give a relevant answer worthy of credit.*						
				Question 6 total	**6**	**3**	**0**	**9**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		Kills bacteria	1			1		
		(ii)		• (Gram positive) {have (thick) peptidoglycan in cell wall / no additional lipopolysaccharides} (so more susceptible to antibiotic) (1) • Inhibits formation of cross linkages between {peptidoglycans/ amino acids} (1) • (peptidoglycan) cell wall is {broken down/ digested} /Cell wall is weakened (1) • {Osmosis/ water moves in} causing cell to {lyse/ burst} (1)	1	2	1	4		1
		(iii)		**Any three (×1) from:** • Reference to mutation (1) • (means some bacteria) become <u>resistant</u> (1) • (The resistant bacteria) have a selective advantage /are able to survive antibiotic (1) • Resistance passed on (when bacteria divide/ reproduce/to next generation) (1)		3		3		
		(iv)		Don't scratch bites/ wash area/ use of anti-bacterial cream/ AVP Reject antibiotics/ insect repellents			1	1		
	(b)	(i)		Endemic – (always) present at low levels, epidemic – significant increase (in usual number of cases) (1) Pandemic – affects a large number of people/occurs {over a wide area/ many countries/ global} (1)	1		1	2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		**Any two (x1) from:** Different species (of *Plasmodium)* (1) Different antigen(ic types) (1) Mutates regularly (1)	2			2		
	(c)	(i)		less vaccination			1	1		1
		(ii)		73500 = 2 marks If incorrect award 1 mark for 10.5/100 x 700000 Allow 1 mark for 63000 (figure for 2018 instead of 2020)		2		2	2	
		(iii)		**Any three (x1) from:** • Memory cells already present (1) • Due to prior exposure to antigen (1) • Memory cells detect antigen (1) • Shorter latent period (1) • Memory cells divide faster if same antigens are encountered (1)	1	2		3		
		(iv)		1994/ 1995/ 1996 Accept 2016			1	1		1
				Question 7 total	**6**	**9**	**5**	**20**	**2**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		Biceps contract **+** triceps relax.	1			1		
		(ii)		Effort – bicep, load – weight, fulcrum – elbow (1) Effort is in the middle/between the fulcrum and the load/effort is between the elbow and the weight (1)		2		2		
	(b)	(i)		**Any two (×1) from:** Muscle respires anaerobically (1) Build-up of lactic acid/lactate (1) Lack of ATP (1)		2		2		
		(ii)		-0.05 = 2 marks 2.1 – 6.83 / 90 = 1 mark Unit = mV/s or mVs^{-1} (1)		3		3	2	
		(iii)		**Any three (×1) from:** Females fatigue {slower/ at a lower rate} (1) Overlap in data / example of overlapping data from table (1) Small sample size/ only 3 males and females (1) Unknown controlled variables e.g. Different weights / fitness/ age (1)			3	3		3
	(c)	(i)		3 correct for 1 mark  	1			1		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		**Any four (×1) from:** • Less calcium stored in sarcoplasmic reticulum/ T tubules (1) • less calcium binds to troponin (1) • Fewer myosin binding sites exposed (1) • Less cross bridges with actin/ less myosin binds to actin (1) • Less overlap of myosin and actin (1) • Shortening the sarcomere (1) Max three if answer not comparative	3		1	4		
	(d)	(i)		Thoracic (1) Facets for articulation with ribs (1)	1	1		2		
		(ii)		Forwards/ ventrally			1	1		
		(iii)		Surgery/brace/physiotherapy		1		1		
				Question 8 total	**6**	**9**	**5**	**20**	**2**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		Higher ranking individuals are dominant / animals are submissive to animals in higher ranks	1			1		
		(ii)		**Any two (×1) from:** Decreases {aggression/ fighting} associated with {feeding/mating} (1) Ensures fittest {survive/ breed} / ensures resources are shared out (1) Pass on {genes/alleles} (1)		2		2		
		(iii)		Decreases risk of injury/ owtte		1		1		
		(iv)		**Any four (×1) from:** • Controls autonomic nervous system (1) • Sympathetic (branch) (1) • Noradrenaline released (1) • Increases heart rate (and ventilation) rate (1) • Increased oxygen to muscles (1) • Required for increased {activity/ respiration} (in display) (1)	2	2		4		
	(b)	(i)		30.77% = 2 marks 0.85-0.65 x 100 = 1 mark 0.65		2		2	2	2
		(ii)		Become higher ranked so more likely to mate (1)			1	1		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		Instinctive behaviour/ inborn behaviour/not learned behaviour Reject inherited behaviour	1			1		
		(ii)		• {Elaborate / or description of} {tail/ feathers} (1) • Peahen selects male with most elaborate tail/ Elaborate tail increases chance of {attracting female/ mating} (1) • Disadvantage as male more likely predated (1)		1	2	3		
	(d)	(i)		It is involved in {learning/ spatial memory/ spatial awareness} (1) permanent memory storage/ consolidating memories (1) short-term to long-term memory = 2 marks	2			2		
		(ii)		• Positive correlation/ as time increases <u>percentage</u> difference increases (1) • change in structure of brain / new {neurones/ neural pathways/ connections/ synapses} / synaptic pruning /redistribution of neurones from anterior to posterior (1) • (indicates) memory stored in posterior hippocampus (1)		1	2	3		1
				Question 9 total	**6**	**9**	**5**	**20**	**2**	**3**

UNIT 4: VARIATION, INHERITANCE AND OPTIONS

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	6	8	1	**15**	3	2
2	5	3	1	**9**	0	1
3	0	5	8	**13**	3	5
4	0	6	5	**11**	4	4
5	4	7	2	**13**	0	0
6	6	3	0	**9**	0	0
options	6	9	5	**20**	2	3
Total	**27**	**41**	**22**	**90**	**12**	**15**