NWU®

Benodigdhede vir hierdie vraestel/Requirements for this paper:			
Antwoordskrifte/ Answer scripts:		Multikeusekaarte (A5)/ Multi-choice cards (A5):	
Presensiestrokies (Invulvraestel)/ Attendance slips (Fill-in paper):	X	Multikeusekaarte (A4)/ Multi-choice cards (A4):	
Rofwerkpapier/ Scrap paper:		Grafiekpapier/ Graph paper:	

Sakrekenaars/Calculators: **Ja/Yes**

Ander hulpmiddels/Other resources:

Tipe assessering/ Type of assessment:	**Examination 2nd opportunity Paper/Vraestel 2**	Kwalifikasie/ Qualification:	**B.Sc., B.Pharm, B.Ing.**
Modulekode/ Module code:	**NCHE111**	Tydsduur/ Duration:	**3 uur 3 hour**
Modulebeskrywing/ Module description:	**Introduction to Inorganic and Physical Chemistry**	Maks/ Max:	**100**
Eksaminator(e)/ Examiner(s):	**Dr CE Read Prof. CA Strydom Dr. E Mashuga**	Datum/ Date:	**5 July 2019**
Interne/Internal moderator(s):	**Prof. CGCE van Sittert**	Tyd/ Time:	**14:00**

Inhandiging van antwoordskrifte/Submission of answer scripts: **Gewoon/Ordinary**

Titel: **Title:** _____ **Van:** **Surname:** **MEMORANDUM**

Volle voorletters: **Full initials:** _____ **Universiteitsnommer:** **University number:** _____

Eksamenvoorskrifte / Examination instructions

1. Studente mag in die eerste halfuur van 'n sessie tot die lokaal toegelaat word, maar geen ekstra tyd word toegestaan nie.
2. Geen student word toegelaat om die lokaal te verlaat binne die eerste halfuur van 'n eksamensessie nie.
3. Studente bring sakke na lokaal op **eie risiko**, en moet dit voor in die lokaal neersit.
4. Studente mag nie selfone/elektroniese toestelle by hulle hê en/of hanteer nie.
5. Geen verversings word in 'n eksamenlokaal toegelaat nie.
6. Studente mag nie die lokaal verlaat om te gaan rook nie.
7. Skryf op beide kante van die bladsye.
8. Skryf slegs in swart of blou ink.
9. Geen bladsye mag uit die antwoordskrif verwyder word nie.
10. Studente mag nie ontoelaatbare materiaal by hulle hê tydens 'n sessie nie, bv. notas en/of objekte wat notas bevat nie.
11. Geen items mag tydens die sessie geleen word nie.
12. Studente mag nie 'n ander student probeer help of probeer om hulp te kry nie.
13. Studente **moet** hul antwoordskrifte aan toesighouers oorhandig voordat hulle die lokaal verlaat.
14. Die presensiestrokie op die agterblad, wat ook as onderneming geld, **moet** voltooi en ingegee word.

1. Students are allowed into the venue in the first half hour of a session, but no extra time is granted.
2. No student is allowed to leave the venue before half an hour of the examination session has elapsed.
3. Students bring bags to the venue at **own risk**, and must put them in front of the room.
4. Students may not have cell phones/electronic devices with them and/or handle them.
5. No refreshments are allowed in the examination venue.
6. Students may not leave the room for a smoke break.
7. Write on both sides of each page.
8. Write in black or blue ink only.
9. No pages may be removed from the answer scripts.
10. Students may not have unauthorized material with them during a session, e.g. notes and/or objects that contain notes.
11. No items may be borrowed during the session.
12. Students may not attempt to assist another student, or attempt to obtain assistance.
13. Students **must** hand in their answer scrips to invigilators before they leave the venue.
14. The attendance slip on the back cover that also serves as an undertaking, **must** be completed and handed in.

LEES DIE VOLGENDE INSTRUKSIES DEEGLIK

Antwoorde op vrae moet in die oopgelate ruimtes by elke vraag gegee word.

Die rugkante van bladsye kan ook gebruik word, maar dan moet dit duidelik by die vraag aangedui word. Dit kan ook vir rofwerk gebruik word.

Die vraestel moet in pen voltooi word.

'n Periodiek tabel is aangeheg en jy mag die bladsy afskeur vir gebruik.

Sakrekenaars is toelaatbaar. Die sakrekenaarfasiliteit op selfone is nie toegelaat nie.

Avogadrogetal (N_A): 6,022 x 10^{23} mol^{-1}

Alle berekeninge moet getoon word!

READ THE FOLLOWING INSTRUCTIONS THOROUGHLY

Answers on questions must be given in the blank spaces below each question.

The back of pages can also be used, but it should then be indicated at each question. It can also be used for own scribbling.

The paper must be completed in pen.

A periodic table is attached and you may tear it off for use.

Calculators are allowed. The calculator facility on mobile phones is not allowed.

Avogadro's number (N_A): 6,022 x 10^{23} mol^{-1}

All calculations must be shown!

√ = $\frac{1}{2}$ **punt**

√ = 1 **punt**

For ALL calculations in this paper allow for a small deviation on the answers because of different ways of rounding of the answers. Also, if the answer is correct you don't have to give marks for steps. If an answer is correct and a method was followed you can give full marks for that question. Only look for individual marks when the answer is wrong.

Vraag 1. / *Question 1.* **[40 PUNTE. / *40 MARKS.*]**

STUDY UNITS 2, 3, 4 AND 5 (THIS IS NOT GOING TO STAND IN THE PAPER).

Beide kampusse se studente antwoord vraag 1.1 / *Students from both campuses answer question 1.1*

1.1 Skryf formule of die naam vir die volgende verbindings. / *Write the formula or the name for the following compounds.* **[3]**

Naam van verbinding. *Name of compound.*	Formule van verbinding. *Formula of compound.*
Silwer(I)oksied / *Silver(I) oxide*	**Ag_2O** ✓
Bariumperchloraat / *Barium perchlorate*	**$Ba(ClO_4)_2$** ✓
Kobalt(III)sianied. / Cobalt(III) cyanide ✓	$Co(CN)_3$

Beide kampusse se studente antwoord vraag 1.2 / *Students from both campuses answer question 1.2*

1.2 Watter van die volgende atome het die grootste aantal protone? / *Which of the following atoms contains the largest number of protons?* **[1]**

a. ^{226}Ra b. ^{227}Ac c. ^{232}Th **d. ^{231}Pa** ✓ e. ^{222}Rn

Beide kampusse se studente antwoord vraag 1.3 / *Students from both campuses answer question 1.3*

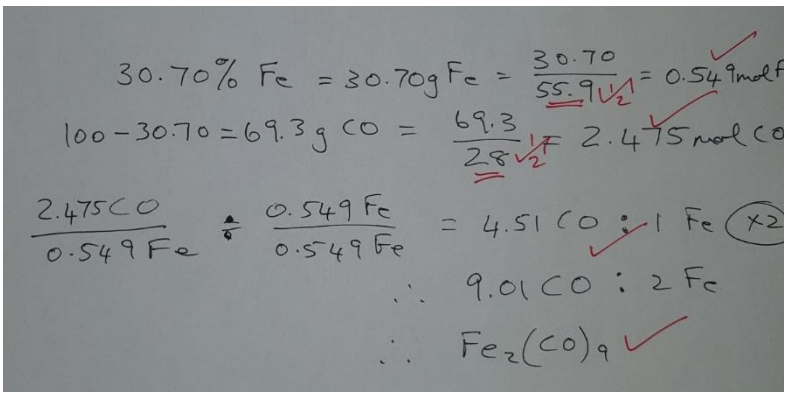
1.3 Watter van die volgende is korrek vir 'n element met 28 protone en 31 neutrone? / *Which of the following is correct for an element with 28 protons and 31 neutrons?* **[1]**

a. $^{59}_{31}Ga$ b. $^{31}_{28}Ni$ c. $^{28}_{59}Pr$ **d. $^{59}_{28}Ni$** ✓

e. $^{31}_{3}Li$

Beide kampusse se studente antwoord vraag 1.4 / *Students from both campuses answer question 1.4*

1.4 $Fe_x(CO)_y$ bestaan uit 30,70% yster. Bereken die eenvoudigste (empiriese) formule van die verbinding. *$Fe_x(CO)_y$ consists of 30,70% iron. Calculate the simplest (empirical) formula of the compound.* **[5]**



Beide kampusse se studente antwoord vraag 1.5 / *Students from both campuses answer question 1.5*

1.5 Voltooi en benoem die chemiese reaksietipes van die volgende reaksies in waterige oplossings:
Complete and name the chemical reaction types of the following reactions in aqueous solution:

[6]

1.5.1 $Hg_2(NO_3)_2(aq) + CuSO_4(aq) \rightarrow Hg_2SO_4(s) + Cu(NO_3)_2(aq)$ ☑☑ precipitation

1.5.2 $Ca(OH)_2(aq) + 2HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$ ☑☑ acid-base

1.5.3 $2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g)$ ☑☑ redox – displacement

Beide kampusse se studente antwoord vraag 1.6 / *Students from both campuses answer question 1.6*

1.6 Balanseer die volgende oksidasie-reduksie reaksie wat plaasvind in basiese oplossing deur van die half-reaksie metode gebruik te maak. / *Balance the following oxidation-reduction reaction which occur in basic solution using the half-reaction method*. **[6]**

$Al(s) + MnO_4^-(aq) \rightarrow MnO_2(s) + Al(OH)_4^-(aq)$

Oxidation numbers: Al = 0 Mn = +7 Mn = +4 Al = +3 ☑☑

O½: $Al + 4OH^- \rightarrow Al(OH)_4^- + 3é$ ☑

R½: $MnO_4^- + 2H_2O + 3é \rightarrow MnO_2 + 4OH^-$ ☑

$Al(s) + MnO_4^-(aq) + 2H_2O(l) \leftrightarrows Al(OH)_4^-(aq) + MnO_2(s)$ ☑☑

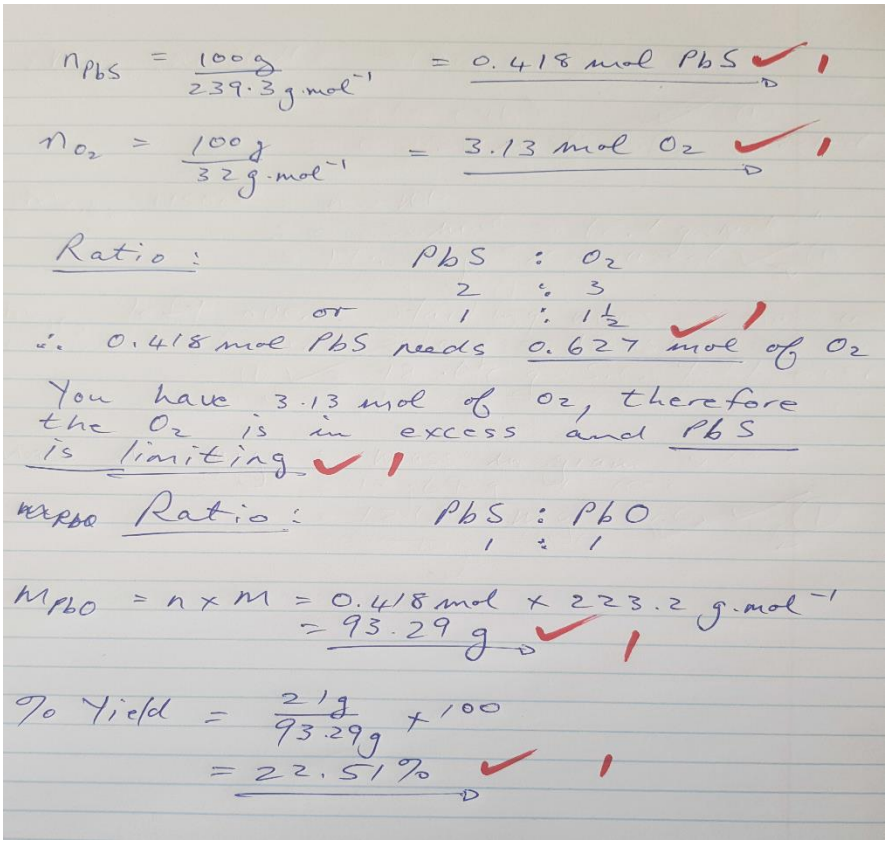
Beide kampusse se studente antwoord vraag 1.7 / *Students from both campuses answer question 1.7*

1.7 Gegee die volgende vergelyking: / *Given the following equation*:

$$2PbS(s) + 3O_2(g) \rightarrow 2PbO(s) + 2SO_2(g)$$

Indien 100 g PbS(s) reageer met 100 g $O_2(g)$ en slegs 21 g PbO(s) word gevorm, watter reagens is die beperkende reagens en wat is die persentasie opbrengs van die reaksie? / *If 100 g PbS(s) react with 100 g $O_2(g)$ and only 21 g PbO(s) is formed, which reagent is the limiting reagent and what is the percentage yield of the reaction?* **[6]**

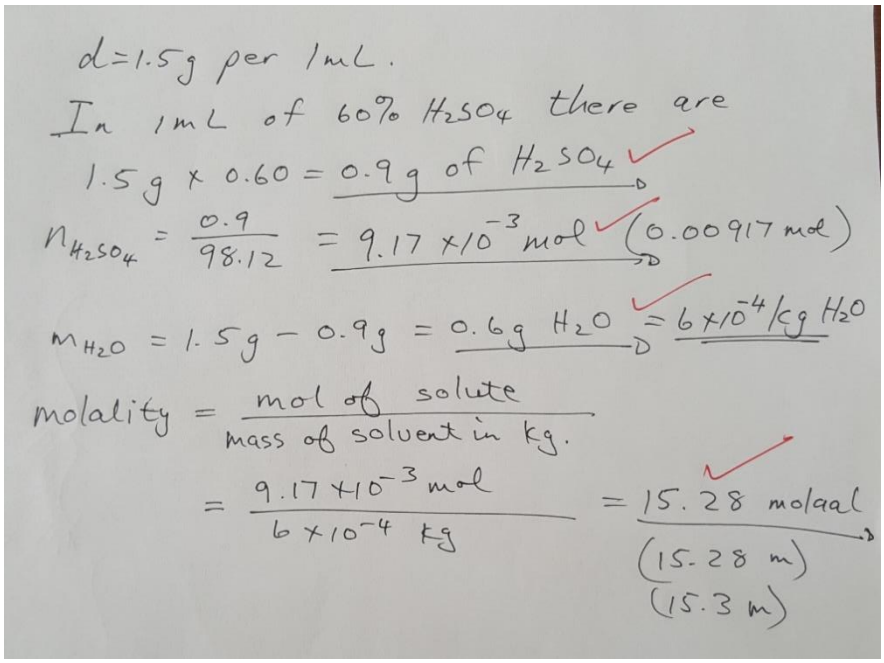
(**Gegee: / *Given*:** $M_{PbS} = 239.3\ g.mol^{-1}$; $M_{O2} = 32\ g.mol^{-1}$; $M_{PbO} = 223.2\ g.mol^{-1}$).



Beide kampusse se studente antwoord vraag 1.8 / *Students from both campuses answer question 1.8*

1.8 Gekonsentreerde swaelsuur (98.12 g.mol^{-1}) het 'n digtheid van 1.5 g/cm^3 en is 60 % H_2SO_4 per massa. Die res is water. Bereken die molaliteit van die suur. / *Concentrated sulphuric acid (98.12 g.mol^{-1}) has a density of 1.5 g/cm^3 and is 60 % H_2SO_4 per mass. The rest is water. Calculate the molality of the acid.*

[4]



Beide kampusse se studente antwoord vraag 1.9 / *Students from both campuses answer question 1.9*

1.9 Gegewe die volgende data: / *Given the following data:* **[4]**

(i)	$Ca(s) + 2C(grafite) \rightarrow CaC_2(s)$	$\Delta H = -62.8$ kJ
(ii)	$Ca(s) + ½O_2(g) \rightarrow CaO(s)$	$\Delta H = -635.5$ kJ
(iii)	$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$	$\Delta H = -653.1$ kJ
(iv)	$C_2H_2(g) + 5/2O_2(g) \rightarrow 2CO_2(g) + H_2O(l)$	$\Delta H = -1300.0$ kJ
(v)	$C(grafite) + O_2(g) \rightarrow CO_2(g)$	$\Delta H = -393.5$ kJ

Bereken ΔH vir die volgende reaksie, deur van Hess se wet en manipulasie van die gegewe reaksies gebruik te maak. / *Calculate ΔH for the following reaction by using Hess's law and manipulating the given reactions:*

$$CaC_2(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + C_2H_2(g) \quad \mathbf{\Delta H = ?}$$

(i)	Reverse $CaC_2(s) \rightarrow Ca(s) + 2C(grafite)$	$\Delta H = +62.8$ kJ	☑
(ii)	$Ca(s) + ½O_2(g) \rightarrow CaO(s)$	$\Delta H = -635.5$ kJ	
(iii)	$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$	$\Delta H = -653.1$ kJ	
(iv)	Reverse $2CO_2(g) + H_2O(l) \rightarrow C_2H_2(g) + 5/2O_2(g)$	$\Delta H = +1300.0$ kJ	☑
(v)	(x2) $2C(grafite) + 2O_2(g) \rightarrow 2CO_2(g)$	$\Delta H = 2(-393.5$ kJ)	☑
		$\Delta H = -712.8$ kJ	☑

Beide kampusse se studente antwoord vraag 1.10 / *Students from both campuses answer question 1.10*

1.10 'n Stukkie chroom (25.5 g) word verhit tot 100.0 °C (373.15 K) en dan in 55.5 g water by 16.5 °C (289.65 K) laat val. Die finale temperatuur van die metaal en water is 18.9 °C. Bereken die spesifieke hittekapasiteit van chroom. (Aanvaar dat geen energie verlore gegaan het na die houer of die omringende lug nie). Die spesifieke hittekapasiteit van water is 4.184 J/g.K). / *A 25.5 g piece of chromium is heated to 100.0 °C (373.15 K) and is then dropped into 55.5 g of water at 16.5 °C (289.65 K). The final temp. of the metal and water is 18.9 °C. Calculate the specific heat capacity of chromium. (Assume no energy is lost to the container or to the surrounding air). The specific heat capacity of water is 4.184 J/g.K).* **[4]**

Because of conservation of energy, $q_{(Cr)} = -q_{(H2O)}$ (energy out of Cr = energy into H_2O) or $q_{(Cr)} + q_{(H2O)} = 0$ ✓

$q_{(Cr)} = (25.5\ g)(C_p)(18.9\ ^\circ C - 100.0\ ^\circ C)$

$q_{(Cr)} = -2068.05\ X\ C_p$ ✓

$q_{(H2O)} = (55.5\ g)(4.184\ J/K \bullet g)(18.9\ ^\circ C - 16.5\ ^\circ C)$

$q_{(H2O)} = 557.3088\ J$ ✓

$q_{(Cr)} + q_{(H2O)} = -2068.05\ C_p + 557.309 = 0 \rightarrow C_p = 0.269\ J/g \bullet K$ ✓

Allow for a small deviation in the answer because students round off differently.

Vraag 2. / *Question 2.* **[20 PUNTE. / *20 MARKS*.]**

ONLY STUDY UNIT 7 (THIS IS NOT GOING TO STAND IN THE PAPER).

Beide kampusse se studente antwoord vraag 2.1 / *Students from both campuses answer question 2.1*

2.1 K_c vir die ontbinding van ammoniumwaterstofsulfied is 1.8×10^{-4} by 25^0C. / *K_c for the decomposition of ammonium hydrogen sulfide is 1.8×10^{-4} at 25^0C.*

$$NH_4HS(s) \leftrightarrows NH_3(g) + H_2S(g)$$

2.1.1 Bereken die ewewigskonsentrasies van beide produkte wanneer die suiwer sout ontbind in 'n fles. / *Calculate the equilibrium concentrations of both products when the pure salt decomposes in a flask.* **[2]**

$K = [NH_3][H_2S] = 1.8 \times 10^{-4} = x^2$ ☑

X = square root $1.8 \times 10^{-4} = 0.0134$ mol/L = $[NH_3] = [H_2S]$ ☑

2.1.2 Indien NH_4HS in 'n fles geplaas word wat alreeds 0.020 mol/L NH_3 bevat en die sisteem dan toegelaat word om ewewig te bereik, bereken dan die ewewigskonsentrasies van NH_3 en H_2S. *If NH_4HS is placed in a flask already containing 0.020 mol/L of NH_3 and then the system is allowed to come to equilibrium, calculate the equilibrium concentrations of NH_3 and H_2S?* **[4]**

$K = [NH_3][H_2S] = 1.8 \times 10^{-4} = (0.020 + x)\, x = (0.02)x$ ☑

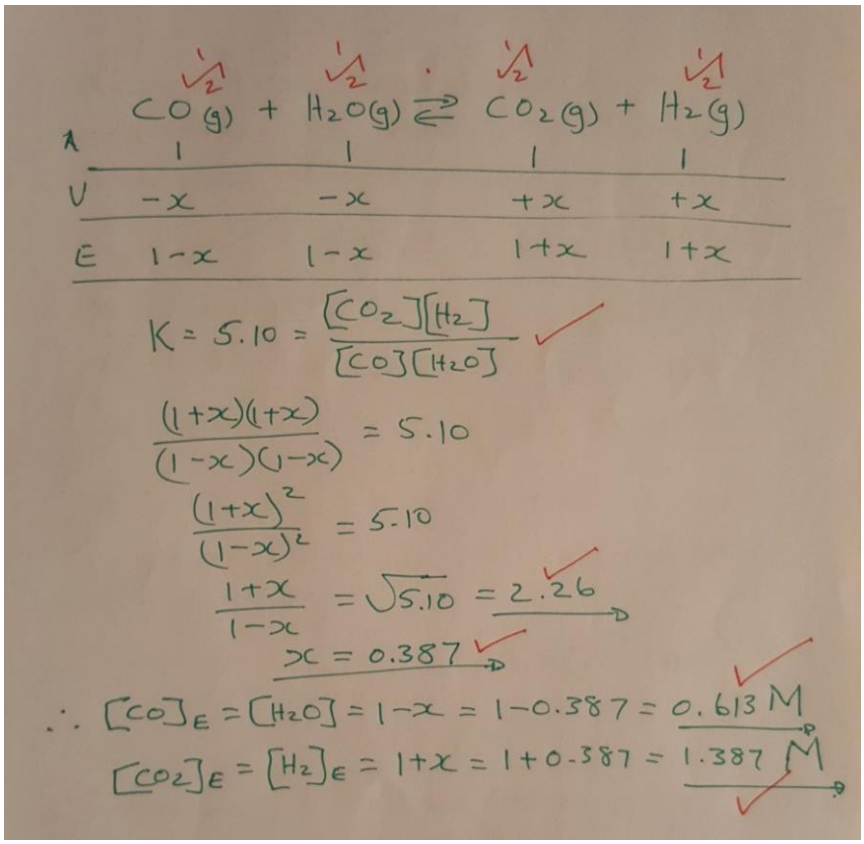
$X = (1.8 \times 10^{-4}) / 0.020 = 0.009$ ☑

$[NH_3] = 0.020 + 0.009 = 0.029$ mol/L ☑ with quadratic eq = 0.027 mol/L

$[H_2S] = 0.009$ mol/L ☑ with quadratic eq = 0.0067 mol/L

Beide kampusse se studente antwoord vraag 2.2 / *Students from both campuses answer question 2.2*

2.2 Koolstofmonoksied reageer met stoom om koolstofdioksied en waterstofgas te produseer. By 700 K is die ewewigskonstante gelyk aan 5.10. Bereken die ewewigskonsentrasies van al die spesies indien met 1.00 mol.L^{-1} van elk begin is. / *Carbon monoxide reacts with steam to yield carbon dioxide and hydrogen gas. At 700 K the equilibrium constant is equal to 5.10. Calculate the equilibrium concentrations of all the species if the reaction was started with 1.00 mol.L^{-1} of each.* **[7]**

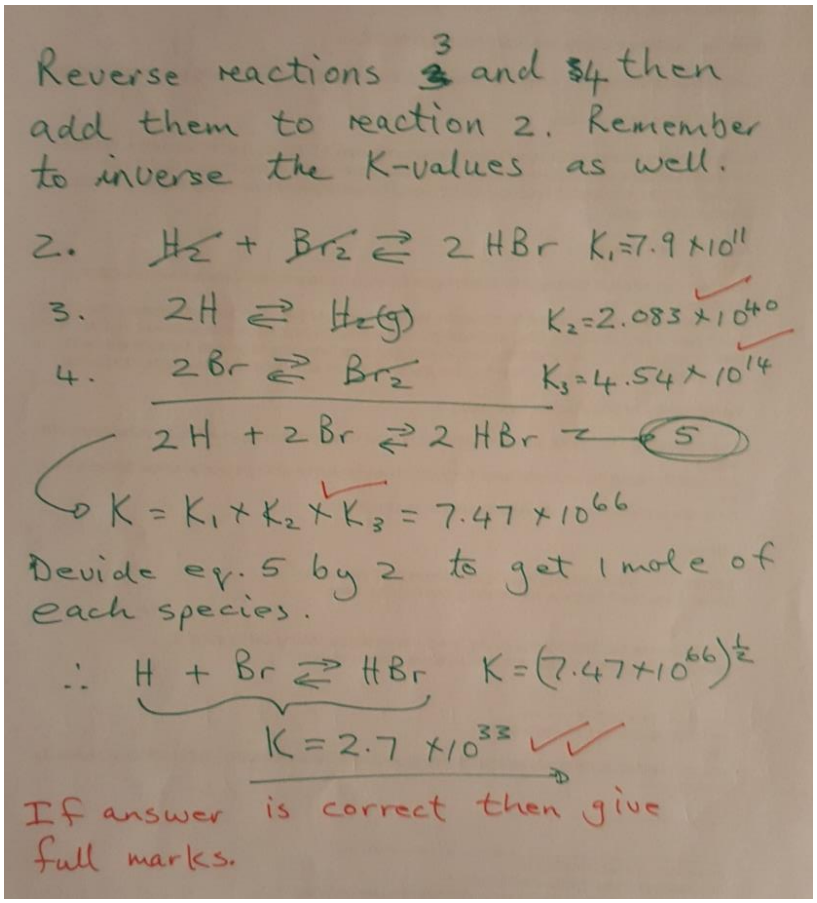


Beide kampusse se studente antwoord vraag 2.3 / *Students from both campuses answer question 2.3*

2.3 Bepaal die ewewigskonstante K vir die vorming van HBr volgens die reaksie hieronder genommer 1 deur gebruik te maak van die ewewigskonstantes van die reaksies genommer 2 tot 4. / *Determine the equilibrium constant K for the formation of HBr according to the reaction numbered 1 below by using the equilibrium constants of the reactions numbered 2 to 4.* **[5]**

1. $H(g) + Br(g) \rightleftharpoons HBr(g)$ **K = ?**

2. $H_2(g) + Br_2(g) \rightleftharpoons 2HBr(g)$ $K_1 = 7.9 \times 10^{11}$
3. $H_2(g) \rightleftharpoons 2H(g)$ $K_2 = 4.8 \times 10^{-41}$
4. $Br_2(g) \rightleftharpoons 2Br(g)$ $K_3 = 2.2 \times 10^{-15}$



Beide kampusse se studente antwoord vraag 2.4 / *Students from both campuses answer question 2.4*

2.4 Sal jy (op grond van jou antwoord in vraag 2.3) sê dat reaksie nommer 1 'n hoë produk opbrengs sal hê? Omkring JA of NEE en gee 'n rede vir jou antwoord. / *Will you (on the basis of your answer in question 2.3) say that reaction number 1 will have a high product yield? Circle YES or NO and give a reason for your answer.* **[2]**

JA (*YES*). √ NEE (*NO*)

Rede: K > 1 √

Vraag 3. / *Question 3.* **[20 PUNTE. / *20 MARKS.*]**

ONLY STUDY UNIT 8 (THIS IS NOT GOING TO STAND IN THE PAPER).

Beide kampusse se studente antwoord vraag 3.1 / *Students from both campuses answer question 3.1*

3.1 Bereken die massa KOH wat nodig is om 'n 800.0 mL oplossing met 'n pH = 11.56 voor te berei.

Calculate the mass of KOH necessary to prepare 800.0 mL of a solution that has a pH = 11.56. **[4]**

pOH = 14 – pH = 14 – 11.56 = 2.44 ☑

$[OH^-] = 10^{-pOH} = 10^{-2.44} = 0.00363$ mol/L ☑

Strong base [KOH] = $[OH^-]$ = 0.00363 mol/L

1000 mL equal 0.00363 mol

800 mL equal (0.00363 x 800)/1000 = 0.00290 mol ☑

Mass = nM = 0.00290 x (39.1 + 16 + 1.01 = 56.11) = 0.163 gram ☑

Beide kampusse se studente antwoord vraag 3.2 / *Students from both campuses answer question 3.2*

3.2 Sitroensuur ($H_3C_6H_5O_7$) is 'n triprotiese suur met 'n $K_{a1} = 8.4 \times 10^{-4}$; $K_{a2} = 1.8 \times 10^{-5}$ en $K_{a3} = 4.0 \times 10^{-6}$. Bereken die pH van 'n 0.15 M sitroensuuroplossing. / *Citric acid ($H_3C_6H_5O_7$) is a tri-protic acid with $K_{a1} = 8.4 \times 10^{-4}$; $K_{a2} = 1.8 \times 10^{-5}$ and $K_{a3} = 4.0 \times 10^{-6}$. Calculate the pH of 0.15 M citric acid solution.*

[5]

$H_3C_6H_5O_7 + H_2O \leftrightarrows H_2C_6H_5O_7^- + H_3O^+$ ☑

$K_{a1} = x^2 / 0.15 = 8.4 \times 10^{-4}$ {ignore x in (0.15 – x) because 0.15 / 8.4×10^{-4} = 178.57 > 100}

$X^2 = 0.150 \times 8.4 \times 10^{-4} = 0.000126$ ☑

X = 0.01122 ☑

pH = -log $[H^=]$ = -log (0.01122) = 1.949 ☑

The pH is determined ONLY by the first K_a ☑

If a student did not indicate that the pH is only determined by the 1st Ka value, but still calculated the pH correctly he/she can still get full marks for the question.

Beide kampusse se studente antwoord vraag 3.3 / *Students from both campuses answer question 3.3*

3.3 In 'n waterige oplossing wat 10^{-8} M soutsuur (HCL) en 10^{-8} M asynsuur (CH_3COOH) bevat sal die H^+-ione hoofsaaklik verskaf word deur .... / *In an aqueous solution containing 10^{-8} M (hydrochloric acid) HCl and 10^{-8} M acetic acid (CH_3COOH) the H^+ ions will mostly be supplied by ....* **[1]**

A) die sterk suur. / *the strong acid.* √

B) die swak suur. / *the weak acid.*

C) beide die sterk en die swak sure. / *both the strong and the weak acids.*

D) water. / *water.*

Beide kampusse se studente antwoord vraag 3.4 / *Students from both campuses answer question 3.4*

3.4 Die sianiedioon, CN^-, ontvang 'n proton vanaf water om HCN te vorm. Is CN^- 'n Brønsted-Lowry suur of basis of is dit amfiproties? / *The cyanide ion, CN^-, accepts a proton from water to vorm HCN. Is CN^- a Brønsted-Lowry acid or base or is it amphiprotic?* **[1]**

Base ✓

Beide kampusse se studente antwoord vraag 3.5 / *Students from both campuses answer question 3.5*

3.5 Wat is die pH en die ioon konsentrasies in 'n oplossing van 0.10 M natriumformaat, $NaCHO_2$? K_b vir die formaatioon, HCO_2^- is 5.6×10^{-11}. Wys al jou berekeninge. / *What are the pH and ion concentrations in a solution of 0.10 M sodium formate, $NaHCO_2$? K_b for the formate ion, HCO_2^- is 5.6×10^{-11}. Show all your calculations.* **[4]**

	pH	$[Na^+]$	$[CHO_2^-]$	$[OH^-]$
a.	5.63	0.10	0.10	2.4×10^{-6}
b.	**8.37**	**0.10**	**0.10**	**2.4×10^{-6}** ✓
c.	8.22	0.050	0.050	1.7×10^{-6}
d.	5.63	0.10	0.10	4.2×10^{-9}
e.	8.22	0.10	0.050	1.7×10^{-6}

	$NaCHO_2$ (aq) + H_2O (l)	OH^- (aq)	+	CHO_2H (aq)
A	**0.10**	**0**		**0**
V	**-x**	**+x**		**+x**
E	**0.10 – x**	**x**		**x**

$5.6 \times 10^{-11} = x^2 / 0.1$ ✓

$X^2 = (5.6 \times 10^{-11})(0.10)$

X = vierkantswortel van $5.6 \times 10^{-12} = 2.36 \times 10^{-6} \approx 2.4 \times 10^{-6}$

DUS: $[OH^-]$ by ewewig = 2.4×10^{-6} M ✓

$[Na^+]$ by ewewig = 0.10 M ✓

$[CHO_2^-]$ by ewewig = 0.10 M ✓

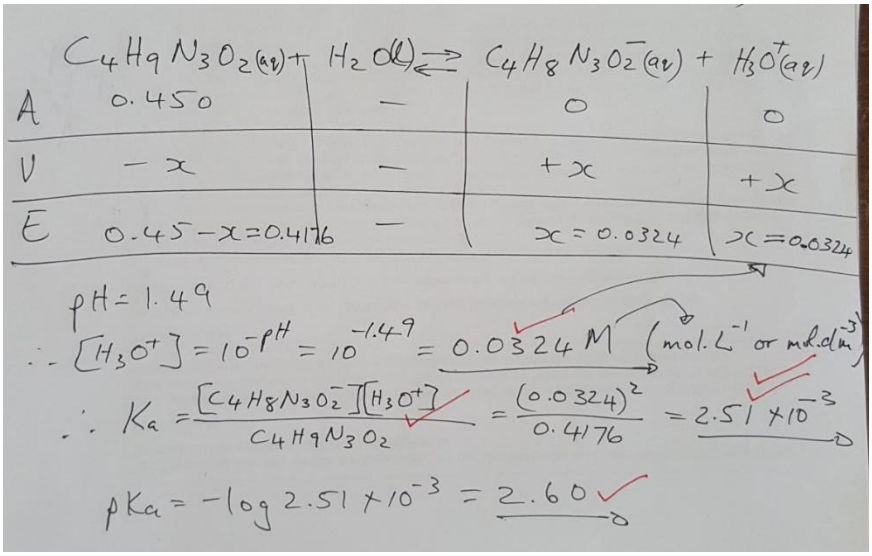
pOH = -log 2.4×10^{-6} = 5.63 ✓

pH = 14.00 – 5.63 = 8.37 ✓

Beide kampusse se studente antwoord vraag 3.7 / *Students from both campuses answer question 3.7*

3.7 'n 0.450 M waterige oplossing van kreatien, ($C_4H_9N_3O_2$), het 'n pH van 1.49. Bereken die waarde van die ewewigskonstante van kreatien sowel as die pK_a waarde. / *A 0.450 M aqueous solution of creatine, ($C_4H_9N_3O_2$), has a pH of 1.49. Calculate the value of the equilibrium constant for creatine as well as the pK_a value.* **[5]**

$$C_4H_9N_3O_2\ (aq) + H_2O\ (l) \rightleftharpoons C_4H_8N_3O_2^-\ (aq) + H_3O^+\ (aq)$$



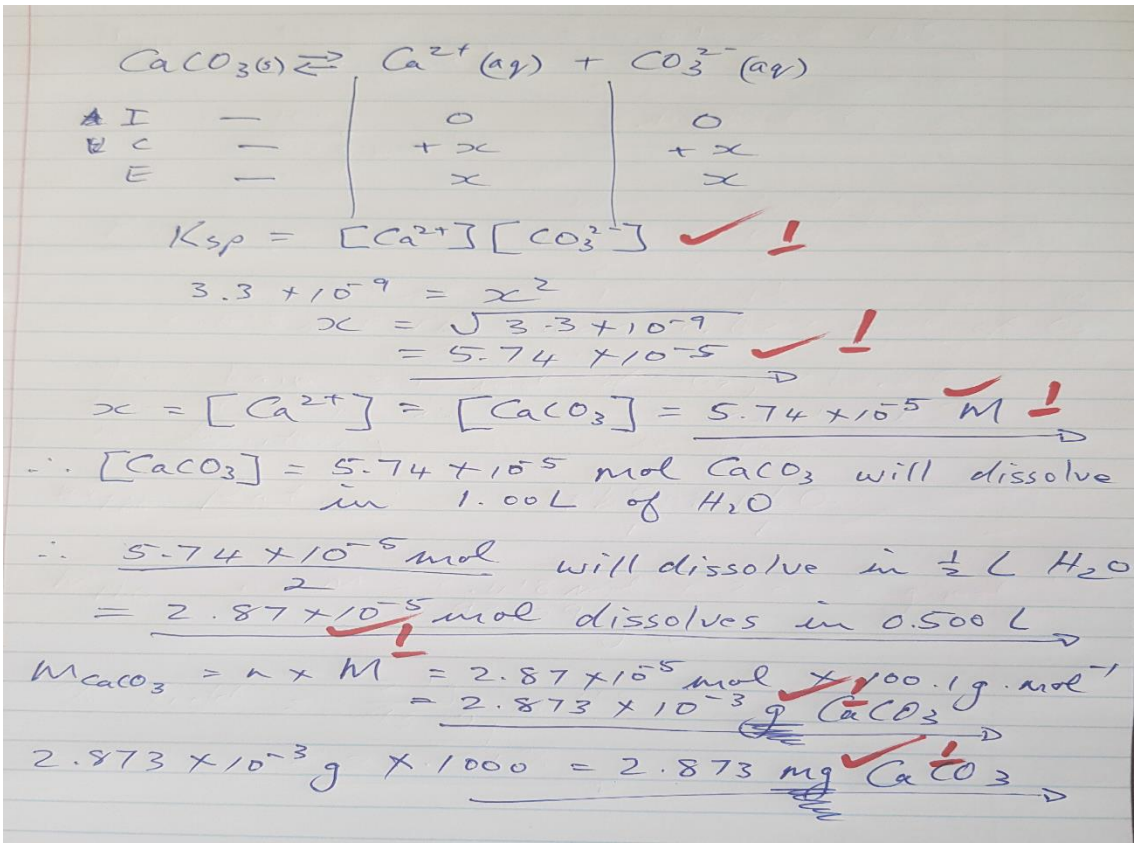
Vraag 4. / *Question 4.* **[20 PUNTE. / *20 MARKS*.]**

ONLY STUDY UNIT 9 (THIS IS NOT GOING TO STAND IN THE PAPER).

Beide kampusse se studente antwoord vraag 4.1 / *Students from both campuses answer question 4.1*

4.1 Die oplosbaarheidsproduk-konstante van kalsiumkarbonaat is 3.3 x 10^{-9} by 25^{0}C. Bereken die hoeveelheid (in gram en in milligram) $CaCO_3$ wat sal oplos in 'n half liter water by 25^{0}C. / The solubility product constant of calcium carbonate is 3.3 x 10^{-9} at 25^{0}C. Calculate the amount (in gram and in milligram) of $CaCO_3$ that will dissolve in half a litre of water at 25^{0}C. **[6]**

(**Gegee: / *Given:*** M_{H2O} = 18.02 g.mol^{-1} en/*and* M_{CaCO3} = 100.1 g.mol^{-1})



Beide kampusse se studente antwoord vraag 4.2 / *Students from both campuses answer question 4.2*

4.2 Definieer 'n bufferoplossing. Van wat word 'n bufferoplossing berei? Beskryf hoe buffers bygevoegde H^+- en OH^--ione absorbeer sodat 'n baie klein pH verandering plaasvind. 'n Sekere buffer is berei deur $NaHCO_3$ en $NaCO_3$ in water op te los. Skryf reaksievergelykings neer wat wys hoe die buffer bygevoegde H^+- en OH^--ione sal neutraliseer.

Define a buffer solution. What makes up a buffered solution? Explain how buffers absorb added H^+ or OH^- with little pH change. A certain buffer is made by dissolving $NaHCO_3$ and Na_2CO_3 in come water. Write equations to show how this buffer neutralizes added H^+ and OH^-. **[6]**

A buffer solution is a solution that resists a change in its pH when H^+ or OH^- are added. ☑

Any solution that contains a weak acid and its conjugate base OR a weak base and its conjugate acid, is classified as a buffer. ☑

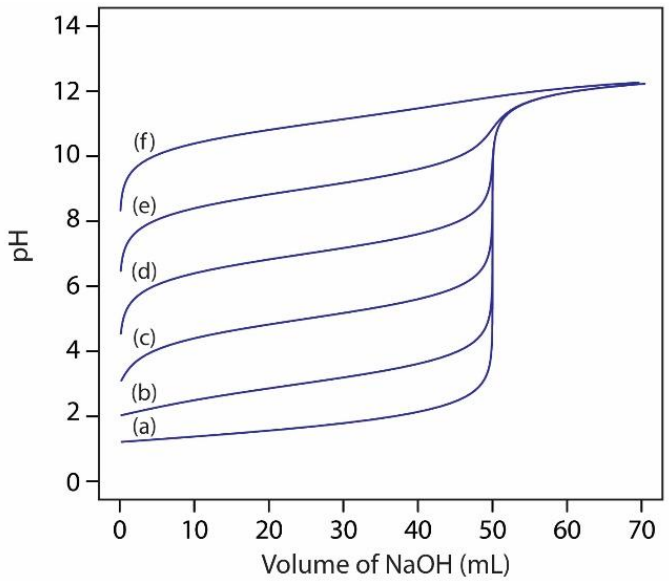
The pH of the buffer depends on the [base] / [acid] ratio. **When H^+** is added to the buffer, the weak base component of the buffer reacts with the H^+ and forms the acid component of the buffer. Even though the concentrations of the acid and the base components of the buffer change some, the ratio of [base] / [acid] does not change that much. **When OH^-** is added to the buffer, the weak acid component of the buffer reacts with the OH^- and forms the base component of the buffer. Again, the ratio of [base] / [acid] does not change a lot, so that the pH does not change much. ☑☑

Buffer HCO_3^- and CO_3^{2-}

H^+ + $CO_3^{2-} \leftrightarrows HCO_3^-$ ☑ OR **OH^-** + $HCO_3^- \leftrightarrows H_2O + CO_3^{2-}$ ☑

Beide kampusse se studente antwoord vraag 4.3 / *Students from both campuses answer question 4.3*

4.3 Die volgende grafiek wys die pH kurwes vir titrasies van verskeie sure met 0.10 M NaOH (al die sure was 50.0 mL monsters met konsentrasies van 0.10 M). / *The following plot shows the pH curves for the titrations of various acids with 0.10 M NaOH (all the acids were 50,0 mL samples of 0.10 M concentration).*



4.3.1 Watter pH kurwe stem ooreen met die swakste suur? Gee 'n rede vir jou antwoord. / *Which pH curve corresponds to the weakest acid? Give a reason for your answer.* **[2]**

(f) is the curve of the weakest acid. ☑ The acid is in the flask and NaOH is added from the burette. The acid is so weak that after the first drops of base is added the pH immediately change from acidic to basic at pH = 9 before 5 mL of base is added. ☑

4.3.2 Watter pH kurwe stem ooreen met die sterkste suur? Gee 'n rede vir jou antwoord. / *Which pH curve corresponds to the strongest acid? Give a reason for your answer.* **[2]**

(a) is the strongest acid. ☑ The pH of the acid stays almost constant at pH = 1.3 until 20 mL base is added. Only when 50 mL base is added does the pH change dramatically. ☑

4.3.3 Watter punt op die pH kurwe sal jy bestudeer om te sien of die suur 'n sterk suur of 'n swak suur is? / *Which point on the pH curve would you examine to see if the acid is a strong acid or a weak acid?* **[2]**

The best point to look at to differentiate a strong acid from a weak acid (if initial concentrations are similar and the base is NaOH) is the equivalence point pH. If the pH = 7 the acid is strong, if the pH is greater than 7, the acid is weak. ☑☑ (The shape of the curve at the beginning and the end of the plot can also be used.)

4.3.4 Watter pH kurwe stem ooreen met 'n suur met 'n $K_a = 1 \times 10^{-6}$? Gee 'n rede vir jou antwoord. Which pH curve corresponds to an acid with $K_a = 1 \times 10^{-6}$? Give a reason for your answer. **[2]**

(d). ☑ $pK_a = - \log K_a = -\log 1x10^{-6} = 6$.

At the halfway point to the equivalence point in the titration pH = pK_a. Therefore curve (d) is the nearest to pH 6 at the halfway point. ☑

TOTAAL/TOTAL: 100

JY MAG HIERDIE BLADSY AFSKEUR!

YOU MAY TEAR OF THIS PAGE!

PERIODIC TABLE OF THE ELEMENTS
PERIODIEKE INDELING VAN DIE ELEMENTE

IA (1)	IIA (2)	IIIB (3)		IVB (4)	VB (5)	VIB (6)	VIIB (7)	VIII (8)	VIII (9)	VIII (10)	IB (11)	IIB (12)	IIIA (13)	IVA (14)	VA (15)	VIA (16)	VIIA (17)	0 (18)
1 **H** 1,01																		2 **He** 4,00
3 **Li** 6,94	4 **Be** 9,01												5 **B** 10,8	6 **C** 12,0	7 **N** 14,0	8 **O** 16,0	9 **F** 19,0	10 **Ne** 20,2
11 **Na** 23,0	12 **Mg** 24,3												13 **Al** 27,0	14 **Si** 28,1	15 **P** 31,0	16 **S** 32,1	17 **Cl** 35,45	18 **Ar** 39,9
19 **K** 39,1	20 **Ca** 40,1	21 **Sc** 45,0		22 **Ti** 47,9	23 **V** 50,9	24 **Cr** 52,0	25 **Mn** 54,9	26 **Fe** 55,9	27 **Co** 58,9	28 **Ni** 58,7	29 **Cu** 63,4	30 **Zn** 65,4	31 **Ga** 69,7	32 **Ge** 72,6	33 **As** 74,9	34 **Se** 79,0	35 **Br** 79,9	36 **Kr** 83,8
37 **Rb** 85,5	38 **Sr** 87,6	39 **Y** 88,9		40 **Zr** 91,2	41 **Nb** 92,9	42 **Mo** 95,9	43 **Tc** (98)	44 **Ru** 101,1	45 **Rh** 102,9	46 **Pd** 106,4	47 **Ag** 107,9	48 **Cd** 112,4	49 **In** 114,8	50 **Sn** 118,7	51 **Sb** 121,6	52 **Te** 127,6	53 **I** 127,9	54 **Xe** 131,3
55 **Cs** 132,9	56 **Ba** 137,3	57 **La** 138,9	*	72 **Hf** 178,5	73 **Ta** 180,9	74 **W** 183,9	75 **Re** 186,2	76 **Os** 190,2	77 **Ir** 192,2	78 **Pt** 195,1	79 **Au** 197,0	80 **Hg** 200,6	81 **Tl** 204,4	82 **Pb** 207,2	83 **Bi** 209,0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226,0	89 **Ac** 227,0	#	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)									

atomic number / atoomgetal
symbol / simbool
atomic mass / atoommassa

lanthanides* / lantaniede	58 **Ce** 140,1	59 **Pr** 140,9	60 **Nd** 144,2	61 **Pm** (145)	62 **Sm** 150,4	63 **Eu** 152,0	64 **Gd** 157,3	65 **Tb** 158,9	66 **Dy** 162,5	67 **Ho** 164,9	68 **Er** 167,3	69 **Tm** 168,9	70 **Yb** 173,0	71 **Lu** 175,0
actinides# / aktiniede	90 **Th** 232,0	91 **Pa** 231,0	92 **U** 238,0	93 **Np** 237,0	94 **Pu** (244)	95 **Am** (234)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (258)	103 **Lr** (260)