Chemistry: Name Key

PHASES OF MATTER Date _____ Period _____

Gas laws

Aim

- to analyze the relationship among the number of particles, temperature, pressure, and volume of a gas

Notes

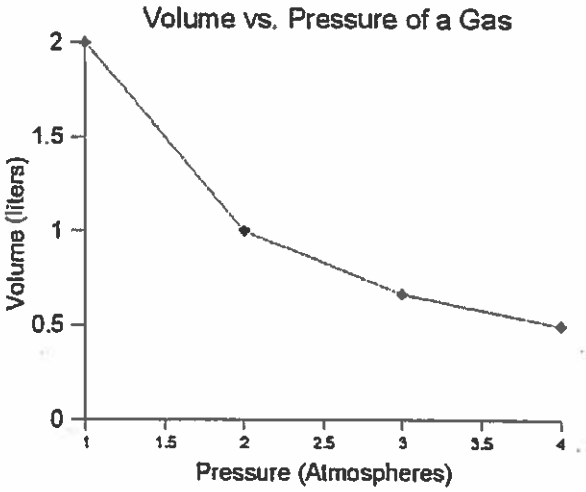
Relationship between the pressure and volume of a gas (at a constant temperature)

★ Observations

☆ Putting pressure on a gas compresses it or reduces its volume

☆ Sample data

Trial	Pressure (atmospheres)	Volume (liters)	Pressure × Volume (atm-L)
1	1.0	2.0	2.0
2	2.0	1.0	2.0
3	3.0	0.67	2.0
4	4.0	0.50	2.0



☆ Conclusion - The volume of a gas is inversely proportional to the pressure at a constant temperature

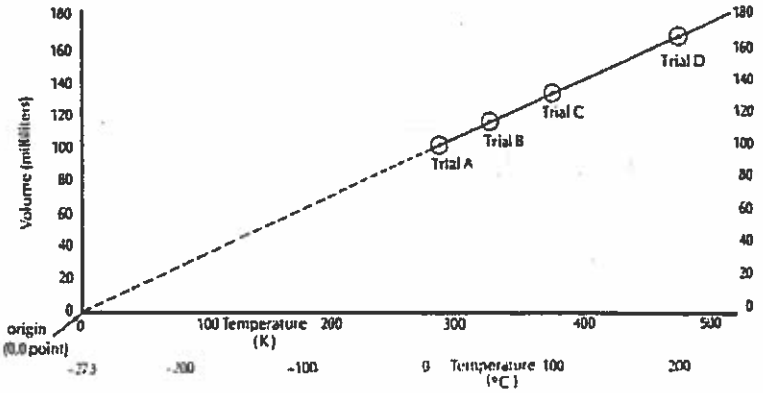
Relationship between temperature and volume of a gas (at a constant pressure)

★ Observations

☆ As the temperature of a gas increases at a constant pressure, its volume increases

☆ Sample data

Trial	Temperature		Volume (mL)	Ratio: V/T
	Celsius	Kelvin		
A	10.0	283	100	0.35
B	50.0	323	114	0.35
C	100.0	373	132	0.35
D	200.0	473	167	0.35



★ Conclusion - At a constant pressure, the volume of a gas is directly proportional to its Kelvin temperature

Combined gas law

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

Number of particles

★ Equal volumes of different gases at the same temperature and pressure contain an equal number of particles.

Standard temperature and pressure (STP)- agreed upon value of temperature and pressure for the sake of comparing gases

★ Temperature: 0°C or 273 K

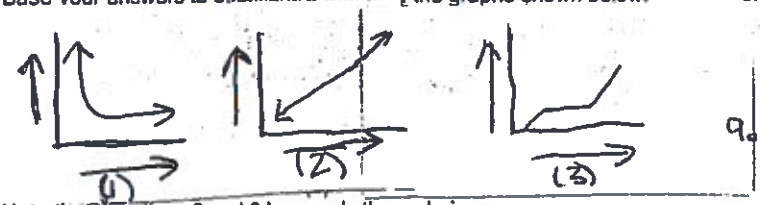
★ Pressure: 101.3 kPa or 1 atmosphere

Done in class

Answer the questions below by circling the number of the correct response showing work when needed for answer.

1. A sample of a gas is at STP. As the pressure decreases and the temperature increases, the volume of the gas (1) decreases (2) increases (3) remains the same

Base your answers to questions 2 and 3 on the graphs shown below.



Note that questions 2 and 3 have only three choices.

2. Which graph best represents how the volume of a given mass of a gas varies with the Kelvin temperature at constant pressure? 2

3. Which graph best represents how the volume of a given mass of a gas varies with the pressure on it at constant temperature. 1

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4. A 100. milliliter sample of a gas at a pressure of 50.8 kPa is reduced to 25.4 kPa at constant temperature. What is the new volume of the gas? (1) 50.0 mL (2) 90.0 mL (3) 200. mL (4) 290. mL

100(50.8) = (25.4)x

5. At STP, which gas would most likely behave as an ideal gas? (1) H_2 (2) CO_2 (3) C_{l2} (4) SO_2

6. At constant temperature the pressure on 8.0 liters of a gas is increased from 1 atmosphere to 4 atmospheres. What will be the new volume of the gas? (1) 1.0 ℓ (2) 2.0 ℓ (3) 32 ℓ (4) 4.0 ℓ

(8)(1) = (4)(x)

7. As the temperature of a sample of gas decreases constant pressure. the volume of the gas (1) decreases (2) increases (3) remains the same

8. A 100 milliliter sample of a gas is enclosed in cylinder under a pressure of 101.3 kPa. What volume would the gas sample occupy at a pressure of 202.6 kPa, temperature remaining constant? (1) 50 mL (2) 100 mL (3) 200 mL (4) 380 mL

(100)(101.3) = x(202.6)

9. The volume of a sample of hydrogen gas at STP is 1.00 liter. As the temperature decreases, pressure remaining constant, the volume of the sample (1) decreases (2) increases (3) remains the same

10. The pressure on 200. milliliters of a gas at constant temperature is changed from 0.500 atm to 1.00 atm. The new volume of the gas is (1) 100. mL (2) 200. mL (3) 400. mL (4) 600. mL

(200)(.5) = (1)(x)

11. As the pressure on a given sample of a gas increases at constant temperature, the mass of the sample (1) decreases (2) increases (3) remains the same

+273=283

12. A gas sample is at 10.0°C. If pressure remains constant, the volume will increase when the temperature is changed to (1) 263 K (2) 283 K (3) 273 K (4) 293 K

Get Checked by Mrs. Young

Name _____

THE NATURE OF GASES

Part A: Completion

Use the vocabulary words below to fill in the blanks.

0°C/ 273K	~~collisions~~	~~far apart~~	1atm/ 101.3kPa
~~Kinetic energy~~	~~independently~~	~~movement~~	atmospheric
	random/ rapid	~~empty space~~	~~simultaneous~~

1. The kinetic theory describes the movement of particles in matter and the forces of attraction between them. The theory assumes that the volume occupied by a gas is mostly empty space, that the particles of gas are relatively far apart, move independently of each other, and are in constant random/rapid motion. The collisions between particles are perfectly elastic so that the total Kinetic energy remains constant. Gas pressure results from the simultaneous collisions of billions of particles with an object. Barometers are used to measure atmospheric ___ pressure. Standard conditions are defined as a temperature of 0°C/273K and a pressure of 1atm/101.3 kPa

Part B: Questions and Problems

2. Describe the motion of particles of a gas according to the kinetic molecular theory.

- move in straight lines
- no attractive forces
- take up no space & sep. by great distances
- collisions are elastic

3. What simple evidence demonstrates that gas particles are in constant motion?

smell food cooking when go in door

4. What causes a gas to exert pressure?

a. Collisions
b. Density
c. Temperature
d. Elevation

Explain "Why" you chose your answer
pressure is a force & collisions create that pressure.

5. Millimeters of mercury (mm Hg) is a measurement of
   a. Length
   b. Temperature
   c. Pressure
   d. Distance
6. In general, as the temperature increases, the volume increases, and as the temperature decreases, the volume decreases.

Part C: True or False: State whether the following are true or false and if false, correct the statement.

7. At any given temperature, the particles of all substances have the same average kinetic energy.
   a. true
8. The Kelvin temperature of a substance is directly proportional to the total kinetic energy of the particles in the substance.
   a. True

The Gas Laws

Part A: Completion

Use the vocabulary words below to fill in the blanks.

Directly Kelvin Mass Inversely Combined Increases

1. The pressure and volume of a fixed mass of gas are inversely related. If one decreases, the other increases. The volume of a fixed mass of gas is directly proportional to its Kelvin temperature. This relationship states that the pressure of a gas is directly proportional to the Kelvin temperature if the volume remains constant. These three separate parts of the gas law can be written as a single expression called the combined gas law.

Part B: True or False: State whether the following are true or false and if false, correct the statement.

2. When using the combined gas law, pressure ~~must always~~ may be in kilopascals, or atm, but temperature can be in Kelvins ~~or degrees Celsius~~.
   a. False (now true)
3. The combined gas law states that pressure and ~~volume~~ temp are directly proportional when volume is held constant.
   a. False
   P & V are inversely when temp.

Part C: Questions and Problems

4. Explain Avogadro's law in your own words (see p. ~~35~~ your notes packet for the ideas related to this OR find the definition in your text book).

At the same P, T & V 2 samples of gas will have the same # of molecules

5. Give an example question for Avogadro's law.

Which 2 containers have the same # of molecules?

$H_2O_{(s)}$	$CO_{(g)}$	$Cl_{2(g)}$
2.0 atm	2 atm	2 atm
1 L	4 L	1 L
104 K	104 K	104 K

H_2O & Cl_2

6. Which is NOT a measurable property of gases?
   a. Pressure
   b. Odor
   c. Temperature
   d. Volume

Explain "Why" you chose your answer
All others in combined gas law

7. A can contains a gas at 50 kPa and 20°C. What is the pressure in the can if it is heated to 50°C?
   a. Show the formula, substitution and final answer with units for credit.

+273 = 293

T 273 323

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

$\frac{50}{293} = \frac{x}{323}$

$16150 = 293x$

$x = 55.119$ kPa

8. At a winter carnival, a balloon is filled with 5.00 L of helium at a temperature of 273K. What will be the volume of the balloon when it is brought into a warm house at 295K?

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

$\frac{5}{273} = \frac{x}{295}$

$1475 = 273x$

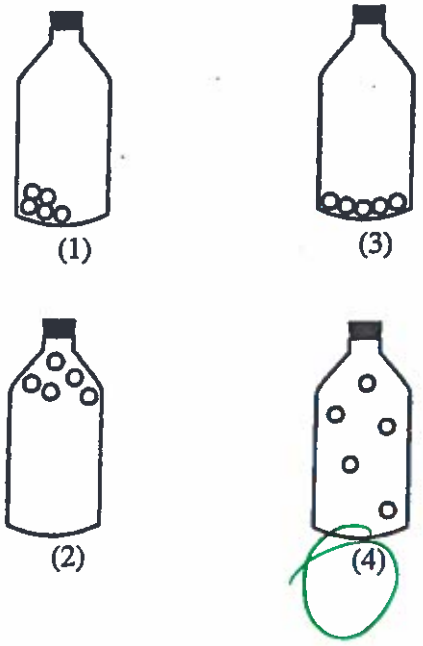
$x = 5.4$ L

1. When a sample of a gas is heated at constant pressure, the average kinetic energy of its molecules
   (1) decreases, and the volume of the gas decreases
   (2) increases, and the volume of the gas increases
   (3) increases, and the volume of the gas decreases
   (4) decreases, and the volume of the gas increases

2. According to the kinetic theory of gases, which assumption is correct?
   (1) Gas particles travel in curved paths.
   (2) Gas particles strongly attract each other.
   (3) Energy may be transferred between colliding particles.
   (4) The volume of gas particles prevents random motion.

3. The concept of an ideal gas is used to explain
   (1) the mass of a gas sample
   (2) why some gases are diatomic
   (3) the behavior of a gas sample
   (4) why some gases are monatomic

4. Which diagram best represents a gas in a closed container?



5. One reason that a real gas deviates from an ideal gas is that the molecules of the real gas have
   (1) no net loss of energy on collision
   (2) a negligible volume
   (3) a straight-line motion
   (4) forces of attraction for each other

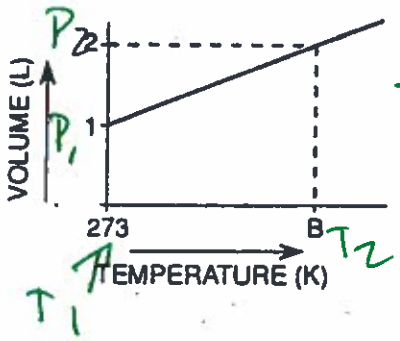
6. The diagrams below represent four 500-milliliter flasks. Each flask contains the gas represented by its symbol. All gas samples are at STP.

Each flask contains the same number of
   (1) atoms, only
   (2) molecules, only
   (3) atoms and molecules

$\frac{(120)(50)}{400} = \frac{(x)(60)}{200}$

7. A gas has a pressure of 120 kPa, a temperature of 400. K, and a volume of 50.0 milliliters. What volume will the gas have at a pressure of 60 kPa and a temperature of 200. K?
   (1) 200. ml
   (2) 12.5 ml
   (3) 50.0 ml
   (4) 100. ml

8. The graph below illustrates the change in the volume of a gas sample as its temperature rises at constant pressure.



$\frac{T_1}{273} = \frac{2}{X}$

What temperature is represented by point *B*?
   (1) 546 K
   (2) 298 K
   (3) 273 K
   (4) 0 K