DEPARTEMENT CHEMIE
DEPARTMENT OF CHEMISTRY

100 1908 - 2008

UNIVERSITEIT VAN PRETORIA
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CMY 117
SEMESTERTOETS 2 / SEMESTER TEST 2

DATUM / DATE: 29 Maart 2010
TYD / TIME: 2½ ure / hours
PUNTE / MARKS: 100
Afdeling A / Section A: 40
Afdeling B / Section B: 60

EKSAMINATORE: Dr PB Ramatsetse
EXAMINERS: Prof. S Lotz
Mr. D Molefe
Prof. WJ Schoeman
EKSTERN / EXTERNAL: Mev A Botha
Mev B Castleman

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AFDELING A / *SECTION A*

VAN EN VOORLETTERS: Memorandum
SURNAME AND INITIALS:

REGISTRASIENOMMER: ---------- **GRAADKURSUS:** ----------
REGISTRATION NUMBER: ***DEGREE COURSE*:**

HANDTEKENING / *SIGNATURE* : ----------

VRAAG QUESTION	PUNTE MARKS		EKSAMINATOR EXAMINER
1		13	
2		13	
3		14	
TOTAAL:AFDELING A TOTAL:SECTION A		40	
TOTAAL:AFDELING B TOTAL:SECTION B		60	
TOTAAL / TOTAL		100	

INSTRUKSIES	INSTRUCTIONS
Alle berekeninge, sketse en diagramme moet in ink gegee word. Alle berekeninge moet volledig getoon word. Antwoorde moet tot die korrekte aantal betekenisvolle syfers gegee word. 'n Datablad is aangeheg aan Afdeling B.	All answers (calculations, sketches, and diagrams) must be given in ink. All calculations must be shown in full. Ans wers must be given to the correct number of significant figures. An information page is attached to Section B.

Vraag 1 Stoïgiometrie en Neerslag [13]	Question 1 Stoichiometry and Precipitation [13]
1.1 Beskou die volgende reaksievergelyking:	1.1 Consider the following reaction equation:
$Al(OH)_3 + H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2O$	
76.50 g aluminiumhidroksied word met 81.35 g swaelsuur gemeng, en die reaksie word toegelaat om plaas te vind. Bereken watter massa aluminiumsulfaat word verkry as die persentasie-opbrengs 85.5% is. [5]	76.50 g of aluminium hydroxide is mixed with 81.35 g of sulphuric acid, and the reaction is allowed to take place. Calculate the mass of aluminium sulphate obtained if the percent yield is 85.5% [5]

1. Balanced equation:

78.01 g.mol^{-1} 98.09 g.mol^{-1} 342.17 g.mol^{-1}

$2\,Al(OH)_3 + 3\,H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6\,H_2O$

2. Limiting reactant:

If all the H_2SO_4 reacts

$\Rightarrow$ 81.35 g H_2SO_4 reacts

$= 81.35/98.09 = 0.8293$ moles H_2SO_4

$\Rightarrow \frac{2}{3}(0.8293) = 0.5529$ mol $Al(OH)_2$ must react

$= 0.5529 \times 78.01 = 43.13$ g $Al(OH)_3$

much more $Al(OH)_3$ is available

$\Rightarrow$ $Al(OH)_3$ will be left over, thus H_2SO_4 is the limiting reactant.

Note: some kind of argument must be given how the lim. reagent has been determined.

3. Mass of $Al_2(SO_4)_3$ formed:

$81.35/98.09 = 0.8293$ moles H_2SO_4

$\Rightarrow \frac{1}{3}(0.8293) = 0.2764$ moles $Al_2(SO_4)_3$

$= 0.2764 \times 342.17 = 94.59$ g

Real mass $= 94.59 \times 85.5\%$

$= (80.88\text{ g}) = 80.9$ g

1.2 Die volgende twee oplossings word bymekaar gevoeg en goed gemeng:

- 50.00 cm^3 van 'n 1.500 $mol.dm^{-3}$ oplossing van natriumhidroksied;
- 75.00 cm^3 van 'n 0.8750 $mol.dm^{-3}$ koper(II)nitraat.

1.2.1 Bereken watter massa neerslag vorm. [5]

1.2 The following two solutions are added together and mixed well:

- 50.00 cm^3 of a 1.500 $mol.dm^{-3}$ solution of sodium hydroxide;
- 75.00 cm^3 of a 0.8750 $mol.dm^{-3}$ solution of copper(II) nitrate.

1.2.1 Calculate the mass of the precipitate formed. [5]

1. Reaksie: 97.57 g/mol

$$Cu(NO_3)_{2(aq)} + 2NaOH_{(aq)} \rightarrow Cu(OH)_{2(s)} + 2NaNO_{3(aq)}$$

$(0.8750\ M \times 0.07500\ dm^3) = 0.06563\ mol$ $\quad$ $(1.500\ M \times 0.05000\ dm^3) = 0.07500\ mol$

Nota: dit moet gewys word. Enige argument is aanvaarbaar.

2. Beperkende reagens: as dit $Cu(NO_3)_2$ is:

0.06563 mol $Cu(NO_3)_2$ moet reageer

dus, 2×0.06563 mol NaOH nodig = 0.1313 mol NaOH.

=> nie genoeg NaOH is gegee nie!

=> $Cu(NO_3)_2$ is nie die beperkende reagens nie.

NaOH is die beperkende reagens.

3. Massa neerslag:

massa $Cu(OH)_2 = 0.07500 \times \frac{1}{2} \times 97.57 = 3.659\ g$

2.1.2 Bereken die konsentrasie van nitraatione in die finale oplossing [3]

2.1 Calculate the concentration of the nitrate ions in the final solution. [3]

1. $n(NO_3^-)$ from first solution $= 0.8750 \times 0.07500 \times 2$

2. volume of final solution $= 125.00\ cm^3$

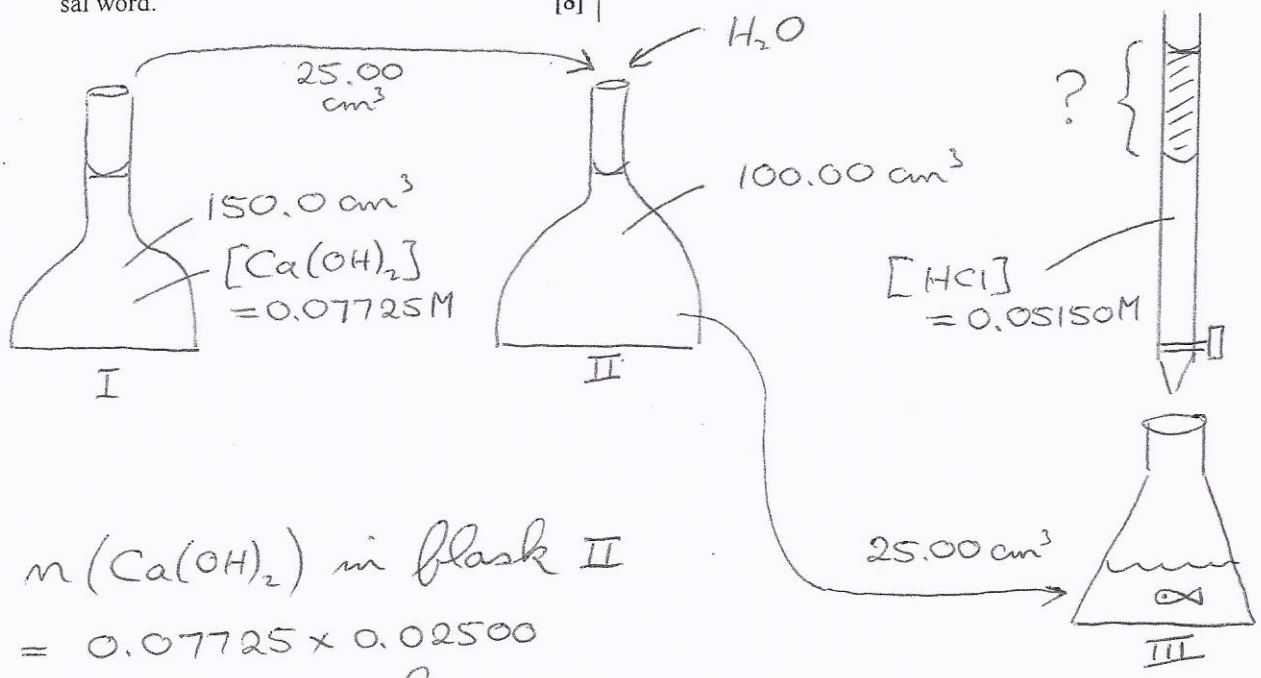
3. $[NO_3^-] = \frac{0.8750 \times 0.07500 \times 2}{0.12500}$

$= 1.050\ mol/dm^3$

Vraag 2 Titrasies en Verdunnings [13]	Question 2 Titrations and Dilutions [13]

2.1 'n Voorraadoplossing van kalsiumhidroksied met volume 150.0 cm^3 en konsentrasie 0.07725 $mol.dm^{-3}$ is beskikbaar in die laboratorium.
25.00 cm^3 van hierdie oplossing word na 'n leë 100.00 cm^3 volumetriese fles oorgedra. Die fles word opgemaak met gedistilleerde water tot by die merk en goed gemeng.
25.00 cm^3 van laasgenoemde oplossing word in 'n koniese fles oorgedra. Dit word met 'n 0.05150 $mol.dm^{-3}$ soutsuur-oplossing getitreer.
Bereken die volume (in cm^3) soutsuur wat benodig sal word. [8]

2.1 A stock solution of calcium hydroxide with volume 150.0 cm^3 and concentration 0.07725 $mol.dm^{-3}$ is available in the laboratory.
25.00 cm^3 of this solution is transferred into an empty 100.00 cm^3 volumetric flask. The flask is made up to the mark with distilled water and is mixed well.
25.00 cm^3 of the latter solution is transferred into a conical flask, and is titrated with a 0.05150 $mol.dm^{-3}$ solution of hydrochloric acid.
Calculate the volume (in cm^3) of hydrochloric acid required. [8]



1. $n(Ca(OH)_2)$ in flask II
$= 0.07725 \times 0.02500$
$= 0.001931$ mol

2. $[Ca(OH)_2]$ in flask II $= \frac{0.001931}{0.10000} = 0.01931$ M

3. $[Ca(OH)_2]$ in flask III $= 0.01931$ M

4. $n(Ca(OH)_2)$ in flask III $= 0.01931 \times 0.02500$
$= 0.0004828$ mol

5. $n(OH^-)$ in flask III $= 0.0004828 \times 2$
$= 0.0009656$ mol

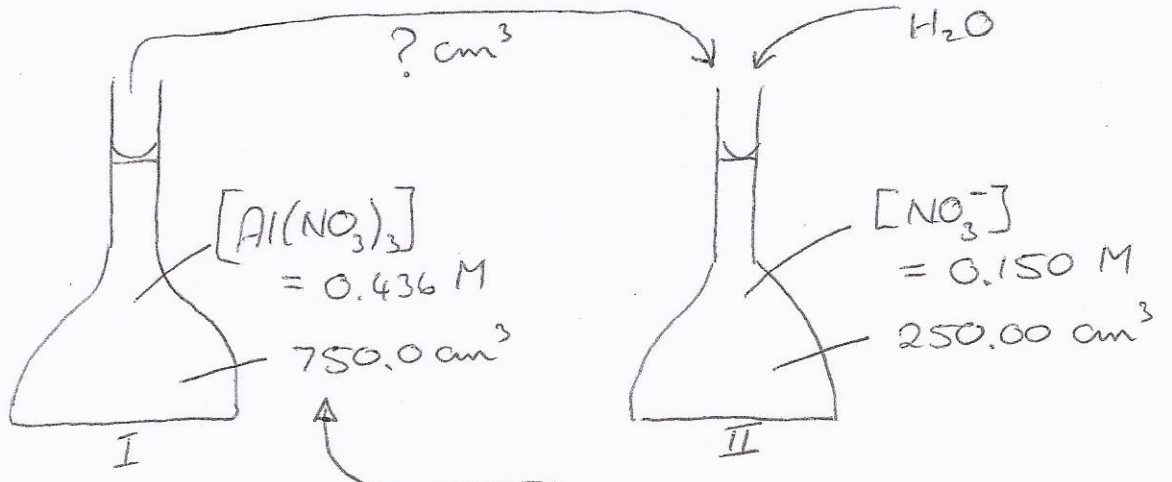
6. Reaction: $2HCl_{(aq)} + Ca(OH)_{2(aq)} \rightarrow 2H_2O_{(l)} + CaCl_{2(aq)}$

7. $n(HCl)$ from burette $= 0.0009656$ mol

8. volume of HCl $= \frac{0.0009656}{0.05150} = 0.01875\ dm^3$
$= 18.75\ cm^3$

2.2 'n Voorraadoplossing van aluminiumnitraat met volume 750.0 cm^3 en konsentrasie 0.436 $mol.dm^{-3}$ is beskikbaar in die laboratorium.
250.00 cm^3 van 'n 0.150 $mol.dm^{-3}$ nitraatoplossing moet hiervan berei word.
Bereken watter volume van die voorraadoplossing (in cm^3) moet verdun word. [5]

2.2 A stock solution of aluminium nitrate with volume 750.00 cm^3 and concentration 0.436 $mol.dm^{-3}$ is available in the laboratory.
250.00 cm^3 of a 0.150 $mol.dm^{-3}$ nitrate solution is to be prepared.
Calculate what volume (in cm^3) of the stock solution should be diluted. [5]



Nota: hierdie volume word nie gebruik nie.

1. $n(NO_3^-)$ in fles II
$= 0.150 \times 0.25000$
$= 0.0375$ mol

2. $n(Al(NO_3)_3)$ benodig $= \frac{0.0375}{3} = 0.0125$ mol

3. volume van die oplossing in fles I wat 0.0125 mol $Al(NO_3)_3$ bevat
$= \frac{0.0125}{0.436}$
$= 0.0287\ dm^3$
$= 28.7\ cm^3$

Vraag 3 **Redoksreaksies en Lewisstrukture** [14]	**Question 3** **Redox Reactions and Lewis Structures** [14]

3.1 Die volgende redoksreaksie vind plaas in 'n waterige kaliumhidroksied-medium:

$$KMnO_4 + 2KBr \rightarrow MnO_2 + KBrO_3$$

Balanseer die reaksievergelyking volledig. Gee die oksidasiegetalle, halfreaksies, netto ioniese vergelyking en die netto molekulêre vergelyking. [8]

3.1 The following redox reaction takes place in an aqueous medium of potassium hydroxide:

$$KMnO_4 + 2KBr \rightarrow MnO_2 + KBrO_3$$

Balance the reaction equation fully. Give the oxidation numbers, half reactions, net ionic equation and the net molecular equation. [8]

$+VII \quad -I \quad +IV \quad +V$

$MnO_4^- + Br^- \rightarrow MnO_2 + BrO_3^-$

Reduction:

$$MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$$

$$2MnO_4^- + 8H^+ + 6e^- \rightarrow 2MnO_2 + 4H_2O$$

Oxidation:

$$Br^- + 3H_2O \rightarrow BrO_3^- + 6H^+ + 6e^-$$

Net ionic:

$$2MnO_4^- + H_2O + Br^- \rightarrow 2MnO_2 + BrO_3^- + 2OH^-$$

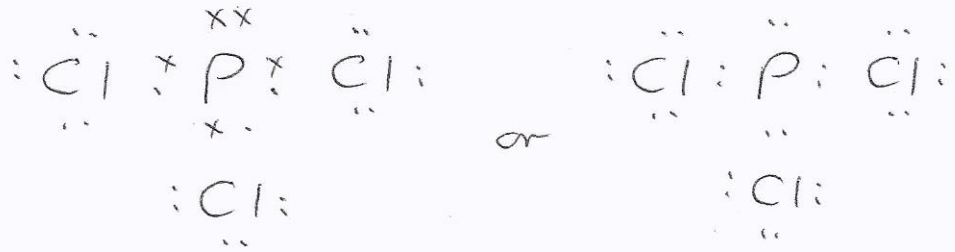
Net molecular:

$$2KMnO_4 + H_2O + KBr \rightarrow 2MnO_2 + KBrO_3 + 2KOH$$

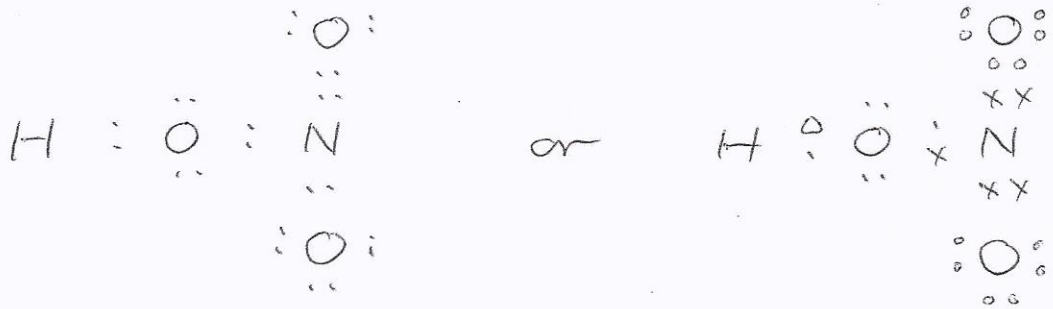
3.2 *Teken die Lewisstrukture van die volgende molekules. Stel die valenselektrone voor met simbole, en toon alle alleenpare aan. Moet nie strepies gebruik om bindings mee voor te stel nie.*

3.2 Draw Lewis structures of the following molecules. Represent the valance electrons with symbols and show all lone pairs. Do not use dashes to represent bonds.

3.2.1 PCl_3 **[3]**



3.2.2 HNO_3 **[3]**



CMY 117
Semestertoets 2
29 Maart 2010

Afdeling B

1	J	0
2	E	2
3	C	2
4	E	2
5	J	2
6	F	2
7	C	2
8	D	2
9	B	2
10	H	2
11	A	2
12	I	3
13	D	3
14	A	3
15	D	3
16	E or/of H	2
17	C	2
18	J	2
19	B	2
20	B	2
21	G	2
22	D	2
23	H	2
24	B	2
25	D	2
26	F	2
27	A	2
28	D	2
29	G	2
		60