Mark Scheme (Results)

January 2022

Pearson Edexcel International GCSE

In Chemistry (4CH1) Paper 1CR and Science (Double Award) (4SD0) Paper 1CR

Question number	Answer	Notes	Marks
1 (a)	**C** red is correct because litmus indicator in an acidic solution is red **A** is incorrect because litmus indicator in an acidic solution is not blue **B** is incorrect because litmus indicator in an acidic solution is not orange **D** is incorrect because litmus indicator in an acidic solution is not yellow		1
1 (b)	**C** 7 is correct because the pH value of a neutral solution is 7 **A** is incorrect because the pH value of a neutral solution is not 0 **B** is incorrect because the pH value of a neutral solution is not 4 **D** is incorrect because the pH value of a neutral solution is not 14		1

Question number	Answer	Notes	Marks
1 (c)	**D** is correct because a solution with a pH value of 9 is weakly alkaline **A** is incorrect because a solution with a pH value of 9 is not strongly acidic **B** is incorrect because a solution with a pH value of 9 is not strongly alkaline C is incorrect because a solution with a pH value of 9 is not weakly acidic		1
1 (d)	**A** is correct because HNO_3 is the chemical formula of an acid **B** is incorrect because H_2O is not the chemical formula of an acid **C** is incorrect because NaCl is not the chemical formula of an acid **D** is incorrect because NaOH is not the chemical formula of an acid		1

Question number	Answer	Notes	Marks
1 (e)	neutralisation	**ALLOW** exothermic	1
1 (f)	**M1** potassium chloride **M2** water	**ACCEPT** in either order **ALLOW** correct chemical formulae	2

Total for Question 1 = 7 marks

Question number	Answer	Notes	Marks
2 (a) (i)	(solute is) the substance/solid that dissolves (in a solvent) OWTTE		1
(ii)	(solvent is) the substance/liquid the solute/solid/substance dissolves in OWTTE		1
(b)	**M1** (saturated solution) contains as much dissolved solute/solid/substance as possible OWTTE **M2** at a particular temperature		2
(c)	**M1** process called diffusion **M2** particles spread out (evenly throughout water/solution/liquid)	**ALLOW** particles move from area of high concentration to area of low concentration	2

Total for Question 2 = 6 marks

Question number	Answer	Notes	Marks
3 (a)	**M1** (same) solvent **M2** (same type of chromatography) paper	**ALLOW** (same) named solvent eg water **IGNORE** reference to size/length **of paper** **ALLOW** reference to use of pencil (for start line)/spots must start on horizontal line /solvent must start below line or spots **ALLOW** same distance travelled by solvent **IGNORE** distance of line from bottom of paper **IGNORE** amount/volume/concentration of solvent /references to size/volume of dyes or spots /references to temperature/time	2
3 (b) (i)	C is insoluble (in the solvent)		1
(ii)	**M1** Student 2 and dye D/(R_f value) 1.20 **M2** because R_f value must be less than 1 / cannot be greater than 1	 ALLOW spot cannot move further than solvent front OWTTE	2

Question number	Answer	Notes	Marks
3 (c)	**M1** (R_f =) $\frac{9.7}{12}$ **M2** = 0.808(33..) **M3** = 0.81 (to 2 SF)	 0.808(33..) with no working scores **M1** and **M2** **ALLOW M2** ECF if used 10.7 or 13 and R_f < 1 **ALLOW** 1 mark for $\frac{12}{9.7}$ = 1.2(37..) **ALLOW M3** ECF **M2** (must be correct to 2 SF) 0.81 with no working scores 3	3

Total for Question 3 = 8 marks

Question number	Answer	Notes	Marks
4 (a)	number of protons (in nucleus of atom)	**IGNORE** references to electrons	1
4 (b) (i)	**D** 29 is correct because mass number = total number of protons and neutrons = 14 + 15 = 29 **A** is incorrect because 14 is the number of protons **B** is incorrect because 15 is the number of neutrons **C** is incorrect because 28 is the number of protons + the number of electrons		1
4 (b) (ii)	**M1** (group) 4 **M2** because 4 electrons in outer shell	 **ALLOW** electronic configuration is 2.8.4	2

Question number	Answer	Notes	Marks
4 (c)	**M1** $\frac{(32 \times 95.0) + (33 \times 0.75) + (34 \times 4.25)}{100}$ OR $\frac{(3040) + (24.75) + (144.5)}{100}$ **M2** = 32.0925 **M3** = 32.1 (1 dp)	 32.09(25) with no working scores 2 **ALLOW** 1 mark for 3209.25 **ALLOW** M2 ECF M1 if minor error in calculation using all 3 isotopes correct answer to 1 dp with or without working scores 3 **ALLOW M3** ECF **M2** (must be correct to 1 dp)	3

Total for Question 4 = 7 marks

Question number	Answer	Notes	Marks
5 (a)	(good) conductors of electricity / malleable	**ACCEPT** (good) conductors of heat/ductile/have basic oxides/hydroxides **ALLOW** high density/ high melting point/ sonorous/shiny/hard/ strong	1
5 (b)	**M1** (in mercury) particles can move/flow OWTTE **M2** (in solid metal) particles do not move /are in fixed positions	**IGNORE** references to spacing/gaps between particles / energy of particles **ACCEPT** particles vibrate (about fixed position)	2
5 (c) (i)	(bright) white flame	**ALLOW** white light **ACCEPT** white solid/ash/powder (formed)	1
5 (c) (ii)	(product/magnesium oxide is) basic / a base	**ALLOW** (product/magnesium oxide) neutralises acid / dissolves in/reacts with acid /(produces) alkali (when added to water) **REJECT** if incorrect product given	1
5 (d) (i)	magnesium/sulfur would react with/ burn in oxygen	**ACCEPT** magnesium oxide (not magnesium sulfide) would be formed **ALLOW** sulfur dioxide would be formed	1
5 (d) (ii)	**M1** magnesium (atom) loses two electrons **M2** sulfur (atom) gains two electrons (from magnesium) **M3** charge on magnesium (ion) $2^+/Mg^{2+}$ AND charge on sulfur/sulfide (ion) $2^-/ S^{2-}$	two electrons transferred from magnesium (atom) to sulfur (atom) scores **M1** and **M2**	3

Question number	Answer	Notes	Marks
5 (d) (iii)	**M1** strong (electrostatic) force of attraction **M2** between magnesium ions/Mg^{2+} and sulfide ions/S^{2-} ions **M3** large amount/lot of (heat/thermal) energy needed to overcome forces/attraction	**ALLOW** strong ionic bonds but No **M1** or **M2** if between atoms/molecules or any reference to intermolecular forces / covalent bonds **ACCEPT** between oppositely charged ions **ACCEPT** between positive and negative ions **ACCEPT** large amount/lot of (heat/thermal) energy needed to break the bonds **IGNORE** more energy No **M3** if reference to overcoming / breaking intermolecular forces / covalent bonds	3
5 (d) (iv)	$MgS + 2HCl \rightarrow MgCl_2 + H_2S$ **M1** all formulae correct **M2** correctly balanced	IGNORE **state symbols** **M2 DEP M1** **ACCEPT** multiples and fractions	2

Total for Question 5 = 14 marks

Question number	Answer	Notes	Marks
6 (a)	136		1
6 (b)	**M1** simplest (whole number) ratio of atoms present (in a compound) **M2** empirical formula (of ocimene/$C_{10}H_{16}$) is C_5H_8	**ALLOW** elements for atoms **ALLOW** C : H ratio 5:8	2

Question number	Answer	Notes	Marks
6 (c)	unsaturated hydrocarbon because **M1** contains (carbon to carbon) double bond(s) **M2** contains carbon and hydrogen (atoms) **M3** only	 **REJECT** molecules **M3** DEP on mention of carbon and hydrogen	3
6 (d) (i)	**A** addition B is incorrect because the type of reaction between an alkene and bromine is addition not polymerisation C is incorrect because the type of reaction between an alkene and bromine is addition not precipitation D is incorrect because the type of reaction between an alkene and bromine is addition not substitution		1

Question number	Answer	Notes	Marks
6 (d) (ii)	ocimene contains more than one double bond /three double bonds		1

Question number	Answer	Notes	Marks
6 (e)	$C_{10}H_{16} + 14\,O_2 \rightarrow 10\,CO_2 + 8\,H_2O$ **M1** $CO_2 + H_2O$ **M2** correctly balanced	 **ACCEPT** in either order **M2 DEP M1** **ACCEPT** multiples or fractions	2
6 (f) (i)	**M1** carbon/C/soot **M2** carbon monoxide/CO	**ACCEPT M1 M2** in either order	2
(ii)	(carbon monoxide/CO) reduces capacity of blood to carry oxygen OWTTE	**ACCEPT** correct references to haemoglobin / carboxyhaemoglobin	1

Total for Question 6 = 13 marks

Question number	Answer	Notes	Marks
7 (a)	**M1** breaking up/down of a compound/substance OWTTE **M2** by heat(ing)	**REJECT** elements **REJECT** any references to heat being given out/exothermic	2
(b)	examples of calculation of maximum mass of K_2CO_3 **M1** M_r of $KHCO_3$ = 100 AND M_r of K_2CO_3 = 138 **M2** 200 g $KHCO_3$ produces 138 g K_2CO_3 **M3** 2.50 g $KHCO_3$ produces $\frac{138 \times 2.50}{200}$ = **M4** 1.725 (g K_2CO_3) OR **M1** M_r of $KHCO_3$ = 100 AND M_r of K_2CO_3 = 138 **M2** amount $KHCO_3$ = $\frac{2.50}{100}$ = 0.025 (mol) **M3** amount K_2CO_3 = $\frac{0.025}{2}$ = 0.0125 (mol) **M4** mass K_2CO_3 (= 0.0125 x 138) = 1.725 (g)	**ALLOW** 2 or more SF **M2 M3 M4 ECF M1** correct answer with or without working scores 4 **ALLOW** 2 or more SF **M2 M3 M4 ECF M1** correct answer with or without working scores 4 3.45/3.46/3.5/6.9 scores 3	4

Total for Question 7 = 6 marks

Question number	Answer	Notes	Marks
8 (a)	$Zn\ (s) + H_2SO_4\ (aq) \rightarrow ZnSO_4\ (aq) + H_2\ (g)$ all state symbols correct		1
8 all clip with graph (b) (i)	all points correctly plotted (within +/- half a square)		1
(ii)	circle around point at 6 min		1
(iii)	smooth curve of best fit		1
(iv)	student took reading too soon/before 6 min		1
(v)	mass from graph at 6 min	IGNORE UNITS	1
8 (c) (i)	**M1** curve becomes less steep /gradient decreases (as time increases) **M2** so rate of reaction decreases	 **M2** DEP **M1**	2
(ii)	the (sulfuric) acid was in excess OWTTE	**ALLOW** not all (sulfuric) acid reacted **ALLOW** zinc was limiting reagent **ALLOW** zinc was not in excess	1

Question number	Answer	Notes	Marks
8 (d)	**M1** magnesium (more reactive than zinc so) would make reaction faster/increase the rate **M2** less concentrated acid would make reaction slower/decrease the rate **M3** (so) difficult/impossible to know whether rate will increase or decrease overall OWTTE	**REJECT** reference to different surface area **REJECT** references to differences in energy/speed of particles **ALLOW** difficult/impossible to know which change has greater effect OWTTE **ALLOW** idea of difficult/impossible to predict (overall) effect of changing two factors at same time OWTTE **ALLOW** idea of difficult/impossible to know if changes cancel each other out OWTTE	3
8 (e)	**M1** at higher temperature particles have more (kinetic) energy **M2** more (successful) collisions per unit time **M3** rate of reaction increases	**ACCEPT** more particles have the required activation energy **ALLOW** particles move faster **ALLOW** more frequent (successful) collisions	3

Total for Question 8 = 15 marks

Question number	Answer	Notes	Marks
9 (a)	**M1** copper(II) carbonate is green **M2** copper(II) carbonate is insoluble/cannot form a solution OWTTE	**IGNORE** is not white/is a different colour	2
9 (b)	Description including six of following points (Test for potassium ions) **M1** flame test **M2** lilac flame (Test for carbonate ions) **M3** add acid (to mixture of solids/solution) **M4** (pass/bubble) gas/carbon dioxide into limewater **M5** which goes cloudy/milky / white ppt forms (Test for iodide ions) **M6** (add dilute nitric acid followed by) silver nitrate (solution) **M7** yellow ppt/solid	 **ALLOW** description of flame test **ALLOW** any named acid **IGNORE** references to concentration **M4** DEP on **M3** **M5** DEP on mention of limewater **M7** DEP on mention of silver nitrate	6

Total for Question 9 = 8 marks

Question number	Answer	Notes	Marks
10 (a)	contain water of crystallisation /are hydrated		1
10 (b) (i)	3.18g		1
(ii)	3.78g		1
(iii)	calculation with following steps **M1** calculate moles of Na_2CO_3 **M2** calculate moles of H_2O **M3** divide each by smaller to obtain ratio 1 : 7 example calculation: **M1** $\frac{3.18}{106} = 0.03$ **M2** $\frac{3.78}{18} = 0.21$ **M3** $\frac{0.03}{0.03} : \frac{0.21}{0.03} = 1 : 7$ Alternative method: **M1** (If formula is $Na_2CO_3.7H_2O$ products will form in ratio) 106 g Na_2CO_3 : 126 g H_2O **M2** so mass of water that forms with 3.18 g Na_2CO_3 should = $\frac{(126 \times 3.18)}{106}$ **M3** = 3.78 g so formula is correct	**ALLOW** ECF from (i) **ALLOW** ECF from (ii)	3
(c) (i)	explanation including **M1** not heated crystals (for long) enough **M2** so not all water removed/evaporated OWTTE		2
(ii)	**M1** repeat heating (and cooling) **M2** until constant mass OWTTE	**ALLOW** heat for longer	2

Total for Question 10 = 10 marks

Question number	Answer	Notes	Marks
11 (a)	Award 1 mark each for any six of the following: **Method 1** **M1** polystyrene (insulator so) reduces/prevents heat loss (to atmosphere) OWTTE **M2** no lid so heat/thermal energy will be lost (to atmosphere) **M3** stirring will ensure even temperature / more accurate (highest) temperature OWTTE **M4** no lid so possibility of spillage **OR** polystyrene cup (containing thermometer) unstable/may fall over OWTTE **Method 2** **M5** glass bottle poor insulator so heat/thermal energy loss occurs OWTTE **M6** bung helps reduce/prevent heat/thermal energy loss (to atmosphere) **M7** bung so no spillage **M8** cannot stir so cannot ensure even temperature / cannot ensure accurate (highest) temperature OWTTE	**ALLOW** references to heat/thermal energy evenly spread (throughout solution) OWTTE **IGNORE** references to increases rate of reaction **ALLOW** references to heat /thermal energy not evenly spread (throughout solution) OWTTE	6

11 (b)	**M1** 0.025 mol $CuSO_4$ reacts with 0.025 mol Zn **M2** mass Zn needed = 0.025 x 65 = 1.625 g (3g > 1.625g so having 3g Zn is excess) OR **M1** 0.025 mol $CuSO_4$ reacts with 0.025 mol Zn **M2** 3g Zn = $\frac{3}{65}$ = 0.046 mol (0.046 > 0.025 so having 3g Zn is excess)	**ALLOW** reference to 1:1 molar ratio or (only) 0.025 mol Zn needed **M2** subsumes **M1** **ALLOW** reference to 1:1 molar ratio or (only) 0.025 mol Zn needed	2

Question number	Answer	Notes	Marks
11 (c) (i)	**M1** calculation of temperature rise **M2** correct substitution into Q = m x 4.2 x temp rise **M3** correct evaluation of Q Example calculation **M1** (40.6 – 21.1) OR 19.5 **M2** Q = 50 x 4.2 x 19.5 **M3** = 4100 (J)	ALLOW 4095 IGNORE sign	3
(ii)	**M1** answer to (i) ÷ 0.025 **M2** correct evaluation in J **M3** correct conversion to kJ and minus sign Example calculation **M1** 4095 ÷ 0.025 **M2** = 163 800 (J) **M3** = −160 kJ	**ACCEPT** use of 4000 **ACCEPT** 160 000/ 164 000 **ACCEPT** −163.8/−164 160/163.8/164 scores 2	3
11 (d)	**M1** Zn/zinc is oxidised because loses electrons **M2** Cu^{2+}/copper ions reduced because gains electrons		2

Total for Question 11 = 16 marks

Total for paper = 110 marks