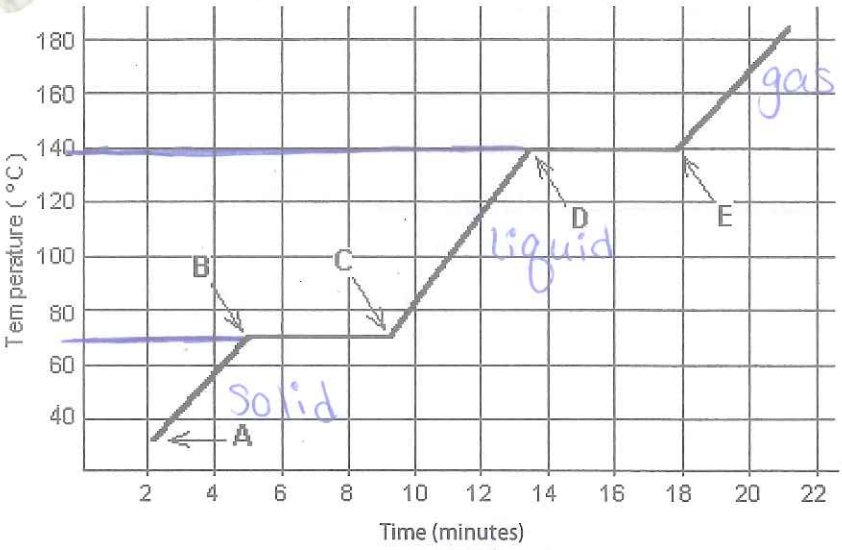
Slopes = state of matter; heat = ↑ temp = ↑ KE
plateaus = phase change; heat = break IMFs & separate molecules

Interpreting the Heating Curve of an Unknown Substance



The heating curve (at right) was developed while heating an unknown substance

Substance	Melting point	Boiling point
Bolognium	20 °C	100 °C
Unobtainium	40 °C	140 °C
Foosium	70 °C	140 °C

- **Segment A-B:** (positive slope) → At the beginning of the heating curve, the substance exists as a ___solid___ (single state of matter). Matter in this phase has a(n) ___definite___ volume and a(n) ___definite___ shape. With each passing minute, ___heat___ is added to the substance. This causes a rise in the ___temperature___ of the substance. As a result, the molecules of the substance will ___move___ more rapidly, which means an increase in the molecules' ___kinetic___ energy.

- ★ **Segment B-C:** (plateau = no slope) → During this segment of the heating curve the temperature is a constant ___70___ °C. The solid begins to ___melt___. Therefore, the temperature at point B is known as the ___melting___ ___point___ of the substance. Between points B and C, heat continues to be added over time. This heat is used, to convert the substance from a ___solid___ to a ___liquid___. This heat energy is known as the **latent heat of fusion** (fusion = melting).

heat added changes the potential energy

- **Segment C-D:** (positive slope) → At this point, the substance is completely in the ___liquid___ phase. Matter in this phase has a(n) ___definite___ volume and a(n) ___indefinite___ shape.

- ★ **Segment D-E:** (plateau = no slope) → At this point in the heating curve the temperature is a constant ___140___ °C. This is when the liquid begins to ___vaporize___ and the temperature at point D is known as the ___boiling___ ___point___ of the substance. Between points D and E, the heat which is added is used to convert the substance from a ___liquid___ to a ___gas___. This heat energy is called the **latent heat of vaporization.**

- **Segment E-F:** (positive slope) → At this point the substance is completely in the ___gas___ phase and the molecules are moving ___faster___ as indicated by the high temperatures. Matter in this phase has a(n) ___indefinite___ volume and a(n) ___indefinite___ shape. Any heat added after point E will continue to cause an increase in the ___temperature___ of the substance.

Heating Curve of Water & Relation to Specific Heat

The flat parts (plateaus) on a heating curve represent a phase change. For example, when ice melts, the energy added to the ice increases the vibrations of the solid molecules until they reach a high enough temperature, the melting point. At the melting point, the molecules finally have enough kinetic energy of motion to break free from the attractive forces holding the solid molecules together. Notice that there is no increase in temperature until all of the ice has been converted to liquid water. This process is similar for vaporization. Again, the liquid molecules will continue to move faster as heat is added and the temperature increases. At the boiling point, the liquid molecules have gained enough energy to escape into the gas phase. Two terms that you will need to know are:

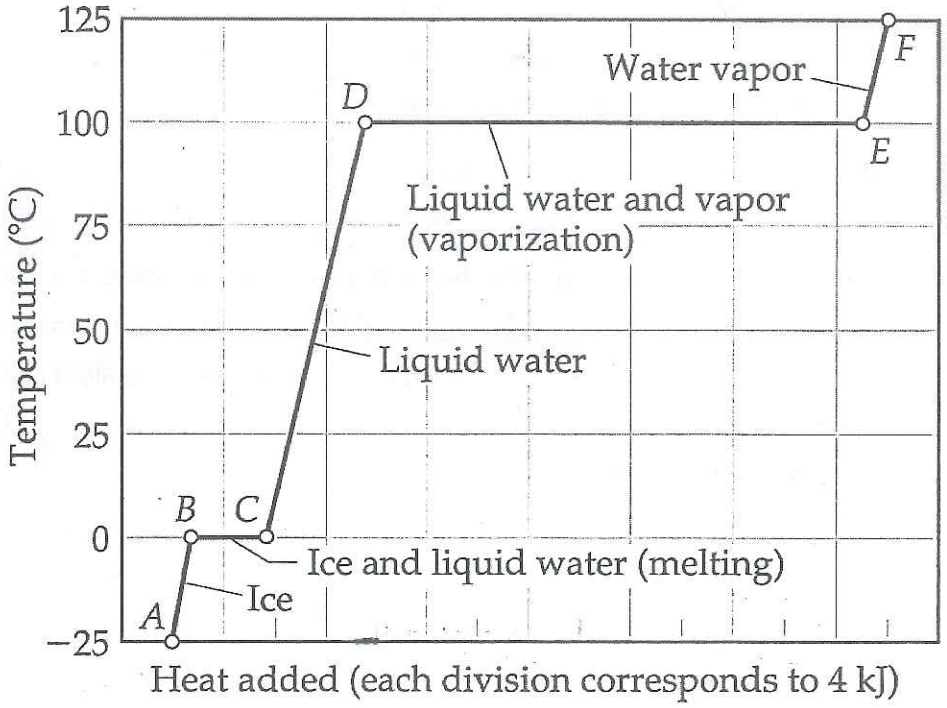
1) Heat of Fusion – energy needed to melt 1 gram of a substance at its melting point.

2) Heat of Vaporization – energy needed to vaporize 1 gram of a substance at its boiling point.

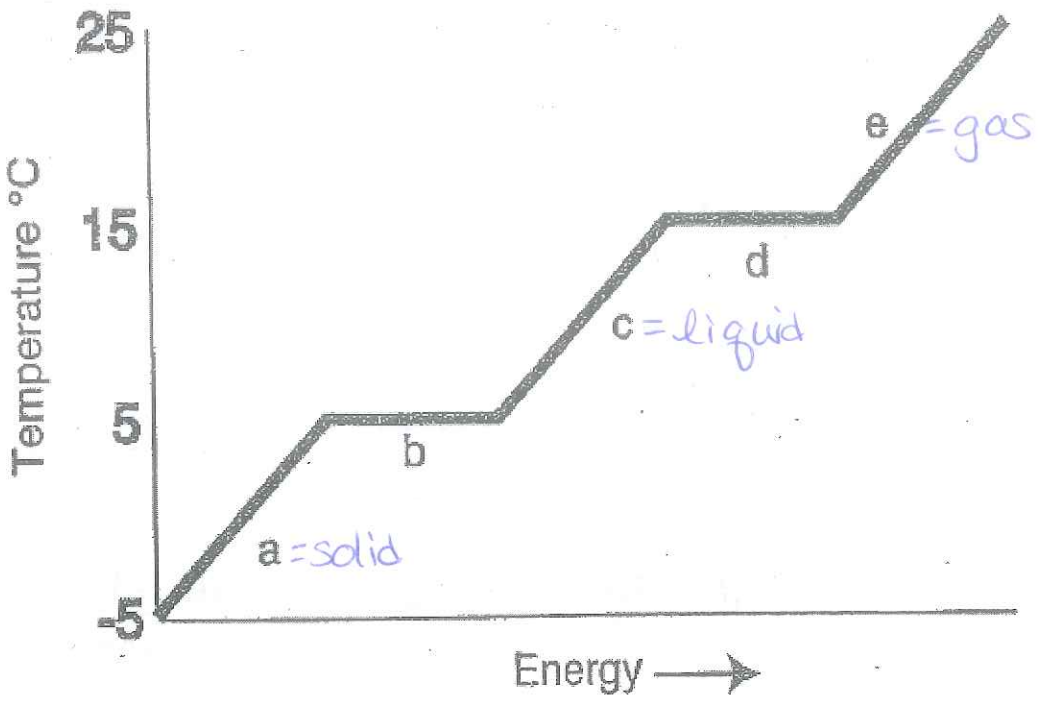
The slopes of the slanted lines represent the specific heat capacity. The sharper the slope, the smaller the specific heat capacity of the substance is. This is significant because the sharper the slope, the more quickly the temperature rises when the substance is heated.

3) Specific Heat Capacity – quantity of heat needed to raise 1 gram of a substance by 1°C

It is possible to calculate the quantity of heat is needed (along each segment of a heating curve) to heat a substance so much that it changes phases.



Heating/Cooling Curve of an Unknown Substance



Directions: Answer the following questions using the heating curve above:

1) What is the freezing point of the substance? 5°C
2) What is the boiling point of the substance? 15°C
3) What is the melting point of the substance? 5°C
4) What letter represents the range where the solid is being warmed? a
5) What letter represents the range where the liquid is being warmed? c
6) What letter represents the range where the vapor is being warmed? e
7) What letter represents the melting of the solid? b
8) What letter represents the vaporization of the liquid? d
9) What letter(s) show a change is potential energy? b, d → plateaus
10) What letter(s) show a change in kinetic energy? a, c, e → temp change = slope
11) What letter represents condensation? d
12) What letter represents crystallization (aka: freezing)? b