



# **GCE MARKING SCHEME**

## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 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

Questions	Marking details	Marks Available
1. (a) (i)	Biosensor;	1
	(ii) Tissue;	1
(b) (i)	<p>Prokaryotic has no nucleus vs eukaryotic has a nucleus / eukaryotic has membrane bound organelles vs prokaryotic no membrane bound organelles (Accept named membrane bound organelle) / prokaryotes smaller ribosomes (70S) vs Eukaryotes larger (80S) / DNA circular v DNA in chromosomes or strands [must refer to both terms];</p> <p>Reject reference to cell wall;</p> <p>Reject reference to size;</p> <p>Reject reference to plasmid;</p>	1
	(ii) Chloroplast contain chlorophyll vs mitochondria have no chlorophyll (accept photosynthetic pigments) / grana vs no grana / stroma vs matrix / cristae vs no cristae / thylakoid vs no thylakoids / cristae vs grana / infolding of membrane in mitochondria not in chloroplasts [must refer to both structures];	1
<b>Question total</b>		<b>4</b>

Questions	Marking details	Marks Available
2. (a) (i)	<p><math>\alpha</math> glucose OH on C1 down, H up + <math>\beta</math> glucose OH on C1 up, H down; Allow HO (both for 1 mark).</p>	1
(b) (i)	<p>Cellulose –Beta Starch – alpha; (both for 1 mark). Allow symbols.</p>	1
(ii)	<p>Starch: <b>any 2</b> correct reference to amylose and/or amylopectin; glycosidic bonds (<math>\alpha</math> 1-4); molecules coil/branch (in amylopectin); NOT compact NOT: amylopectin – coiled or amylase branched easy to add/remove <u>{glucose / maltose}</u> units;</p>	2
	<p>Cellulose: <b>any 2</b> alternate units rotate / head up, head down / 180° rotation; straight chain only / no branches; NOT parallel hydrogen bonds between / reference to cross linking; gives strength or stability / forming microfibrils;</p>	2
<b>Question total</b>		<b>6</b>

Questions	Marking details	Marks Available
3. (a)	(i) Nucleotide;	1
	(ii) Phosphate / phosphoric acid / $\text{PO}_4$ / $\text{PO}_3^-$ ; NOT phosphorus / P	1
	(iii) Deoxyribose in DNA <b>and</b> ribose in RNA (both);	1
	(iv) Adenine, Thymine, Cytosine, Guanine (1 if 1 error).	2
(b)	<b>Any 4</b> Pairing described A-T and C-G (both needed); Backbone / Chains / polynucleotide formed by alternating sugar phosphate groups; two chains <u>connected</u> / <u>joined</u> by base pairs; hydrogen bonding; two chains (twisted) to form a helix / double helix; NOT alpha helix. Accept labelled diagram.	4
(c)	<u>{forming template / code / instructions}</u> for {protein synthesis / mRNA / amino acid sequence / primary structure of protein / transcription} (accept Replication in dividing cells) / NOT genetic material alone.	1
<b>Question total</b>		<b>10</b>

Questions	Marking details	Marks Available
4. (a)	<p>2 chromosomes in female cell;  1 chromosome in male cell;  Diagrams must match each other.  Accept 'chromatids' in each cell. Do not accept chromatid in male cell if chromosomes drawn in female cell or opposite.</p>	2
(b) (i)	<p>2 Chromosomes arranged on equator of spindle; (ignore orientation)  2 V shaped {chromosomes / chromatids} with centrosomes towards each centriole/pole;  Ecf from one diagram to other.</p>	2
(ii)	<p>Labelling: chromatids, centromere, spindle, centrioles, equator, cell membrane.  2 marks for 4 correct labels on either diagram;  1 mark for 3.</p>	2
(iii)	<p>To provide {genetically identical cells / clones};  Repair / replacement {<u>of cells / tissue</u>} / regeneration qualified;  NOT growth.</p>	2
(iv)	<p>Making gametes / sperm cells / sex cells / produce haploid cells for reproduction;</p>	1
(v)	<p>Meiosis / reduction division;  Spelling must be correct.</p>	1
(vi)	<p>Genetic variation (in the offspring) / restore diploid number (in zygote) OWTTE;</p>	1
(c)	<p>Fertilised eggs will develop into females, unfertilised eggs into males; (both for 1 mark);  Accept: fertilised will give genetically varied ants, unfertilised would give clones;  IGNORE haploid / diploid.</p>	1

**Question total 12**

Questions	Marking details	Marks Available
5. (a)	(i) OH and H removal shown on diagram; formation of water (H <sub>2</sub> O) shown; dipeptide correctly drawn with C joined to N;	3
	(ii) Condensation;	1
	(iii) Peptide; NOT dipeptide;	1
(b)	(i) Mosaic: <u>Proteins</u> are scattered (in lipid layer); Fluid: molecules / components / (phospho)lipids / proteins are free to move around;	2
	(ii) B;	1
	(iii) Drawing shows a lipid bilayer with A and B in the correct places, B intrinsic (through the middle) A extrinsic (on top or bottom, outside phosphate heads); Need not use N and P, but must be clear which is A and B any 1 correct label from phospholipid / hydrophobic / hydrophilic / cholesterol / phosphate (head) / lipid or fatty acid (tails);	1
	(iv) <u>Cell</u> {recognition / interaction / identification / cell to cell recognition / adhesion / signalling} / receptor qualified e.g. {hormone receptor / antigens};	1
(c)	(i) Secondary;	1
	(ii) Ribosomes / rough endoplasmic reticulum; Accept nucleus; NOT golgi body / nucleolus.	1
(d)	(i) Endocytosis (accept phagocytosis / pinocytosis); NOT exocytosis.	1
	(ii) Any 2: Diffusion / osmosis; Facilitated diffusion; Active transport;	2

Questions	Marking details	Marks
		Available
6. (a) (i)	0.4M; no units no marks.	1
	(ii) -1052 (kPa); allow ECF	1
(b)	correct reference to osmosis;  bathing solution {has a lower water potential / is more concentrated / is more negative / hypertonic} than the water potential of beetroot cells / ORA;  water leaves / moved {out of / from} cells / into bathing solution;  bathing solution became less dense / lighter than original sucrose solution;  REJECT reference to water moving into or out of the drop.	4
(c)	-790 = -1100 + $\Psi_p$ ;  $\Psi_p = 310$ kPa;  2 marks for correct answer.	2
(d) (i)	Diagram shows cell plasmolysed (any stage);  Mark diagram using labels.  No labels = 0 marks.  Any <b>2</b> correct labels from  cell wall; plasma / cell membrane (part or all of which must be away  from cell wall); tonoplast or vacuolar membrane; vacuole;  IGNORE incorrect labels.	1
	(ii) Plasmolysed / plasmolysis;	1
<b>Question total</b>		<b>12</b>



Questions	Marking details	Marks
		Available
7. (a)	A Nucleus;	1
	B Contains DNA code for amino acid sequence; NOT genetic information alone;	1
	C Carries out transcription / makes RNA copy;	1
	D Nucleolus;	1
	E Makes ribosomes / organises transcription / makes rRNA;	1
	F { <u>Rough</u> ER / Ribosomes} { translate mRNA / put amino acids together / protein synthesis};	1
	G Endoplasmic reticulum;	1
	H Transports protein;	1
	I (To) Golgi;	1
	J Packages protein into vesicle;	1
	K Modifies protein or description;	1
	L <u>Secretory</u> vesicle;	1
	M Vesicle migrates towards plasma membrane; (can award M and N if use vesicle instead of secretory vesicle)	1
	N Vesicle fuses / merges with plasma membrane;	1
	O Contents of vesicle emptied by <u>exocytosis</u> ;	1
<b>Question total</b>		<b>10</b>

Questions	Marking details	Marks Available
7. (b) A	Temperature;	1
B	description of (exponential) increase to optimum / maximum / certain temperature then (sudden) decline / sketch graph showing;	1
C	Increasing temperature increases rate because of increased energy / moving molecules faster / kinetic energy / ORA;	1
D	{Increasing frequency of / more / more likely} <u>successful</u> collisions / Enzyme Substrate Complexes forming / ORA;	1
E	pH;	1
F	description of optimum pH and declining activity further from optimum in both directions / sketch graph / optimum pH and narrow range;	1
<b>(Award G, H, I, J in context for Temp and/or pH )</b>		
G	(3D) <u>shape</u> of <u>active site</u> changes;	1
H	Changing away from optimum affects bonds holding <u>tertiary</u> structure / structure of enzyme molecules;	1
I	Correct reference to hydrogen / covalent / ionic bonds; NOT disulphide / peptide	1
J	Substrates do not fit into active site / is not complementary (so rate reduced);	1
K	Substrate concentration; NOT amount;	1
L	Enzyme concentration; NOT amount;	1
(Award M,N, O in context for Enzyme conc and/or Substrate conc)		
M	Activity increases up to maximum when it levels off / sketch graph showing / ORA;	1
N	Increasing substrate / enzyme conc. increases number of active sites occupied / Enzyme Substrate complexes / successful collisions / ORA;	1
O	Maximum rate when <u>all</u> active sites <u>occupied</u> / <u>saturated</u> correct reference to limiting factors;	1

## GCE BIOLOGY BY2

Questions	Marking details	Marks Available
1.	Fungi; Animalia / animal; Protoctista; Accept Protists; Prokaryotae / Monera; NOT bacteria; Plantae/plant;	
<b>Question total</b>	<b>5</b>	

Questions	Marking details	Marks Available
2. (a) (i)	A Alveoli/alveolar sacs; B Capillary (network); Both for 1 mark.	1
(ii)	C Pulmonary artery; D Pulmonary vein; Both for 1 mark.	1
(b)	<b>Any 2</b> Thin <u>alveolus</u> (walls) /one <u>cell</u> thick; NOT membrane or thin alone. Large surface area / highly folded; (volume – neutral) Large number of capillaries (or implied);	2
(c)	Contraction of <u>intercostal</u> muscles <b>and</b> diaphragm OR ribcage moves up and out <b>and</b> diaphragm flattens / contract; Increased volume <b>and</b> decreased pressure <b>so</b> air moves in(to lungs);	2
<b>Question total</b>		<b>6</b>

Questions	Marking details	Marks Available
3.	Parasites <u>{live in / on a}</u> host and obtain nourishment {at the expense of / do harm to} the host; NOT feed (can be neutral) Tapeworm / ticks / leeches / fleas / headlice / roundworm / plasmodium / malaria parasite / any parasite;	2
	Autotrophs use {(simple) inorganic molecules / carbon dioxide and water} to synthesise {(complex) organic compounds / named organic compound / sugars}; NOT food Plant / named Plant / Algae / Bacteria must be qualified by <u>chemosynthetic</u> ;	2
	Saprobionts {secrete enzymes onto the food outside the body / feed by extracellular digestion} <u>and absorb</u> ( or e.q.) the (soluble) products (by diffusion); NOT ingest Bacteria / Fungi / or named;	2
<b>Question total</b>		<b>6</b>

Questions	Marking details	Marks Available
4. (a)	A <u>Right</u> atrio-ventricular / tricuspid.	1
	B <u>Left</u> AV valve / bicuspid / mitral	1
	Award one mark for identifying both Atrioventricular Valves but not right and left.	
	C Semi lunar valves.	1
(b)	Coronary; Supplies oxygen / blood to the heart <u>muscle / wall / tissue / cells</u> OR correct function for vein;	2
(c) (i)	Valve {exposed to / works at} a <u>higher</u> pressure (in left ventricle)/ {Right ventricle pumps blood at / valve A exposed to} <u>lower</u> pressures (to lungs);	1
(ii)	Blood leaks back (from ventricle) <u>to atrium</u> ;	1
(iii)	Breathlessness / fluid retention / fatigue / rapid or irregular heartbeat / blue lips / oedema / lower bp / faint / heart murmur;	1
	<b>Question total</b>	<b>8</b>

Questions	Marking details	Marks
		Available
5. (a)	(Gill) lamellae / filaments / plates;	1
(b)	<p><b>Any 3</b></p> <p>Large surface area (for diffusion); (volume neutral)</p> <p>Thin / short diffusion pathway;</p> <p>Permeable;</p> <p>Good blood supply or implied; NOT transport system</p> <p>NOT moist.</p>	3
(c)	<p>Water is forced over the gill by {ventilation mechanisms / pressure differences / continuous swimming};</p> <p>Unidirectionally / one way flow;</p> <p>Countercurrent flow of blood and water / or description of;</p> <p>{Diffusion / concentration} gradient is maintained or description of;</p> <p>over the entire gill surface;</p> <p>High affinity Hb;</p>	4
<b>Question total</b>		<b>8</b>

Questions	Marking details	Marks
		Available
6. (a)	A Capillaries; NOT blood vessels;	1
	B Epithelium / epithelial cells; NOT endothelium;	1
	C Lacteal; NOT lymph;	1
(b)	D Arteriole;	1
	E Venule;	1
(c)	Microvilli:	1
	Increase SA for diffusion / uptake of molecule / digestion (of molecules);	1
	Mitochondria:	1
	(Synthesis of) <u>ATP for active transport</u> ;	1
(d)	Goblet cell / mucus secreting cell; NOT Brunner's gland.	1
	Secretes / makes mucus; Accept even if named incorrectly above.	1
<b>Question total</b>		<b>11</b>



Questions	Marking details	Marks Available
7. (a) (i)	<p><b>Any 3</b></p> <p>Has a reduced surface area / surface area:volume ratio;</p> <p><u>Thick cuticle</u>;</p> <p>Curled / rolled (downwards with the stomata inside);</p> <p>Hairs (to trap water vapour);</p>	3
	<p>(ii) Any scientifically correct explanation of their chosen feature /</p> <p>cuticle – comment on waterproofing /</p> <p>curled – trapping water /</p> <p>SA – less area over which water can be lost /</p> <p>stomata – trapping water vapour;</p>	1
(b)	Xerophyte;	1
(c) (i)	<p>Xylem;</p> <p>Transports water (and minerals);</p>	2
	<p>(ii) Phloem;</p> <p>Transports carbohydrates / sugars / products of photosynthesis /</p> <p>sucrose / amino acids;</p> <p>Not glucose/nutrients</p>	2
	(iii) Endodermis / starch sheath.	1
	<p>(iv) Decent diagram of endodermis cell;</p> <p>Endodermis – with Casparian strip/band clearly labelled;</p>	2

Questions	Marking details	Marks Available
(v)	<p data-bbox="379 304 461 331"><b>Any 4</b></p> <p data-bbox="379 371 970 398"><u>Waterproof</u> / Casparian strip / band / suberin;</p> <p data-bbox="379 439 762 465">Blocks the apoplast pathway;</p> <p data-bbox="379 506 1142 600">Selective uptake / Active uptake / transport of minerals (by endodermis cells);</p> <p data-bbox="379 640 683 667">Into symplast pathway;</p> <p data-bbox="379 707 927 734">Active transport of minerals into pericycle;</p> <p data-bbox="379 775 719 801">Water follows by osmosis;</p> <p data-bbox="379 842 970 869">Water and minerals move into xylem vessels;</p>	4
<b>Question Total</b>		<b>16</b>

Question	Marking details	Marks Available
8. (a)	<p>A. Reference to Asexual <b>and</b> sexual;</p> <p>B. Asexual produces offspring that are genetically identical / clones;</p> <p>C. By mitosis;</p> <p>D. Allows (rapid) colonisation in favourable / stable conditions OR outcompetes (slower) sexual reproduction;</p> <p>E. But if conditions / or e.g. such as temp change / unstable or disease occurs;</p> <p>F. All individuals may die / none may have resistance / species may not be able to adapt;</p> <p>G. Sexual reproduction produces offspring that are genetically different;</p> <p>H. (Gametes) produced by meiosis;</p> <p>I. Genetic variability allows a species to adapt to environmental change /evolution;</p> <p>J. Slower/needs a partner (usually) / asexual faster;</p> <p style="text-align: right;"><b>7 Max</b></p> <p>K. Relationship with animals / insects for pollination;</p> <p>L. Relationship with animals / insects for seed dispersal;</p> <p>M. Pollen can survive dessication / without water;</p> <p>N. Seed with stored food enables the embryo plant to grow until leaves form / are exposed to sunlight;</p> <p>O. Seed has a resistant (coat) to withstand adverse conditions;</p> <p style="text-align: right;"><b>3 Max</b></p>	
<b>Question total</b>		<b>10</b>

Question	Marking details	Marks Available
8. (b)	<p>A. Transpiration is the loss/evaporation of water (vapour) from (inside) the leaves (and stem) of a plant;</p> <p>B. Through stomata;</p> <p>C. Down a water potential gradient;</p> <p>D. <u>High</u> TEMPERATURE increases (Rate of) Transpiration / ORA;</p> <p>E. Correct explanation of effect of temp / increased kinetic energy / rate of movement of water molecules;</p> <p>F. <u>Increased</u> AIR MOVEMENT / eq which increases (Rate of) Transpiration / ORA;</p> <p>G. Correct explanation of effect of wind / increasing diffusion gradient;</p> <p>H. <u>High</u> HUMIDITY which decreases (Rate of) Transpiration / ORA;</p> <p>I. Plus correct explanation / decreased diffusion gradient;</p> <p>J. <u>High</u> LIGHT INTENSITY which increases (Rate of) Transpiration / ORA;</p> <p>K. Because it causes stomatal opening;</p>	<b>7 Max</b>
	<p>L. Set up under water / with a continuous column of water / make sure air cannot get in / it is air tight / equilibration;</p> <p>M. Any description of how to change one factor / may be apparent on diagram;</p> <p>N. Volume of water / movement of bubble taken up per unit <u>time</u> is measured;</p> <p>O. To give a (close) approximation of transpiration rate;</p>	<b>3 Max</b>

**Question Total 10**

## GCE HUMAN BIOLOGY HB2

Question	Marking details	Marks Available
1. (a)	Amylase; Maltose; Maltase; Glucose; Hydrolysis / hydrolytic;	5
<b>Question total</b>		<b>5</b>

Question	Marking details	Marks Available
2. (a)	Protein / cell surface marker / polysaccharide; Stimulates immune response / antibody production;	2
(b)	Recognised / detected by specific B cells / lymphocytes; Ref. T helper cells; Antigen / binding receptor sites / immunoglobulins on B cells; Antigen presentation; Clonal selection; B cell clones itself / clonal expansion / proliferation; Ref plasma cells releasing antibody;	4
(c)	(i) Greater antibody concentration in the blood; More rapid increase / response; Less decline in antibody concentration from the peak / remains longer in the blood; Shorter <u>latent</u> period for second injection;	2
	(ii) Memory cells present from first injection; Multiply rapidly; Produce large numbers of plasma / B cells; Leads to more rapid response / more antibody produced;	2
<b>Question total</b>		<b>10</b>

Question	Marking details	Marks Available
3. (a)	(i) A = alveoli; C = <u>ciliated</u> epithelium;	2
	(ii) Large surface area; Increases gaseous exchange / uptake of oxygen;	2
	(iii) Pressure changes in bronchioli / lung; Prevents passageway from closing / collapsing / keep passageways open; Which would prevent passage of air;	2
(b)	(i) Breathlessness / wheezing / shortness of breath; Difficulty breathing <u>out</u> ; Inability to move / confined to bed / lack of energy / tiredness;	2
	(ii) Walls broken down / coalesce; Forming large spaces / decrease in surface area / larger alveoli; Thicker walls;	2
	(iii) Trace showing less tidal volume; Longer exhalation trace;	2
	(iv) Age; Sex; Weight;	2
<b>Question total</b>		<b>14</b>

Question	Marking details	Marks Available
4. (a)	Causes Bohr {shift/effect} / dissociation curve moves to right; CO <sub>2</sub> combines with water to form carbonic acid / HCO <sub>3</sub> <sup>-</sup> ; Dissociation to form H <sup>+</sup> and HCO <sub>3</sub> <sup>-</sup> ; Hydrogen ions combine with haemoglobin; Haemoglobinic acid formed / haemoglobin reduced; Decreases affinity for oxygen; <u>More</u> oxygen released / cannot hold as much oxygen; NOT quicker / more easily.	Max 4
(b)	(i) Foetal haemoglobin 54/55% <u>and</u> normal haemoglobin 35/36%. Both for one mark;	1
	(ii) Greater affinity for oxygen; More saturated than maternal / normal haemoglobin; At all partial pressures of oxygen; Oxygen will (always) pass from maternal to foetal haemoglobin;	3
	(iii) Oxygen store; OWTTE.	1
<b>Question total</b>		<b>9</b>



Question	Marking details	Marks Available
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5. (a)

	Name of structure	Function in absorption
<b>B</b>	Capillary;	(Absorption of) glucose / amino acids;
<b>C</b>	Lacteal;	(Absorption) glycerol / fatty acids / fats / triglycerides;
<b>F</b>	Microvillus;	Large surface area / carrier proteins / increase rate of uptake;

6

(b) (i) Epithelial;

1

(ii) Prevents digestion of surface by enzymes / autolysis / acid;  
Neutralises acid / provides optimum pH for enzymes;  
Lubricates / reduces friction from the passage of food;

2

(c) (i) Lymphatic system;

1

(ii) Hepatic portal vein;

1

(d) Blood clotting / colour change difficult to observe;

1

**Question total 9**

Question	Marking details	Marks Available
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6. (a)

Position	Time from start of wave(s)
SAN	
AVN	
Bundle of his	0.165;
Base of ventricles	0.205;
Top of ventricles	

2

(b) Continues beating after removal from body;

1

(c) Allows atria to complete contraction / completely empty;

3

Before wave passes to ventricles

/ before ventricles begin to contract;

Otherwise ventricles would not completely fill;

(d) All blood forced out / if contraction was from top some blood would

2

remain;

Via aorta and pulmonary artery;

All of muscle contracts with greater force

/ pressure from base upwards;

AV valves forced shut;

(e)

Cardiac control	Action of heart muscle	ECG activity
	atria contract / systole;	
		QRS wave/complex;

2

**Question total 10**

Question	Marking details	Marks Available
7. (a)	<p>A = Caused by a bacterium;</p> <p>B = Airborne droplets / coughed out;</p> <p>C = Breathed into lungs;</p> <p>D = Easily spread in crowded places / close contact;</p> <p>E = Pasteurisation of milk;</p> <p>F = X-ray screening;</p> <p>G = Isolation of patients;</p> <p>H = Use of antibiotics;</p> <p>I = Range of antibiotic used to prevent resistance;</p> <p>J = BCG / BCQ tests / Heaf / skin tests for natural immunity;</p> <p>K = BCG vaccine given (to non-resistant individuals);</p> <p>L = Vaccine is attenuated form of bacterium;</p> <p>M = Health checks at ports / airports OWTTE;</p> <p>N = Disease notifiable;</p> <p>O = Increase in number of cases linked to AIDS/HIV;</p>	10
<b>Question total</b>		<b>10</b>

Question	Marking details	Marks Available
7. (b)	<p>A = Prokaryotes are unicellular organisms;</p> <p>B = No cellulose cell wall / Murein;</p> <p>C = No membrane bound internal structures / organelles / no nuclear membrane;</p> <p>D = Protoctista possess membrane bound organelles;</p> <p>E = No tissue differentiation;</p> <p>F = Fungi consist of hyphae / mycelium;</p> <p>G = Cell wall of chitin;</p> <p>H = Reproduction is by spores;</p> <p>I = Plants carry out photosynthesis/ autotrophic;</p> <p>J = Possess chloroplasts / membrane bound organelles;</p> <p>K = Cellulose cell walls;</p> <p>L = Animals are <u>heterotrophic</u>;</p> <p>M = Show nervous co-ordination;</p> <p>N = cells lack a cell wall;</p> <p>O = Names of five Kingdoms;</p>	10
<b>Question total</b>		<b>10</b>

## GCE BIOLOGY BY4

Questions	Marking details	Marks Available
1. (a) (i)	28.0 - 13.8/13.8 OR 14.2/13.8; 102.9 / 103%; (2 marks for correct answer) (1 mark for calculation if answer incorrect)	2
(ii)	Any 2 from: Genes switched on; Synthesis of enzymes / protein synthesis; Replication DNA; Cells increase in size / storage of nutrients; Digestion / absorption; Getting used to new medium / OWTTE; NOT reference to small number	2
(iii)	Population grows at an increasing <u>rate</u> / <u>doubles in unit time</u> / is growing logarithmically; NOT birth rate.	1
(iv)	{Competition for / Lack of} nutrient; build-up of waste products; oxygen supplied; Accept ref to competition with other species / predation (qualified); Accept carrying capacity has been <u>exceeded</u> .	2

Questions	Marking details	Marks Available
(b)	<p><b>Any 3</b> from</p> <p>Suitable / optimum / stated / best / temperature;</p> <p>Suitable optimum / stated / best / pH;</p> <p>Source of carbon / named carbohydrate / sugar / lipids / glycerol;</p> <p>Source of nitrogen / amino acids / nitrates / ammonium;</p> <p>Or nutrients (1 mark alternative if above not named);</p> <p>Mineral ions;</p> <p>Absence of Oxygen / anaerobic conditions;</p> <p>If state oxygen <u>needed</u> = Max 2 marks.</p>	3
(c)	<p>234 x 10 000;</p> <p>2.34 million / 2 340 000; (2 marks for correct answer / 1 for calculation if answer incorrect)</p>	2
(d)	<p>Sterile equipment / autoclave equipment;</p> <p>Flame loop;</p> <p>Disinfectant bench;</p> <p>Flame neck of tube;</p> <p>Work next to flame / updraft;</p> <p>Ref to lid of petri dish;</p> <p>NOT wash hands / wear lab coat / shut windows</p>	2
<b>Question total</b>		<b>14</b>

Questions	Marking details	Marks Available
2. (a)	<p>(i) A Dorsal root <u>ganglion</u>;</p> <p>B Central canal / spinal canal / (accept Cerebro Spinal fluid);</p> <p>C Ventral root;</p> <p>D Spinal nerve/ nerve (fibres) / collection of neurones;</p>	4
	<p>(ii) White matter made of myelin (sheath) / Schwann cells / lipid / phospholipid;</p> <p>NOT fat.</p> <p>Grey matter made of cell bodies / nuclei;</p>	2
(b)	<p>(i) 1 mark for each neurone correctly labelled and in correct position, including position of cell bodies.</p> <p>Sensory neurone – labelled, connecting receptor to grey matter, passing through dorsal root, with correct cell body;</p> <p>Relay nerve – labelled, connecting sensory and motor, inside grey matter;</p> <p>Motor nerve – labelled, connecting relay to effector, through ventral root on opposite side;</p> <p>Reject continuous line.</p>	3
	<p>(ii) Dendrite conducts {impulse / electrical signal / action potential} towards {cell body / nucleus}, axon conducts away from {cell body / nucleus};</p> <p>NOT message / information.</p>	1
<b>Question total</b>		<b>10</b>

Questions	Marking details	Marks Available
3. (a) (i)	<p>A Glycolysis;</p> <p>B Calvin cycle / light independent reactions;</p> <p>C Krebs cycle / citric acid cycle / tricarboxylic acid cycle (Accept TCA cycle);</p>	3
(ii)	<p>Different places within <u>cell</u>; NOT different places in the chloroplast;</p> <p>Different enzymes;</p> <p>A Cytoplasm / glycolysis takes place in cytoplasm;</p> <p>B Chloroplast / calvin cycle takes place in chloroplast;</p> <p>C Mitochondria / krebs cycle takes place in mitochondria;</p> <p>Reference membrane separation / compartmentalisation;</p>	3
(iii)	<p>Dependent;</p> <p>Grana / thylakoid (membranes);</p> <p>NADPH<sub>2</sub> / reduced NADP / NADPH; } can be either way round</p> <p>ATP; }</p>	4
(b)	<p>Oxygen;</p> <p>Organic materials / compounds / named organic material / fixing carbon;</p> <p>NOT nutrients / food / ref to CO<sub>2</sub>.</p>	2
(c) (i)	<p>DNA;</p> <p>Nucleic acids;</p> <p>RNA;</p> <p>chlorophyll;</p> <p>ATP;</p> <p>NAD;</p> <p>FAD;</p>	1
(ii)	<p>Chlorophyll;</p> <p>NOT chloroplast.</p>	1
<b>Question total</b>		<b>14</b>



Questions	Marking details	Marks
		Available
4. (a)	Response controlled by relative length of the light and dark periods; Accept Response controlled by relative length of the {light / day} / {dark / night} periods;	1
(b) (i)	{Photoperiod / duration of light / day length} detected by <u>leaf</u> OR only one leaf needs to be exposed to light for flowering to occur; Makes {Hormone / plant growth substance / chemical / florigen}; High PFR / P730;	2
(ii)	Expose whole plant / leaf to short day periods;	1
(c)	Hormone same in all species / both plants; Transported from long day to short day plant; In phloem;	3
<b>Question total</b>		<b>7</b>

Questions	Marking details	Marks Available
5. (a) (i)	<p>(Stimulation) causes sodium ions to {move in / diffuse};            NOT active transport.            Inside becomes less negative / <u>some</u> depolarisation;            Threshold not reached / Ref to 'all or nothing' law;            Sodium voltage gated channels remain closed / no action potential;</p>	3
(ii)	<p>Sodium ions in; NOT pumped / active transport;            Threshold reached;            Sodium (voltage gated) channels open;            Depolarisation;            Inside becomes +ve / (from -60 to) +40mV;            Action potential;            Sodium (gated) channels close <u>and</u> Potassium channels open;            K<sup>+</sup> move (down concentration gradient) / diffuse out;            Repolarised;            Ref hyperpolarisation / refractory period;            sodium potassium pump restores resting potential;</p>	6
(b)	<p><u>Excitatory</u>            Mimic normal transmitter;            Inhibit breakdown of transmitter / cholinesterase;            Blocks uptake back into presynaptic knob;            Increases number of receptors on post synaptic membrane;</p>	2
	<p><u>Inhibitory</u>            Prevent exocytosis / stop release of transmitter substance;            Bind with receptors on post synaptic membrane and block it;            Prevents Ca<sup>2+</sup> entry into presynaptic knob;</p>	2
<b>Question total</b>		<b>13</b>

Questions	Marking details	Marks Available
6.	Endocrine; Homeostasis; Negative feedback; Hypothalamus; {Water / solute} potential; <u>Posterior</u> pituitary; Blood; Collecting duct / distal convoluted tubule; NOT DCT; Receptors / glycoproteins; Osmosis; Tissue fluid; Urine;	12
<b>Question total</b>		<b>12</b>

Questions	Marking details	Marks Available
7. (a)	<p>A Afferent vessel wider than efferent; NOT bigger.</p> <p>B Increase in blood pressure;</p> <p>C Gaps / pores between / in endothelial cells;</p> <p>D Gaps / pores in basement membrane;</p> <p>E Podocytes <u>feet / filtration slits</u>;</p> <p>F Ultra filtration {into Bowman's capsule / from glomerulus};</p> <p>G Example of substance which can pass through <u>and</u> one which cannot;</p> <p>H Proximal convoluted tubule cells have microvilli to give large surface area / Folded base membrane / basal channels;</p> <p>I Large numbers mitochondria for active transport / ATP synthesis;</p> <p>J Selective re-absorption in proximal convoluted tubule;</p> <p>K Ascending limb loop of Henle pump Na<sup>+</sup> / out;</p> <p>L But impermeable to water;</p> <p>M Decreases water potential in medulla;</p> <p>N Descending limb permeable to water / water moves out by osmosis;</p> <p>O Collecting duct walls receptors for ADH;</p> <p>P Collecting duct / distal convoluted tubule walls variable permeability / OWTTE;</p>	

**Question total      10**

(b) Similarities

- A Both involve transport of electrons;
- B {ETC / cytochrome chain / carriers} in membrane;
- C Energy released used to pump;
- D Protons;
- E Creates Proton gradient / pH gradient across the membrane;
- F Protons diffuse down concentration gradient;
- G Stalked particles / ATP synthetase;
- H ref to Chemiosmosis in correct context;

Differences

	RESPIRATION	PHOTOSYNTHESIS
I	Substrate level phosphorylation /	No Substrate level phosphorylation;
J	Electrons from hydrogens produced in respiration / reduced carriers /	Electrons come from chlorophyll / water;
K	Hydrogen from glucose / fats / amino acids /	OR Production of NADPH <sup>+</sup> increases the proton gradient;
L	Electrons combine / reduce H <sup>+</sup> and O to form water / oxygen is final electron acceptor;	
M		Cyclic phosphorylation - electrons back to chlorophyll/ {Non cyclic to NADP / final electron acceptor is NADP};
N	Chemiosmosis occurs - Mitochondria, inner membrane /	on the thylakoid membranes (of the chloroplasts);
O	Low pH / H <sup>+</sup> mitochondria inter membrane space /	Chloroplasts thylakoid cavity;
P	3 (types of) proton pump in mitochondria /	1 (type of) proton pump in chloroplasts;

Question total

10

## GCE HUMAN BIOLOGY HB4

<b>Question</b>	<b>Marking details</b>	<b>Marks Available</b>
1. (a)	All correct for 3 marks, 3 correct for 2 marks, 2 correct for 1 mark.	3

<b>Letter</b>	<b>Name</b>
A	Relay / connector neurone
B	Grey matter
C	Dorsal root ganglion
D	Central Canal / CSF

(b)	Arrow drawn on sensory neurone away from receptor AND on motor neurone towards effector;	1
(c) (i)	Node of Ranvier;	1
(ii)	Electrical insulation / Speeds up impulse transmission / Saltatory conduction;	1

**Question total      6**

Question	Marking details	Marks Available
2. (a)	Thylakoids / thylakoid membrane / Granum;	1
(b)	<u>Photophosphorylation</u> ;	1
(c)	Nucleotide;	1
(d)	<p><b>Any 3</b> from</p> <p>Photolysis/splitting of water;</p> <p>Replaces electrons lost from {chlorophyll / PSII};</p> <p>Provides {protons / H<sup>+</sup>};</p> <p>To reduce NADP / ATP synthesis;</p>	3
<b>Question total</b>		<b>6</b>

Question	Marking details	Marks Available
3.	(a) (i) Nitrification;  (ii) Denitrification;	2
(b)	<b>Any 3</b> from Atmospheric nitrogen turned into <u>{ammonium ions / ammonia}</u> ; By <u>nitrogen fixation</u> / nitrogen fixing bacteria; By <i>Rhizobium</i> in root nodules (of leguminous plants); By <i>Azotobacter</i> (free living) in soil; Lightning;	3
(c)	Ploughing produces aerobic conditions / aerates the soil; Favours {nitrification / conversion of ammonia to nitrates}; Inhibits {denitrification / conversion of nitrates to atmospheric nitrogen};	3
<b>Question total</b>		<b>8</b>

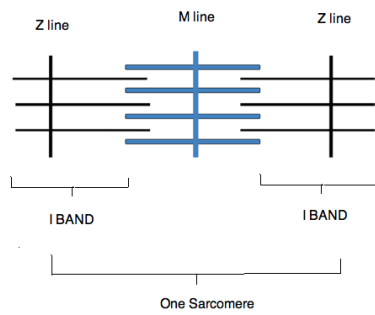


Question	Marking details	Marks Available
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4. (a) One Z line correctly labelled;  
 M line correctly labelled;  
 One I band correctly labelled;  
 One sarcomere correctly labelled;  
 (-1 for each incorrect label).

3

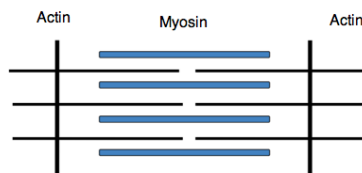
e.g.



- (b) Actin and myosin correctly labelled;  
 Diagram to show shorter sarcomere;

3

e.g.



**Question****Marking details****Marks****Available****Any 2 from**

(c)

<b>Slow twitch</b>	<b>Fast twitch</b>
Have more mitochondria;	Have fewer mitochondria;
(Adapted for) aerobic respiration;	(Adapted for) anaerobic respiration;
High resistance to fatigue;	Lower resistance to fatigue;
Continuous extended contraction;	Generate short bursts of strength / speed;

2

Comparison needed.

**Question**      **Marking details**

**Marks**  
**Available**

(d)      Description (1) explanation (1), e.g.

Description	Explanation
Capillary network increases;	More blood allows more oxygen, so more aerobic respiration / more ATP produced;
Increase in number / size of mitochondria;	More aerobic respiration / more ATP produced;
Increase in amount of myoglobin;	More aerobic respiration / more ATP produced;
Increase tolerance to lactate;	Less fatigue caused by lactate;

2

**Question total**      **10**

Question	Marking details	Marks Available
5. (a)	Wash hands / disinfect bench; use <u>sterile / autoclave</u> pipette; Flame neck of culture bottle / loop;	2
(b) (i)	Gram positive; Cocci;	2
(ii)	Differences in cell wall structure; {Purple / gram positive} bacteria have <u>thicker</u> cell wall / ORA; Made of peptidoglycan / murein; Which takes up {gram / purple} stain / crystal violet; {Pink / Gram negative} bacteria have lipopolysaccharide layer; Do not retain stain;	3
<b>Question total</b>		<b>7</b>

**Question**      **Marking details**      **Marks Available**

6. (a)

Statement	Glycolysis	Link reaction	Krebs Cycle	Electron Transport Chain
Occurs in the mitochondrial matrix	x	✓	✓	x;
ATP produced by substrate level phosphorylation	✓	x	✓	x;
FAD reduced	x	x	✓	x;
NADH <sub>2</sub> oxidised	x	x	x	✓;

4

1 mark per row

(b)      ATP phosphorylates glucose;  
 Producing {glucose / hexose} (bi)phosphate;  
 Makes molecule more reactive / easier to split;  
 Into triose phosphate;

Max 3

(c)      Reduction of pyruvate to lactate / transfer of hydrogen from NADH<sub>2</sub> to pyruvate;  
 Regenerates NAD / oxidises NADH<sub>2</sub>;  
 Allowing glycolysis to continue;  
 Lactate can be oxidised later / build up of oxygen debt;

Max 2

**Question total**      **9**

Question	Marking details	Marks Available										
7. (a)	<p>Potential difference between inside and outside <u>when {a nerve impulse is not being conducted / no action potentials}</u>;</p> <p>The membrane of a neurone {is <u>negatively</u> charged internally with respect to the outside / is <u>-70mv</u>} (accept: -50 to -90mv);</p> <p>Membrane is said to be <u>polarised</u>;</p>	2										
(b)	<p>Membrane is more permeable to K<sup>+</sup> / impermeable to Na<sup>+</sup>;</p> <p>Some K<sup>+</sup> gates are open (allows K<sup>+</sup> to pass out);</p> <p>Na<sup>+</sup> gates are closed (prevents Na<sup>+</sup> entering);</p> <p>(Na<sup>+</sup> / K<sup>+</sup> pump) {actively transports / pumps} K<sup>+</sup> in, Na<sup>+</sup>out;</p> <p>3 K<sup>+</sup> in for every 2 Na<sup>+</sup> out;</p> <p>Ref. to organic anions;</p>	3										
(c) (i)	<p><u>549-443</u> x 100</p> <p>443</p> <p>= 23.9% acc. 24%;</p>	2										
(ii)	<p>Answer can refer to healthy OR MS sufferer but must be clear.</p> <table border="0"> <tr> <td><b>Healthy person</b></td> <td><b>M.S. sufferers</b></td> </tr> <tr> <td>Myelin sheath prevents action potential / action potential only forms at nodes;</td> <td>Depolarisation occurs along whole length of neurone;</td> </tr> <tr> <td>Action potential 'jumps' from node to node / saltatory conduction;</td> <td>Lack of myelination prevents <u>saltatory</u> conduction;</td> </tr> <tr> <td>Greatly increasing nerve conductance speed / impulses travel faster;</td> <td>{nerve conductance / speed of impulse} in motor neurones is <u>slower</u>;</td> </tr> <tr> <td></td> <td>Note reaction time is slower;</td> </tr> </table>	<b>Healthy person</b>	<b>M.S. sufferers</b>	Myelin sheath prevents action potential / action potential only forms at nodes;	Depolarisation occurs along whole length of neurone;	Action potential 'jumps' from node to node / saltatory conduction;	Lack of myelination prevents <u>saltatory</u> conduction;	Greatly increasing nerve conductance speed / impulses travel faster;	{nerve conductance / speed of impulse} in motor neurones is <u>slower</u> ;		Note reaction time is slower;	3
<b>Healthy person</b>	<b>M.S. sufferers</b>											
Myelin sheath prevents action potential / action potential only forms at nodes;	Depolarisation occurs along whole length of neurone;											
Action potential 'jumps' from node to node / saltatory conduction;	Lack of myelination prevents <u>saltatory</u> conduction;											
Greatly increasing nerve conductance speed / impulses travel faster;	{nerve conductance / speed of impulse} in motor neurones is <u>slower</u> ;											
	Note reaction time is slower;											
(d)	{Sensory neurones / optic nerve} affected / lose myelin.	1										

**Question total 11**

Question	Marking details	Marks Available
8. (a)	Cortex;	1
(b)	J = Bowmans Capsule K = (Proximal or distal) convoluted tubules L = Glomerulus	2
(-1 for each error)		
(c)	(i) <u>Many</u> mitochondria; Provide ATP for active transport; Have <u>microvilli</u> / basal channels; Increasing / larger surface area for {diffusion / absorption}; Increased number of carrier proteins for facilitated diffusion / active transport.	4
(ii)	Water is (re)absorbed by <u>osmosis</u> ; Urea is not (re)absorbed (allow references to limited reabsorption); Reference to same mass of urea in less water;	2
(iii)	I {Growth/repair} of muscles , so {reduced <u>excess</u> amino acids / reduced deamination};	1
	OR Increased water in diet, so { <u>more</u> water in urine / <u>more</u> dilute urine}.	
	II Increased protein in diet, so {more <u>excess</u> amino acids / more deamination};	1
	OR {Dehydration / increased sweating} resulting in <u>less</u> water in urine.	

Question	Marking details	Marks Available
(d)	(Due to high blood glucose) not all glucose can be reabsorbed in Proximal Convoluted Tubule; Some glucose remains in filtrate in region S; Water potential of filtrate lowered; Water leaves cell by osmosis; Not references to higher blood pressure.	2
<b>Question total</b>		<b>13</b>



Question	Marking details	Marks Available
9. (a)	<p data-bbox="376 271 651 304">Kidney failure essay:</p> <p data-bbox="376 353 839 387">A <u>Main</u> treatment is by dialysis;</p> <p data-bbox="376 436 676 470">B <b>Haemodialysis;</b></p> <p data-bbox="376 519 1117 607">C Blood passes into a machine with {semi / partially} permeable membrane;</p> <p data-bbox="376 656 1190 743">D And dialysis {fluid / solution} flows in opposite direction / counter current flow;</p> <p data-bbox="376 792 1102 880">E Dialysis fluid has same {water potential / glucose} concentration as normal blood;</p> <p data-bbox="376 929 1182 963">F (Urea / excess water / salt) diffuse out into dialysis fluid;</p> <p data-bbox="376 1012 730 1046">G <b>Peritoneal dialysis;</b></p> <p data-bbox="376 1095 810 1128">H Peritoneum acts as a filter;</p> <p data-bbox="376 1178 1198 1211">I (Catheter used to) fill abdominal cavity with dialysis fluid;</p> <p data-bbox="376 1261 1182 1294">J Fluid drained off after a time, removing waste e.g. urea;</p> <p data-bbox="376 1344 719 1377">K <b>Kidney transplant;</b></p> <p data-bbox="376 1426 1177 1460">L Involves <u>surgically</u> transplanting a kidney from a donor;</p> <p data-bbox="376 1509 1203 1597">M Donor must be close {tissue type / blood group} match to recipient;</p> <p data-bbox="376 1646 1182 1733">N Use of immuno-suppressant drugs to reduce chance of rejection;</p> <p data-bbox="376 1783 1225 1935">O AVP e.g. advantage / disadvantage e.g. haemodialysis is more efficient than peritoneal OR peritoneal can be carried out at home;</p>	Max 10
<b>Question total</b>		<b>Max 10</b>

Question	Marking details	Marks Available
9. (b)	<p>Synapse essay:</p> <p>A Calcium channels open;</p> <p>B Calcium ions rush / influx into synaptic knob;</p> <p>C (Synaptic) vesicles migrate to <u>pre</u> synaptic membrane;</p> <p>D Fusing with it / discharge contents into cleft / exocytosis;</p> <p>E Neurotransmitter / acetylcholine (released);</p> <p>F Diffuses across cleft / synapse;</p> <p>G <u>Bind</u> to receptors on;</p> <p>H Sodium channels / Post-synaptic membrane;</p> <p>I Causing sodium channels to open;</p> <p>J Sodium ions rush in;</p> <p>K Depolarising post synaptic membrane;</p> <p>L Death of brain cells;</p> <p>M (Results in) dopamine no longer produced / deficient;</p> <p>N Tremor / repetitive shaking / difficulty in controlling {movement / walking / co-ordination};</p> <p>O AVP e.g. Treatment includes use of levodopa / synthetic drug that is converted into dopamine in the brain;</p>	10
<b>Question total</b>		<b>10</b>

## GCE BIOLOGY BY5

<b>Question</b>	<b>Marking details</b>	<b>Marks Available</b>
1. (a)	A	1
(b)	I	1
(c)	H/C	1
(d)	F	1
(e)	G	1
<b>Question total</b>		<b>5</b>

Question	Marking details	Marks
		Available
2. (a)	The transfer of pollen from the anther to the stigma.	1
(b) (i)	Embryo sac.	1
(ii)	Through stigma, style, ovary wall, micropyle. (Must travel through ovary wall to bottom before going into micropyle)	1
(c) (i)	Oviduct / fallopian tube;	
(ii)	<ul style="list-style-type: none"> <li>• (Acrosome / Y) <u>contains enzymes</u>; Not Y is an enzyme</li> <li>• which {<u>hydrolyse / dissolve / breakdown / digest / softens</u>} the {<u>zona pellucida / jellycoat</u>};</li> </ul>	2
(d)	<ul style="list-style-type: none"> <li>• <u>Formation / growth of tube</u>;</li> <li>• <u>nucleus</u> travels along a {<u>tube / channel / pathway</u>} (into the egg / ovule);</li> <li>• <u>enzymes are produced</u> which {<u>allow a tube to grow / which digests a path</u>};</li> <li>• both are chemotropic;</li> <li>• membranes burst to release male gametes;</li> </ul>	2
<b>Question total</b>		<b>8</b>

<b>Question</b>	<b>Marking details</b>	<b>Marks Available</b>
3. (a)	1. Smooth, coloured; 2. Wrinkled, colourless; Accept non- coloured;	2
(b)	Linked / on same chromosome / (genes) are inherited together; NOT sex linked;	1
(c) (i)	Smooth, colourless AND wrinkled, coloured;	1
(ii)	Crossing over / exchange of alleles; Not independent assortment / recombinants / chiasmata alone.	1
(d)	F1 SsCc	1
	F2 Sscc or SScc or ssCc or ssCC	1
<b>Question total</b>		<b>7</b>

<b>Question</b>	<b>Marking details</b>	<b>Marks Available</b>
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4.

<b>Part</b>	<b>Correct</b>	<b>Ignore</b>	<b>Reject</b>
(a)	4 and 5	3	1,2
(b)	2		1,3,4,5
(c)	1 and 3	5	2,4
(d)	1 and 3	5	2,4
(e)	2		1,3,4,5
(f)	3	5	1,2,4

6

**Question total**      **6**

Question	Marking details	Marks Available				
5. (a) (i)	Inserting a {normal / correct} {gene / DNA sequence} / <u>Replacing</u> {defective / faulty} genes with {copies of a new DNA sequence / normal allele / normal gene} / (owtte);	1				
(ii)	<table border="1"> <tr> <td>Somatic cell therapy</td> <td>Germ line therapy</td> </tr> <tr> <td>1 and 4</td> <td>2 and 3</td> </tr> </table> <p>(Must have both for 1 mark)</p>	Somatic cell therapy	Germ line therapy	1 and 4	2 and 3	2
Somatic cell therapy	Germ line therapy					
1 and 4	2 and 3					
(b) (i)	<ul style="list-style-type: none"> <li>• CFTR is a {Channel protein / carrier protein / ion pump}; Not active transport alone</li> <li>• Blocks {transport / movement} of chloride ions out of cells (into mucus) / ORA;</li> <li>• Water retained in cell / water prevented from leaving / no osmosis;</li> <li>• Unable to remove mucus in lungs;</li> <li>• {Infection/ more susceptible to disease} / coughing {more likely / increased};</li> <li>• <u>{Narrowing / blocking}</u> of air passages (so reduced air flow);</li> <li>• <u>{Increased diffusion distance / reduced surface area}</u> for <u>gas exchange</u> / insufficient oxygen received / not enough oxygen absorbed;</li> </ul>	4				
(ii)	<ul style="list-style-type: none"> <li>• (Modified / normal / correct) genes are inserted;</li> <li>• into liposomes / virus (as vector);</li> <li>• Liposomes fuse with cell membrane / virus infects cell / ref to endocytosis;</li> <li>• (Modified) gene passes through membranes / into cell;</li> <li>• Applied by aerosol / spray / inhaler;</li> </ul> <p>(Any 3 points)</p>	3				

Max 2 for symptoms only

Question	Marking details	Marks Available
(c)	(i) Each new DNA molecule consists of one {original / parent / old / template} strand and one new strand of DNA;	1
	(ii) I To (break bonds between DNA strands or bases to) <u>separate</u> original DNA into two single strands;	1
	II Triggers / Allows {primers / short pieces of RNA / single-strand DNA / free nucleotides} to {bind / attach / join} (to single stranded DNA);	1
	III TAQ / DNA polymerase {makes nucleotides join / makes a strand of DNA / catalyses the synthesis of a complementary strand};	1
(iii)	<ul style="list-style-type: none"> <li>• (Percentage) risk is too high (for <i>human</i> application) / Incorrect base sequence;</li> <li>• Incorrect mRNA;</li> <li>• Different tRNA / brings incorrect amino acid;</li> <li>• Structure of protein synthesised unknown / folding of protein is different / sequence of amino acid altered;</li> <li>• Protein {non-functional / function altered} / chloride ions not transported / thick mucus still produced / gene therapy not effective;</li> </ul>	3
	(Any 3 points)	
	<b>Question total</b>	<b>17</b>



Question	Marking details	Marks Available
6. (a)	RNA polymerase;	1
(b) (i)	CGT TAC CAA;	1
(ii)	CGU UAC CAA;	1
(c) (i)	Alanine;	1
(ii)	<ul style="list-style-type: none"> <li>• Mutation 1 – no change to sequence of amino acids;</li> <li>• Codon for alanine / degenerate codon / same amino acid coded for;</li> <li>Neutral mutation;</li> <li>• Mutation 2 – valine replaced by alanine / codon for alanine;</li> <li>• (Tertiary) {structure / shape of protein} may change / position of bonds may change / sequence of amino acids changing / structure of protein changing / protein non functional;</li> </ul>	2
(d)	<ul style="list-style-type: none"> <li>• Translation prevented;</li> <li>• Tetracycline {binds to / blocks / inhibits} {mRNA triplet / codon / CGC / second attachment site};</li> <li>• {Anticodon / tRNA triplet} cannot pair with {mRNA triplet / codon} / cannot form codon-anticodon complex;</li> <li>• Amino acid not added to polypeptide chain / peptide bonds not formed;</li> </ul> <p style="text-align: right;">(Any 3 points)</p>	3
<b>Question total</b>		<b>11</b>

Question	Marking details	Marks
		Available
7. (a) (i)	C and D;	1
	(ii) Fragments 64 and 36 (kb);	1
(b) (i)	1, 2, 3 & 6 AND 1 and 3;	1
	(ii) <ul style="list-style-type: none"> <li>Colonies {1, 2, 3 &amp; 6 / shown / present} have taken up {plasmid / ampicillin resistant gene};</li> <li>Reject taken up human gene;</li> <li>Ignore recombinant plasmid;</li> <li>Because they are resistant to ampicillin / able to grow on ampicillin;</li> <li>4 and 5 have not taken up the {plasmid / ampicillin resistant gene};</li> <li>And so are not resistant to ampicillin;</li> </ul>	2
	(iii) <ul style="list-style-type: none"> <li>Colonies 1 and 3 do not have the gene / recombinant plasmid;</li> <li>As they (remain) resistant to tetracycline / gene for tetracycline resistance has not been {disrupted / destroyed};</li> <li>Colonies 2 and 6 do have the gene / recombinant plasmid;</li> <li>Tetracycline resistance destroyed / prevents gene from being expressed;</li> </ul>	3
<b>Question total</b>		<b>8</b>

Question	Marking details	Marks Available
8. (a) (i)	<ul style="list-style-type: none"> <li>• Change in structure in a <u>community</u> over time;</li> <li>• Change in {composition of species / species present} (in a community) over time;</li> <li>• Either due to change in environmental / (named) abiotic factors;</li> </ul>	2
(ii)	A stable community which {undergoes no further change / reached equilibrium} / no further succession;	1
(b)	<ul style="list-style-type: none"> <li>• (Increased) interspecific competition / other plant species compete with heather / heather outcompetes other plant species;</li> <li>• For light / nutrients / minerals / named nutrient / water (linked to competition); Reject resources unqualified.</li> </ul>	2
(c)	<ul style="list-style-type: none"> <li>• More energy used in respiration;</li> <li>• Higher respiration relative to {photosynthesis / GPP} / NPP decreases;</li> <li>• {Fewer leaves / less surface area} for photosynthesis;</li> <li>• Less energy / glucose to {produce new biomass / for growth / synthesis of protein or named compound};</li> <li>• (Heather increases in size / ages / more competition from other species) soil fertility decreases / less minerals or nutrients available / greater competition for named resources;</li> <li>• Growth rate decreases / fewer leaves produced;</li> <li>• (As heather increases in size) less light penetrates the centre of the plant;</li> <li>• Loss of central leaves, (therefore woody parts increase);</li> </ul> <p>(Any 3 points)</p>	3
<b>Question total</b>		<b>8</b>

Question	Marking details	Marks
		Available
9 (a)	A Extinction is the loss of species;	1
	B Conservation is the <u>planned</u> preservation of wildlife / the {enhancement / maintenance} of biodiversity;	1
	C To ensure the survival of the species;	1
	D Conservation of existing <u>gene pools</u> ;	1
	E To conserve potentially useful {genes / genetic sources} (for future generations);	1
	F Qualification / Example of E – resistance to disease or other;	1
	G Use of plants / animals as a gene bank to cross with highly cultivated varieties;	1
	H Conservation of <u>plants</u> with medicinal properties;	1
	I (Planned) preservation of habitat, with example – wetlands, coral reef, sand dune;	1
	J Seed / sperm banks;	1
	K Re-introduction programmes, e.g. Red Kite;	1
	L Protection / breeding of endangered species in specialised zoos / captive breeding programmes / rare breeds;	1
	M Trade restrictions on endangered species / reference to CITES / ivory / whaling;	1
	N Relevant reference to NGOs {e.g. WWFN / government agency / CCW / SSSI / National Parks / nature reserves} / ecotourism / education;	1
	O Correct reference to relevant <u>legislation</u> e.g. to prevent over-grazing / over-fishing / hunting / poaching in context / collecting birds eggs / picking wild flowers / collecting plants;	1
<b>Question total</b>		<b>10</b>

Question	Marking details	Marks Available
9 (b)	A (Embryo cloning) {in vitro fertilised egg / zygote} divides to form {a ball of cells / embryo} / undergoes mitosis;	1
	B Embryo is split into separate cells;	1
	C Before differentiation / 8 cell stage;	1
	D (Nuclear transplant) nucleus / DNA may be removed from diploid / somatic / udder;	1
	E (Nuclear transplant) nucleus / DNA may be removed from egg / ovum / secondary oocyte;	1
	F Introduce nucleus to donor egg / Donor and recipient cells are fused together;	1
	G The embryo is allowed to develop in a surrogate;	1
	H Animal born is genetically identical to the original donor;	1
	I Reference to totipotent / cells are able to differentiate into more than one cell type / form a whole organism;	1
	J Example of tissue that contains stem cells – bone marrow, testes, embryonic stem cells;	1
	K Human stem cells could be used to {grow into required organ or tissue / therapeutic uses (treat range of diseases) / or named example;	1
	L Less likelihood of rejection / no need for immunosuppressant drugs	1
	(Any 8 from 13)	
M Embryos have to be destroyed to provide the stem cells/ Pro-life issues -embryos have the potential for independent life (in the future);	1	
N Unknown long term side effects of stem cells;		
O Genetic modification of humans for non-medical reasons / eugenics issues related to selection of embryos;	1	
(Any 2 from 13)		
<b>Question total</b>		<b>10</b>



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