

# Mark Scheme (Results)

January 2015

Pearson Edexcel International GCSE in  
Chemistry (4CH0) Paper 2C

Pearson Edexcel Certificate in  
Chemistry (4CH0) Paper 2C

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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.

Question number	Answer	Accept	Reject	Marks
1 (a)	D (a molecule)			1
(b)	A (covalent)			1
(c)	NH <sub>3</sub>	H <sub>3</sub> N		1

**Total 3 marks**

Question number	Answer	Accept	Reject	Marks
2 (a) (i)	(solubility/it) increases as temperature increases	positive correlation	references to proportionality	1
(ii)	(solid) B			1
(b)	<b>M1</b> – solid/crystals would form	precipitate for solid goes cloudy		1
	<b>M2</b> – (solid A) becomes less soluble (as the solution cools) / solubility (of solid A) decreases (as temperature decreases)	reverse argument		1

**Total 4 marks**

Question number	Expected Answer	Accept	Reject	Marks										
3 (a)	<b>M1</b> P – iron ore / haematite ignore iron(III) oxide/ $\text{Fe}_2\text{O}_3$ <b>M2 Q</b> - calcium silicate	slag / $\text{CaSiO}_3$		2										
(b)	<table border="1" data-bbox="302 466 976 775"> <thead> <tr> <th data-bbox="302 466 761 528">Type of reaction</th> <th data-bbox="761 466 976 528">Letter</th> </tr> </thead> <tbody> <tr> <td data-bbox="302 528 761 590">one that gives out heat</td> <td data-bbox="761 528 976 590">A</td> </tr> <tr> <td data-bbox="302 590 761 652">one that is a thermal decomposition</td> <td data-bbox="761 590 976 652">D ;</td> </tr> <tr> <td data-bbox="302 652 761 715">one that is a neutralisation</td> <td data-bbox="761 652 976 715">E ;</td> </tr> <tr> <td data-bbox="302 715 761 775">one that forms a poisonous gas</td> <td data-bbox="761 715 976 775">B ;</td> </tr> </tbody> </table>	Type of reaction	Letter	one that gives out heat	A	one that is a thermal decomposition	D ;	one that is a neutralisation	E ;	one that forms a poisonous gas	B ;			3
Type of reaction	Letter													
one that gives out heat	A													
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one that forms a poisonous gas	B ;													
(c)	<b>M1</b> - oxygen <b>IGNORE O</b> <b>M2</b> – water	air $\text{O}_2$ moisture/ $\text{H}_2\text{O}$		2										

(d)	<p><b>M1</b> zinc corrodes/reacts instead of iron / faster than iron</p> <p><b>M2</b> iron corrodes/reacts instead of tin / faster than tin</p> <p>lack of comparison with other metal max 1 from <b>M1</b> and <b>M2</b> ignore references to tin rusting</p> <p><b>M3</b> correct reference to order of reactivity of all three metals</p>	<p>zinc loses electrons/is oxidised instead of iron</p> <p>iron loses electrons/is oxidised instead of tin</p> <p>accept reverse arguments</p>	<p>zinc rusts (instead of iron)</p>	<p>3</p>
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**Total 10 marks**

Question number	Answer	Accept	Reject	Marks
4(a)(i)	fermentation			1
(ii)	(to provide the) catalyst/enzyme/zymase	to increase the rate of the reaction		1
(b)(i)	<b>M1</b> (test) – flame test	suitable description of flame test		2
	<b>M2</b> (observation) – brick red / orange-red	red		
(ii)	copper(II) ions:	accept other suitable alkalis		5
	<b>M1</b> (test) – (aqueous) sodium hydroxide / NaOH	suitable alternatives to precipitate	all other colours	
	<b>M2</b> (observation) – blue precipitate ignore shades of blue			
	<b>M2</b> dep on <b>M1</b> or near miss of formula, eg Na(OH) <sub>2</sub>			
	sulfate ions:	(dilute) nitric acid / HNO <sub>3</sub>		
	<b>M1</b> (test) – (dilute) hydrochloric acid / HCl	(aqueous) barium nitrate / Ba(NO <sub>3</sub> ) <sub>2</sub>	Reject sulfuric acid for <b>M1</b> only	
	<b>M2</b> (test) - (aqueous) barium chloride / BaCl <sub>2</sub>			
	<b>M3</b> (observation) – white precipitate			
	<b>M3</b> dep on <b>M2</b> or near miss			



Question number	Answer	Accept	Reject	Marks
4 (c)	<p><b>M1</b> (pressure) – 60-70 atm</p> <p><b>M2</b> (catalyst) – phosphoric acid / <math>\text{H}_3\text{PO}_4</math> ignore references to concentration</p>	<p>any pressure or range within this range</p> <p>phosphoric(V) acid</p>	any other oxidation state	2
(d)	<p><b>M1</b> (<math>\Sigma</math> bonds broken) 348 + 412 + 360 (= 1120)</p> <p><b>M2</b> (<math>\Sigma</math> bonds made) 612 + 463 (= 1075)</p> <p><b>M3</b> <b>M1</b> – <b>M2</b> / <math>\Sigma</math> bonds broken – <math>\Sigma</math> bonds made</p> <p><b>M4</b> (+)45 (kJ/mol)</p> <p>Correct answer with no working scores 4</p> <p>– 45 (kJ/mol) scores 3</p>	<p>3231</p> <p>3186</p>		4

**Total 15 marks**

Question number	Answer		Accept	Reject	Marks						
5 (a)	<table border="1"> <tr> <td data-bbox="293 276 676 312"><b>M1</b> temperature after</td> <td data-bbox="676 276 831 312">27.1</td> </tr> <tr> <td data-bbox="293 312 676 349"><b>M2</b> temperature before</td> <td data-bbox="676 312 831 349">18.8</td> </tr> <tr> <td data-bbox="293 349 676 416"><b>M3</b> temperature change</td> <td data-bbox="676 349 831 416">(+) 8.3</td> </tr> </table>	<b>M1</b> temperature after	27.1	<b>M2</b> temperature before	18.8	<b>M3</b> temperature change	(+) 8.3	<p>Recorded temperatures correct but in wrong order scores 1 for <b>M1</b> and <b>M2</b> <b>M3</b> csq on <b>M1</b> and <b>M2</b></p>	one trailing zero	more than one trailing zero	3
<b>M1</b> temperature after	27.1										
<b>M2</b> temperature before	18.8										
<b>M3</b> temperature change	(+) 8.3										
(b)	<p><b>M1</b> heat (energy) /thermal energy lost (to the atmosphere) ignore just energy lost</p> <p><b>M2</b> potassium hydroxide dissolves (very/too) slowly</p>		<p>water evaporates</p> <p>potassium hydroxide does not completely dissolve</p> <p>potassium hydroxide is impure</p> <p>less than 3 g of potassium hydroxide is used</p> <p>more than 50 cm<sup>3</sup> of water is used</p>		2						

**Total 5 marks**

Question number	Answer				Accept	Reject	Marks
6 (a)	<b>Element</b>	<b>Arrangement of electrons in atom</b>	<b>Arrangement of electrons in ion</b>	<b>Charge on ion</b>	K <sup>(1)+</sup> / K <sup>+1</sup>  S <sup>2-</sup> / S <sup>-2</sup>  positive for potassium and negative for sulfide for 1 mark		3
			2.8.8	(1)+/+1			
			2.8.8	2-/-2			
<p><b>M1</b> – <u>both</u> arrangements correct</p> <p><b>M2</b> – charge on potassium ion</p> <p><b>M3</b> – charge on sulfide ion</p>							
(b) (i)	<u>ions</u> move/travel (to the electrodes)				<u>ions</u> are free to move / <u>ions</u> are mobile	electrons free to move	1
(b) (ii)	<p><b>M1</b> (electrostatic) forces (of attraction) between (oppositely charged) <u>ions</u></p> <p><b>M2</b> are (relatively) strong</p> <p><b>M3</b> large amount of energy required to overcome the forces / separate the ions from the lattice</p> <p><b>M2</b> dep on mention of forces (of attraction) or bonds</p> <p>Mention of covalent bonds or intermolecular forces no <b>M1</b></p>				<p><u>ionic</u> bonding / <u>ionic</u> bonds</p> <p>break the bonds</p>		3

**Total 7 marks**

Question number	Answer	Accept	Reject	Marks
7 (a)	$\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$	multiples and fractions		1
(b)	<p><b>M1</b> 32 (of S) <math>\rightarrow</math> 80 (of <math>\text{SO}_3</math>) (tonnes or g)</p> <p><b>M2</b> mass of <math>\text{SO}_3 = \frac{80}{32} \times 80</math></p> <p><b>M3</b> = 200 (tonnes)</p> <p><b>M2 csq on M1</b></p> <p><b>M3 csq on M2</b></p> <p>Correct answer with no working scores 3</p>	<p><b>M1</b> <math>n(\text{S}) = (n(\text{SO}_3)) = \frac{80 \times 10^6}{32}</math> (mol) (= 2 500 000 (mol))</p> <p><b>M2</b> mass of <math>\text{SO}_3 = \mathbf{M1 \times 80 (= 200\ 000\ 000\ (g))}</math></p> <p><b>M3</b> = <math>\mathbf{M2} \div 10^6 / 200</math> (tonnes)</p>		3
(c)	<p><b>M1</b> 64 (g) (of <math>\text{SO}_2</math>) reacts with 12 (<math>\text{dm}^3</math>) (of <math>\text{O}_2</math>)</p> <p><b>M2</b> (64 tonnes) reacts <math>12 \times 10^6</math> (<math>\text{dm}^3</math>) OR <math>1.2 \times 10^7</math> (<math>\text{dm}^3</math>)</p> <p><b>M2 csq on M1</b></p> <p>Correct answer with no working scores 2</p>	<p><b>M1</b> <math>n(\text{SO}_2) = \frac{64 \times 10^6}{64}</math> (mol) (= <math>10^6</math> mol)</p> <p><b>M2</b> <math>\frac{\mathbf{M1}}{2} \times 24 / 1.2 \times 10^7</math> (<math>\text{dm}^3</math>)</p> <p>OR</p> <p><b>M1</b> mass of oxygen</p> <p>accept <math>1.2 \times 10^{10}</math> <u><math>\text{cm}^3</math></u></p>		2

**Total 6 marks**

Question number	Answer	Accept	Reject	Marks
8	<p><b>M1</b> – add (aqueous) chlorine to (aqueous) KBr</p> <p><b>M2</b> – (solution) turns orange</p> <p><b>M3</b> – add (aqueous) bromine to (aqueous) KI</p> <p><b>M4</b> - (solution) turns brown</p> <p><b>M5</b> – <math>\text{Cl}_2 + 2\text{KBr} \rightarrow \text{Br}_2 + 2\text{KCl}</math></p> <p>OR</p> <p><math>\text{Br}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KBr}</math></p> <p>Ignore state symbols</p>	<p>yellow / brown</p> <p>red-brown / orange</p> <p>correct ionic equations</p> <p>accept <math>\text{Cl}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KCl}</math> if chlorine is added to potassium iodide</p>	<p>red</p> <p>yellow</p>	5

**Total 5 marks**

Question number	Answer	Accept	Reject	Marks
8	<p><b>M1</b> – add (aqueous) bromine to (aqueous) KCl</p> <p><b>M2</b> – no change</p> <p><b>M3</b> – add (aqueous) iodine to (aqueous) KBr</p> <p><b>M4</b> - no change / no change</p> <p>If this route is chosen then <b>M5</b> cannot be scored</p>	<p>orange / yellow / brown solution/colour produced only if it is clear that no reaction has occurred</p> <p>brown / red-brown / orange solution/colour produced only if it is clear that no reaction has occurred</p>	<p>red</p> <p>yellow</p>	5

**Total 5 marks**

Question number	Answer	Accept	Reject	Marks
9 (a)(i)	shifts to left	moves in the endothermic direction		1
(ii)	shifts to the right	shifts to the side of the reactants OWTTE		1
(iii)	impossible to know which shift is greater / impossible to know which change has the greater effect	moves in the exothermic direction shifts to the side of the products OWTTE shifts to the side with fewer (gas) moles/molecules  OWTTE the (two) effects are opposing one another		1
(b)	<b>M1</b> – greater proportion of NO <sub>2</sub>  <b>M2</b> – (increase of) temperature has a greater effect than (increase of) pressure	more NO <sub>2</sub> present equilibrium shifts to left		2

**Total 5 marks**

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