



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

**ОЛИМПИАДНАЯ РАБОТА**

Наименование олимпиады школьников: **«Ломоносов»**

Профиль олимпиады: **Химия**

ФИО участника олимпиады: **Гордиевская Мария Владимировна**

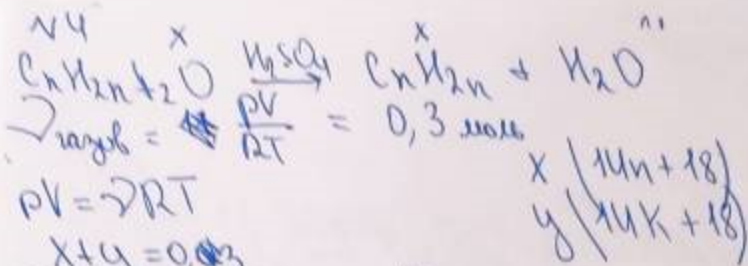
Класс: **11**

Технический балл: **90**

Дата проведения: **27 февраля 2022 года**

9394289	8 баллов	16 баллов	16 баллов	20 баллов,	10 баллов масса карбоната натрия и кр. г. определена не верно, количество азотной кислоты в остатке до прибавления карбоната не правильно	20 ба лл ов	90 ба лл ов
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Ливанцова Л.И.



$$14x + 18x + 14y + 18y = 15,9$$

(53)

$$14x + 18(0,3 - y) + 14y + 18y = 15,9$$

~~14x + 18y = 15,9~~

~~14x + 18y = 15,9~~

$$14x + 5,4 - 18y + 14y + 18y = 15,9$$

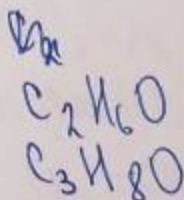
$$14x + 14y = 10,5$$

$$xA + yB = 15,9$$

$$0,3A - Ay + yB = 15,9$$

$$10,5 \quad 35$$

$$35 = \frac{14nx + 14ky}{0,3}$$

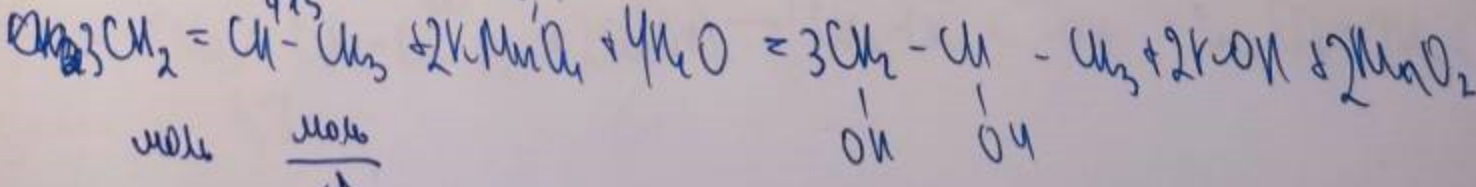
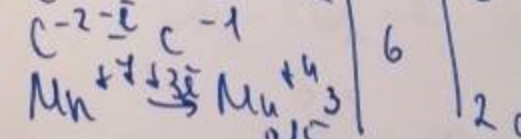
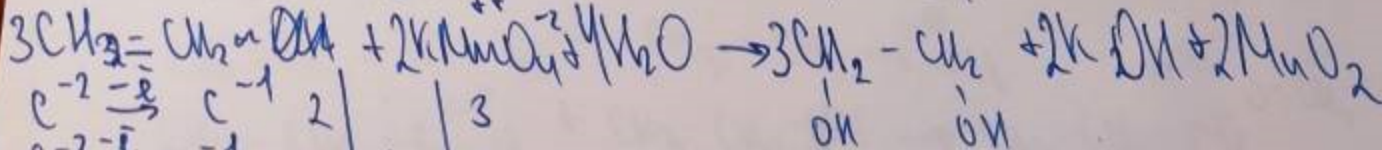


$$10,5 = 14nx + 14ky$$

$$10,5 = 2,1n + 2,1k$$

$$5 = n + k$$

$$-1 \quad 1 \quad 0 \quad 0 \quad 0 \quad 0$$

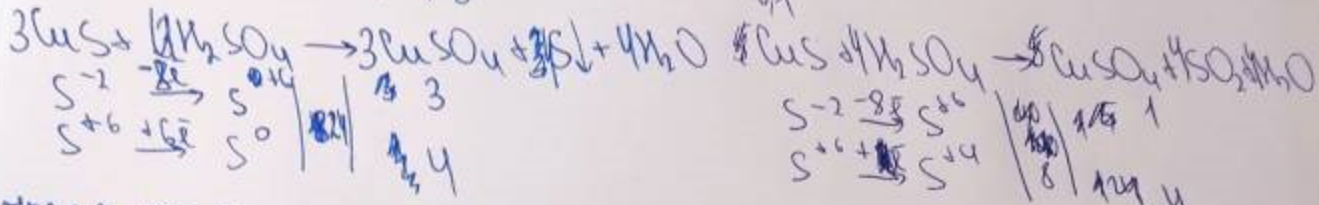
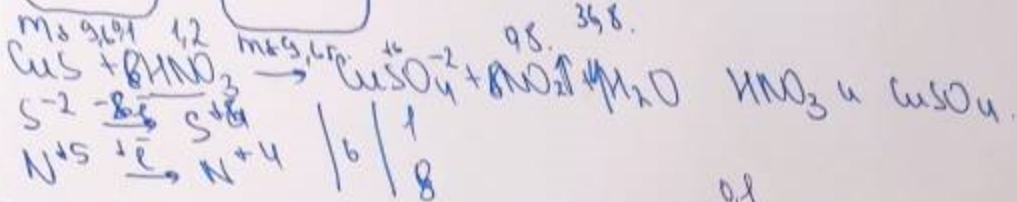
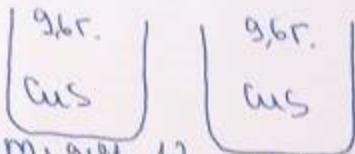


$$V(KMnO_4) = 0,5 \text{ л}$$



5.

Упробен.

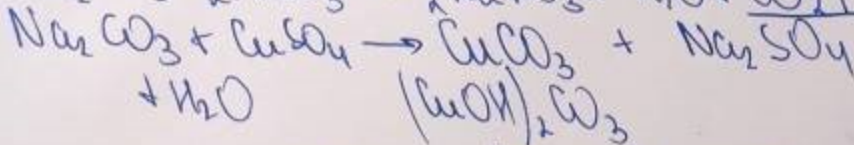
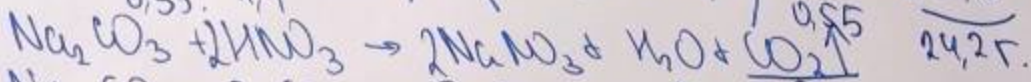


15,6

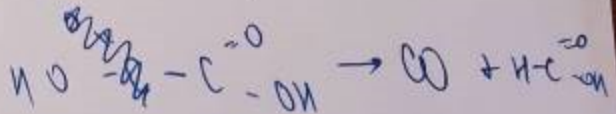
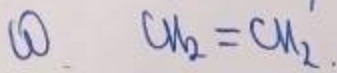
59,5

$$(m + 9,6 + 120 - 36,8) \cdot 0,55 = (m + 9,6 + 142,7) \cdot 1,1$$

$$m + 9,6 + 92,8 - m - 152,3 = -59,5$$

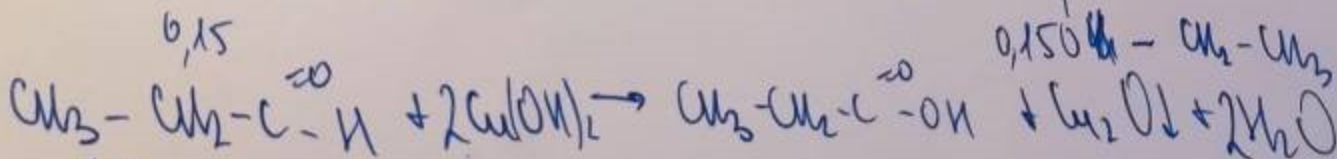
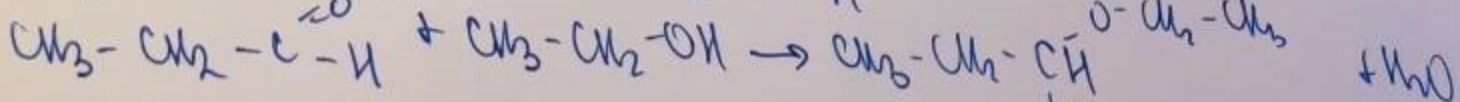
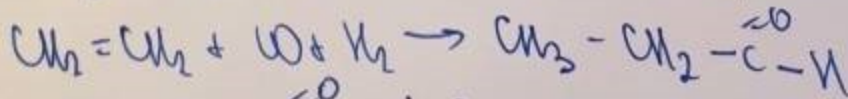
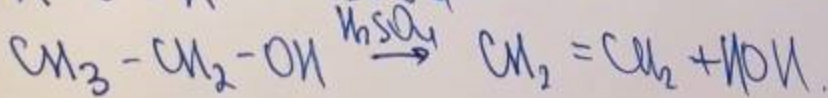
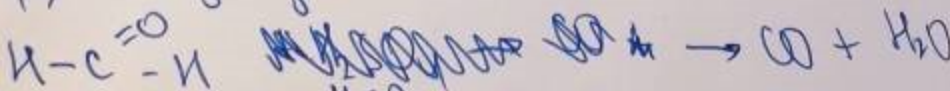


$$m(Na_2CO_3) = 58,3 + 59,5 = 117,8 \text{ г.}$$



6.

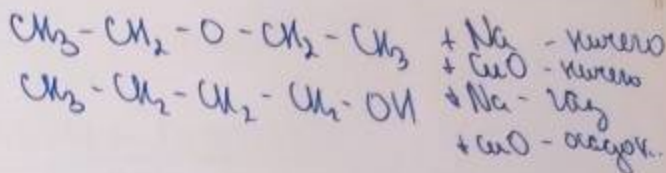
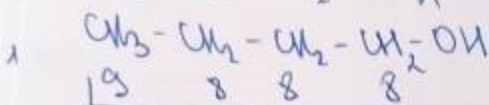
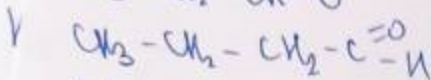
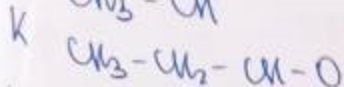
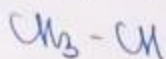
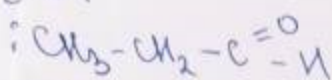
$\xrightarrow{H^+}$  - аутогез.



8,7г.

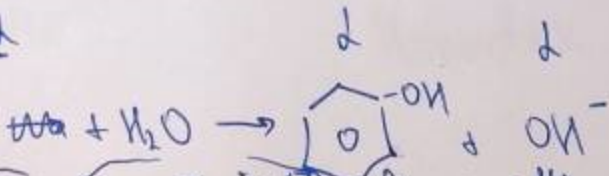
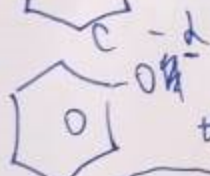
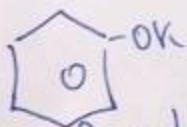
7

2 N1

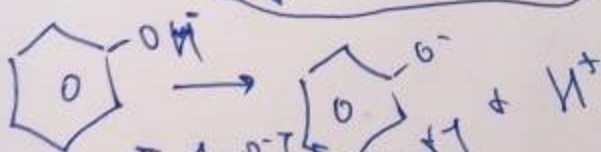


Упробек

N2



$$K_2 = \frac{[a] \cdot [\text{OH}^-] \cdot [\text{H}^+]}{[\text{C}^-] \cdot [\text{H}^+]} = \frac{10^{-14}}{10^{-10}} = 10^{-4} = \frac{d^2}{c-d}$$



$$K_{1g} = \frac{[\text{C}^-] \cdot [\text{H}^+]}{[\text{C}^-] \cdot [\text{OH}^-]}$$

$\text{pOH} = 14 - 11 = 3$

$[\text{OH}^-] = 0,001 = 10^{-3}$

$\frac{d^2}{c-d} = 10^{-4}$

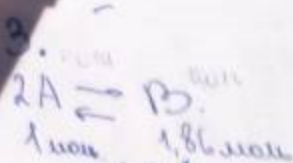
$\frac{0,001 \cdot 10^{-6}}{c - 10^{-3}} = 10^{-4}$

$10^{-4} \cdot c - 10^{-7} = 10^{-6}$

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

$c = 0,011 \frac{\text{моль}}{\text{л}}$





$$K_p = \frac{1,86}{12} = 1,86$$

$$K_p = \frac{K_n}{K_0}$$

$$1,86 = \frac{5 \cdot 10^{-3}}{K_0}$$

$$K_0 = 2,688 \cdot 10^{-3}$$

$$\begin{matrix} 0,014 \\ 0,026 \end{matrix}$$

$$132,653 = \frac{K_n}{K_0} \cdot 5 \cdot 10^{-3}$$

$$3,77 \cdot 10^{-5}$$

$$\Delta = \frac{1 \cdot 101,3}{8,31 \cdot 303} = 0,04 \text{ моль}$$

$$45,9 = \frac{A \cdot 0,014 + B \cdot 0,026}{0,04}$$

моль

$$3,036 = A \cdot 0,014 + B \cdot 0,026$$

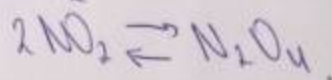
$$217 = A + 1,86B$$

$$217 = A + 1,86(A \cdot 2)$$

$$217 = 3,72A + A$$

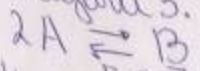
$$A = 46$$

$\text{NO}_2$



Кернолук

Задача 3.



$$K_p = \frac{[B]}{[A]^2}$$

$$V = \frac{101,3}{8,31 \cdot 303} = 0,04 \text{ моль}$$

$$V(A) = x$$

$$V(B) = 1,86x$$

$$x = 0,014$$

$$1,86x = 0,026$$

$$K_p = \frac{0,026}{0,014^2} = 132,653$$

$$K_p = \frac{K_p}{K_0} \quad 132,653 = \frac{5 \cdot 10^{-3}}{K_0}$$

$$2Mr(A) = Mr(B)$$

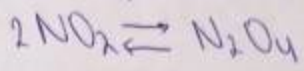
$$75,9 = \frac{0,014A + 0,026B}{0,04}$$

$$3,036 = 0,014A + 0,026B \quad | \cdot 0,014$$

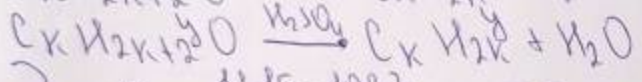
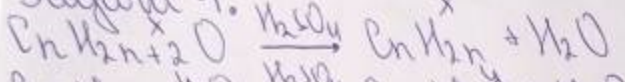
$$217 = A + 1,86 \cdot 2A$$

$$217 = 4,72A$$

$$A = 46 \Rightarrow A - NO_2, B - N_2O_4$$



Задача 4.



$$xn = a$$

$$yk = b$$

$$V_{\text{исход}} = \frac{11,15 \cdot 101,3}{8,31 \cdot 273,15} = 0,3 \text{ моль}$$

$$x + y = 0,3 \text{ моль}$$

$$x(14n + 18) + y(14k + 18) = 15,9$$

$$14a + 18b = 10,5$$

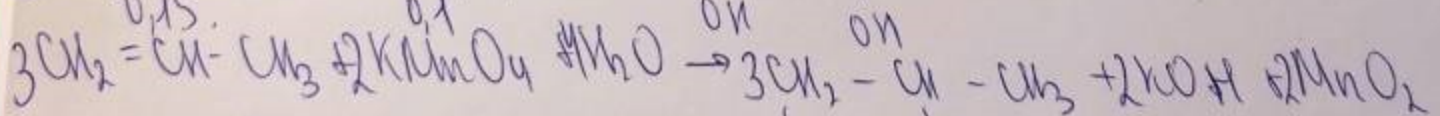
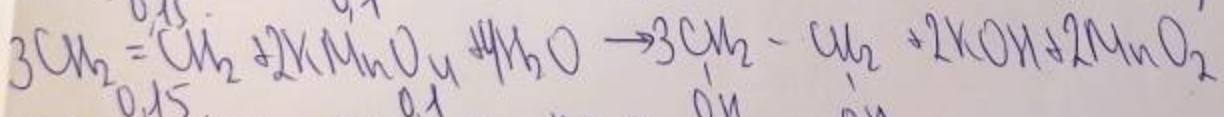
Решение  $x = y$ .

$$2,1k + 2,1n = 10,5$$

$$k + n = 5 \quad \text{Пускаем } k = 2, n = 3.$$

$$m(C_2H_6O) = 46 \cdot 0,15 = 6,9 \quad w(C_2H_6O) = \frac{6,9}{15,9} = 0,434$$

$$m(C_3H_8O) = 60 \cdot 0,15 = 9 \quad w(C_3H_8O) = \frac{9}{15,9} = 0,556$$



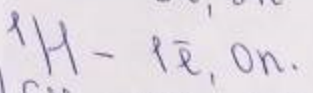
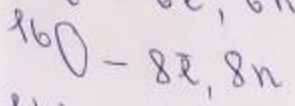
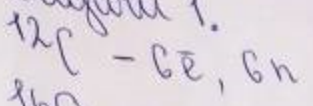
$$V(KMnO_4) = 0,1 + 0,1 = 0,2 \text{ моль}$$

$$V(KMnO_4 \text{ р-ра}) = 0,2 : 0,4 = 0,5 \text{ л}$$



Задача 1.

Условие



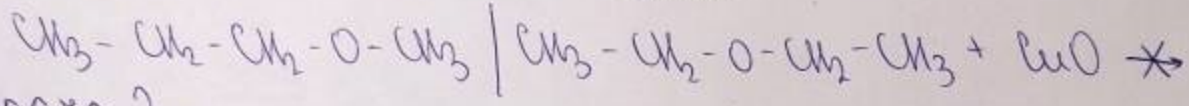
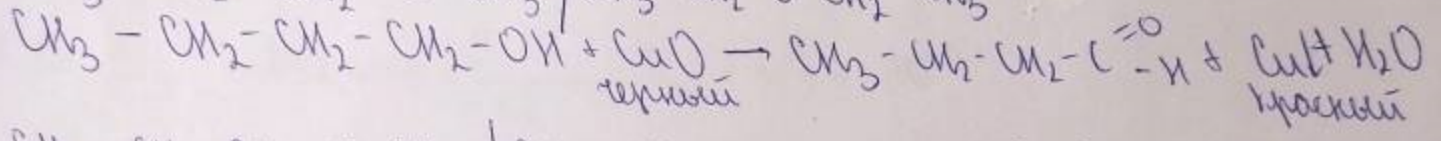
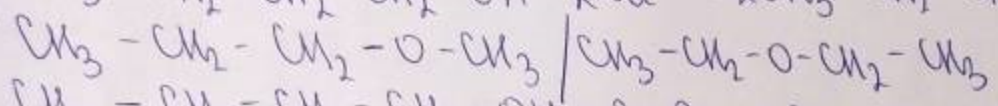
1) CH<sub>3</sub>-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>2</sub>-OH соед. число:

6 + 3 + 6 + 2 + 6 + 2 + 6 + 2 + 8 + 1 = 42e

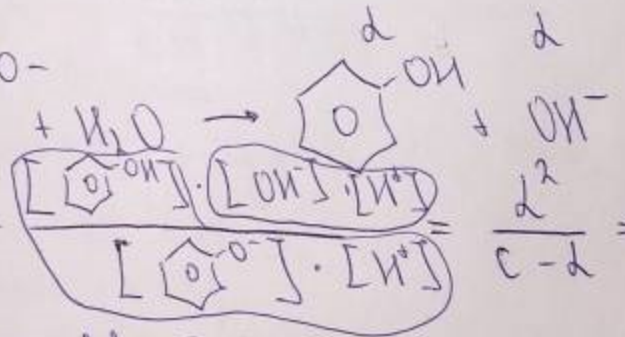
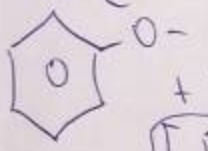
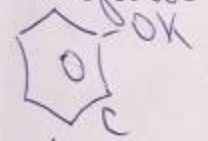
6 + 6 + 6 + 6 + 8 = 32n

2) CH<sub>3</sub>-CH<sub>2</sub>-O-CH<sub>2</sub>-CH<sub>3</sub> или CH<sub>3</sub>-O-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>3</sub> - углерод.

3) 2CH<sub>3</sub>-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>2</sub>-OH + 2Na → 2CH<sub>3</sub>-CH<sub>2</sub>-CH<sub>2</sub>-CH<sub>2</sub>-ONa + H<sub>2</sub>↑



Задача 2.



K<sub>диссоц.</sub> =

$$\frac{[C_6H_5O^-] \cdot [OH^-]}{[C_6H_5OH]} = \frac{d^2}{c-d} = \frac{K_{диссоц}}{K_{осл}} = \frac{10^{-14}}{10^{-10}} = 10^{-4}$$

pOH = 14 - 11 = 3

[OH<sup>-</sup>] = 10<sup>-3</sup> = d

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

c - 10<sup>-3</sup>

$\frac{10^{-6}}{c - 10^{-3}} = 10^{-4}$

c - 10<sup>-3</sup>

10<sup>-4</sup>c - 10<sup>-7</sup> = 10<sup>-6</sup>

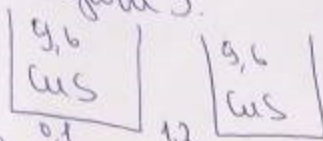
10<sup>-4</sup>c = 10<sup>-6</sup> + 10<sup>-7</sup>

c = 0,011.

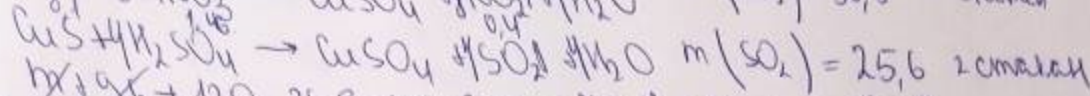
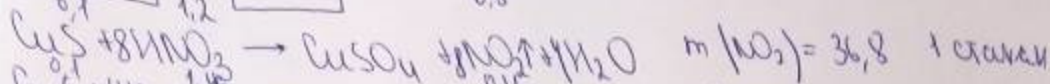


Задача 5.

Умножить.

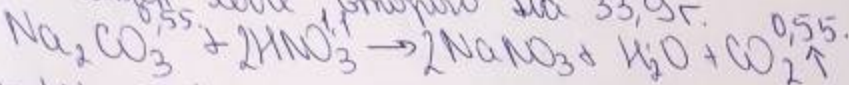


0,8



$$12 \cdot 9,6 + 120 - 36,8 - m - 9,6 - 142,7 + 25,6 = -33,9$$

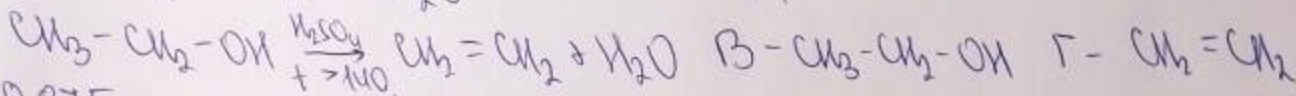
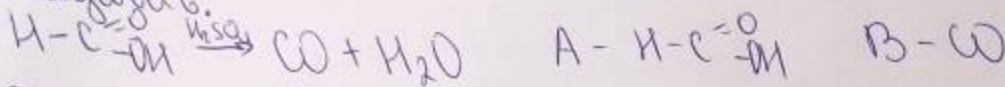
1 масса серы, бромура на 33,9 г.



$$m(\text{Na}_2\text{CO}_3) = 0,55 \cdot (23 \cdot 2 + 12 + 16 \cdot 3) = 58,3 \text{ г}$$

$$m(\text{Na}_2\text{CO}_3 \cdot 10 \text{ H}_2\text{O}) = 58,33 + 33,9 = 92,23 \text{ г}$$

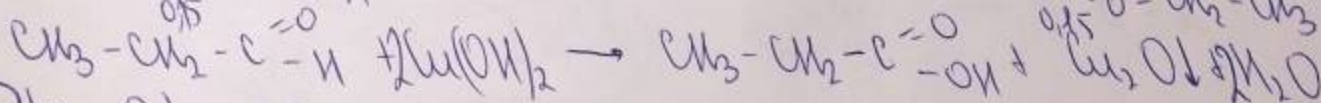
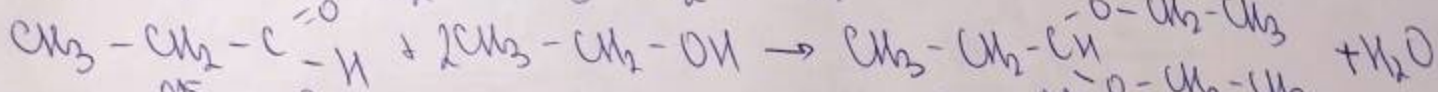
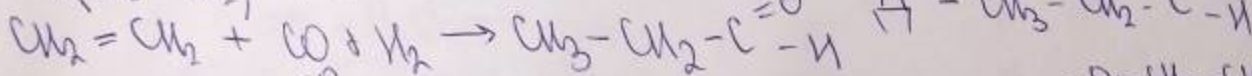
Задача 6.



$$0,875 \cdot 32 = 28$$

$$M(\text{CO}) = 28$$

$$M(\text{CH}_2=\text{CH}_2) = 28$$



$$n(\text{Cu}_2\text{O}) = 0,15$$

$$n(\text{CH}_3-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}) = 0,15 \quad m(\text{CH}_3-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}) = 0,15 \cdot \frac{58}{1} = 8,7 \text{ г}$$

