Gas Problems - Test Review

1) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\frac{(8.5atm)(3.10mL)}{(285K)} = \frac{(1.18atm)V_2}{308K}$

$\boxed{24mL = V_2}$

2) $PV = nRT$ $\frac{.456g\ CO_2}{} \Big| \frac{1mol\ CO_2}{44.01g} = .0104mol$

$P(.160L) = (.0104mol)(.0821)(295K)$

$\boxed{P = 1.57atm}$

$\frac{1.57atm}{} \Big| \frac{760torr}{1atm} = \boxed{1190torr}$

3) $P_1V_1 = P_2V_2$ $(150kPa)(420.mL) = P_2(100.mL)$

$\boxed{630.kPa = P_2}$

4) $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{3.5\times10^3L}{273K} = \frac{V_2}{203K}$ $\boxed{V_2 = 2.6\times10^3L}$

5) $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{680.Torr}{312K} = \frac{620.Torr}{T_2}$ $\boxed{T_2 = 284K}$

$284K - 273 = \boxed{11°C}$

6) $\overset{45.0g}{C_3H_8} + 5O_2 \rightarrow \overset{?L,\ ?mol}{3CO_2} + 4H_2O$ STP

$\frac{45.0g\ C_3H_8}{} \Big| \frac{1mol}{44.11g} = \frac{1.02mol\ C_3H_8}{} \Big| \frac{3mol\ CO_2}{1mol\ C_3H_8} = 3.06mol\ CO_2$

$\frac{3.06mol}{X\ L} = \frac{1mol}{22.4L}$ $\boxed{X = 68.5L}$

7) $\overset{125g}{C_3H_8} + 5O_2 \rightarrow \overset{?L}{\underset{}{\overset{?mol}{3CO_2}}} + 4H_2O$

$\frac{125g\ C_3H_8}{} \Big| \frac{1mol\ C_3H_8}{44.11g} = 2.83mol\ C_3H_8 \Big| \frac{3\ mol\ CO_2}{1mol\ C_3H_8} = 8.49\ mol\ CO_2$

(not at STP, use $PV=nRT$)

$PV=nRT$

$(202.6\ KPa)V = (8.49mol)(8.314)(305K)$

$\boxed{V = 106L}$

8) $\frac{rate_A}{rate_B} = \frac{\sqrt{MM_B}}{\sqrt{MM_A}}$ or $\frac{rate_A}{rate_B} = \sqrt{\frac{MM_B}{MM_A}}$

$1.19 = \sqrt{\frac{x}{28.02g}}$ $\quad 1.19^2 = \frac{x}{28.02g}$ $\quad \boxed{x = 39.7g/mol}$

(larger mass on top → gives >1 rate of effusion)

9) a) $P_{total} = P_{O_2} + P_{H_2O}$

$750.mmHg = P_{O_2} + (9.209mmHg)$

$\boxed{741mmHg = P_{O_2}}$

b) $PV=nRT$ $\quad (741/760)(.275L) = n(.0821)(283K)$ (.975atm)

$(O_2)\ .0115\ mol = n$

$\frac{.0115mol\ O_2}{} \Big| \frac{32.00g}{1mol\ O_2} = \boxed{.368\ g\ O_2}$

10) $d = \frac{(mm)(P)}{RT}$ $\quad d_{NO_2} = \frac{(46.01g/mol)(1.20atm)}{(.0821)(302K)} = \boxed{2.23g/L}$

11) $d = \frac{(MM)(P)}{RT}$ $\quad 3.74\,g/L = \frac{(MM)(1\,atm)}{(.0821)(273K)}$

$\boxed{83.8\,g/mol = MM}$

12) They all have the same K.E. (same temp)

13) The least massive molecule will have the greatest velocity. CH_4

14) $\frac{rate_A}{rate_B} = \sqrt{\frac{MM_B}{MM_A}}$ $\quad \frac{rate_{SO_2}}{rate_{NH_3}} = \sqrt{\frac{17.04\,g/mol}{64.07\,g/mol}}$

rate = .5157

SO_2 effuses .5157X as fast as NH_3 (it's heavier)

$\boxed{or}$

$\frac{rate_{NH_3}}{rate_{SO_2}} = \sqrt{\frac{64.07\,g/mol}{17.04\,g/mol}}$

rate = 1.939

NH_3 effuses ≈ 2X faster than SO_2 (it's lighter)

15) $\frac{rate_{He}}{rate_{N_2}} = \sqrt{\frac{28.02\,g/mol}{4.00\,g/mol}}$

rate = 2.65

Helium diffuse 2.65X faster than N_2, because it's lighter.

16) $\text{rate} = \sqrt{\frac{MM_x}{MM_{O_2}}}$

$$2.00 = \sqrt{\frac{X}{32.00\ g/mol}}$$

$$(2.00)^2 = \frac{X}{32.00\ g/mol}$$

$$\boxed{128\ g/mol = X}$$