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Cambridge International General Certificate of Secondary Education

MARK SCHEME for the May/June 2015 series

0620 CHEMISTRY

0620/33 Paper 3 (Extended Theory), maximum raw mark 80

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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

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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

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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 blast furnace / toothpaste / (making) glass / building / (making) cement / treating acidic river or lakes / chalk;	**1**	

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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

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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

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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

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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

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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

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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

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