Helping you Achieve Highest Grades in IB

IB Biology SL First Assesment 2025

Mark Scheme

Multiple Choice and Short Answer Questions

Theme: A - Unity and Diversity

Sub Topic - Water

Marks: 40

Total Marks: / 40

Suitable for SL Students sitting exams 2025+ onwards. However, HL Students will also find this useful

Mark Scheme

Question 1
A
Explanation:
Water's thermal properties **(Choice A)** include a high heat of vaporisation which results in the absorption of a large amount of heat by water before changing its physical state.
This means that changing the temperature of the water is slow, and this helps to maintain the internal temperature of organisms between set limits.
Water has cohesive properties **(Choice B)** which means it sticks to other water molecules.
Water has adhesive properties **(Choice C)** which means it adheres to charged surfaces.
Water is an excellent solvent **(Choice D)** which means it dissolves a wide array of polar and ionic substances.

Question 2
C
Explanation:
Cholesterol (Choice C) is a non-polar hydrophobic molecule. Therefore, it is insoluble in water.
Glucose **(Choice A)**, amino acids **(Choice B)**, and sodium chloride **(Choice D)** are soluble in water and are hydrophilic.

Question 3
C
Explanation:
Hydrophilic **(Choice C)** substances dissolve in water through the formation of hydrogen bonds with water.
Non-polar (**Choice D)** substances are not attracted to water molecules and do not form bonds with them. These substances are hydrophobic **(Choice B)**, making them insoluble **(Choice A)** in water.

Mark Scheme

Question 4

B

Explanation:

In water, a hydrogen bond **(Choice B)** is formed between partially the positively charged hydrogens of one water molecule and the partially negatively charged oxygens on another water molecule. **Choice A** is incorrect because this bond is intramolecular. **Choices C** and **D** are incorrect because water does not form ionic or metallic bonds with itself.

Question 5

1. **A**ny two of the following:

→ hydrogen bonds are formed between the hydrogen atom of one water molecule and the oxygen atom of another water molecule [1]

→ hydrogen atoms in water molecules are partially positive [1]

→ oxygen atoms in water molecules are partially negative [1]

→ hydrogen bonds are a polar attraction and electrons are not shared [1]

[2 mark maximum]

Sample Answer:

In water molecules, hydrogen bonds are formed between the partially positive (
✓
) hydrogens of one water molecule and the partially negative (
✓
) oxygens of other water molecules.

2. Any one of the following:

→ they are attracted to and form intermolecular bonds with water [1]

→ they form hydrogen bonds [1]

→ they dissolve in water OR are soluble in water [1]

[1 mark maximum]

Mark Scheme

Sample Answer:
Hydrophilic substances are attracted to water(
✓
) and form intermolecular bonds. They are said to be soluble (
✓
) in water.
3. Any one of the following:
→ do not freely associate with water [1]

→ hydrophobic are repelled by water [1]

→ do not dissolve in water OR insoluble in water
[1 mark maximum]

Sample Answer:
Non-polar molecules are hydrophobic (
✓
) and do not dissolve (
✓
) in water.
4. Any two of the following:
→ in cohesion, water molecules stick to each other WHILE in adhesion, water molecules adhere to the polar, OR charged, surfaces of other molecules [1]

→ cohesion explains water’s surface tension properties WHILE adhesion explains capillary action [1]

→ in plants, adhesion allows water to travel by capillary forces WHILE cohesion is responsible for maintaining an uninterrupted water column [1]
[2 mark maximum]

Mark Scheme

Sample Answer:
Water molecules are polar, with one end being partially positive and the other end being partially negative. This polarity allows water to form hydrogen bonds with other molecules. When hydrogen bonds form between two water molecules, this is cohesion(✓), whereas hydrogen bonds forming between water and other polar molecules is adhesion. An example of adhesion and cohesion working together would be in plants, where water travels up xylem vessels against gravity. This is possible because cohesion maintains an uninterrupted water column(✓), and the adhesion of water to the cellulose walls of xylem vessels drives the water upwards through capillary action(✓).

Question 6
D
Explanation:
Choice D is correct because water has a relatively high density compared to many substances which increases the buoyancy forces it exerts on objects submerged in it. **Choice B** is incorrect because specific heat capacity refers to how much energy is required to raise the temperature of a unit of mass of a given substance by one degree Celsius. **Choice C** is incorrect because viscosity refers to the resistance of a fluid to an object moving through it or to flow of the fluid itself.

Question 7
A
Explanation:
Water is cohesive because it is a polar molecule. The oxygen atom in one water molecule forms a hydrogen bond with the hydrogen atom of another water molecule. In xylem vessels water is attracted to the hydrophilic regions of the cell wall and hydrogen bonds are formed. This an accurate description of the adhesive properties of water in the context of water transport in plants **(Choice A)**. These statements are reversed in **Choice D**.
Ions dissolve in water, but this is not related to the cohesive **(Choice B)** or adhesive **(Choice C)** properties of water.

Mark Scheme

Question 8

C

Explanation:

Statement I is correct. Oxygen has a higher electronegativity compared to hydrogen. This means that oxygen will attract shared electrons more strongly.

Statement II is false. Since the shared electrons between oxygen and hydrogen spend more time near oxygen, the hydrogen in the water molecule becomes partially positive.

Statement III is true because oxygen attracts the shared electrons more strongly resulting in the shared electrons spending more time closer to the oxygen atom.

Question 9

Any two of the following:

→ water has a high specific heat capacity COMPARED TO air, so its temperature remains relatively stable compared to air OR so water remains relatively warmer during the winter [1]

→ water has a higher density COMPARED TO air, and this supports the seal's body weight as the water exerts buoyant forces on the seal [1]

→ water has a higher viscosity COMPARED TO air, providing the seal with more resistance to movement OR motion, which provides the seal with thrust and propulsion for swimming [1] **[2 mark maximum]**

Sample Answer:

The ringed seal is mostly able to live in water rather than air as water has a high specific heat capacity compared to air, so its temperature remains relatively stable so that the seal does not get too cold (

✓

). Water has a higher density compared to air, and this supports the seal's body weight as the water exerts buoyant forces on the seal (

✓

).

1. Any two of the following:

→ water has a high surface tension due to hydrogen bonds THEREFORE, 'belly-flopping' will cause pain due to the hydrogen bonds breaking forcefully OR gliding/diving causes hydrogen bonds between water molecules to be broken more gently OR entering head first reduces the body surface area that initially comes into contact with the water THEREFORE reducing water resistance [1]

→ gliding in is more energy-efficient for the seal as they use momentum generated from sliding on ice [1]

→ gliding is more stealthy OR quiet, which allows the seal to avoid predators [1]

→ gliding is more controlled, so the seal is at less risk of injury

[2 mark maximum]

Mark Scheme

Sample Answer:
Gliding in head first' is advantageous as water has a high surface tension due to the high number of hydrogen bonds between water molecules, therefore, 'belly-flopping' may cause pain from breaking the hydrogen bonds forcefully (
✓
). Gliding is more stealthy so the seal has more chance of catching prey or escaping predators (
✓
).

Question 1o

1. Any two of the following:

→ cohesion, OR cohesive properties, of water is responsible [1]

→ water molecules bind to other water molecules [1]

→ water molecules form intermolecular hydrogen bonds [1]

→ cohesion results in high surface tension of water [1]

→ legs of the insect are hydrophobic [1]

[2 mark maximum]

Sample Answer:
Cohesion(
✓
) is the water property that is responsible for this phenomenon. Water molecules bind with other water molecules (
✓
) through hydrogen bonds (
✓
)to create high surface tension(
✓
). The legs of the water strider are covered in a secreted wax, making them hydrophobic(
✓
), which allows the water strider to move on top of the water

Mar Scheme

Any three of the following (maximum of 2 marks if no example is provided):
→ metabolic reactions can only happen in solutions [1]

→ water dissolves hydrophilic substances needed for life processes [1]

→ substances can be transported through the water-based solutions [1]

→ blood plasma dissolves and transports sodium chloride OR glucose OR amino acids OR any other valid example in animals [1]

→ water dissolves and transports nutrients OR minerals needed by plants OR any other valid example in plants [1]

[3 mark maximum]
Sample Answer:
Water dissolves hydrophilic substances(
✓
) required for metabolic reactions (
✓
) which can only occur in solution. Dissolved substances can react with each other and also be transported(
✓
)to other parts of an organism. For example, water dissolves and transports glucose in the blood plasma(
✓
).

Question 11
→ surface tension decreases as detergent solution volume increases [1]
1 mark maximum

Sample answer¯Sample answer:
As the volume of detergent solution increases the surface tension of the water decreases (
✓
).
(units must be included in order to be awarded the mark)
→ 9.25ml [1]
[1 mark maximum]

Mark Scheme

Detergent Brand	Volume detergent solution taken to sink paperclip /ml			
	Trial 1	Trial 2	Trial 3	Trial 4
Deterobubble	4	4	5	5
Easy Clean	8	10	10	9
Dish Shine	13	13	12	13

Mean
= total/number of trials
= 37 (8+10+10+9) / 4
=9.25ml

Sample answer:
Mean = total/number of trials
= (8 ml+10 ml+10 ml+9 ml) / 4
= 37 ml / 4
= 9.25ml (
✓
)

1. (units must be included in order to be awarded the mark)
→ 9.25ml [1]
[1 mark maximum]

Sample answer:
If it takes 9.25 ml of detergent solution to reduce the surface tension enough to sink one paper clip, then the **same volume** would sink 5 paper clips (
✓
).

Any one of the following:
→ volume of the water (in the water tank) [1]

→ size OR mass OR brand OR material of paper clip OR way it is folded [1]

→ wear gloves to prevent skin oil transferring to paperclip [1]

→ distance of burette from water surface [1]
[1 mark maximum]

Mark Scheme

Sample answer:
The size of the paper clip (
✓
) in the experiment would need to be controlled.
Any one of the following:
→ water bath [1]
→ heating/cooling blocks [1]
[1 mark maximum]

Sample answer:
A water bath (
✓
) could be used to maintain a constant temperature.
Any two of the following:
→ the cohesive properties of water create surface tension OR surface tension is due to hydrogen bonding between water molecules [1]

→ cohesive forces OR hydrogen bonding decrease with increasing temperature BECAUSE there is more kinetic energy so molecules move more and interact less OR less attractive forces form between them, OR cohesive forces OR hydrogen bonding increase with decreasing temperature BECAUSE there is less kinetic energy so molecules move less and interact more OR more attractive forces form between them [1]
[2 mark maximum]

Sample answer:
It's important to maintain a constant temperature in this experiment because surface tension is due to cohesion (
✓
) between water molecules which is a result of hydrogen bonding. High temperatures can break hydrogen bonds and reduce the cohesive properties (
✓
) of water which in turn reduces surface tension.
→ surface tension broken by the droplets of detergent solution OR ripples created by droplets of detergent [1]
→ paper clip has residual detergent between trials (if same paper clip is used for each trial) [1]
→ paper clips are different materials OR brands OR texture (if different paper clips are used for each trial) [1]
[1 mark maximum]

Mark Scheme

Sample answer:
A source of error could be that the surface tension of the water is broken by the droplets of detergent (
✓
) which create ripples. This could result in the paperclip sinking.

→ detergents are made using different chemicals OR detergents have different starting concentrations OR different concentrations of chemical ingredients [1]
→ some chemicals OR detergents affect the cohesion between water molecules more AND therefore reduce surface tension more [1]
2 marks maximum

Sample answer¯Sample answer:
There may be a difference between results because each detergent is a different brand which may be made using different chemicals (
✓
). Some of the chemicals found in some detergents may have a greater effect on cohesion between water molecules which means they could reduce the surface tension more (
✓
).

Question 12
Any three of the following:
→ water is cohesive OR hydrogen bonding between water molecules OR strong intermolecular forces so can form a continuous column of water OR counteract gravity [1]
→ water is adhesive OR water molecules can adhere to other polar surfaces OR water adheres to walls of xylem vessels OR to lignin and cellulose of xylem vessels, so prevent collapse of water column OR separation from xylem vessel walls [1]
→ capillary action occurs as water moves upwards against gravity in the narrow xylem vessels [1]
→ the hydrogen bonds between water molecules mean that as water evaporates from the leaf negative pressure OR tension occurs, so water moves upwards against gravity [1]
→ low viscosity reduces resistance to flow within the xylem [1]
[3 mark maximum]

Mark Scheme

Sample answer:
Water can be transported efficiently through the xylem as the water molecules adhere to the inside of the xylem vessels (
✓
) and cohere to each other, therefore forming a continual column of water (
✓
). As the water evaporates from the leaves, the hydrogen bonds between the molecules mean that a negative pressure occurs at the top of this column of water, enabling the water to move upwards, against gravity (
✓
). This is the cohesion-tension theory

Any one of the following:
→ water is a solvent so can dissolve nutrients which can be used by the plant OR provide a medium for various biochemical reactions [1]
→ high specific heat capacity prevents extreme temperature fluctuations that could damage plant tissues OR maintain optimal enzyme activity and metabolic processes in plants [1]
→ transparency allows light to penetrate and reach submerged plants for photosynthesis [1]
[**1 mark maximum]**
Sample answer:
Water is known as a universal solvent, so nutrients can be dissolved in it and be transported to where they are needed (
✓
).
Any one of the following:
→ lipids are hydrophobic OR non-polar, so cannot dissolve in water [1]
[1 mark maximum]
Sample answer:
Water cannot be used to transport lipids in plants as they are hydrophobic (
✓
).

Mark Scheme

Any one of the following:
→ water has a high specific heat capacity, OR it has to lose a lot of energy to freeze [1]
→ due to the high solute concentration of the contents of the xylem [1]
→ increase in pressure in the xylem raises the freezing point of water [1]
→ high specific heat capacity means water can release stored heat slowly, maintaining a stable temperature above freezing point [1]
[1 mark maximum]
Sample answer:
Water in the xylem may not freeze when the temperature drops below -1
o
C, as it has a high specific heat capacity (
✓
).

Question 13
A
Explanation:
Choice A is correct because in many climates water absorbs a large amount of heat during the summer due to its high specific heat capacity and then conducts this heat to the cooler surrounding air during the winter.
Choice B is incorrect because it does not explain how winter air temperatures are made more moderate, only that ice insulates water that is below it which is not where the black-throated loon lives. **Choice C** is incorrect because water does not have a low specific heat capacity. **Choice D** is incorrect because, although it is a true statement, it does not explain how winter temperatures are made more moderate.

Question 14
B
Explanation:
Adhesive properties (Choice B) refer to water's ability to stick to charged surfaces or polar molecules. This, together with cohesion, allows water to move against gravity up the stem through capillary action.
Water's melting point (Choice A) is the temperature at which it changes its state from solid to liquid.
The specific heat capacity (Choice C) of water pertains to the amount of heat energy needed to raise its temperature by 1 °C.
The buoyant force of water (Choice D) is the upward force on an object submerged or partially immersed in water, equal to the weight of the displaced water.