AP Chemistry

Gas Law practice

1. $4Na + O_2 \rightarrow 2NaO$

$n = \frac{PV}{RT} = \frac{(755/760)(2.5)}{(.0821)(273+15)} = .105 \text{ mol } O_2$

$.105 \text{ mol } O_2 \times \frac{4 \text{ mol Na}}{1 \text{ mol } O_2} = .420 \text{ mol Na } (22.99 \text{ g/mol})$

$= \underline{9.66 \text{ g } O_2}$

2. $\text{mol } CO_2 = 13.203/44.01 \text{ g/mol} = .3 \text{ mol}$

$7.2064 \text{ g}/18.02 = .4 \text{ mol } H_2O$

$n_{TL} = .7 \text{ mol}$

$P = \frac{(.7)(.0821)(353.15)}{(20.4)} = .9949 \text{ atm}$

$.9949 \text{ atm} \left(\frac{760 \text{ mmHg}}{1 \text{ atm}}\right) = 756.108 + 11 \text{ mmHg}$

$\approx \underline{767 \text{ torr}}$

3. $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2} \qquad \frac{P_1V_1}{n_1T_1} = \frac{P_2(4V_1)}{(2n_1)(2T_1)}$

$\underline{\underline{P_2 = P_1}}$

4. $2NO + O_2 \rightarrow 2NO_2$

$\frac{30 \text{ g NO}}{30.0061 \text{ g/mol}} \approx 1 \text{ mol} \qquad \frac{30 \text{ g } O_2}{32.0 \text{ g/mol}} = .9375 \text{ mol}$

NO limits

$.9375 - .5 = .4375 \text{ mol } O_2$ left over

1 mol NO_2 produced

$n_{TL} = 1.4375 \text{ mol}$

$P = \frac{(1.4375)(.0821)(293.15)}{10.L}$

$= 3.46 \text{ atm} = 2628 \text{ torr}$

$\underline{2.6 \times 10^3 \text{ torr}}$

5. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad \frac{(1)(12)}{(273.15)} = \frac{(.5)(V_2)}{(243.15)}$

$V_2 = \underline{\underline{21.4 \text{ L}}}$

6. $\frac{20 \text{ g He}}{4.00 \text{ g/mol}} = 5 \text{ mol He}$

$n = \frac{(86.11)(1.50 \text{ L})}{(.0821)(298)} = 5.279 \text{ mol}$

$5.279 \text{ mol} - 5 \text{ mol He}$

$= .279 \text{ mol Unknown}$

$\frac{20.0 \text{ g Unknown}}{.279 \text{ mol}} = \underline{71.68 \text{ g/mol}}$

Closest to Cl_2

7. a. $781 \times \left(\frac{1}{760}\right) = 1.03 \text{ atm}$

b. $356 \left(\frac{101.3}{760}\right) = 47.5 \text{ kpa}$

c. $2.3 \left(\frac{760}{1}\right) = 1748 \text{ torr}$

d. $2.1 \times 10^3 \left(\frac{1}{101,300}\right) = .021 \text{ atm}$

e. $201 \text{ kpa} \left(\frac{1}{101.3}\right) = 1.98 \text{ atm}$

8. $\frac{P_1}{1 \text{ mol}} = \frac{P_2}{5 \text{ mol}} \qquad P_2 = 5P_1$

The pressure will be 5 times greater

9. $760 - 609.5 - 0.5 = 150 \text{ mmHg} = .197 \text{ atm}$ } oxygen

$\frac{150 \text{ mmHg}}{760 \text{ mmHg}} = .197$ mole fraction

Pressure is directly related to # of moles. $P \propto n$

10. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\frac{(760)(1{,}000)}{323} = \frac{(380)(V)}{283}$

$V_2 = 1752\,L = \underline{1.75 \times 10^3\,L}$

11. $\frac{32.0\,g\,O_2}{32.0\,g/mol} = 1\,mol\,O_2$ $P = \frac{nRT}{V}$

$P = \frac{(1)(.0821)(303)}{(20)} = \underline{1.24\,atm}$

12. $PV = nRT$ $PV = \frac{mRT}{M}$

$M = \frac{mRT}{PV}$ $\frac{(96.0)(.0821)(300)}{(3.0)(25.0)}$

$= \underline{31.86\,g/mol}$

13. $2H_2 + O_2 \rightarrow 2H_2O$

$\frac{20.0\,g\,O_2}{32.0\,g/mol} = .625\,mol\,O_2$

$.625\,mol\,O_2\left(\frac{2\,mol\,H_2O}{1\,mol\,O_2}\right) = 1.25\,mol\,H_2O$

$V = \frac{nRT}{P}$ $\frac{(1.25)(.0821)(423.15)}{(.5)}$

$= \underline{86.85\,L}$

14. $\frac{Rate_1}{Rate_2} = \sqrt{\frac{MM_2}{MM_1}} \approx \frac{Time_2}{Time_1}$

The greater the "rate" the shorter the time.

$\frac{1.5}{1} = \sqrt{\frac{MM_2}{32\,g/mol}}$ $MM_2 = (1.5)^2(32)$

$= \underline{72\,g/mol}$

15. The coefficients in the balanced equation are all 1, therefore we expect equal volumes $\underline{2.5 \times 10^{10}\,dm^3\,CO_2}$

16. a. Twice the Volume = $\frac{1}{2}$ pressure

$P = .25\,atm$

b. $(1+.5)/2 = .75\,atm$

c. $(1+0)/2 = .50\,atm$

d. $(1+.5+0)/3 = .50\,atm$

17. $95.3\,kpa = P_{H_2} + 4.24\,kpa$

4.24 kpa is the vapor pressure of water @ 30°C

$P_{H_2} = \underline{91.1\,kpa}$

18. $\frac{\left(\frac{7.2\,g}{39.9\,g/mol}\right)(.0821)(351)}{(0.53)} = \underline{9.8\,L}$

19. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

$\frac{95.34\,g}{160\,g/mol} = .596\,mol\,Fe_2O_3$ $.596\left(\frac{3}{1}\right) = 1.788\,mol\,CO$

$(1)(V) = (1.788\,mol)(.0821)(298.15) = \underline{43.8\,L\,CO}$

20. $1.31_g\,Mg\left(\frac{1\,mol\,Mg}{24.3\,g}\right)\left(\frac{1\,mol\,H_2}{1\,mol\,Mg}\right)\left(\frac{22.4\,L}{1\,mol\,H_2}\right) = \underline{1.21\,L\,H_2}$

21. $PV = \frac{mRT}{M}$ $\frac{m}{V} = density = MP/RT$

$(44.01\,g/mol)(1\,atm)/(.0821)(273.15k) = \underline{1.96\,g/dm^3}$

22. $753\,torr\left(\frac{101.3\,kpa}{760\,torr}\right) = 100.37 \approx \underline{100\,kpa}$

23. $.98\,atm\left(\frac{760\,mmHg}{1\,atm}\right) + 35\,mm = 779.8\,mmHg$

$\approx \underline{780\,mmHg}$

24. $P_1V_1 = P_2V_2$

$(250\,torr)(3.5\,L) = (455\,torr)(V_2)$

$V_2 = \underline{1.9\,L}$

25. $P_1V_1 = P_2V_2$

$P_1(5.0\,L) = P_2(8.0\,L)$

$P_2 = .625\,P_1$

Percent decrease $= 1 - .625 = .375$

$\underline{37.5\%}$