1990 B Answer:

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

mol H_2 = mol O_2 initially, but 2 mole H_2 react for every 1 mol of O_2, therefore, O_2 is left.

$P_T = P_{H2} + P_{O2} + P_{H2O}$

1146 mm Hg = $P_{H2} + P_{O2}$ + 24 mm Hg

$P_{H2} + P_{O2}$ = 1122 mm Hg

1122 mm Hg / 4 = P_{O2} left ($^1/_2$ of initial P_{O2} which is $^1/_2$ total)

P_{O2} = 280.5 mm Hg

$$n = \frac{PV}{RT} = \frac{(\frac{280.5}{760}\ atm)(0.500\ L)}{(0.0821\ \frac{L\_atm}{mol\_K})(298\ K)} = 7.55 \times 10^{-3}\ mol\ O_2$$

(b)

$$\frac{280.5 mmHg}{298\ K} = \frac{P_{O_2}}{363\ K};\quad P_{O_2} = 342\ mmHg$$

$$P_T = P_{O2} + P_{H2O} = (342 + 526)\text{mm Hg} = 868\text{ mm Hg}$$

(c)

$$n = \frac{PV}{RT} = \frac{(\frac{526}{760}\ atm)(0.500\ L)}{(0.0821\ \frac{L\_atm}{mol\_K})(363\ K)} = 0.0116\ mol$$

1993 BAnswer:

(a) Reducing the temperature of a gas reduces the average kinetic energy (or velocity) of the gas molecules. This would reduce the number (or frequency) of collisions of gas molecules with the surface of the balloon; [OR decrease the momentum change that occurs when the gas molecules strike the balloon surface]. In order to maintain a constant pressure vs the external pressure, the volume must decrease.

(b) The molecules of the gas do have volume, when they are cooled sufficiently, the forces of attraction that exist between them cause them to liquefy or solidify.

(c) The molecules of gas are in constant motion so the HCl and NH_3 diffuse along the tube. Where they meet, $NH_4Cl_{(s)}$ is formed. Since HCl has a higher molar mass, its velocity (average) is lower, therefore, it doesn't diffuse as fast as the NH_3.

(d) The wind is moving molecules of air that are going mostly in one direction. Upon encountering a flag, they transfer some of their energy (momentum) to it and cause it to move (flap!).

1994 Answer:

(a) $P_{H2} = P_{atm} - P_{H2O}$ = (745 - 23.8) mm Hg

= 721.2 mm Hg

$n = (PV)/(RT) = (721.2 \text{ mm Hg} \times 90.0 \text{ mL})/(62400 \text{ mm Hg.mL/mol.K} \times 298.15\text{K})$
$= 3.49\times10^{-3}$ mol

(b) $n_{H_2O} = (23.8 \text{ mm Hg} \times 90.0 \text{ mL})/(62400 \text{ mm Hg.mL/mol.K} \times 298.15\text{K}) \times 6.022\times10^{23}$ molecules/mol
$= 6.93\times10^{19}$ molecules

(c) $(\text{mass}_{H2})(\text{velocity}_{H2})^2 = (\text{mass}_{H2O})(\text{velocity}_{H2O})^2$
$2(v_{H2})^2 = 18(v_{H2O})^2$
$v^2_{H2}/ v^2_{H2O} = 9$; $v_{H2}/ v_{H2O} = 3$

(d) H_2O deviates more from ideal behavior:

1995 Answer:

(a) $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

(b) 10.0 g $C_3H_8 \times$ 1 mol C_3H_8/44.0 g $\times$ 5 mol O_2/1 mol C_3H_8) = 1.14 mol O_2

$$V_{O_2} = \frac{nRT}{P} = \frac{(1.14 \text{ mol})(0.0821 \frac{\text{L\_atm}}{\text{mol\_K}})(303 \text{ K})}{1.00 \text{ atm}}$$

= 28.3 L O_2 ; 28.3 L/21.0% = 135 L of air

(c) $$\Delta H^o_{comb} = [\Delta H^o_{f(CO_2)} + \Delta H^o_{f(H_2O)}] - [\Delta H^o_{f(C_3H_8)} + \Delta H^o_{f(O_2)}]$$

-2220.1 = [3(-393.5) + 4(-285.3)] - [X+ 0]
$X = \Delta H^o_{comb} =$ -101.7 kJ/mol

(d) q = 30.0 g $C_3H_8 \times$ 1 mol/44.0 g $\times$ 2220.1 kJ/1 mol = 1514 kJ
$q = (m)(C_p)(\Delta T)$
1514 kJ = (8.00 kg)(4.18 J/g·K)(ΔT)
$\Delta T = 45.3°$

1996 Answer:

(a) CO_2; according to Avogadro's Hypothesis, they all contain the same number of particles, therefore, the heaviest molecule, CO_2 (molar mass = 44), will have the greatest mass.

(b) all the same; at the same temperature all gases have the same kinetic energy.

(c) CO_2; since they are all essentially non-polar, the largest intermolecular (London) force would be greatest in the molecule/atom with the largest number of electrons.

(d) He; it has the smallest size and has the greatest particulate speed and, therefore, it's the easiest to penetrate the wall and effuse.