

Review Packet #3 - Random Topics

1) (a) two points

CO<sub>2</sub> because all contain same number of molecules (moles), and CO<sub>2</sub> molecules are the heaviest

Note: total of 1 point earned if CO<sub>2</sub> 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<sub>2</sub> 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

$$n = PV \div RT = [(721) (0.090)] \div [(62.4) (298)] = 3.49 \times 10^{-3} \text{ mol H}_2$$

Each worth one point:

25°C to 298 K

745 - 24 = 721 mm Hg

calculation of moles H<sub>2</sub>

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

b) two points

$$[(23.8) (0.090)] \div [(62.4) (298)] = 1.15 \times 10^{-4} \text{ mol H}_2\text{O}$$

$$(1.15 \times 10^{-4}) (6.02 \times 10^{23}) = 6.92 \times 10^{19} \text{ molecules H}_2\text{O}$$

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

The average kinetic energies are equal, so:

$$(1/2 mv^2)_{\text{H}_2\text{O}} = (1/2 mv^2)_{\text{H}_2}$$

$$v_{\text{H}_2} / v_{\text{H}_2\text{O}} = \text{square root} [MM_{\text{H}_2\text{O}} / MM_{\text{H}_2}]$$

$$= \text{square root} (18 / 2) = 3$$

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

d) two points

H<sub>2</sub>O deviates more from ideal behavior.

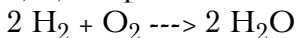
Explanation:

The volume of the H<sub>2</sub>O molecule is larger than that of the H<sub>2</sub> molecule

OR

The intermolecular forces among the H<sub>2</sub>O molecules are stronger than those among H<sub>2</sub> molecules.

3) a) six points



moles H<sub>2</sub> = moles O<sub>2</sub> initially but 2 moles of H<sub>2</sub> react for every mole of O<sub>2</sub>. O<sub>2</sub> is left.

$$P_{\text{tot}} = P_{\text{H}_2} + P_{\text{O}_2} + P_{\text{H}_2\text{O}} \quad 1146 = P_{\text{H}_2} + P_{\text{O}_2} + 24 \text{ (v.p. of H}_2\text{O} = 24 \text{ mmHg)}$$

$$P_{\text{H}_2} + P_{\text{O}_2} = 1122 \text{ mm Hg}$$

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$$1122 \text{ mm} / 4 = P_{\text{O}_2} \text{ left (1/2 of initial O}_2 \text{ which is 1/2 total)} \quad P_{\text{O}_2} = 280.5 \text{ mm}$$

$$P_1 V_1 / T_1 = P_2 V_2 / T_2 \quad ((280.5) (0.5 \text{ L})) / (298) = ((760 \text{ mm}) V_2) / (273)$$

$$V_2 = 0.169 \text{ L therefore } n = 0.169 \text{ L} / 22.4 \text{ L mol}^{-1} = 7.55 \times 10^{-3} \text{ mol}$$

OR

$$PV = nRT \quad ((280.5 / 760) \text{ atm } (0.5 \text{ L})) / ((0.0821 \text{ L atm/mol K}) (298 \text{ K})) = n = 7.55 \times 10^{-3} \text{ mol}$$

b) two points

$$P_{\text{O}_2} (@ 90^\circ\text{C}) / 363 = 280.5 / 298 = 342 \text{ mm Hg}$$

OR

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

$$\text{therefore } P_{\text{tot}} = P_{\text{O}_2} + P_{\text{H}_2\text{O}} = 342 + 526 = 868 \text{ mm Hg}$$

c) one point

$$V_{\text{H}_2\text{O}} (@ \text{ STP}) = ((526 \text{ mm Hg}) (0.5) (273)) / ((760) (363)) = 0.260 \text{ L}$$

$$\text{mol. of H}_2\text{O} = 0.260 \text{ L} / 22.4 \text{ L mol}^{-1} = 0.0116 \text{ mol}$$

OR

$$n = ((526 / 750) \text{ atm } (0.50)) / ((0.0821) (363)) = 0.0116 \text{ mol}$$