



GCE A LEVEL MARKING SCHEME

SUMMER 2024

**A LEVEL
BIOLOGY – UNIT 4
1400U40-1**

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

WJEC GCE A LEVEL BIOLOGY
UNIT 4 – VARIATION, INHERITANCE AND OPTIONS
SUMMER 2024 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.

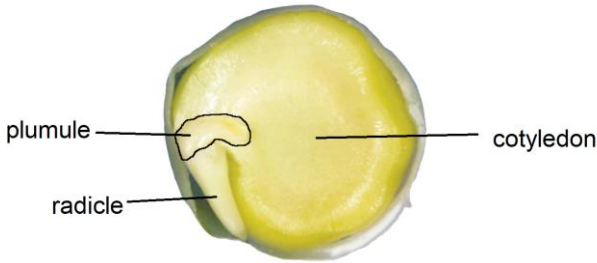
Marking abbreviations

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)			Structure	Number from image 1.1		5			5														
				vas deferens	5	{Transport / carry / travel / e.q.} {sperm / spermatozoa} Ignore semen																		
				scrotum	3	- Maintains a {cool / optimum / 34°C} environment (for spermatogenesis) / Allow temperatures between 34-36 °C - holds testes outside abdomen																		
				testes	4	To produce sperm / spermatogenesis / produce testosterone.																		
				epididymis	6	(Sperm) {undergo maturation / are concentrated}																		
				prostate gland	8	secrete a (slightly) alkaline fluid																		
				1 mark per row If no marks given for description allow 1 mark for 5 correct numbers																				
	(b)			(Carries) <u>urine</u> in <u>both</u> (1) Not secretes urine - Carries {semen / sperm} in males / for ejaculation (1) - Females urine only, males urine and {semen / sperm} (2)			2			2														
	(c)	(i)		<table><tr><th>Cells</th><th>Name</th></tr><tr><td>A</td><td>Primary spermatocytes</td></tr><tr><td>B</td><td>Secondary spermatocytes</td></tr><tr><td>C</td><td>Spermatids</td></tr><tr><td>D</td><td>Spermatozoa</td></tr></table>		Cells	Name	A	Primary spermatocytes	B	Secondary spermatocytes	C	Spermatids	D	Spermatozoa				2			2		
				Cells	Name																			
				A	Primary spermatocytes																			
				B	Secondary spermatocytes																			
				C	Spermatids																			
				D	Spermatozoa																			
4 correct = 2 marks 2/3 correct = 1 mark																								

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		if all cells divided by meiosis (1) then there would be no (Type II) cells to produce sperm/ owtte (1) OR some cells need to undergo mitosis (1) so that there are (Type II) cells to produce sperm/ owtte (1)		1	1	2		
				Question 1 total	9	1	1	11	0	0

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		 all 3 labels correct = 2 marks 2 labels correct = 1 mark		2		2		2
		(ii)		• {Anchors / roots / stabilises} in {soil / earth / ground} (1) • for {water / minerals / nutrients} (1)		2		2		
	(b)			Any three (x1) from A. water is {taken up / imbibed / owtte} through the micropyle (1) B. the testa {splits / owtte} (1) C. (which allows) oxygen (to enter / used in respiration) (1) D. {food reserves / starch / proteins} (from the cotyledons) are {hydrolysed / digested / broken down / owtte} (1)	3			3		
	(c)			Any three (x1) from ABA not produced so: A. gibberellin diffuses to the aleurone layer (1) B. gibberellins {induce / cause the production / cause the release} of {hydrolytic enzymes / amylase / named enzyme} (1) C. {glucose / other nutrients} are used in {(aerobic) respiration / growth} (1) D. {Roots / radicle / coleoptile / plumule} {have grown / are visible} (1)		3		3		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)	(i)		<i>The idea that any of the following may not be the same in each field</i> • <u>soil</u> pH • water supply / rainfall • sunlight / exposure to light / light intensity / shading • (soil) nutrients / minerals / named nutrients / fertility / owtte • Waterlogging / aeration of soil / oxygen content <u>of soil</u> / • Presence of weeds / pests / slugs / snails / rabbits / disease • Clay vs sandy soil / compact vs tilled / owtte Ignore humidity or type of soil (unless qualified) four correct = 2 marks 2/3 correct = 1 mark 0/1 correct = 0 marks		2		2		2
		(ii)		• Any reference to global warming / climate change / owtte (1) • Reduced {crop / yield / wheat} (1) ignore less wheat plants grown • Less for {food / feeding animals} / leads to famine / leads to food insecurity (1)			3	3		
				Question 2 total	3	9	3	15	0	4

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			The {sequence / order} of the (DNA) bases (is known)		1		1		
	(b)			Any three (x1) from A. Do not need to {locate / isolate / find} the gene / do not need to use gene probes (1) B. No need to {use restriction enzymes to cut up DNA / find functional mRNA} (1) C. (Restriction enzyme) may cut within the gene / extracting the gene may damage it (1) D. No {introns / non coding DNA} present / only {exons / coding DNA} present (1)		3		3		
	(c)			<u>Restriction</u> {endonuclease / enzyme} cuts the DNA (in the plasmid) at a specific {sequence of bases / point / owtte} (1) (DNA) ligase {anneals / joins / binds} the {plasmid / vector} and {gene / DNA / owtte} (1) Award 1 mark for 2 correct enzymes if no credit given for description	2			2		2
	(d)	(i)		Only bacteria which have a <u>plasmid</u> can {survive / grow} / shows that these bacteria have taken up a <u>plasmid</u> / OWTTE		1		1		
		(ii)		(The two colonies that) {did not grow / died / are missing} are the bacteria which are {not resistant / are susceptible} to <u>ampicillin</u> (1) - As they have taken up the {HGH gene / recombinant plasmid / recombinant DNA} (1) - So the <u>ampicillin</u> gene is {not expressed / split / interrupted / owtte} (by HGH gene) (1)		1	2	3		3
		(iii)		That they will produce HGH (when in culture) / that the HGH gene is {functional / can be expressed}			1	1		1
	(e)			2.9 X 10 ¹⁴ 2 marks If incorrect award 1 mark for sight of 10 ⁶ x 10 ⁸ 10 ¹⁴ 2900000000000000		2		2	2	
				Question 3 total	2	8	3	13	2	6

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Any three (x1) of A. Image 4.1 shows that bone structures follow a similar pattern (through millions of years) / or description of (1) B. (so) have arisen from {a common ancestor / Mesohippus} (1) C. Example of a change to {jaw / head / skeleton} (e.g. 3 toes to 1 hoof / toe) (1) D. by natural selection / selection pressure / selective advantage (1)			3	3		
	(b)	(i)		dd = 0.01 (1) DD = 0.81 (1) Dd = 0.18 (1) Award 1 mark for q and p if no other credit $q = 0.1$ $p = 0.9$		3		3	3	
		(ii)		Any two (1) from - There may be {selection / better survival rate} for the {dun phenotype / lighter coloured horses} / {Dun / lighter colour} better {camouflaged / blend in better} / ORA (1) Accept advantage of light colour in hot conditions - ref to mutations (1) - Ref to immigration and emigration / migration in and out (1)		1	1	2		
	(c)	(i)		Different species cannot (interbreed to) produce fertile offspring / Mules are {infertile / sterile} Do not award 'viable'	1			1		
		(ii)		(They have) {Longer legs / taller / larger / stronger / less weak} {so can carry heavy loads / owtte} / ORA (Link between size and load bearing ability)			1	1		
				Question 4 total	1	4	5	10	3	0

Question				Marking details	Marks Available															
					AO1	AO2	AO3	Total	Maths	Prac										
5	(a)	(i)	I	$X^D Y$ $X^D X^d$ $X^D Y$ $X^D X^d$ All four correct = 2 marks 2/3 correct = 1 mark 0/1 correct = 0 marks		2		2												
			II	<table><tr><td>Offspring genotypes</td><td>Offspring phenotype</td></tr><tr><td>$X^D X^D$</td><td>Normal female</td></tr><tr><td>$X^D X^d$</td><td>Normal female</td></tr><tr><td>$X^D Y$</td><td>Normal male</td></tr><tr><td>$X^d Y$</td><td>X-SCID male</td></tr></table> All correct = 2 marks 2/3 correct = 1 mark 0/1 correct = 0 marks Accept 'unaffected'	Offspring genotypes	Offspring phenotype	$X^D X^D$	Normal female	$X^D X^d$	Normal female	$X^D Y$	Normal male	$X^d Y$	X-SCID male		2		2		
Offspring genotypes	Offspring phenotype																			
$X^D X^D$	Normal female																			
$X^D X^d$	Normal female																			
$X^D Y$	Normal male																			
$X^d Y$	X-SCID male																			
		(ii)		64 cases = 2 marks If incorrect award 1 mark for <u>3139000</u> 48933 60 / 60.0 / 64.1 / 64.15 (incorrect sf)		2		2	2											

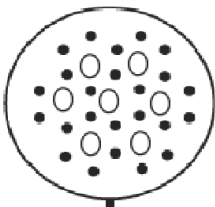
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		Any four (x1) from: A. folic acid (diet) produces more brown offspring / BPA (diet) produces more yellow offspring (1) B. Any correct reference to comparison of correct figures (1) C. there is methylation (of the promoter region of the gene) in brown mice / {no / less} methylation in yellow mice (1) D. Less mRNA in brown mice / mRNA only made during development in brown mice / more mRNA in yellow mice / mRNA produced through lifetime in yellow mice (1) E. methylation {silences / decreases expression of} the {agouti / yellow fur} gene / ORA (1) F. BPA de-methylates (the promoter region of) the gene / {without BPA / with folic acid} (the promoter region of) the gene is methylated (1)		1	3	4		2
		(ii)		(So) {avoid / reduce} (addition of) BPA to (food) {plastics / containers} (1) (Humans) exposed to (plastic) BPA can lead to (an increased incidence of) (diabetes / obesity} (1)			2	2		
				Question 5 total	0	7	5	12	2	2

Question	Marking details	Marks Available					
		AO1	AO2	AO3	Total	Maths	Prac
6	<u>Mutation</u> A1 Mutations are {spontaneous / random events / very low in frequency} A2 The change in structure of {gene / chromosome} or change in {sequence of bases / DNA} A3 Are the source of genetic variation A4 ionising radiations / e.g. gamma radiation / UV / X-rays A5 cigarette smoke / smoking / cigarettes / polycyclic hydrocarbons A6 carcinogens / mutagens / chemicals causing cancer / benzenes / asbestos <u>Gene mutation</u> B1 Ref to point mutation / Ref to {deletion / addition / substitution / inversion} of bases / reference to frame shifts / {nonsense / stop / missense} mutations B2 (Gene mutations) can affect protein synthesis / or description of B3 changing the sequence of amino acid / code for a different amino acid B4 Can change the phenotype of an organism B5 Some mutations have no effect on the phenotype / or description of degenerate code / mutation in introns / silent mutations B6 Example of gene mutation: Cystic fibrosis / sickle cell anaemia <u>Chromosome mutation</u> C1 Chromosomal mutations affect many genes / different sequence of genes (on chromosomes) C2 (Different types of chromosome mutations) e.g. {inversion / translocation / deletion} of part of a chromosome / non-disjunction (in meiosis) C3 Most chromosome mutations occur during crossing over (in prophase-I) C4 Could result in {trisomy / aneuploidy / change in chromosome number} C5 may be fatal C6 Example of chromosome mutation: Downs Syndrome	6	3		9		

Question	Marking details	Marks Available					
		AO1	AO2	AO3	Total	Maths	Prac
	7-9 marks Indicative content of this level is detailed explanation from all three areas of indicative content. <i>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.</i> 4-6 marks Indicative content of this level is detailed explanation from two areas of indicative content or less detail from three areas of indicative content. <i>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.</i> 1-3 marks Indicative content of this level is detail from one area of indicative content. <i>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.</i> 0 marks <i>The candidate does not make any attempt or give a relevant answer worthy of credit.</i>						
	Question 6 total	6	3	0	9	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		A {disease / it} that may be {passed / spread / transmitted / transferred} from {one individual to another / organism to organism / between individuals} Ignore any reference to mode of transmission	1			1		
		(ii)		Uses {weakened / killed / attenuated} pathogen / antigens / toxins} to stimulate {the immune response / production of antibodies / production of memory cells}	1			1		
		(iii)		(As transmitted through) {coughing and sneezing / droplet infection / airborne / aerosol} (1) overcrowded conditions / high population density areas / {high levels / increased risk} of contact (with infected people) (1)		1	1	2		
	(b)	(i)		A description of graph antibody levels constant / zero + then increase + then decrease (1) Explanation – any three (x1) from: B latent period / {macrophages / APC} carry out phagocytosis / antigen presentation takes place (1) C clonal selection / activation of B cells / T helpers release cytokines to stimulate B cells / B cells undergo clonal {expansion / proliferation} (1) D (increases as) plasma cells release antibodies (1) E (decreases as) antibodies are broken down (1)	2	2		4		

Question				Marking details	Marks Available														
					AO1	AO2	AO3	Total	Maths	Prac									
		(ii)		Any four (x1) from A. {Short / no} latent period (1) B. due to memory cells (1) C. <u>rapid</u> production of plasma cells / memory cells undergo clonal expansion faster (1) D. Antibody concentrations increase {faster / sooner / to higher concentrations} (than primary response) (1) E. Antibody concentrations stay higher for longer / remain in the bloodstream for longer (1)	2	2		4											
	(c)	(i)		90.9/ 90.91/91 = 2 marks Award 1 mark for sight of 132-12/132 x 100		2		2	2										
		(ii)		<table><tr><td></td><td>Advantage</td><td>Disadvantage</td></tr><tr><td>Drug A and antibiotics</td><td>TB eradicated / no dormant TB remaining / M. tuberculosis killed (1)</td><td>antibiotics needed / (re)activating {TB / M. tuberculosis} could cause TB (1)</td></tr><tr><td>Drug B alone</td><td>antibiotics not needed / {TB / M. tuberculosis} not reactivated / M. tuberculosis remains dormant (1)</td><td>take drug B for life / (dormant) M. tuberculosis {still present / not killed} (1) NOT: symptoms reappear if drug removed</td></tr></table>		Advantage	Disadvantage	Drug A and antibiotics	TB eradicated / no dormant TB remaining / M. tuberculosis killed (1)	antibiotics needed / (re)activating {TB / M. tuberculosis} could cause TB (1)	Drug B alone	antibiotics not needed / {TB / M. tuberculosis} not reactivated / M. tuberculosis remains dormant (1)	take drug B for life / (dormant) M. tuberculosis {still present / not killed} (1) NOT: symptoms reappear if drug removed			4	4		3
	Advantage	Disadvantage																	
Drug A and antibiotics	TB eradicated / no dormant TB remaining / M. tuberculosis killed (1)	antibiotics needed / (re)activating {TB / M. tuberculosis} could cause TB (1)																	
Drug B alone	antibiotics not needed / {TB / M. tuberculosis} not reactivated / M. tuberculosis remains dormant (1)	take drug B for life / (dormant) M. tuberculosis {still present / not killed} (1) NOT: symptoms reappear if drug removed																	
	(d)			Any two (x1) from: <u>Plasmodium</u> not affected by antibiotics (1) Drugs not effective whilst <u>plasmodium</u> in RBC (1) Resistance to {drugs / named treatments} (1) Reference to antigenic variation / high mutation rate (1)		2		2											
				Question 7 total	6	9	5	20	2	3									

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		 Dots showing myosin filaments in correct position and an organised array of actin around the myosin		1		1		
		(ii)		- The actin {moves / slides} over the myosin / actin pulled by myosin (1) - Causing the H band to {shorten / get narrower} (1) - The myosin filaments do not shorten/change length (during contraction) / A band {shows / is} length of myosin filaments (1) - So the A band remains the same length (1)	2	2		4		
		(iii)		57.14 / 57.1 / 57 = 2 marks Award 1 mark for sight of $(3.5-1.5) / 3.5 \times 100$		2		2	2	
		(iv)		Structure of actin: Any one (x1) of: {Actin / it} has myosin <u>binding sites</u> (1) Contraction: Calcium ions bind to troponin causing {troponin / tropomyosin} to {move / change shape} (1) Cross bridges are unable to form at rest: Any one (x1) of: Binding site is {covered / blocked} by tropomyosin when relaxed (1) No calcium ions bind to troponin (1) tropomyosin blocks myosin heads from forming cross bridges. (1)	2			2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		Structure – high proportion of collagen (1) Function Any one (x1) from smooth to reduce friction (1) {Elastic / compressible} as a shock absorber (1) Hard to keep trachea open (1) Flexible to allow movement of ribcage (1)	1	1		2		
		(ii)		Auto-immune disease / immune system recognises proteins in the joint as antigens / Immune system attacks {bones / cartilage in joints} (1) Any 2 for one mark of: Cartilage / hyaline, bone synovial membrane / tissue	1	1		2		
	(c)	(i)		Any two (x1) from: {Thinner layer / less} compact bone / ORA (1) Spongy bone has become {less dense / have larger holes} / less bone mass (1) Less hydroxy apatite (1)		2		2		
		(ii)		Any three (x1) from: Treatment decreases the fracture rate compared to {group B / control} (1) Treatment does not decrease the fracture rate to the level in {group A / healthy} (1) Treatment increases the bone strength compared to {group B / control} (1) {group C / experimental} bone strength is not as great as {group A / healthy} (1)			3	3		3
		(iii)		Increased number of osteoblasts to rebuild bones (1) Increases bone density / strength (1)			2	2		
				Question 8 total	6	9	5	20	2	3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		The behaviour of one individual (of a species) {influences / learns} the behaviour of others / Involve interactions between individuals (of the same species) and are used to form structured social groups / owtte	1			1		
		(ii)		{Innate / instinctive} behaviour / initiated by sign stimulus Accept behaviour that is not learned (1) Warns other dogs of {danger / predators} / owtte (1)	1	1		2		
		(iii)		Any two (x1) from: A FAP can be modified by learning / a reflex cannot be learnt (1) FAP can be activated by choice / a reflex action cannot be activated by choice (1) FAP is more complex / ORA (1)	2			2		
	(b)	(i)		(Habituation) is learning to ignore stimuli because they are not followed by reward or punishment/the animal {ceases to respond to/ ignores} a repeated stimulus (1) Saves energy (by not responding to a useless stimulus) (1)	1	1		2		
		(ii)		83.33 / 83.3 / 83 = 2 marks If incorrect award 1 mark for (55-30) / 30 X 100		2		2	2	
		(iii)		increase in the concealment distance (for both colonies) (1) no habituation has occurred (1) concealment distance is greater for the rural colonies (1)			3	3		3
	(c)	(i)		{Examines / shows} brain activity	1			1		
		(ii)		Left cerebral hemisphere / Wernicke's area / left temporal lobe / Broca (1) Neuroplasticity (1) (Undamaged) axons form new connections (1) (new neural pathways / synapses formed) in the right hand side of the brain. (1)		3	1	4		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(iii)		{Synaptic pruning / reduction in synapses} of an adult (1) Reduces neuroplasticity (1) Less able to {redevelop language skills / form new pathways} / reduction in the (new) language functioning area (in image 9.5 in comparison to the patient in image 9.4) (1)		2	1	3		
				Question 9 total	6	9	5	20	2	3

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	9	1	1	11	0	0
2	3	9	3	15	0	4
3	2	8	3	13	2	6
4	1	4	5	10	3	0
5	0	7	5	12	2	2
6	6	3	0	9	0	0
Option	6	9	5	20	2	3
TOTAL	27	41	22	90	9	15