

Часть 1

Олимпиада: **Химия 11 класс (1 часть)**

Шифр: **21300178**

ID профиля: **377940**

Вариант 1

Условие 31

Химия, 11 кл, В-1;

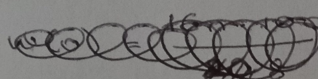
$$w(A) = \frac{Ar \cdot n \cdot 100}{M}$$

1) Пусть $N(O)_A = n \rightarrow 16n - 60$
 $M(A) - 100 \rightarrow M = \frac{16n \cdot 100}{60}$

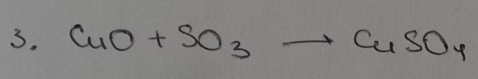
n	1	2	3	4	5
M(A)	26,6	53,3	80	106,7	133,3

, при $n=3$ единственное целочисл. значение

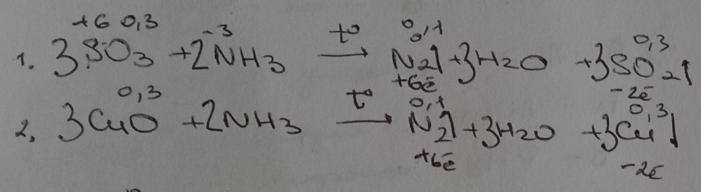
пусть $n=3$, тогда $A - SO_3$ - оксид серы (VI)

 $w(O) = \frac{16n \cdot 100}{M} = \frac{16 \cdot 3 \cdot 100}{80} = 60\%$ ($M=80$ г/моль, т.к. окисл. ст. S = VI)

$\rightarrow n=1 \rightarrow B - CuO$ - оксид меди (II)



$B - CuSO_4$ - сульфат меди (II)



$\Gamma - SO_2$ - оксид серы (IV)

$\Delta - Cu$ - медь

Проверка:

$\nu(SO_3) = \nu(CuO) = \frac{24}{80} = 0,3$ моль

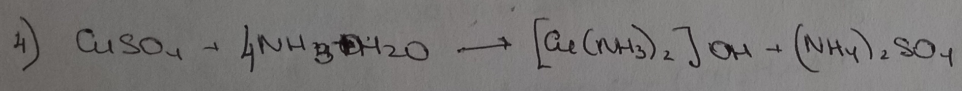
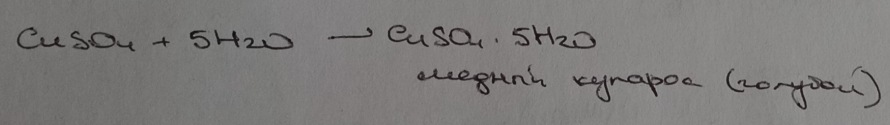
$\nu(NH_3) = \frac{4,48}{22,4} = 0,2$ моль

$\frac{\nu(SO_3)}{\nu(NH_3)} = \frac{3}{2} = \frac{0,3}{0,2}$; $\frac{\nu(CuO)}{\nu(NH_3)} = \frac{0,3}{0,2} = \frac{3}{2}$, т.е.

$\rho_{(Cu)} = 13,75 \rightarrow M_{(Cu)} = 13,75 \cdot 4 = 55$ г/моль

$M_{сер} = \frac{M_1 \cdot \nu_1 + M_2 \cdot \nu_2}{\nu_{сер}} = \frac{28 \cdot 0,1 + 64 \cdot 0,3}{0,4} = 55$ г/моль, т.е.

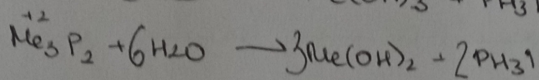
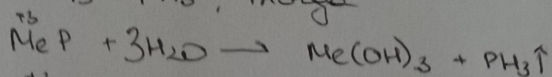
3) при добавлении $CuSO_4$ в водный р-р образуется осадок, т.к.



р-р голубой.

Ответ: $A - SO_3$; $B - CuO$; $B - CuSO_4$; $\Gamma - SO_2$; $\Delta - Cu$;
 р-ции см. в решении.

- 2) мк Б - растворяется в воде, следовательно вещество амфотерное гидрокси-
д металла В - PH_3 , тогда



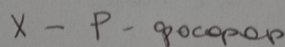
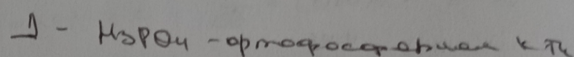
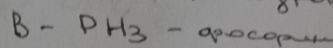
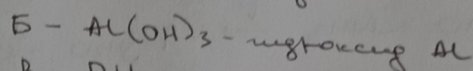
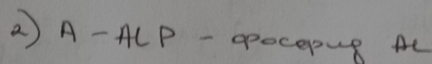
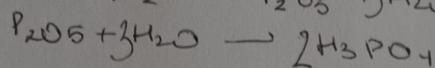
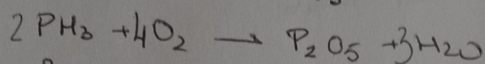
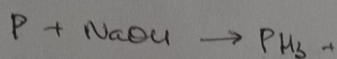
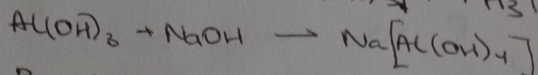
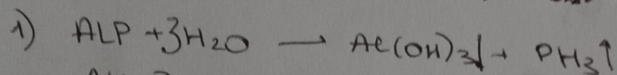
$$J(\text{B}) = \frac{2,24}{22,4} = 0,1 \text{ моль}$$

$$\frac{J(\text{PH}_3)}{J(\text{MeP})} = \frac{1}{1} \rightarrow J(\text{MeP}) = 0,1 \text{ моль}$$

$$M(\text{MeP}) = \frac{58}{0,1} = 58 \text{ г/моль} \rightarrow \text{ALP} - \text{фосфат алюминия}$$

$$\frac{J(\text{PH}_3)}{J(\text{Me}_3\text{P}_2)} = \frac{2}{1} \rightarrow J(\text{Me}_3\text{P}_2) = 0,05 \text{ моль}$$

$$M(\text{Me}_3\text{P}_2) = \frac{116}{0,05} = 2320 \text{ г/моль} \rightarrow \text{Ar(Me)} = 18 - \text{не подходит}$$

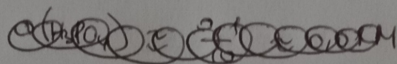


$$3) J(\text{ALP}) : J(\text{PH}_3) = 1 : 1 \rightarrow J(\text{PH}_3) = 0,1 \text{ моль}$$

$$J(\text{PH}_3) : J(\text{P}_2\text{O}_5) = 2 : 1 \rightarrow J(\text{P}_2\text{O}_5) = 0,05 \text{ моль}$$

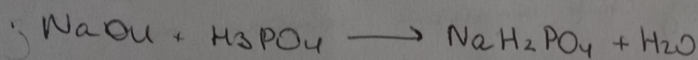
$$J(\text{P}_2\text{O}_5) : J(\text{H}_3\text{PO}_4) = 1 : 2 \rightarrow J(\text{H}_3\text{PO}_4) = 0,1 \text{ моль}$$

$$c(\text{H}_3\text{PO}_4) \approx \frac{0,1}{10} \approx 0,01 \text{ М}$$



$$J(\text{H}_3\text{PO}_4)_{\text{исх}} = 0,15 \cdot 0,01 = 0,0015 \text{ моль}$$

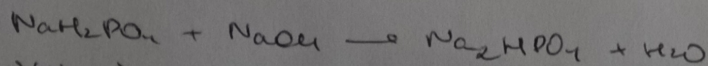
$$J(\text{NaOH}) = 0,05 \cdot 0,04 = 0,002 \text{ моль}$$



$$\frac{J(\text{H}_3\text{PO}_4)}{J(\text{NaOH})} = \frac{1}{1} = \frac{0,0015}{0,002} < 1 \rightarrow \text{не хватает}$$

$$J(\text{NaOH})_{\text{ост}} = 0,0005 \text{ моль}$$

$$J(\text{H}_3\text{PO}_4) : J(\text{NaH}_2\text{PO}_4) = 1 : 1 \rightarrow J(\text{NaH}_2\text{PO}_4) = 0,0015 \text{ моль}$$



$$J(\text{NaOH}) : J(\text{Na}_2\text{HPO}_4) = 1 : 1 \rightarrow J(\text{Na}_2\text{HPO}_4) = 0,0005 \text{ моль}$$

$$J(\text{NaH}_2\text{PO}_4)_{\text{ост}} = 0,001 \text{ моль}$$

$$\text{Итого: } J(\text{NaH}_2\text{PO}_4) = 0,001 \text{ моль}$$

$$J(\text{Na}_2\text{HPO}_4) = 0,0005 \text{ моль}$$

$$\text{Ответ: см. п. 1), 2); } J(\text{NaH}_2\text{PO}_4) = 0,001 \text{ моль, } J(\text{Na}_2\text{HPO}_4) = 0,0005 \text{ моль}$$

Проблемы

$$w(O)_A = 60\%$$

$$w(O)_B = 20\%$$

$$w(H)_A = 40\%$$

$$w(H)_B = 80\%$$

$$w(A) = \frac{Ar \cdot 100}{Ar + 32} = 0,44$$

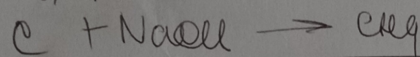
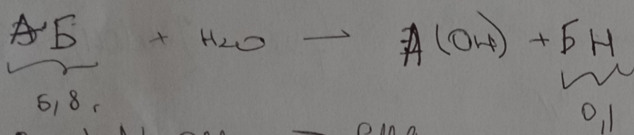
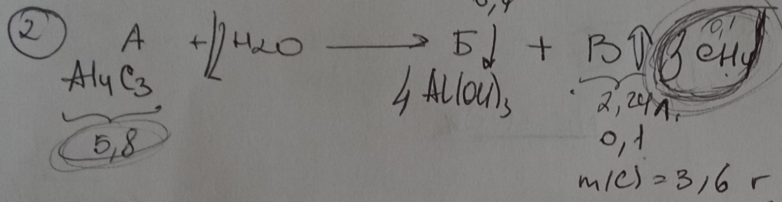
$$9 \cdot Ar + 12,8 = Ar$$

$$0,4 Ar = 12,8$$

$$Ar = 32$$

$$w(A) = \frac{Ar \cdot n \cdot 100}{Ar \cdot n + 32 \cdot n} \rightarrow w(A) = 0,6 = \frac{Ar}{Ar + 48}$$

$$28,8 = 0,6 Ar \rightarrow 48$$



$$w(O) = 60\%, w(H) = 40\%; \quad \exists x O_y \quad M_g = C = \frac{16n - 60}{M} - 100$$

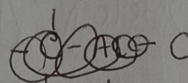
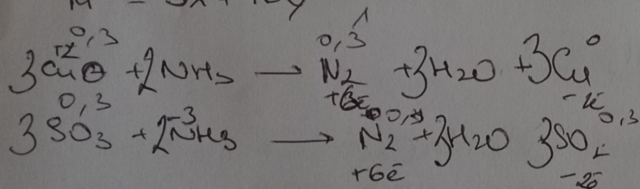
$$w(A) = \frac{Ar \cdot n \cdot 100}{M} \Rightarrow 0,6 = \frac{16y \cdot 100}{M}$$

$$0,4 = \frac{3x}{M}$$

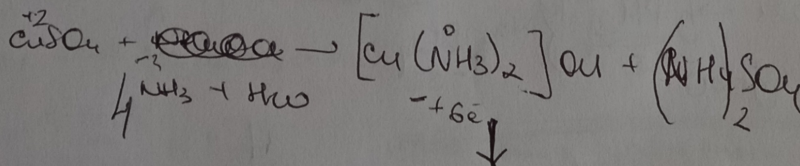
n	1	2	3	4	5
M	26,6	53,2	79,8	106,4	133

$$\frac{16n - 60}{80 - 100}$$

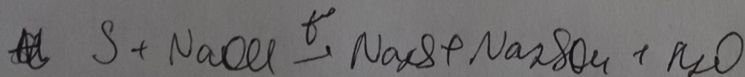
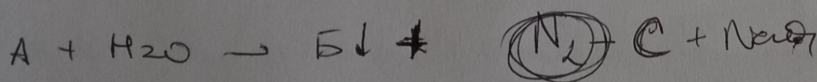
$$M = 3x + 16y$$



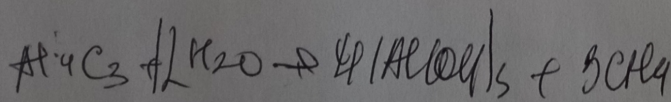
$$55 = \frac{28 \cdot 0,2 + 64 \cdot 0,3}{0,5}$$



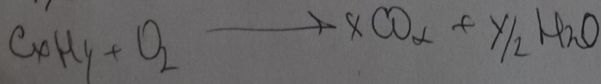
$$0,1:$$

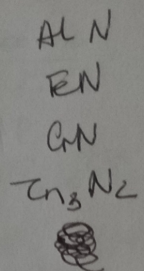
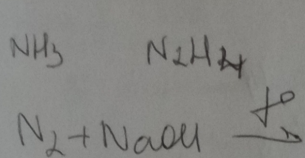


$$393,5x + 142,5y =$$

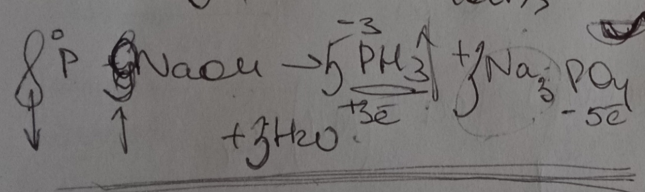
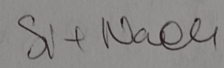
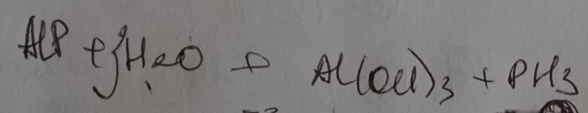
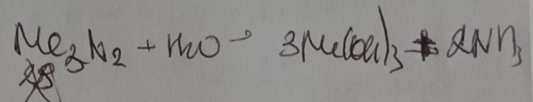
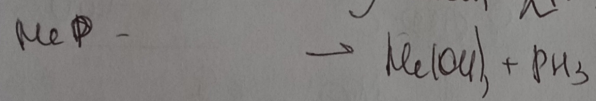
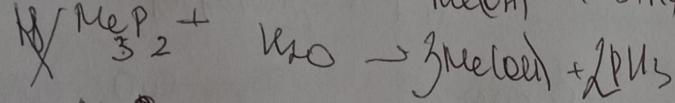
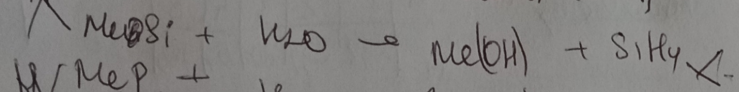
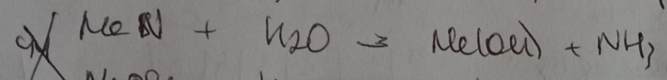
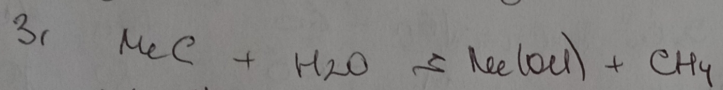
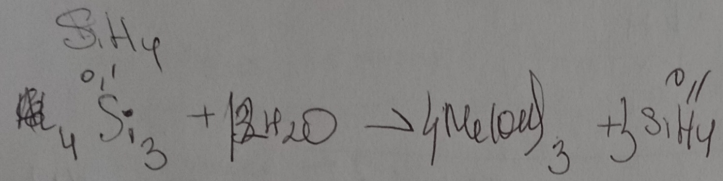
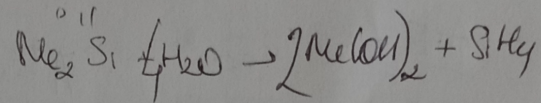
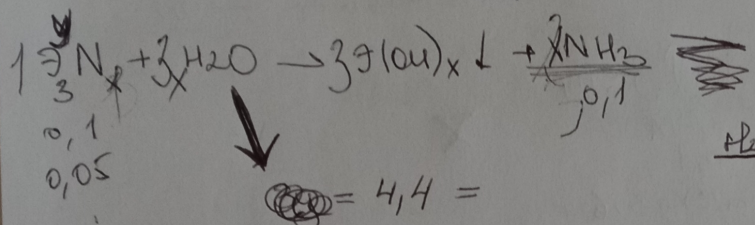


$$496$$





0,1 0,05 0,2
 58 116 28 174



4.

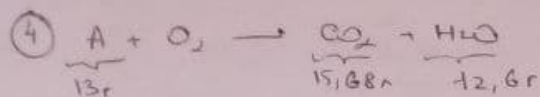
Часть 2

Олимпиада: **Химия 11 класс (2 часть)**

Шифр: **21300178**

ID профиля: **377940**

Вариант 1

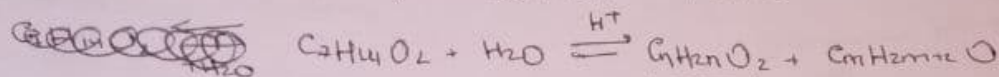


$$\nu(O_2) = \frac{15,68}{22,4} = 0,7 \text{ моль}; \rightarrow \nu(C) = 0,7 \text{ моль}; \rightarrow m(C) = 8,4r$$

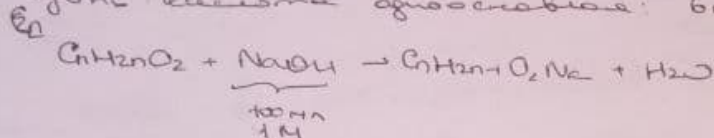
$$\nu(H_2O) = \frac{12,6}{18} = 0,7 \text{ моль}; \rightarrow \nu(H) = 1,4 \text{ моль} \rightarrow m(H) = 1,4r$$

$$m(O) = 13 - 8,4 - 1,4 = 3,2r \rightarrow \nu(O) = 0,2 \text{ моль}$$

$$\nu(C) : \nu(H) : \nu(O) = 0,7 : 1,4 : 0,2 = 3,5 : 7 : 1 = 7 : 14 : 2$$



при каталитическом гидрировании: 6r



$$\nu(NaOH) = 0,1 = 0,1 \text{ моль}$$

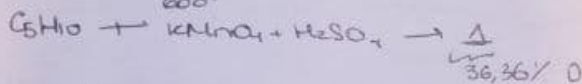
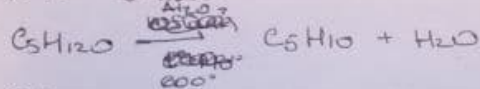
$$\nu(NaOH) : \nu(C_7H_{12}O_2) = 1:1 \rightarrow \nu(C_7H_{12}O_2) = 0,1 \text{ моль}$$

$$M(C_7H_{12}O_2) = \frac{6}{0,1} = 60 \text{ г/моль} \rightarrow 14n + 32 = 60$$

$$14n = 28$$

$$n = 2 \rightarrow CH_3COOH - B$$

$$\Rightarrow B - C_5H_{10}O$$

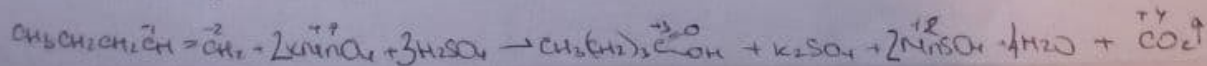
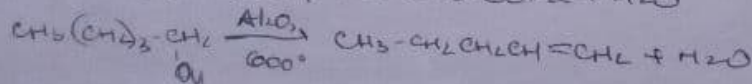
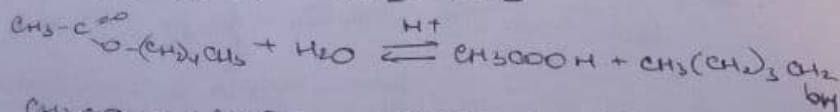
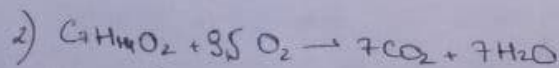
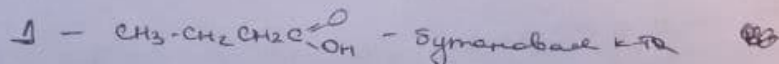
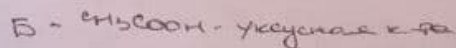
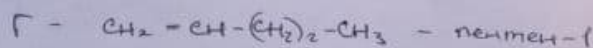
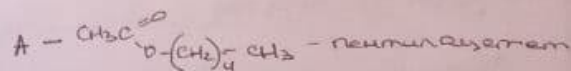
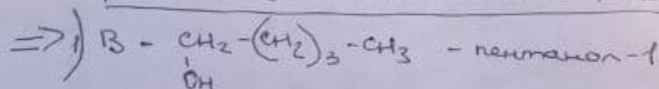


$$w(\Delta) = \frac{4 \cdot n \cdot 100}{M} \rightarrow M(\Delta) = \frac{46 \cdot 2 \cdot 100}{36,36} = 88 \text{ г/моль} \rightarrow C_7H_{12}O_2 - \text{тк кислота}$$

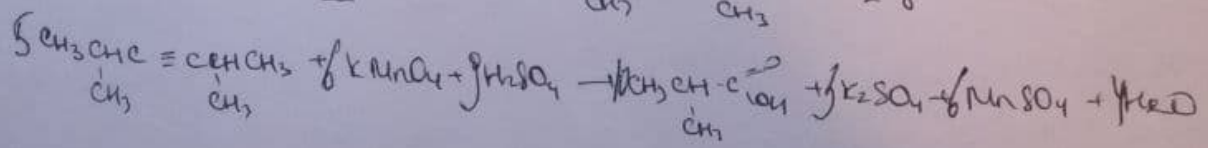
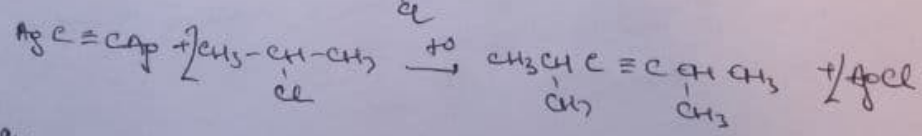
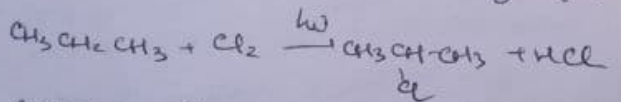
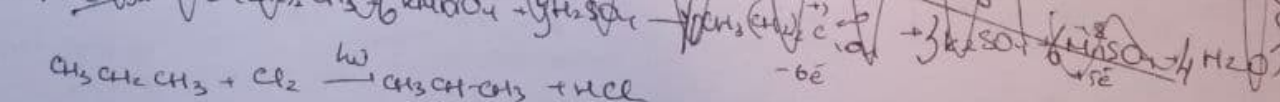
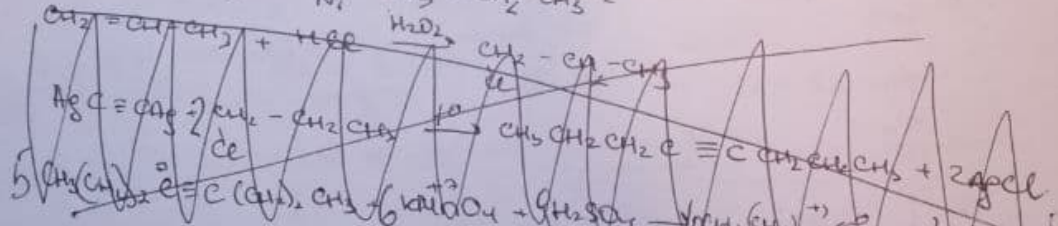
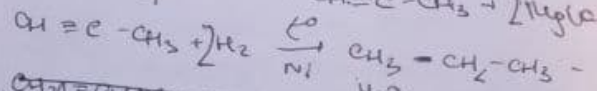
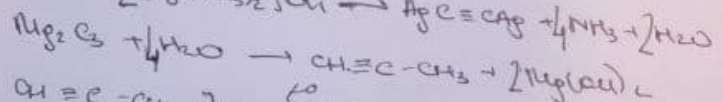
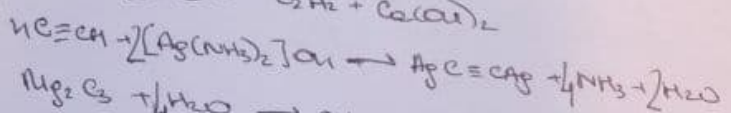
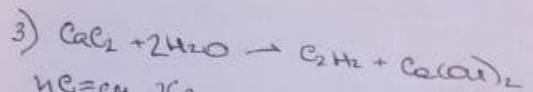
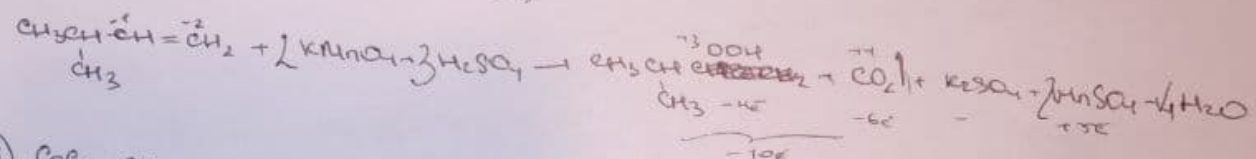
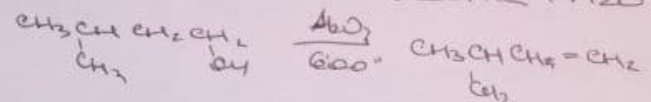
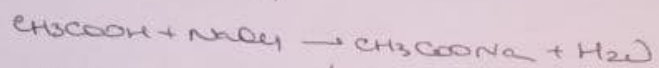
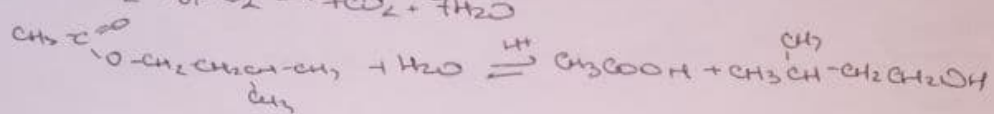
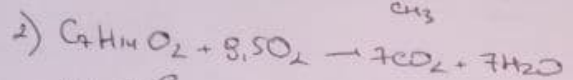
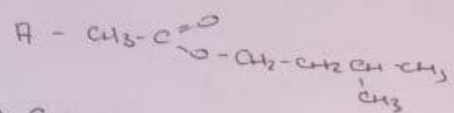
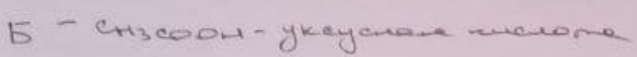
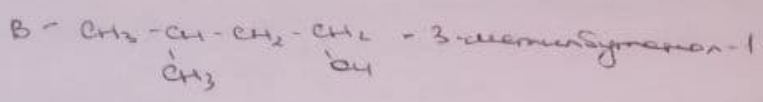
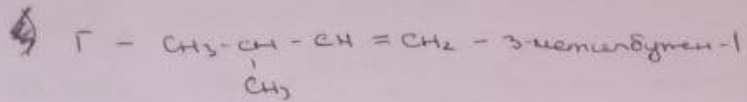
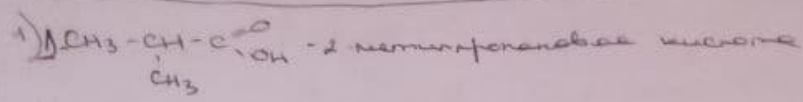
$$14n + 32 = 88$$

$$n = 4 \Rightarrow$$

решение по исправлению условий:



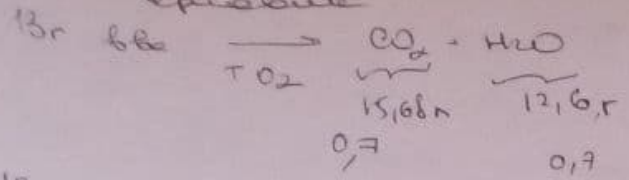
Решения после исправления:



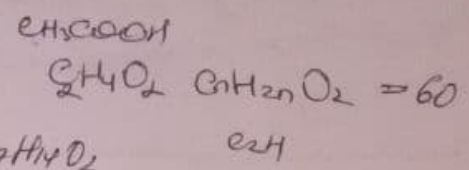
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-
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Умножение 38
децимал

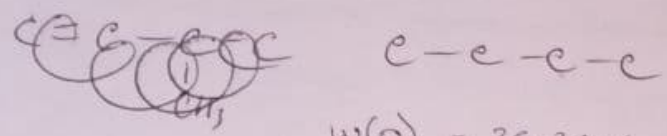
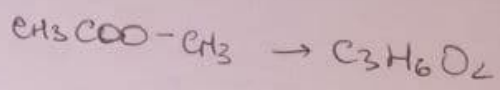
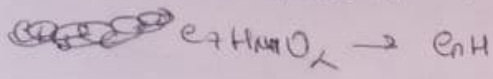
Умножение 11 0 1 0 0 1



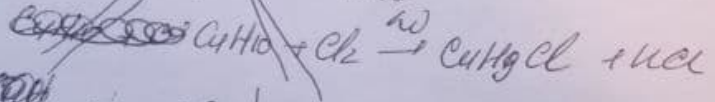
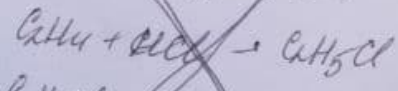
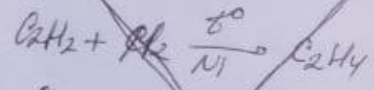
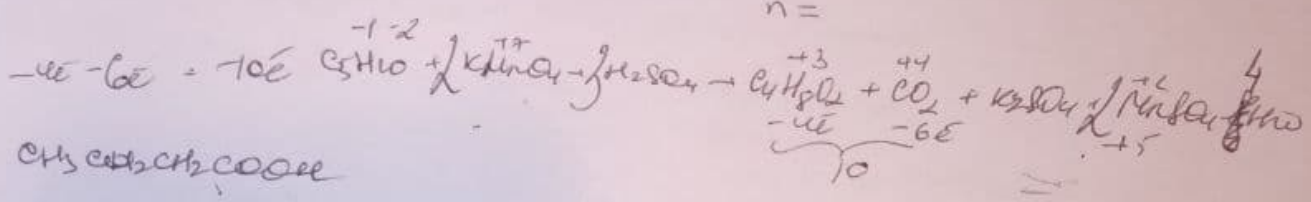
13 - 0,7 - 12 - 0,7 - 2 = 5,2n - m(o)
O(CO) = 0,2



O(C): O(H): O(O) = 100:2 3,5:7:1 = 7:14:2 → C₇H₁₄O₂



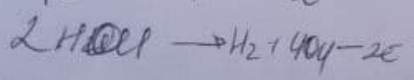
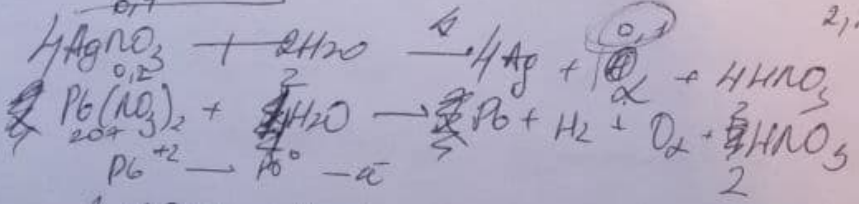
w(O) = 36,36% → C_nH_{2n}O₂ w(H) = $\frac{16 \cdot 2 \cdot 100}{M} = 36,7$
4n = 56
n =



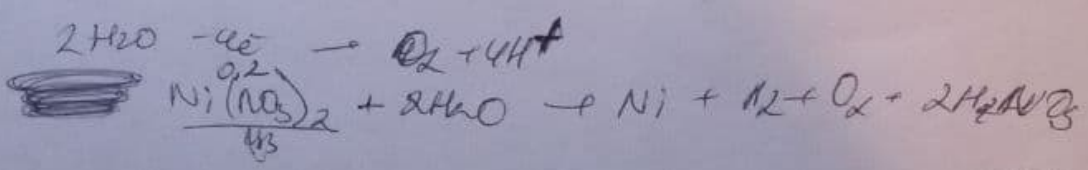
 C₂H₅OH
M = $\frac{2FE}{nF} = \frac{mM \cdot IT}{nF}$
V = $\frac{2FE}{nF} =$ con

43,2 = $\frac{108 \cdot 3 \cdot 4,4}{4 \cdot 9650} =$

2,24 = $\frac{24 \cdot 3 \cdot 6}{4 \cdot 9650} =$ 322



3,574 - 3,57



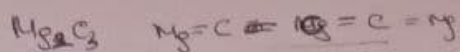
MMH - 522

Умножение 93

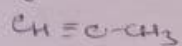
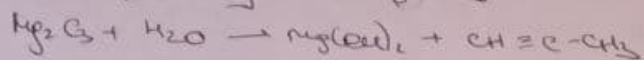
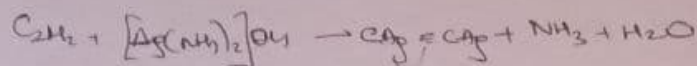
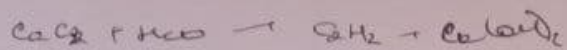
X. 11

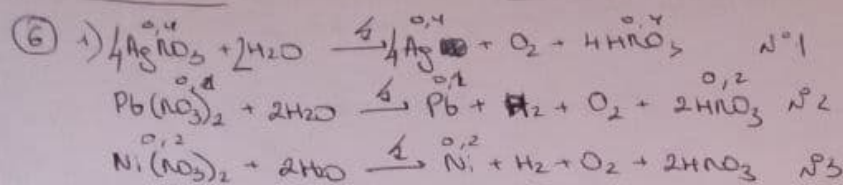
4e

Умножение 2



6





так как активнее металлы, чем водород они уйдут на электролиз

2) $\nu(\text{AgNO}_3)_{\text{век}} = \frac{68}{170} = 0,4 \text{ моль}$

$\nu(\text{Pb}(\text{NO}_3)_2)_{\text{век}} = 0,2 \text{ моль}$

$\nu(\text{Ni}(\text{NO}_3)_2)_{\text{век}} = 0,2 \text{ моль}$

$m = \frac{3m \cdot t \cdot I}{F} = \frac{M \cdot I \cdot t}{n \cdot F} \rightarrow t = \frac{m \cdot n \cdot F}{M \cdot I} = \frac{\nu \cdot n \cdot F}{I} \rightarrow \nu = \frac{t \cdot I}{n \cdot F}$

$t(\text{AgNO}_3)_1 = \frac{0,4 \cdot 1 \cdot 96500}{3} = 12867 \text{ сек} = 244,45 \text{ мин} = 3,57 \text{ ч}$

$t(\text{Pb}(\text{NO}_3)_2)_2 = \frac{0,2 \cdot 2 \cdot 96500}{3} = 214,45 \text{ мин}$

$t_{\text{общ}} = 5,60 + 22 = 322 \text{ мин} \rightarrow \text{Pb}(\text{NO}_3)_2 \text{ не успеет разложиться полностью}$

$t(\text{Pb}(\text{NO}_3)_2)_3 = 322 - 214,45 = 107,55 \text{ мин} = 6453 \text{ сек}$

$\nu(\text{Pb})_4 = \frac{6453 \cdot 3}{2 \cdot 96500} = 0,1 \text{ моль}$

$\nu(\text{Pb}) : \nu(\text{Pb}(\text{NO}_3)_2) = 1:1 \rightarrow \nu(\text{Pb}(\text{NO}_3)_2)_{\text{ост}} = 0,1 \text{ моль}$
 $\nu(\text{Pb}(\text{NO}_3)_2)_{\text{ост}} = 0,1 \text{ моль}$

Итого: в конечном р-ре $\nu(\text{Pb}(\text{NO}_3)_2) = 0,1 \text{ моль}$, $\nu(\text{Ni}(\text{NO}_3)_2) = 0,2 \text{ моль}$
 $\nu(\text{HNO}_3) = 0,4 + 0,2 = 0,6 \text{ моль}$

3) $t(\text{Ni}(\text{NO}_3)_2)_2 = \frac{0,2 \cdot 2 \cdot 96500}{3} = 214,45 \text{ мин}$

$\rightarrow t(\frac{1}{4})_{\text{век}} = 214,45 \cdot 3 = 643,35 \text{ мин}$

$t_f = 322 \text{ мин}$

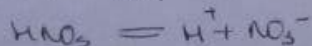
$t_{\text{гон}} = 643,35 - 322 = 321,35 \text{ мин} \rightarrow \text{необходимо еще } 321,35 \text{ мин}$

4) $m(\text{p-ре})_{\text{кон}} = 690,5 - 0,4 \cdot 108 - 0,1 \cdot 32 - 0,1 \cdot 207 - 0,1 \cdot 2 - 0,1 \cdot 32 = 600 \text{ г}$

$\nu(\text{HNO}_3)_{\text{н}} = 0,6 \text{ моль} \rightarrow 600 \text{ г} = m(\text{p-ре})$

$\nu(\text{HNO}_3)_{\text{р}} = \dots \rightarrow 10 \text{ г} = m(\text{p-ре})$

$\rightarrow \nu(\text{HNO}_3)_4 = 0,01 \text{ моль}$



$\nu(\text{HNO}_3) : \nu(\text{H}) = 1:1 \rightarrow \nu(\text{H}^+) = 0,01 \text{ моль}$

$c(\text{H}^+) = \frac{0,01}{0,1} = 0,1 \text{ М} \rightarrow \text{pH} = -\lg[\text{H}^+] = 1$