# Chemistry – Gases – Simple Gas laws (V1) Name: Answers

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

1. Which of the following correctly describes a TRUE mathematical relationship between two variables of an ideal gas?

   I. The pressure of a gas is inversely proportional to its Kelvin temperature.
   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 Kelvin temperature. ✓

   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: $CO_2$ 44  Flask #2: $CH_4$ 16  Flask #3: $O_2$ 32  Flask #4: $SO_2$ 64

   In which flask will the molecules have the **lowest** average velocity? heaviest

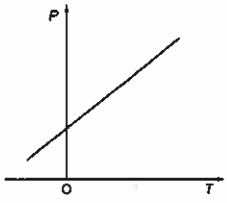
   A) Flask #1  B) Flask #2  C) Flask #3  D) Flask #4

3. Based on the kinetic molecular theory of gases, which one of the following statements is INCORRECT?

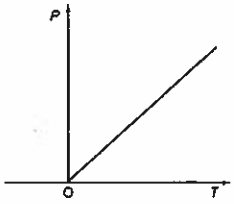
   A) At the same temperature, all gas molecules have the same average velocity.
   B) At the same temperature, all gas molecules have the same average kinetic energy.
   C) The collisions between gas molecules are perfectly elastic.
   D) At absolute zero, the average kinetic energy of all molecules is zero.

4. Which of the following graphs represents the pressure of a gas as a function of temperature in degrees Celsius?
   *The volume of the gas is kept constant.*

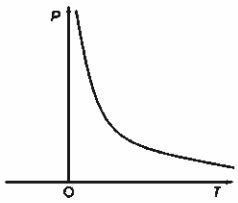
A



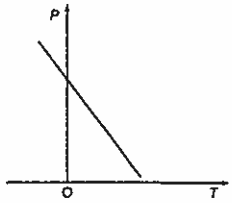

B




C




D




5. A balloon vendor wishes to fill the greatest number of balloons from his helium tank.
   Each balloon is to have a volume of 2 litres.
   **What would be the best atmospheric conditions to inflate the maximum number of balloons?**

   A) High temperature and high atmospheric pressure
   B) High temperature and low atmospheric pressure
   C) Low temperature and high atmospheric pressure
   D) Low temperature and low atmospheric pressure

| Answers | |
|---|---|
| 1 | C |
| 2 | D |
| 3 | A |
| 4 | A |
| 5 | B |

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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) **$H_2$, CFCs, $CO_2$, CO, $CH_4$ (methane), $N_2$, $O_2$, $O_3$ (ozone), $SO_2$, CO, Rn.** (4)

A) An unstable gas that blocks some radiation — $O_3$
B) A non-flammable, gas used in fire extinguishers — $CO_2$ or $N_2$
C) Produces acid rain when exposed to water in the atmosphere — $SO_x$ (& $NO_x$) ($CO_2$ ok)
D) The second most abundant gas in the atmosphere — $O_2$

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

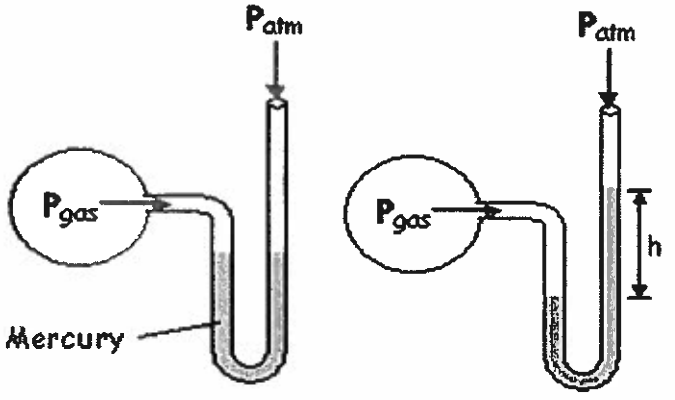
A) $CH_4$
B) $CO_2$
($H_2O$) ($O_3$)

**$P_1V_1 = P_2V_2$** $\quad \frac{V_1}{T_1}=\frac{V_2}{T_2}$ $\quad \frac{P_1}{T_1}=\frac{P_2}{T_2}$ $\quad \frac{v_1}{v_2}=\frac{\sqrt{M_2}}{\sqrt{M_1}}$ $\quad \frac{d_1}{d_2}=\frac{\sqrt{M_2}}{\sqrt{M_1}}$ $\quad \frac{t_1}{t_2}=\frac{\sqrt{M_1}}{\sqrt{M_2}}$

**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 100.3 kPa. Calculate the pressure exerted by the gas in each case. (3)




Equal | h = 45 mm Hg | h = 33 mm Hg

A) 752 mm
B) 797 mm Hg
C) 719 mm Hg

$\frac{x}{760\ mm\ Hg} = \frac{100.3\ kPa}{101.3\ kPa}$

$x = 752.4975$

$= 752$

$P_G = P_{atm} + h$

$= 752 + 45$

$P_G = 797\ mm\ Hg$

$P_G = P_{atm} - h$

$= 752 - 33$

$P_G = 719\ mm\ Hg$

760 mm Hg

9. A weather balloon is filled with 983 mL of He at 1.00 atm. The balloon expands as it rises. What is the balloon's volume when it reaches an atmospheric pressure of 305 mm Hg? (3)

$P_1V_1 = P_2V_2$

$(760\ mm\ Hg)(983\ mL) = (305\ mm\ Hg)\,V_2$

$V_2 = 2449.44\ mL$

**2.45 L**

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10. At 20.0°C, a syringe contains a given volume of oxygen gas, $O_{2(g)}$, at a pressure of 100.0 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)

$T_1 = 20.0°C + 273 = 293\,K$

$T_2 = 40.0°C + 273 = 313\,K$

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

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

$V_1 = 18.7220\,mL$

**18.7 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)

$T_1 = 393\,K$

$T_2 = -100°C + 273 = 173\,K$

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

$\frac{1.9 \times 10^2\,kPa}{393\,K} = \frac{x}{173\,K}$

$x = 83.6386\,kPa$

conversion

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

$x = 0.82565$ atm

**0.83 atm**

12. Two gases are allowed to diffuse over a 5 minutes interval. In this time Sulphur dioxide ($SO_2$) diffuses 30.25 m while the unknown gas only diffuses 19.15 m. Show your calculations to identify which of the gases it is. (4)

$\frac{30.25\,m}{19.15\,m} = \frac{\sqrt{M_2}}{\sqrt{64.07}}$

$\sqrt{M_2} = 12.64398$

$(\sqrt{M_2})^2 = (12.64398)^2$

$M_2 = 159.87$ $Br_2$ Bromine

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

$O_2 \rightarrow \frac{V_1}{V_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}} = \sqrt{\frac{64.07}{32.00}} = \sqrt{2.002} = 1.415$

$SO_2 \rightarrow$

Oxygen diffuses 1.415 times faster.

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