



Education

**KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA**

PHYSICAL SCIENCES P2 (CHEMISTRY)

PREPARATORY EXAMINATION

MEMORANDUM

SEPTEMBER 2017

**NATIONAL SENIOR
CERTIFICATE**

GRADE 12

TIME: 3 hours

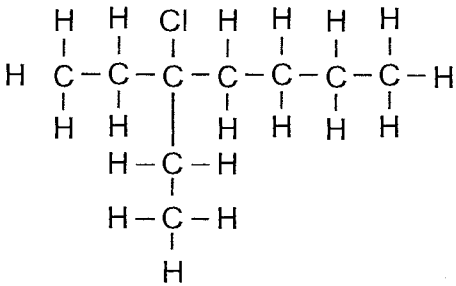
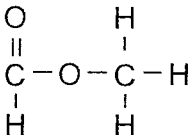
MARKS: 150

This memorandum consists of 9 pages.

QUESTION 1: MULTIPLE CHOICE

- 1.1 D ✓✓ (2)
 1.2 B ✓✓ (2)
 1.3 A ✓✓ OR C (2)
 1.4 D ✓✓ (2)
 1.5 C ✓✓ (2)
 1.6 B ✓✓ (2)
 1.7 A ✓✓ (2)
 1.8 D ✓✓ (2)
 1.9 A ✓✓ (2)
 1.10 C ✓✓ (2)
[20]

QUESTION 2

- 2.1 2-bromo-5-chloro-2,5-dimethylheptane ✓ (2)
 2.2 C_nH_{2n} ✓ (1)
 2.3  (3)
 ✓ correct structural formula
 ✓ Cl in correct position
 ✓ ethyl group in correct position
 2.4 Triple bond ✓ / Accept Alkynes (1)
 2.5  ✓✓ (2)
 Accept any correct formula except the molecular
 2.6 Ketones ✓ (1)
[10]

QUESTION 3

3.1 C ✓ OR Ethanoic acid (1)

3.2 Ethanoic acid has the strongest intermolecular forces ✓
More energy is required to overcome the intermolecular forces ✓
least amount will evaporate ✓ (3)

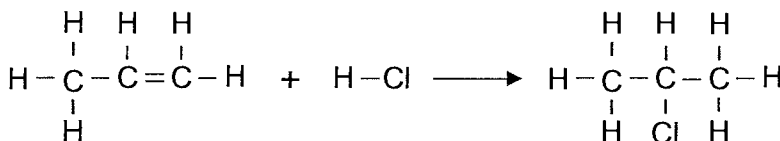
3.3 B ✓ (1)

3.4 Ethanal has the weakest intermolecular forces ✓ (3)
Least energy is required to overcome the intermolecular forces ✓
Ethanal has the lowest boiling point and therefore the highest vapour pressure ✓**[8]****QUESTION 4**4.1 $\text{H}_2\text{SO}_4 / \text{H}_3\text{PO}_4 / \text{Heat}$ ✓ (1)

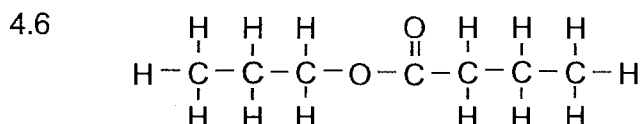
4.2 Pt / Pd / Ni ✓ (1)

4.3 $\text{C}_3\text{H}_8 + 5\text{O}_2 \longrightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$ (3)If any structural formulae used $\frac{2}{3}$ ✓ reactants/left hand side
✓ products/right hand side
✓ balancing

4.4 (3)

If condensed formulae used $\frac{2}{3}$ ✓ reactants/left hand side
✓ products/right hand side
✓ structural formulae

4.5 Sulphuric acid ✓ (1)

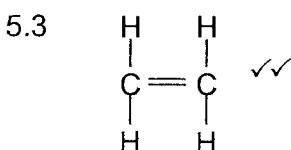
✓ correct functional group
✓ whole structure correct (2)

4.7. Propyl butanoate ✓✓ Any correct name given for 4.6 (2)

[13]**QUESTION 5**

5.1 A molecule that consists of a large number of atoms. ✓✓ (2)

5.2 Polymerisation ✓ (1)

**[5]**

QUESTION 6

6.1 How does the rate of a reaction change with time? ✓✓ (2)

Any given investigative question

6.2 Time ✓ Mark based on given investigative question. (1)

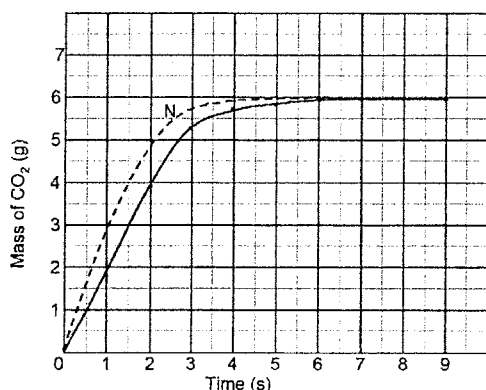
6.3 (2)

Time (s)	0	1	2	3	4	5	6	7	8	9
Mass of flask and its contents (g)	178	176,2	174,1	172,7	172,3	172,2	172,1	172,1	172,1	172,1
Mass of CO ₂ (g) produced (g)	0	1,8	3,9	5,3	5,7	5,8	5,9	5,9	5,9	5,9

✓✓

6.4

Graph of mass of CO₂ produced vs time



- ✓ Correct shape
- ✓✓ plotting of all points
- ✓ Appropriate scale and labels on both axes
- ✓ Correct heading

But plotting 5 or less points subtract one mark.

(5)

6.5 The reaction has reached completion. ✓ (1)

OR

One of the reactants is finished. ✓

6.6

$$\begin{aligned}n &= \frac{m}{M} \checkmark \\&= \frac{5,9}{44} \checkmark \\&= 0,13 \text{ mol}\end{aligned}$$

1 mol occupies 24,46 dm³

0,13 mol will occupy 3,18 dm³ ✓

Accept range 3.18 – 3.28

(3)

6.7 Graph N has a steeper gradient ✓ and finishes at the same point as the original graph ✓ (2)

6.8 Higher temperature, molecules have greater kinetic energy ✓ (3)

More effective collisions per unit time ✓

Reaction rate increases ✓

[19]

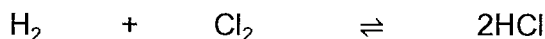
QUESTION 7

7.1

CALCULATIONS USING NUMBER OF MOLES**BEREKENINGE WAT GETAL MOL GEBRUIK****Mark allocation/Puntetoekenning:**

- Calculating number of moles of H_2 , Cl_2 and HCl . ✓
- Molar ratio. ✓
- Number of moles at Equilibrium. ✓
- Dividing by 0,5 to get the concentration. ✓
- K_c expression. ✓
- Substitution in the K_c expression ✓
- Calculating concentration of Cl_2 ✓
- Substitution in $n = cV$. ✓
- Substitution in $m = nM$ ✓
- Final answer ✓

7.1



(10)

Initial mass	10g	355g	0g
Initial n	5	5	0
React/Prod	x	x	2x
n at equilibrium	5 - x	5 - x	2x
Conc. at equilibrium	$\frac{5-x}{0,5}$	$\frac{5-x}{0,5}$	$\frac{2x}{0,5}$

✓ Calc no. of

✓ mol

✓ Ratio

✓

✓ dividing by 0,5

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \quad \checkmark$$

$$\checkmark 60 = \frac{\left(\frac{2x}{0,5}\right)^2}{\left(\frac{5-x}{0,5}\right)\left(\frac{5-x}{0,5}\right)} \quad \checkmark$$

$$x = 3,97$$

$$\text{Conc. } Cl_2 \text{ at equilibrium} = \frac{5-3,97}{0,5} \checkmark$$

$$n = C \cdot V$$

$$= \frac{5-3,97}{0,5} \cdot 0,5$$

$$= 1,03 \text{ mol}$$

$$m = n \cdot M$$

$$= 1,03 \cdot 71 \checkmark$$

$$= 73,13 \text{ g} \checkmark$$

No K_c expression, correct substitution max $\frac{9}{10}$

Wrong KC expression max $\frac{4}{10}$

7.2 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. ✓✓ (2)

7.3

7.3.1 Decrease ✓ (1)

7.3.2 Increase ✓ (1)

7.4 The temperature of the system was increased, according to Le Chatelier's principle, the system reacts by favouring the endothermic reaction. ✓ Hence, the reverse reaction is favoured. ✓ (2)
[16]

QUESTION 8

8.1 8.1.1 Strong acid ✓ (1)

8.1.2 (5)

Vol. of conc. HCl required

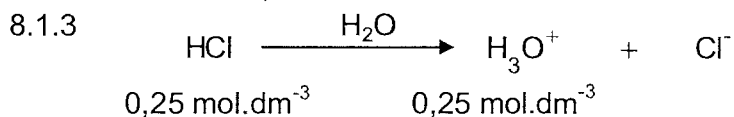
$$\begin{aligned} n &= CV \quad \checkmark \\ &= 0,25 \times 0,5 \quad \checkmark \\ &= 0,0125 \quad \checkmark \end{aligned} \quad \text{OR}$$

$$\begin{aligned} c_1 V_1 &= c_2 V_2 \quad \checkmark \\ (10)(x) &= (0,25)(0,5) \quad \checkmark \\ x &= 0,0125 \text{ dm}^3 \\ &= 12,5 \text{ cm}^3 \quad \checkmark \end{aligned}$$

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

$$10 = \frac{0,0125}{V}$$

$$\begin{aligned} V &= 0,0125 \text{ dm}^3 \\ &= 12,5 \text{ cm}^3 \end{aligned}$$



$$\begin{aligned} \text{pH} &= -\log [\text{H}_3\text{O}^+] \quad \checkmark \\ &= -\log (0,25) \quad \checkmark \\ &= 0,60 \quad \checkmark \end{aligned}$$

(3)

8.2 8.2.1 **Option 1**

$$n(\text{HCl}) = cV = (0,25)(0,5) \checkmark \\ = 0,125 \text{ mol}$$

$$n(\text{NaOH}) = cV = (0,2)(0,14) \checkmark \\ = 0,028 \text{ mol}$$

$$n(\text{HCl}) \text{ reacted with } (\text{NaOH}) = 0,028 \text{ mol} \checkmark \\ n(\text{HCl}) \text{ reacted with } (\text{CaCO}_3) = 0,125 - 0,028 \checkmark \\ = 0,097 \text{ mol}$$

$$n(\text{CaCO}_3) = \frac{1}{2} \times 0,097 \checkmark \\ = 0,0485 \text{ mol}$$

$$\text{mass of CaCO}_3 = nM \\ = 0,0485 \times 100 \checkmark \\ = 4,85 \text{ g} \checkmark$$

Option 2

Volume of HCl reacted with NaOH

$$\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b} \\ \frac{(0,25)V_a}{(0,2)(140)} = \frac{1}{1} \checkmark \\ V_a = 112 \text{ cm}^3$$

Volume of HCl reacted with CaCO_3

$$V_{\text{HCl}} = 500 - 112 \checkmark \\ = 388 \text{ cm}^3 \\ = 0,388 \text{ dm}^3$$

No. of mol of HCl reacted with CaCO_3

$$C = \frac{n}{V} \\ 0,25 = \frac{n}{0,388} \\ n = 0,097 \text{ mol}$$

No. of mol of CaCO_3 reacted with HCl

$$n_{\text{HCl}} : n_{\text{CaCO}_3} = 2 : 1 \\ n_{\text{CaCO}_3} = \frac{0,097}{2} \checkmark \\ = 0,0485 \text{ mol}$$

Mass of mol of CaCO_3 reacted with HCl

$$m = n \cdot M \\ = 0,0485 \cdot 100 \checkmark \\ = 4,85 \text{ g} \checkmark$$

(8)

8.2.2 (3)

$$\begin{aligned}\% \text{ purity} &= \frac{\text{mass of CaCO}_3}{\text{mass of sample}} \cdot 100 \\ &= \frac{4,85}{5} \cdot 100 \quad \checkmark \checkmark \\ &= 97\% \quad \checkmark\end{aligned}$$

[20]**QUESTION 9**

- 9.1 9.1.1 cathode ✓ (1)
- 9.1.2 P to silver medal ✓ (1)
- 9.1.3 Electrode P is made of silver. Rate of oxidation is equal to the rate of reduction. ✓✓ (2)
- 9.1.4 Ag ✓ (1)
- 9.2 9.2.1 Temp = 25 °C ✓ (2)
- Concentration of the electrolyte solution = 1 mol.dm⁻³ ✓ (2)
- 9.2.2 Chemical energy to electrical energy ✓ (1)
- 9.2.3 Maintain electrical neutrality between the two half cells ✓ (2)
- Completes the circuit ✓
- 9.2.4 $E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta}$ ✓
- $2,70 = 0,34 - E_{\text{anode}}^{\theta}$
- $E_{\text{anode}}^{\theta} = -2,36 \text{ V}$ ✓
- The anode must be magnesium ✓ (5)
- 9.2.5 $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^{-}$ ✓✓ (2)
- 9.2.6 $\text{Mg}/\text{Mg}^{2+} // \text{Cu}^{2+}/\text{Cu}$ OR $\text{Y}/\text{Y}^{2+} // \text{Cu}^{2+}/\text{Cu}$ (3)
- 9.2.7 Remain the same ✓ (1)
- 9.2.8 Ag⁺ will form a precipitate with the Cl⁻. This decreases the concentration of the Cl⁻ in solution, but not the concentration of Cu²⁺ ✓✓ (3)
- The reading on the voltmeter can only be affected by a change of concentrations of either Cu²⁺ or Mg²⁺/Y²⁺. ✓ (3)
- [24]**

QUESTION 10

- 10.1 10.1.1 Haber process ✓ (1)
- 10.1.2 Fractional distillation of air ✓ (1)
- 10.1.3 Ostwald process ✓ (1)
- 10.1.4 Platinum ✓ (1)
- 10.1.5 H₂O ✓ OR (H₂O + O₂) (1)

NSC - Grade 12

10.1.6 Enables plants to grow better and faster ✓ (2)

Increases food production ✓

10.1.7 Ammonium nitrate ✓ (1)

10.2 10.2.1 The ratio of N:P:K or primary nutrients in the bag ✓

Amount of fertilizer in the bag ✓ (2)

10.2.2 $\% \text{N} = \frac{22}{50} \times 22 = 9,68\% \checkmark$

$\% \text{P} = \frac{10}{50} \times 22 = 4,40\% \checkmark$

$\% \text{N} = \frac{18}{50} \times 22 = 7,92\% \checkmark$ (3)

OR

22% ✓✓✓

10.2.3 Potassium✓

Shortage of potassium causes poor quality flowers and fruit (colour and taste) and make leaves have brown or yellow edges. ✓ (2)

[15]

TOTAL MARKS: [150]