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**CHEMISTRY**

**0620/42**

Paper 4 Extended Theory

**October/November 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.

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Page 2	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark												
1(a)	fixed volume <b>AND</b> take the shape of the container	1												
1(b)	<table border="1"> <tr> <td>solid</td> <td>touching</td> <td>regular</td> <td>vibrate</td> </tr> <tr> <td>liquid</td> <td></td> <td></td> <td></td> </tr> <tr> <td>gas</td> <td>not touching</td> <td>random</td> <td>random</td> </tr> </table>	solid	touching	regular	vibrate	liquid				gas	not touching	random	random	6
solid	touching	regular	vibrate											
liquid														
gas	not touching	random	random											
1(c)(i)	melting	1												
1(c)(ii)	sublimation	1												

Question	Answer	Mark
2(a)	(total) number of protons and neutrons in a nucleus (of an atom)	2
2(b)	Na    2 : 8 : 1 P <sup>3-</sup> 2 : 8 : 8	2
2(c)	radiotherapy <b>OR</b> treatment of cancer	1
2(d)	<u>average</u> mass of (naturally occurring) <u>atom(s)</u> (of an element) (compared to an atom of <sup>12</sup> C)	2

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<b>Question</b>	<b>Answer</b>	<b>Mark</b>
2(e)	chlorine must have more than one isotope the masses of these isotopes / (any given) mass numbers are averaged	<b>2</b>
2(f)	lattice of labelled $Al^{3+}$ ions electrons seen on the diagram between the ions attraction between (positive) ions and (sea of / delocalised) electrons	<b>3</b>

<b>Question</b>	<b>Answer</b>	<b>Mark</b>
3(a)	nitrogen (78%) <b>AND</b> oxygen (21%) noble gases <b>OR</b> argon (1%)	<b>2</b>
3(b)	nitrogen <b>AND</b> oxygen (from the air) react (in the) high temperatures of a car engine $NO_x$ / oxides of nitrogen react with or dissolve in water (to form an acid)	<b>3</b>
3(c)	any 2 from: (named) ruminant animal / cattle / (anaerobic) digestion / flatulence (in animals) / animal waste / (animal) dung decomposing vegetation / animals / organisms / decaying (organic) matter / (fractional distillation / cracking of) petroleum / crude oil / hydrocarbons / natural gas / coal /	<b>2</b>
3(d)	photosynthesis	<b>1</b>

Page 4	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
4(a)	<i>copper(II) carbonate</i> fizzes / bubbles / effervescence dissolves / disappears	2
	<i>copper(II) oxide</i> dissolves / disappears blue (solution formed)	2
4(b)(i)	$\text{Cu}(\text{NO}_3)_2$ <u>3</u> Cu <b>AND</b> <u>3</u> Cu(NO <sub>3</sub> ) <sub>2</sub>	2
4(b)(ii)	hydrogen (gas) is not produced (when copper reacts with nitric acid)	1

Question	Answer	Mark
5(a)	20 cm <sup>3</sup> <b>M1</b> $M_r$ of MnO <sub>2</sub> : 87 <b>M2</b> moles of MnO <sub>2</sub> used: $3.48 / 87 = 0.04$ <b>M3</b> moles of HCl needed: $0.04 \times 4 = 0.16$ <b>M4</b> volume of HCl needed: $(0.16 / 8.0) \times 1000$ <b>AND</b> 20 cm <sup>3</sup>	4
5(b)(i)	from colourless to yellow / orange / brown	2
5(b)(ii)	$\text{Cl}_2(\text{g}) + 2\text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2\text{Cl}^-(\text{aq})$ <b>M1</b> (aq) as state symbols for the two products given <b>M2</b> correct products <b>M3</b> balancing	3

Page 5	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
5(c)(i)	the (C=C) double bond	1
5(c)(ii)	addition <b>OR</b> bromination	1
5(d)(i)	substitution	1
5(d)(ii)	(compounds with the) same molecular formula different structural formulae or structures	2
5(d)(iii)	structure of 1–chloropropane structure of 2–chloropropane	2
5(e)(i)	I <sub>2</sub> O <sub>5</sub> <b>M1</b> 76.0 / 127 <b>AND</b> 24.0 / 16.0 <b>M2</b> 0.59 <b>AND</b> 1.5 <b>OR</b> 1 <b>AND</b> 2.5 <b>M3</b> I <sub>2</sub> O <sub>5</sub>	3
5(e)(ii)	(turns) red / pink / orange / yellow iodine is a non-metal	2

Question	Answer	Mark
6(a)	bauxite/Alumina is dissolved in <u>molten</u> cryolite cryolite lowers the melting temperature molten aluminium forms <i>anode reaction:</i> $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$ <i>cathode reaction:</i> $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$	5

Page 6	Mark Scheme	Syllabus	Paper
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Question	Answer	Mark
6(b)	carbon or graphite electrode reacts with oxygen / burns (in oxygen) / combusts	2
6(c)	<i>use 1</i> : manufacture of aircraft <i>reason 1</i> : low density <i>use 2</i> : food containers <b>OR</b> cooking foil <i>reason 2</i> : Al resistant to corrosion	4

Question	Answer	Mark
7(a)	large / big molecule made from (many) monomers (joined together)	2
7(b)(i)	hydrolysis	1
7(b)(ii)	acid (conditions) / enzyme	1
7(c)(i)	$\frac{\text{distance moved by substance}}{\text{distance moved by solvent (front)}}$	1
7(c)(ii)	circle around top spot	1
7(c)(iii)	mixture of amino acids is placed as a spot onto a (pencil) baseline placed into a (suitable) solvent / water a locating agent is added to the (finished) chromatogram (to reveal spots)	

<b>Page 7</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
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<b>Question</b>	<b>Answer</b>	<b>Mark</b>
7(d)	fully displayed amide link between any two 'blocks' dipeptide 1: amino acid <b>A</b> on left-hand side and amino acid <b>B</b> on right-hand side <b>AND</b> dipeptide 2: amino acid <b>B</b> on left-hand side and amino acid <b>A</b> on right-hand side correct terminal amine and carboxylic acid group on both correct dipeptides	<b>3</b>