

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International General Certificate of Secondary Education

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

### **0620 CHEMISTRY**

**0620/33**

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.

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

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2015 series for most Cambridge IGCSE<sup>®</sup>, Cambridge International A and AS Level components and some Cambridge O Level components.

© IGCSE is the registered trademark of Cambridge International Examinations.

<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge IGCSE – October/November 2015</b>	<b>0620</b>	<b>33</b>

#### **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)

<b>Page 3</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge IGCSE – October/November 2015</b>	<b>0620</b>	<b>33</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(a)	cobalt chloride (paper)/anhydrous cobalt chloride / $\text{CoCl}_2$ ; from blue; to pink; <b>or</b> copper sulfate / anhydrous copper sulfate / $\text{CuSO}_4$ ; from white; to blue;	<b>3</b>
1(b)	boils at $100\text{ }^\circ\text{C}$ / boiling point $100\text{ }^\circ\text{C}$ / freezes at $0\text{ }^\circ\text{C}$ / freezing point $0\text{ }^\circ\text{C}$ / melts at $0\text{ }^\circ\text{C}$ / melting point $0\text{ }^\circ\text{C}$ ;	<b>1</b>
1(c)	any two from: <ul style="list-style-type: none"> <li>• filtration / sedimentation / sieving / screening / (pass through) gravel (beds) / flocculation / decantation / clarification / coagulation / flotation / settling tank / add aluminium sulfate;</li> <li>• (add) carbon;</li> <li>• chlorination / (add) chlorine / add <math>\text{Cl}_2</math>;</li> <li>• fluoridation / add fluoride;</li> <li>• ozone dosing;</li> <li>• desalination;</li> <li>• aeration;</li> <li>• distillation;</li> </ul>	<b>2</b>
1(d)	any two from: making steel; making paper; textiles; generating electricity / energy / power / turbines; HEP; water mills; steam power (e.g. steam engines); geothermal power; agriculture; livestock; irrigation; hydration of alkenes / manufacture of ethanol / alcohols; manufacture of sulfuric acid / Contact process; manufacture of hydrogen; solvent / dissolving; coolant / cooling; cleaning / washing; (supply of) drinking (water); central heating; production of slaked lime; cooking;	<b>2</b>

<b>Page 4</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge IGCSE – October/November 2015</b>	<b>0620</b>	<b>33</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)	sulfur dioxide / SO <sub>2</sub> ;	<b>1</b>
2(b)	hydrogen / H <sub>2</sub> ;	<b>1</b>
2(c)	ethene / C <sub>2</sub> H <sub>4</sub> ;	<b>1</b>
2(d)	argon / Ar;	<b>1</b>
2(e)	carbon monoxide / CO;	<b>1</b>
2(f)	methane / CH <sub>4</sub> ;	<b>1</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)(i)	vibrate (about fixed position) / vibration;	<b>1</b>
3(a)(ii)	electrostatic force of) attraction; (between) positive ions and negative ions / oppositely charged ions / unlike charged ions / cations and anions;	<b>1</b> <b>1</b>
3(a)(iii)	regular / repeated / pattern / framework / ordered / alternating / organised (arrangement of); positive and negative ions / oppositely charged ions / cations and anions / unlike charged ions;	<b>1</b> <b>1</b>
3(b)(i)	correct direction (going towards negative electrode);	<b>1</b>
3(b)(ii)	Li <sup>+</sup> + e <sup>-</sup> → Li / Li <sup>+</sup> → Li – e <sup>-</sup> ;	<b>1</b>
3(b)(iii)	2Br <sup>-</sup> → Br <sub>2</sub> + 2e <sup>-</sup> / 2Br <sup>-</sup> – 2e <sup>-</sup> → Br <sub>2</sub> formulae; balancing;	<b>2</b>
3(b)(iv)	Br <sup>-</sup> / bromide (ion); electron lost / donated electrons / increased oxidation state / increased oxidation number / oxidation numbers changed from –1 to 0 / increased valency;	<b>1</b> <b>1</b>

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – October/November 2015	0620	33

Question	Answer	Marks
3(c)	<p><b>M1</b> (gas) hydrogen (given off at cathode)/H<sub>2</sub>;  <b>M2</b> hydroxide <u>ions</u>/lithium hydroxide/OH<sup>-</sup>/LiOH are alkali(ne);  <b>M3</b> 2LiBr + 2H<sub>2</sub>O → 2LiOH + H<sub>2</sub> + Br<sub>2</sub>;  <b>or</b>  2H<sup>+</sup> + 2e<sup>-</sup> → H<sub>2</sub>/2H<sup>+</sup> → H<sub>2</sub> - 2e<sup>-</sup>;  <b>or</b>  2Br<sup>-</sup> → Br<sub>2</sub> + 2e<sup>-</sup>/2Br<sup>-</sup> - 2e<sup>-</sup> → Br<sub>2</sub>;  <b>or</b>  2H<sup>+</sup> + 2Br<sup>-</sup> → H<sub>2</sub> + Br<sub>2</sub>;</p>	3

Question	Answer	Marks
4(a)(i)	any three from: <ul style="list-style-type: none"> <li>• (same) general (molecular) formula;</li> <li>• (consecutive members) differ by CH<sub>2</sub>;</li> <li>• same functional group;</li> <li>• common (allow similar) methods of preparation;</li> <li>• same/similar chemical properties/(chemical) reactions;</li> </ul>	3
4(a)(ii)	C <sub>n</sub> H <sub>2n</sub> alkene; C <sub>n</sub> H <sub>2n+2</sub> alkane;	1 1
4(a)(iii)	alkanes <u>all</u> or <u>only</u> (C–C) single bonds/no double bonds/no multiple bonds; alkenes (at least one) C=C/double bond/multiple bond;	1 1
4(b)(i)	heat/high temperature/temperature between 450 °C and 800 °C; catalyst/named catalyst, e.g. zeolites or alumina or aluminium oxide or aluminosilicates or silica or oxides of chromium; <b>or</b> high pressure/pressure in range of 2–70 atm; <b>or</b> steam; absence of air/oxygen;	2
4(b)(ii)	any correct equation producing an alkane and an alkene adding up to seven carbon atoms in the products;	1

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – October/November 2015	0620	33

Question	Answer	Marks
4(b)(iii)	any correct equation producing two alkenes and hydrogen, e.g. $\rightarrow \text{C}_2\text{H}_4 + \text{C}_5\text{H}_{10} + \text{H}_2 / \text{C}_3\text{H}_6 + \text{C}_4\text{H}_8 + \text{H}_2$ ;	1
4(b)(iv)	<b>alkenes:</b> more useful than alkanes / used to make polymers or plastics / used to make chemicals / petrochemicals; <b>or</b> <b>alkanes:</b> (balance the demand for different) fuels / increase petrol (fraction) or hydrogen / produce lighter fractions from heavier fractions or suitable example, e.g. naphtha to gasoline / more useful smaller molecules or more demand for smaller molecules or more demand for smaller fractions / used as fuel / used to make ammonia / used in Haber process / used in hydrogenation of vegetable oils / used to make HCl;	1 1
4(c)(i)	150 (cm <sup>3</sup> );	1
4(c)(ii)	100 (cm <sup>3</sup> );	1
4(c)(iii)	This question was discounted.	1

Question	Answer	Marks
5(a)(i)	proton donor / H <sup>+</sup> donor / hydrogen ion donor;	1
5(a)(ii)	strong acid completely or fully ionises / completely or fully dissociates / completely or fully splits into ions; weak acid partially or incompletely ionises or dissociates or splits into ions / does not ionise fully;	1 1
5(b)(i)	barium sulphite / barium sulfate(IV) / BaSO <sub>3</sub> ;	1
5(b)(ii)	barium sulfate / BaSO <sub>4</sub> ;	1
5(b)(iii)	$\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^- / \text{Br}_2 \rightarrow 2\text{Br}^- - 2\text{e}^-$ ;	1
5(b)(iv)	sulfuric acid;	1
5(c)(i)	( $\rightarrow$ ) magnesium sulfate + water;	1
5(c)(ii)	( $\rightarrow$ ) zinc sulfate + hydrogen;	1
5(c)(iii)	( $\rightarrow$ ) copper(II) sulfate / copper sulfate + carbon dioxide + water;	1
5(d)(i)	$2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4 / \text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)\text{HSO}_4$ ;	1

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – October/November 2015	0620	33

Question	Answer	Marks
5(d)(ii)	$2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ $\text{Na}_2\text{SO}_4$ ; rest of equation correct; <b>or</b> $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ $\text{H}_2\text{O}$ as the only product on the right hand side; rest of equation correct; <b>or</b> $\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{NaHSO}_4 + \text{H}_2\text{O}$ $\text{NaHSO}_4$ ; rest of equation correct; <b>or</b> $\text{OH}^- + \text{H}_2\text{SO}_4 \rightarrow \text{HSO}_4^- + \text{H}_2\text{O}$ $\text{HSO}_4^-$ ; rest of equation correct;	2
5(d)(iii)	$\text{Fe} + \text{H}_2\text{SO}_4 \rightarrow \text{FeSO}_4 + \text{H}_2$ ; $\text{FeSO}_4$ ; rest of equation correct; <b>or</b> $\text{Fe} + 2\text{H}^+ \rightarrow \text{Fe}^{2+} + \text{H}_2$ ; $\text{Fe}^{2+}$ ; rest of equation correct; <b>or</b> $2\text{Fe} + 3\text{H}_2\text{SO}_4 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + 3\text{H}_2$ ; $\text{Fe}_2(\text{SO}_4)_3$ ; rest of equation correct; <b>or</b> $2\text{Fe} + 6\text{H}^+ \rightarrow 2\text{Fe}^{3+} + 3\text{H}_2$ ; $\text{Fe}^{3+}$ ; rest of equation correct;	2

<b>Page 8</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge IGCSE – October/November 2015</b>	<b>0620</b>	<b>33</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(a)	Na/sodium <b>and</b> Li/lithium;	<b>1</b>
6(b)	Cu/copper <b>and</b> Rh/rhodium;	<b>1</b>
6(c)	Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> ;	<b>1</b>
6(d)	Mg <sup>2+</sup> ;	<b>1</b>
6(e)	<p>copper sulfate (solution);  add manganese/Mn to solution;  copper displaced or forms/blue colour changes;  <b>or</b>  (a solution of) an iron salt or a zinc salt;  add copper and manganese to each;  only manganese reacts/displaces;  <b>or</b>  (a solution of a) manganese salt and a copper salt;  add, e.g. iron/zinc;  copper (displaced) and manganese not;  <b>or</b>  to a (dilute) acid/any named acid/water/steam;  add Mn and Cu/both metals to the liquid;  rate faster or shorter time or more bubbles or more hydrogen or more gas with Mn or with the more reactive metal/reaction  only with Mn or with the more reactive metal;  <b>or</b>  copper oxide;  add manganese and heat;  evidence of reaction;  <b>or</b>  burn manganese and copper/both elements;  in air/oxygen;  Mn or more reactive metal burns brighter/only Mn or more reactive metal burns/evidence that manganese reacts faster;  <b>or</b>  add carbon;  to both metal oxides and heat;  evidence that reaction occurs with copper oxide more readily/least reactive metal oxide;</p>	<b>3</b>



<b>Page 9</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge IGCSE – October/November 2015</b>	<b>0620</b>	<b>33</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
	<p><b>or</b>  both metal nitrates or carbonates;  heat;  evidence that manganese compound is most stable / most reactive compound is most stable;</p> <p><b>or</b>  (electrochemical) cell / use of voltmeter / electrolyte;  copper and manganese (as electrodes);  manganese is the negative terminal;</p>	
6(f)	<p><i>physical properties</i>  any three from:  hard; strong; high density; malleable; ductile; sonorous; shiny; high melting point / high boiling point; (good) conductor (of heat/electricity); forms coloured compounds / coloured ions / coloured salts;</p> <p><i>chemical properties</i>  any two:  catalytic behaviour; more than one or different or variable oxidation state or oxidation number or valency / variable charges / many differently charged ions; forms complex (ions); forms coloured compounds / coloured ions / coloured salts;  amphoteric oxide / amphoteric / basic oxide / alkaline oxides / acidic oxide; (other metallic reactions) with acids / water / steam;  reducing agent / electron donor / reacts with non-metal to form ionic compound / forms positive ions;</p>	<b>5</b>

Page 10	Mark Scheme	Syllabus	Paper
	Cambridge IGCSE – October/November 2015	0620	33

Question	Answer	Marks
7(a)	<p>moles of KOH used ( = <math>0.025 \times 2.53</math> =) <math>0.06325/0.063</math>;</p> <p>number of moles of <math>H_2SO_4</math> needed to neutralise the KOH = <math>0.031625/0.032</math>;</p> <p>concentration of dilute sulfuric acid = <math>1.121/1.1</math> (mol/dm<sup>3</sup>);</p>	3
7(b)(i)	<p>repeat experiment using same volume / amount of (same) <math>H_2SO_4</math>;</p> <p>and same volume / amount of (same) KOH;</p> <p><b>or</b></p> <p>(add activated) charcoal / carbon;</p> <p>filter out the charcoal;</p> <p><b>or</b></p> <p>mix volumes / amounts of <math>H_2SO_4</math> and KOH in the ratio 1:2;</p> <p>of the same concentration;</p>	2
7(b)(ii)	<p>make solution of potassium sulfate as above;</p> <p>add same volume / amount of acid again;</p> <p><b>or</b></p> <p>same volume / amount of KOH;</p> <p>add double the volume / amount of <math>H_2SO_4</math>;</p> <p><math>25 \text{ cm}^3 \text{ KOH} + 56.4 \text{ cm}^3 \text{ H}_2\text{SO}_4 = [2]</math></p> <p><b>or</b></p> <p>same volume / amount of <math>H_2SO_4</math>;</p> <p>add half the volume / amount of KOH;</p> <p><math>12.5 \text{ cm}^3 \text{ KOH} + 28.2 \text{ cm}^3 \text{ H}_2\text{SO}_4 = [2]</math></p> <p><b>or</b></p> <p>mix equal volumes / amounts of <math>H_2SO_4</math> and KOH ;</p> <p>of the same concentration;</p> <p>mix solutions containing equal numbers moles of KOH and <math>H_2SO_4 = [2]</math></p>	2

<b>Page 11</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge IGCSE – October/November 2015</b>	<b>0620</b>	<b>33</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
7(c)	<p><i>test:</i> reactive metal / name or formula of suitable metal, e.g. Mg / Fe / Zn; <i>result:</i> bubbles or gas or hydrogen or H<sub>2</sub> evolved / dissolves;</p> <p><i>test:</i> insoluble carbonate or name / formula of suitable insoluble carbonate, e.g. CaCO<sub>3</sub>; <i>result:</i> bubbles or gas or carbon dioxide or CO<sub>2</sub> evolved / dissolves provided that carbonate is insoluble;</p> <p><i>test:</i> alkali or name / formula of suitable alkali, e.g. NaOH / KOH; <i>result:</i> temperature change;</p> <p><i>test:</i> alkali or name / formula of suitable alkali, e.g. NaOH / KOH and indicator; <i>result:</i> colour change;</p> <p><i>test:</i> insoluble base or name / formula of suitable insoluble base; <i>result:</i> dissolves;</p> <p><i>test:</i> indicator, e.g. blue litmus; <i>result:</i> colour change (colour need not be specified);</p> <p><i>test:</i> measure pH / pH paper / UI paper / pH meter; <i>result:</i> pH 0–3 or indicator red / orange or pH lower than pH of K<sub>2</sub>SO<sub>4</sub>;</p>	<b>2</b>