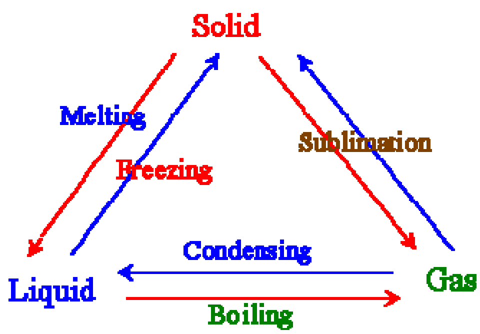
Phases of Matter (chapter 13+14)



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Phases of Matter

- Dependent on particle ____________ and available _______
- Three phases
  - Solid = particles __________ arranged, no _________space
  - Liquid = particles spaced out, move _______
  - Gas = particles __________distributed, ____ apart

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Change of Phase

- Moving from one phase to another
- Dependent on:
  - ______________________
  - ______________________
  - ______________________ (gases only)

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Melting/Boiling

- SOLID ⟶ LIQUID ⟶ GAS

  ______________ ______________

  - Occurs as temperature _____________
  - Energy absorbed (______________)

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Sublimation

- SOLID ————→ GAS

  ____

  – Occurs as temperature ____________
  – Energy absorbed
    - Example: __________

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Condensation/Freezing

- GAS ————→ LIQUID ————→ SOLID

  __________ _______________

  – Occurs as temperature ____________

  – Energy released (___________)

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Deposition

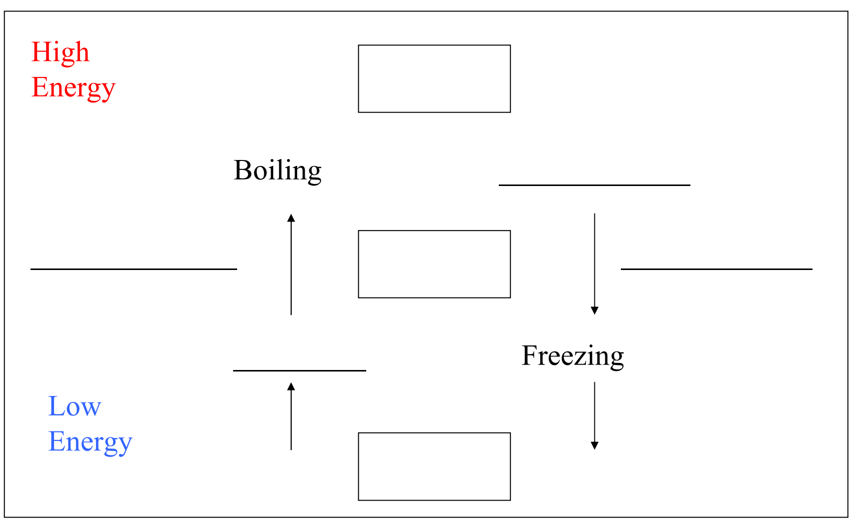
- GAS ____________→ SOLID

  ____

  – Occurs as temperature ______________

  – Energy released
    - Example: ___________________

Endothermic ↑/Exothermic↓ changes



Kinetic Molecular Theory (KMT)

- A model of an ideal gas used to explain the behavior of gases
- Important components:
  - Gas moves in a ______________________ motion
  - Gas molecules are separated by _______________ relative to their size
  - Gas molecules have __________________ forces between them
  - Gas molecules have ____________that result in transfer of _______ (law of conservation of _______)

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Kinetic Molecular Theory (KMT) continued

- The average kinetic energy of gas molecules is dependent on ___________
- Equal volumes of gases at the same temperature and pressure have the same ___________________
  - (This is Avogadro's Law)
- Example of Ideal Gases: _______ gases (group 18)

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Characteristics of Gases

- Gases lack definite _________ and _______
- Gases have the ability to _______ in all ____________
- Gases are ______________
- Gases ____________ and _____ with one another
  - Diffusion- movement of molecules from ____ to ____ concentration
  - Effusion- movement of molecules under _________ through a ____________ (balloons)

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Characteristics of Gases continued

- Most gases are real, not ideal gases
  - Real gases do not follow KMT
  - Real gases can be changed into an ideal gas by either ______________________ or ________________________
    - Will otherwise liquefy under high ______ or low ____________

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Standard Temperature and Pressure (STP)

- Reference points when studying gas
- Defined as _____________ AND __°C (or ___K)
- ____mm of Hg or ___ Torr or _____ kPa are other standard pressure values that may be used
- Found on Table __ in the Chemistry Reference Tables

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The Gas Laws MUST USE KELVIN TEMPS!!!

- Simple mathematical relationships involving:
  - _______________
  - _______________
  - _______________
  - _______________
- You will need to convert to K using the formula provided from Table __

  K = °C + 273

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Boyle's Law $P_1V_1=P_2V_2$

- _________/_________ relationship of gases
- __________ of a gas is proportional to __________
- as one variable increases, the other ____________

Pressure	**Volume**
1atm	_______
_____	100ml
4atm	______

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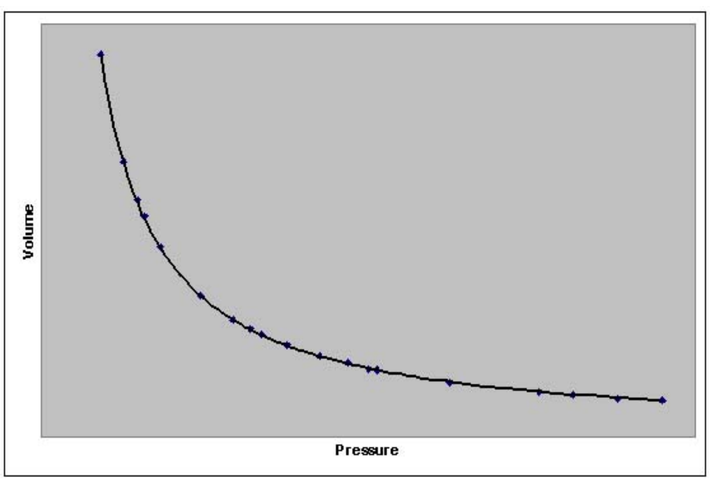
PV = K (where K is a constant)→

$P_1V_1=P_2V_2$



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Boyle's Law example questions

1) The volume occupied by a gas at STP is 250L. At what pressure in kPa will the gas occupy 1500L? (assume Temperature and # of particles constant)

- Given = V_1 = 250L V_2 = 1500L
  P_1 = 101.3 kpa P_2 = X
  - $(P_1)(V_1) = (P_2)(V_2)$

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Boyle's Law example questions

2) A balloon with helium gas has a volume of 500mL at a pressure of 1atm, The balloon reaches an altitude of 6.5km where the pressure is 0.5 atm. Assuming the temperature hasn't changed, what volume does the gas now occupy in the balloon?

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Boyle's Law example questions

3) A gas has a pressure of 1.26 atm and occupies 7.40L. If the gas is compressed to 2.93L, what will its new pressure be, assuming constant temp?

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Charles Law

– __________/__________ relationship of gases
– the __________ of a ___________ of a gas at ____________ pressure is directly related to ________________(__)

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$ Where $\frac{V}{T}$=constant

– as one variable increases, so does the other

Volume	Temperature
10mL	100 K
20mL	200 K
30mL	300 K

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Charles Law example questions

1. A sample of neon gas occupies a volume of 752 mL at 25 °C. What volume will the gas occupy at 50 °C?
   – 25°C=298K
   – 50°C=323K

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

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Charles Law example questions

2. A Balloon filled with oxygen gas occupies a volume of 5.5L at 25 °C. What volume will the gas occupy at 100 °C?

3. A sample of nitrogen gas is contained in a piston with a freely moving cylinder. At 0 °C the volume of gas is 375 mL. At what temperature must the gas be heated to occupy a volume of 500 mL?

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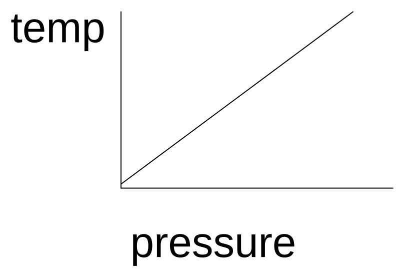
Gay-Lussac's Law

– __________/__________ relationship of gas
– the ___________ of a given gas is directly related to ______________(__)



$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

– as one variable increases, so does the other

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Gay-Lussac's Law example questions

1. The pressure exerted by a gas is 93 kPa at 200K. What pressure does the gas exert at 500K?

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

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Gay-Lussac's Law example questions

2. The pressure of a gas is 50,000 pascals at 327 °C. At what temperature will the pressure be 25 kpa?

- 50,000 Pa * $\frac{1kPa}{1000Pa}$ →

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Combined Gas Law

- expresses the relationship between ____________,____________,and __________(__) of a given gas

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

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Combined Gas Law example question

1. A gas occupies 12 cubic decimeters at 0.5 atm and 300 k. At what temperature will the gas occupy 6 cubic decimeters at 0.25 atm?

- $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

Combined Gas Law example question

2. A gas occupies a volume of 250mL at 50°C at 99.7kPa. What temperature will be required to change the volume to 300mL if the pressure is increased to 150 kPa?

- $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

Avogadro's Law

- at the same ____________and _____________, equal _____________ of any given gas contain an equal number of _____________
- Molar Volume = _____________ of any gas at standard temperature and pressure
  - 0ºC and 1ATM

	CO	O_2	Ar
Pressure	100 torr	100 torr	100 torr
Volume	5.0 L	5.0 L	5.0L
Temp.	800 K	800 K	800 K
#of particles	n	n	n

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Vapor Pressure

- pressure exerted by a _________ in ___________ with it's corresponding _________ at a given __________________
- as temperature of liquid ____________, average kinetic energy _______________
- as average KE increases, there is an increase of molecules _________________
- as number of gas molecules increases, vapor pressure ________________

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