

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International General Certificate of Secondary Education

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

### **0439 CHEMISTRY (US)**

**0439/31**

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)	Na <sup>+</sup> / sodium <b>and</b> O <sup>2-</sup> / oxide;	<b>1</b>
1(a)(ii)	Ca <sup>2+</sup> / calcium;	<b>1</b>
1(a)(iii)	P / phosphorus;	<b>1</b>
1(a)(iv)	Si / silicon;	<b>1</b>
1(b)(i)	<ul style="list-style-type: none"> <li>• <i>number of protons = 29;</i></li> <li>• <i>number of neutrons = 35;</i></li> <li>• <i>number of electrons = 27;</i></li> </ul> <p>three correct = [2]; two correct = [1]</p>	<b>2</b>
1(b)(iii)	<p><i>number of nucleons = 45;</i>  <i>number of charged particles = 42;</i></p>	<b>1</b> <b>1</b>
1(c)(i)	have same proton number / same element / same atomic number; different number of neutrons / nucleons / mass number;	<b>1</b> <b>1</b>
1(c)(ii)	magnesium / Mg;	<b>1</b>
1(c)(iii)	any two from: <ul style="list-style-type: none"> <li>• treating cancer or radiotherapy;</li> <li>• biological tracer;</li> <li>• thickness (of paper or foil);</li> <li>• (checking for) leaks / cracks (in pipes);</li> <li>• (carbon) dating;</li> <li>• (generating) energy / electricity;</li> <li>• smoke detectors;</li> <li>• fill levels in packages;</li> <li>• sterilising surgical instruments;</li> </ul>	<b>2</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
2(a)	add a (dilute) acid; filter; copper does not react or dissolve / zinc reacts or dissolves or forms a salt;	<b>1</b> <b>1</b> <b>1</b>
2(b)	diffusion (through a membrane); nitrogen diffuses faster; because it has the smaller $M_r$ ; <b>or</b> (turn into) liquid; (fractional) distillation; different boiling points; <b>or</b> burn a named substance to make non-gaseous product; oxygen reacts / nitrogen does not react; name of product of combustion;	<b>3</b>
2(c)	chromatography; use a locating agent / the two acids move at different rates / alanine travels faster / alanine higher up paper / travels further;	<b>1</b> <b>1</b>
2(d)	add sodium hydroxide solution; filter; zinc hydroxide (is amphoteric it) will react or will dissolve / magnesium hydroxide does not react or does not dissolve;	<b>1</b> <b>1</b> <b>1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
3(a)	fast(er) reaction; large(r) surface area;	1 1
3(b)	4.76 (dm <sup>3</sup> );	1
3(c)	moves equilibrium to right; increases yield (of sulfur trioxide)/ uses up more sulfur dioxide;	1 1
3(d)(i)	moves equilibrium to left; (forward reaction) exothermic;	1 1
3(d)(ii)	decrease rate; molecules have less energy / move slower; fewer collisions (per second) / fewer particles have the activation energy / fewer collisions have the activation energy;	1 1 1
3(e)(i)	moves to right;	1
3(e)(ii)	high yield at 2 atm;	1
3(f)	vanadium(V) oxide / vanadium pentoxide;	1
3(g)	<b>M1</b> dissolve / react sulfur trioxide in (concentrated) sulfuric acid; add water to product of <b>M1</b> ;	1 1

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(a)(i)	any two from: <ul style="list-style-type: none"> <li>• shortage of sites / landfill sites fill up;</li> <li>• visual pollution / litter;</li> <li>• danger to wild life;</li> </ul>	2
4(a)(ii)	(produce) toxic gases or CO or HCl or HF / carbon dioxide / greenhouse gases;	1
4(b)	any two from: bags / clothing or specified clothing / packaging / bowls / cups / plates / flooring / carpets / pipes / insulation / non-stick coatings / ropes;	1

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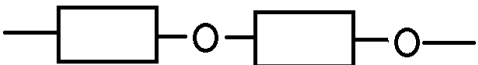
<b>Question</b>	<b>Answer</b>	<b>Marks</b>
4(c)(i)	CH <sub>2</sub> =CHCH <sub>3</sub> double bond is shown; rest of structure correct;	<b>2</b>
4(c)(ii)	ester;	<b>1</b>
4(c)(iii)	(carboxylic) acid; alcohol;	<b>1</b> <b>1</b>
4(d)	addition – polymer only product / only one product; condensation – (polymer and) simple molecule / water / hydrogen chloride made; polymer <b>A</b> is an addition polymer <b>and</b> polymer <b>B</b> is a condensation polymer;	<b>1</b> <b>1</b> <b>1</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
5(a)(i)	adds up to 100%;	<b>1</b>
5(a)(ii)	<b>M1</b> 55.85/12 <b>and</b> 6.97(/1) <b>and</b> 37.2/16; <b>or</b> evaluation 4.650 6.970 2.325; <b>M2</b> C <sub>2</sub> H <sub>3</sub> O; correct answer with no working = [2]	<b>1</b> <b>1</b>
5(a)(iii)	<b>M1</b> (86/)/43; <b>M2</b> C <sub>4</sub> H <sub>6</sub> O <sub>2</sub> ; correct answer with no working = [2]	<b>1</b> <b>1</b>
5(b)(i)	unsaturated / C=C double bond / alkene;	<b>1</b>
5(b)(ii)	(organic / carboxylic) acid / contains or releases H <sup>+</sup> ions;	<b>1</b>
5(b)(iii)	CH <sub>3</sub> CH=CHCOOH / CH <sub>2</sub> =CHCH <sub>2</sub> COOH / CH <sub>2</sub> =CH(CH <sub>3</sub> )COOH;	<b>1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
6(a)(i)	any three from: <ul style="list-style-type: none"> <li>• each oxygen is joined to two silicons / atoms;</li> <li>• each silicon is joined to four oxygens / atoms;</li> <li>• tetrahedral (around silicon)/ similar to diamond;</li> <li>• linear around oxygen;</li> </ul>	<b>3</b>
6(a)(ii)	any three from: <ul style="list-style-type: none"> <li>• high melting point / boiling point;</li> <li>• hard;</li> <li>• strong;</li> <li>• (colourless) crystalline (solid);</li> <li>• brittle / not malleable;</li> <li>• poor / non-conductor (of electricity) / insulator;</li> <li>• insoluble (in water);</li> </ul>	<b>3</b>
6(a)(iii)	SiO <sub>2</sub> reacts with or dissolves in or neutralises an acid or acidic oxide; SiO <sub>2</sub> does not react or dissolve in or neutralise an alkali or base or basic oxide;	<b>1</b> <b>1</b>
6(b)	carbon dioxide has a simple molecular structure;	<b>1</b>

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<b>Question</b>	<b>Answer</b>	<b>Marks</b>
7(a)(i)	<b>step 2 and</b> it is electron gain / oxidation state decreases;	<b>1</b>
7(a)(ii)	silver (ion) <b>and</b> it accepts electrons / gets reduced / oxidation state decreases;	<b>1</b>
7(b)	<p><i>prediction:</i>  the 'not covered' section will be black;  the 'covered in thick card' section will be white / cream;  the 'covered in thin card' section will be grey;</p> <p><i>explanation:</i>  the more light, the more silver ions are reduced;</p>	<b>1</b> <b>1</b> <b>1</b> <b>1</b>
7(c)(i)	carbon dioxide + water → glucose + oxygen reactants correct; products correct;	<b>1</b> <b>1</b>
7(c)(ii)	chlorophyll;	<b>1</b>
7(c)(iii)	 <p>one correct –O– link between rectangles;  two correct glucose units with continuation bonds;</p>	<b>1</b> <b>1</b>
7(c)(iv)	the reaction of glucose with oxygen to release (carbon dioxide and water and) energy; <b>or</b> the reaction of glucose in a biological system to release energy;	<b>1</b>