

1.1 Gee die naam of die formule van die volgende verbindings. / Give the name or the formula of the following compounds. [5]

NaHCO<sub>3</sub>

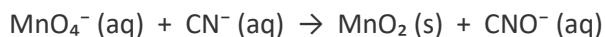
NH<sub>4</sub>NO<sub>2</sub>

KClO<sub>4</sub>

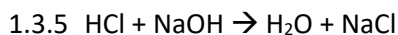
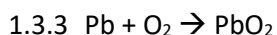
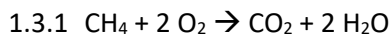
Koper(II) asetaat. / Copper(II) acetate.

Difosfortetrafluoried. / Diphosphorus tetrafluoride.

1.2 Balanseer die volgende redoksreaksie in 'n **basiese medium**: / Balance the following redox reaction in **basic medium**: [6]



1.3 Identifiseer die volgende reaksies in 'n waterige medium as redoks-, presipitasie of suur-basis reaksies. Gee 'n rede vir jou antwoord. / Identify the following reactions in an aqueous medium as redox, precipitation or acid-base reactions. Give a reason for your answer. [10]

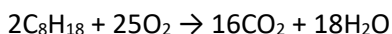


## VRAAG 2. / QUESTION 2.

[21 PUNTE. / MARKS.]

2.1 Die ontbranding van petrol produseer koolstofdiksied en water. Aanvaar dat petrol suiwer oktaan (C<sub>8</sub>H<sub>18</sub>) is en bereken hoeveel kilogram koolstofdiksied in die atmosfeer gevoeg word per 1.0 kg oktaan wat verbrand word. (**Wenk**: Begin deur 'n gebalanseerde vergelyking vir die verbrandingsreaksie neer te skryf.) / The combustion of gasoline produces carbon dioxide and water. Assume gasoline to be pure octane (C<sub>8</sub>H<sub>18</sub>) and calculate how many kilograms of carbon dioxide are added to the atmosphere per 1.0 kg of octane burned. (**Hint**: Begin by writing a balanced equation for the combustion reaction.) [3]

(Gegee: / Given:  $M_{C_8H_{18}} = 114.18 \text{ g}\cdot\text{mol}^{-1}$ ;  $M_{CO_2} = 44 \text{ g}\cdot\text{mol}^{-1}$ )



2.2 Gekonsentreerde swaelsuur het 'n digtheid van  $1.84 \text{ g}/\text{cm}^3$  en is 95.0%  $H_2SO_4$  per gewig. Die res is water. Bereken die molaliteit sowel as die molariteit van die suur. / *Concentrated sulfuric acid has a density of  $1.84 \text{ g}/\text{cm}^3$  and is 95.0% by weight  $H_2SO_4$ . The rest is water. Calculate the molality as well as the molarity of the acid.* [5]

2.3 'n Webtuiste oor vuurwerke verskaf aanwysings vir die bereiding van kaliumnitraat,  $KNO_3$  ( $M_{KNO_3} = 101 \text{ g}/\text{mol}$ ). Volgens die webtuiste moet jy 1.00 kg kaliumkarbonaat ( $M_{K_2CO_3} = 138 \text{ g}/\text{mol}$ ) en 2.00 kg ammoniumnitraat ( $M_{NH_4NO_3} = 80 \text{ g}/\text{mol}$ ) meng volgens die volgende gebalanseerde reaksievergelyking: / *A website on fireworks provides directions for preparing potassium nitrate,  $KNO_3$  ( $M_{KNO_3} = 101 \text{ g}/\text{mol}$ ). According to the website you must mix 1.00 kg of potassium carbonate ( $M_{K_2CO_3} = 138 \text{ g}/\text{mol}$ ) and 2.00 kg of ammonium nitrate ( $M_{NH_4NO_3} = 80 \text{ g}/\text{mol}$ ), according to the following balanced reaction equation:*

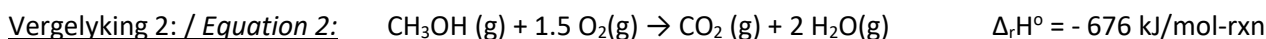
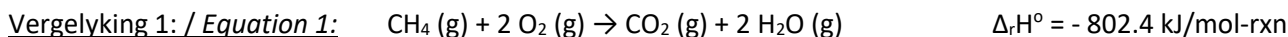


2.3.1 Bereken die beperkende reagens. / *Calculate the limiting reagent.* [3]

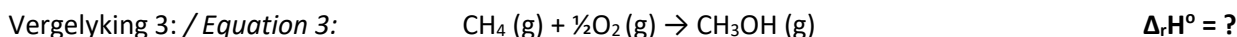
2.3.2 Bereken die massa  $KNO_3$  (in gram en in kilogram) wat berei kan word. / *Calculate the mass of  $KNO_3$  (in gram and in kilogram) that can be prepared.* [3]

2.4 'n Chemiestudent vind 'n blink klip wat sy vermoed goud is. Sy weeg die klip op 'n balans en verkry 'n massa van 14.3 g. Dan kom sy agter dat die temperatuur van die klip van  $25 \text{ }^\circ\text{C}$  na  $52 \text{ }^\circ\text{C}$  styg wanneer dit 174 J se hitte absorbeer. Is die klip goud? Antwoord ja of nee. (Die hittekapasiteit van goud =  $0.128 \text{ J}/\text{g }^\circ\text{C}$ ).  
*A chemistry student finds a shiny rock that she suspects is gold. She weighs the rock on a balance and obtains the mass, 14.3 g. She then finds that the temperature of the rock rises from  $25 \text{ }^\circ\text{C}$  to  $52 \text{ }^\circ\text{C}$  upon absorption of 174 J of heat. Is the rock gold? Answer yes or no. (The heat capacity of gold =  $0.128 \text{ J}/\text{g }^\circ\text{C}$ ).* [3]

2.5 Entalpieveranderinge kan eksperimenteel vir die volgende reaksies verkry word: / *Enthalpy changes for the following reactions can be determined experimentally:*



Gebruik hierdie vergelykings en waardes en Hess se wet om die verandering in entalpie vir die volgende reaksie te bepaal: (**Wenk:** Manipuleer die gegewe vergelykings.). / *Use these equations and values and Hess's law to determine the enthalpy change for the following reaction: (Hint: Manipulate the given reactions.)* [4]

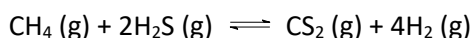


**VRAAG 3. / QUESTION 3.**

**[20 PUNTE. / MARKS.]**

3.1 Wat dui 'n klein ewewigskonstante vir 'n reaksie aan? / *What does a small equilibrium constant indicate for a reaction?* [2]

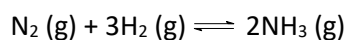
3.2 Skryf 'n ewewigsuitdrukking vir die volgende reaksie neer. / *Write down an equilibrium expression for the following reaction.* [1]



3.3 Teken 'n vryhand grafiek om die verloop van die volgende produkbevoordeelde ewewigsreaksie by 425 °C voor te stel. Benoem die asse van die grafiek en gee volledige byskrifte om die verandering in konsentrasie van die reagense en produk aan te dui. / *Draw a free hand graph to illustrate the progress of the following product-favoured equilibrium reaction at 425 °C. Name the axis of the graph and give full captions to indicate the change in concentration of the reagents and the product.* [10 x ½ = 5]

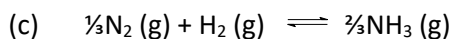
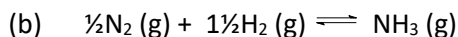
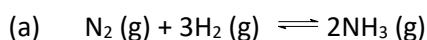
	<b>2H<sub>2</sub>(g)</b>	<b>+</b>	<b>O<sub>2</sub>(g)</b>	<b>⇌</b>	<b>2H<sub>2</sub>O (g)</b>
A (I)	0.0175		0.0175		0
V (C)	- 0.0138		- 0.0138		+ 0.0276
E (E)	0.0037		0.0037		0.0276

- 3.4 'n 50.0 L reaktor bevat 0.0200 M N<sub>2</sub>, 0.0600 M H<sub>2</sub> en 0.0100 M NH<sub>3</sub>. Sal meer ammoniak vorm of sal die ammoniak ontbind wanneer die mengsel ewewig nader by 400 °C? Die reaksievergelyking is: / A 50.0 L reactor contains 0.0200 M N<sub>2</sub>, 0.0600 M H<sub>2</sub> and 0.0100 M NH<sub>3</sub>. Will more ammonia be formed or will the ammonia decompose when the mixture goes to equilibrium at 400 °C? The reaction equation is: [3]



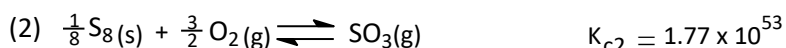
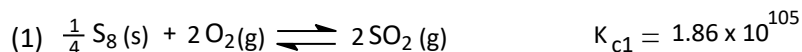
K<sub>c</sub> is 0.500 by/at 400 °C.

- 3.5 Die reaksie vir die produksie van ammoniak kan op verskillende maniere geskryf word: / The reaction for the production of ammonia can be written in a number of ways:

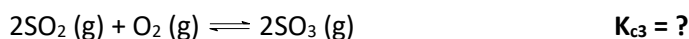


Skryf die ewewigskonstanteuitdrukking vir elke formulering neer. / Write down the equilibrium constant expression for each formulation. [3]

- 3.6 Gegewe die volgende ewewigsreaksies en konstantes: / Given the following equilibrium reactions and constants:



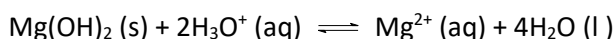
Bereken die ewewigskonstante, K<sub>c3</sub>, vir die volgende reaksie wat belangrik is in die vorming van suurreënlugbesoedeling. Calculate the equilibrium constant, K<sub>c3</sub>, for the following reaction which is important in the formation of acid rain air pollution. [6]



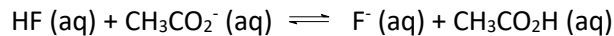
**VRAAG 4. / QUESTION 4.**

**[20 PUNTE. / MARKS.]**

- 4.1 Skryf die gekonjugeerde suur-basispare in die volgende reaksie neer. / Write down the conjugated acid-base pairs in the following reaction. [2]



4.2 Identifiseer die gekonjugeerde suur-basispare in die volgende reaksie. / *Identify the conjugated acid-base pairs in the following reaction.* [1]



- (a) HF/CH<sub>3</sub>CO<sub>2</sub><sup>-</sup> en/and F<sup>-</sup>/CH<sub>3</sub>CO<sub>2</sub>H
- (b) HF/CH<sub>3</sub>CO<sub>2</sub>H en/and F<sup>-</sup>/CH<sub>3</sub>CO<sub>2</sub><sup>-</sup>
- (c) HF/F<sup>-</sup> en/and CH<sub>3</sub>CO<sub>2</sub>H/CH<sub>3</sub>CO<sub>2</sub><sup>-</sup>

4.3 Word die volgende verbindings as sure, basisse of amfiproties geklasifiseer? / *Are the following compounds classified as acids, bases or amphiprotic?* [2]

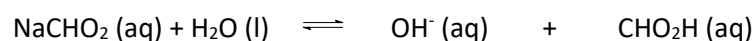
- (a) H<sub>2</sub>O
- (b) NaHCO<sub>3</sub>

4.4 Wat is die pH van 'n 1.2 x 10<sup>-3</sup> M NaOH oplossing? / *What is the pH of a 1.2 x 10<sup>-3</sup> M NaOH solution?* [1]

4.5 Onderstreep die korrekte keuse in die volgende stelling: / *Underline the correct choice in the following statement:* [1]

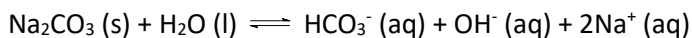
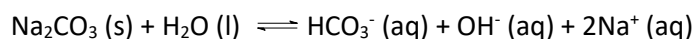
Deur NaH<sub>2</sub>PO<sub>4</sub> by water te voeg sal die pH laat (a) toeneem of (b) afneem of (c) dieselfde bly. / *Adding NaH<sub>2</sub>PO<sub>4</sub> to water will cause the pH to (a) increase or (b) to decrease or (c) to stay the same.*

4.6 Wat is die pH en die ion konsentrasies in 'n oplossing van 0.10 M natriumformaat, NaCHO<sub>2</sub>? K<sub>b</sub> vir die formaatioon, HCO<sub>2</sub><sup>-</sup> is 5.6 x 10<sup>-11</sup>. Wys al jou berekeninge. / *What are the pH and ion concentrations in a solution of 0.10 M sodium formate, NaHCO<sub>2</sub>? K<sub>b</sub> for the formate ion, HCO<sub>2</sub><sup>-</sup> is 5.6 x 10<sup>-11</sup>. Show all your calculations.* [5]



- 4.7 Bereken die ewewigskonstante van 'n 5.20 M natriumkarbonaatoplossing met 'n pH van 12.52 by 25°C.  
*Calculate the equilibrium constant for a 5.20 M sodium carbonate solution with a pH of 12.52 at 25°C.*

[8]



**VRAAG 5. / QUESTION 5.**

**[17 PUNTE. / MARKS.]**

- 5.1 Wanneer 50.00 mL van 'n 1.000 M HCl-oplossing getitreer word met 'n 0.7450 M NaOH-oplossing sal die pH toeneem. Hoeveel mL NaOH is nodig om die ewewigspunt en 'n pH van 7 te bereik? / *When 50.00 mL of a 1.000 M HCl solution is titrated with a 0.7450 M NaOH solution the pH will increase. How many mL of NaOH are required to reach the equilibrium point and a pH of 7?*

[3]

- 5.2 Wat is die  $K_{sp}$  uitdrukking vir silwerkarbonaat? / *What is the  $K_{sp}$  expression for silver carbonate?*

[2]

- 5.3 Bereken die oplosbaarheid van  $\text{MgF}_2$ -sout in (a) mol per liter water en (b) in gram per liter water deur van die volgende data gebruik te maak. / *Calculate the solubility of  $\text{MgF}_2$  salt in (a) mol per litre water and (b) gram per litre water by using the following data. (Gegee: / Given:  $M_{\text{MgF}_2} = 62.3 \text{ g}\cdot\text{mol}^{-1}$ )*

[4]



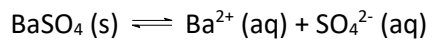
	$\text{MgF}_2 (\text{s})$	$\rightleftharpoons$	$\text{Mg}^{2+} (\text{aq})$	+	$2\text{F}^- (\text{aq})$
<b>Aanvangskonsentrasie. (M)</b> <i>Initial concentration. (M)</i>			0		0
<b>Verandering in konsentrasie. (M)</b> <i>Change in concentration. (M)</i>			+x		+2x
<b>Ewewigskonsentrasie. (M)</b> <i>Equilibrium concentration. (M)</i>			x		2x

- 5.4 Bereken of die  $\text{BaSO}_4$  gaan presipiteer wanneer jy 100.0 mL van 'n 0.0200 M  $\text{BaCl}_2$  oplossing en 50.0 mL van 'n 0.0300 M  $\text{Na}_2\text{SO}_4$  oplossing vermeng deur van die volgende data gebruik te maak. / *Calculate whether the  $\text{BaSO}_4$  will precipitate when you mix 100.0 mL of a 0.0200 M  $\text{BaCl}_2$  solution with a 0.0300 M  $\text{Na}_2\text{SO}_4$  solution by using the following data.*

[3]

$[\text{Ba}^{2+}]$  na vermenging / *after mixing* = 0.0133 M

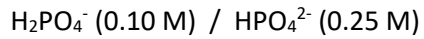
$[\text{SO}_4^{2-}]$  na vermenging / *after mixing* = 0.0100 M



$$K_{\text{sp}} = [\text{Ba}^{2+}][\text{SO}_4^{2-}] = 1.1 \times 10^{-10}$$

5.5 Bereken die pH van die volgende bufferoplossing: / Calculate the pH of the following buffer solution:

**[3]**



Die  $pK_a$  waarde van die diwaterstoffosfaatioon is 7.20. / The  $pK_a$  value of the dihydrogen phosphate ion is 7.20.

5.6 Definieer die term bufferoplossing. / Define the term buffer solution.

**[2]**

**TABEL 5: Ionisasiekonstantes vir sommige sure en hul gekonjugeerde basisse by 25 °C.**

**TABLE 5: Ionization constants for some acids and their conjugate bases at 25 °C.**

K <sub>a</sub> and K <sub>b</sub> Values					
Name of Acid	Acid	K <sub>a</sub>	Name of Base	Base	K <sub>b</sub>
Sulfuric acid	H <sub>2</sub> SO <sub>4</sub>	large	hydrogen sulfate ion	HSO <sub>4</sub> <sup>-</sup>	very small
Hydrochloric acid	HCl	large	chloride ion	Cl <sup>-</sup>	very small
Nitric acid	HNO <sub>3</sub>	large	nitrate ion	NO <sub>3</sub> <sup>-</sup>	very small
Hydronium ion	H <sub>3</sub> O <sup>+</sup>	55.5	water	H <sub>2</sub> O	1.8 × 10 <sup>-16</sup>
Hydrogen sulfate ion	HSO <sub>4</sub> <sup>-</sup>	1.2 × 10 <sup>-2</sup>	sulfate ion	SO <sub>4</sub> <sup>2-</sup>	8.3 × 10 <sup>-13</sup>
Phosphoric acid	H <sub>3</sub> PO <sub>4</sub>	7.5 × 10 <sup>-3</sup>	dihydrogen phosphate ion	H <sub>2</sub> PO <sub>4</sub> <sup>-</sup>	1.3 × 10 <sup>-12</sup>
Hexaaquairon(III) ion	Fe(H <sub>2</sub> O) <sub>6</sub> <sup>3+</sup>	6.3 × 10 <sup>-3</sup>	pentaaquahydroxoiron(III) ion	Fe(H <sub>2</sub> O) <sub>5</sub> OH <sup>2+</sup>	1.6 × 10 <sup>-12</sup>
Hydrofluoric acid	HF	7.4 × 10 <sup>-4</sup>	fluoride ion	F <sup>-</sup>	1.4 × 10 <sup>-11</sup>
Formic acid	HCO <sub>2</sub> H	1.8 × 10 <sup>-4</sup>	formate ion	HCO <sub>2</sub> <sup>-</sup>	5.6 × 10 <sup>-11</sup>
Benzoic acid	C <sub>6</sub> H <sub>5</sub> CO <sub>2</sub> H	6.3 × 10 <sup>-5</sup>	benzoate ion	C <sub>6</sub> H <sub>5</sub> CO <sub>2</sub> <sup>-</sup>	1.6 × 10 <sup>-10</sup>
Acetic acid	CH <sub>3</sub> CO <sub>2</sub> H	1.8 × 10 <sup>-5</sup>	acetate ion	CH <sub>3</sub> CO <sub>2</sub> <sup>-</sup>	5.6 × 10 <sup>-10</sup>
Hexaaquaaluminum ion	Al(H <sub>2</sub> O) <sub>6</sub> <sup>3+</sup>	7.9 × 10 <sup>-6</sup>	pentaaquahydroxoaluminum ion	Al(H <sub>2</sub> O) <sub>5</sub> OH <sup>2+</sup>	1.3 × 10 <sup>-9</sup>
Carbonic acid	H <sub>2</sub> CO <sub>3</sub>	4.2 × 10 <sup>-7</sup>	hydrogen carbonate ion	HCO <sub>3</sub> <sup>-</sup>	2.4 × 10 <sup>-8</sup>
Hydrogen sulfide	H <sub>2</sub> S	1 × 10 <sup>-7</sup>	hydrogen sulfide ion	HS <sup>-</sup>	1 × 10 <sup>-7</sup>
Dihydrogen phosphate ion	H <sub>2</sub> PO <sub>4</sub> <sup>-</sup>	6.2 × 10 <sup>-8</sup>	hydrogen phosphate ion	HPO <sub>4</sub> <sup>2-</sup>	1.6 × 10 <sup>-7</sup>
Hypochlorous acid	HClO	3.5 × 10 <sup>-8</sup>	hypochlorite ion	ClO <sup>-</sup>	2.9 × 10 <sup>-7</sup>
Ammonium ion	NH <sub>4</sub> <sup>+</sup>	5.6 × 10 <sup>-10</sup>	ammonia	NH <sub>3</sub>	1.8 × 10 <sup>-5</sup>
Hydrocyanic acid	HCN	4.0 × 10 <sup>-10</sup>	cyanide ion	CN <sup>-</sup>	2.5 × 10 <sup>-5</sup>
Hexaaquairon(II) ion	Fe(H <sub>2</sub> O) <sub>6</sub> <sup>2+</sup>	3.2 × 10 <sup>-10</sup>	pentaaquahydroxoiron(II) ion	Fe(H <sub>2</sub> O) <sub>5</sub> OH <sup>+</sup>	3.1 × 10 <sup>-5</sup>
Hydrogen carbonate ion	HCO <sub>3</sub> <sup>-</sup>	4.8 × 10 <sup>-11</sup>	carbonate ion	CO <sub>3</sub> <sup>2-</sup>	2.1 × 10 <sup>-4</sup>
Hydrogen phosphate ion	HPO <sub>4</sub> <sup>2-</sup>	3.6 × 10 <sup>-13</sup>	phosphate ion	PO <sub>4</sub> <sup>3-</sup>	2.8 × 10 <sup>-2</sup>
Water	H <sub>2</sub> O	1.8 × 10 <sup>-16</sup>	hydroxide ion	OH <sup>-</sup>	55.5
Hydrogen sulfide ion	HS <sup>-</sup>	1 × 10 <sup>-19</sup>	sulfide ion	S <sup>2-</sup>	1 × 10 <sup>5</sup>