

# Markscheme

November 2021

Biology

Higher level

Paper 2

14 pages

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## Section B

### Extended response questions – quality mark

- Extended response questions for HLP2 each carry a mark total of **[16]**. Of these marks, **[15]** are awarded for content and **[1]** for the quality of the answer.
- **[1]** for quality is awarded when:
  - the candidate's answers are clear enough to be understood without re-reading.
  - the candidate has answered the question succinctly with little or no repetition or irrelevant material.

Candidates that score very highly on the content marks need not necessarily automatically gain **[1]** for quality (and *vice versa*).

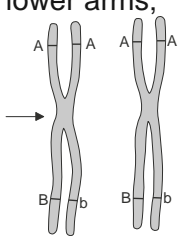
**Section A**

Question		Answers	Notes	Total
1.	a	a negative correlation/decrease (in biomass) as temperature rises in added-nutrients (mesocosms); b little/no (significant) change in biomass as temperature increases in control (mesocosms);		2 max
	b	a autotroph biomass decreases <u>and</u> heterotroph biomass increases with higher temperatures; b decrease in autotrophs is greater/larger/more than increase in heterotrophs <b>OR</b> little difference in biomass (between auto and heterotrophs) at highest temperature/27°C; c autotrophs show smaller and smaller gains in biomass from initial as temperature rises/WTTE; d heterotrophs no gain in biomass at 21°C then larger and larger gains as temperature rises;		2 max
	c	<i>rate of photosynthesis increases as temperature rises because:</i> a temperature is the limiting factor for photosynthesis; b higher temperatures increase enzyme activity; c faster molecular motion/more molecular kinetic energy/more frequent enzyme-substrate collisions; d Calvin cycle/light independent reactions (of photosynthesis) speed up;		2 max
	d	<i>biomass of autotrophs decreases as temperature rises because of:</i> a more herbivory/grazing/feeding by (zooplankton/heterotrophs); b higher populations/numbers/biomass of zooplankton/heterotrophs; c more mortality/more decomposition/decay of autotrophs/phytoplankton; d <u>respiration</u> (rate higher than photosynthesis rate in autotrophs/phytoplankton);		2 max

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
1.	e	a increased temperature raises biomass; b increased nitrate raises biomass more than increased temperature; c increased nitrate and temperature raises biomass by same amount as nitrate alone;		3 max
	f	a water availability/rainfall/humidity; b light/sunlight (intensity) / daylength; c salinity of <u>soil</u> / high/low <u>soil</u> pH; d chemical pollution/herbicides/allelopathy/parasitic weeds;	Mark the first two answers only. Do not accept carbon dioxide or weather conditions.	2 max
	g	<p><i>advantages of mesocosms/converse problems with studies in natural environments</i></p> a easier to manipulate/control variables/conditions / less susceptible to outside influences OR easier to replicate OR take up less space;  <p><i>disadvantages of mesocosms/converse opportunities with studies in natural environments</i></p> b some trophic levels missing/incomplete food chains in mesocosms OR large animals cannot be included / ethical concerns about enclosing animals in mesocosms OR some variables lacking in mesocosms / doesn't show what happens in natural ecosystems;	Allow only one mark for an advantage and one mark for a disadvantage as this is a discuss question.	2 max

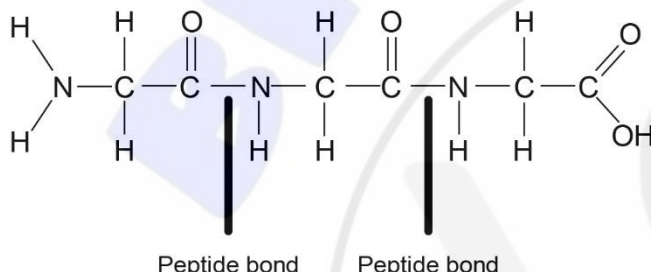
Question			Answers	Notes	Total									
2.	a	i	<p>a parental alleles shown as <math>X^H</math> and <math>X^h</math> (female) and <math>X^H</math> and Y (male);</p> <p>b Punnett square with genotypes of offspring shown as <math>X^H X^H</math> and <math>X^H Y</math> and <math>X^H X^h</math> and <math>X^h Y</math>;</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td><math>X^H</math></td> <td><math>Y</math></td> </tr> <tr> <td><math>X^H</math></td> <td><math>X^H X^H</math></td> <td><math>X^H Y</math></td> </tr> <tr> <td><math>X^h</math></td> <td><math>X^H X^h</math></td> <td><math>X^h Y</math></td> </tr> </table>		$X^H$	$Y$	$X^H$	$X^H X^H$	$X^H Y$	$X^h$	$X^H X^h$	$X^h Y$		2
	$X^H$	$Y$												
$X^H$	$X^H X^H$	$X^H Y$												
$X^h$	$X^H X^h$	$X^h Y$												
	a	ii	$X^H X^h$ ;		1									
2.	b	i	<p>all four upper arms with one A and both chromosomes with one B and one b on the lower arms;</p> 	<i>The chromatids can be shown as single lines rather than the wider versions in the question.</i>	1									
	b	ii	prophase I;		1									
	c		<p>a located on the same chromosome;</p> <p>b genes/gene loci close together (on the same chromosome);</p> <p>c do not follow (the law of) independent assortment;</p> <p>d more chance of recombination if genes are further apart;</p> <p>e inherited together unless crossing over/recombination occurs;</p> <p>f ratios of offspring in dihybrid crosses are different from expected/non-Mendelian</p> <p><b>OR</b></p> <p>more offspring with parental phenotype combinations than expected;</p>		2 max									

(continued...)

(Question 2 continued)

Question		Answers	Notes	Total
	<b>d</b>	a cortical reaction (after first sperm nucleus enters the egg); b vesicles/cortical granules release their contents/enzymes (from the egg/zygote); c zona pellucida/glycoprotein coat/outer coat hardened / fertilization membrane formed; d <u>enzymes</u> of sperm/acrosome cannot digest (hardened coat) OR glycoproteins/ZP3 (in zona pellucida) altered so sperm cannot bind;		<b>2 max</b>

Question		Answers	Notes	Total
<b>3.</b>	<b>a</b>	cells absorb water by <u>osmosis</u> and swell/increase in volume OR cells burst/lyse;		<b>1</b>
	<b>b</b>	leukemia/other diseases of the hematopoietic system / skin burns;		<b>1 max</b>
	<b>c</b>	a depolarization of part of axon/membrane triggers/causes depolarization of next part; b local currents; c diffusion of sodium ions between depolarized part and next/polarized part (of axon); d resting potential reduced/polarization of membrane becomes less /change from -70 to -50mV; e sodium channels open when -50mV/threshold potential reached; f entry of sodium ions causes depolarization; g saltatory conduction in myelinated neurons/axons;	<i>Allow answers in an annotated diagram</i>	<b>3 max</b>

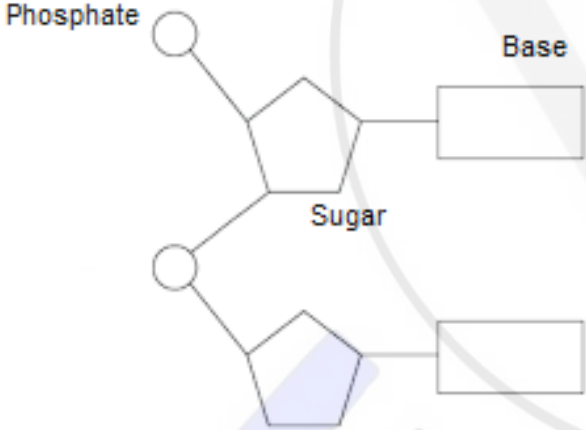
Question 4a and 4c: are common with SLP2 Q2a and 2c			
4.	a	<p>circle/bracket around peptide bond / arrow pointing to peptide bond / peptide bond labelled;</p> 	<p><i>Allow either peptide bond</i></p> <p><i>Allow if adjacent C=O and NH groups are included in the circle/bracket, but do not allow if other parts of the molecule are included.</i></p> <p style="text-align: right;"><b>1</b></p>
	b	<p>a polypeptide wound into a helical structure / alpha/α helix  <b>OR</b>                      polypeptide folded back on itself forming a pleated sheet / beta/β pleated sheet;</p> <p>b stabilized/held in shape by/due to hydrogen bonds (between C=O and N-H groups);</p> <p>c secondary structures are regular/unvarying (within polypeptides/proteins);</p>	<p><i>Allow annotated diagrams</i></p> <p style="text-align: right;"><b>2 max</b></p>
	c	contracts/flattens/becomes less domed/increases volume of thorax;	<b>1</b>

Question			Answers		Notes	Total
Question 5a: is common with SLP2 Q3a						
5.	a		<b>Detritivores</b>	<b>Saprotrophs</b>	Accept not autotrophic/not photosynthetic instead of heterotrophic.  Do not accept that both groups are decomposers or consumers for the similarity.	2
		Similarity	heterotrophic OR feed on/obtain nutrients from dead organic matter/dead organisms;			
		Difference	internal digestion/digestion in gut OR enzymes secreted into gut OR food ingested before digestion	external digestion OR enzymes secreted into surroundings OR food digested before being absorbed;		
	b		a genes for flowering are activated/gene activation/changes to gene expression; b shoot apex changes from producing leaves/stem to producing flowers; c daylength/duration of the day/night length/photoperiod measured/detected/responded to; d short day plants flower when they have a long night/period of darkness OR long day plants only flower when they have a short night/period of darkness; e so short day plants/SDPs flower in late summer/fall/autumn/winter OR so long day plants/LDPs flower in spring/(early) summer;			3 max
	c		a apical meristem (of shoot/stem) produces cells/elongates the stem OR cell division/mitosis in tip/apex of shoot/stem; b auxin stimulates cell/stem growth/extension/enlargement; c elongation of cells causes stem to grow (in length);			2 max

**Section B**

**Clarity of communication: [1]**

The candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.

Question		Answers	Notes	Total
6.	a	<p>a ribose drawn as pentagon and labelled sugar/ribose;                      b base drawn with correct link to (C<sub>1</sub> of) ribose and labelled base/nitrogenous base;                      c phosphate drawn with correct link to (C<sub>5</sub> of) ribose and labelled P/phosphate;                      d two (or more) ribonucleotides drawn with correct link (C<sub>3</sub> to C<sub>5</sub>)</p> 		4 max

(continued...)

(Question 6 continued)

Question		Answers	Notes	Total
6.	b	a synthesis of RNA/mRNA / transcription of DNA to RNA; b RNA nucleotides linked together to form a strand/chain; c RNA strand assembled on DNA template/antisense strand / copy made of sense strand; d <u>RNA polymerase</u> carries out transcription/links RNA nucleotides; e uncoiling/separation of DNA strands; f 3' end of nucleotides linked to 5' end of (growing RNA) strand; g <u>complementary base pairing</u> (is the basis of copying the base sequence); h <u>uracil</u> instead of <u>thymine</u> in RNA; i starts at/RNA polymerase binds to a promoter; j regulated by transcription factors/DNA binding proteins/nucleosomes;	<i>Annotated diagrams can be used.</i>	<b>7 max</b>

(continued...)

(Question 6 continued)

Question		Answers		Notes	Total
6.	c				4 max
		<b>continuous variation</b>	<b>discrete variation</b>		
		a no distinct categories / intermediates / many possible phenotypes	distinct categories / non-overlapping classes / few possible phenotypes;		
		b multiple genes/polygenic	one/few influencing genes;		
		c environmental influences	not influenced by environment;		
d height/weight/skin colour/intelligence/other example	blood groups/number of eggs/ other example;				

Question		Answers	Notes	Total																		
7.	a	a polarity of water; b hydrogen bonds between water molecules; c cohesion between water molecules/water molecules stick together; d cohesion allows tensions/low pressures/transpiration pull/movement upward/against gravity; e adhesion to cellulose/cell walls generates tensions/pull (in xylem) OR adhesion to xylem walls/vessel walls causes capillary rise/upward movement; f solvent for many substances / many substances dissolve; g liquid at most temperatures experienced by plants / liquid so can flow;	<i>Polarity of water and/or hydrogen bonding can be shown in an annotated diagram.</i>	4 max																		
	b	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;"><i>Xylem</i></th> <th style="width: 50%; text-align: center;"><i>Phloem</i></th> </tr> </thead> <tbody> <tr> <td>a transports water/mineral ions</td> <td>sucrose/sugars/amino acids/organic/carbon compounds/products of photosynthesis/food;</td> </tr> <tr> <td>b from roots to leaves</td> <td>from source/leaves to sink/roots;</td> </tr> <tr> <td>c dead/no membranes/no organelles</td> <td>living/membranes present/some organelles;</td> </tr> <tr> <td>d no cross/end walls/hollow/continuous tubes</td> <td>sieve plates/perforated walls/separate elements;</td> </tr> <tr> <td>e flow due to low pressures/tension/suction</td> <td>flow due to high pressure/pressure gradient;</td> </tr> <tr> <td>f thicker walls</td> <td>thinner walls</td> </tr> <tr> <td>g lignified walls / gives support / forms wood</td> <td>does not provide support/strength;</td> </tr> <tr> <td>h wider lumen</td> <td>narrower lumen</td> </tr> </tbody> </table>	<i>Xylem</i>	<i>Phloem</i>	a transports water/mineral ions	sucrose/sugars/amino acids/organic/carbon compounds/products of photosynthesis/food;	b from roots to leaves	from source/leaves to sink/roots;	c dead/no membranes/no organelles	living/membranes present/some organelles;	d no cross/end walls/hollow/continuous tubes	sieve plates/perforated walls/separate elements;	e flow due to low pressures/tension/suction	flow due to high pressure/pressure gradient;	f thicker walls	thinner walls	g lignified walls / gives support / forms wood	does not provide support/strength;	h wider lumen	narrower lumen		4 max
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(continued...)

(Question 7 continued)

Question		Answers	Notes	Total
7.	c	a light-dependent reactions produce ATP/reduced NADP; b ATP generated by chemiosmosis/by photophosphorylation/by ATP synthase; c reduced NADP produced by/using electrons from Photosystem I; d RuBP + CO <sub>2</sub> to glycerate 3-phosphate (in light independent reactions); e glycerate 3-phosphate reduced to triose phosphate (in light independent reactions); f ATP/reduced NADP used in the light-independent reactions; g reduced NADP provides electrons/hydrogen / to reduce (glycerate 3-phosphate) OR reduced NADP used to convert glycerate 3-phosphate to triose phosphate; h ATP provides energy (for reduction of glycerate 3-phosphate); i ATP needed to regenerate RuBP j ATP/reduced NADP run out in darkness k <u>Calvin cycle</u> only possible with light/in the day/is indirectly dependent on light;		7 max

Question		Answers	Notes	Total
8.	a	a change to conformation/shape/tertiary structure/3-D shape; b bonds within the protein/intramolecular bonds broken/changed; c pH and temperature (outside tolerated ranges) can cause denaturation; d vibrations/heat at high temperatures breaks bonds; e high pH/low pH/extreme pH alters ionization/charges (of amino acids and breaks ionic bonds); f protein cannot carry out its function OR active site of enzymes cannot bind substrates/catalyze reaction/no enzyme-substrate complex; g permanent/irreversible change (usually) OR soluble proteins become insoluble/precipitate;	Allow any mark points if made clearly on an annotated graph or diagram.	4 max
	b	a antigens stimulate antibody production; b antibodies produced by lymphocytes; c macrophages/phagocytes ingest/engulf pathogens and display antigens from them; d T-cells activated by binding antigen/by macrophage displaying antigen; e activated T-cells cause activation of B-cells; f mitosis/division of (activated) B-cells (to produce a clone of cells) g plasma cells formed from divided/activated/growing/differentiating B-cells; h plasma cells/plasma B-cells secrete antibodies; i clonal selection / plasma cells make same type of antibody/antibody specific to same antigen; j some activated B-cells become memory cells;		7 max

(continued...)

(Question 8 continued)

Question		Answers		Notes	Total												
8.	c	<table border="1"> <thead> <tr> <th>competitive</th> <th>non-competitive</th> </tr> </thead> <tbody> <tr> <td>a binds to/blocks <u>active site</u></td> <td>binding away from active site/to allosteric site;</td> </tr> <tr> <td>b inhibitor and substrate are (chemically) similar</td> <td>inhibitor different from substrate;</td> </tr> <tr> <td>c binding of <u>substrate</u> prevented (because active site is occupied)</td> <td>active site changed (by inhibitor binding elsewhere) preventing substrate binding;</td> </tr> <tr> <td>d inhibition reduced by increasing substrate concentration</td> <td>inhibition not affected by increased substrate concentration;</td> </tr> <tr> <td>e useful as pharmaceuticals/toxins</td> <td>useful as end-product inhibitors;</td> </tr> </tbody> </table>		competitive	non-competitive	a binds to/blocks <u>active site</u>	binding away from active site/to allosteric site;	b inhibitor and substrate are (chemically) similar	inhibitor different from substrate;	c binding of <u>substrate</u> prevented (because active site is occupied)	active site changed (by inhibitor binding elsewhere) preventing substrate binding;	d inhibition reduced by increasing substrate concentration	inhibition not affected by increased substrate concentration;	e useful as pharmaceuticals/toxins	useful as end-product inhibitors;	<p>Accept <i>mpd</i> in a graph.</p> <p>Accept <i>mpa</i>, <i>mpb</i> or <i>mpc</i> on an annotated diagram.</p> <div data-bbox="1440 517 1951 890" data-label="Figure"> <p>The figure is a line graph titled "Enzyme Inhibition". The y-axis is labeled "Rate of reaction" and the x-axis is labeled "Substrate concentration". Three curves are shown: 1. "Normal enzyme": A curve that rises steeply and then levels off to a high plateau. 2. "Competitive inhibitor": A curve that rises less steeply than the normal enzyme but eventually reaches the same high plateau. 3. "Noncompetitive inhibitor": A curve that rises less steeply and levels off at a lower plateau than the normal enzyme.</p> </div> <p>[Source: Enzyme inhibition curves, ImranKhan1992, Available at: <a href="https://commons.wikimedia.org/wiki/File:Enzyme_kinetics_curve#/media/File:Enzyme_kinetics_curve.png">https://commons.wikimedia.org/wiki/File:Enzyme_kinetics_curve#/media/File:Enzyme_kinetics_curve.png</a> CC0 1.0 Universal (CC0 1.0) Public Domain Dedication <a href="https://creativecommons.org/publicdomain/zero/1.0/deed.en">https://creativecommons.org/publicdomain/zero/1.0/deed.en</a> Source adapted.]</p>	4 max
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References:

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