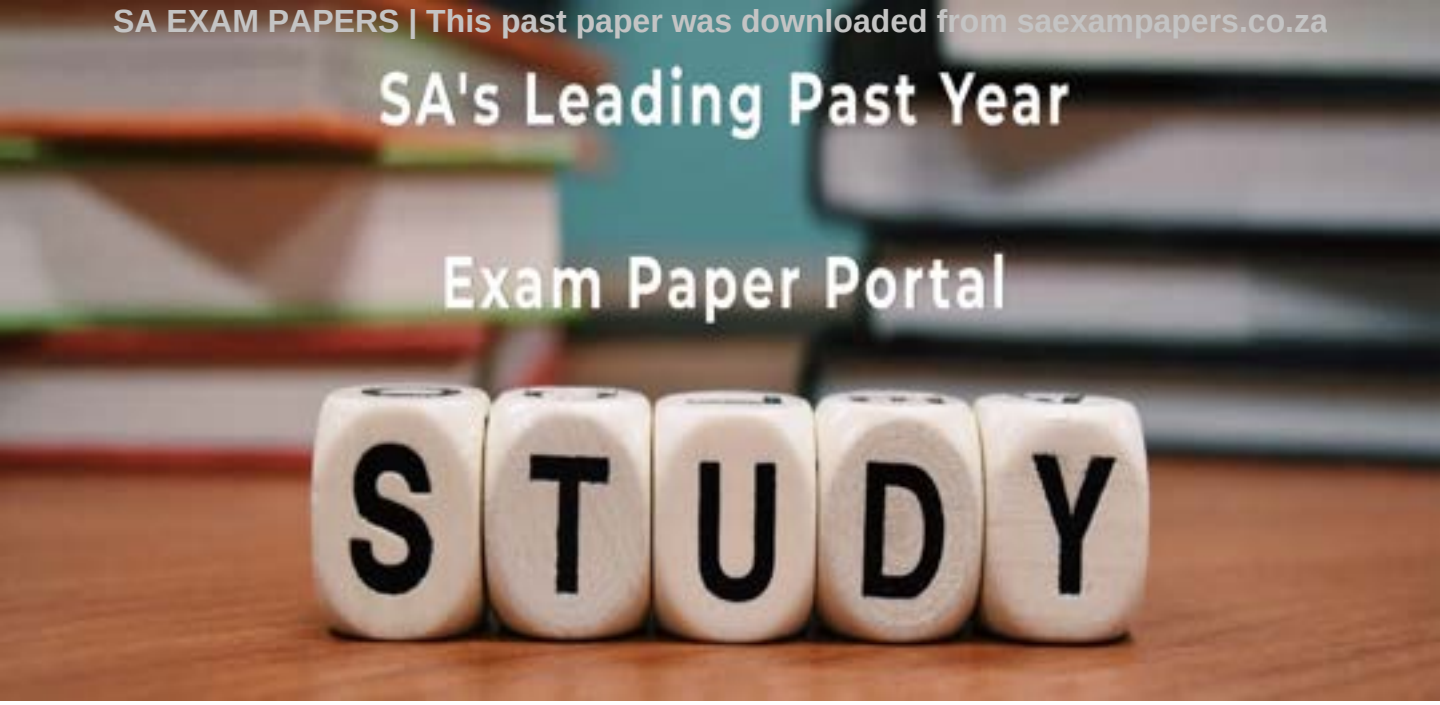


GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
JUNIE EKSAMEN

GRADE/*GRAAD* 12

2024

MARKING GUIDELINES/
NASIENRIGLYNE

PHYSICAL SCIENCES: CHEMISTRY/
FISIESE WETENSKAPPE: CHEMIE

(PAPER/*VRAESTEL* 2)

13 pages/*bladsye*

QUESTION/*VRAAG* 1

1.1 A ✓✓ (2)

1.2 C ✓✓ (2)

1.3 B ✓✓ (2)

1.4 D ✓✓ (2)

1.5 A ✓✓ (2)

1.6 D ✓✓ (2)

1.7 C ✓✓ (2)

1.8 B or C or D ✓✓ (2)

1.9 D ✓✓ (2)

1.10 A ✓✓ (2)

[20]

QUESTION/*VRAAG* 2

2.1 A series of organic compounds that can be described by the same general formula.
OR
A series of organic compounds in which one member differs from the next with a CH_2 group. ✓✓ **(2 or 0)**

'n Reeks organiese verbindings wat deur dieselfde algemene formule beskryf kan word.
OF
'n Reeks organiese verbindings waarin die een lid van die volgende verskil met 'n CH_2-groep. (2)

2.2 2.2.1 Aldehydes/*Aldehiede* ✓ (1)

2.2.2 $CH_3CH_2CH_2C\mathbf{HO}$ ✓ OR/*OF* $C\mathbf{HO}CH_2CH_2CH_3$ OR/*OF* $C\mathbf{HO}(CH_2)_2CH_3$
(do not accept OH) *(moet nie OH aanvaar nie)* (1)

2.2.3 Butan-2-one/*Butan-2-oon* ✓✓
Accept: 2-butanone / butanone
Aanvaar 2-butanoon / butanoon (2)

Marking criteria/*Nasienriglyne*
- Correct functional group: -ONE/*Korrekte funksionele groep: EEN* ✓
- IUPAC name correct ✓

2.3 2.3.1 3,4-dibromo-2,2-dimethylpentane ✓✓✓
3,4-dibromo-2,2-dimetielpentaan

(3)

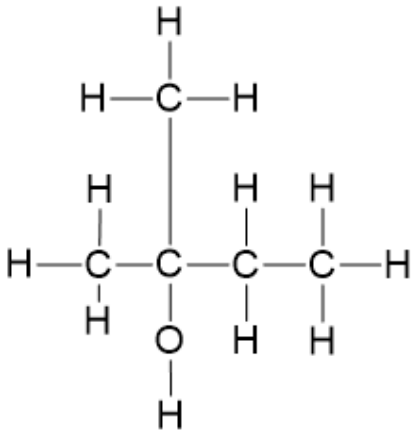
Marking criteria/*Nasienriglyne*
- Correct stem (pentane)/*korrekte stamnaam (pentaan)* ✓
- All substituents (bromo and methyl) were correctly identified./*Alle substituente (broom en metiel) is korrek geïdentifiseer.* ✓
- IUPAC name is completely correct including numbering, sequence, hyphens and commas./*IUPAC-naam is heeltemal korrek insluitend nommering, volgorde, koppeltekens en kommas* ✓

2.3.2 $C_nH_{2n+1}COOH$ OR/*OF* $C_nH_{2n}O_2$ ✓ (1)

2.4 2.4.1 C & D ✓✓ (must have both)/*(moet beide hê) (2 or 0)* (2)

2.4.2 F ✓ (1)

2.5 2.5.1



(2)

Marking criteria/*Nasienriglyne*
- Correct stem (butane)/*korrekte stam (butaan)* ✓/
- Functional group **OH** and **methyl** on the **second** carbon/*Funksionele groep OH en metiel op die tweede koolstof*✓

2.5.2 Tertiary/*Tersiêr* ✓ (1)

2.5.3 Three carbon atoms ✓ are bonded to the carbon atom to which the hydroxyl (OH)/functional group is bonded. ✓

Drie koolstofatome is verbind aan die koolstofatoom waaraan die hidroksielgroep (OH)/ funksionele groep verbind is. (2)

2.6

	% m = 100 g	M	n = $\frac{m}{M}$	Ratio/*Verhouding*	
Carbon/ *Koolstof*	81,82	12	$\frac{81,82}{12}$	$\frac{6,82}{6,82}$ = 1 ×3	3
H	18,18	1	$\frac{18,18}{1}$ ✓	$\frac{18,81}{6,82}$ =2,67 ×3 ✓ ✓	8

C_3H_8 ✓ (4)

Marking criteria/*Nasienriglyne*
- Substitute 12 and 1 respectively into n = $\frac{m}{M}$/*Vervang 12 en 1 onderskeidelik in n* = $\frac{m}{M}$ ✓
- Divide by the smallest amount of mols 6,82 ✓/*Deel deur die kleinste aantal mol 6,82*
- Multiply by 3 to get the smallest whole number ratio/*Vermenigvuldig met 3 om die kleinste heelgetal verhouding te kry* ✓
- Correct empirical formula C_3H_8/*Korrekte empiriese formule* C_3H_8 ✓

[22]

QUESTION/*VRAAG* 3

3.1 *Boiling point* – The temperature at which the vapour pressure of a substance equals atmospheric pressure. ✓✓

Kookpunt – Die temperatuur waarby die dampdruk van die stof gelyk is aan atmosferiese druk.

(2)

Marking criteria/*Nasienkriteria*
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

3.2 3.2.1 Chain length/molar mass/surface area ✓
(do not accept IUPAC name)

Kettinglengte/molêre massa/kontakoppervlakte
(moet nie IUPAC-naam aanvaar nie) (1)

3.2.2 Boiling point/*kookpunt* ✓ (1)

3.2.3 Homologous series ✓ type of intermolecular force
(do not accept same volume, same kind of apparatus)

Homoloë reeks / tipe intermolekulêre kragte
(moet nie aanvaar dieselfde volume, dieselfde soort apparaat nie) (1)

3.3 What is the relationship between chain length/molar mass/surface area and boiling point? ✓✓

Wat is die verwantskap tussen die kettinglengte/molêre massa/kontakoppervlakte en kookpunt?

(2)

Marking criteria/*Nasienriglyne*
- Must mention INDEPENDENT and DEPENDENT variables ✓
  Moet die ONAFHANKLIKE en AFHANKLIKE veranderlikes noem
- Answer to the question CANNOT be YES OR NO ✓
  Antwoord op die vraag mag nie JA of NEE wees nie.

3.4 (ONE reasonable answer)
Keep away from an open flame, OR work in a fume cupboard, OR heat in a water bath. ✓

(EEN redelike antwoord)
Hou weg van 'n oop vlam, OF werk in 'n dampkas, OF verhit in 'n waterbad. (1)

3.5 C ✓, it has the highest boiling point. ✓

C, dit het die hoogste kookpunt.

(2)

3.6 Higher than/*Hoër as* ✓ (1)

3.7
- INTERMOLECULAR FORCES and STRENGTH
  As the chain length increases, ✓ the strength of the London/ intermolecular forces increases, ✓
- ENERGY
  Therefore more energy is needed to overcome the intermolecular forces leading to a higher boiling point. ✓

- *INTERMOLEKULÊRE KRAGTE en STERKTE*
  As die kettinglengte verhoog, verhoog die sterkte van die London/ intermolekulêre kragte.
- *ENERGIE*
  Daarom word meer energie benodig om die intermolekulêre kragte te oorkom wat dan tot 'n hoër kookpunt lei.

(3)

Marking criteria/*Nasienriglyne*:
- Identify the type of intermolecular force./*Identifiseer die tipe intermolekulêre kragte.* ✓
- Refer to the strength of intermolecular forces./*Verwys na die sterkte van die intermolekulêre kragte.* ✓
- Mention the energy required to overcome intermolecular forces./*Noem die energie benodig om die intermolekulêre kragte te oorkom.* ✓

NO MARK if a learner says more energy required to BREAK BONDS/
GEEN PUNTE indien 'n leerder skryf meer energie benodig om BINDINGS TE BREEK NIE.

3.8 3.8.1 J ✓ (1)

3.8.2 The sunlight supplies sufficient energy (heat) to meet the activation energy of the reaction. ✓Will react with the UV of the sunlight.

Die sonlig verskaf genoeg energie (hitte) om gelyk te wees aan die aktiveringsenergie van die reaksie. Sal reageer met die UV van die son. (1)

3.8.3 $C_4H_8\mathbf{Br_2}$ ✓✓ (if only one Br is shown ½)
(indien slegs een Br gewys word ½) (2)

3.8.4 $2C_4H_{10}$ ✓ + $13O_2 \rightarrow 8CO_2 + 10H_2O$ ✓ bal ✓

Ignore phases and double arrows in answers / *Ignoreer fases en dubbel pyl in antwoord* (3)
[21]

QUESTION/*VRAAG* 4

4.1 Compounds in which there are no multiple bonds between carbon atoms in their hydrocarbon chain. ✓✓ (2 OR 0)
OR
A compound in which there are only single bonds between the carbon atoms in the chain.

Verbindings waarin daar geen meervoudige bindings tussen C-atome in hul koolwaterstofkettings is nie. (2 OF 0)
OF
'n Verbinding waarin daar slegs enkel bindings is tussen die koolstofatome in 'n ketting. (2)

4.2 4.2.1 Substitution/*Substitusie* ✓ (1)

4.2.2 Potassium bromide/KBr ✓ *Kaliumbromied/KBr* (1)

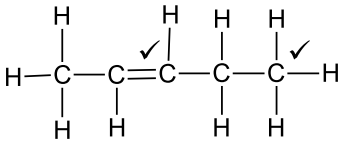
4.2.3 Dilute strong base OR mild heat ✓ OR KOH(aq)
Verdunde sterk basis OF matige hitte OF KOH(aq) (1)

4.3 4.3.1 Pentan-2-ol ✓✓
Pentan-2-ol
Accept 2-pentanol / *Aanvaar 2-pentanol* (2)

Marking criteria/*Nasienriglyne*
- Correct stem (pent**an**)/*Korrekte stam (pent**an**)* ✓
- IUPAC name is completely correct including numbering, sequence, hyphens and commas./
  IUPAC naam is heeltemal korrek met alle nommering, volgorde, koppeltekens en kommas. ✓

4.3.2 Elimination OR Dehydration/*Eliminasie OF Dehidrasie* ✓ (1)

4.3.3



(2)

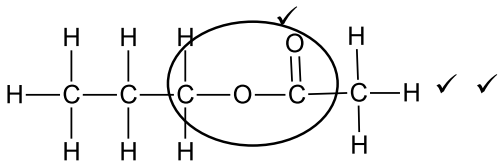
Marking criteria/*Nasienriglyne*
- 5 carbons in the chain/*5 koolstowwe in die ketting* ✓
- Functional group C = C/*Funksionele groep C = C* ✓

4.3.4 H_2O ✓ (1)

4.4 4.4.1 Hydrogenation/*Hidrogenasie of hidrogenering* ✓ (1)

4.4.2 Pt OR/*OF* Pd OR/*OF* Ni ✓ (1)

4.5 4.5.1



(3)

Marking criteria/*Nasienriglyne:*
- Functional group/*funksionele groep* ✓
- correct number of carbon on either side of the functional group/*korrekte hoeveelheid koolstowwe aan beide kante van die funksionele groep* ✓
- Whole structure is correct/*Hele struktuur is korrek* ✓

4.5.2 Propyl ✓ethanoate ✓
Propieletanoaat (2)

4.5.3 Sulphuric acid/ hydrogensulphate ✓
Swawelsuur / waterstofsulfaat (1)

4.5.4 **METHOD 1:**

$C_3H_8OH + CH_3COOH \rightarrow C_5H_{10}O_2 + H_2O$

$M(C_5H_{10}O_2) = 102\ g{\cdot}mol^{-1}$

$m = 90,78\ g$

$n = \frac{m}{M}$

$= \frac{90,78}{102}$ ✓

$= 0,89\ mol$

$n(C_5H_{10}O_2) : n(C_3H_8OH)$

1:1

0,89 : 0,89✓

$M(C_3H_8OH) = 61\ g{\cdot}mol^{-1}$

$n = \frac{m}{M}$

$0,89 = \frac{m}{61}$✓

$m = 54,29\ g$

Percentage purity/

Persentasie suiwerheid =

$\frac{Pure\ mass/Suiwer\ massa}{Impure\ mass/Onsuiwer\ massa} \times 100$

$= \frac{54,29}{60}$ ✓ ×100

= 90,48% ✓

METHOD 2:

$C_3H_7OH + CH_3COOH \rightarrow C_5H_{10}O_2 + H_2O$

$M(C_5H_{10}O_2) = 102\ g{\cdot}mol^{-1}$

$m = 90,78\ g$

$n = \frac{m}{M}$

$= \frac{90,78}{102}$ ✓

$= 0,89\ mol$

$n(C_5H_{10}O_2) : n(C_3H_8OH)$

1:1

0,89 : 0,89✓

$M(C_3H_7OH) = 60\ g{\cdot}mol^{-1}$

$n = \frac{m}{M}$

$0,89 = \frac{m}{60}$✓

$m = 53,4\ g$

Percentage purity/

Persentasie suiwerheid =

$\frac{Pure\ mass/Suiwer\ massa}{Impure\ mass/Onsuiwer\ massa} \times 100$

$= \frac{53,4}{60}$ ✓ ×100

= 89% ✓ (5)

Marking criteria/*nasienriglyne*

- Substitute 102 $g{\cdot}mol^{-1}$ into $n = \frac{m}{M}$ ✓
  Inveranging van 102 $g{\cdot}mol^{-1}$ in $n = \frac{m}{M}$
- Use the mol ratio: $n(C_5H_{10}O_2) : n(C_3H_8OH) = 1 : 1$ ✓
  Gebruik die mol verhouding: $n(C_5H_{10}O_2) : n(C_3H_8OH) = 1 : 1$
- Substitute 61 $g{\cdot}mol^{-1}$ into $n = \frac{m}{M}$ ✓
  Invervanging van 61 $g{\cdot}mol^{-1}$ in $n = \frac{m}{M}$
- Substitute 60 g as the impure mass ✓
  Invervanging van 60 g as die onsuiwer massa
- Final answer: 89 - 90,5% ✓
  Finale antwoord: 89 - 90,5%

[24]

QUESTION/*VRAAG* 5

5.1 Change in concentration of reactants or products per unit time ✓✓ (2 or 0)

Verandering in konsentrasie van reaktante of produkte per eenheid tyd. (2 of 0) (2)

5.2 As the concentration of the acid decreases, the rate of reaction will also decrease. ✓✓
OR
As the concentration of the acid increases, the rate of the reaction will increase.

Soos die konsentrasie van die suur afneem, sal die tempo van die reaksie ook afneem.
OF
Soos die konsentrasie van die suur toeneem sal die tempo van die reaksie ook toeneem.

(2)

Marking criteria/*Nasienriglyne:*
- Identify variables correct ✓
  Identifiseer die veranderlikes korrek
- Correct relationship ✓
  Korrekte verwantskappe

5.3

OPTION 1/*OPSIE 1*:	
$c = \frac{n}{V}$ $2 = \frac{n}{0,015}$ ✓ $n = 0,03\ mol$	$c = \frac{n}{V}$ $c = \frac{0,03}{0,065}$ ✓ $c = 0,46\ mol.dm^{-3}$ ✓

OPTION 2/*OPSIE 2*:

$c_1V_1 = c_2V_2$
(2)(0,015) ✓= c_2 (0,065) ✓
c_2 = 0,46 mol·dm^{-3} ✓ (3)

5.4 Learners should keep the state of division/surface area of the Mg-ribbon the same ✓ and the initial temperature. ✓

Leerders moet die toestand van verdeeldheid/die oppervlakarea van die Mg lint konstant hou en die aanvanklike temperatuur. (2)

5.5 The Mg is the limiting reagent and determines the amount of product. ✓
OR
The same mass of magnesium was used in each experiment.
DO NOT ACCEPT: HCℓ is in excess

Die Mg is die beperkende reagens en bepaal die hoeveelheid produkte wat vorm.
OF
Dieselfde massa magnesium is in elke eksperiment gebruik.
MOET NIE AANVAAR: HCℓ is in oormaat nie. (1)

5.6 5.6.1 60 (cm^3) ✓ (1)

5.6.2 42 (cm^3) ✓ (1)

5.7 Experiment 1 ✓
In the same time, more product ✓is produced and the gradient of the graph is steeper. ✓

Eksperiment 1
In dieselfde tyd word meer produkte geproduseer en die gradiënt van die grafiek is steiler. (3)

5.8

Marking criteria/*Nasienriglyne*

- Use volume of 60 cm^3/ 0,06 dm^3 in $n = \frac{V}{V_m}$
  Gebruik volume van 60 cm^3 in $n = \frac{V}{V_m}$
- Ratio 1:1/*Verhouding 1:1*
- Use M = 24/*Gebruik M = 24*
- Substitute in rate equation
  Vervang in tempo vergelyking
- Answer 0,001/*Antwoord 0,001*

$n = \frac{V}{V_m}$ $n_{Mg} = n_{H_2}$ ✓ $m_{Mg} = nxM$

$n = \frac{0,06}{24}$ ✓ = 0,0025 mol = 0,0025 x 24✓

n = 0,0025 mol = 0,06 g

Rate/*Tempo* = $-\frac{\Delta m}{\Delta t}$

$= -\frac{0-0,06}{60}$✓

= 0,001($g.s^{-1}$) ✓

Answer must be positive/*Antwoord moet positief wees* (5)
[20]

QUESTION/*VRAAG* 6:

6.1 Endothermic ✓
ΔH is greater that zero/is positive ✓

Endotermies
ΔH is groter as nul/is positief (2)

6.2 6.2.1 Reverse✓
The amount of product decreases with time. ✓

Terugwaarts
Die hoeveelheid produkte verminder met tyd. (2)

6.2.2 Equal to/*Gelyk aan* ✓ (1)

6.2.3 $n_{(H2O)} = \frac{m}{M}$
$= \frac{5}{18}$
= 0,28mol

$n_{(C\ell 2)} = \frac{m}{M}$
$= \frac{5}{71}$
= 0,07mol

	H_2O	$C\ell_2$	$HC\ell$	O_2
Ratio *Verhouding*	2	2	4	1
Initial mole *Aanvanklike mol*	0,28✓	0,07✓	1	0,3✓
Change *Verandering*	+0,4	+0,4	-0,8	-0,2
Equilibrium *Ewewig*	0,68	0,47	0,2	0,1✓
$c = \frac{n}{V}$	$\frac{0,68}{5}$ =0,136	$\frac{0,47}{5}$ =0,094	$\frac{0,2}{5}$ =0,04	$\frac{0,1}{5}$✓ =0,02

Ratio ✓

$K_c = \frac{[HC\ell]^4[O_2]}{[H_2O]^2[C\ell_2]^2}$ ✓
$= \frac{(0,04)^4(0,02)}{(0,136)^2(0,094)^2}$ ✓
= 0,0003 ✓ (3,15 x 10^{-4}) (9)

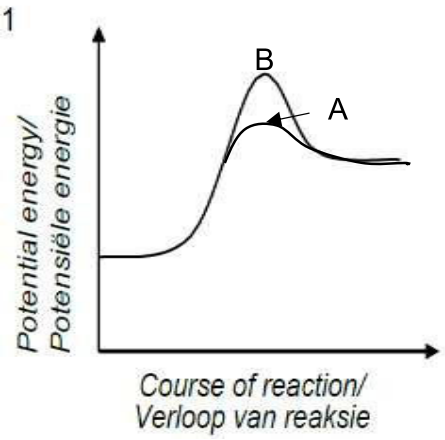
Marking criteria
- Calculate the mole of water. ✓
- Calculate the mole of $C\ell_2$ ✓
- Substitution of initial mole for both $HC\ell$ and O_2 ✓
- Correct use of ratio ✓
- Correct mol at equilibrium for O_2. ✓
- Divide by volume of 5 ✓
- Kc expression ✓ (Wrong Kc max 7/9)
- Substitution of values from Equilibrium concentration ✓
- Correct answer. ✓

Nasienkriteria:
- *Bereken die mol water.* ✓
- *Bereken die mol $C\ell_2$* ✓
- *Vervang beide $HC\ell$ en O_2* ✓
- *Korrekte gebruik van verhouding* ✓
- *Korrekte mol by ewewig O_2.* ✓
- *Deel deur volume van 5* ✓
- *Kc uitdrukking* ✓ *(Verkeerde Kc maks 7/9)*
- *Vervanging van waardes van ewewigskonstante* ✓
- *Korrekte antwoord* ✓

6.3 Remains the same ✓
Only temperature affects K_c. ✓

Bly dieselfde
Slegs temperatuur affekteer Kc. (2)

6.4



Marking criteria/*Nasienkriteria:*
- Both axes correctly labelled./*Asse korrek benoem* ✓
- Shape of Ep curve for endothermic reaction as shown./*Vorm van kurwe vir endotermiese reaksie soos getoon.* (B) ✓✓
- Added catalyst/*Bygevoegde katalisator* ✓ (A)

(4)
[20]

QUESTION 7/*VRAAG 7*:

7.1 7.1.1 An acid is a substance that produces hydrogen ions (H^+) / hydronium ions (H_3O^+) when in solution. ✓✓

'n Suur is 'n stof wat waterstof ione produseer (H^+) hidroniuim ione (H_3O^+) wanneer dit in oplossing is. (2)

7.1.2 It ionises to form 2 protons/*Dit ioniseer om 2 protone te vorm.* ✓ (1)

7.2 7.2.1 Ampholyte or amphiprotic /*amfoliet of amfiproties* ✓ (1)

7.2.2 $HCO_3^-(aq) + H_2O(\ell) \rightleftharpoons H_2CO_3(aq) + OH^-(aq)$

b_1 ✓ a_2 a_1 ✓ b_2

(2)

7.3 7.3.1

OPTION 1/*OPSIE* 1:

$c = \frac{m}{MV}$ ✓

$0,25 = \frac{m}{(36,5)(2,5)}$ ✓✓

m = 22,82 g ✓

range/*gebied*: 22,82 – 23

OPTION 2/*OPSIE* 2:

$c = \frac{n}{V}$ ✓

$n = (0,25)(2,5)$ ✓

n = 0,625

$n = \frac{m}{M}$

$0,625 = \frac{m}{36,5}$ ✓

m = 22,82 g ✓

range/*gebied*: 22,82 – 23

(4)

7.3.2

OPTION 1/*OPSIE 1*:

$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$

$\frac{(0,25)(50)✓}{c_b(20)✓} = \frac{2}{1}✓$

c_b = 0,31 mol·dm^{-3}✓

OPTION 2/*OPSIE 2*:

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

n = (0,25)(0,05) ✓

n = 0,0125 mol

$n_b = ½n_a$✓

= 0,00625 mol

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

$c_b = \frac{0,00625}{0,02}$✓

c_b = 0,31 mol·dm^{-3}✓

(4)

7.3.3 Methyl orange. ✓
Strong acid reacts with weak base ✓

Metieloranje
Sterk suur reageer met 'n swak basis. (2)

[16]

QUESTION/*VRAAG* 8:

8.1 8.1.1 Oxidation is the loss of electrons
Oksidasie is die verlies van elektrone. ✓✓ (2)

8.1.2 Oxidation/*Oksidasie* ✓
Cu^0 ✓→ Cu^{2+}✓ (3)

8.2 **METHOD 1**: MnO_4^{2-}
x + (4(-2)) = -2
x = +6 ✓✓

METHOD 2: MnO_4^-
x + (4(-2)) = -1
x = +7

(2)

[7]

TOTAL/*TOTAAL*: 150