Unit 4 Review

1. $4.29\text{ g } CH_4 \left| \frac{1\text{ mol } CH_4}{16.05\text{ g}} \right. = .267\text{ mol } CH_4$

$1.25\text{ g } C_2H_6 \left| \frac{1\text{ mol } C_2H_6}{30.08\text{ g}} \right. = .0416\text{ mol } C_2H_6$

$5.24\text{ g } C_3H_8 \left| \frac{1\text{ mol } C_3H_8}{44.11\text{ g}} \right. = .119\text{ mol } C_3H_8$

$P_T = \frac{n_T RT}{V} = \frac{(.267\text{ mol} + .0416\text{ mol} + .119\text{ mol})(.0821)(348\text{ K})}{50.0\text{ L}}$

$P = .244$ atm

CH_4 produces most pressure b/c it has more moles than the other gases

2. $Zn_{(s)} + 2H^+_{(aq)} \rightarrow Zn^{+2}_{(aq)} + H_{2(g)}$ $T = 26.0°C$

$P_T = 766.00$ mmHg $= 1$ atm

a) $P_T = P_{H_2O} + P_{H_2}$ $P_{H_2O} = 25.21$ mmHg

$760.00\text{ mmHg} = 25.21\text{ mmHg} + P_{H_2}$

$P_{H_2} = 740.79$ mmHg

b) $PV = \frac{gRT}{MM}$ $\frac{PVMM}{RT} = g_{H_2} = \frac{(740.79/760)\text{ atm}(3.00\text{ L})(2.02\text{ g/mol})}{(.0821)(299\text{ K})}$

$g_{H_2} = .241$ g

3. $4KO_{2(s)} + 2CO_{2(g)} \rightarrow 2K_2CO_{3(s)} + 3O_{2(g)}$

10.0 g; 2.00 L, 1.12 atm, 20°C = 293 K; 5.00 L, 27°C = 300 K, ? P

a) $10.0\text{ g } KO_2 \left| \frac{1\text{ mol } KO_2}{71.1\text{ g}} \right. = .141\text{ mol } KO_2 \left| \frac{3\text{ mol } O_2}{4\text{ mol } KO_2} \right. = .105\text{ mol } O_2$

$n_{CO_2} = \frac{PV}{RT} = \frac{(1.12\text{ atm})(2.00\text{ L})}{(.0821\frac{\text{L atm}}{\text{mol K}})(293\text{ K})} = .0931\text{ mol } CO_2$ $\left| \frac{3\text{ mol } O_2}{2\text{ mol } CO_2} \right. = .140\text{ mol } O_2$

$\therefore$ LR $= KO_2$

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$P = \frac{nRT}{V} = \frac{(.106\ mol\ O_2)(.0821\ \frac{L\cdot atm}{mol\cdot K})(300\ K)}{5.00\ L} = .522\ atm$

4. Graham's Law $\frac{rate\ He}{rate\ CH_4} = \sqrt{\frac{MM_{CH_4}}{MM_{He}}} = \sqrt{\frac{16.0}{4}} = \sqrt{4} = 2$

rate of He effusion is 2x rate of CH_4

5. $PV = nRT \quad PV = \frac{gRT}{MM} \quad PMM = \frac{gRT}{V} \quad PMM = dRT$

$d = \frac{PMM}{RT} = \frac{(2.00\ atm)(20.18\ g/mol)}{(.0821\ \frac{L\cdot atm}{mol\cdot K})(298\ K)} = 1.65\ g/L$

6. $2SO_{2(g)} + O_{2(g)} \leftrightarrow 2SO_{3(g)} \quad K_c = 279 @ 1000\ K$

I	$5.0\times10^{-3}\ M$	$1.9\times10^{-3}\ M$	$6.9\times10^{-3}\ M$	$Q = \frac{(6.9\times10^{-3}\ M)^2}{(5.0\times10^{-3}\ M)^2(1.9\times10^{-3}\ M)}$
	$+2x$	$+x$	$-2x$	
	$5.00\times10^{-3}\ M + 2x$	$1.9\times10^{-3}\ M + x$	$6.9\times10^{-3}\ M - 2x$	

DO NOT SOLVE

$Q = 1002 > K_c$

Shifts Left

$K_p = 279\left[(.0821)(1000)\right]^{2-3} = 3.40$

7. $CO_{2(g)} + H_{2(g)} \leftrightarrow CO_{(g)} + H_2O_{(g)} \quad V = 1.0\ L$

E	$0.0870\ mol$	$0.0870\ mol$	$0.110\ mol$	$0.110\ mol$	$K_c = \frac{(.110\ M)(.110\ M)}{(.0870\ M)(.0870\ M)}$
	$+0.100\ mol$	$+0.100\ mol$			
I	$0.1870\ M$	$0.1870\ M$	$0.110\ M$	$0.110\ M$	$K_c = 1.60$
C	$-x$	$-x$	$+x$	$+x$	
E	$0.1870 - x$	$0.1870 - x$	$0.110 + x$	$0.110 + x$	

$\sqrt{1.60} = \sqrt{\frac{(0.110+x)^2}{(0.1870-x)^2}} \quad 1.26 = \frac{.110+x}{.1870-x}$

$[CO_2] = [H_2] = .1870 - .0560 = .131\ M$

$[CO] = [H_2O] = .110 + .0560 = .166\ M$

$.2365 - 1.26x = .110 + x$

$x = .0560\ M$

$P_T = \frac{(.0870 + .0870 + .110 + .110)(.0821)(1259\ K)}{1.0\ L} = 40.7\ atm$

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8. $H_2O_{(g)} \leftrightarrow H_{2(g)} + \frac{1}{2}O_{2(g)}$

$K_c = \frac{[H_2][O_2]^{1/2}}{[H_2O]}$

2.0 M	0	0	$K_c = \frac{(.20M)(.10M)^{1/2}}{(1.80M)}$
$-x$	$+x$	$+\frac{1}{2}x$	
$2.0-x$	x	$\frac{1}{2}x$	$K_c = .035$
$=1.8M$	$=.20M$	$=.10M$	

10% $H_2O \rightarrow H_2 + O_2$ $\therefore$ x = 10% of 2.0 M = (.10)(2.0) = .20 M

b) $4H_{2(g)} + 2O_{2(g)} \leftrightarrow 4H_2O_{(g)}$

reverse and multiply by 4 $K_c = \left(\frac{1}{.035}\right)^4 = 6.6 \times 10^5$

9. $2NO_{(g)} + O_{2(g)} \leftrightarrow 2NO_{2(g)} + \text{heat}$

a) Right b) left c) left d) right (less moles)

10. $Fe_{(s)} + H_2O_{(g)} \leftrightarrow FeO_{(s)} + H_{2(g)}$

1st Rxn Reverse $H_2O_{(g)} + CO_{(g)} \leftrightarrow CO_{2(g)} + H_{2(s)}$ $K_c = 1/.625$

2nd Rxn Mult 1/2 $Fe_{(s)} + CO_{2(s)} \leftrightarrow FeO_{(s)} + CO_{(g)}$ $K_c = (2.25)^{1/2}$

$H_2O_{(g)} + \cancel{CO_{(g)}} + \cancel{Fe_{(s)}} + \cancel{CO_{2(s)}} \leftrightarrow \cancel{CO_{2(s)}} + H_{2(s)} + \cancel{FeO_{(s)}} \cancel{FeO_{(s)}}$

$K_c = (1/.625)(2.25)^{1/2} = 2.4$

11. $NH_4HS_{(s)} \leftrightarrow NH_{3(g)} + H_2S_{(g)}$ $K_c = 1.8 \times 10^{-4}$ @ 298 K

1.0 mol	0	0	$V = 1.0L$
$-x$	$+x$	$+x$	
$1.0-x$	x	x	

a) $K_c = [NH_3][H_2S]$ $1.8 \times 10^{-4} = x^2$ $x = .0134M$

At equilibrium, $[NH_3] = [H_2S] = .013M$

b) $P_T = n_T RT = \frac{(.0134\,mol + .0134\,mol)\left(.0821\frac{L\,atm}{mol\,K}\right)(298K)}{1.0L} = .66\,atm$

c) % NH_4Hs decomposed $= \frac{.0134\,mol}{1.0\,mol} \times 100 = 1.34\%$

d) $100 - 1.34\% =$ 98.66% remaining

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12. ↑T to make particles move so fast that they do not have time to recognize attractions
↑V/↓P particles far apart so they can't recognize attractions