## Heating/Cooling Curves

A. The following graph is a heating curve showing the addition of heat at a constant rate of 500.0 joules/minute to a 3.00 gram sample of ice at $-20.0^{\circ} \mathrm{C}$. The final temperature of the vapor is $140.0^{\circ} \mathrm{C}$.

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## Questions

1. During which segments is kinetic energy increasing?
2. During which segments does kinetic energy remain the same?
3. During which segments is potential energy increasing?
4. During which segments does potential energy remain the same?
5. During which segments is one phase only present?
6. During which segments are two phases present?
$\qquad$
7. At what time does the liquid phase first appear?
$\qquad$
8. At what time does the gas phase first appear? $\qquad$
9. At what time do the particles have the highest average kinetic energy?
10. Phase changes that occur with an absorption of energy are $\qquad$ thermic.
11. $\qquad$ (f) $\qquad$ ) and $\qquad$ are endothermic phase changes.
12. During which segment could the heat of fusion be determined? $\qquad$
13. During which segment could the heat of vaporization be determined?
14. How long does it take to completely melt the sample at its melting point?
15. How long does it take to completely vaporize the sample at its boiling point? $\qquad$
16. During which segment is the substance entirely in the solid state? $\qquad$
17. During which segment is the substance entirely in the gas state? $\qquad$
18. If 25.0 grams of ice at $0^{\circ} \mathrm{C}$ are heated at a constant rate of 400.0 joules/minute, calculate the time needed to melt the sample completely. SHOW WORK.
19. If 25.0 grams of water at $100^{\circ} \mathrm{C}$ are heated at a constant rate of 400.0 joules/minute, calculate the time needed to vaporize the sample completely. SHOW WORK.
20. Why is the time needed to vaporize the sample of water significantly greater than the time needed to melt the sample? $\qquad$
$\qquad$
B. The following is a cooling curve showing the release of heat at a constant rate of 500.0 joules/minute from a 3.00 gram sample of water vapor at $140.0^{\circ} \mathrm{C}$. The final temperature of the ice is $-20.0^{\circ} \mathrm{C}$.


Questions

1. During which segments is kinetic energy decreasing?
2. During which segments does kinetic energy remain the same?
3. During which segments is potential energy decreasing?
4. During which segments does potential energy remain the same?
5. During which segments is one phase only present? $\qquad$
$\qquad$
6. During which segments are two phases present?
7. At what time does the liquid phase first appear? $\qquad$

8. At what time does the solid phase first appear? $\qquad$
9. At what time do the particles have the highest average kinetic energy?
10. Phase changes that occur with a release of energy are $\qquad$ -.
11. $\qquad$ and $\qquad$ are exothermic phase changes.
12. During which segment could the heat of solidification be determined? $\qquad$
13. During which segment could the heat of condensation be determined? $\qquad$
$\qquad$
14. How long does it take to completely freeze the sample at its freezing point?
15. How long does it take to completely condense the sample at its condensation point?
16. During which segment is the substance entirely in the solid state? $\qquad$
17. During which segment is the substance entirely in the liquid state? $\qquad$
18. During which segment is the substance entirely in the gas state? $\qquad$
19. During which segment is there an equilibrium between the solid and liquid states? $\qquad$
The temperature of the sample at this point is $\qquad$ Kelvin.
20. During which segment is there an equilibrium between the liquid and gas states? $\qquad$ The temperature of the sample at this point is $\qquad$ Kelvin.

Name $\qquad$ Date $\qquad$
C. The following is a heating curve for substance X . 15.00 grams of substance X are heated at a constant rate of 500.0 joules $/ \mathrm{min}$.


## Time (minutes)

For answers that require calculations, express using the correct number of significant figures and include units.

1. The melting point is $\qquad$ . The boiling point is $\qquad$ .
2. The time at which the liquid phase first appears is $\qquad$ minutes. The time at which the gas phase first appears is $\qquad$ minutes.
3. The sample is completely in the liquid phase between $\qquad$ and $\qquad$ minutes.
4. Determine the heat of fusion of this substance.
5. Determine the heat of vaporization of this substance.
6. Determine the specific heat of substance X ( in the liquid state).
7. Compare the intermolecular forces present in substance X to those present in a sample of water. Explain completely.
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