



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

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**CHEMISTRY**

**0620/31**

Paper 3 Core Theory

**October/November 2016**

MARK SCHEME

Maximum Mark: 80

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**Published**

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<b>Question</b>	<b>Answer</b>	<b>Mark</b>
1(a)(i)	H/hydrogen	<b>1</b>
1(a)(ii)	H/hydrogen	<b>1</b>
1(a)(iii)	S/sulfur	<b>1</b>
1(a)(iv)	Ca/calcium	<b>1</b>
1(a)(v)	Al/aluminium	<b>1</b>
1(b)(i)	atoms with the same number of protons but different <u>number</u> of neutrons <b>OR</b> atoms of the same element with different <u>number</u> of neutrons	<b>1</b> <b>1</b> <b>1</b> <b>1</b>
1(b)(ii)	124	<b>1</b>
1(b)(iii)	80	<b>1</b>
1(b)(iv)	78	<b>1</b>

Page 3	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
2(a)(i)	any 2 from: <ul style="list-style-type: none"> <li>• more Na<sup>+</sup> ions in sample <b>B OR A</b></li> <li>• more Cl<sup>-</sup> ions in sample <b>B OR A</b></li> <li>• more Mg<sup>2+</sup> ions in sample <b>B OR A</b></li> <li>• more HCO<sub>3</sub><sup>-</sup> ions in sample <b>A OR A</b></li> <li>• more Ca<sup>2+</sup> ions in sample <b>A OR A</b></li> <li>• more K<sup>+</sup> ions in sample <b>A OR A</b></li> <li>• more SiO<sub>3</sub><sup>2-</sup> ions in sample <b>A OR A</b></li> </ul>	2
2(a)(ii)	Mg <sup>2+</sup>	1
2(a)(iii)	2 mg = [2]  $\frac{200}{1000} \times (10) = [1]$ <b>OR</b> $0.2 \times (10) = [1]$	2
2(b)	<i>test:</i> flame test / description of flame test <i>result:</i> yellow (flame)	2
2(c)	Brownian (motion)	1
2(d)(i)	indicates a reversible reaction	1
2(d)(ii)	dip (indicator) paper in solution / put (indicator paper) in solution compare the colour with the (colour) chart / different colours represent different pH values	1 1
2(d)(iii)	absorbs heat / absorbs infra-red radiation / causes global warming	1
2(d)(iv)	<i>gas:</i> methane <i>source:</i> gases from (digestion in) animals / swamps / decomposition of vegetation / rice paddy fields / fracking / melting of permafrost /	1 1

Page 4	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
3(a)	2 electrons in the outer shell inner shells correct (2, 8, 8)	1 1
3(b)	cathode electrolyte anode	2
3(c)	H <sub>2</sub> (on right) 2(H <sub>2</sub> O) (on left)	1 1
3(d)	<p><i>manufacture</i> (max = [2])</p> <ul style="list-style-type: none"> <li>• limestone / calcium carbonate heated</li> <li>• thermal decomposition</li> <li>• heated in kiln / heated in current of air / coke for heating / carbon for heating</li> </ul> <p><i>uses</i> (max = [2])</p> <ul style="list-style-type: none"> <li>• neutralise acidic waste / treating flue gases</li> <li>• neutralise acidic soils</li> <li>• steelmaking / removing impurities in iron</li> <li>• (lime) mortar / cement / plaster / lime wash</li> <li>• slaked lime / limewater</li> </ul> <p><i>equation</i> (max = [2])</p> <ul style="list-style-type: none"> <li>• e.g. calcium carbonate → calcium oxide + carbon dioxide</li> <li>• calcium oxide + acid → calcium salt + water</li> </ul>	4

Page 5	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
4(a)	any 3 from: <ul style="list-style-type: none"> <li>• diffusion</li> <li>• particles move / motion of particles</li> <li>• (movement is) random / in any direction / in all directions</li> <li>• particles spread out / particles mix</li> <li>• particles move from high to low concentration</li> </ul>	3
4(b)(i)	energy (production) / power (production)	1
4(b)(ii)	any suitable use, e.g. treatment of cancer / tracer / thyroid function / sterilising (medical) instruments /	1
4(b)(iii)	average mass of <u>atoms</u> (of an element) (on a scale where) the $^{12}\text{C}$ atom has a mass of (exactly) 12 (units)	1 1
4(c)(i)	$\text{Cl}_2$ (on left) 2(KCl) (on right)	1 1
4(c)(ii)	any suitable use, e.g. sterilising / killing bacteria / swimming pools / bleach /	1
4(c)(iii)	<u>acidic</u> because chlorine is a non-metal / <u>acidic</u> because chlorine is on the right of the Periodic Table	1
4(c)(iv)	goes colourless / bleached / (goes) white	1

Page 6	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
5(a)(i)	the more carbon, the higher the strength <b>ORA</b>	1
5(a)(ii)	(no) the melting point range does not increase regularly / the melting point range goes up and down / the melting point range remains fairly constant <b>OR</b> (yes) the more carbon, the greater the melting point range / the difference between the higher and lower number is greater with more carbon <b>OR</b> (yes) the average melting point range is higher the more carbon (except for <b>D</b> ) / the general trend is for a higher melting point range with more carbon	1
5(a)(iii)	<b>D</b> because it is resistant to corrosion	1
5(b)	<b>A</b>	1
5(c)(i)	gives strength / so the wire does not break / so the wire does not sag / for support	1
5(c)(ii)	<i>use</i> : any suitable use, e.g. food container / saucepan / aircraft body / <i>property</i> : any suitable property related to the use, e.g. (food container) resistant to acidic foods / (saucepan) good conductor of heat / (aircraft body) low density /	1 1
5(d)(i)	Al / aluminium it gains oxygen	1 1
5(d)(ii)	<u>exothermic</u> because the reactants have more energy than the products / <u>exothermic</u> because the products have less energy than the reactants	1

Page 7	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
6(a)	<p><i>effect on indicator</i> (max = [1])</p> <ul style="list-style-type: none"> <li>• turn (blue) litmus red</li> <li>• turn methyl orange red / pink</li> </ul> <p><i>reaction with metals</i> (max = [1])</p> <ul style="list-style-type: none"> <li>• react with metals to produce hydrogen</li> <li>• react with metals to form a salt</li> </ul> <p><i>reaction with bases</i> (max = [1])</p> <ul style="list-style-type: none"> <li>• react with bases to form a salt and water</li> </ul> <p><i>reaction with carbonates</i> (max = [1])</p> <ul style="list-style-type: none"> <li>• react with carbonates to form a salt and water</li> <li>• react with carbonates to form carbon dioxide</li> </ul> <p><i>one other effect / reaction</i> (max = [1])</p> <ul style="list-style-type: none"> <li>• e.g. have a sour taste / pH below 7 / another property selected from the bullet points above</li> </ul>	4
6(b)(i)	density decreases as the number of carbon atoms increases <b>ORA</b>	1
6(b)(ii)	values between and including 170 (°C)–220 (°C)	1
6(b)(iii)	solid its melting point is above 15 °C / 15 °C is below its melting point	1 1
6(b)(iv)	displayed structure of COOH group showing all of the atoms and all of the bonds	1
6(b)(v)	88 4 × C <b>OR</b> 8 × H <b>OR</b> 2 × O <b>OR</b> C = 48 <b>OR</b> O = 32 scores [1]	2
6(c)	physical / chemical / physical	2

Page 8	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
7(a)	<b>A</b> = melting / fusion <b>B</b> = boiling / vaporisation	<b>1</b> <b>1</b>
7(b)	<i>arrangement</i> : irregular / random / no fixed position / no (fixed) arrangement <i>motion</i> : rapid / fast / random	<b>2</b>
7(c)	any suitable use, e.g. tyre manufacture / making sulfur dioxide / making sulfuric acid / pesticide / insecticide /	<b>1</b>
7(d)	sulfur dioxide is formed sulfur dioxide causes irritation of the throat ( <b>OR</b> nose <b>OR</b> lungs <b>OR</b> eyes or skin)	<b>1</b> <b>1</b>
7(e)(i)	C <sub>4</sub> H <sub>4</sub> S	<b>1</b>
7(e)(ii)	speeds up the rate of a reaction	<b>1</b>
7(e)(iii)	25.2 (g)	<b>1</b>