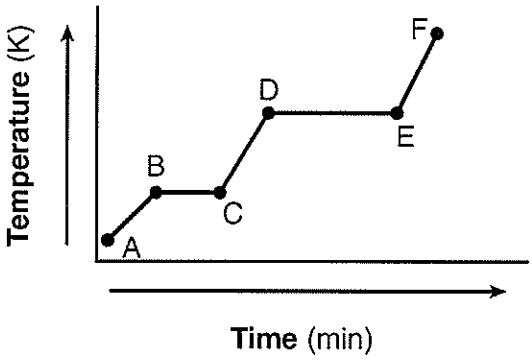
1. *a* Calculate the heat released when 25.0 grams of water freezes at 0°C. Show all work.

   b Record your answer with an appropriate unit.

Base your answers to questions **2** and **3** on the heating curve below, which represents a substance starting as a solid below its melting point and being heated at a constant rate over a period of time.



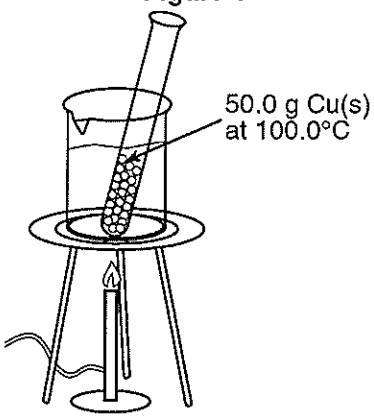
2. What is happening to the average kinetic energy of the particles during segment $\overline{BC}$?

3. How does this heating curve illustrate that the heat of vaporization is greater than the heat of fusion?

_____

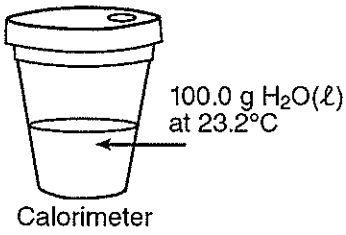
Base your answers to questions **4** through **7** on the information below.

Figure 1



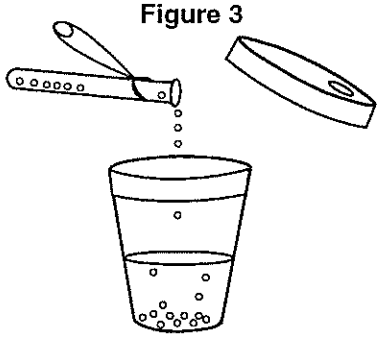
In a laboratory investigation, a 50.0-gram sample of copper is at 100.0°C in a boiling water bath.

Figure 2



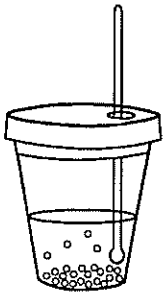
A Styrofoam cup with a lid is used as a calorimeter. The cup contains 100.0 grams of distilled water at 23.2°C.

Figure 3



The hot copper is poured into the cup of water, and the cup is quickly covered with the lid.

Figure 4



A thermometer is inserted through the lid. The copper and water are gently stirred in the cup. The temperature is checked periodically. The highest temperature noted is 26.3°C.

Data Table

Quantity Measured	**Data** (units are given)
Mass of copper	g
Temperature of hot copper	°C
Mass of H_2O in calorimeter	g
Initial temperature of H_2O in calorimeter	°C
Final temperature of H_2O and copper	°C

4. In terms of energy flow, explain why the temperature of the water in the calorimeter increases.

5. In this investigation, the change in heat of the copper is greater than the change in heat of the water. What error could account for this apparent violation of the Law of Conservation of Energy? Do not use human error as part of the answer.

_____

6. In the space below show a correct numerical setup for calculating the number of joules of heat gained by the water.

_____

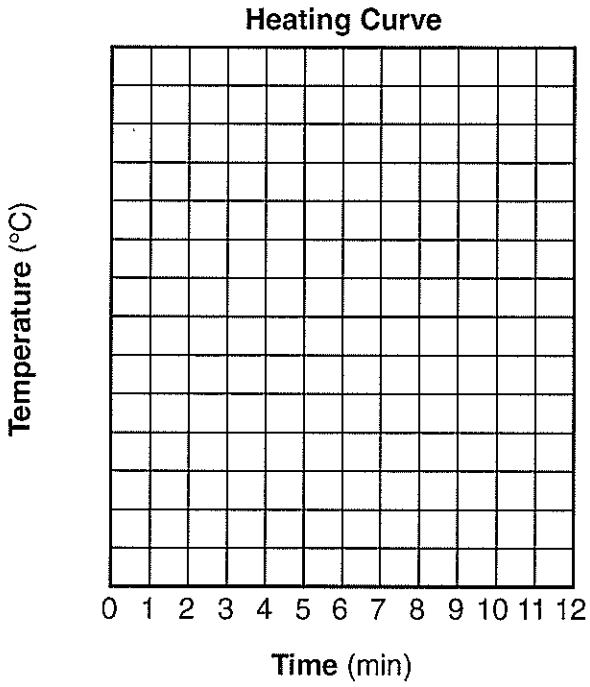
7. Using the information given, complete the data table above.

_____

Base your answers to questions **8** through **12** on the information below.

A substance is a solid at 15°C. A student heated a sample of the solid substance and recorded the temperature at one-minute intervals in the data table below.

Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12
Temperature (°C)	15	32	46	53	53	53	53	53	53	53	53	60	65



8. The heat of fusion for this substance is 122 joules per gram. How many joules of heat are needed to melt 7.50 grams of this substance at its melting point?

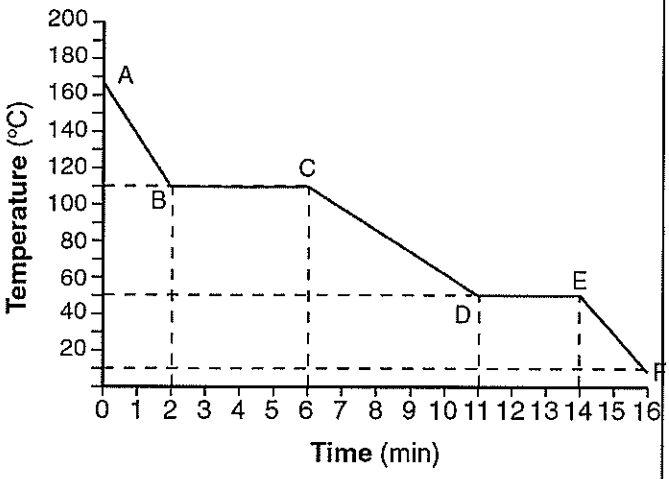
9. What is the evidence that the average kinetic energy of the particles of this substance is increasing during the first three minutes?

10. Based on the data table, what is the melting point of this substance?

11. Plot the data from the data table. Circle and connect the points.

12. On the grid above, mark an appropriate scale on the axis labeled "Temperature (°C)." An appropriate scale is one that allows a trend to be seen.

13. Base your answer to the following question on the graph below, which represents the cooling of a substance starting at a temperature above its boiling point.

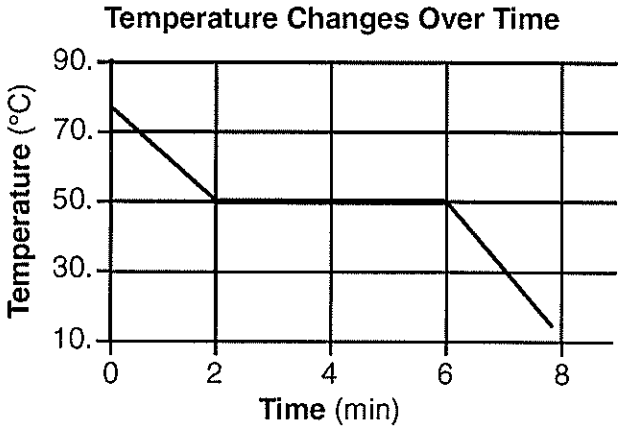


What is the melting point of this substance?

14. What is the total amount of heat energy, in joules, absorbed by 25.0 grams of water when the temperature of the water increases from 24.0°C to 36.0°C?

Base your answers to questions **15** through **18** on the information below.

The graph below shows a compound being cooled at a constant rate starting in the liquid phase at 75°C and ending at 15°C.



15. What kelvin temperature is equal to 15°C?

16. A different experiment was conducted with another sample of the same compound starting in the solid phase. The sample was heated at a constant rate from 15°C to 75°C. On the graph, draw the resulting heating curve.

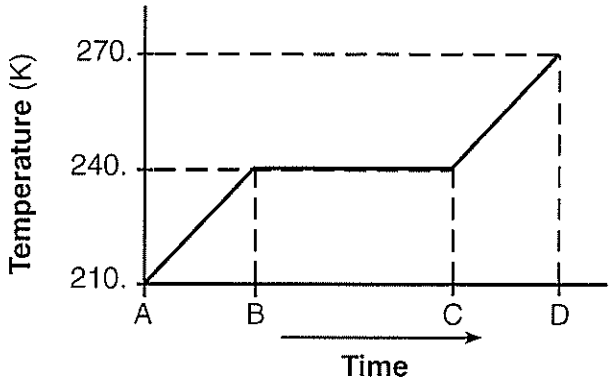
17. State what is happening to the average kinetic energy of the particles of the sample between minute 2 and minute 6.

18. What is the freezing point of the compound, in degrees Celsius?

Base your answers to questions **19** through **21** on the information below

A 5.00-gram sample of liquid ammonia is originally at 210. K. The diagram of the partial heating curve below represents the vaporization of the sample of ammonia at standard pressure due to the addition of heat. The heat is *not* added at a constant rate.

Partial Heating Curve for Ammonia



Some physical constants for ammonia are shown in the data table below.

Some Physical Constants for Ammonia

specific heat capacity of $NH_3(\ell)$	4.71 J/g•K
heat of fusion	332 J/g
heat of vaporization	1370 J/g

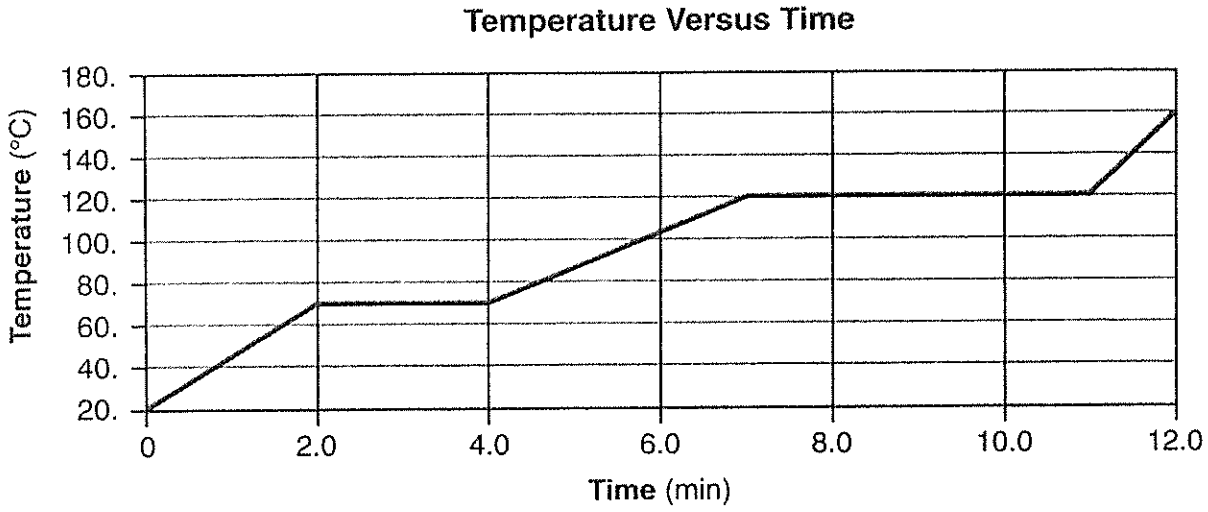
19. Determine the total amount of heat required to vaporize this 5.00-gram sample of ammonia at its boiling point.

20. Describe what is happening to *both* the potential energy and the average kinetic energy of the molecules in the ammonia sample during time interval *BC*. Your response must include *both* potential energy and average kinetic energy.

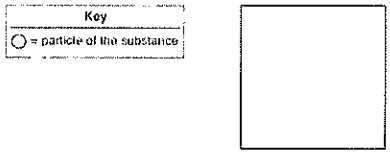
21. Calculate the total heat absorbed by the 5.00-gram sample of ammonia during time interval AB. Your response must include *both* a correct numerical setup and the calculated result.

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

The temperature of a sample of a substance is increased from 20.°C to 160.°C as the sample absorbs heat at a constant rate of 15 kilojoules per minute at standard pressure. The graph below represents the relationship between temperature and time as the sample is heated.



Use the key below to draw at least nine particles in the box, showing the correct particle arrangement of this sample during the first minute of heating.



23. Base your answer to the following question on the following paragraph.

The boiling point of a liquid is the temperature at which the vapor pressure of the liquid is equal to the pressure on the surface of the liquid. The heat of vaporization of ethanol is 838 joules per gram. A sample of ethanol has a mass of 65.0 grams and is boiling at 1.00 atmosphere.

Calculate the minimum amount of heat required to completely vaporize this sample of ethanol. Your response must include *both* a correct numerical setup and the calculated result.

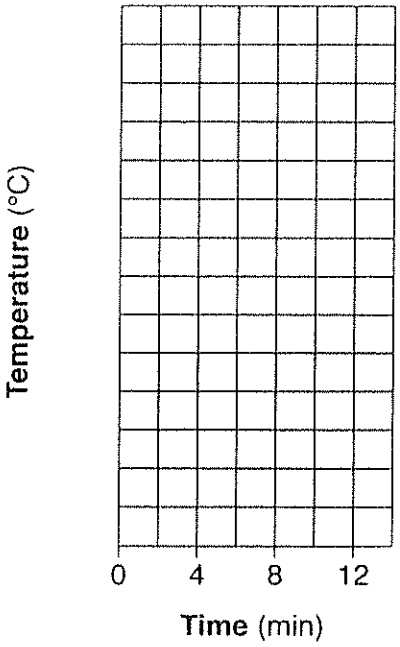
24. Base your answer to the following question on the information and chart below.

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

Cooling Curve for Stearic Acid



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

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

A phase change for carbon dioxide that occurs spontaneously at 20.°C and 1.0 atmosphere is represented by the balanced equation below.

$$CO_2(s) + \text{energy} \rightarrow CO_2(g)$$

Write the name of this phase change.

Unit 6 Review Packet #2
Answer Key
[New Exam]

1. *a* Examples: $q = mH_f$ = (25.0 g)(334 J/g) or 25.0(334)
   b 8350 J

2. It does not change.

3. Responses include, but are not limited to: $\overline{DE}$ is longer than $\overline{BC}$ • More time to boil than to melt

4. Responses include, but are not limited to: Heat is transferred from the copper to the water • Heat flows from the hotter object to the cooler object • Copper heat → water

5. Responses include, but are not limited to, these examples:
   heat lost to surroundings • heat absorbed by the thermometer; heat absorbed by the calorimeter

6. q= (100.0 g) (4.18 J/g•°C) (3.1°C)

7. Data Table

Quantity Measured	Data (units are given)
Mass of copper	50.0 or 50 g
Temperature of hot copper	100.0 or 100°C
Mass of H_2O in calorimeter	100.0 or 100 g
Initial temperature of H_2O in calorimeter	23.2°C
Final temperature of H_2O and copper	26.3°C

8. 915 J

9. The temperature of the substance is increasing.

10. 53°C

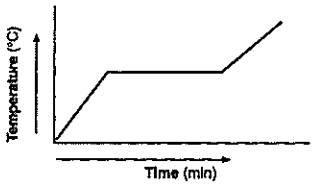
11. Essay

12. Essay

13. 50°C

14. 1250 J

15. 288 K

16. 

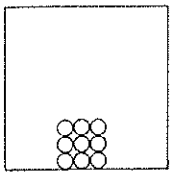
17. Examples: - The average kinetic energy of the particles remains the same. - KE remains constant. - no change

18. 50.°C ± 2°C

19. 6850 J

20. The potential energy of the ammonia molecules increases and the average kinetic energy of the ammonia molecules remains the same.

21. $q = mC\Delta T$ = (5.00 g)(4.71 J/g • K)(30. K)
    (5)(4.71)(30)
    710 J

22. 

23. *Examples:*
    - (65)(838)
    - 5.45×10^4 J - 54 500 J

24. *Examples:* - solidification - freezing - crystallization

25. sublimation