

Biology

Advanced GCE **A2 7881**

Advanced Subsidiary GCE **AS 3881**

Mark Schemes for the Units

June 2009

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Advanced Subsidiary GCE Biology (3881)

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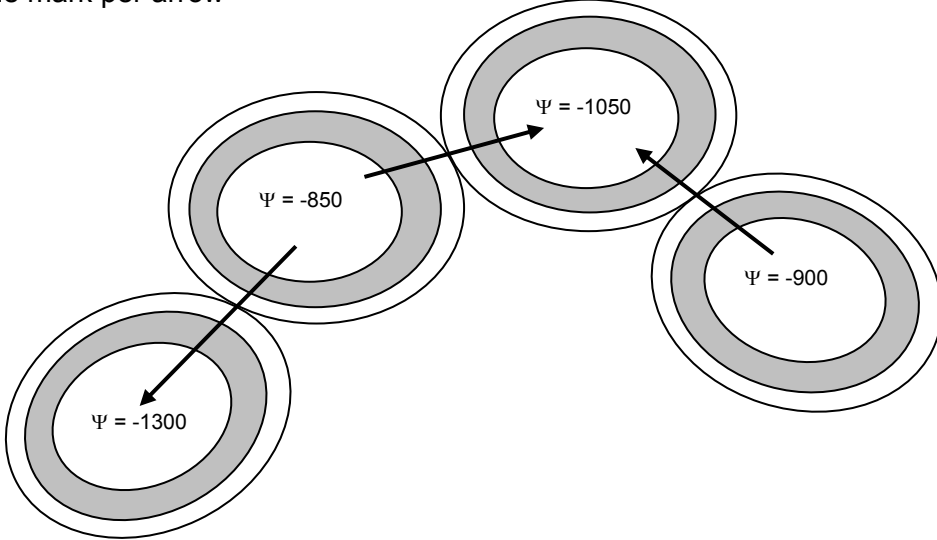
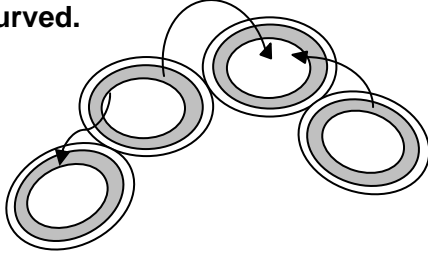
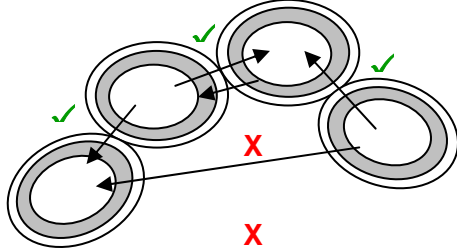
2801 Biology Foundation

Question			Expected Answers	Marks	Additional Guidance								
1	(a)		<table><tr><th><i>active transport</i></th><th><i>facilitated diffusion</i></th></tr><tr><td>against / up , (conc) gradient OR from low conc to high conc</td><td>down / with , (conc) gradient OR from high conc to low conc</td></tr><tr><td>requires , energy / ATP</td><td>no energy / no ATP / passive</td></tr><tr><td>carrier / protein , changes shape</td><td>carrier / protein , doesn't change shape OR (uses) channel protein</td></tr></table>	<i>active transport</i>	<i>facilitated diffusion</i>	against / up , (conc) gradient OR from low conc to high conc	down / with , (conc) gradient OR from high conc to low conc	requires , energy / ATP	no energy / no ATP / passive	carrier / protein , changes shape	carrier / protein , doesn't change shape OR (uses) channel protein	2 max	1 mark per correct row Comparative statements must be made on the same line. DO NOT CREDIT 'along the gradient' DO NOT CREDIT 'active' or 'not passive' for active transport
<i>active transport</i>	<i>facilitated diffusion</i>												
against / up , (conc) gradient OR from low conc to high conc	down / with , (conc) gradient OR from high conc to low conc												
requires , energy / ATP	no energy / no ATP / passive												
carrier / protein , changes shape	carrier / protein , doesn't change shape OR (uses) channel protein												

1	(b)	<p><i>vitamin B₁</i> (3 max) polar / ionic ; cannot pass through , phospholipid layer / hydrophobic regions ; use , <u>protein</u> channels / <u>protein</u> carriers / transport <u>proteins</u> ; (protein channels with) hydrophilic , lining / channel / core ; (3 max)</p> <hr/> <p><i>vitamin K</i> non polar / non ionic ; will dissolve in , phospholipid / hydrophobic regions ; so can pass (directly) through , phospholipid / hydrophobic regions ;</p>	<p><i>A maximum of 3 marks for vitamin B₁</i> DO NOT CREDIT water-soluble (in Q) CREDIT impermeable to vitamin B₁ / water CREDIT transmembrane / intrinsic <u>protein</u> DO NOT CREDIT aquaporin</p> <hr/> <p>DO NOT CREDIT fat-soluble (in Q)</p>	4 max
		Total	6	

Question			Expected Answers	Marks	Additional Guidance
2	(a)		uncontrolled / continuous / AW , <u>mitosis</u> (in context of cancer) ; producing a , mass of cells / tumour ; (are often) unspecialised / not functioning ; all originate from a single cell / genetically identical (cancer) cells ; more likely in areas with greater cell division ; mutation associated with division ; AVP ;	3 max	Only award in the context of cancer e.g. malignant / benign + some detail metastasis / description mutation of proto-oncogene / activation of oncogene telomeres, persist / do not degrade
2	(b)		<i>radiotherapy (max 2)</i> affects <u>dividing</u> cells ; cancerous cells more susceptible than normal cells ; damages , DNA / chromosomes / telomeres ; (max 2) <hr/> <i>decreasing the diameter of blood vessels (max 2)</i> cancer cells / tumour , deprived of , oxygen / glucose / (named) nutrients ; reduces respiration ; waste products / named e.g. , not removed ; stops spread of cancer cells ; lack of , energy / ATP , for , mitosis / replication / cell division ; (max 2) <hr/> kills <u>cancer</u> cells ;	3 max	<i>A maximum of 2 marks for radiotherapy</i> <hr/> <i>A maximum of 2 marks for blood vessels</i> NOT just 'cells' IGNORE growth <hr/> CREDIT once only (in either treatment) if max not achieved for that treatment
			Total	6	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	20 000 / 2×10^4 ; ;	2	Award 2 marks for the correct answer. If answer incorrect, or answer contains units, award 1 working mark for $\div 2$ (μm) or equivalent
3	(a)	(ii)	mitochondrion ;	1	ACCEPT mitochondria
3	(a)	(iii)	(mitochondria) release energy / produce ATP ; by <u>aerobic</u> respiration ; muscle (cells) require <u>much</u> , energy / ATP ; for contraction ; AVP ;	3 max	DO NOT CREDIT 'produces energy' IGNORE relaxation e.g. reduces lactate build-up site of oxidative phosphorylation
3	(b)		Mark 1 st response on each numbered line ... muscle cells have nucleus / nuclear membrane / DNA not free in cytoplasm ; membrane-bound organelles / named e.g. ; larger / 80S / 22nm , ribosomes ; linear DNA ; chromosomes / DNA covered with protein / AW / DNA not naked ; no cell wall ; no mesosome ; no plasmid(s) ; AVP ; ; ;	3 max	<i>unless no response for 2/3, then mark as list</i> CREDIT converse for bacteria stated IGNORE 'more' with respect to organelles DO NOT CREDIT 'muscle cells have more membrane-bound organelles' e.g. have no flagella ; have myosin ; have actin ; have myoglobin ;
			Total	9	

Question		Expected Answers	Marks	Additional Guidance
4	(a)	<p>One mark per arrow</p> 	3	<p>AWARD one mark per arrow.</p> <p>Arrows must clearly indicate direction of flow from one cell to a cell with which it is in contact. The beginning of the arrow must be clearly within the starting cell and the end clearly within the finishing cell. Arrows may be straight or curved.</p>  <p>= 3</p> <p>DO NOT CREDIT any additional arrow(s) that go from low Ψ to high Ψ or arrows that go between non-touching cells.</p> <p>one of these additional arrows = max 2 two of these additional arrows = max 1 three or more of these additional arrows = 0</p>  <p>= 1</p>

Question			Expected Answers	Marks	Additional Guidance
4	(b)	1	hydrogen bonding <u>between</u> water molecules ;	9 max	DO NOT CREDIT within water molecules
		2	liquid at 'normal' temperatures / AW ;		DO NOT CREDIT 'at room temperature'
		3	ice floats on water / water freezes from top down / large bodies of water don't freeze completely ;		
		4	insulates water beneath / animals can still swim etc ;		
		5	change in density (with temperature) causes currents to circulate nutrients ;		
		6			
		7	solvent for , polar / ionic , substances ;		DO NOT CREDIT gases within body
		8	solubility of , oxygen / carbon dioxide / gases (in environment) ;		
		9	(gases needed for) aerobic respiration / photosynthesis ;		
			transport medium for gametes / external fertilisation / dispersal of fruits / dispersal of seeds / dispersal of spores ;		
		10			
		11	water <u>slow</u> to change temperature (under normal environmental conditions) ;		CREDIT relatively constant, NOT constant
		12	lakes / oceans / large volumes , provide <u>thermally</u> stable environment /		
		13	AW ; evaporation not easy so bodies of water do not dry up ;		AVPs must relate to water in the environment e.g. buoyancy qualified support (on ice) qualified using water for cooling, qualified (not sweating etc.)
		14	organism(s) / named organism(s) , can use surface of water (as habitat) ;		
		15	AVP ; AVP ; QWC – legible text with accurate spelling, punctuation and grammar ;	1	
			Total	13	

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	(grease and blood contain) different types of (biological) molecule / different <u>molecular</u> structure / are different substrates ; enzymes are <u>specific</u> ; lipase / lipid-digesting enzyme / protease / protein-digesting enzyme ; enzyme that digests , lipid / grease , will not digest , protein / blood ; ora	2 max	CREDIT 'grease is lipid, and blood isn't' OR 'blood contains protein and grease doesn't' Must be in an appropriate context
5	(a)	(ii)	enzyme(s) denatured ; active site distorted / active site changes shape / no ESC formed / AW ; unable to , digest stains / contribute to cleaning ; cleaning depending entirely on chemical components of powder ;	2 max	'can no longer work' is not quite enough
5	(b)		bacterial enzymes , are thermally stable / have a high optimum temperature / AW ; (powders) can use , higher / greater range of , temperature ;	1 max	DO NOT CREDIT the idea of bacteria being resistant to high temp OR bacteria in the washing powder
5	(c)		environmentally friendly / economically friendly / saves energy / less damage caused to clothing material / AW ;	1	ACCEPT 'clothes don't shrink at this temp' DO NOT CREDIT 'less pollution' unless explained
			Total	6	

Question			Expected Answers	Marks	Additional Guidance																																																
6	(a)		<table> <tr> <th></th><th>converts nitrogen to ammonium ions / ammonia</th><th>converts nitrate ions to nitrogen</th><th>converts ammonium ions to nitrite ions</th><th>converts protein to amino acids</th><th></th></tr> <tr> <td><i>Rhizobium</i></td><td>✓</td><td></td><td></td><td></td><td>;</td></tr> <tr> <td>denitrification</td><td></td><td>✓</td><td></td><td></td><td>;</td></tr> <tr> <td>nitrifying bacteria</td><td></td><td></td><td>✓</td><td></td><td>;</td></tr> <tr> <td>nitrogen fixation</td><td>✓</td><td></td><td></td><td></td><td>;</td></tr> <tr> <td>decomposer</td><td></td><td></td><td></td><td>✓</td><td>;</td></tr> <tr> <td>Haber process</td><td>✓</td><td></td><td></td><td></td><td>;</td></tr> <tr> <td><i>Nitrosomonas</i></td><td></td><td></td><td>✓</td><td></td><td>;</td></tr> </table>		converts nitrogen to ammonium ions / ammonia	converts nitrate ions to nitrogen	converts ammonium ions to nitrite ions	converts protein to amino acids		<i>Rhizobium</i>	✓				;	denitrification		✓			;	nitrifying bacteria			✓		;	nitrogen fixation	✓				;	decomposer				✓	;	Haber process	✓				;	<i>Nitrosomonas</i>			✓		;	7	<p>One mark per correct row</p> <p>Each row must have only 1 tick. No crosses are required but if crosses are also included then they have to occupy all of the 'blank' cells in a row for that row to be awarded the mark.</p> <p>DO NOT CREDIT hybrid ticks</p>
	converts nitrogen to ammonium ions / ammonia	converts nitrate ions to nitrogen	converts ammonium ions to nitrite ions	converts protein to amino acids																																																	
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Haber process	✓				;																																																
<i>Nitrosomonas</i>			✓		;																																																
6	(b)	(i)	<p>Mark 1st response on each numbered line ...</p> <p>reflected off , plant / part of plant ;</p> <p>passes through (leaf) / misses chlorophyll / misses chloroplasts ;</p> <p>only certain <u>wavelengths</u> of light can be , absorbed / used ; ora</p> <p>absorbed by / hits , non-photosynthetic parts / bark / other e.g. ;</p> <p>some (of the sun's energy) is heat (not light) ;</p> <p>(heat is) used in evaporation ;</p> <p>heat produced during ,</p> <p>photosynthesis / conversion of light energy into chemical energy ;</p>	2 max	<p>unless no response for 2, then mark as list</p> <p>NOT ref to energy / light missing the plant</p> <p>ACCEPT not enough chloroplasts</p> <p>ACCEPT suitable ref to green light not absorbed</p>																																																

Question			Expected Answers	Marks	Additional Guidance
6	(b)	(ii)	<p>Mark 1st response on each numbered line ...</p> <p><u>heat</u> from <u>respiration</u> ;</p> <p>digestion / movement / other metabolic process ;</p> <p>some material / e.g. , not digested / lost in faeces / egested / AW ;</p> <p>some material / e.g. , not eaten (by next trophic level) ;</p> <p>loss , via excretion / in urine ;</p> <p>going to , decomposers / another ecosystem ;</p>	2 max	<p>unless no response for 2, then mark as list</p> <p>DO NOT CREDIT growth</p> <p>DO NOT CREDIT if also linking to excretion</p> <p>DO NOT CREDIT if also linking to egestion / faeces / digestion / etc</p>
			Total	11	

Question			Expected Answers	Marks	Additional Guidance
7			transcription ; messenger ; complementary ; pore ; specific ; anticodon ; exposed ; peptide ; condensation ;	9	
			Total	9	

2802 Human Health and Disease

Question		Expected Answers	Marks	Additional Guidance
1	(a)	<p>alveoli</p> <p>fewer alveoli / air sacs ;</p> <p>larger <u>air</u> spaces ;</p> <p>smaller surface area ;</p> <p>bronchiole</p> <p>no cilia / no ciliated cells ;</p> <p>flattened cells / several layers of cells / scar tissue ;</p> <p>wall not folded / smaller lumen ;</p> <p>no, muscle / connective tissue / elastin /elastic fibres ;</p>	2 max	<p><i>assume answer is about B unless stated otherwise</i></p> <p>DO NOT ACCEPT: no alveoli or broken walls unqualified</p> <p>DO NOT ACCEPT: empty spaces/holes</p> <p>ACCEPT: cilia destroyed</p> <p>DO NOT ACCEPT: cilia damaged or paralysed</p> <p>ACCEPT: cells not columnar</p>
1	(b)	<p>less, elasticity / elastic tissue / elastin ;</p> <p>alveoli cannot recoil / no elastic recoil ;</p>	2	<p>ACCEPT: elastic tissue broken /destroyed /damaged / elastic fibres burst</p> <p>ACCEPT: elastin permanently stretched</p> <p>DO NOT ACCEPT: alveoli and bronchiole cannot recoil</p>

Question			Expected Answers	Marks	Additional Guidance
1	(c)		<p>(tar) stops action of cilia / paralyse cilia or cilia can't, waft / beat / sweep;</p> <p>overproduction of mucus / mucus, collects / not moved ; pathogens, multiply/accumulate / pathogens cause infection ; phagocytes/macrophages (move to infected region) ; (release or use) elastase / protease / proteolytic enzyme ; tar inhibits, elastase inhibitor / (alpha) antitrypsin ; elasticity lost /digestion of elastin / breakdown of elastin ; (walls of) alveoli, rupture / burst ;</p>	<p>4 max</p> <p>Total: 8</p>	<p>DO NOT ACCEPT: kills cilia / destroys cilia DO NOT ACCEPT: cilia can't move mucus for this mark as this would get pt 2</p> <p>'alveoli burst' must be in correct context.</p>

Question			Expected Answers	Marks	Additional Guidance
2			mental / psychological ; <u>disease</u> ; <u>carbohydrates</u> ; saturated / animal ; 20 ; <u>70</u> ;	6	ACCEPT anything in region 20 – 60
				Total: 6	

Question			Expected Answers	Marks	Additional Guidance
3	(a)		unprotected sex / AW ; blood to blood contact / AW ; (infected / unscreened) blood products/transfusions ; sharing needles ; unsterilised, operating instruments / tattoo needles / piercing instruments ; across placenta / at birth / mother to fetus (during pregnancy) ; via breastfeeding ; needle stick ;	3 max	ACCEPT: not using <u>condom</u> ACCEPT: description of mixing of seminal and vaginal fluids
3	(b)	(i)	improve medical facilities / screen blood products ; contact tracing ; (improve) availability of, testing /screening ; provide / encourage use of, (subsidised / free) condoms ; (provide) needle exchange facilities / AW ; educate (the public) about the, disease / transmission / methods of prevention /safe sex / breastfeeding of mother HIV+ ;	3 max	medical facilities could be ref. to antivirals
3	(b)	(ii)	TB may be dormant (in healthy people) / symptomless carriers ; HIV / AIDS weakens the immune system /description ; TB is an <u>opportunistic</u> disease / AW ;	2 max	
				Total: 8	

Question		Expected Answers	Marks	Additional guidance
4	(a)	as carbohydrate in diet increases duration of exercise increases / AW ; use of figures re low and high carbohydrate diets as a comparison ;	2	ORA e.g. lasts 60min on low carb. diet but 190min on high carb. diet but allow some leeway e.g. 55 – 65 and 185 – 195 OR about 3 x as long
4	(b)	<p><i>heart</i> any two of the following changes:</p> <p>C1 increased, size / thickness, of heart / cardiac, <u>muscle</u> OR hypertrophy ;</p> <p>C2 increased stroke volume ;</p> <p>C3 increased cardiac output ;</p> <p>C4 increased number / size of mitochondria in cardiac muscle;</p> <p>C5 increased amount myoglobin in heart muscle ;</p> <p>any two of the following explanations, linked to the context of correct change:</p> <p>E1 allows more efficient pumping / produce higher pressures ;</p> <p>E2 allows more blood to be pumped per beat ;</p> <p>E3 more, blood / oxygen, is delivered per minute ;</p> <p>E4 for, release of more energy / to make more ATP ;</p> <p>E5 greater store oxygen/aids aerobic respiration ;</p> <p>....continued</p>	<p>2 max</p> <p>2 max</p>	<p>ACCEPT: myocardium for heart muscle ACCEPT: hypertrophy for increased thickness of heart muscle</p> <p>If they give more than 2 features for a system, mark the ones that have correct explanations , to be fairer to candidate.</p> <p>If they just miss a C mark due to lack of detail, they can have the correctly linked E mark</p> <p>DO NOT ACCEPT: make/produce/create energy</p>

Question			Expected Answers	Marks	Additional guidance
4	(b) contd		<p><i>lungs</i></p> <p>any two of the following changes:</p> <p>C1 increased vital capacity ;</p> <p>C2 increased tidal volume ;</p> <p>C3 increased vascularisation of the <u>alveoli</u> ;</p> <p>C4 improve efficiency of intercostal muscles ;</p> <p>any two of the following explanations, linked to the correct change:</p> <p>E1 allows more <u>air</u> into lungs ;</p> <p>E2 allows greater ventilation rate / larger volume of air exchanged at each breath ;</p> <p>E3 allows more oxygen uptake / increased gaseous exchange ;</p> <p>E4 increases FEV (volume of air forced out) / increases tidal volume / increases volume of air breathed in ;</p> <p><i>circulatory</i></p> <p>any two of the following changes:</p> <p>C1 increased, vascularisation / capillarisation, of muscle ;</p> <p>C2 more, haemoglobin / red blood cells, in the blood ;</p> <p>C3 improved health of <u>arteries</u> / less deposition of atheroma / decreases blood cholesterol level ;</p> <p>C4 increased capillaries to skin ;</p> <p>any two of the following explanations, linked to the correct change:</p> <p>E1 to improve ability to supply oxygen to the muscles ;</p> <p>E2 allows transport of more oxygen ;</p> <p>E3 allows more efficient blood flow ;</p> <p>E4 more blood flow to skin / improved cooling / heat loss ;</p>	2 max <	

Question			Expected Answers	Marks	Additional guidance
5	(a)		cannot be made (with)in the body ; required for cell membrane / phospholipids / lipid bilayer / lipid membrane ; required to make hormones ;	1 max	DO NOT ACCEPT: ref. to amino acids ACCEPT: signalling molecules / prostaglandins
5	(b)		84 ; ;	2 max	allow two marks for correct answer if answer is incorrect, allow one mark for calculation, e.g. 35% of 8830 or $35/100 \times 8830$ or 3090.5 or $\frac{3090.5}{37}$ or 83.53 or 83

Question		Expected Answers	Marks	Additional guidance
5	(c)	<p>saturated / animal, fat raises concentration of LDLs, in the blood ;</p> <p>raises <u>blood</u> cholesterol ;</p> <p>(increases risk of) atherosclerosis /atheroma / plaque / fat or cholesterol <u>in</u> wall of artery ;</p> <p>raises blood pressure / hypertension ;</p> <p>(increases risk of) blood clots / thrombus / thrombosis ;</p> <p>(coronary) heart disease / heart attack / heart failure / MI / angina / CVD / CHD ;</p> <p>stroke / blood clot in brain ;</p> <p>to avoid becoming, overweight / obesity / increase in BMI to over 25 ;</p> <p>to avoid named obesity-related disease / condition ;</p>	4 max	<p>ACCEPT: fat or cholesterol under lining of artery</p> <p>DO NOT ACCEPT: artheroma/artherosclerosis</p> <p>e.g. ref. to surgery being difficult, arthritis, cancer, gall stones, diabetes, hernia, varicose veins, haemorrhoids, joint / knee damage, depression</p> <p>DO NOT ACCEPT lung cancer</p> <p>DO NOT ACCEPT 'mental health problems'</p>

5	(d)	<p><i>mackerel contains:</i></p> <p>more vitamin A / 45µg (per 100g) compared to none ;</p> <p>better sight in dim light / healthier cornea / to make rhodopsin / to make retinal / for epithelial cells / prevent night blindness / prevent xerophthalmia / prevents cornea drying ;</p> <p>more vitamin D / 25µg (per 100g) compared to none ;</p> <p>harder / stronger, bones / teeth / for calcium absorption / deposition in bones / prevents osteomalacia ;</p>	<p><i>If they have not said 'more' but imply it by giving comparative figs. they must have units at least once (for A or D)</i></p> <p>ACCEPT: prevents keratomalacia DO NOT ACCEPT: stops retina drying out / stops scarring of retina</p> <p>DO NOT ACCEPT: to prevent rickets (as data refer to 30 year-old) but this does not negate a ref to osteomalacia</p> <p>ACCEPT: Vit D (may) protect against, heart disease / cancer</p> <p>4 max</p>
			Total: 11

Question			Expected Answers	Marks	Additional guidance
6	(a)		plasma / effector / B (cell) / B lymphocyte ;	1	DO NOT ACCEPT: 'lymphocyte' on own or T lymphocyte
6	(b)		<p><i>pairs of marks must be linked – max 2 for structural features with no explanations. Can't get second mark of the pair without the first.</i></p> <p>has variable region / antigen-binding site ; specific / complementary, to <u>antigen</u> ;</p> <p>has constant region ; attach to phagocyte ;</p> <p>has hinge region ; allow to flex / can bind to more than one antigen ;</p> <p>disulfide bridges ; holds two heavy chains together / maintains shape of molecule ;</p>	4 max	<p>NB: 'Binding site specific to an antigen' = 2 marks</p> <p>DO NOT ACCEPT: 'hinge joint'</p>
6	(c)	(i)	<p>answer must imply or state that time is taken for:</p> <p>antigen presentation / described ;</p> <p>clonal selection / described ;</p> <p>clonal expansion /described ;</p> <p>production of antibodies, by protein synthesis ;</p>	3 max	<p>If APC described, must be correct type of cell e.g. phagocyte or macrophage or dendritic cell</p> <p>e.g. making plasma cells</p> <p>DO NOT ACCEPT: no memory cells as question states it is a first infection</p>

Question			Expected Answers	Marks	Additional Guidance
6	(c)	(ii)	immunological memory / memory cells ; no need for (antigen) presentation ; no need for (clonal) selection ; (only) clonal expansion / AW, required / idea of quick clonal expansion of memory cells ;	max 2	Clonal expansion may be in the context of either B or T cells
6	(c)	(iii)	Idea of exposure to <u>antigen</u> without medical intervention ; involves activation of lymphocytes / involves manufacturing the antibodies / primary (immune) response / any named stage of primary response / making memory cells ;	max 2	e.g. catching the disease and being exposed to <u>antigens</u> on pathogen
6	(d)		<i>HIV</i> antibiotics do not, stop / affect, <u>viruses</u> ; <i>malaria</i> antibiotics do not, kill / stop action of, <u>eukaryotes</u> / <i>Plasmodium</i> is a eukaryote ; <i>TB</i> pathogen, is resistant / has many strains OR (high rate of) mutation / bacteria slow growing (therefore) long course of treatment and people stop taking antibiotics too soon ;	3 max	ACCEPT HIV is a virus DO NOT ACCEPT 'TB is resistant' without a reference to bacterium / pathogen / causative organism / <i>M. tuberculosis</i>
				Total 15	

2803/01 Transport - Written Paper

Question			Expected Answers			Marks	Additional Guidance
1			feature	mammal	plant		
			the contents of the tubular vessels are pumped round the system by an organ	✓	✗		One mark per row Treat blanks as crosses if no crosses shown
			the tubular vessels form a nutrient transport system	✓	✓		If some crosses and some blanks DO NOT CREDIT the row with a blank
			some of the tubular vessels are living and some are dead	✗	✓		DO NOT CREDIT hybrid tick/crosses – unless it is very clear that one has been overscored with the other
			Total			3	

Question			Expected Answers	Marks	Additional Guidance
2	(a)		A = artery B = vein	1	Both needed for one mark. Plurals acceptable.
	(b)		endothelium ;	1	CREDIT <u>squamous</u> epithelium / squamous endothelium DO NOT CREDIT just squamous or just epithelium / epithelia ACCEPT endothelium / endothelial, cell OR <u>squamous</u> epithelial cell phonetic spelling OK e.g. endothelium
	(c)		X collagen ; elastic (tissue / fibres) / elastin ; Y <u>smooth</u> muscle ; elastic (tissue / fibres) / elastin ;	3 max	Max 2 for whole question if muscle included in X DO NOT CREDIT 'collage' ALLOW 'elastic only in artery' DO NOT CREDIT if just elastic recoil mentioned – must imply a tissue DO NOT CREDIT elastic if related to collagen IGNORE collagen in Y DO NOT CREDIT smooth muscle in artery but not in vein elastic muscle would get the elastic mark here (not in X) elastic smooth muscle would get 2 marks IGNORE other named muscle e.g. circular
			Total	5	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	<p>closed</p> <p>1. (blood) stays in vessels / named vessel(s) ; 1</p> <p>double</p> <p>2. blood flows twice <u>through</u> the heart per one, (full) circulation / circuit / cycle (of the body) ;</p> <p>3. pulmonary (circulation) / to lungs ;</p> <p>4. systemic (circulation) / to body ; 2 max</p>	3 max	<p>1. Look for clear statement linking 'closed' to inside vessels; not just general mention of vessels DO NOT CREDIT nothing gets out or in. IGNORE blood does not get in or out (of vessels, named vessel(s))</p> <p>2. DO NOT CREDIT flowing <u>around</u> the heart twice DO NOT CREDIT 'in one beat' OR cardiac cycle</p> <p>4. DO NOT CREDIT systematic. Should NOT be described as 'to the organs' as lungs are an organ</p>

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(ii)	<p>1. separation of oxygenated and deoxygenated blood / AW ;</p> <p>2. helps sustain / maintain, (high blood) pressure OR (too high a) pressure does not damage lungs ;</p> <p>3. less resistance to flow / AW ;</p> <p>4. more rapid circulation / AW ;</p> <p>5. <u>more</u> oxygen reaches tissues / cells / AW ;</p> <p>6. easier to return blood to heart ;</p> <p>7. greater activity possible ;</p>	2 max	<p>1. CREDIT statements like 'only oxygenated blood to body and vice versa' DO NOT CREDIT 'two sides for two types of blood' - as this does not state the type of blood DO NOT CREDIT 'pick up and drop oxygen at same time'</p> <p>2. CREDIT ideas like 'different / higher, pressures to body than lungs' DO NOT CREDIT just 'different pressures' unqualified</p> <p>3. may see this in terms of less impeded</p> <p>4. CREDIT 'blood reaches cells quicker' type of response CREDIT 'fast(er) transport of nutrients' type of response DO NOT CREDIT refs to speed of transport of carbon dioxide DO NOT CREDIT 'blood reaches further'</p> <p>5. Must give the idea of 'more'. ACCEPT adequate / enough</p> <p>DO NOT CREDIT: 'more efficient' unqualified throughout OR 'blood fully oxygenated'</p>

Question			Expected Answers			Marks	Additional Guidance
3	(b)			feature	letter on Fig. 3.2	letter in Table 3.1	There is no scope for ecf here C, D and E are the only correct letters for the features R, U, and T are the only correct functions for the named features If two or more letters in a box then no mark there
				aorta	G	S	
				sino-atrial node	C ;	R ;	
				atrio-ventricular node	D ;	U ;	
				Purkyne fibres	E ;	T ;	
				Total			
				11			

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	one mark for each correct label ; ; ;	4	<p>sieve tube ACCEPT label to lumen or pointing to / touching / bracketing right hand wall</p> <p>sieve pore label goes to gap in horizontal wall</p> <p>companion cell. ACCEPT label to lumen or pointing to / touching / bracketing left hand wall</p> <p>plasmodesma. ONLY ACCEPT label to pore in vertical wall between sieve tube and companion cell</p> <p>as long as labels are identifiable ignore spelling. e.g. plasmodesma often pluralized</p>
		(ii)	nucleus only in companion cell and only one shown per companion cell ;	1	<p>Must be labelled. Only need to be in one companion cell</p> <p>DO NOT CREDIT if nucleus in companion cell and sieve tube</p> <p>ALLOW ecf only if nucleus is in the cell labelled companion cell by candidate</p>
	(b)		<u>sucrose</u> ;	1	

Question			Expected Answers	Marks	Additional Guidance
	(c)	1	from, source to sink ;	6 max	1. Might need to search for this by reading whole answer but are looking for the two technical terms not examples
		2	active removal / ATP driven removal / pumping / energy needed for removal , of H ions / protons, out of companion cells ;		2. there are three parts i.e. energy , protons and out of comp cells
		3	many mitochondria, in companion cell / linked to H ⁺ pump ;		
		4	H ⁺ pass back (into companion cell) taking sucrose / carbohydrate (co-transporter idea) ;		4. DO NOT CREDIT just the term co-transport – needs some description / explanation. ACCEPT the molecule named in 4b
		5	from comp cell to sieve tube via plasmodesmata ;		
		6	osmotic inflow / water uptake / AW, <u>into sieve tube</u> ;		6. CREDIT in terms of correct changes in water potential i.e. sucrose lowers water potential so water enters the sieve tube
		7	(hydrostatic) pressure (gradient) ;		7. Looking for the idea that the pressure is increasing
		8	mass flow / bulk transport ;		8. DO NOT CREDIT in the wrong context e.g.into / out of phloem elements IGNORE 'theory' and 'hypothesis'
		9	unloading by, diffusion / reverse mechanism ;		e.g.'s lack of, much cytoplasm OR organelles in sieve tube, allowing flow
		10	AVP ;		conversion to raffinose in c. cell to stop loss of sucrose in 'wrong direction' sieve plates prevent the sieve tubes bursting detail of how pressure lowered at sink
					IGNORE ref to apoplast and symplast

			QWC – legible text with accurate spelling, punctuation and grammar	1	Bullets acceptable as long as grammatical 11/12 lines 3 or more different spelling errors for non specialist terms = loss This can be awarded even if no marks given for content provided that the account is related to the candidate's view of carbohydrate transport
			Total	13	

Question			Expected Answers	Marks	Additional Guidance
5	(a)		27 ; ;	2	27 is only way to get 2 marks 26.8 = 1 mark allow one mark for working showing $6.15 - 4.85 = 1.3(0)$. OR just the figure 1.3
	(b)	1	<u>more</u> erythropoietin / EPO ;	3 max	<p>3. Watch that just more oxygen is not credited – needs to be carried OR go somewhere ACCEPT ‘more oxygen in blood’ DO NOT ACCEPT haemoglobin more saturated with oxygen OR faster delivery of oxygen</p> <p>5. DO NOT CREDIT ‘making / producing energy’</p> <p>DO NOT CREDIT refs to lung capacity, muscle size, capillarity, myoglobin, cardiac output</p>
		2	<u>more</u> haemoglobin ;		
		3	(so) <u>more oxygen carried</u> OR <u>more oxygen to</u> , body / tissues / cells / (named) e.g muscle ;		
		4	<u>aerobic</u> respiration sustained / more aerobic respiration / AW;		
		5	<u>more</u> , energy release / ATP production ;		
		6	less, lactate / lactic acid / oxygen deficit delayed / AW ;		

Question			Expected Answers	Marks	Additional Guidance
5	(c)	(i)	Bohr (effect / shift) ;	1	ALLOW phonetic spellings e.g bore, Boar, Borh
		(ii)	<p>1. more carbon dioxide (produced) / higher partial pressure of carbon dioxide ;</p> <p>2. (because) more (aerobic) respiration (when exercising) ;</p> <p>3. (CO₂ uptake by RBCs leads to) formation of carbonic acid / H⁺ ;</p> <p>4. H⁺ , displaces oxygen / releases oxygen, from Hb / HbO ;</p> <p>5. ref to comparative figures at pp O₂ between 2 and 6 ;</p>	3 max	<p>1. Free standing mark provided that there is the idea of more CO₂ production</p> <p>2. Look for this in the context of exercise NOT oxygen increase leading to more respiration</p> <p>3. CREDIT use of equation or formulae</p> <p>4. CREDIT idea that the H⁺ causes Hb / HbO to have lower affinity for oxygen</p> <p>5. e.g. at ppO₂ = 4, Hb sat = 20% at pp CO₂ = 1.5 and 41% at pp CO₂ = 1.0 OR the difference is 21% % saturation correct to within 1%; units not required</p> <p>DO NOT CREDIT marking points 2, 3 ,4 and 5 for candidate who states there is less CO₂</p>
			Total	9	

Question	Expected Answers	Marks	Additional Guidance
6	<p><i>cuticle</i></p> <p>1 wax / waxy / waterproof / impermeable ;</p> <p>2 reduces / limits / helps prevent , water loss / transpiration / evaporation / AW ;</p> <p>3 reflective / AW ;</p> <p>4 (so) reduces heating up ; 2 max</p>		<p>1. DO NOT ACCEPT thick / a barrier</p> <p>2. DO NOT ACCEPT stops or anything that suggests all water loss ceases unless qualified e.g. 'prevents water loss so less transpiration'</p> <p>4. needs to be linked to 3</p>
	<p><i>stomatal chambers</i></p> <p>5 saturated air builds up / hairs trap water vapour / AW ;</p> <p>6 reduction of wind effect / AW ;</p> <p>7 reduced, water potential / diffusion, gradient ;</p> <p>8 (so) less, diffusion / transpiration / water loss ;</p> <p>9 refs to stomata /chamber on <u>lower</u> surface correctly qualified ;</p> <p>2max</p>		<p>5. DO NOT CREDIT water / H₂O unqualified. Look for water vapour / moist air / humidity / AW ACCEPT moisture</p> <p>6. ACCEPT moist air / AW , not easily blown away / AW</p> <p>7. DO NOT CREDIT refs to concentration gradients</p> <p>8. Needs to be qualified e.g. 'chambers are sunken' OR in terms of 5, 6 ,7</p> <p>9. Qualification needs to relate the position on the lower surface to being more protected / less wind effect / cooler / AW</p> <p>IGNORE ref to cuticle in stomatal chamber</p>
	Total	4	

2803/03 Practical Examination

Planning Exercise

The mark scheme for the planning exercise is set out on page 4. The marking points **A** to **U** follow the coursework descriptors for Skill P.

Indicate on the plans where the marking points are met by using a tick and an appropriate letter. There are 14 marking points for aspects of the plan and two marks for quality of written communication (QWC).

Practical Test

Pages 6 to 10 have the mark scheme for Questions 1 and 2 for the Practical Test.

AS Biology. Planning exercise

Checking Point	Descriptor	The candidate
A	P.1a	Plans a suitable procedure using different temperatures, equilibrating both solutions and testing at intervals for disappearance of starch with iodine solution <i>or</i> appearance of reducing sugar with Benedict's / Clinistix / Diastix ;
B	P.1a	Gives a prediction about the effect of temperature on the rate of starch hydrolysis – maybe with a graph ;
C	P.1b	Selects suitable equipment and materials, to include apparatus for measuring volumes, iodine solution / Benedict's solution, stop watch and thermometer ;
D	P.3a	States that, amylase / AMG, (catalyses) hydrolysis / breakdown, of starch to give, glucose / maltose / maltotriose ;
E	P.3a	Identifies at least 2 key factors to control, e.g. volume of starch solution, volume of amylase solution, pH, time for equilibration ;
F	P.3b	Decides on an appropriate number of measurements to take: minimum of five different temperatures ;
G	P.3b	Decides on a suitable range of temperatures with minimum range $\geq 60^{\circ}\text{C}$;
H	P.3b	Describes a way of obtaining reliable results by using a minimum of three readings per temperature ;
I	P.5a	Uses appropriate scientific knowledge and understanding in developing a plan, e.g. structure of starch, collision theory, tertiary structure of enzyme ;
J	P.5a	Uses preliminary work or previous practical work in developing a plan ;
K	P.5a	Refers to a hazard and an appropriate precaution ;
L*	P.5b	<i>Gives a clear account, logically presented with accurate use of scientific vocabulary (QWC) ;</i>
M	P.5b	Describes way(s) of obtaining precise results e.g. use of colorimeter, use of photos of results with iodine solution, time to reach colour standard using timer ;
N	P.7a	Uses relevant information from any two written sources , e.g. class notes / text book / web site ; <i>must be cited in plan</i>
O	P.7a	Shows how results are to be presented in a table including appropriate headings and correct use of units ;
P*	P.7a	<i>Uses spelling, punctuation and grammar accurately (QWC) ;</i>
Q	P.7b	Shows how rates are to be calculated ($1/t$ or gradient from a time course graph) ;
R	P.7b	Shows how results are to be presented on a summary graph – axes must be rate with units (A $1/t$) against temperature with $^{\circ}\text{C}$;
S	P.7b	Comments on precision, e.g. ref to subjective nature of recording colour change with iodine, difficulty in determining end point, explains use of colour standards, justifies use of colorimeter, use of known concentrations of starch in the colorimeter, results accurate to nearest sampling interval ;
T	P.7b	Comments on reliability, e.g. difficulty in taking samples in the same way each time, what to do if results are anomalous ;
U	P.7b	Comments on validity, e.g. sensitivity of, iodine test / Benedict's test, taking results at intervals so cannot be sure of time to end point, explains why results have to be taken by sampling and not continuously, justifies using two or more ways of detecting activity of amylase, taking temp of reaction mixture ;

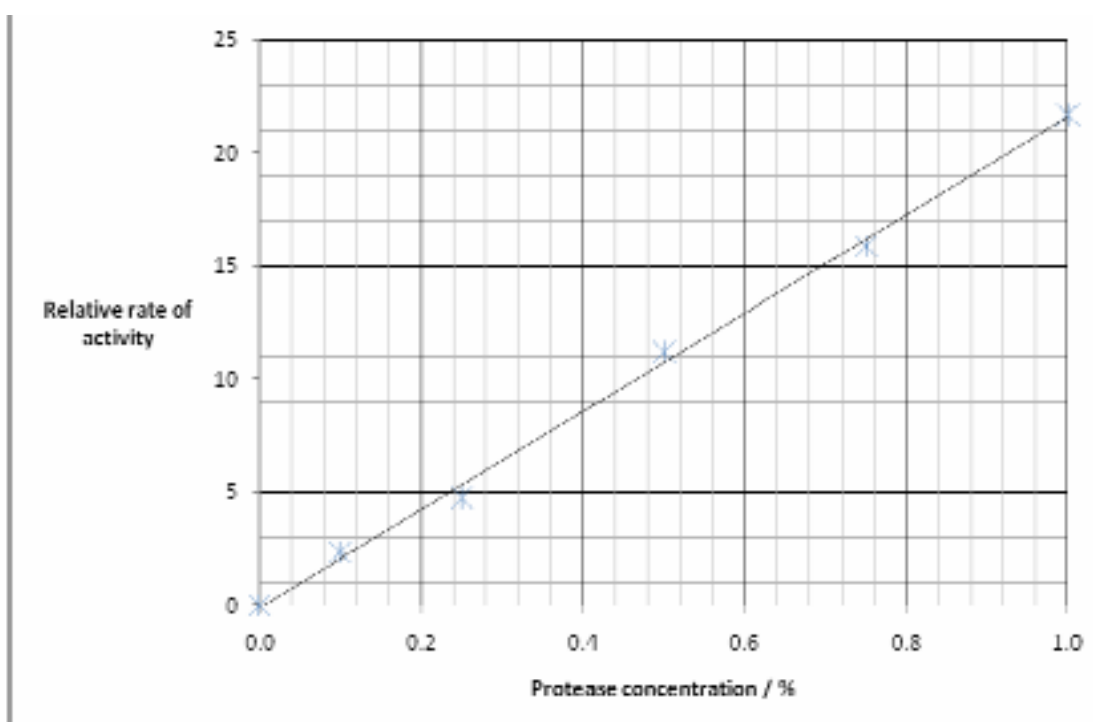
Point mark up to **14** by placing letters **A to U excluding L and P** in the margin at appropriate points. Then award **1** mark for each of **L** and **P** (QWC).

Total: 16

Specimen results for Q.1

tube	concentration of protease / %	time for milk to clear / s	relative rate of activity (/ s ⁻¹ or 1000/t)
B	0	-	0
G	0.10	431	2.32
F	0.25	211	4.74
E	0.50	89	11.24
D	0.75	63	15.87
C	1.00	46	21.74

tube	concentration of protease / %	time for milk to clear / s	relative rate of activity (/ s ⁻¹ or 1000/t)
A			
B	0	-	0
C	1.00	46	21.74
D	0.75	63	15.87
E	0.50	89	11.24
F	0.25	211	4.74
G	0.10	431	2.32



Question	Expected Answers	Marks
1 (a)	<i>table</i>	
1	table format including headings – (protease) concentration, time taken for, rate ; R if more than one table A concentration increasing or decreasing	
2	(protease) concentration in left hand column ; <i>ignore tube letter</i>	
3	units (% and seconds) in headings ; R in the body of the table R min and seconds	
4	correct trend ; (C/1% first etc) A no change in G/0.1% R if F/0.25% does not change	
5	conversion to 1000/t carried out correctly, all results to same decimal places ;	
6	result and rate for B included as 0% protease ;	6
(b)	R control <i>unqualified</i>	
	tube A - to show, end point / when reaction is complete / use as a standard ; R colour comparison	
	tube B - to show, no change without enzyme / enzyme needed ; A ora for distilled water	2
(c)	1 temperature is a control(ed) variable / all variables should be kept constant / temperature influences activity of enzymes ; 2 <i>idea that</i> if it changes then introduces another variable ; 3 higher temperature (A > 35 °C) , reaction occurs too fast to measure / ora for lower ; 4 high temperature (A > 35 °C) would cause denaturing ; R if 'kills' / 'destroys' 5 detail of denaturation ; e.g. breaking of named bond(s) in enzyme / active site changes shape 6 35 °C is likely to be optimum (for protease) ; R ref to 'body' temperature	2 max
(d)	<i>graph</i>	
1	variables correct with concentration on horizontal axis ;	
2	axes labelled with % for concentration ;	
3	correct scaling (check horizontal axis carefully) and use of $\geq \frac{1}{2}$ space ;	
4	B included as 0 rate / line starts at 0,0 ; <i>or at 0.1% if rate for G = 0</i>	
5	all points plotted accurately ; <i>if no change in G, then 0.1% has rate of 0</i>	
6	appropriate line of best fit ; A straight line relationship , but R dot to dot R if extrapolated beyond 1.0%, thick or shaky lines	6
(e)	increase in rate with increase in, protease / enzyme, concentration ; ref to at least two results (concentration with units and rate) ; ref to anomalous result(s) or lack of them ; any appropriate comment on shape of line ; e.g. linear / positive correlation / directly proportional / plateau / sigmoid / S-shape etc	3 max

(f) *increasing enzyme concentration - accept ora*

- 1 ref to more collisions ;
- 2 more enzyme-substrate complexes ;
- 3 more active sites are available ;

- 4 (milk) protein is the substrate ;
- 5 gives cloudiness ;
- 6 peptide bonds are broken ;
- 7 hydrolysis ;
- 8 described ; **A** addition of water to break (peptide) bond
- 9 amino acids / peptides / small proteins ;
- 10 amino acids / AW, are soluble ;

- 11 substrate is in excess ;
- 12 enzyme (concentration) is limiting factor ;
- 13 ref to limiting factor if results show a plateau ;

7 max

(g)

	<i>limitation</i>	<i>improvement</i>
1	difficult to tell when, cloudiness had disappeared / end point reached ; R colour is subjective	<i>either</i> use a colorimeter (to follow disappearance of cloudiness) ; R calorimeter <i>or</i> use a, X / uniform background / AW, beneath / behind, tube ; R use a light detector unqualified
2	protease solution not added at exactly the same time ; A any other problem with timing, e.g. starting the timer	do each tube separately ; R 'use another person'
3	difficult to keep water bath at constant temperature ;	use a thermostatically-controlled water bath ;
4	pH not controlled / AW ;	use a buffer solution / use a pH meter to monitor ;
5	protease solution not warmed (to 35 °C) ;	allow time for equilibration / AW ;
6	not wide enough range of protease concentrations / ora ;	use higher than 1.00% ;
7	not enough intermediate concentrations / ref to drawing line on graph ;	include intermediates within same range / e.g. of intermediates ;
8	no repeats / no replicates / should carry out repeats ; A ref to, anomalous result(s)	repeat at least twice / do minimum of three replicates (and calculate mean);
9	protease and substrate not mixed, at start / during, reaction ;	ref to, stirring / shaking / inverting / using glass rod ;
10	stated problem with syringe ; R 'not accurate' unqualified	use, graduated pipette / burette ;
11	AVP ;	AVP ; <i>must be linked to limitation</i>

**10
max****R** contamination**[Total: max 30]**

Question	Expected Answers	Marks
2 (a) (i)	whole seedling drawn ; clear, sharp, continuous lines ; <i>ignore shading for red colour, ring offending lines</i> shoot shown as hooked ; <i>at least</i> two cotyledons shown ; lateral roots ; distribution of root hairs shown appropriately and labelled ; <i>along root, not at root tips</i>	6
(ii)	appropriate scale included – scale bar, ratio or magnification ; A x2 to x4	1
(b)	red areas shown appropriately ; e.g. along root, bright red at root tip	1
(c)	<i>mitochondria</i> site of <u>aerobic</u> respiration ; production of ATP ; for, growth / mitosis / active uptake of ions ; A nutrients / salts / named ions / minerals <i>root hairs</i> large surface area ; absorption / uptake, of, water / ions ; ref to, osmosis / water potential gradient / active uptake ;	6
(d)	<i>there may be some starch present in the cotyledons</i> <i>starch may be in root cap / root tip (these are starch statoliths)</i> yellow / red-brown, plus distribution ; no starch ; blue-black / blue / black, plus distribution ; R 'dark' starch present ;	2 max
(e)	1 ref to specificity ; 2 carrier proteins, <u>active</u> transport (of, ions / named ion) ; 3 further detail ; e.g. ions in low concentration in soil 4 channel proteins, facilitated diffusion ; 5 further detail ; e.g. ions cannot diffuse through lipid layer / high concentration in soil 6 aquaporins / described ; 7 diffusion of water / absorption by osmosis / water cannot diffuse through lipid layer ; 8 glycoproteins / described, recognition / receptors ; 9 further detail ;	3 max

[Total: max 14]

2804 Central concepts

Question	Expected Answers	Marks
1 (a)	<p>chlorophyll a ; A capital letter, α chlorophyll b ; A capital letter , β (β) carotene / carotenoid ; xanthophyll ; fucoxanthin ; phaeophytin ;</p> <p><i>chlorophyll – 1 mark if chlorophyll a and chlorophyll b not stated</i></p>	max 2
(ii)	<p>1. (from) water ; A water in chemical equation 2. photolysis ; A light induced splitting 3. (linked to), photosystem <u>2</u> ; 4. (water splitting) enzyme ;</p>	max 2
(iii)	NADP ; A NADP ^{red} and alternative formats.	1
(iv)	<p>1. (chloroplasts) retain biochemical activity / AW ; A prevent chloroplast damage</p> <p>2. reduce / prevent, activity of (lysosomal) enzymes / AW ; 3. prevent, membrane / protein damage ; 4. prevent, photosystem / pigment damage ;</p> <p>5. (buffer) keeps pH constant ;</p> <p>6. no change in, volume / turgidity of chloroplast ; A stops chloroplast shrinking or, swelling / bursting 7. no, movement of water / osmosis ;</p>	max 4
(b) (i)	<p>boiled – blue ; A blue green unboiled – green ;</p>	2
(ii)	<p><i>boiled, accept ora for mps 1 – 6 if linked to unboiled suspension</i></p> <p>1 enzymes denatured ; R rubisco 2 change in, tertiary structure / active site ; 3 no photolysis ; 4 no hydrogen released ; 5 DCPIP (remains), oxidised / blue ; 6 photosystem(s) damaged ;</p> <p>7 reason for rate declining in unboiled suspension ; e.g DCPIP oxidised becomes limiting.</p>	max 4

[Total: 15]

Question	Expected Answers	Marks
2 (a) (i)	diameter (of neurone) ; A thickness, width R diameter of nerve (presence / absence of) myelin (sheath) / Schwann cells / nodes of Ranvier ; A myelination, myelinated	2
(ii)	<i>apply ora throughout</i> <i>greater diameter</i> (due to) less leakage of ions ; ref. to surface area to volume ratio ; <i>myelin sheath</i> myelin (sheath) / Schwann cells, impermeable to ions / gives (electrical) insulation ; nodes of Ranvier ; depolarisation occurs at nodes ; A description of depolarisation long local circuits ; saltatory conduction ; A description of saltatory conduction	max 3
(b)	1/ 0.006 x 0.3 or 0.3 / 0.006 ; 50 ;; <i>2 marks for correct answer without working.</i>	2
(c)	1 phospholipid / bilayer, impermeable to K / Na ions ; 2 negatively charged, organic ions / protein molecules unable to cross membrane ; 3 Na - K pump ; 4 active process / ATP used ; 5 3 Na ions out ; 6 2 K ions in ; 7 ions, diffuse / move down gradient ; 8 through <u>protein</u> channels ; 9 more K ion channels open than Na ion channels / AW ; A K ion channels open and Na ion channels closed 10 (membrane) more permeable to K ions than Na ions ; A relative rates of movement 11 (results in) electrical / electrochemical, gradient ; A description of gradient 12 no net movement of ions / balance between chemical and electrical gradient ; <i>reject sodium / potassium, atoms / molecules once then apply ecf. Allow sodium / potassium unqualified.</i>	max 7
	QWC – legible text with accurate spelling, punctuation and grammar;	1
	[Total: 15]	

Question	Expected Answers	Marks
3 (a) (i)	$12 \div 5$ or 2.4 ; 0.3 ;; A 0.30144, 0.30, 0.301, 0.3014 2 marks for correct answer with no working	2
(ii)	1. remove soda lime ; 2. replace with, inert substance / beads / water (of equal volume) ; 3. use same beans / same number / same mass of beans ; 4. same temperature ; 5. reset the meniscus / description of how to reset ; 6. calculate total gas exchange ; 7. use oxygen uptake data to calculate carbon dioxide release / AW ; 8. both values per, minute / unit time ; 9. divide carbon dioxide by oxygen for RQ value / correct equation ;	max 5
(iii)	lipid and carbohydrate / protein (respired) ; lipid 0.7 and carbohydrate 1.0 / protein 0.9 ;	2
(b) (i)	1. respiratory substrate / glucose / lipid / amino acids ; A intermediate substrates 2. dehydrogenation reactions ; A named dehydrogenation reaction 3. glycolysis / link reaction / Krebs cycle ; A beta oxidation of fatty acids 4. NAD / reduced NAD ; 5. FAD / reduced FAD ; 6. from cytoplasm if linked to glycolysis ; 7. from matrix (of mitochondrion) if link reaction / Krebs / beta oxidation ;	max 3
(ii)	<u>inner</u> membrane / cristae / stalked particles ;	1
(iii)	proton gradient / proton motive force / PMF ; across a membrane ; protons move through, protein channels / stalked particles / ATP synth(et)ase ; R ATP ase linked to formation of ATP ;	max 2

[Total: 15]

Question	Expected Answers	Marks
4 (a) (i)	P – prophase 1 ; R prophase 2 Q – anaphase 1 ; R anaphase 2 <i>P prophase and Q anaphase 1 mark</i>	2
(ii)	R- centromere ; S – chromosome / (pair of) chromatids ; R chromatid T – bivalent / pair of <u>homologous</u> chromosomes ; A chromosome, pair of chromatids R chromatid V – chiasma ; A chiasmata, chromatid R chromatids	4
(b)	crossing over (in prophase 1) ; A description of crossing over independent / random, assortment of (homologous) chromosomes ; <i>ignore stage</i> independent / random, assortment of <u>chromatids</u> at <u>metaphase 2</u> ; <u>chromosome</u> mutation / named example of chromosome mutation ;	max 3
(c) (i)	RRYY RrYY RrYy RRYy	1
(ii)	test / back, (cross) ;	1
(iii)	RrYy rryy ; RY, Ry, rY, ry ry (ry ry ry) ; RrYy Rryy rrYy rryy ; round/yellow, round/green, wrinkled/yellow, wrinkled/green ; 1:1:1:1 ; A 4:4:4:4 etc <i>apply ecf once if parental genotypes correct.</i> <i>ie incorrect parental genotypes no marks.</i>	5

[Total: 16]

Question	Expected Answers	Marks
5 (a) (i)	<p>bind to membrane proteins ; inhibit, active transport / facilitated diffusion ; prevent uptake of, mineral ion / named mineral ion ; R nutrients unqualified ref to function of ion ;</p> <p>inhibit enzymes ; detail of inhibition ; e.g. change in shape of active site / AW. Not simply competitive or non - competitive.</p> <p>inhibit respiration or any stage of respiration ; reduced ATP production ;</p> <p>inhibit photosynthesis ; reduced respiratory substrate ;</p> <p>prevent PGR production / inhibit PGR ; A named PGR</p> <p>inhibit protein synthesis ;</p> <p>decreased water potential of soil ; reduced water uptake ;</p> <p>inhibit mitosis ; new cells not produced ;</p>	max 2
(ii)	<p>temperature ; pH (of culture solutions) ; light <u>intensity</u> ; carbon dioxide (concentration) ; volume of solutions ; R amount of solution conc. of other ions in solution ; sample size ; time before measuring roots ;</p>	max 2
(b)	<p>1 <u>mutation</u> ; 2 <u>alleles</u> for (copper) tolerance ; 3 <u>variation</u> in population ; 4 copper is <u>selection pressure</u> ; 5 <u>directional selection</u> occurs ; 6 those with, (copper) tolerant <u>alleles</u> / selective advantage, survive ; 7 reproduce / breed ; A asexual reproduction in correct context 8 offspring are copper tolerant / pass on copper tolerant <u>alleles</u> ; 9 over many generations ; 10 tolerant <u>allele frequency</u> increases ; 11 plants at D less (copper) tolerant ; 12 (tolerance) no, advantage / disadvantage in areas where low copper levels ; 13 mean root growth reduced by 80% ; 14 the more tolerant plants are found where copper levels are high(est) / in A or B ; 15 mean root growth reduced by 45% - 52% ;</p> <p>QWC – clear well organised using specialist terms; Need to use three of the emboldened terms in correct context.</p>	max 7

- (c) (i) reproductive ;
geographic ; **A** allopatric
behavioural / ecological / temporal / polyploidy / mechanical ; **A**
sympatric
A prezygotic and postzygotic for two marks

max 2

- (ii) 1. flies, breed / mate on species of plant they emerge from ;
2. different times of emergence ;
3. therefore population separate from hawthorn population /
reproductively isolated ;
4. different selection pressures / named difference ;
5. sympatric speciation ;
6. two separate gene pools ;
7. differences (in gene pool) accumulate ;
8. until two cannot breed successfully ;

max 5

[Total: 19]

Question	Expected Answers	Marks
6 (a) (i)	<i>L.polyrrhiza</i> reaches higher dry mass / ora ; A larger, bigger <i>L.polyrrhiza</i> grows, more rapidly / AW / ora ; R steeper growth any comparative data quote ; <i>must have reference to dry mass and time/ end of expt</i>	max 2
(ii)	<u>interspecific</u> ; <u>competition</u> ; named limiting factor / eg light ; <i>L.gibba</i> outcompetes <i>L.polyrrhiza</i> ; suggested adaptation of <i>L.gibba</i> ; competitive exclusion principle / overlapping niches ;	max 3
(iii)	light <u>intensity</u> ; daylength ; temperature ; carbon dioxide (concentration) ; R oxygen competition ; primary consumers ; R predation mineral ions ; R nutrients disease ; space / volume of water ; <i>mark first answer on each line unless nothing on second line then mark first two answers on the first line.</i>	max 2
(b) (i)	<u>Pioneer</u> ;	1
(ii)	1.fix carbon / photosynthesise / add oxygen ; 2.death / decomposition (of plants) ; 3.(decomposition) releases minerals / named mineral ; 4.adds organic matter / humus ; 5.pond begins to fill in ; 6.development of soil / AW ; 7.increases <u>biodiversity</u> ; A greater number of <u>species</u> 8.ref to nitrogen fixation ; 9.food for primary consumers ; A named primary consumer	max 2

[Total: 10]

2805/01 Growth, Development and Reproduction

Question	Expected Answers	Marks
1 (a) (i)	maintains / regulates , the internal environment ; at a constant /set point /norm / stable / optimum ; ref to changes in external environment ; accurate ref to receptors <u>and</u> effectors / or description both ;	2 max
(ii)	<p>1 FSH stimulates, production / secretion of oestrogen ; <i>R. refs to breast feeding</i></p> <p>2 Oestrogen inhibits , production / secretion of FSH ; <i>birth</i></p> <p>GnRH stimulates, secretion / production of oestrogen// progesterone ; Oestrogen / progesterone , inhibit production / secretion of GnRH ;</p> <p>3 LH stimulates, production / secretion of progesterone ;</p> <p>4 Progesterone inhibits, production / secretion of LH ;</p> <p><i>Max one if two first parts given do not credit a list for MP 1 and 3 only credit a correct list for mps 2 and 4 if mps 1 and 3 have been awarded, otherwise do not credit a list</i></p>	2 max
(b) (i)	decrease in number / atrophy , of (primary) <u>oocytes</u> (with age) ; (oocytes) damaged by medical treatment ; (chromosomal) mutation more likely / more likely to mutate ; <i>R gene mutation</i>	
	<p><i>AVP any one from:</i></p> <p>medical problem of reproductive tract, qualified e.g. blocked fallopian tubes / endometriosis / thicker mucus at cervix / ovarian cysts tumours / hormone control / balance , disrupted or e.g.; e.g. Follicles / oocyte less sensitive to FSH / FSH builds up</p>	2 max

continued

Question 1 Expected Answers
cont'd

Mark

(ii) *R* ref to eggs once then *A* ecf

preliminary counselling / tests are required ;
 injected with FSH (each day) ;
 superovulation / stimulates growth of many, follicles / (secondary) oocytes ;
laparoscopy ;
secondary oocytes, collected / harvested, (from follicles) with (hollow)
 needle ;
 before ovulation ;
 matured / ripened in incubator for 4-24 hours ;
 (motile) sperm sample mixed with (secondary) oocytes ;
 injection of sperm into cytoplasm / SUZI ;
 (pre implantation) ref to genetic screening ;
 two / three, healthy / selected, embryos inserted into the uterus ;

5
max

(iii) *R* references to gene mutation

one mark for problem, one mark for qualification
max 2 if only qualifications or problems given

mother's body (biologically) aged ;
 more likely to miscarry / suffer ill health / any acceptable result ;

(social problem)
 death / physical fitness ;
 during childhood of offspring, suitably qualified e.g. may die whilst child still
 dependent ;
 increased risk of (chromosomal) mutation ;
 causing genetic disease / named ;

decrease in concentration of reproductive hormones / hormone imbalance /
 AW ;
 increased risk of miscarriage ;

AVP : for problem
 AVP ; for qualification

4
max

[Total: 15]

Question	Expected Answers	Marks
3 (a) (i)	female (gamete), donates / AW, cytoplasm ; A nuclear DNA but R DNA if unqualified	
	male gamete transfers only the nucleus / AW ; (male) mitochondria (usually) left behind ;	max 1 for male 2 max
(ii)	contains the (genetic) code for production of, enzyme(s) / protein(s) / A/W ; ref to respiratory, enzyme / protein / named ; ref to mitochondrial replication ;	R divide if unqualified 2 max
(b) (i)	ref to nucleus with diploid set of chromosomes ; not formed from haploid gametes ; only mtDNA from oocyte ; reduced chance of mutation (as no division to form gamete) ; AVP ;	2 max
(ii)	receives (nuclear) DNA from an older sheep ; idea that genetic age older than chronological age AW ; telomeres shorten (as there have already been many divisions) ; respiration less efficient ; (determined by) Hayflick limit / there is a maximum number of divisions before senescence / AW ;	2 max

continued

Question 3 Expected Answers
cont'd

Mark

- (c) 1 **asexual** reproduction / (developed by) mitosis ;
 2 genetically identical ;
 3 **explants** taken (from stock plant) ;
 4 **totipotent** cells ;
 5 surface sterilisation / disinfection (of explant) / AW ;
 6 placed in sterile, culture medium ;
 7 detail on content from, sucrose / amino acids / vitamins / inorganic ions /
 trace element / named trace element (e.g. iron / copper) ;
 8 grow in **agar** gel ;
 9 cells from **meristem** ;
 10 non-meristematic / non-dividing cells ;
 11 produce a **callus** ;
 12 (meristematic tissue / callus , may be) divided into many parts ;
 13 **undifferentiated** / unspecialised cells ;
 14 use PGR / **auxin** / **cytokinin**, to stimulate growth of roots / shoots / AW ;
 15 AVP ; e.g. use non vascular tissue as is virus free

7
max

QWC - clear, well organised using specialist terms ;

1

*At least 3 of the terms shown in bold : **asexual, explant, totipotent, agar, meristem, cytokinin, callus, undifferentiated, auxin.***

[Total: 16]

Question	Expected Answers	Marks
4 (a) (i)	(bound to large molecule) so stays where it is / AW / ora ; insoluble ; inert / inactive ; easily converted (by enzyme action) ;	2 max
(ii)	transport / carrier, <u>protein</u> / iodine (ion) gate ; <i>do not credit 'channel'</i> ref. to specificity ; in membrane ; changes shape / gate opens ; against diffusion / concentration gradient ; ref. to ATP ; ignore 'energy'	4 max
(b) (i)	<u>thyroid</u> stimulating hormone / TSH ;	1
(ii)	(thyroglobulin molecule) too big to pass through cell membrane ; RMM more than 69 000 ; (pinocytosis is) bulk transport / described ; AVP ; e.g. against concentration gradient ; requires ATP	2 max
(iii)	<i>type of enzyme</i> protease / proteolytic ; <i>type of reaction</i> hydrolysis / addition of water ;	2
(c) (i)	using salt containing iodine reduces the incidence of goitre (in children) / AW ; Q has greatest reduction AW ; smallest reduction in country R / AW ; comparative figs. to illustrate ; <i>must use 4 figs from 2 countries</i>	2 max
	iodine deficiency prevents the formation of thyroxine / ora ; country R low (prevalence) to start with / may be getting adequate iodine from other sources ; example of alternative source ; e.g. green leafy vegetables / seaweed / (drinking) water ; AVP ; genetic differences / reason for enlarged prevalence in S	2 max 4 max

continued

**Question 4 Expected Answers
cont'd****Mark**

- (ii) slow / reduced, mental development / cretinism / AW ;
do not credit myxoedema
low, metabolic rate ;
low, body temperature ;
low , heart rate / cardiac output / respiratory rate ;
obesity / AW ;
slow growth rate / greater growth of soft tissue rather than skeletal / short
and stocky / dwarfism ;

2 max

- (iii) thyroglobulin accumulates / production increases / AW ;
(due to) lack of TSH production ;
problem with, release of thyroxine / hydrolysis of thyroglobulin ;
cells in thyroid multiply ;
immune system attacks thyroid gland A/W ;
AVP; e.g. any refs to negative feedback effects
poor blood supply

2 max**[Total: 19]**

Question	Expected Answers	Marks
5 (a) (i)	<p>= 400 ; ; A range between 420 and 380 but must be a whole number</p> <p>$\frac{120 \times 1000}{20\,000}$ A range between 21 and 19 50 μm</p> <p>1 max only if method correct</p>	2 max
(ii)	<p>magnification is how much larger an image is, compared to the object / actual size / AW ;</p> <p>resolution is the ability to distinguish between two (separate) points ;</p>	2 max
(b)	<p>1 (meristem cell) divides by <u>mitosis</u> ;</p> <p>2 ref to three named/ described <u>zones</u> ;</p> <p>3 cells, enlarge / elongate / get bigger ;</p> <p>4 take up water by <u>osmosis</u> ;</p> <p>5 synthesising, new structural materials / named (eg protein / cellulose / lignin) ;</p> <p>6 become more mature as they are pushed away from apex / tip / AW ;</p> <p>7 <u>differentiate</u> (into xylem vessel) ;</p> <p>8 ref. to gene switching ;</p> <p>9 lignin is deposited, in cell wall ; R on</p> <p>10 lignin , impermeable to water ;</p> <p>11 cell contents break down ;</p> <p>12 end walls break down ;</p> <p>13 (empty) <u>lumen</u> ;</p> <p>14 <u>pits</u> ;</p> <p>15 (pits are) gaps in lignin / areas in wall where plasmodesmata occur(ed) ;</p> <p>16 AVP ; e.g. ref. to cambial meristem, ref. to lignification patterns</p>	7 max
	<p>QWC - legible text with accurate spelling, punctuation and grammar;</p> <p><i>Candidates should have no more than three different spelling errors, sentences should be accurately punctuated according to spoken English and text should be legible.</i></p>	1
(c)	<p>do not collapse (under negative tension) / AW ;</p> <p>lignin is strong / waterproof ;</p> <p>no obstructions, to break water column / impede water / impede mass flow;</p> <p>water molecules are attracted to, lignin ;</p> <p>adhesion ;</p> <p><u>pits</u> allow lateral movement of water / AW ;</p> <p>(pits allow) water to bypass a blockage / air bubble ;</p>	4 max
[Total: 16]		

Question	Expected Answers	Marks
6 (a)	no experimental protocol set up / followed / ora / A/W ; eg no variables controlled / no manipulation of subject unethical to , experiment on human subjects / AW ; detail of why it is unethical ; e.g. foetus cannot give consent / may damage health	2 max
(b)	(any) smoking causes more premature births / births before 36 weeks, compared to non-smokers ; heavy smokers have more premature births / births before 36 weeks, compared to ight smokers ; most babies born before 42 weeks ; R 40 weeks is peak use of figures to illustrate trend ; <i>must use one time and two % refs</i> AVP ; e.g. ref to log scale any other reasonable trend e.g. smoking decreases the length of gestation	3 max
(c)	<i>mark together</i> <i>carbon monoxide</i> carbon monoxide binds irreversibly / AW, with haemoglobin ; A refs to foetus to form <u>carboxyhaemoglobin</u> ; <i>nicotine</i> constricts <u>arterioles</u> ; reduces blood flow through the placenta ; A once only in either section Less, ATP/ respiration / energy, for growth ; reduces exchange of materials / named materials A/W ; placenta does not grow to / AW, adequate size / AW ; ref to carbon monoxide / nicotine <u>diffusing</u> across placenta ; Refs to <u>IUGR</u> ;	2 max
		2 max 5 max
		[Total: 10]

2805/02 Applications of Genetics

Question	Expected Answers	Marks
1 (a)	<p>(i) 1 continuous <u>quantitative</u>, discontinuous <u>qualitative</u> ; 2 discontinuous in discrete classes / continuous intermediates <i>or</i> AW ; A ref to graphs R categories unqualified 3 continuous differences between individuals small / discontinuous large ; 4 continuous more affected by environment / <i>ora</i> ; A ref to V_P, V_G, V_E 5 AVP ; e.g. different alleles have larger effect in discontinuous / <i>ora</i> e.g. an example of each type of variation</p> <p>(ii) <i>continuous</i></p> <p>6 different, alleles / genes, have small effects ; 7 different, <u>genes</u> / <u>loci</u>, have same effect ; R alleles 8 different, <u>genes</u> / <u>loci</u>, have additive effect ; R alleles 9 many / several, <u>genes</u> / <u>polygenes</u>, involved ;</p>	max 6
(b)	<p><i>broad sense</i></p> <p>1 proportion of total phenotypic variation due to genotype (V_G / V_P) ; 2 maximum value of effect of genotype on phenotype ; <i>narrow sense</i> 3 proportion of total phenotypic variation due to additive effects of polygenes (V_A / V_P) ; 4 0 = no genetic contribution / 1 = no environmental contribution ; A higher the number the greater the heritability / <i>ora</i></p> <p>5 values, < 0.02 genotype has little effect / > 0.02 genotype has bigger effect ; A in context of selective breeding 6 higher value = more easily trait can be selectively bred ; A ref to example</p>	max 3
(c) (i)	<p>1 <u>progeny testing</u> ; 2 cross with females with, proven performance / AW ; 3 inspect offspring (for trait) ; 4 average value of offspring ;</p>	max 3
(ii)	<p><i>accept reverse argument</i></p> <p>1 body mass <u>and</u> mean horn length decreased / data quote for both traits; 2 hunting is, selection / selection pressure / selective agent ; 3 higher breeding value / larger <i>or</i> longer horned, individuals shot young ; 4 leave fewer offspring ; 5 frequency of <u>alleles</u> for these trait(s) reduced (in population) ; 6 reduction in <u>genetic</u> diversity / reduction in <u>gene pool</u> ; 7 directional selection ;</p>	max 3

[Total: 15]

Question	Expected Answers	Marks
2 (a) (i)	recessive ; epistasis ; A complementary gene action for one mark	2
(ii)	1 A needed for <u>red or brown</u> / <u>red or brown</u> not expressed in absence of A ; 2 dominant so only one allele needed / ref to heterozygote / AW ; (red / brown) 3 aa gives cinnabar ; 4 A allows expression of B/b ; <i>accept ora</i> 5 B needed for red / if bb no red ; 6 dominant so only one allele needed / ref to heterozygotes / AW ; 7 bb gives <u>brown</u> in presence of A ; 8 B/b has no effect on aa (cinnabar) ; 9 B/b is hypostatic ;	max 4
(iii)	1 ratio is a modified 9:3:3:1 ; 2 ref to, independent assortment / not linked ; A ora 3 expect 3:1 ratio (red: cinnabar) if tightly linked / AW ; 4 loci could be long way apart on same chromosome / AW ; A partial linkage 5 large number of crossovers (Ab + aB) so not in same linkage group / explained ;	max 3
(iv)	<i>This question is about role of enzymes NOT just genes as in (a)(ii)</i> <i>accept the idea that A may produce some drosopeterin and B more of the pigment</i> 1 enzyme encoded by A produces precursor (for red, brown) / AW ; 2 enzyme encoded by a produces, different substance / cinnabar pigment; <i>accept no enzyme produced so no change to cinnabar</i> 3 enzyme encoded by B (converts precursor to give), red pigment / drosopeterin ; 4 enzyme encoded by b (converts precursor to give), brown pigment ; <i>accept no enzyme produced so no change from brown to red</i> 5 A produces brown which is converted to red by B ; 6 <i>idea that cinnabar is, default colour / not red or brown ;</i> 7 AVP ; <i>accept any relevant point about enzymes involved in the pathway</i>	max 3
(b)	1 result not due to chance ; 2 significant / below critical value / ref to 5% / ref to 0.05 ; A even if used in wrong argument 3 <u>null</u> hypothesis disproved / AW ; 4 another (named) factor involved ; e.g. epistasis 5 fourth phenotype not seen because of epistasis ;	max 3

[Total: 15]

Question	Expected Answers	Marks
3 (a) (i)	<p>1 sterile surroundings ; A aseptic technique</p> <p>2 detail ; e.g. laminar air flow cabinet / use of bleach / methods of cell separation / AW</p> <p>3 <u>surface sterilised</u> embryo ;</p> <p>4 nutrient / sterile, medium ; A agar</p> <p>5 detail nutrient ; A minimum of two components (sucrose / organic nutrient / salts)</p> <p>6 plant growth substance / named PGS ; A hormone</p> <p>7 to stimulate mitosis ;</p> <p>8 callus is, undifferentiated cells / unspecialised cells ;</p> <p>9 can be subdivided to give more callus ;</p>	max 5
(ii)	field (gene) bank / botanic garden / growing palms / AW ; R take cuttings, etc.	1
(b)	<p>1 orthodox seeds / non-recalcitrant seeds ;</p> <p>2 store, frozen / -18°C / -20°C ;</p> <p>3 storage life increased by 5°C reduction ;</p> <p>4 store, dehydrated / low humidity / (<) 5% water ; A store dried</p> <p>5 storage life doubled by 2% reduction in humidity ; A ref to ice crystals</p> <p>6 bagged and labelled ;</p> <p>7 germinated / grown, regularly / every 5 years ; A every 2 years</p> <p>8 when % germination falls below 85% ;</p> <p>9 plants / seeds, grown ;</p> <p>10 fresh seed collected (and stored) ;</p> <p>11 may, alter <u>allele</u> frequency / result in loss of valuable <u>alleles</u> ; A AW</p> <p>12 stored in, air-tight / moisture-proof, containers ;</p> <p>13 coated with oil / kept in presence of ash, to reduce insect infestation / AW ;</p> <p>14 problem of fungal infection ;</p> <p>15 strategy for, recalcitrant / non-orthodox, seeds ; e.g. field gene bank / tissue culture / cryogenics for tissues</p> <p>16 growth conditions for different seeds ;</p> <p>17 <u>viability</u> comment in context of germination ; e.g. 'up to 15 years'</p> <p>18 AVP ;</p> <p>19 AVP ;</p>	max 8
	QWC - legible text with accurate spelling, punctuation and grammar	1

[Total: 15]

Question	Expected Answers	Marks
4 (a)	<ol style="list-style-type: none"> 1 movement equates with choice ; 2 some do not move far to find a mate ; 3 nearly half / 47%, of females do move to find nearest mate ; 4 some / 17% / another figure, move up to 34 m to find a mate ; 5 although, 99% have male within 4 m / 100% have male within 9 m ; 	max 2
(b) (i)	<ol style="list-style-type: none"> 1 DNA cut by restriction, endonuclease(s) / enzyme(s) ; 2 placed at one end of gel ; 3 agarose / polyacrilamide ; 4 buffer / electrolyte ; 5 PD / (direct) current, applied ; 6 negatively charged fragments move to anode ; 7 negative charge due to phosphate ; 8 smallest, furthest / fastest ; <i>ora</i> 9 method of visualising position of bands ; e.g. staining gel / Southern blotting 10 detail of method of visualisation ; e.g. fluorescent stain / methylene blue / ethidium bromide / autoradiograph / radioactive probe / gene probe 	max 4
(ii)	<ol style="list-style-type: none"> 1 VNTRs / RFLPs / non-coding regions / AW, inherited ; 2 half from each parent ; 3 number of shared bands shows relationship ; A same / similar, pattern of bands 4 more shared bands more closely related ; 	max 2
(iii)	<p><i>accept increases for maintains</i></p> <ol style="list-style-type: none"> 1 avoids <u>inbreeding depression</u> ; 2 maintains heterozygosity / reduces homozygosity ; 3 maintains, fitness / fertility ; 4 hybrid vigour ; 5 decreases, expression of / homozygotes of, deleterious / lethal / harmful recessive alleles ; A ref to accumulation of such alleles 6 maintains genetic diversity <i>or</i> phenotypic variation / avoids genetic erosion ; 	max 3
(c) (i)	<ol style="list-style-type: none"> 1 several / 6 (4), genes / loci ; A 'supergene' / haplotype 2 each has many alleles ; 3 result of <u>many</u> mutations ; 4 ref to different selective advantages ; 5 AVP ; e.g. gene duplication 	max 2
(ii)	<ol style="list-style-type: none"> 1 genes / loci, <u>tightly</u> linked / AW ; 2 inherited as <u>haplotype</u> ; 3 (almost) no crossing over between loci ; 	max 2

[Total: 15]

Question	Expected Answers	Marks
5 (a)	<p>1 to stimulate ovaries ; A controlled hyperstimulation</p> <p>2 to produce many, mature follicles / oocytes / eggs ; R follicles unqualified</p> <p>3 <u>superovulation</u> ;</p> <p>4 ref to, FSH / gonadotrophin / releasing factors ;</p> <p>5 so number of oocytes can be harvested at same time ;</p> <p>6 to increase chance of successful, fertilisation / implantation ;</p> <p>7 to prepare, uterus / endometrium ;</p>	max 3
(b) (i)	<p>1 little / no significant, difference in percentage resulting in live births ; A <i>ora</i></p> <p>2 mild does not reduce discomfort ;</p>	2
(ii)	<p>1 transferring one embryo reduces multiple births significantly (x26) / <i>ora</i> ; <i>accept statement of figures</i></p> <p>2 ref to (named / described) problem(s) associated with multiple births ;</p> <p>3 ref to embryo splitting being a rare event ;</p> <p>4 significant loss of embryos when two transferred ;</p> <p>5 87% of two-embryo transfers did not result in twins / <i>ora</i> ; A two babies</p>	max 2
(c)	<p>1 women with damaged, ovaries / oviducts, can become pregnant ;</p> <p>2 older women can become pregnant ;</p> <p>3 possible problem <i>re</i> elderly mothers ;</p> <p>4 eggs / embryos, can be stored for use ;</p> <p>5 problem related to embryo storage ;</p> <p>6 allows use of surrogate ;</p> <p>7 genetic test / genetic screening / pre-implantation genetic diagnosis</p> <p>8 (PGD) ;</p> <p>9 named e.g. of a genetic disease ;</p> <p>10 (PGD) karyotype for, older mothers / mothers with history of trisomy / AW ;</p> <p>11 more embryos produced than used ; A 'spare embryos'</p> <p>12 problem for some <i>re</i>, death of these embryos / use for research ;</p> <p>13 embryos with problem, rejected / not used ;</p> <p>14 all male embryos may be rejected <i>re</i> (named) sex-linked condition ;</p> <p>15 side effects fertility drugs ;</p> <p>16 high incidence of infertility leads to, depression / mental illness / AW ;</p> <p>17 use for production of stem cells ;</p> <p>18 ref to eugenics / 'designer babies' ;</p> <p>19 sex preselection ;</p> <p>20 ref to IVF failure rate ;</p> <p>21 AVP ; e.g. religious objections AVP ; ref to cost prioritisation single or multiple embryos implanted</p>	max 7
	QWC - clear, well organised answer using three specialist terms	1

[Total: 15]

Question	Expected Answers	Marks
6 (a)	<p>1 non-disjunction ;</p> <p>2 in meiosis ;</p> <p>3 <u>homologues</u> / <u>homologous chromosomes</u>, fail to separate in <u>meiosis I</u> ;</p> <p>4 so two chromosomes 21 in, oocyte / egg / same cell / daughter cell / gamete ;</p> <p>5 third added, at fertilisation / from sperm ;</p> <p>6 ref to problem from <u>extended</u> prophase I ;</p>	max 3
(b)	<p><i>if candidates give the chromosome content of the zygote / diploid cells, then penalise once in (b)</i></p> <p>(i) normal chromosomes 14 and 21 ; R 2 x 14, 2 X 21</p>	1
	<p>(ii) 14-21 and normal 21 ; A 14-21 + 21, 14 + 21 <i>if diploid given in (i)</i></p>	1
	<p>(iii) 14-21 ; A 14-21 + 14 + 21 <i>if diploid given in (i) or (ii)</i></p>	1
(c) (i)	<p>nuclear:cytoplasmic ratio of transcription factors higher in normal / <i>ora</i> ;</p> <p>A fewer transcription factors in nucleus / more in cytoplasm</p> <p>A use of figures to show effect</p> <p>more genes (controlled by these transcription factors) expressed in normal mice ;</p> <p>A less transcription / use of figures / <i>ora</i></p>	2
(ii)	<p>1 Down's syndrome result of, trisomy / 3 chromosomes 21 ;</p> <p>2 <i>thus</i> x1.5 normal expression ;</p> <p>3 over-expression of D equivalent to, extra chromosome 21 / (Down's) symptoms ;</p> <p>4 (essential) genes not transcribed ; A 'not regulated' / not switched on'</p> <p>R DSCR</p> <p>5 transcription factors, not moving to nucleus / staying in cytoplasm ;</p> <p>6 cells remain inactive ;</p> <p>7 so normal, growth / development, does not occur ;</p>	max 3
(d)	<p><i>benefits</i></p> <p><i>idea that</i> provides animal model for research / AW ;</p> <p>allows, drugs / treatment, to be tested without risking humans ;</p> <p>AVP ; e.g. no ethical problems as with using humans</p> <p><i>hazards</i></p> <p>findings in animals may not relate to humans ;</p> <p>risk of transgene, entering germ line / escaping from containment ;</p> <p>unforeseen effect on mice ;</p> <p>escapes and breeds with, wild population / non GM mice / GM mice for another condition ;</p> <p>AVP ; e.g. use of animals for research unethical / ref to animal rights</p>	max 4

[Total: 15]

2805/03 Environmental Biology

Question	Expected Answers	Marks
1 (a)	8.38 MJ ;;	
	<i>1 mark if incorrectly rounded or for correct working showing subtraction and conversion in MJ</i>	max 2
(b)	fewer raw materials / oil used / AW ; reduced need for landfill / AW ; reduced need for incineration ; <i>idea of</i> plastics taking long time to degrade ; reduced risk of ingestion by wildlife / named wildlife ;	max2
(c) (i)	source or store of, energy ; production of ATP / respiratory substrate ; example of energy using process e.g. binary fission ; can be used as component of membranes ; lipid provides more energy per gram than glycogen / sugars / AW ; no affect upon water potential / AW ;	max 2
(ii)	(potentially) cheap to produce / qualified ; e.g. takes up little space / works at low temperature / could be carried out anywhere ability to clone / reproduce bacteria quickly ; (potentially) unlimited supply / renewable ; ability to manipulated by genetic modification / AW ; reduce dependency on fossil fuels ;	max 2
(iii)	PHB is a long / complex molecule / strongly bonded / AW ; insufficient oxygen / anaerobic / water logged / AW ; decomposition faster in aerobic conditions / AW ; unsuitable / toxic environment in landfill / named toxin e.g. pH / AW ; <i>ref to</i> need for UV degradation / AW ;	max 2
(iv)	fatty acids ; glycerol ;	max 2

[Total: 12]

Question 2 Expected Answers

Marks

- (a) they are more or less abundant in a particular condition / presence or absence / AW ;
they have different tolerances to pollution / AW ;

they have specific adaptations / AW ;
relevant example of adaptation ; max 2
- (b) *max 3 for description (D) and max 3 for explanation (E)*
correct units must be used if oxygen concentration is described
- D lower oxygen concentration compared to other sites ;
D relevant comparative data quote comparing oxygen concentration ; ecf if level used previously
E decomposition by aerobic bacteria ;
E high BOD of organic pollutant ;
- D high numbers (920) tubeworms (at site 2) ;
E specialised adaptation to low oxygen concentration ; ecf as above
- D complete absence of, mayflies / stoneflies (, at site 2) ;
E these can only survive in clean water / AW ;
- D lower numbers of, shrimps / caddis larvae, (than at other 2 sites) ;
E these organisms need (cleaner) water with more oxygen / tolerate lower oxygen concentration ;
- D relevant comparative data quote for individual group of indicator species ;
D relevant comparative data quote for number of indicator species (3 vs 5) ; max 4
- (c) carrying capacity reached (for particular ecosystem) ;
limiting factors to population growth ;
e.g. space / food / breeding sites ;
intraspecific competition **R** interspecific ;
increased disease effect ; max 3
- (d) Winkler method / described ;
detail, e.g. Mn^{2+} oxidized to Mn^{3+} ;
repeats ;
ref to time of measurements ;

or

(oxygen) probes ;
calibration of probes with solutions of known oxygen concentration / AW ;
repeats ;
ref to time of measurements ; max 3

- (e) pH ;
 temperature ;
 turbidity / AW ;
 depth ;
 current speed / AW ;
 stream bed sediments ;
light intensity ;
 named chemicals e.g. heavy metals / aluminum ions / nitrates /
 phosphates / carbonate ions ; **R** nutrient

max 2

- (f) *explanation*
- 1 (fertilizer / AW) will **leach** / **run off** into surrounding water ways ;
 - 2 (fertilizer / AW) is high in **nitrates** ;
 - 3 leading to **eutrophication** ;
 - 4 algal bloom / increased plant growth ;
 - 5 detail of process, e.g. **decomposition** (by **aerobic bacteria**) ;
 - 6 bacteria remove oxygen from water ;
 - 7 leading to absence of (aquatic) organisms / named (aquatic) organism ;
- 5 max

conflict

- 8 (with role of reserve to) protect **biological diversity** / **biodiversity** / AW ;
- 9 *idea* that this is difficult / AW with action of local farm ;
- 10 nature reserve might be an **SSSI** / or alternative designation ;
- 11 reserve should allow education and research ;
- 12 activities of farm could harm reserve revenue / AW ;
- 13 area might be an **ESA** and this would affect actions of farmer ;
- 14 *idea* of the use of, laws / enforcement, in **nitrate vulnerable zone** ;
- 15 ref to **aesthetic** appeal ;

5 max

max 7

QWC - Look for 3 **embolden** technical terms **used in correct context**

1

[Total: 22]

Question	Expected Answers	Marks
3 (a)	egg shell thinning in birds ; affect (mammalian) reproduction ; e.g. lowered fertility damages immune system / increases susceptibility to (viral / bacterial) infection ; cause cancer ; adversely affects memory in humans / AW ; adversely affects IQ in humans / AW ; poor growth in humans / affects on thyroid ; heart problems ; AVP ; R nervous system / liver / kidney / cataracts	max 3
(b)	slow to degrade / AW ; contain carbon / C ;	max 2
(c)	take dolphins from, wild / use dead organisms / by-catch / strandings / AW ; detail of sampling technique e.g. fin clipping / skin scrapings / biopsy ; idea of repeated samples taken ; idea of sample taken from fatty tissue e.g. adipose or liver tissue ; R if blood sample taken take sample from many dolphins / AW ;	max 3
(d)	increased percentage of body fat / blubber / AW ; ora for sea eagle /human PCBs are fat soluble ; diet consists primarily of fish ; idea that fish contain small quantities of PCB that will bioaccumulate / AW ; bioaccumulation lower in eagle as lower level of body fat present / AW ; <i>ref to</i> food, chains / webs ; continuous exposure (to PCB) in aquatic environments / AW ; (because of) leaching / AW ;	max 3

[Total: 11]

Question	Expected Answers	Marks
4 (a) (i)	<p>reduced crop yield / AW ; harbours pest species ; allows weeds / disease to spread through crop ; competition, qualified e.g. for a named resource e.g. water / nutrients ; restriction to farm machinery / AW ; will take time to become established and protect crop / AW ;</p>	max 3
(ii)	<p><i>any two connected points</i></p> <p>use of biological control agent ; further explanation e.g. <i>idea of</i> reintroduction of b. c. a. ;</p> <p>use of insecticides / pesticides ; further explanation e.g. repeated spray application ;</p> <p>use of weed traps / intercropping / set-aside / conservation headland(s) / AW ; further explanation, e.g. growing plants alongside cereal crop to distract pests ;</p> <p>pheromone traps ; detail ;</p> <p>genetically engineered crops ; detail of specific example such as BT toxin in crops ;</p>	max 4
(b)	<p>1 <i>ref to</i> timed searches / AW ; 2 <i>ref. to</i> selecting sampling points, e.g. random / regular / stratified / grid area ; 3 use of pitfall traps / pooters / nets / beating trays ; 4 use identification key ; 5 mark-release-recapture / AW ; 6 detail of m-r-r ; 7 repeated sampling / AW ; 8 <i>ref to</i> timings for taking readings, e.g. early morning or late evening ;</p>	max 4
(c) (i)	<p><i>pesticides</i> food chain damage / less available food / death of non-target species ; (direct) poisoning / sublethal effects ; bioaccumulation linked to appropriate example e.g. egg shell thinning ;</p> <p style="text-align: right;">2 max</p> <p><i>hedgerow removal</i> loss of / disturbance to, nesting / breeding, sites ; loss of food sources ; loss of refuge (from predators) / AW ; loss of shelter ; loss of connectivity / AW ;</p> <p style="text-align: right;">2 max</p>	max 3

Question	Expected Answers	Marks
(c) (ii)	increased predation e.g. increase in (domestic) cat population ; disease ; competition, qualified ; parasitism ; pollution ; climate change / Global warming ; hunting ; problems linked to migration ; change in land use e.g. road building ;	max 2

[Total: 16]

Question	Expected Answers	Marks
5 (a)	road development / widening / AW ; vehicle pollution / damage ; increase in urbanization / AW ; effects of trampling / tourist pressure ; effects of litter by humans ; lack of money needed for maintenance ; effect of grazers e.g. sheep and cattle ; effects of pesticide / fertilizer spray ;	max 4
(b) (i)	control growth of, dominant / woody species ; increases space / light for other plants ; increase niche availability / AW ; ref to decrease in competition ; <i>idea of</i> release of nutrients into soil, e.g. decomposition of plant material ; deflected succession / plagioclimax ;	max 3
(ii)	gives plants time to grow ; allows plants to (flower and) set seed ; maintenance of habitat for, pollinators / beneficial insects ; R germination AVP ; e.g. <i>idea of</i> less destruction of (animal) breeding sites aesthetic reasons / AW	max 2
(c)	1 purchases / manage nature reserves / AW ; 2 development of visitor centres / viewing points / bird boxes ; 3 provide rangers / wardens / volunteers / AW ; 4 links to education, qualified ; 5 raising public awareness, qualified ; 6 prevents trade and use of bird products ; 7 provides evidence to prosecute / AW ; 8 <i>ref to</i> egg stealing / poisoning / shooting of birds of prey ; 9 lobbying (members of) parliament ; 10 <i>ref to</i> farming and conservation issues ; 11 action against development proposals / consultation advice / policies ; 12 <i>ref to</i> action against peat extraction ; 13 raise funding e.g. for research / farming activities / membership ; 14 research e.g. annual bird surveys ; 15 links to other conservation groups ; 16 example of bird conserved by RSPB ; e.g. Black grouse 17 further detail of example ; 18 captive breeding ;	max 8
	QWC – Award 1 mark for quality of punctuation and grammar	1

[Total: 18]

Question	Expected Answers	Marks
6 (a) (i)	hair ; skin scrapings ; blood ; dung ; saliva ; urine ; bone ; biopsy (body) tissues / flesh sample ; sexual fluids ;	max 2
(ii)	closely related organisms (more likely to share) similar groups of <u>alleles</u> ; R gene and then ecf increases chance of seeing (genetic) match / AW ; increase in validity of data (from many chromosomes) / AW ; minimises errors in experimental technique / AW ; AVP e.g. ref to genetic fingerprinting techniques ;	max 3
(b)	different (populations) do not mix / AW ; populations being geographically isolated ; family groupings staying together (behavioural isolation) / AW ; (little) immigration / emigration ; AVP e.g. some populations better protected than others ;	max 2
(c)	1 ban trade (in ivory) ; 2 collapse of (international) markets so price falls / AW ; 3 allow populations to recover / reduces risk of extinction ; 4 ban hunting ; 5 raise awareness / education ; 6 <i>idea of</i> effect on development of (eco)tourism ; 7 economic advantage(s) to 'host' country ; e.g. attracts funding 8 (more) cooperation between countries ; 9 AVP e.g. improvement of custom officials ;	max 4

[Total: 11]

2805/04 Microbiology and Biotechnology

Question	Expected Answers	Marks
1 (a) (i)	<p>use, flamed (inoculating) loop / sterile pipette / sterile syringe ; flame neck of (culture) jar / AW , transfer / AW, onto slide ; smear (prepared) ; heat <u>fix</u> / pass through flame to <u>fix</u> ;</p> <p>flood with / AW, <u>crystal violet</u> / <u>Gram stain</u> ; add (Grams / Lugol's) <u>iodine solution</u> ; A Gram's iodine / Lugol's iodine ref. to adding decolouriser ; e.g. alcohol, ethanol, propanone, acetone- alcohol add / counterstain with, safranin / carbol fuschin ; <i>max 2 if out of sequence OR Gram stain not used</i> R mark point if reason for using chemicals is incorrect</p>	max 5
(ii)	<p><i>Nitrobacter</i> straight rods, whereas <i>Streptomyces</i> filamentous ; <i>Nitrobacter</i> stains, red / pink, whereas <i>Streptomyces</i> stains, purple / violet ; A blue</p>	2
(iii)	<p><i>Nitrobacter</i> and <i>Rhizobium</i> / both, stain, red / pink / same colour ; <i>Nitrobacter</i> and <i>Rhizobium</i> / both, straight rods / same shape ;</p>	2
(iv)	<p>(<i>Clostridium</i>) anaerobic <u>and</u> culture was, exposed to oxygen / in aerobic conditions / AW ; AVP ; e.g. size / antibacterial effect / immature cells may not stain</p>	max 1
(b) (i)	<p>hazy / cloudy / AW, area, indicates (bacterial population) <u>growth</u> ; clear area around disc / zone of inhibition ; A area of inhibition (indicates) bacteria / <i>Clostridium</i>, killed / inhibited ; A no bacteria growing <u>diffusion</u> ; (of) chemical from disc to surrounding agar ; chemical, kills / AW, <i>Clostridium</i> / acting as an antibiotic / acting as an antibacterial ; ref. to efficacy e.g. small zone indicates not very efficient at killing ;</p>	max 4
(ii)	<p>some, are pathogenic / cause disease / cause named disease (e.g. botulism, food poisoning, gangrene) ; A infectious alternative if, resistant to existing antibiotics / mutate to become resistant ;</p>	max 1

[Total: 15]

Question	Expected Answers	Marks
2 (a)	<p><i>max 6 if no desirable trait named, max 7 if mp 1 attempted but rejected (not sufficiently rigorous to score)</i></p> <p>1 named trait ; e.g. herbicide / disease resistance</p> <p>2 ref. to identify gene / removal of gene (from 'donor') ;</p> <p>3 restriction enzyme / endonuclease ; e.g. to remove gene / cleave plasmid OR</p> <p>2 remove mRNA ;</p> <p>3 produce, cDNA / gene, using reverse transcriptase ; OR</p> <p>2 analyse amino acid sequence of desired protein product ;</p> <p>3 use genetic code to synthesise gene ;</p> <p>4 remove (Ti) plasmid from bacterium ;</p> <p>5 cleave / cut open, plasmid and allow gene to insert ;</p> <p>6 (complementary) base pairing / H bonds forming ;</p> <p>7 correct ref. to use of (DNA) ligase ;</p> <p>8 plasmid reintroduced into bacterium ;</p> <p>9 ref. to bacterium, acting as vector / infecting host plant ; OR</p> <p>4 biolistics / microprojectile bombardment ;</p> <p>5 use of (small), tungsten / gold, particles / pellets ;</p> <p>6 coated with gene / DNA ;</p> <p>7 use of particle gun / gene gun / AW ;</p> <p>8 fired into plant cells / AW ;</p> <p>9 ref. to direct gene transfer ; OR</p> <p>4 electroporation / dielectric stress / AW ;</p> <p>5 cells mixed with, DNA / genes ;</p> <p>6 exposed to voltage / electric current ;</p> <p>7 short pulses of, high voltage / very low current / AW ;</p> <p>8 (temporary) holes form in cell surface membrane ;</p> <p>9 genes / DNA, enter(s) directly ;</p> <p>10 ref. to gene integrating into, cells / nuclei, of crop plant ;</p> <p>11 AVP relating to crop plant to be transformed ; e.g. dewaxing, named enzymes (e.g. pectinases, cellulases), use of protoplasts, callus culture</p> <p>12 AVP relating to transfer ; e.g. Agrobacterium (<i>tumefaciens</i>), tumour-inducing genes removed, ref. to plant transformation; use of marker genes; compressed gas / electrical discharge, used to fire particles, recombinant DNA (rDNA)</p>	<p>max 7</p>
	<p>QWC – clear, well organised using specialist terms; <i>three from</i></p> <p>herbicide, restriction enzyme / endonuclease, cleave, plasmid, reverse transcriptase, ligase, amino acid, genetic code, (complementary) base pairing, vector, biolistics / microprojectile, electroporation, dewaxing, pectinases, protoplasts, callus, <i>Agrobacterium</i>, transformation, marker genes</p>	<p>1</p>

Question	Expected Answers	Marks
2 cont. (b)	<p><i>any one valid benefit (1 mark) suitably qualified (1 mark) examples below economic -</i></p> <p>increased production ; ref cheaper crops ;</p> <p>decreased use of pesticides ; ref cost savings ;</p> <p>able to grow crops in non-traditional areas ; reducing transport costs ;</p> <p>ref. crops for food trade ; ref. cash crops / AW ;</p> <p>more abundant food supply ; to feed populations ;</p> <p>improvements in nutritional quality ; improving health of (some) populations ;</p> <p>increased shelf-life / keeping foods fresher for longer ; ref. less wastage / less money lost ;</p> <p>ref. to use of plants to introduce vaccines ; cost savings compared to traditional means / AW ;</p> <p><i>environmental - any one valid benefit suitably qualified</i></p> <p>decreased use of pesticides ; reduces pollution ;</p> <p>able to grow crops in nutrient-poor soils ; increases land available to grow crops / less need to use ecologically threatened areas e.g. rain forests / less need to move towards desert margins and increase desertification ;</p> <p>decreased use of pesticides ; reduces harm to 'beneficial' species ;</p>	<p>max 4</p>
(c)	<p>provide energy ; (provide) carbohydrate / sugar / respiratory substrate ; A named sugar (for) named organism e.g. <i>Saccharomyces</i> / yeast / <i>Zymomonas</i> ; (using sugar) fermentation / (anaerobic) respiration ; R aerobic respiration (fuel for) distillation ; AVP ; detail of crop plant e.g. named (sugar cane, cassava roots, corn maize, straw), use of bagasse for distillation fuel</p>	<p>max 3</p>

Question	Expected Answers	Marks
2 cont. (d)	<p>action of facultative anaerobes ; detail of digestion e.g. large complex compounds broken into smaller or example e.g. starch to sugars ; anaerobic conditions created ; action of acetic acid-forming bacteria ; action of, methanogens / named methanogen (e.g. <i>Methanococcus</i>, <i>Methanobacterium</i>) ; ref. to <u>anaerobic</u>, digestion / respiration ; formation of organic acids ; production of methane ; production of carbon dioxide ; other named gas e.g. hydrogen sulphide, hydrogen ; acceptable, temperature / pH, conditions e.g. 15°C / pH 7 ; A 10 - 25°C</p>	max 4

[Total: 19]

Question	Expected Answers	Marks
3 (a) (i)	(time for) <u>immune</u> / <u>primary</u> , response (to occur) ; further detail ; e.g. recognition and binding, mitosis / cloning / clonal expansion or clonal selection, complementary / specific, B-lymphocyte	2
(ii)	B-lymphocytes / splenocytes ; A B-cells	1
(iii)	unable to, survive / divide / produce antibody, in culture (indefinitely) ; because myeloma cells, can survive / divide / live for longer (in culture) / AW ;	max 1
(iv)	hybridoma ;	1
(v)	not all hybridoma cells are the desired B-lymphocytes (fused with myeloma cells) ; not all (desired) hybridoma cells release antibody ; most active hybridomas selected (for greater productivity) ; (no screening means) lowered productivity in fermenter ; ref. to less, efficient / economically viable / AW, process ; e.g. nutrients wasted less, downstream processing / need to, separate /purify (desired) antibody;	max 2
(vi)	<i>one type of fermenter with one acceptable reason e.g.</i> airlift loop / AW ; (no paddles) reduce damage to cells / delicate cells <i>or</i> can run as continuous ; continuous fermenter ; greater productivity ; batch fermenter ; (‘closed’ fermenter so) reduces problems with contamination / AW ;	max 2

Question	Expected Answers	Marks
(b)	<p>1 larger window line, coloured = pregnant / not coloured = not pregnant ;</p> <p>2 X = not pregnant, Z = pregnant ; <i>treat refs to Y as neutral</i></p> <p>3 line in smaller window / second line, confirms strip working / for quality control / AW ;</p> <p>4 (no line in small window) <u>Y</u> indicates, strip faulty / incorrect use / AW ; ora</p> <p>5 unable to say whether Y pregnant or not ;</p> <p>6 <u>immobilised</u> antibodies in, large / small, window ;</p> <p>7 urine diffuses up strip ;</p> <p>8 flows past coloured mobile antibodies ;</p> <p>9 HCG / human chorionic gonadotrophin, is <u>antigen</u> ;</p> <p>10 Z (urine) contains HCG / X no HCG in urine ; <i>allow ecf mp 2 A pregnancy hormone</i></p> <p>11 HCG binds to coloured mobile antibodies ;</p> <p>12 complex / AW, moves up strip ;</p> <p>13 complex / AW, binds to (immobilised) antibodies in first window (gives coloured line) ;</p> <p>14 (no HCG) mobile antibodies remain unbound ;</p> <p>15 ref. to no complex therefore no, binding (in large window) / coloured line ;</p> <p>16 unbound mobile antibodies form, second coloured line / line in small window ;</p> <p>17 AVP ; not all coloured mobile antibodies bind HCG so will form second line second line of immobilised antibodies are anti-coloured mobile antibodies</p>	<p>max 8</p> <p>1</p> <p>QWC – legible text with accurate spelling, punctuation and grammar</p> <p>[Total: 18]</p>

Question	Expected Answers	Marks
4 (a) (i)	optimum between optima for psychrophiles and mesophiles ; range begins after -5°C - 0°C and stops at 40°C or below ;	2
(ii)	lower temperatures decreases fluidity of membranes / AW ; higher proportion (of unsaturated fatty acids) increases fluidity / AW ; (owing to) 'kinks' in fatty acid tails / AW ; (owing to) presence of double bonds (in hydrocarbon chain) ;	max 2
(b) (i)	<i>justified</i> <i>E. coli</i> 35 degree spread ; A approx 30 – 35 degrees spread for <i>A. tumefaciens</i> 37 / <i>P. fluorescens</i> 36 A most have (approx) spread except <i>M. tuberculosis</i> (only 11 degree spread) all have / use of comparison data for, optimum nearer to maximum ; <i>E. coli</i> 9°C v 26°C / <i>A. tumefaciens</i> 10°C v 27°C / <i>P. fluorescens</i> 15°C v 21°C <i>M. tuberculosis</i> 5°C v 6°C <i>not justified</i> <i>M. tuberculosis</i> spread over 11 degree spread ; A <i>A. tumefaciens</i> 37 degree spread / <i>P. fluorescens</i> 36 degree spread, greater than 35 degree spread	
(ii)	<i>justified</i> <i>E. coli</i> / <i>P. fluorescens</i> , have range similar to, species B / mesophile on Fig 4.1 ; any one valid statement about <i>A. tumefaciens</i> as a psychrotroph ; e.g. grows at lower temperatures than <i>E. coli</i> / <i>P. fluorescens</i> / mesophiles not able to grow below 0 °C has higher optimum growth temperature than psychrophiles has lower optimum than mesophiles / <i>E. coli</i> can't grow above 37°C A data quotes <i>not justified</i> <i>A. tumefaciens</i> grows at 37 °C, whereas (most) psychrotrophs can't ; <i>P. fluorescens</i> has a lower optimum growth temperature than <i>A. tumefaciens</i> ; A mesophile data quotes e.g mesophiles have a minimum temperature of 10°C degrees whereas <i>P. fluorescens</i> only 4 °C	
(iii)	<i>justified</i> minimum growth temperature, higher than others / 31°C compared to one other ; <i>not justified</i> optimum / maximum, growth temperatures similar to, mesophiles / <i>E. coli</i> ; A ora data quotes as to why it cannot be a thermophile pathogenic but thermophiles unlikely to be human pathogens ;	

Question	Expected Answers	Marks
4 cont.		
(iv)	<p><i>justified</i> (Fig. 4.1 shows) compared to others, low rate of growth at lower temperatures / only one growing at low temperatures / AW ;</p> <p><i>not justified</i> psychrotrophs show better growth rate at nearer to psychrophile maximum temperatures ;</p>	
(v)	<p><i>justified</i> temperature range of growth outside, body temperature / 37 °C ; grow well, in fridge temperatures / around 5 °C ;</p> <p><i>not justified</i> low growth rate in fridge temperatures, so unlikely to cause problems (in short term) ;</p>	
(vi)	<p><i>justified</i> body temperature 37 °C, thermophiles / hyperthermophiles, do not survive / slow growth / no growth, at this temperature ; unlikely to, reproduce / increase in numbers, and cause, illness / disease ;</p> <p><i>not justified</i> still grows at body temperature therefore capable of causing disease ; hot tubs / AW, source of infection ; <i>M. tuberculosis</i> is a pathogen and a thermophile ;</p>	max 10
(c)	<p><i>deep sea</i> act as <u>producers</u> ; provide initial input of energy into ecosystems, may ultimately benefit humans / AW ;</p> <p><i>compost heaps</i> act as decomposers ; heat generated does not, kill / inhibit, allows decomposition / AW ;</p> <p><i>general</i> allow, industrial / commercial / AW, processes to be more, productive / efficient ; (as) can run at higher temperatures ; reduces problems caused by overheating ; enzymes (from thermophiles) can be used in high temperature processes ; example of above, e.g. washing powders ; heat stable, proteins / enzymes / named enzyme ; do not denature at high temperatures ; detail of above e.g. extra bonds, protective molecules providing information ; provides knowledge to scientists re. challenges overcome in, metabolism / nutrient uptake / membrane structure etc / AW ; AVP ; e.g. details of Taq polymerase</p>	max 5

[Total: 19]

Question	Expected Answers	Marks
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- 5 (a)** *1 mark each correct production process ;
1 further mark for each correct design feature, if production process correct ;*

operational feature	production process	design feature
oxygen is supplied to enable aerobic respiration to occur	B ;	B / L ;
environmental conditions are constantly monitored so that they are maintained at the optimum	M ;	I ;
small volumes of lactose are periodically added	P ;	C ;
controlled venting of waste gases avoids pressure build-up and allows the culture to circulate	M ;	H ;
the excess heat generated by respiration and by the motor-driven stirrer is removed	P ;	E ;
ammonia is added as a source of nitrogen	M ;	L ;
nutrients are continuously added at a constant rate	M ;	J ;

max 7

- (b)** non-corrosive ;
non-reactive / inert ;
do not impart flavours ;
smooth surfaces easy to clean ;
smooth surfaces reduces contamination / AW ;
strength to resist pressure build-up / AW ;
easily shaped / AW ;
long lasting / durable / AW ;
easily modified (to incorporate latest features) ;
temperature control simple to achieve ;
allows larger fermenters (than other materials) ;

max 4

- (c)** organism / fungus / *Fusarium*, is the product / is mycoprotein / is eaten ;
may affect, flavour / taste ;
ref. to RNA toxic / AW ;
Penicillium / fungus, is not the product / produces, penicillin / antibiotic ;
no RNA, in penicillin / antibiotic / product ;

max 2**[Total: 13]**

Question	Expected Answers	Marks
6 (a)	chymosin / rennet / rennin ; R renin	1
(b)	(pH) 3.5 – 4.5 ; A <i>any value within the range</i>	1
(c)	hops ;	1
(d)	recycled to inoculate next batch / AW ; used as cattle food / AW ; A animal feed used for, yeast extract / Marmite ;	max 1
(e)	enzyme ; protease / papain / bromelain ; digested / AW, protein / fibrous tissue / tendons / connective tissue ; made meat, more palatable / less chewy / AW ;	2

[Total: 6]

2805/05 Mammalian Physiology and Behaviour

Question	Expected Answers	Marks
1 (a) (i)	transmit <u>vibrations</u> from, tympanic membrane / eardrum, to, oval window / D ; <i>ignore sound waves</i>	1
(ii)	<u>oval</u> window ; <i>any one from</i> <u>amplification</u> (of vibrations of, tympanic membrane / eardrum) <i>ecf sound waves</i> or transmission (of vibrations) into, perilymph / <u>fluid</u> in cochlea or inner ear ; <i>ignore endolymph</i>	2
(b) 1	<u>large</u> difference between, human / cow / elephant, and , bat / porpoise / whale ;	
2	comparative figs + units ; <i>any one from</i>	
3	bat / porpoise / whale, use, echolocation / sonar / AW ; <i>idea of navigation</i>	
4	human / cow / elephant rely on other senses / ora ;	
5	cochlear structure ; e.g. size / adaptation	3
(c) (i) 1.	<u>both</u> groups <u>vision</u> deteriorates / decreases ; <i>ignore changes</i>	
2.	Macugen group <u>vision</u> deteriorates at slower (rate) / ora ; <i>this point subsumes point 1</i>	
3.	comparative figs ;	
4.	decrease in vision levels off for <u>both</u> groups ;	3 max
(ii) 1.	negative effect on VEGF ;	
2.	reduces <u>growth</u> of (new) blood vessels ; R decreases number of blood vessels	
3.	reduces, degeneration / breakdown, of (new) blood vessels ;	
4.	reduces <u>leakage</u> (from blood vessels) ;	
5.	AVP ; e.g. decreases blood pressure	3 max

[Total: 12]

Question	Expected Answers	Marks
2 (a)	(pepsinogen) chief / zymogen / peptic ; (hydrochloric acid) oxyntic / parietal ;	2
(b)	1 hydrogen bonds ; A H bond 2 between, polar R groups / polarised H and O atoms ; 3 (di)sulphide, bonds / bridges ; A sulphur bridges 4 between, S-H groups / S-S atoms / cysteine molecules or are covalent bonds ; 5 ionic bonds ; 6 between, amine and carboxyl groups / (positive and negative) charged groups ; 7 hydrophobic interactions ; 8 between non-polar groups ; 9 Van der Waals forces ; <i>if any of marking points 2, 4, 6 or 8 are not achieved, mark to max 3</i>	5 max
(c)	<i>ignore ref to nervous control control</i> 1 food <u>in contact</u> with, stomach mucosa / stomach lining / stomach wall ; 2 gastrin, released / secreted, <u>into blood</u> ; 3 stimulate gastric glands / gastric juice secreted ; 4 negative feedback ; <i>advantage any one from</i> 5 gastric juice only released when food is in stomach / ora ; 6 stops autodigestion / AW ; 7 reduces risk of ulcer ;	2 max 3 max
(d) (i)	comparison / to get baseline figures / AW ; qualified	R 'control' if not 1

- (ii) 1. group A / meal with no, fat / oil, empties fastest
or group B / with fat, has slowest emptying time ;
2. lipase reduces emptying time ;
3. lipase digests fats ;
4. into fatty acids and glycerol ;
5. small(er) molecules leave stomach quicker / AW ;
6. AVP ; e.g. no emulsification therefore lipase action slowed **4 max**
- (e) 1 food provided leads to salivation ;
- 2 innate response / not learned ;
- 3 extra detail ; e.g. sight/ smell → CNS → salivary glands
- 4 (food is) unconditioned stimulus ;
- 5 bell accompanies food ;
- 6 repetition ;
- 7 bell leads to salivation ;
- 8 (bell is) conditioned stimulus ;
- 9 (salivation is) conditioned, response / reflex ;
- 10 AVP ; e.g. classical conditioning
associative learning **5 max**

[Total: 20]

Question	Expected Answers	Marks
3 (a)	<p>1 Haversian system ;</p> <p>2 osteoblasts, secrete / synthesise, tropocollagen ;</p> <p>3 fibrous protein ;</p> <p>4 ref. collagen (fibres) ;</p> <p>5 tensile strength ;</p> <p>6 calcium phosphate deposited ;</p> <p>7 compressive strength ;</p> <p>8 matrix (qualified) ;</p> <p>9 (osteoblasts become) osteocytes ; <i>ecf if mark point 2 states osteoclast</i></p> <p>10 ref. to proportion of components ; e.g. 30% collagen, 60% calcium phosphate (and 10% osteocytes)</p> <p>11 osteocytes maintain contact with each other ;</p> <p>12 receive, nutrients / oxygen, from (central) canal or canal removes waste ;</p> <p>13 osteoclasts break down bone ;</p> <p>14 ref. balance between osteoblasts and osteoclasts ; <i>ecf</i></p> <p>15 AVP ; e.g. ref. calcitonin / parathormone ossification</p>	7 max
	<p>QWC – clear well organised using specialist terms;</p> <p><i>must include at least three of the highlighted words</i></p>	1
(b)	<u>degenerative</u> (disease) ;	1

(c) *describe (any two from)*

- 1 bone density / T-score, constant until 45 / (shows) decrease after 45 ;
- 2 bone density / T-score, normal up to 53 ;
- 3 increased risk of osteoporosis from 53 / significant change in T-score between 45 and 65 ;
- 4 osteoporosis more likely from 65 onwards ;
3 max

explain (any two from)

- 5 ref. menopause ;
- 6 ref. drop in oestrogen ;
- 7 more osteoclast activity ;
- 8 lack of weight bearing exercise ;
- 9 less calcium intake ;
- 10 less vitamin D ;
3 max

4 max

(d) (i) *any two from*
NSAIDs / aspirin / ibuprofen ;

exercise ;

weight loss ;

steroid injections ;

ice packs / warmth ;

glucosamine ;

synovial fluid replacement ;

injections to stimulate chondrocytes ;

removal of damaged cartilage ;

2 max

(ii) less / no, pain ;

increased mobility ;

less / no, drugs ;

AVP ; e.g. long term solution

alternative mark scheme

metal – strong ;

plastic – flexible ;

inert – no immune response ;

2 max

[Total:17]

Question	Expected Answers	Marks
4 (a)	<i>(no credit for the structure of the ANS)</i> <i>(general)</i> 1 SNS – ref. stimulatory effect / flight or fight ; 2 SNS – nor adrenaline (as neurotransmitter) ; 3 PNS – ref. usually inhibitory effect / rest and digest ; 4 PNS – acetylcholine (as neurotransmitter) ; <i>(heart)</i> 5 SNS – increase heart rate / ora for PNS ; 6 SNS – increase force of contraction / ora for PNS ; <i>(digestive system)</i> 7 SNS – reduce peristalsis / close sphincters / ora for PNS ; 8 SNS – reduce rate of enzyme secretion / ora for PNS ; <i>(iris)</i> 9 SNS – radial muscles contract / ora for PNS ; 10 SNS – pupil gets bigger / ora for PNS ;	6 max
	<i>if systems completely wrong way round mark to max 5</i>	
	QWC – legible text with accurate spelling, punctuation and grammar;	1
(b) (i)	36% ; ; <i>1 mark for correct working but wrong answer</i>	2
(ii)	1. APP / (beta) amyloid precursor protein ; 2. found in (plasma) <u>membranes</u> of all cells ; 3. enzyme cuts off part of APP ; 4. releasing, beta amyloid / A β ; 5. peptide of 40 amino acids ; 6. plaques due to <u>more</u> A β / A β deposited at faster rate ; 7. or <u>abnormal</u> A β / A β_{42} ; 8. plaques due to <u>abnormal metabolism</u> of APP ; 9. ref. inherited Alzheimer's and high conc. of A β_{42} ; 10. APO $_{\epsilon}$ / ϵ 4 <u>allele</u> ;	5 max

[Total:14]

(d) *without sterols/ P*

- 1 blood cholesterol concentration has little change / AW ; 1 mark

with sterols / Q

- 2 plant sterols cause a lowering of (blood) cholesterol (concentration) ;
- 3 (blood) cholesterol (concentration), decreases during first 12 months / has a sharp decrease during first 3 months ;
- 4 (blood) cholesterol (concentration) increases again, after 12 months / when sterols are no longer given ;
- 5 after, just over 2 months / 2.3 months, (blood) cholesterol (concentration) was within the recommended range ;
- 6 (blood) cholesterol (concentration) was above recommended range again over one month after stopping taking the sterols ;
- 7 comparative figs ; *between P and Q or within Q* 3 max 4 max

[Total:13]

Question	Expected Answers	Marks
6 (a) (i)	<u>methane</u> ;	1
(ii)	greenhouse (effect) / global warming ; <i>ignore ozone layer</i> detail of how methane does this ; e.g. reflects or absorbs, heat / LW, radiation	2 max
(iii)	mouth / belching / anus ;	1
(b) (i)	<u>cellulose</u> ; <i>1 mark</i> polymer of β glucose / AW ; linked by, glycosidic bonds / condensation reactions ; alternate, bonds / molecules, inverted ; ref. H bonding between adjacent cellulose molecules ; <i>2 max</i>	3
(ii)	1. large intestine not specialised for absorption ; 2. digestion occurs after ileum ; 3. ileum specialised for absorption / most absorption in ileum ; 4. less nutrients obtained from food ; 5. (therefore) less energy ; 6. have to eat, <u>more</u> food / for longer ; 7. AVP ; e.g. prone to colic intestinal torsion correct ref to coprophagia	2 max
(iii)	against concentration gradient ; use of, ATP / energy ; carrier protein / transport protein / protein pumps / ATPase ; change in, tertiary structure / 3D shape ;	2 max

(c) (i) ligaments / muscles ;

1

(ii) discs / cartilage ;

1

(d) pentadactyl ;

1

[Total:14]

2806/01 Unifying Concepts in Biology - Written Paper

Question	Expected Answers	Marks
1 (a)	lipid / fat / phospholipid ; Ignore cholesterol Schwann cell ; A glial cell cell, wraps / encircles / coils round, (neurone / axon) ; Ignore surrounds ref to node(s) of Ranvier ;	2 max
(b)	1 saltatory conduction can't happen / impulses don't jump (from node to node) ; 2 reason for this ref. ion movements ; 3 reason for this ref. length of local circuits ; 4 <u>impulses</u> / <u>action potentials</u> , slower ; 5 less / no, control of muscles / AW ; 6 reduced / slower, reaction (to stimuli) ; R prevents / no, reaction 7 AVP ; idea of differential damage to neurons, ref. reflex pathways	4 max
(c)	1 (conventional vaccine is) inactive / attenuated / dead / fragment of, pathogen ; 2 protein / glycoprotein / antigen, from pathogen ; 3 stimulates (primary) immune response / AW ; 4 memory cells / faster secondary response ; 5 antibody, enables destruction by phagocyte / destroys pathogen ;	3 max
(d)	blood / lymph, sample ; separate white blood cells ; AVP ; detail of technique, e.g. centrifuge, immuno-absorbent / monoclonal antibody, column	2 max
(e)	damages / mutates, DNA / genes / genetic material ; detail of mutation ; problem with, transcription / translation ; altered / absent, proteins / enzymes / receptors ; R denatured	2 max
(f)	not all T cells, are myelin-specific / attack myelin ; other / different, T cells are not attacked (by immune system) ; ORA because they have different, antigens / receptors / don't have myelin receptor ; ORA	2 max

[Total: 15]

Question	Expected Answers	Marks
2 (a)	<p>A glycolysis ;</p> <p>B Calvin cycle / dark or light independent reaction ;</p> <p>C Krebs / TCA / citric acid, cycle ;</p>	3
(b)	<p>synthesis / building up / making more complex molecule from smaller units ;</p> <p>e.g. from diagram ; glucose → starch / cellulose / polysaccharide,</p> <p>amino acids → proteins,</p> <p>glycerol + fatty acids → lipids,</p> <p>triose phosphate → RuBP</p> <p>triose phosphate → hexose phosphate</p> <p>NH₃ + α ketoglutaric → glutamic acid</p> <p>(Wrong definition, anabolic example = 0 marks R con. Wong definition, catabolic e.g. = 1 mark, ecf. Right definition, wrong e.g. = 1 mark. Example must be from diagram.)</p>	2
(c)	<p><i>Max 8 if answer only covers two of the groups. Only credit "condensation" once. Only credit "polymerised" once.</i></p> <p>1 cellulose for cell wall ;</p> <p>2 RuBP carboxylated / AW ;</p> <p>3 glycerate phosphate → triose phosphate ;</p> <p>4 <u>two</u> triose phosphates → hexose phosphate ;</p> <p>5 <u>beta</u> glucose ;</p> <p>6 polymerised / condensation / glycosidic bonds ;</p> <p>7 phospholipids for cell membranes ;</p> <p>8 triose phosphate → glycerol ;</p> <p>9 <u>link reaction</u> ;</p> <p>10 acetyl, groups / coA → fatty acids ;</p> <p>11 add phosphate ;</p> <p>12 detail ; e.g. source of phosphate group / ref. cholesterol / ref. glycoprotein or glycolipid</p> <p>13 condensation / ester / phosphoester bonds ;</p> <p>14 proteins, for cytoplasm / membranes ;</p> <p>15 α-ketoglutaric acid → glutamic acid / amino acid ;</p> <p>16 add ammonia / source of N ;</p> <p>17 <u>transamination</u> ;</p> <p>18 <u>protein synthesis</u> / <u>translation</u> ;</p> <p>19 detail ; e.g. at ribosome or RER / ref DNA / ref. primary structure</p> <p>20 polymerised / condensation / peptide bonds / AW ;</p>	9 max
	QWC – legible text with accurate spelling, punctuation and grammar	1

[Total: 15]

Question	Expected Answers	Marks
3 (a) (i)	(different) genes / genetic ; gene detail e.g. mutations / alleles / polygenes / selectively bred varieties / meiosis ; (different) environment / AW ; detail of environmental factor ; e.g. climate / soil / light different, age / ripeness ; (penalize interspecific e.g. once)	3 max
(ii)	<i>bars to show</i> bilberry 310 ; radish 35.5 ; A 31 – 39 (If no bars max 1 for both correct figs calculated)	2
(b)	anthocyanin poorly absorbed from gut because ; ref. different units ; ref. units vary by factor of 1000 ; very little (anthocyanin), enters / AW, blood / plasma ; little / less, enters / AW, urine ;	3 max
(c) (i)	chokeberry ; lower concentration of extract needed (to reduce colon cancer cell growth) ; A less 9 times, better / more powerful ;	2 max
(ii)	1 (cell cycle) genes control, cell division / mitosis ; R cell growth 2 (cancer involves) cell, cycle / division / mitosis, being out of control / too fast ; 3 ref. oncogenes ; A ras 4 ref. tumour suppressor genes ; A p53 5 (need to), stop / slow, cell division ; 6 switch on genes that, regulate / stop, division ; 7 switch off genes that trigger division ;	4 max

[Total: 14]

Question	Expected Answers	Marks
4 (a) (i)	comparable ; A implication from use of comparative words between years ; proportions / % sightings per county, remain fairly constant year on year ; (despite) fluctuation in overall number reported / AW ;	2 max
(ii)	number of sightings decreased ; from 464 to 271 / by 193 / nearly halved ; % of (total) sightings increased ; from 4.95 % to 9.58 % / by 4.63 % / nearly doubled ;	3 max
(iii)	<i>advantage</i> follow breeding cycle / see how well they, bred / reproduced / survived ; <i>disadvantage</i> 1998 – 2002 cycle, could be unusually, good / bad, for stag beetles ; doesn't monitor stag beetle population in, intervening 3 years / e.g. of year;	2 max
(b) (i)	<i>Crataegus</i> / <i>Fraxinus</i> / <i>Malus</i> / <i>Prunus</i> ;	1
(ii)	<i>corone</i> / <i>domesticus</i> / <i>pica</i> / <i>vulpes</i> ; A if genus name given as well	1
(iii)	31 / 68×100 ; 46 (%) ;	2
(iv)	have similar, characteristics / provide similar habitat ; detail, e.g. similar, scent / taste / chemical make-up / texture, (of wood) ; beetles adapted to these conditions ; R suited to detail, e.g. larvae have right digestive enzymes / females attracted to scent ;	2 max
(c) (i)	fight off other males ; (be more) attractive to females ; defend against / scare off, predators ;	1 max
(ii)	similar DNA means, closely-related / share common ancestor ; ref. mutation / change in DNA ; measure of time elapsed since species divergence / idea of molecular clock ;	2 max

[Total: 16]

2806/03 Practical Examination

Planning Exercise

The mark scheme for the planning exercise is set out on page 4 and 5. The marking points **A** to **U** follow the coursework descriptors for Skill P.

Indicate on the plans where the marking points are met by using a tick and an appropriate letter. There are 14 marking points for aspects of the plan and two marks for quality of written communication (QWC).

Practical Test

Concentrations for minimum of range for **G** on the Planning Exercise:

1 $\mu\text{mol dm}^{-3}$	346/300 $\mu\text{g dm}^{-3}$
0.001 mmol dm^{-3}	0.346/0.3 mg dm^{-3}
0.000001 mol dm^{-3}	0.0003 g dm^{-3}
0.003% of stock solution	
3 / 4 ppm or parts per million	

A2 Biology. Planning exercise

Checking Point	Descriptor	The candidate
A	P.1a	Plans a procedure that involves exposing grains to different concentrations of GA ₃ for minimum of, 12 hours / overnight, and testing the amylase activity ;
B	P.1a	Gives a prediction about the effect of increasing gibberellin concentration on amylase, activity / quantity (in endosperm) ;
C	P.1b	Selects suitable equipment - measuring volumes, a suitable reagent, knife / pestle and mortar / AW for cutting or grinding grains ; R potassium iodide
D	P.3a	States that gibberellin is a plant, hormone / growth regulator, that stimulates production of amylase ; A GA ₃ regulates growth
E	P.3a	Identifies at least 2 key factors to control e.g. volume of gibberellin solution, mass of grain, age / type of grains, time left in gibberellin, temperature ;
F	P.3b	Decides on an appropriate number of measurements to take: minimum of five different GA ₃ concentrations which may include 0 mg dm ⁻³ ;
G	P.3b	Decides on a suitable range of gibberellin concentrations to start at water or 1 µmol dm ⁻³ / 0.003% of stock ;
H	P.3b	Describes a way to obtain reliable results by using a minimum of three samples of grain for each concentration ; R three grains
I	P.5a	Uses appropriate A2 scientific knowledge and understanding in developing a plan, e.g. the genes are switched on / transcribed, receptors for gibberellin, secondary messengers, provide respiratory substrate for named use ;
J	P.5a	Uses preliminary work or previous practical work in developing a plan ;
K	P.5a	Refers to a hazard and an appropriate precaution, e.g. sharp implements, Benedict's solution, iodine solution, GA ₃ ;
L*	P.5b	<i>Gives a clear account, logically presented with accurate use of scientific vocabulary (QWC) ;</i>
M	P.5b	Describes way(s) of obtaining precise results e.g. measuring the zones of clearance to the nearest mm <i>or</i> mm ² / reducing sugars present with appropriate quantitative test / use of colorimeter / narrowing time intervals near end point ; R 'use a ruler' without ref to nearest mm in method
N	P.7a	Uses relevant information from any two written sources , e.g. class notes / text book / web site, etc ; <i>must be cited in plan</i>
O	P.7a	Shows how results are to be presented in a table including correct use of units for gibberellin and amylase activity in terms of starch / [reducing sugar] ;
P*	P.7a	<i>Uses spelling, punctuation and grammar accurately (QWC) ;</i>
Q	P.7a	Uses AS knowledge and understanding, e.g. <u>hydrolysis</u> of starch to maltose <i>or</i> glucose <i>or</i> reducing sugar / protein synthesis / enzyme properties ;
R	P.7b	Shows how results are to be presented on a summary graph of amylase activity as determined in plan against gibberellin concentration with units ;
S	P.7b	Comments on precision, e.g. problems with quantifying starch disappearance or reducing sugar appearance ; this could be a calibration graph

T	P.7b	Comments on reliability, e.g. explains need to run replicates of each set of conditions wrf to anomalies, explains how to deal with anomalous results ;
U	P.7b	Comments on validity, e.g. endogenous gibberellin production (embryo) by discarding embryos <i>or</i> using a control with water, boiled seeds as a control to make sure no non-enzymic breakdown ;

Point mark up to **14** by placing letters **A** to **U** **excluding L and P** in the margin at appropriate points. Then award **1** mark for each of **L** and **P** (QWC).

Total: 16

Example of table expected in Q. 1 (a)

sample	respiratory substrate	rate of respiration / drops per minute	volume of gas in syringe after three minutes / cm ³
A	fructose	17	5.65
B	glucose	14	4.70
C	galactose	6	1.25
D	maltose	14	4.40
E	lactose	3	0.70
F	none - water	4	0.75

Question	Expected Answers	Marks
-----------------	-------------------------	--------------

- | | | |
|-----|--|--------------|
| 1 | <p>(a) table format with, column / row headings ;
 <i>sample / type of sugar, drop rate, extra observation</i>
 A qualitative statement(s) for last parameter A split tables
 units in the table headings not in the body of the table ;
 observation / measurement, other than drops recorded ; R TTC observations
 type of sugar in column to left of results ; <i>ignore syringe letter</i>
 highest number of drops for, glucose / fructose / maltose ;
 at least one repeat for each sugar ;
 means calculated and expressed as whole numbers or to one decimal place ;</p> | 7 |
| (b) | <p>carbon dioxide / CO₂, produced ;
 accumulates at the top / gas cannot escape ;
 increases <u>pressure</u> (in, syringe / yeast suspension) ;
 ref to, decarboxylation ; A CO₂ produced in, Krebs cycle / link reaction ;
 carbon dioxide / CO₂, comes out of solution / diffuses out of cells ;</p> | 3 max |
| (c) | <p>1 identifies, suspension(s) / sugar(s) / sample(s), with most, droplets / respiration ;
 A most gas / CO₂ or least suspension left in syringe
 2 identifies, suspension(s) / sugar(s) / sample(s), with, no / few, droplets / respiration ;
 A least gas / CO₂ or most suspension left in syringe
 3 results for at least two, sugars / samples, quoted ;
 4 ref to any change in drop rate over the time period ; A rate did not change over time
 5 ref to, another, observation / measurement / comment ;
 6 ref to any <u>anomalous</u> results or lack of them ;</p> | 4 max |

- (d) 1 **respiration** linked to different **named** sugars ; **A** minimum of two sugars
 2 correct ref to, size and uptake / metabolism in glycolysis of, **fructose / glucose** ;
 3 **hydrolysis** of maltose ;
 4 **maltose** broken down to glucose ;
 5 (by) **maltase** ;
 6 ref to **glycosidic bond(s)** ;
 7 **enzyme specificity** ;
 8 ref to **active site** ;
 9 **complementary** shape of substrate ;
 10 no, enzyme for hydrolysing **lactose / lactase** ;
 11 (facilitated) diffusion through cell surface membrane ;
 12 carrier / channel / transport, **proteins** for sugars ;
 13 ref to, *idea that* **genes** for enzymes for, galactose / lactose, not switched on ;
 14 no, substrate / sugar (provided) for **F** ;
- 15 **AVP** ;
 16 **AVP** ;
 e.g. as yeast cannot use lactose, may not be any enzyme specific for galactose ;
 e.g. hydrolases / enzymes, for hydrolysing disaccharides, in cell wall / outside cell surface membrane ;
 e.g. ref to sugars having same, molarity / molar concentration
 e.g. maltose gives twice as much glucose as suspension **B**
 e.g. no gene for, lactase / galactose isomerase
 e.g. ref to respiratory substrates stored in yeast cells / AW (may see with **F**)

8 max

- (e) *comments on*
 colour of each suspension recorded ;
 variation in, colours / shades, in different suspensions ;
 comment on bubbling / frothing ;
 settling / precipitation ;
 any other relevant observation ;

3 max

- (f) 1 TTC has been reduced in correct context ; **A** oxidation of sugars
 2 intensity of colour related to rate of, respiration / reduction ;
 3 ref to, NAD / FAD ;
 4 coenzyme(s) ; **A** NAD / FAD / coenzyme A *in correct context*
 5 dehydrogenation / dehydrogenases ;
 6 ref to glycolysis (in cytosol) in context of reduction ;
 7 decarboxylation / decarboxylases ;
 8 ref to, link reaction / Krebs cycle (in mitochondria), in context of reduction ;
 9 ref to oxidative phosphorylation / electron transport chain ;
 10 ref to any specific reaction catalysed by a dehydrogenase ;
 11 **AVP** ; **A** any logical deduction from results in **(e)** e.g. H^+ from water

4 max

- (g) 1 **control** (to observe effect without any added respiratory substrate) ;
2 comparison to see how much, respiration / reduction, has occurred ;
3 ref to, **colour / appearance / activity**, of suspension **F** / yeast and water ;
4 respiratory substrate / glucose / AW, (stored) **inside yeast cells** ;
5 therefore explains same colour with sugars that cannot be utilised by yeast ;
6 without **F** would think yeast can respire galactose and lactose (but slowly) ;
7 AVP ; **A** any logical deduction from results in **(e)**
e.g. ref to number of **drops** **A** no drops / few drops / actual number of drops

2 max

<i>reliability</i>	R	only one sample per sugar / no repeats / should have been repeated ;	ref to at least three , syringes / suspensions, per sugar and calculate, mean/ standard deviation / standard error ;
<i>accuracy / precision of results taking</i>	A	drop size may vary ; ref to colour(s) ; A subjectivity / not quantitative ref to stated problem with syringe with yeast ; e.g. bubbles R 'not precise / accurate' unqualified	ref to another method of determining rate of respiration in yeast (likely to give more accurate / precise results) ; A measuring cylinder / gas syringe colour comparator / colour standards R colorimeter e.g. burette / syringe with smaller gradations ;
<i>validity</i>	V	with time yeast <u>cells</u> are lost ; decreases volume of, yeast / sugar ; loss of CO ₂ from top of syringe ; less carbon dioxide is produced ;	<i>accept</i> another design of respirometer ; sealant around plunger ;
<i>time</i>	T	(idea that) not left for long enough to obtain a regular rate / rate changes over time ; set up at different times ;	carry out over stated time / AW ; draw graph of results over time ; set up separately / staggered start ;
<i>substrates</i>	S	few / only 5, respiratory substrates ; only one (molar) concentration ; over time substrate is used up ;	ref to at least one named appropriate substrate that could be used ; <i>sucrose / starch / fat / protein</i> ref to provide substrate in excess ;
<i>other variables</i>	O	temperature not controlled ; pH not controlled ;	ref to different design where yeast could be in thermostatically-controlled water bath ; use a buffer solution ;
<i>biology - respiration</i>	B	ref to the type of respiration (aerobic / anaerobic) ; stirring introduces oxygen so likely to be aerobic ; over time oxygen concentration falls and respiration may become anaerobic ; carbon dioxide is produced in both types of respiration ; ref to decarboxylation of pyruvate ; ref to ethanol ; ref to decarboxylation during Krebs cycle ;	

8 max

[Total: max 30]

Question	Expected Answers	Marks
----------	------------------	-------

- 2 (a) region **A** islet of Langerhans ;
 region **B** artery / artery wall / tunica media / muscular wall / elastic wall ;
 region **C** lumen (of artery) ;
A ecf if type blood vessel / type of blood vessel given for region **B** **3**

- (b) *If regions not identifiable, mark quality only to max 2*

quality of the drawing

clear, continuous lines ; *ignore shading for nuclei*

no more than 5 nuclei in each region ;

exocrine tissue / area around A

basal nuclei all in same relative position around edge of cells ;

all cells touching ; **R** tubules

endocrine tissue / region A

cells irregular shapes with gaps ;

nuclei proportionally larger than in other area ;

three or more nucleoli in at least one nucleus ;

annotations - comparative comments on

	islet tissue	exocrine tissue
cytoplasm	pink light(er)	purple / blue / red dark(er) ;
nucleus	central / darker more nucleoli greater proportion of cell	basal / lighter fewer nucleoli smaller proportion of cell ;
organisation of cells	randomly / not in clusters gaps	in clusters / AW no gaps ;

10

- (c) *do not credit 'opposite effect(s)' without full role*

β cells, secrete / release / produce, insulin in response to high glucose concentration ;

A level / blood sugar

stimulates, uptake of glucose / conversion of glucose to glycogen ;

A other function

decreases concentration of blood glucose / has hypoglycaemic effect ;

α cells, secrete / release / produce, glucagon in response to low glucose concentration ;

stimulates conversion of glycogen to glucose ;

increases concentration of blood glucose / has hyperglycaemic effect ;

R insulin / glucagon, converts / changes, glucose (as if acting as an enzyme)

6

[Total: max 14]

Grade Thresholds

Advanced GCE Biology 3881 7881
June 2009 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
2801	Raw	60	45	41	37	33	29	0
	UMS	90	72	63	54	45	36	0
2802	Raw	60	44	39	34	29	25	0
	UMS	90	72	63	54	45	36	0
2803A	Raw	120	98	88	78	69	60	0
	UMS	120	96	84	72	60	48	0
2803B	Raw	120	98	88	78	69	60	0
	UMS	120	96	84	72	60	48	0
2803C	Raw	120	95	87	79	71	64	0
	UMS	120	96	84	72	60	48	0
2804	Raw	90	62	55	48	42	36	0
	UMS	90	72	63	54	45	36	0
2805A	Raw	90	49	42	36	30	24	0
	UMS	90	72	63	54	45	36	0
2805B	Raw	90	59	52	45	38	32	0
	UMS	90	72	63	54	45	36	0
2805C	Raw	90	63	57	52	47	42	0
	UMS	90	72	63	54	45	36	0
2805D	Raw	90	66	60	54	48	42	0
	UMS	90	72	63	54	45	36	0
2805E	Raw	90	66	59	53	47	41	0
	UMS	90	72	63	54	45	36	0
2806A	Raw	120	87	79	71	63	55	0
	UMS	120	96	84	72	60	48	0
2806B	Raw	120	87	79	71	63	55	0
	UMS	120	96	84	72	60	48	0
2806C	Raw	120	85	77	69	61	53	0
	UMS	120	96	84	72	60	48	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
3881	300	240	210	180	150	120	0
7881	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
3881	25.0	46.9	68.1	85.4	97.1	100.0	3428
7881	27.3	49.5	69.6	86.2	96.7	100.0	15747

19175 candidates aggregated this series

For a description of how UMS marks are calculated see:

http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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