

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International General Certificate of Secondary Education

**MARK SCHEME for the October/November 2015 series**

**0620 CHEMISTRY**

**0620/32**

Paper 3 (Extended Theory), maximum raw mark 80

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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**Abbreviations used in the Mark Scheme**

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

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)(i)	NF <sub>3</sub> ;	1
1(a)(ii)	P <sub>2</sub> S <sub>3</sub> ;	1
1(b)(i)	Se <sup>2-</sup> ;	1
1(b)(ii)	Ga <sup>3+</sup> ;	1
1(c)(i)	Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> ;	1
1(c)(ii)	Ba(OH) <sub>2</sub> ;	1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)(i)	combustion / burning of a motor vehicle fuel or a named fuel which can act as a motor vehicle fuel; incomplete combustion would produce CO; complete combustion would produce CO <sub>2</sub> ;	3
2(a)(ii)	<i>carbon dioxide</i> : climate change / global warming / greenhouse effect; <i>carbon monoxide</i> : poisonous / toxic;	2
2(a)(iii)	nitrogen and oxygen react or combine; at high temperatures or in presence of spark;	2
2(a)(iv)	it reacts or combines with oxygen / NO + ½O <sub>2</sub> → NO <sub>2</sub> ;	1
2(b)	any two from: <ul style="list-style-type: none"> <li>acid rain is formed;</li> <li>lowers pH or acidifies lakes / rivers or kills fish / aquatic animals;</li> <li>changes composition of soils or reduces fertility of soil or reduces crop yields / deforestation or kills crops or trees or plants or leaves / lowers pH of soil or increases acidity of soil;</li> <li>attacks (limestone) buildings or statues;</li> <li>attacks metal (structures) / bridges;</li> </ul>	2

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(c)	use of a catalytic converter; $2\text{NO} + 2\text{CO} \rightarrow 2\text{CO}_2 + \text{N}_2$ species; balancing;	<b>3</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)	zinc blende is burnt/roasted/heated in air; zinc sulfide + oxygen $\rightarrow$ zinc oxide + sulfur dioxide;	<b>2</b>
3(b)	zinc oxide + carbon $\rightarrow$ zinc + carbon dioxide/monoxide;	<b>1</b>
3(c)	zinc sulfate; pure zinc; $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$ ; $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ ; zinc <u>ions</u> are removed (from solution) and replaced (into solution); at the same rate/speed;	<b>6</b>
3(d)(i)	copper;	<b>1</b>
3(d)(ii)	any two from: <ul style="list-style-type: none"> <li>• hard(er)/less malleable;</li> <li>• strong(er);</li> <li>• (better) appearance;</li> <li>• (more) resistant to corrosion;</li> </ul>	<b>2</b>
3(e)(i)	steel (or iron) is exposed to oxygen <b>and</b> water;	<b>1</b>
3(e)(ii)	Zn more reactive than Fe (allow steel); Zn loses/transfers electrons (more readily) <b>and</b> forms (+ve) ions (in preference to Fe); Fe (allow steel) is more reactive than Cu; Fe loses/transfers electrons (more readily) <b>and</b> forms (+ve) ions (in preference to Cu);	<b>4</b>

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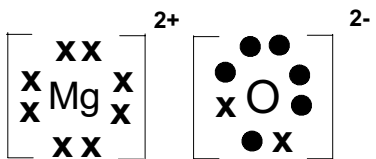
Question	Answer	Marks
4(a)(i)	a reaction whose rate is influenced by light/ reaction which occurs in presence of light;	1
4(a)(ii)	CH <sub>3</sub> CHC(CH <sub>3</sub> ) <sub>2</sub> ;	1
4(a)(iii)	(both have) same molecular formula; different structural formula or structure;	2
4(b)	<b>M1</b> bonds breaking = (8 × 412) + (2 × 348) + 242 = 4234; <b>M2</b> bonds forming = (7 × 412) + (2 × 348) + 338 + 431 = 4349; <b>M3</b> 4234 – 4349 = –115 <b>and</b> exothermic;	3
4(c)(i)	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> Cl + NaOH → CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH + NaCl NaCl as product; rest of equation;	2
4(c)(ii)	propene; CH <sub>2</sub> =CHCH <sub>3</sub> ;	2
4(c)(iii)	propanoic acid;	1
4(d)(i)	46;	1
4(d)(ii)	60;	1
4(d)(iii)	moles of CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH = 0.1; moles of HCOOH = 0.087 (0.09) <b>and</b> limiting reagent is methanoic acid;	2
4(d)(iv)	88 × (mol of limiting reagent in <b>4(d)(iii)</b> ); expected answer: 88 × 0.087 = 7.65 g;	1

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Question	Answer	Marks
5(a)	as a reducing agent; source of heat/energy;	2
5(b)	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ species; balancing;	2
5(c)	silica reacts with limestone or calcium oxide; to form a slag or calcium silicate or $\text{CaSiO}_3$ ; (liquid) slag floats (above molten iron);	3
5(d)	<u>blow</u> or <u>pass</u> oxygen through (molten) iron; $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ ; carbon dioxide escapes or carbon dioxide is a gas;	3

Question	Answer	Marks
6(a)	the number of $e^-$ gained or lost = numerical value of oxidation state;	1
	any two from: <ul style="list-style-type: none"> <li>• Na to Al (Si) lose <math>e^-</math>;</li> <li>• (Si) P to Cl gain <math>e^-</math>;</li> <li>• Si gains and loses <math>e^-</math> / Ar neither gains nor loses <math>e^-</math>;</li> </ul>	2
6(b)	<b>M1</b> positive ions / cations / metallic ions; the (correct) particles named in <b>M1</b> are arranged in a lattice / rows / layers; sea of electrons / delocalised electrons;	3
6(c)	they have mobile electrons;	1
6(d)	chlorine;	1
6(e)	strong covalent bonds ; in a giant lattice / macromolecule / giant (structure);	2

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Question	Answer	Marks
6(f)	any two from: <ul style="list-style-type: none"> <li>sodium chloride is ionic <b>and</b> <math>PCl_3</math> is covalent;</li> <li>ionic bonds are strong <b>and</b> intermolecular forces are weak;</li> <li><math>PCl_3</math> reacts with water <b>and</b> <math>NaCl</math> does not;</li> </ul>	2
6(g)	MgO will react with / dissolve in / neutralise hydrochloric acid / acid / acid oxide; if amphoteric, MgO will react with or dissolve in or neutralise hydrochloric acid or acid or acid oxide <b>and</b> MgO will react with dissolve in or neutralise sodium hydroxide or alkali or base or basic oxide;  MgO will not react with or dissolve in or neutralise sodium hydroxide or alkali or base or basic oxide = [2]	2
6(h)	 <p>magnesium with 8 or 0 outer shell electrons; oxygen with 8 outer shell electrons and 2 indicated differently from the other 6 and these 2 electrons must match the Mg electrons if these have been shown; correct charges;</p>	3