CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the May/June 2015 series

0439 CHEMISTRY (US)

0439/33 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.

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Abbreviations used in the Mark Scheme

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

Question	Answer	Marks	Guidance
1(a)(i)	AlF_3;	1	
1(a)(ii)	As_2O_3;	1	**A** As_2O_5
1(a)(iii)	$SiBr_4$;	1	
1(b)(i)	P^{3-};	1	
1(b)(ii)	Ba^{2+};	1	
1(b)(iii)	Fr^{+};	1	
1(c)	M1 2 double bonds, one between each O and the C atom; M2 each O has 8 outer electrons; M3 each C has 8 outer electrons;	3	**R** wrong symbols for O for M2 **R** wrong symbols for C for M3 **I** missing symbols **A** any combination of x and o

Question	Answer	Marks	Guidance
2(a)	carbon monoxide;	1	**A** CO
2(b)	sodium oxide;	1	**A** Na_2O
2(c)	sulfur dioxide;	1	**A** SO_2
2(d)	zinc oxide **OR** aluminium oxide;	1	**A** ZnO or Al_2O_3
2(e)	silicon(IV) oxide;	1	**A** silicon (di)oxide or SiO_2
2(f)	sulfur dioxide;	1	**A** SO_2

Question	Answer	Marks	Guidance
3(a)	carbon dioxide escapes / leaves / lost / released **OR** not a closed system;	**1**	**A** gas escapes / leaves / lost / released
3(b)	$CaO + H_2O \rightarrow Ca(OH)_2$ reactants; product;	**2**	One mark for each side correct **A** multiples **I** state symbols
3(c)	M1 number of moles of $CaCO_3$ = (12.5 / 100 =) 0.125 **or** 125000 **OR** 56 / 100 = 0.56; M2 mass calcium oxide = (0.125 × 56) = 7 (tonnes) **OR** 0.56 × 12.5 = 7;	**2**	Correct answer scores both marks **A** answers in g or kg
3(d)(i)	*Any **two** from:* does not wash away / insoluble / lasts a long time; does not increase pH above 7 / neutral / has pH 7; naturally occurring / does not need to be processed;	**2**	**A** does not leach out
3(d)(ii)	*Any **three** from:* (flue gas contains) sulfur dioxide; flue gas / sulfur dioxide is acidic; calcium carbonate reacts with sulfur dioxide; to make a salt / calcium sulfite **OR** neutralisation;	**3**	**A** $CaCO_3$ is a base
3(d)(iii)	making steel or iron / in a <u>blast</u> furnace / toothpaste / (making) glass / building / (making) cement / treating acidic river or lakes / chalk;	**1**	

Question	Answer	Marks	Guidance
4(a)(i)	*Any **one** fossil fuel from:* crude oil / petroleum / natural gas / methane / petrol / gasoline / kerosene / paraffin / diesel (oil) / gas oil / fuel oil / refinery gas / LPG / propane / butane;	1	**I** ethane / oil / naphtha / coal / gas **R** coke / bitumen / lubricating oil / wood
4(a)(ii)	(burn to) release energy; take a long time to form (from organic material);	2	If time stated 1000 years or more
4(b)(i)	oxygen / air and sulfur (from fuel) react; (forms) sulfur (di)oxide; (sulfur dioxide) reacts with oxygen / air and water (to form sulfuric acid) **OR** sulfur trioxide reacts with water (to form sulfuric acid) **OR** sulfurous acid reacts with oxygen (to form sulfuric acid);	3	**A** correct formulae throughout **A** sulfurous acid if sulfur reacts with oxygen and water
4(b)(ii)	oxygen and nitrogen react; making oxides of nitrogen; (oxides of nitrogen) react with water (making nitric acid);	3	**A** nitrogen combust **R** if oxygen or nitrogen originate from the fuel **A** named oxide of nitrogen **A** correct formulae **A** NO_x
4(b)(iii)	add sodium hydroxide (solution) and aluminium; (warm) and ammonia made;	2	**A** zinc or Devarda's **A** description of smell of ammonia or test for ammonia

Question	Answer	Marks	Guidance
4(b)(iv)	M1 measure pH / describe how to measure pH (such as use universal indicator); M2 lower pH greater concentration of H^+; **OR** M1 add Ca, Mg, Zn, Fe; M2 faster reaction greater concentration of H^+ / faster bubbles or more hydrogen (in same time); **OR** M1 rate of reaction with (metal) carbonate; M2 faster reaction greater concentration of H^+ / faster bubbles or more carbon dioxide (in same time); **OR** M1 electrical conductivity; M2 greater conductivity greater concentration of H^+; **OR** M1 titrate with (named) alkali; M2 correct result;	**2**	**A** M2 if non specified or other metal added in M1

Question	Answer	Marks	Guidance
5(a)	($CuCO_3$ →) CuO + CO_2; ($Cu(OH)_2$ →) CuO + H_2O; ($2Cu(NO_3)_2$ →) $2CuO$ + ($4NO_2$) + O_2 species; balancing;	4	**A** multiples **I** state symbols
5(b)(i)	(black to) pink / brown / orange;	1	**I** red
5(b)(ii)	(hot) copper reacts / is oxidised; with oxygen / air;	2	**A** forms copper oxide for 2 marks
5(b)(iii)	carbon monoxide / ammonia / methane;	1	
5(b)(iv)	carbon / graphite or any metal more reactive than copper;	1	
5(c)(i)	79.2828685; 79.6205853; 84.7161572;	2	Minimum 3 sig figs **A** rounding or truncating *All three correct = 2 marks,* *Two correct = 1 mark*
5(c)(ii)	the last one **OR** Cu and O_2 **OR** the one from copper; not all the copper oxidised **OR** the outside of the pieces of copper oxidised but the inside did not **OR** (still) contains copper (metal);	2	ecf of biggest for M1

Question	Answer	Marks	Guidance
6(a)(i)	Al^{3+} + 3e → Al formula of Al^{3+} ion; rest correct;	2	**A** multiples **I** state symbols **A** – 3e on right

Question	Answer	Marks	Guidance
6(a)(ii)	$2O^{2-} \rightarrow O_2 + 4e$ species; balancing;	2	**A** multiples **I** state symbols **A** – 4e on left
6(a)(iii)	endothermic **AND** (electrical) energy supplied;	1	**A** energy required to break bonds
6(b)(i)	exothermic **AND** (electrical) energy release;	1	**I** heat energy
6(b)(ii)	magnesium forms ions (in solution) **OR** magnesium loses electrons **OR** magnesium is oxidised; copper is deposited (on the electrode) **OR** copper ions become copper atoms **OR** copper ions gain electrons **OR** copper ions are reduced;	2	**A** magnesium dissolves / goes into solution **A** equation (balanced or unbalanced) **A** equation (balanced or unbalanced) **I** use of terms anode or cathode
6(b)(iii)	M1 set up a magnesium / manganese cell; M2 the negative electrode (is the more reactive) **OR** the electrode that loses mass (is more reactive); **OR** M1 replace magnesium with manganese; M2 if voltage less (positive) manganese is less reactive **OR** if voltage is more (positive) manganese is more reactive;	2	**A** replace Cu with Mn **A** converse
6(c)	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ species; balancing;	2	**A** multiples **I** state symbols
6(d)(i)	(light from the) sun / sunlight;	1	**A** uv
6(d)(ii)	carbon dioxide + water → glucose + oxygen;	1	**A** starch / sugar / (named)carbohydrate **I** energy or light on LHS

Question	Answer	Marks	Guidance
7(a)(i)	alkenes have a (carbon to carbon) double bond;	1	**A** "they" for alkenes **A** alkanes do not have a (carbon to carbon) double bond
7(a)(ii)	alkene; C_nH_{2n} **or** twice as many hydrogen atoms as carbon atoms;	2	**A** fits general formula for alkenes
7(a)(iii)	add bromine (water); remains brown / orange / yellow / no change; becomes colourless / decolourised;	3	**I** red **A** M2 and M3 only available if M1 correct or close (such as bromide or bromination) **I** clear
7(b)(i)	 correct structure with at least two carbons and single C-C bond; continuation bonds with at least 2 carbon atoms in chain; two or more correct repeat units (with correct use of n, if used) **OR** correct use of n;	3	**I** incorrect additional units **R** any incorrect units or non-integral number of repeat units
7(b)(ii)	CH_3-CH=CH-CH_3;	2	**A** award 1 mark for any monomer with C=C as long as both carbons have the correct valency **I** names

Question	Answer	Marks	Guidance
7(b)(iii)	*one from:* addition polymerisation polymer only product; addition polymerisation same functional group in all monomers **or** C=C in monomers; addition polymer has same empirical formula as monomer; *one from:* condensation makes (polymer and) simple/small molecule **OR** water **OR** hydrogen chloride; condensation polymerisation monomers have two (different) functional groups;	**2**	**A** only one monomer **A** (normally two) different monomers
7(b)(iv)	polyester / polyamide;	**1**	**A** protein / polysaccharide / polypeptide / complex carbohydrate **I** names