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Mark Scheme (Results)

January 2016

International GCSE
Chemistry (4CH0) Paper 1C
Science Double Award (4SC0) Paper 1C

Pearson Edexcel Certificate in
Chemistry (KCH0) Paper 1C
Science (Double Award) (KSC0) Paper 1C

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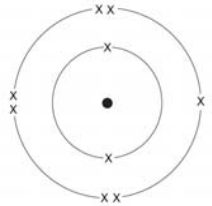
General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question number	Answer	Notes	Marks
1 (a) (i)	A (Ag)		1
(ii)	D (Zr)		1
(b) (i)	3		1
(ii)	(The atom has) three <u>electrons</u> in its outer / valence shell	'energy level' for 'shell' ignore references to inner shells ignore 'it has a valency of 3'	1
(iii)	3		1
(iv)	(The atom has) electrons in three shells / three shells are occupied (with electrons)	'energy levels' for 'shells' accept 'it has three shells'	1
(v)	aluminium / Al		1
(c)		accept any symbol for electrons, eg dots, the letter 'e'	1

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2 (a)</td><td>C (halogens)</td><td></td><td>1</td></tr>
<tr><td>(b) (i)</td><td>M1 <u>atoms</u> of the same element

M2 with different masses</td><td>accept ‘<u>atoms</u> with the same atomic number’ / ‘<u>atoms</u> with the same number of protons’

accept ‘different mass numbers’ / ‘different numbers of neutrons’

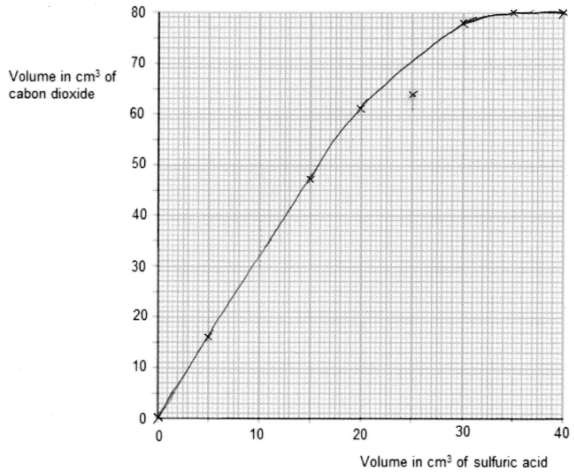
ignore references to electrons unless incorrect</td><td>1

1</td></tr>
<tr><td>(ii)</td><td>
<table>
<tr><th>Isotope</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th></tr>
<tr><td>$^{79}_{35}Br$</td><td>35</td><td>44</td><td>35</td></tr>
<tr><td>$^{81}_{35}Br$</td><td>35</td><td>46</td><td>35</td></tr>
</table>
</td><td></td><td>3</td></tr>
</table>

	M1 first column correct **M2** second column correct M3 third column correct		
(c)	ethane – no change (in colour) ethene – (orange to) colourless / decolourises	accept ‘(stays) orange’ ignore ‘no reaction’ /’nothing happens’ ignore ‘discolours’ ignore starting colour of bromine	1 1

Question number	Answer	Notes	Marks
3 (a)	nitrogen / N_2	accept N	1
(b)	oxygen AND water	accept steam	1
(c)	incomplete combustion (of the octane / fuel)	accept '(burns in a) limited supply / shortage of oxygen/air' reject 'no oxygen'	1
(d) (i)	$N_2 + 2O_2 \rightarrow 2 NO_2$	accept halves and multiples accept as two correct equations via NO	1
(ii)	(It produces) acid rain OR (it causes) breathing problems / asthma	accept 'photochemical smog' ignore refs to greenhouse gas / global warming / climate change ignore refs to pollution	1

Question number	Answer	Notes	Marks
4 (a)	water	accept H_2O accept water vapour if both name and formula given mark name only	1
(b)	carbon dioxide	accept CO_2 if both name and formula given mark name only	1
(c)	**M1** (the copper / it) reacts with oxygen / oxidises **M2** to form copper(II) oxide (which is black)	accept 'combines with/joins with/burns in oxygen' ignore 'air' accept 'copper oxide' reject 'copper(I) oxide'	2

Question number	Answer	Notes	Marks
5 (a)	 **M1** & **M2** all points correctly plotted to nearest gridline **M3** suitable curve of best fit, from the origin	deduct one mark for each incorrectly plotted point do not penalise missing (0, 0) if points are not visible, but graph goes through that point, then do not penalise	3

Question number		Answer	Notes	Marks
(b)	(i)	25 (cm^3)	accept anomalous point based on graph drawn	1
	(ii)	**M1** the volumes (of gas) are the same	accept 'no more gas is being produced/collected (after 35 cm^3)'	2
		M2 therefore the reaction has finished / <u>all</u> of the solid/$MgCO_3$ has reacted / the solid/$MgCO_3$ has been used up	reject 'all of the reactants have reacted' reject 'all of the acid has reacted' ignore refs to $MgCO_3$ dissolving accept refs to $MgCO_3$ being limiting reagent	
	(iii)	value correctly read to nearest gridline from candidate's graph		1
	(iv)	value correctly read to nearest gridline from candidate's graph		1

Question number	Answer	Notes	Marks
6 (a) (i)	$2HgO \rightarrow 2Hg + O_2$	accept halves and multiples	1
(ii)	redox	accept '(thermal) decomposition' ignore 'oxidation' allow 'reduction'	1
(b) (i)	(tap / dropping / separating) funnel	reject 'filter / thistle funnel'	1
(ii)	(the gas / it) contains air (from the conical flask)	accept 'contains impurities' or ref to possible named impurity eg nitrogen reject 'water vapour' allow 'contains less <u>oxygen</u>'	1
(c)	**M1** perform reaction with and without catalyst **M2** keep remaining variables (eg concentration or volume of hydrogen peroxide / temperature) the same **M3** measure time (to fill the gas jar with oxygen) **M4** **o**<u>xygen produced</u> more quickly/at a faster rate/in a shorter time (in experiment) with catalyst **OR** **M1** weigh a sample of manganese(IV) oxide	accept: **M1** **p**erform reaction with and without catalyst **M2** <u>oxygen produced</u> more quickly/at a faster rate/in a shorter time (in experiment) with catalyst **M3** weigh a sample of manganese(IV) oxide (before putting it into the conical flask) **M4** the mass at the end of the reaction should be the same as at the start	4

	(before putting it into the conical flask) **M2** filter (to remove the solid) **M3** dry the solid (and re-weigh it) **M4** the mass should be the same as before		
(d) (i)	$SO_2 + H_2O \rightarrow H_2SO_3$	accept $SO_2 + H_2O + ½O_2 \rightarrow H_2SO_4$ allow products shown as correct ions	1
(ii)	**M1** (Universal Indicator turns) orange/yellow **M2** (the solution/it) is acidic / contains hydrogen ions / contains H^+ ions	accept 'red' allow 'contains sulfurous / sulfuric acid'	2

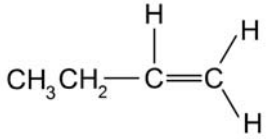
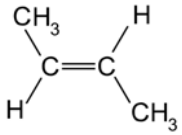
Question number	Answer	Notes	Marks
7 (a)	**M1** (Curve) A **M2** faster reaction (at higher temperature) **M3** therefore curve is steeper / curve levels off sooner	 **M2** and **M3** dep on correct or missing **M1** accept 'reaction takes less time'	3
(b)	**M1** (Curve) C **M2** only half the mass/amount of zinc used **M3** therefore only half the volume / 20 cm^3 of hydrogen produced	 **M2** and **M3** dep on correct or missing **M1** accept 'less zinc used, so less hydrogen produced' for **1** mark, if **M2** and **M3** not scored	3

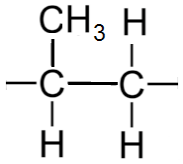
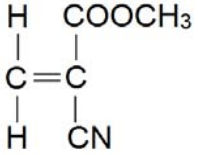
Question number	Answer	Notes	Marks
8 (a)	(because) a precipitate was formed/a reaction took place each time Y was used OR no precipitate was formed/no reaction took place when X and Z were added together	accept 'it reacts with X and Z (to form a precipitate)' allow use of correct names for X, Y and Z	1
(b)	**M1** X is (sodium) iodide and Z is (sodium) chloride **M2** because X gives yellow precipitate or Z gives white precipitate **OR** **M1** X is (sodium) iodide because it forms a yellow precipitate **M2** therefore Z is (sodium) chloride **OR** **M1** Z is (sodium) chloride because it forms a white precipitate **M2** therefore X is (sodium) iodide		2

(c)	**M1** no change/no reaction with (sodium) chloride **M2** colour change (to brown solution) with (sodium) iodide	 accept ‘orange’ / ‘orange-brown’ accept ‘grey/black <u>precipitate</u>’ reject incorrect colour change	2

Question number	Answer	Notes	Marks
9 (a)	**M1** coke **M2** limestone accept answers in either order	ignore 'carbon' / 'charcoal' ignore 'calcium carbonate' ignore formulae	2
(b) (i)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ **M1** all formulae correct **M2** balanced	 **M2** dep on **M1**	2
(ii)	**M1** iron / Fe **M2** (it has) lost oxygen	 **M2** dep on **M1**or near miss eg Fe_2O_3 accept 'iron (III) ions / Fe^{3+} has gained electrons' accept 'oxidation number of iron decreases / oxidation number of iron changes from +3 to 0'	2
(c) (i)	$C + O_2 \rightarrow CO_2$		1
(ii)	C (neutralisation)		1

(d) (i)	**M1** oxygen **M2** water	accept 'air' accept 'moisture' / 'water vapour' ignore 'steam' accept answers in either order	2
(ii)	prevents oxygen/water from coming into contact with the iron	accept refs to acting as a barrier	1
(e) (i)	galvanising	ignore 'sacrificial protection'	1
(ii)	**M1** zinc is more reactive than iron / loses electrons more readily **M2** (and therefore) corrodes in preference (to the iron)	ignore 'sacrificial protection' accept 'reacts (with oxygen/water) in preference (to the iron)' accept refs to zinc converting iron(II) ions to iron (atoms) reject 'zinc rusts' for **M2**	2
(f) (i)	(aluminium/it) is too reactive / more reactive than carbon / <u>above</u> carbon in the reactivity series	accept 'carbon is less reactive than aluminium' accept 'the temperature required is too high' ignore refs to carbon monoxide	1
(ii)	energy costs are too great / electricity is expensive	allow 'it is cheaper to use the blast furnace' ignore refs to iron being below carbon in the reactivity series	1

Question number	Answer	Notes	Marks
10 (a)	(the molecule) contains a (carbon to carbon) double bond	accept 'multiple bond' ignore refs to single bonds	1
(b) (i)	C_8H_{18} and C_2H_4	Ignore names of compounds	1
(ii)	**M1** 600-700ºC		2
	M2 silica / alumina (catalyst)	accept 'aluminium oxide / silicon dioxide / aluminosilicate / zeolite' accept correct formulae	
(c) (i)	**M1** (they have) the same molecular formula	allow 'both have same number of carbon and hydrogen (atoms as each other)'	2
		accept 'the atoms are arranged differently'	
	M2 (but have) different structural formulae /		
(ii)	displayed formulae / structures 	accept  ignore bond angles accept fully displayed formula	1

10 (d) (i)	poly(propene) / polypropene	accept ‘polypropylene’	1
(ii)	 **M1** correct structure **M2** extension bonds	ignore brackets and ‘n’ **M2** dep on **M1** except award **M2** if >1 repeat unit given	2
(e)		penalise incorrect use of upper / lower case letters and subscripts penalise bonds to incorrect atoms	1

Question number	Answer	Notes	Marks
11 (a)	**M1** chromate (ions) are negative **M2** so they are attracted/move towards positive electrode/electrode B	accept 'anions' accept 'anode'	2
(b) (i)	2 2 (1) (1)	accept halves and multiples	1
(ii)	B (HCl(aq))		1
(c) (i)	aq aq aq s	Do not accept words eg aqueous	1
(ii)	**M1** filter (off the precipitate) **M2** wash (with distilled/deionised/pure water) **M3** dry in a warm oven / leave to dry / dry with filter paper	allow 'decant' reject refs to crystallisation for **M2** and **M3** allow 'heat it'	3

Question number	Answer	Notes	Marks
12 (a) (i)	**M1** 0.53 ÷ 106 **M2** 0.005(0) (mol)	 correct answer scores (2)	2
(ii)	**M1** *n*(CO_2) = 0.005 mol / answer to (a)(i) **M2** vol(CO_2) = (110 ÷ 0.005) = 22 000 (cm^3) OR 110 ÷ **M1** correctly evaluated	 correct answer scores (2)	2
(b)	any two from: **M1** the bung was not replaced quickly after the acid was added (so some carbon dioxide/gas escaped) **M2** (some) carbon dioxide/gas dissolved in the water (in the trough or in the acid) **M3** sodium carbonate is not pure	 allow 'the bung was not on tightly/there was a leak around the bung (so some carbon dioxide/gas escaped)' allow 'reacted with the water'	2

Question number	Answer	Notes	Marks
13 (a)	potassium / sodium / magnesium / zinc	accept K / Na / Mg / Zn if both name and symbol given, mark name only	1
(b)	**M1** bubbles of gas produced rapidly/quickly **M2** solid disappears quickly	accept any indication that the rate of evolution of bubbles and the disappearance of the solid is in between that of magnesium and zinc	2
(c) (i)	potassium hydroxide	accept KOH if both name and formula given, mark name only	1
(ii)	MgO		1
(d) (i)	carbon/C <u>and</u> it displaces/replaces zinc/Zn	reject 'displaces zinc oxide / displaces oxygen' accept 'it gains oxygen (from the zinc oxide) / it reduces zinc (oxide)'	1
(ii)	**M1** carbon / C **M2** it removes oxygen from the zinc (oxide) / causes zinc <u>ions</u> to gain electrons / gains oxygen / is oxidised	 **M2** dep on **M1** reject 'displaces oxygen'	2

Question number	Answer	Notes	Marks
14 (a)	**M1** (goes darker because) more NO_2 is formed **M2** as equilibrium/reaction shifts to left **M3** because there are more moles/molecules (of gas) on the left hand side	allow 'moves backwards/in reverse direction' accept 'fewer moles/molecules on the right hand side' ignore references to Le Chatelier's principle	3
(b) (i)	**M1** the equilibrium/reaction has shifted to the right / more N_2O_4 has been formed **M2** a decrease in temperature shifts the equilibrium in the exothermic direction	accept 'therefore the (forward) reaction is exothermic' for **M2** if **M1** has been awarded	2
(ii)	(yes: because) bond making is exothermic/releases (thermal/heat) energy		1

Question number	Answer	Notes	Marks
15 (a)	$3Mg + N_2 \rightarrow Mg_3N_2$ **M1** formula for magnesium nitride correct **M2** rest of equation correct	 **M2** dep on **M1**	2
(b) (i)	**M1** (damp) red litmus (paper) **M2** turns blue **OR** **M1** mix with hydrogen chloride/HCl **M2** white solid/smoke forms	reject 'blue litmus' for both **M1** and **M2** accept any suitable indicator with correct colour change, eg phenolphthalein turns red/pink reject 'hydrochloric acid' / 'HCl(aq)' but accept 'fumes from conc. hydrochloric acid' ignore 'fumes'	2

(b)	(ii)	**M1** M_r of lithium nitride = 35 **M2** (1.40 ÷ 35 =) 0.04(0) (mol)	correct answer scores (2)	2
	(iii)	**M2** from (b)(ii) x 3 / 0.04(0) x 3 = 0.12 (mol)		1
	(iv)	**Using answer to b(iii)** **M1** answer to (b)(iii) ÷ 2 / 0.12 ÷ 2 = 0.06(0) (mol) **M2** answer to **M1** ÷ 0.500 / 0.06(0) ÷ 0.500 **M3** 0.12 dm^3 / 120 cm^3 **Using answer to b(ii)** **M1** answer to (b)(ii) ÷ 2 / 0.04(0) ÷ 2 = 0.02(0) (mol) **M2** answer to **M1** ÷ 0.500 / 0.02(0) ÷ 0.500 **M3** 0.04 dm^3 / 40 cm^3		3

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