Cambridge Assessment

A Level

Biology

Session: 2010 June
Type: Mark scheme
Code: H021-H421
Units: F211; F212; F214; F215

OCR
RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE **F211**

Cells, Exchange and Transport

Mark Scheme for June 2010

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Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	**A** = plasma / cell surface**,** membrane **;** **B** = DNA / chromosome / chromatin / genetic material **;**	2	**DO NOT CREDIT** membrane, cell membrane **DO NOT CREDIT** chromosome**s** (do not accept plural) **CREDIT** loop of / circle of, DNA **DO NOT CREDIT** plasmid, RNA **ACCEPT** nucleoid
1	(a)	(ii)	production of ATP **;** aerobic respiration **;**	max 1	**ACCEPT** named stages of aerobic respiration e.g. Krebs cycle, oxidative phosphorylation, ETC, chemiosmosis, link reaction, substrate level phosphorylation **DO NOT CREDIT** glycolysis, ATP *for* respiration **DO NOT CREDIT** *produce* energy (in form of ATP) **IGNORE** provide / release energy unqualified
1	(a)	(iii)	protein synthesis / translation **;** photosynthesis / described **;**	2	**ACCEPT** production / creation, of proteins / polypeptides, assembly of proteins from amino acids **IGNORE** autotrophic nutrition **DO NOT CREDIT** absorption of light unqualified
1	(b)		large surface area to volume ratio **;** small so demand for**,** O_2 / CO_2**,** is low **;** *idea of:* diffusion (alone) is adequate to meet needs **;**	2	**ACCEPT** large SA**:**Vol or large SA/Vol **ACCEPT** small Vol**:**SA ratio or small Vol/SA **DO NOT CREDIT** large surface area alone **IGNORE** gases alone, nutrients **ACCEPT** *idea of* : body SA large enough to meet needs by diffusion **ACCEPT** idea of : diffusion distance short

Question	Expected Answers	Marks	Additional Guidance
1 (c)	<table><tr><th>cell / tissue</th><th>function in the lungs</th><th></th></tr><tr><td></td><td></td><td></td></tr><tr><td></td><td>recoil **OR** return to original**,** size / shape **OR** to help expel air **OR** prevents alveoli bursting</td><td>;</td></tr><tr><td></td><td>waft / wave / move / AW**,** mucus</td><td>;</td></tr><tr><td></td><td>secrete / release / produce, mucus</td><td>;</td></tr><tr><td></td><td>constrict the airway / AW</td><td>;</td></tr></table>	4	**IGNORE** stretch / expand **ACCEPT** ref to lungs, alveoli, airways recoiling etc **DO NOT CREDIT** ref trachea / bronchi recoiling **ACCEPT** transport / remove**,** mucus **DO NOT CREDIT** dirt particles without ref to mucus **DO NOT CREDIT** excrete mucus **ACCEPT** narrows lumen OR controls, airflow / diameter, of airways **DO NOT CREDIT** ref to alveoli OR greater airflow
	Total	**11**	

Question			Expected Answers	Marks	Additional Guidance
2	(a)		visible / can be seen / increase contrast ; named example of what is now visible (after staining) ;	2	*First mark is for 'seeing' and the second mark is for 'recognising' what can now be seen.* **ACCEPT** see detail **IGNORE** ref to resolution **ACCEPT** recognise different *types* of white blood cell **ACCEPT** can (now) see**,** nucleus / organelles / named organelles **IGNORE** recognise parts inside red blood cell **IGNORE** can now see red blood cells (already visible) 'can now see red and white blood cells' = 2 marks
2	(b)	(i)	3D shape can be seen / greater depth of field ; can see**,** surface features / detail ;	max 1	**DO NOT CREDIT** shape alone **ACCEPT** 'you can see what is on the surface' **IGNORE** 'you see the surface better' because this needs further clarification i.e. features, shape, named structure
		(ii)	smaller / named, organelle (becomes visible) ; shapes / details of organelles ;	max 1	**ACCEPT** named structure(s) such as lysosome, RER, mitochondrion, ribosome, Golgi , vesicle, nucleolus **DO NOT CREDIT** nucleus or chloroplast (already visible)

Question			Expected Answers	Marks	Additional Guidance
2	(c)		*This is a QWC question* **1** fetal <u>haemoglobin</u> has a high<u>er</u> **<u>affinity</u>** (for oxygen) (than adult haemoglobin) **;** **2** (fetal Hb) takes up oxygen in low(er) **partial pressure** of oxygen **;** **3 placenta** has low partial pressure of oxygen **;** **4** at low partial pressure of oxygen / in placenta**,** adult (oxy)haemoglobin will **dissociate** / AW **;**	max 3	**IGNORE** oxyhaemoglobin for haemoglobin **ACCEPT** Hb for <u>haemoglobin</u> (but not HbO) **ACCEPT** fetal Hb becomes *more* saturated at a *low(er)* partial pressure of oxygen **ACCEPT** ppO_2 / pO_2 / oxygen tension / O_2 concentration, for partial pressure of oxygen **ACCEPT** in placenta mother's haemoglobin, releases its oxygen / saturation drops
			QWC (two terms used in correct context and spelt correctly)**;**	max 1	Any **two** terms from the following**:** affinity, dissociate / dissociation, placenta, partial pressure / oxygen tension, saturation / saturated

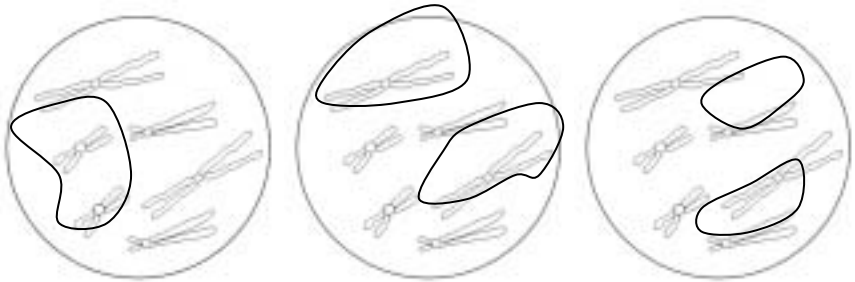
Question			Expected Answers	Marks	Additional Guidance
2	(d)	(i)	curve to right of curve A **;** appropriate sigmoid shape **;**	2	Curve should start at 0% on y axis and reach at least 80% on y axis
2	(d)	(ii)	**1** (actively respiring tissue) needs / requires, *more* oxygen **;** **2** for aerobic respiration / to release *more* energy **;** **3** (actively respiring tissue produces) *more* CO_2 **;** **4** haemoglobin involved in transport of CO_2 **;** **5** less haemoglobin available to combine with O_2 **;** **6** (Bohr shift) causes *more* oxygen to be released **;**	max 2	*idea* of '*more*' should be clear as shown (MP 1,2,3,6) **ACCEPT** make *more* ATP **ACCEPT** produces *a lot* of CO_2 / as CO_2 levels rise **CREDIT** detail to include carbonic acid dissociation / formation of haemoglobinic acid / HHb etc **DO NOT CREDIT** oxygen released *more* quickly / quicker **ACCEPT** oxygen released *more*, readily / easily 'More CO_2 produced so more O_2 released' = 2 marks
			Total	**12**	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)			*MP 1 awarded for observation that the stain was no longer in the surrounding solution and not for the % of cells containing the stain.*
			1 at low temperatures, all stain is in cells **OR** no stain in surrounding solution **;**		**ACCEPT** the stain is not evenly distributed between cells and solution **ACCEPT** stain doesn't move out of cells
			2 (taken up / held) against**,** diffusion / concentration**,** gradient **;**		**ACCEPT** *up* the diffusion gradient
			3 at high temperature stain not held in cells **;**		**ACCEPT** solution now contains stain **ACCEPT** 0% = none / no cells (stained) *MP **1** and **3** - must be stated rather than inferred from quoted figs*
			4 at high temperature enzymes denatured so no ATP for active transport (of stain) **;**		**IGNORE** 'enzymes denatured' alone **CREDIT** active transport / carrier, proteins denatured **ACCEPT** mitochondria stopped working so no ATP produced
			5 use of correct comparative figs to illustrate a point **;**		e.g. 97% at 30°C but 0% at 80°C **IGNORE** figs without units
			AVP **; ;**	max 2	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(ii)	cells, dead / not respiring ; no, (metabolic) energy / ATP, to take up stain ; AVP ;	max1	**DO NOT CREDIT** 'burst' as these cannot be seen **ACCEPT** inhibitor present / membrane impermeable **ACCEPT** no functioning mitochondria
3	(b)	(i)	(membrane) structure disrupted ; (phospho)lipid bilayer, melts / more fluid ; (membrane) proteins / carrier molecules, denatured / unable to function ; (membrane) becomes more permeable ;	max 1	*Mark first suggestion and if correct award mark – if further answers contradict first answer do not award mark.* **ACCEPT** damaged, destroyed, break down **IGNORE** *membrane*, denatured / more fluid **IGNORE** lipid *molecules* melt **ACCEPT** lose shape for denatured **ACCEPT** leaky **IGNORE** refs to bonds breaking

Question			Expected Answers	Marks	Additional Guidance
3	(b)	(ii)	membrane <u>permeable</u> (to stain) **;** methylene blue, leaked out of cells / released to solution **;** by diffusion / down concentration gradient **;**	max 2	**IGNORE** leaky **ACCEPT** stain / blue / pigment, moved out **IGNORE** lost *colour* / *colour* moved out (it is in stem of question) **ACCEPT** by active transport (assuming thermostable enzymes) blue / stain, diffuses out = 2 marks
3	(c)		*accuracy* take readings at intermediate temperatures (between 50 °C – 70 °C) **;** *reliability* take more, readings at each temperature / repetitions **;**	2	*Mark first suggestion only* **DO NOT CREDIT** wider temperature range OR more temperatures unqualified OR more regular intervals **ACCEPT** take readings every 5 degrees / °C **ACCEPT** ref. to haemocytometer **ACCEPT** colorimeter used to measure colour intensity of blue solution **DO NOT CREDIT** ref to use of c<u>a</u>lorimeter **ACCEPT** repeat experiment (ideally 3 readings for each temperature) , increase the number of cells observed **ACCEPT** replica / replicate for repeat

Question			Expected Answers	Marks	Additional Guidance
3	(d)		nucleus divides / mitosis ; *idea of* : cell, swells on one side / bulges ; nucleus / cytoplasm / organelles, move into, bud / bulge ; pinches off / cell wall forms, (so bud becomes a separate cell) ; max 2		**ACCEPT** asexual reproduction / cloning **IGNORE** cell splits, ref to genetically identical cells **IGNORE** *bud* forms on side **IGNORE** replicated DNA enters bud **ACCEPT** cytokinesis **IGNORE** two cells are formed / bud separates unqualified
			Total	**10**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	*plant cell / Y, has*: a wall ; chloroplasts ; vacuole ;	max 2	Credit reverse argument **ACCEPT** thylakoid, discs / membranes OR granum(a) **IGNORE** chlorophyll
4	(a)	(ii)	**A1** a vacuole ; **E1** to take up water / to become turgid ; **A2** cell wall thicker on one side ; **E2** causes, cell to bend / open stoma(ta) ; **A3** mitochondria ; **E3** generates ATP (for active transport) ;	max 2	*Mark adaptation (A) as stand-alone* *Ensure explanation (E) stated is appropriately linked to adaptation* **DO NOT CREDIT** curved cell wall / thick cell wall unqualified **ACCEPT** close stoma(ta) if adaptation correct **IGNORE** ref to chloroplasts
4	(b)	(i)	two homologous chromosomes circled ;	1	**ACCEPT** one circle around both chromosomes or two circles The two chromosomes must be of same length 

4	**(b)**	**(ii)**	*three* chromosomes, one from each pair **;** chromosomes drawn as one bar **;**	2	*Chromosomes should be of different lengths however if two are of similar length, look for different centromere position to award mark* **ACCEPT**  **DO NOT CREDIT** two joined together at centromere 
			Total	**7**	

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	osmosis ;	1	
		(ii)	**2** = symplast (pathway) ; **3** = apoplast (pathway) ;	2	**ACCEPT** symplastic **ACCEPT** apoplastic
		(iii)	S ;	1	

Question			Expected Answers	Marks	Additional Guidance
5	(b)		*This is a QWC question* **1** water moves into xylem down **water potential** gradient **;** **2 root pressure** / high (**hydrostatic**) **pressure** at bottom of xylem **;** **3** water vapour loss / **transpiration** / **evaporation**, at leaves / top of plant **;** **4** (creating) low (hydrostatic) pressure at top of xylem **;** **5** water**,** under **tension** / pulled up (in a continuous column) **;** **6 cohesion** between water molecules / described **;** **7 adhesion** of water molecules to xylem / described **;** **8 capillary action** / described **;** **9** water moves up (xylem / stem) by **mass flow ;** **10** from high(er) (hydrostatic) pressure to low(er) (hydrostatic) pressure / down (hydrostatic) pressure gradient **;**	max 4	**ACCEPT** ψ for water potential **ACCEPT** water moves from high ψ to low ψ **IGNORE** drawn for pulled up **ACCEPT** ref to xylem being very narrow so water rises
			QWC (three terms used in correct context and spelt correctly) **;**	1	Any **three** terms from the following **:** water potential, hydrostatic pressure, transpiration / evaporation, cohesion / cohesive, adhesion / adhesive, tension, root pressure, capillary action / capillarity, mass flow

Question	Expected Answers	Marks	Additional Guidance
5 (c)			*One mark per row* *Both statements must be correct to achieve mark*

xylem vessel	phloem sieve tube element	
present	absent	;
present	absent	;
(water and), minerals / ions / salts	products of photosynthesis / sucrose / assimilates / amino acids / minerals / ions / salts / plant 'hormones'	;
(only) up stem / towards leaves	both directions / up and down / from source to sink	;

DO NOT CREDIT ticks and crosses

Read whole list – if any suggestion is wrong then do not award mark

XYLEM

DO NOT CREDIT 'nutrients' OR 'water' alone

PHLOEM

ACCEPT 'sugar' in place of sucrose
IGNORE unspecified 'solutes'
DO NOT CREDIT glucose

ACCEPT arrows ↑ (xylem) ↓↑ (phloem)
DO NOT CREDIT 'all directions'
IGNORE ref to pits / lateral movement

			Total	**13**	

Question			Expected Answers	Marks	Additional Guidance
6	(a)		a single value between 67 and 80 **; ;**	max 2	two marks for correct answer If answer incorrect, allow one mark for appropriate working i.e. 60 divided by time from trace selected by candidate
6	(b)		heart rate**,** slower / lower / reduced / 60 – 63 beats per minute **;** rest period / diastole longer **;** ventricle takes longer to contract / ventricular systole longer **;**	max 2	*Mark first point on each numbered line* **ACCEPT** length of one beat is longer **DO NOT CREDIT** 'slows heart's activity' **ACCEPT** T wave elongated / increases from 0.24s to 0.32s / increases by 0.1 s **IGNORE** name of chamber **ACCEPT** R wave slightly elongated / increases from 0.07s to 0.12s / increases by 0.05 s
6	(c)		SAN**,** is pacemaker / initiates heart beat **;** (SAN sends) impulse / wave of excitation**,** over atria (walls) **;** AVN delays impulse **;** (AVN) sends impulse down**,** septum / bundle of His / Purkyne fibres **;**	max 3	**ACCEPT** *starts*, wave of excitation / action potential / electrical impulse **IGNORE** 'sends out' (wave) **IGNORE** *through* / *to,* the atrium **DO NOT CREDIT** signal / message for impulse, **allow ecf** **DO NOT CREDIT** pulse **IGNORE** delays contraction **ACCEPT** Purkinje
			Total	**7**	

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Biology

Advanced GCE **F212**

Molecules, Biodiversity, Food and Health

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<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>reagent</th><th>observation</th><th>molecule</th><th>present or absent</th></tr>
<tr><td>ethanol and water</td><td>white emulsion</td><td>lipid</td><td>present</td></tr>
<tr><td>Benedict's solution</td><td>brick-red precipitate</td><td><u>reducing</u> sugar / lactose / glucose / galactose / monosaccharides</td><td>present ;</td></tr>
<tr><td>biuret I and II</td><td>lilac colour</td><td>protein / named milk protein</td><td>present ;</td></tr>
<tr><td>iodine solution</td><td>yellow / brown</td><td>starch / amylose</td><td>absent ;</td></tr>
</table>
</td><td>3</td><td>One mark per correct row.
IGNORE 'yes', 'no' and ticks and crosses
DO NOT CREDIT if anything incorrect is written in any box in the molecule column.
e.g. 'starch or cellulose' = 0 mark

ACCEPT maltose
DO NOT CREDIT sucrose

ACCEPT casein / lactoglobulin / lactalbumin / polypeptide

IGNORE amylopectin</td></tr>
<tr><td>1</td><td>(a)</td><td>(ii)</td><td>milk is already, cloudy / an emulsion / white / AW ;</td><td>1</td><td>ACCEPT idea of difficulty in detecting change because of the appearance of milk</td></tr>
<tr><td>1</td><td>(a)</td><td>(iii)</td><td>(one) glycerol / glyceride ;
3 fatty acids ;

ester bond (between glycerol and fatty acid) ;</td><td>3</td><td>ACCEPT marking points from clearly labelled diagram but DO NOT CREDIT if contradicted in text.
IGNORE individual atoms on diagram and look for correct position of labels
MAX 2 if phosphate group included (as could be confused with phospholipid)

ACCEPT on diagram if 3 shown and at least one labelled
ACCEPT triglycerides are esters</td></tr>
</table>

Question			Expected Answer	Mark	Additional Guidance
1	(b)				**MARK THE FIRST RESPONSE ON EACH NUMBERED LINE**
		1	(thermal) insulation ;		*1* **ALLOW** 'warmth'
		2	energy, store / source / release ;		*2* **CREDIT** answers that refer to the idea of lipid as a respiratory substrate but **DO NOT CREDIT** 'for respiration' unqualified **IGNORE** 'fat contains energy' without further qualification **DO NOT CREDIT** refs to producing energy or to quick energy release **ACCEPT** 'provides energy'
		3	protection ;		
		4	membranes / phospholipid bilayer / control entry and exit into cells ;		*4* **CREDIT** ref to cholesterol in membranes
		5	(steroid) hormones / named steroid hormone ;		
		6	buoyancy ;		
		7	waterproofing ;		
		8	source of water (from respiration) ;		
		9	(electrical insulation) in myelin / around neurones / around axons / around dendrons ;		*9* **CREDIT** nerve fibres / saltatory conduction **IGNORE** nerves
		10	aid, absorption / storage / production, of, fat soluble / A / D / E / K, vitamins ;	3	
1	(c)	(i)	saturated ; (fatty acids have) no / fewer, double bonds ; solid at room temperature ;	1 max	Assume answers refer to animal fats unless otherwise stated **ACCEPT** reverse argument **IGNORE** ref to fats and oils (as stated in question) **ACCEPT** 'fatty acids are not kinked' **ACCEPT** reasonable temperature quoted

Question	Expected Answer	Mark	Additional Guidance
1 (c) (ii)			
1	(death rate for) men greater (at any concentration) / AW ;		*1* **ACCEPT** ora
2	(death rates) rise with increasing cholesterol / AW ;		*2* **ACCEPT** 'positive correlation' (between death and cholesterol)
3	death rate for men, initially / AW, falls ;		*3* **ACCEPT** 4.8 or below as 'initially'.
4	steep(er) / AW, rise (in, males / both) at higher cholesterol levels ;		*4* Answers must refer to latter part of graph only (5.7 or above). **ACCEPT** difference (between sexes) greater at high concentration
5	comparative figures with unit for (blood) cholesterol to support any of the above points ;		*5* There are 3 ways of getting this mark: • values for both sexes at single concentration • two values for single sex at two concentrations • subtraction / calculation, that shows comparison **IGNORE** terms like 'about' See table for acceptable examples of x and y values – if intermediate cholesterol values are used, refer to the graph for the data
		3 max	

blood cholesterol (mmol dm^{-3})	deaths per 10 000	
	women	men
3.6	13.2 - 14.1	31.2 - 32.1
4.3	15.0 - 15.9	26.0 - 26.9
4.8	14.0 - 14.9	24.0 - 24.9
5.2	15.1 - 16.0	24.6 - 25.5
5.7	17.4 - 18.3	25.8 - 26.7
6.2	17.8 - 18.7	33.2 - 34.1
6.7	23.5 - 24.3	31.3 - 32.2
7.3	22.0 - 22.9	44.1 - 45.0
8.2	31.7 - 32.6	59.5 - 60.4

Must include (blood) cholesterol units **Any figure within a particular range is acceptable**

Question			Expected Answer	Mark	Additional Guidance
1	(c)	(iii)			**Mark first two in list**
		1	coronary heart disease / CHD / cardio-vascular diseases / heart attack / cardiac arrest / myocardial infarction / MI / angina **;**		***1*** **DO NOT CREDIT** heart disease alone or 'conary' **ACCEPT** hypertension / high blood pressure
		2	atherosclerosis / atheroma **;**		***2*** **DO NOT CREDIT** arteriosclerosis
		3	stroke **;**		
		4	Type 2 diabetes **;**		
				2	
			Total	**16**	

Question			Expected Answer	Mark	Additional Guidance
2	(a)		placing, living things / organisms / named organisms, into, groups / categories / taxa / named taxonomic groups ; based on / AW, similarity / difference ;	2	**ACCEPT** 'grouping living things' Look for the idea of similar organisms being placed in the same group or different organisms being placed in different groups
2	(b)	(i)			**ACCEPT suitable examples for mps 1 to 4**
		1	morphology / anatomy / (observable / physical) features / appearance / AW ;		*1* **CREDIT** cell features e.g. nucleus / membrane-bound organelles / cell wall / prokaryotic-eukaryotic features / unicellular
		2	biochemistry / cytochrome C ;		*2* **CREDIT** component of cell wall
		3	genes / DNA / genetics / RNA ;		*3* **IGNORE** chromosomes
		4	behaviour / physiology / embryology ;		*4* **ACCEPT** 'how they feed' / nutrition / 'how they reproduce'
		5	idea of shared, evolutionary past / phylogeny ;	3 max	*5* **ACCEPT** 'how closely related' **IGNORE** refs to interbreeding / fertile offspring
2	(b)	(ii)	T S R W U Q ; ; ;	3	**Mark the order of letters** (ignoring the dotted lines) All 6 in correct order = 3 marks If any incorrect, then credit T S in order at beginning = 1 mark U Q in order at end = 1 mark R before W anywhere in the sequence = 1 mark

Question			Expected Answer	Mark	Additional Guidance
2	(c)				**ACCEPT phonetic spellings throughout** **ACCEPT** alternative terms for names of kingdoms and domains throughout (e.g. plants / plantae)
		1	3 domains **AND** 5 kingdoms **;**		
		2	domains are, bacteria / eubacteria, **AND**, archaea / archaebacteria, **AND**, eukarya / eukaryotes **;**		***2*** **ACCEPT** 'eukaryota'
		3	kingdoms are prokaryotes **AND** protoctists **AND** fungi **AND** plants **AND** animals **;**		***3*** **DO NOT CREDIT** protists / protozoa
		4	eukaryotes split into different kingdoms / all eukaryotes are in the same domain **;**		
		5	all prokaryotes are in the same kingdom / prokaryotes split into different domains **;**		
		6	domain classification based on, rRNA / ribosomes / RNA polymerase / protein synthesis / enzymes / flagella / membrane structure **;**	**4 max**	***6*** **IGNORE** RNA unqualified **DO NOT CREDIT** other forms of RNA **ACCEPT** any detail of protein synthesis
			Total	**12**	

Question			Expected Answer	Mark	Additional Guidance
3	(a)		young / elderly / HIV infected / malnourished / post-operative / on immunosuppressants / leukaemia / undergoing cancer treatment / anorexics **;** immature / compromised / weak / AW, immune system **;**	**2**	**IGNORE** prompt lines and mark the answer as a whole **ACCEPT** AW for young / elderly etc **IGNORE** 'ill' or 'unfit' **IGNORE** any reference to populations e.g. those living in vicinity of outbreak **ACCEPT** description **ACCEPT** no immunity
3	(b)	(i)			**DO NOT CREDIT** 'mould' – penalise once only
		1	bacteria / (bacterial) cells, divide / increase in number / multiply / reproduce / proliferate / replicate **;**		***1*** **IGNORE** 'growth' **DO NOT CREDIT** 'mitosis'
		2	(secrete) enzymes / named enzyme **;**		***2*** **DO NOT CREDIT** excrete Answer should **not** imply intracellular enzymes
		3	food, digested / broken down **;**		
		4a	protein / named protein / polypeptides → peptides / amino acids		
			OR		
		4b	fat / triglycerides → fatty acids		***4b*** **IGNORE** cholesterol
			OR		
		4c	starch / amylose / glycogen → glucose / sugar **;**		***4c*** **ACCEPT** other correct carbohydrate breakdown
		5	production / release / excretion / secretion, of, toxins / named toxin / waste products **;**		
		6	(causes) change in, appearance / smell / texture / taste **;**	**3 max**	***6*** **CREDIT** suitable example e.g. 'goes mushy'

Question			Expected Answer	Mark	Additional Guidance
3	(b)	(ii)			Idea of 'more' is needed for all marking points but it can be stated once and linked to more than one point. • e.g. 'more bacteria secreting enzymes' = mp 2 and 4 **ACCEPT** converse argument throughout **ACCEPT** 'fungi' / 'mould' in place of bacteria as question stem does not specify
		1	bacteria, reproduce / AW, more rapidly / faster **;**		***1*** **IGNORE** 'grow' **IGNORE** 'more easily' or 'effectively' **DO NOT CREDIT** if the candidate thinks there is no reproduction at 5°C
		2	(so) more bacteria present **;**		
		3	more, toxins / waste, produced / released / AW **;**		
		4	more enzymes, secreted / AW **;**		***4*** **DO NOT CREDIT** excreted
		5	enzyme, action faster / works better / more effective, at higher temperatures **;**		***5*** **IGNORE** optimum
		6	(substrate and enzymes have) more kinetic energy **;**		
		7	more, enzyme-substrate complexes / ESC / (successful) collisions between substrate and active site **;**	**3 max**	

Question			Expected Answer	Mark	Additional Guidance
3	(b)	(iii)	max 2 for 2 distinct methods max 2 for 2 **correctly linked** explanations Only credit the explanation mark if the method mark has been awarded.		Where more than one method is given, mark first on line and assume explanation linked with that **DO NOT CREDIT** chilling or freezing (as in question)
		M1 **E1**	salting **;** lack of <u>water</u> due to, osmosis / low water potential (outside cell) **;**		***M1*** **IGNORE** drying ***E1*** **ALLOW** low Ψ / high solute potential
		M2 **E2**	sugar **;** lack of <u>water</u> due to, osmosis / low water potential (outside cell) **;**		***M2*** **IGNORE** drying ***E2*** **ALLOW** low Ψ / high solute potential
		M3 **E3**	(air / freeze) drying **;** *idea that* enzymes cannot mobilise / intracellular transport impaired / reactions have no medium in which to occur / (microbes) cannot move **;**		
		M4 **E4**	pickling / (use of) vinegar **;** (low pH) denatures / changes tertiary structure of / changes 3D shape of, enzymes / proteins **OR** substrate no longer fits active site / active site shape changes / prevents ESC **;**		***E4*** **DO NOT CREDIT** high pH
		M5 **E5**	heat treatment / cooking **;** denatures / changes tertiary structure of / changes 3D shape of, enzymes / proteins **OR** substrate no longer fits active site / active site shape changes / prevents ESC **;**		***M5*** **ACCEPT** pasteurising **IGNORE** canning for this mp ***E5, E 6 & E7*** **ACCEPT** 'kills bacteria' or 'kills microbes' as a reason supporting heat treatment, irradiation or smoking **only once**
		M6 **E6**	irradiation / UV / gamma rays / X-rays / <u>ionising</u> radiation **;** destroys / damages / changes / mutates, DNA / genes / genetic material **;**		***M6*** **CREDIT** radiation if correctly qualified in explanation
		M7 **E7**	smoking **;** (so exposed to) antibacterial / named antibacterial, chemical(s) **;**		***M7*** **CREDIT** addition of, sulphites / sodium benzoate / alcohol
		M8 **E8**	vacuum packing / canning / bottling **;** microorganisms cannot respire <u>aerobically</u> **;**		***E8*** **IGNORE** 'denaturing' as a consequence of canning / bottling
				4	

Question			Expected Answer	Mark	Additional Guidance
3	(c)		**This is a QWC question** **Ignore sections and mark as continuous prose**		Assume candidate is talking about mycoprotein unless otherwise stated. **CREDIT** ora for beef throughout. **IGNORE** use of figures alone when awarding mps **1, 3, 6, 7, 9** – look for **descriptive statement**, e.g. • '12 g of protein' = no mark • 'only 12 g protein' = 1 mark (mp 9)
		1	low(er) / less, energy (than beef) **;**		
		2	useful for, slimming / weight control / AW **;**		***2*** **ACCEPT** preventing obesity **ACCEPT '**less energy to burn off *during exercise*' **DO NOT CREDIT** 'burn off' unqualified
		3	low(er) / less, (total) fat **;**		
		4	(very) low / (much) less, saturated fat **;**		
		5	lower, cholesterol **OR** lower risk of, (coronary) heart disease / CHD / cardio-vascular diseases / heart attack / cardiac arrest / myocardial infarction / MI / angina / atherosclerosis / atheroma **/** stroke / hypertension **;**		
		6	contains carbohydrate / AW **;**		***6*** **ACCEPT** 'more carbohydrate than beef' **IGNORE** 'carbs'
		7	low(er) / less, iron content **;**		
		8	(increased risk of) anaemia / fewer RBCs / less haemoglobin / reduced oxygen carrying capacity of blood **;**		***8*** **IGNORE** answers phrased in terms of role of iron alone e.g. 'haemoglobin contains iron' = 0 Answers must show consequence of deficiency e.g. 'less haemoglobin' = 1
		9	low(er) / less, protein **;**		
		10	(mycoprotein provides) more balanced diet **;**		
		11	need larger intake to meet requirements / AW **;**	**7 max**	
			QWC – award for 2 clear references to the table **;**	**1**	Award for 2 sets of comparative figures (stated or calculated) with units – 'content per 100g' not needed **IGNORE** vague terms like 'about' as long as figs are correct
			Total	**20**	

Question			Expected Answer	Mark	Additional Guidance
4	(a)	(i)			**Mark the first response** but do not award the mark if a further answer is incorrect or contradictory **DO NOT CREDIT** refs to length as given in stem
		1	(m)RNA is single stranded / DNA is double stranded **;**		***1*** **ACCEPT** DNA is a double helix (as stranded is implied) **for this mp** **DO NOT CREDIT** DNA is a double *molecule*
		2	(m)RNA is non helical / DNA is helical **;**	1	***2*** **ACCEPT** (mRNA) not twisted / not coiled / not spiral / straight / ora
4	(a)	(ii)			**Mark the first response to (a)(ii)** – but but do not award the mark if a further answer is incorrect or contradictory
		1	RNA contains ribose **and** DNA contains deoxyribose **;**		
		2	RNA contains, uracil / U, **and** DNA contains, thymine / T **;**		***2*** **DO NOT CREDIT** thyamine
		3	3 / more than 1, forms of RNA **;**		***3*** **ACCEPT** 'one form of DNA'
		4	RNA is, single stranded / non helical, **and** DNA is, double stranded / helical **;** *if not already* ***awarded*** *as answer in (i)*	1	
4	(a)	(iii)	gene **;**	1	**IGNORE** allele / operon
4	(a)	(iv)	too big to / does not, fit through pore (in nuclear envelope) **;**	1	**ACCEPT** 'too long to fit … pore'
4	(a)	(v)	*idea that* only copies one, gene / section / part / AW, (of DNA) **;** *idea that* DNA comprises many, genes / alleles **;**	2	e.g. mRNA only codes for 1 protein **DO NOT CREDIT** '1 DNA molecule contains *all* the genes' 'mRNA only codes for 1 protein but DNA codes for many proteins' = 2 marks

Question			Expected Answer	Mark	Additional Guidance
4	(b)	(i)			
		1	non-competitive (inhibitor) ;		
		2	(α-amanitin / inhibitor / toxin) fits into, allosteric site / a place other than active site ;		
		3	active site changes, shape / configuration / conformation / structure ;		3 **ACCEPT** 'distortion of active site'
		4	substrate no longer, fits / complementary to, active site ;	2 max	*4* Mark to be awarded in context of active site (although need not be repeated if stated in mp 3) **IGNORE** ESC
4	(b)	(ii)			
		1	inhibits production of mRNA / mRNA not produced ;		*1* **CREDIT** prevents transcription
		2	prevents protein synthesis / AW ;		*2* **CREDIT** translation
		3	e.g. of, specific named protein / (vital) process, that may be affected ;	2 max	*3* e.g. respiration / photosynthesis (as question refers to 'an organism') / haemoglobin / cytochrome C oxidase
4	(c)	(i)	sequence / order, of amino acids ;	1	**IGNORE** number / organisation
	(c)	(ii)			**ALLOW** phonetic spelling
			A = ionic ;		
			B = hydrogen ;		
			C = disulfide (bond / bridge) ;	3	**DO NOT CREDIT** disulfate
4	(d)	1	increased kinetic energy ;		*1* must contain the idea of more than normal
		2	(any part of protein molecule) vibrates ;		
		3	hydrophilic / hydrophobic / hydrogen / ionic, bonds / interactions, break ;		*3* **IGNORE** Van der Waals **DO NOT CREDIT** if disulfide / covalent / peptide bonds are included
		4	change in, 3D shape / conformation (of protein) ;		*4* **IGNORE** tertiary / structure (as in question) **IGNORE** refs to, active site / enzymes
		5	denatures ;	3 max	
			Total	**17**	

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(i)	mucus traps, bacteria / microbes / pathogens / microorganisms / viruses / spores **;** cilia, sweep / move / waft, mucus / bacteria / pathogens / microorganisms / viruses / spore, upwards / AW **;**	**2**	For both marking points **ACCEPT** ora for what would happen if they didn't work **IGNORE** ref to dirt / dust / etc **ACCEPT** answers that imply out of airways e.g. to the throat / coughed / swallowed

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(ii)			**IGNORE** stage letters and look for correct sequence **DO NOT CREDIT** steps that are biologically out of sequence, e.g. mp6 before mp5. Penalise once only. **ACCEPT** 'bacteria' throughout
			stage A		
		1	phagocyte, attaches / binds / AW, to bacterium / pathogen **;**		
		2	receptor (on phagocyte), attaches to / binds to / recognises / AW, antigen (on bacterium) **;**		*2* **CREDIT** PAMP / antibody marker / complement marker, as AW for antigen
			stage B		
		3	bacterium, engulfed / enters by endocytosis / enters by phagocytosis / AW **;**		*3* **DO NOT CREDIT** 'eaten' **IGNORE** pseudopodia or any other structure
		4	(formation of) phagosome / phagocytic vacuole **;**		
			stage C		
		5	lysosomes, fuse with / join with / move towards (phagosome) **;**		*5* **DO NOT CREDIT 'binds with'**
		6	release / secrete, enzymes / lysins / named enzyme / hydrogen peroxide / free radicals (into phagosome) **;**		
			stage C/D		
		7	bacterium, digested / broken down / hydrolysed **;**		*7* **DO NOT CREDIT** destroyed (as in the question)
		8	(to) amino acid / sugar / glucose / fatty acid / glycerol **;**		
			stage D		
		9	absorbed / AW, into, cytoplasm / cytosol **;**		
		10	by, (facilitated / simple) diffusion / active transport **;**		**IGNORE** refs to antigen presentation as this happens after the stage shown in the diagram
				6 max	
5	(b)	(i)	plasma (cell) **;**	**1**	**ACCEPT** B lymphocyte **ACCEPT** effector cell **DO NOT CREDIT** lymphocyte unqualified

Question			Expected Answer	Mark	Additional Guidance
5	(b)	(ii)	**This is a QWC question**		**CREDIT** a correctly labelled diagram that is clearly an antibody **CON** if diagram and text are contradictory MPs 3, 5, 6, 8, 10 are stand alone but **DO NOT CREDIT** if context is clearly incorrect. e.g. 'constant region gives specificity' **AWARD** mp 2 but not mp 5
		1	Y-shaped molecule / light and heavy chains / disulfide bonds / 4 polypeptide chains **;**		
		2	constant region **;**		
		3	marker for / binds to, phagocytes / AW **;**		***3*** **ACCEPT** ref to opsonisation
		4	variable region **;**		
		5	(antibody) specificity **;**		
		6	(has) complementary shape to antigen (on pathogen) **;**		'Complimentary shape to specific antigen' = 2 marks (mps **5 & 6**)
		7	hinge (region) **;**		
		8	allows flexibility **;**		***8*** **IGNORE** 'movement' unqualified
		9	more than one variable region :		***9*** **DO NOT CREDIT** from diagram unless more than one is explicitly labelled or clearly keyed (e.g. by shading)
		10	allows, agglutination / description of agglutination **or** attachment to more than one, pathogen / antigen **;**		
		11	neutralisation / blocking pathogen's binding sites **;**	**6 max**	***11*** **ACCEPT** ref. to antitoxin
			QWC – award when 2 marks are given in any two of the grouped sections **;**	**1**	2 marks had been awarded from 2 of the following groups of marks (4 marks in total) mps 2 & 3 mps 4 & 5/6 mps 7 & 8 mps 9 & 10

Question			Expected Answer	Mark	Additional Guidance
5	(b)	(iii)	*type of immunity* *artificial active* ☐ *artificial passive* ☐ *natural active* ☐ *natural passive* ✔ ;	1	**DO NOT CREDIT** if more than 1 box is ticked **DO NOT CREDIT** a cross **DO NOT CREDIT** a tick that has been crossed out and is a 'hybrid' tick
			Total	17	

Question			Expected Answer	Mark	Additional Guidance
6	(a)	1	biodiversity (of heathland) ;		
		2	rare / endangered, species / plants / animals / fungi / organisms / named organism ;		
		3	rarity of (this) habitat ;		
		4	example of current *legal* status ;		***4*** e.g. National Park / SSSI / protected species / National Nature Reserves / NNR / other *legal* example
		5	(likely) reduction in size of, habitat / ecosystem / heathland ;		***5*** **IGNORE** 'habitat destruction' alone. Must refer to extent or size of destruction.
		6	effect of reduced size on viability (of whole ecosystem) ;		
		7	effect on, movement / spread, of, species / named species / plants / animals ;		***7*** **CREDIT** effect on wildlife corridors Answers could refer to limiting species spread or introduction of species
		8	a method of minimizing impact / AW / named example ;	**3 max**	***8*** e.g. 'toad tunnels' / relocation of population 'build toad tunnels so that the toads can still move between the two areas of heathland' = 2 marks (mps 7 and 8)
6	(b)	(i)			
		1	*idea of* (collect in) different / wider, area ;		***1*** **ALLOW** several transects e.g. another path
		2	(collect at) different, times of day / times of year / weather conditions ;		
		3	use of named, collecting / identifying, technique ;		***3*** e.g. (sweep) net / photographs / feeding stations **IGNORE** pooter (as could only catch larvae) / light trap / use of key / single transect
		4	method of ensuring that individuals not counted again ;		***4*** This mark refers to an initial or the only sample – it is **not** linked to mp 5
		5	mark-release-recapture / capture-recapture, technique ;	**3 max**	***5*** **CREDIT** count marked individuals in 2nd sample / population = no. in 1st sample x no. in 2nd sample / no. retrapped in 2nd sample

<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>6</td><td>(b)</td><td>(ii)</td><td>
<table>
<tr><th>species</th><th>n</th><th>n/N</th><th>$(n/N)^2$</th></tr>
<tr><td>Grayling (Hipparchia semele)</td><td></td><td></td><td></td></tr>
<tr><td>Large Heath (Coenonympha tullia)</td><td></td><td><u>0.3548</u></td><td></td></tr>
<tr><td>Gatekeeper (Pyronia tythonus)</td><td></td><td></td><td></td></tr>
<tr><td>Green Hairstreak (Callophrys rubi)</td><td></td><td></td><td></td></tr>
<tr><td>Silver-studded Blue (Plebeius argus)</td><td></td><td></td><td></td></tr>
<tr><td>Small Heath (Coenonympha phamhylus)</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Sum (Σ)</td><td>0.31633 OR 0.31217</td></tr>
<tr><td></td><td></td><td>1 - Σ</td><td>D = 0.68367 OR 0.68783</td></tr>
</table>
;
;
;
;
;
;
;
;
;</td><td>3</td><td>Original table on question paper had incorrect figure in $(n/N)^2$ column for Grayling row. Answers for mps 2 & 3 take this into account.

ACCEPT ecf from incorrect answer for Σ (whether decimal places or rounding)</td></tr>
<tr><td>6</td><td>(b)</td><td>(iii)

1

2</td><td>

many species present / high species richness / all species evenly represented / high species evenness / high biodiversity ;

(so) should not be developed / development should be modified / development should be reconsidered / should be conserved / AW ;</td><td>2</td><td>IGNORE refs to relative robustness of habitat

1 ACCEPT ‘types of butterfly’ as AW for species
IGNORE ‘individuals’ or ‘organisms’

2 DO NOT CREDIT ref to ‘planning’ alone (as given in question)
2 IGNORE responses that imply uncertainty about the development. e.g. ‘could’ ‘might’ ‘may’</td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>6</td><td>(c)</td><td>(i)</td><td>
<table>
<tr><th>species</th><th>letter</th></tr>
<tr><td>Grayling (Hipparchia semele)</td><td>A ;</td></tr>
<tr><td>Large Heath (Coenonympha tullia)</td><td>D ;</td></tr>
<tr><td>Gatekeeper (Pyronia tythonus)</td><td>F ;</td></tr>
<tr><td>Green Hairstreak (Callophrys rubi)</td><td>B ;</td></tr>
<tr><td>Silver-studded Blue (Plebeius argus)</td><td>C ;</td></tr>
<tr><td>Small Heath (Coenonympha phamhylus)</td><td>E</td></tr>
</table>
</td><td>5</td><td>DO NOT CREDIT if more than one letter given against any individual species</td></tr>
<tr><td>6</td><td>(c)</td><td>(ii)
1

2

3</td><td>(is) same <u>genus</u> ;

have, features / characteristics / appearance / behaviour / biochemistry / physiology / anatomy / genes / genetic makeup / DNA, that are, similar / in common ;

(share a) common, ancestor / phylogeny ;</td><td>2 max</td><td>1 DO NOT CREDIT vague statements like ‘could be in the same genus’
IGNORE Coenonympha

2 IGNORE ‘similar’ on its own
DO NOT CREDIT ‘same’
IGNORE specific examples (e.g. orange wings / large spot)

3 ACCEPT closely related ;</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>18</td><td></td></tr>
</table>

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Communication, Homeostasis & Energy

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Question			Expected Answer	Mark	Additional Guidance
1	(a)	(i)	**X** adenine **;** **Y** ribose **;** **Z** (tri / 3) phosphate(s) **;**	3	**Mark the first answer for each letter.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** ***X*** **IGNORE** nitrogenous base / base / A **DO NOT CREDIT** adenosine ***Y*** **IGNORE** pentose / sugar **DO NOT CREDIT** ribulose / hexose ***Z*** **IGNORE** chemical formulae (as Q asks for name) **DO NOT CREDIT** phosphorus / phosphoryl (PO)

Question				Expected Answer	Mark	Additional Guidance
1	(a)	(ii)	1	transfers energy / energy 'currency' / releases energy / universal energy molecule / energy intermediate / (immediate) source of energy ;		*1* **IGNORE** contains energy **DO NOT CREDIT** produce energy
			2	phosphate(s) can be removed by hydrolysis ;		*2* $ATP \rightarrow ADP + P_{(i)}$ by hydrolysis **or** $ATP + H_2O \rightarrow ADP + P_{(i)}$ (must include water)
			3	to , release / provide , 30kJ (mol^{-1}) energy ;		*3* **ACCEPT** 28 – 32 kJ **DO NOT CREDIT** produce energy
			4	(energy released for) metabolism / appropriate named reaction / appropriate reaction described ;		*4* e.g. • muscle contraction • active transport • phosphorylation • glycolysis • during movement binding to proteins to change their shape **IGNORE** respiration / photosynthesis unqualified
			5	ADP can attach a phosphate (forming ATP) during , respiration / photosynthesis ;		*5* **CREDIT** during, oxidative phosphorylation / chemiosmosis / substrate level phosphorylation / photophosphorylation
			6	energy released in , small 'packets' (to prevent cell damage) / suitable quantity ;		**NOTE** **'it releases 30kJ of energy when a phosphate is removed by hydrolysis'** = 3 marks (mps 3, 1 and 2)
					3 max	

Question			Expected Answer	Mark	Additional Guidance
1	(b)	(i)	crista ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** 'cristae' / **'**inner mitochondrial membrane' **IGNORE** 'stalked particles'
1	(b)	(ii)	chemiosmosis / oxidative phosphorylation ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** description of chemiosmosis [e.g. • 'ATP synthesis' • 'electron flow along electron carriers'] **IGNORE** **'**aerobic respiration' **IGNORE** 'electron transport chain' alone (as this is not a process)
1	(c)	(i)	**1** substrate respired changes over time ; **2** initially respires (mostly) **,** glucose / carbohydrate ; **3** lower / decrease in / 0.75 **,** RQ indicates (more) **,** fat / lipid **,** as substrate ***or*** as time goes by (more) lipid is respired ; **4** glucose / carbohydrate **,** used up / decreases (over time) ; **5** protein not likely to be used as substrate / protein only used as a last resort ;	3 max	***1*** Needs to be a clear statement and not just names and not inferred from candidate's complete answer ***2*** **IGNORE** respiring protein ***3*** **IGNORE** respiring protein ***5*** 'Less protein respired' isn't quite enough for this mp

Question			Expected Answer	Mark	Additional Guidance
1	(c)	(ii)	***This is a QWC question***		**Only CREDIT** answers that refer to **preventing a decrease** in body temperature – no **ora** **IGNORE** negative feedback (Q only about preventing decrease)
			1 **peripheral** / skin **,** **thermoreceptor**s / (heat) receptors **,** stimulated (by decrease in external temp) **;** **2** (impulses sent to / blood temperature monitored in) **hypothalamus** / sensory **cortex** **;** **3** **vasoconstrict**ion of **,** arterioles / small arteries **,** to reduce heat loss **;** **4** (prevents heat loss by) **radiat**ion / **conduct**ion / **convect**ion **;** **5** increased **,** **metabolic rate** / **metaboli**sm / respiration **,** to generate heat (energy) **;** **6** (release of) **adrenaline** / **thyroxine** **;** **7** shivering / (involuntary) muscle spasms **,** to generate heat (energy) **;** **8** **erector** / hair **,** muscles raise **,** (skin) hair / fur **,** to trap **,** air / heat **;** **9** AVP **;**	**4 max**	***3*** **ACCEPT** '<u>pre</u>-capillary sphincter' instead of 'arterioles' **DO NOT CREDIT** other blood vessels **but allow QWC** ***5*** Emphasis needs to be on increase / higher rate / more ***7*** Needs the idea of generating heat not just 'to keep warm ' ***9*** e.g. • specific behavioural response (such as huddling / increased exercise / move to find sun) • involvement of sympathetic nervous system • reduce sweating / reduce panting / stop panting **DO NOT CREDIT** 'stop sweating'
			QWC - technical terms used appropriately and spelt correctly **;**	**1**	Use of **three** terms from: **peripheral,** **thermoreceptor(s),** **hypothalamus,** **cortex,** **vasoconstrict**ion**,** **metabolic rate / metaboli**sm**,** **adrenaline,** **thyroxine,** **erector** **radiat**ion **/ conduct**ion **/ convect**ion **Please insert a QWC symbol next to the mark total bracket, followed by** **a tick (✓) if QWC has been awarded** **or a cross (✗) if QWC has not been awarded** **You should use the green dot to identify the QWC terms that you are crediting.**
			Total	**[16]**	

Question			Expected Answer	Mark	Additional Guidance
2	(a)	(i)	vein / venule ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** further qualification (e.g. central / hepatic) **but** **DO NOT CREDIT** inappropriate name (e.g. renal vein / hepatic portal vein)
2	(a)	(ii)	hepatocyte(s) / hepatic cells ;	1	**IGNORE** 'liver cells' (as given in Q) and 'sinusoid cells' A list must include 'hepatocytes' or 'hepatic cells' and not include an incorrect cell e.g. hepatocytes and Kupffer cells = 1 hepatocytes and α cells = 0 liver cells and Kupffer cells = 0
2	(b)		<u>deamination</u> ; carbon dioxide / CO_2 ; urea / $CO(NH_2)_2$; water / H_2O ;	4	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** If a formula is given for compounds D, E and F then the formula given must be correct in order to be awarded the mark e.g. **E** 'urea ($CONH_2$)' = 0 as the formula is incorrect

Question			Expected Answer	Mark	Additional Guidance
2	(c)	(i)	***This is a QWC question***		**Max 2 (instead of 3) for content if use the term , receptor / antigen / enzyme , *throughout* instead of antibody**
			1 (testing for) **human chorionic gonadotrophin** / hCG **;**		***1*** **ACCEPT** HCG This mark can be awarded for hCG but the name must be given in full for QWC
			2 hormone small so can pass from blood into **filtrate** (at Bowman's capsule) **;**		
			3 **monoclonal** / **immobilised , antibodies** / immunoglobulin **,** on stick **;**		***3*** **ALLOW** 'strip' instead of stick
			4 antibodies attached to **,** marker / dye **;**		
			5 hormone **,** binds / **complementary ,** to antibody **;**		***5*** **IGNORE** specificity
			6 (triggers) appearance of colour / line becomes visible **;**		
			7 AVP **;**	**3 max**	***7*** e.g. • reference to the second line to validate test • different antibody for second line • 2 coloured lines = pregnant
			QWC - technical terms used appropriately and spelt correctly **;**	**1**	Use of **three** terms from: **human chorionic gonadotrophin, filtrate, monoclonal, immobilised, antibody(ies), complementary**

Question				Expected Answer	Mark	Additional Guidance
2	(c)	(ii)				**IGNORE** enhances performance (as given in Q)
			1	fairness / giving unfair advantage / does not give an 'even playing field' **;**		***1*** **ACCEPT** comment about cheating **IGNORE** idea of should be available to all
			2	*idea of* health risks / dangerous / unhealthy / fatal / side effects **;**		***2*** **IGNORE** 'has an effect on health' as must imply negative effect
			3	specified health risk **;**		***3*** e.g. • depression • aggression • liver **,** damage / failure • heart attack • masculinisation of female athletes • feminisation of male athletes • infertility
			4	*idea of* distrust of 'outstanding' performances / does not reflect athlete's natural talent / sport should reflect athlete's natural talent **;**		
			5	*idea of* pressure to keep up with rival competitors **;**		
			6	*idea that* can train for longer (without tiring) / can respire longer (without tiring) / can recover from injury quicker / can build up muscle mass **;**		
			7	AVP **;**	**3 max**	***7*** e.g. • up to the individual to decide • idea that athletes should be role models
				Total	**[13]**	

Question			Expected Answer		Mark	Additional Guidance
3	(a)	(i)	**Credit in either order** ATP ; reduced NADP / NADPH / NADPH$_2$ / NADPH + H$^+$;		2	**Mark the first two answers.** If either of the answers is correct and an additional answer (i.e. 3rd etc) is given that is incorrect or contradicts the correct answer then -1 for each additional incorrect answer **DO NOT CREDIT** reduced NAD / NADH / NADH$_2$ / NADH + H$^+$ **DO NOT CREDIT** oxygen / O_2 (as not used in Calvin cycle) e.g. ATP (✓) and NADPH (✓) and GP (-1) = 1 NADH (×) and ATP (✓) and oxygen (-1) = 0 GP (×) and H_2O (×) and ATP and NADPH = 0 ATP (✓) and NADPH (✓) and GP (-1) and H_2O (-1) = 0
3	(a)	(ii)	**1** regenerates / produces , ribulose bisphosphate / RuBP ; **2** so cycle can continue / for (further) CO_2 fixation / to combine with CO_2 ; **3** formation of (named) , sugar / glucose / hexose / sucrose / starch / cellulose ; **4** formation of (named) , fat / triglyceride / lipid / fatty acids / glycerol / amino acids / protein / nucleic acids / nucleotides ; **5** 10x TP for RuBP and 2x TP for production **or** most TP used to produce RuBP and the rest for production ;		3 max	***3*** **IGNORE** carbohydrate without qualification **but CREDIT** suitably named carbohydrate ***5*** Needs to refer to both **CREDIT** 5/6 regenerated and the rest for production

Question			Expected Answer		Mark	Additional Guidance
3	(b)	(i)	oxygen used <u>and</u> carbon dioxide **,** produced / excreted **;** (only) occurs in the light / light (energy) required **or** uses **,** (same) photosynthetic enzyme / Rubisco **or** involves Calvin cycle **;**		**2**	**DO NOT CREDIT** comments that categorically state 'it **<u>is</u>** respiration' **CREDIT** 'sun' instead of 'light' **IGNORE** ref to light dependent stage [S & C x 2]
3	(b)	(ii)	**1**	reduces (rate of) photosynthesis / increases (rate of) photorespiration **;**	**3 max**	***2*** **ACCEPT** oxygen blocks active site of Rubisco **CREDIT** 'enzyme' instead of 'Rubisco' Needs to convey the idea that oxygen more successful / more oxygenase activity Be careful not to credit RuBP ***5 & 6*** **IGNORE** number before name unless used to indicate more or less (compare flow charts) [S & C x 3]
			2	less Rubisco available for CO_2 / more oxygen competing with CO_2 for Rubisco / more O_2 binding to Rubisco / O_2 outcompetes CO_2 for Rubisco **;**		
			3	less CO_2 **,** fixation / for Calvin cycle **;**		
			4	CO_2 given off **;**		
			5	less **,** glycerate 3-phosphate / GP / TP **,** produced **;**		
			6	less RuBP **,** regenerated / formed **;**		

Question			Expected Answer	Mark	Additional Guidance
3	(b)	(iii)	*idea that* oxygen **,** not a substrate for / cannot bind to / will not compete for **,** PEP carboxylase **or** PEP carboxylase **,** is only specific to carbon dioxide **;**	**1**	**ACCEPT** PEP carboxylase cannot 'fix' oxygen [S & C x 1]
			Total	**[11]**	

Question			Expected Answer		Mark	Additional Guidance
4	(a)	(i)	starch contains (only) glucose **and** sucrose contains **,** 50% glucose ***or*** glucose and fructose **;** by <u>hydrolysis</u> **,** starch releases more glucose / sucrose releases less glucose **;**		**2**	
4	(a)	(ii)	both starch and cellulose are (only) made of glucose **;** starch **,** is digestible / can be broken down **and** cellulose **,** is indigestible / cannot be broken down **;** (named) enzyme present for starch digestion / no (named) enzyme present for cellulose digestion **;**		**2 max**	
4	(b)		**1**	low / decrease **,** starch **;**		***1*** **ACCEPT** 'no starch'
			2	as starch has the <u>greatest</u> effect on blood glucose conc. **;**		***2*** 'substantial' or 'high' or 'big' is not quite enough
			3	increase / include **,** cellulose / fibre / roughage / fat / protein / meat **,** as no effect on blood glucose **;**		***3*** **IGNORE** the idea that **,** fat / protein **,** increases insulin and could indirectly lower blood glucose (as this is not relevant to Type 2 diabetes) **DO NOT CREDIT** little effect / less effect (as table shows **<u>no</u>** effect)
			4	some / medium amount of **,** sugars / sucrose / lactose **;**		
			5	*idea of* limiting **,** sucrose / lactose / fat / protein **,** as causes an increase in insulin **<u>and</u>** will make cells less responsive (to insulin) **;**	**3 max**	

Question			Expected Answer	Mark	Additional Guidance
4	(c)			3	**Award one mark per row** *both glycogen and glucagon* **IGNORE** polymer or macromolecule unless qualified *glycogen* **DO NOT CREDIT** complex sugar / sugar *both glycogen and glucagon* Look for ***qualification*** of glycogenolysis *glycogen* **ACCEPT** muscle / brain *glucagon* **ACCEPT** 'a cells' **IGNORE** pancrease **DO NOT CREDIT** beta / β **,** cells
			Total	**[10]**	

	glycogen	glucagon	
type of compound	carbohydrate **OR** polysaccharide	hormone **OR** polypeptide **OR** protein	;
role of compound	storage **OR** to provide glucose (when blood glucose conc. falls) **OR** can undergo glycogenolysis	binds to cell receptor **OR** causes conversion of glycogen to glucose **OR** stimulates glycogenolysis **OR** increases (blood) glucose concentration	;
site of production	liver **OR** hepatocytes	pancreas **OR** islets of Langerhans **OR** alpha / α **,** cells	;

Question			Expected Answer	Mark	Additional Guidance
5	(a)	(i)	**E ;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
5	(a)	(ii)	**A** and **F ;**	1	**Mark the first <u>two</u> answers for <u>one</u> mark.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
5	(a)	(iii)	**D ;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
5	(a)	(iv)	**B ;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
5	(b)	(i)	**B ;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
5	(b)	(ii)	channel / receptor / ion **,** is different **;** AVP **;**	1 max	**IGNORE** has enzyme to break it down (as Q states that it is stored in body) **DO NOT CREDIT** ref to active site e.g. • *idea that* toxin confined to **,** organelle / organ / part of the body • toxin not **,** in general circulation / (circulated) in blood • toxin stored in inactive form • contains a compound that neutralises toxin [S & C x 1]

Question			Expected Answer		Mark	Additional Guidance
5	(c)	(i)	1	attacked by the body's (own) immune system ;	2 max	*1* Named parts of the immune system are credited in mp 3 – not in this mp
			2	(immune system) mistakes / treats / recognises , body cells / neurones / myelin , as , 'foreign' / non self ;		
			3	correct ref. to , antibodies / (named) phagocytes / (named) B lymphocytes / (named) T lymphocytes ;		
5	(c)	(ii)	1	(damage to) myelin / sheath / Schwann cell(s) ;	2 max	*1* **IGNORE** damaged neurone (as given in Q) **IGNORE** damaged axon
			2	removes / has less , insulation ;		
			3	interferes with / slows / stops , conduction of , (nerve) impulse / action potential **or** slows / stops / prevents , saltatory conduction / described ;		*3* e.g. • more gaps where depolarisation needs to take place • shorter local , circuits / currents
			4	occurs , in sensory neurones / towards brain / towards CNS / from sensory organ / from receptor ;		
				Total	**[10]**	

[END]

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OCR
RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE **F215**

Control, Genomes and Environment

Mark Scheme for June 2010

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Question			Expected Answer	Mark	Additional Guidance
1	(a)	(i)	microbes **/** (living) organisms **/** cells **/** enzymes **;** (make) product **/** for human benefit / (carry out) conversion / reaction / industrial process **;**	**2**	**CREDIT** microorganisms / bacteria / prokaryotes / fungi **CREDIT** living things **CREDIT** cell components / parts of cells **CREDIT** example such as (named) food or medicine BUT **IGNORE** cheese (as stated in question) **IGNORE** process unqualified
1	(a)	(ii)	microbes **/ AW ,** killed / removed / not present **;** enzymes <u>denatured</u> **;** (so no) competitors **/** unwanted reactions **/** (human) health risk **;**	**2 max**	**Mark the first two suggestions** **IGNORE** contamination / sterile **IGNORE** idea of preserving milk **AW** for microbes as in **(a)(i)** plus **ACCEPT** organisms **DO NOT CREDIT** microbes denatured **CREDIT** (no) competition **CREDIT** (no) food spoilage / change of flavour / loss of quality **CREDIT** (no) pathogens / harmful microbes / TB **"Kills harmful microbes"** or **"Kills pathogens"** scores 2 marks (mps 1 & 3)

Question			Expected Answer	Mark	Additional Guidance
1	(b)	(i)			**Award mp 1 plus 2 max from the other mark points**
		1	enzyme **;**		*1* **ACCEPT** globular / tertiary / catalyst / catalytic (protein)
			plus any 2 of the following	1	
		2	(enzyme) not, changed / used up **; ora**		*2* **ora** = can be used again / re-used **IGNORE** enzyme recycled
		3	*idea of* ESC (forms) / substrate and enzyme (bind) **;**		*3* ESC = enzyme-substrate complex **ACCEPT** substrate entering active site
		4	products (and enzyme) released at end **;**	max 2	
1	(b)	(ii)			**Mark the FIRST suggestion on each numbered line** **IGNORE** 'cheaper' without qualification
		1	(enzyme can be removed to be) used again **;**		
		2	(enzyme can) to leave pure(r) product **; ora**		*2* **ACCEPT** cheaper / easier, downstream processing
		3	(enzyme) more stable / more efficient / works better **;**		*3* **CREDIT** less susceptible to, pH / temperature, change / extremes **"enzymes work at high temperatures"** = 0 **"enzymes work at higher temperatures"** = 1 (because comparative statement made)
				2	

Question			Expected Answer	Mark	Additional Guidance
1	(c)		***This is a QWC question***		
			Section I - Obtaining the gene		
		1	use restriction, enzyme / endonuclease **;**		
		2	to, cut out / get / isolate, (rennin) gene / DNA coding for rennin ***or*** to, fragment / digest, DNA **;**		***1*** **CREDIT** named example e.g. *Eco* R1, *Bam* H1, *Hin* dIII ***2*** **DO NOT CREDIT** 'cut gene' **IGNORE** 'break up DNA'
		3	gene probe **;**		
			OR		
		4	obtain rennin mRNA **;**		***NOTE***
		5	(use) reverse transcriptase **;**		***1-9*** **CREDIT** whichever of the three alternative "obtaining the gene" protocols yields most marks, **either award marking points 1-3 or 4-6 or 7-9**
		6	to make cDNA **;**		
			OR		
		7	sequence, rennin (protein) **;**		
		8	work out base code **;**		
		9	make this DNA sequence **;**		
		10	sticky ends **;**		***10*** can be awarded, once only, in Sections I or II
			Section II - Vector		
		11	cut (open), plasmid / phage **;**		***11*** **DO NOT CREDIT** 'cut out plasmid' **DO NOT CREDIT** 'ring of DNA' unless it is clear that plasmid is being referred to
		12	using same restriction enzyme **;**		***12*** **CREDIT** same named enzyme (re. mp1)
		13	annealing / base pairing of sticky ends **;**		***13*** **CREDIT** idea of sticky end bases hydrogen bonding
		14	join sugar-phosphate backbones **;**		***14*** **CREDIT** formation of phosphodiester bonds
		15	(using DNA) ligase **;**		
		16	recombinant, vector / plasmid / phage / DNA **;**		
			Section III - Introduction into host cell		
		17	mix with bacteria **;**		
		18	detail of conditions **;**		***18*** e.g. Ca^{2+} ions added / heatshock (freeze then inc to $40^{o}C$)
		19	transformation (plasmid) / transduction (phage) **;**	max 7	***19*** **CREDIT** transform / transformed / transduce / transduced **IGNORE** transgenic
			QWC – sequencing of steps – at least 1 mark point scored from each of the three sections, in the correct order ;	1	I. obtaining gene (mp **1 – 9**) followed by II. vector (mp **13 – 16**) followed by III. introduction to host cell (mp **17 – 19**)
			TOTAL	17	

Question			Expected Answers	Marks	Additional Guidance
2	(a)	(i)	red ; vermillion ; cinnabar ;	3	
2	(a)	(ii)	(recessive) epistasis / epistatic ;	1	**ACCEPT** complementary epistasis **DO NOT CREDIT** dominant epistasis
2	(a)	(iii)		max 3	
		1	gene products are enzymes ;		
		2	multi-enzyme / multi-step, pathway ;		***2*** needs to be a clear generalised statement (and not implied - e.g. by awarding mp 3) **IGNORE** 'metabolic' pathway (as given in question)
		3	3, steps / enzymes, change tryptophan to red pigment ;		***3*** **ACCEPT** V, C and B are responsible for the change of tryptophan to red
		4	product of one reaction / intermediate compound, is, substrate / starting point, for next ;		
		5	dominant allele gives, functional / wild-type / AW, enzyme ;		
		6	recessive allele gives, non-functional / different / AW, enzyme ;		
2	(b)	(i)	*if (red-eyed parent) was heterozygous*	max 2	**IGNORE** ref to sex linkage
		1	there would be no difference between, sexes / males and females ;		
		2	red-eyed males **and** white-eyed females would occur ;		***2*** **ACCEPT** "because there are no red-eyed males **and** white-eyed females (in results)" "*all* 4 phenotypes would, occur / be represented" **DO NOT** infer phenotype(s) from genotype(s)
		3	1:1:1:1 ratio **or** 1:1 ratio in both sexes ;		***3*** If 4 phenotypes stated / listed *together with the ratio*, then award mp 2 as well

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>2</td><td>(b)</td><td>(ii)</td><td>parental genotypes XrXr XRY- ;
gametes Xr XR and Y- ;
F1 genotypes XRXr XrY- ;</td><td>3</td><td>ACCEPT alternative letters only if a KEY is given. Must have capital letter for dominant allele and small (same) letter for recessive allele.

CREDIT GAMETES either on the correct line or in correct place on Punnett square, whichever is correct. They do not need to be in circles.

ACCEPT ecf once only if Y wrongly shown as carrying ‘r’ allele
ACCEPT ecf once only if X and Y missing

DO NOT CREDIT F1 genotypes written in blank space if F1 phenotypes put on bottom lines instead</td></tr>
<tr><td>2</td><td>(b)</td><td>(iii)</td><td>
<table>
<tr><th>phenotype of fly</th><th>O</th><th>E</th><th>O - E</th><th>$(O - E)^2$</th><th>$\frac{(O - E)^2}{E}$</th></tr>
<tr><td>red-eyed female</td><td>27</td><td>25</td><td>2</td><td>4</td><td>0.16</td></tr>
<tr><td>white-eyed male</td><td>23</td><td>25</td><td>-2</td><td>4</td><td>0.16</td></tr>
</table>
; ;
χ^2 = 0.32 ;
no significant difference (at 95% confidence level) ;</td><td>4</td><td>One mark per row

ACCEPT fractions in last column (4/25)

ACCEPT not significant
IGNORE ref to happening by chance

ACCEPT ecf for last two points
IGNORE arguments referring to null hypothesis</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>16</td><td></td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)			
		1	similar / same, cells / metabolism ;		*1* **ACCEPT** they are all eukaryotic cells
		2	similar / same / share, genes **or** have genes in common ;		
		3	similar / same, (embryonic) development ;		
		4	shared, ancestry / ancestor **or** all related by evolution ;	max 2	*4* **CREDIT** due to phylogeny **ACCEPT** all same kingdom **IGNORE** 'they are all animals'
3	(a)	(ii)			**Mark the FIRST answer on each numbered line**
		1	small ;		
		2	short life cycle ;		*2* **ACCEPT** fast development / mature quickly / fast reproductive rate / short generation time
		3	easy to, keep / breed / AW ;		*3* **ACCEPT** produce many offspring
		4	cheap (to buy / keep) ;		
		5	readily available / common / not rare ;		
		6	large cells ;		
		7	previously well-studied / many known mutants ;	max 2	*7* **ACCEPT** genome has been, mapped / sequenced
3	(b)	(i)	scanning ; electron (microscope) ;	2	**CREDIT** SEM = 2 marks **ACCEPT** transmission electron / TEM = 1 mark **IGNORE** micrograph
3	(b)	(ii)	description of legs in place of antennae in, mutant / 3.2 / AW ;	1	**ACCEPT** projections on head / antennae / feelers, longer (in Fig. 3.2) **DO NOT CREDIT** antennae / projections vs. none **DO NOT CREDIT** mandibles / fangs **DO NOT CREDIT** incorrect statement e.g. legs on mouth
3	(b)	(iii)	homeotic / homeobox / hox ;	1	

Question			Expected Answers	Marks	Additional Guidance
3	(c)	1	*synthesis*		**MAX 6** marks for synthesis **MAX 6** marks for roles
		2	DNA, copied into / →, mRNA **or** described **;**		
		3	transcription / transcribed **;**		
			one strand copied **;**		***1*** **DO NOT CREDIT** descriptions that contain errors
		4			
		5	complementary base-pairing **;**		***3*** **ACCEPT** coding / sense / non-sense / template, strand (implying one only)
		6	triplet code / code read in threes / codon is 3 bases **;**		
		7	base sequence determines amino acid sequence **;**		***4*** **CREDIT** description of base pairing as correct to context
		8	translation **;**		
		9	ribosomes **;**		
			role of tRNA described **;** **(max 6)**		***9*** e.g. "tRNA brings amino acid" or "tRNA anticodon binds to mRNA codon"
		10	*roles of polypeptides*		
		11	(named) structural protein **;**		
			enzymes / catalyse reactions / control metabolism **;**		
		12			***10*** e.g. actin / myosin / collagen / keratin
		13	hormones / growth factors **;**		
		14	receptor proteins **;**		
			adenyl cyclase / cAMP **;**		***12*** **CREDIT** growth hormone / GH / somatotrophin / FSH
		15			
			idea of switching genes, on / off **;**		***14*** most likely to be expressed in context of mp 12
		16			
			homeotic / homeobox, genes		***15*** **CREDIT** transcription factors / regulatory proteins / repressor proteins
		17	**or** homeodomain proteins **;**		
			idea of master switch gene / one gene turns on/off whole set of other genes / cascades of gene switching **;**		
		18			
			apoptosis **;** **(max 6)**		
				7 max	
			QWC – balanced account ;	**1**	At least 2 marks from points 1 - 9 **and** at least 2 marks from points 10 – 18
			Total	**16**	

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>
<table>
<tr><th></th><th>similarity</th><th>difference</th></tr>
<tr><td>structure</td><td>mitochondria
or
vesicles
or
postsynaptic receptors ;</td><td>NMJ membrane(s), wavy / AW * ora
or
receptors different (shape)
or
enzymes in different places ;</td></tr>
<tr><td>function</td><td>(neuro)transmitter, released I crosses gap
or
changes potential difference / AW **
or
enzymes break down (neuro)transmitter ;</td><td>different neurotransmitters / ACh vs. dopamine
or
muscle contraction vs. nerve impulse
or
different enzymes ;</td></tr>
</table>
</td><td>4</td><td>One mark per box

difference
NMJ is neuromuscular junction
* AW ACCEPT wiggly / bumpy / not smooth / rough / larger SA / any suitable description but IGNORE microvilli

difference
ACh is acetylcholine

similarity
** AW CREDIT depolarises / -70 mV → +40 mV but IGNORE pass on action potential</td></tr>
<tr><td>4</td><td>(b)</td><td>(i)
1

2
3

4</td><td>phenelzine ;

no ecf from incorrect drug
idea that does not bind to (dopamine) receptor ; ora
idea that binds to, MAO / enzyme ;

allosteric site / non-competitive inhibitor ;</td><td>1

max 1</td><td>Award mp1 and, if correct, any 1 from the remaining points

2 CREDIT other two do bind to dopamine receptor
3 IGNORE inhibits, MAO / enzyme (as given in the question)
4 ACCEPT “not a competitive inhibitor”</td></tr>
<tr><td>4</td><td>(b)</td><td>(ii)</td><td>(drug) occupies / blocks / binds to, (dopamine) receptors ;
without causing, action potential / response ;
reduces effect of dopamine / is a dopamine antagonist ;</td><td>2</td><td>CREDIT “without causing depolarisation” / AW
DO NOT CREDIT “inhibits dopamine” or “reduces dopamine levels</td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
4	(c)	(i)	humans are, diploid / 2n ; chromosomes, are in pairs / homologous ; one, (copy / gene / allele), from each parent / on each chromosome of pair ;	2 max	**DO NOT CREDIT** ref to bivalents
4	(c)	(ii)	(gel) electrophoresis ;	1	
4	(d)	1	13 b-p deletion (has most serious consequences) ;		
		2	frameshift / alter reading frame ;		
		3	genetic code is triplet / read in groups of 3 bases ;		
		4	alters all amino acids (coded for) after the mutation ;		
		5	21 b-p deletion causes 7 amino acids to be lost ;		
		6	substitution changes, one / no, amino acids ;	3 max	*6* **CREDIT** could be a silent mutation / 1 b-p substitution may not have an effect
4	(e)	1	natural selection ;		
		2	selective advantage ;		
		3	(allele / behaviour) increases, survival / breeding / AW ;		*3* **CREDIT** increases reproductive success / AW
		4	(because) helped, find food / find new resources / make new tools / get mates ;		*4* **ACCEPT** more promiscuous / AW
		5	allele passed on (to next generation) ;		
		6	(allele / behaviour) increased in frequency over, generations / time ;	4 max	*6* **MUST HAVE** time element
			Total	**18**	

Question			Expected Answers	Marks	Additional Guidance
5	(a)		ecosystem ; producers / autotrophs ; primary ; trophic level(s) ; biotic / living ; minerals / elements ;	6	**DO NOT CREDIT** plants **DO NOT CREDIT** tropic **CREDIT** named, element / ion, e.g. nitrogen, nitrate **ACCEPT** symbol e.g. N / NO_3^- **ACCEPT** nutrient **DO NOT CREDIT** energy / waste products
5	(b)	(i)			
		1	limiting / density-dependent, factors ;		
		2	carrying capacity ;		
		3	intraspecific competition ;		***3*** **ACCEPT** description e.g. ● "competition with other members of the same species" ● "competition with other (small) squirrels"
		4	for, food / nesting sites ;		***4*** **ACCEPT** they run out of food
		5	interspecific competition ;		***5*** **ACCEPT** description e.g. "competition with other species"
		6	with, deer / tree shrew / giant squirrel ;		
			larger squirrel populations		
		7	attract more predators ;		***7*** **DO NOT CREDIT** predation alone, must be linked to larger squirrel population
		8	parasites / diseases, spread more easily ;		***8*** **DO NOT CREDIT** disease alone, must be linked to larger squirrel population
				max 4	

Question			Expected Answers	Marks	Additional Guidance
5	(b)	(ii)	species richness & evenness decrease **; ora** (richness) 29 → 26 (species) **;** (evenness) large numbers of, 2 / some, species, but, low numbers / none, of other species **;**	**max 2**	**ACCEPT** they both, decrease / decline / fall **or** they were higher at start **ACCEPT** 6 → 4 **or** 2 fewer (from table) **or** 3 fewer (from text) **CREDIT** suitable named e.g.s from table
5	(c)	(i)	rare initially / AW **;** prey, numbers have reduced / have become extinct / have left the area **;** idea of slower reproductive rate / AW **;**	**max 1**	**ACCEPT** that there weren't very many at start **DO NOT CREDIT** 'lack of food' unless has indicated that food is an animal **ACCEPT** don't breed as fast / don't have as many offspring
5	(c)	(ii)		**max 3**	**Mark the FIRST suggestion on each numbered line**
		1	aesthetic / amenity / recreational, value **;**		***1*** **ACCEPT** description, e.g. beautiful / so people will visit / so people will use it for leisure
		2	(eco)tourism **;**		***2*** **ACCEPT** description, e.g. raise money from visitors
		3	to, preserve biodiversity / preserve genetic diversity / stop extinction **;**		***3*** **ACCEPT** description, e.g. keep more species
		4	ref. interactions between species / need to preserve whole habitat **;**		***4*** **ACCEPT** description, e.g. if habitat destroyed there will be a knock-on effect on many species
		5	(rainforest species / preserve gene pool as) could be useful, in future / as potential, for, medicine / genetic engineering / AW **;**		***5*** **ACCEPT** for drugs, pharmaceuticals, GM or GM e.g. (like crop improvement)
		6	to support indigenous peoples / AW **;**		***6*** **ACCEPT** let native people continue to live in forest income for indigenous people
		7	to stop effect of deforestation on, atmosphere / climate / soil **;**		***7*** **ACCEPT** to stop, CO_2 % rising / global warming / erosion **or** forest acts as C, sink / store
		8	AVP **;**		***8*** e.g. ● habitat for pollinators ● habitat for predators of pests **DO NOT CREDIT** 'right to life'

Question			Expected Answers	Marks	Additional Guidance
5	(d)		*management practices*		**LOOK FOR** key ideas expressed in different ways
		M1	coppicing / pollarding / description **;**		***M1*** **CREDIT** coppicing with standards / rotational coppicing
		M2	selective felling / description **;**		***M2*** **ACCEPT** only some trees cut down
		M3	rotational felling / description **;**		***M3*** **ACCEPT** cycle of felling different areas
		M4	strip felling **;**		
		M5	replant after felling **;** **(max 2)**		
			explanation of benefits re. sustainability		
		B1	preserves / prevents disruption to, habitat / ecosystems / nesting sites **;**		
		B2	maintains / increases, species diversity / biodiversity **;**		
		B3	prevents, soil erosion / leaching **;**		
		B4	less disturbance by machinery **;**		
		B5	AVP **;** **(max 2)**		***B5*** **CREDIT** specific benefits linked to a practice e.g. ● faster recovery due to seeding from untouched areas nearby (M3) ● pollarding so deer can't eat shoots (M1)
				max 4	
			Total	**20**	

Question			Expected Answers	Marks	Additional Guidance
6	(a)	1	to cope with changing conditions / AW ;		***1*** Looking for a general statement **DO NOT CREDIT** "adapt to change"
		2	avoid <u>abiotic</u> stress ;		
		3	to maximise photosynthesis **or** to obtain more, light / water / minerals **; ora**		***3*** **CREDIT** named elements / ions **IGNORE** nutrients
		4	avoid, herbivory / grazing ;		***4*** methods of preventing grazing could include producing more toxins / more spines / encouraging stinging ants **IGNORE** predation
		5	to ensure, germination in suitable conditions / pollination / seed set / seed dispersal ;	**max 2**	***5*** **DO NOT CREDIT** 'maximise reproduction' without further qualification
6	(b)	(i)			
		1	in water / in **A** / with no abscisic acid, germination increases as conc. GA increases ;		
		2	when abscisic acid present / in **B**, no germination ;		***2*** **DO NOT CREDIT** 'inhibits germination' (as this is a conclusion not a description)
		3	maximum germination 90% with 5 mol dm^{-3} GA, in water / without abscisic acid ;		***3*** **ACCEPT** 91% (± 2%) for 90%
		4	2 comparative figures (x and y refs. plus units) ;		***4*** EITHER compare **A** and **B** at the same GA conc OR two points on same line **with units for both**
		5	GA concentration increases, logarithmically / by a factor of 10, on x axis ;		
		6	10 times more GA gives, 3 (conc 0.05 to 0.5) / 0.5 (conc 0.5 to 5), times more germination ;	**4 max**	

GA conc (mol dm^3)	A (%)	B (%)
0	10 ± 2	0
0.05	22 ± 2	0
0.5	66 ± 2	0
5	91 ± 2	0

Question			Expected Answers	Marks	Additional Guidance
6	(b)	(ii)			
		1	so temperature doesn't affect results / so only desired variable(s) changed / to show just the effect of plant hormones ;		*1* **ACCEPT** fair test **IGNORE** to control temperature / temperature is a limiting factor / temperature is a controlled variable
		2	since temperature affects enzyme activity ;		*2* **CREDIT** "optimum temperature for enzyme activity" or "this is the temperature when enzymes work best"
		3	suitable / optimum, temperature for (lettuce) germination ;		*3* **ACCEPT** 'these' seeds
				2 max	
6	(b)	(iii)			**Mark the FIRST suggestion on each numbered line** **DO NOT CREDIT** conc, GA / giberrellin (as this is the independent variable) **IGNORE** number of seeds (as given in the question)
		1	<u>volumes</u> of liquid(s) ;		*1* **DO NOT CREDIT** amounts / levels **CREDIT** volume of, water / GA / ABA
		2	ABA concentration ;		
		3	oxygen availability ;		*3* **IGNORE** carbon dioxide
		4	age of seeds ;		
		5	previous storage of seeds / viability idea ;		
		6	genotype / variety, of seeds ;		*6* **CREDIT "**from same batch of seeds" or "seeds from same plant"
		7	size / type of, petri dish / filter paper ;		
		8	length of time experiment left for (before recording results) ;		
		9	space between seeds ;		
		10	AVP ;		*10* e.g. ● light qualified (duration / intensity / wavelength) ● use of distilled water ● all lids, off / on
				3 max	

Question			Expected Answers	Marks	Additional Guidance
6	(c)				**Mark the FIRST TWO suggestions** **IGNORE** the names of plant growth regulators
		1	seedless, fruits / grapes **;**		
		2	weedkillers **;**		
		3	rooting powder / to grow cuttings / used in tissue culture **;**		
		4	control fruit ripening **;**		***4*** could be used to speed up or slow down
		5	controls fruit drop **;**		
		6	restrict hedge growth **;**		
		7	preserve, cut flowers / green vegetables **;**		
		8	specific example of improved fruit quality **;**		***8*** e.g. ● longer stalks on grapes ● longer apples
		9	producing malt / in brewing **;**		
		10	AVP **;**		***10 & 11*** e.g. ● promoting sexual maturity in conifers ● promoting latex flow in rubber plants ● promoting sexual maturity in female cucumber plants ● longer nodes in sugar cane ● restricting growth in, chrysanthemums / other e.g.
		11	AVP **;**	**2 max**	
			Total	**13**	

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