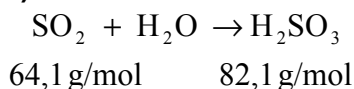


1996/97 õa keemiaolümpiaadi lõppvoorü ülesannete lahendused
9. klass

1. a)



$$\text{b) } 0,0500 = \frac{m(\text{H}_2\text{SO}_3)}{m(\text{H}_2\text{O}) + m(\text{SO}_2)} \Rightarrow \frac{\frac{1}{1} m(\text{SO}_2) \cdot \frac{1 \text{ mol}}{64,1 \text{ g}} \cdot 82,1 \text{ g/mol}}{1,00 \text{ dm}^3 \cdot 997 \text{ g/dm}^3 + m(\text{SO}_2)}$$

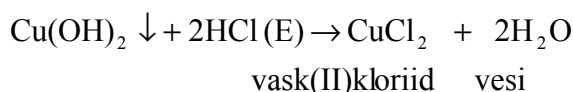
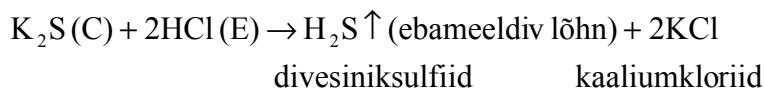
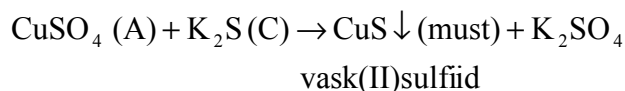
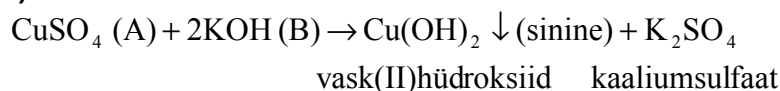
$m(\text{SO}_2) = 40,5 \text{ g}$

$$\text{c) } V_M = 1 \text{ mol} \cdot 0,08206 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 298 \text{ K} \cdot \frac{1}{1,01 \text{ atm}} = 24,2 \text{ dm}^3 / \text{mol}$$

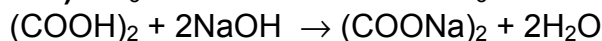
$$\text{d) } V = 40,5 \text{ g} \cdot \frac{1 \text{ mol}}{64,1 \text{ g}} \cdot 24,2 \text{ dm}^3 / \text{mol} = 15,3 \text{ dm}^3$$

2. a) A - CuSO₄; B - KOH; C - K₂S; D - NaNO₃; E - HCl

b)



3. a) CH₃COOH + NaOH → CH₃COONa + H₂O



b) Tiitrimiseks kulunud naatriumhüdroksiidi hulk on:

$$n(\text{NaOH}) = 0,300 \text{ dm}^3 \cdot 1,00 \text{ mol/dm}^3 = 0,300 \text{ mol.}$$

Sellest kulus etanhappe (mida oli x g) neutraliseerimiseks

$$n'(\text{NaOH}) = \frac{1}{1} \cdot x \text{ g} \cdot \frac{1 \text{ mol}}{60,0 \text{ g}}$$

ja oblikhappe [mida oli (16,0-x) g] neutraliseerimiseks

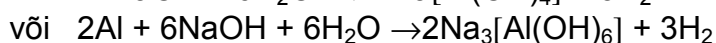
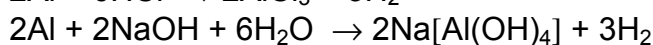
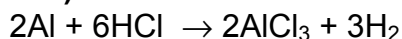
$$n''(\text{NaOH}) = \frac{2}{1} (16,0 - x) \text{ g} \cdot \frac{1 \text{ mol}}{90,0 \text{ g}}$$

Need seosed võimaldavad koostada võrrandi

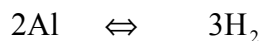
$$\frac{x}{60,0} + \frac{2 \cdot (16,0 - x)}{90,0} = 0,300$$

$$x = 10,0 \text{ g}; \quad m(\text{CH}_3\text{COOH}) = 10,0 \text{ g}; \quad m[(\text{COOH})_2] = 16,0 - 10,0 = 6,0 \text{ g}$$

4. a) Nii HCl-i kui ka NaOH lahus reageerib ainult alumiiniumiga



b)



$$27,0 \text{ g/mol} \quad 22,4 \text{ dm}^3/\text{mol}$$

$$m'(Al) = \frac{2}{3} \cdot 6,72 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} \cdot 27,0 \text{ g/mol} = 5,40 \text{ g}$$

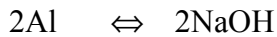
$$m'(Cu) = 10,0 - 5,4 = 4,6 \text{ g}$$

$$m''(Al) = 500 \text{ g (segu)} \cdot \frac{5,40 \text{ g}}{10,0 \text{ g (segu)}} = 270 \text{ g}$$

$$m''(Cu) = 500 \text{ g} - 270 \text{ g} = 230 \text{ g}$$

c)

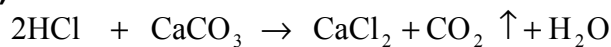
$$270 \text{ g} \quad V(\text{cm}^3) \quad 1,22 \text{ g/cm}^3 \cdot 0,200$$



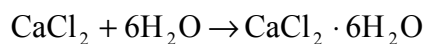
$$27,0 \text{ g/mol} \quad 40,0 \text{ g/mol}$$

$$V(\text{NaOH}) = \frac{2}{2} \cdot \frac{270 \text{ g}}{27,0 \text{ g/mol}} \cdot 40,0 \text{ g/mol} \cdot \frac{1}{0,200} \cdot \frac{1 \text{ cm}^3}{1,22 \text{ g}} = 1639 \text{ cm}^3$$

5. a)



$$36,5 \text{ g/mol} \quad 100,1 \text{ g/mol} \quad 111 \text{ g/mol}$$



$$219 \text{ g/mol}$$

b)

$$V \text{ cm}^3 \cdot 1,05 \text{ g/cm}^3 \cdot 0,100 \quad 100 \text{ g}$$



$$V(\text{HCl}) = \frac{2}{1} \cdot \frac{100 \text{ g}}{1} \cdot \frac{1 \text{ mol}}{219 \text{ g}} \cdot 36,5 \text{ g/mol} \cdot \frac{1}{0,100} \cdot \frac{1 \text{ cm}^3}{1,05 \text{ g}} = 317 \text{ cm}^3$$

$$c) m(\text{CaCO}_3) = \frac{1}{1} \cdot \frac{100 \text{ g}}{1} \cdot \frac{1 \text{ mol}}{219 \text{ g}} \cdot 100,1 \text{ g/mol} = 45,7 \text{ g}$$

d)

$$m(\text{lahus}) = 317 \text{ cm}^3 \cdot 1,05 \text{ g/cm}^3 + 45,7 \text{ g} - \frac{1}{1} \cdot 100 \text{ g} \cdot \frac{1 \text{ mol}}{219 \text{ g}} \cdot 44 \text{ g/mol} = 333 + 46 - 20 = 359 \text{ g}$$

$$V(\text{lahus}) = 359 \cdot \frac{1 \text{ cm}^3}{1,12 \text{ g}} = 321 \text{ cm}^3$$

$$e) m(\text{H}_2\text{O}) = 359 - 100 = 259 \text{ g}$$

6. a) X - aluseline, Y - happeline, Z - aluseline

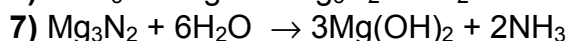
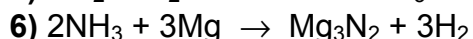
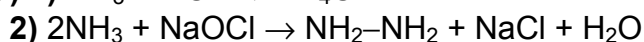
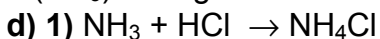
b) X - NH₃ (ammoniaak); M - NH₄Cl (ammooniumkloriid)

c) Gaaside molaarmass ja tihedus on võrdelises sõltuvuses.

$$\text{Seetõttu } M(Y) = \sim 0,98 \cdot 44 \text{ g/mol} = \sim 43 \text{ g/mol}$$

Et ühendi Y molekulis on sama arv aatomeid kui ammoniaagis, siis arvutusel saadud ligilähedasele molaarmassile vastab ühend HN₃.

$$M(\text{HN}_3) = 43 \text{ g/mol}$$



e) Y - HN₃; Z - NH₂-NH₂; Q - Mg₃N₂ (magneesiumnitriid); R - Pb(N₃)₂