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DEPARTMENT OF
EDUCATION

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SENIOR CERTIFICATE
NASIONALE
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GRADE/*GRAAD* 12

PHYSICAL SCIENCES: CHEMISTRY (P2)
FISIESE WETENSKAPPE: CHEMIE (V2)

SEPTEMBER 2019

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 9 pages.
Hierdie memorandum bestaan uit 9 bladsye.

QUESTION 1/VRAAG 1

1.1 B ✓✓ (2)

1.2 D ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B ✓✓ (2)

1.5 A ✓✓ (2)

1.6 A ✓✓ (2)

1.7 B ✓✓ (2)

1.8 C ✓✓ (2)

1.9 C ✓✓ (2)

1.10 D ✓✓ (2)

[20]

QUESTION 2/VRAAG 2

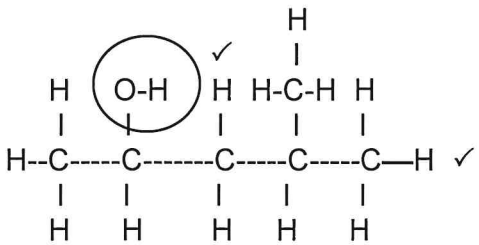
2.1. 1 2,3-dimethyl ✓pent-2-ene✓/
2,3-dimetiel pent-2-een
OR/OF
2,3- dimethyl -2-pentene /
2,3- dimetiel-2-penteen

Mark allocation/ *punte toekenning*
pentene✓
Rest correct✓/ res korrek

(2)

2.1.2 3-bromo-4-methyl ✓heksane ✓/ *3-bromo-4-metielheksaan* (2)

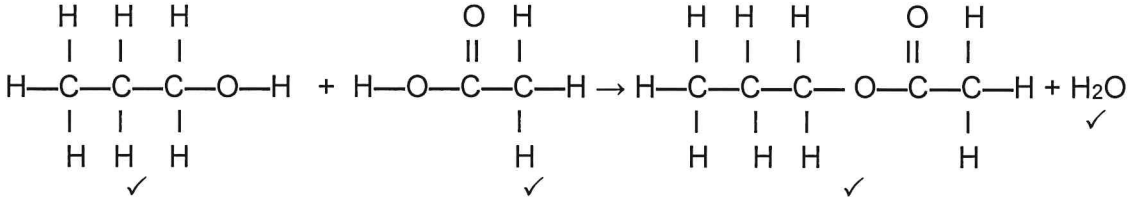
2.2



Mark allocation/ *punte toekenning*
OH✓ (functional group)/funksionele group
Rest correct✓/ res korrek

(2)

2.3



(4)
[10]

QUESTION 3/VRAAG 3

3.1 The temperature✓ at which vapour pressure equals atmospheric pressure✓ (2)
Die temperatuur waar die dampdruk gelyk is aan die atmosferiese druk.

3.2 A ✓ (1)

3.3 Butane✓✓ */Butaan* (2)

3.4.1 Organic molecules with the same molecular formula, ✓ but different structural formulae✓
Organiese molekules met dieselfde molekulêre formule maar verskillende struktuurformule. (2)

3.4.2 Chain isomers✓ */kettingisomere*✓ (1)

3.4.3
- B/Pentane is a straight chain molecule and C/2-methylbutane is branched. ✓
  OR
  B/ Pentane has a larger surface area than C/ 2-methylbutane./ pentane molecules can move closer together.
- The intermolecular forces/ attractive forces between B/ pentane molecules are stronger✓ than those between C/2-methylbutane molecules.
- More energy is needed to overcome the intermolecular forces **between** the B/ pentane molecule.✓ (DO NOT ACCEPT: break **bonds**!!!)

- *B/Pentaan is 'n reguit ketting en C/2-metielbutaan is vertak.*
  OF
  B/Pentaan het 'n groter reaksieoppervlakte as C/ 2-metielbutaan./ pentaan molekule kan nader aan mekaar beweeg.
- *Die aantrekkingskragte /intermolekulêre kragte tussen B/pentaanmolekule is sterker as tussen C/2-metielbutaan molekule.*
- *Meer energie word vereis om die intermolekulêre kragte tussen die B/pentaanmolekule te oorkom.* (3)

3.5
- B/Pentane has London forces (between molecules), D/pentan-1-ol has hydrogen bonding forces
- hydrogen bonding forces are stronger than London forces
- More energy is needed to overcome the intermolecular forces **between** D/pentan-1-ol (than with B/ pentane molecule) /OR less energy needed to overcome the intermolecular forces **between** B/ pentane molecule than between D/pentan-1-ol

- *B/Pentaan besit Londonkragte (tussen die molekule) en D/pentan-1-ol waterstofbindings tussen die molekule.*
- *Waterstofbindings is sterker as Londonkragte*
- *Meer energie is nodig om die intermolekulêre kragte by D/pentan-1-ol te oorkom as by B/pentaan* (4)

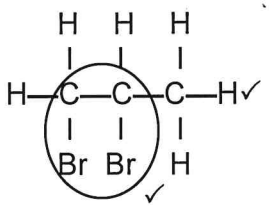
[15]

QUESTION 4/VRAAG 4

4.1.1 Prop-1-ene has a double bond✓/ does not only have single bonds / can undergo addition and bond with another 2 hydrogen atoms/ each C-atom is not bonded to another 4 atoms.
Prop-1-een bevat nie slegs enkelbindings nie / bevat 'n dubbelbinding tussen twee koolstofatome / kan addisie ondergaan en met nog 'n waterstof verbind/ elke C-atoom nie met 4 ander atome verbind nie. (1)

4.1.2 a Addition ✓/*Addisie* ✓ (1) b Substitution✓ /*Substitusie* ✓ (1)

4.1.3



Functional group correct✓/
Funksionele groep korrek ✓
Whole molecule correct✓/
Molekuul korrek ✓

(2)

4.1.4 Heat/ sunlight / ultra violet light ✓
Hitte / sonlig / ultravioletlig (1)

4.1.5 Butane✓ /*Butaan* ✓ (1)

4.1.6 Hydrogen bromide or/of HBr ✓*Waterstofbromied /* (1)

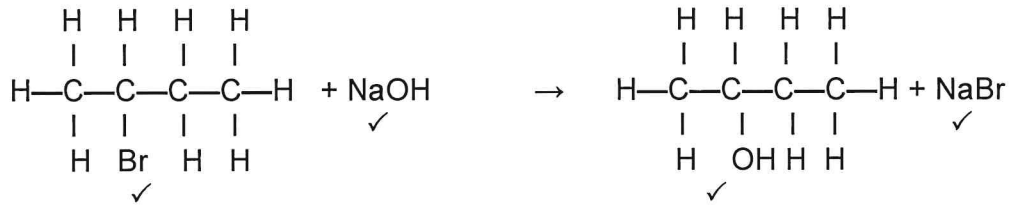
4.1.7 Reaction I ✓
Prop-1-ene is unsaturated ✓ en butane (X) is saturated✓
Reaction I is an addition reaction✓, reaction II a substitution reaction.✓
(addition takes place faster than substitution)./
Reaction I needs less energy✓ than reaction II✓
Any one of the above explanations.

Reaksie I (sal die broom vinniger ontkleur)
Prop-1-een is onversadig en butaan (X) is versadig
By reaksie I vind 'n addisie reaksie plaas en by reaksie II substitusie. Addisie vind vinniger plaas as substitusie./
By reaksie I is minder (aktiverings)energie nodig as by reaksie II om die reaksie te laat plaasvind./
Enige een van bogenoemde verduidelikings. (3)

4.2.1 Elimination ✓/*Eliminasie* ✓ (1)

4.2.2 But-2-ene✓ / 2✓-butene ✓/ *But-2-een* ✓/ *2*✓*-buteen* ✓ (2)

4.2.3



(4)

4.2.4 Hidrolysis ✓/ *Hidrolise* (1)
[19]

QUESTION 5/VRAAG 5

5.1 **ONLY ANY ONE OF/*SLEGS ENIGE EEN VAN*:**

- Change in concentration ✓ of a reactant/product per unit time. ✓
  Verandering in konsentrasie van reaktanse/produkte per eenheidtyd.
- Rate of change in concentration. ✓✓
  Tempo van verandering in konsentrasie.
- Change in amount/number of moles/volume/mass of products/reactants per (unit) time./*Verandering in hoeveelheid/getal mol/volume/massa van produkte/reaktanse per (eenheid)tyd.*
- Amount/number of moles/volume/mass of products formed OR reactants used per (unit) time./*Hoeveelheid/getal mol/volume/massa van produkte gevorm OF reaktanse gebruik per (eenheid)tyd* (2)

5.2 $CaCO_3 + 2HC\ell$ ✓→ $CaC\ell_2 + CO_2 + H_2O$ ✓ (bal ✓) (3)

5.3 0,4 g ✓ (1)

5.4 2-4 minutes✓ /*minute* Gradient is higher/steeper✓ /*Gradient is styler/hoër* (2)

5.5 3,8 minutes✓ /*minute* (1)

5.6.1 Increases✓/ *Neem toe* (1)

5.6.2 Remains the same✓ / *Bly dieselfde* (1)

5.7 R ✓ (1)

5.8.1 Exothermic ✓/*Eksotermies* (1)

5.8.2 Remains the same✓ /*Bly dieselfde* (1)

5.8.3 Activation energy ✓(E_A) decreases ✓
Aktiveringsenergie verlaag (2)
[16]

QUESTION 6/VRAAG 6

6.1 Closed system ✓reversible reaction ✓/
Geslote sisteem, omkeerbare reaksie (2)

6.2 $X_2A_2(g) + A_2(g) \rightarrow 2XA_2(g)$ ✓ (1)
(Note: if ⇌(double arrows), 0 */indien ⇌(dubbel pyltjies), 0*

6.3.1 Increases✓/*Neem toe* ✓ (1)

6.3.2 Remains the same✓ /*Bly dieselfde* ✓ (1)

6.4.1 Decreases✓/*Neem af* ✓ (1)

6.4.2 Exothermic✓ / *Eksotermies.*

- The <u>forward reaction is favoured</u>✓and according to Le Chatelier a <u>decrease in temperature favours the exothermic</u> reaction✓
  Die voorwaartse reaksie word bevoordeel✓ en volgens Le Chatelier sal 'n verlaging in temperatuur✓ die eksotermiese reaksie bevoordeel
- The rate of the reverse reaction decreases more✓than the rate of the forward reaction. ✓/ *die tempo van die terugwaartse reaksie neem meer af✓as die tempo van die terugwaartse reaksie✓* (3)

6.4.3 POSITIVE MARKING FROM QUESTION 6.4.2/POSITIEWE NASIEN VANAF VRAAG 6.4.2
Increases✓/*Neem toe* ✓ (1)
(If endothermic for 6.4.2 only mark decreases correct here)

6.5 **<u>Mark allocation/*Puntetoekenning*</u>**

- $n(A_2)$ formed/*gevorm* = 2,25✓
- <u>USING</u> ratio/*<u>GEBRUIK</u> verhouding:* 2:1:1 ✓
- Equilibrium: $n(XA_2)$ & $n(X_2A_2)$ = initial ± change ✓
  Ewewig: : $n(XA_2)$ & $n(X_2A_2)$ = aanvanklik ± verandering
- Divide by volume/*Gedeel deur volume* (0,5 dm^3) ✓
- Correct K_c expression (<u>formulae in square brackets</u>). ✓
  Korrekte K_c -uitdrukking (<u>formules tussen vierkanthakies</u>).
- Substitution of reactant and product concentrations/*Vervanging van reaktans- en produkkonsentrasies.* ✓
- **Correct** final answer/***Korrekte*** *finale antwoord: 20,25*✓

	$2XA_2(g)$	$X_2A_2(g)$	$A_2(g)$
Initial moles /*Aanvanklik mol*	5	0	0
change/*verandering*	(-) 4,5 (ratio)✓	(+) 2,25	(+) 2,25✓
Equilibrium/*Ewewig* (moles / *mol*)	5-4,5 = 0,5 ✓	2,25	2,25
Concentration / *Konsentraie*	$c = \frac{0,5}{0,5} = 1,0$	$c = \frac{2,25}{0,5} = 4,5$	$c = \frac{2,25}{0,5} = 4,5$

÷0,5✓

$K_c = \frac{[X_2\ A_2]\ [A_2]}{[X\ A_2]^2}$ ✓ $= \frac{(4,5)(4,5)}{(1,0)^2}$ ✓ $= 20,25$ ✓ (7)

6.6.1 [products] >.[reagents] ✓ / *[produkte] >.[reagente]* (1)

6.6.2 0,054 ✓ (1)

[19]

QUESTION 7/VRAAG 7

7.1.1 A proton (H^+) donar ✓✓*/'n Suur is 'n proton (H^+) skenker* ✓✓ (2)

7.1.2 It can donate 2 protons✓/ 2 H^+ ions per H_2SO_4 molecule /
Dit kan 2 protone skenk✓ / 2 H^+ ione per H_2SO_4 molekule vorm (1)

7.1.3 It ionises completely in water✓ to form a high concentration of H_3O^+ ions.
Dit *ioniseer feitlik volledig in water* en vorm 'n hoë konsentrasie H_3O^+ione (1)

7.1.4 Sulphate ion✓ / SO_4^{2-} */ sulfaat-ioon* (1)

7.1.5 Ampholyte /amphiprotic substance✓/*Amfoliet / amfiprotiese stof* (1)

7.2

$n = \frac{m}{M} = \frac{0,32}{106\ ✓} = 0,003$ mol ✓

Na_2CO_3 : HCℓ
0,003 : 0,006 ✓

$c_{HCℓ} = \frac{n}{V} = \frac{0,006}{0,1} = 0,06$ mol·dm^{-3} ✓

$c_1 V_1 = c_2 V_2$

$c_1 \times 10$ ✓$= 0,06 \times 500$✓

$c_1 = 3$ mol·dm^{-3}✓

Marking Criteria/*Nasienriglyne*

- Substitution/*Vervang* M=106 ✓
- Calculate/*Bereken* $n(Na_2CO_3)$ = 0,003 mol✓
- Use ratios/*Gebruik molverhouding*: $n(HCℓ) = n(Na_2CO_3)$ ✓
- Calculate/*Bereken* $c_{HCℓ}$✓
- Substitute/*Vervang* $c_1 \times 10$ ✓
- Substitution/*Vervang* 0,06 x 500✓
- Final answer: 3 mol·dm^{-3}✓

(7)

[13]

QUESTION 8/VRAAG 8

8.1 Reduction ✓/*Reduksie* ✓ (1)

8.2 A substance that gains electrons✓✓ /*Stof wat elektrone ontvang* ✓✓ (2)

8.3 Silver nitrate ✓ /*Silwernitraat* ✓ (1)

8.4 From D to silver✓ /*Van D na die silwer* ✓ (1)

8.5 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓ (any equation on data sheet)
2,46✓ = (+0,8) ✓- E^{θ}_{anode}
E^{θ}_{anode} = -1,66 V ✓ (4)

8.6 Aluminium / Aℓ ✓ (1)

8.7 POSITIVE MARKING FROM QUESTION 8.6/*POSITIEWE NASIEN VANAF VRAAG 8.6*
Aℓ(s) I $Aℓ^{3+}$(aq) (1 mol·dm^{-3}) ✓ II ✓Ag^{+} (aq) (1mol·dm^{-3}) I Ag(s)✓
OF/OR
Aℓ I $Aℓ^{3+}$ ✓ II ✓Ag^{+} I Ag✓ (3)

8.8 Decreases✓ / *Neem af.* ✓
Ag^{+} (aq) + $Cℓ^{-}$ (aq) → AgCℓ (s) /AgCℓ (s) forms /[Ag^{+}] decreases ✓
Silwerchloried vorm wat 'n neerslag is /, die Ag^{+} - konsentrasie verlaag✓ (2)
[15]

QUESTION 9/VRAAG 9

9.1 A solution/liquid/dissolved substance that conducts electricity✓ through the movement of ions / because it contains ions ✓
'n Elektroliet is 'n oplossing/vloeistof/stof wat ione bevat ✓en dus stroom kan gelei.✓ (2)

9.2.1 $2Cℓ^{-} \rightarrow Cℓ_2 + 2e^{-}$ ✓✓ (2)

$2Cℓ^{-} \rightleftharpoons Cℓ_2 + 2e^{-}$	½	$Cℓ_2 + 2e^{-} \leftarrow 2Cℓ^{-}$	2/2
$2Cℓ^{-} \leftarrow Cℓ_2 + 2e^{-}$	0/2	$Cℓ_2 + 2e^{-} \rightleftharpoons 2Cℓ^{-}$	0/2

9.2.2 $Cu^{2+} + 2e^{-} \rightarrow Cu$ ✓✓ (2)

$Cu^{2+} + 2e^{-} \rightleftharpoons Cu$	½	$Cu \leftarrow Cu^{2+} + 2e^{-}$	2/2
$Cu^{2+} + 2e^{-} \leftarrow Cu$	0/2	$Cu \rightleftharpoons Cu^{2+} + 2e^{-}$	0/2

NOTE: if swopped answers for Questions 9.2.1 and 9.2.2 but everything else correct 2/4/ *Indien antwoorde vir Vrae 9.2.1 en 9.2.2 omgeruil 2/4*

9.3 Q ✓
Reduction occurs there ✓/Cu^{2+} is reduced at Q / Cu^{2+} is an oxidising agent / *Reduksie vind daar plaas* ✓ (2)

9.4.1 Cu is a better reducing agent ✓than $Cℓ^{-}$ ✓and thus Cu will be oxidised to Cu^{2+}✓. (no $Cℓ_2$ gas formed but Cu will dissolve/break up)
Cu is 'n beter reduseermiddel ✓as $Cℓ^{-}$ ✓en sal dus na Cu na Cu^{2+} geoksideer word.✓ (3)

9.4.2 P ✓ (1)
[12]

QUESTION 10/VRAAG 10

10.1 Ostwald process✓ */Ostwald-proses* ✓ (1)

10.2 NO ✓and/ *en* H_2O ✓ (2)

10.3 $NH_3 + HNO_3$ ✓→ NH_4NO_3✓ (bal ✓) (3)

10.4 To have all 3 primary nutrients /To mix a fertilizer with N P and K ✓/
Om 'te verkry wat al drie die primêre voedingstwwe (N, P en K) bevat. ✓ (1)

10.5

Option 1/ *Opsie 1*

$n = \frac{m}{M} = \frac{6{,}8\times10^4}{17}$ ✓ $= 4\times10^3$ mol

2 mol NH_3 produces 1 mol $(NH_4)_2SO_4$

∴ 4×10^3 mol NH_3 produces 2×10^3 mol $(NH_4)_2SO_4$ ✓

∴ m = nM $= 2\times10^3 \times 130$✓

$= 2{,}6\times10^5$ g✓

∴ $2{,}6 \times 10^2$ kg✓(2 600 kg) ✓ $(NH_4)_2SO_4$

Option 2/ *Opsie 2*

2 mol NH_3 produces 1 mol $(NH_4)_2SO_4$

∴34g NH_3 ✓(uses 17) produces 130 g $(NH_4)_2SO_4$ ✓(uses 130) ✓(ratio)

∴$6{,}8\times10^4$ g NH_3 produces x g $(NH_4)_2SO_4$

∴ $34x = (130)(6{,}8 \times 10^4)$

$x = 2{,}6 \times 10^5$ g

∴ $2{,}6 \times 10^2$ kg NH_4NO_3 ✓ formed/gevorm

Marking criteria/ Nasien riglyn

- **Use** of 17 in $n = \frac{m}{M}$ ✓
- **Use** of ratio $NH_3 : (NH_4)_2SO_4 = 2:1$ ✓
- Use of molar mass of $(NH_4)_2SO_4 = 130$✓
- Final answer correct ✓

(4)

[11]

TOTAAL: 150