



**МОСКОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ
имени М.В. ЛОМОНОСОВА**

ОЛИМПИАДНАЯ РАБОТА

Наименование олимпиады школьников: **«Ломоносов»**

Профиль олимпиады: **Химия**

ФИО участника олимпиады: **Равочкина Мария Павловна**

Класс: **11**

Технический балл: **96**

Дата проведения: **27 февраля 2022 года**

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Хорошутин А.В.

N1.

Условие

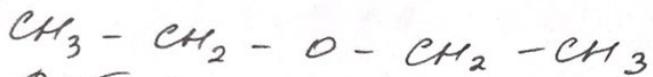
$$C_x H_y O_z$$
$$42 - 10 = 32$$

$$e = 42$$

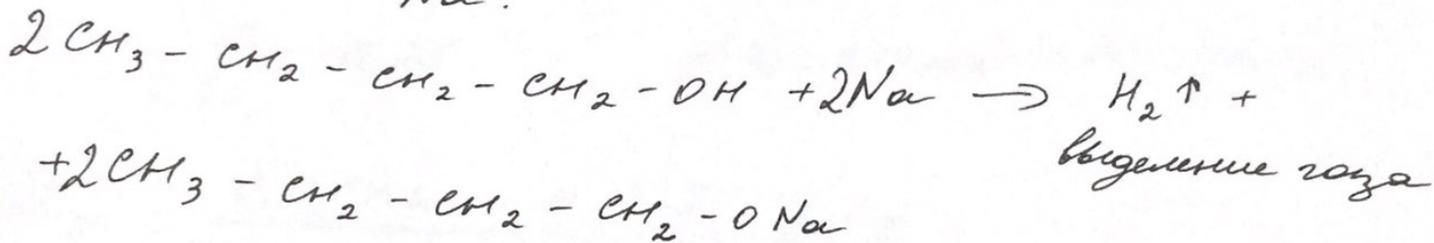
$$n^{\circ} = 32$$



Изомеры:

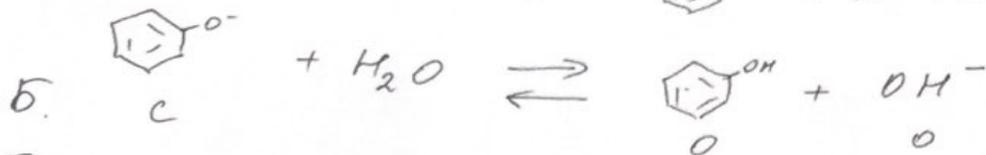
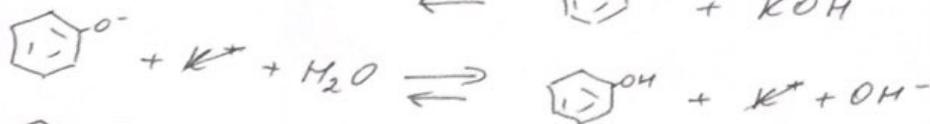


Добавить Na:



N2.

числовик



П. x

Ост. c-x

-
x

$$K_r = \frac{10^{-14}}{K_{\text{дис.}}}$$

$$K_r = \frac{10^{-14}}{10^{-10}}$$

$$K_r = 10^{-4}$$

$$K_r = \frac{[\text{C}_6\text{H}_5\text{OH}] \cdot [\text{OH}^-]}{[\text{C}_6\text{H}_5\text{O}^-]}$$

$$\text{pH} = 11 \Rightarrow [\text{H}^+] = 10^{-11}$$

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

$$K_r = \frac{x^2}{c-x}$$

$$10^{-4} = \frac{(10^{-3})^2}{c - 10^{-3}}$$

$$c = 10^{-2} + 10^{-3}$$

$$c = 0,011$$

$$2A \rightleftharpoons B$$

$$p = \frac{pV}{RT}$$

$$p = \frac{101,3 \cdot 1}{8,314 \cdot 303}$$

$$p = 0,04 \text{ моль}$$

$$\varphi_A = \frac{1}{2,86} = 0,35$$

$$n(A) = 0,04 \text{ моль} \cdot 0,35 = 0,014 \text{ моль}$$

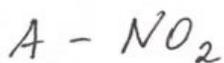
$$\varphi_B = \frac{1,86}{2,86} = 0,65$$

$$n(B) = 0,04 \text{ моль} \cdot 0,65 = 0,026 \text{ моль}$$

$$M_{\text{ср}} = \frac{0,014 M_A + 0,026 \cdot 2 M_A}{0,014 + 0,026}$$

$$75,9 = \frac{0,066 M_A}{0,04}$$

$$75,9 = 1,65 M_A$$



$$M_A = 46$$



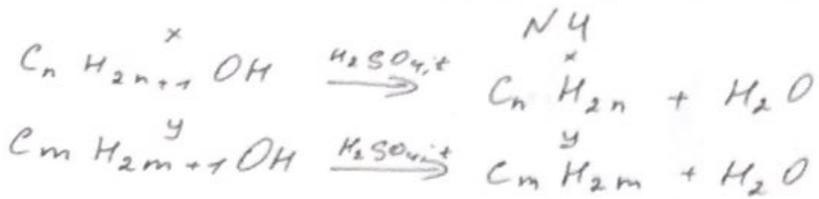
$$M_B = 46 \cdot 2 = 92$$

$$K = \frac{k_1}{k_{-1}} = \frac{[\text{N}_2\text{O}_4]}{[\text{NO}_2]^2}$$

$$K_{-1} = \frac{(0,014)^2 \cdot 5 \cdot 10^{-3}}{0,026}$$

$$K_{-1} = 3,8 \cdot 10^{-5}$$

Чистовик.



$$V = \frac{pV}{RT}$$

$$V = \frac{101,3 \cdot 11,15}{8,314 \cdot 453}$$

$$V = 0,3 \text{ моль}$$

$$\begin{cases} x + y = 0,3 \\ x(14n + 18) + y(14m + 18) = 15,9 \end{cases}$$

$$x = 0,3 - y$$

$$\mu_{gr} = \frac{15,9 \text{ г}}{0,3 \text{ моль}} = 53 \text{ г/моль} \rightarrow C_2H_5OH \text{ этанол.}$$

$$(0,3 - y) \cdot 46 + y(14m + 18) = 15,9$$

$$13,8 - 46y + 14my + 18y = 15,9$$

$$-28y + 14my = 2,1$$

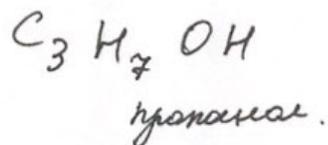
$$y(-28 + 14m) = 2,1$$

$$y = \frac{2,1}{14m - 28}$$

$$m \geq 3; 0,3 > y > 0$$

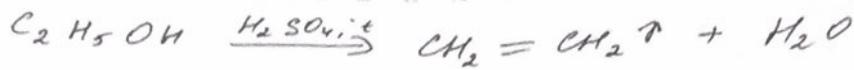
$$\begin{array}{r|l} y & m \\ \hline 0,15 & 3 \end{array}$$

Второй спирт:

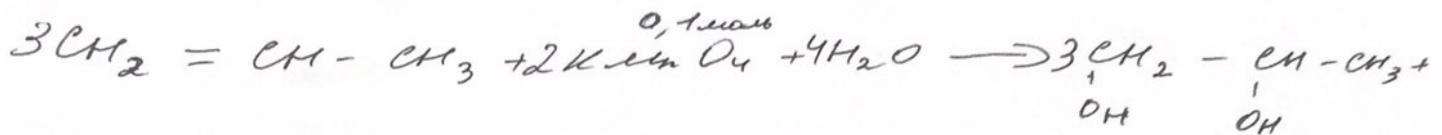
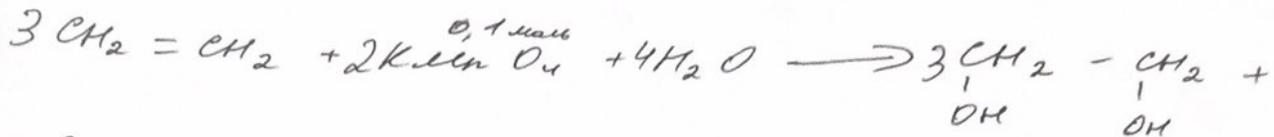
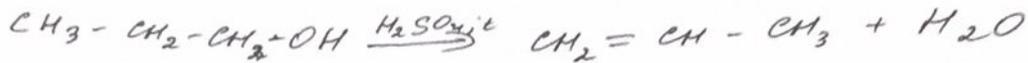


$$y = 0,15 \text{ моль}$$

$$x = 0,3 - 0,15 = 0,15 \text{ моль}$$



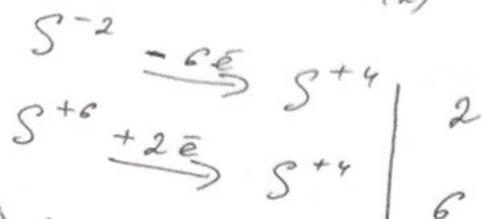
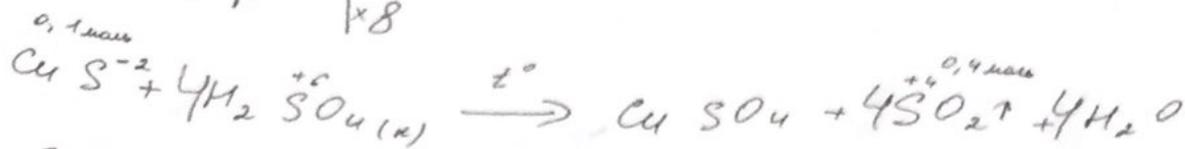
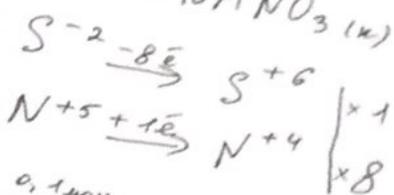
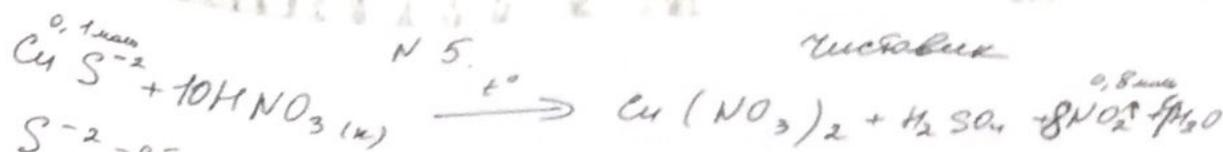
мисраблин



$$C = \frac{V}{V}$$

$$0,4 = \frac{0,2 \text{ моль}}{V}$$

$$V = \underline{\underline{0,5 \text{ л}}}$$



$$\checkmark m(\text{Cu S}) = \frac{9,62}{962/\text{моль}} = 0,1 \text{ моль.}$$

$$\checkmark m(\text{HNO}_3) = \frac{75,62}{632/\text{моль}} = 1,2 \text{ моль}$$

$$\checkmark m(\text{H}_2 \text{SO}_4) = \frac{139,8462}{982/\text{моль}} = 1,427 \text{ моль.}$$

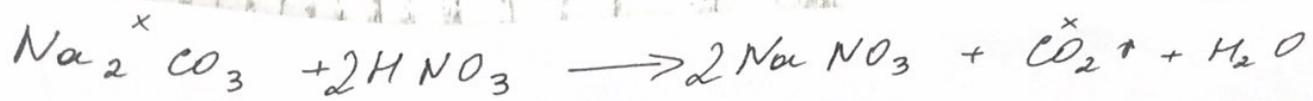
$$m_{\text{p-p}_1} = m(\text{Cu S}) + m(\text{HNO}_3) - m(\text{NO}_2) = 92,82$$

$$m(\text{NO}_2) = 0,8 \text{ моль} \cdot 462/\text{моль} = 36,82$$

$$m_{\text{p-p}_2} = m(\text{Cu S}) + m(\text{H}_2 \text{SO}_4) - m(\text{SO}_2) = 126,72$$

$$m(\text{SO}_2) = 0,4 \text{ моль} \cdot 642/\text{моль} = 25,62$$

$$\Delta m = 126,72 - 92,82 = 33,92$$



$$286x - 44x = 33,9$$

$$242x = 33,9$$

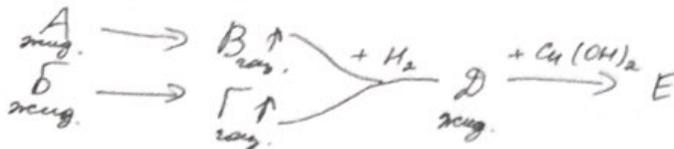
$$x = 0,14 \text{ моль}$$

$$m(\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}) = 0,14 \text{ моль} \cdot 286 \text{ г/моль} = 40 \text{ г}$$

Чистовик

№ 6.

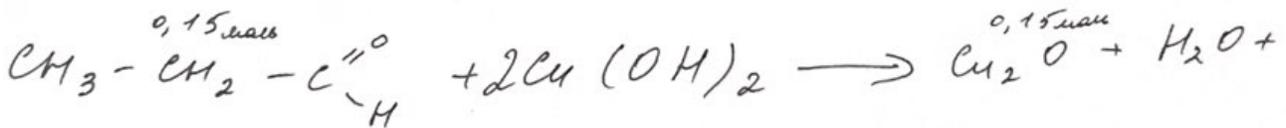
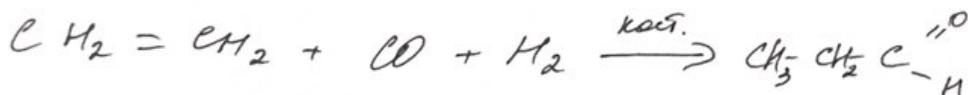
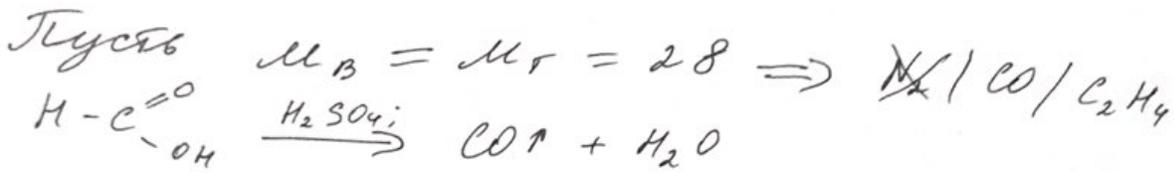
числа



$$\frac{M_x}{M_y} = 0,875$$

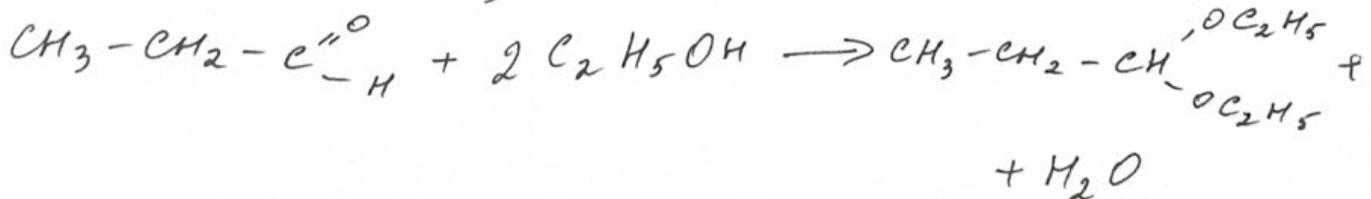
$$\frac{M_x}{32} = 0,875$$

$$M_x = 28$$



$$\downarrow (\text{Cu}_2\text{O}) = \frac{21,62}{1442/\text{моль}} = 0,15 \text{ моль}$$

$$m(\text{CH}_3-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}) = 0,15 \text{ моль} \cdot 582/\text{моль} = \underline{\underline{8,72}}$$

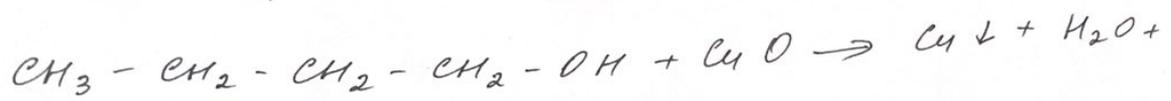


N 1.

Кетрновик



$$42 - 32 = 10$$



$$K_r = \frac{x^2}{c-x}$$

Черновик

$$10^{-4} = \frac{(10^{-3})^2}{c-10^{-3}}$$

$$c = 10^{-2} + 10^{-3} \quad c - 10^{-3}$$

$$c = 0,011$$

N 3.



$$v = \frac{pV}{RT}$$

$$v = \frac{101,3 \cdot 1}{8,314 \cdot 303}$$

$$v = 0,04 \text{ моль.}$$

$$\varphi_A = \frac{1}{2,86} = 0,35$$

$$v(A) = 0,04 \text{ моль} \cdot 0,35 = 0,014$$

$$\varphi_B = \frac{1,86}{2,86} = 0,65$$

$$v(B) = 0,04 \cdot 0,65 = 0,026$$

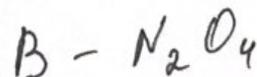
$$M_{\text{ср}} = \frac{0,014 M_A + 0,026 \cdot 2 M_A}{0,014 + 0,026}$$

$$75,9 = \frac{0,066 M_A}{0,04}$$

$$75,9 = 1,65 M_A$$

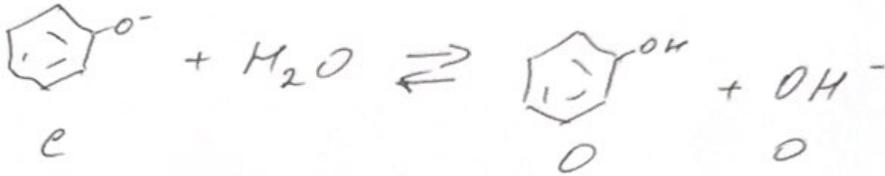
$$M_A = 46$$

$$M_B = 46 \cdot 2 = 92$$



N2.

Углекисл.



б. e

п. x

ост. c-x

-	-
x	x

$$K_r = \frac{10^{-14}}{K_{\text{ост.}}}$$

$$K_r = \frac{10^{-14}}{10^{-10}}$$

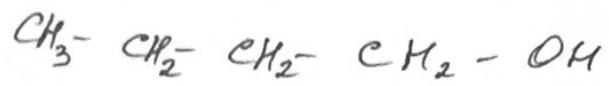
$$K_r = 10^{-4}$$

$$K_r = \frac{[\text{C}_6\text{H}_5\text{OH}] \cdot [\text{OH}^-]}{[\text{C}_6\text{H}_5\text{O}^-]}$$

$$\text{pH} = 11$$

$$[\text{H}^+] = 10^{-11}$$

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



Черновик

