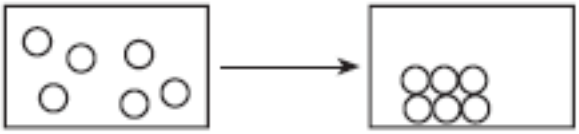
Physical Change And Chemical Change

1 Given the key:

Key
○ = an atom of element A ● = an atom of element Z

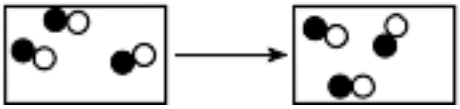
Which particle model diagram represents a chemical change?

(1)



(2)

(3)



(4)

2 When a sample of $CO_2(s)$ becomes $CO_2(g)$, there is a change in

(1) bond type
(2) gram-formula mass
(3) molecular polarity
(4) particle arrangement

3 Which process is a chemical change?

(1) evaporating an alcohol
(2) subliming of iodine
(3) melting an ice cube
(4) rusting of iron

4 Which change is most likely to occur when a molecule of H_2 and a molecule of I_2 collide with proper orientation and sufficient energy?

(1) a chemical change, because a compound is formed
(2) a chemical change, because an element is formed
(3) a physical change, because a compound is formed
(4) a physical change, because an element is formed

5 Which processes represent one chemical change and one physical change?

(1) freezing and melting
(2) freezing and vaporization
(3) decomposition and melting
(4) decomposition and combustion

6 Which change results in the formation of different substances?

(1) burning of propane
(2) melting of NaCl(s)
(3) deposition of $CO_2(g)$
(4) solidification of water

7 Which statement describes a chemical change?

(1) Alcohol evaporates.
(2) Water vapor forms snowflakes.
(3) Table salt (NaCl) is crushed into powder.
(4) Glucose ($C_6H_{12}O_6$) and oxygen produce CO_2 and H_2O.

8 Based on Table I, which compound dissolves in water by an exothermic process?

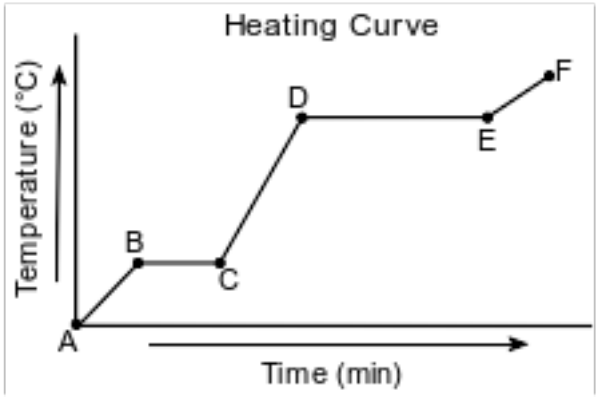
(1) NaCl
(2) NaOH
(3) NH_4Cl
(4) NH_4NO_3

9 During which two processes does a substance release energy?

(1) freezing and condensation
(2) freezing and melting
(3) evaporation and condensation
(4) evaporation and melting

Base your answers to questions 10 on the information below and on your knowledge of chemistry.

Starting as a solid, a sample of a molecular substance is heated, until the entire sample of the substance is a gas. The graph below represents the relationship between the temperature of the sample and the elapsed time.



10 State evidence that indicates the sample undergoes only physical changes during this heating.

Base your answers to questions 11 on the information below and on your knowledge of chemistry.

Wood is mainly cellulose, a polymer produced by plants. One use of wood is as a fuel in campfires, fireplaces, and wood furnaces. The molecules of cellulose are long chains of repeating units. Each unit of the chain can be represented as $C_6H_{10}O_5$. The balanced equation below represents a reaction that occurs when $C_6H_{10}O_5$ is burned in air.

$C_6H_{10}O_5 + 6O_2 \rightarrow 6CO_2 + 5H_2O$ + heat

11 Explain, in terms of substances in the reaction, why the equation represents a chemical change.

Base your answers to questions 12 on the information below.

The reaction between aluminum and an aqueous solution of copper(II) sulfate is represented by the unbalanced equation below.

$Al(s) + CuSO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + Cu(s)$

12 Explain why the equation represents a chemical change.

Base your answers to questions 13 on the information below and on your knowledge of chemistry.

In a laboratory activity, each of four different masses of $KNO_3(s)$ is placed in a separate test tube that contains 10.0 grams of H_2O at 25°C.

When each sample is first placed in the water, the temperature of the mixture decreases. The mixture in each test tube is then stirred while it is heated in a hot water bath until all of the $KNO_3(s)$ is dissolved. The contents of each test tube are then cooled to the temperature at which KNO_3 crystals first reappear. The procedure is repeated until the recrystallization temperatures for each mixture are consistent, as shown in the table below.

Data Table for the Laboratory Activity

Mixture	Mass of KNO_3 (g)	Mass of H_2O (g)	Temperature of Recrystallization (°C)
1	4.0	10.0	24
2	5.0	10.0	32
3	7.5	10.0	45
4	10.0	10.0	58

13 Based on Table I, explain why there is a decrease in temperature when the $KNO_3(s)$ was first dissolved in the water.

Base your answers to questions 14 on the information below and on your knowledge of chemistry.

Nitrogen dioxide, NO_2, is a dark brown gas that is used to make nitric acid and to bleach flour. Nitrogen dioxide has a boiling point of 294 K at 101.3 kPa. In a rigid cylinder with a movable piston, nitrogen dioxide can be in equilibrium with colorless dinitrogen tetroxide, N_2O_4. This equilibrium is represented by the equation below.

$2NO_2(g) \rightleftharpoons N_2O_4(g) + 58\ kJ$

14 State evidence from the equation that the forward reaction is exothermic.

Base your answers to questions 15 on the information below and on your knowledge of chemistry.

During photosynthesis, plants use carbon dioxide, water, and light energy to produce glucose, $C_6H_{12}O_6$, and oxygen. The reaction for photosynthesis is represented by the balanced equation below.

$6CO_2 + 6H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + 6O_2$

15 State evidence that indicates photosynthesis is an endothermic reaction.

Answer Keys

1 4

2 4

3 4

4 1

5 3

6 1

7 4

8 2

9 1

10 Allow 1 credit. Acceptable responses include, but are not limited to:
- No new substance is formed.
- The phase changes do not change the chemical properties of the substance.

11 Allow 1 credit. Acceptable responses include, but are not limited to:
- The products of the reaction are different substances than the reactants.
- The chemical properties of the reactants and the products are different.
- Bonds are broken in the reactants and new bonds are formed in the products.
- Different substances are formed.

12 Allow 1 credit. Acceptable responses include, but are not limited to:
- The products are different substances with different properties from the reactants.
- There is a loss and gain of electrons by substances in the reaction.

13 Allow 1 credit. Acceptable responses include, but are not limited to:
- The solution would decrease in temperature because the dissolving of $KNO_3(s)$ is endothermic.
- The heat of solution is positive, which means the mixture would decrease in temperature.
- The ΔH is + 34.89 kJ, so $KNO_3(s)$ requires energy to dissolve.

14 Allow 1 credit. Acceptable responses include, but are not limited to:
- There are 58 kJ of energy produced by the forward reaction.
- The heat term is on the right side of the equation.

15 Allow 1 credit. Acceptable responses include, but are not limited to:
- Photosynthesis is an endothermic reaction because light energy is absorbed.
- The energy term is on the left side of equation.
- ΔH is positive.
- The reaction requires light.