

2.1 Metabolism & Water

Question Paper

Course	DP IB Biology
Section	2. Molecular Biology
Topic	2.1 Metabolism & Water
Difficulty	Medium

Time allowed: 60
Score: /46
Percentage: /100

Question 1a

- a) Which property or properties (**A**, **B**, **C**) explain the ability of water to dissolve solutes?

Property A: Polarity of water molecules

Property B: High specific heat capacity of water

Property C: Hydrogen bonding

[1 mark]

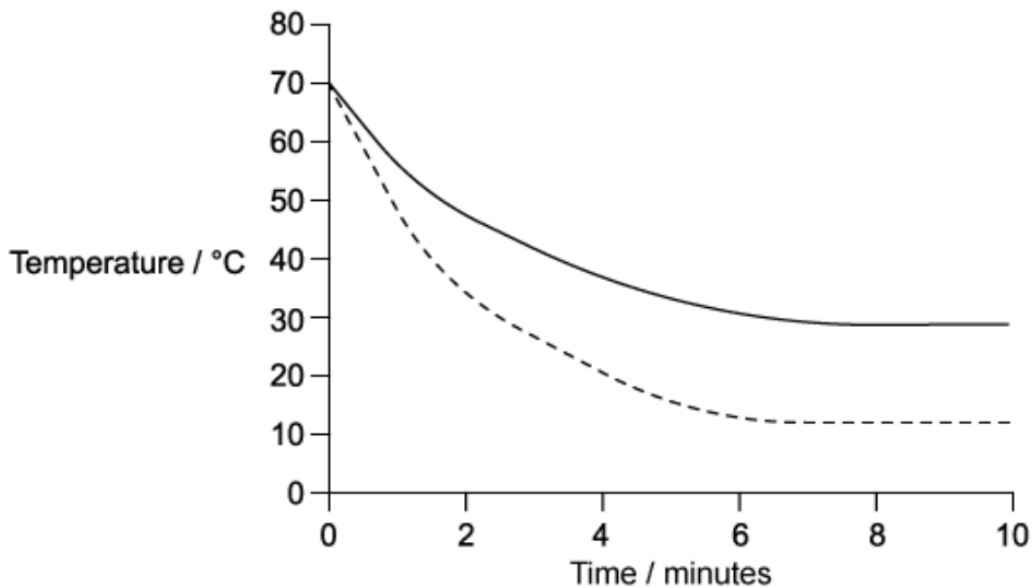
Question 1b

- b) Describe the properties of carbon that make it an ideal element as the basis of living systems.

[3 marks]

Question 1c

- c) A group of students investigated the thermal properties of water. To do this, they poured hot water at 70°C into two thin plastic cups and measured the rate of cooling of each cup. The sides of one cup were covered with tissue paper soaked in hot water. The sides of the other cup were left uncovered. The temperature of the water in each cup was recorded with a thermometer every 2 minutes for 10 minutes. The results are shown in the graph below.



Key:

— uncovered

- - - covered with wet tissue paper

Other than the starting temperature of the water (70°C), give **two** conditions that must be kept the same for each cup throughout the experiment.

[2 marks]

Question 1d

- d) With reference to a thermal property of water, explain how the experiment in part c) can demonstrate the response of the human body to prevent overheating.

[2 marks]

Question 2a

- a) Water plays a very important role within the cytoplasm of cells. Two properties of water that make it an important part of the cytoplasm of cells are its **polarity** and its ability to act as a **universal solvent**.

For each of these **two** properties, explain why this makes water important for the cytoplasm.

[2 marks]

Question 2b

- b) The relatively high specific heat capacity of water is of great biological significance to organisms.

State **one** example of how this property is biologically important.

[1 mark]

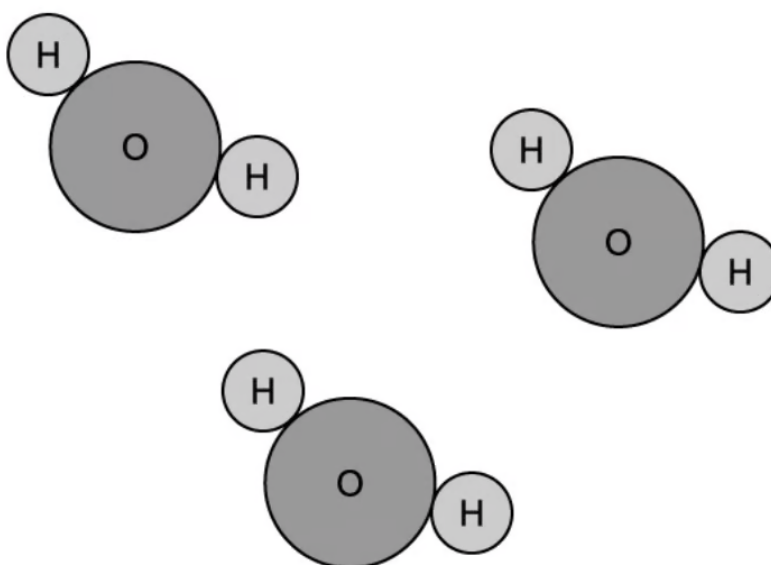
Question 2c

- c) With reference to bonding, explain how the relatively high specific heat capacity of water enables it to buffer temperature changes.

[2 marks]

Question 2d

- d) The diagram below shows three water molecules in close proximity to each other. Using a dotted line, draw a hydrogen bond between water molecules. Also use the symbols δ^+ and δ^- to indicate small electrostatic charges on the appropriate atoms.



[3 marks]

Question 3a

- a) Distinguish between anabolic reactions and catabolic reactions.

[3 marks]

Question 3b

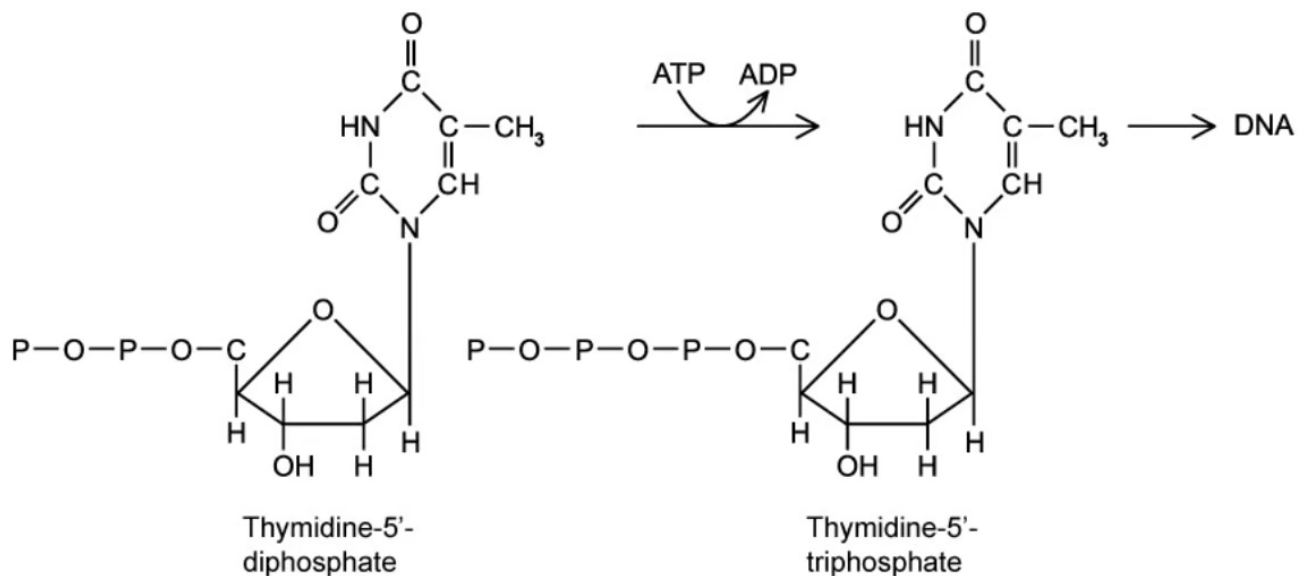
- b) Complete the table with tick marks (✓) in the appropriate boxes.

Cellular reaction	Anabolic	Catabolic
Fats → fatty acids and glycerol		
Accumulation of starch from sugars in plants		
Anaerobic respiration in yeast cells		
Hydrolysis of polypeptides into amino acids		

[2 marks]

Question 3c

- c) The diagram below shows part of a biochemical pathway that takes place commonly in cells.



Deduce whether the pathway is anabolic or catabolic and give evidence from the diagram for your answer.

[2 marks]

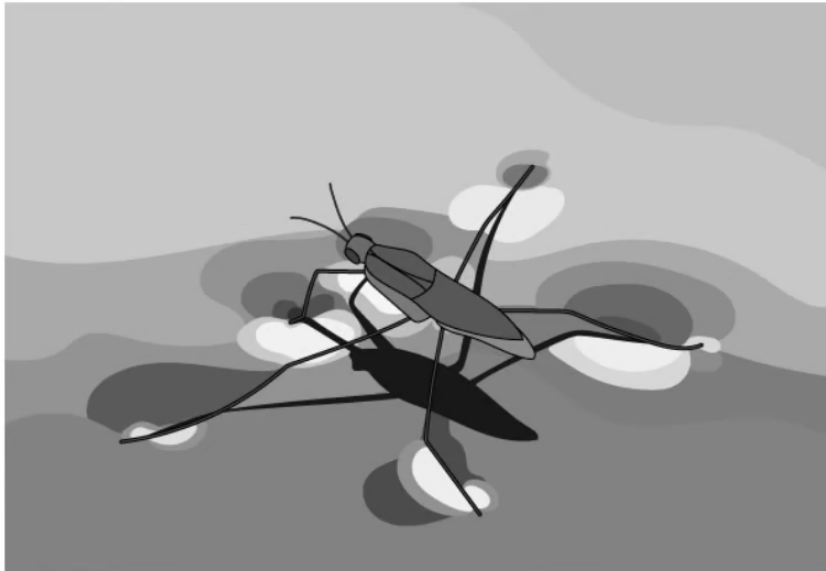
Question 4a

- a) Compare and contrast the terms **adhesion** and **cohesion** in the context of water molecules in biological tissues.

[3 marks]

Question 4b

- b) The diagram shows a pond skater (or water strider).



Certain small animals such as pond skaters and fisher spiders can walk across bodies of water without breaking the surface.

Use your knowledge of water's properties to suggest how detergent pollution contaminating ponds and lakes can have a detrimental effect on these small animals.

[3 marks]

Question 4c

- c) Outline how vasodilation affects the volume of water lost as sweat in humans.

[2 marks]

Question 5a

One mark is available for clarity of communication throughout this question.

- a) Explain the importance of hydrogen bonding in biological molecules.

[7 marks]

Question 5b

- b) Compare and contrast the structures of water (H_2O) and methane (CH_4) and use any structural differences to account for the differences in the two compounds' chemical and physical properties.

[4 marks]

Question 5c

- c) Explain how certain biological molecules are hydrophilic, some are hydrophobic and others are amphipathic. Use named molecules as examples in your answer.

[4 marks]