



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

## **ОЛИМПИАДНАЯ РАБОТА**

Наименование олимпиады школьников: **«Ломоносов»**

Профиль олимпиады: **Химия**

ФИО участника олимпиады: **Иванов Демид Олегович**

Класс: **9**

Технический балл: **65**

Дата проведения: **27 февраля 2022 года**

Шифр 9784701

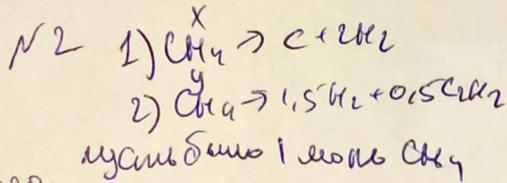
1. 10
2. 10
3. 10 (рассуждения о сере)
4. 10 (есть реакция)
5. 10
6. 15

65

Ле-Дейген И.М.

Учет.

N1  $H-C \equiv C-H$  всего  $14 \bar{e}$ , в 10 граммах пропана в одр. смеси



водород - он один и увеличивается  
 втрое, а в газаре  $6,0 \text{ л} \Rightarrow$  по весу  $CH_4$   
 пропана.

тогда  $\rho(CO_2)_{12} = x \rho(CH_4)_2 = y$  тогда  $\rho(H_2) = 2x + 1,5y \rho(CO_2) = 0,5y$

тогда  $3,50k = \frac{2(2x + 0,5y) + 2(0,5y) + 16(1-x-y)}{2x + 2y + 1-x-y} \rho(CH_4) = 1-x-y$   
 $= \frac{-12x + 16}{1+x+y} \Rightarrow 7 + 7x + 7y = -12x + 16$

$\Rightarrow \begin{cases} 19x + 7y = 9 \\ 16 = 1+x+y \end{cases} \Rightarrow \begin{cases} x = 0,14 \\ y = 0,12 \end{cases} \Rightarrow 40\% \text{ пропана, } 20\% \text{ бутана}$

В

$\frac{3c_1 + 2c_2}{5} = 0 \quad \frac{4c_1 + 3c_2}{1} = 0 \quad \frac{3c_1 + 2c_2}{5} = 0,1$

Сист. линейных уравнений относительно  $c_1 = 1,5M, c_2 = 2M$

$\Rightarrow \frac{1 \cdot 0,15 + (-2) \cdot x}{1+x} = 1 \Rightarrow x = 0,1666 \Rightarrow c_1 : c_2 = 1 : 0,1666 = 6 : 1$

Ответ: 6:1 ;  $c_1 = 1,5M$ ;  $c_2 = 2M$

N3 пусть  $M(A) = 122, M(Y) = 52 \Rightarrow M(O_{см}) = 4,25 \cdot 2 \left(\frac{17}{4}\right)$   
 $M(соед) = 172$

$\Rightarrow \omega(A) \text{ в } X = \frac{17 \cdot 4,25}{12} = 0,944 \text{ и } 0,941176$ . Перебрав разн. степенямм значениям получаем  $X - H_2S \left(\frac{32}{34} = 0,9411\right) A - S$   
 $\gamma$  - углерод.

Решение -  $S + \frac{2}{n} AH_n \rightarrow H_2S + \frac{2}{n} A \Rightarrow M(A) = \frac{4,25}{0,175 \cdot 2 \cdot n}$   
 $\rho(S) = \frac{12}{32} = 0,375$

при  $x = 9$  получаем  $\gamma - NH_3$  - азотистый водород

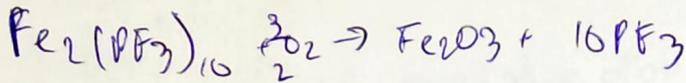
№ 6 это  $Fe_2(CF_4)_{10}$  /  $Fe_2(PF_3)_{10}$  суммола



мысли  $Fe_2(CF_4)_{1002}$ , тогда Fe  $100 : 8786 = 11,286\%$

$w(Fe) = \frac{11,286}{100} = 0,11286$        $w(CF_4)_{10} = 88,71\%$        $\frac{880}{880 + 56 \cdot 2} = 0,8871$

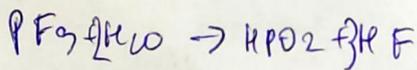
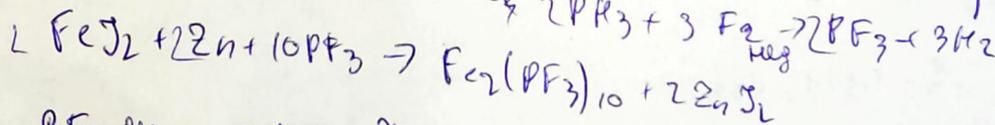
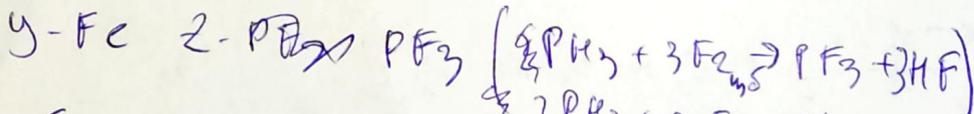
$M(PF_3) = M(CF_4)$        $PF_3$  и  $CF_4$  weigh equally.  $PF_3$  более сложна

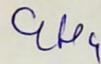
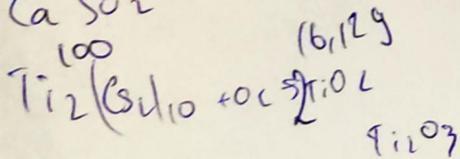
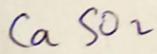
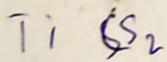
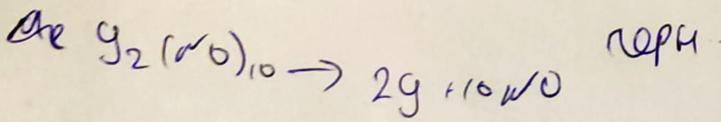


$m(Fe_2O_3) = 100 : 62 = 16,129$        $D(Fe_2O_3) = D(Fe_2(PF_3)_{10}) = \frac{160}{880 + 112} = 0,1$

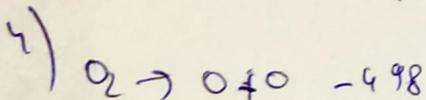
$M(Fe_2O_3) = \frac{16,129}{0,108} = \frac{160}{0,108} = Fe_2O_3$

$CF_4$  number mass, between of  $PF_3$ .  $\Rightarrow$  X -  $Fe_2(PF_3)_{10}$





0,8871



$E(\text{O}=\text{O}) = 498 \text{ kJ/mol}$



9(129)

$106 \text{ kJ} = E(\text{O}=\text{O}) - 2E(\text{O}-\text{O})$

(Z<sub>H16</sub>)

$x = 11129 - x : 5$

Co: 82,56

Fe 87,63

Mn: 88,27

Cu 81,786

M: 82,24

Sc: 4970,716

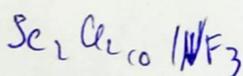
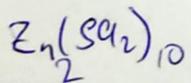
C<sub>4</sub>: 99,946

Zn: 102,77

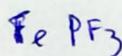
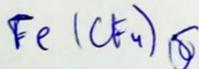
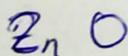
Al: 42,43

(G<sub>9</sub>: 108,5)

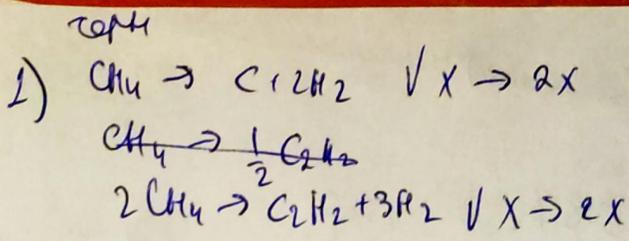
(Z<sub>H16</sub>)



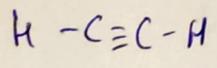
16(129)



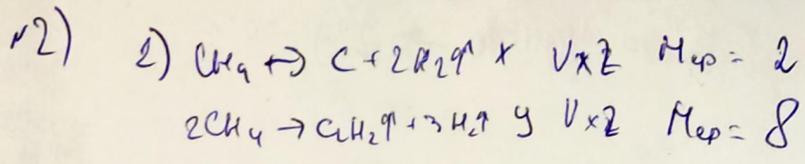
Масса:  $\neq$



$\sqrt{H_4 H}$

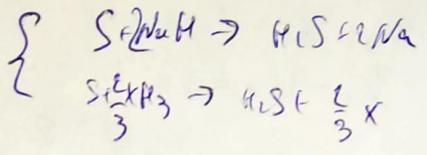


$\bar{e} = 2 \cdot 6 + 2 \cdot 1 = 14 \bar{e}$   
 в окр зарядов  $1 + 2 \cdot 4 \cdot 1 = 10 \bar{e}$



$M_{CH_4} = 16$

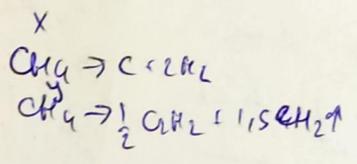
$M = 7$



$\frac{4,25x}{M} = 0,375$   
 $M_{O_2} = 16$

$\rho(CO_2) = 2x + 1,5y$   
 $\rho(C_2H_2) = 0,5y$   
 $\rho(CH_4) = 1 - x - y$

$7 = \frac{4x + 3y + 16 \cdot 0,5y + (1 - x - y)16}{2x + 2y + 1 - x - y} = \frac{4x + 3y + 8y + 16 - 16x - 16y}{1 + x + y}$



$7 = \frac{4x + 3y + 13y + 16 - 16x - 16y}{1 + x + y} = \frac{-12x + 7y + 16}{1 + x + y}$

$7 + 7x + 7y = -12x + 16$

$19x + 7y = 9$

$\frac{1 + 2(x+y)}{1+x+y} \cdot 16 = 1 - x - y + 2x + 2y \quad 1,6 = 1 + x + y$

$x + y = 0,6$

$x = 0,4 \quad y = 0,2$

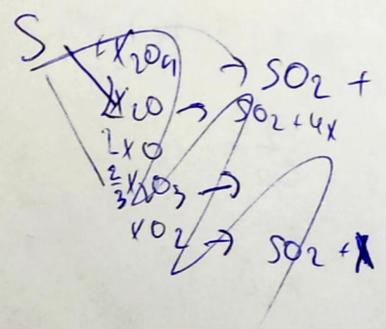
нз 46% б саны во % бергеннен

$2,4 : 1$

$M = 17x \quad m(\bar{e}) = 4,25x$

$x = 12 \quad V \quad 15 \quad C_4$

SOL  
 $H_2S$   
 $S + xH_2$

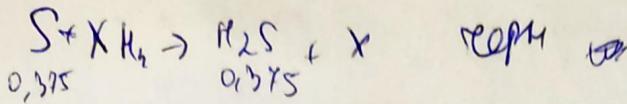


$27 \quad 1n$

$H_2S$

$m(x) = 12,75x \quad w(A) = 0,944$

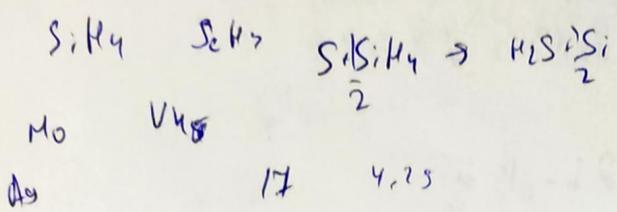
$S + xH$



$$\frac{4,251}{n} = 0,375$$

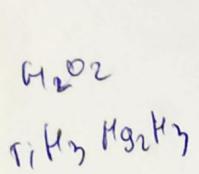
$$0,375n = 4,251$$

$$n = 11,187n$$

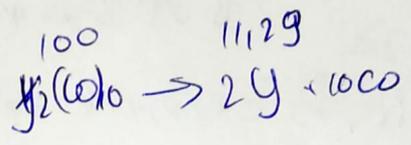


12:5

12 5 4,252



H<sub>2</sub>  
H<sub>4</sub>



$$S) 4C_1 = 3C_2$$

$$4C_1 - 3C_2 = 0$$

$$C_1 = 0,3$$

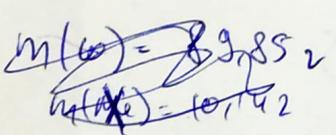
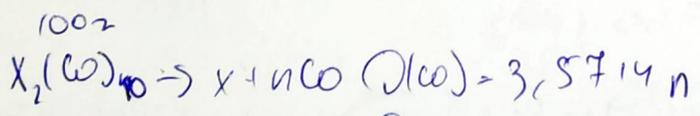
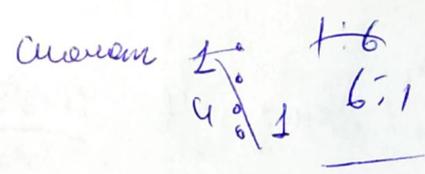
$$3C_1 - 2C_2 = 0,1$$

$$C_2 = 0,4$$

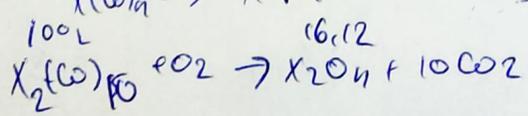
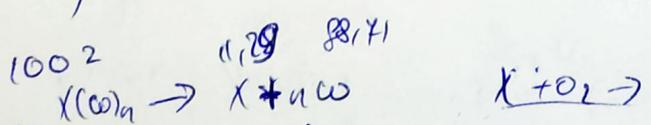
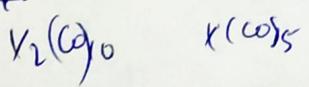
$$C_1 = 1,5 \quad C_2 = 2$$

$$1) 3C_1 \quad 2C_2 \quad \rho(H^+) = 0,5$$

$$\begin{cases} 0 = \frac{4C_1 - 3C_2}{4} \\ 0,1 = \frac{3C_1 + 2C_2}{5} \end{cases} \quad C_1 = 1,5 \quad C_2 = 2$$



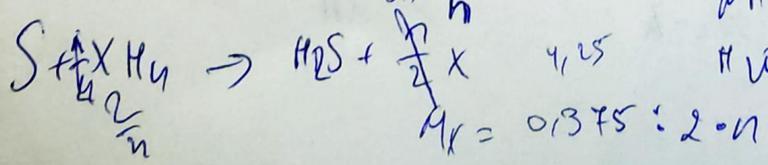
$$\rho(H_2) = 3,5714 n : 8,86 = 0,40309 n$$



$$X = 17,36n$$

$$\frac{100}{29 + 480} = \frac{16,12}{29 + 16n}$$

n<sub>O</sub>  
CO  
NH<sub>3</sub>  
H<sub>2</sub>O



Учет.

N1  $H-C \equiv C-H$  всего  $14\bar{e}$ , в 10 граммах пропана в одр. смеси

N2 1)  $CH_4 \rightarrow C + 2H_2$   
 2)  $CH_4 \rightarrow 1,5H_2 + 0,5C + H_2$   
 пусть было  $x$  молей  $CH_4$

водород - он один и увеличивается  
 втрое, а в газаре в 1,6 раз  $\Rightarrow$  по весу  $CH_4$   
 пропана.

тогда  $\rho(CO_2)_{12} = x \rho(CH_4)_2 = y$  тогда  $\rho(H_2) = 2x + 1,5y \rho(CO_2) = 0,5y$

тогда  $3,50k = \frac{2(2x + 0,5y) + 2(0,5y) + 16(1-x-y)}{2x + 2y + 1-x-y} \rho(CH_4) = 1-x-y$   
 $= \frac{-12x + 16}{1+x+y} \Rightarrow 7 + 7x + 7y = -12x + 16$

$\Rightarrow \begin{cases} 19x + 7y = 9 \\ 16 = 1+x+y \end{cases} \Rightarrow \begin{cases} x = 0,14 \\ y = 0,12 \end{cases} \Rightarrow 40\% \text{ пропана, } 20\% \text{ бутана}$

В

$\frac{3C_1 + 2C_2}{5} = 0 \quad \frac{4C_1 + 3C_2}{1} = 0 \quad \frac{3C_1 + 2C_2}{5} = 0,1$

Сист. линейных уравнений относительно  $C_1 = 1,5M \quad C_2 = 2M$

$\Rightarrow \frac{1 \cdot 0,15 + -2 \cdot x}{1+x} = 1 \Rightarrow x = 0,1666 \Rightarrow C_1 : C_2 = 1 : 0,1666 = 6 : 1$

Ответ: 6:1 ;  $C_1 = 1,5M$ ;  $C_2 = 2M$

N3 пусть  $M(A) = 122, M(Y) = 52 \Rightarrow M(O_{см}) = 4,25 \cdot 2 \left(\frac{17}{4}\right)$   
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$\Rightarrow \omega(A) \text{ в } X = \frac{17 \cdot 4,25}{12} = 0,944 \text{ и } 0,941176$ . Перебрав разн  
 степенными значениями получаем  $X - H_2S \left(\frac{32}{34} = 0,9411\right) A - S$   
 $\gamma$  и др.

Решение -  $S + \frac{2}{n} AH_n \rightarrow H_2S + \frac{2}{n} A \Rightarrow M(A) = \frac{4,25}{\frac{2}{n} \cdot 0,9411 \cdot 2 \cdot n}$   
 $\rho(S) = \frac{12}{32} = 0,375$

при  $x = 9$  получаем  $\gamma - NH_3$  - элемент ванадия

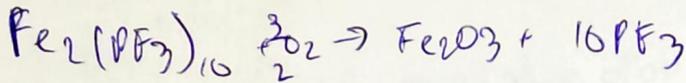
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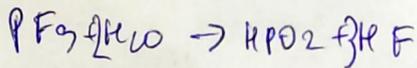
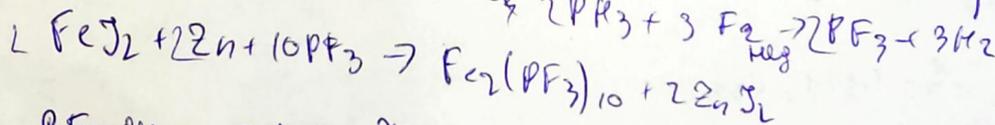
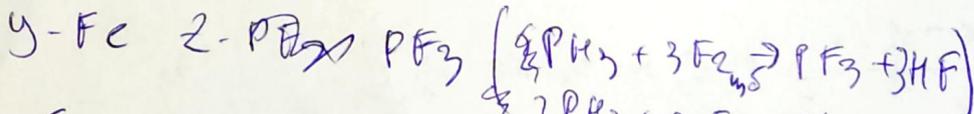
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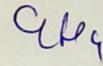
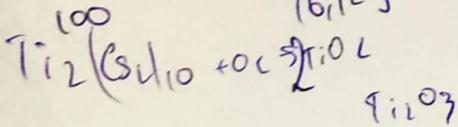
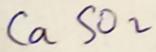
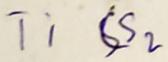
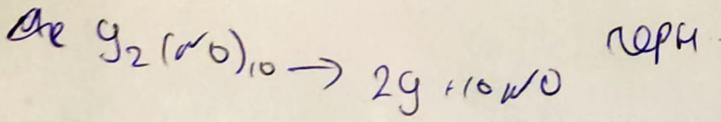


$m(Fe_2O_3) = 100 : 62 = 16,129$        $D(Fe_2O_3) = D(Fe_2(PF_3)_{10}) = \frac{160}{880 + 112} = 0,1$

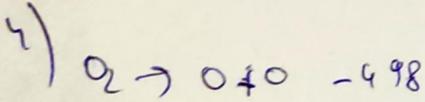
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$CF_4$  number mass, between of  $PF_3$ .  $\Rightarrow$  X -  $Fe_2(PF_3)_{10}$





0,887r



$E(\text{O}=\text{O}) = 498 \text{ kJ/mol}$



9(12g)

$106 \text{ kJ} = E(\text{O}=\text{O}) - 2E(\text{O}-\text{O})$

(2H<sub>10</sub>)

$x = 11,29 - x : 5$

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Mn: 88,27

Cu 81,786

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Sc: 4970,716

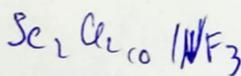
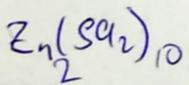
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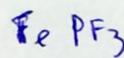
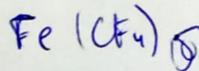
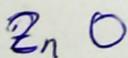
Al: 42,43

(G: 108,5)

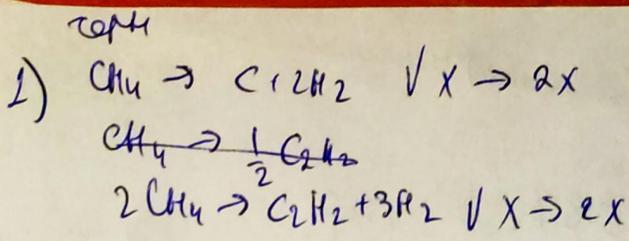
(I H<sub>10</sub>)



16,12g

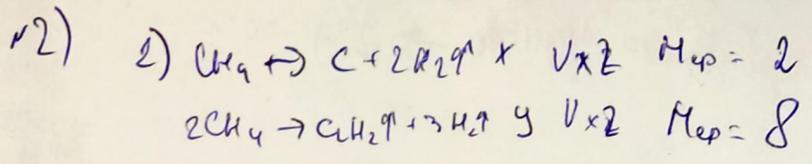


Масса:  $\neq$



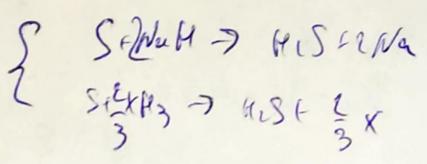
$\sqrt{H_4 H}$

$H-C \equiv C-H \quad \bar{e} = 2 \cdot 6 + 2 \cdot 1 = 14 \bar{e}$   
 в окр заряде  $1 + 2 \cdot 4 \cdot 1 = 10 \bar{e}$



$M_{CH_4} = 16$

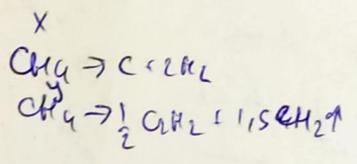
$M = 7$



$\frac{4,25x}{M} = 0,375$   
 $M_{O_2} = 16$

$\rho(CO_2) = 2x + 1,5y$   
 $\rho(C_2H_2) = 0,5y$   
 $\rho(CH_4) = 1 - x - y$

$$7 = \frac{4x + 3y + 16 \cdot 0,5y + (1 - x - y)16}{2x + 2y + 1 - x - y} = \frac{4x + 3y + 8y + 16 - 16x - 16y}{1 + x + y}$$



$$7 = \frac{4x + 3y + 13y + 16 - 16x - 16y}{1 + x + y} = \frac{-12x + 7y + 16}{1 + x + y}$$

$7 + 7x + 7y = -12x + 16$   
 $19x + 7y = 9$

$\frac{1 + 2(x+y)}{1+x+y} \cdot 16 = 1 - x - y + 2x + 2y$   
 $1,6 = 1 + x + y$   
 $x + y = 0,6$

$x = 0,4 \quad y = 0,2$

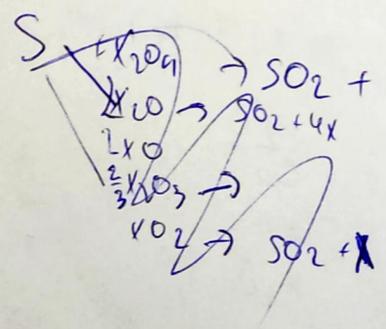
нз 46% б саны во % бергеннен

$2,4 : 1$

$M = 17x \quad m(\bar{e}) = 4,25x$

$x = 12 \quad V \quad 15 \quad C_4$

sol  
 $H_2S$   
 $S + xH_2$

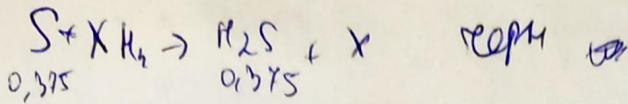


$27 \ln$

$H_2S$

$m(x) = 12,75x \quad w(A) = 0,944$

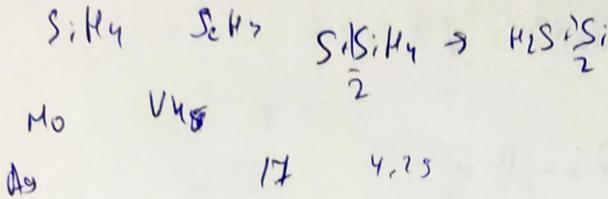
$S + xH$



$$\frac{4,251}{n} = 0,375$$

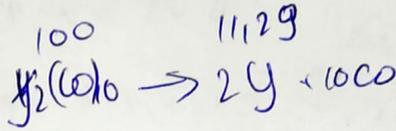
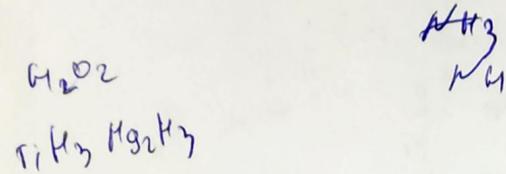
$$0,375n = 4,251$$

$$n = 11,187n$$



12:5

12 5 4,252



$$S) 4C_1 = 3C_2$$

$$4C_1 - 3C_2 = 0$$

$$C_1 = 0,3$$

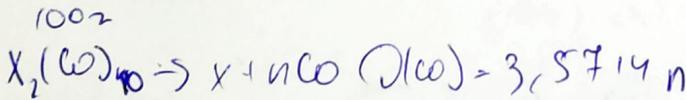
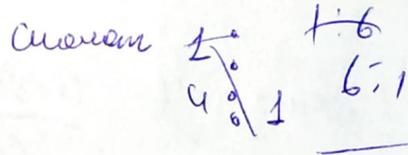
$$3C_1 - 2C_2 = 0,1$$

$$C_2 = 0,4$$

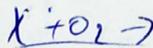
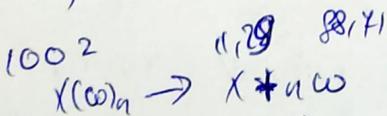
$$C_1 = 1,5 \quad C_2 = 2$$

$$1) 3C_1 - 2C_2 \quad \text{O(H}^+) = 0,5$$

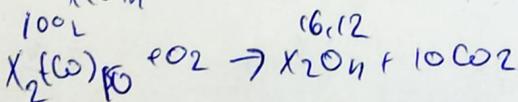
$$\begin{cases} 0 = \frac{4C_1 - 3C_2}{4} \\ 0,1 = \frac{3C_1 - 2C_2}{5} \end{cases} \quad C_1 = 1,5 \quad C_2 = 2$$



$$\text{O(CO)} = 3,5714n : 8,86 = \frac{0,40309n}{X} \Rightarrow$$



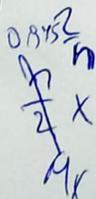
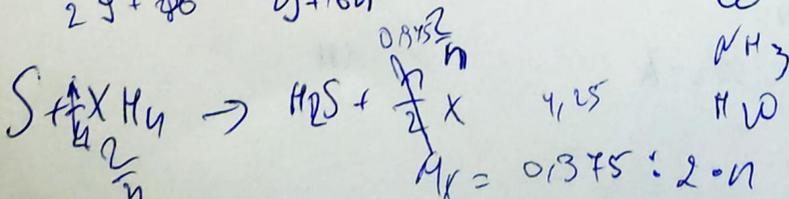
CO 9,56



$$X = 17,36n$$

$$\frac{100}{29 + 480} = \frac{16,12}{29 + 16n}$$

$$\frac{nO}{CO}$$



$$4,25$$



$$0,375 : 2 = n$$