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Physical Changes

Definition and Examples

Physical changes involve alterations in the physical properties of a substance such as shape, size, state, or appearance without forming any new substance. These changes are usually reversible. Examples include cutting paper into pieces, melting ice to water, boiling water to steam, and stretching a rubber band.

Activities Demonstrating Physical Changes

Cutting paper into smaller pieces changes its shape and size but not its chemical composition. Melting ice changes its state from solid to liquid, and boiling water changes it from liquid to gas. These changes do not produce new substances and can be reversed by physical means.

Properties Involved

Physical properties affected include shape, size, color, and state of matter. No new chemical bonds are formed or broken during physical changes.

Solved Examples

Example 1: Ice cubes melt to form water. Is this a physical change?

Solution: Yes, melting ice is a physical change because the state changes from solid to liquid without forming a new substance. The process is reversible by freezing.

Example 2: A rubber band is stretched. Is this a physical change?

Solution: Yes, stretching a rubber band changes its shape but not its chemical composition. It is a physical change and reversible.

Practice Set

- **Level 1:** What happens to the shape of paper when it is cut into pieces? Is it a physical or chemical change?
- **Level 2:** Explain why melting of ice is considered a physical change.
- **Level 3:** Describe an experiment to demonstrate a physical change involving state change.

Answer Key

- **Level 1:** The shape changes but the paper remains the same substance; it is a physical change.
- **Level 2:** Melting ice changes its state from solid to liquid without forming a new substance; it is reversible, so it is a physical change.

- **Level 3:** Heat ice in a container to melt it into water, showing a change from solid to liquid state, demonstrating a physical change.

Chemical Changes

Definition and Examples

Chemical changes involve the formation of one or more new substances with different properties from the original substances. These changes are usually irreversible. Examples include rusting of iron, burning of magnesium, reaction of vinegar with baking soda, and displacement reactions.

Characteristics of Chemical Changes

Chemical changes are often accompanied by heat, light, sound, color change, gas formation, or odor change. New substances formed have different chemical properties.

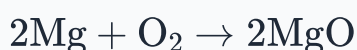
Common Chemical Reactions

Rusting of iron occurs when iron reacts with oxygen and water to form iron oxide (rust). Burning magnesium reacts with oxygen to form magnesium oxide. Vinegar reacts with baking soda to produce carbon dioxide gas, water, and sodium acetate.

Solved Examples

Example 1: Write the chemical equation for the burning of magnesium ribbon.

Solution: The reaction is:



Magnesium reacts with oxygen to form magnesium oxide, a new substance.

Example 2: What happens when iron is placed in copper sulphate solution?

Solution: Iron displaces copper from copper sulphate solution forming iron sulphate and copper metal:



Practice Set

- **Level 1:** What new substance is formed when iron rusts?
- **Level 2:** Describe the reaction between vinegar and baking soda.
- **Level 3:** Explain why burning of magnesium is a chemical change with reference to energy changes.

Answer Key

- **Level 1:** Iron oxide (rust) is formed when iron rusts.
- **Level 2:** Vinegar (acetic acid) reacts with baking soda (sodium bicarbonate) to produce carbon dioxide gas, water, and sodium acetate.
- **Level 3:** Burning magnesium releases heat and light energy, forming magnesium oxide, a new substance; this energy release and new substance formation confirm it is a chemical change.

Rusting

Process and Conditions

Rusting is a chemical change where iron reacts with oxygen and water to form iron oxide (rust). Both oxygen and moisture are essential for rusting. High humidity accelerates rusting.

Prevention Methods

Rusting can be prevented by applying paint, grease, or coatings of metals like zinc (galvanisation). Stainless steel, an alloy of iron with chromium and other metals, resists rusting.

Economic Impact

Rusting causes significant damage to iron structures like bridges, ships, and vehicles, leading to monetary loss and safety hazards.

Solved Examples

Example 1: Write the chemical equation for rusting of iron.

Solution:



Iron reacts with oxygen and water to form hydrated iron(III) oxide (rust).

Practice Set

- **Level 1:** What two elements are necessary for rusting?
- **Level 2:** How does galvanisation prevent rusting?
- **Level 3:** Why does rusting occur faster near coastal areas?

Answer Key

- **Level 1:** Oxygen and water (moisture) are necessary for rusting.
- **Level 2:** Galvanisation coats iron with zinc, which prevents oxygen and water from reaching iron, thus preventing rusting.
- **Level 3:** Coastal areas have higher humidity and salt in the air, which accelerates rusting by increasing moisture and corrosive effects.

Crystallisation

Definition and Process

Crystallisation is a physical process where pure solid crystals are formed from a saturated solution as the solvent evaporates or the solution cools. It is used to obtain pure substances from solutions.

Example

When copper sulphate solution is heated and saturated, then allowed to cool, blue crystals of copper sulphate form. This process is called crystallisation.

Significance

Crystallisation helps in purifying substances and studying their crystal structure. It is a physical change as no new substance is formed.

Solved Examples

Example 1: Describe how to obtain copper sulphate crystals from its solution.

Solution: Heat water and dissolve copper sulphate until no more dissolves. Filter the solution and allow it to cool undisturbed. Crystals of copper sulphate will form as the solution cools.

Practice Set

- **Level 1:** What is crystallisation?
- **Level 2:** Why does crystallisation occur when a solution cools?
- **Level 3:** How can crystallisation be used to purify a substance?

Answer Key

- **Level 1:** Crystallisation is the process of forming solid crystals from a saturated solution.
- **Level 2:** Cooling reduces solubility, causing the dissolved substance to come out as crystals.
- **Level 3:** Impurities remain dissolved while pure substance forms crystals, allowing separation and purification.

Quick Reference Table

Physical Changes: Changes in physical properties without new substances; reversible; examples: melting, boiling, cutting.

Chemical Changes: Formation of new substances; often irreversible; accompanied by energy changes; examples: rusting, burning, reactions.

Rusting: Iron + Oxygen + Water → Iron oxide (rust); prevented by paint, grease, galvanisation.

Crystallisation: Formation of pure crystals from saturated solution by cooling or evaporation.

Common Mistakes and Misconceptions

1. Confusing physical changes with chemical changes; physical changes do not form new substances.
2. Assuming all changes are irreversible; many physical changes are reversible.
3. Believing rust is iron; rust is a new substance (iron oxide) formed by chemical change.
4. Thinking crystallisation is a chemical change; it is a physical change.

Glossary

Physical Change: Change affecting physical properties without new substances.

Chemical Change: Change producing new substances with different properties.

Rusting: Chemical reaction of iron with oxygen and water forming iron oxide.

Galvanisation: Coating iron with zinc to prevent rusting.

Crystallisation: Process of forming solid crystals from a solution.