COMPONENT 1 – ENERGY FOR LIFE

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 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)*			155-65 = 90 /500 = 0.18 /100 = 0.0018 (1) 2×10^{-3} (1) Max 1 if not expressed in standard form		2		2	2	
	(b)			Part A: CO_2 is in excess so as light intensity increases so does rate of uptake (1) Part B: concentration of CO_2 becomes a limiting factor for photosynthesis(1)	2			2		2
	(c)			(below 50 lux) rate of respiration must be higher than rate of photosynthesis as {CO_2 is being produced / -ve uptake of CO_2} (1) (at 50 lux) CO_2 produced in respiration equals that used in photosynthesis / O_2 produced in photosynthesis equals that used in respiration/ description of compensation point(1)			2	2		
	(d)			It stops electrons from PS II being moved to PS I (1) So blocking the reduction of $NADP^+$ to NADPH (1) No photolysis of water (1) Cyclic Photophosphorylation is not stopped as the electrons pass from PSI and return to PSI (1)		4		4		
	(e)			Plant cannot generate $NADPH_2$/ less ATP synthesised (1) Calvin cycle stops (1) So growing parts of the plant/sinks will not have glucose for respiration (1)		3		3		
				Question 1 total	**2**	**9**	**2**	**13**	**2**	**2**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	*(a)*			Sample B must contain mitochondria (1) Because only mitochondria can use pyruvate as a substrate (1) And CO_2 is only produced in Link reaction and Krebs Cycle which only take place in mitochondria/ matrix (1) Sample E must contain only cytoplasm as it does not contain organelles(1) so only glycolysis can take place (1)		1	1 1 1 1	5		
	(b)			Cyanide would only affect mitochondria as cytochrome oxidase is part of the electron transport chain (1) No NAD is available to act as the hydrogen acceptor and Krebs cycle would therefore stop(1) No carbon dioxide would be produced(1)		1 1	1	3		
	(c)			So that water potential / solute concentration inside and outside organelles is the same (1) Organelles would burst / lyse in pure water (1)		2		2		2
				Question 2 total	**0**	**5**	**5**	**10**	**0**	**2**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*			(as plants get older / larger) more N for protein / nucleic acid synthesis (1) more Mg for chlorophyll synthesis (1)	2			2		
	(b)			oxygen needed for ATP synthesis and ATP needed for active transport of ions (1) into root hairs to follow the symplast route (1) (then) move ions from apoplast into symplast route at the endodermis (1) (and) for pericycle to control movement of ions into the xylem (1)		4		4		
	(c)			Independent: concentration of nitrate (1) Dependent: change in mass of roots (1) Controlled: time exposed to each concentration (1) same temperature / light intensity / volume of growth medium (1)			4	4		4
				Question 3 total	**2**	**4**	**4**	**10**	**0**	**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	*(a)*	(i)		Correct bacterium labelled + *C.jejuni* is a helical bacterium so has a spiral shape + is Gram negative so would stain red (1)	1			1		1
		(ii)		(because it is Gram –ve) lipoprotein / lipopolysaccharide layer outside cell wall (1) Penicillin / antibiotics cannot penetrate and reach cell / cell wall (1)	2			2		
		(iii)		most human pathogens would have an optimum temperature of 37/38^{o}C so only *C.jejuni* would grow well at 42^{o}C (1)		1		1		1
	(b)	(i)		Plate U – there are enough colonies for reliable results and the colonies are easily countable (1) Plate R/S/T - cannot distinguish individual colonies and too many colonies to count accurately (1) Plate V has too few colonies to provide a reliable estimate (1)			3	3		3
		(ii)		69 colonies x 10 000 (dilution factor) x 2 (or 1/0.5) (1) 1 380 000/ 1.38 x 10^6 colonies per cm^3 (1)		2		2	2	2
		(iii)		does not include {dead / non-viable bacteria}(1) cannot be sure that {each colony has grown from a single bacterium/ colonies are not clumped}/ ORA; (1)	2			2		
				Question 4 total	**5**	**3**	**3**	**11**	**2**	**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*	(i)		9.4/30 x 60 or use suitable values from the tangent (1) 18.8 mg min^{-1} (1)		2		2	2	
		(ii)		Maximum concentration of glucose at start/ less glucose available as reaction progresses (1) All active sites occupied at start/ some active sites vacant as reaction progresses (1)	2			2		
	(b)	(i)		FAD acts as a hydrogen acceptor/ electron acceptor(1)		1		1		
		(ii)		Blood + urine (1)	1			1		
		(iii)		(oxygen electrode) could detect {use / depletion} of oxygen (1) The number of molecules of oxygen used in <u>Step 2</u> is proportional to the number of molecule of glucose broken down(1)			2	2		
		(iv)		Change in temperature would affect kinetic energy and result in readings being higher or lower than expected (1) Production of gluconic acid would lower pH (1) lowering pH would change shape of active sites resulting in readings being lower than expected (1)		3		3		3
	(c)			Change in oxygen levels would not be proportional to glucose concentration in sample (1) (because) Benzoate ion has a similar shape to glucose so would act as a competitive inhibitor of glucose oxidase (1) Benzoate would occupy active site and prevent formation of enzyme-substrate complexes (1) Therefore less $FADH_2$ would be reduced in <u>Step 1</u>(1) and so {less oxygen would be used in <u>Step 2</u> (1)		1	1 1 1 1	5		
				Question 5 total	**3**	**7**	**6**	**16**	**2**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*	(i)		GPP = gross primary <u>productivity</u> + NPP = net primary <u>productivity</u> (1) GPP is the rate at which producers convert light energy into chemical energy in glucose (1) NPP is the rate at which energy is converted into {biomass / chemical energy} that can be passed on to consumers / the rate of photosynthesis, minus respiration of the producers (1)	3			3		
		(ii)		Secondary productivity	1			1		
		(iii)		Respiratory loss = 3368 – 1095 – 383 = 1890 (1) % energy lost through respiration = 1890 / 3368 x 100 = 56.1163 = 56% (to 2 sig figs) (1) Max 1 if not expressed as 2 sig figs		2		2	2	
	(b)	(i)		Excretion and egestion Death Emigration /movement of animals from the area / removal of organisms by humans 3 correct = 2 marks, 2 correct = 1 mark 1/0 correct = 0 marks	2			2		
		(ii)		6 606 x 17 000 =112 302 000 (kJ m^{-2} yr^{-1}) (1) 1.12302 x 10^8 (1)		2		2	2	
		(iii)		Passes to {decomposers / detritivores} (1) {Respired / released} by decomposers/ lost as heat (1)	2			2		
	(c)			Factory farms more efficient as less energy is lost (1) reduces energy losses via respiration by controlling the temperature as less energy needed to maintain body temperature (1) animals are stocked at high densities which restricts movement so reduces energy loss (via respiration) for muscle contraction (1) herbivores are lower down the food chain than carnivores so less energy is lost via respiration or being expelled (1)		4		4		
				Question 6 total	**8**	**8**	**0**	**16**	**4**	**0**

Question			Marking details	AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*		A threshold value for a global process that is affected by human activity(1) Crossing these boundaries could generate abrupt or irreversible environmental changes. (1)	2			2		
	(b)		The number of species and the number of organisms of each species in a particular area (1) Any **1** from: (1) Seed / sperm banks Captive breeding programmes Fishing quota Trade restrictions Management of wild populations Restrict habitat destruction / pollution / deforestation / other means of habitat destruction	2			2		
	(c)		{Increasing demand for fresh water/ land for crops} are possible causes of an increase in extinction rate (1) {Because demand for fresh water increased by 627% / land use for crops 24%} greater than the preindustrial value (1) {Increased land use for crops/ for dams to provide fresh water} leads to destruction of habitats (1)			3	3		
			Question 7 total	**4**	**0**	**3**	**7**	**0**	**0**

Question			Marking details	AO1	AO2	AO3	Total	Maths	Prac
8	*(a)*	(i)	C and T are pyrimidines and A and G are purines (1) DNA is double stranded and a purine in one strand bonds to a pyrimidine in the complementary strand so same % purine as % pyrimidine (1) Maize and humans have different DNA sequences so A+T : C+G ratio will be different (1)	1	2		3		
		(ii)	(ratio not exactly 1.00) due to experimental error / loss of material during experimental processes(1)		1		1		1
	(b)	(i)	change (from cytosine to 5 methyl cytosine) does not alter the DNA base sequence (1) so no effect on {primary structure / amino acid sequence} of protein (1)	1	1		2		
		(ii)	(epigenetic) because the change to the DNA changes the ability of the gene to be transcribed (1) protein would not be produced and so change {appearance / ability to digest / process} (1) Accept suitable example where a protein plays a structural or functional role			2	2		
			Question 8 total	**2**	**4**	**2**	**8**	**0**	**1**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9				**Indicative content** Farmers can improve soil fertility through the addition of manure / dead animal and plant material which is decomposed by bacteria. This provides a slow release of nitrogen in a suitable form. Organic forms of nitrogen have to be broken down into ammonium compounds and then converted into nitrates. *Nitrosomonas* converting ammonium ions into nitrites. *Nitrobacter* converting nitrites into nitrates. Farmers can also apply nitrate fertilisers which are soluble and are in a form that can be taken up by plants. This is a faster way of improving soil fertility. Farmers could also plant leguminous plants to increase nitrate levels; Leguminous plants have the bacteria *Rhizobium* in root nodules. *Rhizobium* combines glucose from plant with nitrogen from the air to form amino acids. Ploughing and drainage encourages aerobic conditions which favours nitrification and discourages denitrification. The growing of leguminous crops increases soil fertility if ploughed in and not removed. Improving soil fertility by the addition of organic and inorganic nitrogen has a negative environmental impact if it is leached into water courses- eutrophication. The energy/ electrical input needed to produce inorganic fertilisers is very large and would lead to increased carbon dioxide production and consequently increasing global warming.	4	5		9		

				7-9 marks The candidate gives a full and detailed account of how the application of fertilizers, planting leguminous crops and farming practices increase soil fertility. This must include a detailed explanation of the role of named bacteria in each of these processes. In addition a detailed explanation of the negative impacts of eutrophication and impact of fertilizer production on global warming. *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** The candidate gives an account of how the application of fertilizers, planting leguminous crops and farming practices increase soil fertility. This must include the role of some named bacteria in these processes. In addition some explanation of the negative impacts of eutrophication and/or the impact of fertilizer production on global warming. *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 The candidate gives a limited account of how farming practices increase soil fertility. This must include a reference to named bacteria. In addition, identifies at least one negative impact of these farming practices. *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.* **0 marks** *The candidate does not make any attempt or give a relevant answer worthy of credit.*						
				Question 9 total	**4**	**5**	**0**	**9**	**0**	**0**

COMPONENT 1: ENERGY FOR LIFE

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Q	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	9	2	13	2	2
2	0	5	5	10	0	2
3	2	4	4	10	0	4
4	5	3	3	11	2	7
5	3	7	6	16	2	3
6	8	8	0	16	4	0
7	4	0	3	7	0	0
8	2	4	2	8	0	1
9	4	5	0	9	0	0
TOTAL	30	45	25	100	10	19