11-7

ТЕТРАДЬ

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ЛБНОУ СРНОШ школы

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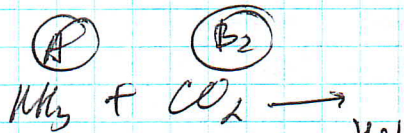
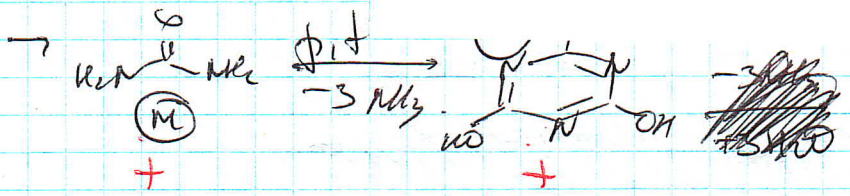
Задача 11 – 7.

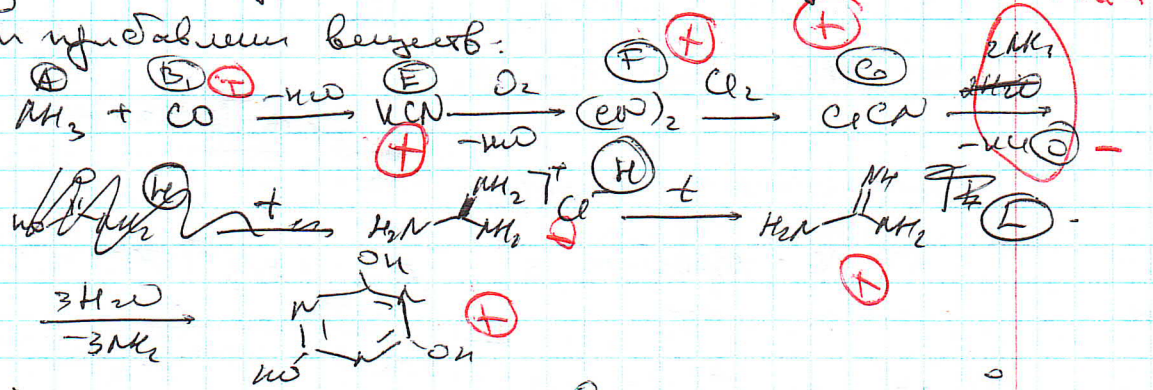
	№1	№2	№3	№4	№5	Σ
балл	11	11,25	15	13	7,5	
подпись						
испр.	+1,25				+2,5	



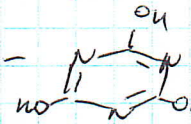


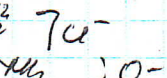
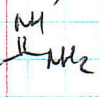
Известно, что $(CN)_2$ горит при высоких температурах, его получают из HCN, который получают из CO и NH_3 → A и B_1 – CO и NH_3

Дальнейшее решение основано на внешнем и удобавлении веществ:



A – NH_3; B_2 – CO_2; C – $H_2N-\overset{O}{\overset{\|}{C}}-NH_2 \cdot H_2O$; M – $H_2N-\overset{O}{\overset{\|}{C}}-NH_2$;

N –  ; B_1 – CO; D_1 – H_2O; E – HCN; D_2 – O_2;

F – $(CN)_2$; G – ClCN; H –  ; O – HCl; L – 

(2) Пусть 1000г H_2O $\Rightarrow m(HCN) = 5$ г.

$n(HCN) = 0.186$ моль $\Rightarrow C = 0.186$ М

$HCN \rightleftarrows H^+ + CN^-$; $K_a = \frac{[H^+][CN^-]}{[HCN]} = \frac{[H^+]^2}{C_0 - [H^+]}$

$[H^+]^2 + K_a[H^+] - K_a C_0 = 0$

$[H^+]^2 + 10^{-9.2}[H^+] - 10^{-9.2} \cdot 0.186 = 0$

$[H^+] = 1.071 \cdot 10^{-5}$; $\Rightarrow pH = 4.97$?

(3)] α - степень диссоциации $\alpha = \frac{[H^+]}{C_0}$

тогда $K_a = \frac{\alpha^2 \cdot C_0^2}{C_0 - C_0\alpha} = \frac{\alpha^2 \cdot C_0}{1-\alpha}$ $K_a = \frac{[H^+]}{C_0}$

] α - степень диссоциации: $\alpha = \frac{[H^+]}{C_0} = \frac{[CN^-]}{C_0}$,

тогда $K_a = \frac{\alpha^2 \cdot C_0}{1-\alpha}$

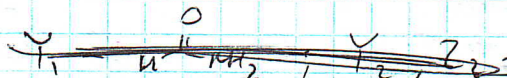
(4) X - газ тогда $pV = \nu RT$ $\nu = \frac{m}{M_r}$

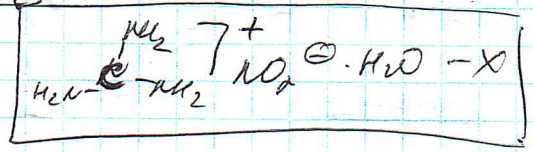
Если 5 моль газа, то: $pV = \frac{m}{M_r}RT \Rightarrow M_r = \frac{pRT}{p}$

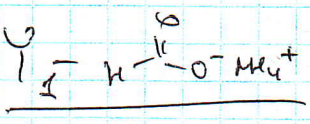
$M_r = 5 \cdot 24.8 = 124$ г - это нереально $M_r = 24.8$ г/моль

пар $2NH_3 + H_2O + N_2 + CO_2$

$M_{ср} = \frac{2 \cdot 17 + 18 + 28 + 44}{5} = 24.8$ г/м



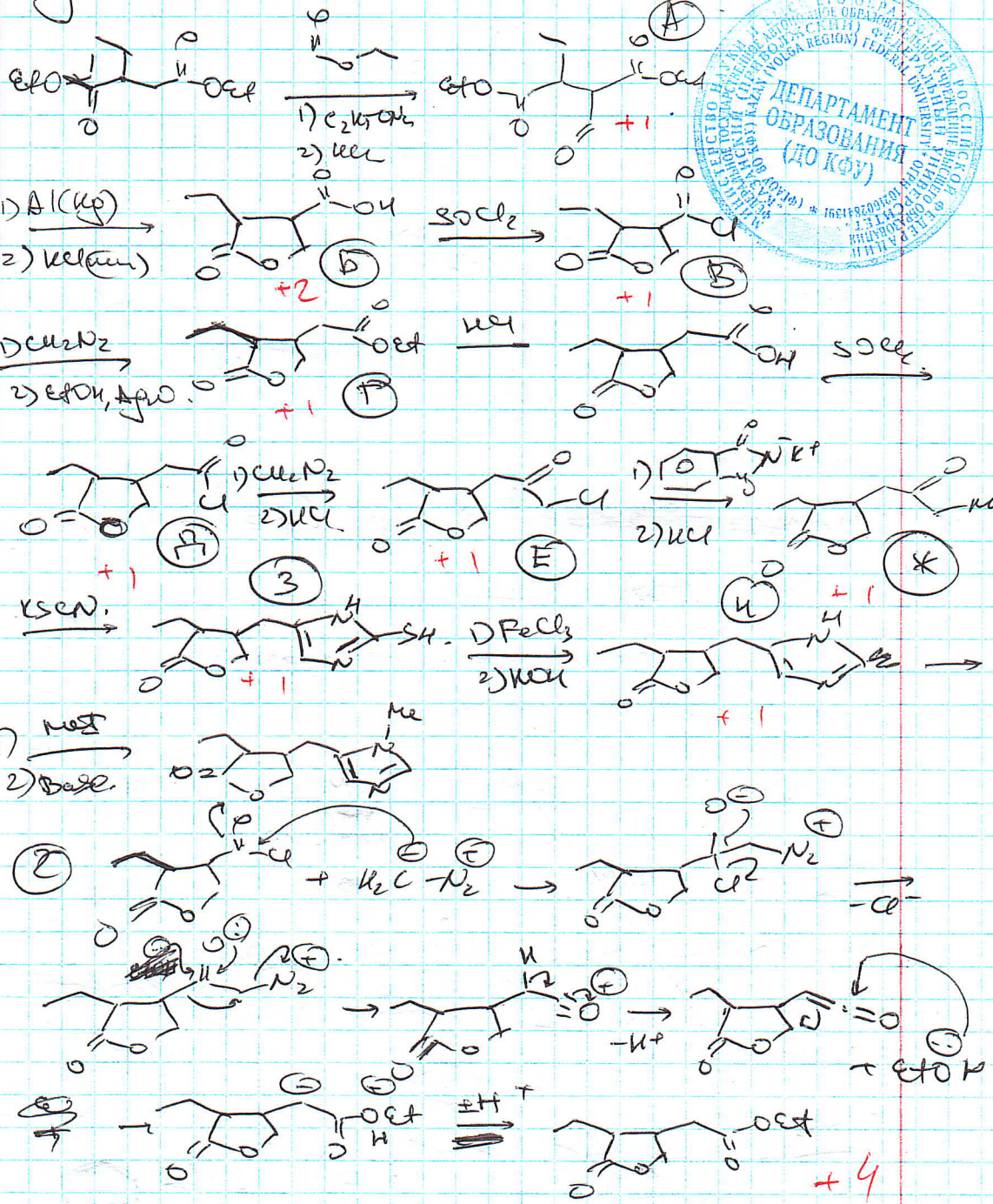
$\Rightarrow X - N_4CO_3H_8 \equiv$ 



+ +

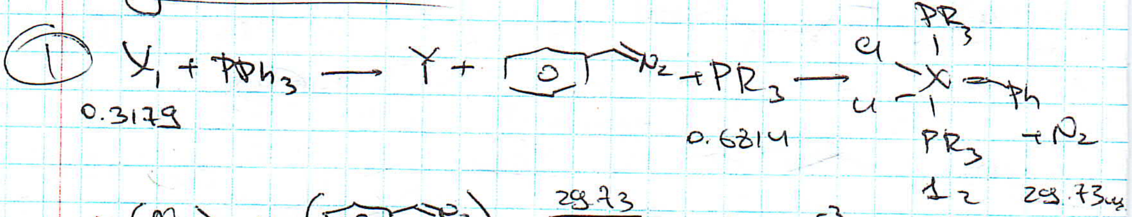
Y_2 и Z : $(NH_4)_2CO_3$; NH_4HCO_3

Задание 11-3



③ Уменьшения р-ти в воде. (становится более полярной в-во.). +1

Задача 11-4.



$n(N_2) = n(PhCHN_2) = \frac{29.73}{1000 \cdot 22.4} = 1.327 \cdot 10^{-3}$ моль

$n(Y) = n(X_1) = n(N_2) = 1.327 \cdot 10^{-3}$ моль.

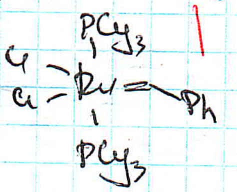
~~$Mr(X_1) = \frac{0.3179}{1.327 \cdot 10^{-3}}$~~ R – очевидно Cy ≡ C_6H_{11} ≡ 

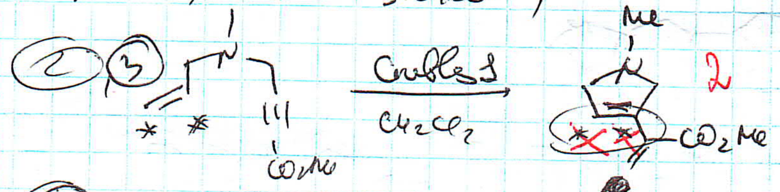
$n(X) = \frac{n(PCy_3)}{2} = \frac{0.6814}{2 \cdot 280} = 0.001216$ моль

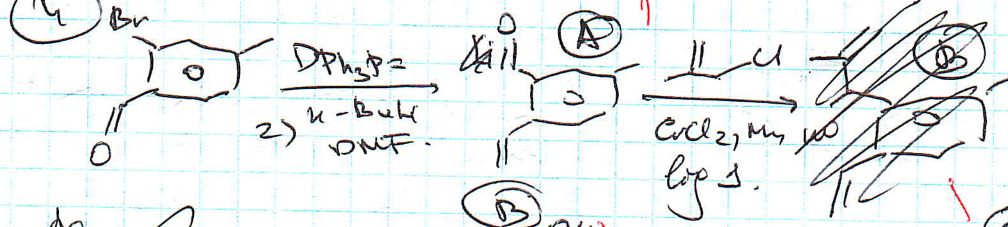
$Mr(X) = \frac{0.3179}{0.001216} = 261$ г/моль ≡ $RuCl_3 \cdot 3H_2O$.

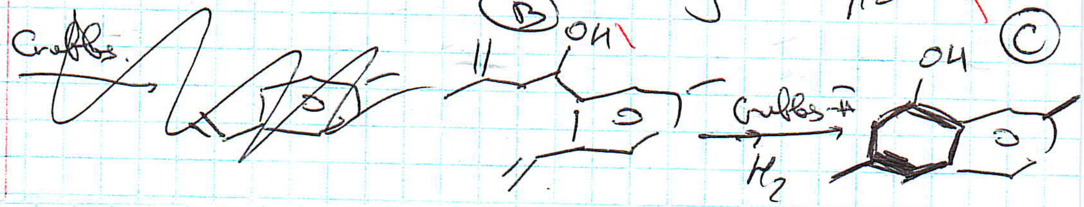
X – Ru; X_1 – $RuCl_3 \cdot 3H_2O$;

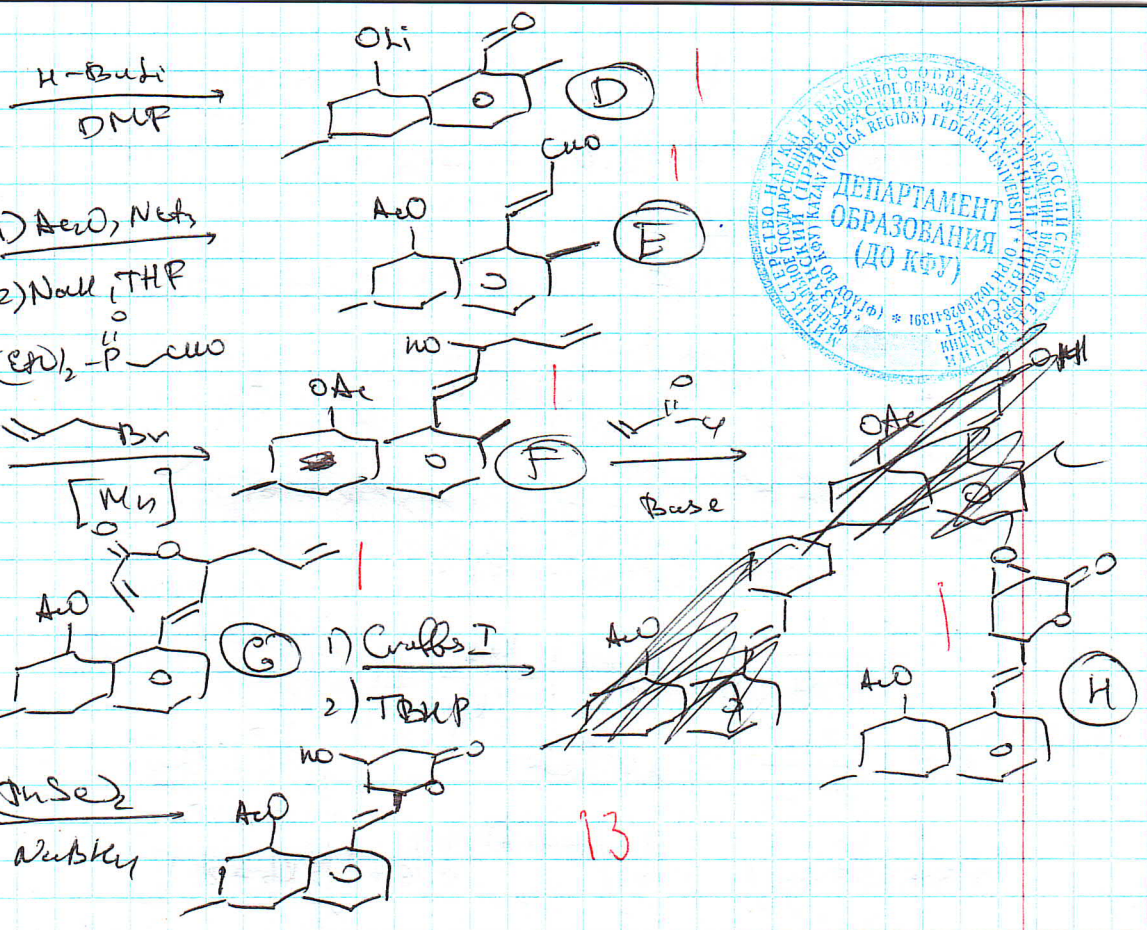
Grubbs I











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Задача 11-5

① Бом и Габер + 1

② ~~$2CaCO_3 + 5C \rightarrow 2CaC_2 + 3CO_2$~~

$2CaCO_3 + 5C \rightarrow 2CaC_2 + 3CO_2$

$CaC_2 + N_2 \rightarrow CaCN_2 + C$

$CaCN_2 + 3H_2O \rightarrow CaCO_3 + 2NH_3$

$CaC_2 + H_2O \rightarrow CaO + C_2H_2$

A - $CaCO_3$; B - C; C - CaC_2; D - CO_2;

E - $Ca(OH)_2$; F - C_2H_2. +3,5

③ $K = \frac{\theta}{p_s(1-\theta)}$ $\quad S_{(z)} + - \rightleftharpoons S^*$

$\frac{\theta_1}{p_{s_1}(1-\theta_1)} = K$ $\quad \frac{\theta_2}{p_{s_2}(1-\theta_2)} = K$ $\quad p_{s_2} = 2p_{s_1}$

p_{s_1} $\quad \theta_1 = 0.5$ $\quad \theta_2 = 0.6$

$p_{s_1}(1-0.5)$ $\quad 2p_{s_1}(1-0.6)$

$\theta_1 = \frac{Kp_1}{1+Kp_1}$; $\theta_2 = \frac{Kp_2}{1+Kp_2}$

$0.5 = \frac{Kp_1}{1+Kp_1}$; $0.6 = \frac{2Kp_1}{1+2Kp_1}$ $\quad 0.6 = \frac{2K(p_s+1)}{1+2K(p_s+1)}$

$0.5 = 0.5Kp_1$ $\quad 0.6 = \frac{2Kp_s+2}{3+3Kp_s}$

$Kp_1 = 1$

$K = \frac{0.5}{p_s(1-0.5)}$; $K = \frac{0.6}{(p_s+1)(1-0.6)}$

$K = \frac{1}{p_s}$; $K = \frac{3}{2p_s+2}$ $\rightarrow$ $\frac{1}{p_s} = \frac{3}{2p_s+2}$

$p_s = \frac{2p_s+2}{3}$

$K = \frac{1}{p_s} = \frac{1}{2} = 0,5$

$p_s = \frac{\frac{2}{3}}{1-\frac{2}{3}} = \frac{\frac{2}{3}}{\frac{1}{3}} = 2$ atm

$K = 0.5$ +1

4) $H_{2(г)} + \_ \rightleftharpoons H_2^*$ (K_1)

$N_{2(г)} + \_ \rightleftharpoons N_2^*$ (K_2)

+0,5

$$\begin{cases} K_1 = \dfrac{\theta_{H_2}}{p_{H_2}(1-\theta_{H_2}-\theta_{N_2})} & (1) \\ K_2 = \dfrac{\theta_{N_2}}{p_{N_2}(1-\theta_{H_2}-\theta_{N_2})} \Rightarrow & (2) \end{cases}$$ +0,5

$K_2 p_{N_2} - K_2\theta_{H_2} + K_2\theta_{N_2} = \theta_{N_2}$

$\theta_{N_2} = \dfrac{K_2 p_{N_2} - K_2\theta_{H_2}}{1+K_2}$

$\theta_{N_2} = \dfrac{K_2 p_{N_2}}{1+K_2 p_{N_2}+K_1 p_{H_2}}$

(2):

$p_{N_2}K_2 - p_{N_2}K_2\theta_{H_2} - p_{N_2}K_2\theta_{N_2} = \theta_{N_2}$

$$\theta_{N_2} = \frac{p_{N_2}K_2 - p_{N_2}K_2\theta_{H_2}}{1+p_{N_2}K_2} \quad (3)$$

$\theta_{H_2} = \dfrac{p_{H_2}K_1 - p_{H_2}K_1\theta_{N_2}}{1+p_{H_2}K_1} =$

$= \dfrac{p_{H_2}K_1 - p_{H_2}K_1 \cdot \dfrac{p_{N_2}K_2 - p_{N_2}K_2\theta_{H_2}}{1+p_{N_2}K_2}}{1+p}$

(1): $K_1 p_{H_2} - K_1 p_{H_2}\theta_{H_2} - K_1 p_{H_2}\theta_{N_2} = \theta_{H_2}$

$K_1 p_{H_2} - K_1 p_{H_2}\theta_{H_2} - K_1 p_{H_2} \cdot \dfrac{p_{N_2}K_2 - p_{N_2}K_2\theta_{H_2}}{1+p_{N_2}K_2} = \theta_{H_2}$.

$K_1 p_{H_2}\left(K_1 - K_1 \cdot \dfrac{p_{N_2}K_2}{1+p_{N_2}K_2}\right) = \theta_{H_2}\left(1 + K_1 p_{H_2} + \dfrac{p_{N_2}K_2}{1+p_{N_2}K_2} \cdot K_1 p_{H_2}\right)$

$$\theta_{H_2} = \frac{p_{H_2}K_1\left(1 - \dfrac{p_{N_2}K_2}{1+p_{N_2}K_2}\right)}{1 + K_1 p_{H_2} + \dfrac{p_{N_2}K_2 K_1 p_{H_2}}{1+p_{N_2}K_2}}$$

$$\theta_{H_2} = \frac{p_{H_2} K_1 \left(1 - \frac{p_{N_2} K_2}{1 + p_{N_2} K_2}\right)}{1 + K_1 p_{H_2} + \frac{p_{N_2} K_2 K_1 p_{H_2}}{1 + p_{N_2} K_2}}$$ +1

(5) $H_{2(z)} + 2\_ \rightleftharpoons 2H^*(K_3)$

$$K_3 = \frac{(2\theta_H)^2}{p_{H_2} \cdot (1-\theta_H)^2} \quad +0{,}5 \qquad K_3^{\frac{1}{2}} = \frac{2\theta_H}{p_{H_2}^{\frac{1}{2}} (1-\theta_H)}$$

$$(K_3 p_{H_2})^{\frac{1}{2}} - K_3^{\frac{1}{2}} p_{H_2}^{\frac{1}{2}} \theta_H = 2\theta_H$$

$$\theta_H = \frac{(K_3 p_{H_2})^{\frac{1}{2}}}{2 + (K_3 p_{H_2})^{\frac{1}{2}}} \quad \pm 1$$

(6) $$K_3 = \frac{(2\theta_H)^2}{p_{H_2} (1 - \theta_H - \theta_{H_2})^2} \quad (5)$$

$$K_1 = \frac{\theta_{H_2}}{p_{H_2} (1 - \theta_H - \theta_{H_2})} \quad (6)$$

(5): $$2\theta_H = (K_3 p_{H_2})^{\frac{1}{2}} - (K_3 p_{H_2}^{\frac{1}{2}}) \theta_H - K_3 p_{H_2}^{\frac{1}{2}} \theta_{H_2}$$

$$\theta_H = \frac{(K_3 p_{H_2})^{\frac{1}{2}} - (K_3 p_{H_2})^{\frac{1}{2}} \theta_{H_2}}{2 + (K_3 p_{H_2})^{\frac{1}{2}}}$$

$$\theta_H = \frac{(K_3 p_{H_2})^{\frac{1}{2}} (1 - \theta_{H_2})}{2 + (K_3 p_{H_2})^{\frac{1}{2}}}$$

(6): $\theta_{H_2} = K_1 p_{H_2} - K_1 p_{H_2} \theta_H - K_1 p_{H_2} \theta_{H_2}$

$$\theta_{H_2} = K_1 p_{H_2} - K_1 p_{H_2} \cdot \frac{(K_3 p_{H_2})^{\frac{1}{2}} - \theta_{H_2}(K_3 p_{H_2})^{\frac{1}{2}}}{2 + (K_3 p_{H_2})^{\frac{1}{2}}} = K_1 p_{H_2} \theta_{H_2}$$

$$\theta_{H_2} = \frac{K_1 p_{H_2} - K_1 p_{H_2} \cdot \frac{(K_3 p_{H_2})^{\frac{1}{2}}}{2 + (K_3 p_{H_2})^{\frac{1}{2}}}}{1 - \frac{(K_3 p_{H_2})^{\frac{1}{2}} \cdot K_1 p_{H_2}}{2 + (K_3 p_{H_2})^{\frac{1}{2}}} + K_1 p_{H_2}}$$

$$\theta_{H_2} = \frac{K_1 p_{H_2}\left(1 - \frac{(K_3 p_{H_2})^{\frac{1}{2}}}{2 + (K_3 p_{H_2})^{\frac{1}{2}}}\right)}{1 + K_1 p_{H_2} - \frac{(K_3 p_{H_2})^{\frac{1}{2}} \cdot K_1}{2 + (K_3 p_{H_2})^{\frac{1}{2}}}} = \frac{K_1 p_{H_2}\left(1 - \frac{(K_3 p_{H_2})^{\frac{1}{2}}}{2 + (K_3 p_{H_2})^{\frac{1}{2}}}\right)}{1 + K_1 p_{H_2} - \frac{K_3^{\frac{1}{2}} \cdot K_1 \cdot p_{H_2}^{\frac{3}{2}}}{2 + (K_3 p_{H_2})^{\frac{1}{2}}}}$$

(5): $2\theta_H = (p_{H_2} K_3)^{\frac{1}{2}} - (p_{H_2} K_3)^{\frac{1}{2}} \theta_H - (p_{H_2} K_3)^{\frac{1}{2}} \theta_{H_2}$

$$2\theta_H = (p_{H_2} K_3)^{\frac{1}{2}} - (p_{H_2} K_3)^{\frac{1}{2}} \theta_H - (p_{H_2} K_3)^{\frac{1}{2}} \cdot \frac{K_1 p_{H_2} - K_1 p_{H_2} \theta_H}{1 + K_1 p_{H_2}}$$

$$\theta_H = \frac{(p_{H_2} K_3)^{\frac{1}{2}}\left(1 - \frac{K_1 p_{H_2}}{1 + K_1 p_{H_2}}\right)}{2 + (p_{H_2} K_3)^{\frac{1}{2}} - (p_{H_2} K_3)^{\frac{1}{2}} \cdot \frac{K_1 p_{H_2}}{1 + K_1 p_{H_2}}}$$

$$\theta_H = \frac{(p_{H_2} K_3)^{\frac{1}{2}}\left(1 - \frac{K_1 p_{H_2}}{1 + K_1 p_{H_2}}\right)}{2 + (p_{H_2} K_3)^{\frac{1}{2}} - \frac{K_1 K_3^{\frac{1}{2}} p_{H_2}^{\frac{3}{2}}}{1 + K_1 p_{H_2}}}$$

(7). а) $N_2 + - \rightleftharpoons N_2^*$, $\Delta H = -33.472 \frac{кДж}{моль}$

б) $E_{св} = 392 \frac{кДж}{моль}$ +0,5

в) $\Delta H_r = 46 \frac{кДж}{моль}$ +0,5

а): $-\Delta H = E(N^* + 3H^*) - E(0.5N_2 + 1.5H_2) - E(0.5N_2 + 1.5H_2)$

$= (336 - 62 - 270) \cdot 4.184 = 33.472 \frac{кДж}{моль}$

$\Delta H = -33.472 \frac{кДж}{моль}$

б): $E_{св} = \frac{E(NH_3 - (NH_2 + H)) + E((NH_2 + H) - (NH + 2H)) + E((NH + 2H) - (N + 3H))}{3}$

$= \frac{113 + 93 + 75}{3} \cdot 4.184 = 392 \frac{кДж}{моль}$

в): $-\Delta H_r = 3E_{св} - E(0.5N_2 + 1.5H_2) = 3 \cdot 392 - 270 \cdot 4.184$

$= 46.32 \frac{кДж}{моль}$, $\Delta H = -46.32 \frac{кДж}{моль}$

(8) $-RT \ln K_f = \Delta H - T\Delta S$.

$\ln K_f = \frac{-\Delta H}{RT} + \frac{\Delta S}{R}$

$\ln K_{f_1} - \ln K_{f_2} = \frac{-(\Delta H_1 + \Delta H_2)}{RT} - \frac{-\Delta H}{RT_1} + \frac{\Delta H}{RT_2} = \frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

$\ln \frac{K_{f_1}}{K_{f_2}} = \frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$

$\frac{K_{f_1}}{K_{f_2}} = e^{\frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)} = e^{-\frac{46320}{8.314}\left(\frac{1}{673} - \frac{1}{773}\right)} = 0.3427$

$\Rightarrow \frac{K_{f_2}}{K_{f_1}} = 2.92$ дәлә +1

~~75~~

10.

Задача 11-1

Из условий видно, что Б - вероятнее всего Te, тогда X - MTe_2

т.к. при нагревании с KOH/$KClO_3$ может образоваться соли типа M_2TeO_4

=> M - имеет с.о. +6. => можно предположить, что

$MTe_2 + O_2 \longrightarrow MO_2 + 2TeO_2$

тогда $n(MTe_2) = \frac{n_0(O)}{6} = \frac{0.269}{6 \cdot 16} = 0.0028$ моль

$Mr(MTe_2) = \frac{1}{0.0028} \approx 357$ г/моль => Ru

$RuTe_2$ — X; A - Ru; Б - Te

1) $RuTe_2 + 3O_2 \longrightarrow RuO_2 + 2TeO_2$ (A₁) (Б₁) ✓

~~$3RuTe_2 + 10KClO_3 + 18KOH \longrightarrow 3K_2RuO_4 + 6K_2TeO_4 + 10KCl + 9H_2O$~~

2) $RuTe_2 + 3KClO_3 + 6KOH \longrightarrow K_2RuO_4 + 2K_2TeO_4 + 3KCl + 3H_2O$ (A₂) (Б₂) ✓

3) $K_2RuO_4 + Cl_2 \longrightarrow RuO_4 + 2KCl$ (A₃) ✓

3,5

4) $RuO_4 \xrightarrow{t} RuO_2 + O_2$ ✓

5) $2RuO_4 + 2NaOH$ ~~$+ H_2O$~~ $\longrightarrow 2NaRuO_4 + H_2O + \frac{1}{2}O_2\uparrow$ (A₄) ✓

6) $2NaRuO_4 + 2NaOH \longrightarrow 2Na_2RuO_4 + H_2O + \frac{1}{2}O_2\uparrow$ ✓

7) $2Na_2RuO_4 + 16HCl \longrightarrow 2RuCl_3 \cdot 3H_2O + 3Cl_2 + 4NaCl + 2H_2O$ (A₅) ✓

~~8) $Na_2RuO_4 + 8HCl + 4KCl \rightarrow K_4[Ru_2OCl_{10}] \cdot H_2O + Cl_2 + 3H_2O$~~

0,5 +0,5

8) $2Na_2RuO_4 + 14HCl + 4KCl \rightarrow K_4[Ru_2OCl_{10}] \cdot H_2O \downarrow$ (A6) $+ 2Cl_2 + 4NaCl + 6H_2O$ ✓

$$\omega(Cl)_{A6} = \frac{35.453 \cdot 10}{746.53} = 0.4749 \Rightarrow$$ вуно!

9) $Na_2TeO_4 + 2H_2O \rightarrow Na_2H_4TeO_6$ (Б3) ✓

10) $Na_2H_4TeO_6 + 2HNO_3 \rightarrow H_6TeO_6$ (Б4) $+ 2NaNO_3$ ✓

11) $MnCl_2 + 3H_6TeO_6 + 2KClO + 8KOH \rightarrow K_6[Mn(H_3TeO_6)_2(H_2TeO_6)] \cdot 5H_2O + 4KCl + 4H_2O$

= откуда

Б5 – $Mn_xK_yTe_zO_\gamma H_\beta$

$$x : y : z : \gamma : \beta = \frac{5.19}{54.94} : \frac{22.16}{39} : \frac{36.17}{127.6} : \frac{34.77}{16} : 1.71$$

$$0.0944 : 0.568 : 0.2834 : 2.17 : 1.71$$

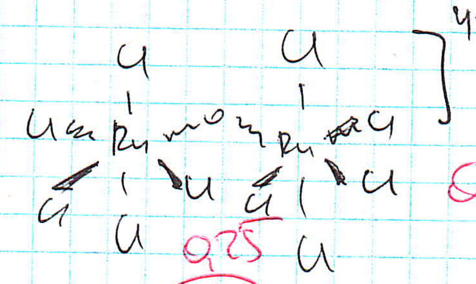
$$1 : 6 : 3 : 23 : 18$$

$\Rightarrow K_6MnTe_3H_{18}O_{23}$ = ~~$K_6[Mn(HTeO_6)_3] \cdot 5H_2O$~~

(Б) $= K_6[Mn(H_3TeO_6)_2(H_2TeO_6)] \cdot 5H_2O$

X	A1	A2	A3	A4	A5	A6	Б1	Б2	Б3	Б4	Б5
$RuTe_2$	RuO_2	K_2RuO_4	RuO_4	$NaRuO_4$	$RuCl_3 \cdot 3H_2O$	$K_4Ru_2OCl_{10} \cdot H_2O$	TeO_2	Na_2TeO_4	$Na_2H_4TeO_6$	H_6TeO_6	~~$K_6Mn(HTeO_6)_3 \cdot 5H_2O$~~ $K_6Mn(H_3TeO_6)_2(H_2TeO_6) \cdot 5H_2O$
✓	✓	✓	✓	–	✓	≈	✓	✓	✓	✓	✓

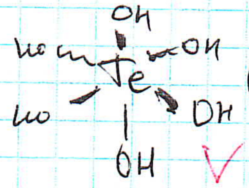
(3) ~~Ru Ru~~



0,5

0,25

(4)



V 0,5

(Б4)

n_e: 48 − 4 + 2 + 5·2 + 2 = 18ē

⇒ законченная внешняя оболочка

от $[Ru_2OCl_{10}]^{4-}$ — диамагнитно)

все ē спарены!

(5) Желто-оранжевые V 0,5