Name: SOLUTIONS
Hour: _____ Date: _____

PHASE CHANGES

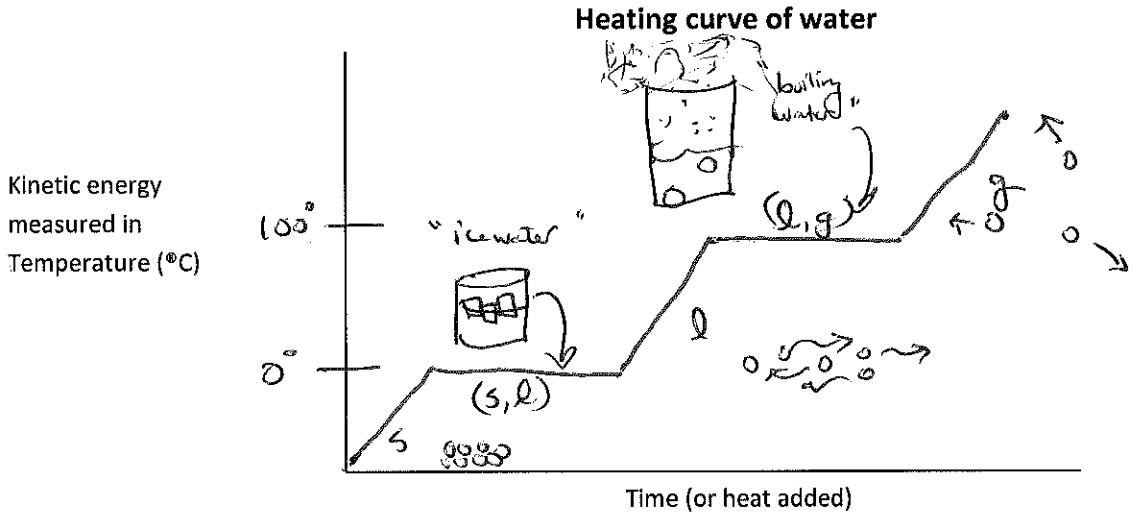
The state of matter of a substance depends on the kinetic energy of the particles and the intermolecular attractions between those particles.

Heating Curves

Consider the heating curve for water. Assume standard pressure conditions (1 atm).

a. What is the melting point (in Celsius) of water?: 0°C (273 K)

b. What is the boiling point (in Celsius) of water?: 100°C (373 K)



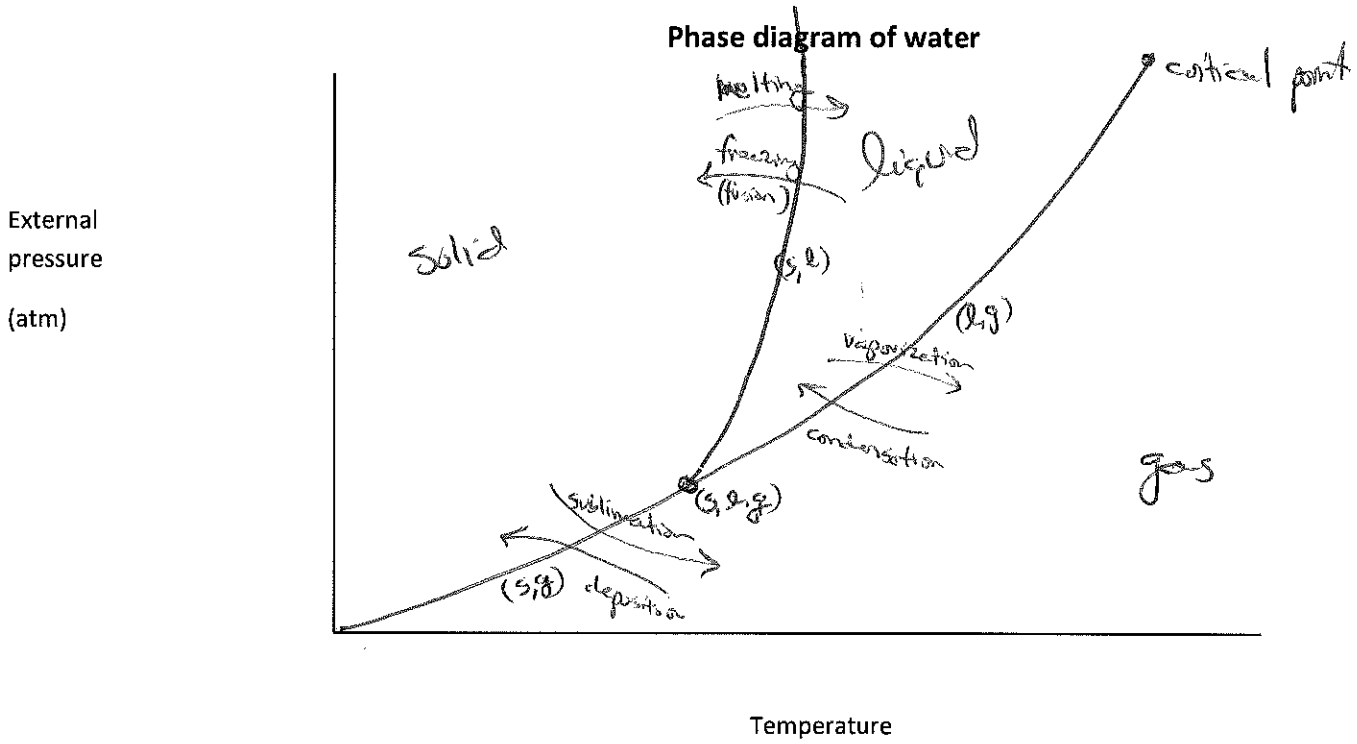
c. In your own words, describe what is happening to the molecules of a substance when the heating curved has a positive slope:

The KE of the molecules is increasing (the molecules are moving/vibrating faster). Only 1 phase exists when we see (+) slope.

d. Describe what is happening to the molecules of a substance when the heating curved has a slope of zero (i.e. temperature remains constant over time as energy is supplied to the system):

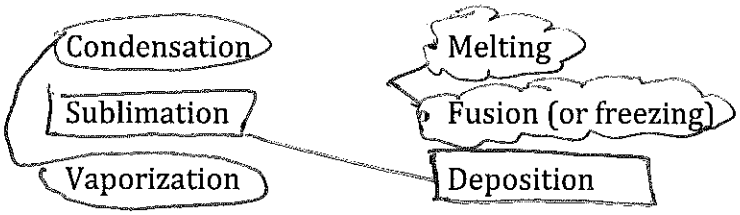
The added energy is going into breaking the IMFs that hold molecules close to each other. Until ALL IMFs have been broken, temperature will stay constant b/c all E is going into braking IMFs, not making molecules move faster that are already in higher E phase. ∴ 0 slope during phase changes.

Phase Diagrams



Vocabulary to know:

a) Match the phase change pairs and then write them onto your phase diagram above.



b) Phase changes that are ENDOthermic in nature (i.e. require KE) include:

Going from lower E state to a higher E state:

- Sublimation
- Melting
- Vaporization

c) Phase changes that are EXOthermic in nature (i.e release KE) include:

Going from higher E state to a lower E state:

- deposition
- fusion
- condensation

d) Triple point:

The pressure and temperature conditions at which a substance can ~~exist in equilibrium~~ coexist as all 3 phases (s, l, g).

e) Normal boiling point: ~~bilbate~~ The temperature at which a substance boils (or condenses) under standard pressure conditions (101.3 kPa or 1 atm)

f) Normal freezing point: The temperature at which a substance freezes (or melts) under standard pressure conditions (101.3 kPa or 1 atm)

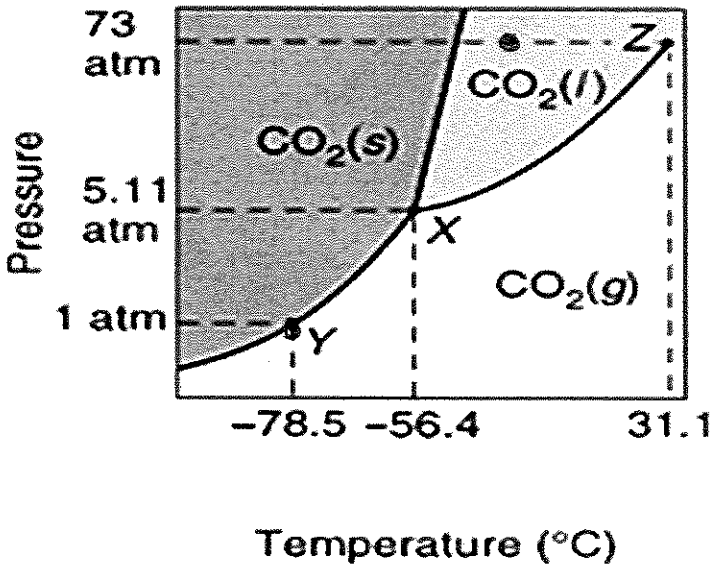
Example problems:

1. Tomorrow, we'll be working with dry ice, which is frozen CO_2. Using the phase diagram below, identify the different characteristics of this substance.

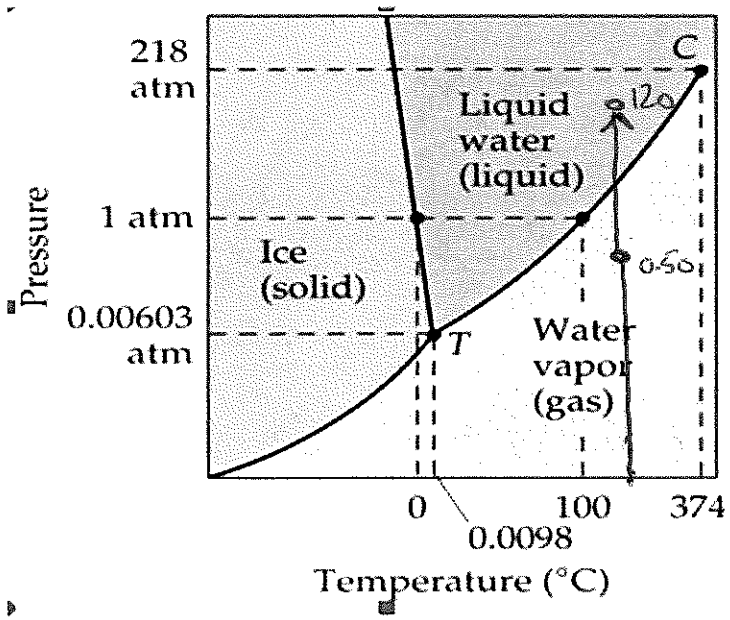
   a) The point at which CO_2 will sublime at 1 atm? Y

   b) What state(s) does CO_2 exist in at point X?
   s, l, g

   c) What state(s) does CO_2 exist as when the system is at 73 atm and 10°C?
   liquid



2. A sealed container of water vapor, whose internal temperature is 110°C, is subjected to an increase of pressure from 0.50 atm to 120 atm. What phase will water be in once the system has come to rest?



Water will condense from the vapor phase and will become a liquid at 110°C as we move from a lower pressure to a higher pressure.