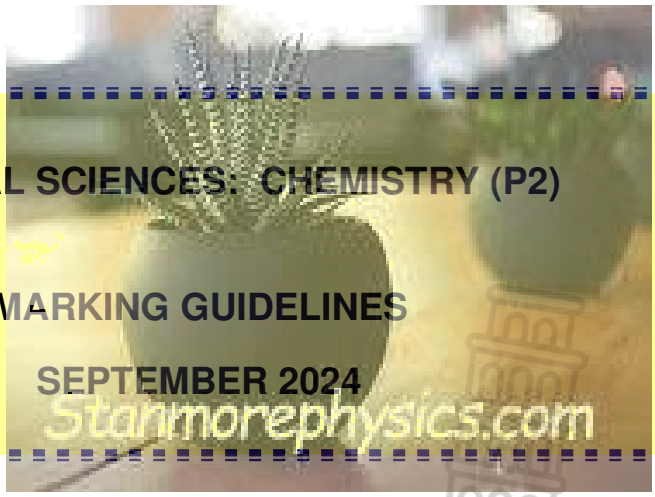
LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR SERTIFICATE

GRADE 12



PHYSICAL SCIENCES: CHEMISTRY (P2)

MARKING GUIDELINES

SEPTEMBER 2024

This marking guideline consists of a cover page and 10 pages.

TOTAL: 150

TIME: 3 HOURS

GRADE 12 TRIAL EXAMINATION – LIMPOPO
2024 SEPTEMBER PAPER 2: CHEMISTRY MARKS: 150
MARKING GUIDELINES

QUESTION 1

1.1 A ✓✓ (2)

1.2 C ✓✓ (2)

1.3 D ✓✓ (2)

1.4 B ✓✓ (2)

1.5 B ✓✓ (2)

1.6 C ✓✓ (2)

1.7 A ✓✓ (2)

1.8 A ✓✓ (2)



1.9 D ✓✓ (2)

1.10 A ✓✓ (2)

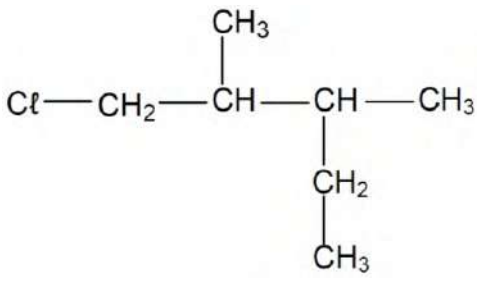
[20]

QUESTION 2

2.1 Carbon has four valence electrons✓, so it can achieve a full outer energy level by forming four covalent bonds✓ (this property is known as tetravalency). Carbon can form single, double, or triple covalent bonds with other carbon atoms to produce long chain or ring structures. (2)

2.2.1 C_nH_{2n+2} ✓ (1)

2.2.2 (3)



Marking criteria

- Two methyl substituents✓
- Chlorine substituent✓
- Whole structure correct✓

2.2.3 SATURATED ✓ (1)

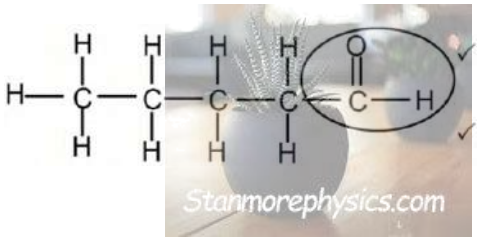
2.3.1 Compounds with the <u>same molecular formula</u>, ✓ but <u>different positions of the side chain/substituents/functional groups</u> ✓ on the parent chain. (2)

2.3.2 carbonyl ✓ (1)

2.3.3 pentan-3-one / 3-pentanone (2)

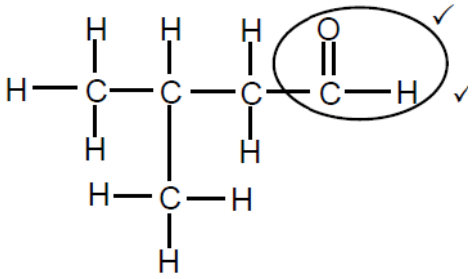
<u>Marking criteria</u>
- Functional group and correct position i.e., 3 ✓
- *Correct IUPAC name* ✓

2.3.4

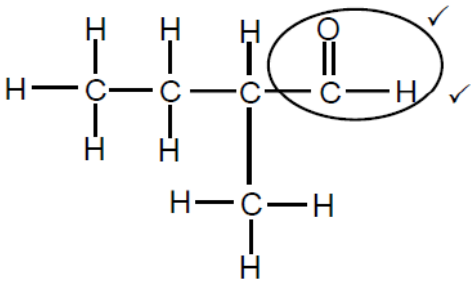


<u>Marking criteria</u>
- Correct functional group✓
- Whole structure correct✓

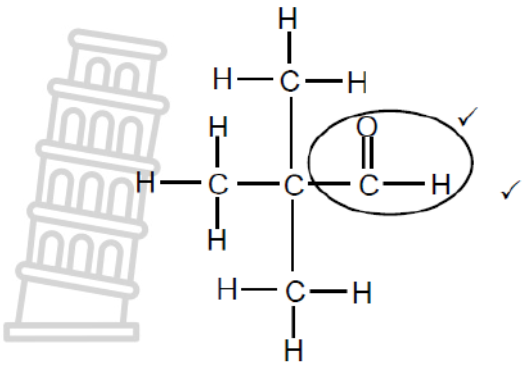
<u>OR: Any correct structure of an aldehyde with five carbon atoms.</u>



OR



OR



(2)

2.4.1 TERTIARY ✓
The C atom bonded to the functional group/hydroxyl (group)/-OH is bonded to three other C atoms. /The C-atom bonded to the hydroxyl (group) has no hydrogen atoms. ✓ (2)

2.4.2 2-methylpropan-2-ol / 2-methyl-2-propanol (2)

Marking criteria
- 2-methyl ✓
- propan-2-ol / 2-propanol ✓
- Any errors e.g., hyphens omitted and/or incorrect sequence: Max: 1/2

Stanmorephysics.com

[18]

QUESTION 3

3.1 Relative molecular mass/molar mass/*Mr* ✓ (1)

3.2.1 Boiling point ✓ (1)

3.2.2 Type of organic compound/homologous series/functional group✓ (1)
(alkane,alcohol,carboxylic acid)

3.3.1 LOWER THAN ✓ (1)

3.3.2 ***Negative marking from question 3.3.1*** –

- 2-methylpropane is a spherical molecule, therefore smaller surface area ✓ is presented to other molecules (sphere is 3D shape with lowest surface-to-volume ratio).
- Less surface area at which van der Waals interactions with other molecules can occur ✓ /fewer van der Waals interactions/fewer cohesive interactions.
- Less energy required ✓ to overcome cohesive forces as liquid hydrocarbon is vaporised. (3)

3.4 The pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓(2 or 0) (2)

3.5 *Ethanoic acid (**C**)* – It is possible for 2 H-bonds✓ (at C=O and O-H) to form between adjacent carboxylic acid molecules. Therefore H-bonds stronger ✓ in carboxylic acid. Therefore, more energy required✓ to overcome the stronger forces of attraction/to overcome the IMF BETWEEN molecules.

OR

propan-1-ol (**B**) – H-bonds weaker in alcohol ✓ as it is only possible for 1 H bond✓ at O-H to form between adjacent molecules of alcohol therefore less energy required ✓ to overcome the strong forces of attraction/to overcome the IMF BETWEEN molecules. (3)

[12]

QUESTION 4

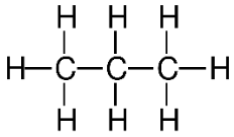
4.1.1 Substitution ✓ / halogenation (1)

4.1.2 Substitution ✓ (1)

4.1.3 Substitution ✓ (1)

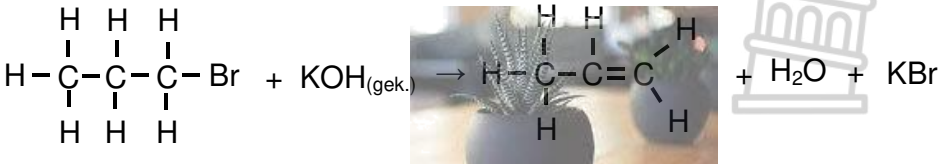
4.1.4 Substitution ✓/ dehydrohalogenation (1)

4.2 $CH_3CH_2CH_2Br$ ✓ + H_2O ✓ → $CH_3CH_2CH_2OH$ ✓ + HBr ✓ (4)

4.3  (2)

3-C atoms in chain ✓ Whole structure correct✓

4.4 H_2O ✓
CO_2 ✓ (2)

4.5  (3)

Marking criteria
- *Correct structural formula of 1-bromopropane ✓*
- *Correct structural formula of prop-1-ene ✓*
- *H_2O + KBr ✓*

Stanmorephysics.com

4.6 Propan-1-ol / [illegible]

Marking criteria

- *Functional group and correct position, ie.1.* ✓
- *Propanol* ✓

(2)

4.7 Esters ✓ (1)

4.8 propyl✓ethanoate✓ (2)

[20]

QUESTION 5

5.1 Activation energy ✓ (1)

5.2.1 C ✓ – (1)

5.2.2 ***Negative marking*** (1)

Total area under graphs **A** and **C** approximately the same, but more molecules with greater average E_k therefore area **X** of graph **C** greater – more molecules with greater average E_k.✓

5.2.3
- Increased temperature therefore increased average kinetic energy ✓of molecules.
- More of these molecules will have sufficient kinetic energy ✓ to react./ Ek≥activation energy
- More effective collisions per second ✓/unit time.
- Increased rate of reaction. ✓ (4)

5.3.1 A catalyst will speed up a chemical reaction ✓ (2)
without itself undergoing permanent change. ✓

5.3.2 INCREASES ✓ (1)

5.3.3 A catalyst will create an alternative path of lower activation energy ✓
"line Y" moves to the left ✓ – therefore area X increases in size. (2)

[12]

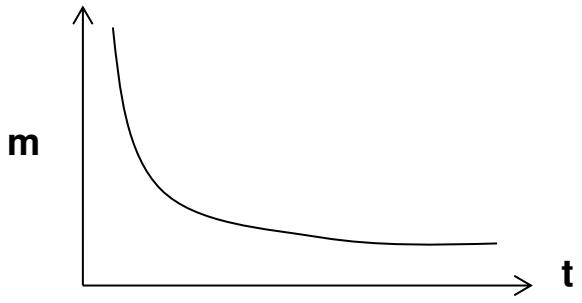
QUESTION 6

6.1 The change in concentration of reactants or products ✓ (2)
per unit time. ✓ or any other acceptable definition(see Guideline)

6.2 It starts at zero in t_0 ✓ and increases to time t_1✓ (2)

6.3 Equilibrium ✓ is reached. (1)

6.4



Criteria for graph
Axes labelled correctly. ✓
Gradient of graph initially high and then decreases with time. ✓

Graph ends parallel to x-axis to represent equilibrium. ✓ (3)

6.5.1 Decreases ✓ (1)

6.5.2 Decreases ✓ (1)

6.5.3 Decreases ✓ (1)

6.6 At lower T, the <u>exothermic (forward) reaction is favoured</u>. ✓
Therefore, the <u>reverse reaction is favoured</u>, ✓
<u>reducing the concentration of the gas</u> (products). ✓If concentration of products decrease then Kc will also decrease✓

(4)

6.7 $Kc = [CO_2]$✓ $= 1{,}4 \times 10^{-2}$✓ (2)

[17]

QUESTION 7

7.1.1 An acid is a proton (H^+-ion) -donor. ✓✓ (2)

7.1.2 It ionises to form 2 protons/<u>2 mol H^+-ions</u>. ✓ (1)
OR
It donates $2H^+$-ions per H_2SO_4 -molecule.

7.2.1 Amphiprotic (substance)/Ampholyte ✓ (1)

7.2.2 H_2CO_3 (aq) ✓ (1)

7.3.1 $n(H_2CO_3) = \frac{m}{M}$ ✓

$= \frac{27}{84}$ ✓

$= 0{,}32\ mol$ $(0{,}3214285714\ mol)$

$n(H_2SO_4) = \frac{1}{2}n(NaHCO_3)$

$= \frac{1}{2}(0{,}32)$ ✓

$= 0{,}16\ mol$ $(0{,}1607142857\ mol)$

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

$6 = \frac{0{,}16}{V}$ ✓✓ (6 and 0,16)

$\therefore V = 0{,}03\ dm^3$✓ $(30\ cm^3\ /\ 0{,}027\ dm^3\ /\ 27\ cm^3)$ (6)

7.3.2 $n_a(initial) = n_a(final)$
$c_a v_a(initial) = c_a v_a(final)$

$\therefore (6)v_a = (0{,}1)(1)$✓

$\therefore v_a = 0{,}02\ dm^3$✓

$(20\ cm^3\ /\ 0{,}0167\ dm^3\ /\ 16{,}7\ cm^3)$ (2)

7.3.3 Shows end point (of titration). ✓ /Shows when neutralisation occurs. (1)

7.3.4

Marking criteria:
- Substitute initial [acid] and volume
- Substitute initial [base] and volume
- Use ratio 1 : 2
- Initial mole acid – mole acid reacted
- Substitute volume acid + volume base
- pH formula
- Substitute 2 x c_a in pH formula
- Final answer: 1,44

$n_a(initial) = c_a v_a$

$= (0{,}1)(25 \times 10^{-3})$ ✓

$= 2{,}5 \times 10^{-3}\ mol$

$n_b(reacted) = c_b v_b$

$= (0{,}1)(30 \times 10^{-3})$ ✓

$= 3 \times 10^{-3}\ mol$

Stanmorephysics.com

$\frac{n_a}{n_b} = \frac{1}{2}$

$\therefore n_a(neutralised) = \frac{1}{2}n_b = \frac{1}{2}(3 \times 10^{-3})$✓ $= 1{,}5 \times 10^{-3}\ mol$

$n_a(left) = n_a(initial) - n_a(neutralised)$

$= 2{,}5 \times 10^{-3} - 1{,}5 \times 10^{-3}$ ✓

$= 1 \times 10^{-3}\ mol$

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

$= \frac{1 \times 10^{-3}}{(25 \times 10^{-3} + 30 \times 10^{-3}\ ✓)}$

$= 0{,}018\ mol.dm^{-3}$

$pH = -log[H_3O^+]$ ✓

$= -\log\ [2(0{,}018)✓]$

$= 1{,}44$ ✓ (8)

[22]

QUESTION 8

8.1 Pb ✓ (lead) (1)

8.2 $Zn \rightarrow Zn^{2+} + 2e^-$ ✓✓ (2 or 0) (2)

8.3 $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ ✓
$= -0{,}13$ ✓ $- (-0{,}76)$ ✓
$= 0{,}63\ (V)$ ✓ (4)

8.4
- Temperature ✓
- (initial) concentration of the electrolytes. ✓ (2)

8.5.1 EQUAL TO ✓ (1)

8.5.2 Area/size of electrodes has no effect on the emf of a cell. ✓✓ / It is still a standard cell. (2)

8.6.1 The cell has internal resistance. ✓ (1)

8.6.2 The emf decreases as the <u>concentration of Pb^{2+}(aq) decreases.</u> ✓ / The cell is running flat as the electrolyte concentration in the Pb cell decreases. (1)

[14]

QUESTION 9

9.1 A substance of which the aqueous solution contains ions. ✓✓ / A substance that dissolves in water to give a solution that conducts electricity. (2)

9.2 Endothermic ✓ (1)

9.3 Bracelet ✓ (1)

9.4.1 REMAINS THE SAME ✓ (1)

9.4.2 The <u>rate of oxidation</u> of copper at the anode is <u>equal</u> ✓ to the <u>rate of reduction</u> of copper (II) ions at the cathode. ✓ (2)

9.4.3 $Cu \rightarrow Cu^{2+} + 2e^-$ ✓✓ (2)

Notes:

$Cu \rightleftharpoons Cu^{2+} + 2e^-$ $(^1/_2)$

$Cu^{2+} + 2e^- \rightarrow Cu$ $(^0/_2)$

$Cu^{2+} + 2e^- \leftarrow Cu$ $(^2/_2)$

$Cu^{2+} + 2e^- \leftrightharpoons Cu$ $(^0/_2)$

Stanmorephysics.com

9.5 $n(Cu) = \frac{m}{M}$

$= \frac{0,86}{63,5}$ ✓

$= 0,0135\ mol$ ✓

$(0,01354330709\ mol)$

$n(electrons) = 2n(Cu) = 2(0,0135) = 0,027\ mol$✓

$n = \frac{N}{N_A}$ ✓

$0,027 = \frac{N}{6,02 \times 10^{23}}$ ✓ (6)

$\therefore N = 1,63 \times 10^{22}$ ✓ $electrons$

[15]

TOTAL: 150