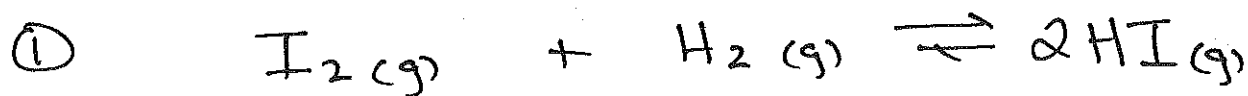


Eq'm

I	1.38×10^{-3}	9.84×10^{-4}	0
C	$-x$	$-x$	$+2x$

E	$1.38 \times 10^{-3} - x$	$9.84 \times 10^{-4} - x$	$2x$
---	---------------------------	---------------------------	------

$$= 4.73 \times 10^{-4}$$

$$\therefore x = 0.907 \times 10^{-3}$$

$$\begin{aligned} [\text{H}_2]_{\text{eq'm}} &= 9.84 \times 10^{-4} - 9.07 \times 10^{-4} \\ &= 7.7 \times 10^{-5} \text{ mol/L} \end{aligned}$$

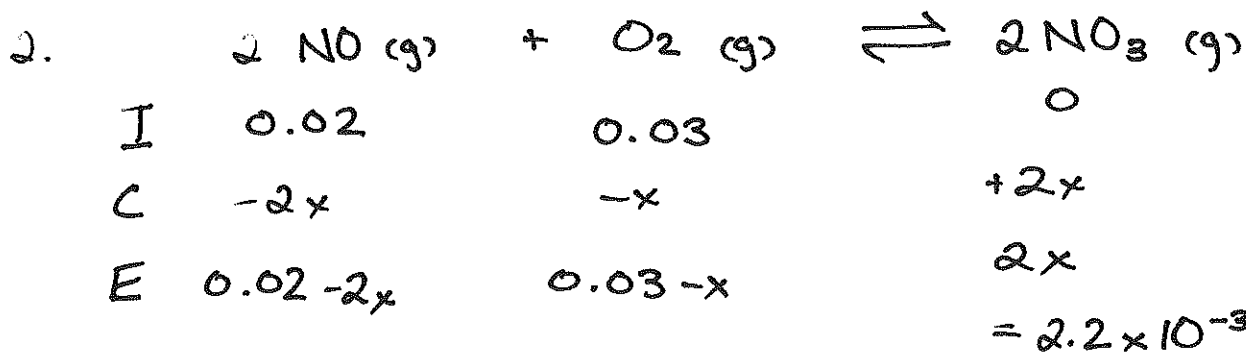
$$\begin{aligned} [\text{HI}] &= 2(9.07 \times 10^{-4}) \\ &= 1.81 \times 10^{-3} \text{ mol/L} \end{aligned}$$

$$\begin{aligned} K_c &= \frac{[\text{HI}]^2}{[\text{I}_2][\text{H}_2]} \\ &= \frac{(1.81 \times 10^{-3})^2}{(4.73 \times 10^{-4})(7.7 \times 10^{-5})} \end{aligned}$$

$$= 89.95$$

$$K_c = 90.0$$

⑤



$$x = 1.1 \times 10^{-3}$$

$$2x = 2.2 \times 10^{-3}$$

$$\begin{aligned}
 [\text{NO}]_{\text{eqm}} &= 0.02 - 2x \\
 &= 0.02 - 2(1.1 \times 10^{-3}) \\
 &= 0.0178 \frac{\text{mol}}{\text{L}}
 \end{aligned}$$

$$\begin{aligned}
 [\text{O}_2]_{\text{eqm}} &= 0.03 - x \\
 &= 0.03 - 1.1 \times 10^{-3} \\
 &= 0.0289 \frac{\text{mol}}{\text{L}}
 \end{aligned}$$

$$\begin{aligned}
 K_c &= \frac{[\text{NO}_3]^2}{[\text{NO}]^2 [\text{O}_2]} \\
 &= \frac{(2.2 \times 10^{-3})^2}{(0.0178)^2 (0.0289)} \\
 &= 0.529
 \end{aligned}$$



(c)

(a)

$$\begin{aligned} [\text{SbCl}_5]_{\text{eqm}} &= \frac{m}{M \cdot V} \\ &= 6.91 \text{ g SbCl}_5 \times \frac{1 \text{ mol SbCl}_5}{299.00 \text{ g SbCl}_5} \times \frac{1}{5.00 \text{ L}} \\ &= 4.62 \times 10^{-3} \text{ mol/L} \end{aligned}$$

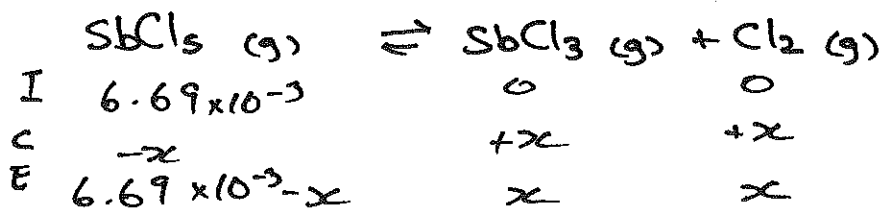
$$\begin{aligned} [\text{SbCl}_3]_{\text{eqm}} &= \frac{m}{M \cdot V} = 16.46 \text{ g SbCl}_3 \times \frac{1 \text{ mol SbCl}_3}{228.1 \text{ g SbCl}_3} \times \frac{1}{5.00 \text{ L}} \\ &= 0.0144 \text{ mol/L} \end{aligned}$$

$$\begin{aligned} [\text{Cl}_2]_{\text{eqm}} &= \frac{m}{M \cdot V} = 5.11 \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{70.90 \text{ g Cl}_2} \times \frac{1}{5.00 \text{ L}} \\ &= 0.0144 \text{ mol/L} \end{aligned}$$

$$\begin{aligned} K_c &= \frac{[\text{SbCl}_3][\text{Cl}_2]}{[\text{SbCl}_5]} \\ &= \frac{(0.0144)(0.0144)}{(4.62 \times 10^{-3})} \end{aligned}$$

$$K_c = 0.0450$$

(b)



$$\begin{aligned} [\text{SbCl}_5] &= \frac{10 \text{ g}}{(299)(5)} \\ &= 6.69 \times 10^{-3} \end{aligned}$$

$$K_c = \frac{[\text{SbCl}_3][\text{Cl}_2]}{[\text{SbCl}_5]}$$

$$0 = x^2 + 0.0450x - 3.61 \times 10^{-4}$$

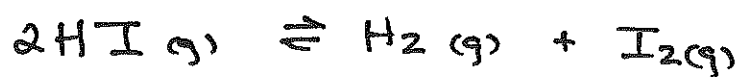
$$x = 5.9 \times 10^{-3}$$

$$[\text{SbCl}_3] = [\text{Cl}_2] = 5.9 \times 10^{-3} \text{ mol/L}$$

$$[\text{SbCl}_5] = 7.9 \times 10^{-4} \text{ mol/L}$$

$$0.0450 = \frac{(x)(x)}{6.69 \times 10^{-3} - x}$$

4.



①

$$K_{c1} = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2}$$

$$= 0.021$$



$$K_{c2} = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{1}{\frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2}}$$

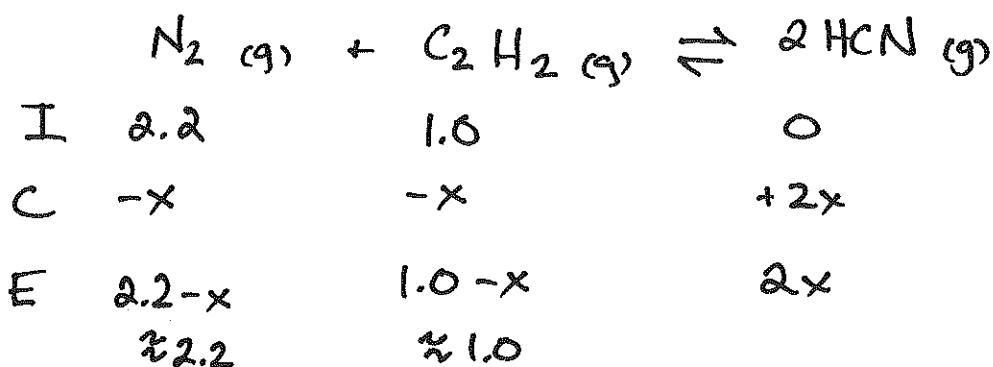
~~$K_{c2} = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$~~

$$K_{c2} = \frac{1}{K_{c1}} = \frac{1}{0.021}$$

$$K_{c2} = 47.6$$

⑤

⑤



$$K_c = \frac{[\text{HCN}]^2}{[\text{N}_2][\text{C}_2\text{H}_2]}$$

$$2.3 \times 10^{-4} = \frac{(2x)^2}{(2.2)(1.0)}$$

$$4x^2 = 5.06 \times 10^{-4}$$

$$x = 0.011$$

$$[\text{N}_2]_{\text{eq'm}} = 2.2 - 0.011$$

$$\approx 2.2 \text{ mol/L}$$

$$[\text{C}_2\text{H}_2]_{\text{eq'm}} = 1 - 0.011$$

$$\approx 1.0 \text{ mol/L}$$

$$[\text{HCN}]_{\text{eq'm}} = 2(0.011)$$

$$= 0.022 \text{ mol/L}$$

check

$$\frac{[\text{HCN}]^2}{K_c} = \frac{1.0}{2.3 \times 10^{-4}}$$

$$= 4348 \ 77500$$

$$\therefore 2.2 - x \approx 2.2$$

$$1.0 - x \approx 1.0$$

proof.

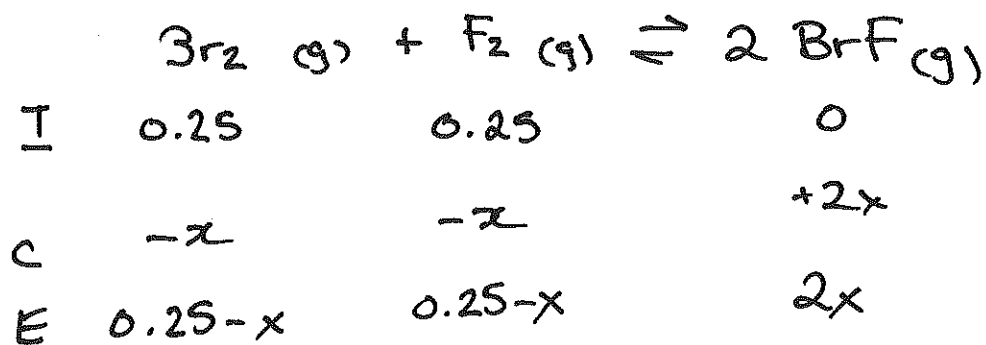
$$\frac{x}{[\text{N}_2]} \times 100\% < 50\%$$

$$\frac{0.011}{1} \times 100\%$$

$$= 1.1\% < 5\%$$

∴ assumpt.
valid

6



$$K_c = \frac{[\text{BrF}]^2}{[\text{Br}_2][\text{F}_2]}$$

$$55.3 = \frac{(2x)^2}{(0.25-x)(0.25-x)}$$

perfect square
take square
root of
both sides

$$7.44 = \frac{2x}{0.25-x}$$

$$1.86 = 7.44x = 2x$$

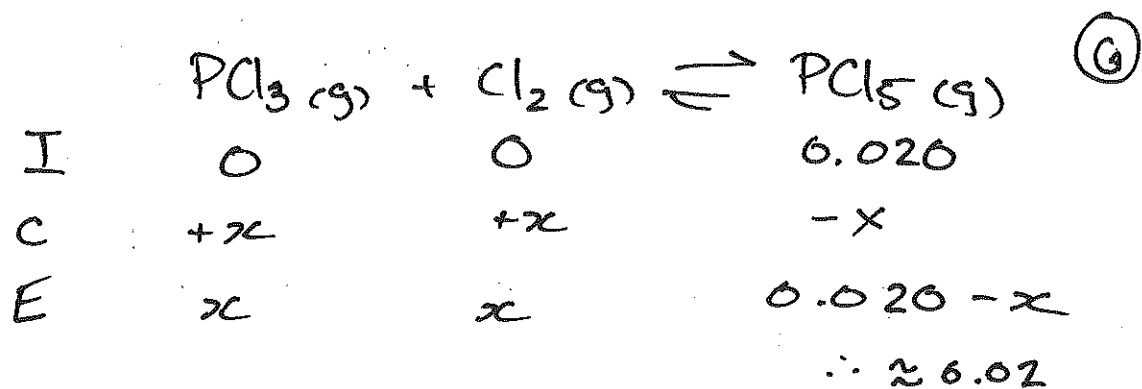
$$1.86 = 9.44x$$

$$x = 0.197$$

$$\begin{aligned} [\text{Br}_2]_{\text{eqm}} = [\text{F}_2]_{\text{eqm}} &= 0.25 - 0.197 \\ &= 0.05 \text{ mol/L} \end{aligned}$$

$$[\text{BrF}]_{\text{eqm}} = 0.240 \text{ mol/L}$$

7.



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

$$962 = \frac{(0.02 - x)}{(x)(x)}$$

$$962 = \frac{0.02}{x^2}$$

$$x^2 = \frac{0.02}{962}$$

$$x = 4.6 \times 10^{-3}$$

check

$$\frac{[\]_I}{K_c}$$

$$\frac{0.02}{962} \ll \text{small}$$

\therefore change from product is small

proof

$$\frac{x}{[\]_I} \times 100\%$$

$$\frac{4.6 \times 10^{-3}}{2 \times 10^{-2}} \times 100\%$$

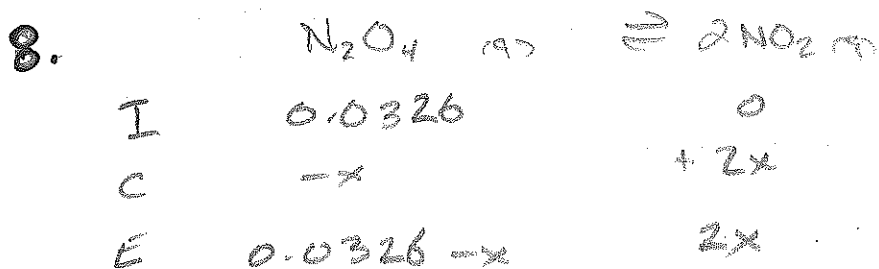
$$22\% \gg 5\%$$

\therefore quadratic ←

$$0 = 962x^2 + x - 0.02$$

$$x = 4.1 \times 10^{-3} \text{ mol/L}$$

$$[\text{PCl}_3]_{\text{eqm}} = [\text{Cl}_2]_{\text{eqm}} = 4.1 \times 10^{-3} \text{ mol/L}$$



(E)
(H)

$$[\text{N}_2\text{O}_4]_{\text{initial}} = \frac{m}{MV} = \frac{15.0 \text{ g N}_2\text{O}_4 \times \frac{1 \text{ mol N}_2\text{O}_4}{92.02 \text{ g N}_2\text{O}_4}}{5.00 \text{ L}}$$

$$= 0.0326 \text{ mol/L}$$

$$K_c = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]}$$

$$5.85 \times 10^{-5} = \frac{(2x)^2}{(0.0326 - x)}$$

$$1.91 \times 10^{-6} - 5.85 \times 10^{-5} x = 4x^2$$

$$0 = 4x^2 + 5.85 \times 10^{-5} x - 1.91 \times 10^{-6}$$

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

$$= \frac{-5.85 \times 10^{-5} \pm \sqrt{(5.85 \times 10^{-5})^2 - 4(4)(-1.91 \times 10^{-6})}}{2(4)}$$

$$= \frac{-5.85 \times 10^{-5} \pm \sqrt{3.06 \times 10^{-5}}}{8}$$

$$x = 6.8 \times 10^{-4}$$

(b)

$$\% \text{ rxn} = \frac{\text{change}}{[]_I} \times 100\%$$

$$= \frac{6.8 \times 10^{-4}}{0.0326} \times 100\%$$

$$\% \text{ rxn} = 2.1\%$$

$$[\text{NO}_2]_{\text{eq}} = 2x$$

$$= 1.4 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$n_{\text{NO}_2} = [] V$$

$$= 1.4 \times 10^{-3} \frac{\text{mol}}{\text{L}} \times 5 \text{ L}$$

$$= 6.8 \times 10^{-3} \text{ mol NO}_2$$

9.



I	0.125	0
C	-4x	+4x
E	0.125 - 4x	4x

$$[\text{H}_2\text{O}]_{\text{I}} = \frac{m}{M \cdot V}$$

$$= 36 \text{ g} \times \frac{1 \text{ mol}}{18.02 \text{ g}} \times \frac{1}{16 \text{ L}}$$

$$= 0.125 \text{ mol/L}$$

* do not include
solids in
Kc expression
as they have a
constant []

$$K_c = \frac{[\text{H}_2]^4}{[\text{H}_2\text{O}]}$$

$$4.6 = \frac{(4x)^4}{(0.125 - 4x)^4}$$

$$\sqrt[4]{4.6} = \frac{4x}{0.125 - 4x}$$

$$1.46 = \frac{4x}{0.125 - 4x}$$

$$0.1825 - 5.84x = 4x$$

$$0.1825 = 9.84x$$

$$x = 0.0185$$

take 4th root

$$[\text{H}_2]_{\text{eqm}} = 4(0.0185) \\ = 0.074 \frac{\text{mol}}{\text{L}}$$

$$[\text{H}_2\text{O}]_{\text{eqm}} = 0.125 - 4(0.0185) \\ = 0.051 \frac{\text{mol}}{\text{L}}$$