AQA A-LEVEL · 7402

BIOLOGY



MARK SCHEME

3.1.7 WATER

SCORE	PERCENTAGE
/45	%

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Q1.

(a) 1. (water has a relatively) high (specific) heat capacity;
Ignore numbers relating to heat capacity

2. Can gain / lose a lot of heat / energy without changing temperature;
OR
Takes a lot of heat / energy to change temperature;
Accept due to H bonding between water molecules

2

(b) Adenosine diphosphate and (inorganic) phosphate;
Accept ADP for adenosine diphosphate
Accept Pi / PO_4^{3-} / P in a circle for inorganic phosphate
Reject adenine diphosphate
Reject phosphorus / P for phosphate

1

(c) 1. Species / organism the muscle tissue came from;
OR
Thickness / type / source of the muscle tissue;
Ignore surface area of muscle tissue

2. Temperature of the muscle tissue / ATP solution / slides;
Need to be qualified

3. pH of the ATP solution;
Need to be qualified
Reject concentration / volume of ATP hydrolase

2 max

(d) Description
1. As concentration of ATP increases, length of muscle decreases;
Accept negative correlation

Explanation
2. More ATP (hydrolysed by ATP hydrolase), **so** more energy released, **so** more muscle contraction / shortening of muscle;
Accept more ATP available for correct/named aspect of muscle contraction
Idea of more is required once.
Reject energy produced

2

(e) 4.88×10^{-6} ;;;

If answer incorrect

EITHER

Allow 1 mark for 0.244

Allow 1 mark for 1.22×10^{-5}

OR

Allow 1mark for 12200 / 1.525

Allow 1 mark for 0.61

Accept 5×10^{-6}

Accept correct answer however expressed

Max 2 for incorrect final answer

3

[10]

Q2.

(a) 1. Polar molecule;

2. Acts as a (universal) solvent;

OR

3. (Universal) solvent;

4. (Metabolic) reactions occur faster in solution;

OR

5. Reactive;

6. Takes place in hydrolysis / condensation / named reaction;

Polar molecule so acts as (universal) solvent so (metabolic reactions are faster = 3 marks

4

(b) Name of ion;

Correct function within cell;

Ions other than sodium in specification are H^+, Fe^{2+} and PO_4^{3-} but accept any correct ion (other than sodium) plus relevant function = 2.

Allow ion to be named in words but not as element, e.g, iron ion but not iron.

2

(c) 1. Comparison: both move down concentration gradient;

2. Comparison: both move through (protein) channels in membrane;

Accept aquaporins (for water) and ion channels

3. Contrast: ions can move against a concentration gradient by active transport

3

[9]

Q3.

(a) Any **two** valid reasons;

e.g.

1. Increase in plant diversity leads to more types of food for animals;

2. Increase in variety of animals leads to increase in predator species;

3. Increase in niche / habitat

2 max

(b) 1. Repeat soil sorting for different times and record number of species collected;

2. Find optimum time / time beyond which further sorting does not lead to increase in animal species found

2

(c) 1. No data on number of individuals in each

species / diversity index $= \frac{N(N-1)}{\sum n(n-1)}$

1

(d) Principle:

1. Overlap of 2 × SD shows probability of differences (in means) being due to chance is greater than 0.95;

Allow converse of MP1

Credit MP1 wherever it appears

Agree:

2. No difference in number of earthworms and millipedes (per m^2)

3. No difference in number of species of centipedes or millipedes.

Disagree:

4. More beetles and woodlice in grassy strips;

5. More species of beetles, earthworms, woodlice in grassy strips.

4 max

[9]

Q4.

Low humidity results in more woodlice moving;

So increased movement increased chance of leaving dry / unfavourable environment so reduce water loss / reduce evaporation;

[2]

Q5.

(a) (i) both are polymers / polysaccharides / built up from many sugar units / both contain glycosidic bonds / contain (C)arbon, (H)ydrogen and (O)xygen;

1

(ii) hemicellulose shorter / smaller than cellulose / fewer carbons;

hemicellulose from pentose / five-carbon sugars and cellulose from hexose / glucose / six-carbon sugars;

(only credit answers which compare like with like.)

2

(b) protein / nucleic acid / enzyme / RNA / DNA / starch / amylose / amylopectin polypeptide;

1

(c) (i) to make sure that all the water has been lost;

1

(ii) only water given off below 90 °C;
(above 90°C) other substances straw burnt / oxidised / broken down;
and lost as gas / produce loss in mass;

2

(d) enzymes are specific;
shape of lignin molecules will not fit active site (of enzyme);
OR
shape of active site (of enzyme);
will not fit molecule;

2 max

(e) 1. made from β-glucose;
2. joined by condensation / removing molecule of water / glycosidic bond;
3. 1 : 4 link specified or described;
4. "flipping over" of alternate molecules;
5. hydrogen bonds linking chains / long straight chains;
6. cellulose makes cell walls strong / cellulose fibres are strong;
7. can resist turgor pressure / osmotic pressure / pulling forces;
8. bond difficult to break;
9. resists digestion / action of microorganisms / enzymes;

(allow maximum of 4 marks for structural features)

6 max

[15]

Q1.

Answers to (a) showed good knowledge, but there was some confusion between heat capacity and the latent heat of vaporisation. Many students hedged their bets by referring to latent heat capacity. There were several students who stated that a high heat capacity was caused by strong hydrogen bonds, or that hydrogen bonds were between H^+ and O^{2-} in water, not between water molecules.

Question (b) was well answered; the most common mistake was stating *adenine* diphosphate instead of adenosine diphosphate.

In (c) many students did not consider the question and either gave variables whose control had already been given in the question, or gave unqualified answers of temperature and pH. Only 7% of students scored two marks. Many also stated the concentration of ATP hydrolase, again showing a failure to consider the question and realising that this cannot be controlled as it was produced by the muscle tissue.

In question (d), the description was well answered by the majority, however many students thought the muscle became shortened as the muscle tissue was being hydrolysed. Several also stated that ATP released more energy for respiration. References to energy being 'produced' negated otherwise good responses.

Students found (e) very difficult, with only 3.7% of them scoring all three marks. Many failed to use the table correctly and realise that the concentration of ATP added to the slide was $\times 10^{-6}$ mol dm^{-3}. Two marks were regularly awarded for incorrect responses, however, for including 12200 and 0.61 in the workings. 7.5% of students made no attempt whatsoever to answer this question.

Q4.

Many candidates were confused about low relative humidity environments and whether they were dry or moist. Also, many did not use the data from **Resource B** to state that more woodlice move in a low humidity environment. Several candidates linked low humidity to water on the gills and so decreased gas exchange.

Q5.

(a) (i) Answers to parts of this question were not infrequently marred by lack of knowledge of the basic structure of cellulose as a polymer of β-glucose. Thus, although all that was required here was to note that both molecules were polymers, many disqualified their answers by referring to cellulose as also being a pentose.

(ii) Limited question technique frequently restricted the credit available. Many candidates concentrated on functional rather than structural differences. As a consequence, the answer boxes were often so full that they rarely compared like with like and offered a valid comparison. Among the better, more focused, answers were some which unfortunately were a little too concise, referring to hemicellulose as a pentose and cellulose as a hexose. Questions requiring structural similarities are likely to remain a feature of BYA1. Candidates clearly need an effective strategy for answering them.

(b) Starch and protein were correctly identified by many, but a range of incorrect responses included glycogen, phospholipid and various monosaccharides.

(c) (i) Answers suggested that, although candidates were clearly familiar with the term “constant mass”, they were by no means all conversant with the idea that it represented the point at which all water had been lost.

(ii) There were many correct answers. Answers to this second part, such as “Going over 90 °C would start to boil the water so that we would be unable to calculate the water content” were frequent and suggested that candidates had failed to focus on the information provided in the second paragraph of the passage. The better candidates at whom this question was directed were generally able to point out, however, that high temperatures might lead to other substances being broken down and a consequent loss in mass.

(d) Although most candidates were aware of the specific nature of enzyme action, they experienced varying degrees of difficulty in relating the general concepts involved to the context of this question. Those candidates who gained least credit were inclined to reword the question and offer an explanation in terms of the lignin covering. Others offered responses centred around lignin acting as an enzyme inhibitor. Better candidates clearly understood the concepts of molecular shape and fit and were able to apply them to this situation.

(e) Answers to this part of the question ranged from those of the more able candidates who wrote clearly and logically about cellulose structure and function, often with a pleasing level of accuracy and detail, to those which did not gain credit. Among the latter were many who failed to attempt this part of the question and others who confused cellulose with other molecular components of plant cells such as starch and plasma membranes. There was much confusion between hydrogen bonds and glycosidic bonds, and between α-glucose and β-pleated sheets.

Other incorrect assertions which frequently arose were that cellulose is formed from alternating α- and β-glucose residues, and that it contains both 1-4 and 1-6 linkages. Many candidates correctly identified strength as one of the molecule’s properties and went further in discussing the importance of this in withstanding pressures resulting from osmosis. A frequent error, however, was to assign the function of energy storage to cellulose.