

② ^{137}Ba : 56 protons + 81 neutrons

$$56 \times 1.007885 = 56.44156$$

$$81 \times 1.008665 = 81.701865$$

$$\begin{array}{r} 138.143425 \\ - 136.905812 \\ \hline \end{array}$$

$$\Delta m = 1.237613 \text{ amu}$$

$$\Delta m (\text{kg}) = 1.237613 \text{ amu} \times \frac{1 \text{ g}}{6.0221 \times 10^{23} (\text{g/amu})} \times \frac{1 \text{ kg}}{1000 \text{ g}}$$

$$= 2.0551186 \times 10^{-27} \text{ kg}$$

$$E = (\Delta m)(c^2) = (2.0551186 \times 10^{-27} \text{ kg}) (3.0 \times 10^8 \text{ m/s})^2$$
$$= 1.849 \times 10^{-10} \text{ J / nuclei}$$

$$E = 1.849 \times 10^{-10} \text{ J / nuclei} \times 6.0221 \times 10^{23} \frac{\text{nuclei}}{\text{mole}}$$

$$= 1.114 \times 10^{14} \text{ J / mole} = 1.114 \times 10^{11} \text{ KJ / mole}$$

Short way:

$$E = \left(\Delta m (\text{amu}) \div \frac{1 \text{ kg}}{1000 \text{ g}} \right) \times (3.0 \times 10^8 \text{ m/sec})^2$$

$$= 1.114 \times 10^{14} \text{ J / mole} = 1.114 \times 10^{11} \text{ KJ / mole}$$

④ $t_{1/2}$ of ^{32}P = 14.3 days

since $\ln \frac{n_t}{n_0} = -\lambda t$ and $t_{1/2} = \frac{0.693}{\lambda}$

$$\therefore \ln \frac{n_t}{n_0} = -0.693 \left(\frac{t_t}{t_{1/2}} \right)$$

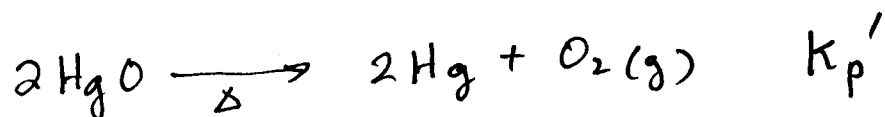
$n_0 = 10 \text{ g}$; $t_t = 28.6 \text{ days}$, $t_{1/2} = 14.3 \text{ days}$
 $n_t = ?$

$$\ln \frac{n_t}{10} = -0.693 \left(\frac{28.6}{14.3} \right)$$

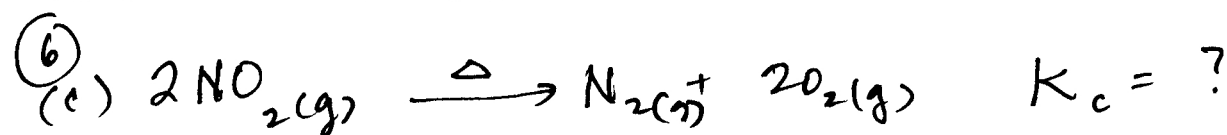
$$\ln \frac{n_t}{10} = -0.693 (2) = -1.386$$

$$\frac{n_t}{10} = e^{-1.386} = 0.25$$

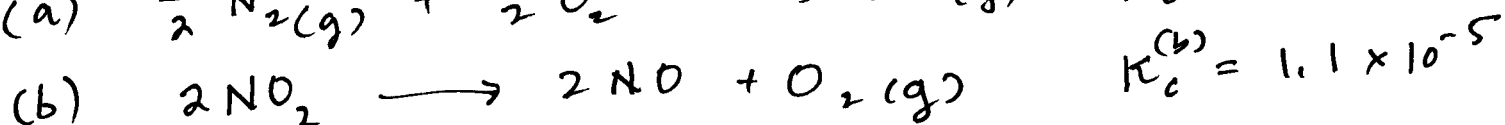
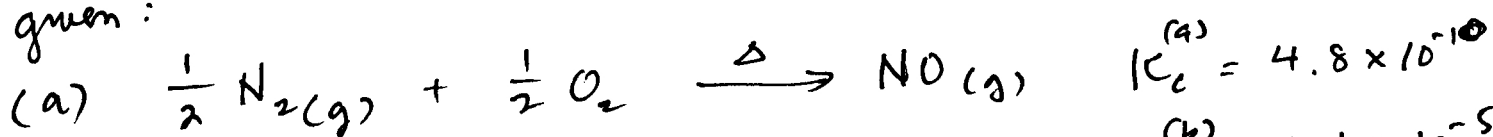
$$\underline{n_t = 2.5 \text{ g}}$$



$$K_p' = \left(\frac{1}{K_p} \right)^2 = \left(\frac{1}{9.1 \times 10^{14}} \right)^2 = 1.2 \times 10^{-30}$$



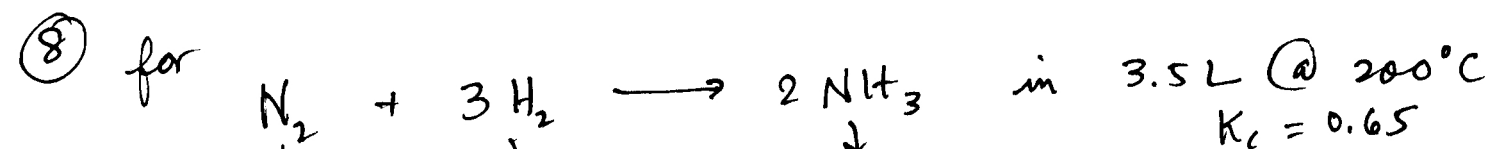
given:



(c) = -2 \times (a) + (b)

$$\therefore K_c = \left(\frac{1}{K_c^{(a)}} \right)^2 \times K_c^{(b)} = \left(\frac{1}{4.8 \times 10^{-10}} \right)^2 \times 1.1 \times 10^{-5}$$

$$= 4.8 \times 10^{13}$$

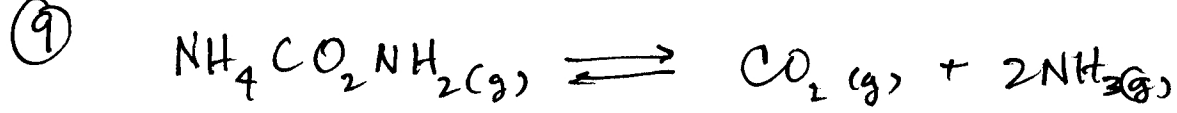


initial conc $\left(\frac{0.249}{3.5} \right) \quad \left(\frac{3.21 \times 10^{-2}}{3.5} \right) \quad \left(\frac{6.42 \times 10^{-4}}{3.5} \right)$

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} \quad ; \quad Q_c = \frac{\left[\frac{6.42 \times 10^{-4}}{3.5} \right]^2}{\left[\frac{0.249}{3.5} \right] \left[\frac{3.21 \times 10^{-2}}{3.5} \right]^3}$$

$$Q_c = 0.613$$

$\therefore Q_c < K_c (0.65) \therefore \longrightarrow \text{products}$

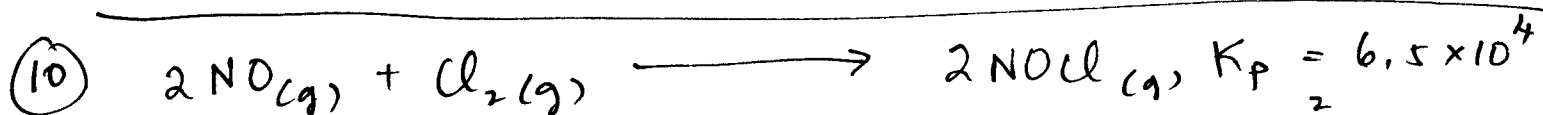


$$K_p = P_{\text{CO}_2} \times P_{\text{NH}_3}^2 ; P_{\text{CO}_2} + P_{\text{NH}_3} = 0.363 \text{ atm}$$

$$\therefore 2 P_{\text{CO}_2} = P_{\text{NH}_3} \quad \therefore P_{\text{CO}_2} = 0.121 \text{ atm}$$

$$P_{\text{NH}_3} = 0.242 \text{ atm}$$

$$K_p = (0.121) (0.242)^2 = 7.09 \times 10^{-3}$$



at equilibrium:

$$P_{\text{NO}} = 0.35 \text{ atm}$$

$$P_{\text{Cl}_2} = 0.10 \text{ atm}$$

$$P_{\text{NOCl}} = ?$$

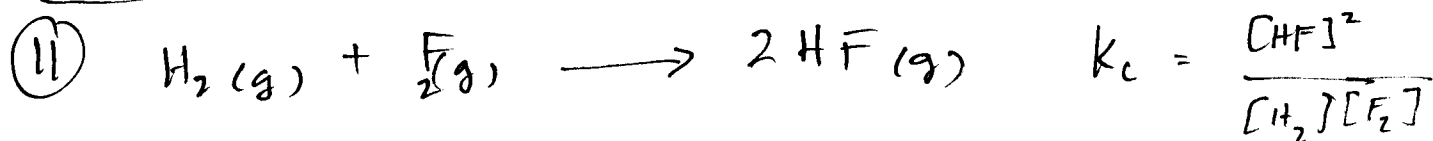
$$K_p = \frac{(P_{\text{NOCl}})^2}{(P_{\text{Cl}_2})(P_{\text{NO}})^2}$$

$$\therefore (P_{\text{NOCl}})^2 = P_{\text{Cl}_2} \times (P_{\text{NO}})^2 \times K_p$$

$$P_{\text{NOCl}} = \sqrt{P_{\text{Cl}_2} \times P_{\text{NO}}^2 \times K_p}$$

$$= \sqrt{(0.10) \times (0.35)^2 \times (6.5 \times 10^4)} = 28.2 \text{ atm}$$

$$= 28 \text{ atm}$$



	H_2	F_2	HF
I	0.010	0.050	0
C	-x	-x	2x
E	0.01-x ↓ 3.75×10^{-3}	0.05-x 4.375×10^{-2}	0.0125 ↓ $x = 0.00625$

$$K_c = \frac{[0.0125]^2}{(3.75 \times 10^{-3})(4.375 \times 10^{-2})}$$

$$= 0.95 = 9.5 \times 10^{-1}$$



$$K_p = \frac{P_{\text{NO}_2}^2}{P_{\text{NO}}^2 \cdot P_{\text{O}_2}} = 6.5 \times 10^{-4} @ 308 \text{ K}$$

$$K_p = K_c (RT)^{\Delta n (\text{gas})}$$

$$\Delta n = \# \text{ gas prod.} - \# \text{ gas react.}$$

$$= 2 - 3 = -1$$

$$K_c = K_p / (RT)^{\Delta n}$$

$$= K_p / (RT)^{-1} = K_p (RT)$$

$$K_c = 6.5 \times 10^{-4} (R) (308) \quad R = 0.08206$$

$$K_c = 1.64 \times 10^{-6} = \underline{\underline{1.6 \times 10^{-6}}}$$

(14)

$$[\text{OH}] = 0.50 \text{ M} \rightarrow \text{pOH} = 0.301 = 0.3$$

$$\text{pH} = \cancel{13.699} 13.699 = 13.7$$

(15)

0.25 M weak acid pH = 3.5

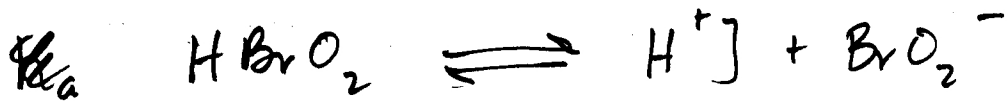
$$[\text{H}^+] = 3.162 \times 10^{-4}$$

$$K_a = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]}$$

$$= \frac{(3.162 \times 10^{-4})(3.162 \times 10^{-4})}{[0.25 - (3.162 \times 10^{-4})]} = \frac{1 \times 10^{-7}}{6.2496}$$

$$K_a = 4 \times 10^{-7}$$

(16)



$$K_a = \frac{[\text{H}^+][\text{BrO}_2^-]}{[\text{HBrO}_2]}$$

$$5.3 \times 10^{-5} = \frac{x^2}{0.35 - x}$$

	HBrO_2	H^+	BrO_2^-
I	0.35	0	0
C	-x	+x	+x
E	0.35 - x	x	x

$$= x = 4.3 \times 10^{-3}$$

(0.3457) (98% ok)

$$\text{pH} = 2.366 = 2.37$$

(17)

$$K_b = 1.80 \times 10^{-5}$$

$$\text{pH} = ?$$

	$\text{NH}_3 + \text{H}_2\text{O}$	NH_4^+	OH^-
I	0.45	0	0
C	-x	+x	+x
E	0.45 - x	x	x

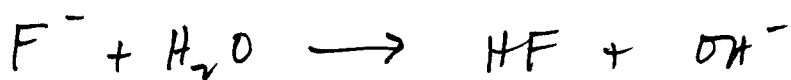
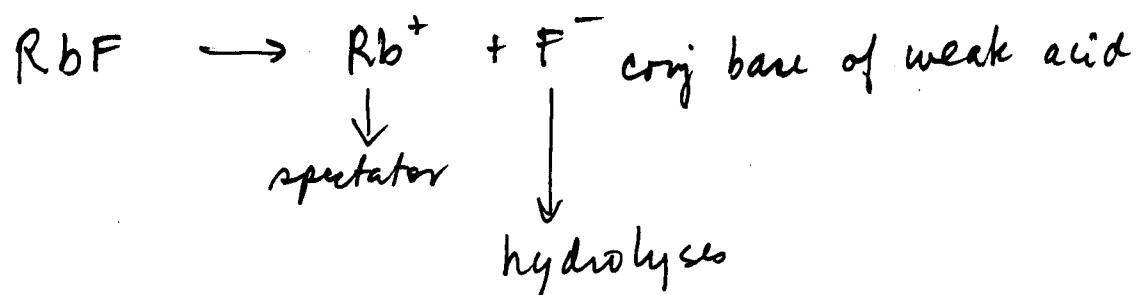
$$\frac{x^2}{0.45 - x} = 1.8 \times 10^{-5}$$

$$x = 2.846 \times 10^{-3} = [\text{OH}^-]$$

$$\text{pOH} = 2.546$$

$$\text{pH} = \underline{\underline{11.45}}$$

(20) pH = ? 0.300 M RbF K_a of HF = 7.28×10^{-4}



$$K_b = \frac{[\text{HF}][\text{OH}^-]}{[\text{F}^-]} = \frac{K_w}{K_a} = 1.389 \times 10^{-11}$$

	F^-	$[\text{HF}]$	OH^-
I	0.300	0	0
C	$-x$	$+x$	$+x$
E	$0.3 - x$	x	x

$$1.389 \times 10^{-11} = \frac{x^2}{0.3 - x} =$$

$$x = [\text{OH}^-] = [\text{HF}] = 2.041 \times 10^{-6}$$

$$\text{pOH} = 5.69$$

$$\text{pH} = 8.31$$
