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2.1 Metabolism & Water

Hard

BIOLOGY

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2.1 Metabolism & Water

Question Paper

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

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Time allowed: 10

Score: /5

Percentage: /100

Question 1

In the years before 1828, a theory called 'vitalism' was widely accepted that stated that all biological molecules found in living organisms came from a 'vital force' that existed inside living things and the synthesis of these molecules could not be recreated artificially.

This theory was falsified in 1828 following the work of a scientist called Frederick Wöhler.

Which of the statements below was not a feature of Wohler's work?

A. Wöhler synthesised urea artificially using silver isocyanate and ammonium chloride

B. Urea had been thought of as a molecule found in living organisms as well as in inorganic matter

C. Wöhler was widely ridiculed for his theory when he first published his findings

D. Wöhler's research was corroborated by that of fellow scientists in the period following his discovery

[1 mark]

Question 2

Sodium hydrogen carbonate ($NaHCO_3$) dissociates into sodium ions (Na^+) and bicarbonate ions (HCO_3^-) when it is dissolved. The latter creates an alkaline environment suitable for certain enzymes and bicarbonate ions in the blood help to buffer lactic acid during exercise.

How does water help the production of bicarbonate ions?

A. The oxygen atoms form ionic bonds with bicarbonate ions.

B. The oxygen atoms in water attract bicarbonate ions.

C. The hydrogen atoms form hydrogen bonds with bicarbonate ions.

D. The hydrogen atoms in water attract bicarbonate ions.

[1 mark]

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Question 3

Water and methane are both simple compounds with covalent bonds and a similar molecular mass.

In theory this should mean that they share similar chemical properties, however this is not at all the case.

The table below compares some of the features of methane and water:

	Water	Methane
Molecular weight	18	16
Latent heat of vaporisation / kJ kg^{-1}	2260	510
Specific heat capacity / kJ kg^{-1} °C^{-1}	4.2	2.2
Melting point / °C	0	-182
Boiling point / °C	100	-162

Which of the statements below correctly describes the reason for these differences in properties?

A. Water is able to form hydrogen bonds with adjacent water molecules.

B. Methane forms a tetrahedral structure due to the fact carbon is able to form four covalent bonds.

C. Methane has a higher energy content in its bonds than water.

D. Water has a higher density than methane in a liquid state.

[1 mark]

Question 4

Which of the following does not rely on the specific heat capacity of water?

A. Heat loss through evaporation of sweat

B. Enzyme function

C. Aquatic ecosystems withstanding extreme temperature change

D. Humans living in sub-zero temperatures

[1 mark]

Question 5

The formation of the 3D shape of a globular protein relies on hydrophobic and hydrophilic interactions.

Which of the statements below correctly describes this process?

A. When peptide bonds form, the condensation reaction releases water, which forms hydrogen bonds with the hydrophilic R groups of the amino acids.

B. Certain hydrophilic amino acid R groups are able to form hydrogen bonds with other hydrophilic amino acids R groups on different proteins.

C. Hydrophobic R groups of amino acids are repelled by the water surrounding the protein, forcing them into the centre of the protein away from the water, and the hydrophilic R groups get pulled to the outside.

D. Hydrophilic R groups are repelled by the water and are forced away into the centre of the 3D structure, causing the shape to be distorted.

[1 mark]

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