

# Chemistry – Gases – Simple Gas laws V3 Name: \_\_\_\_\_

Multiple choice – Answer in the table provided (4 marks each)

1. Which statements describe a TRUE mathematical relationship between two variables of an ideal gas?

- I. The pressure of a gas is inversely proportional to its volume. ✓
- II. The volume of a gas is inversely proportional to its Kelvin temperature. ✗
- III. The volume of a gas is directly proportional to its Kelvin temperature. ✓
- IV. The pressure of a gas is directly proportional to its Volume. ✗

- A) I and II      B) II and IV      C) III and IV      **D) I and III**

2. Consider the following four **identical** flasks filled with different gases at STP.

Flask #1: CO<sub>2</sub> **44**      Flask #2: CH<sub>4</sub> **16**      Flask #3: O<sub>2</sub> **32**      Flask #4: SO<sub>2</sub> **64**

In which flask will the molecules have the **greatest** average velocity? **lightest**

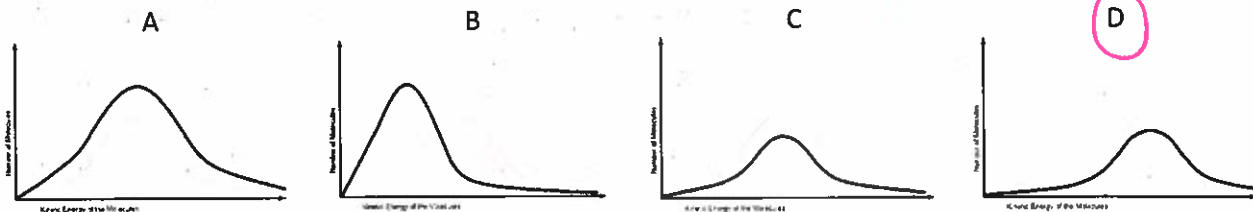
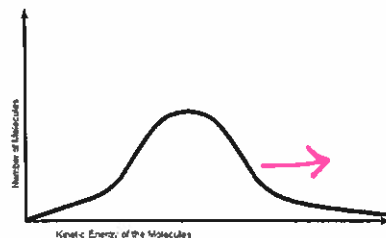
- A) Flask #1      **B) Flask #2**      C) Flask #3      D) Flask #4

3. Which of the following statements would be considered to be part of the **Kinetic Molecular Theory of Gases**?

- 1. Gases consist of extremely small particles.
- 2. The distances between gas molecules are very large compared to the size of the molecules themselves.
- 3. All gas molecules move at the same speed, depending on the temperature. ✗
- 4. Gas molecules are in constant motion; they move in straight lines in all directions.
- 5. Gas molecules collide among themselves and with the walls of their container.

- A) 1, 2, 4 and 5**      C) 1, 2 and 3  
 B) 1, 2, 3, 4 and 5      D) 2, 4 and 5

4. This graph shows the Maxwell distribution curve of carbon dioxide molecules at 20°C. Which graph below could represent the same gas molecules at a temperature of 80°C?



5. When a helium-filled weather balloon rises into the atmosphere, its **volume increases**. Which of the following explains why its volume increases?

- A) The helium in the balloon is lighter than air.
- B) The atmospheric temperature decreases with altitude.
- C) The atmospheric pressure decreases with altitude.**
- D) The helium in the balloon diffuses more quickly than air.

Answers	
1	D
2	B
3	A
4	D
5	C

Gas properties.

6. Properties of gases. From the list of gases, write the name of a gas beside the phrase that describes its properties. (4)  $H_2$ , He, CFCs,  $CO_2$ , CO,  $CH_4$  (methane),  $N_2$ ,  $O_2$ ,  $O_3$  (ozone),  $SO_2$ , Rn. (4)

- A) A non-toxic refrigerant that damages the ozone layer
- B) A non-flammable, gas used as a preservative
- C) A radioactive noble gas formed by the disintegration of uranium
- D) The most abundant gas in the atmosphere

CFC  
 $CO_2$   $N_2$   
Rn  
 $N_2$

7. List two prominent green house gases. (2)

- A)  $CH_4$
  - B)  $CO_2$
- ( $H_2O$ ) ( $O_3$ )

$P_1V_1 = P_2V_2$

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

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

$\frac{v_1}{v_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$

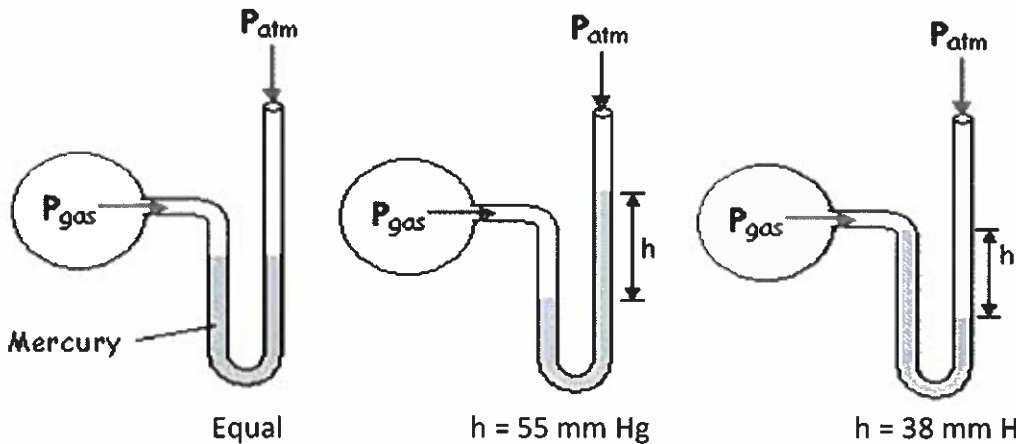
$\frac{d_1}{d_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$

$\frac{t_1}{t_2} = \frac{\sqrt{M_1}}{\sqrt{M_2}}$

1.00 atm = 101.3 kPa = 760 mm Hg

Show all your work! Provide units in your final answer. Round to Sig.figs. No work = no mark!

8. Consider the three open-ended manometers below. The atmospheric pressure is 100.8 kPa. Calculate the pressure exerted by the gas in each case. (3)



- A) 756 mm Hg
- B) 811 mm Hg
- C) 718 mm Hg

$\frac{x}{760 \text{ mmHg}} = \frac{100.8 \text{ kPa}}{101.3 \text{ kPa}}$

$x = 756.249$   
 $x = 756$

$P_G = P_{atm} + h$   
 $= 756 + 55$

$P_{Gas} = 811 \text{ mmHg}$   
 $= 760 \text{ mmHg}$

$P_G = P_{atm} - h$   
 $= 756 - 38$

$P_{Gas} = 718 \text{ mmHg}$

9. A weather balloon is filled with 983 mL of He at 101.3 kPa. The balloon expands as it rises. What is the balloon's volume when it reaches an atmospheric pressure of 315 mm Hg? (3)

$P_1V_1 = P_2V_2$   
 $(760 \text{ mmHg})(983 \text{ mL}) = (315 \text{ mmHg})(V_2)$   
 $V_2 = 2371.68 \text{ mL}$   
 $V_2 = 2.37 \text{ L}$

2.37 L

10. At 20.0°C, a syringe contains a given volume of oxygen gas, O<sub>2(g)</sub>, at a pressure of 101.3 kPa. When the temperature is raised to 40.0°C while the pressure is kept constant, the volume of gas stabilizes at 20.0 mL. What is the initial volume of the gas in the syringe? (4)

$$T_1 = 20.0^\circ\text{C} + 273 = 293\text{K}$$

$$T_2 = 40.0^\circ\text{C} + 273 = 313\text{K}$$

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

$$\frac{V_1}{293\text{K}} = \frac{20.0\text{mL}}{313\text{K}}$$

$$V_1 = 18.7220\text{mL}$$

$$V_1 = 18.7\text{mL}$$

11. The pressure inside an aerosol can is  $1.9 \times 10^2$  kPa at 393K. If the temperature of the gas changes to -100°C, what will be the new pressure inside the can? Express your answer in atm. Assume a constant volume. (4)

$$T_1 = 393\text{K}$$

$$T_2 = -100^\circ\text{C} + 273 = 173\text{K}$$

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

$$\frac{1.9 \times 10^2 \text{ kPa}}{393\text{K}} = \frac{P_2}{173\text{K}}$$

$$x = 83.6386\text{ kPa}$$

conversion

$$\frac{83.6386\text{ kPa}}{101.3\text{ kPa}} = \frac{x}{1.00\text{ atm}}$$

$$x = 0.825653$$

$$x = 0.83\text{ atm}$$

12. Two gases are allowed to diffuse over a 5 minutes interval. In this time Sulphur dioxide (SO<sub>2</sub>) diffuses 30.20 m while the unknown gas only diffuses 28.71 m. Show your calculations to identify which of the gases it is. (4) (The gas is an elemental gas.... a pure substance found on the periodic table.)

$$\frac{d_1}{d_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$$

$$\frac{30.20\text{m}}{28.71\text{m}} = \frac{\sqrt{M_2}}{\sqrt{64.07}}$$

$$\sqrt{M_2} = 8.41979$$

$$(\sqrt{M_2})^2 = (8.41979)^2$$

$$M_2 = 70.8928$$

$$M_2 = 70.89$$

Cl<sub>2</sub> = Chlorine

13. How fast does oxygen diffuse compared to helium gas under the same conditions? (2)

$$\text{He} \rightarrow \frac{V_1}{V_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{32.00}{4.00}} = \sqrt{8} = 2.83$$

O<sub>2</sub>

Helium diffuses 2.83 times faster than oxygen.

