

UNIT 3 – ENERGY, HOMEOSTASIS AND THE ENVIRONMENT**MARK SCHEME****GENERAL INSTRUCTIONS**Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark.

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 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)			Pores / gaps between endothelial cells(1) Pores in basement membrane(1) Filtration slits in feet of podocytes(1)	3			3		
	(b)			$(6.0-3.7) - (1.3-0.4) = 1.4\text{kPa}(1)$		1		1	1	
	(c)	(i)		$(140-92)/92 \times 100(1)$ 52% increase(1)		2		2	2	
		(ii)		Any 5 from Prevent/ reduce Na^+ /glucose being actively transported out of cell (1) As no ATP available(1) Concentration of Na^+ / glucose increases in the epithelial cell(1) Concentration gradient of Na^+ / glucose decreases(1) Facilitated diffusion / co-transport of Na^+ / glucose decreases(1) does not diffuse into cell from glomerular filtrate(1)		5		5		
	(d)			50% DR3 DR4 and 50% DR2 DR3 (1) DR3 DR4 children would have increased risk of Type I diabetes (1) Because alleles are co-dominant (1) DR2 DR3 children would not develop Type 1 diabetes (1) Because of protective DR2 allele (1)		1 1	1 1	5		
Question total					3	10	3	16	3	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)		Light dependent stage(1) (Absorbed) energy passed to reaction centre / primary pigment / chlorophyll a {excites electron / electron lost / emitted}(1) Reference to PS II(1) Photolysis + use of photolysis equation / description of replacement electrons lost (from PSII) (1) Oxygen released(1)	5			5		
	(b)	(i)	Bacteria must be aerobic (1) Because most bacteria / more bacteria in red and blue region and very few bacteria in green/ yellow / orange (1) Highest rate of photosynthesis occurs when exposed to red and blue wavelengths and therefore most oxygen produced(1)			3	3		
		(ii)	Repeat experiment without prism(1) Keep all other conditions same(1) Bacteria should be distributed evenly along the filamentous alga(1)			3	3		3
Question 2 total				5	0	6	11	0	3

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)	Mix well and transfer 1cm ³ into 9 cm ³ of water/ medium(1) To give a 1 in 10 dilution(1) Repeat to give a series of dilutions(1) Too many bacteria to count in original sample / colonies touch each other/ confluent(1)	4			4		4
		(ii)	85 x 10 000 x 20(1) 17 000000 (1) 1.7 X 10 ⁷ (1)		3		3	3	
		(iii)	Viable count indication of number of live bacteria + Total live and dead(1)	1			1		
	(b)		In phase B (nearly) all cells are viable(1) Any 2 from Phase A : slow cell division would result in the slow production of a viable culture(1) Phase C : slow cell division/ many non-viable cells + Phase D: most cells are dying/ non-viable(1)			3	3		
			Question total	5	3	3	11	3	4

GCE AS and A LEVEL BIOLOGY Specimen Assessment Materials 166

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)		Sodium / potassium pumps + (3) Na ⁺ out (2) K ⁺ in(1) {COO ⁻ / Organic anions/ -ve charged molecules / proteins/ Cl ⁻ } inside axon(1) Membrane leakage, more permeable to K ⁺ than Na ⁺ (1)	3			3		
	(b)	(i)	Threshold potential reached(1) Sodium voltage gated channels open(1) Sodium ions {flood into/ diffuse rapidly into} neurone / cytoplasm(1)	3			3		
		(ii)	(hyperpolarisation) means that the axon is more negative inside axon than resting potential(1) So a stronger stimulus is needed to exceed the threshold potential(1)		2		2		
	(c)		Time for sensory neurone = $0.9/0.08 = 11.25\text{ms} +$ Time for motor neurone = $0.9/0.12 = 7.5\text{ms}(1)$ $3 \times 2 = 6\text{ms}$ (synaptic delay)(1) $24.75\text{ms}(1)$		3		3	3	
	(d)		no myelin sheath so local circuits occur(1) Normally myelin sheath electrically insulates neurone so ion exchange only occurs at nodes of Ranvier(1) And the action potential jumps from one node of Ranvier to next / saltatory conduction takes place(1) In MS more membrane has to be depolarised therefore slower(1)		4		4		
	(e)		Any 2 from: Block calcium channels into presynaptic knob so prevent exocytosis (1) {Block receptors on post synaptic membrane / blocks synapse / change shape of neurotransmitter } so neurotransmitter cannot bind (1) Lowers resting potential of post-synaptic membrane so increases depolarisation needed to generate an action potential (1)		2		2		
			Question 4 total	6	11	0	17	3	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)		Any 2 from: No need to buy fertilisers(1) Ash provides a source of plant nutrients therefore increases soil fertility(1) Increase yield from food crops (1)		2		2		
	(b)		Increased growth of crops(to meet increased demand for food) removes <u>more</u> minerals from soil(1) Crops are removed so do not decompose to replace minerals in the soil(1) So soil minerals are depleted/ soil becomes less fertile(1)		3		3		
	(c)		Statement not completely valid as only plantation/ monoculture results in almost complete destruction(1) No shrubs, climbers or epiphytes and 60% less herbaceous plants / 154% less trees (use of data to exemplify effect on biodiversity)(1) Traditional agroforest decreases overall number of species(1) But does reduce biodiversity(1) Approx. 47% decrease in epiphytes/ 45% decrease in trees/ 22% shrubs/ 100% increase in herbaceous plants/ no change in climbers(use of data)(1)			5	5		
			Question 5 total	0	5	5	10	0	0

GCE AS and A LEVEL BIOLOGY Specimen Assessment Materials 168

Question			Marking details		Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Krebs S(1) Oxidative phosphorylation R(1) Decarboxylation S(1) Most acidic region Q(1) 4 correct = 2; 3 or 2 correct = 1; 1 or 0 correct = 0	2			2		
	(b)		I II	DNA: Codes for enzymes/amino acid sequence/ polypeptide / protein(1) Ribosomes: Translation / protein synthesis(1)	2			2		
	(c)			Citrate 6 α ketoglutarate 5 succinate 4 All correct (1)	1			1		
	(d)	(i)		(Skeletal) muscle(1) High numbers of mitochondria and easy to access/eq(1)		2		2		
		(ii)	I	That the pathway leading to Acetyl Co A is not working/{enzymes/dehydrogenase/decarboxylase} is not active(1) That the pathway between α -ketoglutarate and the rest of the cycle is working correctly(1) Because there cannot be enough reduced NAD/FAD to drive the ETC which needs oxygen(1)			3	3		
			II	Enzymes catalysing the conversion of the molecule to the next in the cycle are not functional(1) So the molecule cannot be converted to the next intermediate(1)			2	2		
	(e)			Both have circular DNA/ can self replicate(1) Both have small ribosomes/ 70S(1) Mesosomes/cristae increase surface area(1) Double membrane of mitochondria is similar to a bacterium inside a phagocytic vesicle(1)			4	4		
				Question 6 total	5	2	9	16	0	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7			<p>Indicative content</p> <p>The increasing human population is increasing the use of fossil fuels and resulting in our exceeding the boundary for CO₂. As this is an indicator of climate change, unless CO₂ levels are reduced to below the boundary, there will be significant changes to the climate due to global warming. This will affect weather patterns and the loss of habitat.</p> <p>This is already having an effect on biodiversity as the extinction rate is already ten to hundred times higher than the boundary. The loss of species could result in a loss of useful genes and unknown species that could be potential sources of food or have medical/ industrial uses.</p> <p>In addition, the increased demand for food is resulting in a large increase in percentage of the Earth's surface used for food production. However, we have not as yet exceeded the planetary boundary but we can only use a further 3% of the Earth's surface before the boundary is exceeded. Deforestation to provide more land for food production is contributing to both an increase in atmospheric CO₂ (due to a decrease in photosynthesis) and a decrease in biodiversity.</p> <p>The use of nitrogen for fertilisers has exceeded the planetary boundary by 85 million tonnes per year. While this has enabled humans to increase food production without exceeding the planetary boundary for land use, it is likely that much of the nitrogenous fertiliser will have been washed into waterways and caused eutrophication.</p>		9		9		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>7-9 marks</p> <p>The candidate clearly explains and links the effects of increasing human population to the observed changes in how close humans are living to the planetary boundaries listed. The need to decrease CO₂ levels is linked to climate change and loss of habitat and the consequent loss of biodiversity. The impact of loss of potentially useful genes is explained. Future land use for food production and the contributions of land clearance are clearly explained and related to possible future consequences. In addition, there is a clear understanding that human use of nitrogenous fertiliser has far exceeded the planetary boundary and how this has enabled humans to control land use. The waste of nitrogen and eutrophication are explained. All explanations are supported by reference to information provided.</p> <p><i>The candidate constructs an articulate, integrated account, 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></p> <p>4-6 marks</p> <p>The candidate links the effects of increasing human population to the observed changes in how close humans are living to the planetary boundaries listed. CO₂ levels higher than the boundary are linked to climate change and loss of habitat and the consequent loss of biodiversity. The impact of loss of potentially useful genes is described. Some attempt to explain how future land use for food production and the impact of land clearance are explained and an attempt is made to relate this to possible future consequences. Some explanation is made regarding the use of nitrogenous fertiliser which has far exceeded the planetary boundary but does not clearly explain how this has enabled humans to control land use. Some correlation between excessive use of nitrogen and eutrophication is made. Some reference is made to the information provided to support some explanations.</p>						

			<p><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></p> <p>1-3 marks The candidate links some of the effects of increasing human population to the observed changes in how close humans are living to the planetary boundaries listed. A link is made between increasing CO₂ levels and global warming and consequently climate change and loss of habitat. Some understanding of the impact of land use and the loss of biodiversity is conveyed. The impact of loss of potentially useful genes is described. There is no clear understanding of how humans need to control future land use for food production. A reference is made to the use of nitrogenous fertiliser but does explain how this has enabled humans to control land use. Limited reference is made to the information provided.</p> <p><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></p> <p>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p>						
			Question 7 total	0	9	0	9	0	0

COMPONENT 3: ENERGY, HOMEOSTASIS AND THE ENVIRONMENT - SUMMARY OF ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	10	3	16	3	0
2	5	0	6	11	0	3
3	5	3	3	11	3	4
4	6	11	0	17	3	0
5	0	5	5	10	0	0
6	5	2	9	16	0	1
7	0	9	0	9	0	0
TOTAL	24	40	26	90	9	8