



GCE MARKING SCHEME

**BIOLOGY/HUMAN BIOLOGY
AS/Advanced**

SUMMER 2015

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2015 examination in GCE BIOLOGY/HUMAN BIOLOGY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were 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 conferences was to ensure that the marking schemes were 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' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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GCE BIOLOGY BY1
MARK SCHEME – SUMMER 2015

Question		Marking details		Marks Available
1	(a)	<p>Statement</p> <p>Is a monosaccharide Any 2 from 3 correct</p> <p>Is a dipeptide</p> <p>Would be found in nucleic acids</p> <p>contain C=C bonds</p> <p>Contains a glycosidic bond</p> <p>Is a triose sugar</p>	<p>Letter(s)</p> <p>A,F,G ;</p> <p>C ;</p> <p>A ;</p> <p>E ;</p> <p>B ;</p> <p>G ;</p>	7
	(b)	<p>(i) Add Benedicts/Fehlings (reagent) and <u>heat / boil</u>;</p> <p>Colour would change from <u>blue</u> to {red / orange / green / brown};</p> <p>Blue precipitate = neutral</p> <p>(ii) Glucose is a reducing sugar / reduces copper II sulphate (to copper I oxide) / sucrose is a non reducing sugar;</p>		2
		Question 1 total		[10]

Question		Marking details	Marks Available
2	(a)	$(3.4/0.34) \times 5$ or $3.4 \times 5/0.34$ = 50 Correct Answer = 2 marks correct calculation, incorrect answer = 1 mark Wrong unit = 1 mark only	2
	(b)	Any one from: double {stranded / polynucleotide chains} / not single stranded; helical; NOT alpha helix antiparallel strands;	max1
	(c) (i)	<u>RNA</u> ; NOT mRNA, tRNA, rRNA The percentages of G and C are not equal and so there is <u>no</u> (complementary) <u>base pairing</u> ;	2
	(ii)	Pyrimidine;	1
		Question 2 total	[6]

Question		Marking details	Marks Available
3	(a)	<p>A {polar / hydrophilic / phosphate} {head / group}; NOT layer</p> <p>Glycerol = neutral</p> <p>B extrinsic protein;</p> <p>C {non-polar / hydrophobic} tails / fatty acids ; NOT lipid tail</p> <p>D transmembrane protein / carrier protein / channel protein / intrinsic protein;</p>	4
	(b)	<p>active transport / reference to {<u>carrier</u> protein / protein pump}</p> <p>changing shape;</p> <p>NOT channel protein</p> <p>NOT reference to more than one type of transport</p> <p>using ATP / energy;</p>	2
	(c)	<ol style="list-style-type: none"> 1. ref to fluid mosaic (model); 2. proteins free to move (within membrane / bilayer); NOT in the cell 3. {after fusion / 1 hour} there is a new arrangement of proteins / OWTTE; 	3
		Question 3 total	[9]

Question		Marking details	Marks Available
4	(a)	<p>Any 4 from</p> <ol style="list-style-type: none"> {nuclear membrane / nucleolus} disappear; <u>chromosomes</u> {shorten / thicken / contracts / condense} / chromatin condenses; (appear as) <u>{two / pair / sister}</u> chromatids; NOT pairing up chromatids joined at centromere; spindle forms; Reject ref to centrioles making spindle fibres <p>Accept labelled diagram for 3, 4 and 5</p>	Max 4
	(b)	<p>$5/100 \times (24 \times 60)$ or $(24 \times 60)/20 = 72$ Correct Answer = 2 marks correct calculation, incorrect answer = 1 mark</p>	2
	(c)	<p>Any 3 from</p> <ol style="list-style-type: none"> both show <u>interphase</u> because DNA {doubles / changes from 2 to 4 / replicates}; NOT DNA increases unqualified (with vincristine) there is {no halving of DNA / DNA does not decrease from 4 to 2 arbitrary units}; (lack of spindle fibres) prevents chromatids being pulled to the {poles / ends of spindle}(in anaphase); allow chromosomes therefore no cytokinesis / no separation into two cells; daughter cells not produced 	Max 3
	(d)	<p>meiosis produces <u>genetically</u> different cells AND mitosis produced {<u>genetically</u> identical cells / clones}; meiosis halves chromosome number AND mitosis maintains chromosome number / cells produced by meiosis are haploid AND those by mitosis are diploid ;</p>	2
Question 4 total			[11]

Question		Marking details	Marks Available
5	(a)	The {potential / tendency / ability / capacity} for water to move out of* a {solution / system / cell}/ pressure exerted by water molecules in a {system / cell}; *Accept 'in to' by osmosis / correct definition of osmosis;	2
	(b)	Any 4 from <ol style="list-style-type: none"> 1. 6 cells turgid, 6 cells plasmolysed / {50%/half} of viewed cells were plasmolysed; 2. reference to incipient plasmolysis; 3. Pressure potential of tissue = zero; 4. No net movement of water; 5. solute potential = {water potential / -1120kPa}; Accept symbols 6. {so molarity of solution / 0.4M} = <u>molarity of tissue</u>; 	Max 4
	(c)	Any 3 from <ol style="list-style-type: none"> 1. As water passes into cell (by osmosis); 2. As {protoplast / cell contents / cytoplasm / vacuole} {expand / swell}; 3. (cellulose) cell wall {is inelastic / won't stretch / won't expand}; rigid = neutral 4. (cell wall)pushes against (expanding) {protoplast / cytoplasm / cell contents};NOT cell wall pushes against {vacuole / cell membrane} 5. generating <u>pressure potential</u> (by resistance of cell wall); 	Max 3
		Question 5 total	[9]

Question		Marking details	Marks Available
6	(a)	Produced by cells / is a protein; speed up (the rate of a) reaction (without being used or changed themselves) ; NOT activation energy	2
	(b)	(i) <u>all</u> (three) enzymes {have high activity / are working well};	1
		(ii) blood;	1
		(iii) <ul style="list-style-type: none"> 1. enzymes are <u>specific</u>; 2. each {stain / protein} has a different <u>shape</u> / different <u>shaped</u> substrates; NOT structure alone 3. would not fit one <u>active site</u> / three <u>different active sites</u> are needed; 	Max 2
(iv) <ul style="list-style-type: none"> 1. (at this temperature) <u>all</u> (three) enzymes {non-functional / denatured / no activity}; 2. due to breaking of <u>hydrogen</u> bonds; Allow H bonds REJECT listing of all bonds 3. active site deforms; 4. {prevents / no} { enzyme-substrate complexes forming / successful collisions}; REJECT: less enzyme-substrate complexes 	4		

Question		Marking details	Marks Available
	(c)	(i)	Max 4
		(i)	
		(ii)	1
		Question 6 total	[15]

Question		Marking details	Marks Available
7	(a)	<p>Biosensor essay</p> <p>A. A biosensor can detect a <u>specific</u> molecule;</p> <p>B. in a mixture (of blood);</p> <p>C. ref to glucose oxidase;</p> <p>D. enzyme immobilised;</p> <p>E. on inert support / matrix;</p> <p>F. e.g. alginate beads or gel membrane;</p> <p>G. ref to selectively permeable membrane separating (blood) from sensor;</p> <p>H. When {a mixture / glucose} is passed over the enzyme {an enzyme substrate complex is formed/ correct reference to glucose oxidase reaction (glucose + oxygen = gluconic acid + hydrogen peroxide)};</p> <p>I. {product / fall in oxygen} is proportional to the concentration of the {substrate / glucose};</p> <p>J. detected by electrode / converted into electrical impulses by transducer;</p> <p>K. gives rapid result;</p> <p>L. gives {quantitative data / numerical value};</p> <p>M. can detect at very low concentrations;</p> <p>N. accurate {concentration / measurement} is produced;</p> <p>O. for {diagnosis / monitoring} of diabetes;</p> <p>Question 7 total</p>	[10]

Question		Marking details	Marks Available
7	(b)	<p>Organelle essay</p> <p>Mitochondrion</p> <p>A <u>folded</u> inner membrane / cristae;</p> <p>B increases surface area;</p> <p>C for (attachment of) {enzymes / ATP synthetase} / location of {electron transport chain / stalked particles};</p> <p>D site of (aerobic) respiration / ATP production;</p> <p>E good diagram / description of location of any four from - cristae, matrix, stalked particles, inter membrane space, inner / outer membrane, (circular) DNA, ribosomes ;</p> <p>Chloroplast</p> <p>F thylakoids contain {photosynthetic pigments / chlorophyll};</p> <p>G thylakoids stacked into grana;</p> <p>H function is photosynthesis;</p> <p>I Starch grains store {photosynthetic products / glucose}</p> <p>J good diagram / description of location of any four from - stroma, {thylakoid / grana}, ribosomes, (circular) DNA, starch grain, lipid droplet, lamellae, inner / outer membrane;</p> <p><u>similar to prokaryotic cell</u></p> <p>K contain ribosomes;</p> <p>L similar size;</p> <p>M (circular) DNA;</p> <p>N for self replication;</p> <p>O comparison mesosome with cristae;</p> <p>Question 7 total</p>	[10]

GCE BIOLOGY BY2
MARK SCHEME – SUMMER 2015

Question			Marking details	Marks Available														
1	(a)	(i)	One mark for each correct column	2														
			<table border="1" style="width: 100%; text-align: center;"> <tr> <td>Kingdom</td> <td>Animalia</td> </tr> <tr> <td>Phylum</td> <td>Chordata</td> </tr> <tr> <td>Class</td> <td>Mammalia</td> </tr> <tr> <td>Order</td> <td>Carnivora</td> </tr> <tr> <td>Family</td> <td>Felidae</td> </tr> <tr> <td>Genus</td> <td><i>Panthera</i></td> </tr> <tr> <td>Species</td> <td><i>uncia</i></td> </tr> </table>		Kingdom	Animalia	Phylum	Chordata	Class	Mammalia	Order	Carnivora	Family	Felidae	Genus	<i>Panthera</i>	Species	<i>uncia</i>
		Kingdom	Animalia															
	Phylum	Chordata																
	Class	Mammalia																
	Order	Carnivora																
Family	Felidae																	
Genus	<i>Panthera</i>																	
Species	<i>uncia</i>																	
	(ii)	Possess a backbone / spine / internal skeleton / (well developed) CNS / brain within a cranium;	1															
(b)	(i)	Lion and jaguar/ <i>Panthera leo</i> and <i>Panthera onca</i> ;	1															
	(ii)	They would have <u>more / most</u> {bands / sequences} in {common / similar} (compared to other species); NOT amino acids	1															
Question 1 total				[5]														

Question		Marking details	Marks Available								
2	(a)	<table border="1"> <tr> <td>The main sites of mechanical digestion</td> <td>A & C; Ignore K</td> </tr> <tr> <td>The site of lipase production</td> <td>E;</td> </tr> <tr> <td>The digestion of protein begins</td> <td>C;</td> </tr> <tr> <td>The final stages of carbohydrate digestion</td> <td>F; Ignore K</td> </tr> </table>	The main sites of mechanical digestion	A & C; Ignore K	The site of lipase production	E;	The digestion of protein begins	C;	The final stages of carbohydrate digestion	F; Ignore K	4
		The main sites of mechanical digestion	A & C; Ignore K								
		The site of lipase production	E;								
		The digestion of protein begins	C;								
	The final stages of carbohydrate digestion	F; Ignore K									
(b)	(i) Increases the (total) surface area (of the lipids); {Increasing the rate of <u>digestion</u> / <u>broken down</u> more quickly / <u>broken down</u> more efficiently} <u>by lipase</u> ;		2								
	(ii) <u>Optimum</u> pH for enzymes / to <u>neutralise</u> {stomach acid / chyme}; Ignore: to create an alkaline pH		1								
(c)	(i) Arrow pointing at small intestine;		1								
	(ii) <ul style="list-style-type: none"> • (The tapeworm) lacks a digestive system; • (The small intestine) contains the {products of digestion / digested nutrients / named soluble nutrients / soluble nutrients} / nutrients can simply be {absorbed / diffuse} across the tapeworm's <u>body surface / membrane</u>; Accept skin 		2								
Question 2 total			[10]								

Question		Marking details	Marks Available
3	(a)	<ol style="list-style-type: none"> 1. They have <u>many</u> alveoli; 2. Which increases / provides a large surface area (for gas exchange); 3. The {alveolar / capillary} <u>walls</u> are {thin / one cell thick} / capillaries are close to alveoli / alveoli are composed of squamous epithelial cells; 4. Providing a short diffusion {pathway / distance} (for oxygen to enter the blood); 5. Many blood {capillaries / vessels} / {<u>rich / good</u>} blood supply / capillary network; reject arteries / veins 6. To maintain (steep) concentration gradients; <p>(Max 2 from 1,3 and 5 and Max 2 from 2,4 and 6)</p>	Max 4
	(b)	(i) <ol style="list-style-type: none"> 1. The intercostal muscles relax allowing the ribcage to move downwards <u>and</u> inwards; (ignore reference to internal / external) 2. The diaphragm (muscles) relaxes <u>and</u> becomes dome shaped; 3. This decreases the volume of the {<u>thoracic cavity / thorax</u>}; NOT lungs 4. Which increases the pressure inside the {lungs / thoracic cavity}; 5. {Forcing / pushing} air out of the lungs / moving air out of the lungs down a pressure gradient; <p>(NB must be reference to air moving from higher pressure to lower pressure not simply 'air moves out of lungs' unqualified)</p>	Max 4
		(ii) <ul style="list-style-type: none"> • Have high metabolic rates / are {homeothermic / endothermic}; • Ventilation maintains a (steep) concentration gradient (at the alveoli) / {sufficient / enough / more} <u>oxygen</u> supplied to the {alveoli / gas exchange surface}; 	2
		Question 3 total	[10]

Question			Marking details	Marks Available
4	(a)	(i)	<ul style="list-style-type: none"> It saves {time / energy} as a partner doesn't need to be found Produces {genetically identical individuals / clones} which will be well adapted to {stable / favourable} environmental conditions Can bring about a rapid increase in population size in {favourable / stable} conditions ; 	1
		(ii)	<ul style="list-style-type: none"> It produces <u>genetic</u> variation, allowing {some offspring to survive / species to adapt to} {change in environment/ named change } / NOT {offspring / organisms} adapt produces resistant stage in the life cycle to survive harsh environmental conditions; 	1
	(b)	(i)	Incomplete metamorphosis;	1
		(ii)	Nymphs / instars;	
		(iii)	The {larvae / caterpillar} would look different to the {adult / butterfly};	1
			There would be an (additional) {pupal stage / chrysalis / cocoon} (in the lifecycle) / there is no moulting;	2
	(c)	(i)	The stickleback; As it produces the <u>fewest / least</u> number of {offspring / eggs};	2
		(ii)	The dogfish; As it has the <u>largest</u> (diameter of) egg, which would contain the {most / more} {nutrients / yolk / food reserve} (for the developing embryo);	2
	Question 4 total			[10]

Question		Marking details	Marks Available	
5	(a)	<ul style="list-style-type: none"> It has a large surface area to absorb {water / minerals / ions} / Accept: for osmosis many mitochondria for active transport of minerals / ions thin cell wall for a short diffusion pathway; 	1	
	(b)	<p>Apoplast pathway – (water travels) through the cell walls; Symplast pathway – (water travels) through the cytoplasm <u>and</u> plasmodesmata;</p>	2	
	(c)	<ol style="list-style-type: none"> The casparian strip / suberin; Blocks the apoplast pathway / forces water into the symplast pathway; The (endodermal cells / pericycle) <u>actively transport ions into the xylem vessels</u>; This lowers the water potential in the xylem; Causing water to move <u>into the xylem by osmosis</u>; Producing hydrostatic pressure (forcing water upwards); 	Max 4	
	(d)	(i)	Palisade / spongy / mesophyll;	1
		(ii)	Sucrose;	1
	(e)	(Sucrose is) transported in the {phloem / sieve tubes};	1	
	(f)	(i)	Radioactivity was detected above and below the {source / leaf} / Radioactivity was detected A and {B / C};	1
		(ii)	38/90; 0.42 (cm min ⁻¹); Correct answer = 2 marks	2
Question 5 total			[13]	

Question		Marking details	Marks Available	
6	(a)	It can generate its own {impulse / contraction} / it does not need to be stimulated by a nerve to make it <u>contract</u> ;	1	
	(b)	(i) Acts as the pacemaker / generates the cardiac impulse/ releases a wave of excitation / generates an electrical stimulation; Brings about atrial {systole / contraction};	2	
		(ii) Transmits impulse to apex of heart / spreads the cardiac impulse through (the walls of) the ventricles; Bringing about ventricular {systole / contraction};	2	
	(c)	(i)	The atrio-ventricular valve closes	0.2
			The aortic valve closes	0.56
		(ii)	Blood is flowing from the atria to the ventricles	A / E
			Blood is flowing from the ventricle to the aorta	C
			When there is no movement of blood through the heart	B / D
		(iii)	<ul style="list-style-type: none"> The {atrio-ventricular valves / bicuspid / mitral} close (preventing backflow of blood); When the pressure in the ventricles exceeds the pressure in the atria / during ventricular {systole / contraction}; Tendons prevent valves inverting; 	Max 2
	Question 6 total		[12]	

Question			Marking details	Marks Available
7	(a)	<p>A The formation of tissue fluid is the difference between hydrostatic pressure and osmotic effect;</p> <p>B The arterial end of the capillary has a high {hydrostatic / blood} pressure;</p> <p>C Which <u>forces</u> {fluid / water and small molecules}(out of the capillary); NOT blood/ plasma/ tissue fluid</p> <p>D Through the {pores / gaps / fenestrations} in the {capillary / endothelium} / through the {pores / gaps} in the basement membrane / filters plasma;</p> <p>E (Large) plasma proteins remain in the {capillary / blood / plasma};</p> <p>F Tissue fluid bathes the cells with (essential) nutrients;</p> <p>G such as glucose/products of digestion / ions / hormones / water; NOT oxygen</p> <p>H loss of fluid causes the {hydrostatic / blood} pressure to fall;</p> <p>I at the venule end of the capillary the {hydrostatic / blood} pressure is low;</p> <p>J plasma has a {lower water potential / greater osmotic pressure} than the tissue fluid;</p> <p>K this causes <u>water</u> to re-enter the capillary by <u>osmosis</u>;</p> <p>L {waste products / named waste products} (of metabolism) <u>diffuse</u> back into the capillary; NOT carbon dioxide</p> <p>M more {fluid / water} leaves the capillary than is returned;</p> <p>N <u>excess</u> tissue fluid drains into lymph {vessels / capillaries / system}; reject lacteal</p> <p>O lymph is returned to the circulation via the {thoracic duct / veins in the neck / subclavian vein};</p> <p>Question 7a total</p>		
				[10]

Question			Marking details	Marks Available
7	(b)	A	Haemoglobin (transports) oxygen as oxyhaemoglobin;	
		B	One haemoglobin molecule can transport 4 molecules of oxygen; Accept correct equation	
		C	Haemoglobin has a high <u>affinity</u> for oxygen at high {partial pressures/ oxygen saturation / oxygen concentration};	
		D	So it will therefore {associate / load / bind} oxygen (in the lungs/high ppO ₂);	
		E	Haemoglobin has a low <u>affinity</u> for oxygen at low {partial pressures / oxygen saturation / oxygen concentration};	
		F	So it will therefore {dissociate / unload / release} oxygen (in the tissues / low ppO ₂);	
		G	for <u>aerobic</u> respiration;	
		H	{ <u>During exercise / high rates</u> of respiration} the {partial pressure of carbon dioxide increases/ the pH decreases};	
		I	(partial pressure of carbon dioxide increasing / the pH decreasing) lowers the <u>affinity</u> of haemoglobin for oxygen;	
		J	the dissociation curve shifts to the right/ known as the Bohr {effect / shift}; Accept from labelled graph correctly drawn	
		K	(bohr effect) causes haemoglobin to unload <u>more</u> oxygen to the tissues; reject faster	
		L	In environments with a low partial pressure of oxygen;	
		M	For example at high altitude / muddy burrows / uterus;	
		N	{Organisms / named organism} possess haemoglobin with a { <u>higher affinity / very high affinity</u> } for oxygen;	
		O	This enables the haemoglobin to become fully saturated (at lower partial pressures);	
			Question 7b total	[10]

GCE BIOLOGY HB2
MARK SCHEME – SUMMER 2015

Question			Marking details	Marks Available
1			vitamin C / ascorbic acid;	1
			(skin) flora;	1
			inflammation / histamine(s);	1
			phagocytes / macrophages / granulocytes;	1
			ciliated;	1
			Question 1 total	[5]

Question		Marking details	Marks Available
2	(a)	All three for 1 mark: X = mouth / buccal cavity Y = stomach Z = duodenum Accept small intestine	1
	(b)	amylase;	1
	(c)	to prevent {autolysis / self-digestion};	1
	(d)	different enzymes have different optimum pH / prevent enzymes denaturing;	1
	(e)	emulsify fats / fats broken down into smaller globules; increase surface area and {for action of lipase / increase rate of digestion of lipids};	2
	(f)	(i) {Additional / outer / extra} layer of {lipoprotein / lipopolysaccharide}; prevents antibiotics getting to {murein / peptidoglycan layer};	2
	(ii)	(10 000 billion / 10 billion) = 1000;	1
		Question 2 total	[9]

Question		Marking details	Marks Available
3	(a)	Biodiversity	1
	(b)	(tropical) rain forest; coral reef;	2
	(c)	{the higher the latitude / the further from the equator} the lower the number of species / ORA;	1
	(d)	Very {little water / rainfall} / ref temperature; A {low variety of / not enough different} {plants for them to feed on / types of food};	2
Question 3 Total			[6]

Question		Marking details	Marks Available
4	(a)	Endocrine system / hormones / adrenalin / epinephrine; nervous system / vagus nerve / cardiac control centre;	2
	(b)	(i) Any 2 from <ul style="list-style-type: none"> • blood flow to heart <u>muscle</u> decreased; • {less / no} <u>oxygen</u> reaches heart (muscle) / heart (muscle) cannot respire <u>aerobically</u>; • heart <u>muscle</u> {cannot contract as efficiently / dies}; 	Max 2
		(ii) a clot at P would {reduce / prevent blood flow} to a larger part of the left {ventricle / side of heart}; {more / whole} of left ventricle cannot {contract / pump blood} / OWTTE;	2
	(c)	(i) Any two from: lack of exercise; stress; smoking; genetics / age / gender; alcohol; NOT high cholesterol diet	2
		(ii) Any four from: Angioplasty; threading a {balloon / stent / micro-devices} {into the affected artery / to site of atheroma}; to enlarge restricted artery / owtte; by-pass surgery / graft healthy blood vessel; to carry blood around the blocked region of the artery;	4
Question 4 Total			[12]

Question		Marking details	Marks Available
5	(a)	ectoparasite lives {on the outside of / in } a host (organism) endoparasite lives inside a host organism;	1
	(b)	Head lice have claws / pincers to hold onto hair; Accept {eggs / nits} are {glued onto / attached} hairs <i>Taenia</i> has hooks <u>and</u> suckers to cling to wall of (small) intestine; Reject hookers	2
	(c)	Any two from: {eggs / embryos} passed out in faeces; NOT pig infective stage develops in a secondary host / pig; humans eat {undercooked / raw} infected {pork / secondary host};	2
	(d)	Any two from: tapeworm {absorbs nutrients from gut contents / causes malnutrition}; block gut lumen; (larval forms) can form cysts in vital organs;	Max 2
	(e)	(i) <i>Plasmodium</i> ;	1
		(ii) <i>Anopheles</i> / female mosquito;	1
	(f)	(i) The higher the rainfall the higher the number of new cases of malaria;	1
		(ii) Any two from: <i>Anopheles</i> / mosquito / vector needs water to breed; higher rainfall provides more breeding places for mosquito; more mosquitoes can transmit parasite to more people;	2
Question 5 Total			[12]

Question		Marking details	Marks Available
6	(a)	{minimise / reduce} heat <u>and</u> water loss Reject: prevent	1
	(b)	Any four from: <ul style="list-style-type: none"> • Intercostal muscles contract (and expand the ribcage); • (outer) pleural membranes pulled out (by expanding ribcage); • pleural pressure reduced; • (inner) pleural membrane pulls on lungs and expand alveoli; • alveolar pressure lowers; • air moves in {when alveolar pressure is lower than atmospheric pressure / and increases alveolar pressure}; • reference to data from graph; 	4
	(c)	Premature babies / lung transplants / respiratory distress syndrome; lowers surface tension of the fluid in the alveoli / to prevent alveoli from collapsing;	2
		Question 6 Total	[7]

Question		Marking details	Marks Available
7	(a)	(concentration of HIV) increases then decreases; Any two from: latent period (following infection); no prior exposure to antigen / no memory cells; no antibodies to {destroy / inactivate} {HIV / virus / it}; as antibody concentration increases more (HIV) destroyed;	3
	(b)	(i) Any two from: HIV {lives in / destroys / attacks} T helper lymphocytes; Fewer T helper lymphocytes to activate B lymphocytes; Less antibodies produced;	2
		(ii) too few T helper lymphocytes to respond to foreign antigen; unable to control infection / destroy cancerous cells;	2
	(c)	Any two from: wide range of antigens / strains; HIV mutates frequently; antigens keep changing / antigenic shift; memory cells don't recognise (changed) antigens	2
		Question 7 Total	[9]

Question		Marking details	Marks Available
8	(a)	Describe the functions of the different components of human blood.	[5]
		Explain what is meant by the ABO blood group system and its importance in blood transfusion.	[5]
		A (blood is a) fluid connective tissue / (consisting of) cells suspended in (a liquid matrix called) plasma;	
		B {leucocytes / white blood cells} – {involved in fighting infection / defence against disease};	
		C {lymphocytes / agranulocytes / B lymphocytes / plasma cells} + {produce antibodies / humoral immune response};	
		D T lymphocytes + cell mediated immunity;	
		E {Granulocytes / macrophages / phagocytes / neutrophils} – carry out phagocytosis;	
		F {erythrocytes / red blood cells} – transport oxygen (and carbon dioxide);	
		G {thrombocytes / platelets} clot blood;	
		H <u>plasma</u> transports	
		Any two of	
		• digested food products / named products of digestion	
		• hormones	
		• proteins / albumin / fibrinogen / antibodies	
		• ions	
		• heat	
• carbon dioxide / hydrogencarbonate			
• urea;	(5 max)		
I letters A, B and O refer to the presence or absence of antigens (carried on cell membranes) of {red blood cells / erythrocytes};			
J (people with) {antigen A / blood group A} produce antibodies against antigen B OR (people with) {antigen B / blood group B} produce antibodies against antigen A;			
K (people with) {antigens A and B / blood group AB} do not produce antibodies against A or B;			
L (people with) {neither antigen A or B / blood group O} produce antibodies against both antigen A and B;			
M transfusion of wrong blood group leads to antibodies binding to antigens;			
N (called) haemagglutination (Reject: clotting of blood);			
O blood group O blood can be given to anyone + universal donor;			
P blood group AB blood can receive blood from anyone + universal recipient;	(5 max)		
Question 8 a Total		[10]	

Question		Marking details	Marks Available
8	(b)	<p>The sorting of living organisms, including humans, into groups of a manageable size is known as taxonomy or classification.</p> <p>Describe and explain the principles underlying modern classification.</p> <p>A (modern classification) aims to show how organisms are related through evolution;</p> <p>B closely related organisms share more features / characteristics;</p> <p>C a taxon is a group of organisms that share basic characteristics / example;</p> <p>D {classification groups / taxa} are discrete and hierarchical;</p> <p>E (taxa include): kingdom phylum class order family genus species;</p> <p>F correct sequence of taxa ;</p> <p>G hierarchy / sequence of taxa shows: kingdom – largest group to species – smallest group;</p> <p>H kingdom – least closely related to species – most closely related;</p> <p>I organisms grouped into the kingdoms: animalia, plantae, fungi, protocista and prokaryotae;</p> <p>J all have eukaryotic cells except for prokaryotes;</p> <p>K {binomial system / genus and species} used to name organisms;</p> <p>L genus is a group of closely related species;</p> <p>M species is a group of organisms that can interbreed to produce fertile offspring;</p> <p>N {biochemical methods / named method} compare similarities in DNA / proteins of different species;</p> <p>O the greater the similarity the more closely related the species;</p> <p>P biochemical methods are reducing mistakes made due to convergent evolution;</p> <p>Question 8 b Total</p>	<p>[10]</p> <p>[10]</p>

GCE BIOLOGY BY4
MARK SCHEME – SUMMER 2015

Question		Marking details			Marks Available	
1						[4]
			<i>Statement</i>	<i>True</i>	<i>False</i>	
			Motor neurones have only a single dendrite.		✓	
			Motor neurones have many axons.		✓	
			Dendrites receive and integrate impulses.	✓		
			Dendrites of motor neurones are rarely myelinated.	✓		
		Question 1 total			[4]	

Question			Marking details	Marks Available
2	(a)	(i)	Run off / Leaching;	1
		(ii)	(Farmers apply) {fertiliser / ammonium nitrate} / (Spreading of) {manure / slurry};	1
	(b)	X	<i>Nitrosomonas / Nitrococcus</i> ;	2
		Y	<i>Nitrobacter</i> ;	2
	(c)	Any 2 from: To be able to be absorbed by root hair cells / plant by <u>active transport</u> ; Used to synthesise {amino acids / proteins / (named)nucleic acids / nitrogenous bases}; To convert toxic ammonia into (non-toxic) nitrate;	2	
	<u>Aerobic</u> conditions encourages nitrification / <u>Anaerobic conditions</u> encourages {denitrification/conversion of nitrates to atmospheric N ₂ }; Decreases soil fertility / less crop growth / less grass growth / ORA;	2		
			Question 2 total	[8]

Question		Marking details	Marks Available												
3	(a)	<p>A Obligate aerobe B Facultative anaerobe C Obligate anaerobe</p> <p>All 3 correct for 2 marks 2 correct for 1 mark 0/1 correct = 0 marks</p>	2												
	(b)	<p>Any 4 from:</p> <ol style="list-style-type: none"> 1. Use of glycolysis / only glycolysis takes place; 2. Conversion of <u>pyruvate</u> to {lactate / ethanol / lactic acid fermentation / alcoholic fermentation}; 3. Using the reduced NAD; 4. To regenerate NAD / allowing glycolysis to continue; 5. Reference to substrate level phosphorylation; 6. Any reference to an alternative final electron acceptor eg nitrate / sulphate; 	4												
	(c) (i)	<table border="1"> <thead> <tr> <th></th> <th><i>Optimum temp C</i></th> <th><i>Environment</i></th> </tr> </thead> <tbody> <tr> <td>psychrophiles</td> <td>9-12</td> <td>Mountains / deep sea / N/S Pole / arctic soil / tundra / glaciers / fridge / freezer;</td> </tr> <tr> <td>mesophiles</td> <td>36-38</td> <td>Warm blooded animals / mammals / Human body / cheese / yogurt;</td> </tr> <tr> <td>hyperthermophiles</td> <td>91-94</td> <td>Deep sea vents / geysers / hot springs / volcanoes;</td> </tr> </tbody> </table> <p>1 mark for each linked temp / environment</p>		<i>Optimum temp C</i>	<i>Environment</i>	psychrophiles	9-12	Mountains / deep sea / N/S Pole / arctic soil / tundra / glaciers / fridge / freezer;	mesophiles	36-38	Warm blooded animals / mammals / Human body / cheese / yogurt;	hyperthermophiles	91-94	Deep sea vents / geysers / hot springs / volcanoes;	3
		<i>Optimum temp C</i>	<i>Environment</i>												
psychrophiles	9-12	Mountains / deep sea / N/S Pole / arctic soil / tundra / glaciers / fridge / freezer;													
mesophiles	36-38	Warm blooded animals / mammals / Human body / cheese / yogurt;													
hyperthermophiles	91-94	Deep sea vents / geysers / hot springs / volcanoes;													
(ii)	<p>Any 2 from:</p> <p>Freezing of cell contents / damage by ice / water crystals; <u>Enzymes</u> {slow / inactive / must have a low optimum temperature}; Transport proteins inactive; Inflexibility of cellular membranes;</p>	2													
Question 3 Total			[11]												

Question		Marking details	Marks Available
4	(a)	Any 2 from: Reaction centre / antenna complex; In a photosystem; In the thylakoid (membrane);	2
	(b)	19/68 or 20/68; 0.28 or 0.29; (2d.p.) ecf Xanthophyll;	1 1 1
	(c)	(i) <u>Absorption</u> spectrum;	1
		(ii) (Green) light is reflected (by the pigments);	1
		(iii) Any 2 from: <ul style="list-style-type: none"> • {light / photons} can be absorbed over {a greater range of / more} wavelengths; Accept correct use of figures • More {light / photons} absorbed means more products from the light dependent stage; • {Greater rate of / faster} photosynthesis / Photosynthesis is more efficient; 	2
(d)	Any 3 from: <ul style="list-style-type: none"> • Light absorbed by (pigments in) {photosystems / PSI / PSII / description of photosystem}; • {Excites electrons / raises electrons} to higher energy level; • Electrons emitted from reaction centre/chlorophyll a; • Used to power proton pumps / generate an EC gradient; • Movement of protons through a stalked particle / ATP synthase allows ATP generation; 	3	
Question 4 Total			[12]

Question			Marking details	Marks Available
5	(a)	(i)	to provide oxygen / aerobic conditions for <u>respiration</u> ; (Sterile air) prevents contamination;	2
		(ii)	Lactose/monosaccharide (accept glucose / sucrose / corn syrup); Amino acids / ammonium (ions);	2
		(iii)	Addition of acid / alkali;	1
		(iv)	<ul style="list-style-type: none"> • If the temperature rises <u>more cold water</u> is pumped into the jacket; • Removing heat generated by (aerobic) <u>respiration</u> to {maintain optimum temperature for <u>enzyme</u> activity / prevent enzymes denaturing}; 	2
	(b)	(i)	76-78 hours;	1
		(ii)	Synthesis of enzymes;	1
		(iii)	Any 3 from: <ol style="list-style-type: none"> 1. Penicillin is a secondary metabolite and only produced in the late {log phase / stationary phase}; 2. (Fungal population) is {in early log phase / not in the stationary phase}; 3. (During X there are) {excess / plenty of nutrients}/ little (intra-specific) competition; 4. Penicillin only produced to {kill competitors / reduce competition}; 	3
	Question 5 Total			[12]

Question		Marking details	Marks Available						
6	(a)	<table border="1"> <tr> <td>A</td> <td>Cortex</td> <td>Presence of Bowman's capsule / Glomerulus / renal capsule;</td> </tr> <tr> <td>B</td> <td>Medulla</td> <td>(Sections of) collecting ducts / (Only sections of) loops of Henle / collecting ducts;</td> </tr> </table> <p>1 mark for each correct row</p>	A	Cortex	Presence of Bowman's capsule / Glomerulus / renal capsule;	B	Medulla	(Sections of) collecting ducts / (Only sections of) loops of Henle / collecting ducts;	2
	A	Cortex	Presence of Bowman's capsule / Glomerulus / renal capsule;						
	B	Medulla	(Sections of) collecting ducts / (Only sections of) loops of Henle / collecting ducts;						
(b)	<p>Any 5 from:</p> <ol style="list-style-type: none"> 1. Mention of glomerulus + Bowman's capsule; 2. Glomerulus has a high hydrostatic / blood pressure; 3. Because afferent arteriole / blood vessel is wider diameter than efferent; 4. Glomerulus <u>capillaries</u> have many small holes / fenestrations / are leaky; 5. Some correct reference to basement membrane acting as a dialysing membrane eq; 6. Allowing {small molecules / plasma minus the large proteins} to squeeze through; 7. Correct reference to function of podocytes / filtration slits; 	5							
(c)	<p>Any 3 from:</p> <p><i>Protein controlled diet</i></p> <p>High protein means (more) urea which cannot be removed; Accept High protein intake makes the blood more acidic (uric acid);</p> <p><i>Low sodium chloride</i></p> <p>Excess Salt does not need to be removed; High salt causes high blood pressure / Fluid retention / oedema;</p>	3							

Question			Marking details	Marks Available
6	(d)	(i)	A Collecting duct; C (posterior lobe) Pituitary gland; NOT anterior	2
		(ii)	Any 2 for 1 mark High solute intake or e.g. / Sweating / Low water intake / Vomiting / Diarrhoea; dehydration = neutral	1
		(iii)	Increased permeability of the collecting duct to water / more aquaporins / water channels so more water flows into the medulla (by osmosis);	1
		Question 6 Total		

Question		Marking details	Marks Available
7	(a)	<p>Any 5 from:</p> <ol style="list-style-type: none"> 1. Acetylcholine is normally hydrolysed / broken down by Acetyl Cholinesterase; 2. Organophosphates prevent the breakdown of acetylcholine; 3. So Acetylcholine remains bound to receptors on post-synaptic membrane; 4. So {synaptic transmission / action potentials} continue to be generated; 5. Sustained contraction of muscle; 6. Uncontrolled contractions of {diaphragm / intercostal muscles} interferes with breathing / OWTTE; 	5
	(b)	<p>Any 4 from:</p> <ol style="list-style-type: none"> 1. Some drugs prevent {synthesis / resynthesis} of neurotransmitter; 2. Blocking of {calcium ions / Ca²⁺} uptake; 3. Some drugs inhibit {release / exocytosis} of neurotransmitters; 4. Some drugs block receptors in post-synaptic membrane preventing neurotransmitters binding to them; 5. Sodium ion channels change shape; 6. Faster reabsorption of neurotransmitter; 7. Hyperpolarisation of post-synaptic membrane; 8. Named example: Valium / Temazepam / benzodiazepines / beta-blockers / cannabis / alcohol; 	4
		Question 7 Total	[9]

Question		Marking details	Marks Available
8	(a)	<p>A Reduced NAD (and reduced FAD) provide;</p> <p>B {Light / photon} energy excited electrons in the reaction centre provide;</p> <p>C High energy electrons / transfer of electron energy;</p> <p>D Which fuel the proton pumps;</p> <p>E proton pumps pump H⁺ into the {inter-membrane / thylakoid} cavity;</p> <p>F Creating an {electro-chemical / chemiosmotic} gradient/ pH gradient / H⁺ gradient;</p> <p>G Use of electron carriers to move electrons to next proton pump;</p> <p>H The synthesis of ATP takes place by means of a flow of protons from {inter-membrane space to matrix / thylakoid cavity to stroma};</p> <p>I (Down a) concentration gradient through the enzyme ATP {synthase / synthetase};</p> <p>J Use of oxygen as the final electron acceptor / formation of water (in mitochondrion);</p> <p>K Use of NADP as the final electron acceptor (in chloroplast);</p> <p>L Energy is released {when ATP is broken down to ADP and phosphate / terminal phosphate of ATP is hydrolysed};</p> <p>M This is linked to energy-requiring reactions / active transport, muscle contraction, synthesis of organic chemicals / drives the Calvin Cycle;</p> <p>N Called the 'universal energy currency';</p> <p>O Used by all living organisms for cellular processes;</p> <p><i>9 max if no ref to K-O</i></p> <p>Question 8 a Total</p>	[10]

Question		Marking details	Marks Available
8	(b)	<p>A Glycolysis takes place in the cytoplasm <u>and</u> does not require oxygen;</p> <p>B Glucose is phosphorylated / use of ATP;</p> <p>C The splitting of the {6C / hexose phosphate} formed into two {3C/ triose phosphate} molecules/ eq;</p> <p>D Removal of hydrogen/action of dehydrogenase enzymes;</p> <p>E Formation of reduced NAD (used in the ETC);</p> <p>F substrate level phosphorylation;</p> <p>G Yield of 4 ATP per glucose / 2 ATP per triose phosphate;</p> <p>H Net yield of 2 ATP (for cellular processes / or eg);</p> <p>I Pyruvate passes into the link reaction;</p> <p>J Which takes place in the matrix of the mitochondrion;</p> <p>K The conversion of pyruvate to acetate;</p> <p>L (As a result of) the removal of carbon / carbon dioxide / action of decarboxylase enzymes;</p> <p>M And the removal of hydrogen by the reduction of NAD / eq;</p> <p>N the acetyl group then combines with co-enzyme A;</p> <p>O And enters the Krebs cycle;</p> <p>Question 8 b Total</p>	<p>[10]</p> <p>[10]</p>

GCE BIOLOGY HB4
MARK SCHEME – SUMMER 2015

Question		Marking details	Marks Available
1	(a)	1 = respiration and 2= photosynthesis;	1
	(b)	Provides <u>aerobic</u> conditions;	1
	(c)	Decomposer / saprobiont / saprotroph;	1
	(d)	Nitrogen fixation;	1
	(e)	Nitrifying bacteria;	1
	(f)	Denitrification;	1
	(g)	Rhizobium;	1
			Question 1 total

Question			Marking details	Marks Available							
2	(a)	(i)	20/22 x 100; 90.90 / 91%% 2 marks for correct answer	2							
		(ii)	Any 2 from: Time to reach sexual maturity; time of gestation; small number of embryos developing; very small numbers at start; difficulty in finding a mate; any other valid point.	2							
		(iii)	Any 3 from: Birth control; medication, increased food production; ref. hygiene / clean water/ disposal waste; better housing; ref war; Accept immigration / emigration;	3							
	(b)	Any 3 comparisons from:		3							
		<table border="1"> <tbody> <tr> <td>Human</td> <td>Bacteria</td> </tr> <tr> <td>Longer lag phase</td> <td>Short lag phase</td> </tr> <tr> <td>Not reached carrying capacity</td> <td>Reached carrying capacity</td> </tr> <tr> <td>No stationary phase / plateau</td> <td>Stationary / plateau</td> </tr> <tr> <td>No decline / death phase</td> <td>Stationary / death phase</td> </tr> </tbody> </table>			Human	Bacteria	Longer lag phase	Short lag phase	Not reached carrying capacity	Reached carrying capacity	No stationary phase / plateau
Human	Bacteria										
Longer lag phase	Short lag phase										
Not reached carrying capacity	Reached carrying capacity										
No stationary phase / plateau	Stationary / plateau										
No decline / death phase	Stationary / death phase										
Question 2 total			[10]								

Question			Marking details	Marks Available
3	(a)	(i)	Any 2 from: facilitated diffusion / through proteins; down concentration gradient / high conc. to low concentration; passive / no energy required;	2
		(ii)	Any 3 from: Osmosis; High water potential to low water potential; partially permeable membrane; No energy required / no ATP	3
		(iii)	Facilitated diffusion into cell from glomerular filtrate; Sodium potassium pump; Active transport / ATP used;	3
		(iv)	facilitated diffusion / through proteins; glucose and amino acids diffuse with sodium ions; glucose and amino acids diffuse + glucose actively transported from PCT cells into blood;	3
	(b)	Any 3 from: More sodium and glucose absorbed from gut into blood; more glucose and sodium ions in glomerular filtrate; more sodium ions diffuse into PCT cell <i>because of higher conc. gradient</i> ; more glucose co-transported; lowers water potential, more water reabsorbed by osmosis; reference Loop of Henle / collecting ducts qual:	3	
Question 3 Total				[14]

Question		Marking details	Marks Available	
4	(a)	circle on diagram at +40; Action potential membrane depolarised / inside becomes +ve;	2	
	(b)	Synaptic vesicles only on presynaptic membrane side of synapse; Refractory period / hyperpolarisation;	2	
	(c)	(i)	Z = Schwann cell ; X = Axon / axoplasm; Y = myelin sheath / coiled membrane of Schwann cell;	3
		(ii)	Slow down; saltatory conduction would not take place / local circuit shortened;	2
	(d)	(i)	Any 3 from: Curare has a complementary shape binds to receptors on post synaptic membrane; prevents transmitter substance / acetylcholine binding; <i>post synaptic membrane</i> not depolarised / Na ⁺ ions do not move in / Na ⁺ gated channels remain closed / no action potential;	3
		(ii)	Different transmitter used to trigger contraction in heart / adrenalin used / heart is myogenic / AVP;	1
Question 4 Total			[13]	

Question		Marking details	Marks Available
5	(a)	A = Triose phosphate / TP; B = Pyruvate / pyruvic acid; C = Acetyl coenzyme A / acetate / Coenzyme A; D = NAD / NADH ₂ ; E = CO ₂ ; F = O ₂ ;	6
	(b)	(i) inner mitochondrial membrane / cristae;	1
		(ii) Hydrogen;	1
		(iii) Any 5 from: As electrons pass along the ETC energy released; used to pump protons; into inter membrane mitochondrial space; creates proton concentration gradient / electrochemical gradient / proton motive force; protons flow through / move down surface of stalked particles; provides energy for ATP synthetase / ATP synthase ; ADP + Pi to ATP; chemiosmosis;	5
Question 5 Total			[13]

Question			Marking details	Marks Available
6	(a)	(i)	Myosin / thick filaments and actin / thin filaments;	1
		(ii)	A H zone; B I band;	2
		(iii)	transmit action potential / nerve impulse into centre of fibre; so that all myofibrils contract at same time; OR Increased surface area; For increased diffusion;	2
	(b)	(i)	Heart rate goes up / increased blood supply / greater rate and depth of ventilation;	1
		(ii)	Any 2 from: Anaerobic respiration; glycolysis <u>and</u> glucose to pyruvate; pyruvate reduced to lactate by reduced NAD / NADH ₂ .	2
		(iii)	Any 1 from: Muscle fatigue / cramp; pH lowers; increased dissociation of oxyhaemoglobin / Bohr effect;	1
		(iv)	Any 2 from: Lactate {converted back into pyruvate / broken down / oxidised}; extra oxygen required; correct ref to oxygen debt; Accept Lactate diffuses into blood; taken to liver;	2
	(c)		Any 2 from: Amino acids deaminated in liver ; amino group converted into urea; rest of molecule used in respiration / alternative respiratory substrate to glucose; reduction of renal blood flow; dehydration / sweating;	2
	Question 6 Total			[13]

Question		Marking details	Marks Available
7	(a)	<p>Kidneys</p> <p>A Salt imbalance in blood+ example of salt / ion;</p> <p>B Water imbalance + effect water potential of blood;</p> <p>C High urea / toxin levels in blood / 2 from weakness, shortness of breath, lethargy, confusion, high blood pressure, nausea, drowsiness;</p> <p>D Haemodialysis qualified;</p> <p>E Urea + excess salts + water removed by dialysis fluid / dialysis fluid isotonic to blood, contains correct levels of ions, glucose and no urea;</p> <p>F Urea + excess salts + water removed by dialysis fluid;</p> <p>G Explanation of diffusion gradient maximised;</p> <p>H Peritoneal dialysis – Uses the peritoneum which acts as a natural filter that lines the abdomen;</p> <p>I Less effective, equilibrium between blood and dialysis fluid/ diffusion gradient not maintained;</p> <p>J Kidney transplant from antigenic match;</p> <p>K Immunosuppressant's increase risk of {cancer / infection}.</p> <p>L Max 7 from A-K</p> <p>L Donor left with only one kidney / opt in opt out;</p> <p>M Ethical issues using kidney from a cadaver / brain dead person / fetus;</p> <p>N Risk of rejection / surgical risk / should recipient be age limited;</p> <p>O religious objections to genetic engineering of animals / xenotransplantation / medical intervention;</p> <p>P Risks of people selling kidneys;</p> <p>Max 3 for L –P.</p> <p>Question 7 a Total</p>	<p>[5]</p> <p>[10]</p>

Question		Marking details	Marks Available
7	(b)	<p>Bacteria.</p> <p>A Viable count + counting living cells;</p> <p>B Direct count +living and dead cells;</p> <p>C One cell gives rise to one colony / number of colonies = number of viable cells;</p> <p>D Sterilisation of equipment and media;</p> <p>E One eg. of sterilising technique – autoclave / oven/ radiation;</p> <p>F Culture needs diluting by ten-fold steps;</p> <p>G Serial dilution;</p> <p>H 1 cm³ of original sample added to;</p> <p>I 9cm³ of sterile water;</p> <p>J Mixed and process repeated;</p> <p>K Known volume (or eg. such as 1cm³ / 0.5cm³) added to plates;</p> <p>L Incubated at 25⁰C for 24-36 hours;</p> <p>M Ref. temp 37⁰C pathogenic bacteria risk;</p> <p>N Count number of colonies in appropriate plate / 50 – 100 colonies;</p> <p>O Multiply by dilution factor to calculate number of cells per cm³in original sample;</p> <p>P Ref to unreliability with reference to clumping of cells / multiplication by dilution factor / repeat and use mean;</p> <p>Question 7 b Total</p>	<p>[10]</p> <p>[10]</p>

GCE BIOLOGY BY5
MARK SCHEME – SUMMER 2015

Question			Marking details	Marks Available
1	(a)	(i)	P – stigma, Q – ovary (wall) BOTH for 1 mark	1
		(ii)	Nectar;	1
		(iii)	attracts {insects / named insects};	1
	(b)	I	{ <u>Pollen / it</u> } deposited on insect;	1
		II	{ <u>Pollen / it</u> } transferred to stigma;	1
	(c)	(i)	Anther and stigma touch same part of bee;	1
		(ii)	Anthers and stigma mature at different times / protandry;	1
	(d)	(i)	Anther;	1
		(ii)	Meiosis; correct spelling	1
		(iii)	10-----5-----5;	1
		(iv)	I fertilisation / it is the gamete / formation of the endosperm; II controls the growth of the pollen tube (through the style); Accept produce enzymes (to digest the style) NOT contain / hold enzymes (to digest the style)	2
	Question 1 Total			[12]

Question			Marking details	Marks Available
2	(a)	(i)	Correct parental genotypes: BbRr BbRr; Correct gametes: BR Br bR br; Correct headings on punnet square: BR Br bR br; Correct completion of genotypes in punnet square;(ecf)	4
		(ii)	Chocolate $\frac{3}{16}$ / 18.75% and yellow $\frac{4}{16}$ / $\frac{1}{4}$ / 25%; both for 1(ecf)	1
		(iii)	$\frac{1}{4}$ /25%;	1
		(iv)	All the noses should be brown; Accept fur is black and skin is brown	1
	(b)	(i)	BBrr;	1
		(ii)	Cross with {yellow, brown nose dog / homozygous recessive / bbr} / back cross / test cross;	1
		(iii)	Yellow with a brown nose;	1
	Question 2 Total			[10]

Question			Marking details	Marks Available	
3	(a)	(i)	Produce {gametes / sex cells} / halves chromosome number / produces haploid cells / introduce <u>genetic</u> variation;	1	
		(ii)	Testes / ovaries;	1	
	(b)	(i)	X-centriole AND Y-spindle (fibre) / microtubules;	1	
		(ii)	div I 2 chromosomes in each cell 1 big 1 little; straddling equator; Ignore lack of crossing over div II 2 chromosomes in each cell 1 big 1 little; showing correct recombinants;	4	
	(c)	1 pair reversed across equator;	1		
	(d)	(i)	Prophase I; NOT prophase alone	1	
		(ii)	Drawing showing non sister chromatids <u>crossing over</u> ; and parts being exchanged; Accept correct annotations or second diagram	2	
		(iii)	Crossing over / chiasmata;	1	
	Question 3 Total				[12]

Question			Marking details	Marks Available
4	(a)	(i)	AATT and TTAA;	1
		(ii)	they have unpaired bases / they have exposed bases / they are single stranded DNA sections;	1
		(iii)	EcoR1;	1
	(b)	(i)	{Ring of / circle of / loop of} DNA (found in bacteria); Accept {additional / extra} DNA qualified	1
		(ii)	so that the cut ends (of the fragment and the plasmid) are <u>complementary</u> ;	1
		(iii)	Ligase;	1
	(c)	<ul style="list-style-type: none"> • Introns are {non-coding / blocks of repeated nucleotides} /exons code (for proteins); • so there is more variability / more unique to individual / {number of times that the blocks are repeated varies/ {STRs / VNTRs} vary / ORA for exons; 	2	
	(d)	Same position and thickness of bands;	1	
	(e)	(i)	{Makes multiple copies / amplifies} DNA; NOT replicates unqualified	1
		(ii)	<u>DNA</u> polymerase; (DNA) <u>replication</u> ;	2
Question 4 Total				[12]

Question		Marking details	Marks Available
5	(a)	All the alleles (of all the genes) in a population;	1
	(b)	(i) The harder the food the {larger / wider / deeper} the beak/ long beaks for flowers and fruits / wide beaks for eating seeds;	1
		(ii) The higher the CaM the longer the beak / low CaM results in short beak / ORA;	1
	(c)	(i) Genetic drift / founder effect / or descriptions of ; Accept mutation	1
		(ii) Any 4 from: A. Birds with (high) CaM (allele) will have longer beaks; B. (birds with longer beaks) will get <u>more</u> food from cactus flowers / better adapted for feeding; C. (more of) these birds will survive, reproduce and pass on their (high) CaM <u>alleles</u> to the next generation; D. CaM (alleles) will {become more common/ increase in frequency} in the next generation; E. use of {natural selection / selective advantage / survival of the fittest/ selection pressure} anywhere in the account, in the correct context;	4
	(d)	(i) They are not able {to interbreed / or description of interbreeding} / breed or reproduce <u>with each other</u> and produce fertile offspring;	1
		(ii) <ul style="list-style-type: none"> • geographic isolation / correct reference to allopatric speciation; • over time develop adaptations which prevent successful breeding with original population / there is no flow of genes between the two populations / or description of example e.g. courtship behaviour; 	2
	Question 5 total		

			Marking details	Marks Available	
6	(a)	(i)	(Photosynthetic efficiency is a measure of) how well a plant is able to {capture/convert} light energy (and convert to biomass / chemical energy / product) / the percentage of light captured by the plant; NOT rate	1	
		(ii)	Gross is the total {energy / CO ₂ } {transferred / fixed by plant}, net is total energy minus the energy lost in plant respiration / NPP=GPP-{Respiration / R};	1	
	(b)	(i)	The higher the temperature the higher the {NPP / dry matter productivity} and The higher the rainfall the higher the {NPP / dry matter productivity};	1	
		(ii)	Rainforest have high temperature and rainfall;	1	
	(c)	(i)	$(8820 \div 44100000) \times 100$; = 0.02(%); Correct answer = 2 marks	2	
		(ii)	$(35280 - 8820) = 26460 = 2.6 \times 10^4$ [tropical – agricultural crops] $(2.6 \times 10^4) \times (2.1785 \times 10^4) = 5.8 \times 10^8$ [multiply by area of Wales (km ²)] $(5.8 \times 10^8) \times 10^6 = 5.8 \times 10^{14}$ [convert to m ²] Correct answer = 2 marks $57643110 / 5.8 \times 10^7 = 1$ mark	2	
		(iii)	<ul style="list-style-type: none"> Energy is lost in transfer to {next trophic level / description of e.g. plants to cow}; to respiration of herbivores / movement / keeping warm / excretory products / not all plant {eaten / digested}; 	2	
		(iv)	<ul style="list-style-type: none"> (Cattle produce) {Methane / carbon dioxide} / deforestation occurs so less carbon dioxide absorbed in photosynthesis / the burning of the cut trees produces carbon dioxide; reference to greenhouse {effect / gas}; NOT global warming 	2	
		(v)	<u>Burning</u> the biofuel increases carbon dioxide in the air and <u>photosynthesis</u> removes carbon dioxide (during growth);	1	
	Question 6 total				[13]

Question		Marking details	Marks Available
7	(a)	A* <u>Transcription</u> takes place in the nucleus; Can be awarded in H if transcription is referenced	1
		B* <u>Translation</u> takes place in the cytoplasm;	1
		C DNA replication takes place in the nucleus;	1
		D (Transcription is) <u>use of</u> a DNA strand to make a <u>complementary</u> strand of mRNA / owtte;	1
		E one of the DNA strands is used as a template / use of term {sense / coding} strand;	1
		F Reference to RNA polymerase;	1
		G Description of nucleotides attaching to mRNA chain (by base pairing);	1
		H mRNA leaves the nucleus by passing through nuclear pores;	1
		I mRNA attaches to ribosomes;	1
		J Ribosomes made of rRNA / rRNA made by nucleolus;	1
		K Translation is the production of {a polypeptide chain / an amino acid chain} in an order determined by the {mRNA / original DNA} (codon);	1
		L Correct description of {tRNA / anticodon} binding to a codon;	1
		M A tRNA molecule carries an amino acid and has an anticodon;	1
		N (An enzyme catalyses) <u>peptide bond formation</u> (between the growing chain and the amino acid brought in by tRNA);	1
		O Ribosomes pass along mRNA , one codon at a time;	1
Any 10 from 15			
*Max 9 without points A or B which can be anywhere in the answer.			
Question Total			[10]

Question			Marking details	Marks Available
7	(b)	<p>A {Ovulation / release of secondary oocyte} takes place from ovary; NOT egg</p> <p>B Wall of fallopian tube transports {secondary oocyte / embryo / blastocyst} (towards uterus) <u>by ciliated epithelium</u>;</p> <p>C Sperm(atozoa) travel (from the vagina) to the fallopian tube.</p> <p>D Capacitation;</p> <p>E changes in the membrane covering the acrosome;</p> <p>F Fertilization takes place in the fallopian tubes</p> <p>G acrosome reaction;</p> <p>H Digestion of {zona pellucida / corona radiata} / release enzymes;</p> <p>I Cortical reaction / {description of / formation of} fertilisation membrane;</p> <p>J Purpose of cortical reaction - to prevent polyspermy / owtte;</p> <p>K Triggers second meiotic division of oocyte ;</p> <p>L Nuclei fuse to form <u>zygote</u>;</p> <p>M {Cleavage / Splitting / dividing} of {<u>zygote / early embryo / fertilised oocyte / fertilised egg</u>} / undergoes mitosis;</p> <p>N To form {blastocyst / hollow ball of cells};</p> <p>O {Implantation takes place / owtte} in {uterine lining / endometrium};</p> <p>Any 10 from 15</p>		
		Question total		[10]



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