Sem. ② CMY 117 2008

2007

Vraag 1: Chemiese Samestelling
Question 1: Chemical Composition [6]

In 'n reaksie reageer 2.04 g vanadium met 1.93 g swael om 'n suiwer verbinding te gee. Die molêre massa van die verbinding is 396.22 g.mol^{-1}.

1.1 Bepaal die molekulêre formule van hierdie verbinding.

During a reaction 2.04 g vanadium reacts with 1.93 g sulphur to produce a pure compound. The molar mass of the compound is 396.22 g.mol^{-1}.

Determine the molecular formula of this compound.

[6]

$V_{(s)} + S_{(s)} \longrightarrow V_x S_y$

$n(V) = \frac{2.04}{50.95} = (0.040039)$ mol

$n(S) = \frac{1.93}{32.07} = (0.060181)$ mol

$\Rightarrow V_{0.040039} S_{0.060181}$

$\Rightarrow V_1 S_{1.5}$

$\Rightarrow V_2 S_3$

$M(V_2S_3) = 198.11$ g.mol^{-1}

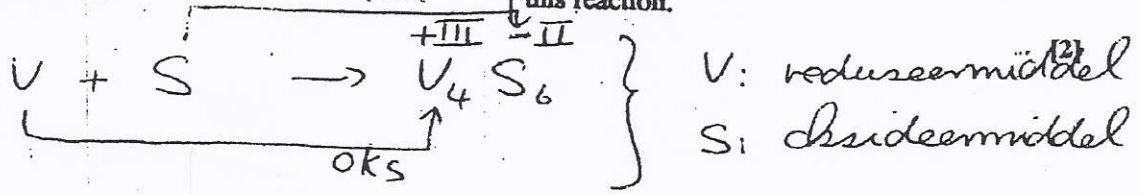
$\Rightarrow$ faktor $= \frac{396.22}{198.11} = 2$

$\Rightarrow$ molekulêre formule : $(V_2S_3)_2$

$V_4 S_6$

1.2 Gee die oksideermiddel en reduseermiddel in hierdie reaksie.

Give the oxidising agent and reducing agent in this reaction.



[2]

Vraag 2 Stoigiometrie
Question 2: Stoichiometry [10]

[5] 2.1 Natriumjodaat reageer met natriumwaterstofsulfiet om natriumwaterstofsulfaat, natriumsulfaat, water en jodium te gee:

Sodium iodate reacts with sodium hydrogen sulphite to produce sodium hydrogen sulphate, sodium sulphate, water and iodine:

$$2NaIO_3(aq) + 5NaHSO_3(aq) \rightarrow 3NaHSO_4(aq) + 2Na_2SO_4(aq) + H_2O(\ell) + I_2(aq)$$

In die laboratorium word jodium berei deur oplossings van die twee reagense bymekaar te voeg. Die eerste oplossing bevat 150.g natriumjodaat.
85.0 g jodium moet berei word.
Bereken watter volume (in cm^3) van 'n 3.234 $mol.dm^{-3}$ natriumwaterstofsulfiet-oplossing moet by die eerste oplossing gevoeg word.

In the laboratory, iodine is prepared by mixing the two reagent solutions. The first solution contains 150.g sodium iodate.

85.0 g iodine has to be produced.
Calculate the volume (in cm^3) of a 3.234 $mol.dm^{-3}$ sodium hydrogen sulphite solution that has to be added to the first solution.

[7]

$n(I_2)$ to be prepared $= \frac{85.0}{253.80} = 0.335\ mol$

$\Rightarrow n(NaIO_3)$ needed $= 2 \times 0.335 = 0.670\ mol$

$\Rightarrow$ mass $NaIO_3$ needed $= 0.670 \times 197.89$

$= 133\ g$

$\Rightarrow$ to much $NaIO_3$ is present.

$n(NaHSO_3)$ needed $= 5 \times 0.335$

$= 1.67\ mol$

$\Rightarrow$ volume $(NaHSO_3) = \frac{1.67}{3.234} = 0.518\ dm^3$

$= 518\ cm^3$

2.2 Bereken watter massa van watter reagens bly oor na die reaksie.

Determine what mass of which reactant remains after the reaction.

[3]

$NaIO_3$ remains.

Mass $= (150. - 133)\ g = 17\ g$

Vraag 3 Konsentrasie en Verdunning
Question 3: Concentration and Dilution [12]

3.1 167.56 g bariumchloried word in 'n skoon 500.00 cm^3 volumetriese fles geplaas, opgelos in gedistilleerde water en opgemaak tot by die merk met gedistilleerde water, en goed gemeng.
25.00 cm^3 van hierdie oplossing word met 'n pipet oorgedra in 'n glasbeker.
150. cm^3 van 'n 0.340 $mol.dm^{-3}$ lood(II)nitraatoplossing word by die bariumchloriedoplossing in die beker gevoeg.
Bereken watter massa neerslag sal vorm in die glasbeker.

167.56 g barium chloride is placed in a clean 500.00 cm^3 volumetric flask and dissolved in some distilled water. More distilled water is added to the calibration mark and the solution is thoroughly mixed.
25.00 cm^3 of this solution is transferred to a glass beaker using a pipette.
150. cm^3 of a 0.340 $mol.dm^{-3}$ lead(II) nitrate solution is added to the barium chloride solution in the beaker.
Calculate the mass of the precipitate formed in the glass beaker.

[10]

[5]

$n(BaCl_2) = \frac{167.56}{208.23} = 0.8047$ mol

$[BaCl_2] = \frac{0.8047}{0.50000} = 1.609$ mol/dm^3

$n(BaCl_2)$ transferred $= 1.609 \times 0.02500$
$= 0.04023$ mol

$n(Cl^-)$ transferred $= 0.04023 \times 2$
$= 0.08047$ mol

$n(Pb^{2+})$ added $= 0.340 \times 0.150$
$= 0.201$ mol

reaction: $Pb^{2+}_{(aq)} + 2Cl^-_{(aq)} \longrightarrow PbCl_2 \downarrow$

$\Rightarrow Cl^-$ is the limiting reagent.

$\Rightarrow$ 0.08047 moles Cl^- will react.

$\Rightarrow$ 0.04023 moles $PbCl_2$ will form. Mass$(PbCl_2)$ $= 0.04023 \times 277.92$
$= 11.18$ g

3.2 Gee die oksideermiddel en reduseermiddel in hierdie reaksie.

Give the oxidising agent and reducing agent in this reaction.

[2]

This is not a redox reaction. Oxidation states do not change. Therefore, no oxidising or reducing agents.

Vraag 4 : Redoksreaksies
Question 4: Redox Reactions [12]

(5)

Balanseer die volgende redoksreaksie volledig met die halfreaksiemetode. Gee die halfreaksies en alle stappe duidelik weer. Gee ook al die oksidasiegetalle.

Balance the following redox reaction by the half-reaction method. Write the half reactions and clearly indicate all steps. Also give all the oxidation numbers.

$$\overset{+III}{Cr(OH)_3} + \overset{0}{Cl_2} + NaOH \rightarrow \overset{+IV}{Na_2CrO_4} + \overset{-I}{NaCl}$$

red

oks

[12]

oksidasie: $Cr(OH)_3 \rightarrow CrO_4^{2-}$

$Cr(OH)_3 + H_2O \rightarrow CrO_4^{2-} + 5H^+ + 3e^-$ (×2)

$2Cr(OH)_3 + 2H_2O \rightarrow 2CrO_4^{2-} + 10H^+ + 6e^-$

reduksie: $Cl_2 + 2e^- \rightarrow 2Cl^-$ (×3)

$3Cl_2 + 6e^- \rightarrow 6Cl^-$

netto ione:

$2Cr(OH)_3 + 2H_2O + 3Cl_2 \rightarrow 2CrO_4^{2-} + 10H^+ + 6Cl^-$

basiese medium: ← (add $10OH^-$ each side)

$2Cr(OH)_3 + 2H_2O + 3Cl_2 + 10OH^- \rightarrow 2CrO_4^{2-} + 10H_2O + 6Cl^-$ ← $(10H^+ + 10OH^-)$

$\Rightarrow 2Cr(OH)_3 + 3Cl_2 + 10OH^- \rightarrow 2CrO_4^{2-} + 8H_2O + 6Cl^-$

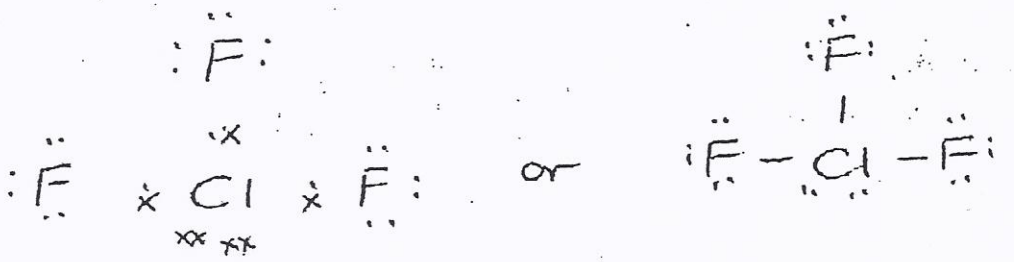
netto molekuler: ← (add $10Na^+$ each side)

$2Cr(OH)_3 + 3Cl_2 + 10NaOH \rightarrow 2Na_2CrO_4 + 6NaCl + 8H_2O$

5.1 Teken die Lewisstruktuur van die ClF_3 molekule. U mag die bindingselektrone met simbole of strepies aandui. Alle alleenpare moet aangedui word.

Draw the Lewis structure of the ClF_3 molecule. You may indicate the bonding electrons with symbols or lines. All lone pairs must be included.

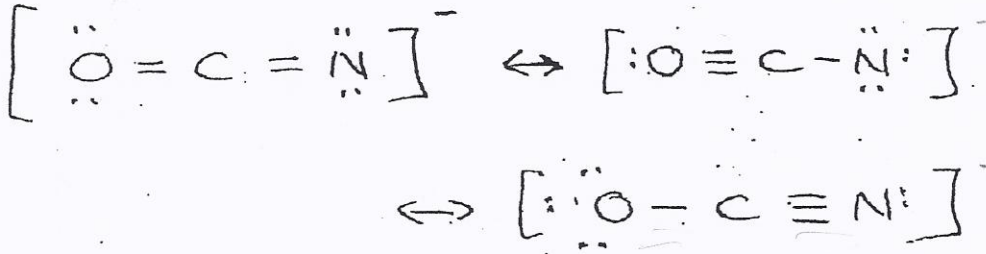
[5]

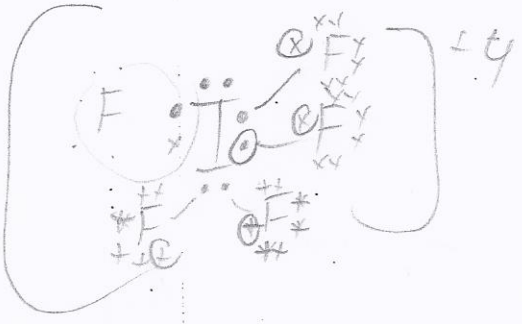


5.2 Teken Lewisstrukture van al die moontlike resonansstrukture van die sianaatioon, OCN^-. (Wenk: die koolstofatoom is altyd in die middel.)
U mag die bindingselektrone met simbole of strepies aandui. Alle alleenpare moet aangedui word.

Draw the Lewis structures of all possible resonance structures of the cyanate ion, OCN^-. (Hint: the carbon atom is always in the center.)
You may indicate the bonding electrons with symbols or lines.
All lone pairs must be included.

[7]





[12]

6.1 Skryf die volledige elektronkonfigurasie neer van 'n ioon met 'n +3 lading, wat 24 protone bevat.

Write the complete electron configuration of an ion with 24 protons and a +3 charge.

[4]

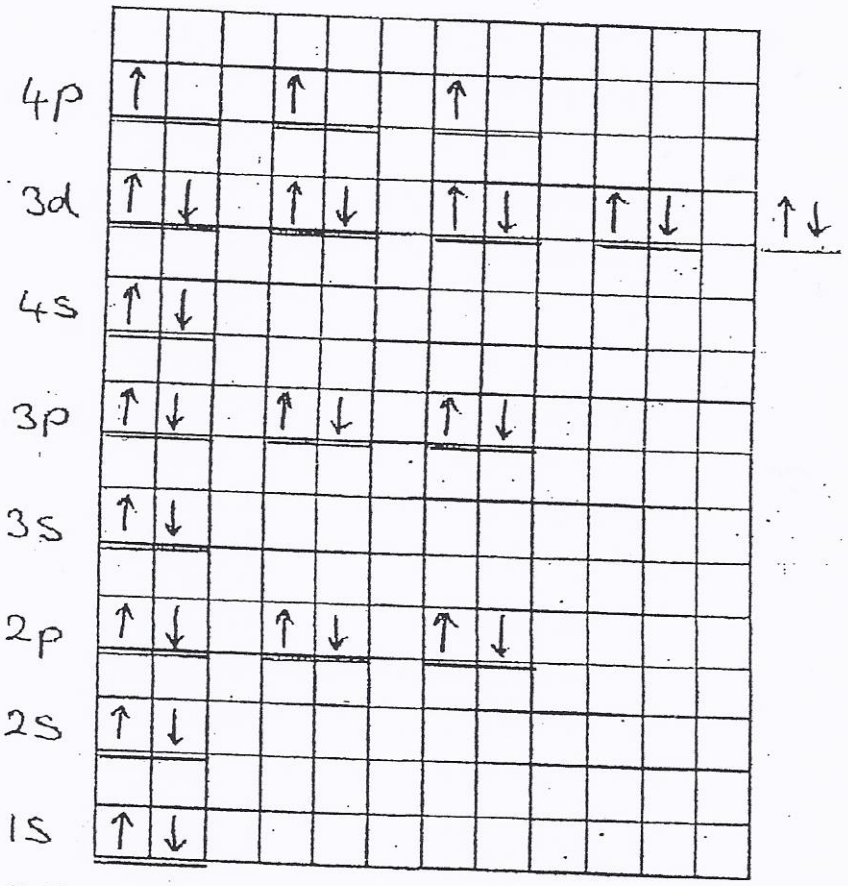
Cr^{3+}

$1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 3d^3$

6.2 Teken 'n volledige energievlakdiagram, wat die relatiewe energieë van die orbitale aandui, van die elektronkonfigurasie van arseen.
Stel die elektrone voor met op en af pyltjies.

Draw the energy orbital diagram which indicates the relative energies of the orbitals for the electron configuration of arsenic.
Indicate the electrons with up and down arrows.

[4]



6.3 Gee die volledige stel kwantumgetalle (met die simbool van elk) van:

Give the complete set of quantum numbers (with the symbol of each) of:

6.3.1 Enige elektron in 'n 3d-orbitaal van arseen.

Any electron in a 3d-orbital of arsenic.

$n = 3$ $\quad m_\ell = -2$ or -1 or 0 or $+1$ or $+2$

$\ell = 2$ $\quad m_s = +\frac{1}{2}$ or $-\frac{1}{2}$

[2]

6.3.2 Enige p valenselektron van antimoon.

Any p valence electron of antimony.

[2]

5p elektron.

$n = 5$ $\quad m_\ell = -1$ or 0 or $+1$

$\ell = 1$ $\quad m_s = +\frac{1}{2}$ or $-\frac{1}{2}$