① a) $\frac{[CO][Cl_2]}{[COCl_2]}$

Remember divide by volume to get concentration ↙

b) $k = \frac{[\frac{.76}{2}][\frac{1.50}{2}]}{[\frac{1.70}{2}]} = \frac{[0.38][0.75]}{[0.85]} = \boxed{0.34}$

② Compare Q to K

$Q > K$ shift Left
$Q = K$ no shift
$Q < K$ shift right

A) $Q = \frac{0.144^2}{0.156} = 0.133$
no shift

B) $Q = \frac{0.175^2}{0.102} = 0.300$
shift left

$Q = \frac{P_{NO_2}^2}{P_{N_2O_4}}$

C) $Q = \frac{0.056^2}{0.048} = 0.0653$
shift right

③

	H_2 +	Br_2 →	$2HBr$
I	2.25M	2.25M	0
C	$-x$	$-x$	$+2x$
E	$2.25-x$	$2.25-x$	$2x$

$k = \frac{[HBr]^2}{[H_2][Br_2]}$

$3.50 \cdot 10^4 = \frac{(2x)^2}{[2.25-x][2.25-x]}$

$\sqrt{3.50 \cdot 10^4} = \frac{2x}{2.25x}$

$1.87 \cdot 10^2 = \frac{2x}{2.25-x}$

$4.209 \cdot 10^2 - 1.87 \cdot 10^2 x = 2x$

$4.209 \cdot 10^2 = 1.8908 \cdot 10^2 x$

$x = 2.23$

$[H_2] = [Br_2] = 0.02$

$[HBr] = 4.46$

(4) A) $Q = \frac{1.00 \cdot 1.00}{1.20} = 0.833$ $Q > K_p$ shift left

B)

	SO_2Cl_2 →	SO_2 +	Cl_2
I	1.20	1.00	1.00
C	+x	−x	−x
E	1.20+x	1.00−x	1.00−x
	1.31	0.894	0.894

$K_p = \frac{P_{SO_2} P_{Cl_2}}{P_{SO_2Cl_2}}$

$0.612 = \frac{(1.00-x)^2}{1.20+x}$

$0.612x + 0.734 = x^2 - 2x + 1.00$

$x^2 - 2.612x + 0.266 = 0$

$x = .106$

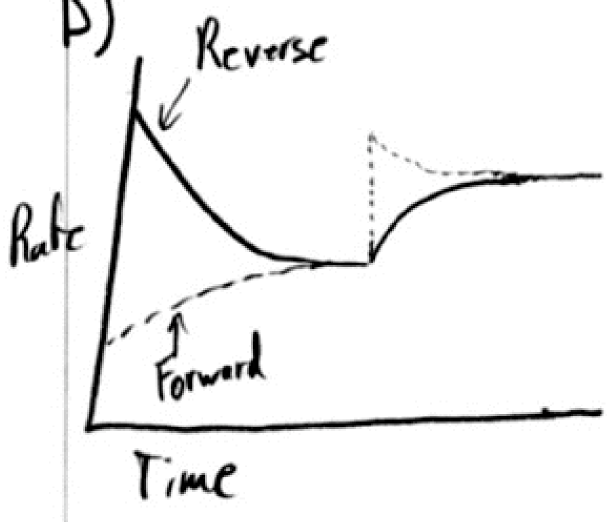
C)

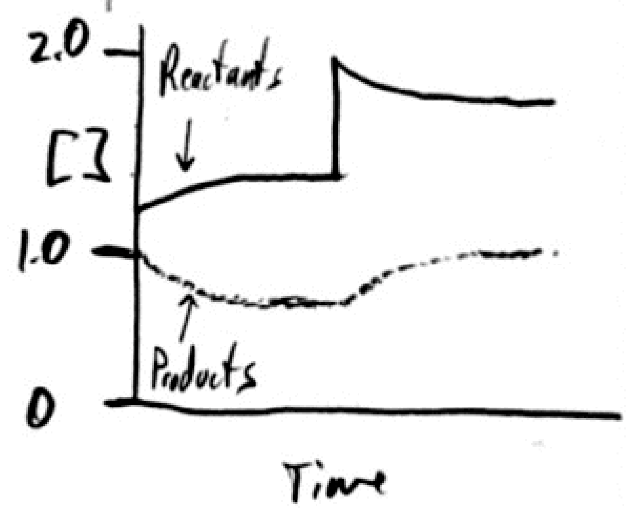
	SO_2Cl_2 →	SO_2 +	Cl_2
I	2.00	0.894	0.894
C	−x	+x	+x
E	2.00−x	0.894+x	0.894+x
	1.83	1.06	1.06

$0.612 = \frac{(0.894+x)^2}{2.00-x}$

$x = 0.166$

D)





(5) A) $2NO_2 \rightleftarrows N_2O_4$ k

$$K_p = \frac{P_{N_2O_4}}{P_{NO_2}^2}$$

B)

	$2NO_2$ ⇄	N_2O_4
I	1.22	0
C	−2x	+x
E	1.22−2x	x

← we need pressures use PV=nRT

$$P_{NO_2} = \frac{0.050 \cdot 0.0821 \cdot 298}{1.0L} = 1.22 \quad (1)$$

$$5.85 \cdot 10^{-3} = \frac{x}{(1.22 - 2x)^2}$$ ← 5% rule

$$\frac{1.74 \cdot 10^{-2}}{1.22} = 1.4\%$$

$x = 8.707 \cdot 10^{-3}$

$P_{N_2O_4} = 8.71 \cdot 10^{-3}$ atm

$P_{NO_2} = 1.20$ atm

C) (1) shift to Reactant ratio will increase because reaction is exothermic.

(2) No change. partial pressures of reactants and products are not changed.

(3) Partial pressures drop in half by change equilibrium will shift to reactands. ratio will increase as more NO_2 is produced. Forward reaction is effected more dramatically by change in volume because NO_2 has a coefficent of 2.

(6) position 3, forward & reverse reaction rates are equal.

(7) Reactants, [ ] of reactants are higher at equilibrium ∴ $K_{eq} < 1$

(8) As concentration of reactants decreases the rate of the forward reaction is decreasing. At the same time concentration of products is increasing causing the reverse reaction rate to increase.

(9) A) $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{.2^2}{.2 \cdot .5^3} = 1.6$

B) $K_p = K_c(RT)^{\Delta n} = 1.6(0.0821 \cdot 570)^{-2} = 7.31 \cdot 10^{-4}$

C) i) $[H_2]$ increases reaction is exothermic increase temp causes K to decrease.
ii) $[H_2]$ initialy decrease but will then increas. as equilibrim shifts to left there are 4 gas molecules as reactants on 2 as products.
iii) $[N_2]$ decrease, forward rxn. rate increase using up reactants and producing products
iv) No change not part of rxn.

(10) A)

	$N_2O_4 \rightleftarrows 2NO_2$	
I	1.0	0
C	-.04	+.08
E	.04	.08

4% of 1.00 mol
.04

$$K = \frac{[0.08]^2}{[0.04]} = 0.16$$

B)

	$N_2O_4 \rightleftarrows 2NO_2$	
I	.85	.060
C		
E		

$$Q = \frac{.060^2}{.85} = 4.235 \cdot 10^{-3}$$

Q<K shift right
produce more NO_2