



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

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**CHEMISTRY**

**0620/42**

Paper 4 Theory (Extended)

**May/June 2016**

MARK SCHEME

Maximum Mark: 80

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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### Abbreviations used in the Mark Scheme

- ; separates marking points
- / separates alternatives within a marking point
- **OR** gives alternative marking point
- **R** reject
- **I** ignore mark as if this material was not present
- **A** accept (a less than ideal answer which should be marked correct)
- **COND** indicates mark is conditional on previous marking point
- owtte or words to that effect (accept other ways of expressing the same idea)
- max indicates the maximum number of marks that can be awarded
- ecf credit a correct statement that follows a previous wrong response
- ( ) the word / phrase in brackets is not required, but sets the context
- ora or reverse argument

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)(i)	nitrogen / oxygen / fluorine / neon;	<b>1</b>
1(a)(ii)	carbon;	<b>1</b>
1(a)(iii)	oxygen;	<b>1</b>
1(a)(iv)	nitrogen;	<b>1</b>
1(a)(v)	neon;	<b>1</b>
1(a)(vi)	carbon;	<b>1</b>
1(a)(vii)	lithium / fluorine;	<b>1</b>
1(a)(viii)	lithium;	<b>1</b>
1(b)(i)	B <sub>2</sub> O <sub>3</sub> ;	<b>1</b>
1(b)(ii)	Li <sub>3</sub> N;	<b>1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>																				
2(a)(i)	<u>number of protons</u> in one atom of an element;	<b>1</b>																				
2(a)(ii)	<b>M1</b> <u>number of protons and neutrons</u> in one atom of an element; <b>M2</b> in one atom of an element;	1 1																				
2(b)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>A</td> <td>6</td> <td>6</td> <td>6</td> <td><math>^{12}_6\text{C}</math></td> </tr> <tr> <td>B</td> <td>12</td> <td>12</td> <td>12</td> <td><math>^{24}_{12}\text{Mg}</math>;</td> </tr> <tr> <td>C</td> <td>8</td> <td>10;</td> <td>8;</td> <td><math>^{16}_8\text{O}^{2-}</math></td> </tr> <tr> <td>D</td> <td>11</td> <td>10</td> <td>13</td> <td><math>^{24}_{11}\text{Na}^+</math> 11, 24; Na;+;</td> </tr> </tbody> </table>	A	6	6	6	$^{12}_6\text{C}$	B	12	12	12	$^{24}_{12}\text{Mg}$ ;	C	8	10;	8;	$^{16}_8\text{O}^{2-}$	D	11	10	13	$^{24}_{11}\text{Na}^+$ 11, 24; Na;+;	<b>6</b>
A	6	6	6	$^{12}_6\text{C}$																		
B	12	12	12	$^{24}_{12}\text{Mg}$ ;																		
C	8	10;	8;	$^{16}_8\text{O}^{2-}$																		
D	11	10	13	$^{24}_{11}\text{Na}^+$ 11, 24; Na;+;																		

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)(i)	<b>M1</b> positive ions/cations (labelled or named in text); <b>M2</b> electrons (labelled or named in text); <b>M3</b> attraction between positive and negative;	1 1 1
3(a)(ii)	(conduction due to) movement of electrons / mobile electrons;	<b>1</b>
3(b)	$\text{GaCl}_3$ ; $\text{Ga}_2(\text{SO}_4)_3$ ;	1 1
3(c)(i)	$\text{Ga}_2\text{O}_3 + 6\text{HNO}_3 \rightarrow 2\text{Ga}(\text{NO}_3)_3 + 3\text{H}_2\text{O}$ formula of $\text{Ga}(\text{NO}_3)_3$ ; all formulae and balancing correct;	<b>2</b>
3(c)(ii)	$\text{Ga}_2\text{O}_3 + 2\text{NaOH} \rightarrow \text{Na}_2\text{Ga}_2\text{O}_4 + \text{H}_2\text{O}$ ; formula of $\text{Na}_2\text{Ga}_2\text{O}_4$ ; all formulae and balancing correct;	<b>2</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(d)	any 2 from: <ul style="list-style-type: none"> <li>• (do not) corrode;</li> <li>• strong;</li> <li>• hard;</li> <li>• (improved) appearance;</li> </ul>	<b>2</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)	<b>M1</b> substance that speeds up a reaction/increases rate; <b>M2</b> unchanged (chemically) at the end/not used up/lowers activation energy/provides alternative pathway;	<b>2</b> 1 1
4(b)	<b>M1</b> too slow/slower; <b>M2</b> lower yield/less product(s)/equilibrium shifts to left/equilibrium shifts in direction of reactants/backward reaction favoured/reverse reaction favoured;	<b>2</b> 1 1
4(c)	faster/increase rate;	<b>1</b>
4(d)	lower yield/less product(s)/equilibrium shifts to left/equilibrium shifts in direction of reactants/backward reaction favoured/reverse reaction favoured; <b>OR</b> higher cost/expensive; <b>OR</b> safety risks;	<b>1</b>
4(e)(i)	<b>M1</b> breakdown of an ionic compound when molten or in aqueous solution; <b>M2</b> (using) electricity/electric current/electrical energy;	<b>2</b> 1 1
4(e)(ii)	carbon/graphite/platinum;	<b>1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(e)(iii)	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ ; <b>OR</b> $2\text{H}_3\text{O}^+ + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{H}_2\text{O}$ ;	<b>1</b>
4(e)(iv)	cathode/negative electrode;	<b>1</b>
4(e)(v)	<b>M1</b> damp blue litmus paper; <b>M2</b> bleaches/loses colour/turns white/turns colourless;	1 1
4(f)	$2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 + \text{Cl}_2$ all formulae correct; balancing;	<b>2</b>
4(g)	<b>M1 chlorine:</b> treating (drinking) water/treating water in swimming pools/kill bacteria in water/chlorination of water/ (manufacture of) paper products/plastics/PVC/dyes/textiles/medicines/antiseptics/insecticides/herbicides/ fungicides/solvents/paints/disinfectant/bleach/hydrochloric acid; <b>M2 sodium hydroxide:</b> drain cleaner/oven cleaner/extraction of aluminium/purification of bauxite/(manufacture of) biodiesel/paper/ soap/detergents/washing powder/textiles/dyes; <b>M3 hydrogen:</b> fuel/rocket fuel/fuel cells/in welding/(manufacture of) ammonia/ $\text{NH}_3$ /margarine/methanol/hydrochloric acid/ refrigerants;	1  1  1

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)(i)	more than enough to react (with all the hydrocarbon); <b>OR</b> (some) oxygen remaining;	<b>1</b>
5(a)(ii)	75 cm <sup>3</sup> ;	<b>1</b>
5(a)(iii)	2 : 15 : 10;	<b>1</b>
5(a)(iv)	2 : 15 : 10 : 10; C <sub>5</sub> H <sub>10</sub> ;	<b>2</b> 1 1
5(b)(i)	C <sub>7</sub> H <sub>16</sub> ;	<b>1</b>
5(b)(ii)	contains a double bond/triple bond/multiple bond; <b>OR</b> not all bonds are single bonds;	<b>1</b>
5(b)(iii)	test: aqueous bromine/bromine (water)/Br <sub>2</sub> ; result: (orange/yellow/brown) to colourless/decolourised/colour disappears;	<b>2</b> 1 1
5(c)(i)	addition;	<b>1</b>
5(c)(ii)	1 (kg);	<b>1</b>
5(c)(iii)	propene: CH <sub>2</sub> ; polypropene: CH <sub>2</sub> ;	<b>2</b> 1 1

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(a)(i)	roast/heat <b>and</b> in air/oxygen;	<b>1</b>
6(a)(ii)	$2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$ ; SO <sub>2</sub> on right of equation; all formulae and balancing correct;	<b>2</b>
6(b)(i)	<p><b>M1</b> heat produced by carbon/coke (burning in) oxygen/air; <b>OR</b> <math>\text{C} + \text{O}_2 \rightarrow \text{CO}_2</math> produces heat/exothermic; <b>OR</b> <math>2\text{C} + \text{O}_2 \rightarrow 2\text{CO}</math> produces heat/exothermic (scores <b>M1</b> and <b>M2</b>);</p> <p><b>M2</b> <math>\text{C} + \text{CO}_2 \rightarrow 2\text{CO}</math>; <b>OR</b> <math>2\text{C} + \text{O}_2 \rightarrow 2\text{CO}</math>;</p> <p><b>M3</b> <math>\text{ZnO} + \text{CO} \rightarrow \text{Zn} + \text{CO}_2</math>; <b>OR</b> <math>\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}</math>; <b>OR</b> <math>2\text{ZnO} + \text{C} \rightarrow 2\text{Zn} + \text{CO}_2</math>;</p>	<p><b>3</b></p> <p>1</p> <p>1</p> <p>1</p>
6(b)(ii)	temperature (inside the furnace) is above 907 °C/temperature (inside the furnace) is above the boiling point (of zinc)/1000 °C is above the boiling point (of zinc);	<b>1</b>
6(b)(iii)	condensation/condensing/condense;	<b>1</b>
6(c)	<p><b>M1</b> zinc is more reactive than iron/zinc is higher in the reactivity series than iron ora;</p> <p><b>M2</b> zinc loses electrons;</p> <p><b>M3</b> iron/steel/oxygen/air/water gains electrons <b>OR</b> electrons move to iron/steel/oxygen/air/water;</p> <p><b>M4</b> (therefore) iron does not lose electrons/get oxidised/form iron(II)/form iron(III);</p>	<p><b>4</b></p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>



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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(d)(i)	green precipitate; red-brown/brown/orange precipitate;	<b>2</b> 1 1
6(d)(ii)	oxidising agent/oxidant;	<b>1</b>
6(d)(iii)	reducing agent/reductant;	<b>1</b>
6(d)(iv)	iron(III)/Fe <sup>3+</sup> ;	<b>1</b>
6(d)(v)	iron(II)/Fe <sup>2+</sup> ;	<b>1</b>