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Mark Scheme (Results)

Summer 2019

Pearson Edexcel GCSE
In Chemistry (1CH0) Paper 2H

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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.

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.

Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.

When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

Assessment Objective		**Command Word**	
Strand	**Element**	**Describe**	**Explain**
AO1		An answer that combines the marking points to provide a logical description	An explanation that links identification of a point with reasoning/justification(s) as required
AO2		An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding	An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding)
AO3	1a and 1b	An answer that combines points of interpretation/evaluation to provide a logical description	
AO3	2a and 2b		An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning
AO3	3a	An answer that combines the marking points to provide a logical description of the plan/method/experiment	
AO3	3b		An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning

Question number	Answer	Additional guidance	Mark
1(a)(i)	high melting point / high boiling point / conducts (electricity) **when molten** (1)	ignore conducts (electricity) when in solution allow does not conduct (electricity) (when solid) ignore strong / shiny allow brittle / hard	**(1)**

Question number	Answer	Additional guidance	Mark
1(a)(ii)	+4 / 4+ / Ti^{+4} / Ti^{4+}	reject 4- allow 4 plus	**(1)**

Question number	Answer	Mark
1(b)(i)	**C** 1 x 10^{-7} metres (correct 100 nanometers) is the only correct answer. **A** is not correct because it is 100 000 nanometers **B** is not correct because it is 10 000 nanometers **D** is not correct because it is 1 nanometer	**(1)**

Question number	Answer		Mark
1(b)(ii)	A description to include the following points can {absorb/block} **UV** light from the skin (1) therefore can prevent sunburn (1) OR particles are very small (1) (therefore) appear invisible / cannot be seen on the skin (1)	allow reflects **UV** light ignore sunlight allow can prevent {skin/cell} damage / protects skin /can help prevent skin cancer allow is not white on the skin ignore insoluble in water so water resistant	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)(iii)	An explanation linking two from do not know the risks fully / long term risks not yet known (1) because they have not been used for a long enough time / are new technology / no long term research (1) might pass into the body / through cell membranes / enter skin / enter the bloodstream (1) could {change / catalyse} reactions in body (1)	allow named change / damage to named organ ignore harm the skin/ body/ causes rashes /illness ignore nanoparticles could be inhaled allow any plausible risk of sunscreen (1) with linked explanation (1)	**(2)**

(Total for Question 1 = 7 mark)

Question number	Answer	Mark
2(a)	**B** Crude oil is a mixture of hydrocarbons is the only correct answer Answer **A**, **C** and **D** are factually incorrect	**(1)**

Question number	Answer	Additional guidance	Mark
2(b)(i)	 kerosene: (fuel for) aircraft / jets / lamps / cooking / heaters / fire lighters / rocket fuel (1) diesel oil: (fuel for) cars / trains / trucks / lorries / vehicles / tractors / generators / boats (1)	Ignore generic uses such as factories / machines / engines / fuel reject trains, boats allow ships	**(2)**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	any one of • boiling point: low(er) • melting point: low(er) • ignition: easy / easier • viscosity: low(er)/ {runny / runnier} / thin(ner) • flammability: high(er) • volatility: high(er) • density: low(er)	Note : unless otherwise stated, comparison is kerosene with diesel oil ignore lower number of carbons and hydrogens: lower length of chain: lower /shorter molecule / colour allow sootiness: diesel has sootier flame accept reverse argument for diesel oil note: property may be implicit in comparison	**(1)**

Question number	Answer	Additional guidance	Mark
2(c)(i)	An explanation linking • they differ **by CH_2** / differ by **one** carbon atom / pentane has **one** more carbon (1) • they have the **same** general formula / C_nH_{2n+2} / both alkanes (1)	ignore: similar chemical properties, quoting the two molecular formulae, they are both saturated, both have single bonds (only) reject carbon or hydrogen molecules for MP1 ignore same pattern of formula / **similar** general formula reject **same** {chemical / molecular} formula	**(2)**

Question number	Answer	Additional guidance	Mark
2(c)(ii)	82.8 with or without working scores 3 correct answer but incorrectly rounded or not to 3sf scores 2 4 x 12 (1) (= 48) OR $\frac{100}{58}$ (= 1.724...) (1) $\frac{48}{58}$ x 100 (1) (= 82.759) = 82.8 (g) (1)	allow ecf but calculation must use 12, 58, 100 if working rounded to 1dp and carried forward, allow full marks eg 1.72 x 48 = 82.56 (2) or 82.6 (3) $\frac{100}{58}$ (1) (= 1.72414) = 1.72 (1) (to 3 sf) OR $\frac{100}{58}$ (1) x 12 (= 20.68966) = 20.7 (1) (to 3 sf) OR 4 x 12 (1) x 100 (= 4800) = 4.80 x 10^3 (1) (to 3 sf)	**(3)**

(Total for Question 2 = 9 marks)

Question number	Answer	Mark
3(a)	**B** 13 14 10 is the only correct answer **A** is incorrect because it is the numbers of subatomic particles in the atom not the ion **C** is incorrect because it would be an isotope of silicon with a +4 charge to it **D** is incorrect because it would be another isotope of silicon but with a 3- charge to it.	**(1)**

Question number	Answer	Additional guidance	Mark
3(b)	2.25/ 2.3 with or without working scores 3 MgO = 24 + 16 = 40 (1) **THEN** 1 g Mg forms $\frac{40}{24}$ (1) = 1.67 (g) MgO 1.35 g Mg forms $\frac{40 \times 1.35}{24}$ (1) MgO = 2.25 (g) **OR** Mg $\frac{1.35}{24}$ (1) = 0.05625 MgO 0.05625 x 40 (1) = 2.25 (g)	allow ecf for incorrect formula mass allow 48 g Mg forms 80 g MgO (1) (could be under the equation) **THEN** 1 g Mg forms $\frac{80}{48}$ (1) = 1.67 g MgO 1.35 g Mg forms $\frac{80 \times 1.35}{48}$ (1) MgO = 2.25 (g) **OR** Mg $\frac{1.35}{48}$ (1) = 0.028125 MgO 0.028125 x 80 (1) = 2.25 (g) Note 40 x 1.35 = 54 (2) or 80 x 1.35 = 108 (2)	**(3)**

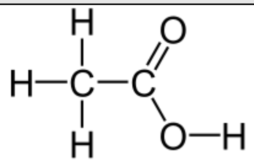
Question number	Answer	Additional guidance	Mark
3(c)	$Cl_2 + H_2 \rightarrow 2HCl$ (3) $Cl_2 + H_2 \rightarrow$ (1) $\rightarrow$ HCl (1) balancing of correct formulae (1)	do not penalise incorrect small/ capital letters for left hand side formulae, do not allow Cl^2 or Cl2, but allow MP3 if correctly balanced allow reactants in either order allow ClH for HCl allow = for → allow multiples ignore state symbols if molecules have a + or – charge do not allow mark for formulae but allow MP3 for correct balancing	(3)

Question number	Answer	Additional guidance	Mark
3(d)	Na^+ 2.8 (1) Cl^- 2.8.8 (1)	allow any separator e.g 2,8 send any atom diagrams to review allow Na^+ 2.8.0 (1) Cl^- 2.8.8.0 (1)	(2)

(Total for Question 3 = 9 marks)

Question number	Answer	Additional guidance	Mark
4 (a)	An explanation linking • yeast provides enzymes (1) • (at 80°C) the enzymes {not effective / denatured} (1)	allow yeast provides a biological catalyst allow yeast provides zymase allow yeast {contains/is} an enzyme allow yeast is denatured ignore enzyme is killed allow yeast grows well at 30°C but yeast cells are killed at 80°C .	**(2)**

Question number	Answer	Mark
4 (b)(i)	**B** oxidised is the only correct answer **A**, **C** and **D** are factually incorrect	**(1)**

Question number	Answer	Additional guidance	Mark
4 (b)(ii)	 (2) or correct carboxylic acid group (1) correct methyl group (1)	allow correct dot and cross diagram ignore incorrect bond angles allow OH for O-H	**(2)**

		reject methyl group with additional carbons max 1 mark if double bond present 2 carbons	

Question number	Answer	Additional guidance	Mark
4 (c)(i)	A description to include • heat water to increase temperature by 30°C (1) **AND** any two from • extinguish flame (1) • (re-)determine mass of burner containing ethanol (1) • subtract final from initial mass / calculate the change in mass (1)	ignore references to timing allow watch thermometer until the temperature increases 30°C / wait for temperature to rise 30°C allow put a cap on the burner (to extinguish flame) allow '(re-)weigh the burner'	**(3)**

Question number	Answer	Additional guidance	Mark
4 (c)(ii)	vertical axis with linear scale that uses more than half of the edge of the grid (1) all points correctly plotted to +/- ½ small square (1) single line of best fit drawn (1)	allow axis not starting at 0 allow points joined by straight lines / dot to dot ignore the line after points reject tramlines correct bar chart can gain MP1 and MP2	**(3)**

Total for Question 4 = 11 marks)

Question number	Answer	Mark
5(a)(i)	**D** 95 decreased is the only correct answer **A** is incorrect as the percentage of carbon dioxide was thought to be 95% **B** is incorrect as the percentage of carbon dioxide was thought to be 95% **C** is incorrect as the amount of carbon dioxide has decreased	**(1)**

Question number	Answer	Additional guidance	Mark
5(a)(ii)	An explanation to include any two linked pairs	each pair to be separately marked; MP2 dependent on MP1	**(4)**
	combustion/ burning of fossil fuels (1) {increases/ gives out} carbon dioxide (1)	allow named fossil fuel / carbon compound that is burnt e.g wood ignore 'use of fossil fuels' / 'use of cars' but allow MP2	
	respiration (1) increases carbon dioxide (1)	ignore 'breathing'/ 'population increase' but allow MP2	
	increases in sea temperature (1) release of (dissolved) carbon dioxide (1)		
	photosynthesis (1) {absorbs/ takes in/ reduces} carbon dioxide (1)	ignore 'plants/ trees' etc but allow MP2	
	carbon dioxide (dissolves) into the sea (1) carbon dioxide decreases (1)		
	volcanic emissions (1) releases carbon dioxide (1)		
	deforestation means **less photosynthesis** (1) carbon dioxide increases (1)	ignore 'deforestation' alone but allow MP2	

	use of alternative energy/ electric cars (1) less carbon dioxide release (1)		

Question number	Answer	Additional guidance	Mark
5(b)	An explanation linking **weak** {forces between molecules / intermolecular forces} (1) (intermolecular forces need) little {heat/energy} required (1)	reject weak covalent bond for both mark points allow **weak** intermolecular bonds / **weak** bonds **between molecules** ignore easy to break ignore 'easier to separate molecules' ignore needs a low temperature to break	**(2)**

Question number	Answer	Additional guidance	Mark
5 (c)	1.5×10^{21} with or without working scores 3 $\frac{0.11}{44}$ (1) (= 0.0025) $0.0025 \times 6.02 \times 10^{23}$ (1) $= 1.5 \times 10^{21}$ (1) **OR** 44g contains 6.02×10^{23} molecules (1)	allow 15×10^{20} allow ecf in MP2 and MP3 if using 0.11 and/or 44 **and** Avogadro constant	**(3)**

	0.11g contains $\frac{0.11}{44} \times 6.02 \times 10^{23}$ molecules (1) (=1.505×10^{21}) = 1.5×10^{21} (1)		

Total for Question 5 = 10 marks)

Question number	Answer	Mark
6 (a)	**D** 3 3 is the only correct answer. **A** is incorrect as the metal is in group 3 **B** is incorrect as the metal is in group 3, period 3 **C** is incorrect as the metal is in period 3	**(1)**

Question number	Answer	Additional guidance	Mark
6 (b)(i)	A description to include from • effervescence / bubbles / fizz (1) • disappears / gets smaller (1) • explodes / flame / ignites / sparks (1)	ignore gas / smoke ignore hydrogen given off allow dissolves allow moves around very fast allow forms a ball / melts ignore floats /sinks ignore ‘pops’ / hydrogen	**(2)**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	an explanation linking **outer** {electron /shell} closer to nucleus (1) so more attraction for {electron/shell} (1) (therefore) electron is harder to lose (1)	allow smaller atomic radius / fewer shells reject less outer shells for MP1 allow less shielding allow more energy to lose electron ORA for potassium	**(3)**

Question number	Answer	Additional guidance	Mark
6(c)	6.92 with or without working scores 4 7.59 x 6 (1) (= 45.54) 92.41 x 7 (1) (= 646.87) (1) $\frac{45.54 + 646.87}{100}$ (1) (= 6.9241) 6.92 (1)	penalise early rounding once only $\frac{(7.59 \times 6) + (92.41 \times 7)}{100}$ (3) 6 x 0.0759 (1) (= 0.4554) 7 x 0.9241 (1) (= 6.4687) 0.4554 + 6.4687 (1) = 6.92 (1) allow 7.59% of 6 (1) (= 0.4554) 92.41% of 7 (1) (= 6.4687) 0.4554 + 6.4687 (1) = 6.92 (1) allow ecf	**(4)**

		allow MP4 for incorrect answer with working to 2 dp if using most of the data in question	

Total for Question 6 = 10 marks)

Question number	Answer	Additional guidance	Mark
7(a)	an explanation linking contains hydrogen and carbon **only** (1) contains a {double / multiple} bond (between two carbon atoms) (1)	 reject is a mixture of carbon and hydrogen reject contains hydrogen and carbon molecules ignore bonds that haven't been used	**(2)**

Question number	Answer	Additional guidance	Mark
7(b)	$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ (3) $C_2H_4 + O_2 \rightarrow$ (1) $\rightarrow CO_2 + 2H_2O$ (1) balancing of correct formulae (1)	allow correct multiples allow = for → penalise incorrect subscripts once only	**(3)**

Question number	Answer	Additional guidance	Mark
7(c)	A description to include bromine water is {yellow / orange / red-brown} (1) ethene: becomes colourless /decolourises (1) poly(ethene): (remains) {yellow / orange / red-brown} / no colour change (1)	 allow brown ignore red alone ignore clear /discolours allow no reaction	**(3)**

		ignore poly(ethene) turns {yellow / orange / red-brown}	

Question number	Answer	Additional guidance	Mark
7(d)	C_6H_{12} with or without working gains 3 marks relative mass $CH_2 = 12 + (2x1)$ (1) (= 14) CH_2 units in hydrocarbon = $\frac{84}{14}$ (1) (=6) molecular formula is C_6H_{12} (1)	allow ECF	**(3)**

(Total for Question 7 = 11 marks)

Question number	Answer	Additional guidance	Mark
8(a)	delivery tube, not in liquid, connected to flask sealed with a bung/cork (1) gas syringe / measuring cylinder or burette inverted over water (1)	do not allow a single line for a delivery tube allow sealed cross sections (e.g. delivery tube going through solid bung) labels and graduations not required mark independently	**(2)**

Question number	Answer	Additional guidance	Mark
8(b)	an explanation linking breaking bonds {needs energy/ endothermic} (1) making bonds {releases energy/ exothermic} (1) more energy is **given out** than is **taken in** (1)	allow heat for energy Ignore refs to energy level diagrams ignore refs to number of bonds made/broken	**(3)**

Question number	Indicative content	Mark
***8(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (3 marks) AO3 (3 marks)** • less gas produced with large lumps in same amount of time • therefore, reaction slower ORA • larger lumps have smaller surface area ORA • fewer particles available for reaction • fewer collisions in given time • more gas produced at higher concentration in all experiments • higher concentration there are more particles in same volume • more particles available to react • more frequent collisions • most gas produced in same time with small lumps and highest concentration ORA • therefore, fastest reaction is with small lumps and highest concentration ORA	**(6)**

Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance One statement (1) Two unlinked statements (2) One simple explanation (2)	Possible candidate responses less gas produced with large lumps (1) more gas produced with higher concentration of acid (1) smaller lumps have larger surface area (1) large lumps produced less gas and higher concentration produced more gas (2) the rate of reaction is higher with smaller lumps because they have a larger surface area (2) more gas at a higher concentration because there are more acid particles (2)
Level 2	3–4	Additional guidance Two simple explanations (4) One full explanation including reference to particles and frequency of collisions for either surface area OR concentration (4)	Possible candidate responses less gas with large lumps, reaction is slower due to smaller surface area. more gas at higher concentrations due to more particles (4) more gas at higher concentrations due to more particles having more frequent collisions (4) more gas at higher concentrations due to more particles having more collisions (3) Less gas with large lumps, reaction is slower due to smaller surface area as fewer particles fewer collisions in given time (4) with large lumps, reaction is slower as lower surface area fewer collisions in a given time (4)
Level 3	5–6	Additional guidance One full explanation including reference to particles frequency of collisions AND one simple explanation. The volume of gas must be referred to in at least one part of the answer. (6)	Possible candidate responses Less gas with large lumps, the reaction is slower due to smaller surface area. Fewer particles are available for reaction and fewer collisions in a given time. Whereas more gas is produced with a higher concentration as there are more particles (6) There is more gas produced at higher concentration because at a higher concentration there are more particles, this means that more particles available to react so there are more frequent collisions. Whereas less gas is produced with large lumps because they have a smaller surface area. (6) with large lumps the reaction is slower so less gas is produced because they have a smaller surface area so there are fewer particles available for reaction and fewer collisions. Whereas there is higher rate with a higher concentration as there are more particles in the same volume of solution (5)

(Total for Question 8 = 11 marks)

Question number	Answer	Additional guidance	Mark
9(a)	A description to include (damp) litmus / indicator paper bleaches / goes white (1)	 allow dip litmus into solution reject bleaches then goes red MP2 dependent on MP1	**(2)**

Question number	Answer	Additional guidance	Mark
9(b)	hydrobromic acid (1)	Ignore hydrogen bromide solution ignore HBr(aq)	**(1)**

Question number	Answer	Additional guidance	Mark
9(c)	colour: grey/ black (1) state: solid (1) black/grey (1)	Allow any shade of grey/ gray	**(2)**

Question number	Answer	Additional guidance	Mark
9(d)	an explanation linking 4 of the following • {chlorine / bromine} are more reactive than iodi**n**e / iodine is the least reactive (1) • (in the reaction of chlorine with potassium iodide) chlorine displaces iodine / iodine formed / iodide ions oxidised (1) • (in the reaction of bromine with potassium iodide) bromine displaces iodine / iodine formed / iodide ions oxidised (1) • brown colour of final mixture is due to iodine (1) • iodine with KI has no reaction / iodine cannot displace iodine from its compound (1)	ignore iodide in MP1 In MP2 and MP3: allow 'iodide displaced' mark(s) could be scored in word or symbol equations (symbol equations do not have to be balanced and allow I for I_2) allow iodine cannot displace itself	**(4)**

Question number	Answer	Additional guidance	Mark
9(e)	$2Fe + 3F_2 \rightarrow 2FeF_3$ (2) correct formulae only (1) balancing of correct formulae (1)	allow multiples reject Fe(III) on LHS reject incorrect capitals and subscripts reject charges on LHS but ignore charges on RHS. allow = for →	**(2)**

(Total for Question 9 = 11 marks)

Question number	Answer	Additional guidance	Mark
10(a)	A description to include **flame** photometer (1) two (sets of) emissions / OWTTE (1)	 allow flame emission spectroscopy / spectroscope ignore flame test allow compare emission to reference samples	**(2)**

Question number	Answer	Additional guidance	Mark
10(b)	$2H^+ + CO_3^{2-} \rightarrow H_2O + CO_2$ (3) $H^+ + CO_3^{2-} \rightarrow$ (1) $\rightarrow H_2O + CO_2$ (1) balancing of correct formulae (1)	ignore state symbols allow = for →	**(3)**

Question number	Indicative content	Mark
*10(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (3 marks) AO3 (3 marks)** • the chloride ion is justified as it produces a white precipitate with nitric acid and silver nitrate solution in K and L • Fe^{2+} ion is justified because it forms green precipitate with sodium hydroxide solution in M • in K ammonium ion is justified by adding more sodium hydroxide solution and heating • gas evolved turns damp red litmus paper blue • in L aluminium ion is justified by adding more sodium hydroxide solution • until in excess • precipitate dissolves • to give colourless solution • in M sulfate ion is justified by adding dilute hydrochloric acid • and barium {chloride / nitrate} solution • white precipitate	**(6)**

Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Two or more statements as to which ions are justified by the students conclusions (1) OR A full explanation of one of the students conclusions (2)	Possible candidate responses In K and L chloride ion is justified (1) in K chloride is justified, ammonium is not justified (1) in K chloride is justified, in M iron is justified (1) In K and L chloride ion is justified as test 1 shows a white precipitate. (2) In K chloride ion is justified as test 1 shows a white precipitate, for ammonium ion is justified as warm and test gas with damp litmus which turns blue (2)
Level 2	3–4	Additional guidance a partial explanation of the further work required to justify two of the ions and why chlorine or iron are justified (3) OR A full explanation of two of the students conclusions (4)	Possible candidate responses In L chloride ion is justified as test 1 shows a white precipitate but aluminium is not justified by test 2, add more sodium hydroxide which should dissolve the white precipitate. In M iron is justified by green precipitate (3) In K chloride ion is justified as test 1 shows a white precipitate, In L chloride ion is justified as test 1 shows a white precipitate, In M iron ion is justified as test 2 shows a green precipitate (3) In M sulfate is not justified by any test, add barium chloride white precipitate is formed, iron is justified by green precipitate in test 2. In K chloride ion is justified as test 1 shows a white precipitate, warm and test gas with damp litmus which turns blue to test for ammonium ion (4)
Level	5–6	Additional guidance An explanation of the further work required to justify three of the ions and a reason why at least and why chlorine or iron are justified (5) OR A full explanation of three of the students conclusions (6)	Possible candidate responses In K chloride ion is justified as test 1 shows a white precipitate, to test for the ammonium ion warm and test gas with damp litmus which turns blue. In L chloride ion is justified as test 1 shows a white precipitate but aluminium is not justified by test 2, add more sodium hydroxide which should dissolve the white precipitate. In M, the sulfate ion can be justified by adding dilute hydrochloric acid and barium chloride solution to get a white precipitate. (5) In K chloride ion is justified as test 1 shows a white precipitate, warm and test gas with damp litmus which turns blue to justify ammonium ion. In L chloride ion is justified as test 1 shows a white precipitate but aluminium is not justified by test 2, add more sodium hydroxide which should dissolve the white precipitate. In M, iron ion is justified because it forms green precipitate in test 2. The sulfate ion can be justified by adding dilute hydrochloric acid and barium chloride solution to get a white precipitate. (6)

Total for question 10 = 11 marks