A-Level Biology

ATP, Water and Inorganic Ions

Mark Scheme

Time available: 87 minutes
Marks available: 70 marks

1.

(a) 1. and 2. Accept for 2 marks correct names of three components adenine, ribose/pentose, <u>three</u> phosphates;;

Accept for 1 mark, correct name of two components

*Accept for 1 mark, ADP **and** phosphate/Pi*

Ignore adenosine

Accept suitably labelled diagram

3. Condensation (reaction);

Ignore phosphodiester

4. ATP synthase;

Reject ATPase

4

(b) Correct answer for 1 mark = 57/57.1;

1

(c) 1. (Amino acid uptake by) active transport;

Accept for 'transport', process

2. Cyanide reduces/stops amino acid uptake;

3. ATP production stops on <u>membranes</u>

OR

Enzymes not working on <u>membranes</u>;

4. ATP production continues in cytoplasm

OR

Enzymes active in cytoplasm;

3 max

[8]

2.

(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]

3. (a)

Letter	Statement
B;	is a monomer in an enzyme's active site
D;	is a monomer in cellulose
C;	is produced during photosynthesis and respiration
B;	forms a polymer that gives a positive result with a biuret test

Must be in correct order

4

(b) C = 18, H = 32, O = 16;

Accept only these answers

1

(c) 1. Heat with acid **and** neutralise;

Accept boil/water bath for heat

Accept named alkali for neutralise

Accept named examples, eg HCl, $NaHCO_3$

2. Heat with Benedict's (solution);

3. Red precipitate/colour;

Accept other colours eg orange/ brown/green

3

[8]

4. (a)

Must have MP1 for 5 max

3 max for sodium and 3 max for phosphate

Iron ions

1. Haemoglobin binds/associates with oxygen
OR
Haemoglobin transports/loads oxygen;

Ignore reference to 2^+ or 3^+ in Fe^{2+} or Fe^{3+}

Sodium ions

2. Co-transport of glucose/amino acids (into cells);

3. (Because) sodium moved out by active transport/Na – K pump;

4. Creates a sodium concentration/diffusion gradient;

5. Affects osmosis/water potential;

Phosphate ions

6. Affects osmosis/water potential;

*Accept 5. OR 6. – **not** both*

7. Joins nucleotides/in phosphodiester bond/in backbone of DNA/RNA/in nucleotides;

8. Used in/to produce ATP;

Reject 'energy produced'

9. Phosphorylates other compounds (usually) making them more reactive;

10. Hydrophilic/water soluble part of phospholipid bilayer/membrane;

Accept for 1 mark,

Sodium ions cause water reabsorption in kidneys
OR
Sodium ions establish resting potential (in neurones)
OR
Sodium ion diffusion creates action potential

5 max

(b) 1. Phospholipid (bilayer) allows movement/diffusion of non-polar/lipid-soluble substances;

1. and 2. Accept correct named examples

1. and 2. Ignore water

Accept phospholipid (bilayer) allows movement/diffusion of O_2/CO_2

Accept water-insoluble

2. Phospholipid (bilayer) prevents movement/diffusion of polar/ charged/lipid-insoluble substances
OR
(Membrane) proteins allow polar/charged substances to cross the membrane/bilayer;

Accept water-soluble

3. Carrier proteins allow active transport;

4. Channel/carrier proteins allow facilitated diffusion/co-transport;

Accept aquaporins allow osmosis

5. Shape/charge of channel / carrier determines which substances move;

6. Number of channels/carriers determines how much movement;

7. Membrane surface area determines how much diffusion/movement;

6. and 7. Accept correct reference to faster/slower/rate for 'how much movement'

Accept microvilli / Golgi (apparatus) / ER / rER

Accept surface area to volume for 'surface area'

8. Cholesterol affects fluidity/rigidity/permeability;

Accept cholesterol affects vesicle formation/ endocytosis/exocytosis /phagocytosis;

5 max

[10]

5. (a) 1. A <u>metabolite</u> **in** condensation/hydrolysis/ photosynthesis/respiration;

2. A solvent **so** (metabolic) reactions can occur
OR
A solvent **so** allowing transport of substances;

3. High heat capacity **so** buffers changes in temperature;
For 'buffer' accept 'resist'.

4. Large latent heat of vaporisation **so** provides a cooling effect (through evaporation);

5. Cohesion (between water molecules) **so** supports columns of water (in plants);
For 'columns of water' accept 'transpiration stream'.
Do not credit 'transpiration' alone but accept description of 'stream'.
For 'columns of water' accept 'cohesion-tension (theory)'.
For cohesion accept hydrogen bonding

6. Cohesion (between water molecules) **so** produces surface tension supporting (small) organisms;
For cohesion accept hydrogen bonding

Ignore reference to pH.
Allow other suitable properties but must have a valid explanation.
For example
- *ice floating **so** maintaining aquatic habitat beneath*
- *water transparent **so** allowing light penetration for photosynthesis*

5 max

(b)

4 max if marks gained from only 2 substance tests.

Lipid

1. Add ethanol/alcohol **then** add water **and** shake/mix
   OR
   Add ethanol/alcohol **and** shake/mix **then** pour into/add water;

   Reject heating emulsion test.

   Accept 'Add Sudan III and mix'.

2. White/milky emulsion
   OR
   emulsion test turns white/milky;

   Ignore cloudy.

   Reject precipitate.

   Accept (for Sudan III) top (layer) red.

Non-reducing sugar

3. Do Benedict's test **and** stays blue/negative;

   Ignore details of method for Benedict's test for this mp.

4. Boil with acid **then** neutralise with alkali;

   Accept named examples of acids/alkalis.

5. Heat with Benedict's **and** becomes red/orange (precipitate);

   Do not credit mp5 if no attempt at mp4.

   For 'heat' ignore 'warm'/'heat gently'/'put in a water bath' but accept stated temperatures ≥ 60°C.

   Heat must be stated again, do not accept using residual heat from mp4.

   Accept 'do the Benedict's test' ***if*** *full correct method given elsewhere.*

   Accept 'sodium carbonate, sodium citrate and copper sulfate solution' for Benedict's but must have all three if term 'Benedict's' not used.

Amylase

6. Add biuret (reagent) **and** becomes purple/violet/mauve/lilac;

   Accept 'sodium or potassium hydroxide and copper sulfate solution' for 'biuret'.

   Reject heating biuret test.

7. Add starch, (leave for a time), test for reducing sugar/absence of starch;

5 max

(c)

Ignore reference to dimers.

1. A condensation reaction joins monomers together **and** forms a (chemical) bond **and** releases water;

2. A hydrolysis reaction breaks a (chemical) bond between monomers **and** uses water;

3. A suitable example of polymers and the monomers from which they are made;

   3. and 4. Polymers must contain many monomers.

   3. and 4: suitable examples include

   - *amino acid **and** polypeptide, protein, enzyme, antibody or specific example*
   - *nucleotide **and** polynucleotide, DNA or RNA*
   - *Alpha glucose **and** starch/glycogen*
   - *Beta glucose **and** cellulose.*

   If neither specific carbohydrate example is given, allow monosaccharide/glucose and polysaccharide.

   3. and 4. Reject (once) reference to triglycerides.

4. A second suitable example of polymers and the monomers from which they are made;

5. Reference to a correct bond within a named polymer;

   Reject reference to ester bond.

5

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6.

(a) 1. A metabolite **in** condensation/hydrolysis/ photosynthesis/respiration;

2. A solvent **so** (metabolic) reactions can occur

OR

A solvent **so** allowing transport of substances;

3. High (specific) heat capacity **so** buffers changes in temperature;

For 'buffer' accept 'resist'.

4. Large latent heat of vaporisation **so** provides a cooling effect (through evaporation);

Reject latent heat of evaporation

5. Cohesion (between water molecules) **so** supports columns of water (in plants);

For 'columns of water' accept 'transpiration stream'. Do not credit 'transpiration' alone but accept description of 'stream'.

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6. Cohesion (between water molecules) **so** produces surface tension supporting (small) organisms;

For cohesion accept hydrogen bonding

Ignore reference to pH. Allow other suitable properties but must have a valid explanation.

For example

- *ice floating **so** maintaining aquatic habitat beneath*
- *water transparent so allowing light penetration for photosynthesis*

5 max

(b) 1. DNA helicase unwinds DNA/double helix

OR

DNA helicase breaks hydrogen bonds;

2. Both strands act as templates;

Accept description of 'template', eg exposed bases on single (polynucleotide) strands

3. (Free DNA) nucleotides line up in complementary pairs/A-T and G-C;

4. DNA polymerase joins nucleotides (of new strand);

Reject forms hydrogen bonds/joins bases

5. Forming phosphodiester bonds;

6. Each new DNA molecule consists of one old/original/template strand and one new strand;

5 max

[10]

7.

(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]