Blast-off : States of Matter Mark Scheme

Page 3: Classifying Substances

1. **Classify these substances as solids, liquids, or gases:**
    - **Camping fuel**: Gas
    - **Melted chocolate**: Liquid
    - **Carbon dioxide**: Gas
    - **Jelly**: Solid
    - **Sugar**: Solid
    - **Paint**: Liquid
    - **Steam**: Gas
    - **Custard**: Liquid
    - **Water**: Liquid
    - **Wood**: Solid
    - **Petrol**: Liquid
    - **Metal**: Solid

Page 8: Changes of State

Solid to liquid:

- When a solid is **heated**, the particles gain more energy and move **faster** until the bonds break. They can then slide over and past each other. The particles are now **further** apart and can slide over and past each other. The solid has **melted** and is now a liquid.

Liquid to gas:

- The particles in a liquid have more **energy** than in a solid. When a liquid is heated, the particles gain more energy and move **faster**. When they have enough energy, the bonds will break and the particles will be free to move anywhere. The liquid has **evaporated**, and the substance is now a gas.

Gas to liquid:

- When a gas is cooled, the particles **lose** energy, slow down, and move closer together. The gas **condenses** into a liquid.

Liquid to solid:

- When a liquid is cooled, the particles lose energy, **slow** down, and move so close together that they can only vibrate. The liquid **freezes** to become a solid.

Sublimation:

- Some substances have melting and **boiling** points so close together that when they are **heated**, they won't melt but turn straight into a gas. This is called sublimation, and iodine is an example of such a substance.

Page 11: Thermometers and Expansion

1. **Explain how a thermometer works:**
    - When temperature increases, the particles in the liquid inside the thermometer gain energy, move faster, and spread out, causing the liquid to expand and rise up the tube. When the temperature decreases, the

particles lose energy, move slower, and come closer together, causing the liquid to contract and drop in the tube.

2. **Draw particle diagrams:**
    - **Cold solid**: Particles are tightly packed and vibrating in fixed positions.
    - **Hot solid**: Particles are still closely packed but vibrating more rapidly and slightly further apart.
3. **What happens to the mass of the solid when it is heated?**
    - The mass of the solid remains the same.

Page 16: Hydrogen Gas

1. **Complete the diagram labels:**
    - A: Delivery tube
    - B: Gas collection container
    - C: Stopper
    - D: Flask
    - E: Water trough
2. **Why is it important that A is above the level of liquid in the container?**
    - To prevent liquid from entering the flask and to ensure the gas is collected efficiently.
3. **Describe the test for hydrogen gas:**
    - Collect the gas and place a lit splint near the opening. If hydrogen is present, it will produce a squeaky pop sound.
4. **Why is hydrogen not used in hot air balloons anymore?**
    - Hydrogen is highly flammable, making it unsafe for use in balloons. Modern balloons use helium, which is non-flammable.

Page 19: Diffusion

1. **Definition of diffusion:**
    - Diffusion is the movement of particles from an area of high concentration to an area of low concentration.
2. **Why can't diffusion happen in solids?**
    - In solids, particles are tightly packed and can only vibrate, so they cannot move freely.
3. **Explain diffusion of bromine vapour:**
    - The bromine vapour particles move from an area of high concentration (the lower jar) to an area of low concentration (the upper jar) until the concentration is equal throughout, due to the concentration gradient.
4. **How could the teacher speed up diffusion?**
    - Increase the temperature to give the particles more energy and make them move faster.

Page 23: Solubility Vocabulary

1. **The liquid a substance is being dissolved in:** Solvent
2. **The solid being dissolved:** Solute
3. **A substance that will not dissolve:** Insoluble
4. **A mixture of a solute and a solvent:** Solution
5. **Two liquids that mix together:** Miscible

6. **A substance that will dissolve:** Soluble
7. **A solution that will not dissolve any more solute:** Saturated
8. **Two liquids that will not mix together:** Immiscible
9. **Why do people stir their tea when they add sugar?** To increase the rate of dissolution by moving the sugar particles and spreading them into the liquid.
10. **In a cup of tea, what substance is the solvent?** Water
11. **In a cup of tea, what substance is the solute?** Sugar

Page 25: Investigating the Flow of Oil

1. **(a) What equipment did they use to measure the time?**
    - A **stopwatch**.
2. **(b) Complete the table:**

Factor	Change it	Keep it the same	Measure it
Temperature of the oil	✓		
Type of oil		✓	
Volume of oil		✓	
Time taken for all the oil to flow through the funnel			✓

Page 26: Results Analysis

1. **What happens to the time taken for the oil to flow through the funnel as its temperature increases?**
    - The time taken **decreases** as the temperature increases.
2. **How long would it take for the oil to flow through the funnel at 15°C?**
    - **180 seconds** (based on the trend in the data).

Page 27: Methane Changes of State

1. **(i) Match physical states to particle diagrams:**
    - Gas → Widely spaced particles.
    - Liquid → Closely packed but able to move around each other.
    - Solid → Tightly packed and vibrating in fixed positions.
2. **(ii) Identify arrows representing changes of state:**
    - Evaporation: **P**
    - Melting: **R**

Page 28: Solubility of Copper Sulphate

1. **(a) Circle the anomalous result:**
    - The anomalous result is at **60°C**.
2. **(b) Suggest a more likely measurement for the anomalous result:**
    - Around **45 g** (based on the smooth trend of the graph).
3. **(c) Suggest a mistake that might have caused the anomaly:**
    - The students may not have allowed enough time for all the copper sulphate to dissolve.

Page 30: Tea Bag Investigation

1. **(a) How is the second plan better than the first?**

    - It controls variables like water temperature and measures the time more precisely.
2. **(b) Why should they take care when adding hot water at 65°C?**
    - To avoid burns and ensure safety while handling hot liquids.

Page 31: Measuring Dissolution Time

1. **(c) How did the cross help to make their test more accurate?**
    - It provided a consistent endpoint to determine when the tea was dissolved.
2. **(d) Results Table:**
    - The recorded part of the investigation is the **results**.
3. **(e) Order of dissolution times:**
    - **Quickest:** Triangle → **Second:** Circle → **Slowest:** Square.

age 32: Solubility Graph

1. **(i) Compare the solubility of sodium chloride and potassium chloride in the range 10°C to 90°C:**
    - Potassium chloride's solubility increases significantly as temperature rises, from about 20 g/100 cm^3 at 10°C to around 50 g/100 cm^3 at 90°C.
    - Sodium chloride's solubility remains relatively constant, increasing only slightly from about 35 g/100 cm^3 to around 40 g/100 cm^3 over the same range.
2. **(ii) Ken cooled a solution containing 54 g of potassium chloride in 100 cm^3 of water to 40°C. What would he see in the beaker?**
    - **Observation:** Crystals of potassium chloride would form.
    - **Explanation:** At 40°C, the solubility of potassium chloride is about 40 g/100 cm^3, so the excess 14 g of potassium chloride would precipitate out of the solution.

Page 33: Salt Deposition

1. **(i) Evidence that the salts were deposited at a temperature above 25°C:**
    - From the graph, all three salts are more soluble at higher temperatures, allowing for their deposition as water evaporated.
2. **(ii) Order of deposition at 10°C:**
    - **Top:** Potassium chloride
    - **Middle:** Sodium chloride
    - **Bottom:** Calcium sulphate

Page 34: Separating Seawater

1. **(a) True or False Statements:**
    - Water is a solvent for salt: **True**
    - Sand sinks in water because water is more dense than sand: **True**
    - When a solid dissolves in water, the solid is called a solute: **True**
2. **(b) How can Amy collect pure water from seawater?**
    - Use **distillation**: Heat the seawater to evaporate the water, then condense the water vapor back into a liquid, leaving the salt behind.

Page 35: Substance Groups

1. **Match substances to groups and descriptions:**
    - **Seawater → Mixture:** It contains two or more types of atoms or molecules which can be physically separated.
    - **Salt → Compound:** Two or more types of atoms are chemically joined together.
    - **Oxygen → Element:** It contains only one type of atom.

Page 36: Stefan's Snow Observations

1. **(a) Complete the sentence:**
    - Snowflake changes from a **solid** to a **liquid** when it melts.
2. **(ii) Why does snow melt faster on Stefan's nose?**
    - The heat from Stefan's body warms the snow faster than the surrounding air temperature.
3. **(iii) Are the following changes reversible?**
    - Ice melting: **Yes**
    - Wood burning: **No**
    - Toasting bread: **No**

Page 37: Gas in a Container

1. **(a) How can you tell it's a gas and that it's pure?**
    - **Gas:** Particles are widely spaced and move freely.
    - **Pure:** All particles are identical (same size and type).
2. **(b) How does Diagram B show increased pressure?**
    - The particles are compressed into a smaller volume, increasing collisions with the container walls.

Page 38: Boiling Point Investigation

1. **(i) Independent variable:**
    - Mass of salt dissolved in water.
2. **(ii) Dependent variable:**
    - Boiling point of the salt solution.
3. **(iii) Variable with least effect:**
    - Temperature of the laboratory.

Page 39: Graph Comparison

1. **(i) How can you tell pure water was used?**
    - Both graphs show a boiling point of 100°C when no salt is added.
2. **(ii) Why is Tom's line of best fit better?**
    - Tom's line of best fit is straighter and closer to the data points, indicating more consistent results.