

1997/98. õa 9. klassi vabariikliku vooru ülesannete lahendused

1. a) II peaalarühma karbonaatide kuumutamisel tekivad oksiidid MeO ja CO₂

$$M(\text{CO}_2) = 44 \text{ g/mol}$$

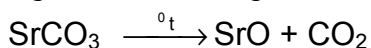
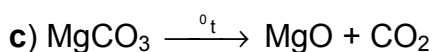
Olgu kumbagi karbonaati üks mool

$$M(\text{Me}^{\text{I}}\text{O} + \text{Me}^{\text{II}}\text{O}) = 2 \cdot 44 \text{ g/mol} \cdot \frac{1}{38} \cdot 62 \approx 144 \text{ g/mol}$$

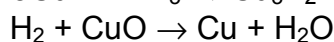
b) $M(\text{M}^{\text{I}} + \text{M}^{\text{II}}) = 144 \text{ g/mol} - 32 \text{ g/mol} = 112 \text{ g/mol}$

II peaalarühm	Be	Mg	Ca	Sr	Ba	Ra
M(g/mol)	9	24,3	40,1	87,6	137	226

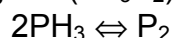
$$M(\text{Mg} + \text{Sr}) = 24,3 \text{ g/mol} + 87,6 \text{ g/mol} = 111,9 \sim 112 \text{ g/mol}$$



2. a) $3\text{Cu} + 2\text{PH}_3 \rightarrow \text{Cu}_3\text{P}_2 + 3\text{H}_2$

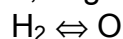


b) I torus $4,96 \text{ g} = m(\text{Cu}_3\text{P}_2) - m(3\text{Cu}) \Leftrightarrow m(\text{P}_2)$



$$n(\text{PH}_3) = \frac{2}{1} \cdot 4,96 \text{ g} \cdot \frac{1 \text{ mol}}{2 \cdot 31,0 \text{ g}} = 0,160 \text{ mol}$$

II torus $5,76 \text{ g} = m(\text{CuO}) - m(\text{Cu}) \Leftrightarrow m(\text{O})$



$$n(\text{H}_2 \text{ kokku}) = 5,76 \text{ g} \cdot \frac{1 \text{ mol}}{16,0 \text{ g}} = 0,360 \text{ mol}$$

$$n(\text{H}_2 \text{ fosfaanist}) = \frac{3}{2} \cdot 0,160 \text{ mol} = 0,240 \text{ mol}$$

$$n(\text{H}_2 \text{ lähte}) = 0,360 \text{ mol} - 0,240 \text{ mol} = 0,120 \text{ mol}$$

c) $V_{\text{st}} = 22,4 \text{ dm}^3 / \text{mol} \cdot \frac{298}{273} = 24,45 \approx 24,5 \text{ dm}^3 / \text{mol}$

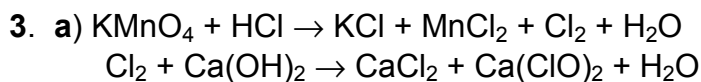
d) $M(\text{PH}_3) = 34,0 \text{ g/mol}$; $m(\text{H}_2) = 2,02 \text{ g/mol}$

$m(\text{lähtesegu}) = 0,16 \text{ mol} \cdot 34 \text{ g/mol} + 0,12 \text{ mol} \cdot 2,02 \text{ g/mol} = 5,44 \text{ g} + 0,24 \text{ g} = 5,68 \text{ g}$

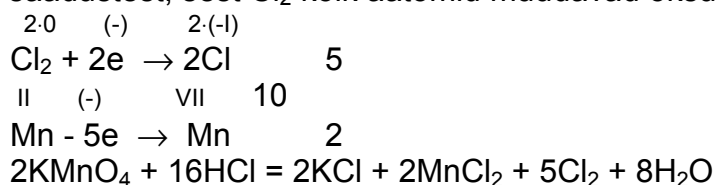
$$V = (0,16 + 0,12) \text{ mol} \cdot 24,45 \text{ dm}^3 / \text{mol} = 6,846 \text{ dm}^3$$

$$\rho = \frac{5,68 \text{ g}}{6,846 \text{ dm}^3} = 0,820 \text{ g} / \text{dm}^3$$

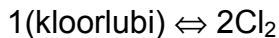
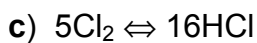
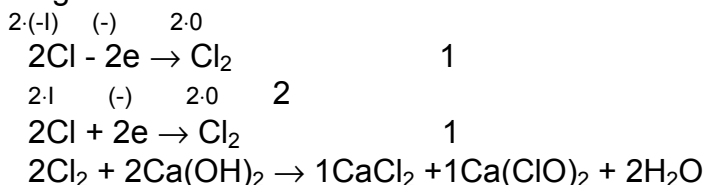
Märkus: Arvutustes pole vajalik murdarvule nulle taha kirjutada, küll aga tuleb lõppvastuses lähteandmete tüvenumbritega arvestada. Vahetehetes on kasulik säilitada lisanumber.



b) Kloori saamise reaktsiooni võrrandi kordajate leidmist on ratsionaalsem alustada saadustest, sest Cl_2 kõik aatomid muudavad oksüdatsiooni- astet



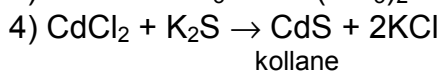
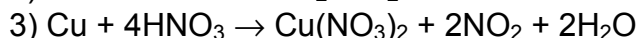
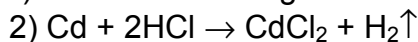
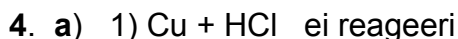
Ka Cl_2 disproportsioneerumise reaktsiooni võrrandi kordajate leidmist on mugavam alustada saadustest



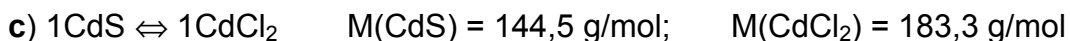
$M[\text{CaCl}_2 \cdot \text{Ca(ClO)}_2] = 254 \text{ g/mol}$

$$m(\text{kloorlubi}) = \frac{1}{2} \cdot \frac{5}{16} \cdot 69,8 \text{ cm}^3 \cdot 1,189 \text{ g/cm}^3 \cdot 0,365 \cdot 0,26 \cdot$$

$$\cdot \frac{1 \text{ mol}}{36,5 \text{ g}} \cdot 254 \text{ g/mol} = 8,56 \text{ g}$$



b) A - Cu (vask); B - Cd (kaadmium); C - CdCl_2 (kaadmiumkloriid); D - Cu (vask);
 E - $\text{Cu(NO}_3)_2$ (vasknitraat); F - NO_2 (lämmastikdioksiid); G - CdS (kaadmiumsulfiid)



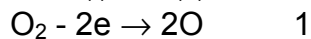
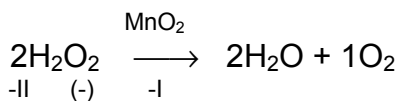
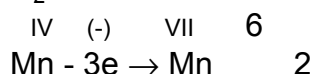
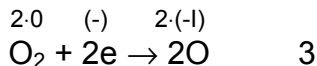
$$m(\text{CdCl}_2) = \frac{1}{1} \cdot 14,45 \text{ g} \cdot \frac{1 \text{ mol}}{144,5 \text{ g}} \cdot 183,3 \text{ g/mol} = 18,33 \text{ g}$$

$$m(\text{Cu}) = (37,99 - 18,33) \text{ g} = 19,66 \text{ g}$$

$$d) m(\text{Cd}) = 14,45 \text{ g} \cdot \frac{1 \text{ mol}}{144,5 \text{ g}} \cdot 112,4 \text{ g/mol} = 11,24 \text{ g}$$

$$\%(\text{Cd}) = \frac{11,24}{11,24 + 19,66} \cdot 100 = 36,38$$

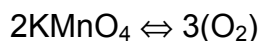
$$\%(\text{Cu}) = \frac{19,66}{30,90} \cdot 100 = 63,62$$



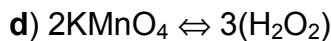
$$b) n(\text{O}_2) = 2,016 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} = 0,0900 \text{ mol} = 9,00 \cdot 10^{-2} \text{ mol}$$

$$c) n(\text{KMnO}_4) = 20,0 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot 0,100 \text{ mol/dm}^3 =$$

$$= 0,00200 \text{ mol} = 2,00 \cdot 10^{-3} \text{ mol}$$

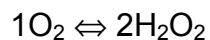


$$n(\text{O}_2) = \frac{3}{2} \cdot 0,002 \text{ mol} = 0,00300 \text{ mol} = 3,00 \cdot 10^{-3} \text{ mol}$$



$$n(\text{H}_2\text{O}_2) = \frac{3}{2} \cdot 0,002 = 0,00300 \text{ mol} = 3,00 \cdot 10^{-3} \text{ mol}$$

$$n(\text{O}_2 \text{ katal}) = 0,09 \text{ mol} - 0,003 \text{ mol} = 0,0870 \text{ mol}$$



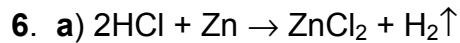
$$n(\text{H}_2\text{O}_2) = \frac{2}{1} \cdot 0,087 = 0,174 \text{ mol}$$

e) $M(\text{H}_2\text{O}_2) = 34,0 \text{ g/mol}$

$$n(\text{H}_2\text{O}_2) = (0,174 + 0,003) \text{ mol} = 0,177 \text{ mol}$$

$$m(\text{H}_2\text{O}_2) = 0,177 \text{ mol} \cdot 34,0 \text{ g/mol} = 6,02 \text{ g}$$

$$\%(\text{H}_2\text{O}_2) = \frac{6,02 \text{ g}}{100 \text{ cm}^3 \cdot 1,02 \text{ g/cm}^3} \cdot 100 = 5,90 \%$$



b)
$$V = 1000 \text{ cm}^3 - 100 \text{ g} \cdot \frac{1 \text{ cm}^3}{1,180 \text{ g}} - 9,00 \text{ g} \cdot \frac{1 \text{ cm}^3}{7,14 \text{ g}} =$$
$$= 1000 \text{ cm}^3 - 84,75 \text{ cm}^3 - 1,26 \text{ cm}^3 = 914 \text{ cm}^3$$
$$n(\text{õhk}) = 0,914 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} = 0,0408 \text{ mol}$$

c) Kontrollime, millise lähteaine järgi vesiniku hulka arvutada

$$m(\text{Zn}) = 100 \text{ g} \cdot 0,365 \cdot \frac{1 \text{ mol}}{36,5 \text{ g}} \cdot 65,4 \text{ g/mol} = 65,4 \text{ g}$$

Järelikult HCl-i on ülehulgas

$$n(\text{H}_2) = \frac{1}{1} \cdot 9,00 \text{ g} \cdot \frac{1 \text{ mol}}{65,4 \text{ g}} = 0,1376 \text{ mol}$$

$$n(\text{gaasid}) = 0,0408 \text{ mol} + 0,1376 \text{ mol} = 0,178 \text{ mol}$$

d)
$$p = 0,178 \text{ mol} \cdot 0,0820 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 293 \text{ K} \cdot \frac{1}{0,914 \text{ dm}^3} = \approx 4,68 \text{ atm}$$