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PROVINCIAL GOVERNMENT
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DEPARTMENT OF EDUCATION

**NATIONAL
SENIOR CERTIFICATE**

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



**SA EXAM
PAPERS**

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

QUESTION 1

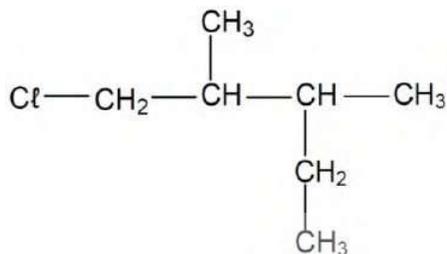
- 1.1 A ✓✓ (2)
- 1.2 C ✓✓ (2)
- 1.3 D ✓✓ (2)
- 1.4 B ✓✓ (2)
- 1.5 B ✓✓ (2)
- 1.6 C ✓✓ (2)
- 1.7 A ✓✓ (2)
- 1.8 A ✓✓ (2)
- 1.9 D ✓✓ (2)
- 1.10 A ✓✓ (2)

[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 same molecular formula, ✓ but different positions of the side chain/substituents/functional groups ✓ on the parent chain. (2)

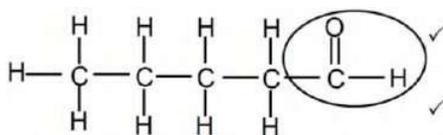
2.3.2 carbonyl ✓ (1)

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

Marking criteria

- Functional group and correct position i.e., 3 ✓
- Correct IUPAC name ✓

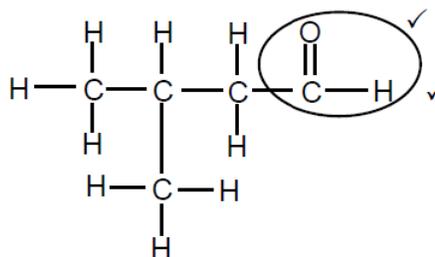
2.3.4



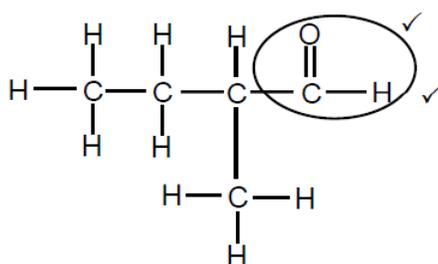
Marking criteria

- Correct functional group ✓
- Whole structure correct ✓

OR: Any correct structure of an aldehyde with five carbon atoms.



OR



OR





- 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

[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 (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 $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \checkmark + \text{H}_2\text{O} \checkmark \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \checkmark + \text{HBr} \checkmark$ (4)

- 4.3
$$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & | & | & | & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{H} & & \\ & | & | & | & & & \\ & \text{H} & \text{H} & \text{H} & & & \end{array}$$
 3-C atoms in chain ✓ Whole structure correct ✓ (2)

- 4.4 $\text{H}_2\text{O} \checkmark$
 $\text{CO}_2 \checkmark$ (2)

- 4.5
$$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & | & | & | & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{Br} & + & \text{KOH}_{(\text{gek.})} \rightarrow \\ & | & | & | & & & \\ & \text{H} & \text{H} & \text{H} & & & \end{array} \begin{array}{ccccccc} & \text{H} & \text{H} & & \text{H} & & \\ & | & | & & / & & \\ \text{H} & - \text{C} & - \text{C} & = & \text{C} & & \\ & | & & & \backslash & & \\ & \text{H} & & & \text{H} & & \end{array} + \text{H}_2\text{O} + \text{KBr}$$
 (3)

Marking criteria

- Correct structural formula of 1-bromopropane ✓
- Correct structural formula of prop-1-ene ✓
- $\text{H}_2\text{O} + \text{KBr} \checkmark$

- 4.6 Propan-1-ol /

<p><u>Marking criteria</u></p> <ul style="list-style-type: none">• 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./ $E_k \geq \text{activation energy}$
- More effective collisions per second ✓ /unit time.
- Increased rate of reaction. ✓ (4)

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

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)

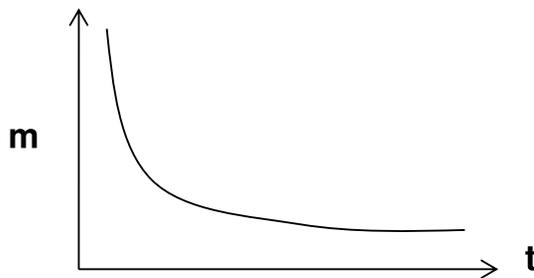
[12]**QUESTION 6**

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

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 exothermic (forward) reaction is favoured. ✓
Therefore, the reverse reaction is favoured, ✓
reducing the concentration of the gas (products). ✓ If concentration of products decrease then Kc will also decrease ✓ (4)
- 6.7 $K_c = [CO_2] ✓ = 1,4 \times 10^{-2} ✓$ (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/2 mol H^+ -ions. ✓ (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 $n(H_2CO_3) = \frac{m}{M} ✓$
 $= \frac{27}{84} ✓$
 $= 0,32 \text{ mol} \quad (0,3214285714 \text{ mol})$
- $n(H_2SO_4) = \frac{1}{2} n(NaHCO_3)$
 $= \frac{1}{2} (0,32) ✓$
 $= 0,16 \text{ mol} \quad (0,1607142857 \text{ mol})$
- $c = \frac{n}{V}$
 $6 = \frac{0,16}{V} ✓ ✓$ (6 and 0,16)
- $\therefore V = 0,03 \text{ dm}^3 ✓$ (30 cm^3 / 0,027 dm^3 / 27 cm^3) (6)

- 7.3.2 $n_a(\text{initial}) = n_a(\text{final})$
 $c_a v_a(\text{initial}) = c_a v_a(\text{final})$



$$\begin{aligned}\therefore (6)v_a &= (0,1)(1)\checkmark \\ \therefore v_a &= 0,02 \text{ dm}^3\checkmark \\ &(20 \text{ cm}^3 / 0,0167 \text{ dm}^3 / 16,7 \text{ cm}^3) \quad (2)\end{aligned}$$

7.3.3 Shows end point (of titration). \checkmark /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 $2 \times c_a$ in pH formula
- Final answer: 1,44

$$\begin{aligned}n_a(\text{initial}) &= c_a v_a \\ &= (0,1)(25 \times 10^{-3}) \checkmark \\ &= 2,5 \times 10^{-3} \text{ mol}\end{aligned}$$

$$\begin{aligned}n_b(\text{reacted}) &= c_b v_b \\ &= (0,1)(30 \times 10^{-3}) \checkmark \\ &= 3 \times 10^{-3} \text{ mol}\end{aligned}$$

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

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

$$\begin{aligned}n_a(\text{left}) &= n_a(\text{initial}) - n_a(\text{neutralised}) \\ &= 2,5 \times 10^{-3} - 1,5 \times 10^{-3} \checkmark \\ &= 1 \times 10^{-3} \text{ mol}\end{aligned}$$

$$\begin{aligned}c_a &= \frac{n}{V} \\ &= \frac{1 \times 10^{-3}}{(25 \times 10^{-3} + 30 \times 10^{-3}) \checkmark}\end{aligned}$$

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

$$\text{pH} = -\log[H_3O^+] \checkmark$$

$$\begin{aligned}&= -\log [2(0,018)\checkmark] \\ &= 1,44 \checkmark\end{aligned}$$

(8)

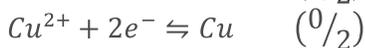
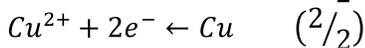
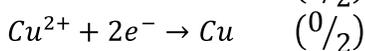
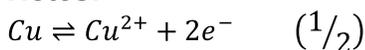
[22]

QUESTION 8

- 8.1 Pb ✓ (lead) (1)
- 8.2 $Zn \rightarrow Zn^{2+} + 2e^-$ ✓✓ (2 or 0) (2)
- 8.3 $E_{cell}^{\theta} = E_{oxidising\ agent}^{\theta} - E_{reducing\ agent}^{\theta}$ ✓
 $= -0,13 \checkmark - (-0,76) \checkmark$
 $= 0,63 (V) \checkmark$ (4)
- 8.4 • Temperature ✓ (2)
 • (initial) concentration of the electrolytes. ✓
- 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 concentration of $Pb^{2+}(aq)$ decreases. ✓ / 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 rate of oxidation of copper at the anode is equal ✓ to the rate of reduction of copper (II) ions at the cathode. ✓ (2)
- 9.4.3 $Cu \rightarrow Cu^{2+} + 2e^-$ ✓✓ (2)

Notes:

$$\begin{aligned}
 9.5 \quad n(\text{Cu}) &= \frac{m}{M} \\
 &= \frac{0,86}{63,5} \checkmark \\
 &= 0,0135 \text{ mol} \checkmark \\
 &\quad (0,01354330709 \text{ mol})
 \end{aligned}$$

$$n(\text{electrons}) = 2n(\text{Cu}) = 2(0,0135) = 0,027 \text{ mol} \checkmark$$

$$\begin{aligned}
 n &= \frac{N}{N_A} \checkmark \\
 0,027 &= \frac{N}{6,02 \times 10^{23}} \checkmark \\
 \therefore N &= 1,63 \times 10^{22} \checkmark \text{ electrons}
 \end{aligned}
 \tag{6}$$

[15]

TOTAL: 150