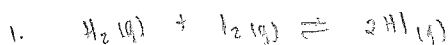
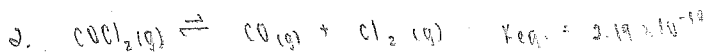


Part 2: predict the direction of  $Q$



$$K_{eq} = \frac{[HI]^2}{[H_2][I_2]} \quad Q = \frac{[HI]^2}{[H_2][I_2]} = \frac{(0.950)^2}{(0.150)(0.175)} = 34.4$$

$Q < K_{eq}$  therefore, the reaction will shift towards products.



$$K_{eq} = \frac{[CO][Cl_2]}{[COCl_2]}$$

a)  $Q = \frac{(3.31 \times 10^{-2} M)(3.31 \times 10^{-2} M)}{(5.00 \times 10^{-2} M)} = 2.19 \times 10^{-2}$

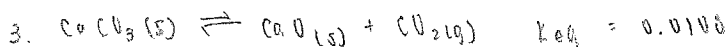
$Q > K_{eq}$  shifts left

b)  $Q = \frac{(1.11 \times 10^{-5} M)(3.50 \times 10^{-4} M)}{3.50 \times 10^{-3} M} = 1.03 \times 10^{-8}$

$Q > K_{eq}$  shifts left

c)  $Q = \frac{(1.56 \times 10^{-6} M)(1.56 \times 10^{-6} M)}{1.45 M} = 1.68 \times 10^{-12}$

$Q < K_{eq}$  shifts right



$$K_{eq} = [CO_2]$$

a)  $15.0g CO_2 \cdot \frac{mol}{44.0g CO_2} \cdot \frac{1}{10.0L} = 0.034 M$

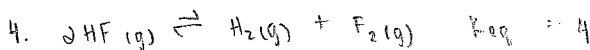
$Q > K_{eq}$  mass increases

b)  $4.75g CO_2 \cdot \frac{mol}{44.0g CO_2} \cdot \frac{1}{10.0L} = 0.0108 M$

$Q = K_{eq}$  no change

c)  $0.50g CO_2 \cdot \frac{mol}{44.0g CO_2} \cdot \frac{1}{10.0L} = 5.68 \times 10^{-3} M$

$Q < K_{eq}$  mass decreases



$$K_{eq} = \frac{[H_2][F_2]}{[HF]^2}$$

a)  $[H_2] = \frac{2.0 mol}{5.0 L} = 0.40 M$

$[F_2] = \frac{4.0 mol}{5.0 L} = 0.80 M$

$[HF] = \frac{3.0 mol}{5.0 L} = 0.60 M$

$Q = \frac{(0.40)(0.80)}{(0.60)^2}$

$= 0.89$

$Q < K_{eq}$

RIGHT

b)  $[H_2] = 0.10 M$

$[F_2] = 0.12 M$

$[HF] = 0.04 M$

$Q = \frac{(0.10)(0.12)}{(0.04)^2}$

$= 7.5$

$Q > K_{eq}$

LEFT

c)  $[H_2] = 0.36 M$

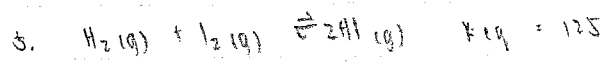
$[F_2] = 0.04 M$

$[HF] = 0.06 M$

$Q = \frac{(0.36)(0.04)}{(0.06)^2}$

$= 4$

NO SHIFT



$$K_{\text{eq}} = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

$$[\text{HI}] = \frac{0.15 \text{ mol}}{10.0 \text{ L}} = 0.015 \text{ M}$$

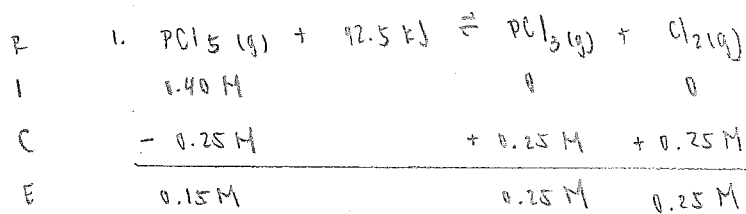
$$[\text{H}_2] = \frac{0.034 \text{ mol}}{10.0 \text{ L}} = 0.0034 \text{ M}$$

$$[\text{I}_2] = \frac{0.0096 \text{ mol}}{10.0 \text{ L}} = 0.00096 \text{ M}$$

$$Q = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{(0.015)^2}{(0.0034)(0.0096)} = 6.89$$

$Q < K_{\text{eq}}$  . SHIFT RIGHT

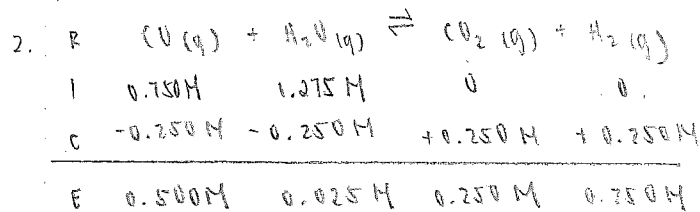
calculating equilibrium constants



$$K_{\text{eq}} = \frac{[\text{PCl}_3][\text{Cl}_2]}{[\text{PCl}_5]}$$

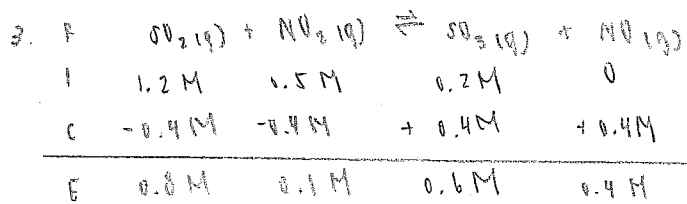
$$= \frac{(0.25)(0.25)}{0.15} = 0.42$$

a)  $[\text{PCl}_5] = 0.15 \text{ M}$   
 $[\text{PCl}_3] = 0.25 \text{ M}$   
 $[\text{Cl}_2] = 0.25 \text{ M}$



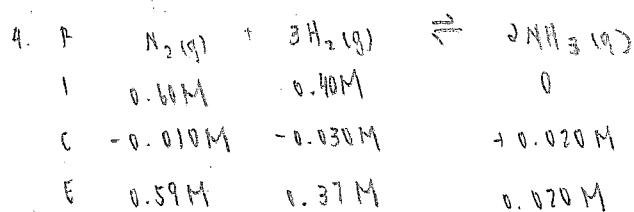
$$K_{\text{eq}} = \frac{[\text{CO}_2][\text{H}_2]}{[\text{CO}][\text{H}_2\text{O}]}$$

$$= \frac{(0.250)(0.250)}{(0.500)(0.025)} = 5.0$$



$$K_{\text{eq}} = \frac{[\text{SO}_3][\text{NO}]}{[\text{SO}_2][\text{NO}_2]}$$

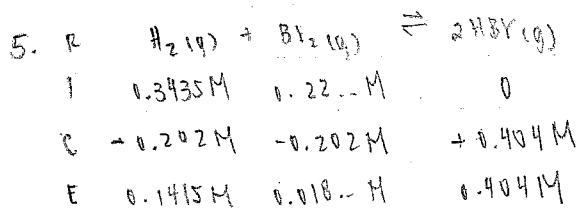
$$= \frac{(0.6)(0.4)}{(0.8)(0.1)} = 3.0$$



$$K_{\text{eq}} = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

$$= \frac{(0.020)^2}{(0.59)(0.37)^3} = 0.013$$

b) If 6.0 mol  $\text{NH}_3$  was left, its concentration would be 1.2 M.  $K_{\text{eq}}$  would be undisturbed, too much product left, reaction goes to completion.



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

$$= \frac{(0.404)^2}{(0.1415)(0.018)}$$

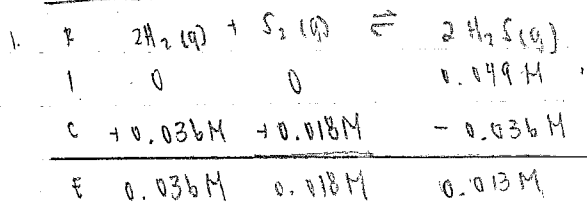
$$= 64$$

$$1.374g H_2 \cdot \frac{mol}{2.0g} \cdot \frac{1}{2.00L} = 0.3435 M$$

$$70.31g Br_2 \cdot \frac{mol}{159.8g} \cdot \frac{1}{2.00L} = 0.2199937427 M$$

$$0.566g H_2 \cdot \frac{mol}{2.0g} \cdot \frac{1}{2.00L} = 0.1415 M$$

part 4



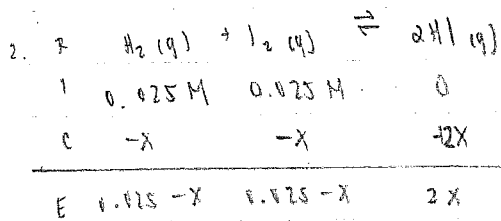
$$K_{eq} = \frac{[H_2S]^2}{[H_2]^2 [S_2]} = 7.5$$

$$7.5 = \frac{[H_2S]^2}{(0.036)^2 (0.018)}$$

$$[H_2S]^2 = 1.7496 \times 10^{-4} M$$

$$[H_2S] = 0.013 M$$

$$Moles H_2S = \frac{0.049 mol}{L} \cdot 2.0 L = 0.098 mol$$



$$K_{eq} = \frac{[HI]^2}{[H_2][I_2]} = 49.5$$

$$49.5 = \frac{[2x]^2}{(0.025-x)^2}$$

$$7.03 = \frac{2x}{0.025-x}$$

$$7.03(0.025-x) = 2x$$

$$0.176 - 7.03x = 2x$$

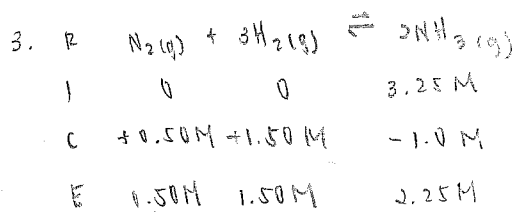
$$9.04x = 0.176$$

$$x = 0.01946634765$$

$$[H_2] = [I_2] = 0.025 - 0.019$$

$$= 5.53 \times 10^{-3} M$$

$$[HI] = 2(0.019) = 0.038 M$$



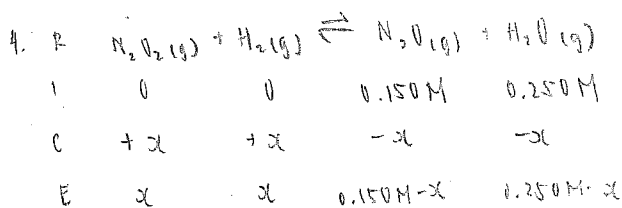
$$K_{eq} = \frac{[NH_3]^2}{[N_2][H_2]^3} = 3.0$$

$$[NH_3] = \sqrt{K_{eq} \cdot [N_2] \cdot [H_2]^3}$$

$$= \sqrt{3.0 \cdot 0.50 \cdot (1.50)^3}$$

$$= 2.25 M$$

$$\frac{2.25 \text{ mol } NH_3}{L} \cdot 5.0 L = 11.25 \text{ mol } NH_3$$



$$K_{eq} = \frac{[N_2O][H_2O]}{[N_2O_2][H_2]} = 1.00$$

$$K_{eq} = \frac{[N_2O][H_2O]}{[N_2O_2][H_2]}$$

$$1.00 = \frac{(0.150-x)(0.250-x)}{x^2}$$

$$0.09375 M \rightarrow 0.0938 M N_2O_2$$

was present at equilibrium

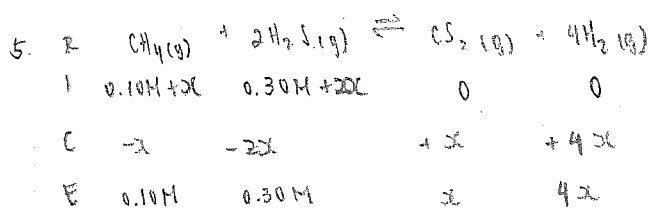
$$1.00 = \frac{0.0375 - 0.40x + x^2}{x^2}$$

$$1.00x^2 = 0.0375 - 0.40x + x^2$$

$$0.40x = 0.0375$$

$$x = 0.09375$$

$$x = (4x)^4$$



$$K_{eq} = \frac{[CS_2][H_2]^4}{[CH_4][H_2S]^2} = 100$$

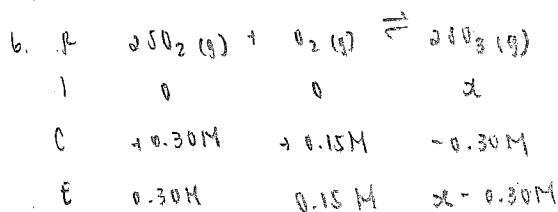
$$100 = \frac{256x^5}{(0.10)(0.30)^2}$$

$$100 = \frac{256x^5}{9.0 \times 10^{-3}}$$

$$256x^5 = 0.90$$

$$x = \sqrt[5]{\frac{0.90}{256}} = 0.32 M$$

$[CS_2]$  at equilibrium was 0.32 M



$$K_{eq} = \frac{[SO_3]^2}{[SO_2]^2 [O_2]} = 5.0$$

$$5.0 = \frac{(x-0.30)^2}{(0.30)^2 (0.15)}$$

$$5.0 = \frac{(x-0.30)^2}{0.0135}$$

$$[SO_3] = 0.56 M$$

$$0.26 = x - 0.30$$

$$x = 0.56 M$$

$$7. \quad K_{eq} = \frac{[Br]^2}{[Br_2]} = 1.04 \times 10^{-3}$$

$$1.04 \times 10^{-3} = \frac{[Br]^2}{7.67 \times 10^{-3}}$$

$$[Br] = \sqrt{(1.04 \times 10^{-3})(7.67 \times 10^{-3})}$$
$$= 2.82 \times 10^{-3} M$$

$$[Br_2] = 0.245 g Br_2 \cdot \frac{mol}{159.8 g} \cdot \frac{1}{0.200 L} = 7.67 \times 10^{-3} M$$

$$g Br_2 = \frac{2.82 \times 10^{-3} mol}{L} \cdot \frac{159.8 g}{mol} \cdot 0.200 L = 0.045 g$$

0.045 g Br present in volume

8.

$$K_{eq} = [NH_3][H_2S] = 1.2 \times 10^{-4}$$

$$[NH_3] = [H_2S] = \sqrt{1.2 \times 10^{-4}} = 0.011 M$$