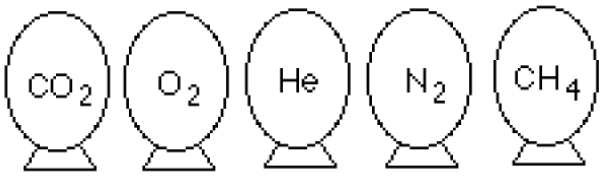
1996 - #5



Represented above are five identical balloons, each filled to the same volume at 25°C and 1.0 atmosphere pressure with the pure gas indicated.

(a) Which balloon contains the greatest mass of gas? Explain. **CO_2 b/c mass is largest**
(b) Compare the average kinetic energies of the gas molecules in the balloons. Explain.
All the same b/c temp is the same for all gases.
(c) Calculate the root mean square velocity of any two gases. Indicate the gases chosen.
CO_2 = 411 m/s; O_2 = 482 m/s; He = 1360 m/s; N_2 = 515 m/s; CH_4 = 681 m/s
(d) Twelve hours after being filled, all the balloons have decreased in size. Predict which balloon will be the smallest. Explain your reasoning. **He because it has the smallest molar mass**

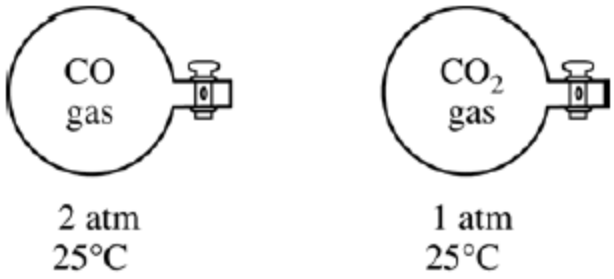
2002B - #2
A rigid 8.20 L flask contains a mixture of 2.50 moles of H_2, 0.500 mole of O_2, and sufficient Ar so that the partial pressure of Ar in the flask is 2.00 atm. The temperature is 127ºC.
(a) Calculate the total pressure in the flask. **14.0 atm**
(b) Calculate the mole fraction of H_2 in the flask. **0.714**
(c) Calculate the density (in g L^{-1}) of the mixture in the flask. **5.00 g L^{-1}**
The mixture in the flask is ignited by a spark, and the reaction represented below occurs until one of the reactants is entirely consumed.

$$2\ H_2(g) + O_2(g) \rightarrow 2H_2O(g)$$

(d) Give the mole fraction of all species present in the flask at the end of the reaction.
H_2: 0.500; O_2: 0.0; H_2O: 0.333; Ar: 0.167

2003 - #2
A rigid 5.00 L cylinder contains 24.5 g of $N_2(g)$ and 28.0 g of $O_2(g)$.
(a) Calculate the total pressure, in atm, of the gas mixture in the cylinder at 298 K. **8.56 atm**
(b) The temperature of the gas mixture in the cylinder is decreased to 280 K. Calculate each of the following.
(i) The mole fraction of $N_2(g)$ in the cylinder **0.500**
(ii) The partial pressure, in atm, of $N_2(g)$ in the cylinder **4.02**
(c) If the cylinder develops a pinhole-sized leak and some of the gaseous mixture escapes, would the ratio $\frac{moles : Nitrogen}{moles : Oxygen}$ in the cylinder increase, decrease, or remain the same? Justify your answer. **Decrease because oxygen effuses slower because its molar mass is greater than nitrogen**.

A different rigid 5.00 L cylinder contains 0.176 mol of NO(g) at 298 K. A 0.176 mol sample of $O_2(g)$ is added to the cylinder, where a reaction occurs to produce $NO_2(g)$.
(d) Write the balanced equation for the reaction. **$2NO + O_2 \rightarrow 2NO_2$**
(e) Calculate the total pressure, in atm, in the cylinder at 298 K after the reaction is complete. **1.29 atm**



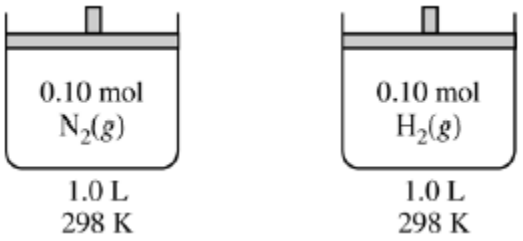
(i) Indicate whether the average kinetic energy of the $CO_2(g)$ molecules is greater than, equal to, or less than the average kinetic energy of the CO(g) molecules. Justify your answer. **Equal because kinetic energy is a function of temperature. Since both are at the same temperate, both have the same kinetic energy.**

(ii) Indicate whether the root-mean-square speed of the $CO_2(g)$ molecules is greater than, equal to, or less than the root-mean-square speed of the CO(g) molecules. Justify your answer. **CO is faster because its molecular mass is lower than CO_2**

(iii) Indicate whether the number of $CO_2(g)$ molecules is greater than, equal to, or less than the number of CO(g) molecules. Justify your answer. **More CO because pressure and moles are directly related. An increase in pressure is directly related to an increase in the number of moles.**

2005B - #6

Consider two containers of volume 1.0 L at 298 K, as shown to the right. One container holds 0.10 mol $N_2(g)$ and the other holds 0.10 mol $H_2(g)$. The average kinetic energy of the $N_2(g)$ molecules is 6.2×10^{-21} J . Assume that the $N_2(g)$ and the $H_2(g)$ exhibit ideal behavior.



(a) Is the pressure in the container holding the $H_2(g)$ less than, greater than, or equal to the pressure in the container holding the $N_2(g)$? Justify your answer. **Equal. Since volume, temperature and moles are equal, pressures must be too.**

(b) What is the average kinetic energy of the $H_2(g)$ molecules? **6.2×10^{-21} J**

(c) The molecules of which gas, N_2 or H_2 , have the greater average speed? Justify your answer. **H_2 because H_2 has a lower molar mass than N_2.**

(d) What change could be made that would decrease the average kinetic energy of the $N_2(g)$ molecules in the container? **Decrease the temperature.**

(e) If the volume of the container holding the $H_2(g)$ was decreased to 0.50 L at 298 K, what would be the change in each of the following variables? In each case, justify your answer.

(i) The pressure within the container **A decrease in volume causes an increase in pressure. Pressure and volume are inversely related.**

(ii) The average speed of the $H_2(g)$ molecules **The average speed would not change because there is no change in temperature.**