Western Cape Government
Education

METRO CENTRAL EDUCATION DISTRICT

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P2) – MARKING GUIDELINE

SEPTEMBER 2025

MARKS: 150

TIME: 3 hours

QUESTION 1

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

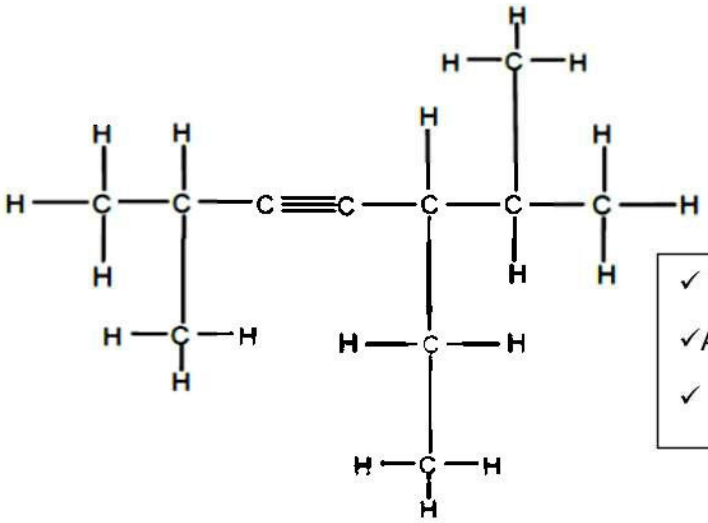
QUESTION 2

2.1.1 A ✓ (1)

2.1.2 B ✓ (1)

2.2.1 C_nH_{2n-2} ✓ (1)

2.2.2



✓ 7 C chain with all bonds and H
✓Alkyne functional group on carbon 3
✓ Dimethyl on carbon 2,6 and ethyl on 5

(3)

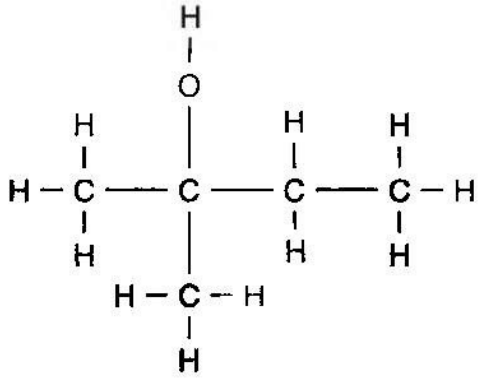
2.3 Pentanal

Pentan ✓ al ✓ (2)

2.4.1 Butan-2-ol

Butan ✓ 2-ol ✓ ACCEPT: 2-butanol (2)

2.4.2



✓ 4 C chain with all bonds and H
✓ OH and methyl group on carbon 2

(2)

2.5 $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ ✓ Reactant, ✓ product, ✓ Balanced eq. (3)

Note: No balancing mark, if reactants and products are incorrect.

[15]

QUESTION 3

3.1 The temperature at which the vapour pressure of a substance equals atmospheric pressure. ✓✓ (2)

3.2 3.2.1 Carbon chain length/Molecular mass/Number of carbon atoms/ number of London forces.(sites) ✓ (1)

3.2.2 Primary Alcohols/ Straight chains alcohol
ACCEPT: Functional group/ Homologous series/ type of IMF/ atmospheric pressure✓ (1)

3.3 FROM **A** to **D**

- Chain length increases / larger surface area / higher molecular mass. ✓
- The number of London forces increases
  OR
  Increasing strength of the Intermolecular forces. ✓
- More energy needed to overcome the increase in intermolecular forces. ✓
  (If learners write, "break bonds", only penalise once.)

∴ Boling point increases (3)

3.4 NO ✓ Two independent variables
ACCEPT: molar mass/type of IMF/ different functional groups). ✓ (2)

3.5 **OPTION 1**

- Compound D / Pentan-1-ol has hydrogen bonding (and London forces) between its molecules, whereas Compound E / Pentane has London forces between its molecules. ✓
- Hydrogen bonding forces are stronger than London forces OR
  Intermolecular forces in Compound D / Pentan-1-ol are stronger than the intermolecular forces in Compound E / Pentane. ✓
- More energy is needed to overcome the intermolecular forces in Compound D / Pentan-1-ol than in Compound E / Pentane..

∴ Boiling point of Compound D / Pentan-1-ol is higher than compound E /Pentane. ✓

OPTION 2

- Compound E / Pentane has London forces between its molecules whereas Compound D / Pentan-1-ol has hydrogen bonding (and London forces) between its molecules. ✓
- London forces are weaker than hydrogen bonding OR
  Intermolecular forces in Compound E / Pentane are weaker than the intermolecular forces in Compound D / Pentan-1-ol. ✓
- Less energy is needed to overcome the intermolecular forces in Compound E / Pentane than in Compound D / Pentan-1-ol.

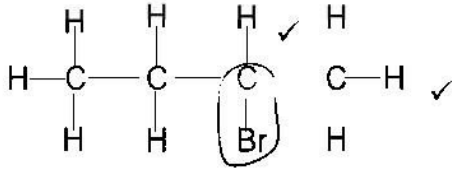
∴ Boiling point of Compound D / Pentan-1-ol is higher than Compound E / Pentane ✓ (3)

3.6 Compound Z (Ester) ✓
Compound Z has the weakest intermolecular forces (dipole-dipole) of the two. ✓
(while compound F has stronger hydrogen bonds between the molecule.
Or
Compound F has the stronger intermolecular forces (Hydrogen bonding) of the two. (while ✓ (2)

[14]

QUESTION 4

4.1

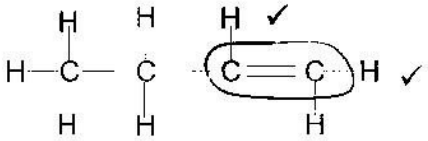


- ✓ 4-C chain with all H
- ✓ Br on second C

(2)

4.2 4.2.1 Elimination / dehydrohalogenation / dehydrobromination ✓ (1)

4.2.2



- ✓ 4-C chain with all H
- ✓ double bond on first C

(2)

4.3 $\underline{CH_3CH_2CHBrCH_3 + NaOH}$ ✓ ⟶ $CH_3CH_2CHOHCH_3$✓ + NaBr✓ (3)

[If molecular formula used → 1 mark for NaBr]

4.4

- Add HBr or NaBr or KBr ✓
- Absence of water or heat ✓ (2)

4.5 Hydration ✓ (1)

4.6.1 Heat or Catalyst $\underline{Ni/Pd/Pt}$ ✓ (1)

4.6.2 C_nH_{2n+2} ✓ (1)

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QUESTION 5

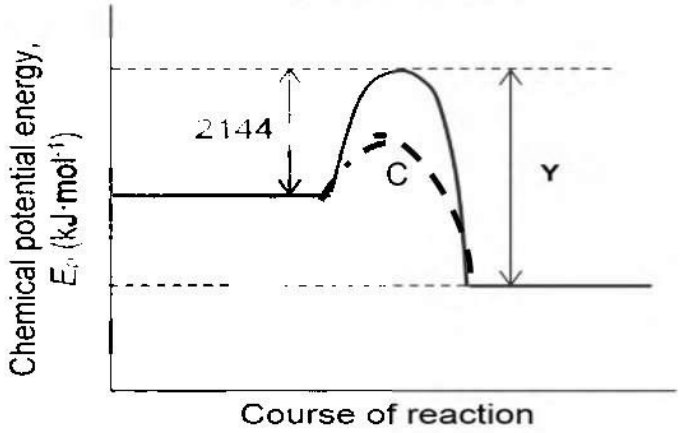
5.1.1 The unstable transition state✓ from reactants to products ✓ (2)

5.1.2 $\Delta H = E_{absorbed} - E_{released}$

$-203 = 2\,144 - Y$

$Y = 2\,347\ (kJ \cdot mol^{-1})$ ✓✓ (2)

5.1.3



✓ correct energy of reactants and product AND lower activated complex
✓ label C (2)

5.2.1 The change in concentration of reactants or products per unit time✓✓.[2 or 0] (2)

5.2.2 **R** ✓

- R is at a higher temperature and therefore there are more particles with sufficient kinetic energy or Ek > Ea. ✓
- More collisions per unit time.
- More effective collisions per unit time. ✓
- Higher/greater/faster rate of reaction.

NB. If **P** selected and the following explanation given [maz 2 marks]:

- Fewer particles with sufficient kinetic energy above E_a ✓
- Fewer effective collisions per unit time ✓ (3)

5.3.1 $\text{Rate} = -\frac{\Delta C}{\Delta t}$ ✓

$1{,}73 \times 10^{-5}$✓ $= -\frac{(C-0.01)}{(200-0)}$ ✓

$C = 6{,}54 \times 10^{-3}$ ✓ $(mol \cdot dm^{-3})$ → unit not necessary

Or $C = 0{,}00654 \approx 0{,}007$ accept (4)

5.3.2 (a) $n(H_2O_2) = cV$

$= (0,01 - 0,0053)$ ✓ $(\frac{25}{1000})$ ✓

$= 1,175 \times 10^{-4}$ moles

(b) $n(H_2O_2) : n(O_2)$

2 : 1 ✓ ratio

$1,175 \times 10^{-4} : 5,875 \times 10^{-5}$

(c) $n(O_2) = \frac{V}{V_m}$ ✓

$5,875 \times 10^{-5} = \frac{V}{25,7}$ ✓

$V = 1,510 \times 10^{-3}$ dm³ ✓ 0,00151 dm³ (6)

[23]

QUESTION 6

6.1 It is that stage of a chemical reaction when the rate of the forward reaction equals the rate of the reverse reaction ✓✓ [2 or 0] (2)

6.2 **Marking criteria**

- Assume QS (2x) reacts and Q_2 (x) and RS_3 (x) produced.
- Equilibrium moles
- Equilibrium concentration
- Kc equation
- Substitution of Kc
- Substitution of conc of reactants and products
- Answer for x (= 0,127 moles).

OPTION 1

Reaction	**Q_2**	**RS_3**	**2QS**	**RS(s)**
Initial moles	0,6	0,6	0,4	0,4
Change in moles	+ x	+ x	- 2x	
Equilibrium mol	0,6 + x	0,6 + x	0,4 – 2x	
Equilibrium [ ] mol·dm^3	$\frac{0,6+x}{0,5}$	$\frac{0,6+x}{0,5}$	$\frac{0,4-2x}{0,5}$	

✓ ✓ ✓ ← Divide by 0,5 dm^3✓

$$Kc = \frac{[QS]^2}{[Q_2][RS_3]} \checkmark$$

$$0,04 \checkmark = \frac{\left(\frac{0,4-2x}{0,5}\right)^2}{\left(\frac{0,6+x}{0,5}\right)\left(\frac{0,6+x}{0,5}\right)} \quad \checkmark$$

$$0,2 = \frac{0,4-2x}{0,6+x}$$

x = 0,127 moles = change in moles of Q_2 ✓ (7)

ACCEPT **[max 5 marks**

if correct conclusion made → then 6 marks]

Reaction	**Q_2**	**RS_3**	**2QS**	**RS(s)**
Initial moles	0,6	0,6	0,4	0,4
Change in moles	- x	- x	+ 2x	
Equilibrium mol	0,6 - x	0,6 - x	0,4 + 2x	
Equilibrium [ ] mol·dm^3	$\frac{0,6-x}{0,5}$	$\frac{0,6-x}{0,5}$	$\frac{0,4+2x}{0,5}$	

No mark

✓

✓ ← Divide by 0,5 dm^3✓

$$K_c = \frac{[QS]^2}{[Q_2][RS_3]} \checkmark$$

$$0,04 \checkmark = \frac{\left(\frac{0,4+2x}{0,5}\right)^2}{\left(\frac{0,6-x}{0,5}\right)\left(\frac{0,6-x}{0,5}\right)} \checkmark$$

$$0,2 = \frac{0,4+2x}{0,6-x}$$

$x = -0,127$ moles

$\therefore$ change in moles of Q_2 = <u>- (-0,127) = 0,127 mole</u> ✓

OPTION Concentration route

Reaction	Q_2	RS_3	2QS	RS
Initial moles mol	0,6	0,6	0,4	0,4
Initial conc	1,2	1,2	0,8	
Change in conc	+x	+x	- 2x	
Equilibrium mol·dm^3	1,2+x	1,2+x	0,8-2x	

✓ ← Divide by 0,5 dm^3✓

✓

✓

$$Kc = \frac{[QS]^2}{[Q_2][RS_3]} \quad ✓$$

$$0,04 \ ✓ = \frac{(0,8-2x)^2}{(1,2+x)(1,2+x)} \quad ✓$$

$$0,2 = \frac{0,8-2x}{1,2+x}$$

$$0,2(1,2+x) = 0,8-2x$$

$$0,24 + 0,2x = 0,8 - 2x$$

$$2,2x = 0,8 - 0,24$$

$$X = 0,25455 \text{ mol·dm}^{-3}$$

∴ change in moles of Q = cV

= (0,25455)(0,5)

= 0,127 moles ✓ (7)

6.3 POSITIVE ✓

Mark Explanation independently

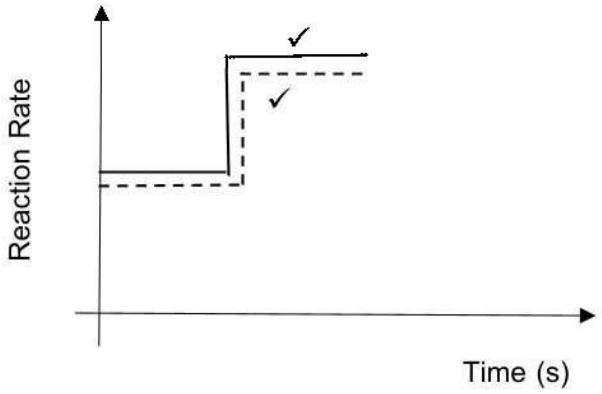
- An increase in temperature favours an endothermic reaction, ✓ the reactants are being decreased indicating the forward reaction is favoured
- Therefore the forward reaction is endothermic. ✓ (3)

6.4 Concentration of Reactants increases / Q_2 and/or RS_3 added ✓ (1)

6.5

- Increase in concentration of reactants results in an increase in the rate of the forward reaction. ✓
- As reactants are used, the rate of forward reaction decreases. ✓
- As products are formed, the rate of the reverse reaction increases. ✓
- Equilibrium is obtained after 20 s when the rates of the forward and reverse reactions are equal. (3)

6.6



Criteria
✓ both vertical line
✓ both horizontal lines

(2)

[18]

QUESTION 7

7.1.1 An acid is a substance when ionized in water produces (H^+) /(H_3O^+) hydronium ions OR
Acids produces hydrogen ions (H^+) /(H_3O^+) hydronium ions ✓ in an aqueous solution. ✓✓ [2 or 0] (2)

7.1.2 HSO_4^- / hydrogen sulphate ion ✓ (1)

7.1.3 H_3O^+ ✓ (1)

7.1.4

$pH = - \log [H_3O^+]$ ✓
$= - \log (0,6)$ ✓
$= 0,22$ ✓ (3)

7.2.1 pH > 7 ✓ (1)

7.2.2 OPT 1: $CO_3^{2-}(aq) + H_2O(\ell)$ ✓ $\rightarrow HCO_3^-(aq) + OH^-(aq)$ ✓
OR
OPT 2: $CO_3^{2-}(aq) + 2H_2O(\ell)$ ✓ $\rightarrow H_2CO_3(aq) + 2OH^-(aq)$ ✓
(OH^- was formed ∴ pH > 7)

ACCEPT: $Na_2CO_3 + 2H_2O$ ✓ $\rightarrow 2NaOH + H_2CO_3$ ✓ [(2)

7.3.1 **Initial mol of H_2SO_4**

(a) $pH = - \log [H_3O^+]$ ✓
$0,2$ ✓ $= - \log [H_3O^+]$
$[H_3O^+] = 0,63096\ mol.dm^{-3}$

(b) $[H_3O^+] : [H_2SO_4]$
$2 : 1$
$0,63096 : 0,31548\ mol.dm^{-3}$ $[H_2SO_4]$ [ACCEPT: 0,32 mol·dm^{-3}] ✓ (3)

7.3.2 **POSITIVE MARKING FROM 7.3.1**

Marking criteria

- $n_{initial} = C.V$ formula ✓
- Substitution into formula ✓
- Initial mol of NaOH substitution ✓
- Mol of H_2SO_4 reacted with Na_2CO_3 subtraction ✓
- $m = n.M$ formula ✓
- Substitution into formula ✓
- Percentage purity answer ✓

(a) $n_{initial} = C.V$ ✓

= (0,31548)(0,1) ✓

= 0,031548 mol

Initial mol of NaOH

(b) $n_{initial} = C.V$

= (0,1)(0,05) ✓

= 0,005 mol

Mol of H_2SO_4 reacted with NaOH

(c) n(NaOH) : n(H_2SO_4)

1 : 2

0,005 : 0,0025 mol of H_2SO_4

Mol of H_2SO_4 reacted with Na_2CO_3

(d) $n_{initial} - n_{reacted(NaOH)}$

0,031548 - 0,0025 ✓

= 0,029048 mol

Mass of pure Na_2CO_3

(e) n(H_2SO_4) : n(Na_2CO_3)

1 : 1

0,029048 : 0,029048 mol of Na_2CO_3

(f) $n(Na_2CO_3) = \frac{m}{M}$ ✓

$0,029048 = \frac{m}{106}$ ✓

m = 3,079 g

Percentage purity of Na_2CO_3

(g) Percentage purity = $\frac{3,079}{5} \times \frac{100}{1}$

= 61,58 % ✓ [Range: 61,48% – 61,59%] (7)

[20]

QUESTION 8

8.1 Chemical energy to electrical energy ✓ (1)

8.2 $Mg\ (s) \rightarrow Mg^{2+}\ (aq) + 2e^-$ ✓✓ (2)
Double arrow = 1 mark

Accept: $Mg^{2+}\ (aq) + 2e^- \leftarrow Mg\ (s)$ ✓✓
Double arrow = no marks

8.3 X^{3+} is the oxidising agent because it gains electrons and its oxidation number decreases from +3 to 0. ✓ (1)

8.4 • Pt is inert or Unreactive. OR
• Very good conductor of electricity ANY ONE ✓ (1)

8.5 • Temperature: 25 °C or 298K ✓
• Pressure: 1atm or 101,3 kPa ✓
[Must give values for temperature and pressure] (2)

8.6

Marking Criteria
- anode (reducing agent I oxidised species) ✓
- salt bridge || ✓
- cathode (oxidising agent I reduced species) ✓

$$\overset{\checkmark}{X(s)} \mid \underset{(1\ mol.dm^{-3})}{\overset{\checkmark}{X^{3+}(aq)}} \parallel \overset{\checkmark}{C\ell_2(g)} \mid \underset{(1\ mol.dm^{-3})}{\overset{\checkmark}{C\ell^-(aq)}} \mid Pt(s)$$

[NOTE: NO deductions if 1 mol.dm^{-3} or state of matter omitted] (3)

8.7 $E^{\ominus}_{cell} = E^{\ominus}_{reduction} - E^{\ominus}_{oxidation}$ ✓
2,10 ✓ = + 1,36 - (X) ✓
X = - 0,74 (V) ✓

X is Cr / Chromium ✓ (5)

8.8 Increases ✓

Nett Cell Reaction: $2Cr + 3C\ell_2 \rightarrow 2Cr^{3+} + 3C\ell^-$
Adding $AgNO_3$ will precipitate $AgC\ell$ ✓ leading to a decrease in chloride ion ($C\ell^-$) concentration. ✓ Therefore forward reaction is favoured. (3)

[18]

QUESTION 9

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

9.2 $Cu(NO_3)_2$ / $CuNO_3$✓ (1)

9.3 Iron rod ✓
Mark reason below independently
Reduction takes place (on the iron rod) OR
Cu^{2+} (or Cu^{+}) ions gain electrons to form Cu ✓ (2)

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

ACCEPT: $Cu(s) \rightarrow Cu^{+}(aq) + e^-$ ✓✓ (2)

9.5 Copper ions ✓/copper(II) ions / copper(I) ions [ACCEPT: Cu^{2+} /Cu^{+}]
Silver ions ✓ [ACCEPT: Ag^{+}] (2)

9.6 **Mark independently from 9.5**
Since Ag is connected to the anode it will undergo oxidation to produce Ag^{+} ions.
In the solution there will now be Ag^{+} ions and Cu^{2+} ions.
Ag^{+}/silver (I) ions is a stronger oxidising agent ✓ than Cu^{2+}/copper (II) ions ✓
and will be reduced more readily to form silver/Ag on the iron rod.
OR
Cu^{2+}/copper (II) ions is a weaker oxidising agent ✓ than Ag^{+}/silver ions ✓
and will not be reduced readily to form copper/Cu on the iron rod.

ACCEPT: $Ag^{+} + e^- \rightarrow Ag$ (one mark) (2)

[11]

TOTAL 150 MARKS