Mark Scheme (Results)

Summer 2025

Pearson Edexcel Level GCE Advance Subsidiary In Chemistry (8CH0)
Paper 01: Core Inorganic and Physical Chemistry

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

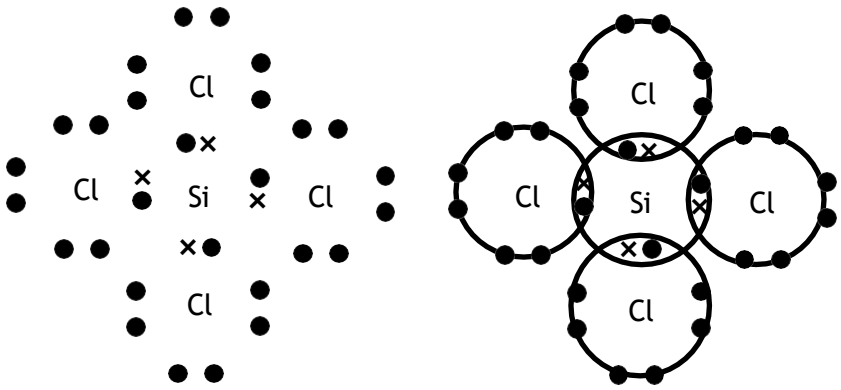
/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

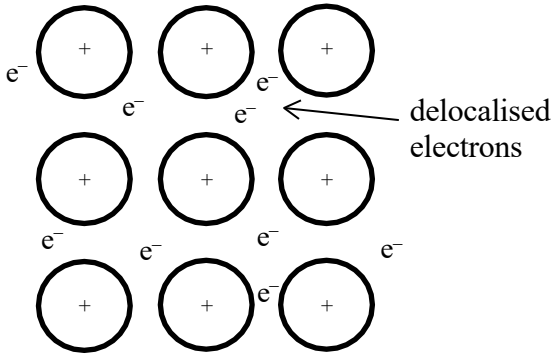
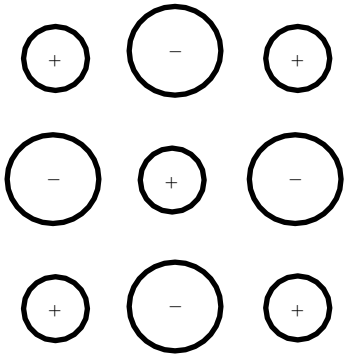
Question Number	Answer	Mark
1(a)	The only correct answer is **B** (a pair of electrons from a covalent bond) ***A*** *is not correct because electronegativity is defined as attracting a pair of electrons* ***C*** *is not correct because electronegativity refers to the attracting of electrons from a covalent bond not an atom* ***D*** *is not correct because electronegativity is defined as attracting the electrons from a covalent bond*	**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)	An answer that makes reference to the following points: • four bonding pairs of electrons and no lone pairs on the central silicon atom **(1)** • 3 lone pairs of electrons on each chlorine atom **(1)**	<u>Example of diagram</u>  Allow dots and crosses reversed Allow any symbols for electrons as long as two different symbols, one for chlorine and one for silicon All electrons the same scores M2 only	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)	An explanation that makes reference to the following points: • chlorine molecules are non-polar because there is no electronegativity difference between the atoms (so no dipole) **(1)** • the Si-Cl bond is polar / has a (permanent) dipole **(1)** • but the molecule is symmetrical so the dipole moments cancel out (so silicon tetrachloride is non-polar) **(1)**	Allow chlorine (3.0) is more electronegative than silicon (1.9) Allow tetrahedral for symmetrical	**(3)**

Question Number	Answer	Additional Guidance	Mark
1(d)	An explanation that makes reference to the following points: (chlorine has a lower boiling temperature because) chlorine and silicon tetrachloride both have London forces (holding the molecules together) **(1)** but chlorine has fewer electrons so the London forces are weaker **(1)**	Allow reverse arguments Allow (instantaneous) induced dipole – dipole forces, dispersion forces, van der Waals' forces for London forces	**(2)**

(Total for Question 1 = 8 marks)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	An answer that makes reference to the following points: • diagram for sodium showing singly positively charged ions is a regular array **(1)** • labelled delocalised electrons between the ions **(1)** • diagram of alternate cations and anions in a regular array **(1)**	 Allow any representation of an electron  Accept five negative ions to four positive ions Accept circles touching Ignore size of ions	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An explanation that makes reference to the following points: • (sodium metal has strong) electrostatic attractions between the positive ions / cations / Na^+ and the sea of delocalised electrons **(1)** • (sodium chloride has strong) electrostatic attractions between the oppositely charged ions **(1)**	Allow Na^+ and Cl^- / sodium and chloride ions / cation and anion If electrostatic is not mentioned award max 1 mark	**(2)**

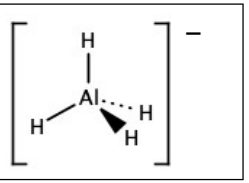
Question Number	Answer	Additional Guidance	Mark
2(a)(iii)	An answer that makes reference to the following point: • (the metallic) bonding in sodium are not as strong as (the ionic) bonding in sodium chloride	Allow reverse argument Allow more energy to overcome the bonds in sodium chloride than sodium	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(a)(iv)	An answer that makes reference to the following points: similarity • both conduct electricity when molten **(1)** differences • only sodium conducts electricity as a solid **(1)** • (free / delocalised) electrons carry the charge in sodium **and** ions carry the charge in sodium chloride **(1)**	Ignore conductivity of solutions of sodium chloride Allow sodium chloride only conducts when molten (and aqueous)	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	An answer that makes reference to the following point: • balanced equation	<u>Example of equation</u> $2Na + H_2 \rightarrow 2NaH$ Allow multiples Ignore state symbols, even if incorrect	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	An answer that makes reference to the following point: • $4NaH + AlCl_3 \rightarrow NaAlH_4 + 3NaCl$	Allow multiples Ignore 1 before $AlCl_3$ and $NaAlH_4$	**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	An answer that makes reference to the following points: • the bond is a dative (covalent) / coordinate bond **(1)** • a (lone) **pair** of electrons are donated from $H(^-)$ to Al **(1)**		**(2)**

Question Number	Answer	Mark
2(b)(iv)	The only correct answer is **D** (trigonal planar ) ***A*** *is not correct because there are no lone pairs on the aluminium in aluminium chloride and the tetrahydridoaluminate(III) ion is not planar* ***B*** *is not correct because there are no lone pairs on the aluminium in aluminium chloride* ***C*** *is not correct because the tetrahydridoaluminate(III) ion is not planar*	**(1)**

(Total for Question 2 = 14 marks)

Question Number	Answer	Mark
3(a)	The only correct answer is **C** (London forces, permanent dipoles and hydrogen bonds) ***A*** *is not correct because there also London forces and permanent dipoles between the molecules* ***B*** *is not correct because there are also hydrogen bonds between the molecules* ***D*** *is not correct because there are also London forces between the molecules*	**(1)**

Question Number	Answer	Mark
3(b)	The only correct answer is **C** (ethanol forms hydrogen bonds with water but ethanethiol does not) ***A*** *is not correct because although this is true it does not explain why ethanethiol does not dissolve and ethanol does* ***B*** *is not correct because although this is true it does not explain why ethanethiol does not dissolve in water* ***D*** *is not correct because although this is true it does not explain why ethanol dissolves and ethanethiol does not*	**(1)**

(Total for Question 3 = 2 marks)

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	An answer that makes reference to the following points: • hydrogen / H_2 **(1)** • burns with a (squeaky) pop (extinguishing / putting out the flame) **(1)**	Do not allow H	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	An answer that makes reference to the following points: • correct substances **(1)** • balancing and state symbols **(1)**	$Mg(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2(g)$ Allow $Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$	**(2)**

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	An answer that makes reference to the following point: • correct substances and balancing	$Mg + 4HNO_3 \rightarrow Mg(NO_3)_2 + 2NO_2 + 2H_2O$ Ignore state symbols even if incorrect	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	An answer that makes reference to the following point: • the gas is brown before bubbling through the UI solution **and** the gas is colourless afterwards		**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	An explanation that makes reference to the following points: • because the brown gas / NO_2 / nitrogen dioxide has been removed **(1)** • (the universal indicator goes red) because nitrogen dioxide is an acidic gas **(1)**	Allow nitric acid is formed	**(2)**

Question Number	Answer	Mark
4(b)(iii)	The only correct answer is **B** (236 cm^3) ***A*** *is not correct because this value assumes each large gradation is 5 cm^3 and each small gradation 1 cm^3* ***C*** *is not correct because this assumes each large gradation is 5 cm^3 and each small gradation 1 cm^3 reading up from 250 cm^3* ***D*** *is not correct because it is the value reading up from 250 cm^3*	**(1)**

Question Number	Answer	Additional Guidance	Mark
4(b)(iv)	• calculation of moles of magnesium nitrate **(1)** • calculation of moles of oxygen produced **(1)** • calculation of molar volume **(1)** • units corresponding to their volume **and** answer to 3 SF **(1)**	<u>Example of calculation</u> = 2.966 ÷ 148.3 = 0.0200 (mol) = 0.0200 ÷ 2 = 0.0100 (mol) = 236 ÷ 0.0100 = 23 600 cm^3 mol^{-1} / 23.6 dm^3 mol^{-1} Do not award just cm^3 / dm^3 Allow TE on volume of gas collected in (b)(iii) A = 21.8 dm^3 mol^{-1} C = 25.7 dm^3 mol^{-1} D = 26.4 dm^3 mol^{-1} Allow TE on an incorrect volume of gas other than those in (b)(iii) Allow TE throughout	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(b)(v)	An answer that makes reference to the following points: • the volume is read to 3 significant figures (whereas all the other data is to 4 significant figures) **(1)** • this is the least number of significant figures for the data used in this calculation **(1)**	Allow the measuring cylinder volume can be read to the nearest 1 cm^3 Ignore references to accuracy and precision	**(2)**

(Total for Question 4 = 15 marks)

Question Number	Answer	Additional Guidance	Mark
5(a)(i)	An answer that makes reference to the following points: • Zn $(1s^2)\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2$ **(1)** • Mg^{2+} $(1s^2)\ 2s^2\ 2p^6$ **(1)**	Allow $(1s^2)\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(a)(ii)	An answer that makes reference to the following points: • (both atoms) have a large jump in energy between second and third ionisation energies **(1)** • The third electron is removed from a new (sub-)shell **(1)**	Allow both have a relatively low first and second ionisation energy	**(2)**

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	An answer that makes reference to the following points: • correct number of protons **and** neutrons	<table><tr><th></th><th>Number of protons</th><th>Number of neutrons</th></tr><tr><td>$^{64}_{30}Zn$</td><td>30</td><td>34</td></tr></table>	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(ii)	An answer that makes reference to the following points: • the mass is measured relative to carbon-12	Allow the masses of protons and neutrons are not exactly 1 (amu) / integers	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iii)	• calculation of abundance of the fifth isotope **(1)** • expression for calculation of relative atomic mass **(1)** • calculation of relative isotopic mass to 3.d.p. **(1)** • formula of isotope **(1)**	Example of calculation = 100 − 48.63 − 27.90 − 4.10 − 0.62 = 18.75 65.396 = ((63.929 × 48.63) + (65.926 × 27.90) + (66.927 × 4.10) + (69.925 × 0.62) + (rel. iso. mass × 18.75)) ÷ 100 OR 65.396 = (5266.0 + (rel. iso. mass × 18.75)) ÷ 100 OR (rel. iso. mass × 18.75) = 6539.6 − (63.929 × 48.63) + (65.926 × 27.90) + (66.927 × 4.10) + (69.925 × 0.62) OR (rel. iso. mass × 18.75) = 6539.6 − 5266.0 = 1273.6 = 67.928 $^{68}_{30}Zn$ Value for relative isotopic mass to 3 d.p. scores 3 Value for relative isotopic mass to other decimal places scores 2 Final formula with no working scores 1 Allow TE throughout	**(4)**

Question Number	Answer	Additional Guidance	Mark
5(b)(iv)	• calculation of Avogadro's number to 4 or 5 SF	Example of calculation $= 63.929 \div 1.06157 \times 10^{-22}$ $= 6.0221 \times 10^{23}$	**(1)**

Question Number	Answer	Additional Guidance	Mark
5(c)	• calculation of mass of water lost **(1)** • calculation of moles of water lost **(1)** • calculation of moles of anhydrous zinc sulfate **(1)** • calculation of final value of x giving x as an integer **(1)**	<u>Example of calculation</u> = 450 – 253 = 197 (mg) = 197 ÷ 18 = 10.944 (mmol) = 253 ÷ 161.5 = 1.5666 (mmol) = 10.944 ÷ 1.5666 = 6.9861 ≈ 7 Therefore x = 7 Final answer with some working scores 4 Final answer must be an integer Allow TE throughout Ignore SF except 1 SF in working	**(4)**

(Total for Question 5 = 15 marks)

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	An explanation that makes reference to the following points: • because H_2S / I_2 (gas) is toxic (by inhalation) / poisonous / corrosive **(1)** • so it is not released into the laboratory / is not breathed in **(1)**	Allow H_2S is hazardous for the environment (1) If not other mark is scored allow H_2S has an unpleasant / foul smell so fume cupboard is used to prevent release into the lab / prevent it being smelled for (1)	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	An answer that makes reference to any two of the following points: • formation of a black / grey solid **(1)** • formation of a purple vapour **(1)** • effervescence • condensation		**(2)**

Question Number	Answer	Mark
6(b)	The only correct answer is **A** (from +6 to −2) ***B*** *is not correct because this assumes that each H in* H_2S *is* -1 ***C*** *is not correct because this assumes that the oxidation number of O is* -1 ***D*** *is not correct because the oxidation number of one of the S atoms does change*	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(c)	An answer that makes reference to the following points: • oxidation half-equation **(1)** • reduction half-equation **(1)**	 $2I^- \rightarrow I_2 + 2e^{(-)}$ $H_2SO_4 + 8H^+ + 8e^{(-)} \rightarrow H_2S + 4H_2O$ / $SO_4^{2-} + 10H^+ + 8e^{(-)} \rightarrow H_2S + 4H_2O$ Allow multiples Ignore state symbols even if incorrect	**(2)**

Question Number	Answer	Additional Guidance	Mark
6(d)(i)	An answer that makes reference to the following point: • hydrogen chloride / HCl((g))	 Allow hydrochloric acid or HCl (aq)	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(d)(ii)	An explanation that makes reference to the following points: • the chloride (ion) does not reduce concentrated sulfuric acid (as no redox reaction occurs) **(1)** • so iodide (ion) is a stronger reducing agent / chloride (ion) is a weaker reducing agent **(1)**	Allow chloride remains −1 during the reaction Allow chloride does not change its oxidation state during the reaction Allow the reaction between potassium chloride and concentrated sulfuric acid is an acid-base reaction MP2 dependent on MP1 Ignore values for changes in oxidation number of sulfur for iodide ion reaction even if incorrect	**(2)**

(Total for Question 6 = 10 marks)

Question Number	Answer	Additional Guidance	Mark
7(a)	An explanation that makes reference to the following points: (the outer electrons are closer to the nucleus because) • (outermost) electrons are in the same shell **(1)** • and the number of protons / nuclear charge increases (so the attraction for the nucleus is greater) **(1)**	Allow same shielding / number of shells	**(2)**

Question Number	Answer	Mark
7(b)	The only correct answer is **C** ($\frac{1}{2}N_2(g) - e^- \rightarrow N^+(g)$) as the nitrogen is a molecule and not an atom ***A*** *is not correct because first ionisation energy is the removal of 1 mol of electrons from 1 mol of gaseous atoms* ***B*** *is not correct because first ionisation energy is the removal of 1 mol of electrons from 1 mol of gaseous atoms* ***D*** *is not correct because first ionisation energy is the removal of 1 mol of electrons from 1 mol of gaseous atoms*	**(1)**

Question Number	Answer	Mark
7(c)	The only correct answer is **B** (Mg^{2+}) ***A*** *is not correct because the outermost electrons in all these ions are in the same shell and magnesium has the greatest number of protons* ***C*** *is not correct because the outermost electrons in all these ions are in the same shell and magnesium has the greatest number of protons* ***D*** *is not correct because the outermost electrons in all these ions are in the same shell and magnesium has the greatest number of protons*	**(1)**

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>*7(d)</td>
<td>
This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.

Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.

The following table shows how the marks should be awarded for indicative content.

<table>
<tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5–4</td><td>3</td></tr>
<tr><td>3–2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>

The following table shows how the marks should be awarded for structure and lines of reasoning.

<table>
<tr><th></th><th>Number of marks awarded for structure of answer and sustained line of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout.</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning.</td><td>1</td></tr>
<tr><td>Answer has no linkages between points and is unstructured.</td><td>0</td></tr>
</table>
</td>
<td>
Guidance on how the mark scheme should be applied:

The mark for indicative content should be added to the mark for lines of reasoning.

For example, an answer with five indicative marking points, which is partially structured with some linkages and lines of reasoning, scores 4 marks (3 marks for indicative content and 1 mark for partial structure and some linkages and lines of reasoning).

If there are no linkages between points, the same five indicative marking points would yield an overall score of 3 marks (3 marks for indicative content and no marks for linkages).

In general it would be expected that 5 or 6 indicative points would get 2 reasoning marks, and 3 or 4 indicative points would get 1 mark for reasoning, and 0, 1 or 2 indicative points would score zero marks for reasoning.

Reasoning marks may be reduced for extra incorrect chemistry.
</td>
<td>(6)</td>
</tr>
</table>

Question Number	Acceptable Answer	Additional Guidance	Mark
*7(d) contd	**Indicative content:** • IP1 - general trend (Ionisation energy increases in general across Period 3) as the number of protons in the nucleus / nuclear charge increases • IP2 - shells The electrons are in the same shell • IP3 - Group 3 / aluminium (The first ionisation energy for aluminium is less than for magnesium) suggesting the electron has increased shielding • IP4 - s-subshell and p-subshells The aluminium electron is a p-orbital (which is shielded by the s-orbitals) while the magnesium electron is in the s-orbital • IP5 - Group 6 / sulfur (The first ionisation energy of sulfur is less than that of phosphorus) as the electron is being removed from an orbital containing two electrons / (spin) pairing has occurred • IP6 - spin-pair repulsion There is repulsion between the electrons (so the electron is lost more easily) **or** Half filled (sub-) shell is stable	Allow same shielding / same distance from the nucleus Ignore reference to atomic radius Ignore suggesting they are further from the nucleus Allow new subshell / orbital further from the nucleus (that its own s-subshell / orbital) Do not award the aluminium electron is further from the nucleus than the magnesium electron Allow orbital for sub-shell	**(6)**

(Total for Question 7 = 10 marks)

Question Number	Answer		Additional Guidance	Mark
8			<u>Example of calculation</u>	**(6)**
	• calculation of mass of water **and** mass of carbon dioxide	**(1)**	36.74 – 36.34 = 0.40 (g) 37.23 – 35.28 = 1.95 (g)	
	• calculation of moles of water **and** moles of hydrogen	**(1)**	(0.40 ÷ 18) = 0.0222222 (mol) × 2 = 0.044444 (mol)	
	• calculation of moles of carbon dioxide / carbon	**(1)**	1.95 ÷ 44 = 0.044318 (mol)	
	Either • calculation of sum of mass of carbon and hydrogen **and** moles of iron	**(1)**	= 0.044444 + (0.044318 × 12) = 0.57626 (g) = 0.830 – 0.57626 = 0.25374 = 0.25374 ÷ 55.8 = 0.0045473	
	• calculation of empirical formula		Fe : C : H = 1 : 9.8 : 9.8	
	• calculation of empirical formula mass **and** molecular mass = 186	**(1)**	= $FeC_{10}H_{10}$ = 55.8 + (12 × 10) + 10 = 185.8	

	Or • calculation of moles of ferrocene **and** ratio in ferrocene • calculation of M_r of $C_{10}H_{10}$ **and** calculation of mass of iron • calculation of moles of iron in formula **and** deduction of formula	**(1)** **(1)** **(1)** **(1)**	0.830 ÷ 186 = 0.0044624 (mol) Ferrocene:C:H = 0.00446:0.0443:0.0444 = 1:10:10 (12 × 10) + 10 = 130 and 186 - 130 = 56 (56 ÷ 56 = 1) so Fe is 1 and So molecular formula is $FeC_{10}H_{10}$	

(Total for Question 8 = 6 marks)

TOTAL FOR PAPER = 80 MARKS

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