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Mark Scheme (Results)

Summer 2016

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

Pearson Edexcel Level 1/Level 2 Certificate Biology (KCH0) Paper 1C
Science (Double Award) (KSC0) Paper 1C

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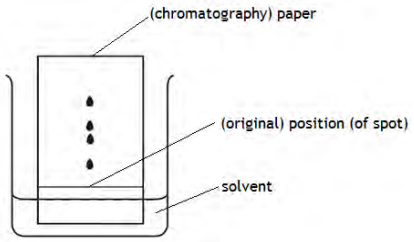
Summer 2016
Publications Code 4CH0_1C_1606_MS

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)	**B** (condensation)		1
(b)	**M1** (the particles/they) lose (kinetic) energy / have less energy **M2** (the particles/they) move closer together / pack more closely **M3** (the particles/they) do not move as freely / move more slowly / move less randomly **NB M1, M2** and **M3** can be scored anywhere across the whole answer	ACCEPT lose potential/heat energy ACCEPT not as many gaps / smaller gaps REJECT refs to density ACCEPT molecules for particles REJECT atoms **once only**.	3

Question number	Answer	Notes	Marks
2 (a)	**A** (argon)		1
(b)	CO_2 / H_2O do not allow as part of an equation	IGNORE names even if correct	1
(c) (i)	**M1** (the copper) <u>reacts/combines</u> with oxygen / oxidised **M2** to form copper(II) oxide	IGNORE bonds with oxygen IGNORE burns / combusts REJECT refs to rust ACCEPT copper oxide REJECT any other oxidation state	2
(ii)	the volume of a gas changes with temperature / gas expands when hot/heated	ACCEPT reverse argument IGNORE refs to density	1
(iii)	<u>all</u> the oxygen has reacted / the oxygen has been used up / no oxygen (left to react)	DO NOT ACCEPT refs to 'not enough oxygen'	1
(d)	**M1** (150 − 125) **or** 25 (cm^3) **M2** (25/150) x 100 = 16.7 (%) **OR** **M1** 100 x (125/150) = 83.3 (cm^3) **M2** 100 − 83.3 = 16.7 (%) **M2** is cq on **M1**	 ACCEPT 17 / 16.67 / $16.\dot{6}$ ACCEPT 83 / 83.33/ $83.\dot{3}$ REJECT 16.6 for **M2** correct answer (with no working) scores 2	2

Question number	Answer	Notes	Marks
3 (a)	**D** (filtration)		1
(b) (i)		award one mark for each correct label solvent: ALLOW label line to any point under the solvent level paper: ALLOW label line to paper, including under solvent level original spot: has to be in the centre of the baseline i.e. below the visible spots	3
(ii)	Four because there are four spots/dots (above the baseline in the chromatogram)	ALLOW blobs / marks / colours IGNORE refs to different heights	1

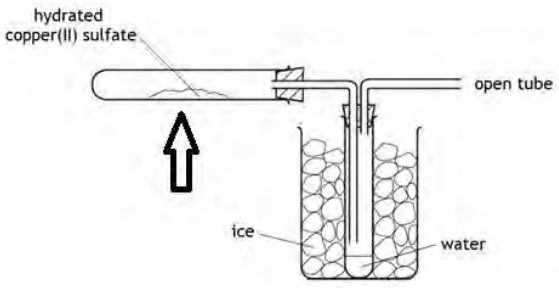
Question number	Answer	Notes	Marks
4 (a) (i)	E		6
(ii)	B		
(iii)	F		
(iv)	C		
(v)	F		
(vi)	E		
(b) (i)	**M1** (bonding/shared) electrons **M2** nuclei **OR** **M1** nuclei **M2** bonding/shared electrons	ACCEPT protons / nucleus(es) ACCEPT nucleus(es)	2
(ii)	A_2D / DA_2	ACCEPT H_2O REJECT if charges shown	1

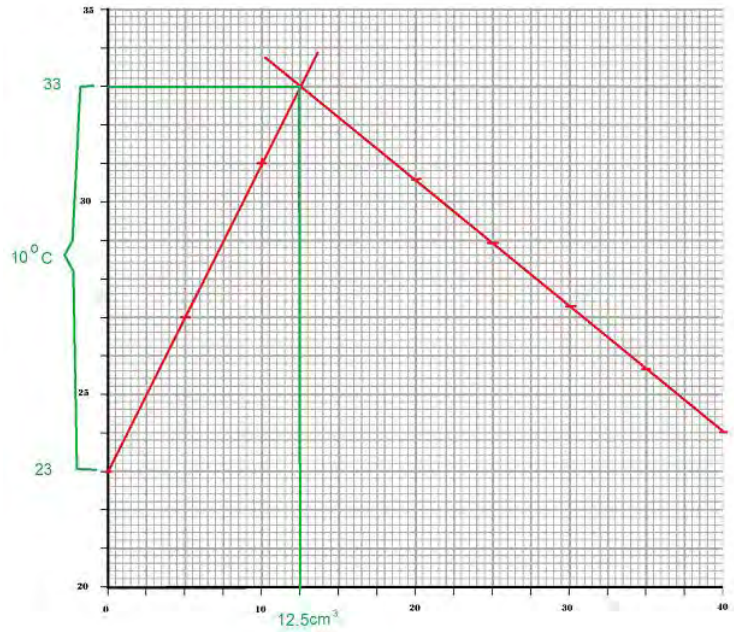
Question number	Answer	Notes	Marks
5 (a)	<table><tr><th>Metal</th><th>Highest temperature</th></tr><tr><td>aluminium</td><td>42.0</td></tr><tr><td>copper</td><td>25.0</td></tr><tr><td>iron</td><td>29.0</td></tr><tr><td>magnesium</td><td>46.5</td></tr><tr><td>zinc</td><td>31.5</td></tr></table>	**M1** for magnesium and zinc **M2** and **M3** for other 3 metals − 1 mark for 2 correct, 2 marks for all 3 correct Penalise missing trailing 0 once only	3
(b) (i)	magnesium	mark csq on table in (a)	1
(ii)	it/copper does not react (with sulfuric acid)	ACCEPT there is no reaction / the (sulfuric) acid does not react (with copper) IGNORE copper is unreactive	1
(c)	**M1** (change/rise in temperature would be) less **M2** because there is a larger volume/mass of solution/liquid (to be heated) **OR** same (amount of) energy distributed to a larger number of particles	ACCEPT halved IGNORE any quoted temperatures ACCEPT there is more/twice as much solution/liquid to be heated ALLOW acid for solution/liquid REJECT the magnesium has to react with more acid **M2** dep on **M1**	2

Question number	Answer	Notes	Marks
6 (a) (i)	 **NB** H does not need to be shown if touching / overlapping circles are shown	ACCEPT any combination of dots and crosses if overlapping / touching circles used both electrons must be within the overlapping/touching area	1
(ii)	**M1** weak forces (of attraction) between molecules / weak intermolecular forces **M2** (therefore) little (thermal/heat) energy required to overcome these forces / separate the molecules (into the gaseous state)	ACCEPT particles ACCEPT bonds for forces for both **M1** and **M2** ACCEPT correctly named IMF IGNORE more easily separated / easier to break REJECT atoms for both **M1** and **M2** **NB** any mention of breaking covalent or ionic bonds scores 0	2
(b) (i)	**M1** <u>atoms</u> of the same element **M2** with different masses	<u>atoms</u> with same atomic number / <u>atoms</u> same number of protons different mass numbers / different numbers of neutrons IGNORE references to electrons unless incorrect	2
(ii)	<table><tr><th></th><th>^{1}H</th><th>^{2}H</th><th>^{3}H</th></tr><tr><td>protons</td><td>1</td><td>1</td><td>1</td></tr><tr><td>neutrons</td><td>0</td><td>1</td><td>2</td></tr><tr><td>electrons</td><td>1</td><td>1</td><td>1</td></tr></table>	one mark for each correct row	3

Question number	Answer	Notes	Marks
(c) (i)	exothermic		1
(ii)	$2H_2 + O_2 \rightarrow 2H_2O$ **M1** all formulae correct **M2** balanced	ACCEPT multiples and halves IGNORE state symbols even if incorrect	2
(iii)	**M1** (add to) <u>anhydrous</u>/<u>white</u> copper(II) sulfate **M2** turns blue **M2** dep on **M1** or near miss	turns copper(II) sulfate from white to blue scores 2 ACCEPT equivalent description of test with anhydrous cobalt(II) chloride (blue to pink) IGNORE any references to testing with indicators	2
(iv)	**M1** <u>measure/determine</u> the boiling point **M2** 100 °C **OR** **M1** <u>measure/determine</u> the melting/freezing point **M2** 0 °C **OR** **M1** <u>measure/determine</u> the density **M2** 1 g/cm^3	ACCEPT boil the water / heat until it boils it boils at 100 °C ALLOW "heat it and it boils at 100 °C " for 2 ACCEPT freeze the water / cool until it freezes it freezes at 0 °C ALLOW "cool it and it freezes at 0 °C " for 2	2

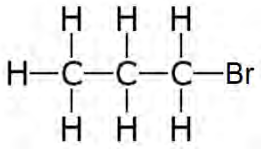
Question number	Answer	Notes	Marks
7 (a) (i)	**Any two from:** **M1** calcium/solid/it disappears **M2** bubbles (of gas) / fizzing / effervescence **M3** white solid (forms) / white suspension (forms) / (liquid) turns milky / (liquid) turns cloudy / white trails forms **M4** calcium moves (up and down) **M5** water/solution/liquid gets warm	 ACCEPT dissolves / gets smaller IGNORE mass decreases ACCEPT gas given off IGNORE hydrogen given off IGNORE incorrect gas / colour ACCEPT white precipitate forms IGNORE floats REJECT refs to moving on the surface ACCEPT temperature of water/solution/ liquid rises IGNORE refs to heat released	2
(ii)	**M1** any value greater than 7 **M2** hydroxide ions/OH^- are present / calcium hydroxide/$Ca(OH)_2$ is an alkali / calcium hydroxide/$Ca(OH)_2$ is a base **M2** dep on correct or missing **M1**	ACCEPT "greater than 7" ACCEPT metal hydroxides are alkalis/bases IGNORE hydroxides are alkalis/bases IGNORE calcium is an alkali metal	2
(b)	**M1** (Solid X) – CaO / calcium oxide **M2** (Solution Y) – $CaCl_2$ / calcium chloride **M3** (Solid Z) – $CaCO_3$ / calcium carbonate	if both formula and name given both must be correct REJECT $Ca(HCO_3)_2$ / calcium hydrogencarbonate	3

Question number	Answer	Notes	Marks
8 (a)	 **NB** the arrow must point to the solid	ACCEPT a flame if >1 arrow drawn, all must be correct	1
(b)	to condense the (water) vapour / steam	ACCEPT to cool the water vapour ACCEPT to cool/condense the gas (given off) IGNORE to condense the water IGNORE to stop the water escaping as water vapour IGNORE to condense the product	1
(c)	**M1** $n(CuSO_4.5H_2O)$ = 2.50 ÷ 250 **OR** 0.01 (mol) **M2** $n(H_2O)$ = 0.01 x 5 **OR** 0.05 (mol) **M3** mass of water = (0.05 x 18) = 0.9(0) (g) **OR** **M1** 5 x 18 **OR** 90 **M2** 250 (g) → 90 (g) **M3** 2.50 (g) → 0.9(0) (g) **OR** **M1** 5 x 18 **OR** 90 **M2** 90 ÷ 250 x 100 (%) → 36 (%) **M3** 36 (%) x 2.50 (g) → 0.9(0) (g)	mark csq throughout correct final answer (with no working) scores 3 ACCEPT calculations that use A_r of Cu as 63.5 (giving 0.9(05) (g) as a final answer) **M2** subsumes **M1** for all methods	3

Question number	Answer	Notes	Marks
9 (a)			4
	M1 & **M2** all points plotted correctly, to the nearest gridline	deduct one mark for each incorrectly plotted point	
	M3 best fit straight line through first 3 points drawn with the aid of a ruler	ALLOW **M3** and **M4** even if lines do not intersect	
	M4 best fit straight line through last 6 points drawn with the aid of a ruler		
(b) (i)	value correctly read (± 0.25 cm^3) to nearest gridline from candidate's graph (12.5 cm^3 if correctly drawn)	Do not award these marks if lines do not cross	1
(ii)	value correctly read (± 0.1°C) to nearest gridline from candidate's graph (10 °C if correctly drawn)		1

Question number	Answer	Notes	Marks
9 (c)	**M1** (water) – to remove/flush out solution (X) **M2** (solution Y) – to remove the water / avoid diluting solution Y	 ACCEPT so that the only liquid in the burette is solution Y IGNORE to remove impurities for both **M1** and **M2**	2
(d)	solution Y is less concentrated (than solution X) **OR** solution (in Experiment 2) is less concentrated	IGNORE references to reactivity ALLOW weaker / less strong instead of less concentrated IGNORE refs to more/less acidic ACCEPT reverse argument	1

Question number	Answer	Notes	Marks
10 (a) (i)	Q R S P **M1** Q and P correct **M2** R and S correct		2
(ii)	**M1** magnesium chloride **M2** hydrogen **M1** and **M2** can be in either order	ACCEPT correct formulae IGNORE incorrect formulae	2
(b)	**M1** (add) (aqueous) silver nitrate / $AgNO_3$ **M2** white precipitate (forms)	IGNORE refs to nitric acid do not award **M1** if hydrochloric acid also **added** **M2** dep on mention of silver nitrate in **M1**	2

Question number	Answer	Notes	Marks
11 (a)	propane		1
(b)	C_4H_{10}	ACCEPT $H_{10}C_4$ penalise incorrect use of symbols and subscripts REJECT structural and displayed formulae	1
(c)	W X Y	all three required	1
(d)	CH_2	ACCEPT H_2C REJECT C_nH_{2n}	1
(e)	**M1** (unsaturated) contains a (carbon to carbon) double bond **M2** (hydrocarbon) (compound/molecule/substance) contains (the elements/atoms) hydrogen and carbon… **M3** …only	ACCEPT multiple bonds IGNORE refs to single bonds REJECT element/atom/ mixture for compound/ molecule/substance REJECT ions/molecules for elements/atoms **M3** dep on mention of hydrogen & carbon in **M2** ACCEPT other equivalents e.g. solely, just, exclusively	3
(f) (i)		ACCEPT bromine in any position ACCEPT multiple substitutions ACCEPT correct displayed formula given as a **product** of an equation IGNORE any structural formula eg $CH_3CH_2CH_2Br$ or molecular formula IGNORE H−Br	1 1
(ii)	UV / ultraviolet light/radiation	IGNORE references to heat / (high) temperature / (high) pressure	

Question number	Answer	Notes	Marks
12 (a)	**M1** (Fe) (Ti) (O) $\frac{36.8}{56}$ $\frac{31.6}{48}$ $\frac{31.6}{16}$ **M2** 0.66 0.66 1.98 **M3** 1 1 3 **OR** **M1** calculation of M_r of $FeTiO_3$=152 **M2** expression for % of <u>each</u> element e.g. Fe: 56 ÷ 152 x 100% **M3** evaluation to show these equal 36.8% Fe, 31.6% Ti, 31.6% O	Division by atomic number scores 0 ACCEPT any number of sig figs except one ALLOW 0.65, 0.65, 1.97	3
(b)	**M1** (element oxidised) – carbon / C **M2** (reason) – (it has) gained/ combined with oxygen / forms carbon dioxide **M2** dep on **M1**	IGNORE refs to electron loss ACCEPT oxidation state/ number increases ACCEPT oxidation state/ number changes from 0 to (+)4	2
(c) (i)	$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$ **M1** all formulae correct **M2** balanced	ACCEPT multiples and halves IGNORE state symbols even if incorrect	2 1
(ii)	titanium / Ti / magnesium / Mg reacts with oxygen **OR** titanium / Ti / magnesium / Mg reacts with nitrogen	IGNORE refs to oxidation ACCEPT forms an oxide ACCEPT forms a nitride	
(iii)	<u>magnesium chloride</u> will dissolve more quickly / to help the <u>magnesium chloride</u> to dissolve / more of the <u>magnesium chloride</u> is in contact with the water	IGNORE to speed up the reaction IGNORE refs to increasing surface area	1

(d) (i)	**M1** positive ions/cations/nuclei and delocalised electrons **M2** attract (one another) **M2** dep on **M1**	IGNORE metal ions ALLOW sea of electrons IGNORE free electrons any refs to ionic bonding, covalent bonding or IMFs scores zero	2
(ii)	(delocalised) electrons can flow/move (through structure)/are mobile (when voltage/pd is applied)	IGNORE carry charge	1

Question number	Answer	Notes	Marks
13 (a)	$I_2 + Cl_2 \rightarrow 2ICl$	ACCEPT halves and multiples	1
(b) (i)	**M1** rate of forward reaction = rate of backwards reaction	ACCEPT both reactions occur at the same rate IGNORE forward reaction = backwards reaction	2
	M2 concentrations of reactants/ products remain constant	ACCEPT amounts/masses for concentrations ACCEPT don't change/stay for remain IGNORE concentrations/ amounts of reactants and products are the same/are equal ALLOW colour remains constant	
(ii)	**M1** equilibrium has shifted to the left / equilibrium has shifted to the ICl side / equilibrium has shifted to the reactants side **OR** more ICl has been produced / more reactants have been produced	IGNORE references to Le Chatelier's principle e.g. an increase in temperature favours the endothermic reaction	2
	M2 an increase in temperature shifts the equilibrium in the endothermic direction	ACCEPT 'therefore the (backward) reaction is endothermic' for **M2** if **M1** has been awarded	

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>14 (a)</td><td><table><tr><th>Solid</th><th>Amount</th></tr><tr><td>$KHCO_3$</td><td>0.080</td></tr><tr><td>K_2O</td><td>0.059</td></tr><tr><td>KOH</td><td>0.099</td></tr><tr><td>K_2CO_3</td><td>0.040</td></tr></table>
all four correct = 2 marks
three correct = 1 mark</td><td>ALLOW values (corrected rounded) from 1 sf up to calculator value</td><td>2</td></tr>
<tr><td>(b)</td><td>M1 equation 3

M2 the (mole) ratio of $KHCO_3$ to K_2CO_3 /reactant to product is 2:1</td><td>mark csq on amounts given in part (a)</td><td>2</td></tr>
</table>

Question number	Answer	Notes	Marks
15 (a)	Enthalpy change (of reaction)	ACCEPT heat (energy) change	1
(b)	**M1** temperature rise = 23.5 (ºC) **M2** heat produced = 200 x 4.2 x 23.5 **M3** = 20 000(J) **OR** 20 kJ unit must be given <u>if answer in kJ</u>	 Penalise use of 0.725 / 200.725 / 199.275 g in **M2** only ACCEPT 19 740 / 19 700 (J) ACCEPT 19.74(0) / 19.7(00) kJ IGNORE sign mark consequentially throughout correct answer (with no working) scores 3	3
(c) (i)	(the reaction is) exothermic **OR** transfers heat/thermal energy to the surroundings / gives out heat/thermal energy **OR** gives out heat	 ACCEPT loses for gives out DO NOT ACCEPT just energy ACCEPT loses for gives out	1
(ii)	<u>incomplete</u> combustion/burning (of the butane) **OR** (burns in a) limited supply of oxygen/air		1
(iii)	less heat (energy) / thermal energy produced **OR** temperature rise less (than expected)	ACCEPT less heat (energy) / thermal energy transferred to the water ALLOW soot has absorbed some of the heat (energy) / soot has acted as an insulator	1
(iv)	heat/energy is lost to the air/ beaker/surroundings / water evaporates	ALLOW beaker is not insulated/has no lid ALLOW water is not stirred	1

Question number	Answer	Notes	Marks
16 (a)	to avoid loss of acid (spray) / solution / liquid **OR** only gas/carbon dioxide can escape	REJECT to avoid $CaCO_3$ /solid escaping	1
(b)	carbon dioxide / gas **AND** escapes / given off / released	REJECT incorrectly named gas	1
(c) (i)		**M2** dep on **M1**	2
(ii)		ACCEPT ions REJECT atoms / molecules ACCEPT per unit time / per minute ACCEPT collision frequency increases IGNORE any refs to chance of collisions	3

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