



35-50-23-04
(64.2)



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

Вариант _____

Место проведения Красноярск
город

ПИСЬМЕННАЯ РАБОТА

Олимпиада школьников Ломоносов 2024
наименование олимпиады

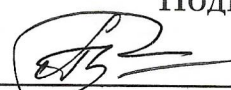
по Химии
профиль олимпиады

Анисимовой Виктории Сергеевны
фамилия, имя, отчество участника (в родительном падеже)

Время: 19:00

Вернется: 19:03

Дата
«03» марта 2024 года

Подпись участника


Чистовик

1	2	3	4	5	6	7	Σ
4	8	12	15	16	6	21	82

Задача №5

$$V(\text{HCl})_{\text{p-p}} = 20 \text{ мл} = 0,02 \text{ л}$$

$$V(\text{NaOH}) = 4 \text{ мл} = 0,004 \text{ л}$$

$$c(\text{NaOH}) = 0,05 \text{ моль/л}$$

$$c = \frac{\nu}{V} \Rightarrow \nu = c \cdot V$$

$$\nu(\text{NaOH}) = 0,004 \cdot 0,05 = 0,0002 \text{ моль} +$$

$$\frac{\nu(\text{NaOH})}{\nu(\text{HCl})} = \frac{1}{1} \Rightarrow \nu(\text{HCl}) = 0,0002 \text{ моль}$$

$$c = \frac{\nu}{V}$$

$$c(\text{HCl}) = \frac{0,0002}{0,02} = 0,01 \text{ моль/л} +$$

$$V(\text{HCl})_{\text{всего}} = 200 \text{ мл} = 0,2 \text{ л}$$

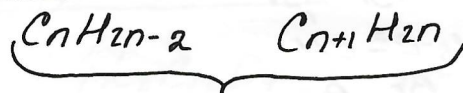
$$\nu(\text{HCl})_{\text{всего}} = 0,2 \cdot 0,01 = 0,002 \text{ моль} +$$

$$\nu(\text{HCl})_{\text{p-p}} = \nu(\text{HCl})_{\text{конц}} = 0,002 \text{ моль}$$

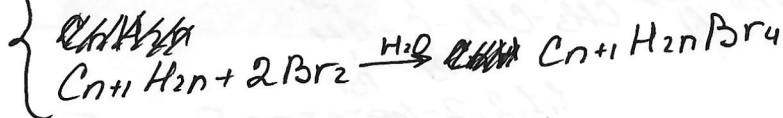
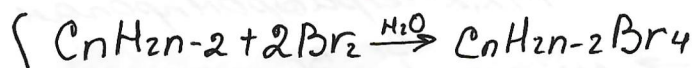
$$V(\text{HCl})_{\text{конц}} = 1 \text{ мл} = 0,001 \text{ л}$$

$$c(\text{HCl})_{\text{конц}} = \frac{0,002}{0,001} = 2 \text{ моль/л} +$$

Ответ: $c(\text{HCl})_{\text{перв}} = 2 \text{ моль/л}$

Задача №7

$$\text{отсн} = 29,6 \text{ г}$$



$$m(\text{Br}_2)_{\text{в}} = 9600 \text{ г}; \omega(\text{Br}_2) = 2\%$$

$$\omega(\text{в-ва}) = \frac{m(\text{в-ва}) \cdot 100}{m_{\text{p-p}}} \Rightarrow m(\text{в-ва}) = \frac{\omega(\text{в-ва}) \cdot m_{\text{p-p}}}{100}$$

$$m(\text{Br}_2)_{\text{в}} = \frac{9600 \cdot 2}{100} = 192 \text{ г}$$

$$\nu(\text{Br}_2) = 192 : 160 = 1,2 \text{ моль} +$$

С1 уз 7

Чистовик

Пусть $\nu(C_nH_{2n-2}) = x$ моль; а $\nu(C_{n+1}H_{2n}) = y$ моль

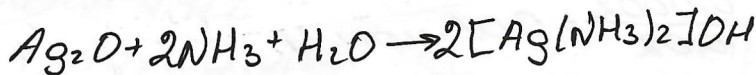
$$\frac{\nu(C_nH_{2n-2})}{\nu(Br_2)_1} = \frac{1}{2} \Rightarrow \nu(Br_2)_1 = 2x \text{ моль}$$

$$\frac{\nu(C_{n+1}H_{2n})}{\nu(Br_2)_2} = \frac{1}{2} \Rightarrow \nu(Br_2)_2 = 2y \text{ моль}$$

$$\begin{cases} (14n-2) \cdot x + (14n+12)y = 29.6 \\ 2x + 2y = 1.2 \end{cases} \Rightarrow y = 2.2 - 0.6n$$

n	y
2	1
3	0.4
4	-0.2

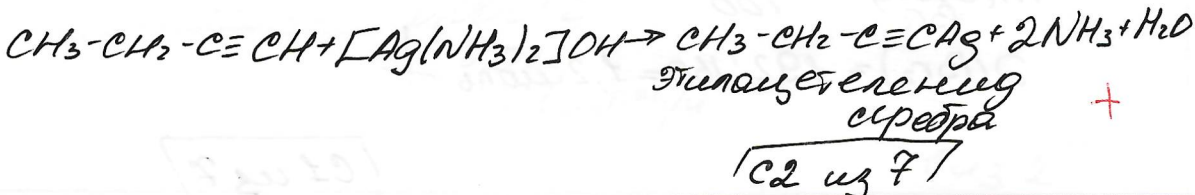
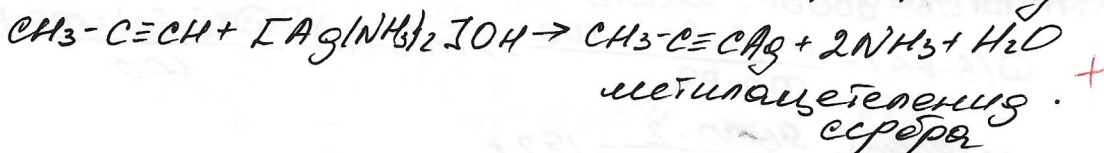
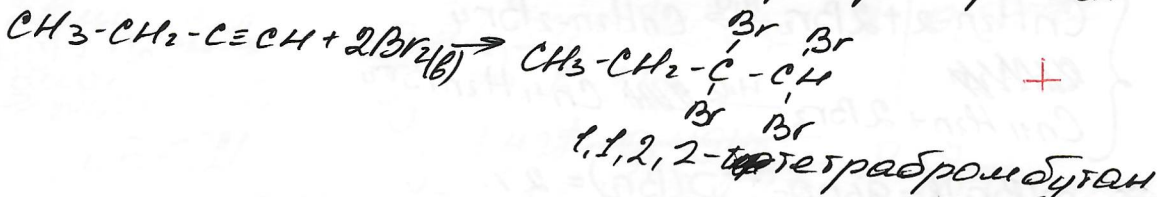
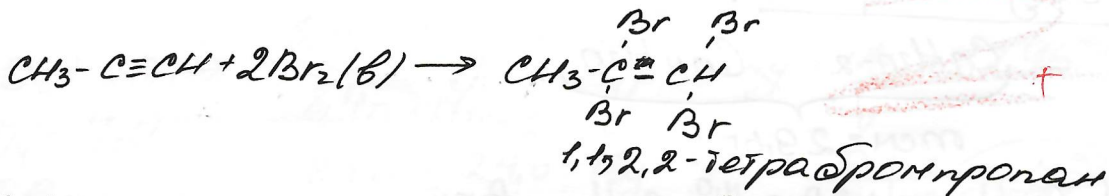
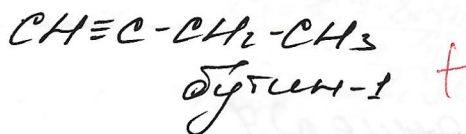
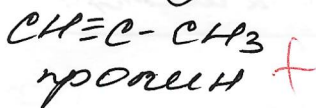
$y = 0.4$ моль $\nu(C_4H_8)$
 $x = 0.2$ моль $\nu(C_3H_4)$



$$m(Ag_2O) = 69.6 \text{ г} \Rightarrow \nu(Ag_2O) = 69.6 : 232 = 0.3 \text{ моль}$$

$$\frac{\nu(Ag_2O)}{\nu([Ag(NH_3)_2]OH)} = \frac{1}{2} \Rightarrow \nu([Ag(NH_3)_2]OH) = 0.6 \text{ моль}$$

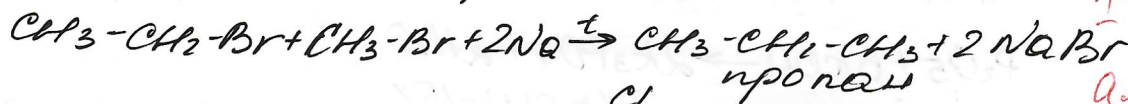
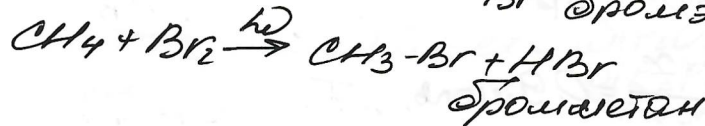
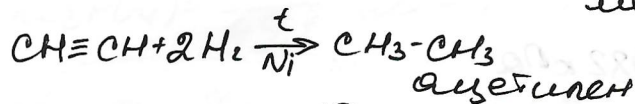
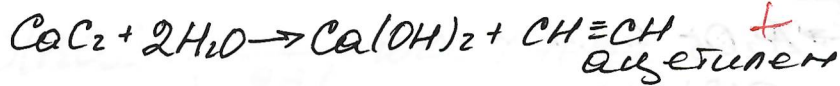
\Rightarrow Оба алкина взаимодействуют с аммиачным раствором оксида серебра \Rightarrow тройная связь у крайних атомов углерода



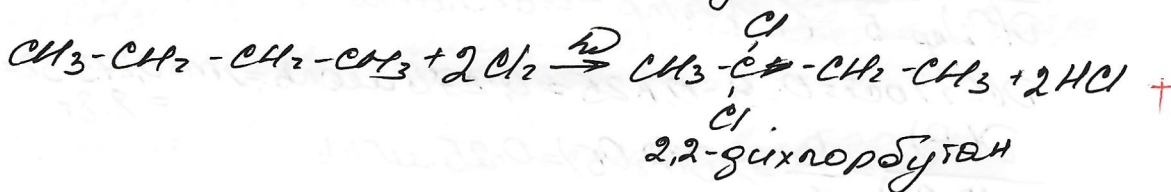
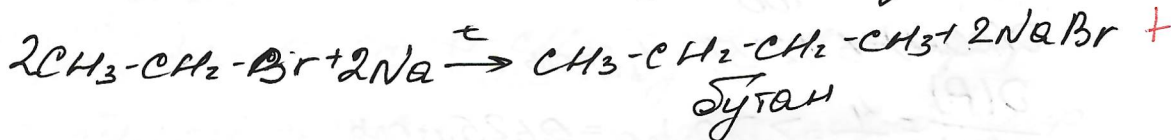
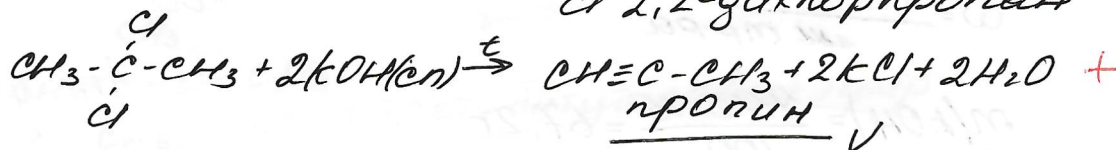
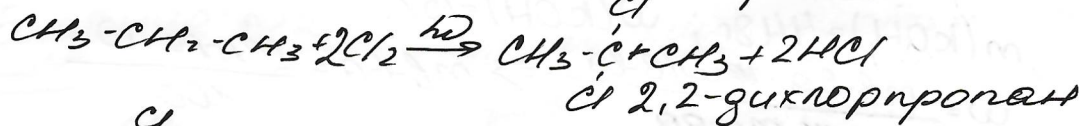
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Чистовик



+ Соесть
Алканов!



СЫВЕТЫ

Задание №1

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~~бутилен-1~~ ?

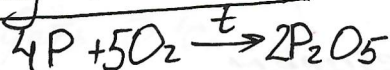


~~Задание №2~~

СЗ и з

Задание №6

Чистовик



$$m(P) = 15,5 \text{ г} \Rightarrow \nu(P) = 15,5 : 31 = 0,5 \text{ моль} +$$

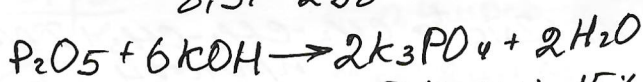
$$\nu(O_2) = 7 \text{ л}$$

$$P_{\text{ж}} = 3,14 \text{ атм} = 318,082 \text{ кПа}$$

$$t = 25^\circ \text{C} \Rightarrow T = 298 \text{ К}$$

$$PV = \nu RT \Rightarrow \nu = \frac{PV}{RT}$$

$$\nu(O_2) = \frac{318,082 \cdot 7}{8,31 \cdot 298} = 0,9 \text{ моль} +$$



$$m(KOH) = 448 \text{ г}; \omega(KOH) = 15\%$$

$$\omega = \frac{m_{\text{в-ва}} \cdot \omega(\text{в-ва})}{m_{\text{р-ра}}} \Rightarrow m_{\text{в-ва}} = \frac{m_{\text{р-ра}} \cdot \omega}{100}$$

$$m(KOH) = \frac{448 \cdot 15}{100} = 67,2 \text{ г}$$

$$\nu(KOH) = 67,2 : 56 = 1,2 \text{ моль} +$$

$$\frac{\nu(P)}{\nu(O_2)_{\text{нр}}} = \frac{4}{5} \Rightarrow \nu(O_2)_{\text{нр}} = 0,625 \text{ моль}$$

$$\nu(O_2)_{\text{ост}} = 0,9 - 0,625 = 0,275 \text{ моль} \Rightarrow m = 0,275 \cdot 32 = 8,8 \text{ г}$$

$$\frac{\nu(P)}{\nu(P_2O_5)} = \frac{2}{1} \Rightarrow \nu(P_2O_5) = 0,25 \text{ моль}$$

$$\frac{\nu(P_2O_5)}{\nu(KOH)} = \frac{1}{6} \Rightarrow \nu(KOH)_{\text{нр}} = P_2O_5 \text{ в избытке}$$

$$\frac{\nu(KOH)}{\nu(P_2O_5)_{\text{нр}}} = \frac{6}{1} \Rightarrow \nu(P_2O_5)_{\text{нр}} = 0,2 \text{ моль}$$

$$\nu(P_2O_5)_{\text{ост}} = 0,25 - 0,2 = 0,05 \text{ моль}$$

$$m(P_2O_5)_{\text{ост}} = 0,05 \cdot 142 = 7,1 \text{ г}$$

$$\frac{\nu(KOH)}{\nu(K_3PO_4)} = \frac{3}{1} \Rightarrow \nu(K_3PO_4) = 0,4 \text{ моль}$$

$$m(K_3PO_4) = 0,4 \cdot 212 = 84,8 \text{ г}$$

$$\frac{\nu(KOH)}{\nu(H_2O)} = \frac{3}{1} \Rightarrow \nu(H_2O) = 0,4 \text{ моль}$$

$$m(H_2O) = 0,4 \cdot 18 = 7,2 \text{ г}$$

$$m_{\text{см}} = 7,2 + 84,8 + 7,1 = 99,1 \text{ г}$$

Не утменно
образ. P₂O₃!

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Чистовик

$$\omega(\text{P}_2\text{O}_5)_{\text{ост}} = \frac{7,1}{99,1} \cdot 100 = 7,16\%$$

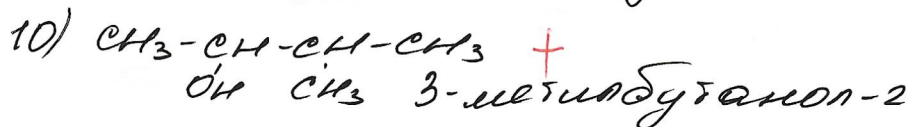
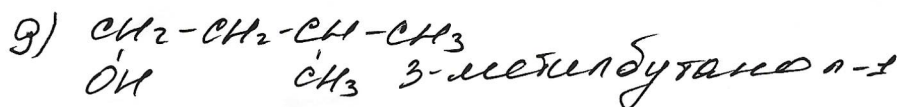
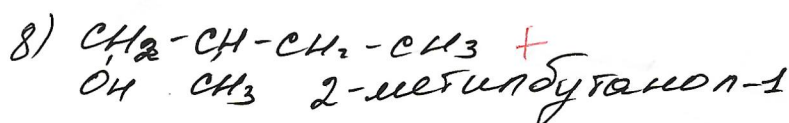
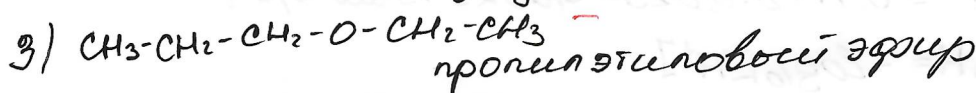
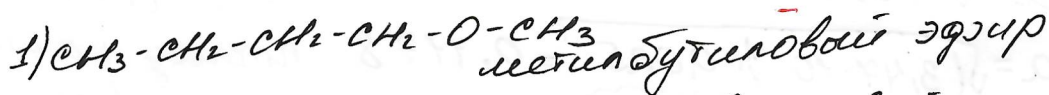
$$\omega(\text{K}_3\text{PO}_4) = \frac{84,8}{99,1} \cdot 100 = 85,57\%$$

$$\omega(\text{H}_2\text{O}) = \frac{7,2}{99,1} \cdot 100 = 7,27\%$$

Ответ: $\omega(\text{P}_2\text{O}_5) = 7,16\%$
 $\omega(\text{K}_3\text{PO}_4) = 85,57\%$
 $\omega(\text{H}_2\text{O}) = 7,27\%$

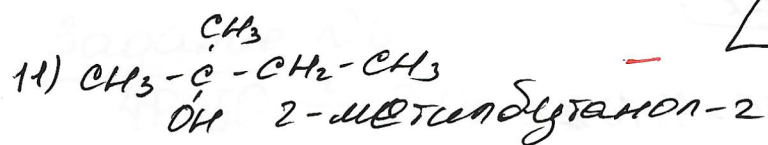
Задание №2

В задании требовалось привести оптимальный изomer



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Чистовик

Задача №4

$$V(\text{C}_4\text{H}_6\text{O}_5)_p = 200 \text{ мл} = 0,2 \text{ л}$$

$$m(\text{C}_4\text{H}_6\text{O}_5) = 0,67 \text{ г} \Rightarrow \rho(\text{C}_4\text{H}_6\text{O}_5) = 0,67 : 134 = 0,005 \text{ моль/л}$$

$$c = \frac{D}{V}$$

$$c(\text{C}_4\text{H}_6\text{O}_5) = \frac{0,005}{0,2} = 0,025 \text{ моль/л}$$

$$K_1 = 3,47 \cdot 10^{-4}$$

$$a = \sqrt{K / (18 - 6a)}$$

$$a = \sqrt{3,47 \cdot 10^{-4} : 0,025} = 0,1178$$

$$c(\text{H}^+) = a \cdot c(18 - 6a)$$

$$c(\text{H}^+) = 0,1178 \cdot 0,025 = 0,002945 \text{ моль/л}$$

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

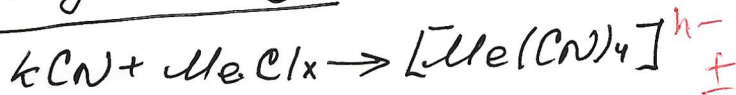
$$\text{pH} = -\log_{10} [0,002945] = 2,53$$

Ответ: $\text{pH} = 2,53$

нет объема
потому равновесная
конц-ция H^+ -тов =
исходной конц.

С6437

Задача №3

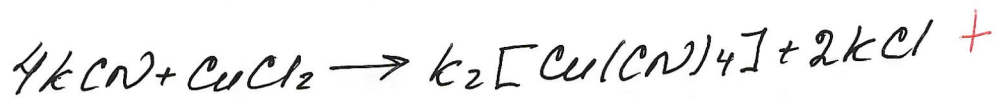
Шистовик

$$\omega(Me) = 38,1\%$$

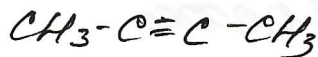
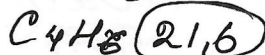
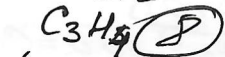
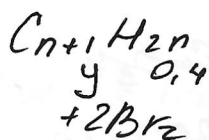
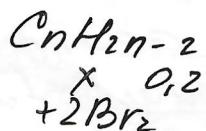
$$\omega(\%) = \frac{Ar(\%) \cdot n \cdot 100}{M(B-ва)}$$

$$\text{Пусть } M(Me) = x \text{ г/моль}$$

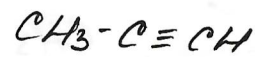
$$38,1 = \frac{x \cdot 100 \cdot 1}{x + 104} \Rightarrow x = 64 \text{ г/моль} \Rightarrow Cu$$

С7 из 7

Черновик



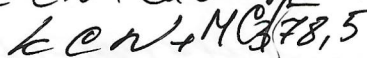
$$(14n-2)x + (14n+12)y = 29,6$$



$$2x + 2y = 1,2$$

$$x = 0,6 - y$$

$$(14n-2)(0,6-y) + (14n+12)y = 29,6$$



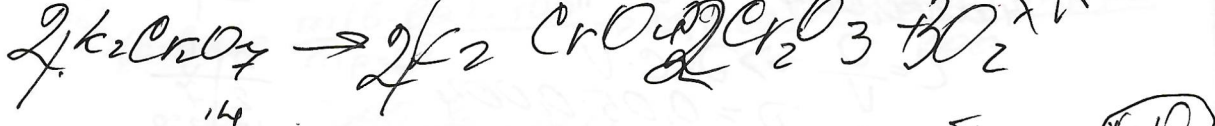
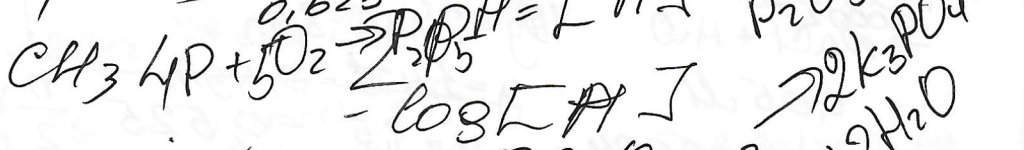
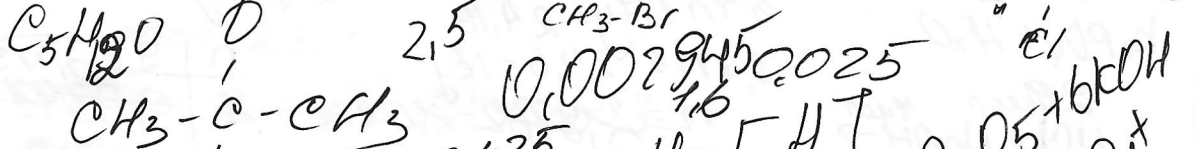
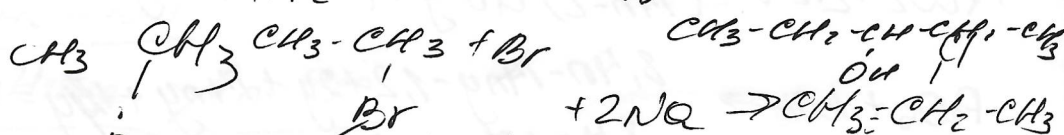
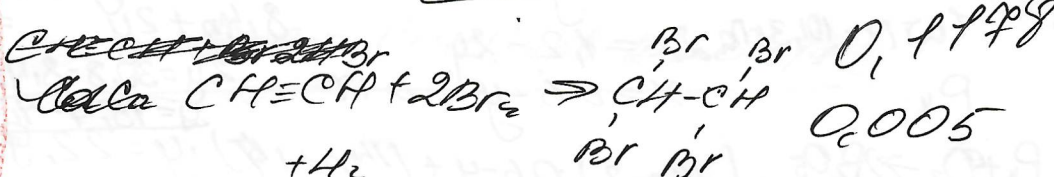
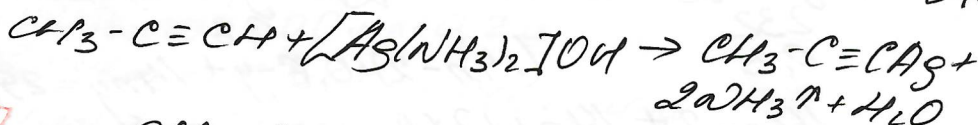
$$8,4n - 14ny - 1,2 + 2y + 14ny + 12y = 29,6$$

$$8,4n + 14y = 30,8$$

$$14y = 30,8 - 8,4n$$

$$y = 2,2 - 0,6n$$

$$\frac{n}{2} = \frac{y}{1} \Rightarrow \frac{n}{2} = \frac{2,2 - 0,6n}{1}$$



$$0,5 \sqrt{7} \quad P = 318,082 \quad L = 298 \quad 0,9 \quad PV = DRT \quad D = \frac{PV}{R \sqrt{2432}} = 0 \frac{10}{6}$$

Черновик



20.0.0.0.0.0

CH₃

200 мн

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

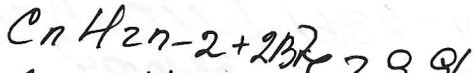
$\frac{0.2420 - 0.02}{200 \text{ мн}} \cdot 1 \text{ мин}$

$C = \frac{D}{V} \Rightarrow D = C \cdot V = 0.002 \text{ мн}$

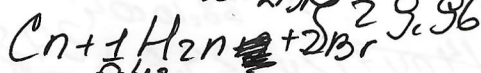
$0.01 = \frac{D}{20}$
 $x = \frac{D}{1 \text{ мин}}$



$M = 134 \cdot 0.01 =$



0.005



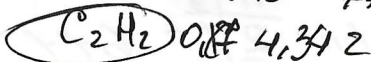
0.025 мн

18.86%

C_3H_5 0.43

$9600r \quad D = 2i \Rightarrow M = 192 \Rightarrow 1,2$

17.83 17.753



2.32

0.3

$(14n-2) \cdot 0.6 \cdot y + 14ny = 29.6$

$14n-2 \neq 14n+12+3$

~~28n~~

$(14n-2) \cdot x + (14n+12) \cdot y = 22.96$

$2x + 2y = 1.2$

$8.4n - 1.2 + 2y = 29.6$

$8.4n + 2y = 30.8$

$t_{атм} = 101.3 \text{ кПа}$

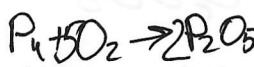
$2x = 1.2 - 2y$

$2y = 30.8 - 8.4n$

P_4

$x = 0.6 - y$

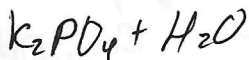
$y = 15.4 - 4.2n$



$(14n-2) \cdot 0.6 \cdot y + (14n+12) \cdot y = 22.96$



$8.4n - 1.2 + 2y + 1.2 + 2y + 1.2 + 2y = 22.96$



$8.4n + 1.2 + 2y = 24.16$

$8.4n = 24.16 - 1.2 + 2y$

$n = \frac{24.16 - 1.2 + 2y}{8.4}$

$1.8y = 24.16 - 8.4n$

$y = \frac{24.16 - 8.4n}{1.8}$

$y = 1.51 - 0.525n$

n	y
2	0.433
2	0.932

n	y
2	0.46
3	0.14

$C = \frac{D}{V} \Rightarrow D = C \cdot V$

$D = 0.05 \cdot 0.004$

0.0002

0.02

0.01 моль/л

n	y
2	7
3	2.8
	1.4

1432