

**GCE BIOLOGY - BY4**  
**MARK SCHEME - SUMMER 2014**

Question	Marking details	Marks Available
1 (a)	{Ammonium/ammonia} ions/ $\text{NH}_4^+$ ;	1
(b)	<i>Azotobacter</i> ;	1
(c)	Root nodules;	1
(d)	1. ( <i>Rhizobium</i> synthesises) {nitrogen containing compounds/or eg} {which pass to plant/ which plant can use}/ allows legumes to grow in low fertility soil; NOT fixes nitrogen 2. (Plant synthesises) {carbohydrates/organic acids} which pass to the <i>Rhizobium</i> / {Plant/ leghaemoglobin} provides anaerobic conditions for the bacteria; NOT Plant provides protection for the bacteria/ nutrients passing to bacteria	2
(e)	{Small/additional} rings of DNA (which occur in addition to the chromosomal DNA);	1
<b>Question 1 total</b>		<b>[6]</b>

Question	Marking details	Marks Available
2 (a) (i)	Obligate aerobe {microorganisms/bacteria} that {grow/divide/ metabolise} in the presence of <u>oxygen</u> ;	1
(ii)	Obligate anaerobe {microorganisms/bacteria} that will only {grow/divide/metabolise} in the absence of <u>oxygen</u> ;	1
(iii)	Facultative anaerobe {microorganism/bacteria} that can {grow/divide/ metabolise} with or without <u>oxygen</u> ;	1
(b)	Gram +ve PURPLE Gram –ve RED/PINK ( <b>both</b> colours correct for one mark); Gram positive retain the {(crystal) violet/ purple} stain because of their {thick/peptidoglycan/murein} cell wall; Gram negative do not retain the stain because of their {thinner cell wall/ less peptidoglycan/ less murein/lipopolysaccharide layer}; Gram positive retain crystal violet because they have a thicker cell wall than the gram negative = 2 marks	3
(c)	<b>Both for one mark</b> Cocci            sphere/ spherical Bacilli         Rod;    Accept cylinder	1
<b>Question 2 Total</b>		<b>[7]</b>

Question	Marking details	Marks Available
3	(a) (i) <b>Both X and Y correct for one mark</b> X White matter Y Grey matter; Explanation: Grey matter contains the (darkly staining) cell bodies/nuclei of neurones whilst the white matter is mainly {axons/myelin};	<b>1 for both</b>  1
	(ii) L Dorsal Root ganglion; Z Central canal;	2
	(b) (i) Schwann cell; Myelin/ phospholipid; NOT lipid	2
	(ii) Insulates the axon; Allows saltatory conduction/ impulse jumps from node to node; So speeding up the transmission of the action potential/ increase speed of conduction;	Max 2
	(iii) Impulses cannot jump node to node/ saltatory conduction is stopped/ local circuits {too short/insufficient}/ {Few/no} voltage gated Na <sup>+</sup> channels (between Nodes of Ranvier); So action potential cannot be generated/ speed of conduction is reduced/ action potential does not reach destination;	2
	(iv) Remyelinate the axon/use of stem cells/make the membrane add Na <sup>+</sup> channels in bare areas/prevent further demyelination/ immune {suppressants/ inhibitory} drugs; Accept physiotherapy	1
	(c) (i) Nerve net drawn	1
	(ii) Respond to a limited number of stimuli; Cannot detect source of stimulus/ impulses pass in all directions; Number of effectors is small; No CNS; Accept no brain Action potential can be carried in more than one direction along a neurone; Only one type of cell/ unmyelinated/ facilitation - qualified/ slower response;	Max 2
<b>Question 3 Total</b>		<b>[14]</b>

Question	Marking details	Marks Available
4 (a) (i) A	Collecting duct;	3
B	Proximal Convoluted Tubule;	
C	Distal Convoluted Tubule;	
(ii)	Label to Glomerulus capillary/centre of Bowman's capsule; Label to PCT;	2
(b)	<b>Both for one mark</b> X Renal artery Y Renal vein;	1
(c)	Water leaves descending limb {osmotically/by osmosis}/ Na <sup>+</sup> is retained in descending limb; At apex Na <sup>+</sup> is very concentrated/ the ascending limb receives a filtrate rich in Na <sup>+</sup> /OWTTE; Na <sup>+</sup> {actively transported/pumped out} of the ascending limb; Lowering the water potential in the medulla; Ascending limb {does not allow the escape of water/ impermeable to water}; Counter current system = neutral	Max 4
(d)	{High osmotic pressure /low water potential/ low solute potential/ high solute concentration} of <u>blood</u> detected by { <b>osmoreceptors/hypothalamus</b> }; (Secretion of) ADH by pituitary; Reject: anterior pituitary Causes collecting duct (walls) to {become more permeable to water/insertion of aquaporins}; Water moves into the medulla by osmosis; (Quickly) removed by the {Vasa Recta/capillaries/ blood}; <u>Low volumes</u> of <u>concentrated</u> urine produced;	Max 4
<b>Question 4 Total</b>		<b>[14]</b>

Question	Marking details	Marks Available
5 (a)	(i) <b>1 mark for both</b> Y Cyclic <u>phot</u> ophosphorylation Z Non cyclic <u>phot</u> ophosphorylation	1
	(ii) (High energy) electrons/electron {carriers/acceptors};	1
	(iii) NADP → NADPH <sub>(2)</sub> / reduced NADP;	1
	(iv) Oxygen/ O <sub>2</sub> / ½ O <sub>2</sub> ;	1
	(v) Carbon dioxide/ CO <sub>2</sub> ;	1
	(vi) Glucose;	1
(b)		4

Area	Letter	Name of region
Where the light dependent stage occurs	<b>C;</b>	Grana/Thylakoid;
Where the light independent stage occurs	<b>D;</b>	Stroma;

One mark for each box

(c)	Synthesis of amino acids/proteins <b>using {a nitrogen source/ named nitrogen source}</b> ;	Max 3
	Synthesis of phospholipids with <b>phosphate</b> ;	
	Synthesis of chlorophyll with <b>magnesium</b> ;	
	Synthesis of {nucleotides/named nucleotide} with a <b>nitrogen source and phosphate source</b> ;	

**Question 5 Total [13]**

Question	Marking details	Marks Available
6	(a) (i) <b>All three correct for one mark</b> Citrate 6 α-ketoglutarate 5 Succinate 4	1
	(ii) 4C oxaloacetate plus 2 C acetyl; 1C lost/ CO <sub>2</sub> lost {before α-ketoglutarate/ from isocitrate}/ isocitrate is decarboxylated <b>and</b> 1C lost/ CO <sub>2</sub> lost {from α-ketoglutarate/ before succinate} / α-ketoglutarate decarboxylated;	2
	(b) Reduced NAD and reduced FAD pass electrons to the Electron Transport Chain; The <u>high energy</u> electrons/ electrons provide energy; (Used to power) proton pumps; On the inner mitochondrial membrane/cristae; Which pump H <sup>+</sup> into the inter-membrane space; Reduced NAD powers all 3 pumps/ Reduced FAD passes to 2 <sup>nd</sup> pump/ OWTTE; ATP synthesis = neutral	Max 4
	(c) Dehydrogenase; decarboxylase;	2
	(d) (Skeletal) muscle; High numbers of mitochondria and easy to access/ OWTTE;	2

Question	Marking details	Marks Available
(e)	<p><i>Low with pyruvate</i></p> <p>{The pathway leading to Acetyl Co A/link reaction} is not working/ {Enzymes/dehydrogenase/decarboxylase} are not active/ There is no reduced NAD for the Electron Transport Chain (so no O<sub>2</sub> needed);</p> <p><i>High with α-ketoglutarate</i></p> <p>The pathway between α-ketoglutarate and the rest of the cycle is working correctly/ There is enough reduced {NAD/FAD} to drive the ETC (which needs O<sub>2</sub>);</p>	2
(f)	<p>Enzymes catalysing the conversion of the molecule to the next in the cycle are not functional/ The {molecule/named example} cannot be converted to the {next intermediate/ named example} / build up of reduced NAD and FAD;</p>	1
(g)	<p>The {Krebs cycle/ link reaction/ Electron Transport Chain} is not working (as well);</p> <p>Pyruvate levels {build up/ increase/ higher};</p> <p>(Excess) {pyruvate/NADH<sub>2</sub>} is converted to Lactate;</p>	Max 2
<b>Question 6 Total</b>		<b>[16]</b>

Question	Marking details	Marks Available
7 (a)	<p>Any 10 from:</p> <p><b>A 3 for 1 mark</b></p> <p>The main photosynthetic pigments found in plants are chlorophyll <b>a</b>, chlorophyll <b>b</b>, carotene and xanthophyll;</p> <p><b>B</b> The function of these pigments is to <b>absorb</b> {light <u>energy/ photons</u>};</p> <p><b>C</b> Correct reference to pigments in photosystems/ antenna complexes;</p> <p><b>D</b> Correct reference to pigment positions within the thylakoid membrane/grana;</p> <p><b>E</b> Of a chloroplast;</p> <p><b>F</b> Chlorophyll a molecules in the reaction centre;</p> <p><b>G</b> {Reaction centre/ chlorophyll} emitting high energy electrons;</p> <p><b>H</b> Ref to range of pigments absorbing more {light energy/ photons}/ over a greater range of wavelengths</p> <p><b>I</b> Used to synthesise ATP {to drive/for} the {Calvin cycle/light independent stage};</p> <p><b>J</b> Some mention of {spotting plant pigments/ crushing leaf} onto a TLC/chromatography paper;</p> <p><b>K</b> Addition of solvent (extraction of pigment or for separation);</p> <p><b>L</b> Pigments are carried different distances;</p> <p><b>M</b> According to their {solubility (in solvent)/ size};</p> <p><b>N</b> Correct reference to {relative solubility/ different spot positions} {i.e. carotene more soluble than chlorophyll a and b/ carotene carried further};</p> <p><b>O</b> Identify using R<sub>f</sub> values/comparison with known separation of pigments;</p>	[10]
<b>Question 7a Total</b>		



**Question****Marking details****Marks Available****7 (b)**

Correct term and **explanation** of events in each of A, B, C and D:

- A lag phase – enzyme synthesis/ rehydration/ inability to find mates/ time for sexual maturity NOT getting used to environment;
- B log/ exponential phase – rate of reproduction exceeds death rate/ {no environmental pressure/ OWTTE};
- C stationary phase – environmental pressure/ limiting factors/ rate of reproduction = death rate;
- D death phase - death rate exceeds rate of reproduction/ lack of resources/ build up of toxins;
- E Graph drawn the correct shape with BOTH axes labeled with Population size/ eq and time (if use units must be appropriate);
- F Correctly **explained** carrying capacity (NOT just a labeled line on the graph) as the max numbers of a pop that can be sustained by the environment;
- G Correct explanation of inter-specific competition (2 different species competing for a given resource) and e.g.;
- H Correct explanation of intra-specific competition (same species competing for a given resource) and e.g.;
- I Explanation of how density dependent factor affects population growth (increase numbers in population increases competition for resources);
- J One suitable e.g. of dependent factor affecting pop growth;
- K Explanation of how density independent factors affects population (Independent of population size);
- L One suitable e.g. of density independent factor affecting pop<sup>n</sup>;
- M Immigration and emigration definition;
- N Description of predator prey relationship; Accept labelled diagram
- O Births and immigration = deaths and emigration {at stationary phase / in a stable population};

**Question 7b Total****[10]**