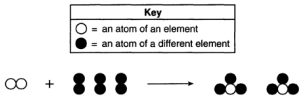
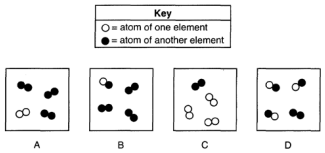
1. Given the balanced particle-diagram equation:



Which statement describes the type of change and the chemical properties of the product and reactants?

A) The equation represents a physical change, with the product and reactants having different chemical properties.
B) The equation represents a physical change, with the product and reactants having identical chemical properties.
C) The equation represents a chemical change, with the product and reactants having different chemical properties.
D) The equation represents a chemical change, with the product and reactants having identical chemical properties.

2. Which two particle diagrams represent mixtures of diatomic elements?



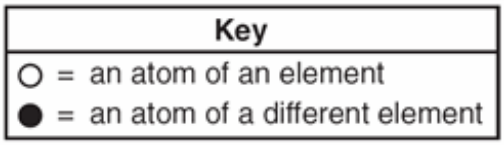
A) *A* and *B* B) *A* and *C*
C) *B* and *C* D) *B* and *D*

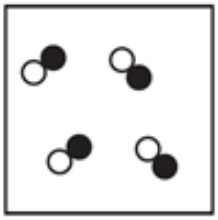
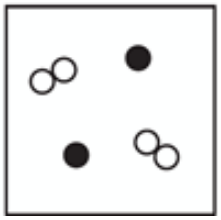
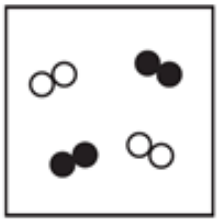
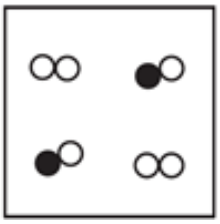
3. Given the particle diagram representing four molecules of a substance:

Which particle diagram best represents this same substance after a physical change has taken place?

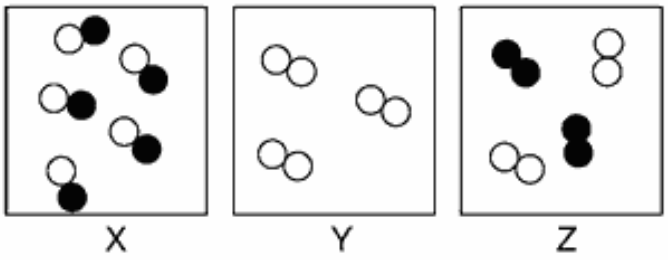
A) 
B) 
C) 
D) 

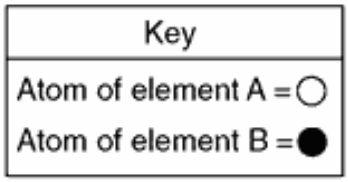
4. Which particle diagram represents a mixture of an element and a compound?



A) 
B) 
C) 
D) 

5. Given the diagrams *X, Y,* and *Z* below:





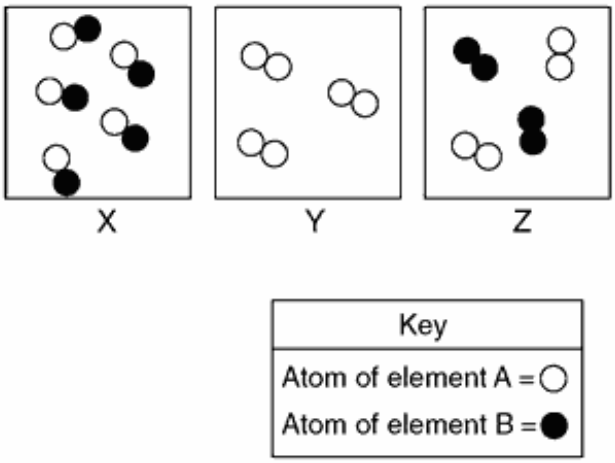
Which diagram or diagrams represent a mixture of elements *A* and *B*?

A) *X,* only B) *Z,* only
C) *X* and *Y* D) *X* and *Z*

6. Describe diagrams *X, Y,* and *Z* using the following terms:

   Pure substance
   Compound
   Element
   Mixture of elements
   Mixture of compounds

   You may use more than one term for each diagram.



X _____

Y _____

Z _____

Base your answers to questions **7** and **8** on the information below and on your knowledge of chemistry.

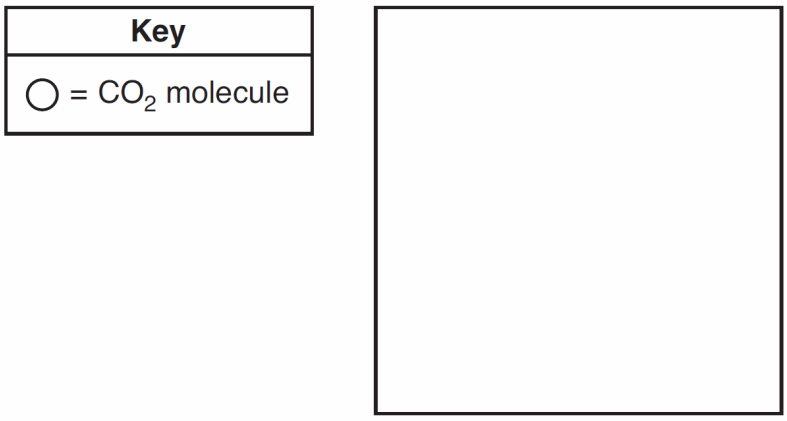
A few pieces of dry ice, $CO_2(s)$, at $-78^\circ C$ are placed in a flask that contains air at $21^\circ C$. The flask is sealed by placing an uninflated balloon over the mouth of the flask. As the balloon inflates, the dry ice disappears and no liquid is observed in the flask.

7. Write the name of the process that occurs as the dry ice undergoes a phase change in the flask.

8. State the direction of heat flow that occurs between the dry ice and the air in the flask.

9. Base your answer to the following question on the information below and on your knowledge of chemistry.

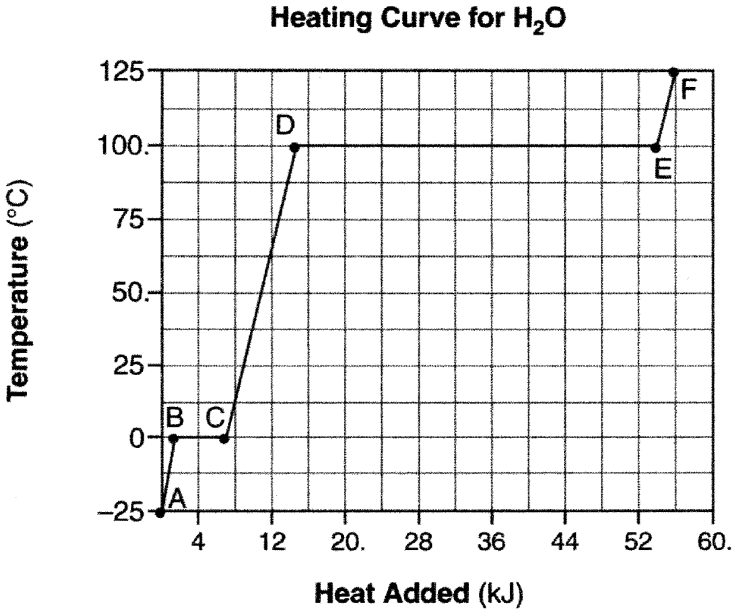
Paintball is a popular recreational activity that uses a metal tank of compressed carbon dioxide or nitrogen to launch small capsules of paint. A typical tank has a volume of 508 cubic centimeters. A 340.-gram sample of carbon dioxide is added to the tank before it is used for paintball. At 20.°C, this tank contains both $CO_2(g)$ and $CO_2(\ell)$. After a paintball game, the tank contains only $CO_2(g)$.



In the box above, use the key to draw a particle diagram to represent the two phases of CO_2 in a newly filled tank. Your response must include *at least* six molecules of CO_2 in each phase.

Base your answers to questions **10** and **11** on the information below and on your knowledge of chemistry.

Starting as a solid at –25°C, a sample of H_2O is heated at a constant rate until the sample is at 125°C. This heating occurs at standard pressure. The graph below represents the relationship between temperature and heat added to the sample.

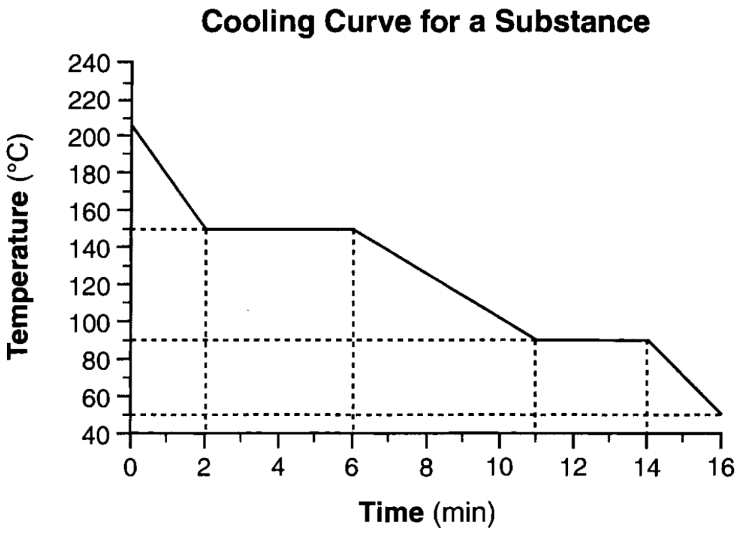


10. Explain, in terms of heat of fusion and heat of vaporization, why the heat added during interval *DE* is greater than the heat added during interval *BC* for this sample of water.

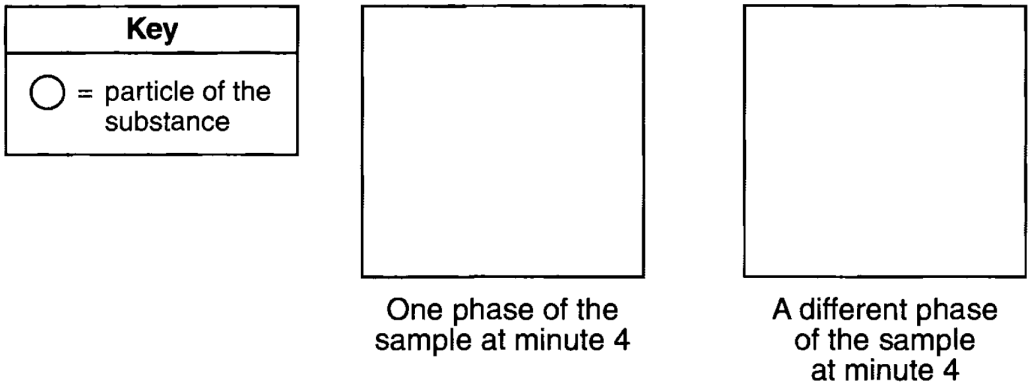
11. Using the graph, determine the total amount of heat added to the sample during interval *CD*.

12. Base your answer to the following question on the information below.

Starting as a gas at 206°C, a sample of a substance is allowed to cool for 16 minutes. This process is represented by the cooling curve below.



Using the key below, draw *two* particle diagrams to represent the *two* phases of the sample at minute 4. Your response must include *at least six* particles for *each* diagram.

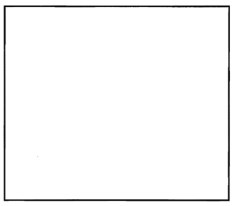


13. Base your answer to the following question on
Heat is added to a sample of liquid water, starting at 80.ºC, until the entire sample is a gas at 120.ºC. This process, occurring at standard pressure, is represented by the balanced equation below.

$$H_2O(\ell) + \text{heat} \rightarrow H_2O(g)$$

In the box below, using the key, draw a particle diagram to represent *at least five* molecules of the product of this physical change at 120.°C.

Key
● = atom of hydrogen
○ = atom of oxygen



Base your answers to questions **14** through **16** on the information below.

Heat is added to a 200.-gram sample of $H_2O(s)$ to melt the sample at 0°C. Then the resulting $H_2O(\ell)$ is heated to a final temperature of 65°C.

14. Compare the amount of heat required to vaporize a 200.-gram sample of $H_20(\ell)$ *at its boiling point to the amount of heat required to melt a 200.-gram sample of $H_2O(s)$ at its melting point.*

15. In the space below, show a numerical setup for calculating the total amount of heat required to raise the temperature of the $H_2O(\ell)$ from 0°C to its final temperature.

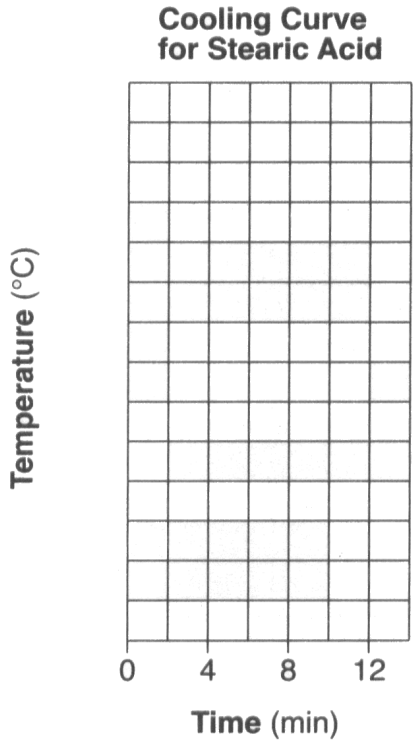
16. Determine the total amount of heat required to completely melt the sample.

Base your answers to questions **17** and **18** on the information and chart below.

A 150.-gram liquid sample of stearic acid, $C_{17}H_{35}COOH$, is cooled at a constant rate. The temperature of the sample is recorded at 2-minute intervals in the data table below.

Cooling Data for Stearic Acid

Time (min)	**Temperature** (°C)
0	75.0
2	72.0
4	69.3
6	69.3
8	69.3
10.	69.3
12	65.0

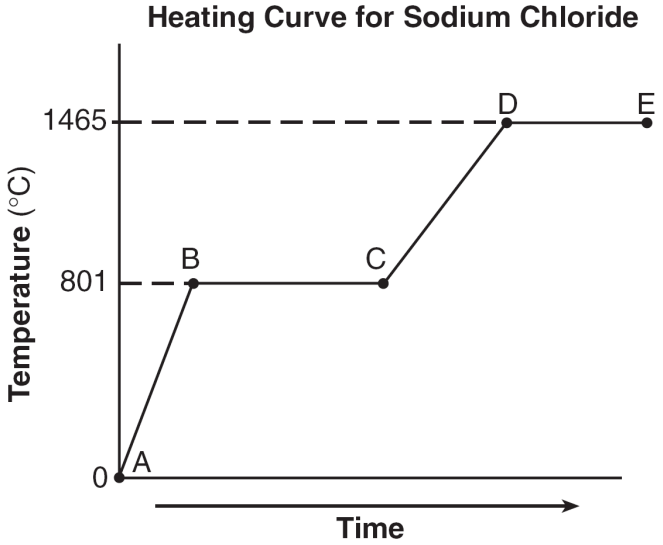


17. Determine the gram-formula mass of stearic acid.

18. Identify the physical change occurring during the time interval 4 minutes to 10. minutes.

Base your answers to questions **19** and **20** on on the information below.

A 100.0-gram sample of NaCl(s) has an initial temperature of 0°C. A chemist measures the temperature of the sample as it is heated. Heat is *not* added at a constant rate. The heating curve for the sample is shown below.



19. Identify *one line segment on the curve where the NaCl sample is in a single phase and capable of conducting electricity.*

20. Identify *one* line segment on the curve where the average kinetic energy of the particles of the NaCl sample is changing.