



# **Mark Scheme (Results)**

January 2017

International GCSE  
Chemistry (4CH0) Paper 2C

Pearson Edexcel Certificate in  
Chemistry (KCH0) Paper 2C

## **Edexcel and BTEC Qualifications**

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at [www.edexcel.com](http://www.edexcel.com) or [www.btec.co.uk](http://www.btec.co.uk). Alternatively, you can get in touch with us using the details on our contact us page at [www.edexcel.com/contactus](http://www.edexcel.com/contactus).

## **Pearson: helping people progress, everywhere**

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: [www.pearson.com/uk](http://www.pearson.com/uk)

January 2017

Publications Code 4CH0\_2C\_1701\_MS

All the material in this publication is copyright

© Pearson Education Ltd 2017

## General Marking Guidance

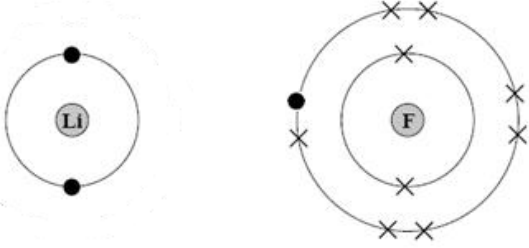
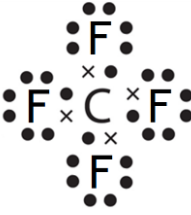
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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	Notes	Marks
1 (a)	air		1
(b)	hydrogen	<b>ACCEPT</b> H <sub>2</sub> <b>IGNORE</b> H	
(c)	chlorine	<b>ACCEPT</b> Cl <sub>2</sub> <b>IGNORE</b> Cl	1
(d)	chlorine	<b>ACCEPT</b> Cl <sub>2</sub> <b>IGNORE</b> Cl	1
(e)	iron	<b>ACCEPT</b> Fe	1
		<b>Total</b>	<b>5</b>

Question number	Answer	Notes	Marks
2 (a) (i)	(both are) solids  <b>AND</b>  (both) form alkaline solutions (in water)	<b>ALLOW</b> (both are) <u>slightly</u> soluble	1
(ii)	(both are) gases  <b>AND</b>  (both) form acidic solutions (in water)		1
(b) (i)	the oxide is solid		1
(ii)	the oxide forms an acidic solution (in water)		1
(c)	<b>M1</b> the lamp does not light up  <b>M2</b> (so this shows that) phosphorus/it does not conduct electricity	<b>ACCEPT</b> reverse arguments	2
		<b>Total</b>	<b>6</b>

Question number	Answer	Notes	Marks
3 (a)	<p><b>M1</b> calcium is the most reactive; titanium is the second most reactive; tin is the least reactive</p> <p>OR</p> <p>calcium most reactive <b>AND</b> tin least reactive</p> <p><b>M2</b> (because) titanium displaces tin</p> <p><b>M3</b> (and because) titanium does not displace calcium</p>	<p><b>ACCEPT</b> Ca &gt; Ti &gt; Sn</p> <p><b>ACCEPT</b> replaces</p> <p><b>ACCEPT</b> replaces</p>	3
(b) (i)	$2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$	<p><b>ACCEPT</b> multiples and halves</p>	1
(ii)	<p><b>M1</b> aluminium</p> <p><b>M2</b> because it has gained oxygen</p> <p>OR</p> <p>because it has lost electrons</p> <p>OR</p> <p>because its oxidation number has increased</p> <p>OR</p> <p>because its oxidation number has changed from 0 to +3</p>	<p><b>M2</b> DEP on <b>M1</b></p>	2
(iii)	<p><b>M1</b> (powders have) larger surface area</p> <p><b>M2</b> (therefore) faster reaction</p>	<p><b>ACCEPT</b> reverse arguments</p> <p><b>IGNORE</b> references to collisions between particles</p>	2
		<b>Total</b>	<b>8</b>

Question number	Answer	Notes	Marks
4 (a)	<b>D</b> ( $\text{NH}_4^+$ )		1
(b)	<b>D</b> ( $\text{I}^-$ )		1
(c)	<b>A</b> (carbonate)		1
(d)	<b>C</b> (blue, green, brown)		1
(e)	<b>A</b> (carbonate)		1
		<b>Total</b>	<b>5</b>

Question number	Answer	Notes	Marks
5 (a)		<p>1 mark for each correct ion</p> <p><b>IGNORE</b> charges on ion</p> <p><b>ALLOW</b> any combination of dots and crosses</p> <p>Diagram showing sharing of electrons scores 0</p>	2
(b)		<p><b>M1</b> all four bonding pairs correct, and only 8 electrons shown in outer shell of carbon</p> <p><b>M2</b> all non-bonding pairs correct</p> <p><b>IGNORE</b> inner shells even if incorrect</p> <p>If rings are drawn then both bonding electrons must be in the overlapping area</p> <p><b>M2</b> DEP on <b>M1</b></p>	2



Question number	Answer	Notes	Marks
(c)	<p><b>M1</b> (high melting point of LiF) strong forces (of attraction) between (oppositely charged) ions / strong forces (of attraction) between <math>\text{Li}^+</math> and <math>\text{F}^-</math></p> <p><b>M2</b> (good conductivity of LiF) ions are mobile</p> <p><b>M3</b> (low melting point of <math>\text{CF}_4</math>) weak forces (of attraction) between molecules / weak intermolecular forces (of attraction)</p> <p><b>M4</b> (poor conductivity of <math>\text{CF}_4</math>) molecules are not charged / molecules are neutral / no charged particles</p>	<p><b>ACCEPT</b> strong (ionic) bonding / strong (ionic) bonds <b>ACCEPT</b> large amount of energy required to overcome the forces between the ions/break (ionic) bonds <b>REJECT</b> any reference to molecules or intermolecular forces <b>REJECT</b> reference to atoms</p> <p><b>ACCEPT</b> ions can move <b>REJECT</b> any reference to electrons are mobile/delocalised electrons</p> <p><b>ACCEPT</b> weak van der Waals forces / weak London forces / weak dispersion forces <b>ACCEPT</b> very little energy required to overcome the intermolecular forces. <b>ALLOW</b> weak intermolecular bonds <b>REJECT</b> any references to covalent bonds broken</p> <p><b>IGNORE</b> no free electrons/all electrons used in bonding <b>IGNORE</b> there are no ions <b>ALLOW</b> no delocalised / no mobile electrons</p>	4
		<b>Total</b>	<b>8</b>

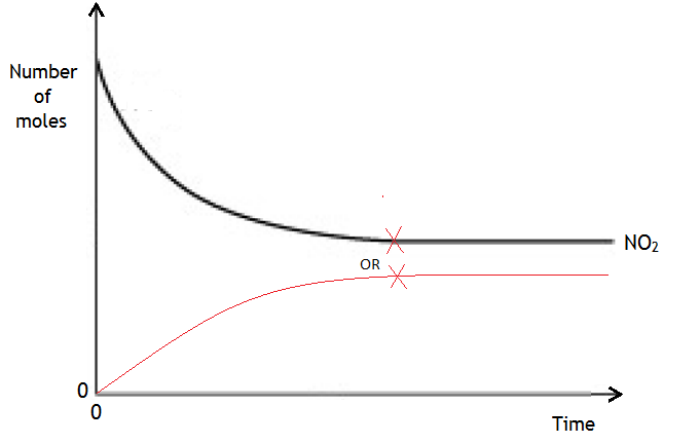
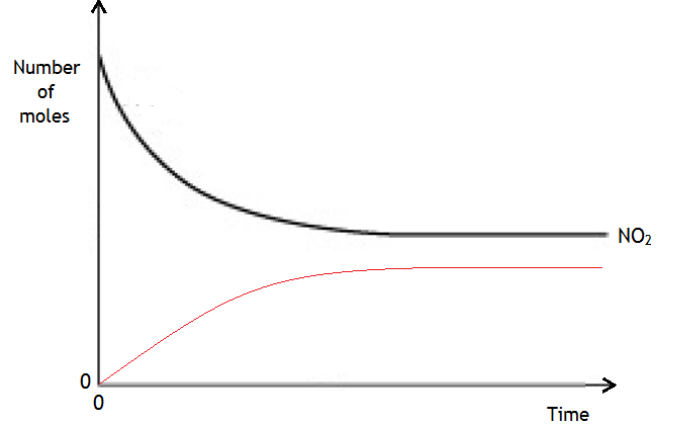
Question number	Answer	Notes	Marks
6 (a) (i)	(to provide the) zymase/enzyme (that acts as a catalyst)	<b>ALLOW</b> (to act as a) catalyst <b>ALLOW</b> to increase the rate of reaction <b>IGNORE</b> to lower the activation energy <b>IGNORE</b> to start the reaction <b>REJECT</b> to provide (activation) energy	1
(ii)	(turns) milky / cloudy / turbid (then clear)		1
	OR		
	<u>white</u> precipitate / <u>white</u> suspension / <u>white</u> solid (forms then disappears)		
(iii)	30 °C	<b>ACCEPT</b> any temperature, or range of temperatures, between 25 and 40 °C	1

Question number	Answer	Notes	Marks
(b)	<p><b>Route 1:</b></p> <p><b>M1</b> <math>\Sigma(\text{bonds broken}) =</math>  <math>348 + (5 \times 412) + 360 + 463 + (3 \times 496)</math>  OR  4719 (kJ/mol)</p> <p><b>M2</b> <math>\Sigma(\text{bonds made}) = (4 \times 743) + (6 \times 463)</math>  OR  5750 (kJ/mol)</p> <p><b>Route 2:</b></p> <p><b>M1</b> <math>\Sigma(\text{bonds broken}) =</math>  <math>348 + (5 \times 412) + 360 + (3 \times 496)</math>  OR  4256 (kJ/mol)</p> <p><b>M2</b> <math>\Sigma(\text{bonds made}) = (4 \times 743) + (5 \times 463)</math>  OR  5287 (kJ/mol)</p> <p><b>M3</b> <math>4719 - 5750</math> (kJ/mol) / <b>M1 - M2</b></p> <p><b>M4</b> - 1031 (kJ/mol)  OR  correct evaluation of <b>M3</b></p>	<p><b>IGNORE</b> negative sign</p> <p><b>IGNORE</b> negative sign</p> <p>Sign required  <b>ACCEPT</b> answers given to three significant figures</p> <p>Correct answer with no working scores 4  + 1031 (kJ/mol) scores 3</p>	4

Question number	Answer	Notes	Marks
6 (c) (i)	<p><b>M1</b> 32</p> <p><b>M2</b> <math>(32 \times 15.6) = 500</math> (kJ)</p> <p>OR</p> <p><b>M1</b> <math>\times 15.6</math> correctly evaluated</p>	<p><b>ACCEPT</b> 499 / 499.2</p> <p>Correct answer with no working scores 2</p>	2
(ii)	<p><b>M1</b> &amp; <b>M2</b> Any two from:</p> <ul style="list-style-type: none"> <li>• mass of water / volume of water / amount of water</li> <li>• distance of flame from the can</li> <li>• length of wick</li> </ul>	<p><b>IGNORE</b> temperature of water (at start)</p> <p><b>ALLOW</b> distance of burner from can</p>	2
(iii)	<p>Any two from:</p> <p><b>M1</b> heat (energy)/thermal energy is lost (to /surroundings)</p> <p><b>M2</b> incomplete combustion (of the fuel)</p> <p><b>M3</b> evaporation of water/fuel</p>	<p><b>IGNORE</b> just energy lost</p> <p><b>IGNORE</b> not all of the ethanol is burned</p>	2
<b>Total</b>			<b>13</b>

Question number	Answer	Notes	Marks
7 (a) (i)	<p><b>M1</b> 0.080 mol of HCl react with 0.040 mol of MgCO<sub>3</sub></p> <p><b>M2</b> 0.050 &gt; 0.040</p>	<p><b>ACCEPT</b> any method involving correct ratios of moles, eg HCl to MgCO<sub>3</sub> is 2:1 0.08 to 0.05 is 2:1.25</p> <p><b>ACCEPT</b> correct calculations involving masses</p>	2
(ii)	<p><b>M1</b> <math>n(\text{CO}_2) = \frac{1}{2} \times 0.08(0)</math> OR <math>0.04(0)</math></p> <p><b>M2</b> <math>\text{vol}(\text{CO}_2) = (0.04(0) \times 24\,000)</math> <math>= 960 \text{ (cm}^3\text{)}</math></p> <p>OR</p> <p><b>M1</b> <math>\times 24\,000</math> correctly evaluated</p>	<p>Correct answer with no working scores 2</p> <p>1920 (cm<sup>3</sup>) scores 1 mark</p>	2
(b) (i)	<p><b>M1</b> <math>M_r(\text{MgCl}_2 \cdot 6\text{H}_2\text{O}) = 203</math></p> <p><b>M2</b> % yield = <math>((5.5 \div (203 \times 0.050)) \times 100)</math> <math>= 54</math></p>	<p><b>M2</b> CSQ on <b>M1</b></p> <p><b>ACCEPT</b> any number of significant figures except one (eg reject 50)</p> <p>Calculator value is 54.1871921182</p> <p><b>REJECT</b> answers &gt; 100</p>	2
(ii)	<p>Any one of:</p> <ul style="list-style-type: none"> <li>some of the crystals remained in the filtrate (after cooling and filtration)</li> <li>the solution was not allowed to cool for long enough (for complete crystallisation)</li> <li>magnesium carbonate is impure</li> </ul>	<p><b>IGNORE</b> references to side reactions</p> <p><b>REJECT</b> not all of the magnesium carbonate reacted</p>	1
<b>Total</b>			<b>7</b>

Question number	Answer	Notes	Marks
8 (a)	<p><b>M1</b> rate of forward reaction = rate of backward reaction</p> <p><b>M2</b> concentrations of reactants/products remain/stay constant</p>	<p><b>IGNORE</b> forward reaction = backward reaction</p> <p><b>ACCEPT</b> amounts/masses for concentrations <b>ACCEPT</b> do not change for remain constant <b>ALLOW</b> colour remains constant <b>ALLOW</b> pressure remains constant <b>IGNORE</b> concentrations/amounts of reactants and products are the same/are equal</p>	2

Question number	Answer	Notes	Marks
8 (b) (i)	 <p data-bbox="231 795 845 862">cross drawn on either curve just where it becomes horizontal</p> 		1
(ii)	<p data-bbox="231 1366 885 1444"><b>M1</b> curve starts at 0,0 and has the general shape shown</p> <p data-bbox="231 1467 885 1579"><b>M2</b> curve becomes horizontal at approximately the same time as the original curve</p> <p data-bbox="231 1612 885 1657"><b>M3</b> curve finishes below original curve</p>	<p data-bbox="949 1624 1388 1736"><b>M2</b> and <b>M3</b> DEP on <b>M1</b> or near miss (eg curve does not start at exactly 0,0)</p>	3

Question number	Answer	Notes	Marks
8 (c)	<p><b>M1</b> equilibrium has shifted to the left / equilibrium has shifted to the NO<sub>2</sub> side / equilibrium has shifted to the reactants side</p> <p>OR</p> <p>more NO<sub>2</sub> has been produced / more reactants have been produced</p> <p><b>M2</b> (therefore) backward reaction is endothermic</p>	<p><b>IGNORE</b> references to Le Chatelier's principle eg an increase in temperature favours the reaction that reduces the temperature</p> <p><b>ACCEPT</b> (forward) reaction is exothermic</p>	2
		<b>Total</b>	<b>8</b>





