

G10-REVISION BOOKLET-MARK SCHEME
CONCEPT-CHANGE
BIOCHEMISTRY AND ENZYMES

1 (a)	(lemon juice is) acid(ic);	[1]
(b)	no colour change / less colour change in dish 2 ;	Max [1]
(c) (I)	lemon juice is acidic ; denature enzyme ; browning does not happen ;	[3]
(ii)	<u>Method:</u> put apples in high or very low temperature ; <u>Result:</u> no or less colour change / not or less brown ; <u>Explanation:</u> high temperatures denature enzymes OR cold temperatures inactivate enzymes / stops enzyme activity ;	[3]
(d) (I)	<u>Comparative colour change</u> cut surface goes darker brown / greater colour change ; <u>Speed of reaction</u> cut surface turns brown more quickly ;	[2]
(ii)	cells separated and contents remain intact	[1]
		[Total: 11]

2.

(i)	Use of reducing sugar and starch test reagents only ; <i>reducing sugar test:</i> crush / mix with water / AW ; add Benedict's solution ; heat ; <i>starch test:</i> add iodine solution ; <i>Safety feature:</i> goggles / lab. coat AW / tongs / heat in water bath ;	[6]
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(ii)	<p><i>Observation for reducing sugar test:</i> to green / yellow / orange / red ;</p> <p><i>Observation for starch test:</i> to blue / black ;</p>	[2]
	<p><i>method:</i> two containers – one with banana, one with plantain / AW ; OR one container / choice chamber containing banana AND plantain / AW ;</p> <p><i>controlled variable:</i> idea of same time period / same mass fruit ;</p> <p><i>collecting results:</i> record number flies seen / find change in mass of banana and plantain AW ;</p> <p><i>conclusion:</i> if more flies in banana than plantain it is preferred fruit and vice versa / AW / larger loss in mass of preferred fruit and vice versa ;</p>	Max [3]

PHOTOSYNTHESIS

(a) (i)	<i>Independent variable</i> – (attachment / presence or absence of leaves;	[1]	
(ii)	to prevent / stop the evaporation (of water from the surface) / AW;	[1]	
(iii)	<i>Height of water in:</i> test-tube without leaves 65 mm and test-tube with leaves 51 mm;	[1]	Both measurements correct for one mark. A +/- 1mm Reject cm or inch values unless the units are changed [inches 2.5 and 2.0]
(iv)	<i>Description:</i> (test-tube) with leaves is less than without leaves Or without leaves is more; <i>Explanation :</i> transpiration / evaporation (of water from the leaves);	[2]	Accept with leaves has lost more water / without leaves has lost less water. explanation should relate to their description Ignore ref. to photosynthesis / respiration / growth / water uptake / water use.
(b) (i)	<i>distance moved by coloured water in</i> shoot without leaves 12 mm shoot with leaves 90 mm;	[1]	Both measurements correct for one mark. A +/- 1mm
(ii)	(yes) as (more) water taken up / absorbed in shoot <u>with</u> leaves / less water taken up by shoot <u>without</u> leaves; (so) the water in the test-tube is lower <u>with</u> leaves / water is higher in the test-tube <u>without</u> leaves / AW;	[2]	award both marks if explanation implies both ideas. A. water uptake faster in shoots with leaves. Ignore 'used or consumed water'. If No reject first mark but ecf for explanation if applied link.
(iii)	3 of: 1 idea of at least three temperatures tested; 2 suitable range of temperatures; 3 control variable (eg light / wind / height or volume of water / humidity); 4 method of measuring rate of water uptake; 5 Repeat for reliability;	[max 3]	Ignore how the temperature is being changed Accept 5°C–40°C If used 'hot and 'cold' aware of testing more than one temperature allow 1 mark for first 2 marking points. Accept alternative control variables – same age / type / species / same number of leaves. Need both time and mass / distance / height in shoot or test-tube. e.g. mass lost per unit time / time taken to reach given height in shoot / height reached after time/ fall in mass of water in test-tube per unit time. Ignore if 'repeat alone' needs qualification. Ignore repeat for accuracy.

(c) (i)	Axes – labelled with units and suitable scale; Size – occupies at least half the grid; Plot – points plotted accurately $\pm \frac{1}{2}$ small square; Line – connecting all plot points $\pm \frac{1}{2}$ small square;	[4]	<p>if axes reversed – reject A mark but continue marking ecf if correct for S,P and L</p> <p>x axis – time of day (using 24 h clock), y axis – mass lost / g – (see exemplars).</p> <p>Accept 1 error in plots. Plot points must not be larger than $\frac{1}{2}$ small square. Plots must be in correct time of Table 1.1 sequence [see exemplars].</p> <p>Accept point to point / smooth curve. R lines that are curved up or down unevenly between the points and thick lines / extrapolation more than 1 small square / bar charts. For bar charts and histogram allow A, S and P Max 3. Reject line of best fit.</p>
(c) (ii)	<i>description</i> – mass / weight loss occurs during the day / light or decreases / stops at night / in dark / AW; <i>explanation</i> – transpiration / water loss during the day or light or less water loss at night or darkness / AW; <i>reason for correct ref. to stomata opening / closing</i>	[3]	<p>Accept evaporation. Ignore ref. to absorption / use of water / growth / photosynthesis / respiration. It is important that transpiration is linked to day or ORA. Do not allow for the word 'transpiration' alone.</p> <p>Mass loss during the day by transpiration through stomata = 3 marks.</p>
(d)	G: epidermal cell; H: guard cell;	[2]	Allow epidermis / cuticle
(ii)	0.4 (mm);	[1]	Ignore working.
(iii)	0.4 x 0.4; 0.16 (mm^2);	[2]	<p>A ecf from (ii)</p> <p>Allow both marks for a correct answer without any working.</p>
(iv)	$\frac{12}{0.16}$ or $\frac{1}{0.16} \times 12$; 75;	[2]	<p>Allow both marks for a correct answer without any working. Answer must be a whole number. Answer in (i) is divided by answer in (iii). Accept ecf from (iii) instead of 0.16. Accept 11 stomata from (i) = 69. if 0.16 used. R 68.75 not a whole number.</p>
(v)	675000;	[1]	<p>A ecf from (iv) 621000 for 11 stomata or 618750 if use 68.75)</p>
		[Total: 27]	

Diffusion & Osmosis

1.

(i)	cell / it, has shrunk or is smaller / AW ; cell walls are indented / AW ; vacuole / AW is smaller ; gap developed (between wall and membrane) ;	2	<p>A cell / it, has become flaccid I shape / size, has changed unqualified</p> <p>A plasmolysis / gap between cell wall and protoplast A has one more chloroplast / AW ;</p>														
(ii)	<table border="1"> <tr> <td>diffusion</td> <td>active transport</td> </tr> <tr> <td>movement from high to low (solute) concentration / down a concentration gradient</td> <td>movement for low to high (solute) concentration / AW</td> </tr> <tr> <td>does not require a membrane</td> <td>does require a membrane</td> </tr> <tr> <td>no energy needed / passive process</td> <td>requires energy / active process / requires ATP</td> </tr> <tr> <td>occurs in (living and) non-living</td> <td>only occurs in living</td> </tr> <tr> <td>rate dependent on concentration gradient</td> <td>rate dependent on requirements</td> </tr> <tr> <td>AVP</td> <td>AVP</td> </tr> </table>	diffusion	active transport	movement from high to low (solute) concentration / down a concentration gradient	movement for low to high (solute) concentration / AW	does not require a membrane	does require a membrane	no energy needed / passive process	requires energy / active process / requires ATP	occurs in (living and) non-living	only occurs in living	rate dependent on concentration gradient	rate dependent on requirements	AVP	AVP	3	
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2.

2	(a) root hairs ; water moves, from high water <u>potential</u> to low water <u>potential</u> /down water <u>potential</u> gradient ; by osmosis ; through partially permeable membrane ; through protein pores (in membrane) ;	max [4]	
	(b) (i) movement of gas/oxygen/carbon dioxide, into and out of leaf ; for, photosynthesis/respiration ; allows transpiration ; enables water to be pulled up the plant/AW ;	max [2]	ignore air A transpiration pull
	(ii) greater density/more stomata, in variety A ; four times more ;	[2]	
	(iii) more stomata/AW, in variety A ; more transpiration in variety A ; ora greater opportunity for loss of water vapour through stomata in variety A ; ora by evaporation, from surfaces of (mesophyll) cells/into air spaces (in leaf) ; loss of water from leaf (cells) lowers water potential ; (this) pulls on/creates tension (in water column in xylem) ; cohesion of water molecules/AW ;	max [3]	A transpiration pull A 'stick together' /ref to polar
(c)	sunken stomata ; hairs ; fleshy/succulent, leaves ; thick cuticle ; small surface area ; few/shedding of, leaves ; AVP ; e.g. rolling of leaves/reflective surfaces	max [2]	ignore ref to stems/roots
(d)	water vapour <u>condenses</u> to form, clouds/fog /dew ; precipitation ; rainwater drains into rivers ; seeps/AW, into soil/forms ground water ;	max [2]	
			[Total: 15]

Tropism

(i)	gravity ;	[1]	
(ii)	negative/away from (gravity) ; (gravi)tropism/(geo)tropism ;	[2]	
(iii)	<i>upwards</i> grow towards (where) light (should be) ; more, light absorbed/photosynthesis ; more growth ; flowers more likely to attract, insects/pollinators ; more likely to, release/shed/disperse, seeds ; <i>downwards</i> better, anchorage/AW ; absorb, water/mineral ions ; AVP ; ref to competition/damage	[max 2]	
(iv)	auxins <u>made</u> in shoot tip ; (auxin) spread/move/diffuse ; <i>idea of unequal distribution of auxin</i> ; auxins collect, in <u>lower</u> side of stem ; auxin stimulates (cell) elongation (where it accumulates) ; AVP ;	[max 4]	I found in tip I growth e.g. (by) absorption of water (osmosis)/ref to turgor pressure (and) stretching of cell walls/statoliths/detect gravity

Transpiration and translocation

1 (a)		[2]	<p>1 mark for drawing and 1 mark for labelling drawing must represent correct position of xylem and phloem as shown in Fig. 4.1</p> <p><i>if cells are drawn, these must be in the correct positions for xylem and phloem as in the photograph</i></p>												
(b)	<u>sucrose</u> ;	[1]	<p>A ignore sugar / non-reducing sugar A phonetic spellings</p>												
(c)	<p>1 during growing season / when photosynthesising / when food is made ; 2 (substances are transported (down), to the roots or to (named) 3 transported (up) to the, growing points / flowers / fruits / seeds / new leaves / AW ; 4 (time of year) when no photosynthesis / when food is not made ; 5 (substances are transported upwards) from, roots / storage organ / seed ; 6 (substances transported) from <u>source</u> to <u>sink</u> ;</p>	[max 4]	<p>A when there is plenty of light</p> <p>A move for are transported MP3 A transported up for either time of year once only</p> <p><i>source may be a storage organ or a leaf depending on the time of year</i></p>												
(d)	<p>1 evaporation of water, from (surfaces of) mesophyll ; 2 movement / diffusion / loss of, water vapour ; 3 from, leaves ; A (named) aerial / upper, parts ; 4 through / from, stomata / cuticle ;</p>	[max 3]													
(e)	<p>1 evaporation / transpiration, causes movement of water ; 2 in xylem ; 3 reduces pressure at the top of the plant / ref to a water potential 4 transpiration pull ; 5 maintained by cohesion between water molecules ; 6 maintains a continuous column of water / AW ; 7 adhesion of water / AW, to walls of xylem ;</p>	[max 4]	<p>A ignore capillarity (except if discussing events at interface between water and air in mesophyll in leaf)</p>												
2 (a)	<table border="1"> <tr> <td>pea plant</td> <td>D</td> <td>E</td> </tr> <tr> <td>substance transported</td> <td>sucrose</td> <td>pho ions</td> </tr> <tr> <td>transport tissue</td> <td>phloem ;</td> <td>xylem ;</td> </tr> <tr> <td>sink</td> <td>growing tip / flower / fruit / seed / stem / root ;</td> <td>growing tip / flower / fruit / seed / stem / leaves / chloroplasts ;</td> </tr> </table>	pea plant	D	E	substance transported	sucrose	pho ions	transport tissue	phloem ;	xylem ;	sink	growing tip / flower / fruit / seed / stem / root ;	growing tip / flower / fruit / seed / stem / leaves / chloroplasts ;	[4]	<p>A ignore any vessels / tubes / etc</p> <p>A growing point / meristems / areas where growth occurs</p>
pea plant	D	E													
substance transported	sucrose	pho ions													
transport tissue	phloem ;	xylem ;													
sink	growing tip / flower / fruit / seed / stem / root ;	growing tip / flower / fruit / seed / stem / leaves / chloroplasts ;													
(b)	amino acids ; R proteins	[1]	A (named) plant hormones												
(c)	<p>1 photosynthesis ; 2 light (energy) is, absorbed / trapped, by chlorophyll ; 3 carbon dioxide reacts with water in the presence of light (energy) ; 4 to make glucose (and oxygen) ; 5 glucose used to make sucrose ; A ignore fructose</p>	[max 3]	<p>A word equation / balanced equation if MP3 not written out do not award MP3 if 'broken down' A formula for glucose in an equation</p> <p>MP5 do not award if glucose is broken down unless already penalised in MP3</p>												
(d)	<p>1 respired / oxidised to provide energy / used to provide energy / energy for a suitable process ; R 'produce energy' A respiration unqualified 2 converted to starch for (energy) storage ; 3 converted to cellulose to make cell walls ; 4 used to make nectar to attract, pollinators / AW ; 5 stored in fruits to attract animals (for seed dispersal) ;</p>	[max 2]	<p>e.g. energy for, growth / active transpo</p> <p>R to make fruit / seed unqualified</p>												
2 (e)	<p>1 root hairs / root hair cells ; 2 active transport ; 3 against, concentration / diffusion, gradient A from low to high concentration ; 4 using, energy / ATP ; R energy produced / production of energy from respiration ; 5 ref to, proteins / carrier molecules (in membranes) ;</p>	[max 3]	<p>A ignore diffusion / movement down a concentration gradient / osmosis</p> <p>A ignore gradient in 'from low concentration gradient to high concentration gradient'</p>												

Gas exchange

part	name	role in breathing in
A ↑ ↓	ribs; Ⓐ rib cage	prevent collapse of thoracic cavity or lungs AW (as a result of pressure changes) AW/ ref. to attachment of muscles/ move up to + increase volume/decrease pressure; R space
B	intercostal muscle;	contracts + to move ribcage up or out/to increase volume of chest cavity or lungs AW/decrease pressure; Ⓑ refs to internal intercostals
C	diaphragm ;	contracts/moves downwards + to increase volume of chest cavity AW/decrease pressure ; Ⓑ ref. to 'space'

max. [6]

(b)(i)

- ref. to cilia + beat/move AW; Ⓑ refs to hairs Ⓒ cilia trap germs
- to move dust/mucus + up or out (of bronchus);
- ref. to secretion/production + of mucus;
- ref. to sticky nature AW;
- to trap + dust/bacteria; (linked to mucus)

max. [4]

(ii) NO MARK FOR AFFECT WITHOUT CORRECT NAMED SUBSTANCE
1 MARK FOR THE SUBSTANCE, 1 MARK FOR EFFECT

- Ⓑ carbon monoxide
- nicotine:
 - cilia + become paralysed/stop working AW ; Ⓑ killed
 - cilia unable to remove mucus from + bronchi/airways AW;
 - cell lining AW can be infected by trapped microbes;
 - tar:
 - ref. to cells become cancerous AW;
 - increased production of mucus;
 - cilia + become paralysed/stop working AW; Ⓑ killed
 - carbon particles;
 - increased production of mucus;

max. [2]

Total: [12]

Q2 no MS

Transport and circulation

(a) (i)	urea/hydrogencarbonate (ions) ;	[1]	Mark first response on each line A lactic acid
(ii)	fibrinogen/insulin ;	[1]	Mark first response on each line
(b) (i)	<u>anaerobic respiration</u> ; <u>oxygen debt</u> /vigorous exercise with insufficient oxygen supply ;	[max 1]	
(ii)	(blood) clotting ; converted into fibrin to form a mesh ;	[1]	
(iii)	<u>any two from</u> dilation of pupils ; reduced blood flow through, digestive system/skin ; <u>increase in</u> , blood pressure or heart rate/pulse/stroke volume ; increase in breathing rate ; increase in oxygen concentration in the blood ; increase in glycogen converted to glucose ; increase in glucose/sugar concentration in the blood ; increase in respiration rate ; increase in blood flow through the muscles ; increase in awareness/anxiety/alertness ; broncho-dilation/widen airways ;	max [2]	

(c)	1 (liver cells respond) to insulin if blood glucose is high ; 2 (enzymes/liver cells) conversion of glucose to <u>glycogen</u> ; 3 glycogen is stored (in the liver) ; 4 (liver cells respond) to <u>glucagon</u> if blood glucose is low ; 5 (enzymes) break down <u>glycogen</u> to glucose ; 6 ref to, homeostasis/negative feedback ;	max [3]	Reject reference of insulin/glucagon production in liver
(d) (i)	$\frac{3500 - 1300}{1300} \times 100$ 169 (%) ;;	[2]	
(ii)	1 <u>nonspecific</u> immune response ; 2 engulf/ingest/AW, bacteria/pathogens/dead cells ; A phagocytosis 3 into vacuole ; 4 use enzymes ; 5 to digest bacteria / pathogens ; 6 identify antigen/pathogens, <u>for lymphocytes</u> ;	max [3]	Reject destroy disease
(iii)	1 recognition tissue is foreign/AW ; 2 ref to antigens ; 3 lymphocytes release antibodies ; 4 phagocytes / lymphocytes, cause tissue destruction ;	max [3]	
[Total: 17]			

Habitat, habitat change and destruction

1.

(i)	1 all arrows point from food to feeder ; 2 millipedes eat dead leaves <u>and</u> fungi ; 3 food chain : bacteria → nematodes → springtails → centipedes ; 4 centipedes eat millipedes, springtails and earthworms ;	[4]
(ii)	1 ref to, respiration/decomposition ; 2 release <u>carbon dioxide</u> ; 3 carbon dioxide is taken in by, plants / photosynthesis ;	max [2]

2.

(a)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th><th style="text-align: center;">total number of flies</th><th style="text-align: center;">mean number of flies</th></tr> </thead> <tbody> <tr> <td>purple</td><td style="text-align: center;">8</td><td style="text-align: center;">4</td></tr> <tr> <td>green</td><td style="text-align: center;">15;</td><td style="text-align: center;">5;</td></tr> </tbody> </table>		total number of flies	mean number of flies	purple	8	4	green	15;	5;	[2]	Mark by columns. 1 mark for both totals 1 mark for both means
	total number of flies	mean number of flies										
purple	8	4										
green	15;	5;										
(b)	2 of: (Repeat) more lilies / flowers (of each type); same number of both colours / equal numbers / one more purple / AW; sample from a number of different habitats; method of preventing flies escaping;	Max [2]	No mark for repeat alone. 'Same number (of green sheaths) one mark. Accept 'take 10 green and 10 purple' = 2 marks. Ignore controlled variables e.g. same age, size, mass growing conditions etc.									
[Total: 4]												

3.

(a)	(i)	<u>deforestation / slash and burn</u> ;	1
(timber use)	(ii)	ref. (to timber) for housing / furniture / wood / paper / fence posts AW ; ref. to (timber for) fuel AW ; A burn to keep warm	
(land use)(spaces)		ref. to roads / industry / housing / airports / other use of land ;	max. 2
	(iii)	i. ref. to soil erosion / mudslides / silting of rivers / desertification / dust bowl ; ii. due to lack of (tree) <u>roots</u> to stabilise soil ; (linked to i.) iii. ref. to increased risk of flooding ; iv. due to lack of trees to slow down water ; (linked to ii.) A leaf litter absorbs water v. ref. to leaching of soil / minerals washed out / soil becomes infertile ; vi. can lead to eutrophication of rivers / lakes AW ; vii. less photosynthesis / burning or rotting wood ; viii. less CO ₂ absorbed from atmosphere / more CO ₂ produced / in atmosphere ; ix. ref. to global warming / greenhouse effect ; (linked to vii. or viii.) x. ref. to drop in oxygen in atmosphere AW ; xi. less rain (change in weather) ; xii. due to less transpiration AW ; (linked to xi.) xiii. ref. to reduction of habitats AW / habitats split up AW ; xiv. ref. to disruption of food chains / loss of food ; xv. so animals / plants + can become extinct or numbers depleted / loss of biodiversity ; xvi. ref. to loss of genes / sources of chemicals for medicines AW ; xvii. ref. to more pollution + due to smoke / road traffic / factories AW ; xviii. ref. loss of income + tourism	max. 6
(b)	MAX. 3 IF ONLY ONE NUTRIENT IS USED IGNORE ENERGY REFS PROTEIN		
(fat)	i.	soya contains less fat ; A both sets of figures	
	ii.	ref. to less cholesterol ;	
	iii.	less risk of atherosclerosis / blockage of arteries / atheroma / stroke ;	
	iv.	less risk of a heart attack / heart disease AW ;	
	v.	ref. to less risk of obesity ; (O.R.A.)	
(fibre)	vi.	soya contains (more) fibre ; A both sets of figures	
	vii.	so there is less risk of constipation (prevents) ;	
	viii.	less risk of colon cancer ; fibre absorbs or removes toxins ; (O.R.A.)	max. 4
(ii)	FOOD CHAINS MUST USE NAMED ORGANISMS R plant etc. (soya food chain) soya → human ; A description (corned beef food chain) grass → cow → human ; A description beef food chain has an extra level AW / has extra link / beef food chain longer ; energy lost through food chain / 90% energy lost at each level; more energy is lost in beef chain ; example of energy loss e.g. body heat / movement of animal / not all food digested / energy lost in faeces / urinating / excretion / respiration / egestion ; in food chain there is more biomass in soya than in cows ; R more producers than consumers unequal. R less energy in beef than soya		
			max. 4
			total max. 17

Pollution/Conservation

(a)	pinna / external ear ; fur ; <u>mammary glands</u> / secretes milk ; sweat glands ; endothermic / homoeothermic / AW ; A – warm blooded different types of teeth ; 3 middle ear bones ;	[max 3]
(b)	MP1 redirects blood away from skin to (internal / vital) organs ; MP2 vasoconstriction ; MP3 fat under the skin ; MP4 fur / hair ; MP5 traps air ; MP6 fat / air, poor conductors of heat / insulators ; MP7 reduces heat loss ; MP8 by, conduction / convection ; MP9 generate heat, by metabolism / shivering ; A – endothermic MP10 small surface area to volume ratio / large size ;	[max 5]
(c)	group of organisms of one species ; live in the same place, at the same time / together ;	[2]
(d)	different species have different, genes / DNA ;	[1]
(e)	any two suitable suggestions, e.g. maintaining, genetic diversity ; important in food web ; possible medical application / useful genes ;	[max 2]
		[Total: 13]

2.

(a)	animals written in the correct boxes in the food web (Ruppell's) vulture ; cheetah ; mice / mouse ;	[3]	
(b)	(primary) producer ; <u>primary / first consumer</u> ;	[2]	
(c) (i)	Sun / sunlight / light ;	[1]	
(ii)	(lost) to the atmosphere / (lost as) infra red (radiation) / heat / AW ;	[1]	R reflect R 'lost' only – needs qualifying
(d) 1 2 3 4 5 6 7 8 9 10	idea that small percentage of energy from sun is 'fixed' by photosynthesis ; most energy from sun not available / reference to wrong wavelength / AW ; energy is lost, between / within, trophic levels / along food chain ; ref. to 10% energy transfer / ORA ; ref. to material that is, inedible / not digestible ; energy lost, in respiration / heat / (named) metabolic process / decomposers ; ref. to (small) total percentage reaching fourth trophic level ; not enough energy in fourth trophic level to support another level ; except parasites ; ref. to another problem of animal that would prey on, top carnivores / scavengers ;	[max 3]	NB: MP3 is for loss with no reference to magnitude, also award MP4 if magnitude given e.g. '90% lost between trophic levels' is marks MP5 A ref to faeces examples for MP10 animal would have to be very large, would need much energy to catch a cheetah, there would be very small populations

(e) 1 2 3 4 5 6 7 8 9 10 11	feed is expensive / fish is sold at high price ; more energy efficient to feed humans on, crops / producers / animals used to make the fish food ; waste from salmon / excess feed, causes eutrophication ; diseases / parasites, spread easily in (high density of) salmon ; diseases spread to, wild fish / other organisms ; chemicals used to control disease also pollutants ; escapes breed with wild fish ; idea of genetic pollution of wild fish ; escapees compete with wild fish ; extinction of wild fish ; AVP ;	No credit for energy losses along the chain as already given in Question 1d AVP e.g. chemicals / antibiotics / hormones in feed passed on e.g. less waste if humans could eat hi protein 'fish food' instead e.g. low quality stock compared with wi (less competition) [max 3]	
		[Total : 13]	

3.

(ii)	<p>deforestation/description ; two examples of the effects of deforestation e.g. soil erosion / habitat loss / soil fertility / reduced biodiversity :: increase in carbon dioxide (from deforestation/coal/oil/power stations); carbon dioxide is a greenhouse gas ; causes global warming/enhanced greenhouse effect ; two examples of the effects of global warming e.g. rising sea levels / climate change / desertification / increased yield :: AVP ; e.g. increased use of fossil fuels ref to power stations, affecting breathing/asthma /causes acid rain</p>
	[5]

Inheritance and variation, Natural selection, Speciation and extinction

(i)	$I^A I^O \times I^B I^O$; $I^A, I^O + I^B, I^O$; $I^O I^O$, (blood group) O ; (allele) I^O recessive to I^A and I^B ; parents must both have I^O / O / be heterozygous ;	<i>accept:</i> $AO \times BO$; $A, O + B, O$; OO , (blood group) O ; (allele) O recessive to A and B ;	R one I for the genotypes, e.g. I^{AO} gametes must be derived correctly from the parental genotypes written explanation may be written in terms of parents pass on the allele I^O <i>ignore</i> gene for allele
(ii)	25% / 0.25 / $\frac{1}{4}$ / 1 in 4 ;	[max 4]	[1] R a ratio e.g. 1:3

2.

(a)	phenotype ; gene ; haploid ; mitosis ;	[4]	
(b)	<i>if there is an error in the genetic diagram allow ecf even if final phenotypes are NOT all different as stated in the question</i> $I^A I^O \times I^B I^O$; $I^A, I^O + I^B, I^O$; $I^A I^O, I^A I^B, I^B I^O, I^O I^O$; A AB B O ; <i>blood types must match genotypes</i>	[4]	accept I^A, I^B and I^O for alleles A, B and O for alleles MP2 and 3 in Punnett square ignore spaces, commas or dots in diploid genotypes very little space between gamete genotypes reject I^{AB} etc as genotypes for parents or children I without A, B and o
(c)	1 two (or more) alleles ; R two blood groups 2 two / both, are expressed / equally dominant / both dominant / give different phenotype ; 3 in heterozygous / described (individual) ; 4 AB, $I^A I^B$ (as example) ;	[3 max]	A two (or more) implied, e.g. 'neither' / 'each other' / 'both' <i>ignore</i> ref to genes 'neither is fully expressed' = 1 mark for MP1 'neither is dominant over the other' = 2 marks R ref. to recessive and dominant A idea 'when both alleles are present in the genotype' A refs. roan cattle, pink flowers as other correct examples

3.

(a)(i)	N and S ;	1	either order
(a)(ii)	R has different characteristics to the parent / has dark eyes / knobs on the end of antennae / knobs on abdomen ;	1	
a)(iii)	phenotype ;	1	
(b)(i)	height ; weight ; skin colour ; hair colour ; AVP ;;; e.g. leg length / arm length	3	A hair length
(b)(ii)	tongue rolling / gender / AVP ;	1	A blood group

4

'(a)	<p>small ears ; reduce heat loss ; or fur / coat ; reduce heat loss / insulation / keep body temperature constant ; or white, hair/fur ; for camouflage ; or large body / small surface area to volume ratio ; reduce heat loss ; or large feet ; spread weight on snow/ice ; dark / black nose/lips ; heat absorption AW ;</p>	2	explanation must relate to the given feature features must be visible in Fig. 7.1
'(b)	<p>1 variation within, populations / organisms ; 2 more offspring produced than will survive ; 3 competition (for resources) ; 4 best adapted survive ; 5 best adapted reproduce ; 6 passing on their, alleles (to the next generation) ;</p>	4	
'(c)(i)	<p>reasons for becoming endangered</p> <p>climate change/ global warming ; habitat destruction / ice melting ; hunting / poaching ; pollution ; reduced (access to) food supply ; AVP ; e.g. disease</p> <p>conservation methods</p> <p>protecting habitats / national park ; ref to education ; captive breeding programmes ; zoos / wildlife park / sanctuary / protecting species ;</p>	4	max 3 from either section

5

(a)	feathers ;	max [1]																									
(b)	<table border="1"> <tr><td>go to 2</td><td></td></tr> <tr><td>go to 4</td><td></td></tr> <tr><td><i>Spinus tristis</i></td><td>D</td></tr> <tr><td>go to 3</td><td></td></tr> <tr><td><i>Ara ararauna</i></td><td>A</td></tr> <tr><td><i>Aquila chrysaetos</i></td><td>F</td></tr> <tr><td><i>Platalea regia</i></td><td>C</td></tr> <tr><td>go to 5</td><td></td></tr> <tr><td><i>Trochilus polytmus</i></td><td>E</td></tr> <tr><td>go to 6</td><td></td></tr> <tr><td><i>Recurvirostra americana</i></td><td>G</td></tr> <tr><td><i>Phoenicopterus minor</i></td><td>B</td></tr> </table>	go to 2		go to 4		<i>Spinus tristis</i>	D	go to 3		<i>Ara ararauna</i>	A	<i>Aquila chrysaetos</i>	F	<i>Platalea regia</i>	C	go to 5		<i>Trochilus polytmus</i>	E	go to 6		<i>Recurvirostra americana</i>	G	<i>Phoenicopterus minor</i>	B	[3]	5 or 6 correct = 3 3 or 4 correct = 2 1 or 2 correct = 1
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(c) (i)	A – meiosis ; B – zygote ;	[2]																									
(ii)	(cell/nucleus) has two sets of chromosomes ; has pairs of chromosomes ; has chromosomes from two, haploid cells/sperm and egg/two gametes ; has chromosomes from male and female (parents) ; has twice the number of chromosomes as the gametes ;	max [1]	ignore has 80 chromosomes ignore 2n unqualified																								
(iii)	increase in complexity ; (named) cells/tissue(s)/organ(s)/organ system(s), become specialised/differentiate/AW ;	max [1]	R ref to increase in cell number and cell size																								
(iv)	ref adaptation to, new/changed, environment/habitat/ecosystem ; any example ; e.g. ref to (new) disease/camouflage/escaping from (new) predators allows, selection/evolution ; ref to reduces competition ; increases chances of survival of the species/reduces chance of extinction ; AVP ; e.g. increase in gene pool	max [2]	A ref to selective advantage																								

6.

(a)	<p>little / less / AW / no variation / (genetic) diversity ; ref to becoming homozygous ; less chance of surviving/adapting / evolving, to, changing conditions / new environments / (new) disease ; risk of extinction ; increase chance of genetic disease ; adapted variety spreads / AW ; only one plant needed / no mate required ; R if 'asexual reproduction' is given greater chance of pollination / ensures pollination occurs ; idea that reproduction / fertilisation, successful if no other plants (of same species) nearby ; less wastage of pollen ; not dependent on (named) agent of pollination ; AVP ; no hybrid vigour / smaller gene pool</p>		4	<p>A fewer alleles I ref to gene(s) R cloning / uniformity)</p> <p>A increased risk of abnormalities / genetic 'weakness' / AW</p> <p>A gametes I no wastage</p>
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Genetic modification, Cloning, Ethical implications

1.

(a)	<p>taking a, gene/DNA/allele, from one species ; inserting it into another organism ; OR changing the, genetic material/chromosome of, an organism/cell ; by removing /changing/inserting, genes/DNA/alleles ;</p>		max [2]																						
(b)	<table border="1"> <thead> <tr> <th>Letter from fig</th> <th>Name</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>M</td> <td>chromosomes</td> <td>threads of DNA found in the nucleus</td> </tr> <tr> <td>N</td> <td>gene/allele ;</td> <td>section of DNA removed from human cell</td> </tr> <tr> <td>Q</td> <td>plasmid</td> <td>vector / loop / circle, of DNA (that can carry a foreign section of DNA) / separate piece of DNA (from chromosome) ;</td> </tr> <tr> <td>R</td> <td>bacterial (cell) ; A yeast</td> <td>type of cell that is genetically engineered</td> </tr> <tr> <td>O</td> <td>insulin/protein ;</td> <td>specific chain of amino acids coded by the section of DNA removed from the human cell</td> </tr> <tr> <td>P</td> <td>fermenter</td> <td>(container in which) bacteria/microorganisms /cells, reproduce/grow/produce insulin ;</td> </tr> </tbody> </table>	Letter from fig	Name	Description	M	chromosomes	threads of DNA found in the nucleus	N	gene/allele ;	section of DNA removed from human cell	Q	plasmid	vector / loop / circle, of DNA (that can carry a foreign section of DNA) / separate piece of DNA (from chromosome) ;	R	bacterial (cell) ; A yeast	type of cell that is genetically engineered	O	insulin/protein ;	specific chain of amino acids coded by the section of DNA removed from the human cell	P	fermenter	(container in which) bacteria/microorganisms /cells, reproduce/grow/produce insulin ;		[5]	
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P	fermenter	(container in which) bacteria/microorganisms /cells, reproduce/grow/produce insulin ;																							
(c)	<p>clone / (genetically) identical ; rapid/less energy to reproduce (asexually)/only one parent / no gametes ; large quantity of insulin produced ; all bacteria, have the insulin gene / produce insulin ; same insulin produced ; once cells are engineered does not have to be repeated ; AVP ; e.g. cheap/ethical or religious reasons /less allergic reaction / no immune rejection / more efficient / no risk of disease (transmission)</p>		max [3]	<p>A <u>no</u> variation</p> <p>only accept in context of comparisons with animal insulin extraction methods</p>																					

2.

(a)	<i>full marks may be possible from a fully annotated genetic diagram</i> females are XX, males are XY ; female gametes are X, male gametes are X or Y ; ref to random fusion of gametes/shown in a Punnett square or alternative ; 1:1/50:50/described, shown/stated ;	[4]	
(b)	ref to, identify/separate, sperm with X (chromosome) ; semen/spERM, inserted/injected, into, uterus/oviduct ; at/around time of, ovulation/AW ;	max [2]	
(c)	1 formula milk is, similar/closer in composition, to human milk ; 2 any nutrient with similar quantities in formula and human milk ; 3 <i>idea that</i> human milk meets requirements of human babies ; <i>comparisons with cow's milk</i> 4 formula supplies less protein which is harder to digest ; 5 formula supplies more iron, for haemoglobin formation/to prevent anaemia ; 6 formula supplies more vitamin D for, absorption of calcium/formation of bone/for strong bones/prevention of rickets ; 7 formula supplies more vitamin A, for immune system/retina/rods/vision in dim light/prevention of night blindness ; 8 use of comparative figures with correct units ;	max [4]	
(d)	biological/made by cells ; catalyst/speeds up the rate of a reaction ; made of protein ;	max [2]	
(e)	tubes 1 and 3 – the effect of pH 1 lysozyme is active in, 1/pH 4.0/acid ; 2 <u>cell walls</u> , broken down/digested/destroyed in tube 1 ; 3 no (bacterial) growth in tube 1 ; tubes 1 and 4 – the effect of type of bacteria 4 lysozyme, destroys/AW, bacteria, A/in tube 1 ; 5 lysozyme does not, destroy/AW, bacteria, B/in tube 4 ; 6 ref to specificity to bacteria A/bacteria B is resistant ; <i>ignore</i> bacteria are immune 7 <i>idea that</i> nothing in (cell wall of) bacteria B for lysozyme to digest ; tubes 1 and 2 – the effect of boiling 8 lysozyme denatured (by boiling) ; 9 lysozyme not, active ; 10 <i>idea that</i> tube 2 is a control to show that lysozyme is responsible for no growth in tube 1 ;	max [6]	
(f)	1 gives (passive) immunity ; 2 defends against, infection/illness/disease/pathogens/AW ; 3 ref to diseases that the mother has had ; 4 any one function of antibodies ;	max [2]	

Concept-Systems

Movement and Energy transfer

Cell respiration, aerobic and anaerobic

(a)	increased blood flow or heart, pumps/beats, faster ; more, oxygen/glucose (for muscles)/carbon dioxide removed ; more energy released by respiration ; for muscle contraction ;	max [2]	ignore increased, pulse rate/heart rate R 'energy produced' / 'energy created'
(b)	increase in, time/exercise intensity/effort, increase in lactic acid concentration ; increase is, steady/proportional ; after exercise lactic acid concentration continues to increase ; after exercise/near end of exercise, concentration levels off/AW ; appropriate use of data ;	max [3]	units must be used at least once
(c) (i)	the release of a relatively small amount of energy ; by the breakdown of glucose ; in the absence of oxygen/without oxygen ;	max [2]	R 'produce/AW, energy' ignore 'use' unqualified ignore air / fermentation unqualified
(ii)	(by) diffusion ;	[1]	
(iii)	(blood) plasma ;	[1]	
(d)	<i>in trained cyclists</i> lower <u>anaerobic</u> respiration / more <u>aerobic</u> respiration ; less lactic acid produced (during exercise) ; because more oxygen supplied to muscles ; less <u>oxygen debt</u> ; less oxygen required, to oxidise/breakdown, lactic acid ; (breakdown) to glucose/carbon dioxide and water ; quicker, removal/breakdown, of lactic acid ; appropriate comparative data quote with units ;	max [4]	
		[Total: 13]	

Food chains and webs, Ecosystem, nutrient cycles

- (a) (i) ref. to moist skin ; [1]
- (ii) mammal ;
bird ;
fish ;
reptile ; [max. 2]
- (b) ref. to both belonging to the same genus (or ref. to Bufo) ; [1]
(ignore refs. to both animals being toads)
- (c) ref. to sand dunes becoming developed for + camp sites ;
ref. to habitat is changing e.g. to woodland ; Ⓢ ref. to loss of habitat
natterjacks cannot survive in colder habitats AW ; [max. 2]
- (d) ref. to some heathland or sand dunes becoming protected areas AW ;
ref. to removal of trees / seedling trees AW + from heathland ;
ref. to creation of more heathland / sand dunes + introduction of natterjacks ;
ref. to captive breeding programmes ; [max. 2]
- (e) secondary consumer / third level ; Ⓢ (top) carnivore [1]
- (ii) insect larvae + adult insects ; (BOTH NEEDED FOR 1 MARK) [1]
- (iii) ref. to a wider range of food sources AW ; [1]
- [max. 11]

2. a & b

	<p>1 N / nitrogen, fixation ; 2 bacteria / Rhizobium ; R 'nodules are bacteria' 3 convert, nitrogen / N₂ / AW, into, ammonia / NH₃ / ammonium / NH₄⁺ / amino acid(s) ; 4 plants use (fixed) nitrogen to make, amino acids / proteins / AW ; [3 max]</p>	<p>N-fixing bacteria = 2 mar R to nitrite / nitrate A plants use NH₃ / NH₄⁺</p>
	<p>1 (dead plants) eaten by, animals / detritivores / scavengers ; 2 e.g. earthworms / termites / AW ; 3 ref. their faeces / increase in surface area ; 4 decay / decomposition ; A decomposers 5 by, bacteria / fungi / saprophytes / saprotrophs ; 6 break down proteins to amino acids ; 7 deamination ; 8 ammonia / NH₃ / NH₄ ; } 9 ammonia to nitrite ; } 10 nitrite to nitrate ; A one mark for ammonia to nitrate 11 nitrification / nitrifying bacteria ; 12 Nitrosomonas / Nitrobacter in correct context of nitrification ; [6 max]</p>	<p>MP3 must be related to MP1 or 2 A even if linked to incorrect organism R if wrong type of bacteria (e.g. N-fixing) A if in context of MP1 or 2 but do not award twice protein → ammonia / AW = 1 mark if 6, 7, 8 not given R 'nitride' unless qualified by NO₂ R nitrate unqualified by nitrite or ammonia</p>
2 (d)	<p>1 light intensity ; A limited sunlight / lack + of sunlight / sunshine 2 light duration ; A day length 3 water / moisture availability ; A drought / flood / humidity / soil water 4 carbon dioxide, availability / concentration / tension / level ; 5 temperature ; 6 competition / overcrowding / space / weeds ; 7 grazing / herbivores / predation / primary consumers ; 8 pests ; 9 parasites / disease ; 10 use of (inappropriate) herbicides / nearby use of herbicides ; A drift of herbicides / weed killers 11 pollution / sulphur dioxide / acid rain ; 12 soil pH / depth of soil / type of soil / poor soil / oxygen in the soil ; 13 wind speed ; 14 salt concentration of soil ;</p>	<p>[3 max]</p> <p>R heat / warmth R oxygen unqualified</p>

e

(e) ignore refs to nitrogen fixation / denitrification
 marking points 7 + 8 must be in the correct context

- 1 (eaten / digested by) (named) scavenger(s) / hyenas / vultures ;
- 2 excretion / urine / egestion / faeces / AW ;
- 3 dung beetles / detritivores / maggots ;
- 4 decay / decomposition / rotting, by, bacteria / fungi / named decomposer ;
- 5 protein → amino acids ;
- 6 deamination / amino acids → ammonia ; } A protein → ammonia
- 7 ammonia → nitrite ; }
- 8 nitrite → nitrate ; } A ammonia → nitrate
- 9 nitrification / nitrifying bacteria ;
- 10 Nitrosomonas / Nitrobacter in correct context of nitrification ;
- 11 plants absorb, nitrate / ammonia ;

'decomposition by nitrifying bacteria' = 0

[max 5]

f.

	<p>1 feed is expensive / fish is sold at high price ; 2 more energy efficient to feed humans on, crops / producers / animals used to make the fish food ; 3 waste from salmon / excess feed, causes eutrophication ; 4 diseases / parasites, spread easily in (high density of) salmon ; 5 diseases spread to, wild fish / other organisms ; 6 chemicals used to control disease also pollutants ; 7 escapees breed with wild fish ; 8 idea of genetic pollution of wild fish ; 9 escapees compete with wild fish ; 10 extinction of wild fish ; 11 AVP ;</p>	<p>No credit for energy losses along the chain as already given in Question 1d</p> <p>[max 3]</p> <p>AVP e.g. chemicals / antibiotics / hormones in feed passed on e.g. less waste if humans could eat hi protein 'fish food' instead e.g. low quality stock compared with wi (less competition)</p>
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Cell functions

1

(a)	transports, oxygen /gases ;		[1]	
(b) (i)	1 2 3	controls activities in the cell /AW ; contains, chromosomes /genes /alleles/genetic information /DNA ; controls how cells, develop/divide/reproduce/grow ;		max [1]
(ii)	more space for haemoglobin ; to enable greater oxygen carrying capacity /AW ; more flexible shape (to move through capillaries) ;		max [1]	
(c) (i)	0.15 mol dm^{-3} (red blood cells) are normal shape/biconcave ; 0.20 mol dm^{-3} (red blood cells) have shrunk/crenation /AW ;		max [2]	
(ii)	1 2 3 4	osmosis ; (diffusion/osmosis) of water molecules into cells ; down a water <u>potential</u> gradient/from high water <u>potential</u> (of solution) to low water potential (in cells) ; across partially permeable membrane ;		max [3]
(iii)	cell wall (offers resistance) ; water potential (of plant cells) could be equal/higher/less negative (than 0.1 M solution) (so no net osmosis) ;		max [1]	
(d) (i)	0.15 mol dm^{-3} ; no net movement of water / (red blood) cells will remain normal shape/AW ;		[2]	units must be included A (red blood) cells won't be damaged / isotonic (with solution)
(ii)	1 2 3 4 5 6	ref to platelets ; fibrinogen converted to fibrin ; soluble to insoluble/fibrin is insoluble ; thrombin/enzyme in context ; mesh/network/web, to trap blood (cells) ; AVP ; e.g. reference to prothrombin or involvement of calcium ions		max [3]
				[Total: 14]

2.

(a)	nucleus: 1 controls (activities in) the cell /AW; 2 contains, chromosomes /genes /alleles/genetic information /DNA; 3 controls how cells, develop/divide/reproduce/grow; 4 cell membrane: 5 forms a barrier/separates a cell from surroundings; 6 allows/controls, movement of (named) substance(s), across/in/out; keeps contents of cell inside/keeps cytoplasm intact/AW;	max 4	I 'brain' of cell /'tells cell what to do' MP1 A ref to making proteins A makes ribosomes e.g. O_2/CO_2 /nutrients I ref to shape /'covers cell'/protects cell
(b)	a group of cells, same type/do the same function;	1	cells are in the same place = group
(c)	1 mucus traps, particles/any example; 2 mucus protects lining; 3 (cilia) beat /create wave motion/wafting; 4 move, mucus/fluid away; 5 reduce risk of/stop, (named) pathogens entering lungs;	max 3	e.g. dust/bacteria/spores/virus I 'collects' particles
		[Total: 8]	

3.

(a)

structural feature	animal cell	plant cell
cell wall	x	✓
nucleus	✓	✓;
(cell) membrane	✓	✓;
cytoplasm	✓	✓;
chloroplast	x	✓;
(large) vacuole	x	✓;
vacuolar sap	x	✓;
vacuolar membrane / tonoplast	x	✓;
nuclear membrane	✓	✓;
nucleolus	✓	✓;

max 4

mark nucleus and next 3 answers

R chlorophyll

Receptors, Senses, nervous system, Homeostasis, Hormones

(a)	central (nervous system) ; peripheral (nervous system) ; spinal cord ;	[3]	R spine
(b) (i)	sensory neurone ;	[1]	A afferent neurone R sensory nerve
(ii)	simple reflex/reflex ;	[1]	A reflex arc
(iii)	slower/takes more time ; needs thought/uses (higher centres of) the brain/conscious control ; learnt/not inherited/not innate/needs training/AW ; not automatic ; response is not always the same to the stimulus ;	[max 2]	

2 (a)

name of part	letter from Fig. 3.1
hair	R ;
blood vessel/arteriole/small artery	S ;
sweat gland	U ;

[3] 1 mark per correct row

R artery, capillary

(b)

(involuntary responses are) automatic/no conscious decision/does not involve thought/decision making/innate/reflex ;
(higher centres of) brain not involved ;
faster/immediate/rapid ;
response always the same/response specific to stimulus ;
may involve glands ;
they are protective/linked to survival/AW ;
AVP ;

max [3] A reverse argument written in favour of voluntary responses if this is clearly stated

(c)

(change in) temperature/hot / cold is stimulus ;
temperature receptors (in skin) / V ;
(electric) impulse ;
travels through sensory neurone ;
to brain ;
relay/connector/intermediate neurone ;
motor neurone ;
to effector ;
example of effector (arteriole/erector, muscle) ;

max [4] R messages
points need to be in the correct sequence
A 'muscle' unqualified.

(d)

change in temperature, is detected/acts as a stimulus ;
to keep temperature, constant / at 37°C / within limits / near set point / at the norm/AW ;
corrective/opposite, action by the body ;
return to normal temperature ;
correct ref to homeostasis ;

max [3]

[Total: 13]

3 (a)	hepatic portal vein ;	[1]	
(b)	(semi lunar) valves ; prevent backflow ; large, lumen ; low, pressure /resistance to blood flow ; thin/less elastic/less muscular, walls (than arteries) ; low blood pressure ; allows vein to be squeezed by (surrounding skeletal) muscles ;	2 + 2 max [4]	in each case the explanation must be linked to a correct feature
(c)	= $(181 - 135) \div 135 \times 100$; = 34 (%) ;;	max [2]	
(d) (i)	(liver) responds to insulin (from pancreas) ; increased, uptake/respiration, of glucose ; glucose converted to glycogen ; by enzymes ; glycogen is, insoluble/stored ; negative feedback ;	max [2]	A glycogenesis R hormones carrying out conversions directly ignore homeostasis
(ii)	temperature ; water ; AVP ; e.g. pH/ions/urea/carbon dioxide	max [1]	

(e)	deamination ; (part of excess) amino acids converted to urea ; (part of) amino acid converted to ammonia ; ammonia converted to urea ; ammonia is harmful ; (rest of) amino acid molecule, releases energy/converted to glucose/glycogen/respired ; (some amino acids) used to make proteins e.g. fibrinogen ; AVP ; e.g. transamination	max [3]	A description of amino group removal ignore protein converted to urea
(f)	bile production/AW ; breakdown/remove, hormones/red blood cells/toxins/alcohol/drugs ; storage of, iron/vitamin A/vitamin D ; AVP ; e.g. cholesterol, synthesis/AW	max [1]	R homeostasis, deamination, protein synthesis, transamination
[Total: 14]			

4 (a) (i)	eaten/absorbed, a (sugary/high carbohydrate) meal/AW ; (secretion/effect, of) adrenaline ; (secretion/effect, of) glucagon ; dehydration/loss of water ;	max [1]	
(ii)	used in respiration ; (named) exercise/physical activity ; hungry/fastng/starvation ; (secretion/effect, of) insulin ;	max [1]	
(iii)	liver ; muscle ; kidney ; testes ;	max [2]	
(b)	1 pancreas/islets of Langerhans, detects increase in glucose concentration ; 2 (pancreas/islets) secretes/produces, insulin ; 3 transported in, blood/plasma ; 4 liver/muscle/cells, convert glucose to glycogen ; 5 ref to, enzymes (converting glucose to glycogen) ; 6 homeostasis/negative feedback ;	max [3]	
(c)	water, diffuses out of (red blood cells) ; through, partially permeable membrane ; by osmosis ; down water potential gradient/from high water potential to low water potential ; (red cells) decrease in volume/shrink/crenated/AW ;	max [3]	

Overexploitation, Mitigation of adverse effects, Human influences

1 (a)	pollutant		effect on the environment	
	heavy metals, e.g. lead and mercury	factories/industries/mining / exhaust from transport/chemical plants/sewage (sludge) ;		
	phosphate sulfur dioxide	fertiliser/detergents / sewage ; (combustion of) coal/oil/factories/power stations/chemical plants/exhaust from transport ;		
	ionising radiation	nuclear fall-out/radioactive waste/nuclear industries/nuclear power plants/uranium/plutonium/X-rays	mutations/cancers ; A changes genes/changes DNA	[5]

- (b)
- | | |
|---|---|
| 1 | growth of algae/algae bloom ; |
| 2 | light blocked (by algae) ; |
| 3 | reduced/no, photosynthesis ; |
| 4 | (so) algae/(fixed) water plants, die ; |
| 5 | less/no, oxygen released by plants ; |
| 6 | algae/plants, fed on/decayed/decomposed, by bacteria ; |
| 7 | bacteria, multiply/increase/grow/divide ; |
| 8 | (aerobic) respiration ; |
| 9 | low levels of oxygen cause, death/suffocation/migration, of, (named) fish/animals/invertebrates/(aquatic) creatures/organisms / consumers ; |
- [7]
- (c)
- | | |
|---|--|
| 1 | add lime(stone)/calcium carbonate /CaCO ₃ /alkali, to, lakes/rivers/soils ; |
| 2 | use less fossil fuels ; ignore stop using fossil fuels |
| 3 | use low sulfur fuels ; A stop using sulfur fuels |
| 4 | desulfurisation of, coal/oil ; |
| 5 | flue gas desulfurisation/'use (wet) scrubbers'/neutralise waste gases with lime ; |
| 6 | catalytic converters/use electric cars ; |
| 7 | idea of international treaty for reducing emissions ; |
- [5]

(d)

- | | |
|---|---|
| 1 | kill other plants that are not weeds ; |
| 2 | harms, insect/animals ; |
| 3 | bioaccumulation/AW ; |
| 4 | loss of biodiversity/destroy habitat ; |
| 5 | run off into, streams/rivers/lakes ; |
| 6 | selects for herbicide, resistance/tolerance ; |
| 7 | weeds become more difficult to control/AW ; |

[5]

3.

1 (a)	MP1 reduction of (wild) habitat / change the ecosystem ; MP2 area too small to support many organisms ; MP3 populations, are too small / isolated, to survive / breed; MP4 disruption to food chain / food web ; MP5 flooding ; MP6 erosion ; MP7 leaching of minerals ;	[max 3]
(b)	MP1 more energy available ; MP2 energy loss, within / between, <u>trophic levels</u> ; MP3 energy lost in animal's, metabolism / respiration / movement / excretion ; MP4 little energy for animal growth ; MP5 (about) 90% loss / (only) 10% passed on to humans ;	[max 3]
(c)	MP1 burning trees gives off carbon dioxide ; MP2 less photosynthesis ; MP3 so less carbon dioxide, absorbed ; MP4 less oxygen produced ; MP5 cows give off, methane ; MP6 methane, greenhouse gas ; MP7 traps heat in the atmosphere ; MP8 less transpiration ; MP9 reduced rainfall ;	[max 3]
(d)	soils, are thin / have little humus content ; no / less, recycling organic material ; competition for minerals from crop ; constant cultivation, removes / overuses, minerals ; plant pest population increases ;	[max 2]
(e)	less, forest cleared ; less energy used ; less water used in paper production from recycled paper ; less waste to, landfill ; less rubbish burnt, so less carbon dioxide given off ;	[max 2]

[Total: 13]

decrease number of trees used / less deforestation ;
any consequence for biodiversity ;
less carbon dioxide produced (by burning) ; A ora
ref to greenhouse gas / global warming ;
less energy needed to recycle compared to making paper from trees ;

[5]

3D tissues and organ printing

3D bioprinting contributes to significant advances in the medical field of tissue engineering by allowing for research to be done on innovative materials called biomaterials. Biomaterials are the materials adapted and used for printing three-dimensional objects. Some of the most notable bioengineered substances are usually stronger than the average bodily materials, including soft tissue and bone. These constituents can act as future substitutes, even improvements, for the original body materials. Alginate, for example, is an anionic polymer with many biomedical implications including feasibility, strong biocompatibility, low toxicity, and stronger structural ability in comparison to some of the body's structural material. Synthetic hydrogels are also commonplace, including PV-based gels. The combination of acid with a UV-initiated PV-based cross-linker has been evaluated by the Wake Forest Institute of Medicine and determined to be a suitable biomaterial. Engineers are also exploring other options such as printing micro-channels that can maximize the diffusion of nutrients and oxygen from neighboring tissues In addition, the Defense Threat Reduction Agency aims to print mini organs such as hearts, livers, and lungs as the

potential to test new drugs more accurately and perhaps eliminate the need for testing in animals.

Nutrition and digestion

1 (a) (i)	both have different types of teeth / named teeth / both have teeth on upper and lower jaws;	[1]	I. reference to canines A. have teeth for grinding /chewing										
(ii)	<table border="1"> <thead> <tr> <th>sheep</th> <th>dog</th> </tr> </thead> <tbody> <tr> <td>No teeth /incisors in upper jaw at front</td> <td>Teeth / incisors in front in both jaws;</td> </tr> <tr> <td>Space between front and back teeth / diastema</td> <td>No space / diastema;</td> </tr> <tr> <td>No / short canines</td> <td>long / pointed canines / canines present;</td> </tr> <tr> <td>Ridged / not smooth / interlocking back teeth AW</td> <td>smooth / not so ridged / not interlocking back teeth ;</td> </tr> </tbody> </table>	sheep	dog	No teeth /incisors in upper jaw at front	Teeth / incisors in front in both jaws;	Space between front and back teeth / diastema	No space / diastema;	No / short canines	long / pointed canines / canines present;	Ridged / not smooth / interlocking back teeth AW	smooth / not so ridged / not interlocking back teeth ;	[max 2]	<p>Only accept one correct answer per box. Need correct statement in both columns or correct comparative answer.</p> <p>A. horny pad in sheep / none in dog I. size of incisors / teeth in general as no scale I. space between teeth A. fangs A. correct reference to carnassial teeth I. rough / sharp I. reference to number / spacing of teeth</p>
sheep	dog												
No teeth /incisors in upper jaw at front	Teeth / incisors in front in both jaws;												
Space between front and back teeth / diastema	No space / diastema;												
No / short canines	long / pointed canines / canines present;												
Ridged / not smooth / interlocking back teeth AW	smooth / not so ridged / not interlocking back teeth ;												
(b) (i)	<p>Drawing: O: single clear outline of whole tooth; S: larger size than Fig. 1.2; R: ridges; Label: L: root / crown / ridges/ dentine / enamel /cusp;</p>	[max 2] [max 1]	<p>R. sketched / artistic lines A. shading for dentine only / reject any other shading. I. broken lines, may be due to scanning</p> <p>A. detail of ridges internally or on top surface Mark with a vertical line of ticks / crosses down in order [O, S, R, L] but enter correct total, they may not tally. I. root canal</p>										
(ii)	<table border="1"> <thead> <tr> <th>herbivore</th> <th>carnivore</th> </tr> </thead> <tbody> <tr> <td>ridges / rough / more points</td> <td>Smooth / less or 4 points;</td> </tr> <tr> <td>worn / incomplete enamel / dentine visible</td> <td>not worn / enamel complete / dentine not visible;</td> </tr> </tbody> </table>	herbivore	carnivore	ridges / rough / more points	Smooth / less or 4 points;	worn / incomplete enamel / dentine visible	not worn / enamel complete / dentine not visible;	[2]	<p>Only accept one correct answer per box.</p> <p>A. comparative answer. I. sharp / blunt I. edges I. decay / food remains / plaque / hole I. size / shape / narrow / wide / surface area / black / white</p>				
herbivore	carnivore												
ridges / rough / more points	Smooth / less or 4 points;												
worn / incomplete enamel / dentine visible	not worn / enamel complete / dentine not visible;												
(c)	<p>less / low protein / fat (in green leaves); (herbivores) take energy in form of carbohydrate (not fat) ; carbohydrate has less energy / half the energy of fat;</p>	[max 2]	<p>If not stated, assume answers refer to herbivores I. less nutrients / reference to carbohydrates I. amylase / chewing / fibre</p>										
(d)	<p>Fat: equal amounts food; equal amounts reagents; grind up / homogenise food; add ethanol / alcohol/methanol; dissolve the fat; pour / decant into tube of water / add water; emulsion / cloudiness / goes white / milky; compare; safety precautions;</p>	[max 6]	<p>A. cut up / chop – any process to increase S.A. I. grind in water A. at any stage I. to dissolve food</p> <p>I. precipitate I. length of time taken for comparison E.g. ‘the one which is cloudier / thicker has more fat’ = 2 A. one safety precaution e.g. goggles / no naked flame / hair tied back / lab. coat / AVP. I. alcohol is inflammable without safety precaution. If use heat then [max 5] – not safe If omit alcohol / add cooking oil – no marks for emulsion and can only have [max 5]</p> <p>Alternative if no reference to ethanol, then look for grease test: A. Grease test: qual amounts food; qual amounts reagents; grind up / homogenise food; rub on paper; translucent / greasy mark; compare; safety precautions;</p>										
[Total: 16]			[max 4]										

Energy transfer and movement

- a) Chemical energy to heat energy.
 - b) Chemical to heat.
 - c) Light to chemical.
 - d) Chemical to kinetic.
 - e) Chemical to chemical/heat/kinetic.
- a) More energy available for detritivores than herbivores; herbivores eat living plants whereas detritivores eat dead leaves/dead organic matter; both can get energy from plants.
 - b) All energy flows are reduced.
 - c) Smaller biomass of detritivores and primary consumers (though the biomass of omnivores is greater).
 - d) Less predation by carnivores; food supplies more variable so advantage in having a flexible diet.
- i) No, orangutan areas on 1930 map do not extend to all areas shown as forest on 2010 map.
 - ii) Yes, as some of industrial plantations on 2010 map are shown as orangutan areas on 1930 map.
 - iii) Yes, as some areas of intact forest on 2010 map are shown with orangutans on 1930 map.
 - b) Both have affected large areas shown as orangutan habitat on 1930 map; but logged areas could regenerate as forest/ retain some trees so provide better orangutan habitat; so industrial plantations (probably) more harmful.
- a) Testable hypotheses: all vegetable oils have an energy content of about 40 MJ per kg (hypothesis based on energy values in databases)/yield of palm oil in kilograms per hectare is more than other oils so the energy content is lower (to give an equal energy yield per hectare)/alternative reasoned hypothesis.
 - b)
 - i) Palm oil; another named oil (but if palm oil is unobtainable, two other oils could be used in the experiment).
 - ii) Measure mass of a sample of oil; measure the volume of water that will be heated; ignite and burn the oil; use the flame from the burning oil to heat the water; measure the water temperature before and after burning the oil; 4.2 J of energy per cm³ of water and per degree Celsius of temperature rise (specific heat capacity of water).
 - iii) Constant/known mass of oil; constant/known volume of water; constant size/surface area of tube to hold the water.
 - iv) Care needed to avoid burns from flame/hot tube; care to avoid spilling hot water and causing scalds; care with glassware to avoid breakages and cuts.
- a) Columns with headings on table; rows with headings on table; table shows temperature before and after and preferably also temperature rise.
 - b) Bar chart; temperature rises shown with bars; y axis with temperature scale and appropriate legend.
 - c) Energy yield per hectare = average yield (kg ha⁻¹ year⁻¹) × energy yield per kilogram (J kg⁻¹); correct calculations; palm oil yield per hectare is higher.
 - d) More photosynthesis in palm oil crop; higher temperature so more photosynthesis; higher light intensity so more photosynthesis; higher proportion of energy from photosynthesis stored in oil by oil palms than by other crops.

6. Analysis of tropical peat soils; identification of peat soils on which palm oil can be grown without excessive CO₂ emissions; identification of peat soils that should be conserved; life cycle assessment of oil crops; establishment of nature reserves in upland areas; establishment of wildlife corridors between reserves.

7. Award marks in a range from 0 marks for invalid arguments not based on evidence to 5 marks for a convincing argument based on evidence.

8. Shows that an article is based on evidence; gives academic credence; allows information/facts to be checked; allows data analysis/statistics to be checked; allows researchers to find other relevant sources.

Concept-Relationships

Cell structure, Tissues, Organs, Systems

Classification, Unity and Diversity in life forms

(a)	body divided into/segmented three parts / head, thorax and abdomen (one pair of) antennae / feelers wings three pairs / 6 legs compound eyes	[max 3]	R segmented body unqualified <i>do not accept arthropod features</i>
(b)	<u>arthropod</u> / Arthropoda	[1]	must have arthr so accept arthropod but reject anthropod
(c)	chromosome nucleus mitochondria chloroplast plasmid nucleolus		Note: Apply list rule
(d)	1 two groups: 1 – 6 and 11 & 12 migrate to New Zealand 2 1 – 6, New Caledonia / indirect / migration A 3 11&12, direct (Australia) / migration B 4 correct example of (evolutionary) relationship / DNA similarity, e.g. 13 & 14 most distantly related from others / 9 & 10 most closely related to each other ref to, clade(s) / cladogram	[max 3]	

2.

(a)	group of vertebrates	scaly skin	external ear (pinna)	feathers	mammary glands	
	birds	✓	✗	✓	✗	
	bony fish	✓	✗	✗	✗ ;	
	amphibians	✗	✗	✗	✗ ;	
	reptiles	✓	✗	✗	✗ ;	
	mammals	✗	✓	✗	✓ ;	

[4]

3.

(a)	<u>arthropods/Arthropoda</u> ;	[1]	R 'anthropod'
(b)	<p>A – spiny/oval, carapace/AW ; jagged edge of carapace ; claws same length ; eyes on (short) stalks ;</p> <p>B – long/coiled/soft , abdomen ; abdomen not under carapace ; (long) antennae ; multiple, appendages/mouth parts ; shorter back (walking) legs ; uneven length of, chelipeds/claws/pincer ; hair on claws ; eyes on stalks ;</p> <p>C – uneven length of, chelipeds/claws/pincers ; square/rectangular, carapace ; eyes on (long) stalks ;</p> <p>D – rounded/flattened/less hairy, back/hind (walking) legs ; longer/wider back (walking) legs (compared to other legs) ; jagged edge on claws ; jagged/pointed edge, of carapace ; short antennae ; no eye stalks ; claws same length ;</p>	<p>A descriptions of carapace/back/'shell' ignore exoskeleton for carapace</p> <p>ignore 'tail' for abdomen ignore segmented abdomen</p> <p>ignore clamp ignore fur for hair</p> <p>A larger/bigger as BOD (for hind legs)</p>	[4]
(c)	<p>(i) mass ; size of a named suitable feature ; length of named suitable feature ; width of named suitable feature; number of hairs ; number of spikes/roughness ; thickness of a suitable named feature ; hardness of a suitable named feature ; depth of colour ;</p>	[max 1]	<p><i>features qualified in (c)(ii) may be credited in (c)(i)</i></p> <p>R number of anything absolute (e.g. legs) R shape unqualified R colour unqualified R fur ignore comparing species rather than individuals</p>
	(ii) balance/weighing machine/scales ; use of ruler described ; calipers ; any other suitable method for the feature given in (i) ;	[max 1]	<p>ignore measure unqualified No ECF from (c)(i)</p>
(d)	<p>1 population remains the same if birth rate = death rate/ref to carrying capacity ; 2 death rate must be high ; 3 many young crabs do not survive to, adulthood/breed ; 4, 5 example of cause of high death rate ; 6 lack of/competition for, food ; 7 ref to <u>limiting factor(s)</u> ;</p>	[max 3]	<p><i>examples of MP4 and MP5</i> eaten by predators competition with other crabs (of the same species/other species) competition with other non-crab species (infectious) disease effect of abiotic factor (e.g. dehydration) indirect effect of man, e.g. pollution/habitat destruction genetic disease/genetic 'fault' fishing/crabbing</p>
(e)	<p>1 stops/reduces, blood loss/bleeding ; 2 reduce (bacterial) infection/bacteria killed in wound ; 3 (clotting) prevents entry of pathogens ; 4 more red blood cells, trapped in mesh/fibrin (forming a clot/scab) ; 5 promotes healing ; 6 (in an emergency) may need wound to be sealed quickly ; 7 less chance of allergies ;</p>	[max 3]	<p>ignore bandages help quicker clotting R <u>viral</u> infections</p>
			[Total: 13]

Competition, Predator/ prey, Interdependency

DNA, Genome mapping and application

(i)	nucleus ;	[1]	Ignore chromosomes
(ii)	1 idea that animals are identified accurately ; R identify unqualified 2 barcoding is, cheap/easy/quick/efficient ; 3 barcoding is useful if distinguishing characteristics/dichotomous key are difficult ; 4 identify previously unknown species ; 5 helps to identify, threatened/endangered species ;	max [2]	
(iii)	1 ref to genes ; 2 codes for (specific) proteins ; 3 stores genetic information ; 4 can be copied to pass on information to new cells ;	max [2]	

2

(a)	DNA / genome is the same / similar ; genes are same ; AVP ; e.g. ref to DNA bases / sequence, same / similar	[max 2] [3]
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Cell division, Mitosis, Reproduction, Life cycles

(a)(i)	<table border="1"> <tr> <td>meiosis</td><td>/</td><td></td><td>/</td><td></td></tr> <tr> <td>mitosis</td><td></td><td>/</td><td></td><td>/</td></tr> </table> :::	meiosis	/		/		mitosis		/		/	2	correct answer column 1 and 2 = 1 i correct answer column 3 and 4 = 1 i
meiosis	/		/										
mitosis		/		/									
7(b)	selection by humans / AW ; of individuals(s) with desired features / AW ; crossing / mating / breeding, (them together) ; selecting offspring with desired features and breed again ; over many generations ;	3											
7(c)	changing the, genetic material / DNA, of an organism ; by using genes ; from another organism ; (adding genes to) confer resistance to, herbicides / insect pests ; to make vitamins ; examples ;	4	A genetically modify an organism A alleles max 2 for examples A other examples include : salt tolerance / drought resistance / growth in harsh conditions nitrogen fixation virus resistance delayed ripening seedless watermelons flavr savr tomatoes make plants grow faster										
7(d)	herbicides ; insecticide ; fertilisers ; irrigation / watering ; use of machinery ; crop rotation ; biological pest control ; more light ; AVP ::	2	I weather e.g. pesticides / fungicide										

[11]

2

(i)	meiosis ;	[1]	
(ii)	maintains/increases population ; allows variation ; adaptation to, new / changed, environment(s) ; natural selection / evolution / formation of new species ; AVP ; e.g. two parents contribute to survival of offspring e.g. allows expression of recessive, alleles / traits / genes	max [3]	ignore survival unqualified
(i)	gas exchange/named example with direction ; transfer of (dissolved) nutrients, from maternal (circulation) / to fetal ; transfer of excretory products, from fetal / to maternal ; by diffusion ; produces/secretes, (named) hormone ; passive immunity/antibodies, from maternal / to fetal ; prevents/limits, mixing of blood ; ref to regulating blood pressure ; AVP ; e.g. maternal/fetal attachment point e.g. ref to counter current flow / maintains concentration gradient e.g. hormone function described	max [4]	ignore food/nutrition for nutrients A glucose/amino acids/ions/water A urea/(nitrogenous) waste A progesterone/oestrogen/HCG/HPL/HCS
(ii)	protection from (mechanical) shock (of fetus) ; maintains (constant) temperature (of fetus) ; allows movement (of fetus) ; prevents dehydration ; AVP ;	max [2]	

3.

(i)	N and S ;	1	either order
(ii)	R has different characteristics to the parent / has dark eyes / knobs on the end of antennae / knobs on abdomen ;	1	
(iii)	phenotype ;	1	

Factors affecting human health, Vaccination, Pathogens/ parasites

1.

(a) (i)	line shows less steep gradient / line levels off / line goes down ;	[1]	could be a time delay, A. change some time after X
(ii)	shortage of food / build up of toxins / lack of space;	[1]	I. optimum / competition
(b) (i) and (ii)	correct label hyphum / hypha / (i) to any part below the spores; spore / (ii) to any of the spores;	[2]	
(c)	no chloroplasts / chlorophyll; cell wall / vacuole / nucleus; cell wall / large or permanent vacuole;	[3]	If not stated then assume answer refers to fungus e.g. no cell wall = 0 I. structures which are not visible e.g. cell membrane / glycogen
(d)	human cells lack cell wall; human cells not affected; bacteria can't grow / killed / weakened / unable to reproduce;	[max 2]	I. living cells, not qualified I. humans unqualified I. references to white blood cells / antibodies / immunity White blood cells / antibodies kill bacteria = 0 A. bacteria burst
(e) (i)	E;	[1]	more than one letter = 0
(ii)	largest clear area surrounding disk / more bacteria are affected / killed;	[1]	give credit for numerical comparison of clear area I. it spreads more – need idea of less bacteria or larger area cleared

2.

(i)	1 (vaccine contains) harmless / attenuated / dead / AW, form of, (named) pathogen / antigen ; 2 (antigens / vaccine) stimulate an <u>immune response</u> ; 3 ref to lymphocytes ; 4 lymphocytes / white blood cells, make antibodies ; 5 ref to specificity ; 6 production of memory cells ; 7 rapid, immune response / AW, if exposed to same, pathogen / antigen ; 8 gives long-term immunity ; 9 AVP ;	
(ii)	1 bacteria may still be present (in the population) ; 2 in carriers / in people who have no symptoms ; 3 infected people moving into the, country / area / AW ; 4 if few people are, immune / vaccinated, bacterium is more likely to be transmitted ; 5 idea of herd immunity ; 6 some people cannot respond to, antigens / vaccines ; 7 protects people who travel to other countries ; 8 booster vaccinations are sometimes required) / AW ;	8,6