Monday & Tuesday Plans

Monday:

- New Packet needs to be passed out
- Notes on States of Matter & the Kinetic Molecular Theory Slides 1-9
- Worksheet using Combined Gas Law & Ideal Gas Law

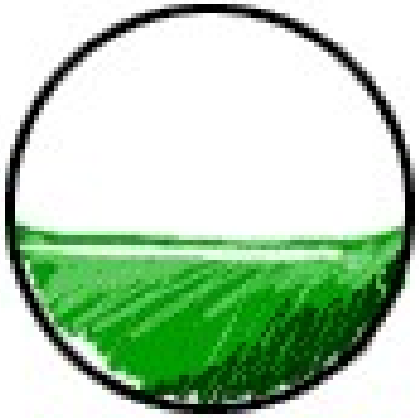
Tuesday:

- Notes Slides 9-22
- Worksheet

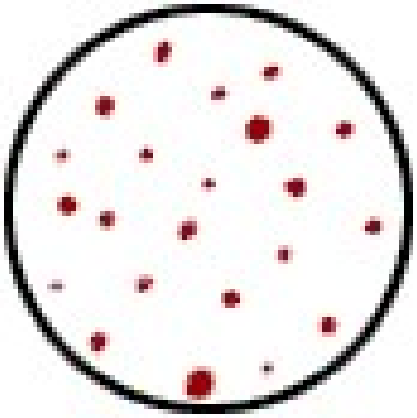
Bellringer: 12/4/2017

1. Create a Venn Diagram to compare and contrast the 3 states of matter.
2. Define Kinetic.
3. What is a theory?

SOLIDS

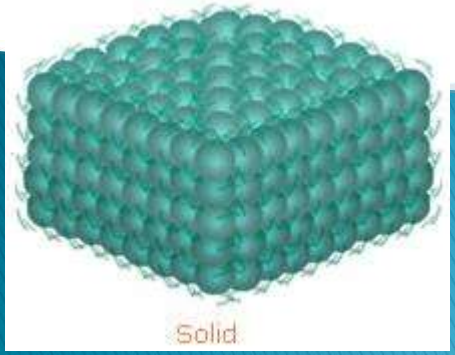


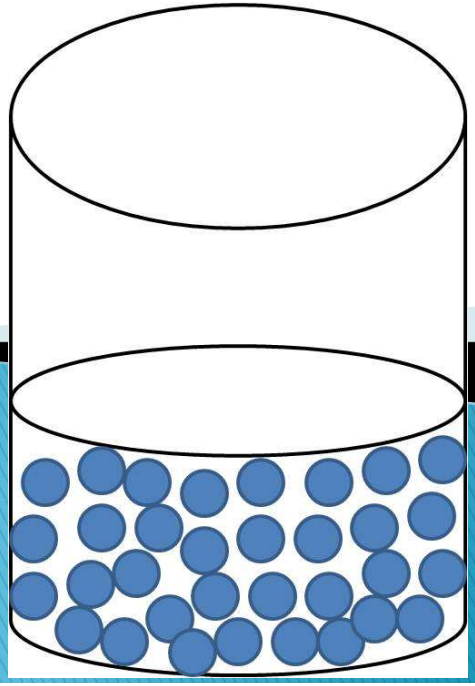
LIQUIDS

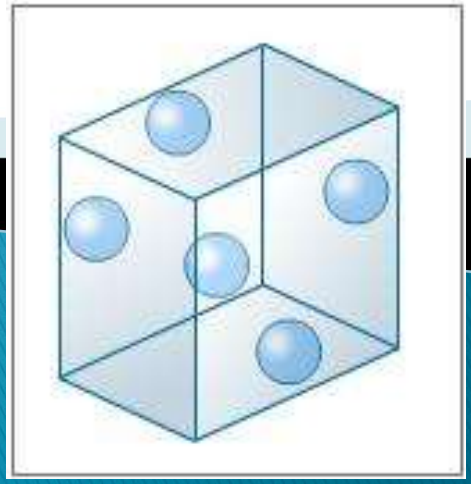


GASES

Phases of Matter

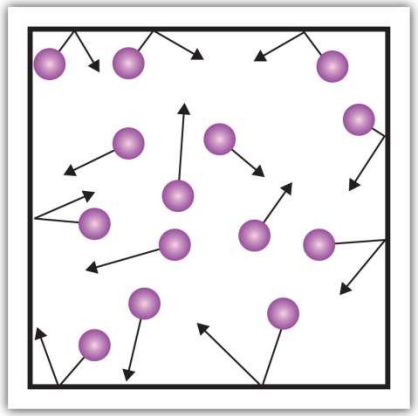






Properties of Gases

- The Kinetic –Molecular Theory (KMT) of Gases
  - All Gases are **Ideal Gases**
  - 5 parts
    1. Gases are particles are far apart
    2. All collisions are **Elastic Collisions**
       - No loss of kinetic energy
    3. Gases are ALWAYS moving
    4. Gases are NOT attracted/repulsed by each other
    5. kinetic energy depends on the temperature



Most gases are not Ideal Gases & do not completely follow KMT

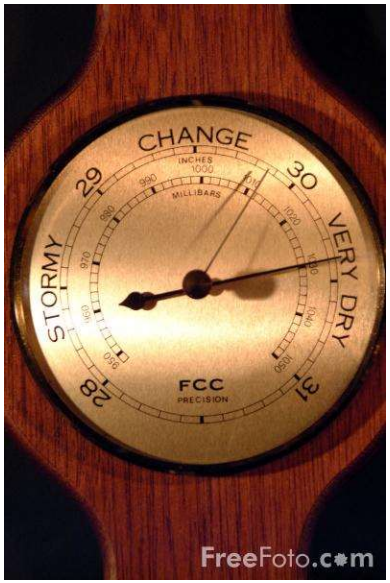
end

Properties of Gases

- Based on KMT, gases:
  - Can Expand/Compress
  - Have a Low Density
  - Are Fluids
  - Can Diffuse
    - Spread out and mix with other gases
  - Can Effuse
    - Move through a small opening

end

Pressure and Temperature



- Pressure
  - Amount of Force per Area
  - Measured with a Barometer
  - Standard Pressure

1.00 atm = 760. mmHg = 760. torr = 101.3 kPa

- Temperature
  - Average kinetic energy of a substance
  - Standard Temperature

0 °C = 273 K K = °C + 273

end

Gas Laws

- Combined Gas Law
  - Combination of Boyle, Charles, and Gay-Lussac

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

  - Pick the parts you need, leave the others out
  - T must be in Kelvin!!! **K=273+ ^{0}C**

end

Gas Laws

1. A balloon has a volume of 50.0 L at 25 °C and 1.08 atm. What volume will it have at 0.855 atm and 10. °C?
2. A gas is at a pressure of 3.00 atm at 25 °C. What is the pressure when the gas is heated to 52 °C?
3. A sample of gas occupies a volume of 752 mL at 25 °C. What volume will the gas occupy at 50 °C?

end

Gas Laws

- The Ideal Gas Law

In Kelvin
K=273+ ^{0}C

Number of Moles

$$PV = nRT$$

  - CHECK YOUR UNITS!!!

Gas Constant
**In the Reference table. There are 3 gas constants on the first page. Choose the constant that matches you unit of measurement for pressure

end

Gas Laws

1. What is the pressure in atms exerted by a 0.500 mol sample of N_2 in a 10.0 L container at 298 K?
2. What is the volume, in L, of 0.250 mol of oxygen gas at 20.0 °C and 0.974 atm?
3. What mass of Cl_2 is contained in a 10.0 L tank at 27 °C and 3.50 atm?

end

Bellringer: 12/5/2016

1. A balloon has a volume of 3.00L and a pressure of 1.00 atm at standard temperature. If the pressure of the balloon is increased to 1.50 atm and the temperature remains the same, what will the volume of the balloon be?
2. A 20.00L oxygen tank is at a temperature of 300. K and a pressure of 1.00 atm. How many moles of oxygen are contained inside of the container?

Gas Laws

- Dalton's Law of Partial Pressures
  - P of each gas adds together to give the total pressure

$$P_T = P_1 + P_2 + P_3 + \ldots$$

1. A vessel contains 1.03 atm of Ar, 5.63 atm of CO, and 0.325 atm of Ne. If the total pressure of the vessel is 9.52 atm, what is the pressure of N_2?
2. A jar contains 1.23 atm of O_2, 453 atm of Kr, and 543 atm of Cl_2. What is the total pressure of the jar in atm?

end

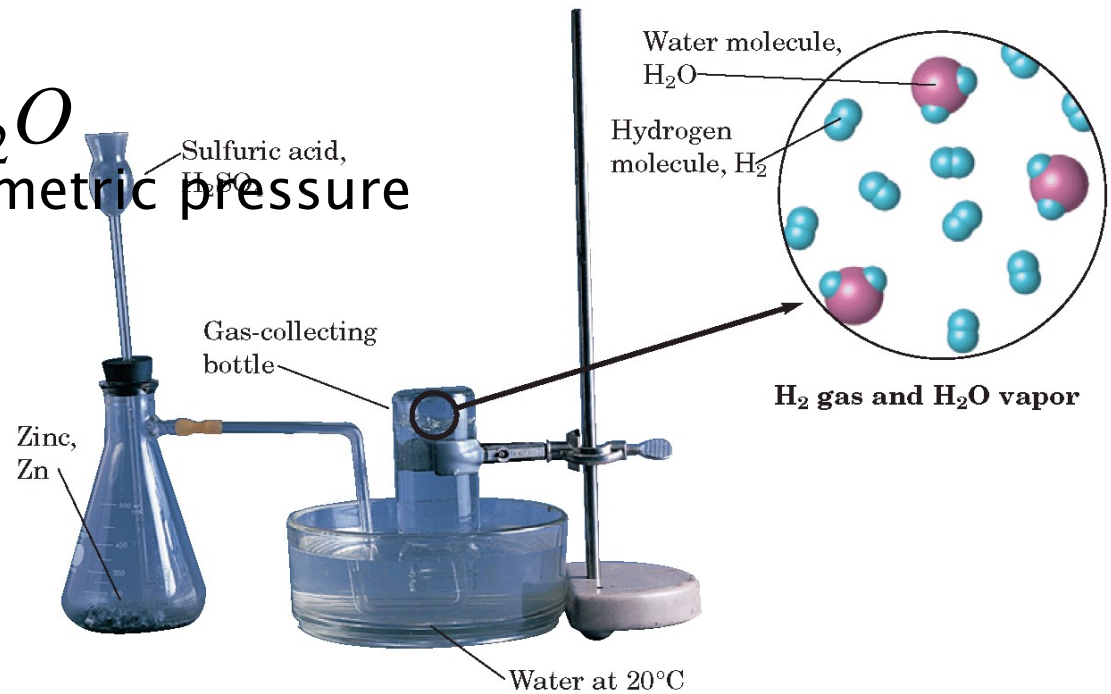
Gas Laws

- In the lab, gases are collected using water displacement
  - Some of the water becomes a gas and mixes with the product
  - To determine the pressure of gas created:

$$P_T = P_{gas} + P_{H_2O}$$

P_T = atmospheric/barometric pressure

Use Table A-8 for P_{H2O}



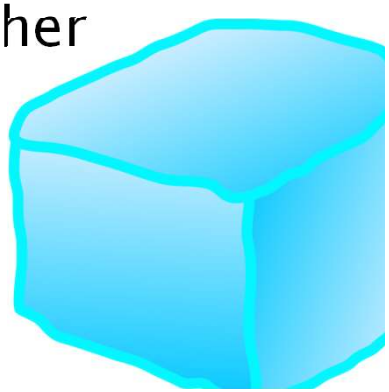
Gas Laws

1. O_2 gas is collected by water displacement. The barometric pressure and temperature were 731.0 torr and 20.0 °C. What was the partial pressure of gas collected?
2. Helium gas is collected over water at 25 °C. What is the partial pressure of helium, given that the barometric pressure is 750.0 mmHg?

end

States of Matter

- KMT can describe all phases of matter:
  - Molecules Slow Down= Stronger IM Forces
  - Gas
    - No Definite Shape and No Definite Volume
    - Most Motion
  - Liquid
    - No Definite Shape and Definite Volume
    - Particles flow and are semi-attracted to each other
  - Solid
    - Definite Shape and Definite Volume
    - Particles vibrate and are very attracted to each other
    - Least Motion



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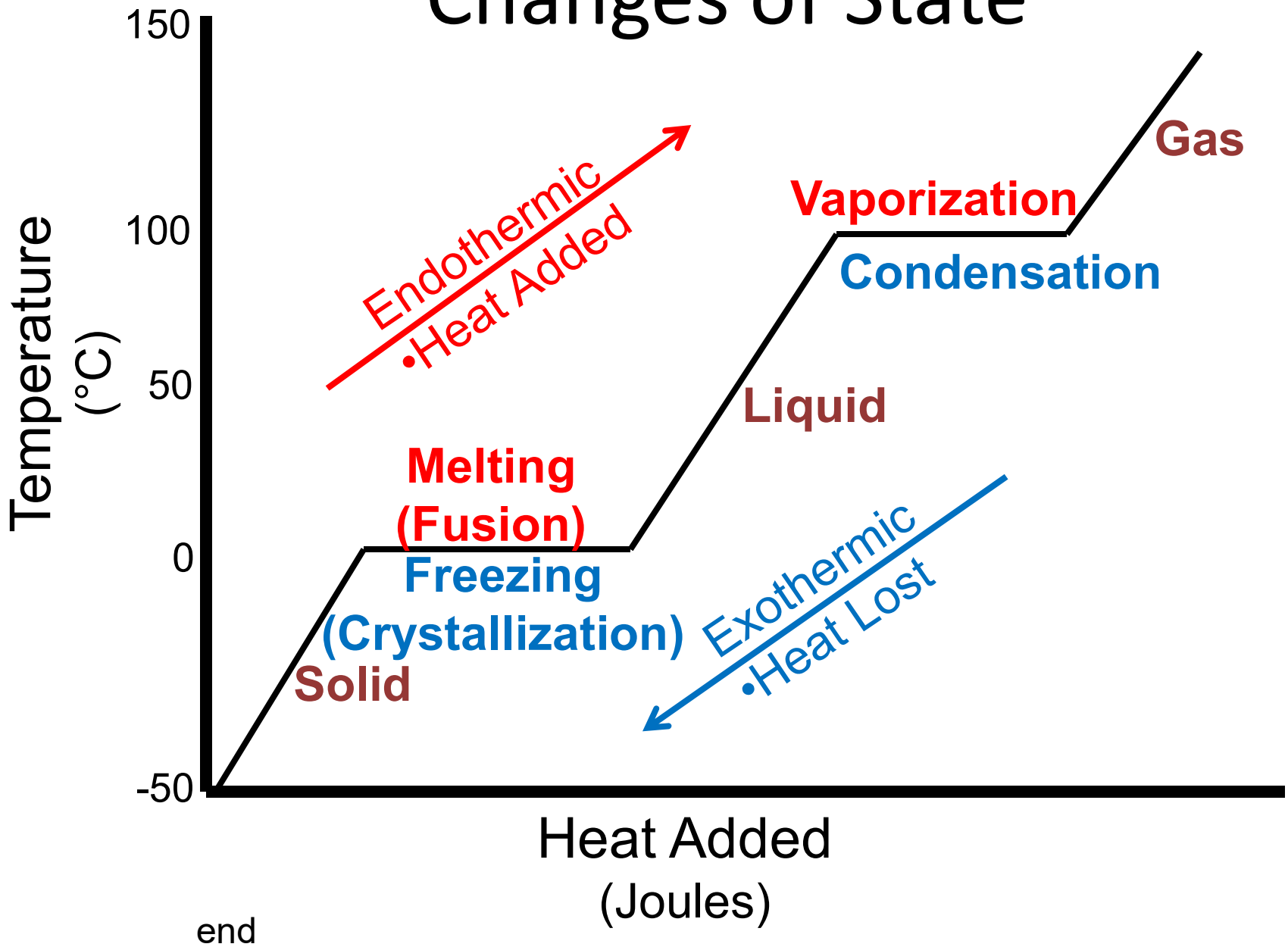
States of Matter

- Assuming constant pressure:
  - There are 4 basic phase changes
  - Vaporization (liquid to gas)
  - Condensation (gas to liquid)
  - Melting (solid to liquid)
  - Freezing (liquid to solid)

States of Matter

- Heating a solid/liquid/gas increases the temp.
  - Kinetic Energy!
- Phase Change = NO Temp. Change
  - Heat added increases Potential Energy
    - Distance between the particles
    - Latent Heat

Changes of State



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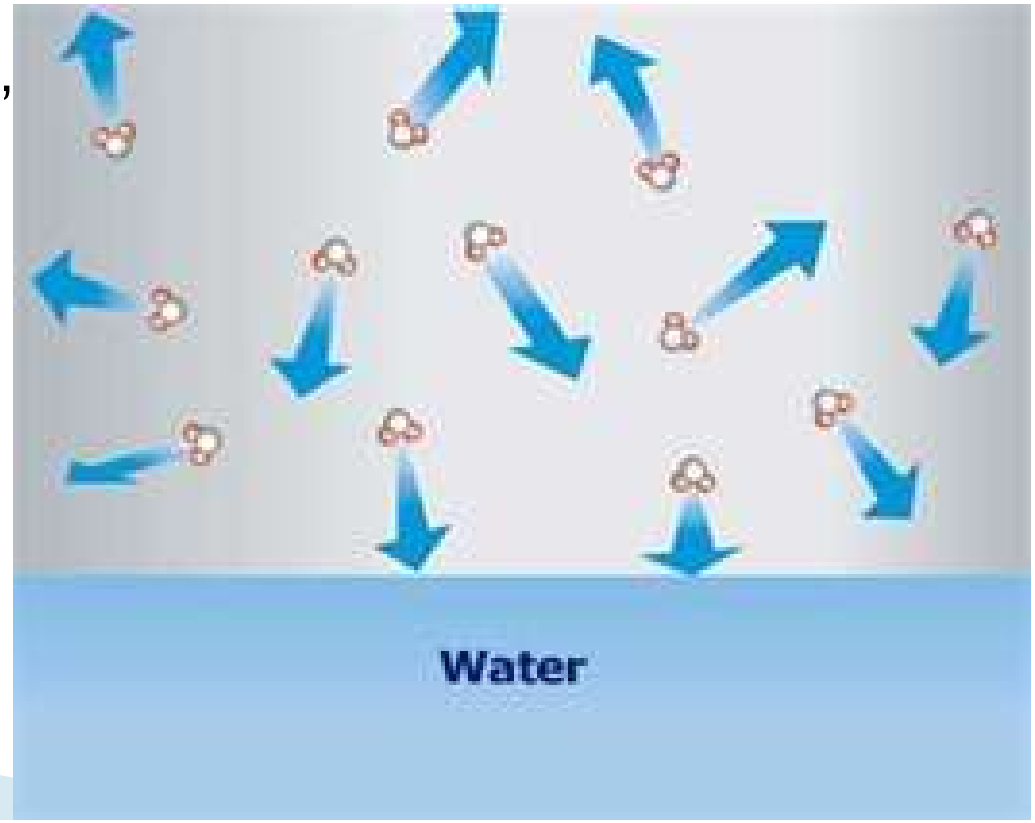
States of Matter

- Vaporization vs. Evaporation
  - Vaporization = Liquid Boils to become a gas
    - **Heat is added!!!**
  - Evaporation = Liquid "Disappears"
    - Based on Vapor Pressure
    - Spilled water "disappears"



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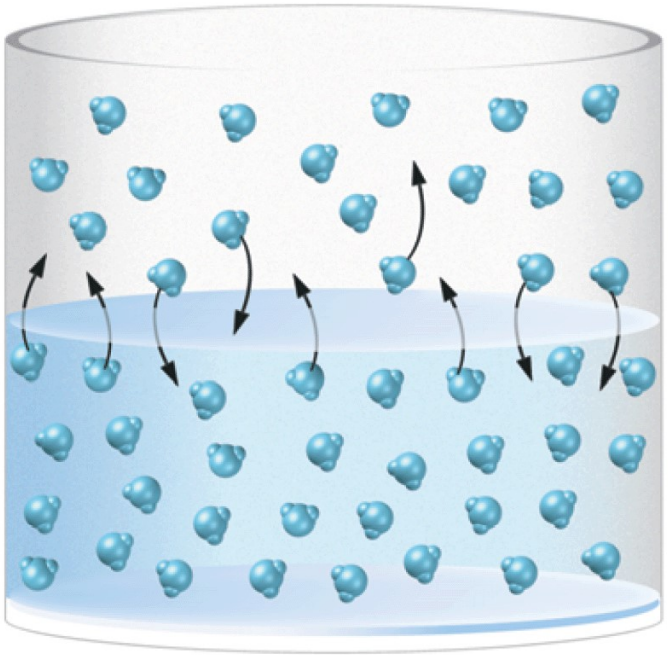
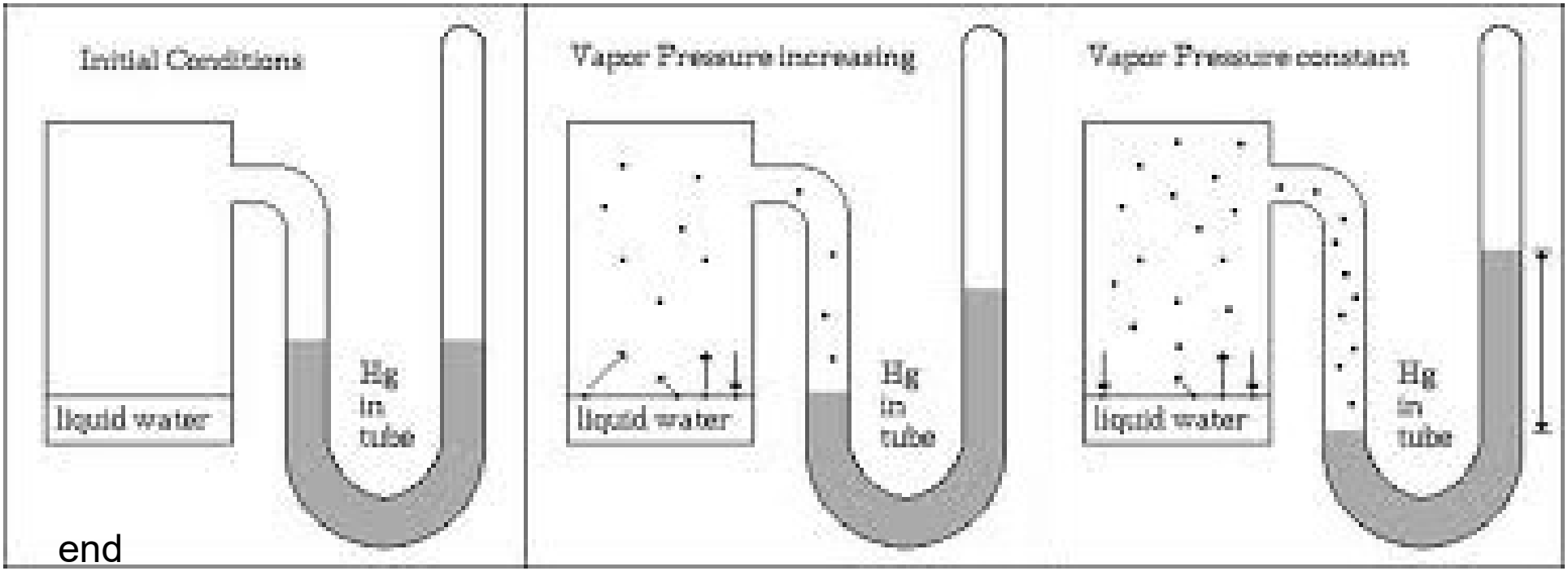
States of Matter

- Vapor Pressure
  - Liquid particles become gas
  - Push on the air above the liquid



Pure water



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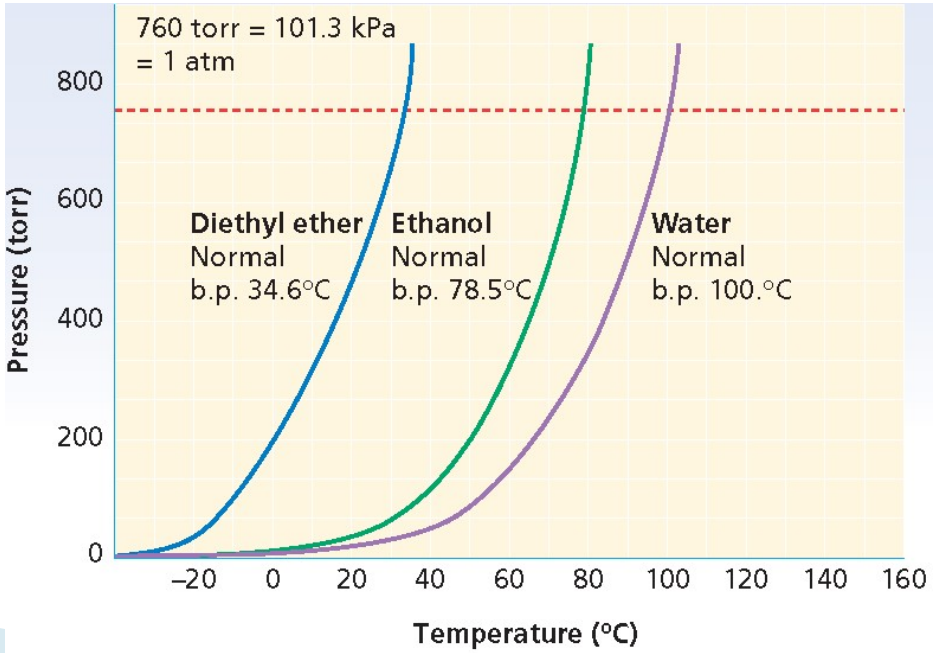
States of Matter

- Boiling occurs when:
  - The substance has enough pressure to push past the air
    - **Vapor Pressure = Atmospheric Pressure.**
      - **Usually 1 atm**
    - Lower Pressure = Lower Boiling Point
      - Water boils at a colder temp. on top of a mountain



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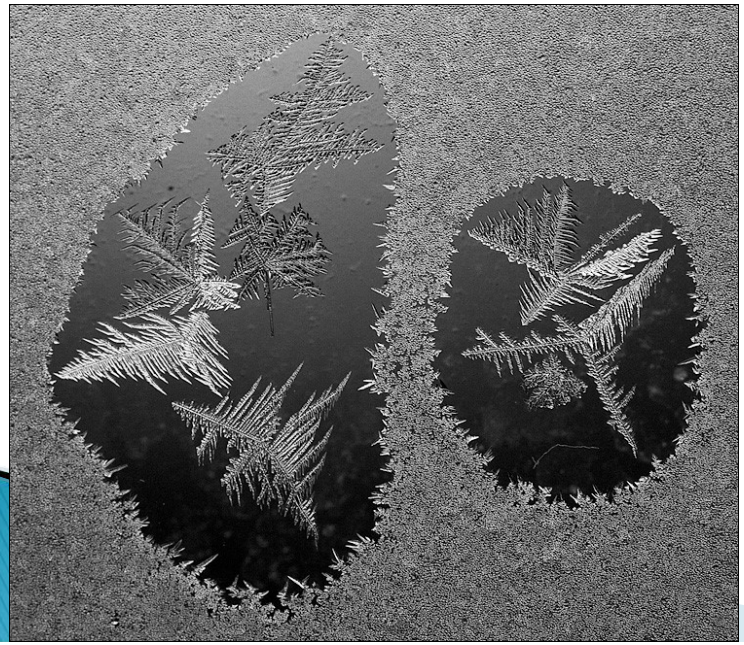
States of Matter

- States of Matter also depend on Pressure
  - Radiators, pressure cookers, dry ice,…
- Changing pressure gives 2 more Phase Changes:
  - Sublimation– Solid → Gas
  - Deposition– Gas → Solid



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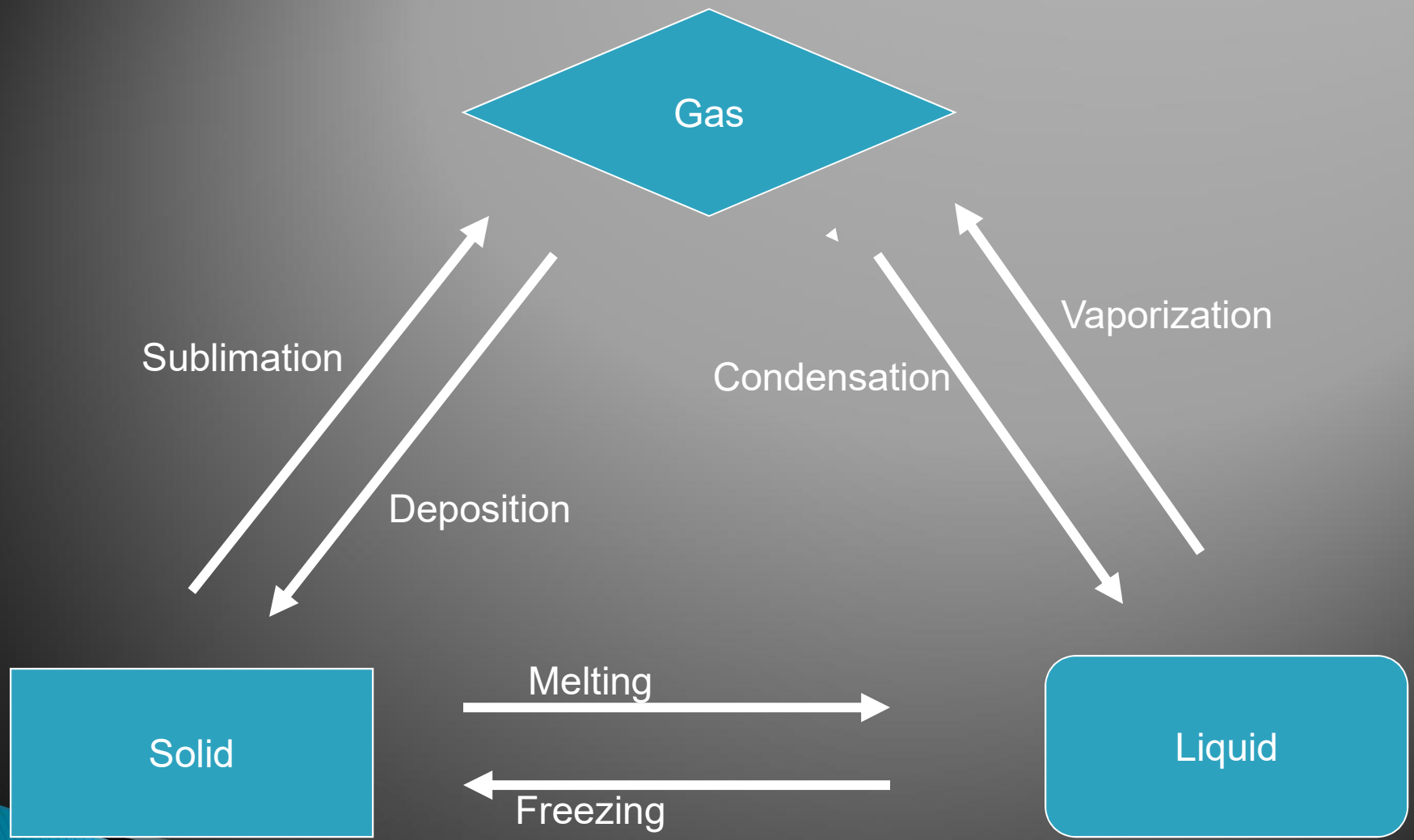
Phase Changes



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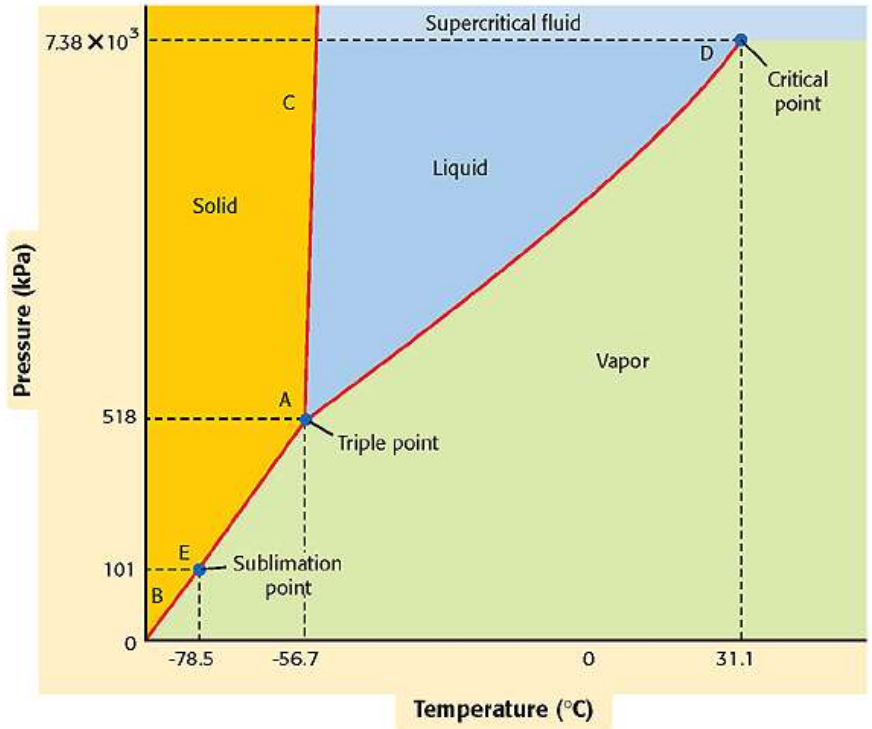
Bellringer: 12/13/2016

1. The pressure of a mixture of nitrogen, carbon dioxide, and oxygen is 150 kPa. What is the partial pressure of oxygen if the partial pressures of the nitrogen and carbon dioxide are 100 kPA and 24 kPa, respectively?
2. Which phase changes are endothermic?
3. Which phases are exothermic?
4. Describe temperature and energy during a phase change.
5. STOTD

States of Matter

- P vs. T Phase Diagrams
  - Triple Point
    - T and P where a substance is a solid, liquid, and gas
      - **AT THE SAME TIME!**
  - Critical Point
    - T and P that a substance can NO longer be a liquid

- Phase Diagram for CO_2
  - AND MOST other substances



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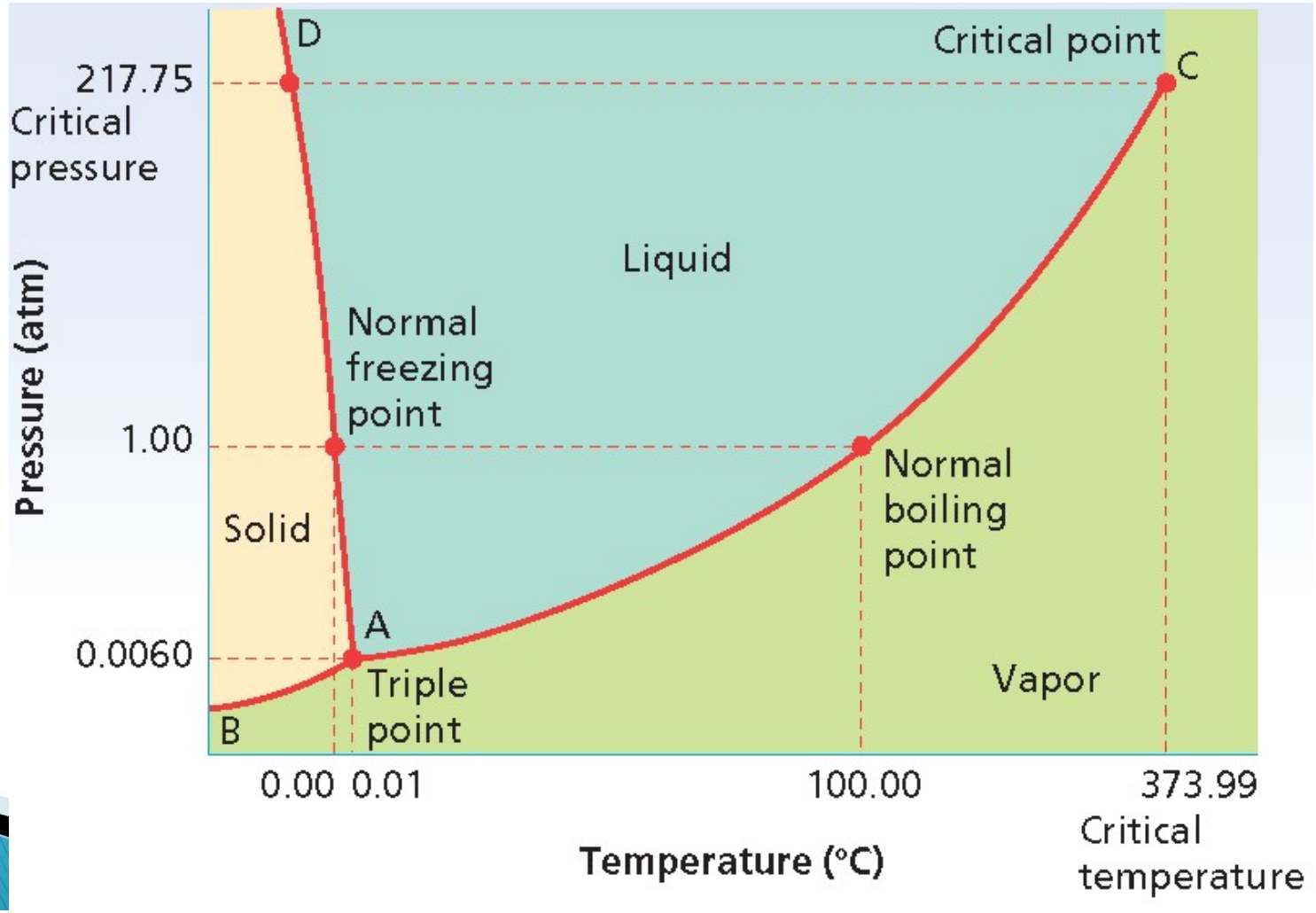
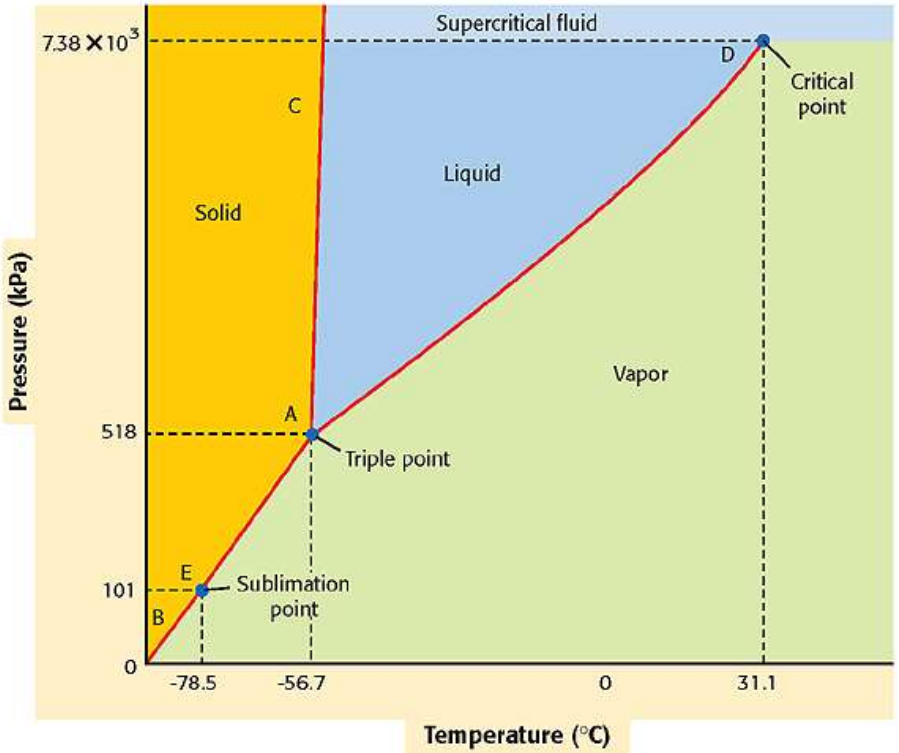
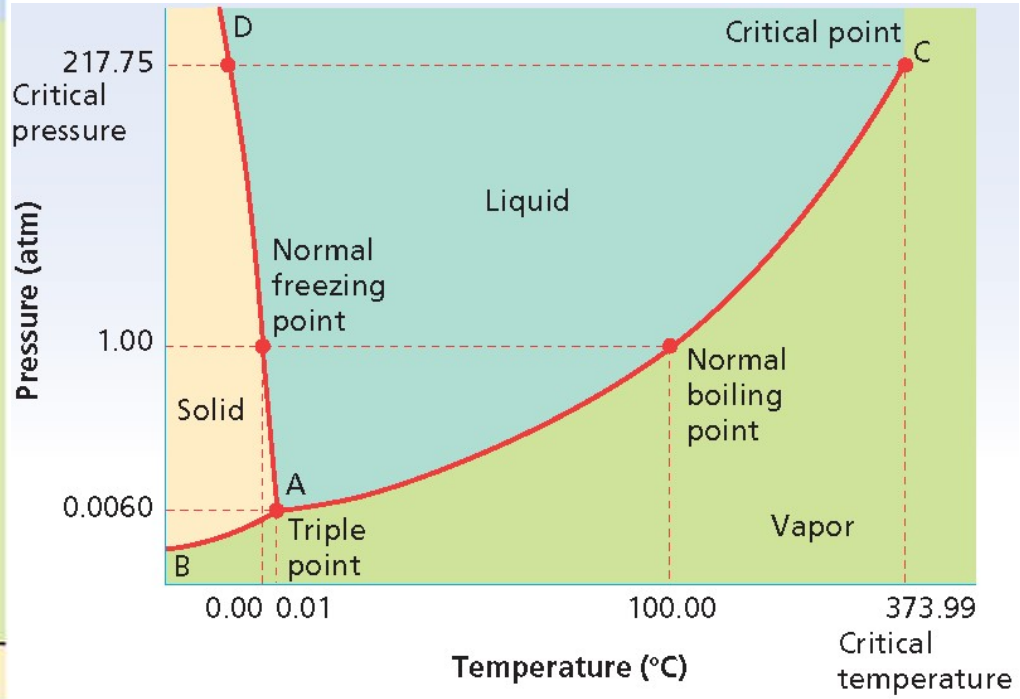
States of Matter

- Phase Diagram for H_2O

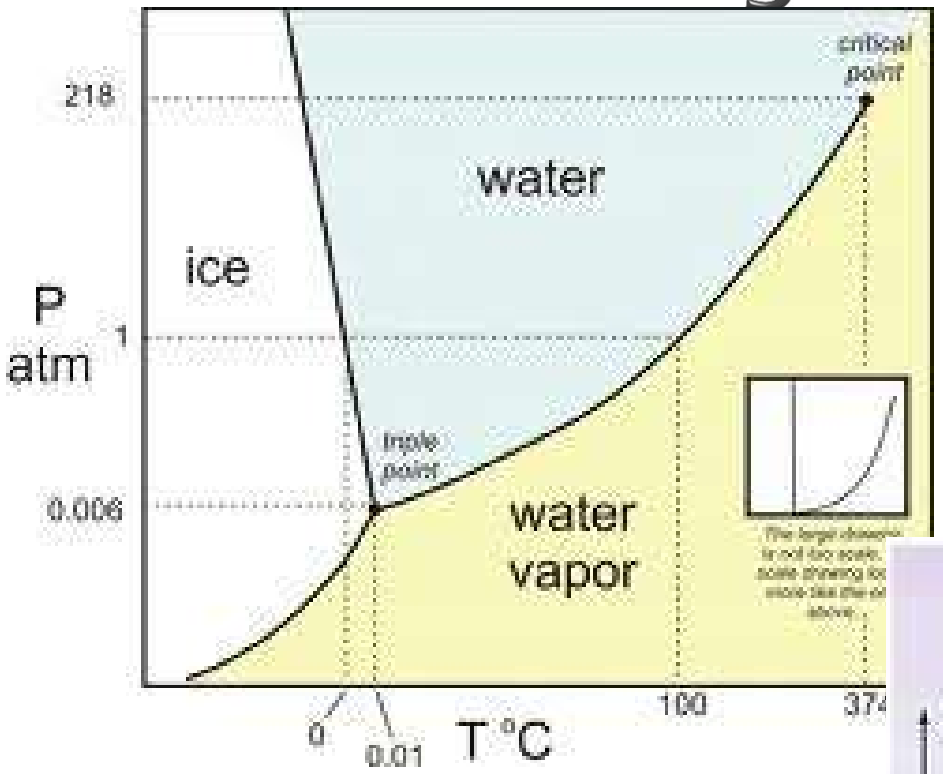


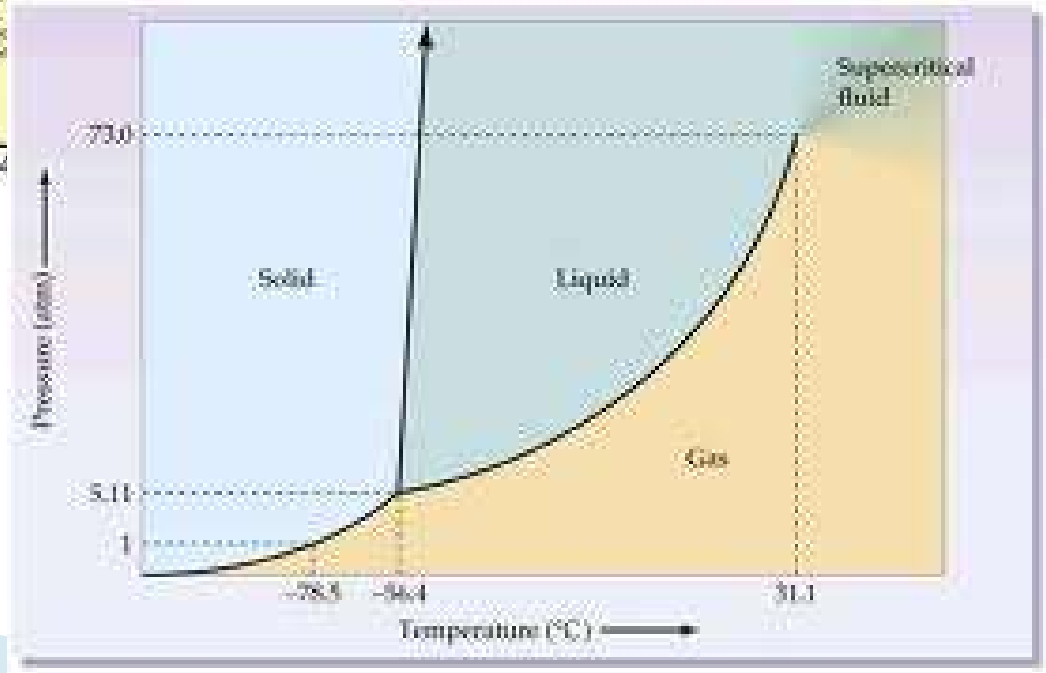
States of Matter





Phase Changes





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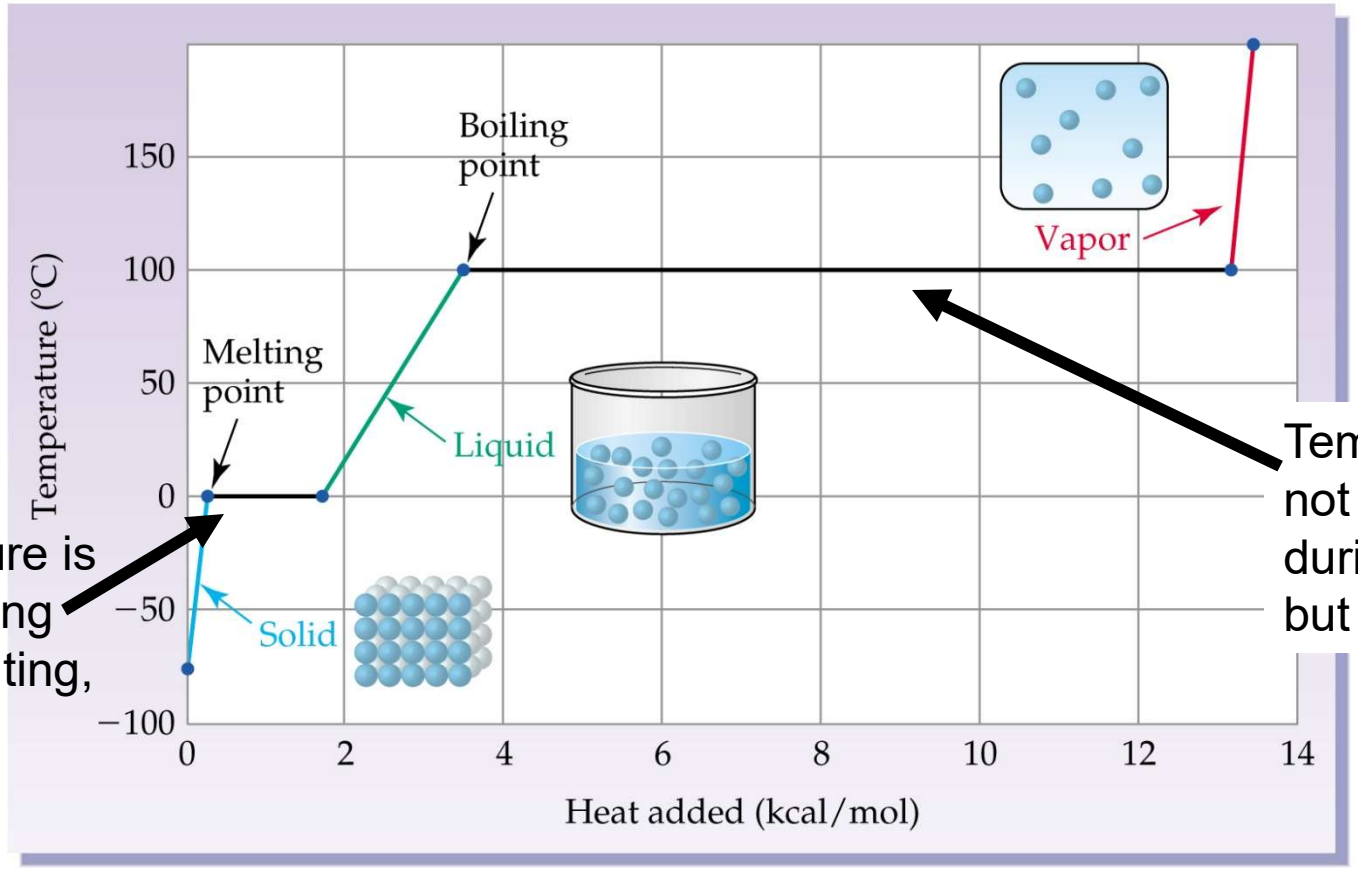
Phase Changes



Temperature is not changing during melting, but heat is added

Temperature is not changing during boiling, but heat is added

end

Thermal Energy

- Specific Heat (c)
  - Heat needed to raise the temp. of a substance
  - Low Specific Heat = Less Energy Needed

end

Thermal Energy

- Heat
  - **Moves from Hot Objects to Cold Objects**
  - Measured in joules (J) or calories (cal)
    - 1 Calorie (big C from food labels) = 1000 cal

$$Q = mc\Delta T$$

Change in Temp.
$= T_f - T_i$

  - Do NOT use when going through a Phase Change

end

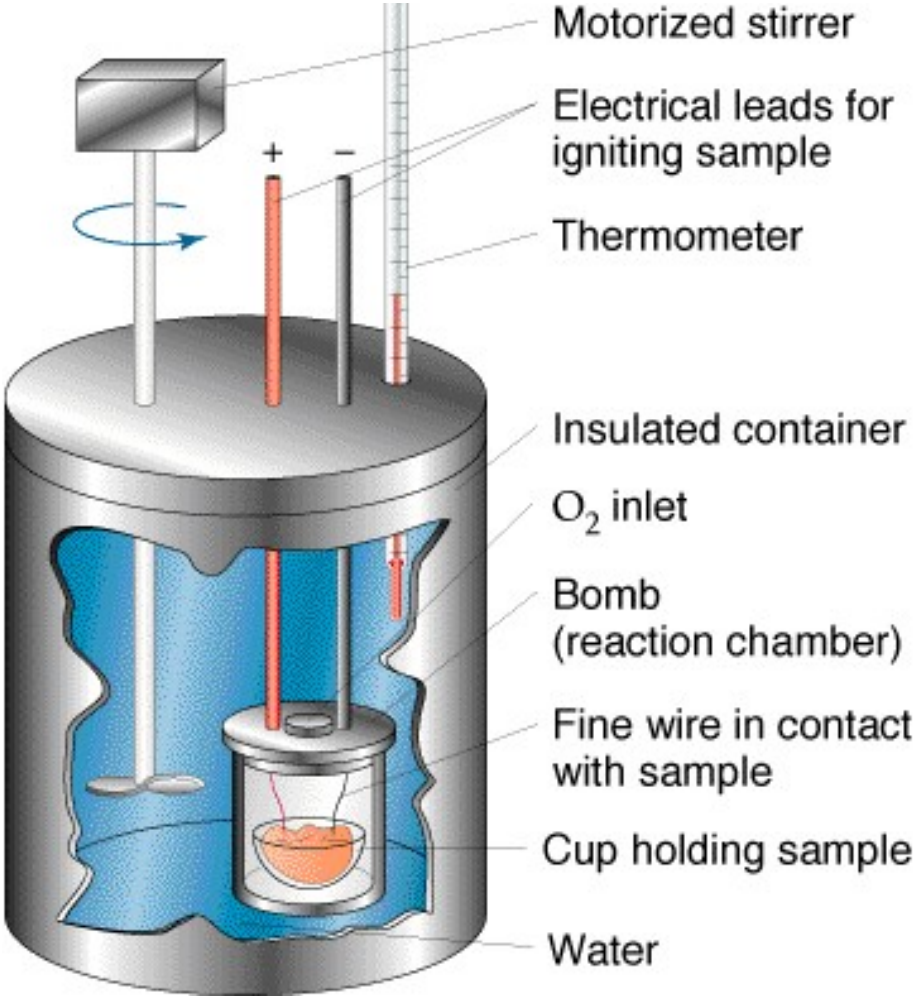
Thermal Energy

- A piece of iron has a mass of 500. g and a specific heat of 0.449 J/g·°C. How much heat must be absorbed to raise the temperature by 95.0 °C.
- 100 g of water is heated from 25.0 °C to 60.0 °C. If c = 4.18 J/g·°C, how much heat was absorbed by the water?

end

Thermal Energy

- Calorimeter
  - Temp. change of water is used to calculate the energy of a substance



end

Thermal Energy

- When going through a Phase Change:

$$Q = mH_v$$

Heat of Vaporization (Boiling)

$$Q = mH_f$$

Heat of Fusion (Freezing)

end

Thermal Energy

- How much heat is needed to melt 400 g of ice?
- If 369 J of heat are needed to vaporize a pot of water, what is the mass of the water?
- 235 g of ice at −15 °C is heated until it reaches a temperature of 75 °C. How much energy was needed?

end

Thermal Energy

- How much heat is given off when 5.0 g of water cool from 75 °C to 25 °C, if the specific heat of water = 4.18 J/g·°C.
- How many joules of heat are necessary to raise the temperature of 25 g of water from 10 °C to 60 °C, if the specific heat of water is 4.18 J/g·°C.

end

Bellringer: 12/14/2016

1. How much energy is required to melt 5.00 grams of ice?
2. If it requires 10,500. J of energy to vaporize a pot of water, what mass of water is in the pot?
3. If a piece 10.0 gram piece of aluminum goes from 100 °C to 22 °C, what is the change in thermal energy?
4. STOTD