Review Packet #3 - Random Topics

1) (a) two points

CO_2 because all contain same number of molecules (moles), and CO_2 molecules are the heaviest

Note: total of 1 point earned if CO_2 not chosen but same number of molecules (moles) is specified

(b) two points

All are equal because same temperature, therefore same average kinetic energy

Note: just restatement of "same conditions, etc." does not earn second point

(c) two points

CO_2 because either one:

- it has the most electrons, hence is the most polarizable
- it has the strongest intermolecular (London) forces

Note: also allowable are "polar bonds", "inelastic collisions"; claiming larger size or larger molecular volume does not earn second point

(d) two points

He because any one:

- greatest movement through the balloon wall
- smallest size
- greatest molecular speed
- most rapid effusion (Graham's law)

2) a) three points

$n = PV \div RT = [(721)\ (0.090)] \div [(62.4)\ (298)] = 3.49 \times 10^{-3}$ mol H_2

Each worth one point:

- 25°C to 298 K
- 745 - 24 = 721 mm Hg
- calculation of moles H_2

Note: 62.4 is R in units of L torr per mol K

b) two points

$[(23.8)\ (0.090)] \div [(62.4)\ (298)] = 1.15 \times 10^{-4}$ mol H_2O

$(1.15 \times 10^{-4})\ (6.02 \times 10^{23}) = 6.92 \times 10^{19}$ molecules H_2O

c) two points (one for formula, one for calculation)

The average kinetic energies are equal, so:

$(1/2\ mv^2)_{H2O} = (1/2\ mv^2)_{H2}$

v_{H2} / v_{H2O} = square root $[MM_{H2O} / MM_{H2}]$

= square root $(18 / 2) = 3$

Note: credit also given for correct use of v_{rms} = square root $(3RT / M)$

d) two points

H_2O deviates more from ideal behavior.

Explanation:

The volume of the H_2O molecule is larger than that of the H_2 molecule

OR

The intermolecular forces among the H_2O molecules are stronger than those among H_2 molecules.

3) a) six points

$2\ H_2 + O_2 \text{ ---> } 2\ H_2O$

moles H_2 = moles O_2 initially but 2 moles of H_2 react for every mole of O_2. O_2 is left.

$P_{tot} = P_{H2} + P_{O2} + P_{H2O}$ $\quad$ $1146 = P_{H2} + P_{O2} + 24$ (v.p. of H_2O = 24 mmHg)

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

1122 mm / 4 = P_{O2} left (1/2 of initial O_2 which is 1/2 total) P_{O2} = 280.5 mm

$P_1V_1 / T_1 = P_2V_2 / T_2$ ((280.5) (0.5 L)) / (298) = ((760 mm)V_2) / (273)

V_2 = 0.169 L therefore n = 0.169 L / 22.4 L mol^{-1} = 7.55 x 10^{-3} mol

OR

PV = nRT ((280.5 / 760)atm (0.5 L)) / ((0.0821 L atm/mol K) (298 K)) = n = 7.55 x 10^{-3} mol

b) two points

P_{O2} (@ 90°C) / 363 = 280.5 / 298 = 342 mm Hg

OR

P = ((7.55 x 10^{-3} mol) (0.0821) (363)) / 0.5 = 0.45 atm = 342 mm Hg

therefore $P_{tot} = P_{O2} + P_{H2O}$ = 342 + 526 = 868 mm Hg

c) one point

V_{H2O} (@ STP) = ((526 mm Hg) (0.5) (273)) / ((760) (363)) = 0.260 L

mol. of H_2O = 0.260 L / 22.4 L mol^{-1} = 0.0116 mol

OR

n = ((526 / 750)atm (0.50)) / ((0.0821) (363) = 0.0116 mol