



## **Mark Scheme (Results)**

January 2017

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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January 2017

Publications Code 4CH0\_1C\_1701\_MS

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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)	A (He)		1
(b)	D (water)		1
(c)	C (simple distillation)		1
(d) (i)	to prevent the inks/spots dissolving/mixing (in the solvent)	Ignore references to spots smudging/running Ignore references to diffusion/absorption  Accept spots would be washed off / washed away / leached  Ignore water for solvent	1
(ii)	M1 identification of inks as (only) B  M2 (P and B) have a spot at the same height / OWTTE	Accept blob/mark/dye for spot Accept at same level/same distance/same place Accept a spot which has the same $R_f$ value  M2 DEP on M1	2
(iii)	insoluble in the solvent	Accept water for solvent Allow does not mix with solvent Ignore does not react with solvent	1

	(iv)	M1 measurement of distance moved by A M2 calculation of $R_f$ value	accept any value in range 18-22  accept any number of significant figures Ignore units  M2 CQ M1 Correct answer with no working scores 2	2
(e)	(i)	NH <sub>4</sub> Cl		1
	(ii)	a circle around s AND a circle around g		1
<b>(Total for Question 1 = 11 marks)</b>				

Question number	Answer	Notes	Marks
2 (a)	diagram showing solid state	Accept minimum of two complete rows	1
(b)	C (regular vibrating)		1
(c)	C (freezing)		1
(d)	sublimation		1
2 (e)	M1 water vapour M2 steam	Accept in either order	2
<b>(Total for Question 2 = 6 marks)</b>			

Question number	Answer	Notes	Marks
3 (a)	V		1
(b)	U AND X		1
(c)	V		1
(d) (i)	M1 $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ M2 $\text{C}_2\text{H}_4 + 2\text{O}_2 \rightarrow 2\text{CO} + 2\text{H}_2\text{O}$	Accept multiples and fractions Accept multiples and fractions	2
(ii)	it decreases the capacity of blood to transport oxygen OWTTE	Accept correct references to haemoglobin and/or carboxyhaemoglobin	1
(e) (i)	nitrogen AND oxygen	Accept answers in either order	1
(ii)	$\text{HNO}_3$		1
(iii)	iron / steel / limestone / marble	Ignore chalk Ignore formula even if incorrect	1
<b>(Total for Question 3 = 9 marks)</b>			

Question number	Answer	Notes	Marks		
4 (a)	(i) M1 A and B	DEP on correct choice of letters Accept same atomic number Ignore references to electrons  Allow M3 if at least two from A, B and E given for M1 Ignore references to neutrons  Statement about equal/same numbers of protons and electrons scores M2 and M3	3		
	M2 they have the same numbers of protons				
	M3 the numbers of protons and electrons are equal				
	(ii)		M1 G and H	DEP on correct choice of letters  Accept same atomic number Ignore references to electrons  Allow M3 if at least two from D, F, G, H given for M1  Ignore references to neutrons	3
			M2 they have the same numbers of protons		
			M3 there are more electrons than protons		



(iii)	M1 A M2 it has the fewest (total number of) protons and neutrons	DEP on correct choice of letter  Accept fewest nucleons Accept because its mass number is 10 Allow (A) because mass number is (sum of) the number of protons and neutrons  Ignore references to electrons	2
(iv)	2.5	Accept comma and other punctuation marks  Accept diagram showing electrons on circles	1

(b)	M1 setting out of calculation M2 evaluation M3 answer to 1 dp	eg $(24 \times 0.786) + (25 \times 0.101) + (26 \times 0.113)$  24.327 / 24.33  24.3 Ignore units  Correct final answer with no working scores 3 marks  <b>(Total for Question 4 = 12 marks)</b>	3
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Question number	Answer	Notes	Marks
5 (a) (i)	2 AND 3 AND 4 AND 5	Accept 2 – 5	1
(ii)	M1 Ar / argon  M2 (because) it does not (easily) share/lose/gain electrons	Allow it has a full/complete outer shell (of electrons) Allow it has eight electrons in its outer shell Ignore references to being stable / inert / a noble gas / in Group 0  M2 DEP on M1	2
(iii)	(they both have the) same number of / three (electron) shells	Accept energy levels for shells Accept valence shell is the third shell  Ignore both have two electrons in inner/ first shell / shell nearest nucleus  Ignore both have eight electrons in second/middle shell	1
(iv)	(they both have) one electron / the same number of electrons in their outer shell	Accept energy level for shell  Ignore both have two electrons in inner/first shell / shell nearest nucleus  Ignore both have eight electrons in second shell	1

(v)	(good) conductor of electricity	Accept (good) conductor of heat Ignore references to melting point / boiling point / density Allow malleable/ductile Ignore shiny	1
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Question number	Answer	Notes	Marks
5 (b) (i)	Any two of: effervescence  (element/metal/lithium/potassium) moves  (element/metal/lithium/potassium) floats  (element/metal/lithium/potassium) disappears / becomes smaller	1 mark for each  Accept equivalents including bubbles / fizzing Allow gas evolved / gas given off / gas formed / gas produced Ignore hydrogen / H <sub>2</sub> Ignore incorrect name/formula of gas  Accept equivalents including darts  Allow dissolves  Reject melts Ignore white trail / vigorous reaction / heat produced / temperature rises	2
(ii)	flame / (element/metal/potassium) burns	Ignore colour of flame Accept melts / forms a ball Ignore explodes	1
(iii)	$(2\text{Li} + 2\text{H}_2\text{O} \rightarrow) \mathbf{2\text{LiOH} + \text{H}_2}$	M1 formulae LiOH and H <sub>2</sub> M2 correct balancing  M2 DEP on M1	2
(iv)	pink / red	Ignore qualifiers such as light and dark Reject all other colours	1

(v)	$\text{OH}^- / \text{HO}^-$	Ignore name	1
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Question number	Answer	Notes	Marks
5 (c) (i)	(mass of oxygen = 34.8 – 32.4 =) 2.4 g		1
5 (c) (ii)	M1 amount of silver (= $\frac{32.4}{108}$ ) = 0.3 (mol)		3
	M2 amount of oxygen (= $\frac{2.4}{16}$ ) = 0.15 (mol)	M2 ECF from 5 (c) (i)	
	M3 formula = Ag <sub>2</sub> O	If division upside down or division by atomic number, or incorrect Ar then cannot score M3  Correct final answer with no working scores 3 marks	
<b>(Total for Question 5 = 17 marks)</b>			

Question number	Answer	Notes	Marks
6 (a)	$\text{Cl}_2 + 2\text{KBr} \rightarrow \text{Br}_2 + 2\text{KCl}$ <p>M1 all formulae correct</p> <p>M2 correct balancing</p>	<p>Ignore state symbols Accept multiples or fractions</p> <p>M2 DEP on M1</p>	2
(b)	<p>M1 solution becomes yellow / orange</p> <p>M2 reaction type is redox / displacement</p> <p>M3 bromine / Br<sub>2</sub> (causes final colour)</p> <p>M4 chlorine more reactive (than bromine)</p>	<p>Reject red Ignore brown</p> <p>Allow reduction / oxidation Ignore substitution</p> <p>Ignore Br Reject bromide</p> <p>Accept reverse argument Reject chloride/bromide in place of chlorine/bromine</p>	4
<b>(Total for Question 6 = 6 marks)</b>			

Question number	Answer	Notes	Marks
7 (a)	(i) M1 wait until all the air has been flushed through	Accept wait for a short time Allow check for leaks	2
	(i) M2 (because) prevents (possible) explosion / otherwise might be an explosion	Ignore hydrogen burns/is flammable  If no marks awarded allow 1 mark for (hydrogen can be) explosive / tie back hair (to stop catching fire)	
	(ii) M1 effervescence	Accept equivalents including bubbles / fizzing Allow gas evolved / given off / formed / produced Ignore hydrogen / H <sub>2</sub> Ignore incorrect name/formula of gas	2
	(ii) M2 (element/metal/magnesium) disappears / becomes smaller	Allow dissolves  Ignore heat produced / temperature rises / flask gets warm	
	(iii) Solid/copper(II) oxide/it goes (from black to) orange / brown / pink	Accept (drops of) liquid / water (on glass)	1



(iv)	blue	Ignore qualifiers such as pale / dark Reject all other colours	1
(v)	(first equation) M1 magnesium sulfate AND hydrogen	Accept names in either order Ignore formulae even if incorrect	3
	(second equation) M2 copper AND water	Accept names in either order Ignore formulae even if incorrect	
	(third equation) M3 water AND hydrated copper(II) sulfate	Ignore formulae even if incorrect Accept hydrated copper sulfate Reject incorrect oxidation number Ignore hydrous	

Question number	Answer	Notes	Marks
7 (b)	M1 (litmus colour becomes) red	Ignore qualifiers such as pale / dark Allow pink	2
(c)	M2 (oxide of sulfur is) acidic  MgSO <sub>3</sub>	M2 dep on correct or missing M1  Allow MgSO <sub>3</sub> as <u>product</u> of an equation Ignore H <sub>2</sub> O	1
<b>(Total for Question 7 = 12 marks)</b>			

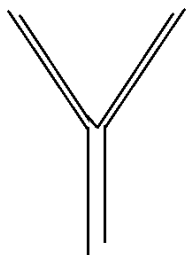
Question number	Answer	Notes	Marks
8 (a) (i)	<p>M1 sodium hydroxide / NaOH (solution)</p> <p>M2 pipette used to transfer (25 cm<sup>3</sup> of) sodium hydroxide / alkali to a conical flask</p> <p>M3 place (sulfuric) acid in burette</p> <p>M4 add indicator (to conical flask)</p> <p>M5 add acid (from burette to conical flask) until indicator changes colour</p>	<p>Accept sodium carbonate / Na<sub>2</sub>CO<sub>3</sub></p> <p>Accept sodium carbonate / Na<sub>2</sub>CO<sub>3</sub> M2 subsumes M1 if sodium hydroxide /sodium carbonate mentioned</p> <p>Accept suitable named indicator Reject Universal Indicator</p> <p>M5 subsumes M3 if burette mentioned</p> <p>If named indicator is given any final colour given must be correct</p> <p>Alkali in burette and acid in pipette/conical flask can score max 3</p>	5

(a) (ii)	M1	(after)	23.20	Award 1 mark for both readings correct but in wrong order  M3 CQ on (M1 – M2)  Penalise an answer not to 2 dp once only eg 23.2 3.5 19.7 scores 1	3
	M2	(before)	3.55		
	M3	(added)	19.65		

Question number	Answer	Notes	Marks
8 (b)	<p>M1 name of soluble barium compound</p> <p>M2 mix/react/add (solutions/reactants) together OWTTE</p> <p>M3 filter</p> <p>M4 wash solid/residue/barium sulfate (with distilled/deionised water)</p> <p>M5 appropriate method of drying solid eg leave it (to dry) / leave in a warm place / place in an oven / place in desiccator / heat it / dry with absorbent paper (eg kitchen/filter/blotting)</p>	<p>eg barium chloride / barium nitrate / barium hydroxide accept correct formulae</p> <p>M2 DEP on M1</p> <p>Accept decant / pour off liquid</p> <p>M4 and M5 DEP on M3</p> <p>If method refers to, or infers use of, filtrate / solution / crystallisation then cannot score M4, M5</p> <p>Not just dry it Accept leave on a window ledge</p> <p>M3 M4 M5 can be scored even if preceding method invalid eg barium + sodium sulfate</p> <p style="text-align: right;"><b>(Total for Question 8 = 13 marks)</b></p>	5

Question number	Answer	Notes	Marks
9 (a) (i)	M1 $M_r(\text{CuO}) = 79.5$ M2 $n(\text{CuO}) = (6.3 \div 79.5) = 0.079 \text{ (mol)}$	Accept 80  $6.3 \div 79.5$ Calculator gives 0.0792452830185 Accept any number of SF so Allow 0.08 Reject 0.07  $6.3 \div 80$ calculator gives 0.07875  ECF on incorrect Mr  Correct answer with no working scores 2	2
(ii)	M1 $n(\text{H}_2\text{SO}_4) = \frac{52 \times 1.1}{1000}$ M2 $= 0.057 \text{ (mol)}$	Accept 0.0572 Allow 0.06 Reject 0.05  Allow 1 mark for 57.2  Correct answer with no working scores 2	2
(iii)	to (completely) neutralise the (sulfuric) acid	Accept so that <u>all</u> acid used up/reacted  Ignore to obtain a pure product	1

(iv)



Ignore labelling  
Need funnel and paper

1

(b)

M1  $M_r(\text{CuSO}_4 \cdot 5\text{H}_2\text{O}) = 249.5$

M2  $m(\text{CuSO}_4 \cdot 5\text{H}_2\text{O}) = 249.5 \times 0.12 = 30(\text{g})$

Accept 250

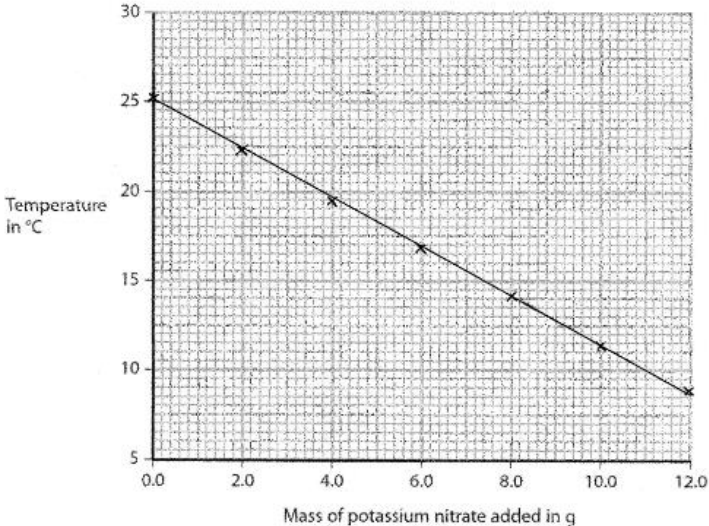
Accept 29.94 and 29.9

If use 250 accept 30.0 or 30

M2 CQ Mr

2

**(Total for Question 9 = 8 marks)**

Question number	Answer	Notes	Marks
10 (a)	$(38 \div 2 =) 19 \text{ (g)}$	Accept $[(37 \text{ to } 40) \div 2 =] 18.5 \text{ to } 20$	1
(b) (i)		<p>M1 + M2 all points plotted correctly to nearest gridline Deduct 1 mark for each error</p> <p>M3 straight line of best fit CQ points plotted</p>	
(ii)	7.4 (g)	Accept 7.2 to 7.6	1
(iii)	M1 temperature decreases		2

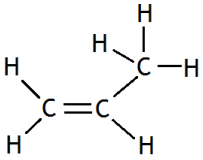
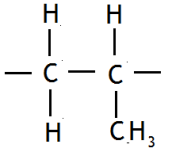


	M2 (so) change is endothermic	Accept $\Delta H$ is positive M2 DEP on correct or missing M1	
(iv)	horizontal line above original line AND labelled potassium nitrate solution	Accept potassium nitrate (aq) / aqueous potassium nitrate CQ on M2 in (iii)	1

Question number	Answer	Notes	Marks
10 (c)	<p>M1 correct substitution of values including temperature change</p> <p>M2 correct final answer (in J)</p>	<p><math>Q = 50 \times 4.2 \times 19</math></p> <p><math>= 4000 / 3990</math></p> <p>M2 CQ on incorrect <math>\Delta T</math></p> <p>If <math>m = 65</math> allow 1 mark for 5200, 5190 or 5187</p> <p>Accept answer in kJ</p> <p>Ignore sign</p> <p>Correct final answer with no working scores 2 marks</p> <p style="text-align: right;"><b>(Total for Question 10 = 10 marks)</b></p>	2

Question number	Answer	Notes	Marks
11 (a)	<p>Any four from:</p> <p>M1 heat / vaporise (the crude oil)</p> <p>M2 vapour/gas rises up the column</p> <p>M3 column cooler at top / hotter at bottom</p> <p>M4 fractions condense when temperature lower than their boiling point</p> <p>M5 fuel oil has high boiling point so condenses/is collected near bottom</p>	<p>Accept boil</p> <p>Accept hydrocarbons / molecules / fuel oil / crude oil in place of vapour</p> <p>Accept temperature gradient in column</p> <p>Allow fuel oil condenses at its boiling point</p> <p>Accept reference to fractions/hydrocarbons separate according to boiling points</p> <p>Heavier fractions / heaviest fractions / long chain molecules / longest chain molecules condense/are collected near bottom</p>	4
(b) (i)	alumina / silica	<p>Accept aluminosilicate / zeolite</p> <p>aluminium oxide / silicon dioxide</p> <p>Accept correct formulae</p>	1
(ii)	$C_{17}H_{36} \rightarrow 2C_3H_6 + C_{11}H_{24}$		1

(iii)	M1	(they/all contain) hydrogen and carbon (atoms)	Accept H and C Accept particles/elements in place of atoms Reject ions/molecules/compounds in place of atoms Reject element instead of they/all Reject H <sub>2</sub> Reject mixture	2
	M2	only	Accept equivalent terms such as solely / and no other element  M2 DEP on reference to hydrogen and carbon even if M1 not awarded	
(iv)	M1	C <sub>17</sub> H <sub>36</sub> and C <sub>11</sub> H <sub>24</sub>	Accept reactant AND other product/alkane formed	2
	M2	(because they) have only single bonds	Accept have no double/multiple bonds	
(c)	M1	(EF is CH <sub>3</sub> S) and EF mass = 47	Accept EF mass = half of Mr / EF mass = half of 94 / Mr = 2 x EF mass / 94 ÷ 47 = 2	2
	M2	C <sub>2</sub> H <sub>6</sub> S <sub>2</sub>	Accept elements in any order Award 2 marks for correct final answer with no working	
(d)	B	(C <sub>3</sub> H <sub>6</sub> Br <sub>2</sub> )		1

Question number	Answer	Notes	Marks
11 (e) (i)		Ignore bond angles	1
(ii)		<p>M1 chain of two carbon atoms joined by single bond AND both continuation bonds</p> <p>M2 one CH<sub>3</sub> group in any position AND three H atoms</p> <p>M2 DEP on M1</p> <p>Do not penalise bond to H of CH<sub>3</sub></p> <p>Any structure with double bond scores 0/2</p> <p>Three or more CH<sub>2</sub> groups linked together scores 0/2</p> <p>Allow two or more repeat units if correct Ignore brackets and subscripted n</p> <p style="text-align: right;"><b>(Total for Question 11 = 16 marks)</b></p>	2

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