WODSS SCIENCE Name: _____

SCH 3UI Date: _____

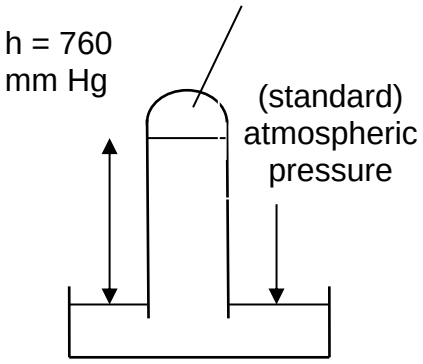
Unit 5: Gases and Atmospheric Chemistry

The Kinetic Molecular Theory of Gases

1. The volume of the particles is _____ compared to the volume of the container. In other words, a sample of gas is mainly _____ space.
2. The particles are in _____. They collide with each other, and with the walls on the container.
3. There is _____ of energy when the two particles collide.
4. In the gas phase there are _____ attractive forces between particles (this is in contrast with liquid and solid phases).
5. At any given _____, the average kinetic energy of the particles in all gases is the same.

Measuring Gas Pressure

_____ – instrument used for measuring atmospheric pressure (designed by Torricelli)



- Consists of a long glass tube that is sealed at one end and filled with liquid
- tube is inverted, with open end immersed in a dish containing the same liquid as the tube
- Some of the liquid flows from the tube into the dish, creating a vacuum at the sealed end of the tube
- The height of this column of liquid is a measure of the pressure being exerted by the atmosphere

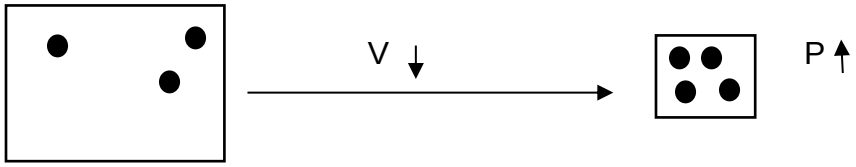
Units of Pressure

- in early experiments with the mercury barometer, Torricelli measured gas pressure in mm Hg
  1 torr = 1 mm Hg
- SI unit of pressure is the _____ (Pa)
  - very small unit
  - calculated that a dollar bill lying flat on a table exerts a pressure of about ____ Pa
  - we generally use kilopascal (kPa)
- at sea level, our atmosphere exerts a pressure of
  _____ mm Hg = _____ kPa = 1 _____

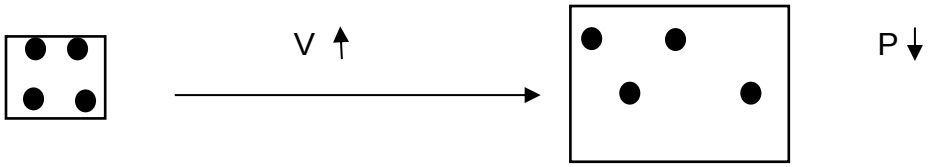
Volume and Pressure

How does a change in volume affect pressure?

- If the volume of a sample is _____, the gas molecules would hit the walls of the container more often, and therefore the pressure on the container walls would be _____



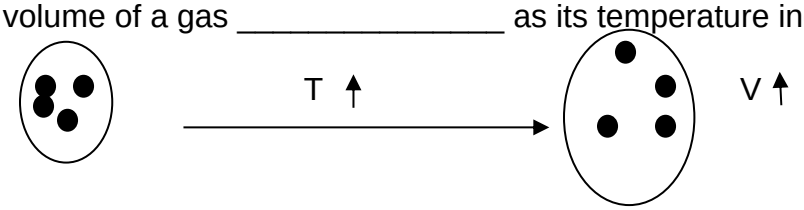
- If the volume of the container was _____, the gas molecules would collide with the walls less frequently because they have further to travel, therefore pressure would _____



Temperature and Volume

How does a change in temperature affect the volume of a gas-filled container which can easily be expanded?

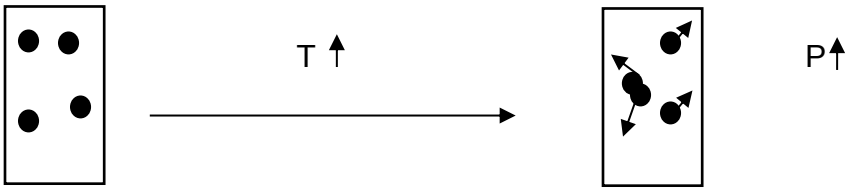
- If a balloon is _____, the gas molecules will speed up
- They will strike the wall of the balloon more _____ and with more _____
- Thus the volume of a gas _____ as its temperature increases



Pressure and Temperature

How does a change in temperature affect the pressure of a gas filled container that cannot expand?

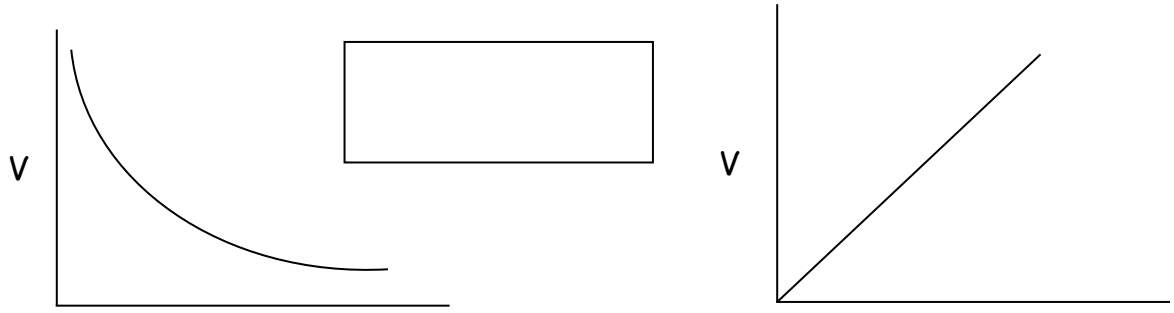
- If a scuba container is heated, the gas molecules will speed up
- They will strike the walls of the container more frequently and with more force
- Therefore the _____ will increase
- The pressure of a gas _____ as its temperature increases, and decreases with a _____ in temperature



Boyle's Law

- relationship between pressure and volume

BOYLE'S LAW → at constant temperature, the volume of a fixed mass of any gas is inversely proportional to its pressure **V α 1/P**



Pressure (kPa) 1/Pressure (1/kPa)

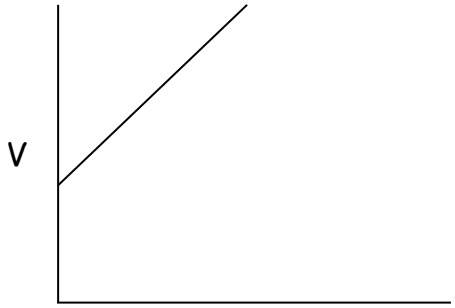
Ex. 1 A balloon with a volume of 5.0 L is filled with air at 101 kPa pressure. The balloon is taken up to the mountains where the atmospheric pressure is 91 kPa. If the temperature is the same in both places, what is the new volume of the balloon?

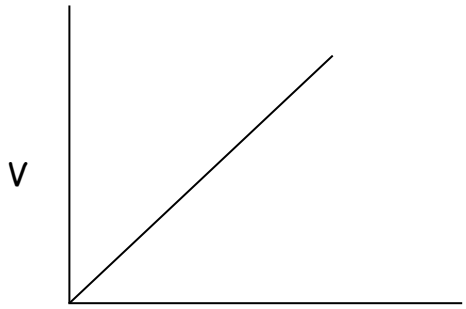
Charles' Law

- relationship between volume and temperature

Absolute zero → temperature at which particles would cease to move and would therefore have zero kinetic energy (zero volume)

Kelvin temperature scale → °C + 273.15 = K or °C = K – 273.15





CHARLES' LAW → at constant pressure, the volume of a fixed mass of any gas is directly proportional to its **Kelvin temperature**

$V \alpha T$

Ex. A balloon is filled with helium gas to a volume of 1.20 L at a pressure of 105 kPa and a temperature of 15.0°C. If the pressure remains constant and the temperature rises to 30.0°C, what will be the new volume of the balloon?

Gay-Lussac's Law (P-T Law)

- relationship between pressure and temperature
- if a gas is contained in a vessel that cannot expand, as the temperature increases the pressure increases

GAY-LUSSAC'S LAW – at constant volume, the pressure of a fixed mass of any gas is proportional to its Kelvin temperature

$P \alpha T$

Ex. A steel cylinder with a volume of 450 mL contains a gas at a pressure of 520 kPa at 25 °C. If the cylinder is heated to 410 °C, what will the new pressure be?

The Combined Gas Law Equation

- in each of the three gas laws discussed, one of the variables (pressure, volume or temperature) was held constant
- in practice, we often find that all three variables change

COMBINED GAS LAW EQUATION – combination of the equations pertaining to Boyle's Law, Charles' Law, and Gay-Lussac's Law

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

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
T = constant	P = constant	V = constant
Boyle's Law	Charles' Law	Gay-Lussac's Law

Ex. 1 An aerosol can with a volume of 325 mL contains a gas at 445 kPa and 12 °C. What volume would the gas occupy if it was allowed to escape at 101 kPa and 21 °C?

STP – standard temperature and pressure

SATP – standard ambient temperature and pressure

HW

1. Summary Chart including the following:
2. Boyle's Law Q#1-3 pg 514
3. Charles' Law Q#11,12,14 pg 522
4. GL Q#21-23 pg 525
5. Combined Q#2-4 pg 542