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

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_4Cl		1
	(ii)	a circle around s AND a circle around g		1
			(Total for Question 1 = 11 marks)	

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
(e)	M1 water vapour M2 steam	Accept in either order	2
		(Total for Question 2 = 6 marks)	

Question number	Answer	Notes	Marks
3 (a)	V		1
(b)	U AND X		1
(c)	V		1
(d) (i)	M1 $CH_4 + \mathbf{2}O_2 \rightarrow CO_2 + \mathbf{2}H_2O$	Accept multiples and fractions	2
	M2 $C_2H_4 + \mathbf{2}O_2 \rightarrow \mathbf{2}CO + \mathbf{2}H_2O$	Accept multiples and fractions	
(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)	HNO_3		1
(iii)	iron / steel / limestone / marble	Ignore chalk Ignore formula even if incorrect	1
		(Total for Question 3 = 9 marks)	

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

(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 × 0.786) + (25 × 0.101) + (26 × 0.113) 24.327 / 24.33 24.3 Ignore units Correct final answer with no working scores 3 marks **(Total for Question 4 = 12 marks)**	3

Question number	Answer	Notes	Marks
5 (a) (i)	2 AND 3 AND 4 AND 5	Accept 2 – 5	1
(ii)	M1 Ar / argon		2
	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	
(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

Question number	Answer	Notes	Marks
5 (b) (i)	Any two of:	1 mark for each	2
	effervescence	Accept equivalents including bubbles / fizzing Allow gas evolved / gas given off / gas formed / gas produced Ignore hydrogen / H_2 Ignore incorrect name/formula of gas	
	(element/metal/lithium/potassium) moves	Accept equivalents including darts	
	(element/metal/lithium/potassium) floats		
	(element/metal/lithium/potassium) disappears / becomes smaller	Allow dissolves Reject melts Ignore white trail / vigorous reaction / heat produced / temperature rises	
(ii)	flame / (element/metal/potassium) burns	Ignore colour of flame Accept melts / forms a ball Ignore explodes	1
(iii)	(2Li + $2H_2O$ →) **$2LiOH + H_2$**	M1 formulae LiOH and H_2 M2 correct balancing M2 DEP on M1	2
(iv)	pink / red	Ignore qualifiers such as light and dark Reject all other colours	1

(v)	OH^- / HO^-	Ignore name	1

Question number	Answer	Notes	Marks
5 (c) (i)	(mass of oxygen = 34.8 – 32.4 =) 2.4 g		1
(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_2O	If division upside down or division by atomic number, or incorrect A*r* then cannot score M3 Correct final answer with no working scores 3 marks	
			(Total for Question 5 = 17 marks)

Question number	Answer	Notes	Marks
6 (a)	Cl_2 + 2KBr → Br_2 + 2KCl	Ignore state symbols Accept multiples or fractions	2
	M1 all formulae correct		
	M2 correct balancing	M2 DEP on M1	
(b)	M1 solution becomes yellow / orange	Reject red Ignore brown	4
	M2 reaction type is redox / displacement	Allow reduction / oxidation Ignore substitution	
	M3 bromine / Br_2 (causes final colour)	Ignore Br Reject bromide	
	M4 chlorine more reactive (than bromine)	Accept reverse argument Reject chloride/bromide in place of chlorine/bromine	
		(Total for Question 6 = 6 marks)	

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
	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_2 Ignore incorrect name/formula of gas	2
	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 (second equation) M2 copper AND water (third equation) M3 water AND hydrated copper(II) sulfate	Accept names in either order Ignore formulae even if incorrect Accept names in either order Ignore formulae even if incorrect Ignore formulae even if incorrect Accept hydrated copper sulfate Reject incorrect oxidation number Ignore hydrous	3

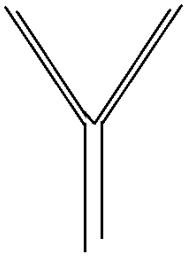
Question number	Answer	Notes	Marks
7 (b)	M1 (litmus colour becomes) red	Ignore qualifiers such as pale / dark Allow pink	2
	M2 (oxide of sulfur is) acidic	M2 dep on correct or missing M1	
(c)	$MgSO_3$	Allow $MgSO_3$ as <u>product</u> of an equation Ignore H_2O	1
		(Total for Question 7 = 12 marks)	

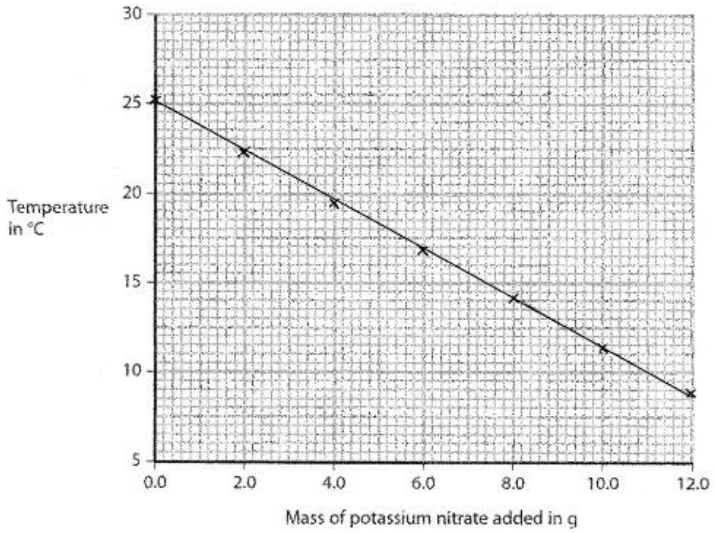
Question number	Answer	Notes	Marks
8 (a) (i)	M1 sodium hydroxide / NaOH (solution)	Accept sodium carbonate / Na_2CO_3	5
	M2 pipette used to transfer (25 cm^3 of) sodium hydroxide / alkali to a conical flask	Accept sodium carbonate / Na_2CO_3 M2 subsumes M1 if sodium hydroxide /sodium carbonate mentioned	
	M3 place (sulfuric) acid in burette		
	M4 add indicator (to conical flask)	Accept suitable named indicator Reject Universal Indicator	
	M5 add acid (from burette to conical flask) until indicator changes colour	M5 subsumes M3 if burette mentioned If named indicator is given any final colour given must be correct Alkali in burette and acid in pipette/conical flask can score max 3	

(a) (ii)	M1 (after) 23.20 M2 (before) 3.55 M3 (added) 19.65		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

Question number	Answer	Notes	Marks
8 (b)	M1 name of soluble barium compound	eg barium chloride / barium nitrate / barium hydroxide accept correct formulae	5
	M2 mix/react/add (solutions/reactants) together OWTTE	M2 DEP on M1	
	M3 filter	Accept decant / pour off liquid	
	M4 wash solid/residue/barium sulfate (with distilled/deionised water)	M4 and M5 DEP on M3 If method refers to, or infers use of, filtrate / solution / crystallisation then cannot score M4, M5	
	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)	Not just dry it Accept leave on a window ledge M3 M4 M5 can be scored even if preceding method invalid eg barium + sodium sulfate	
		(Total for Question 8 = 13 marks)	

Question number	Answer	Notes	Marks
9 (a) (i)	M1 M_r (CuO) = 79.5	Accept 80	2
	M2 n (CuO) = (6.3 ÷ 79.5) = 0.079 (mol)	6.3 ÷ 79.5 Calculator gives 0.0792452830185 Accept any number of SF so Allow 0.08 Reject 0.07 6.3 ÷ 80 calculator gives 0.07875 ECF on incorrect Mr Correct answer with no working scores 2	
(ii)	M1 n (H_2SO_4) = $\frac{52 \times 1.1}{1000}$		2
	M2 = 0.057 (mol)	Accept 0.0572 Allow 0.06 Reject 0.05 Allow 1 mark for 57.2 Correct answer with no working scores 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 ($CuSO_4.5H_2O$) = 249.5 M2 m ($CuSO_4.5H_2O$) = 249.5 × 0.12) = 30(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)	

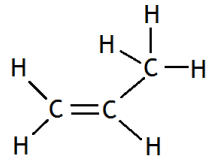
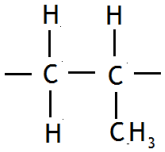
Question number	Answer	Notes	Marks
10 (a)	(38 ÷ 2 =) 19 (g)	Accept [(37 to 40) ÷ 2 =] 18.5 to 20	1
(b) (i)		M1 + M2 all points plotted correctly to nearest gridline Deduct 1 mark for each error M3 straight line of best fit CQ points plotted	
(ii)	7.4 (g)	Accept 7.2 to 7.6	1
(iii)	M1 temperature decreases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

	M2 (so) change is endothermic	Accept Δ*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)	M1 correct substitution of values including temperature change M2 correct final answer (in J)	Q = 50 × 4.2 × 19 = 4000 / 3990 M2 CQ on incorrect Δ*T* If m = 65 allow 1 mark for 5200, 5190 or 5187 Accept answer in kJ Ignore sign Correct final answer with no working scores 2 marks	2
			(Total for Question 10 = 10 marks)

Question number	Answer	Notes	Marks
11 (a)	Any four from: M1 heat / vaporise (the crude oil) M2 vapour/gas rises up the column M3 column cooler at top / hotter at bottom M4 fractions condense when temperature lower than their boiling point M5 fuel oil has high boiling point so condenses/is collected near bottom	 Accept boil Accept hydrocarbons / molecules / fuel oil / crude oil in place of vapour Accept temperature gradient in column Allow fuel oil condenses at its boiling point Accept reference to fractions/hydrocarbons separate according to boiling points Heavier fractions / heaviest fractions / long chain molecules / longest chain molecules condense/are collected near bottom	4
(b) (i)	alumina / silica	Accept aluminosilicate / zeolite aluminium oxide / silicon dioxide Accept correct formulae	1
(ii)	$C_{17}H_{36} \rightarrow 2C_3H_6 + \mathbf{C_{11}H_{24}}$		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_2 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	$C_{17}H_{36}$ and $C_{11}H_{24}$	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_3S) 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	$C_2H_6S_2$	Accept elements in any order Award 2 marks for correct final answer with no working	
(d)	B	($C_3H_6Br_2$)		1

Question number	Answer	Notes	Marks
11 (e) (i)		Ignore bond angles	1
(ii)		M1 chain of two carbon atoms joined by single bond AND both continuation bonds M2 one CH_3 group in any position AND three H atoms M2 DEP on M1 Do not penalise bond to H of CH_3 Any structure with double bond scores 0/2 Three or more CH_2 groups linked together scores 0/2 Allow two or more repeat units if correct Ignore brackets and subscripted n	2
		(Total for Question 11 = 16 marks)	

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