GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

GAUTENGSE DEPARTEMENT VAN ONDERWYS

PREPARATORY EXAMINATION

VOORBEREIDENDE EKSAMEN

2020

MARKING GUIDELINES
NASIENRIGLYNE

10842

PHYSICAL SCIENCES: CHEMISTRY
FISIESE WETENSKAPPE: CHEMIE

PAPER/*VRAESTEL 2*

12 pages/*bladsye*

QUESTION/*VRAAG* 1

1.1 D✓✓ (2)

1.2 A✓✓ (2)

1.3 A✓✓ (2)

1.4 C✓✓ (2)

1.5 D✓✓ (2)

1.6 A ✓✓ (2)

1.7 C ✓✓ (2)

1.8 B ✓✓ (2)

1.9 A ✓✓ (2)

1.10 D ✓✓ (2)

[20]

QUESTION/*VRAAG* 2

2.1.1 A or/*of* C ✓ (1)

2.1.2 B ✓ (1)

2.1.3 F ✓ (1)

2.1.4 D ✓ (1)

2.2.1 4,5-dimethyl ✓hex-2-ene ✓ */ 4,5-dimetielheks-2-een*

Marking criteria 2.2.1-2.2.3/*Nasienriglyne:*

Only functional group correct/*Slegs funksionele groep korrek:* Max/*Maks:* $\frac{1}{2}$

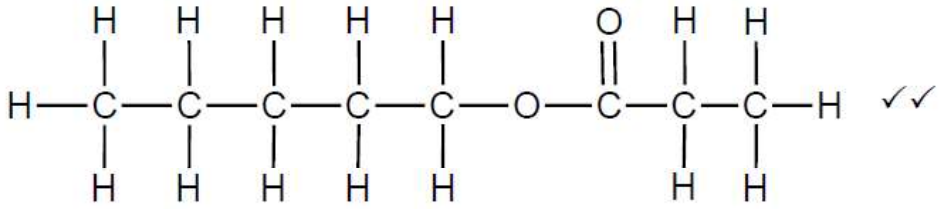
Whole structure correct/*Hele struktuur korrek:* $\frac{2}{2}$ (2)

2.2.2 2,3-dibromo-5-methyl ✓heptane ✓

2,3-dibromo-5-metielheptaan (2)

2.2.3 4-methyl ✓pent-2-yne ✓

4-metielpent-2-yn (2)

2.3.1  ✓✓ (2)

Marking criteria/*Nasienriglyne*

- Only functional group correct/*Slegs funksionele groep korrek:*
  Max/Maks: ½
- Whole structure correct:/*hele struktuur korrek* 2/2

2.3.2 Propanoic acid✓✓

Propanoësuur (1)

2.3.3 Sulphuric acid/H_2SO_4 ✓

Swawelsuur/ H_2SO_4 (1)

[14]

QUESTION/*VRAAG* 3

3.1 The temperature at which the solid and liquid phase are at equilibrium ✓✓

Die temperatuur waarby die vaste stof en die vloeistof fase in ewewig is. ✓✓ (2)

3.2 C ✓ It has a lower vapour pressure ✓

C ✓ Dit het 'n dampdruk ✓ (2)

3.3.1 Organic compounds with the same molecular formula, but different structural formulae. ✓ ✓
2 or zero

Organiese verbindings met dieselfde molekulêre formule, maar verskillende struktuurformules. ✓✓
2 of nul (2)

3.3.2 Compound **B** heptane is less branched/has a longer chain/less compact/less spherical/has a larger surface area. ✓

Stronger intermolecular forces/Van der Waals forces/dispersion forces/London forces/Induced dipole- induced dipole forces. ✓
More energy needed to overcome intermolecular forces✓
OR
Compound **A**/2-methyhexane is more branched/more compact/more spherical/has shorter chain/has a smaller surface area. ✓
It has weaker intermolecular forces/Van der Waals forces/dispersion forces/London forces/Induced dipole- induced dipole forces. ✓
Less energy needed to overcome intermolecular forces. ✓

*Verbinding **B**, heptaan, is minder vertak/het 'n langer ketting/minder kompak/minder sferies/ het 'n groter oppervlak area.* ✓

Sterker intermolekulêre kragte/Van der Waals kragte/dispersiekragte/Londonkragte/geïnduseerde kragte. ✓
Meer energie benodig om intermolekulêre kragte te oorkom. ✓
OF
*Verbinding **A**/2-metielheksaan is meer vertak/meer kompak/meer sferies/het 'n korter kettinglengte/het 'n kleiner oppervlak area.* ✓
Dit het 'n swakker intermolekulêre krag/Van der Waals kragte/dispersiekragte/Londonkragte/geïnduseerde dipoolkragte. ✓
Minder energie word benodig om die intermolekulêre kragte te oorkom. ✓ (3)

3.4 Both compounds C and D have hydrogen bonding between molecules. ✓Compound C has one site for hydrogen bonding whilst compound D has two sites for hydrogen bonding ✓
OR
Compound C has less sites for hydrogen bonding/weaker hydrogen bonding than compound D.
More energy needed to overcome intermolecular forces in compound D/less energy needed to overcome intermolecular forces in compound E. ✓

Beide verbindings C en D het waterstofbindings tussen die molekule. ✓ *Verbinding C het een plek vir waterstofbinding terwyl verbinding D twee plekke het vir waterstofbinding.* ✓
OF
Verbinding C het minder plekke vir waterstofbinding/swakker waterstofbinding as verbinding D.
Meer energie word benodig om die intermolekulêre kragte te oorkom in verbinding D/minder energie word benodig om die intermolekulêre kragte in verbinding E te oorkom. ✓ (3)
[12]

QUESTION/*VRAAG* 4

4.1.1 It contains a double bond/C=C between two carbon atoms in its hydrocarbon chain/All carbon atoms not bonded to the maximum number of atoms/four atoms✓

Daar is dubbelbindings/C=C tussen twee koolstofatome in die koolwaterstof ketting/Alle koolstofatome is nie gebind aan die maksimum aantal atome/vier atome nie. ✓ (1)

4.1.2 (a) Addition/Bromination ✓
Addisie/Broominasie (1)

(b) Substitution ✓
Substitusie (1)

4.1.3 Heat/sunlight/ultraviolet light ✓
Hitte/sonlig/ultraviolet lig (1)

4.1.4 Butane✓/*butaan* (1)

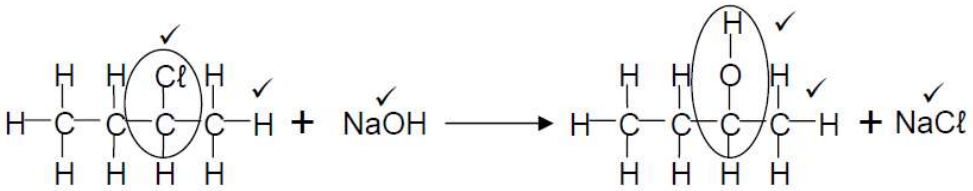
4.1.5 Hydrogen bromide/HBr✓

Waterstofbromied/ HBr (1)

4.2.1 Elimination✓
Eliminasie (1)

4.2.2 But✓-2-ene✓
But-2-een (2)

4.2.3



(6)
[15]

QUESTION/*VRAAG* 5

5.1 Carbon dioxide/CO_2 ✓

Koolstofdioksied/CO_2 (1)

5.2.1 The decrease in concentration of hydrochloric acid per unit time. ✓✓

Die afname in konsentrasie van waterstofchloried per eenheid tyd. ✓✓ (2)

5.2.2 Concentration (of the acid) ✓

Konsentrasie (van die suur) ✓ (1)

5.2.3 For a fair test/comparison ✓

Vir 'n regverdige toets/of vergelyking ✓ (1)

5.3.1
- Higher acid concentration in experiment 2 means more particles/molecules per unit volume✓
- More particles have kinetic energy equal to or greater than activation energy/More particles have enough kinetic energy ✓
- More effective collisions per unit time/frequency of effective collisions increases
- Rate of effective collisions increases. ✓

Hoër konsentrasie suur in eksperiment 2 beteken meer deeltjies/molekule per eenheid volume ✓
Meer deeltjies het kinetiese energie gelyk of groter as die aktiveringsenergie/Meer deeltjies het genoeg kinetiese energie. ✓
Meer effektiewe botsings per eenheid tyd/frekwensie van effektiewe botsings verhoog.
Tempo van effektiewe botsings verhoog. ✓ (4)

5.3.2 $n(CaCO_3) = m/M$

$= 4/100$✓ $= 0,04$ mol

$n(HCl) : n(CaCO_3) = 2 : 1$

$n(HCl) = 2(0,04)$ ✓ $= 0,08$mol

$c(HCl) = n/V$

$0.4 = 0,08/V$✓

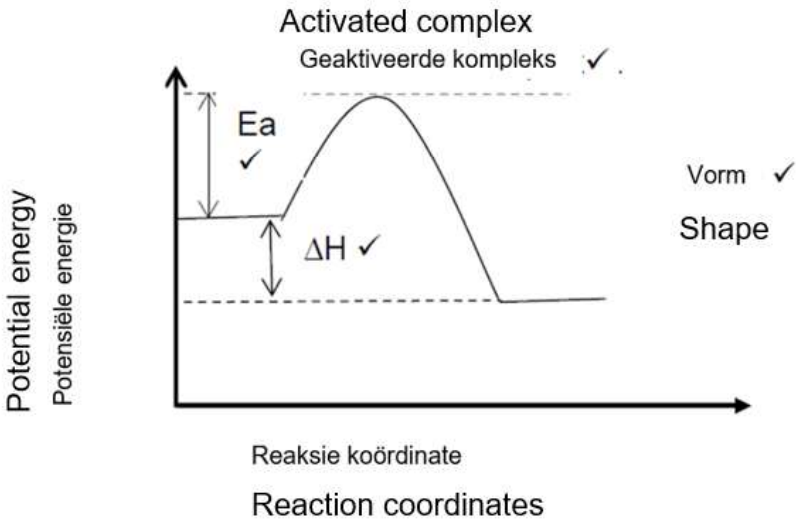
$V = 0,2\ dm^{-3} = 200\ cm^3$✓

Marking Criteria
- Substituting 100 into formula m/M
- Using ratio 2:1
- Substituting the number of moles into formula c= n/v
- Final answer

Nasienriglyne:
- *Vervang 100 in formule m/M*
- *Gebruik verhouding 2:1*
- *Vervang getal mol in formule c=n/V*
- *Finale antwoord*

(4)

5.4



(4)
[17]

QUESTION/*VRAAG* 6

6.1 The reaction is reversible. ✓

Die reaksie is omkeerbaar. ✓ (1)

6.2 This reaction is in contact with a catalyst, and therefore is known as the contact process. ✓

Hierdie reaksie is in kontak met 'n katalisator en daarom staan dit bekend as die Kontakproses. ✓ (1)

6.3

6.3.1 If the temperature is too low the reaction rate will be too slow for the yield to be enough. ✓✓

Indien die temperatuur te laag is sal die reaksietempo te stadig wees vir die opbrengs om genoeg te wees. ✓✓ (2)

6.3.2 A high temperature favours an endothermic reaction ✓
If the temperature is high the reverse reaction will be favoured ✓
Less product will be formed which is not favourable. ✓

'n Hoë temperatuur bevoordeel die endotermiese reaksie. ✓
Indien die temperatuur hoog is word die terugwaartse reaksie bevoordeel. ✓
Minder produkte sal vorm en dit is nie voordelig nie. ✓ (3)

6.4 Marking guideline/*Nasienriglyne*:

- Use the Ratio/*Gebruik ratio* ✓
- $n(SO_2)_{eq/ewe} = n(SO_2)_{initial/begin} - \Delta n(SO_2)$ } ✓
  $n(O_2)_{eq/ewe} = x - \Delta n(O_2)$
- Divide equilibrium moles by 200 dm^3/*Deel ewewigsmol deur 200 dm^3*✓
- Correct K_c expression (formulae in square brackets)✓
  Korrekte K_c uitdrukking(formules in blokhakies)
- Substitution of values in expression/*Vervanging van waardes in uitdrukking* ✓
- Substitution of/*Vervanging van* 32 $g \cdot mol^{-1}$ in m = nM ✓
- Final answer/*Finale antwoord:* 891,17g ✓
- Range/*Gebied:* 891,167 – 891,2

	SO_2	O_2	SO_3
Initial amount(moles) *Aanvangs hoeveelheid*	50	x	0
Change in amount(moles) *Verandering in hoeveelheid*	22	11	22
Equilibrium amount(moles) *Hoeveelheid*	28	x – 11 ✓	22
Equilibrium concentration($mol \cdot dm^{-3}$) *Ewewigkonsentrasie*($mol \cdot dm^{-3}$)	0,14	$\frac{(x-11)}{200}$	0,11

Ratio✓

Divide by 200 dm^3✓

$$K_c = \frac{[SO_3]^2}{[SO_2]^2\,[O_2]} \checkmark$$

$$7{,}328 = \frac{(0{,}11)^2}{(0{,}14)^2\left(\frac{x-11}{200}\right)} \checkmark$$

$$x = 27{,}849 \text{ mol}$$

m= n x M
= (278,849)(32)✓
= 891,167g ✓

(7)

6.5 Forward ✓✓/ *Voorwaarts* (2)

[16]

QUESTION/*VRAAG* 7

7.1

7.1.1 Acid-base reaction/neutralisation/protolysis ✓

Suur-basis reaksie/ neutralisasie/protoliese ✓ (1)

7.1.2 Barium hydroxide ✓
Bariumhidroksied (1)

7.1.3 X- Burette ✓ *Buret* (1)

7.1.4 A white <u>precipitate</u> in a <u>yellow</u> solution that gradually turns orange ✓✓

'n Wit neerslag in 'n geel oplossing wat geleidelik oranje word. ✓✓ (2)

7.1.5 (a) ✓ Remains constant Barium Hydroxide is a strong base that will dissociate/ionise from the start

Bly konstant. Bariumhidroksied is 'n sterk basis wat sal dissosieer/ioniseer van die begin af. ✓

(b) Decrease ✓ *Verminder*

(c) Decrease ✓ *Verminder* (3)

7.1.6 <u>Marking guidelines/*Nasienriglyne*</u>

- Any formulae/*Enige formule:* ✓
- Division by Volume ✓/ *deel deur volume*
- Use mole ratio ✓ *gebruik molverhouding*
- Use M = 233 g·mol^{-1} in m = nM ✓
- Answer = 1,165 g ✓

<u>OPTION 1: *OPSIE 1*</u>

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \quad ✓$$

$$\frac{c_a(30)}{(0,1)(50)} = \frac{1}{1} \quad ✓$$

$$c_a = 0,167 mol \cdot dm^{-3}$$

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

$$0,167 = \frac{n}{0,03}$$

$$n = 0,005\ mol$$

<u>OPTION 2: *OPSIE 2*</u>

$$c = \frac{n}{V} \quad ✓$$

$$0,1 = \frac{n}{0,05}$$

$$n = 0,005\ mol \quad ✓$$

$n(BaSO_4) = n(Ba(OH)_2$ ✓
$= 0,005$ mol

m = n x M
= (0,005)(233) ✓
= 1,165 g ✓ (5)

7.2

7.2.1 $NH_4^+(aq) + H_2O(\ell) \rightarrow NH_3$✓ $+ H_3O^+$ ✓ (2)

7.2.2 $CH_3CHOO^-(aq) + H_2O(\ell) \rightarrow CH_3COOH$✓ $+ OH^-$✓ (2)

[17]

QUESTION/*VRAAG* 8

8.1 A galvanic/voltaic cell✓
Galvaniese sel/voltaïese sel (1)

8.2 $A\ell(s)$ I $A\ell^{3+}(aq)(1\ mol{\cdot}dm^{-3})$ ✓II $Cu^{2+}(aq)(1\ mol{\cdot}dm^{-3})$ I $Cu(s)$ ✓

Accept

$A\ell$ I $A\ell^{3+}$ ‖Cu^{2+} ICu (3)

Marking criteria: *Nasienriglyne:*
- Oxidation ✓ *Oksidasie*
- Salt bridge✓ *soutbrug*
- Reduction✓ *reduksie*

8.3 $A\ell$ to Cu✓

$A\ell$ na Cu✓ (1)

8.4 $A\ell \rightarrow A\ell^{3+} + 3e^-$ ✓✓

Marking guidelines/*Nasienriglyne*

- $A\ell \rightleftharpoons A\ell^3 + 3e^-$ $^1/_2$ $A\ell^{3+} + 3e^- \rightleftharpoons A\ell$ $^0/_2$
  $A\ell^{3+} + 3e^- \leftarrow A\ell$ $^2/_2$ $A\ell^{3+} + 3e^- \rightarrow A\ell$ $^0/_2$
- Ignore if charge omitted on electron./*Ignoreer indien lading weggelaat op elektron.*
- If charge (+) omitted on $A\ell^{3+}$ /*Indien lading (+) weggelaat op* $A\ell^{3+}$*:*
  Example/*Voorbeeld:* $A\ell \rightarrow$ $A\ell^{3+} + 3e^-$ ✓
  Max./*Maks:* $^1/_2$

(2)

8.5 $E^\ominus_{cell} = E^\ominus_{reduction} - E^\ominus_{oxidation}$ ✓
= 0,34✓ – (-1,66) ✓
= 2 V✓ (4)

Notes
- Accept any other correct formula from the data sheet./*Aanvaar enige ander korrekte formule vanaf gegewensblad.*
- Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:/*Enige ander formule wat onkonvensionele afkortings gebruik bv.* $E°_{sel} =$ ***:3/4***
- *$E°_{OM} - E°_{RM}$ gevolg deur korrekte vervangings:* $^3/_4$

8.6

8.6.1 Decrease ✓ *Verminder* (1)

8.6.2 **NEGATIVE MARKING FROM 8.6.1/*NEGATIEWE NASIEN VANAF 8.6.1***

The concentration of $A\ell^{+3}$ will increase. According to Le Chatelier the system needs to decrease the concentration. ✓
The reverse reaction will be favoured. ✓
Therefore the reading will decrease. ✓

Die konsentrasie van $A\ell^{+3}$ sal vermeerder. Volgens Le Chatelier sal die sisteem die konsentrasie moet verlaag. ✓
Die terugwaartse reaksie sal bevoordeel word. ✓
Dus sal die lesing verminder. ✓ (3)

8.7 Chemical energy to electrical energy✓

Chemiese potensiële energie na elektriese energie. ✓ (1)
[16]

QUESTION/*VRAAG* 9

9.1 A ✓ (1)

9.2 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

9.3 Marking guidelines/*Nasienriglyne*

- Multiply nx2 or mx2 ✓ *Vermenigvuldig nx2 of mx2*
- $m_{deposite}$ = 31,75g ✓
- $m_{lost\ at\ anode}$ = (31,75 + 15,8)g ✓
- Answer/*antwoord* 66,77% ✓

$$n = \frac{m}{M}$$
$$(0{,}25 \times 2) \checkmark = \frac{m}{63{,}5}$$
$$m = 31{,}75\ g$$

$$\%purity = \frac{m_{deposited}}{m_{lost\ at\ anode}} \times 100 \checkmark$$
$$= \frac{31{,}75}{(31{,}75 + 15{,}8)} \checkmark \times 100$$
= 66,67% ✓

0,25 mol Cu formed in 1 800 s so in 3 600s (2x0,25) mol formed
0,25 mol Cu vorm in 1 800 s dus in 3 600 s (2x0,25) mol gevorm (4)

9.4.1 Electrolyte is a solution/liquid/dissolved substance that conducts electricity through the movement of ions (2 or 0)

Elektroliete is 'n oplossing/vloeistof/opgeloste stof wat elektrisiteit gelei deur die beweging van ione ✓✓ *(2 of 0)* (2)

9.4.2 The rate of oxidation is equal to the rate of reduction. ✓

Die tempo waarteen oksidasie plaasvind is gelyk aan die tempo van reduksie. ✓ (1)
[10]

QUESTION/*VRAAG* 10

10.1

10.1.1 Nitrogen ✓ *stikstof*
Phosphorus ✓ *fosfor*
Potassium ✓ *kalium*

Accept/*aanvaar*

N : P : K (3)

10.1.2 Potassium/K✓
Kalium/ K (1)

10.1.3 Phosphates/P ✓
Fosfate/ P (1)

10.1.4 Haber or/*of* Ostwald ✓ (1)

10.2 Eutrophication: The process by which an ecosystem eg. A river or dam, becomes enriched with inorganic nutrients✓, especially phosphorus and nitrogen, resulting in excessive plant growth ✓

Eutrofikasie: Die proses waarby 'n ekosisteem bv. 'n rivier of dam, verryk word met anorganiese voedingstowwe ✓, veral fosfor en stikstof, wat 'n oorgroot toename in plantegroei tot gevolg het. ✓ (2)

10.3 Marking guidelines/*Nasienriglyne*

- m(N) = $\frac{4}{6}x36$ ✓
- Double up on Fertilizer B ✓ *verdubbel kunsmis B*
- Fertilizer A m(N) = 24kg, m(P)=m(K) = 6 kg ✓
- Fertilizer B m(N) = 19,09kg, m(P)=m(K) = 5,45 kg ✓
- Answer Fertilizer B✓

Fertilizer A/*kunsmis A*
In 100kg 4.1.1(36)
m(N) = $\frac{4}{6}x36$
= 24 kg ✓
m(P)=m(K) = $\frac{1}{6}x36$
= 6 kg ✓

Fertilizer B/*kunsmis B*
In 50 kg 7.2.2(15) ✓
∴ In 100kg 14.4.4(30)
m(N) = $\frac{14}{22}x30$
= 19,09 kg
m(P)=m(K) = $\frac{14}{22}x30$
= 5,45 kg ✓

Therefore **Fertilizer B** will be the best ✓

Kunsmis B sal die beter een wees. (5)
[13]

TOTAL/*TOTAAL*: 150