LIMPOPO

PROVINCIAL GOVERNMENT

REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF

EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES

PAPER 2 (CHEMISTRY)

MARKING GUIDELINES

SEPTEMBER 2023

MARKS: 150

This marking guideline consists of 9 pages including THE COVER PAGE

QUESTION 1

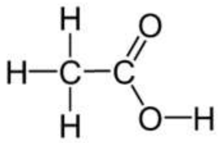
1.1	D ✓✓	(2)
1.2	C ✓✓	(2)
1.3	B ✓✓	(2)
1.4	C ✓✓	(2)
1.5	A ✓✓	(2)
1.6	C ✓✓	(2)
1.7	B ✓✓	(2)
1.8	D ✓✓	(2)
1.9	C ✓✓	(2)
1.10	A ✓✓	(2)

[20]

QUESTION 2

2.1 A series of organic compounds that can be described by the same general formula ***OR*** in which one member differs from the next with a CH_2 group. ✓✓ (2)

2.2.1



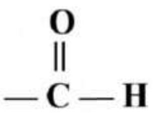
Functional group	✓
Whole structure correct.	✓

(2)

2.2.2 1,1-dimethyl✓propan✓-1-ol✓ / 1,1-dimethyl-1-propanol (3)

2.2.3 ketone ✓ (1)

2.2.4



✓ (1)

2.3.1 C_nH_{2n+2} ✓ (1)

2.3.2 $\underline{2C_4H_{10} + 13O_2}$ ✓→ $\underline{8CO_2 + 10H_2O}$ ✓ bal. ✓ (3)

2.4.1 C ✓ (1)

2.4.2 ethyl✓ethanoate ✓ (2)

[16]

QUESTION 3

3.1 The pressure exerted by a vapor at equilibrium with its liquid in a closed system. ✓✓ (2)

3.2 A ✓ (1)

3.3.1 SATURATED ✓ (1)

3.3.2 Only single bonds between C- atoms.✓ (1)

3.3.3 London forces ✓ / dispersion forces / induced dipole forces (1)

3.4.1 Compounds with the same molecular formula, ✓ but different structural formulae. ✓ (2)

3.4.2

- 2-methylbutane is a spherical molecule that offers a smaller surface area to other molecules.✓// Pentane is a linear molecule which offers a larger surface area to other molecules.
- Less/smaller surface area where intermolecular forces (London forces) can interact with other molecules.✓// Greater/larger surface area where intermolecular forces (London forces) can interact with other molecules.
- Less energy required to overcome the intermolecular forces.✓// More energy required to overcome the intermolecular forces. (3)

3.5

- pentan-1-ol (D): H-bonds are stronger✓ than the weaker London forces ✓in (B), alkanes.
- Therefore, more energy is required to ✓overcome the stronger intermolecular forces in (D).
- Consequently (D) has a higher boiling point. ✓ (4)

OR

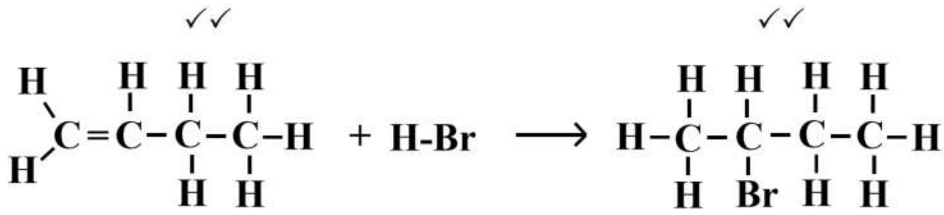
- Pentane (B): London forces are weaker in alkanes than the stronger H-bonds in alcohols in (D).
- Less energy is required to overcome the forces of attraction in (B).

Consequently (B) has a lower boiling point.

[15]

QUESTION 4

4.1

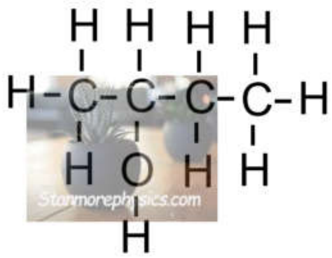


(4)

4.2 addition / hydrohalogenation ✓ (1)

4.3 butan-2-ol ✓/ 2-butanol

Hydroxyl group on the 2nd carbon.	✓
Whole structure correct.	✓



(3)

4.4 hydrolysis ✓ (1)

4.5.1 Water ✓ (1)

4.5.2 H_2SO_4 ✓/ HCl / H_3PO_4 (1)

4.5.3 hydration ✓ (accept addition) (1)

4.6.1 but-2-een / 2-buteen ✓ (1)

4.6.2 dehydrohalogenation ✓ / elimination (1)

[14]

QUESTION 5

5.1.1 Sufficient kinetic energy (molecules move fast enough) during the collisions. ✓
Molecules must be correctly orientated. ✓

(2)

5.1.2 Increased temperature:

More molecules move fast enough or have sufficient E_k. ✓
There are more effective collisions per unit time ✓ / Ek ≥ activation energy.
(2)

5.2.1 Activation energy ✓ (1)

5.2.2 (a) Increase in the concentration of one or both reactants. ✓ (1)
(b) Increase in temperature. ✓ (1)

5.3.1 How will a change in concentration affect the reaction rate?

OF

What is the relationship between the concentration and reaction rate?

- Identify dependent and independent variable.✓ ✓
- Ask a question (?) about the relationship between dependent and independent variable. ✓

(3)

5.3.2 HNO_3 ✓/ Nitric acid
The magnesium is used up. / Magnesium is the limited reagent. ✓
(2)

5.3.3

<table>
<tr><td>Opsie 1
Δn = 1,0 – 0,8 ✓= 0,2 mol

$n = \frac{m}{M}$
$0,2 = \frac{m}{24}$ ✓
$\therefore m = 4,8\ g$

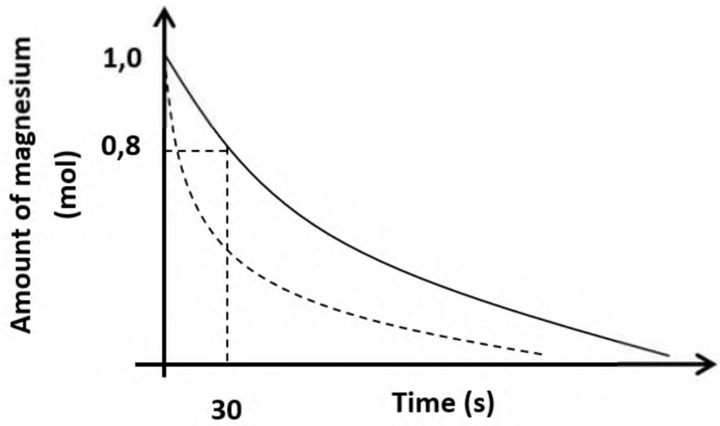
Gem. reaksietempo $= \frac{\Delta m}{\Delta t}$
$= \frac{4,8✓}{30-0✓}$
$= 0,16\ g.s^{-1}$ ✓</td><td>Opsie 2
$n = \frac{m}{M}$ $n = \frac{m}{M}$
$1 = \frac{m}{24}$ ✓ $0,8 = \frac{m}{24}$ ✓
$\therefore m = 24\ g$ $\therefore m = 19,2\ g$

Gem. reaksietempo $= \frac{\Delta m}{\Delta t}$
$= \frac{19,2 - 24✓}{30 - 0✓}$
$= 0,16\ g.s^{-1}$ ✓</td></tr>
</table>

(5)

5.3.4

- Steeper slope below original graph.✓
- Intercept x-axis earlier. ✓



(2)
[19]

QUESTION 6

6.1.1 Increases ✓ (1)

6.1.2 Forward ✓ (1)

6.1.3 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. ✓✓ (2)

6.1.4 Increase in temperature increases K_C. ✓
Increase in K_C indicates that the forward reaction has been favoured. ✓
Increase in temperature favours the endothermic reaction. ✓
Therefore, the forward reaction is endothermic. ✓ (4)

6.1.5 Add a catalyst. ✓ Decrease pressure OR
Increase the volume of the container. ✓ (2)

6.2

	$2SO_2$	O_2	$2SO_3$
Initial mol	8	y	0
Mol reacted	-2x	-x	+2x ✓
Mol at eq	2	y-3 ✓	6
[ ] at eq	1	$\frac{y-3}{2}$	3 ✓ (÷2)

$K_c = \frac{[SO_3]^2}{[SO_2]^2\,[O_2]}$ ✓ correct Kc expression

$9 = \frac{(3)^2}{(1)^2\frac{(y-3)}{2}}$ ✓ correct substitution

Y = 5mol ✓

(6)

[16]

QUESTION 7

7.1 A proton donor (H^+ ion donor).✓✓ (2)

7.2 WEAK ACIDS: ionizes incompletely in water to form only a few H_3O^+ ions.✓
DILUTED ACIDS: contains a large amount of water added to it.✓

(2)

7.3.1 EXOTHERMIC ✓ (1)

7.3.2 $pH = -\log[H_3O^+]$ ✓

$2,3$ ✓ $= -\log[H_3O^+]$

$\therefore [H_3O^+] = 10^{-2,3}$

$= 0,005 \text{ mol.dm}^{-3}$ ✓

(3)

7.3.3 n(HCl) initial = cV✓
= 0,25(0,5) ✓
= 0,125 mol✓

n(HCl) after addition = cV
= 0,005(1) ✓
= 0,005 mol✓

Reaction: $HCl + NaOH \rightarrow NaCl + H_2O$

Number of moles of HCl reacted with NaOH:
= 0,125 – 0,005 = 0,12 mol ✓

So 0.12 mol of NaOH reacted with 0.12 mol of HCl:

$$[NaOH]_{initial} = \frac{n}{V}$$

$$= \frac{0,12}{0,5} ✓$$

$$= 0,24\ mol.dm^{-3} ✓$$

(8)

[16]

QUESTION 8

8.1.1 Hydrogen✓ (1)

8.1.2 In terms of the reducing agent:

- Cu is a weaker reducing agent✓ than H_2✓ and will not reduce H^+ (to H_2). ✓ (3)

In terms of the oxidizing agent:

- H^+ is a weaker oxidising agent than Cu^{2+} and will not oxidise Cu (to Cu^{2+}).

(NOTE: Compare the two reducing agents in the two half reactions OR the two oxidizing agents in the two half reactions.)

OR

H^+ (H_2SO_4) is a weaker oxidizing agent than Cu (to Cu^{2+}).

(NOTE: No marks if referring to the relative positions on the table.)

8.1.3 $\overset{✓}{Zn} + 2H^+ \rightarrow \overset{✓✓}{Zn^{2+} + H_2}$ or $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ (3)

8.2.1 Mg | Mg^{2+} ✓ ||✓ Ag^+ | Ag ✓ (3)

8.2.2 25 °C ✓ / 298K and 1moldm^{-3} ✓ (2)

8.2.3 E^θcell = E^θcathode – E^θanode ✓

= $\overset{✓}{0,8}$ – $\overset{✓}{(-2.36)}$

= 3,16V✓ (4)

8.2.4 $I = \frac{P}{V} = \frac{6W}{3V} = 2\,A$,

The light bulb is manufactured to work effectively when connected to a 3 V source that can deliver a current of 2 A. This cell produces a large enough potential difference, but the current is probably too small ✓ due to a very large internal resistance. (1)

8.2.5 Anode: Mg is oxidized and therefore forms the anode.

The amount of $AgNO_3$ available determines how much of the anode (Mg) will go into solution.

1 mol Mg reacts with 2 mol Ag^+

n($AgNO_3$) = cV✓

= 1(0,4) ✓

= 0,4 mol

$\therefore n(Mg) = \frac{1}{2}\, n(Ag^+)$
$= \frac{1}{2}(0,4)$ ✓
$= 0,2$ mol

$\therefore$ maxmimum loss in mass = nM✓
$= 0,2(24)$ ✓
$= 4,8$ g Mg✓

(6)
[23]

QUESTION 9

9.1 NEGATIVE ✓

(1)

9.2 To improve electrical conductivity.✓ ✓

(2)

9.3 Decrease ✓
$Cu \rightarrow Cu^{2+} + 2e^-$ ✓✓

(3)

9.4 $n(Cu) = \frac{1}{2}(2)$ ✓ $Cu^{2+} + 2e^- \rightarrow Cu$
$= 1$ mol

$m(Cu) = nM$
$= 1(63,5)$ ✓
$= 63,5$ g

% purity = $\frac{m_{pure}}{m_{impure}} \times 100$

$= \frac{63,5✓}{95,7✓} \times 100$

$= 66,35\ g$✓

(5)
[11]

TOTAL: 150

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PAPER 2: THE PAPER SHOULD BE MARKED OUT OF 140.

QUESTION 1

1.6 Removed. - **2 marks**

QUESTION 2

2.2.2 2-methylbutan-2-ol

Marking criteria:

Correct stem : butan-2-ol ✓

Correct substituent : 2-methyl✓

IUPAC name correct including hyphens✓ (3)

QUESTION 3

3.3.2 No multiple bonds between C- atoms. ✓ (1)

QUESTION 4

4.6.1 **Correct spelling** is but-2-ene

QUESTION 5

5.3.1 Accept any of the following factors for the **independent variable:**

- Change the surface area of Mg.
- Add a catalyst.
- Change in the temperature for the reactants.

E.g How will a Change the surface area of Mg affect the reaction rate? ✓ ✓ (2)

5.3.2 Removed. **- 2 marks**

5.3.3 $Average\ rate = -\frac{\Delta m}{\Delta t}$ ✓

$$= -\frac{0{,}8 ✓ - 1{,}0 ✓}{30 - 0 ✓}$$

$$= 6{,}67 \times 10^{-3}\ g \cdot s^{-1} ✓$$ (5)

QUESTION 6

6.1.4 Endothermic. ✓

- Increase in temperature increases K_c ✓
- Increase in K_c indicates that the forward reaction is favoured ✓
- Increase in temperature favours the endothermic reaction ✓ (4)

6.1.5
- Decrease pressure ✓
- Decrease temperature✓ (2)

6.2 **Removed** **- 6 marks**

QUESTION 7

7.2 Weak acids ionize incompletely in water to form low concentration of H_3O^+ ✓

Dilute acids contain large amount of water. ✓ (2)

7.3.3 **POSITIVE MARKING FROM 7.3.2**

Marking criteria:

- Formula $n(HCl)_{initial} = cV$ ✓
- Substitution of c (HCl) initial = 0,25 and V= 0,5 ✓
- Substitutionof c (HCl) after addition = 0,005 and V= 1 ✓
- Calculation of n(HCl)reacted ✓
- Ratio NaOH : HCl ✓
- Substitution in the formula for [NaOH] ✓
- Final answer ✓

n(HCl) initial $= c V$ ✓

$= 0,25 (0,5)$ ✓

$= 0,125$ mol

n(HCl) after addition $= c V$

$= 0,005 (1)$ ✓

$= 0,005$ mol ✓

Number of moles of HCl reacted with NaOH :

$= 0,125 - 0,005 = 0,12$ mol ✓

Ratio: 0,12 mol HCl : 0,12 mol NaOH ✓

$[NaOH]_{\text{initial}} = \frac{n}{V}$

$= \frac{0,12}{0,5}$ ✓

$= 0,24$ $mol.dm^{-3}$ ✓ (8)

QUESTION 8

8.1.2 H_2 is a stronger reducing agent ✓ than Cu ✓ and Cu will not reduce H^+ (to H_2)

ACCEPT

Zn is a stronger reducing agent than Cu, ✓ therefore Zn will be oxidized.

Cu is a weak reducing agent, ✓ than Zn therefore will not undergo oxidation and will not produce gas. ✓

(3)

8.2.2 Temperature of 25℃ / 298K ✓

Concentration of $1 mol\cdot dm^{-3}$ ✓ (2)

8.2.4 **OR**

Voltage drop due to the internal resistance. ✓ (1)

8.2.5 **MARK ALLOCATION**

Remove 1 mark from

$n(AgNO_3) = cV$

allocate it in the ratio

QUESTION 9

9.4 n (Cu) $= {}^{1}/_{2}\,(2)$ ✓

$= 1$ mol

m (Cu) $= n\,M$

$= 1(63{,}5)$ ✓

$= 63{,}5$ g

POSITIVE MARKING

% purity $= \dfrac{m_{pure}}{m_{impure}} \times 100$

$= \dfrac{63{,}5 \checkmark}{95{,}7 \checkmark} \times 100$

$= 66{,}35$ g ✓ (5)

TOTAL MARKS : 140