

4E Chemistry P3 Prelim 2025 MS

1(a)(i) PDO **Results**

5

Final burette reading/cm ³	34.30	34.80
Initial burette reading/cm ³	11.60	12.10
Volume of solution S used/cm ³	22.70	22.70
Best titration (✓)	✓	✓

	Marking point	Mark
1	Record initial burette readings, final burette readings and volume added with correct headings and units in a titration table.	1
2	All burette readings for all accurate titres in titration table are recorded to nearest 0.05 cm ³ .	1
3	Concordance: at least two titre values are within 0.20 cm ³ (using uncorrected titres) [1]	1
4	(a) For the average titre (of consistent readings) within 0.20 cm ³ of Supervisor's average value (22.50- 22.90) [2] OR (b) For the average titre (of consistent readings) within 0.30 cm ³ of Supervisor's average value (22.40 – 23.00) [1]	Max 2

Markers comment: Many students used pencil to write heading and data for the table. Though not penalised for this prelim, students should note to write in pen for all heading and data. Many students also cannot give accurate headings and wrote 'initial/final volume' instead. Several students also did not give burette readings in nearest 0.05 cm³.

1(a)(ii) MMO Average volume of S used = $(22.70 + 22.70)/2 = 22.70 \text{ cm}^3$

1

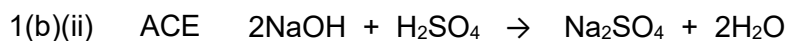
Markers comment: Several students also did not give burette readings in nearest 0.05 cm³ or missed the unit.

1(b)(i) MMO M_r of NaOH = $23 + 16 + 1$
= 40

1

Mole concentration of R = $4.00/40$

$$= 0.100 \text{ mol/dm}^3$$



$$\begin{aligned} \text{Number of moles of NaOH} \\ &= 0.100 \times (25/1000) \\ &= 0.0025 \text{ mol} \end{aligned}$$

1

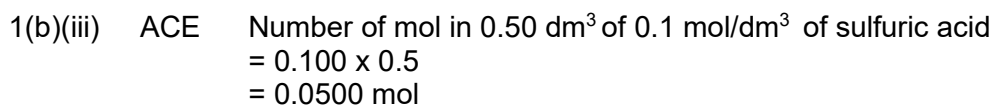
$$\begin{aligned} \text{Mole ratio of NaOH: H}_2\text{SO}_4 \\ &= 2: 1 \end{aligned}$$

$$\begin{aligned} \text{Number of moles of H}_2\text{SO}_4 \\ &= 0.025/2 \\ &= 0.00125 \text{ mol} \end{aligned}$$

$$\begin{aligned} \text{Concentration of H}_2\text{SO}_4 \\ &= 0.00125 / \frac{22.70}{1000} \\ &= 0.055066 \\ &= 0.0551 \text{ mol/dm}^3 \end{aligned}$$

1

Markers comment: Poorly done as students did not write the balance equation to derive the mole ratio.



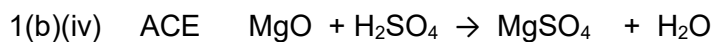
$$\begin{aligned} \text{Number of mol in } 0.50 \text{ dm}^3 \text{ of } 0.055066 \text{ mol/dm}^3 \text{ of sulfuric acid} \\ &= 0.055066 \times 0.5 \\ &= 0.027533 \text{ mol} \end{aligned}$$

1

$$\begin{aligned} \text{Number of mol of acid that reacted with magnesium oxide} \\ &= 0.05 - 0.027533 \\ &= 0.022466 \\ &= 0.0225 \text{ mol} \end{aligned}$$

1

Markers comment: Students did not understand the question and many did not attempt the question.



$$\begin{aligned} \text{Mole ratio of MgO: H}_2\text{SO}_4 \\ &= 1: 1 \end{aligned}$$

Number of mol of magnesium oxide that reacted
 = 0.022466
 = 0.0225 mol

1

1(b)(v) ACE Mr of MgO = 24 + 16
 = 40

Mass of MgO = 40 x 0.022466
 = 0.89867 g
 = 0.899 g (3 s.f)

1

+

Additional 1m for all correct sf for all parts in (b)

1

1(c) ACE With lesser volume of R in the conical flask, the titre value will be lower,
 resulting in a higher calculated concentration of acid. This will result in a
lower calculated mass of magnesium oxide.

1

1

Markers comment: Students are generally able to tackle the question.

[Total: 16]

2(a) PDO
 MMO

4

metal carbonate	mass of boiling tube and contents before heating / g	mass of boiling tube and contents after heating / g	other observation(s)
W	31.42	31.09	White solid turned yellow when hot and turned white when cooled. Rate of bubbling into limewater was slow.
X	32.64	32.53	Green solid turned black. White ppt formed in limewater and dissolved after some time.

Y	31.68	31.48	No observable change for solid. No ppt formed in limewater. Rate of bubbling into limewater was slow.
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Masses recorded to 2 dp consistently and mass decrease after heating [1]
Each observation [1]

- 2(b) ACE Y, W, X 1
Y did not decompose completely while X decompose quickly to produce carbon dioxide at a rapid rate. 1

Accept other valid points, comparing the decomposition process (whether it is complete or the rate of decomposition) OR the rate of bubbling of gas in limewater. OR mass of carbon dioxide lost from least to most. (ECF awarded for explanation)

- 2(c) ACE Disagree. The decomposition reaction may not be completed hence the exact mass of carbon dioxide lost may not be accurate to determine the amount of metal carbonate given. 1

Markers comment: Many students wrote agree and said that the number of moles can be calculated from mass lost but students need to note that the carbonates may not have undergone complete decomposition reaction to derive accurate mass of carbon dioxide produced.

- 2(d) ACE The student will not be able to observe the rate of the bubbling of the gas in limewater (as the rate of formation of white precipitate is determined by the student bubbling into the limewater). 1
OR
The student has to bubble the gas several more times to observe the white precipitate formed in limewater/take a longer time to observe the white precipitate formed in limewater (as the gas formed will escape faster to the surroundings in the open boiling tube)

Video to show collection of gas:
<https://www.youtube.com/watch?v=kGgmB2IBOcY>

- 2(e) PDO 3
MMO

Test	Procedure	Observation
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1	Add about 2 cm depth of solution A into a clean test-tube. To this test-tube, add one piece of magnesium ribbon and leave it to stand for a few minutes. While waiting, continue with the rest of the tests below.	No observable changes Accept: bubbles formed on Mg
2	Add about 1 cm depth of solution A into a clean test-tube. To this test-tube, add aqueous sodium hydroxide slowly with shaking until no further changes are seen.	White ppt formed. White ppt remained insoluble in excess NaOH.
3	Add about 1 cm depth of solution A into a clean test-tube. To this test-tube, add two drops of aqueous ammonia slowly with shaking.	No observable change//no ppt formed

1m each

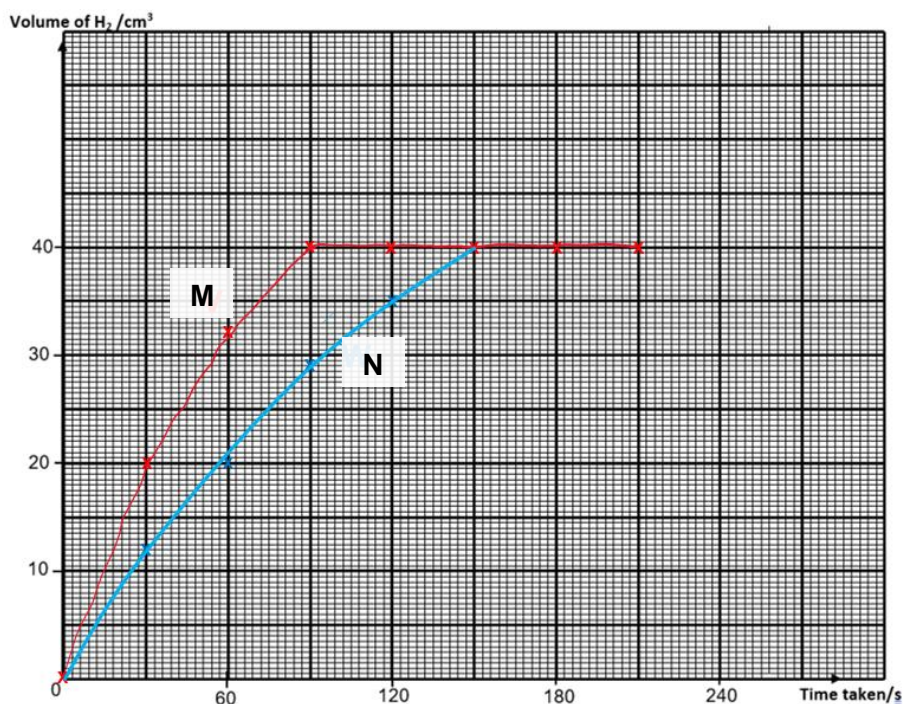
2(f)	ACE	Markers comment: Generally well done.	
		Y is calcium carbonate.	1
		From test 2, calcium hydroxide formed does not dissolve in excess NaOH OR From test 3, no ppt formed with aqueous ammonia, indicating presence of calcium ion	1

Markers comment: Students could identify the carbonate but have to work on the explanation as many did not indicate how the observation prove that calcium ion is present.

[Total: 13]

3(a)	MMO	Graph [1] Axis labels + units (x-axis: time/ s; y-axis: volume of hydrogen / cm³) [1] Appropriate scale and at least 50% occupied [1] All points correctly plotted for both graphs [1] lines of best fit	4
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Deduct 1m if **M** and **N** are not labelled on graphs.



Markers comment: Many students did not plot (0,0) or had odd scale and made careless mistake while reading the scale.

- 3(b) ACE Experiment with metal M has higher rate of reaction as the gradient for M is steeper. 1
 OR it takes a shorter time taken to produce same volume of gas
 OR the experiment is completed at 90s instead of 150s.
- 3(c) ACE Total volume of hydrogen gas produced is the same (and the metals are limiting), the number of moles of metals used must be the same 1
 Mass of M and N will not be the same as the Ar of metals are different 1

Markers comment: Question was challenging for students as many correlate mass of hydrogen lost to mass of metal formed.

[total: 7]

- 4 P [1] Independent variable and approach 4
 [1] Dependent variable and approach
 [1] Variables that are kept constant
 [1] Data processing

Suggested answer:

1. Use a measuring cylinder to measure 50 cm^3 of water and pour into a beaker.
2. Use an electronic balance and weigh 50 g of oxalic acid in another beaker.
3. Add one spatula of oxalic acid carefully into the beaker of water and stir. Continue adding till no more solid can be dissolved. Filter any remaining solid. Rinse and dry the solid.
4. Weigh the solid to find out excess solid that was undissolved, mass y
5. Weigh the remaining solid in the beaker of oxalic acid to find out mass of oxalic acid added, mass x . The total mass of oxalic dissolved will be mass $x - y$.
6. Repeat the experiment with same volume of ethanol.
7. The solvent which has greater mass of oxalic acid dissolved indicates that oxalic acid is more soluble in that solvent.

Markers comment: Several handfuls of students did not attempt the question. Many students were able to state the approach of dissolving the oxalic acid in solvents but cannot elaborate further. Students should note the difference between solubility and rate of dissolving.

[total: 4]