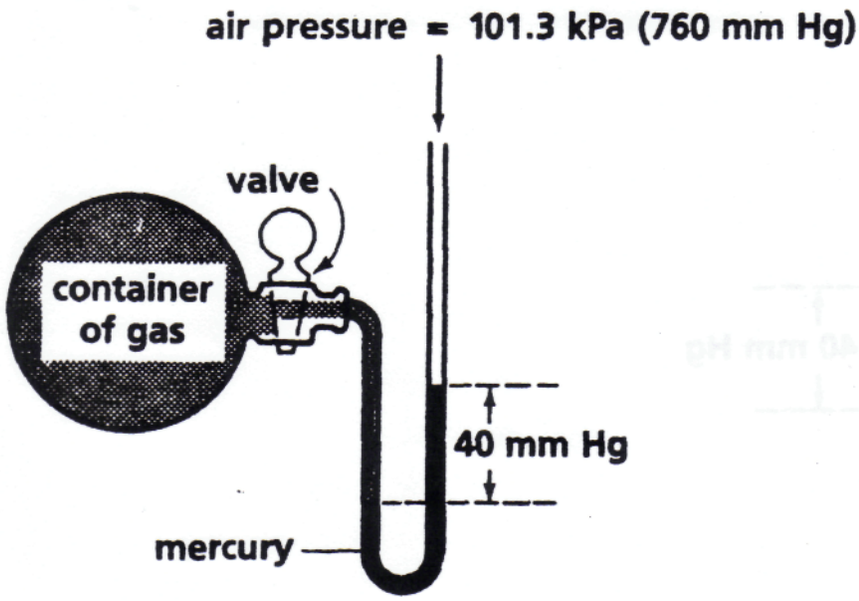
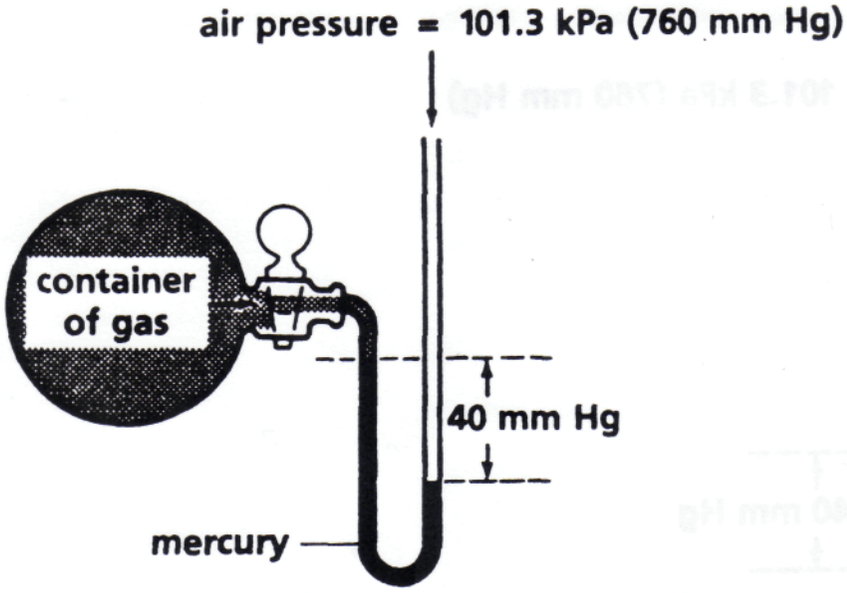
U-Tube Manometer, Problem 1



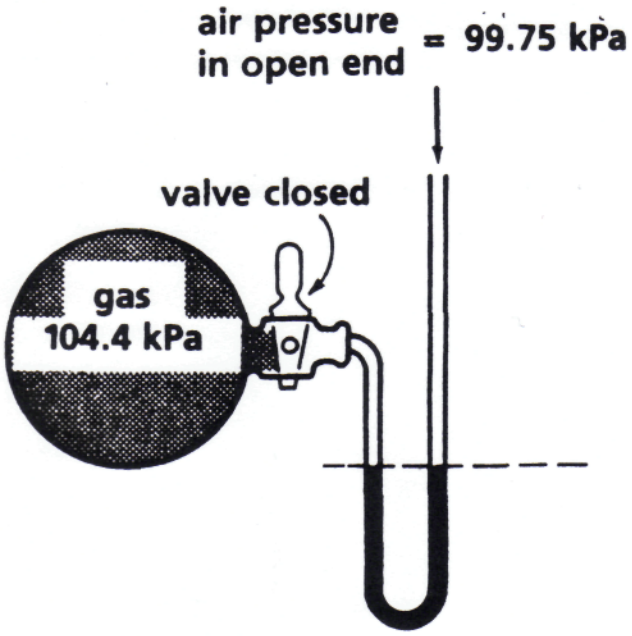
Assuming that the valve is open, what pressure, in kilopascals, is the gas exerting?

U-Tube Manometer, Problem 2



Assuming that the valve is open, what pressure, in kilopascals, is the gas exerting?

U-Tube Manometer, Problem 3



1. When the valve is opened, will the mercury in the right arm of the U-tube move up or down?

2. After the mercury stops moving, what will be the difference in height of the mercury levels in the two arms of the tube?

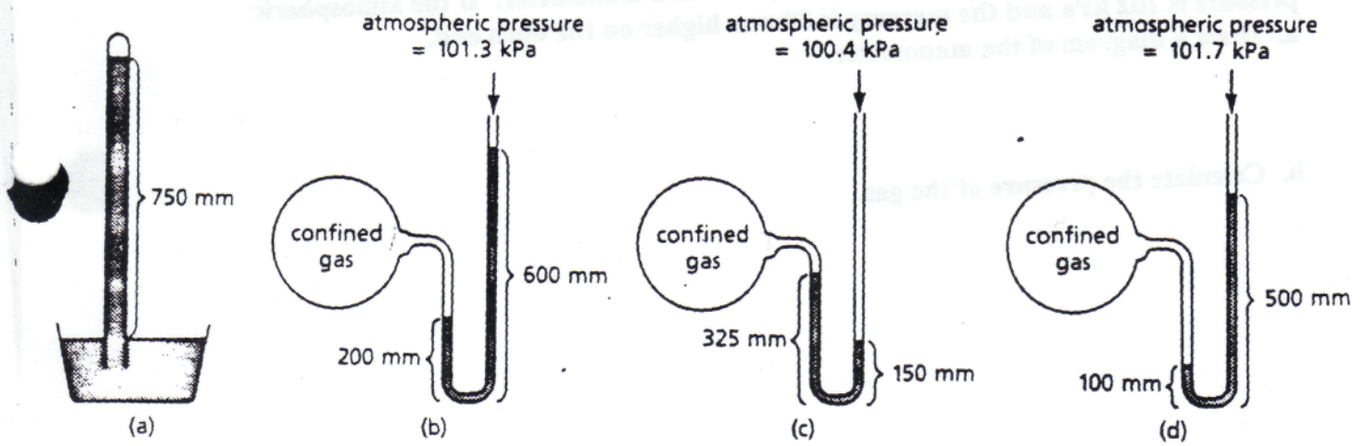
Measuring Pressure

Barometers and open-ended manometers are devices used to measure pressure. In a barometer, the height of a column of mercury (in millimeters) equals the atmospheric pressure, in millimeters of mercury. (1 mm Hg = 0.133 kPa).

The tube of an open-ended manometer is open, at one end, to the atmosphere. Therefore, atmospheric pressure is being exerted on the column of mercury in that arm of the tube. If the height of the mercury in the open arm is greater than that in the other arm, the difference between the two heights must be added to the atmospheric pressure to find the pressure of the confined gas, in mm Hg. If the height in the open arm is less than that in the other arm, the difference in height must be subtracted from the atmospheric pressure.

After you have calculated the pressure in millimeters of mercury, convert the answer to kilopascals by multiplying by the conversion factor $0.133 \frac{\text{kPa}}{\text{mm Hg}}$.

Refer to the figures below in answering the following questions.



1. What is the atmospheric pressure, in kPa, indicated by the barometer in Figure A? **1.** _____

2. What is the pressure, in kPa, of the confined gas as indicated by the open-ended manometer in Figure B? **2.** _____

3. What is the pressure, in kPa, of the confined gas indicated by the open-ended manometer in Figure C? **3.** _____

4. What is the pressure, in kPa, of the confined gas indicated by the open-ended manometer in Figure D? **4.** _____

Gas pressure problems

1. An open ended manometer is attached to a container of gas that is exerting a pressure of 104.5 kPa. The atm. pressure is 99.8 kPa.
a. Draw a diagram of the manometer.

b. When the valve is opened, will the mercury in the open arm of the u-tube move up or down?

c. After the Hg in the U-tube stops moving what will be the difference in height of the Hg levels in the 2 arms.

2. A container of gas is hooked up to an open ended monometer. If the atmospheric pressure is 102 kPa and the mercury is 30 mm higher on the open end.
a. Draw a diagram of the manometer.

b. Calculate the pressure of the gas.

BOYLE'S LAW

Do now: Think back to biology and explain what happens when you breathe in and out?

Activity:

1. Write down your observations of the demonstration representing Boyle's Law.

a. As the pressure is increased on the air in the dropper, does the volume increase or decrease?

b. Is the relationship between gas volume and pressure an inverse or direct relationship?

2. On the next page graph the following data:

Trial	Pressure	Volume	PV = K
1	1.00 atm	800 cm^3	_____
2	2.00 atm	400 cm^3	_____
3	3.00 atm	267 cm^3	_____
4	4.00 atm	200 cm^3	_____
5	6.00 atm	_____	_____

3. Boyle's Law:_____

4. Boyle's Law Problems:

a. The volume of a scuba tank is 10.0 L. It contains a mixture of nitrogen and oxygen at 290.0 atm. What volume of this mixture could the tank supply to a diver at 2.40 atm?

b. A 1.00 L balloon is filled with helium at 1.20 atm. If the balloon is squeezed into a 0.500L beaker and doesn't burst, what is the pressure of the helium?

c. Two liters of air at atmospheric pressure are compressed into a 0.45 L canister of a warning horn. If its temperature remains constant, what is the pressure of the compressed air?

d. For thought: Explain how an air mattress supports the weight of a person lying on it.

Note: Tutorial–
ftp://truth.chem.sfu.ca/pub/chem1/mac/gasesdemo.sea

CHARLE'S LAW

Do now: Why do hot-air balloons rise?

Activity:

1. Write down your observations of the demonstration of Charle's Law.

a. As the temperature is increased, what happens to the volume of the balloon?

b. Is the relationship between gas volume and temperature an inverse or direct relationship?

2. On the next page graph the following data:

TRIAL	TEMPERATURE	VOLUME
1	10.0 C	100 cm^3
2	50.0 C	114 cm^3
3	100.0 C	132 cm^3
4	200.0 C	167 cm^3
5	300.0 C	_____

3. Charle's Law:_____

_____

_____

_____

_____

4. Charle's Law problems

a. A balloon is filled with 3.0 L of helium at 22°C and 760 mm Hg. It is then placed outdoors on a hot summer day when the temperature is 31°C. If the pressure remains constant, what will the volume of the balloon be?

b. A sample of air in a piston at 25°C occupies 35 ml. What volume will it occupy if the temperature is raised to 250°C?

c. A sample of hydrogen gas is collected from the reaction of magnesium and HCl occupies a volume of 125 ml at 300°K. Predict its volume at standard temperature?

d. For thought: Why do breads and pastries rise when baked?

Note: Tutorial–
ftp://truth.chem.sfu.ca/pub/chem1/mac/gasesdemo.sea

Name _____ Date _____ Class _____

CHAPTER 12 REVIEW ACTIVITY

Text Reference: Section 12-2

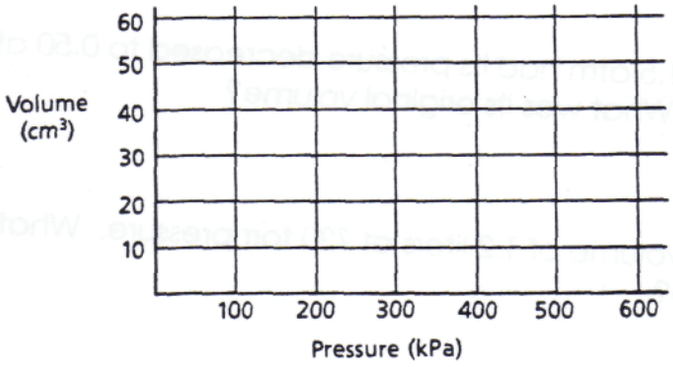
Boyle's Law

According to Boyle's law, the product of the pressure (P) and volume (V) of a fixed mass of gas at constant temperature is a constant (K). The following table contains pairs of pressure and volume readings for a gas under such conditions.

For each pair of readings, multiply $P \times V$ to find the value of K.

	Pressure (kPa)	Volume (cm^3)	K (kPa × cm^3)	
1.	20.0	60.0	?	1. _____
2.	30.0	40.0	?	2. _____
3.	40.0	30.0	?	3. _____
4.	60.0	20.0	?	4. _____
5.	100.0	12.0	?	5. _____
6.	200.0	6.00	?	6. _____
7.	300.0	4.00	?	7. _____
8.	400.0	3.00	?	8. _____

9. Now plot on the following grid the values of P and V from the table above. Connect the points with a smooth curve.



10. What is the name of the kind of curve you have drawn? 10. _____

BOYLE'S LAW

Name _____

Boyle's Law states that the volume of a gas varies inversely with its pressure if tempera is held constant. (If one goes up, the other goes down.) We use the formula:

$$P_1 \times V_1 = P_2 \times V_2$$

Solve the following problems (assuming constant temperature).

1. A sample of oxygen gas occupies a volume of 250. mL at 740. torr pressure. What volume will it occupy at 800. torr pressure?

   _____

2. A sample of carbon dioxide occupies a volume of 3.50 liters at 125 kPa pressure. What pressure would the gas exert if the volume was decreased to 2.00 liters?

   _____

3. A 2.0 liter container of nitrogen had a pressure of 3.2 atm. What volume would be necessary to decrease the pressure to 1.0 atm?

   _____

4. Ammonia gas occupies a volume of 450. mL at a pressure of 720. mm Hg. Wh volume will it occupy at standard pressure?

   _____

5. A 175 mL sample of neon had its pressure changed from 75 kPa to 150 kPa. What is its new volume?

   _____

6. A sample of hydrogen at 1.5 atm had its pressure decreased to 0.50 atm produci a new volume of 750 mL. What was its original volume?

   _____

7. Chlorine gas occupies a volume of 1.2 liters at 720 torr pressure. What volume wil occupy at 1 atm pressure?

   _____

8. Fluorine gas exerts a pressure of 900. torr. When the pressure is changed to 1.50 c its volume is 250. mL. What was the original volume?

   _____

Name _____ Date _____ Class _____

CHAPTER 12 REVIEW ACTIVITY

Text Reference: Section 12-3

Charles's Law

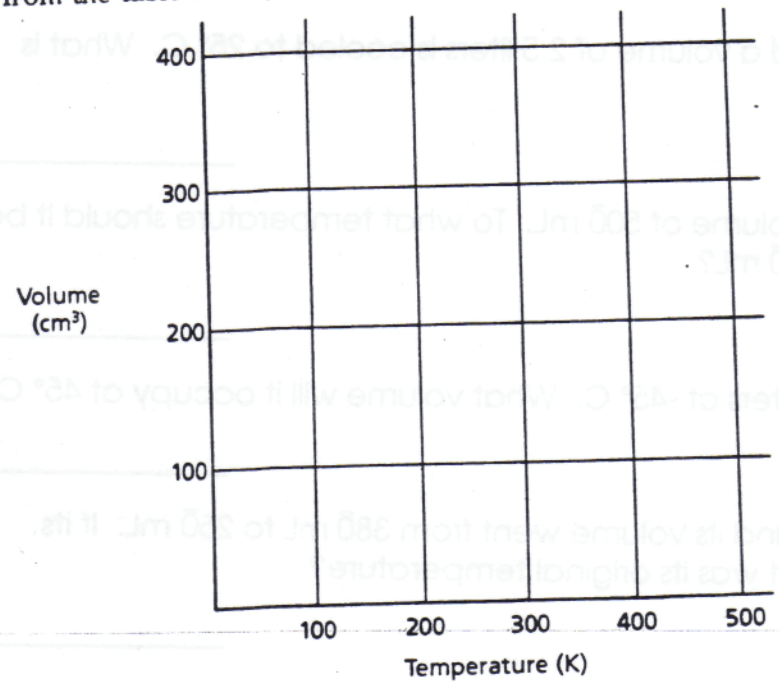
According to Charles's law, the volume of a fixed mass of gas varies directly with its kelvin temperature if its pressure is constant. The following table contains Celsius temperature and volume readings for a gas under such conditions. Recall that

$$K = °C + 273.$$

Convert each Celsius temperature to kelvins.

	Temperature (°C)	Temperature (K)	Volume (cm^3)	
1.	−150	?	100	1. _____
2.	−100	?	141	2. _____
3.	−50	?	181	3. _____
4.	0	?	222	4. _____
5.	50	?	263	5. _____
6.	100	?	303	6. _____
7.	150	?	344	7. _____

8. Now plot on the following grid the values of T (in kelvins) and V from the table above, and connect the points.



9. What is the shape of the graph you have drawn? 9. _____

CHARLES' LAW

Name _____

Charles' Law states that the volume of a gas varies directly with the Kelvin temperature, assuming that pressure is constant. We use the following formulas:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \text{or} \quad V_1 \times T_2 = V_2 \times T_1$$

$$K = °C + 273$$

Solve the following problems assuming a constant pressure.

1. A sample of nitrogen occupies a volume of 250 mL at 25° C. What volume will it occupy at 95° C?

   _____

2. Oxygen gas is at a temperature of 40° C when it occupies a volume of 2.3 liters. To what temperature should it be raised to occupy a volume of 6.5 liters?

   _____

3. Hydrogen gas was cooled from 150° C to 50° C. Its new volume is 75 mL. What was its original volume?

   _____

4. Chlorine gas occupies a volume of 25 mL at 300 K. What volume will it occupy at 600 K?

   _____

5. A sample of neon gas at 50° C and a volume of 2.5 liters is cooled to 25° C. What is the new volume?

   _____

6. Fluorine gas at 300 K occupies a volume of 500 mL. To what temperature should it be lowered to bring the volume to 300 mL?

   _____

7. Helium occupies a volume of 3.8 liters at -45° C. What volume will it occupy at 45° C?

   _____

8. A sample of argon gas is cooled and its volume went from 380 mL to 250 mL. If its final temperature was -55° C, what was its original temperature?

   _____

NAME _____

Worksheet

Boyle's Law, Charles' Law, STP.

1. What will be the final volume of a gas, if the pressure on it is changed from 8 atm to 2 atm, at constant temperature, given that its initial volume is 50 liters? 1._____

2. Suppose that the temperature of 32 liters of $O_2(g)$ is raised from 27°C to 327°C, at constant pressure. Find the volume that this gas will occupy at the higher temperature. 2._____

3. A gas occupies 16 liters at a pressure of 200 Torr. What volume will it occupy at standard pressure, if the temperature is held constant? 3._____

4. A sample of $N_2(g)$ occupies 100 liters at STP. If the pressure is held constant, and the temperature falls to - 40°C, find the new volume that the nitrogen will occupy. 4._____

5. 300 ml of He(g) at a pressure of 3 atm undergoes a pressure change to a new pressure of 12 atm; how many ml will the He(g) occupy at this new pressure? 5._____

6. 800 ml of Ne(g) at STP is heated to a temperature of 273°C, without changing the pressure; find the new volume that the Ne(g) will occupy. 6._____

7. Suppose that some Ar(g) is moved from a container with a volume of 18 liters to one with a volume of 9 liters, at constant temperature. If the pressure in the first container was 150 mm Hg, what is the pressure in the second container? 7._____

8. A sample of a gas occupies a volume of 250 liters at STP. If the gas is transferred to a new container having a volume of 500 liters, without changing the temperature, what will be the pressure in the new container? 8._____

9. 400 ml of a gas is at 100°K. What volume will this gas occupy at 300°K? Assume that the pressure remains constant. 9._____

10. How much extra space would a sample of $H_2(g)$ that is filling a 500 ml flask require if its temperature is increased from - 40°C to 60°C? Assume that the pressure doesn't change. 10._____

GAY-LUSSAC'S LAW

Do now: Based on Boyle's Law and Charles' Law, derive the relationship between pressure and temperature?

Activity:

1. Write down your observations of the demo of Gay-Lussac's Law?

a. How did the egg get into the flask?

b. How can you remove the egg?

2. Gay-Lussac's Law:_____

_____

_____

_____

3. Gay-Lussac's Law Problems:

a. At a temperature of -33.0 degrees Celsius, a sample of confined gas exerts a pressure of 53.3 Kpa. If volume remains constant, at what temperature will the pressure reach 133 Kpa?

b. A gas confined in a rigid container exerts a pressure of 33.5 Kpa at a temperature of 17.0 degrees Celsius. What will the pressure of this gas be if it is cooled to a temperature of -23 degrees Celsius.

c. For thought: Why should tire pressure always be checked when the tire is cold?

COMBINED GAS LAW

Do now: Combine Boyle's law, Charle's law and Gay-Lussac's law into one law.

Activity:

1. Combined gas law:

2. Gas Law Problems:

a. A sample of oxygen gas has a volume of 205 cubic centimeters when its temperature is 22.0 degrees Celsius and its pressure is 30.3 spa. What volume will the gas occupy at STP?

b. Given 50 ml of Carbon dioxide at 20 degrees Celsius and 750 mm pressure

1. What is the volume of the gas at STP?

2. If the density of carbon dioxide is 1.98 g/l at STP. Calculate the mass of carbon dioxide.

c. For thought: Why is it important to determine the volume of a gas at SUP?

COMBINED GAS LAW

Name _____

In practical terms, it is often difficult to hold any of the variables constant. When there is a change in pressure, volume and temperature, the combined gas law is used.

$$\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2} \quad \text{or} \quad P_1V_1T_2 = P_2V_2T_1$$

Complete the following chart.

	P_1	V_1	T_1	P_2	V_2	T_2
1	1.5 atm	3.0 L	20° C	2.5 atm		30° C
2	720 torr	256 mL	25° C		250 mL	50° C
3	600 mmHg	2.5 L	22° C	760 mmHg	1.8 L	
4		750 mL	0.0° C	2.0 atm	500 mL	25° C
5	95 kPa	4.0 L		101 kPa	6.0 L	471 K or 198° C
6	650. torr		100° C	900. torr	225 mL	150° C
7	850 mmHg	1.5 L	15° C		2.5 L	30° C
8	125 kPa	125 mL		100 kPa	100 mL	75° C

Name _____ Date _____ Class _____

Non-SI Supplementary Problems

The standard SI unit of volume is the cubic decimeter. Other non-SI units are often used to indicate the volume of gases or liquids. Many sources of chemical information list volumes in milliliters (mL) and liters (L). The volumes represented by 1 dm^3 and 1 L are identical. Only the name is different.

Example: A gas occupies a volume of 14.0 L at a pressure of 860 torr. What will the volume of the gas be if the pressure is changed to 740 torr while the temperature remains constant?

Use Boyle's Law to express the relation between volume and pressure:

$$P_1V_1 = P_2V_2$$

$$V_2 = \frac{P_1V_1}{P_2} = \frac{860 \text{ torr} \times 14.0 \text{ L}}{740 \text{ torr}} = 16.27 \text{ L} = 16.3 \text{ L}$$

This new volume of 16.3 liters is reasonable since pressure and volume are inversely related. As the pressure decreases, the volume increases. Atmospheres and mm Hg can also be used as long as the same unit is used for both the original pressure (P_1) and the new pressure (P_2).

Charles' Law problems are solved in a similar manner. Simply use the same volume unit for V_1 and V_2 and be sure that the temperature is in kelvins.

Exercises

Solve the following problems on a separate sheet of paper, showing all work. Express your answers in the correct units with the appropriate number of significant figures.

1. The pressure on a gas is increased from 572 mm Hg to 1425 mm Hg. What will the new volume of the gas be if the original volume was 4.5 L? (Assume that the temperature remains constant.)

2. An 8.0-L sample of helium gas at standard pressure is allowed to expand to a new volume of 22.0 L. If the temperature of the gas does not change, what is the new pressure of the gas expressed in atm?

3. A sample of oxygen has a volume of 4.68 L at a pressure of 1520 torr. What would be the pressure of this gas if it were allowed to expand to 10.0 L? (Assume that the temperature remained constant.)

4. A sample of a gas has a volume of 3.20 L at a temperature of 100°C. If the pressure does not change, which will be the new volume of the gas when the temperature is raised to 200°C?

5. A gas is held at a constant pressure while its volume decreases from 450 mL to 200 mL. What will the final temperature be if the initial temperature is 25.0°C? (Express the temperature in kelvins.)

6. A sample of a gas has a volume of 32 L and a temperature of 10°C. If the pressure is not changed, to what temperature must it be raised in order to double the volume? (Express the temperature in kelvins.)

7. If the pressure remains constant, what volume will 42.3 mL of a gas at 24°C occupy at standard temperature?

8. A sample of a gas has a mass of 14.2 g and occupies a volume of 678 mL at 25.0°C and a pressure of 0.80 atm. What will the volume of the gas be at STP?

9. What is the density of the gas in problem 8

a. at the original temperature and pressure?

b. at STP?

10. What is the density of a gas if 44.0 g of gas occupy 36.0 L at STP?

GRAHAM'S LAW OF EFFUSION

Name _____

Graham's Law says that a gas will effuse at a rate that is inversely proportional to the square root of its molecular mass, MM. Expressed mathematically:

$$\frac{rate_1}{rate_2} = \sqrt{\frac{MM_2}{MM_1}}$$

Solve the following problems.

C?

1. Under the same conditions of temperature and pressure, how many times faster will hydrogen effuse compared to carbon dioxide?

_____

olume

f

2. If the carbon dioxide in Problem 1 takes 32 sec to effuse, how long will the hydrogen take?

_____

3. What is the relative rate of diffusion of NH_3 compared to He? Does NH_3 effuse faster or slower than He?

_____

4. If the He in Problem 3 takes 20 sec to effuse, how long will NH_3 take?

_____

of

5. An unknown gas diffuses 0.25 times as fast as He. What is the molecular mass of the unknown gas?

_____

IDEAL GAS LAW

Name _____

Use the Ideal Gas Law below to solve the following problems.

PV = nRT where	P = pressure in atmospheres
	V = volume in liters
	n = number of moles of gas
	R = Universal Gas Constant 0.0821 L•atm/mol•K
	T = Kelvin temperature

1. How many moles of oxygen will occupy a volume of 2.5 liters at 1.2 atm and 25° C

   _____

2. What volume will 2.0 moles of nitrogen occupy at 720 torr and 20° C?

   _____

3. What pressure will be exerted by 25 g of CO_2 at a temperature of 25° C and a volu of 500 mL? _____

4. At what temperature will 5.00 g of Cl_2 exert a pressure of 900. torr at a volume 750 mL? _____

5. What is the density of NH_3 at 800 torr and 25° C? _____

6. If the density of a gas is 1.2 g/L at 745. torr and 20° C, what is its molecular mass?

   _____

7. How many moles of nitrogen gas will occupy a volume of 347 mL at 6680 torr and 27° C? _____

8. What volume will 454 grams (1 lb) of hydrogen occupy at 1.05 atm and 25° C?

   _____

9. Find the number of grams of CO_2 that exert a pressure of 785 torrs at a volume of 32.5 L and a temperature of 32° C. _____

10. An elemental gas has a mass of 10.3 g. If the volume is 58.4 L and the pressure 758 torrs at a temperature of 2.5° C, what is the gas? _____

IDEAL GAS LAW

1. What is the mass of 100 liters of oxygen gas at 750 mm pressure and 25 degrees Celsius?

2. What pressure will be exerted by 0.300 moles of gas contained in an 8.00 liter vessel at 18 degrees Celsius?

3. How many moles of a gas will a 486 ml flask hold at 10 degrees Celsius and 500 torr pressure.

4. What is the molecular mass of a gas if 372 ml has a mass of 0.800 grams at 100 degrees Celsius and 800 mm pressure?

5. 500 ml of an unknown gas at 740 mm pressure and 50 degrees Celsius has a mass of 2.112 grams. Find its molecular mass.

LIQUIDS AND SOLIDS

A. LIQUIDS:

1. **Liquefaction temperature:** is the temperature at which a gas becomes a liquid.
2. **Critical temperature and Critical Pressure:** Gases may resist liquefaction no matter how high a pressure is exerted unless the temperature is reduced to a specific temperature called the critical temperature. **Critical temperature** is the temperature above which the substance can exist only as a gas and cannot be liquefied by pressure alone. Each gad has a critical temperature. **Critical pressure** is the pressure required to liquefy a gas at the critical temperature. (Triple point diagram)
3. **Properties of liquids:**
   *Definite volume but takes the shape of its container.
   *Practically incompressible
   *Diffuse very slowly although the liquid particles are in constant motion.
   *Particles have no regular arrangement and are in constant motion.
4. **Vapor pressure (Table H):** When a liquid substance changes to a gas the The process is called **evaporation.** Evaporation tends to take place at all temperatures. **Vapor** is the term used to describe the gas phase of a substance that is normally a liquid or solid at room temperature. If a container is partially filled with a liquid, such as water, and then closed the water will begin to evaporate into the gas phase above the liquid. The vapor particles exert pressure. This increase in pressure in the gas phase is called **vapor pressure.** In their random motion in the confined space above the liquid, some of the vapor particles will return back to the liquid state. Eventually a state of dynamic equilibrium occurs when **the** number of particles evaporating will equal the number of particles condensing. The vapor pressure exerted at this stage is called the equilibrium vapor pressure and its magnitude is dependent on the nature of the liquid and its temperature. In closed system, the produced vapor exerts a pressure, which increases as the temperature of the liquid is raised and is characteristic for each substance and temperature. The higher the vapor pressure, the more rapidly a liquid will evaporate.
5. **Boiling Point:** As the temperature of a liquid is raised its kinetic energy is also raised. If the temperature is raised sufficiently, the liquid will start boiling at its boiling point. **Boiling point** of a liquid is defined as the temperature at which the vapor pressure of the liquid equals the atmospheric pressure. (At higher elevations the boiling point is lower) **Normal boiling point** is the temperature at which the vapor pressure of the liquid equals 1 atmospheric pressure (101.3 kPa). The normal boiling point of water is 100 degrees Celsius.
6. **Heat of Vaporization:** is the energy required to vaporize a unit mass of a liquid at constant temperature. If the unit mass is 1 mole of a liquid it is called the molar heat of vaporization. (540 cal/g or 2259 J/g)

A sufficient amount of heat is needed to vaporize a liquid. Heat energy increase the average kinetic energy of the particles and simultaneously causes a rise in temperature of the liquid until the boiling point of the liquid is reached. At this point the added heat only overcomes the binding forces of the particles, but does not increase the kinetic energy of the particles. The liquid boils, but the temperature during the change from a liquid to the vapor phase remains constant.

Problem: How much heat is absorbed when 10 grams of water at 20 degrees Celsius changes to steam?

Answer: Do the problem in two sections:

M X C X ▲T = (10 g)(4.2 J/gC)(80 C)= 3360 Joules

M X Ht. Of Vap. = (10g)(2259 J/g)= 22590 Joules

Total: 25950 Joules

B. SOLIDS

1. **Properties of solids:**

*Definite shape and volume

*Incompressible

*Diffuse slower than liquids and gases

*Molecules move slow, close together and have strong attraction between particles. Regular geometric pattern is known as a crystal.

*When liquids are cooled they form solids

2. **Crystals:** Crystals contain homogeneous particles (Atoms, ions or molecules), which are arranged in a regular three-dimensional geometric pattern. These particles are constantly vibrating in the solid phase, although they do not change the relative positions in the regular geometric pattern. Crystals can be classified according to their geometric shape (Crystallography—Cubic, tetragonal, orthorhombic, monoclinic, hexagonal, or triclinic) or according to their lattice structure (Binding forces—ionic, polar molecular, nonpolar molecular, network solid or metallic solid)

3. ***Melting Point of a Solid:*** *Melting point is the temperature at which a solid substance changes to a liquid at constant temperature. Temperature at which the solid and liquid phases exist in equilibrium.*

4. **Heat of Fusion:** The heat energy required to change a unit mass of a solid to a liquid at constant temperature. If the unit mass is 1 mole of a solid it is called the molar heat of fusion. The heat of fusion 80 cal/gram or 333.6 Joules/gram.

5. **Hydrates:** Crystals that contain a definite amount of water are called hydrates. The water in the compound is called the water f hydration. (For example: $CuSO_4 \cdot 5H_20$) When you heat a compound to lose the water the process is called **decrepitation.** If the water is loss spontaneously the process is called **efflorescence.** The remaining salt, without the water, is known as **anhydrous.**

6. If a solid absorbs moisture from the air it is known as **hygroscopic.** If the substance absorbs enough moisture from the air they dissolve themselves the substance is called **deliquescent** and the process is called **deliquescence.** (For example $CaCl_2$ is used in closets to reduce humidity)

Processes Involving Liquids and Solids

Choose words from the list to fill in the blanks in the paragraphs.

Word List

boiling
condensation
crystallization
decrepitation
deliquescence
distillation
efflorescence
equilibrium
evaporation
fusion
hydration
sublimation

The change of a liquid to a gas is called ___(1)___. The change of a gas to a liquid is called ___(2)___. A balance in the rates of such opposing processes is called ___(3)___.

The change of a liquid to bubbles of gas of the same substance within the liquid is called ___(4)___. A process for purifying a liquid by changing it to a gas and then changing it back to a liquid is called ___(5)___.

The quantity of heat needed to change a unit mass of a solid to a liquid is called the heat of ___(6)___ of the substance. The quantity of heat released when a unit mass of a liquid changes to a solid is called the heat of ___(7)___ of the substance. The change of a solid directly to a gas is called ___(8)___.

The water that is sometimes chemically combined in the crystals of a compound is called water of ___(9)___. The spontaneous loss of such water at room temperature is called ___(10)___. The removal, by heat, of water that is only mechanically enclosed and not chemically bound in a crystal is called ___(11)___. The spontaneous absorption, by a solid, of enough atmospheric moisture to dissolve the solid is called ___(12)___.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

Phases of Matter—Liquids and Solids

Indicate whether each statement is true or false by writing T or F in the space at the right.

1. At a given temperature, all the molecules of a liquid have the same kinetic energy. 1. _____
2. Boiling occurs only at the surface of a liquid, but evaporation occurs throughout the liquid. 2. _____
3. Water vapor is neither a gas nor a liquid but a phase in between the two. 3. _____
4. Water that evaporates from a salt solution will contain no salt. 4. _____
5. The vapor pressure of a liquid decreases as the temperature increases. 5. _____
6. The boiling point of a liquid decreases with an increase in the pressure on the liquid. 6. _____
7. Water is an exception to the general rule that the solid phase of a substance is denser than the liquid phase. 7. _____
8. The boiling point of a liquid is the temperature at which its vapor pressure is less than the pressure on the surface of the liquid. 8. _____

Match each process in Column 1 with its description in Column 2 and write its letter in the space at the right.

Column 1	Column 2	
9. sublimation	(A) change of a gas into a liquid	9. _____
10. condensation	(B) loss of water of hydration at room temperature	10. _____
11. evaporation	(C) entrance of any substance into the liquid phase	11. _____
12. liquifaction	(D) change of a liquid into a gas	12. _____
13. deliquescense	(E) change of solid to gas without passing through the liquid phase	13. _____
14. efflorescence	(F) solid absorbing enough moisture from the air to dissolve itself	14. _____

Write the answer to each of the following problems in the space at the right.

15. If 3.00×10^4 calories are required to boil away 200 grams of a substance at STP, what is the heat of vaporization of the substance? 15. _____
16. How much heat, expressed in joules, is released when 100 grams of water at 0°C changes to ice at the same temperature? 16. _____

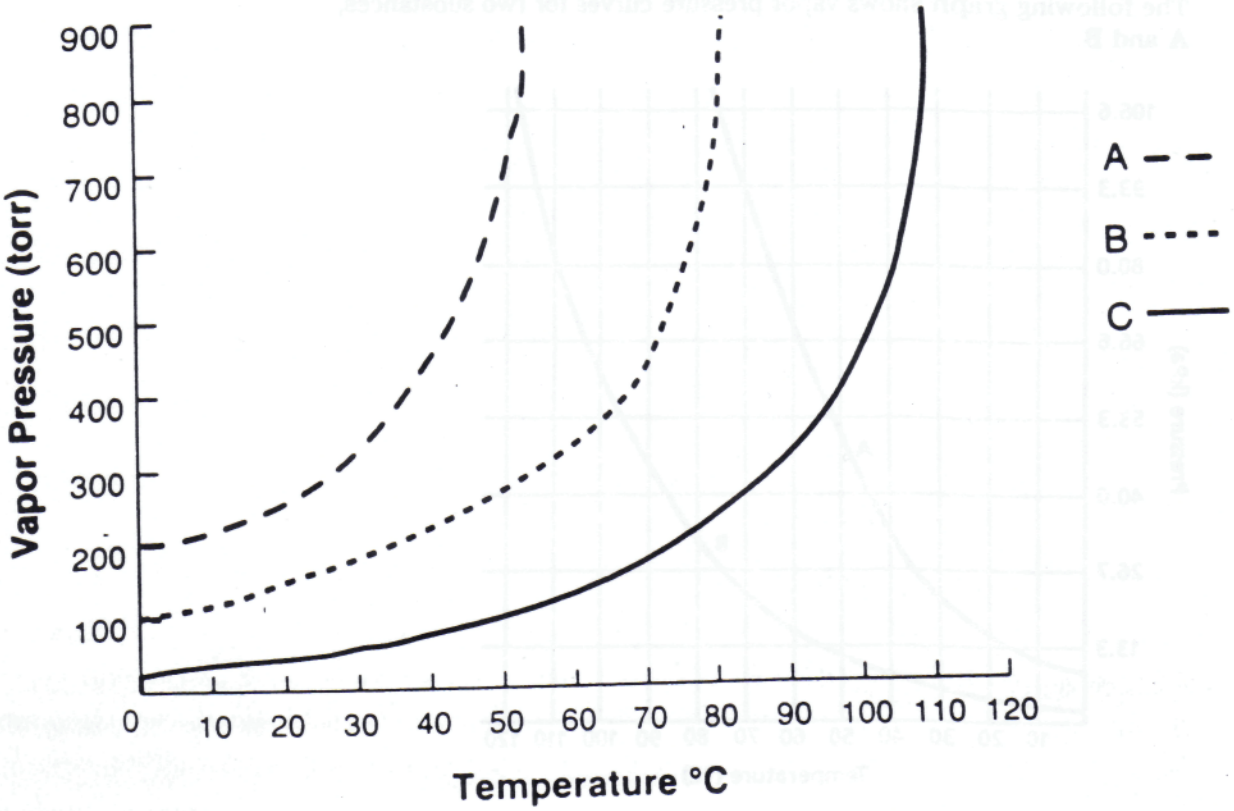
In the space at the right, write the words or terms described in each of the following.

17. A crystal made up of a solid substance combined chemically with water in a definite ratio. 17. _____
18. The pressure exerted by the gaseous phase of a substance when the gaseous phase is in equilibrium with the liquid phase. 18. _____
19. The heat required to change one gram of a solid to a liquid at a constant temperature. 19. _____
20. The pattern of the atoms or molecules in a crystal. 20. _____

VAPOR PRESSURE AND BOILING

Name _____

A liquid will boil when its vapor pressure equals atmospheric pressure. Answer the questions following the graph.



1. At what temperature would Liquid A boil at an atmospheric pressure of 400 torr? _____
2. Liquid B? _____
3. Liquid C? _____
4. How low must the atmospheric pressure be for Liquid A to boil at 35° C? _____
5. Liquid B? _____
6. Liquid C? _____
7. What is the normal boiling point of Liquid A? _____
8. Liquid B? _____
9. Liquid C? _____
10. Which liquid has the strongest intermolecular forces? _____

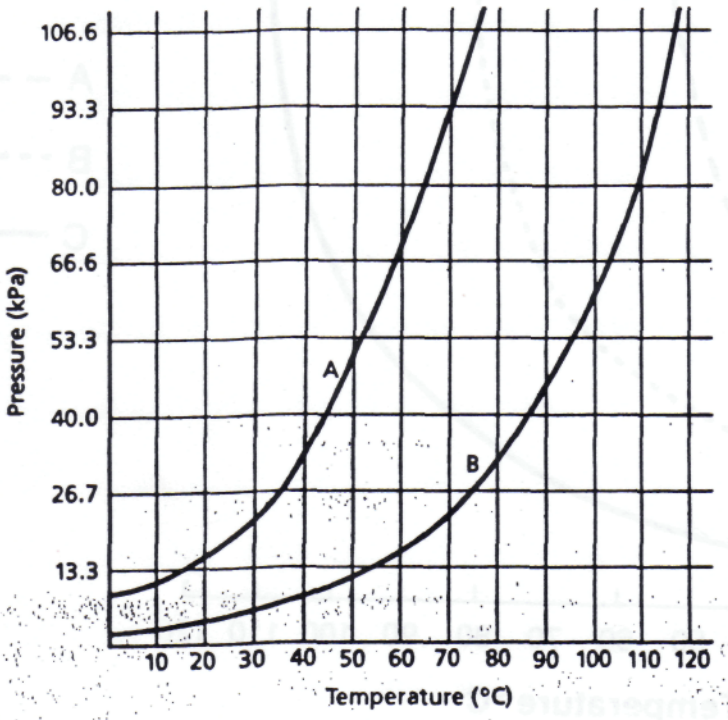
Name _____ Date _____ Class _____

CHAPTER 11 REVIEW ACTIVITY

Text Reference: Section 11-10

Vapor Pressure and Boiling

The following graph shows vapor pressure curves for two substances, **A** and **B**.



Answer the following questions.

1. What is the vapor pressure of **A** at 35°C? 1. _____
2. What is the vapor pressure of **B** at 35°C? 2. _____
3. At what temperature is the vapor pressure of **A** 106.6 kPa? 3. _____
4. What is the vapor pressure of **B** at this temperature? 4. _____
5. At what temperature is the vapor pressure of **B** equal to 106.6 kPa? 5. _____
6. What is meant by "normal boiling point"? 6. _____
7. What is the normal boiling point of **A**? 7. _____
8. What is the normal boiling point of **B**? 8. _____
9. At what temperature would **A** boil if atmospheric pressure were 93.3 kPa? 9. _____
10. What would the atmospheric pressure have to be in order for **B** to boil at the temperature you gave as your answer to Question **9**? 10. _____