GCE MARKING SCHEME

BIOLOGY - HUMAN BIOLOGY
AS/Advanced

SUMMER 2014

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 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.

GCE BIOLOGY BY1

MARK SCHEME - SUMMER 2014

Question			Marking details	Marks Available
1	(a)	(i)	Cuboidal; Kidney tubule; Accept kidney/ liver/named gland/ureter/ovary/glands	2
		(ii)	Ciliated;NOT cilia Trachea / oviduct/fallopian tube/ bronchi/bronchioles;	2
	(b)			4

B	*nucleus*	contains <u>DNA</u> which {codes for/ controls} <u>protein synthesis</u>/ transcription/ <u>DNA</u> {synthesis/replication};
C	*nuclear pores*	{Transport/movement} of {mRNA/ nucleotides/rRNA}; Accept ribosomes NOT transport of mRNA in
D	Nucleolus;	Produces {rRNA/ribosomes/tRNA}; NOT produces RNA unqualified

(c) 1

Organelle A	Nucleus
<u>Inner</u> membrane is folded / Has cristae	No folding of <u>inner</u> membrane / no cristae;
No ribosomes attached	ribosomes attached;

must be comparative

(d) Ribosomes are not attached to {membranes/ ER} in prokaryotes (some) are in animal cells; 2
Ribosomes are {larger/80S} in animal cells than prokaryotes / 70S;
must be comparative

Question 1 Total [11]

Question			Marking details	Marks Available
2	(a)		(An organ) is an {aggregation/collection} of several tissues; To carry out a {specific/particular} {function/task/job} (for the whole organism);	2
	(b)	(i)	Carbohydrates; Accept polysaccharides	1
		(ii)	Any **two** from Alternating molecules rotated through 180º form straight chains; {Cross links/hydrogen bonds/ H bonds} form between chains; forming microfibrils;	Max 2
		(iii)	Proteins/amino acids/nucleic acids/ nucleotides/ {organic/nitrogenous} bases; NOT DNA/RNA	1
			Question 2 Total	**[6]**

Question		Marking details	Marks Available
3	(a)	Iron / $Fe2^{+}$;	1
	(b)	{Four polypeptide chains / two alpha and two beta subunits}; in tertiary form are {combined/joined};	2
	(c)	Add {biuret (reagent) / copper sulphate and sodium hydroxide}; Reject boil/heat Colour changes from blue to {purple/lilac/violet};	2
	(d)	Biosensor;	1
		Question 3 Total	**[6]**

Question			Marking details	Marks Available
4	(a)		A – Phosphate; Accept phosphoric acid B – Deoxyribose; NOT pentose C – {Organic/nitrogenous} base; NOT named base (can be neutral)	3
	(b)		Uracil in RNA thymine in DNA; NOT U in RNA and T in DNA RNA is (usually) single stranded, DNA is double stranded; DNA is <u>longer</u> molecule than RNA ; Sugar is ribose in RNA, deoxyribose in DNA;	Max 2
	(c)	(i)	Interphase;	1
		(ii)	Anaphase;	1
		(iii)		3

Meiosis	**Mitosis**
<u>4</u> cells	<u>2</u> cells produced;
Haploid/ half the number of chromosomes of the parent cell	Diploid/ same number of chromosomes as the parent cell
<u>Genetically</u> different;	<u>genetically</u> identical; Accept clone

Question 4 Total **[10]**

Question		Marking details	Marks Available
5	(a)	(Method) Diffusion; (Reason) Rate is proportional to concentration; NOT graph is proportional	2
	(b)	(Increasing ion concentration) increases chance that (a molecule will) {collide with/ pass through} {pump/carrier/protein};	1
	(c)	Active transport;	1
	(d)	$\Psi_S = \Psi - \Psi_P$ / i.e. -100 -200; -300 kPa; (Must have units) Correct answer + unit = 2 marks Correct answer + no unit = 1 mark	2
		Question 5 Total	**[6]**

Question			Marking details	Marks Available
6	(a)		7/8 **nm** (must have correct units); Accept range of 6-10	1
	(b)		Vitamin A - {Dissolves in /can pass directly through} {phospholipid layer/ hydrophobic regions}; By diffusion; Glucose – Cannot pass through phospholipid layer therefore uses {protein channels/ carriers/ transport proteins/ hydrophilic channels/intrinsic proteins}; By facilitated diffusion; Accept active transport	4
	(c)	(i)	Ethanol {dissolves/emulsifies} (phospho)lipids/ denatures protein; NOT cell membranes Creates {gaps/holes/pores} in the membrane/ makes membrane more porous; NOT makes membrane more permeable	2
		(ii)	Increased temperature increases kinetic energy of {dye/membrane} molecules; Increases (rate of) diffusion (of dye across membrane)/dye diffuses across the membrane more rapidly;	2
			Question 6 Total	**[9]**

Question			Marking details	Marks Available
7	(a)		Any **two** from Product not contaminated with enzyme; Enzyme can be re-used/ small quantity of enzyme required; Can {withstand/tolerate} a wider range of pH; Can be used in a continuous process;	Max 2
	(b)		Increases (contact) time between enzymes and substrate/ more time for pectinase to digest {apple pulp/pectin}; More successful collisions/more enzyme substrate complexes formed; NOT ESC	2
	(c)	(i)	40°C to 60°C {decrease in/less} (volume of) juice extracted; NOT less juice extracted above 40 °C Above 60 °C no juice extracted; Between 40 °C and 60 °C enzymes are denaturing/ above 60°C they are denatured; Hydrogen bonds break; {Tertiary structure deformed / active site changes shape} {Substrate can no longer fit/ fewer enzyme substrate complexes formed};	Max 4
		(ii)	(Free enzymes) can move; Increased chance of successful collision / more enzyme substrate complexes formed;	2
		(iii)	(Increased juice extracted with membrane bound enzymes) because membrane bound enzymes are {more accessible/OWTTE} to substrate; (Enzymes immobilised inside bead) substrate has to {diffuse/pass} into bead;	2
			Question 7 Total	**[12]**

Question		Marking details	Marks Available
8	(a)	**Carbohydrates**	Max 10
	A	Glucose for respiration;	
	B	Starch for storage of {glucose/energy}in plants;	
	C	Cellulose for structural support in plant cell walls/ chitin in {insect exoskeleton/ fungi};	
	D	Glycogen for storage of {glucose/energy} in animals;	
	E	{Glycogen/starch} <u>insoluble</u> so no osmotic effect;	
	F	Disaccharides or named + function (e.g. sucrose for transport in plants);	
		Lipids	
	G	Saturated fatty acids for storage in animals/ unsaturated fatty acids for storage in {seeds/plants};	
	H	Thermal insulation/buoyancy;	
	I	Waxes for waterproofing in leaves;	
	J	Good source of energy, twice as many as carbohydrates or value 38 kJ per g;	
	K	Correct ref to protection of organ <u>from physical damage</u> (e.g. kidney);	
	L	Electrical insulation in neurons (ref to myelin);	
	M	Source of metabolic water from <u>respiration</u> of lipids;	
		Used to make other molecules (CHO / glucose / lipids needed to make)	
	N+	Any two for one mark each from:	
	O	Chlorophyll *with* magnesium / phospholipids *with* phosphate/ {DNA/RNA/ATP} *with* nitrogen and phosphate / amino acids *with* nitrogen/ glycoprotein *with* protein;	

Question		Marking details	Marks Available
8	(b)	**Rough Endoplasmic Reticulum**	Max 10
	A	Flattened sacs/cisternae (or from diagram);	
	B	Continuous with nuclear membrane (or from diagram);	
	C	With attached ribosomes (must be clearly labelled on diagram);	
	D	Site of {protein synthesis/translation}/transport system;	
		Golgi	
	E	Golgi consists of a {series/system/group/stack} of (dynamic) flattened sacs (diagram must show at least 3);	
	F	Function in packaging proteins (for secretion);	
	G	Vesicles containing proteins from RER fuse with Golgi membrane and contents are shed into Golgi sacs/ coalescence of vesicles;	
	H	(Contents are built into more complex molecules such as) enzymes/glycoproteins;	
	I	Other Golgi function, e.g. carbohydrate secretion/ transporting or storing lipids;	
	J	{Vesicles containing product/lysosomes} are budded off;	
	K	Ref. to exocytosis of contents; NOT in context of lysosomes	
		Lysosomes	
	L	Lysosomes contain digestive enzymes/lysozyme;	
	M	Function is to {break down worn out organelles/digest foreign material/ cause autolysis/ intracellular breakdown};	
	N	{Lysosomes/vesicles} fuse with membrane of digestive vacuoles;	
	O	Enclosed by <u>phagocytosis;</u> NOT in context of lysosomes	
		Award Max 8 if only 2 organelles described	
		Points A,B,C and E can be accepted from clear diagram	
		Question 8 Total	**[10]**

Question			Marking details	Marks Available
1	(a)		A = Capillary (network)/ capillaries ; B = Epithelial cell/ epithelium/ epithelial layer; C = Lacteal/ lymph vessel; NOT lymph node	3
	(b)		<table><tr><th>Feature</th><th>Explanation</th></tr><tr><td>Microvilli/ folded epithelium;</td><td><u>Increase/ large</u> surface area/ greater {absorption/diffusion} (of digested products); increase catalytic surface area for digestion</td></tr><tr><td>(Dense/large) <u>capillary network</u>/ {good/rich} blood supply/ lots of capillaries;</td><td>{Transport/absorb} {glucose/amino acids] / maintain a {diffusion/concentration} gradient;</td></tr><tr><td>Presence of lacteal/ lymph vessel;</td><td>Absorb {lipids/fats/ fatty acids};</td></tr><tr><td>Thin epithelium/ epithelium one cell thick;</td><td>Short diffusion pathway;</td></tr></table>	Max 4
	(c)	(i)	Mucus;	1
		(ii)	{Lubricates/ reduces friction} (for passage of food); Prevents {auto digestion of /digestion of/ autolysis of/ the effect of acid/ enzymes on} the gut wall;	2
	(d)		Peristalsis; Correct action of circular <u>and</u> longitudinal muscles/ wave of muscle contraction; {Forces/pushes/ propels} food along/mixes food (for more efficient digestion/absorption); NOT move	3
	(e)		Deamination/ amino group removed; (amino groups) to urea; remainder to {carbohydrate/ glycogen};	Max 2
			Question 1 Total	**[15]**

Question			Marking details	Marks Available
2	(a)	(i)	Loss of water <u>vapour</u>/evaporation of water; From leaf/stomata/lenticels;	2
		(ii)	Cooling effect/{supply/movement} of {mineral (ions)/water} /maintains transpiration {pull/stream} /required for photosynthesis /allows water to reach aerial parts;	1
	(b)	(i)	Prevent entry of air into <u>xylem</u>/ prevent formation of air bubble in <u>xylem</u>; Which would break {transpiration stream/ cohesive forces}/ block movement of water;	2
		(ii)	Diameter of capillary tube; Distance travelled by bubble; Time taken;	Max 2
	(c)	(i)	Xerophytes;	1
		(ii)	{High humidity/ humid atmosphere} in <u>air chamber</u>; Because {water <u>vapour</u>/humid air} not removed by wind/ water <u>vapour</u> trapped; This produces a {less steep / reduces} {water potential/ diffusion/concentration} gradient; Between inside of leaf and air chamber/ inside and outside of stoma;	Max 3
		(iii)	{Smaller/less/ rolled} leaves/spines + reduced <u>surface area</u> (exposed to environment); {Reduced number/closure of stomata} + <u>less openings</u> for water to be lost through; {Hairs on leaves/rolled leaves} + {increases humidity/ reduces {water potential/ diffusion/ concentration} gradient/ traps water <u>vapour</u>}; <u>Thick</u> cuticle + reducing <u>evaporation</u> from surface of leaf;	Max 2
			Question 2 Total	**[13]**

Question			Marking details	Marks Available
3	(a)	(i)	Adaptive radiation;	1
		(ii)	Mutation (in common ancestor); (Leads to) variation/ change of beak (shape); Becomes specialised/ adapted {to occupy a particular {niche/environment}/eat particular food}; Have a selective advantage/ are better {suited/ adapted} to a particular environment/ better chances of survival/OWTTE; (More) reproduce and pass on {genes/ alleles};	Max 4
	(b)	(i)	Humans closely related to gorillas; More amino acids <u>in common</u>/ gorilla has 572 <u>in common</u> with Humans while horse has 557/ gorilla has 2 <u>different</u> from human while horse has 17 <u>different</u>; Share <u>more recent</u> common ancestor;	3
		(ii)	Chromatography/electrophoresis;	1
		(iii)	Reduces mistakes made in classification due to convergent evolution;	1
			Question 3 Total	**[10]**

Question			Marking details	Marks Available
4	(a)		Increases surface area; Diffusion takes place (over whole area);	2
	(b)	(i)	Mouth opens/floor of buccal cavity lowered; Volume of {buccal cavity/inside the mouth} increases/pressure lowered inside {buccal cavity/mouth}; Water {pulled in from outside/ enters due to pressure difference}; Mouth closes **and** {buccal cavity then contracts/ floor of buccal cavity raises}; Water forced {across/through} gills (into gill cavity); Pressure in gill cavity increases; Forces open the operculum / gill slits;	Max 4
		(ii)	Blood flows across (gills/ filaments/ lamellae/ gill plates) in opposite direction to water; Blood always meets water containing a higher oxygen concentration/{diffusion/ concentration} gradient maintained/ equilibrium is never reached; Across entire {gill/ gas exchange surface}; Higher saturation of blood with oxygen achieved;	Max 3
	(c)	(i)	Diffusion pathway would be too long/ ensures a short diffusion pathway; Speed of diffusion too slow; To supply sufficient oxygen;	Max 2
		(ii)	Less fluid/ fluid moves into muscle fibres/ fluid level decreases; More area for gaseous exchange/ shorter diffusion pathway;	2
			Question 4 Total	**[13]**

Question		Marking details	Marks Available
5	(a)	(Phloem) parenchyma; (Phloem) fibres;	2
	(b)	<table><tr><th>Feature</th><th>Explanation</th></tr><tr><td>Presence of <u>sieve</u> {plates/pores};</td><td>Permits bidirectional flow/ permits flow {from cell to cell/ through the plant};</td></tr><tr><td>{Few/no} organelles/ {thin/peripheral} cytoplasm;</td><td>No obstruction to flow of solutes;</td></tr><tr><td>Plasmodesmata;</td><td>Allows transport of {molecules/ ATP/ sucrose} from <u>companion cell</u> (to sieve tube element);</td></tr></table> Maximum of two features with matched explanation Explanation mark only given if feature correct	Max 4
	(c)	Mass flow is {a passive process/ not an active process}; From high to low {concentration/pressure}/ down a concentration gradient; {Mitochondria/energy/ATP} not required (in a passive process);	3
		Question 5 Total	**[9]**

Question			Marking details	Marks available
6	(a)	A	(some) CO_2 {<u>dissolves</u> directly/ <u>in solution</u>} in the plasma;	
		B	(some)CO_2 {diffuses into/absorbed by} {red blood cells /erythrocytes};	
		C	(some) CO_2 combines with haemoglobin/ to form carbamino {haemoglobin/ compounds};	
		D	(most) CO_2 combines with water to give carbonic acid;	
		E	(catalysed) by carbonic anhydrase;	
		F	carbonic acid dissociates into hydrogen carbonate and hydrogen ions;	
		G	hydrogen carbonate ions pass out (into plasma);	
		H	(chloride shift) allows movement of Cl^- into red blood cells;	
		I	to maintain {electrical/ electrochemical} neutrality;	
		J	<u>increased</u> {conc/partial pressure} of CO_2 (dissolved in blood);	
		K	lowers pH of blood/blood becomes more acidic;	
		L	oxyhaemoglobin {accepts H^+/acts as a buffer};	
		M	reduces <u>affinity</u> of haemoglobin for oxygen;	
		N	<u>more</u> oxygen is released (from oxyhaemoglobin)/ <u>more</u> oxyhaemoglobin dissociates;	
		O	oxygen dissociation curve moves to the right/Bohr {shift/effect}; Accept credit from graph/ diagram	

Question		Marking details	Marks available
(b)	A	Both are tubular/contain a lumen/ OWTTE;	
	B	Both have movement by mass flow/OWTTE;	
	C	Both movement along pressure gradients;	
	D	Both movement in one direction only;	
	E	Artery transports blood, xylem water;	
	F	Movement of liquid pulsatile in arteries, smooth in xylem;	
	G	Arteries living, xylem dead;	
	H	Pressure generated by heart in arteries, no pump for xylem;	
	I	Xylem vessels contain lignin;	
	J	Xylem has support function;	
	K	{Adhesive forces/ hydrophilic lining} in xylem;	
	L	Arteries have {muscle/elastic tissue}; can be shown on diagram	
	M	Arteries distend/recoil;	
	N	Smooth endothelium of artery/ endothelium reduces friction;	
	O	Artery <u>walls</u> composed of layers;	10
		Question 6 Total	**[10]**

Question			Marking details	Marks Available
1.	(a)		Capillary;	1
	(b)		Lymph/ lymphatic fluid;	1
	(c)	(i)	Protein / (serum) albumin;	1
		(ii)	Kwashiorkor / marasmus / protein-energy malnutrition; (PEM)	1
			Question 1 Total	**[4]**

Question		Marking details	Marks Available
2.	(a)	An organism that lives **in** another (host) organism **and** {obtains nourishment (at the expense) of the host / causes damage to the host};	1
	(b)		4

	ascariasis	**schistosomiasis**
where	(Small) intestine; NOT large	Blood vessels (supplying the intestine / bladder);
entry	{Touching the mouth with hands / by ingesting food or water} + contaminated with <u>eggs</u> (from the soil) ;	Intermediate host releases infective larval forms + penetrate the skin;

	(c)	**Ascaris:** Absorb products of digestion/nutrients (from the small intestine); Infected person suffers from iron deficiency / malnutrition; **Schistosoma:** {Eats/damages/reduces} number of red blood cells; <u>Eggs</u> damage wall of {gut / bladder}; Causes bleeding (into {gut / bladder})/ blood lost in {faeces / urine};	2 max 2
		Question 2 Total	**[9]**

Question			Marking details	Marks Available
3.	(a)	(i)	Phylogenetic (tree); Accept cladogram	1
		(ii)	SIMILARITY: Both show *H. heidelbergensis* / *H. ergaster* as being {common ancestor/evolved from} of *H. sapiens* and *H.neanderthalensis;*	1
			DIFFERENCE: Model A shows *H. habilis* as the ancestor of all other hominids shown; Model A shows *H. ergaster* as the common ancestor of *H. heidelbergensis* and *H. erectus;* Model B shows an unknown common ancestor for all hominids shown; Accept reverse arguments Reject references to timescale	Max 1
		(iii)	Fossils not found as yet / insufficient (fossil) evidence (to support theory);	1
	(b)		<u>Comparison</u> of DNA {sequences/bases/composition}; greater the similarity the closer the relationship(ORA)/ human DNA may contain genes from other hominid species;	2
			Question 3 Total	**[6]**

Question			Marking details	Marks Available
4.	(a)		Teeth + reference to {chewing / grinding}/ reference to role of tongue; Contraction of {stomach/gut} wall}/ peristalsis; Accept Bile + emulsification of fats	2
	(b)		Both for **one** mark	1
		(i)	**A** amylase **C** maltas**e**	
			Both for **one** mark	1
			B maltose **D** glucose	
		(ii)	Mouth / buccal cavity + Duodenum / small intestine (both needed for **one** mark)	1
	(c)	(i)	**E** endopeptidase;	2
			F exopeptidase;	
		(ii)	**pepsinogen:** <u>hydrochloric</u> acid / HCl; Accept pepsin **trypsinogen:** enterokinase;	2
		(iii)	Less mucus produced (because cells are killed)/ mucus lining destroyed; More {HCl/acid} produced (to compensate for neutralising action of NH_3); Acid in food / HCl can {attack / damage/erode} lining of stomach (wall); Pepsin can cause <u>autolysis / self-digestion</u>;	Max 3
			Question 4 Total	**[12]**

Question		Marking details	Marks Available

5. (a)

FUNCTION	STRUCTURE
Flattens	H/ diaphragm
Become constricted	C/ bronchioles
Contain a surfactant	E/ alveoli

3

(b)

(Thin walls)	Reduce diffusion distance/short diffusion path (for gas exchange);	1
(capillaries)	In close contact to reduce diffusion distance/speed up gas exchange; Circulation {creates/establish/maintains} {diffusion/concentration} gradient; Transports gases to and from site of gas exchange; Large surface area {for gas exchange (with blood)/ so oxygen can be absorbed/ to ensure blood is saturated with oxygen};	max 2

Question	Marking details	Marks Available
(c) (i)	Max 2 if no values used Answers must be comparative	3

Breath out	Emphysema cannot breathe out as deeply as healthy/ smaller expiratory reserve (Reject EV) healthy = 1.5dm^3 emphysema = 1.0dm^3 /residual volume bigger than healthy emphysema 3.2 healthy 2.0;
Breath in	Emphysema reaches a higher max volume/ healthy max = 6 dm^3 emphysema max = 6.3dm^3 /smaller inspiratory reserve (Reject IV) healthy IV = 1.5 dm^3 emphysema IV = 1.3 dm^3 /vital capacity in healthy is higher than in emphysema Healthy = 4.0 dm^3 Emphysema 3.1 dm^3 ;
normal	Faster breathing rate / healthy = 12 per min emphysema = 16 per min /less time to {inhale / breath in} /longer to {exhale/breathe out} healthy 3s in 2s out emphysema 1s in 3s out /shallower breathing healthy Tidal Volume = 1.0dm^3 emphysema Tidal Volume = 0.4dm^3 (Reject TV)

Question	Marking details	Marks Available

(ii) For three marks the candidate needs:

- to describe one way that the lungs are damaged;
- to explain how this affects the lungs ;
- to explain the difference in breathing pattern;

DAMAGE	AFFECT ON LUNGS	DIFFERENCE
Alveoli breakdown / coalesce / merge	Reduced surface area/ Larger air spaces	Faster breathing rate (to compensate for less efficient gas exchange)
	Fewer obstructions to air flow	{Less time to inhale / breath in} (easier for air to get into air sacs)
		Higher max volume of breath (easier for air to get into air sacs)
Walls of alveoli thickened	Increase in diffusion distance	Faster breathing rate (to compensate for less efficient gas exchange)
Lung tissue less elastic/ less elastic recoil	Exhalation / breathing out more difficult	{Longer to exhale / breath out} (have to force air out of lungs)
		{Smaller expiratory reserve / can't breathe out as deeply} (can't force as much air out of lungs)
		{Smaller inspiratory reserve / can't breathe in as deeply}/ residual volume is greater in emphysema (lungs can't stretch as much)

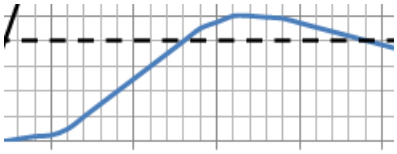
[Max 3]

Question 5 Total [12]

Question		Marking details		Marks Available
6.	(a)	**A**	Platelets / thrombocytes	2
		B	Lymphocyte (ignore ref. T or B) Reject T or B cell	
		C	Red blood cell / erythrocyte NOT rbc	
		D	Phagocyte / macrophage / granulocytes (2 ✓= 1 mark)	
	(b) (i)		Transport of oxygen (and carbon dioxide);	1
	(ii)		Candidates need to describe an adaptation + a <u>related</u> function for two marks.	max 2

ADAPTATION	ROLE IN CARRYING OUT FUNCTION
Thin;	Reduces diffusion distance;
Biconcave;	Increases surface area;
Non-nucleated;	More space for haemoglobin;
Small;	Increases surface area: volume ratio;
Contains haemoglobin;	Transporting oxygen;

	(c) (i)		Protein / toxin / cell surface /(marker) molecule; Recognised as foreign to the body/ for cell recognition; Eliciting immune response/ stimulates antibody production;	max 2
	(ii)		Recipient's blood / plasma (could) contain antibodies against {A , B, Rh /D / red blood cell / blood group} antigens; Antigen-antibody reaction / antibodies bind to the antigens on red blood cells; (Haem) agglutination / cross-link red blood cells; NOT clotting	max 2
			Question 6 Total	**[9]**

Question			Marking details	Marks Available
7.	(a)	(i)	12.5 (days)	1
		(ii)	Memory cells already present; Less antigen needed to stimulate immune response; More plasma cells produced in a shorter period of time;	max 2
	(b)	(i)	(Approximately same shape as primary immune response:) **Start at 0** at 40 days;  **Some indication of a latent period + slow increase**; **Reaches a peak** similar to primary response after 13 – 17 days (day 53 – 57) then decreases;	3
		(ii)	No prior exposure to the antigen; Produces a primary immune response / no memory cells; Has to go through a latent period; Needs time to recognise foreign antigen / for clonal expansion / clonal selection / development of humoral response;	max 2
			Question 7 Total	**[8]**

Question			Marking details	Marks Available
8.	(a)	A	{Heart/Cardiac} muscle is myogenic/ spontaneously active / external stimulus not needed to initiate contraction;	
		B	Sino Atrial node controls contraction rate (or rhythm) (of muscle cells) / initiate contraction /acts as pacemaker;	
		C	Wave of contraction/excitation spreads over atria **and** atria contract {simultaneously/ together};	
		D	Layer of {connective tissue/non conductive tissue} prevents wave of excitation spreading to the ventricles;	
		E	AtrioVentricular node transmits impulses (to ventricles);	
		F	Through Bundle of His / Purkinje fibres to {apex/base} (of ventricles);	
		G	Purkinje fibres (in the ventricle) walls carry the {wave of excitation/ impulse} upwards (through the ventricle muscle);	
		H	Ventricles contract (together) from base up;	
		I	Contraction of the ventricles is delayed after the atria contract	(6 max)
		J	(An electrocardiogram / electrocardiograph / ECG) records/ electrical {changes/activity} in the heart;	
		K	The P wave corresponds to atrial contraction/systole;	
		L	The Q, R and S waves precede ventricular contraction/ systole;	
		M	T wave represents relaxation of the ventricles/ ventricular diastole;	
		N	Compare ECG from a patient against normal PQRST trace / identify arrhythmias/ diagnose irregularities;	
		O	ONE named example: ventricular fibrillation / heart block / atrial fibrillation / bradycardia / tachycardia;	(4 max)
			Question 8 a Total	**[10]**

Question			Marking details	Marks Available
8.	(b)	A	Bacteriostatic;	
		B	Prevent bacterial growth;	
		C	Bactericidal;	
		D	Kill bacteria;	
		E	Effective against {only bacterial metabolic processes / not those of the host};	
		F	Narrow spectrum;	
		G	Affect {(metabolic) processes/ named process} found in <u>some</u> bacteria only;	
		H	Broad spectrum;	(max 6)
		I	Affect {metabolic processes/ named process} common to <u>most</u> bacteria;	
		J	(Penicillin) affects(the formation of) <u>cross linkages</u> in the {murein / peptidoglycan} cell wall/ inhibits enzyme responsible for cross linkages;	
		K	During growth / cell wall formation / cell division;	
		L	Osmotic changes cause lysis/ or description of;	
		M	Gram negative bacteria have a protective outer layer;	
		N	Containing lipoprotein **+** lipopolysaccharide;	
		O	Prevents penicillin {coming into contact with the (proteoglycan) cell wall/ inhibiting the enzyme};	(max 4)
			Question 8 (b) Total	**[10]**

Question		Marking details	Marks Available
1	(a)	{Ammonium/ammonia} **ions/** NH_4^+;	1
	(b)	*Azotobacter;*	1
	(c)	Root nodules;	1
	(d)	1. *(Rhizobium* 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 *Rhizobium/ {*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
		Question 1 total	**[6]**

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
					1
	(b)		Gram +ve PURPLE Gram –ve RED/PINK (**both** 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)		**Both for one mark** Cocci sphere/ spherical Bacilli Rod; Accept cylinder		1
				Question 2 Total	**[7]**

Question			Marking details	Marks Available
3	(a)	(i)	**Both X and Y correct for one mark** 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};	**1 for both** 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+ 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^+ 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
				Question 3 Total **[14]**

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;		2
			Label to PCT;		
	(b)		**Both for one mark**		1
			X Renal artery		
			Y Renal vein;		
	(c)		Water leaves descending limb {osmotically/by osmosis}/ Na^+ is retained in descending limb;		Max 4
			At apex Na^+ is very concentrated/ the ascending limb receives a filtrate rich in Na^+/OWTTE;		
			Na^+ {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		
	(d)		{High osmotic pressure /low water potential/ low solute potential/ high solute concentration} of <u>blood</u> detected by {**osmoreceptors/hypothalamus}**;		Max 4
			(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;		
				Question 4 Total	**[14]**

Question			Marking details	Marks Available
5	(a)	(i)	**1 mark for both** Y Cyclic photophosphorylation Z Non cyclic photophosphorylation	1
		(ii)	(High energy) electrons/electron {carriers/acceptors};	1
		(iii)	NADP → NADPH(2)/ reduced NADP;	1
		(iv)	Oxygen/ O_2/ ½ O_2;	1
		(v)	Carbon dioxide/ CO_2;	1
		(vi)	Glucose;	1
	(b)			4

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

One mark for each box

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

Question 5 Total [13]

Question			Marking details	Marks Available
6	(a)	(i)	**All three correct for one mark** Citrate 6 α-ketoglutarate 5 Succinate 4	1
		(ii)	4C oxaloacetate plus 2 C acetyl; 1C lost/ CO_2 lost {before α-ketoglutarate/ from isocitrate}/ isocitrate is decarboxylated **and** 1C lost/ CO_2 lost {from α-ketoglutarate/ before succinate} / α-ketoglutarate decarboxylated;	2
	(b)		Reduced NAD and reduced FAD pass electrons to the Electron Transport Chain; The high energy electrons/ electrons provide energy; (Used to power) proton pumps; On the inner mitochondrial membrane/cristae; Which pump H^+ into the inter-membrane space; Reduced NAD powers all 3 pumps/ Reduced FAD passes to 2^{nd} 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)	*Low with pyruvate* {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_2 needed); *High with α-ketoglutarate* 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_2);	2
(f)	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;	1
(g)	The {Krebs cycle/ link reaction/ Electron Transport Chain} is not working (as well); Pyruvate levels {build up/ increase/ higher}; (Excess) {pyruvate/$NADH_2$} is converted to Lactate;	Max 2
	Question 6 Total	**[16]**

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

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^{n};	
	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]**

Question		Marking details	Marks Available
1	(a)	Condition does not affect sensory neurons/ only motor neurons affected;	1
	(b)	Parkinson's disease caused by lack of dopamine (which is a neurotransmitter);	1
	(c)	Some strokes caused by burst blood vessels;	1
	(d)	At 37^{o}C risk of culturing pathogenic human bacteria;	1
	(e)	Prevents contamination which therefore avoid competition / toxic waste products / pathogenic bacteria / contamination of product.	1
	(f)	Keep at optimum pH for enzymes;	1
	(g)	Act as neurotransmitters in brain / modify synaptic transmission in brain.	1
	(h)	Lipopolysaccharides/ lipoprotein deposited in walls as cells age;	1
		Question 1 total	**[8]**

Question			Marking details	Marks Available
2	(a)	(i)	Two from the following for one mark Organic, protein / amino acids/ DNA/ RNA/ ATP/ nucleotides/ chlorophyll/ inorganic, ammonium ions/ nitrites/ nitrates; Reject ammonia.	1
		(ii)	C = decomposition / decay / ammonification / putrefaction; D = denitrification;	2
		(iii)	Drainage/ ploughing; encouraging aerobic conditions;	2
		(iv)	I Rhizobium;	1
			II convert atmospheric nitrogen / soil nitrogen ; Amino acids / protein; Decomposition returns ammonium ions to soil;	3
	(b)		13.6kg/ha;	1
	(c)		Any **two** from Urine; faeces; A dung. leguminous plants/ clover; wheat absorbs more/ needs more; increased drainage in ploughed fields;	2
			Question 2 total	**[12]**

Question			Marking details	Marks Available
3	(a)	(i)	A = Myelin sheath; B = Axon / axoplasm; C = Sarcolemma/ plasma membrane/ motor end plate ; Accept post synaptic membrane; D = Myofibril;	4
		(ii)	Ca^{2+} gates open; Ca^{2+} / calcium ions diffuse into synaptic knob/ neurone; Reject into membrane Synaptic vesicles move towards presynaptic membrane; Fuse with membrane; Transmitter substance / acetylcholine released into synaptic cleft; Diffuse across gap {join with/ bind to} receptors on postsynaptic membrane; Sodium gates open sodium ions diffuse into cell; Action potential generated;	Max 5
	(b)	(i)	Synaptic vesicles cannot bind to presynaptic membrane; No exocytosis / release acetyl choline into cleft + qualification of effect; Receptors post synaptic membrane blocked + qualification of effect; Sodium ion channels blocked on post synaptic membrane + qualification of effect;	Max 2
		(ii)	Enzymes destroy it / antibody attack; New synapses produced; Protein replaced; Any sensible suggestion.	Max 1
			Question 3 Total	**[12]**

Question			Marking details	Marks Available
4	(a)	(i)	Sequence of amino acids;	1
		(ii)	Two or more linked tertiary polypeptides + held together by hydrophobic interaction / ionic bonds/ hydrogen bonds;	1
	(b)	(i)	Actin;	1
		(ii)	Correct on diagram;	1
		(iii)	ADP, iP;	1
		(iv)	Allows cross bridges to form/ owtte; Clubbed head of myosin moves back and forth/ owtte; Ratchet mechanism;	3
	(c)			4

Slow Twitch	Fast Twitch
Good blood supply	Poor blood supply
High numbers mitochondria	Low numbers mitochondria
More myoglobin	Less myoglobin
Low density myofibrils	High density myofibrils
Small diameter myofibrils / fibres	Large diameter myofibrils / fibres
Low glycogen levels	High glycogen levels
aerobic / no lactic acid / low lactate tolerance	Anaerobic / lactic acid / high tolerance to lactate
Slow contraction / weak force / fatigue slowly / endurance.	Quick contraction / strong force / fatigue quickly / speed.

Question 4 Total **[12]**

Question			Marking details	Marks Available
5	(a)	(i)	Aerobic: mitochondria;	1
			Anaerobic: sarcoplasm/ cytoplasm;	
		(ii)	When oxygen use exceeds supply;	1
	(b)	(i)	Glycolysis;	4
			Accept description.	
			Pyruvic acid / pyruvate;	
			Hydrogen from $NADH_2$;	
			Reform NAD;	
		(ii)	Lowers pH;	Max 1
			Denatures enzymes/ cramp;	
			No enzymes in muscle to convert it back into pyruvate;	
	(c)		Extra oxygen required to convert lactic acid back into pyruvic acid/ to combine with hydrogen from $NADH_2$;	1
	(d)		I Obligate anaerobe;	1
			II Facultative anaerobe;	1
			Question 5 Total	**[10]**

Question			Marking details	Marks Available
6	(a)	(i)	Water absorbed into blood, water potential rises; Osmoreceptors hypothalamus; (Posterior) pituitary, releases less ADH; R anterior pituitary DCT/ collecting duct, less permeable; Less water reabsorbed, large volumes dilute urine produced;	Max 4
		(ii)	Same/ less salt but in a greater volume of urine/ Owtte;	1
		(iii)	Age; Sex; Activity levels / exterior temperature; Diet / salt intake; Previous fluid intake; mass/ weight; external temperature; normal kidney function;	Max 2
	(b)	(i)	Efferent arteriole narrower than afferent/ ORA/ ventricular systole;	1
		(ii)	Protein;	1
		(iii)	Down water potential gradient; Osmosis	2
		(iv)	10 – 6.7; 3.3kPa;	2

Question		Marking details	Marks Available
(c)	**(i)**	(circular) muscles contract, lumen gets smaller / ORA; Less difference between afferent and efferent diameter therefore pressure drops;	2
	(ii)	Increased glomerular filtration, dehydration / increased vol. Urine / damage kidney;	1
		Question 6 Total	**[16]**

Question		Marking details	Marks Available
7	(a)	A. Inner mitochondrial membrane;	MAX 10
		B. Hydrogen from glycolysis;	
		C. Link reaction or Krebs;	
		D. Reduced NAD / FAD;	
		E. Hydrogen from reduced NAD used to reduce a protein in membrane;	
		F. Hydrogen split into protons and electrons;	
		G. Electrons passed along ETC;	
		H. Energy released used to pump protons ;	
		I. Into inter membrane space;	
		J. Creates proton gradient / pH gradient/ proton motive force / electrochemical gradient;	
		K. Protons diffuse down gradient back into matrix of mitochondrion;	
		L. Through / on outside of stalked particles;	
		M. Cause ATP synthase / synthetase;	
		N. ADP + iP to ATP	
		O. Protons combine with electrons and oxygen producing water;	

Question		Marking details	Marks Available
7	(b)		
		A. Photons / light energy;	
		B. Absorbed by photosystems;	
		C. Electron from chlorophyll excited / pushed to higher energy level;	
		D. Electron acceptor passed to ETC;	
		E. Cyclic and non cyclic photophoshorylation;	
		F. ATP produced;	
		G. Photolysis of water qual;	
		H. Electrons, protons reduce NADP	
		I. RUBP fixes CO_2 ;	
		J. 2 mols GP;	
		K. ATP, $NADPH_2$ used to produce TP ;	
		L. TP to Glucose;	
		M. Calvin cycle produces lipids and amino acids;	
		N. Oxygen produced;	
		O. Ref. thylakoid membranes and stroma qual.	
		Question 8 Total	**[10]**

Question			Marking details	Marks Available
1	(a)		A – Corona radiata / follicle (cells)/ cumulus cells/ granulosa cells; B- Zona pellucida;	2
	(b)	(i)	Acrosome;	1
		(ii)	{Releases/ contains} {enzymes/proteases/carbohydrase}; To {digest/ break down/ penetrate/ soften} {corona radiata/ zona pellucida};	2
	(c)	(i)	{Splitting/dividing} of {<u>zygote/early embryo</u>} cells to form new cells;	1
		(ii)	Hollow ball of cells/ ball of {undifferentiated/ partly differentiated} cells;	1
		(iii)	The {burying/ embedding/ implanting} of the {blastocyst/ embryo} into the {uterine lining/endometrium};	1
			Question 1 Total	**[8]**

Question			Marking details	Marks Available
2	(a)	(i)	DNA molecule unwinds; Unzips/ breaks hydrogen bonds/ strands separate; (free) {nucleotides } {join/align} with {complementary bases/ A to T/ C to G};	3
		(ii)	{To join the nucleotides together/ catalyses the addition of nucleotides} to form a {new strand/ backbone/ phosphodiester bonds};	1
	(b)		Each new DNA molecule has one {original/ template} strand; And one new strand which has been {made/ synthesised/ replicated};	2
			Question 2 Total	**[6]**

Question			Marking details	Marks Available
3	(a)		40;	1
	(b)	(i)	Correct diagram; two chromosome pairs vertically orientated one of each pair on each side of the equator one pair of chromosomes bigger than the other	1
		(ii)	Correct **labelling** of chromatid, centromere, centriole, spindle fibres 2 marks for 4 correct labels 1 mark for 2 or 3 correct labels	2
		(iii)	Correct diagrams; Two chromosomes in each cell (one large and one small) Centromeres on dotted line	1
		(iv)	{Random/ independent} assortment of {chromosomes/ chromatids}/ description of {random/ independent assortment}; crossing over/ chiasmata; produces haploid cells;	3
			Question 3 Total	**[8]**

Question			Marking details	Marks Available
4	(a)	(i)	NnGg for both; NG Ng nG ng for both; correct completion of punnet square; correct ratio 9:3:3:1; correct phenotypes matched to ratio;	5
		(ii)	Correct expected number column 72 : 24 : 24 : 8;	1
	(b)	(i)	0.667/ 0.67/ ⅔;	1
		(ii)	7.82 circled;	1
		(iii)	Accept because χ^2 value is to left of {critical value/ 7.82}/ Accept because χ^2 value has probability higher than {0.05/5%}/ Accept because χ^2 value falls between {0.9/90%} and {0.8/ 80%} probability/ Accept because the probability lies between 80-90% that it is due to chance alone; *If not circled any answer for (ii) must refer to 7.82 in (iii)* ECF from chi squared table	1
	(c)		{Common phenotypes/red grey and scarlet ebony} are due to linkage/ description of linkage; {Rare phenotypes/ red ebony and scarlet grey} due to {crossing over/ recombinants};	2
			Question 4 Total	**[11]**

Question			Marking details	Marks Available
5	(a)		Restriction {endonuclease/ enzymes} used to cut (out the desired gene); The same {endonuclease/ enzyme} is used to open the plasmids; Producing {complementary/ corresponding} 'sticky ends'; Ligase is used to {join/ splice/ attach/ adhere/ anneal} gene into plasmid;	4
	(b)		Placed in sterile, (aerated) {medium/agar}; NOT soil (Allow) cells to form {callus/ mass of {undifferentiated/ totipotent cells}}; Callus is subdivided; Apply hormones to callus to differentiate into plantlets/ Plantlets {transplanted/put} into sterile soil;	Max 3
	(c)	(i)	'Roundup' will not kill crop but it will kill {other plants / weeds}; Reducing competition in the field; Allowing increased yield;	3
		(ii)	There will be increased use of herbicide; a reduction in biodiversity/ may lead to {herbicide resistant weeds/ superweeds} bioaccumulation in food chain; OR Dispersal of pollen from crops engineered for herbicide resistance to {wild relatives/ weeds}; may lead to {herbicide resistant weeds/ superweeds}; OR Dispersal of pollen from crops engineered for herbicide resistance to other crops; May contaminate organic crops; OR (GM crop) produces a new protein; Unknown effects of eating new protein;	Max 2
			Question 5 Total	**[12]**

Question			Marking details	Marks Available
6	(a)	(i)	CGC is replaced by TGC/ C is replaced by T; Amino acid cys has replaced arg;	2
		(ii)	Change in {protein/ tertiary} structure/ different protein is made; MC1R will not be stimulated (by the hormone); {Less/no} eumelanin will be produced;	Max 2
	(b)	(i)	Mice with light fur found in an environment providing {light backgrounds/sandy beaches} **AND** mice with dark fur in {forest /dark backgrounds}/ Dark fur is found in the darker background/ light fur is found in the lighter background; For camouflage/ OWTTE;	2
		(ii)	Small populations (of mice);	1
		(iii)	Mice with light fur {are less easily seen/caught by predators/ correct reference to camouflage/ have a selective advantage}; Light fur mice (survive to) reproduce and pass {allele C/ advantageous allele/ light fur allele} to next generation; Increasing the frequency of the allele; 95% of population (have allele C);	4
		(iv)	{Genetic/behavioural/geographic/allopatric/reproductive/ sympatric/ seasonal/ temporal} isolation;	1
			Question 6 Total	**[12]**

Question			Marking details	Marks Available
7	(a)		Primary: environment not previously colonised/ from bare rock; Secondary: environment has soil/previous inhabited;	2
	(b)	(i)	Acid/acidic; NOT low	1
		(ii)	<table><tr><td>feature</td><td>Betula</td><td>Ulex</td></tr><tr><td>pH</td><td>(from 3.56 to 4.24, difference of 0.68) Increases pH/makes more alkali/ makes less acidic/</td><td>(from 3.56 to 3.55 difference of 0.01) Not much/ no change/ no effect/ slight decrease;</td></tr><tr><td>Phosphorus</td><td>(from 3.88 to 4.7 difference of 0.82) Increases a lot</td><td>(from 3.88 to 4.16 difference of 0.28) Small increase;</td></tr><tr><td>Nitrate</td><td>(from 0.68 to 0.84 difference of 0.14) Increases</td><td>(from 0.68 to 2.37 difference of 1.69) Very large increase;</td></tr></table> 1 mark for valid COMPARISON of each feature	3
	(c)	(i)	*Ulex europaeus*;	1
		(ii)	The {invading /dominant/ new/ named species} {change the soil chemistry/ named change}; Giving them a competitive advantage/ competition for named resource/ existing species are at a disadvantage/ so are better suited to the environment;	2
	(d)	(i)	Climax community;	1
		(ii)	Increases;	1
		(iii)	*{C. vulgaris /E. cinerea /E. tetralix}* are disappearing from plus B and plus PS; These are surviving in plus U; Names must be included to access any marking points	2
			Question 7 Total	**[13]**

Question			Marking details	Marks Available
8	(a)	A*	Sepal/calyx –tough leaf-like- to protect more delicate parts {in bud/ when immature}/ can be coloured to attract insects/ green for photosynthesis;	
		B*	Petals/corolla - large/brightly coloured/scented - to attract insects ;	
		C	{Nectaries/nectar /sugar} to attract insects;	
		D*	Filament – thin/stalk-like/short/hooked – to hold anthers where they will come in contact with insect/ contains vascular tissue to provide anther with nutrients;	
		E	Anther-– to {produce/ contain} {haploid gametes/male gametes/pollen /microspore};	
		F*	Anther – is hollow/ has a line of weakness- description of splitting and rolling to put pollen on outside/ correct reference to dehiscence/ getting pollen onto insect;	
		G*	Pollen (grain) - sculptured exine/ has hooks – to attach to insects body;	
		H*	Stigma – {is sticky – to catch/trap pollen (grains)}/{ - secretes chemicals/sugar} – to stimulate pollen tube growth};	
		I	Style to hold stigma where it will come in contact with insects/ pollen tube {gains nutrients from the style/ digests its path though the style};	
		J	Correct reference to relative positions of anthers and stigmas to {prevent self /encourage cross} pollination;	
		K*	Ovary – {walls - to {protect/contain} developing ovule/embryo sac}/ { -secretes chemicals – pollen tube growth};	
		L*	Ovule- integuments – to protect developing embryo;	
		M	(Ovule) – tiny hole/micropyle – to allow entry of pollen tube;	
		N	Good drawing correctly labelled with at least 4 of above;	
		O	Appropriate means of ensuring cross pollination, e.g. dimorphism (single sex plants)/ protogyny (ovules mature first)/ protandry (pollen matures first)/genetic incompatibility/ chemical inhibition on the stigma;	
			To award * there must be a name, a description and a function	
			Question 8 Total	**[10]**

Question			Marking details	Marks Available
8	(b)	A	Sun is source of energy/ energy enters as light energy;	
		B	Photosynthesis converts light energy to chemical energy (in organic molecules);	
		C	{Not all light/ only some light} striking plants is used for photosynthesis;	
		D	Some {is reflected/ passes between {cells/chloroplasts}/ wrong wavelength/ is transmitted/ passes through};	
		E	Correct definition of GPP/ total (bio)mass of (organic) produce/ rate at which products are formed/ $kJm^{-2}yr^{-1}$;	
		F	Correct definition for NPP/ Mass available to primary consumers; Accept correct equation to credit E and F (GPP- Respiration=NPP)	
		G	{<u>Biomass/ plant matter/ chemical energy</u>} is transferred from producer to {herbivores/primary consumers} when it is eaten;	
		H	Not all plant is {eaten e.g. roots/ digested e.g. cellulose};	
		I	(Respiration) energy is lost as heat energy/ used for {movement/ metabolism/ active transport};	
		J	{<u>Biomass/ chemical energy</u>} is passed to {carnivores/secondary consumers};	
		K	Energy in {faeces /urine/ dead bodies} is <u>passed to decomposers</u>; NOT excretion	
		L	Carnivores are more efficient **+** protein is more easily digestible/ herbivores are less efficient **+** cellulose is less easily digestible; *Keeping animals in heated sheds with little room to move about*	
		M	Less heat energy will be lost {if the difference between body temperature and shed temperature is small/ maintaining body temperature};	
		N	Less energy will be lost in movement if the animals are prevented from moving;	
		O	More of the energy is used for making meat / eggs / milk / increasing {biomass/ size}yield;	
			Question 8 Total	**[10]**

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