education

Department of Education
FREE STATE PROVINCE

PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN

GRADE/GRAAD 12

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

SEPTEMBER 2017

MARKS/*PUNTE*: 150

MEMORANDUM

This memorandum consists of 12 pages.
Hierdie memorandum bestaan uit 12 bladsye.

Acknowledgement to Northern Cape
Erkenning aan Noord-Kaap

Please turn over
Blaai om asseblief

QUESTION 1/*VRAAG 1*

1.1 D✓✓ (2)

1.2 A✓✓ (2)

1.3 C✓✓ (2)

1.4 B✓✓ (2)

1.5 C✓✓ (2)

1.6 C✓✓ (2)

1.7 D✓✓ (2)

1.8 A✓✓ (2)

1.9 B✓✓ (2)

1.10 B✓✓ (2)

[20]

QUESTION 2/VRAAG 2

2.1

2.1.1 aldehyde/*aldehied* ✓ (1)

2.1.2 ketone/*ketoon* ✓ (1)

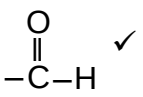
2.2 methanol✓✓/*metanol* (2)

2.3 E✓ (1)

2.4

2.4.1 An addition polymer is a substance that have a molecular structure built up from a large number monomers ✓ (usually containing a double bond) that are covalently bonded together to form polymer chains.✓
'n Addisiep*olimeer is 'n stof waarin die molekulêre struktuur opgebou is uit 'n groot aantal monomer (wat gewoonlik 'n dubbelbinding bevat) wat kovalent gebind is om 'n polimeerketting te vorm.* (2)

2.4.2 F ✓ (1)

2.5  ✓ (1)

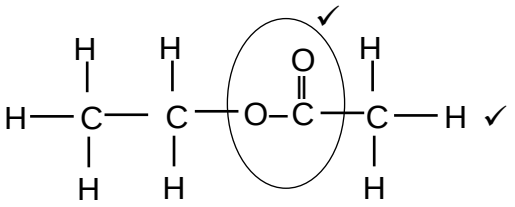
2.6 CnH_2n ✓ (1)

2.7 Saturated ✓/*versadig*
There are only single bonds between the carbon atoms✓/
Daar is slegs enkelbindings tussen naasliggende koolstofatome (2)

2.8 $2C_4H_{10} + 13O_2$ ✓ → $10H_2O + 8CO_2$ ✓ (bal✓) (3)
[15]

QUESTION 3/VRAAG 3

3.1



(2)

3.2
- **<u>Structure/*Struktuur*</u>:**
  Compound **G** (ethanoic acid) has two sites for hydrogen bonds (between two molecules) compared to the one site of hydrogen bond in compound **D** (propanol) ✓
  *Verbinding **G** (etanoësuur) bevat 'n dubbel waterstofbinding (tussen twee atome) terwyl verbinding **D** (propanol) net 'n enkele waterstofbinding bevat.*

- **<u>Intermolecular forces/*Intermolekulêre kragte:*</u>**
  Stronger intermolecular force/Van der Waals force present in compound **G** ✓
  *Sterker intermolekulêre kragte/Van Der Waals-kragte is teenwoordig in verbinding **G**.*

- **<u>Energy/*Energie:*</u>**
  More energy needed to overcome or braek intermolecular forces/Van der Waals forces in compound **G**. ✓
  *Meer energie is nodig om die intermolekulêre kragte te breek in verbinding **G**.* (3)

3.3 **FROM A to C**
As chain length/surface area increases,✓the strength of Van der Waals force/London force increases.✓ Hence the boiling point increases.
VANAF A tot C
As die kettinglengte/oppervlakarea toeneem, sal die sterkte van die Van Der Waals-kragte/Londonkragte toeneem. Daarom verhoog die kookpunt. (2)

3.4 Lower than ✓/*laer as* (1)

3.5

3.5.1 Structural isomers are two substances with the same molecular formula, but different structures. ✓ ✓/*Isomere is stowwe met dieselfde molekulêre formule maar verskillende struktuurformules* (2)

3.6.2 Chain isomer/Kettingisomeer ✓ (1)

[11]

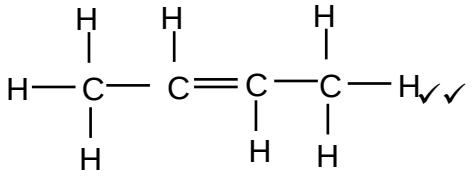
QUESTION 4/VRAAG 4

4.1

4.1.1 Elimination ✓/*Eliminasie* (1)

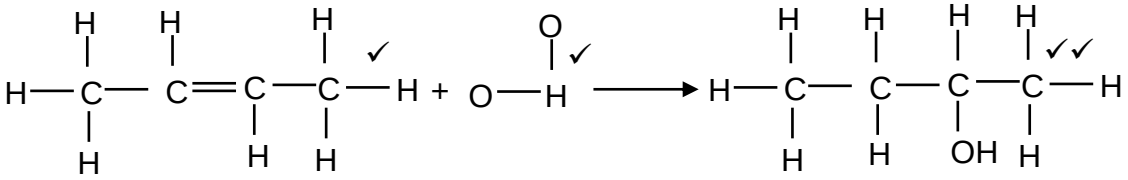
4.1.2 Addition ✓/*Addisie* (1)

4.2



(2)

4.3



(4)

4.4 Dilute strong base/*Verdunde sterk basis*/Dil. NaOH/KOH/LiOH✓
(Moderate) heat✓/(*matige) hitte* (2)

4.5

4.5.1 Butane/*butaan*✓ (1)

4.5.2 Hydrogenation/*hidrogenering* ✓ (1)

4.6

4.6.1 Propanoic acid/*propanöesuur* ✓ (1)

4.6.2 Sulphuric acid/swawelsuur ✓ (1)

4.6.3 esterification/*verestering*✓ (1)

[15]

QUESTION 5/VRAAG 5

5.1 The rate of a reaction is the change in concentration of reactant/product per unit time.✓✓*Reaksietempo is die verandering in konsentrasie van die reaktante/produkte per tydseenheid.* (2)

5.2

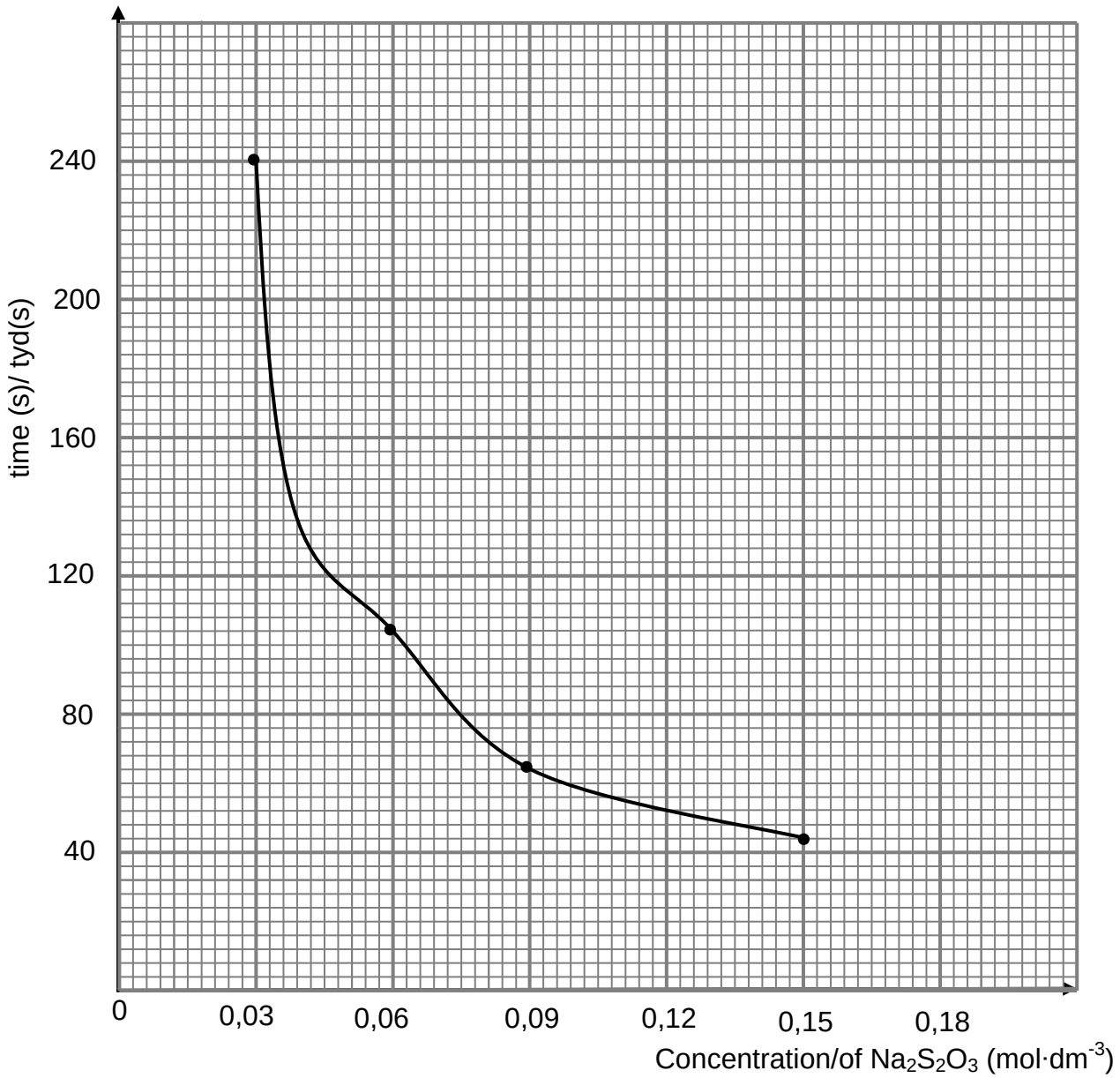
5.2.1 Concentration of sodium thiosulphate/*konsentrasie natriumtiosulfaat* ✓ (1)

5.2.2 ANY ONE✓
Concentration of hydrochloric acid/*konsentrasie soutsuur*
Temperature/*temperatuur* (1)

5.3 S (sulphur/swawel)✓ (1)

5.4 Trial 1✓/*Eksperiment 1* (1)

5.5



RUBRIC FOR THE GRAPH/*RUBRIEK VAN GRAFIEK*	
Both axes labelled correctly/Beide asse korrek benoem	1 mark
All the points plotted correctly/Alle punte korrek geplot	2 mark
A smooth curve/vorm 'n kurwe	1 mark

(4)

5.6 The rate of reaction increases as the concentration (of $Na_2S_2O_3$) increases✓✓/
Die reaksietempo verhoog as die konsentrasie van ($Na_2S_2O_3$) verhoog (2)

5.7 Increase the temperature of the reaction mixture✓/*Verhoog die temperatuur van die reaksiemengsel.*
Use a catalyst✓/*gebruik 'n katalisator* (2)

[14]

QUESTION 6/VRAAG 6

6.1 Exothermic ✓/Eksotermies
Products have a lower energy than the reactants✓/*produk verkeer by 'n laer energie as die reaktante* (2)

6.2 Correct orientation of the molecules ✓/*Korrekte oërientasie van molekule*
Must have enough kinetic energy to form an activation complex✓/*Moet oor genoeg kinetiese energie beskik om 'n geaktiveerde kompleks te vorm* (2)

6.3 Catalyst (vanadium pentoxide) lowers the activation energy✓ so that more molecules will have an energy equal or greater than the activation energy✓ to take part in the reaction.
Die katalisator *verlaag die aktiveringsenergie sodat meer molekule genoeg kinetiese energie het om te reageer.* (2)

6.4 $\Delta H = E_P - E_R$✓
$= -86 - 25$ ✓
$= -111 \text{ kJ·mol}^{-1}$ ✓ (3)

6.5 An unstable (transition) state from reactants to products✓✓/*Die geaktiveerde kompleks is 'n onstabiele tussentoestand bestaande uit die reaktante en produkte* (2)

6.6 $\Delta Ea = 68 - (-86) = 154 \text{ kJ.mol}^{-1}$✓✓ (2)
[13]

QUESTION 7/VRAAG 7

CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT AANTAL MOL GEBRUIK
Mark allocation:

- Change in n(NO) & n(O_2) ✓
- Ratio n(NO) : n(O_2) : n(NO_2) = 2 : 1 : 2 ✓
- n(NO_2) & n(O_2) at equilibrium ✓
- Divide three equilibrium amounts by 0,5 (calculation of concentration) ✓
- K_c expression✓
- Substitution into K_c expression✓
- Final answer : ***x*** = 2 ✓

Punte toekenning:

- Verandering in n(NO) & n(O_2) ✓
- Verhouding van n(NO) : n(O_2) : n(NO_2) = 2 : 1 : 2 ✓
- n(NO_2) & n(O_2) by ewewig ✓
- Deel die drie ewewigshoeveelhede deur 0,5 (konsentrasie berekening) ✓
- K_c-uitdrukking✓
- Substitusie in K_c-uitdrukking✓
- Finale antwoord : ***x*** = 2 ✓

7.1 **OPTION 1/*OPSIE 1:***

	$2NO(g) + O_2(s) \rightarrow 2NO_2(g)$		
	2 moles/mol	1moles/mol	2moles/mol
Start/begin	4 moles/mol	2,5 moles/mol	***x***
Reacted/gereageer	1 moles/mol	0,5 moles/mol	✓ Ratio✓
Formed/gevorm	-----	----	1 moles/mol
Equilibrium/ewewig	3 moles/mol	2 moles/mol	***x*** + 1 moles/mol ✓
Equilibrium concentration ($\frac{n}{V}$) *Ewewig konsentrasie*	$\frac{3}{0,5}$ = 6mol.dm^{-3}	$\frac{2}{0,5}$ = 4mol.dm^{-3}	$\frac{x+1}{0,5}$ mol.dm^{-3}✓

(7)

$$K_c = \frac{[NO_2]^2}{[NO]^2[O_2]}$$ ✓

$$0,25 = \frac{\left[\left(\frac{x+1}{0,5}\right)\right]^2}{[6]^2[4]}$$ ✓

Taking square root on both sides/*trek 'n vierkantswortel aan albei kante*

$$\sqrt{0,25} = \frac{\sqrt{\left[\left(\frac{x+1}{0,5}\right)\right]^2}}{\sqrt{(6^2)(4)}}$$

x = 2 mol✓

OPTION 2/*OPSIE 2:*

Amount of NO reacted/*Hoeveelheid* NO *wat reageer* = 4-3 = 1 mol ✓
Ratio n(NO) : n(O_2) : n(NO_2) = 2 : 1 : 2 ✓
n(O_2) at equilibrium = 2,5 - 0,5 = 2 mol
n(NO_2 formed) = x + 1 mol } ✓

$c(NO) = \frac{n}{V} = \frac{3}{0,5} = 6\ mol\cdot dm^{-3}$
$c(O_2) = \frac{n}{V} = \frac{2}{0,5} = 4\ mol\cdot dm^{-3}$
$c(NO_2) = \frac{n}{V} = \frac{X+1}{0,5}\ mol\cdot dm^{-3}$ } ✓

$$K_c = \frac{[NO_2]^2}{[NO]^2[O_2]}$$ ✓

$$0,25 = \frac{\left[\left(\frac{x+1}{0,5}\right)\right]^2}{[6]^2[4]}$$ ✓

Taking square root on both sides/*trek 'n vierkantswortel aan albei kante*

$$\sqrt{0,25} = \frac{\sqrt{\left[\left(\frac{x+1}{0,5}\right)\right]^2}}{\sqrt{(6^2)(4)}}$$

x = 2 mol✓

7.2 Homogeneous, ✓ only one phase is present ✓
Homogeen, want daar is net een fase betrokke (2)

7.3 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓✓/*Wanneer die ewewig in 'n geslote sisteem versteur word, sal die sisteem 'n nuwe ewewig instel deur die reaksie te bevoordeel wat die versteuring teenwerk.* (2)

7.4 The system reacts to oppose by favouring the reaction that produces lesser number of moles. ✓ Favour the forward reaction and the concentration of NO_2 will increase.✓/*Die sisteem reageer om die versteuring teen te werk deur die reaksie wat lei tot volume vermindering (minder mol gevorm) te bevoordeel. Die voorwaartse reaksie word bevoordeel en dus sal die konsentrasie NO_2 verhoog.* (2)
[13]

QUESTION 8/VRAAG 8

8.1 A solution of which the concentration is (precisely) known✓✓/
'*n Oplossing waarvan die konsentrasie presies bekend is*. (2)

8.2 HSO_4^- ✓ (1)

8.3

OPTION 1/OPSIE 1

$pH = -\log [H^+]$ ✓

$1 = -\log [H^+]$ ✓

$[H^+] = 0,1 \text{ mol·dm}^{-3}$

$[H_2SO_4] = ½ [H^+] = 0,05 \text{ mol·dm}^{-3}$✓

$n_a = c_aV$

$= (0,05)(0,012)$ ✓

$= 6x10^{-4}$ mol

$n(H_2SO_4) : n(NaHCO_3) = 1:2$

$n(NaHCO_3) = (2)(6x10^{-4})$ ✓

$= 12 x10^{-4}$ mol

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

$c = \frac{12x10^{-4}}{0,02}$ ✓

$= 0,06 \text{ mol·dm}^{-3}$✓

OPTION 2/OPSIE 2

$pH = -\log [H^+]$ ✓

$1 = -\log [H^+]$ ✓

$[H^+] = 0,1 \text{ mol·dm}^{-3}$

$[H_2SO_4] = ½ [H^+] = 0,05 \text{ mol·dm}^{-3}$✓

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

✓ $\frac{1}{2} = \frac{(0,05)(12)}{(c_b)(20)}$ ✓

$c_b = 0,06 \text{ mol·dm}^{-3}$✓

(7)

8.4 **POSITIVE MARKING FROM QUESTION 8.3/POSITIEWE NASIEN VAN VRAAG 8.3**

$c = \frac{m}{MV}$ ✓

$0,06 = \frac{m}{(84)(0,25)}$ ✓

m = 1,26 g✓ (3)

8.5 methyl orange/*metieloranje*✓
Here the pH of the salt produced will be below 7. ✓/*Die pH van die gevormde sout is kleiner as 7*

ACCEPT/AANVAAR
Weak base react with strong acid/*Swak basis reageer met 'n sterk suur* (2)
[15]

QUESTION 9/VRAAG 9

9.1.1 Salt bridge/*soutbrug* ✓ (1)

9.1.2 concentration of electrolytes/*konsentrasie van elektroliete* = 1 mol·dm^{-3}✓
Standard temperature/*standaardtemperatuur* = 25^{o} C/298 K ✓ (2)

9.1.3 Zn – sink ✓ (1)

9.1.4 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓
0,4 ✓ = $E^{\theta}_{cathode}$ –(-0,76) ✓
$E^{\theta}_{cathode}$ = - 0,27 V✓
X = Ni ✓ (5)

9.1.5 $Zn + Ni^{2+}$ ✓ → $Zn^{2+} + Ni$ ✓ (bal✓) (3)

9.1.6 INCREASES✓/*VERMEERDER* (1)

9.1.7 0 (V) ✓ (1)

9.2.1 Electrical to chemical✓
Elektries na chemies (1)

9.2.2 ANY ONE✓
Copper sulphate/*Kopersulfaat*/$CuSO_4$
Copper nitrate/*Kopernitaraat*/$Cu(NO_3)_2$
Copper chloride/*Koperchloried*/($CuC\ell_2$)
ACCEPT/A*ANVAAR*
Cu^{2+} (aq)/Cu^{2+} solution/ *Cu^{2+}-oplossing* (1)

9.2.3 Cu^{2+} (aq) + $2e^{-}$ → Cu (s) ✓✓ (2)
[18]

QUESTION 10/VRAAG 10

10.1 fractional distillation of (liquid) air✓/*fraksionele distillasie van vloeibare lug* (1)

10.2 $3H_2 + N_2$✓ → $2NH_3$ ✓ (balancing/balansering ✓) (3)

10.3

10.3.1 Ostwald process/proses ✓ (1)

10.3.1 ammonium sulphate/ammoniumsulfaat ✓ (1)

10.5 $2SO_2 + O_2$ ✓ → $2SO_3$ ✓ (balancing/balansering ✓) (3)

10.5 NH_4NO_3 ✓ (1)

10.6 ✓$15 = (\frac{5}{x})(30$✓

$x = 10$ ✓

$10 = 5+2+ K$

Thus/Dus K = 3✓ (4)

10.7 Eutrification is caused by fertilizer that promotes growth of algae in water,✓ which lead to decreasing oxygen levels and the death of water organisms✓
Eutrifikasie word veroorsaak deur kunsmis in water wat alge laat groei en dit lei tot 'n suurstoftekort in die water wat die dood van waterorganismes veroorsaak. (2)

[16]

TOTAL/TOTAAL: 150