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Chapter 1 - Water (AICE)

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AICE Marine Science Chapter 1: Water - Flashcard Study Guide

🎯 LEARNING OBJECTIVES
By the end of this chapter, you should be able to:
- Explain the unique properties of water and their importance to marine life
- Describe water's molecular structure and polarity
- Analyze how water's properties affect marine ecosystems
- Compare different states of water and phase changes
- Evaluate the role of water in supporting life on Earth

🔴 ESSENTIAL CONCEPTS - Flashcards

Q: What is the molecular formula for water and describe its structure?

A: H_2O - consists of 2 hydrogen atoms covalently bonded to 1 oxygen atom, forming a bent/angular shape with a 104.5° bond angle.

Q: What makes water a polar molecule?

A: Oxygen is more electronegative than hydrogen, creating partial negative charge (δ-) on oxygen and partial positive charges (δ+) on hydrogens, resulting in an uneven distribution of charge.

Q: Define hydrogen bonding in water.

A: Weak intermolecular attractions between the partially positive hydrogen of one water molecule and the partially negative oxygen of another water molecule.

Q: What is cohesion and why is it important in marine environments?

A: The attraction between water molecules due to hydrogen bonding. Creates surface tension, allows water striders to walk on water, and helps maintain water column structure.

Q: What is adhesion and give a marine example?

A: The attraction between water molecules and other substances. Example: Water clinging to marine organisms' surfaces or rocky substrates in tide pools.

Q: Define specific heat capacity and its value for water.

A: The amount of energy needed to raise 1 gram of water by 1°C. Water's specific heat is 4.18 J/g°C, which is unusually high.

Q: Why is water's high specific heat important for marine life?

A: It moderates temperature changes in marine environments, preventing rapid temperature fluctuations that could harm marine organisms.

Q: What is the density of pure water at 4°C?

A: 1.0 g/cm³ (1000 kg/m³) - this is water's maximum density.

🟡 IMPORTANT CONCEPTS - Flashcards

Q: Explain why ice floats on water.

A: Ice is less dense than liquid water (0.92 g/cm³) because hydrogen bonding creates an open crystalline structure with more space between molecules.

Q: What is surface tension and how does it affect marine organisms?

A: The cohesive force at water's surface creating a "skin-like" barrier. Allows some marine insects to walk on water and affects how organisms break through the surface.

Q: Define heat of vaporization for water.

A: The energy required to convert liquid water to water vapor (2260 J/g). This high value helps regulate temperature through evaporation.

Q: What is capillary action?

A: Water's ability to move up narrow spaces against gravity due to adhesion and cohesion. Important in marine sediments and organism transport systems.

Q: How does salinity affect water's properties?

A: Increases density, lowers freezing point, raises boiling point, and affects the formation of hydrogen bonds.

Q: What is the universal solvent property of water?

A: Water can dissolve many ionic and polar substances due to its polarity, making it essential for transporting nutrients and waste in marine organisms.

Q: Describe water's role in thermoregulation.

A: High specific heat and heat of vaporization allow water to absorb and release large amounts of heat with minimal temperature change, stabilizing marine environments.

Q: What happens to water density as temperature decreases?

A: Density increases until 4°C (maximum density), then decreases as water approaches freezing due to hydrogen bond formation.

🟢 SUPPORTING CONCEPTS - Flashcards

Q: What are the three states of water found in marine environments?

A: Solid (ice), liquid (seawater), and gas (water vapor/humidity).

Q: How do hydrogen bonds affect water's boiling point?

A: Hydrogen bonds must be broken for molecules to escape as gas, requiring more energy and resulting in a higher boiling point (100°C) than expected.

Q: What is hydration in the context of marine chemistry?

A: The process where water molecules surround and interact with dissolved ions or molecules, helping them stay in solution.

Q: How does water's transparency benefit marine ecosystems?

A: Allows sunlight penetration for photosynthesis by marine plants and algae, supporting the base of marine food webs.

Q: What is the relationship between water temperature and dissolved oxygen?

A: Colder water can hold more dissolved oxygen than warmer water - crucial for marine organism respiration.

Q: Define latent heat and its importance in marine systems.

A: Hidden energy absorbed or released during phase changes without temperature change. Helps moderate climate through evaporation and condensation cycles.

Q: How does water's incompressibility affect deep-sea environments?

A: Water maintains relatively constant density under pressure, allowing organisms to maintain structure in deep ocean environments.

Q: What role does water play in marine organism metabolism?

A: Acts as a medium for biochemical reactions, transports nutrients and waste, and maintains cellular structure through turgor pressure.

🔍 QUICK CHECK CONNECTIONS

Connection Point 1: Water's polarity → Hydrogen bonding → Unique properties (cohesion, adhesion, high specific heat)

Connection Point 2: High specific heat → Temperature stability → Marine habitat consistency → Organism survival

Connection Point 3: Universal solvent → Nutrient transport → Marine food webs → Ecosystem function

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📝 KEY EXAM FORMULAS & VALUES
- Water molecular formula: **H_2O**
- Maximum density: **1.0 g/cm³ at 4°C**
- Specific heat: **4.18 J/g°C**
- Heat of vaporization: **2260 J/g**
- Bond angle: **104.5°**

🎯 EXAM STRATEGY TIPS
1. **Memorize key values** (density, specific heat, molecular formula)
2. **Connect properties to functions** in marine environments
3. **Practice explaining** how molecular structure leads to macro-scale properties
4. **Be ready to compare** water with other substances
5. **Know real-world applications** in marine ecosystems

💡 *Study Tip: Use these flashcards for active recall - read the question, answer aloud, then check. Focus extra time on 🔴 Essential concepts as these are most likely to appear on exams.*