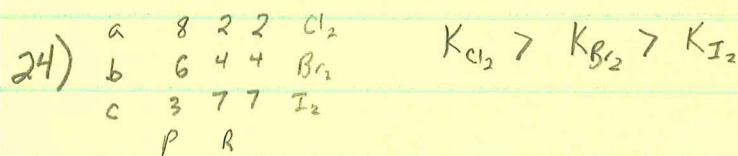


Ch16 Chemical Equilibrium Exercises

21c) $K = \frac{[CS_2][H_2]^4}{[CH_4][H_2S]^2}$ d) $K = \frac{[CO_2]^2}{[CO]^2[O_2]}$



25 data

	H ₂	I ₂	HI
(i)	10	10	0
(ii)	7	7	6
(iii)	5	5	10
(iv)	4	4	12
(v)	3	3	14
(vi)	3	3	14

23) The K_{eq} is much smaller than 1 so reactants will be favored. (independent of initial concs)

25) a) eq by step V since conc same at vi

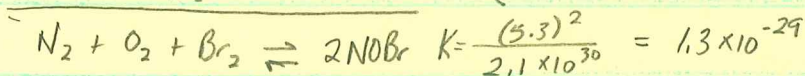
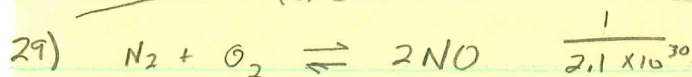
b) reach eq faster

c) same amt catalyst ↑ speed but does not change eq conditions

26) The K_{eq} gives the ratio of products to reactants at eq it does not say how long it takes to reach eq so the rxn w/ the smaller K_{eq} must have faster kinetics

27) a) $K = \frac{1}{2.26 \times 10^{-4}} = 4.42 \times 10^{-5}$ R favored b) $\frac{1}{2}$ conc $K = (2.26 \times 10^{-4})^{1/2} = 1.50 \times 10^{-2}$ P favored

c) $K = \frac{1}{(2.26 \times 10^{-4})^2} = 1.95 \times 10^{-9}$ R favored



32b) $K_p = (3.7 \times 10^8)(0.08206 \times 298)^{2-4} = 6.2 \times 10^5$

33a) $K_{eq} = \frac{[HCO_3^-][OH^-]}{[CO_3^{2-}]}$

b) $K_{eq} = [O_2]^3$

35) $K_c = \frac{[CH_3OH]}{[CO][H_2]^2} = \frac{(0.185)}{(0.105)(0.114)^2} = 136$

37) $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{(0.439)^2}{(0.115)(0.105)^3} = 1.45 \times 10^3$

$9.6 = \frac{(0.128)^2}{(0.110)x^3}$ $x = 0.249$

$0.0584 = \frac{x^2}{(0.120)(0.140)^3}$

$x = 0.00439$

31)b) $K_p = K_c(RT)^{\Delta n}$ $K_c = \frac{K_p}{(RT)^{\Delta n}}$

$K_c = \frac{7.7 \times 10^{24}}{(0.08206 \times 298)^{4-2}} = 1.3 \times 10^{22}$

c) $K_c = \frac{81.9}{(0.08206 \times 298)^{2-2}} = 81.9$

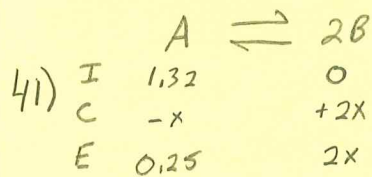
39) $P_{NO} = 108 \text{ torr} \times \frac{1 \text{ atm}}{760} = 0.142 \text{ atm}$

$P_{Br_2} = 126 \text{ torr} \times \frac{1}{760} = 0.1658 \text{ atm}$

$K_p = \frac{(P_{NOBr})^2}{(P_{NO})^2(P_{Br_2})}$ ← must be in atm

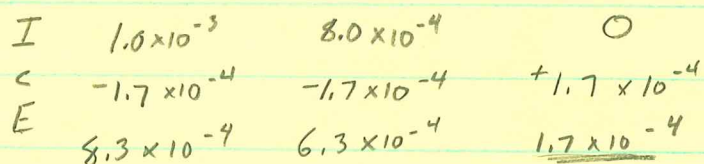
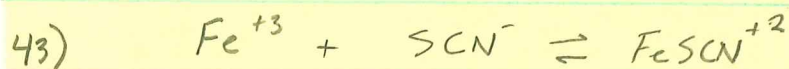
$28.4 = \frac{x^2}{(0.142)^2(0.1658)}$

$x = 0.308 \text{ atm} = 234 \text{ torr}$

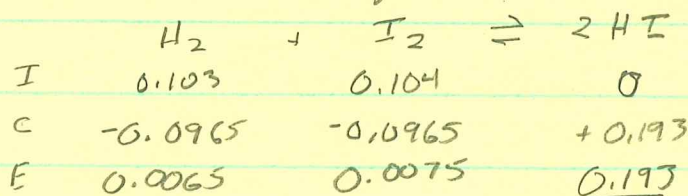
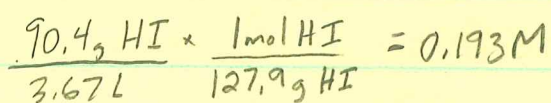
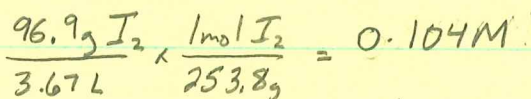
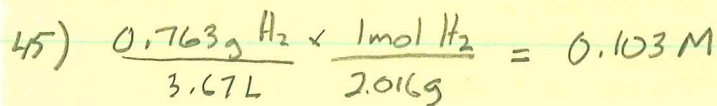


$x = 1.07 \quad 2x = 2.14$

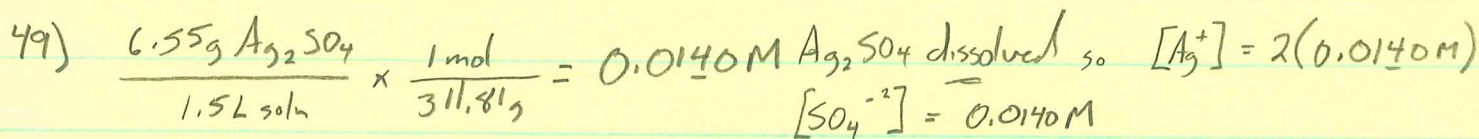
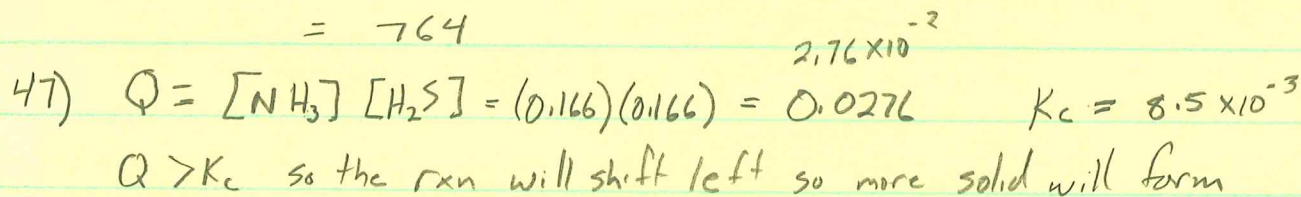
$$K_p = \frac{(P_B)^2}{(P_A)} = \frac{(2.14)^2}{(0.25)} = 18$$



$$K_c = \frac{[FeSCN^{+2}]}{[Fe^{+3}][SCN^-]} = \frac{1.7 \times 10^{-4}}{(8.3 \times 10^{-4})(6.3 \times 10^{-4})} = 330$$

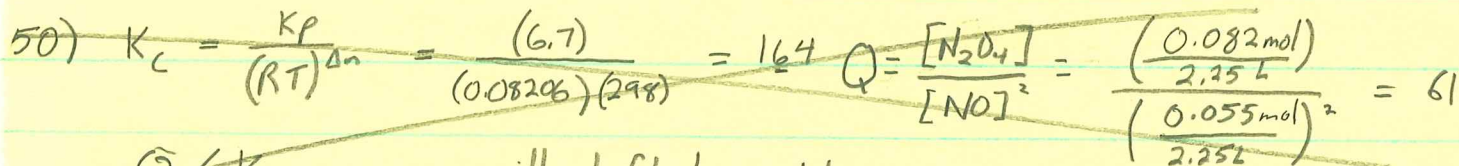


$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{(0.193)^2}{(0.0065)(0.0075)} = 764$$

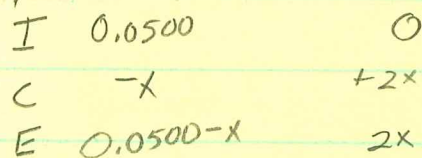
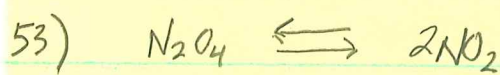


$$Q = [Ag^+]^2 [SO_4^{2-}] = (0.0280)^2 (0.0140) = 1.1 \times 10^{-5}$$

$Q = K$ so system is at eq
 + soln is sat No more solid will dissolve



$Q < K_c$ so rxn will shift to right



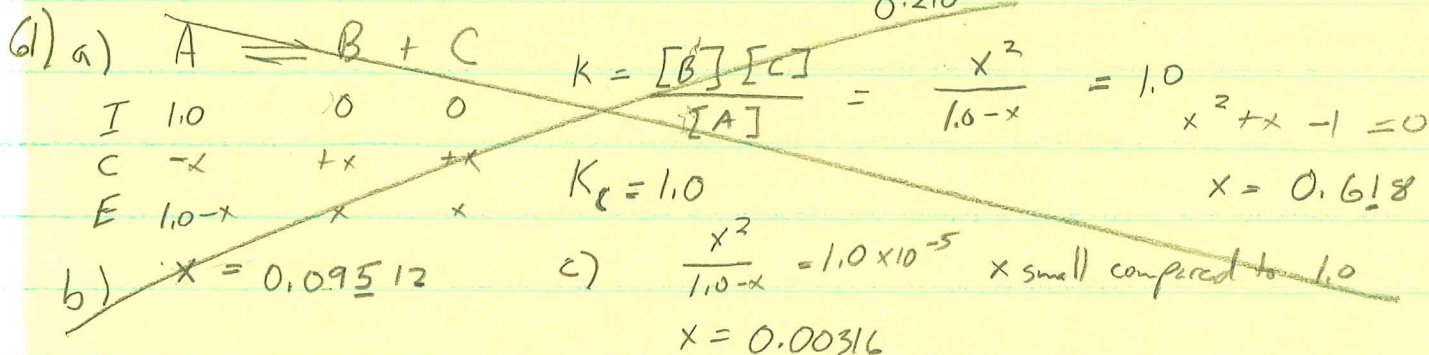
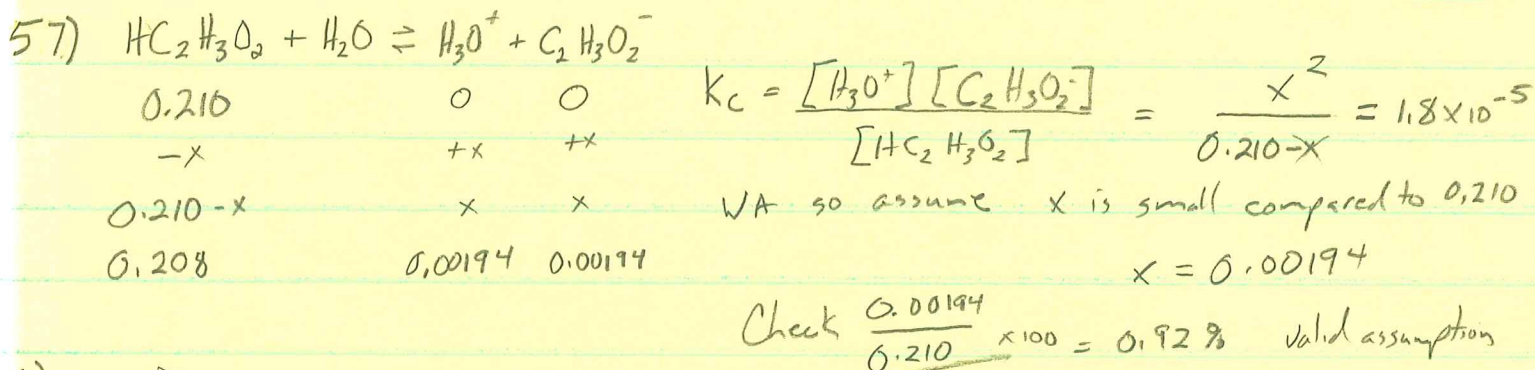
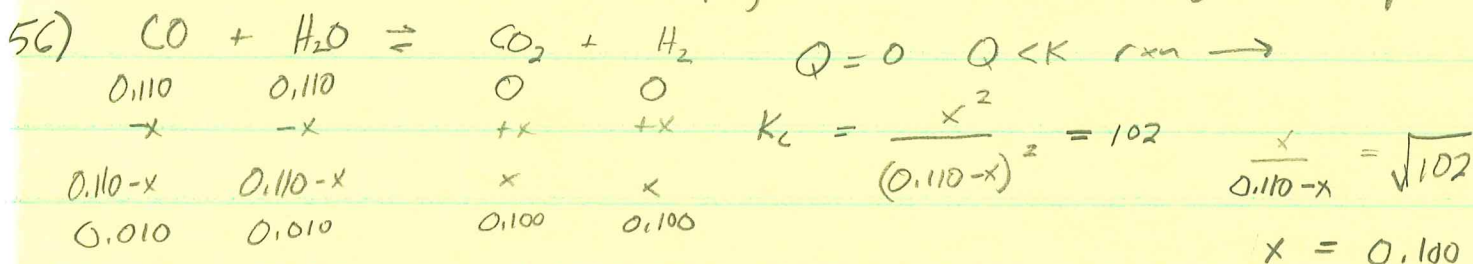
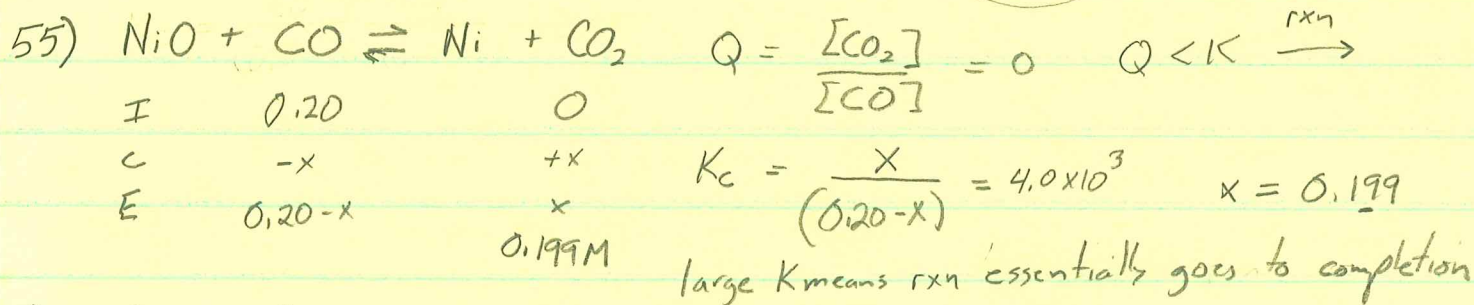
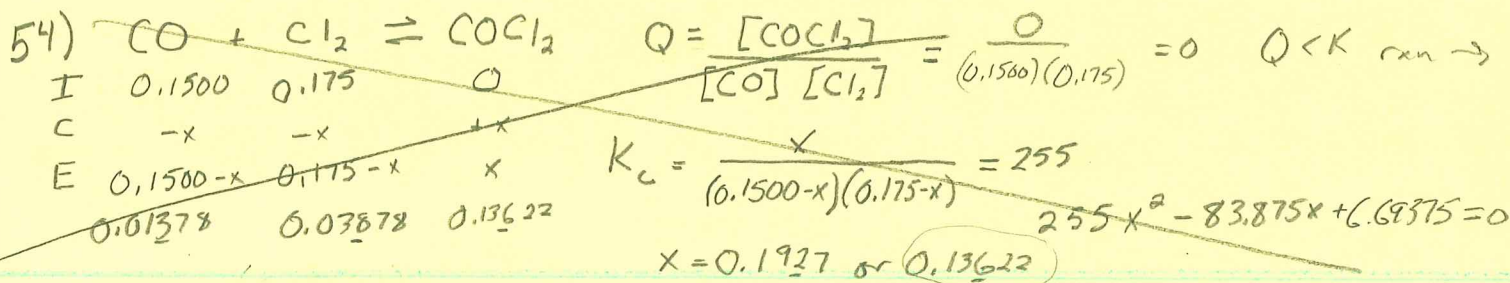
$$Q = \frac{[NO_2]^2}{[N_2O_4]} = \frac{0}{0.0500} = 0 \quad Q < K \text{ rxn} \rightarrow$$

$$K_c = \frac{[2x]^2}{(0.0500 - x)} = 0.513 \quad 4x^2 + 0.513x - 0.02565 = 0$$

$0.0115M \quad 0.0770M$

$x = -0.1667 \text{ or } 0.0385$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



63) a) shift L
b) shift R
c) shift R

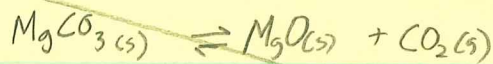
65) a) L
b) No change
c) "
d) L

67) a) $\uparrow V \downarrow P$ shift R to more (gas) moles
b) $\downarrow V \uparrow P$ shift L
c) $\downarrow V \uparrow P$ No change (equal moles)

69) $\uparrow T$ adds heat since rxn is endo shift \rightarrow conc of products \uparrow
 conc products \downarrow value of K will \uparrow

71) a) No change b) Shift R \checkmark c) rxn is exo shift L d) $\downarrow V \uparrow P$ shift R \checkmark
 e) catalyst speeds up rxn reaches eq faster f) No change

77) $P_1 V_1 = P_2 V_2$ $(0.0260 \text{ atm})(10.0 \text{ L}) = P_2 (0.100 \text{ L})$ $P_2 = 2.60 \text{ atm}$



$$2.60$$

$$-x$$

$$2.60 - x$$

$$K_p = P_{\text{CO}_2} = 0.0260 = 2.60 - x$$

$$x = 2.579 \text{ atm}$$

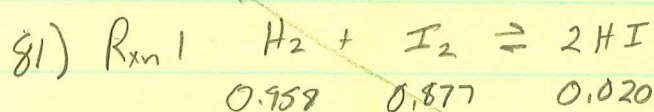
$$0.0248 \text{ mol MgO} \times \frac{1 \text{ mol MgCO}_3}{1 \text{ mol MgO}} \times \frac{84.31 \text{ g}}{1 \text{ mol}}$$

$$= 2.09 \text{ g MgCO}_3$$

$$n = \frac{PV}{RT} = \frac{(2.579)(10.0)}{(0.08206)(650)} = 0.4835 \text{ mol CO}_2 \text{ ER}$$

$$1.0 \text{ g MgO} \times \frac{1 \text{ mol}}{40.30 \text{ g}} = 0.0248 \text{ mol MgO LR}$$

79) a) $\uparrow V \downarrow P$ shift L b) shift R \checkmark c) $\downarrow T$ removes heat rxn will shift R to produce \checkmark heat
 d) shift R \checkmark



$$0.958$$

$$0.877$$

$$0.020$$

$$K_p = \frac{(0.020)^2}{(0.958)(0.877)} = 4.76 \times 10^{-4}$$

Rxn 2

$$0.621$$

$$0.621$$

$$0.101$$

$$+x$$

$$+x$$

$$-2x$$

$$Q = \frac{(0.101)^2}{(0.621)^2} = 0.0264$$

$Q > K$ shift L

$$0.621 + x \quad 0.621 + x \quad 0.101 - 2x$$

$$K_p = \frac{(0.101 - 2x)^2}{(0.621 + x)^2} = 4.76 \times 10^{-4}$$

$$x = 0.0433$$