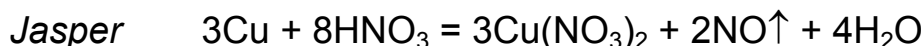
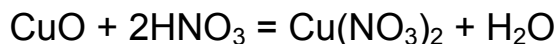


Keemia lahtise võistluse ülesannete lahendused

Noorem rühm (9. ja 10. klass)

13. november 2004. a.



ii) *Kaur* $n(\text{HNO}_3) = \frac{4}{1} \cdot 3000 \text{ g} \cdot \frac{1 \text{ mol}}{187,5 \text{ g}} = 64 \text{ mol}$

Sander $n(\text{HNO}_3) = \frac{2}{1} \cdot 3000 \text{ g} \cdot \frac{1 \text{ mol}}{187,5 \text{ g}} = 32 \text{ mol}$

Jasper $n(\text{HNO}_3) = \frac{8}{3} \cdot 3000 \text{ g} \cdot \frac{1 \text{ mol}}{187,5 \text{ g}} = 42,7 \text{ mol} \approx 43 \text{ mol}$

b) Nii Kauri kui Jasperi kasutatud meetodil moodustub lõpptulemusena keskkonda reostav NO_2 .

Kaur $n(\text{NO}_2) = \frac{2}{1} \cdot 3000 \text{ g} \cdot \frac{1 \text{ mol}}{187,5 \text{ g}} = 32 \text{ mol}$

Jasper $n(\text{NO}_2) = n(\text{NO}) = \frac{2}{3} \cdot 3000 \text{ g} \cdot \frac{1 \text{ mol}}{187,5 \text{ g}} = 10,7 \text{ mol} \approx 11 \text{ mol}$

Sanderi meetodis mürgiseid gaase ei eraldunud.

c) Kõik vennad lähtusid samast vase hulgast, lämmastikhapet kulus aga Sanderil kõige vähem. Temal ei tekkinud ka keskkonda saastavat gaasi. Sanderi meetod on kõige odavam ja keskkonnasõbralikum.

2. a) elektroni laeng $e^- = \frac{F}{N_A} = \frac{9,648456 \cdot 10^4 \text{ C} \cdot \text{mol}^{-1}}{6,022045 \cdot 10^{23} \text{ mol}^{-1}} = 1,602189 \cdot 10^{-19} \text{ C}$

b) $m(\text{elektron}) = \frac{e^-}{e^- / m} = \frac{1,602189 \cdot 10^{-19} \text{ C}}{1,7588047 \cdot 10^{11} \text{ C} \cdot \text{kg}^{-1}} = 9,109535 \cdot 10^{-31} \text{ kg} =$
 $= 9,109535 \cdot 10^{-28} \text{ g}$

c) $M(e^-) = m \cdot N_A = 9,109534 \cdot 10^{-28} \text{ g} \cdot 6,022045 \cdot 10^{23} \text{ mol}^{-1} = 5,485803 \cdot 10^{-4} \text{ g} \cdot \text{mol}^{-1}$

d) $m(\text{H}) = m(\text{prooton}) + m(\text{elektron}) = 1,6726485 \cdot 10^{-27} \text{ kg} + 0,00091095 \cdot 10^{-27} \text{ kg} =$
 $= 1,673560 \cdot 10^{-27} \text{ kg}$

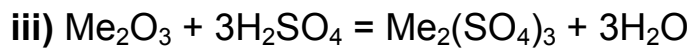
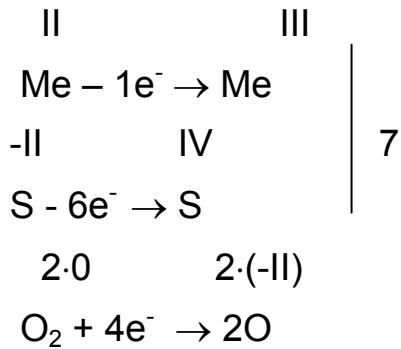
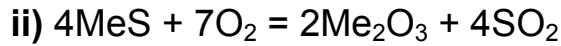
e) i) $\frac{m(\text{H})}{m(e^-)} = \frac{1,6735595 \cdot 10^{-27} \text{ kg}}{9,109534 \cdot 10^{-31} \text{ kg}} = 0,1837151 \cdot 10^4 = 1837,151$

$$\text{ii) } \frac{m(\text{Maa})}{m(e^-)} = \frac{5,976 \cdot 10^{24} \text{ kg}}{9,109534 \cdot 10^{-31} \text{ kg}} = 0,6560 \cdot 10^{55} = 6,560 \cdot 10^{54}$$

3. a) i) A – MeS

B – Me₂O₃

C – Me₂(SO₄)₃



b) $n(\text{Me}) = n(\text{MeS}) \Rightarrow \frac{176 \text{ g}}{[A_r(\text{Me}) + 32] \text{ g/mol}} = b(\text{tundmatu})$

$$m(\text{H}_2\text{SO}_4, \text{lahus}) = \frac{3}{2} \cdot b \cdot 98 \cdot \frac{1}{0,376} = b \cdot 391 \text{ g/mol}$$

$$m(\text{Me}_2\text{O}_3) = \frac{b}{2} \cdot [2A_r(\text{Me}) + 48] = b[A_r(\text{Me}) + 24] \text{ g/mol}$$

$$m(\text{saadud lahus}) = m(\text{H}_2\text{SO}_4, \text{lahus}) + m(\text{Me}_2\text{O}_3) = 391 \text{ g/mol} \cdot b + b \cdot [A_r(\text{Me}) + 24] \text{ g/mol} = b[A_r(\text{Me}) + 415] \text{ g/mol}$$

$$m[\text{Me}_2(\text{SO}_4)_3] = \frac{b}{2} [2A_r(\text{Me}) + 288] = b[A_r(\text{Me}) + 144] \text{ g/mol}$$

$$0,425 = \frac{b[A_r(\text{Me}) + 144] \text{ g/mol}}{b[A_r(\text{Me}) + 415] \text{ g/mol}} \Rightarrow \frac{A_r(\text{Me}) + 144}{A_r(\text{Me}) + 415}$$

$$A_r(\text{Me}) = 56 \qquad \text{Me} - \text{Fe, raud}$$

c) $n(\text{Fe}) = n(\text{FeS}) = \frac{1,76 \text{ g}}{88 \text{ g/mol}} = 0,020 \text{ mol}$

$$m(\text{lahus peale jahutamist}) = 0,020 \text{ mol} \cdot (56 + 415) \text{ g/mol} - 2,75 \text{ g} = 6,67 \text{ g}$$

$$m[\text{Fe}_2(\text{SO}_4)_3, \text{löpplahuses}] = 6,67 \text{ g} \cdot 0,306 = 2,04 \text{ g}$$

$$m[\text{Fe}_2(\text{SO}_4)_3, \text{kristallhüdraadis}] = 0,020 \text{ mol} \cdot (56 + 144) \text{ g/mol} - 2,04 \text{ g} = 1,96 \text{ g}$$

$$m(\text{H}_2\text{O}, \text{kristallhüdraadis}) = 2,75 \text{ g} - 1,96 \text{ g} = 0,79 \text{ g}$$

$$n[\text{Fe}_2(\text{SO}_4)_3] = \frac{1,96 \text{ g}}{400 \text{ g/mol}} = 0,0049 \text{ mol}$$

$$n(\text{H}_2\text{O}) = \frac{0,79 \text{ g}}{18 \text{ g/mol}} = 0,0439 \text{ mol}$$

$$\frac{n(\text{H}_2\text{O})}{n[\text{Fe}_2(\text{SO}_4)_3]} = \frac{0,0439}{0,0049} = 8,96 \approx 9$$

Kristallhüdraadi **D** valem on $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$

4. a) A – N_2 , lämmastik

B – O_2 , hapnik

C – NO , lämmastik(mono)oksiid

D – NO_2 , lämmastikdioksiid

E – HNO_3 , lämmastikhape

F – NH_4NO_3 , ammooniumnitraat

G – N_2O , dilämmastik(mono)oksiid

b) i) $\text{N}_2 + \text{O}_2 = 2\text{NO}$

ii) $2\text{NO} + \text{O}_2 = 2\text{NO}_2$

iii) $4\text{NO}_2 + \text{O}_2 + 2\text{H}_2\text{O} = 4\text{HNO}_3$

iv) $\text{HNO}_3 + \text{NH}_3 = \text{NH}_4\text{NO}_3$

O_t

v) $\text{NH}_4\text{NO}_3 = \text{N}_2\text{O} + 2\text{H}_2\text{O}$

c) $n(\text{HNO}_3) \Leftrightarrow n(\text{NO})$

$$n(\text{HNO}_3) = \frac{1}{1} \cdot 1,0 \cdot 10^9 \text{ J} \cdot 0,05 \cdot \frac{1 \text{ mol}}{9,037 \cdot 10^4 \text{ J}} = 553 \text{ mol} \approx 550 \text{ mol}$$

5. a) i) CaO – kaltsiumoksiid

PbO_2 – plii(IV)oksiid

CrO_3 – kroom(VI)oksiid

OsO_4 – osmium(VIII)oksiid

Na_2O – naatriumoksiid

Al_2O_3 – alumiiniumoksiid

V_2O_5 – vanaadium(v)oksiid

Mn_2O_7 – mangaan(VII)oksiid

ii) CO – süsinikmonooksiid

CO₂ – süsinikdioksiid

SO₃ – vääveltrioksiid

N₂O – diämmastik(mono)oksiid

N₂O₃ – diämmastiktrioksiid

N₂O₅ – diämmastikpentaoksiid

Cl₂O₇ – dikloorheptaoksiid

b) i) X₂O₂ näiteks Na₂O₂, naatriumperoksiid

ii) XO₂ näiteks KO₂, kaaliumhüperoksiid

iii) IA rühm, leelismetallid

iv) -I -1/2

Na₂O₂, KO₂

6. a) $V(96,50\% \text{ vol etanooli lahus}) = \frac{40,00 \text{ ml}}{0,965} = 41,45 \text{ ml} \sim 41,5 \text{ ml}$

b) $m(\text{etanool}) = 40 \text{ ml} \cdot 0,78924 \text{ g/cm}^3 = 31,5696 \text{ g}$

$m(40,00\% \text{ vol etanooli lahus}) = 100 \text{ cm}^3 \cdot 0,94805 \text{ g/cm}^3 = 94,805 \text{ g}$

$V(\text{H}_2\text{O}) = \frac{94,805 \text{ g} - 31,5696 \text{ g}}{0,99820 \text{ g/cm}^3} = 63,349 \text{ cm}^3 \approx 63,35 \text{ cm}^3$

c) Teada peab olema 96,5% vol etanooli lahuse tihedus.