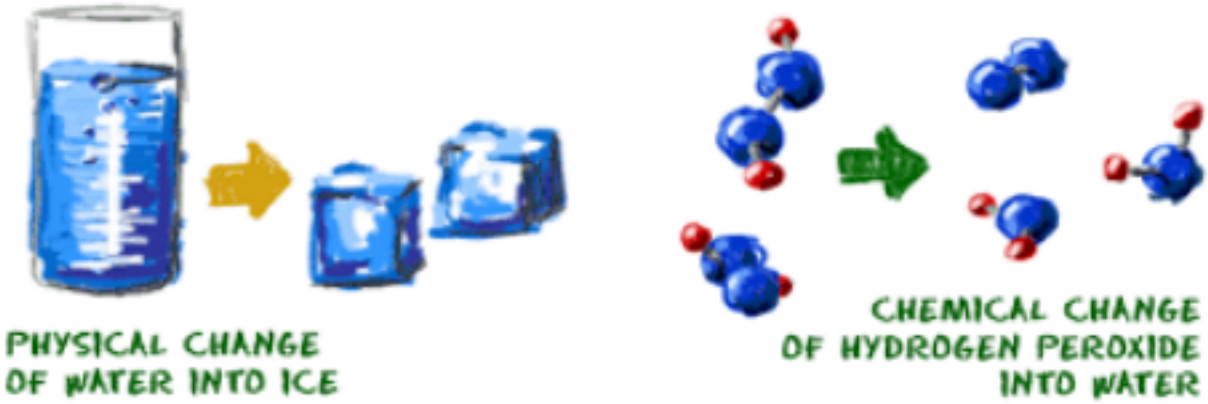
Unit 1: Matter and Measurement

Physical and Chemical Changes in Matter

Matter exhibits fascinating transformations through chemical and phase changes. Chemical changes, such as rust forming on iron or bubbling, bring about new substances with altered properties. In contrast, phase changes, like water evaporating into steam, transition between solid, liquid, and gas states while preserving the substance's identity. The process is driven by energy changes (hv) and enthalpy (Δ), reflecting the production or consumption of heat. These changes showcase matter's dynamic nature, from the molecular level to observable shifts in state and composition.



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1. Physical changes alter a substance's appearance, form, or state without changing its chemical composition.
    a. Give an example of a physical change.
    b. Does a physical change create new substances?
    c. Can physical changes be temporary or reversible?

2. Phase changes involve transitions between states like solid, liquid, gas, driven by energy changes. Chemical changes alter substances at a molecular level, creating new substances with distinct properties through reactions.
    a. What distinguishes a phase change from a chemical change?
    b. Give an example of a phase change and explain why it is a physical change.
    c. Provide an example of a chemical change and explain how it differs from a phase change.
    d. After mixing two chemicals together in a solution, you notice bubbling. Is this a chemical or physical change?

3. Chemical changes involve transformations in a substance's composition, leading to the creation of new substances with distinct properties. These changes often involve reactions with other substances, alterations in molecular structures, and energy exchanges.
    a. Give an example of a chemical change in everyday life.
    b. Why do chemical reactions sometimes cause a color change? Example?
    c. You are mixing several different chemicals in a flask and note a strong smell and color change. Is this a physical or chemical change?

$$E = h\nu = \frac{hc}{\lambda}$$

Where E = Photon Energy (J)
h = Planck's Constant ($6.62607015 \times 10^{-34}$ J*s)
c = speed of light ($3.0*10^{8}$ m/s)
λ = photon wavelength
v = photon frequency

4. A chemical reaction requires 120 kJ of energy input. If each photon ("hv") has an energy of 10 kJ, how many photons are needed?

5. In an exothermic reaction, the change in enthalpy ("ΔH") is -100 kJ/mol. If 2 moles of reactants are used, how much energy is released? (a negative ΔH denotes a release in heat from the system to the surrounding whereas a positive ΔH denotes an absorption of heat from the surrounding to the system)

ChemTalk

ANSWER KEY

1. Physical changes alter a substance's appearance, form, or state without changing its chemical composition.
    a. Give an example of a physical change.
    b. Does a physical change create new substances?
    c. Can physical changes be temporary or reversible?

a) Melting an ice cube is a physical change because the water changes from a solid to a liquid without altering its chemical composition.

b) No, physical changes do not create new substances; they involve alterations in the physical properties of the material.

c) Yes, most physical changes are reversible, and substances often return to their original state in conditions change back.

2. Phase changes involve transitions between states like solid, liquid, gas, driven by energy changes. Chemical changes alter substances at a molecular level, creating new substances with distinct properties through reactions.
    a. What distinguishes a phase change from a chemical change?
    b. Give an example of a phase change and explain why it is a physical change.
    c. Provide an example of a chemical change and explain how it differs from a phase change.
    d. After mixing two chemicals together in a solution, you notice bubbling. Is this a chemical or physical change?

a) Phase changes involve transitions between states of matter (solid, liquid, gas) without altering the substance's chemical identity, while chemical changes result in new substances with altered properties.

b) Melting ice to water is a phase change. It's physical because the substance transitions between solid and liquid states without altering its chemical composition.

c) Burning wood is a chemical change. Unlike a physical change, it involves a rearrangement of atoms and the creation of new substances (ash, gases) with different physical properties.

d) The bubbling indicates a chemical change. The formation of gas bubbles often suggests the release of new substances due to a chemical reaction, altering the composition and properties of the solution

3. Chemical changes involve transformations in a substance's composition, leading to the creation of new substances with distinct properties. These changes often involve reactions with other substances, alterations in molecular structures, and energy exchanges.
    a. Give an example of a chemical change in everyday life.
    b. Why do chemical reactions sometimes cause a color change? Example?
    c. You are mixing several different chemicals in a flask and note a strong smell and color change. Is this a physical or chemical change?

a) Baking bread involves a chemical change, where the dough's components undergo reactions to form the bread's texture and taste.
b) Color changes often indicate alterations in a substance's molecular structure, reflecting changes in the arrangement of atoms and electrons. An example of this would be rust, which usually appears orange.
c) The occurrence of a strong smell and a color change when mixing chemicals in a flask suggests a chemical change. These changes are indicative of the formation of new substances with distinct properties, characteristic of chemical reactions.

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4. A chemical reaction requires 120 kJ of energy input. If each photon ("hv") has an energy of 10 kJ, how many photons are needed?

Energy = Number of photons × Energy per photon,
Number of photons = Energy / Energy per photon
Number of photons = 120 kJ / 10 kJ/photon = 12 photons.

5. In an exothermic reaction, the change in enthalpy ("ΔH") is -100 kJ/mol. If 2 moles of reactants are used, how much energy is released? (a negative ΔH denotes a release in heat from the system to the surrounding whereas a positive ΔH denotes an absorption of heat from the surrounding to the system)

Energy released = ΔH × Number of moles
Energy released = -100 kJ/mol × 2 moles = -200 kJ