DEPARTMENT OF EDUCATION

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# PROVINCIAL COMMON PAPER

## GRADE 12

## PHYSICAL SCIENCES: CHEMISTRY (P2)

## MEMORANDUM

## SEPTEMBER: 2022

**MARKS: 150**

**TIME: 3 hours**

**This memorandum consists of 11 pages**

## QUESTION 1 /*VRAAG 1*

1.1 B✓✓ (2)

1.2 C✓✓ (2)

1.3 D✓✓ (2)

1.4 D✓✓ (2)

1.5 A✓✓ (2)

1.6 C✓✓ (2)

1.7 B✓✓ (2)

1.8 C✓✓ (2)

1.9 A✓✓ (2)

1.10 B✓✓ REMOVE (2)

**[20]**

## QUESTION 2 / VRAAG 2

2.1

2.1.1 D ✓ (1)

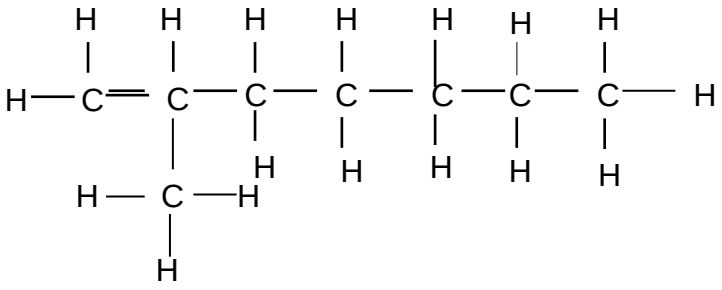
2.1.2 C or G ✓ (1)

2.1.3 B ✓ REMOVE (1)

2.2

2.2.1 1-Bromo butane / 1-broombutaan✓ (1)

2.2.2

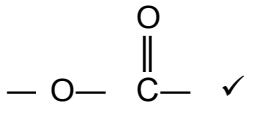


**Marking guidelines/ Nasienriglyne**
Functional group correct ✓
Whole structure correct✓ (3)

2.2.3 Ethyl propanoate / *etiel* ✓ *propanoaat* ✓ (2)

2.2.4 $C_2H_4$ ✓ (1)

2.2.5



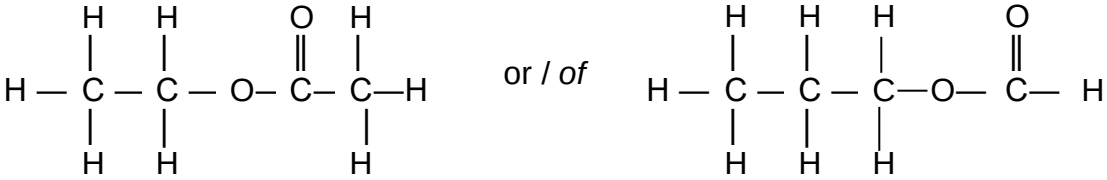
(1)

2.3 Secondary ✓/ *sekondêr*
The carbon to which the hydroxyl group is attached are also attached to two other carbon atoms✓/*Die koolstof waaraan die hidroksielgroep verbind is, is aan twee ander koolstof atome verbind* (2)

2.4

2.4.1 Compounds with the same molecular formula but different functional groups / *Verbindings met dieselfde molekulere formule maar verskillende funksionele groepe*✓✓ (2)

2.4.2



**Marking guidelines/ Nasienriglyne**
Functional group correct ✓
Whole structure correct✓ (2)

2.5 $H_2O$ ✓ / water ✓ (1)

**[18]**

## QUESTION 3 / VRAAG 3

3.1 The amount/ number of carbon atoms/ length of chain ✓ / *die hoeveelheid/ aantal koolstof atome/ lengte van ketting* (1)

3.2 As the length of the carbon chain increases, the boiling point increases. / An increase in the chain length of the alcohols/ number of carbon atoms causes an increase in the boiling point. ✓✓
Soos die lengte van die koolstofketting toeneem, neem die kookpunt toe./
Soos die kettinglengte van die alkohole toeneem, so neem die kookpunte ook toe
**Criteria for conclusion:**
Dependent and independent variables correctly identified.
Relationship between the independent and dependent variables correctly state (2)

3.3 **FROM methanol to 1-pentanol**
As chain length/surface area/number of carbon atoms increases, ✓ the strength of Van der Waals force/ London forces/ Intermolecular forces increases.✓Hence the boiling point increases.
**VANAF metanol tot 1-pentanol**
As die kettinglengte/ oppervlak area/ aantal koolstof atome toeneem sal die sterkte van die Van Der Waals kragte/ Londonkragte/ Intermolekulere kragte toeneem. Daarom verhoog die kookpunt. (2)

3.4 ***Marking Guidelines/ Nasien Riglyne***

- Name intermolecular forces – London and hydrogen bonds/
  *Name van intermolekulêre kragte – London of waterstofbindings*
- Compare strengths of IMF
  *Vergelyk sterkte van IMK*
- Compare energy needed to overcome IMF (NB! Not to break BONDS)
  *Vergelyk energie nodig om IMK te oorkom (NB! Nie bindings te breek nie)*

- **Structure/*Struktuur*:**
  The alcohols has a hydroxyl group attached to the carbon chain compared to the alcanes which is only a straight carbon chain✓
  *Alkohole bevat 'n hidroksielgroep aan hul koolstofketting terwyl die alkane net bestaan uit reguit ketting koolstofatome.*

- **Intermolecular forces/*Intermolekulêre kragte:***
  Between the alkane molecules are weak London forces but the alcohols have strong hydrogen bonds and weak London forces ✓
  *Tussen die molekules van die alkane is swak Londonkragte terwyl alkohole sterk waterstofbindings asook swak Londonkragte bevat.*

- **Energy/*Energie:***
  More energy is needed to overcome or break intermolecular forces/ hydrogen bond in alcohols. ✓
  *Meer energie is nodig om die intermolekulêre kragte/waterstofbinding te breek in alkohole* (3)

3.5

- **Structure/*Struktuur*:**
  The isomer of butane contains a methyl side chain that leads to a spherical structure which decreases the contact surface of the molecule while butane has a straght chain.✓
  *Die isomeer van butaan het 'n metiel vertakking wat aanleiding gee tot 'n sferiese struktuur wat die kontak oppervlakte van die molekule verminder, terwyl butaan net 'n reguit onvertakte ketting is.*

- **Intermolecular forces/*Intermolekulêre kragte:***
  Because of the decreased contact surface in the isomer of butane✓ the London forces is weaker than in butane with a greater contact surface ✓
  *As gevolg van die kleiner kontak oppervlakte in butaan se isomeer is die Londonkragte swakker as in butaan met 'n groter kontak oppervlakte.* (3)

3.6 $C_5H_{12}$ + $8O_2$ ✓ → $6H_2O$ + $5CO_2$ ✓ (bal✓) (3)

**[14]**

**QUESTION 4 / VRAAG 4**

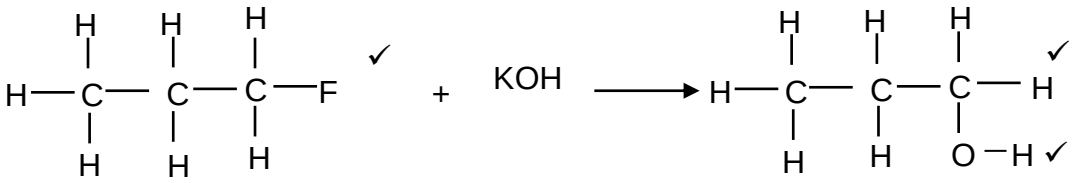
4.1

4.1.1 SUBSTITUTION ✓ / *SUBSTITUSIE* (1)

4.1.2 Propane / *propaan* ✓ (1)

4.2

4.2.1




+ KF ✓ (4)

4.2.2 (moderate) heat / (matige) hitte ✓ (1)

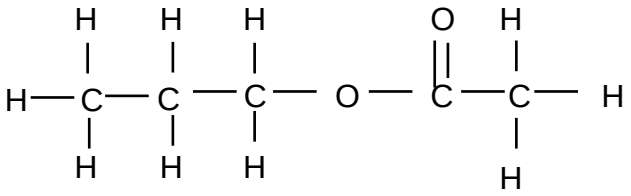
4.2.3 1- propanol✓/ *1- propanol* (1)

4.3

4.3.1 $H_2SO_4$✓ (1)

4.3.2 ethanoic acid / etan*öesuur* ✓ (1)

4.3.3



**Marking guidelines/ Nasienriglyne**
Functional group correct ✓
Whole structure correct✓

(2)

(1)

4.3.4 Esterification or dehydration / *esterifikasie of dehidrasie* ✓

4.4 **Step 1:**

$$CH_3CH_2CH_2CH_2OH\checkmark + H_2SO_4 \checkmark \xrightarrow{\text{Heat } \checkmark} CH_3CH_2CHCH_2 + H_2O\checkmark$$

**Step 2:**

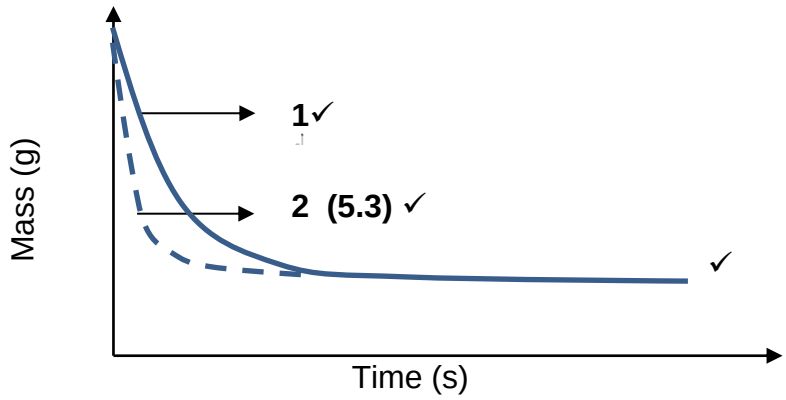
$$CH_3CH_2CHCH_2 + H_2 \checkmark \xrightarrow{\text{Pd (kat) } \checkmark} CH_3CH_2CH_2CH_3 \checkmark$$

(7)
**[20]**

**QUESTION 5 / VRAAG 5**

5.1 The tempo decreace over time because the reactants decrease✓/ Die tempo neem af met tyd omdat die reaktante verminder (1)

5.2




(2)

5.3 Graph ✓ (1)

5.4 Reaction rate / reaksietempo✓ (2)

5.5

- Larger surface area/state of division. ✓
  *Groter reaksieoppervlak/toestand van verdeeldheid* (3)

- More particles (per volume) with correct orientation/*Meer deeltjies (per volume) met korrekte oriëntasie*. ✓

**OR/*OF***

More contact points./*Meer kontakpunte.*

- More effective collisions per (unit) time./Frequency of effective collisions increases./More particles collide with sufficient kinetic energy & correct orientation per (unit) time.✓✓

*Meer effektiewe botsings per (eenheids)tyd./Frekwensie van effektiewe botsings verhoog./Meer deeltjies bots met genoeg kinetiese energie & korrekte oriëntasie per tyd(seenheid).*

5.6 Catalist added / MgO is a catalyst / There is now an alternative path with lower activation energy ✓
*Katalisator is bygevoeg / MgO is 'n katalisator / Daar is nou 'n alternatiewe pad met 'n laer aktiveringserergie*. REMOVE
(1)

5.7

**OPTION 1/*OPSIE 1***

$n = V/Vm$ ✓

$nH_2 = \frac{0,26}{24,06}$ ✓

$= 0,01$ mol

$n(H_2) = n(Mg) = 0,01$ mol ✓

$m(Mg) = nM$
$= (0,01)(24)$ ✓
$= 0,26$ g ✓

$\triangle m(Mg) = 1.2 - 0,26$✓

$= 0,94$ g ✓

(7)

**[17]**

## QUESTION 6 / VRAAG 6

6.1 In a dynamic equilibrium, the rate of the forward reaction equals the rate of the reverse reaction✓✓/ *Die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaartse reaksie*.
**Or / of**
Concentration of products and reactants remain constant / *Konsentrasie van produkte en reaktante bly konstant.*

(2)

**NOTE**: -1 mark for each key word/phrase omitted in the correct context
***LET WEL:*** *-1 punt vir elke sleutelwoord/frase in korrekte konteks weggelaat.*

6.2 All the compounds is in a gaseous phase/same phase✓ / Al die verbindings is in `n gasfase/dieselfde fase (1)

6.3 **Marking guidelines / *Nasienriglyne*:**

- Substitution of 0,5 moles $O_2$ at equilibrium ✓
- Change in n($O_{2:}$) Final n($O_2$)– initial n($O_2$) ✓
- Using ratio ✓/ Gebruik van verhouding
- n($SO_3$) at equilibrium = initial n($SO_3$) - used n($SO_3$)
- n($SO_2$) at equilibrium = initial n($SO_2$) + formed n(SO2) ✓
- Division of equilibrium moles by 0,5 to get equilibrium concentration✓
- Correct $K_c$ expression*) ✓/ Korrekte Kc uitdrukking*
- Substitution of 9 ✓/ *Substitusie van 9*
- Substitution of concentrations into $K_c$ expression✓
- Final answer/*finale antwoord* : 3✓

**Option 1 / *Opsie 1***

| | $2SO_3$ (g) | $2SO_2$(g) | $O_2$(g) |
|---|---|---|---|
| | 2 moles/mol | 2moles/mol | 1moles/mol |
| Initial amount (moles)<br>Aanvangshoeveelheid (mol) | X | 2 | 1,5 |
| Amount Reacted (moles/mol)<br>Hoeveelheid gereageer | 1 | | Ratio ✓ |
| Amount Formed (moles)<br>Hoeveelheid gevorm (mol) | ----- | 1 ✓ | 0,5 |
| Equilibrium amount (moles)<br>Ewewighoeveelheid (mol) | X-1 | 3 ✓ | 2 ✓ |
| Equilibrium concentration<br>$(\frac{n}{V})$ mol.dm$^{-3}$ | $\frac{x-1}{0,5}$ | $\frac{3}{0,5}$ = 6 | 4 ✓ |

| | | | |
|---|---|---|---|
| *Ewewig konsentrasie* | | | |

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

9✓ = $6^2 x 4 / (x+1 / 0,5)^2$ ✓

3x + 3 = 12 x 0,5

x = 1 mol✓ `

(9)

**Option 2/*Opsie 2:***

Ratio $n(SO_3) : n(SO_2) : n(O_2) = 2 : 2 : 1$ ✓
Change in $n(SO_2)$ & $n(O_2)$ ✓
$n(O_2)$ at equilibrium = 1,5 + 0,5 = 2 mol ✓
$n(SO_2)$ at equilibrium = 2 + 1 = 3 mol ✓

$c(SO_2) = \frac{n}{V} = \frac{3}{0,5} = 6 \text{ mol·dm}^{-3}$
$c(O_2) = \frac{n}{V} = \frac{2}{0,5} = 4 \text{ mol·dm}^{-3}$
$c(SO_3) = \frac{n}{V} = \frac{X+1}{0,5} \text{ mol·dm}^{-3}$ ✓

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

$$9 = \frac{[6]^2[4]}{[x+1/0,5]^2}$$ ✓ ✓

3x + 3 = 12 x 0,5

x = 1 mol ✓ (9)

6.4 High / hoog✓ Kc value is big / *Kc waarde is groot*✓ (2)

6.5 Decrease / af*neem*✓Increase in pressure favours the reaction that leads to a decrease in volume ✓/ less moles of gas in this case the reverse reaction✓/ *toename in druk bevoordeel die reaksie wat lei tot 'n afname in volume / minder mol gas, in die geval die terugwaartse reaksie.*

(3)
**[17]**

**QUESTION 7 / VRAAG 7**

7.1 An acid is a proton donor / 'n Suur is 'n protondonor ✓✓ (2)

7.2 Strong base✓/ *Sterk basis,* dissociates completely in water✓/ *dit dissosieer volledig in water* (2)

7.3 No/Nee ✓Ethanoic acid ionizes incompletely in water to form a low concentration of $H_3O^+$ and hydrochloric acid ionizes completely in water to form a high concentration of $H_3O^+$ ✓ (2)

7.4 $H_2O$ ✓ (1)

7.5

**OPTION 1/*OPSIE 1***

$K_w = [H_3O^+][OH^-]$

$\therefore 1 \times 10^{-14} = [H_3O^+](0,5)$ ✓

$\therefore [H_3O^+] = 2 \times 10^{-14}\ mol \cdot dm^{-3}$

$pH = - \log[H_3O^+]$ ✓

$= - \log (2 \times 10^{-14})$ ✓

$= 13,7$ ✓

**OPTION 2/*OPSIE 2***

$pOH = - \log[OH^-]$ ✓

$= - \log(0,5)$ ✓

$= 0,3$

$pH = 14 - pOH$ ✓

$= 14 - 0,3$

$= 13,7$

✓

(4)

7.6

$n(NaOH) = cV$ ✓

$= (0,5)(0,04)$ ✓

$= 0,02$ mol

$n(CH_3COOH) = n(NaOH) = 0,02$ mol ✓

$m(CH_3COOH) = nM$ ✓

$= (0,02)(60)$ ✓

$= 1,2$ g

% mass of / *massa van* $CH_3COOH = \frac{1,2}{20} \times 100 = 6\%$ ✓ (6)

7.7 pH › 7 ✓

A strong base react with a weak acid. ✓/ *'n sterk basis reageer met 'n swak suur*

(2)

**[19]**

## QUESTION 8 / VRAAG 8

8.1 Salt bridge / *soutbrug* ✓ it completes the citcuit / maintains electrical neutrality. (2)
*dit voltooi die stroombaan / handhaaf elektriese neutraliteit* ✓

8.2 . The voltmeter reading for this cell has a positive value ✓/ *Die voltmeterlesing vir die sel het 'n positiewe waarde .* (1)

8.3.1 $Zn / Zn^{2+}$ ✓// ✓ $Ag^{+} / Ag$✓ (3)

8.3.2 $Ag^{+} + e^{-} \rightarrow Ag$✓✓ (2)

8.3.3 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓
= 0,80 ✓ - (-0,76) ✓
= 1,56 V✓ (4)

8.3.4 $2Ag^{+} + Zn$ ✓ → $2Ag + Zn^{2+}$ ✓ (2)

8.3.5 The cell potential is zero ($E^{\ominus} = 0$) / Die selpotensiaal is nul. ✓ The cell can be activated by increasing the concentration of $Ag^{+}$ at the cathode (thus by increasing the reactants) / *Die sel kan geaktiveer word deur die konsentrasie van die* $Ag^{+}$ *by die katode te verhoog (dus 'n toename in reaktante).* ✓ (2)
**[16]**

## QUESTION 9 / VRAAG 9

9.1 Electrical ✓ to chemical✓/ *Elektries na Chemies* (2)

9.2 A ✓ (1)

9.3 Cathode✓ - Reduction of $Cu^{2+}$ -ions takes place✓ / Katode- Reduksie van $Cu^{2+}$ -ione vind plaas (2)

9.4 $Cu \rightarrow Cu^{2+} + 2e^{-}$ ✓✓ (2)

9.5 A → B / A to/na B✓ (1)

9.6 endothermic✓ / *endotermies* (1)

**[9]**

**GRAND TOTAL/ GROOTTOTAAL 150**