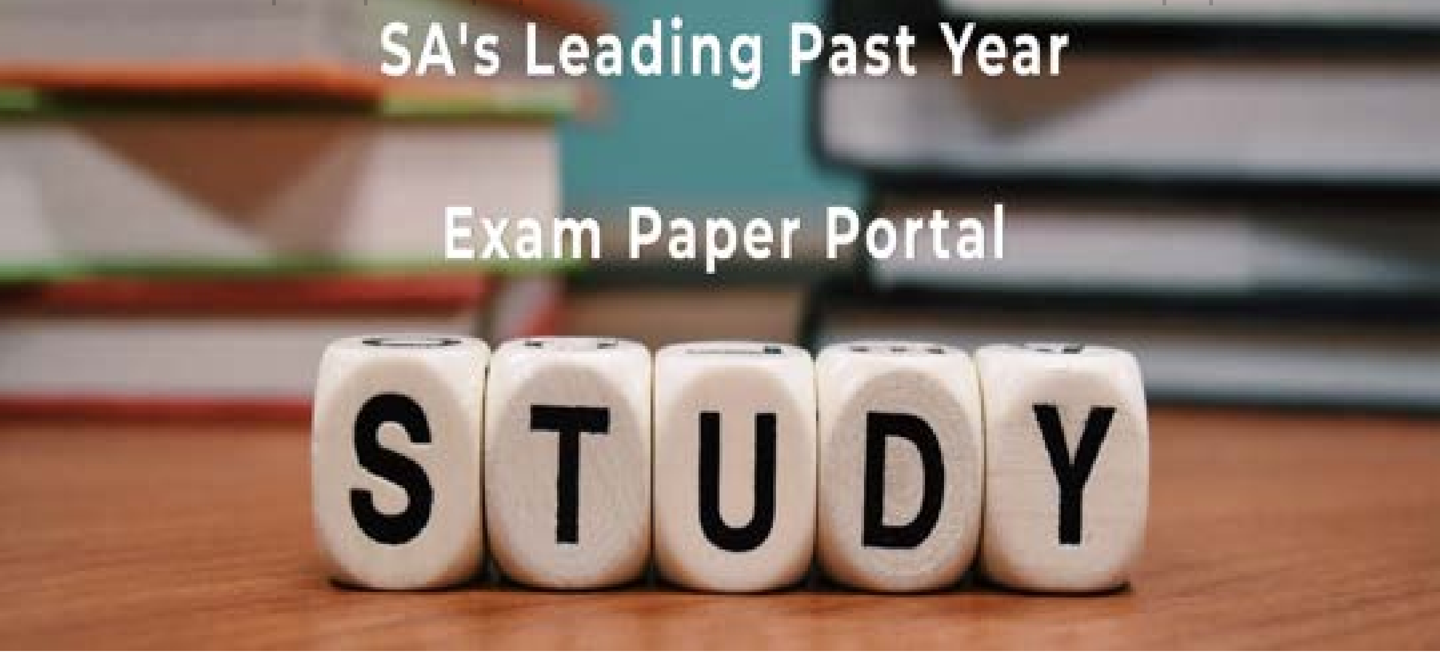
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REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

VOORBEREIDENDE EKSAMEN

2023

MARKING GUIDELINES

NASIENRIGLYNE

PHYSICAL SCIENCES: CHEMISTRY (PAPER 2) (10842)
FISIESE WETENSKAPPE: CHEMIE (VRAESTEL 2) (10842)

16 pages/bladsye

QUESTION 1/VRAAG 1

1.1	D ✓✓	(2)
1.2	D ✓✓	(2)
1.3	B ✓✓	(2)
1.4	C ✓✓	(2)
1.5	A ✓✓	(2)
1.6	C ✓✓	(2)
1.7	A ✓✓	(2)
1.8	B ✓✓	(2)
1.9	D ✓✓	(2)
1.10	B ✓✓	(2)

[20]

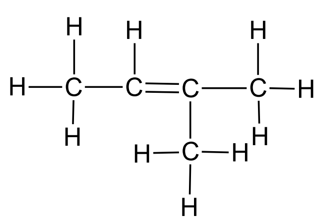
QUESTION 2/VRAAG 2

2.1 2.1.1 TERTIARY alcohol ✓
The carbon atom, to which the functional group/hydroxyl is bonded, is bonded (directly) to three other carbon atoms. ✓

TERSIÊRE alkohol ✓
Die koolstofatoom, waaraan die funksionele groep/hidroksiel gebind is, is direk gebind aan drie ander koolstofatome. ✓ (2)

2.1.2 2-methyl ✓ butan-2-ol ✓
2-metiel ✓ *butan-2-ol* ✓ (2)

2.1.3



✓ functional and methyl group
✓ whole structure
✓ *funksionele en metielgroep*
✓ *algehele struktuur*

If double bond on first C and methyl group – maximum one mark
Indien dubbelbinding op eerste C en metielgroep-maksimum 1 punt (2)

2.2 2.2.1 Organic compounds with the same molecular formula, ✓ but different functional groups ✓

Organiese verbindings met dieselfde molekulêre formule ✓, *maar verskillende funksionele groepe* ✓ (2)

2.2.2 Ketone ✓
Ketoon ✓ (1)

2.2.3 Pentanal ✓✓ **(2 or 0)**
Pentanaal ✓✓ ***(2 of 0)*** (2)

2.2.4 E ✓ (1)

2.3 $\underline{C_5H_{12}} + 8O_2 \rightarrow 5CO_2 + 6H_2O$

✓ reactant/*reaktant* $\underline{C_5H_{12}}$
✓ $O_2 \rightarrow CO_2 + H_2O$
✓ balancing/*balansering*
(Balancing mark can only be awarded if all reactants and products are also correct)
(Balansering punt kan slegs toegeken word indien alle reaktante en produkte korrek is)

Award marks for multiple balancing e.g.
Ken punte toe vir veelvoude van balansering, vb
2:16:10:12

(3)
[15]

QUESTION 3

3.1 Melting point is the temperature at which the solid and liquid phases of a substance are at equilibrium. ✓✓ **(2 or 0)**
Smeltpunt is die temperatuur waarby die vaste- en vloeistoffases van ŉ stof in ewewig is. ✓✓ ***(2 of 0)*** (2)

3.2 Branching/Chain length/Surface area ✓
Vertakking/Kettinglengte/Oppervlakarea ✓ (1)

3.3 These molecules are structural isomers because they have the same molecular formula ✓ but different structural formulae ✓
Hierdie molekules is struktuurisomere omdat dit dieselfde molekulêre formule ✓ maar verskillende struktuurformules ✓het. (2)

3.4 London forces ✓or dispersion forces or momentary dipole forces or induced dipole forces
London kragte ✓of dispersie kragte of oombliklike dipoolkragte of geïnduseerde dipoolkragte (1)

3.5 **MARKING CRITERIA:**
A Compare structures. ✓
B Compare the strength of intermolecular forces. ✓
C Compare the energy required to overcome intermolecular forces. ✓
D State the difference in melting point. ✓

NASIENRIGLYNE:
A Vergelyk strukture. ✓
B Vergelyk die sterkte van intermolekulêre kragte. ✓
C Vergelyk die energie benodig om intermolekulêre kragte te oorkom.✓
D Stel die verskil in smeltpunt. ✓

OPTION 1/OPSIE 1 (Symmetry/simmetrie)

	MOLECULE A ***MOLEKUUL A***	**MOLECULE B** ***MOLEKUUL B***
A	• Less spherical/symmetrical *Minder series/simmetries*	• More spherical/symmetrical *Meer series/simmetries*
B	• Weaker intermolecular forces *Swakker intermolekulêre kragte*	• Stronger intermolecular forces *Sterker intermolekulêre kragte*
C	• Less energy needed to overcome IMF *Minder energie nodig om IMK te oorkom*	• More energy needed to overcome IMF *Meer energie nodig om IMK te oorkom*
D	• Lower melting point (than B) *Laer smeltpunt (as B)*	• Higher melting point (than A) *Hoër smeltpunt (as A)*

(4)

OPTION 2/OPSIE 2(Chainlength/Kettinglengte)

	MOLECULE A ***MOLEKUUL A***	**MOLECULE B** ***MOLEKUUL B***
A	• Less branched *Minder vertakkings* • Larger surface area *Groter oppervlaksarea* • Longer chain length *Langer kettinglengte*	• More branched *Meer vertakkings* • Smaller surface area *Kleiner oppervlaksarea* • Shorter chain length *Korter kettinglengte*
B	• Stronger intermolecular forces *Sterker intermolekulêre kragte*	• Weaker intermolecular forces • *Swakker intermolekulêre kragte*
C	• More energy needed to overcome IMF *Meer energie nodig om IMK te oorkom*	• Less energy needed to overcome IMF *Minder energie nodig om IMK te oorkom*
D	• Higher melting point (than B) *Hoër smeltpunt (as B)*	• Lower melting point (than A) *Laer smeltpunt (as A)*

3.6

A	211 (mmHg) ✓
B	235 (mmHg)
C	319 (mmHg) ✓

(2)

3.7 The <u>boiling point of (A) is higher</u> ✓than the boiling point of (B). ✓
Therefore the higher the boiling point the less the vapour pressure. ✓
Die <u>kookpunt van (A) is hoër ✓</u>as die kookpunt van (B)✓.
Hoe hoër die kookpunt, hoe laer is die dampdruk. ✓

OR/OF

<u>(A) has lower vapour pressure</u> ✓than (B) ✓.
Therefore the lower the vapour pressure the higher the boiling point. ✓
<u>(A) het 'n laer dampdruk</u> ✓as (B). ✓
Hoe laer die dampdruk, hoe hoër is die kookpunt. ✓ (3)

[15]

QUESTION 4/ VRAAG 4

4.1 4.1.1 Elimination/Dehydration ✓
Eliminasie/Dehidrasie ✓ (1)

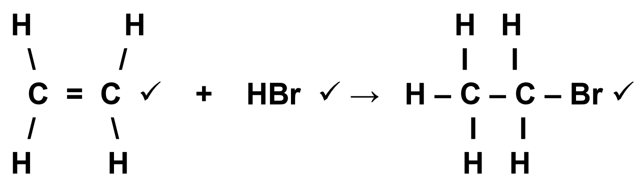
4.1.2 Substitution/Hydrolysis ✓
Substitusie/Hidrolise ✓ (1)

4.2
- Catalyst/*Katalisator*: H_2SO_4/H_3PO_4 ✓
- Heat/*Hitte* ✓ (2)

4.3 4.3.1 Water ✓ (Must be NAME/*Moet NAAM wees*) (1)

4.3.2 H_2SO_4/H_3PO_4 ✓ (Must be CHEMICAL FORMULA/*Moet CHEMIESE FORMULE wees*) (1)

4.4 4.4.1



✓ Structural formula of ethene ✓ HBr ✓ Structural formula of bromoethane ✓*Struktuurformule van eteen* ✓*HBr* ✓*Struktuurformule van bromoetaan*

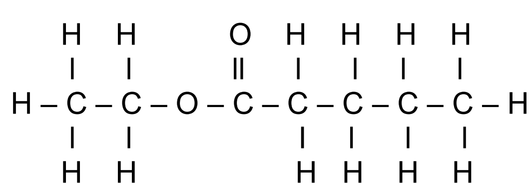
(3)

4.4.2 To avoid the formation of the hydroxyl group/an alcohol ✓
Om die vorming van die hidroksielgroep/'n alkohol te voorkom ✓ (1)

4.5 4.5.1 Esterification ✓/ Condensation
Esterifikasie ✓/ *Kondensasie* (1)

4.5.2 (Concentrated) H_2SO_4 ✓ (Must be CHEMICAL FORMULA)
(Gekonsentreerde) H_2SO_4 ✓ *(Moet CHEMIESE FORMULE wees)* (1)

4.5.3



✓ Functional group ✓ Whole structure ✓*Funksionele groep* ✓*Hele struktuur*

(2)

4.5.4 Ethyl✓ pentanoate ✓
Etiel ✓*pentanoaat* ✓ (2)

4.6 $CH_3CH_2Br + NaOH \rightarrow CH_2CH_2 + NaBr + H_2O$

✓ ✓ ✓

✓ Condensed structural formulae of organic reactant
✓ Condensed structural formulae of organic product
(Accept CH_2=CH_2)
✓ NaBr and H_2O as inorganic products (Both correct for one mark)
Penalised by one mark if structural formulae are used

✓Gekondenseerde struktuurformule van organiese reaktans
✓Gekondenseerde struktuurformule van organiese produk
(Aanvaar CH_2=CH_2)
✓NaBr en H_2O as anorganiese produkte (Beide korrek vir een punt)
Penaliseer met een punt indien struktuurformules gebruik is.

(3)

4.7 4.7.1 Hexane ✓ (or any branched alkane with formula C_6H_{14} e.g. 2-methylpentane)
Heksaan ✓(of enige vertakte alkaan met formule C_6H_{14} vb 2-metielpentaan) (1)

4.7.2 In shorter chained ✓alkenes and branched alkanes the surface area is less ✓ / will have weaker IMF / less activation energy / more flammable / higher vapour pressure

Korter ketting alkene ✓en vertakte alkane het verminderde oppervlakarea ✓/ swakker IMK/minder aktiveringsenergie/meer vlambaar/ hoër dampdruk (2)

[22]

QUESTION 5/ VRAAG 5

5.1
- Temperature
- Concentration of HNO_3 ✓

(Any ONE)

- *Temperatuur*
- *Konsentrasie van HNO_3* ✓

(Enige EEN) (1)

5.2 Rate of reaction / volume of gas <u>per unit time</u> ✓
Reaksietempo/volume gas <u>per eenheid tyd</u>✓ (1)

5.3 Average rate/*gem tempo* = $\frac{\Delta V}{\Delta t}$

$= \frac{48 - 42}{150 - 120}$ ✓ ✓

$= 0{,}2\ cm^3 \cdot s^{-1}$ ✓ (3)

5.4 LESS THAN /*KLEINER AS*✓
- The gradient is <u>less steep</u> at 250 s than at 120 s, indicating a decreased reaction rate. ✓
  Die gradient is <u>minder steil</u> by 250 s as by 120 s, dit dui op 'n verminderde reaksietempo. ✓

  OR

- There will be <u>fewer reactants left</u> after 250 s resulting in fewer effective collisions per unit time.
  Daar sal <u>minder reaktante</u> oor wees na 250 s wat minder effektiewe botsings per eenheid tyd tot gevolg het. (2)

5.5 DECREASE/*AFNEEM* ✓ (1)

5.6

OPTION 1	**OPTION 2**
✓ (A) Dividing volume of H_2 (from graph) by 24 dm^3 ✓ (B) <u>Using</u> mole ratio for H_2 to Mg ✓ (C) Multiplying n(Mg) with M_r(Mg) in the correct formula ✓ (D) Subtract mass Mg used from initial mass of Mg ✓ (E) Final answer	✓ (A) Dividing volume of H_2 (from graph) by 24 dm^3 ✓ (B) <u>Using</u> mole ratio for H_2 to Mg ✓ (C) Subtract mole Mg used from initial mole of Mg ✓ (D) Multiplying n(Mg) with M_r(Mg) in correct formula ✓ (E) Final answer
$n(H_2)$ produced = $\frac{V}{Vm}$ = $\frac{0,06}{24}$ ✓ (A) = $2,5 \times 10^{-3}$ mol From the balanced equation: n(Mg) : $n(H_2)$ 1:1 ✓ (B) n(Mg) = $2,5 \times 10^{-3}$ mol Calculating mass of magnesium used: m(Mg) = nM = $(2,5 \times 10^{-3})(24)$ ✓ (C) = 0,06 g Calculating mass of magnesium left: Δm (Mg) = 2 – 0,06 ✓ (D) = 1,94 g ✓ (E)	$n(H_2)$ produced = $\frac{V}{Vm}$ = $\frac{0,06}{24}$ ✓ (A) = $2,5 \times 10^{-3}$ mol From the balanced equation: n(Mg) : $n(H_2)$ 1:1 ✓ (B) n(Mg) = $2,5 \times 10^{-3}$ mol Calculating initial moles of magnesium: m(Mg) = nM 2 = n (24) = 0,083 mol Calculating moles of magnesium left: Δn (Mg) = 0,083 – $(2,5 \times 10^{-3})$ ✓ (C) = 0,08 mol Calculating mass of magnesium left: m(Mg) = nM = (0,08) (24) ✓ (D) = 1,94 g ✓ (E)

(5)

OPSIE 1	***OPSIE 2***
✓*(A) Deel volume H_2 (vanaf grafiek) deur 24 dm^3* ✓*(B) <u>Gebruik</u> molverhouding H_2 tot Mg* ✓*(C) Vermenigvuldig n(Mg) met M_r(Mg)* ✓*(D) Trek massa Mg af van aanvanklike massa Mg* ✓*(E) Finale antwoord*	✓*(A) Deel volume H_2 (vanaf grafiek) deur 24 dm^3* ✓*(B) <u>Gebruik</u> molverhouding H_2 tot Mg* ✓*(C) Trek n(Mg) gebruik af van aanvanklike n(Mg)* ✓*(D) Vermenigvuldig n(Mg) met M_r(Mg)* ✓*(E) Finale antwoord*
$n(H_2)$ geproduseer = $\frac{V}{V_m}$ *= $\frac{0,06}{24}$* ✓ (A) *= $2,5 \times 10^{-3}$ mol* *Vanaf die gebalanseerde vergelyking:* *n(Mg) : $n(H_2)$* *1:1* ✓ (B) *n(Mg) = $2,5 \times 10^{-3}$ mol* *Bereken die massa magnesium gebruik:* *m(Mg) = nM* *= $(2,5 \times 10^{-3})(24)$* ✓ (C) *= 0,06 g* *Bereken die massa magnesium oor:* *Δm (Mg) = 2 – 0,06* ✓ *= 1,94 g* ✓ (E)	*$n(H_2)$ geproduseer = $\frac{V}{V_m}$* *= $\frac{0,06}{24}$* ✓ (A) *= $2,5 \times 10^{-3}$ mol* *Vanaf die gebalanseerde vergelyking:* *n(Mg) : $n(H_2)$* *1:1* ✓ (B) *n(Mg) = $2,5 \times 10^{-3}$ mol* *Bereken die aanvanklike mol magnesium:* *m(Mg) = nM* *2 = n (24)* *= 0,083 mol* *Bereken die mol magnesium oor:* *Δn (Mg) = 0,083 – $(2,5 \times 10^{-3})$* ✓ (C) *= 0,08 mol* *Bereken die massa magnesium oor:* *m(Mg) = nM* *= (0,08) (24)* ✓ (D) *= 1,94 g* ✓ (E)

5.7
- Powders have <u>increased/larger surface area/ more contact sites</u> than solid tablets. ✓
- <u>More effective collisions per unit time occurs</u>. ✓

- *Poeiers het 'n <u>verhoogde/groter oppervlaksarea</u> as soliede tablette.* ✓
- *<u>Meer effektiewe botsings per eenheid tyd</u>* ✓ *vind plaas.* (2)

[15]

QUESTION 6/ VRAAG 6

6.1 When the equilibrium in a closed system is disturbed, the system will reinstate a new equilibrium by favouring the reaction that will oppose the disturbance. (part marks) ✓✓

Wanneer die ewewig in 'n geslote sisteem versteur word, stel die stelsel 'n nuwe ewewig in deur die reaksie wat die versteuring teenwerk, te bevoordeel. (2)

6.2 6.2.1
- Adding more CH_4 will increase the concentration of CH_4. ✓
- The forward reaction is favoured. ✓
- The yield of H_2 will increase. ✓

- *Toevoeging van CH_4 sal die konsentrasie van CH_4 laat toeneem.* ✓
- *Die voorwaartse reaksie word bevoordeel.* ✓
- *Die opbrengs van H_2 sal toeneem.* ✓ (3)

6.2.2
- An increase in pressure favours the reaction that produces the lower number of moles/number of molecules. ✓
- The reverse reaction is favoured. ✓
- The yield of H_2 decreases. ✓

- *'n Toename in druk bevoordeel die reaksie wat die minste mol/hoeveelheid molekules produseer.* ✓
- *Die terugwaartse reaksie word bevoordeel.* ✓
- *Die opbrengs van H_2 verminder.* ✓ (3)

6.3 The reaction is in (dynamic/chemical) equilibrium ✓/ the rates of the forward and reverse reactions are equal.

Die reaksie is in (dinamiese/chemiese) ewewig waar die tempo van die voorwaartse en terugwaartse reaksies dieselfde is. ✓ (1)

6.4 **MARKING CRITERIA:**
a) Mole at equilibrium 0,6 ✓
b) Use mole ratio 1 : 1 : 1 : 3 ✓
c) Subtract CH_4 , H_2O and add H_2 ✓
d) Divide by 2 dm^3 ✓
e) Correct Kc expression (formulae in square brackets) ✓
f) Substitution of concentrations into correct Kc expression ✓
g) Final answer (range 1,82 – 1,83) ✓

Option with concentration can also be used.

NASIENRIGLYNE:
a. Mol by ewewig 0,6 ✓
b. Gebruik molverhouding 1 : 1 : 1 : 3 ✓
c. Aftrek van CH_4 , H_2O en optel van H_2 ✓
d. Deel deur 2 dm^3 ✓
e. Korrekte Kc uitdrukking (formules in vierkantige hakies) ✓
f. Vervanging van konsentrasies in korrekte Kc uitdrukking ✓
g. Finale antwoord 1,8225/1,823/1,82 ✓

	CH_4	H_2O	CO	H_2	
Initial amount (moles) *Aanvangshoeveelheid (mol)*	1,4	1,2	0	0	
Change in amount (moles) *Verandering in hoeveelheid (mol)*	0,6	0,6	0,6	1,8	ratio b)✓
Equilibrium amount (moles) *Ewewigshoeveelheid (mol)*	0,8	0,6	**0,6** **a)**✓	1,8	-/+ c)✓
Concentration at equilibrium *Konsentrasie by ewewig*	0,4	0,3	**0,3**	0,9	÷2 d)✓

$$Kc = \frac{[CO][H_2]^3}{[CH_4][H_2O]} \quad e)✓$$

$$= \frac{(0,3)(0,9)^3}{(0,4)(0,3)} \quad f)✓$$

$$= 1,82 \quad g)✓$$

- No Kc expression, correct substitution: Max. $^6/_7$
- No square brackets: Max. $^6/_7$
- Wrong Kc expression: Max. $^4/_7$

- *Geen Kc uitdrukking, korrekte substitusie: Maks.* $^6/_7$
- *Geen blok-hakies: Maks.* $^6/_7$
- *Verkeerde Kc uitdrukking: Maks.* $^4/_7$

(7)

6.5 DECREASE/*AFNEEM* ✓ (1)

[17]

QUESTION 7/VRAAG 7

7.1 STRONG (acid) ✓
Ionises completely (in water) ✓

STERK (suur) ✓
Ioniseer volledig in water ✓ (2)

7.2 HSO_4^- ; SO_4^{2-} ✓ AND/EN H_2O ; H_3O^+ ✓ (2)

7.3 It is a 2 proton donor/
Dit is 'n 2-protonskenker
OR
It donates 2 H^+ / H_3O^+ ions/protons. ✓✓
Dit skenk 2 H^+ / H_3O^+ *ione/protone*
OR
It ionises to form 2 moles of H^+ / H_3O^+ions
Dit ioniseer en vorm 2 mol of H^+ / H_3O^+*ione* (2)

7.4 HSO_4^- ✓ (1)

7.5 7.5.1

$c = \frac{n}{V}$

$= {}^{0,09}/_{0,6}$ a)✓

$= 0,15\ mol \cdot dm^{-3}$

$n(H_2SO_4)$: $n(H_3O^+)$
1 : 2
0,15 : 0,3 b)✓

$pH = -\log[H_3O^+]$ c)✓
$= -\log(0,3)$ d)✓
$= 0,52$ e)✓ (5)

MARKING CRITERIA:
a) Substitution into concentration
b) Using mole ratio correctly
c) pH formula
d) Substitution in pH formula
e) Final answer

7.5.2 OPTION 1

$n = \frac{m}{M}$ ✓

$= \frac{11,2}{56}$✓

$= 0,2$ mol
Thus 0,2 x 80% ✓
n = 0,16 mol of KOH ✓

OPTION 2

m = (80% of 11,2) ✓= 8,96 g

$n = \frac{m}{M}$ ✓

$n = {}^{8,96}/_{56}$ ✓

n = 0,16 mol of KOH ✓ (4)

7.5.3 **Positive marking from 7.5.2/*Positiewe nasien vanaf 7.5.2***
ACIDIC/*SUUR* ✓

Mol ratio H_2SO_4 : KOH
1 : 2
0,08 : 0,16 ✓

MARKING GUIDELINE:
✓ Mole ratio
✓ Indicating excess
✓ Acidic

(3)

OR

H_2SO_4 : KOH
0,09 : 0,18 (not enough/nie genoeg)
(the 0,09 is given)

∴ There will be an **excess of H_2SO_4** ✓ (0,01 mol of H_2SO_4 in excess).
∴ *Daar sal 'n* ***oormaat H_2SO_4*** ✓ *wees (0,01 mol H_2SO_4 in oormaat).*

[19]

QUESTION 8/ VRAAG 8

8.1 YES ✓ emf is greater than zero /emf is positive ✓
Accept
reducing and oxidizing agents are used

JA ✓ EMK is groter as nul/is positief✓
Aanvaar:
Reduseer- en oksideermiddels is gebruik (2)

8.2 Mn ✓ (1)

8.3 E°cell = E°cathode – E°anode ✓
1,05✓ = X - (-1,18) ✓
X = - 0,13 (V) ✓

X = Pb✓

NOTES:

- Accept any other correct formula from the data sheet
  Aanvaar enige ander korrekte formule vanaf die inligtingsbladsy
- Any other formula using unconventional abbreviations, e.g. followed by correct substitutions:
  $E_{cell} = E_{OM} - E_{RM}$ **4/5**

(5)

8.4 8.4.1 Concentration/*Konsentrasie* is 1 mol·dm^{-3} ✓ (2)
Temperature/*Temperatuur* 298 K/25 °C ✓

8.4.2 Mn(s) I Mn^{2+}(aq) (1 mol·dm^{-3}) II Pb^{2+}(aq) (1 mol·dm^{-3}) I Pb(s) (2)
✓ ✓

Accept /Aanvaar
Mn I Mn^{2+} II Pb^{2+} I Pb
✓ ✓

8.4.3 $Pb^{2+} + 2e^- \rightarrow$ Pb ✓✓ (1/2 if double arrows) (2)
[14]

QUESTION 9/ VRAAG 9

9.1 Electrical to chemical (energy) ✓
Elektriese na chemiese (energie) ✓ (1)

9.2 B ✓ (1)

9.3 $Cu \rightarrow Cu^{2+} + 2e^-$ ✓✓ (if double arrows maximum ½) (2)

9.4 REMAIN THE SAME /DIESELFDE BLY✓ (1)

9.5 Zn is a stronger reducing agent ✓ than Cu ✓
therefore Cu^{2+} ions will be reduced to Cu ✓
Zn is 'n sterker reduseermiddel ✓ *as Cu* ✓
daarom sal Cu^{2+} *ione reduseer tot Cu* ✓

OR/OF
Zn^{2+} is a weaker oxidising agent and will not be reduced to deposit on the cathode
Zn^{2+} is 'n swakker oksideermiddel en sal nie reduseer om op die katode neer te slaan nie

OR/OF
Zn will be oxidised to Zn^{2+}
Zn sal oksideer tot Zn^{2+}

(3)

9.6 9.6.1

$$n(Cu) = \frac{m}{M} \checkmark$$

$$= \frac{15}{63,5} \checkmark$$

$$= 0,24 \text{ mol} \checkmark \quad (0,236 \text{ mol})$$

(3)

9.6.2 Positive marking from 9.6.1/*Positiewe nasien vanaf 9.6.1*

$nCu : 2n\ e^-$
$n = 2 \times 0,236$ ✓
$= 0,472$ mol of e^- ✓ (2)

[13]

TOTAL/*TOTAAL* : 150