11-4

ТЕТРАДЬ

для _____

_____

учени _____ класса _____

_____ школы _____

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ученик 11-го класса ГБОУ РИЛИ
города Уфы
Учитель: Гумеров Айнур Мансурович

	№1	№2	№3	№4	№5	Σ
балл	13,5	15	13	15	15	71,5
подпись	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
испр.						

Зад[illegible]

1. [illegible]

Определим Б по [illegible]

1 $M_н$, тогда

$$M(Б) = \frac{54.938}{0.0519} \cdot 0.3617 : n = \frac{382.87}{n}$$

Единственный подходящий вариант при $n=3$ $M = 127.6$ $= M(Te)$, тогда $Б_1 - TeO_2$ $Б_2 - K_2TeO_4$

стехиометрия у A_2 такая же значит это метал с высшей ст. о. если $A_1 - M_2O_m$, то

$$\frac{1}{M + 127.6 \cdot 2} \cdot \left(\frac{2M + 16m}{2} + 2 \cdot (127.6 + 16 \cdot 2)\right) = 1.269$$

при $m = 4$ $M = 101.7 \approx M(Ru)$, который подойдёт далее. $A_5 - RuCl_3 \cdot 3H_2O$ $\left(\frac{1}{101.07 + 127.6 \cdot 2} \cdot (101.07 + 35.453 \cdot 3 + 3 \cdot 18) = 0.734г\right)$

$A_6 - K_4[Ru_2OCl_{10}] \cdot H_2O$ $\frac{35.453 \cdot 10}{M(K_4Ru_2OCl_{10} \cdot H_2O)} = 0.4745$

$$\frac{1.008 \cdot 2}{M(K_4Ru_2OCl_{10} \cdot H_2O)} = 0.0027$$

$Б_5$: $n(K) : n(Mn) : n(Te) : n(H) : n(O) = \frac{\omega(Э_i)}{M(Э_i)} : \dots =$

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

$K_6MnTe_3H_{18}O_{23} \Rightarrow K_6MnH_8[TeO_6]_3 \cdot 5H_2O$

анионы должны отличаться на 1 H, тогда

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

X ✓	A_1 ✓	A_2 ✓	A_3 ✓	A_4 ✓	A_5 ✓
$RuTe_2$	RuO_2	K_2RuO_4	RuO_4	$KRuO_4$	$RuCl_3 \cdot 3H_2O$

A_6 ✓	$Б_1$ ✓	$Б_2$ ✓	$Б_3$ ✓
$K_4[Ru_2OCl_{10}] \cdot H_2O$	TeO_2	K_2TeO_4	$K_2H_4TeO_6$

$Б_4$ ✓	$Б_5$ ✓
H_6TeO_6	$K_6[Mn(H_3TeO_6)_2(H_2TeO_6)] \cdot 5H_2O$

2.

1| $RuTe_2 + 3O_2 \rightarrow RuO_2 + 2TeO_2$ ✓

2| $RuTe_2 + 3KClO_3 + 6KOH \rightarrow K_2RuO_4 + 2K_2TeO_4 + 3KCl + 3H_2O$ ✓

3| $K_2RuO_4 + Cl_2 \rightarrow 2KCl + RuO_4$ ✓

4| $RuO_4 \rightarrow RuO_2 + O_2$ ✓

5| $4RuO_4 + 4KOH \rightarrow 4KRuO_4 + O_2 + 2H_2O$ ✓

6| $4KRuO_4 + 4KOH \rightarrow 4K_2RuO_4 + O_2 + 2H_2O$ ✓

7| ~~RuO_4~~ $2RuO_4 + 16HCl \rightarrow 2RuCl_3 \cdot 3H_2O + 5Cl_2 + 2H_2O$ ✓

8| $2RuO_4 + 4KCl + 14HCl \rightarrow K_4[Ru_2OCl_{10}] \cdot H_2O + 4Cl_2 + 6H_2O$ ✓

9| $K_2TeO_4 + 2H_2O \rightarrow K_2H_4TeO_6$ ✓

10| $K_2H_4TeO_6 + 2HNO_3 \rightarrow 2KNO_3 + H_6TeO_6$ ✓

5

~~11| $6KClO + MnCl_2 + 3H_6TeO_6 + 4H_2O \rightarrow$~~

$\rightarrow K_6[Mn(H_3TeO_6)_2(H_2TeO_6)] \cdot 5H_2O + 8HCl$

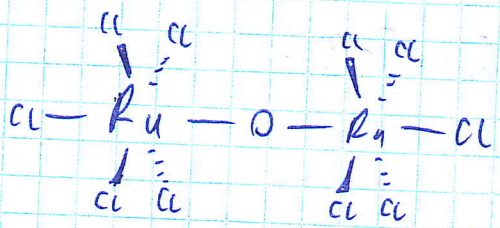
~~1| $KClO + MnCl_2 + 3H_6TeO_6 + H_2O + 8KOH$~~

~~$\rightarrow K_6[Mn(H_3TeO_6)_2(H_2TeO_6)] \cdot 5H_2O + 3KCl$~~

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

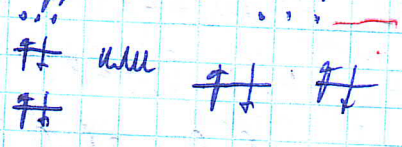
~~$+ 3KCl + 4H_2O$~~ $+ 3KCl + 4H_2O$ —

3. 4-



Ru^{+4} $[Kr]4d^4$ ✓

искажение октаэдрической симметрии и спаривание электронов на двух низших энерг. уровнях; а - спаривание т.к. у 5d и 6d высокая энергия расщепления кр. поля (+ высокая ст. ок.)



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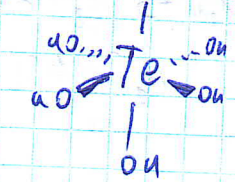


✓ октаэдрическую ✓

1

5.

~~Оксид~~ (могут не как $Mn(H_2O)_6^{4+}$ или MnO_4^{4-})

красную ✓

0,5

Задача 11-2

1.

$Э_1$ ~~чего~~ исходит из белка, это азот

~~По и~~ Информация о E и F напоминает о цианиде. Проведем E – HCN

$M(B) = 1 : \frac{0.9649}{1+12+14} = 28 = M(CO)$ соответствует методу получения. тогда A – NH_3 (т.к. содержит N)

По описанию $D_2 - H_2O_2$, тогда $D_1 - H_2O$

по 3-ей информации $Э_2$ – O (для H большая массовая доля)

$M(N) = \frac{16}{0.3719} = 43 = M(HOCN)$ $\quad M(C) = \frac{14n}{0.3588} = 39n$

при n = 1 $N_1C_{..}O$ не поместится ⇒ n = 2 M = 78 $\quad 78 - 14 \cdot 2 - 12 - 16 \cdot 2 = 6$

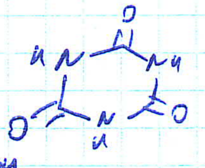
$Э_1$ – N $\quad Э_2$ – O $\qquad CH_6N_2O_2$, тогда $B_2 - CO_2$

A – NH_3 $\quad B_1$ – CO $\quad B_2$ – CO_2 $\quad$ C – $NH_4^+ \, H_2NCOO^-$ (NH_4^+ $H_2N-C(=O)-O^-$)

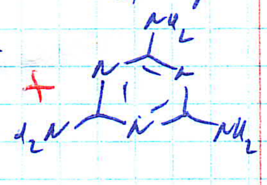
$D_1 - H_2O$ $\quad D_2 - H_2O_2$ $\quad$ E – HCN $\quad$ F – C_2N_2 $\quad$ G – ClCN

~~H – L –~~ $\qquad$ ~~M – CO(H~~

M – $CO(NH_2)_2$ $\qquad$ N – HOCN, но в схеме – $3NH_3$, тогда пример N – $(HOCN)_3$ или



, тогда L –



~~H – H₂N–C(NH)NH₂~~ $\qquad$ O – NH_4Cl (т.к. содержит N) $\qquad$ H – $H_2N-C\equiv N$

2.

HCN

Все хорошо

$V = 1$ л $m(HCN) = 1000 \cdot 0.5\% = 5$ г $n(HCN) = \frac{5}{M(HCN)} = 0.185$ моль

$C_0(HCN) = 0.185$ M

+1,5б $HCN \rightleftarrows H^+ + CN^-$

$$K_a = 10^{-9.21} = \frac{x^2}{0.185 - x} = \frac{[H^+][CN^-]}{[HCN]} \approx \frac{x^2}{0.185}$$

⇓

~~$x = [H^+] = 1.068 \cdot 10^{-5}$ M $pH = -\lg[H^+] = 4.97$~~

$x = 1.068 \cdot 10^{-5}$ M   (или $K_a = \frac{\alpha^2}{1-\alpha} \cdot C_0$)

$$\alpha = \frac{x}{C_0} = 5.77 \cdot 10^{-5} = 5.77 \cdot 10^{-3}\ \%$$

3.

$$\alpha(CN^-) = \frac{K_a}{K_a + [H^+]} =$$

$C_0 = 30 \Rightarrow [H^+] = 10^{-7}$ ($pH = 7$)
т.к. HCN почти не влияет на pH нейтр.

+1,5б

$$= \frac{10^{-9.21}}{10^{-9.21} + 10^{-7}} = 6.13 \cdot 10^{-3} = 0.613\%$$

4 Все соли наверно аммонийные

~~0.7145 г~~

X: $pM = \rho RT$ $M_{ср} = \frac{\rho RT}{p} = \frac{0.7145 \cdot 8.314 \cdot (150+274)}{101.325} =$

$= 24.8$ г/моль

Если это $(NH_4)_2C_2O_4$, то   + 0,75

$(NH_4)_2C_2O_4 \rightarrow 2NH_3 + H_2O + CO_2 + CO$

$M_{ср} = \frac{1}{5}(2 \cdot 17 + 18 + 28 + 44) = 24.8$ г/моль

Y_1 – ~~это~~ есть азот и восстановитель: $HCOONH_4$ ($H-C(=O)-O^-NH_4^+$) (формиат)

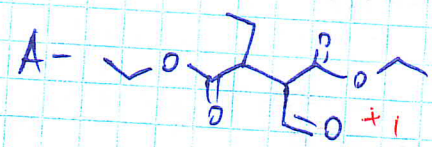
разумеется – карбонаты

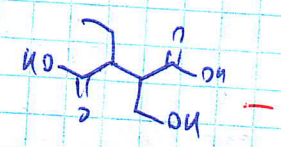
X – $(NH_4)_2C_2O_4$ Y_1 – $HCOONH_4$ + Y_2 – NH_4HCO_3 +

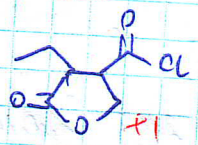
Z – $(NH_4)_2CO_3$ +

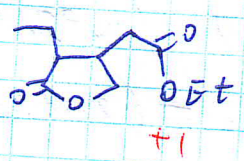
Задача 11-3

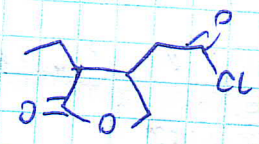
1.

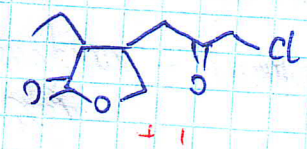
А- 

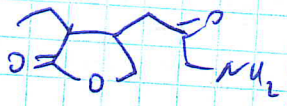
Б- 

В- 

Г- 

Д- 

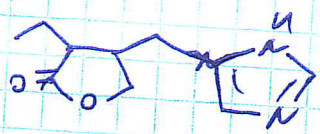
Е- 

Ж- 

$C_9H_{15}NO_3$

З- 

$C_{10}H_{14}N_2SO_2$

И- 

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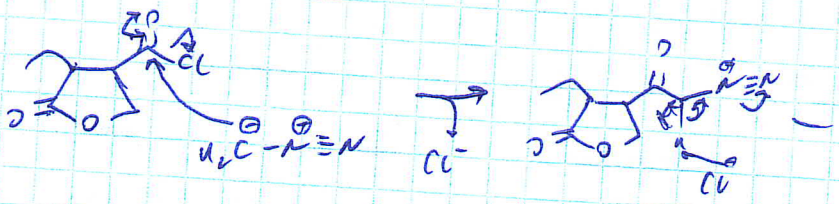
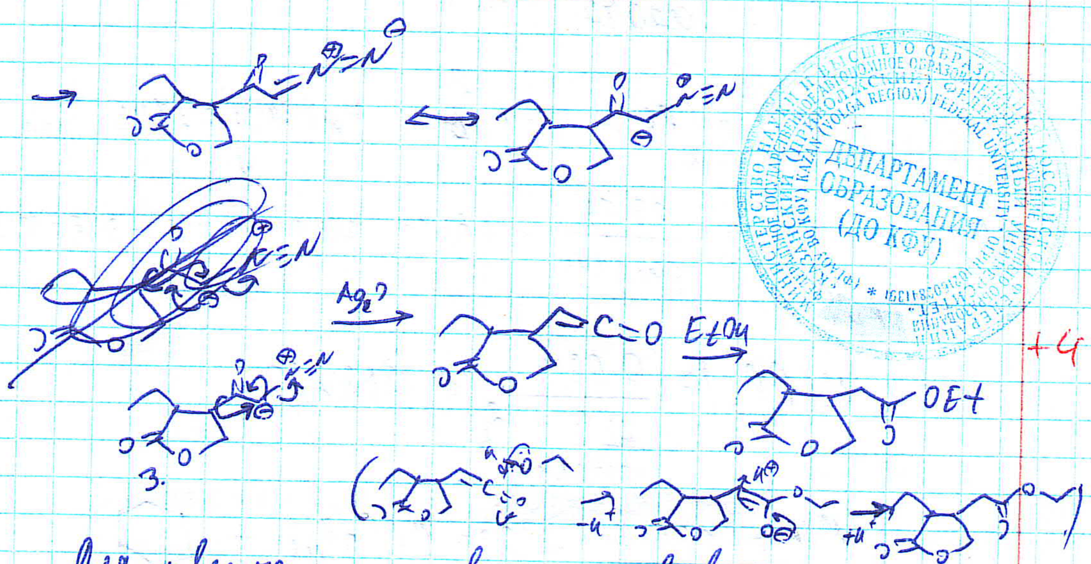




+4

Для увеличения ~~растворимости~~ в воде растворимости

+1

Задача 11-4

$n(X_1) : n(N_2) : n(PR_3) = 1 : 1 : 2$ $\quad V_m(\text{газ}) = 29.45 \frac{л}{моль}$

$M(X_1) = 0.3179 : \frac{29.73}{1000 \cdot 29.45} = 261.44$ $\quad 261.44 - 35.45 \cdot 3 - 3 \cdot 18 = 101$

$= M(Ru)$

$M(PR_3) = \frac{0.6814}{\frac{29.73}{1000 \cdot 29.45} \cdot \frac{2}{3}} = 280$

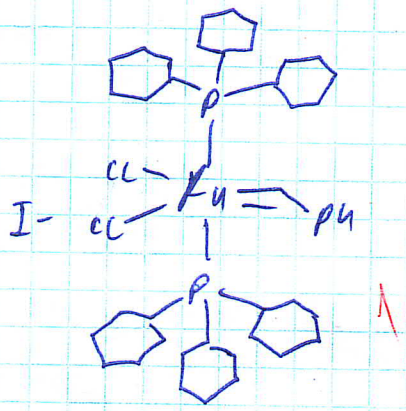
$M(R) = \frac{280 - 31}{3} = 83 = M(C_6H_{11}) -$ 

$X - Ru$ $\quad X_1 - RuCl_3 \cdot 3H_2O$

$M(I) = \frac{1}{\frac{29.73}{1000 \cdot 29.45}} = 822 =$

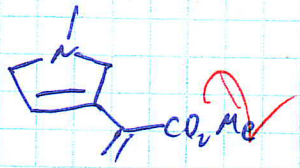
$= 101 + (12+1) + 12 \cdot 6 + 5 + 35.5 \cdot 2 +$
$+ 2 \cdot (31 + (12 \cdot 6 + 11) \cdot 3)$

I-



2

Z-



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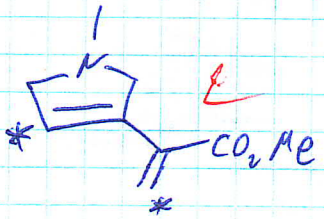
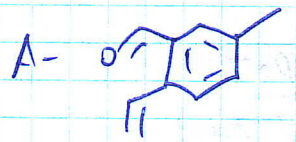


4.

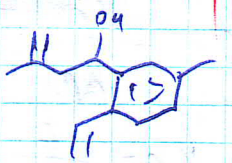
A-



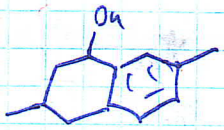
B-

C-

B-



C-



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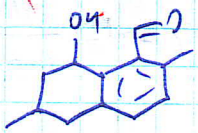

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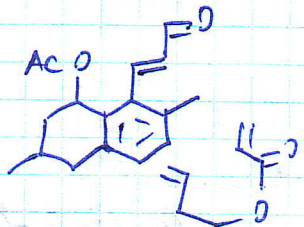

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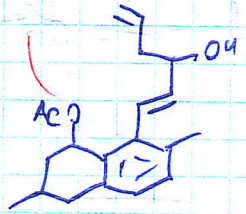

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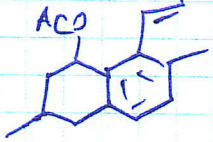

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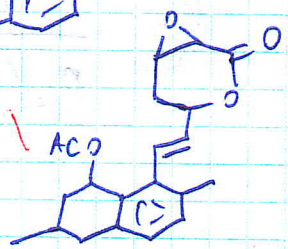


Задача 11-5.

1.

Габер и Бош +1

2.

A- $CaCO_3$ B- C C- CaC_2 D- CO E- $CaCN_2$

F- C_2H_2 +3

3.

$0.5 = \frac{Kp_0}{1+Kp_0}$ $0.6 = \frac{K(p_0+1)}{1+K(p_0+1)}$

$\theta = \frac{Kp}{1+Kp}$ $\theta + \theta Kp = Kp$ $\theta = Kp(1-\theta)$

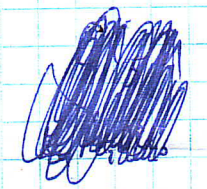
$Kp = \frac{\theta}{1-\theta}$ $Kp_0 = \frac{0.5}{1-0.5} = 1$

$K(p_0+1) = \frac{0.6}{1-0.6} = 1.5$ $\frac{Kp_0}{Kp_0+1} = \frac{1}{1.5} \Rightarrow p_0 = 2$

$K = \frac{1}{p_0} = \frac{1}{2} = 0,5$ +1

4.

$K_1 = \frac{\theta_{H_2}}{p_{H_2}(1-\theta_{H_2}+\theta_{N_2})}$ +0,5 $K_2 = \frac{\theta_{N_2}}{p_{N_2}(1-\theta_{N_2}+\theta_{H_2})}$ +0,5



Задача 11-5 (прод.)

4.

$$\theta_{N_2} + \theta_{u_2} + \theta = 1 \qquad (\theta - \text{для свободных мест})$$

$$K_1 \rho_{u_2} = \frac{\theta_{u_2}}{1 - \theta_{u_2} - \theta_{N_2}} \qquad K_2 \rho_{N_2} = \frac{\theta_{N_2}}{1 - \theta_{u_2} - \theta_{N_2}} \qquad \theta = \frac{\theta_{u_2}}{K_1 \rho_{u_2}}$$

$$\frac{K_2 \rho_{N_2}}{K_1 \rho_{u_2}} = \frac{\theta_{N_2}}{\theta_{u_2}} \qquad \theta_{N_2} = \frac{K_2 \rho_{N_2}}{K_1 \rho_{u_2}} \cdot \theta_{u_2}$$

$$\theta_{u_2} + \frac{K_2 \rho_{N_2}}{K_1 \rho_{u_2}} \theta_{u_2} + \frac{\theta_{u_2}}{K_1 \rho_{u_2}} = 1$$

$$\theta_{u_2} \left(1 + \frac{K_2 \rho_{N_2}}{K_1 \rho_{u_2}} + \frac{1}{K_1 \rho_{u_2}} \right) = 1$$

$$\theta_{u_2} = \frac{1}{1 + \frac{K_2 \rho_{N_2}}{K_1 \rho_{u_2}} + \frac{1}{K_1 \rho_{u_2}}} = \frac{K_1 \rho_{u_2}}{1 + K_1 \rho_{u_2} + K_2 \rho_{N_2}} + 1$$

5.

$$K_3 = \frac{\theta_u^2}{\rho_{u_2} \cdot \theta^2} = \frac{\theta_u^2}{\rho_{u_2} \cdot 0} \quad \frac{\theta_u^2}{\rho_{u_2}(1-\theta_u)^2} + 1$$

$$K_3 \rho_{u_2} = \left(\frac{\theta_u}{1-\theta_u}\right)^2 \qquad \sqrt{K_3 \rho_{u_2}} = \frac{\theta_u}{1-\theta_u}$$

$$\sqrt{K_3 \rho_{u_2}} = \theta_u \left(1 + \sqrt{K_3 \rho_{u_2}}\right)$$

$$\theta_u = \frac{\sqrt{K_3 \rho_{u_2}}}{1 + \sqrt{K_3 \rho_{u_2}}} + 2.$$

6.

$$\sqrt{K_3 \rho_{u_2}} = \frac{\theta_u}{\theta} \qquad K_1 \rho_{u_2} = \frac{\theta_{u_2}}{\theta}$$

$$\frac{\theta_{u_2}}{\theta_u} = \frac{K_1 \rho_{u_2}}{\sqrt{K_3 \rho_{u_2}}} \qquad \theta_{u_2} = \theta_u \cdot \frac{K_1 \rho_{u_2}}{\sqrt{K_3 \rho_{u_2}}} \quad \theta_u = \theta_{u_2} \cdot \frac{\sqrt{K_3 \rho_{u_2}}}{K_1 \rho_{u_2}}$$

$$\theta_{u_2} + \theta_u + \theta = 1$$

$$\theta_{u_2}\left(1 + \frac{K_1 \rho_{u_2}}{\sqrt{K_3 \rho_{u_2}}} + \frac{1}{K_1 \rho_{u_2}}\right)$$

$$\theta_{H_2}\left(1+\frac{\sqrt{K_3 p_{H_2}}}{K_1 p_{H_2}}+\frac{1}{K_1 p_{H_2}}\right)=1$$

$$\theta_{H_2}=\frac{1}{1+\frac{\sqrt{K_3 p_{H_2}}}{K_1 p_{H_2}}+\frac{1}{K_1 p_{H_2}}}=\frac{K_1 p_{H_2}}{1+\sqrt{K_3 p_{H_2}}+K_1 p_{H_2}} \quad +1$$

$$\theta_H=\theta_{H_2}\cdot\frac{\sqrt{K_3 p_{H_2}}}{K_1 p_{H_2}}=\frac{\sqrt{K_3 p_{H_2}}}{1+\sqrt{K_3 p_{H_2}}+K_1 p_{H_2}} \quad +1$$

8.

а) $N_{2(г.)} \rightarrow N_2^{ф}$

$\Delta H(0.5N_2^{ф} 1.5H_2) - \Delta H(0.5N_2 1.5H_2) = (336-62) - 270 =$

$= -4 \Rightarrow 0.5N_{2(г.)} \rightarrow 0.5N_2^{ф} \quad -4 \cdot 2 = -8$

$N_{2(г.)} \rightarrow N_2^{ф} \quad \Delta H = -8 \frac{ккал}{моль} = -33.47 \frac{кДж}{моль}$ (+0,5)

$NH_{3(г.)} \rightarrow NH_3^{ф} \quad \Delta H = \Delta H(NH_2+H \leftrightarrow NH_3) - \Delta H(NH_2+H \leftrightarrow NH_3^{ф}) =$

$= 113 - 125 = -12 \frac{ккал}{моль}$

$NH_{3(г.)} \rightarrow NH_3^{ф} \quad \Delta H = -12 \frac{ккал}{моль} = -50.21 \frac{кДж}{моль}$ (+0,5)

б) $E_1 = \Delta H(NH+2H \leftrightarrow N+3H) = 75$ ккал/моль

$E_2 = \Delta H(NH_2+H \leftrightarrow NH+2H) = 93$ ккал/моль

$E_3 = \Delta H(NH_3 \leftrightarrow NH_2+H) = 113$ ккал/моль

$E_{ср} = \frac{E_1+E_2+E_3}{3} = \frac{75+93+113}{3} = 93.67$ ккал/моль =

$+0,5 = 391.9$ кДж/моль

в) $0.5N_{2(г.)} + 1.5H_{2(г.)} \rightarrow NH_{3(г.)}$ $\Delta_r H$

$\Delta H(NH_3 \leftrightarrow N+3H) = -(75+93+113) = -281$ ккал/моль

$\Delta_r H = \Delta H(NH_3 \leftrightarrow N+3H) - \Delta H(0.5N_2 + 1.5H_2 \leftrightarrow N+3H) =$

$= -281 - (-270) = -11$ ккал/моль $+0,5$

$0.5N_{2(г.)} + 1.5H_{2(г.)} \rightarrow NH_{3(г.)}$ $\Delta H = -11$ ккал/моль $= -46.02$ кДж/моль

8.

$\ln K_p = -\frac{\Delta_r H^\circ}{RT} + \frac{\Delta_r S^\circ}{R}$

$$\ln(K_2) - \ln(K_1) = \frac{\Delta_r H^\circ}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln\left(\frac{K_2(T_2)}{K_1(T_1)}\right) = \frac{\Delta_r H^\circ}{R} \cdot \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\frac{K_2(T_2)}{K_1(T_1)} = e^{\frac{\Delta_r H^\circ}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

$$\frac{K_2(400^\circ C)}{K_1(500^\circ C)} = e^{-\frac{46020}{8.314}\left(\frac{1}{500+273} - \frac{1}{400+273}\right)} = 2,9$$

увеличится в 2,9 раз + 1

15.