① $K_c = \frac{[SO_2][Cl_2]}{[SO_2Cl_2]}$ $\qquad K_c = \frac{[O_2]}{[H_2O_2]^2}$

2. a. ↓ amount reactant → more reactants form
b. ↑ product → more reactants form
c. No change! solids are not part of the equilibrium
d. More moles of gas in the reactants. A decrease in volume equates to an increase in pressure of gases (Boyle's Law). Preactants goes up more than Products
So... need to make more products

3. $2NaHCO_3(s) \rightleftharpoons Na_2CO_3(s) + CO_2(g) + H_2O(g)$ $\qquad K_p = 0.26\ atm^2$

I	0	0
C	+x	+x
E	x	x

$0.26\ atm^2 = x^2$
$x = 0.51\ atm$

$P_{CO_2} = 0.51\ atm$
$P_{H_2O} = 0.51\ atm$

4. $Q = \frac{P_{CH_4}}{P_{H_2}^2} = \frac{3\ atm}{(0.2\ atm)^2} = 75\ atm^{-1}$

$K > Q$ Not at equilibrium
need to make more products

5. $K_c = \frac{[Ni(CO)_4]}{[CO]^4}$ $\qquad 5 \times 10^{-1}\ M^{-3} = \frac{0.85\ M}{[CO]^4}$ $\qquad [CO]^4 = 1.75 \times 10^{-5}\ M^4$
$[CO] = 0.0642\ M$

6. $COCl_2 \rightleftharpoons CO + Cl_2$

I	0.5 M	Ø	Ø
C	-x	+x	+x
E	0.5-x	x	x

Known: $[CO]_{equilibrium} = 0.046\ M$

$x = 0.046\ M$

$K_c = \frac{[CO][Cl_2]}{[COCl_2]} = \frac{(0.046\ M)(0.046\ M)}{0.454\ M}$

$K_c = 0.00466\ M$

$[CO] = 0.046$
$[Cl_2] = 0.046\ M$
$[COCl_2] = 0.5 - 0.046 = 0.454\ M$

7. $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$

I	0.5 atm	0	0
C	$-2x$	$+2x$	$+x$
E	$0.5-2x$	$2x$	x

$P_{NO_2} = 0.5 - 2(0.232) = 0.036$ atm

$P_{NO} = 2(0.232) = 0.464$ atm

$P_{O_2} = 0.232$ atm

$P_{TOT} = P_{NO_2} + P_{NO} + P_{O_2}$

$0.732 = 0.5 - 2x + 2x + x$

$0.732 = 0.5 + x$

$x = 0.232$

$K_p = \frac{(0.464\ atm)^2 (0.232\ atm)}{(0.036\ atm)^2} = 38.52\ atm^2$

8. $2ICl(g) \rightleftharpoons I_2(g) + Cl_2(g)$

I	0.433	0	0
C	$-2x$	$+x$	$+x$
E	$0.433-2x$	x	x

$[I_2] = \frac{0.65\ mol}{1.5\ L} = 0.433\ M$

$K_c = 0.11 = \frac{x^2}{(0.433-2x)^2} = \frac{x^2}{(0.1875 - 0.866x - 0.866x + 4x^2)}$

$0.11(0.1875 - 1.732x + 4x^2) = x^2$

$0.02096 - 0.1905x + 0.44x^2 = x^2$

$0 = 0.56x^2 + 0.1905x - 0.02096$

$a = 0.56 \quad b = 0.1905 \quad c = -0.02096$

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

$x = 0.0875$

~~$x = -0.428$~~ ← not possible!

$[Cl_2] = x = 0.0875\ M$

$[I_2] = x = 0.0875\ M$

$[ICl] = 0.433 - 2x = 0.258\ M$