Pearson Edexcel

Mark Scheme (Results)

November 2020

Pearson Edexcel International GCSE
In Chemistry (4CH1) Paper 1C and Science
(Double Award) (4SD0) Paper 1C

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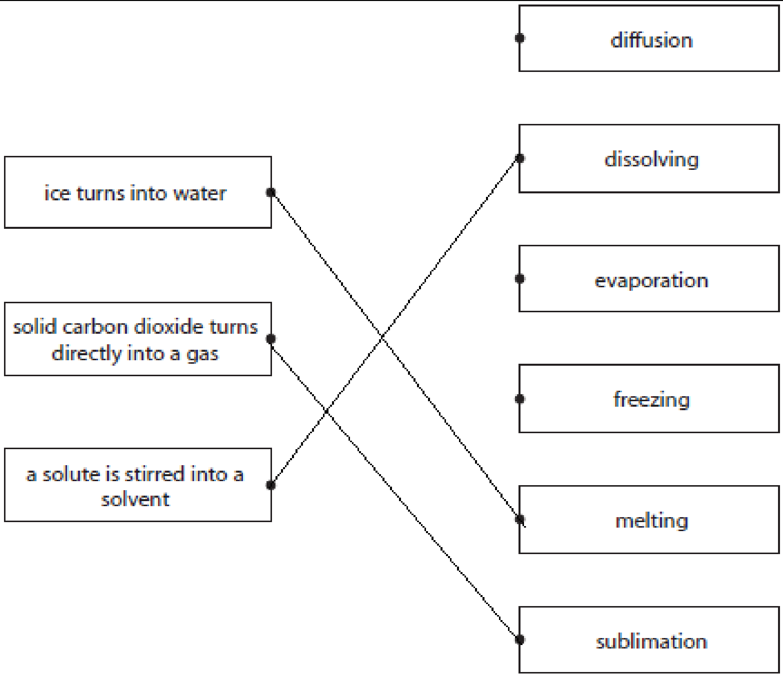
General Marking Guidance

- 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) (i)	Boron/B		1 cler
(ii)	Na/Mg/Al		1 cler
(iii)	Silicon/Si		1 cler
(iv)	Nitrogen/N	ALLOW N_2	1 cler
(v)	aluminium oxide	ALLOW Al_2O_3	1 cler
(b) (i)	**D** Group 0 is correct because Group 0 contains elements that are all unreactive **A** is not correct because Group 2 does not contain elements that are all unreactive **B** is not correct because Group 5 does not contain elements that are all unreactive **C** is not correct because Group 6 does not contain elements that are all unreactive		1 comp
(ii)	**B** lithium is correct because lithhium is the least reactive element in Group 1 **A** is not correct because caesium is not the least reactive element in Group 1 **C** is not correct because potassium is not the least reactive element in Group 1 **D** is not correct because sodium is not the least reactive element in Group 1		1 comp

Total for Q1 = 7 marks

Question number	Answer	Notes	Marks
2 (a)		1 mark for each correct line form boxes on left If more than one line from a box on left column do not award mark for that box	3 cler
(b)	a description including M1 measure the melting point M2 if fixed/sharp melting point the substance is pure M3 if melts over range of temperatures the substance is a mixture	ALLOW measure boiling point for M1 and substitute b.p. for m.p in M2 and boils for melts in M3 ALLOW max 2 if reference to freezing point as opposed to melting point	3 grad

Total for Q2 = 6 marks

Question number	Answer	Notes	Marks
3 (a) (i)	Q		1 cler
(ii)	might be explosive/dangerous/unsafe		1 grad
(iii)	R S P Q		1 cler
(b) (i)	galvanising/galvanisation		1 grad
(ii)	Any one from paint/oil/grease/sacrificial protection OWTTE	IGNORE barrier method If answer to (i) missing or incorrect credit galvanising in (ii)	1 grad
(c) (i)	zinc displaces copper	ALLOW zinc replaces copper/zinc takes oxygen from copper	1 grad
(ii)	M1 copper(II) oxide/CuO M2 because copper(II) oxide/CuO/it loses oxygen	ALLOW because copper(II) oxide/CuO/it gives oxygen to zinc/is reduced M2 DEP M1 or near miss e.g. Cu as it gives oxygen to zinc scores 1 mark for M2 IGNORE references to electrons	2 expert

Total for Q3 = 8 marks

Question number	Answer	Notes	Marks
4 (a) (i)	hydroxide/OH^-	ALLOW HO^- REJECT OH	1 grad
(ii)	**C** 11 is correct because 11 is a possible pH for ammonia solution **A** is not correct because 3 is not a possible pH for ammonia solution **B** is not correct because 6 is not a possible pH for ammonia solution **D** is not correct because 14 is not a possible pH for ammonia solution		1 comp
(b) (i)	**C** a proton donor is correct because an acid acts as a proton donor **A** is not correct because an acid does not act as a neutron donor **B** is not correct because an acid does not act as a neutron acceptor **D** is not correct because an acid does not act as a proton acceptor		1 comp
(ii)	**C** is correct because phenolphthalein is pink in alkali and colourless in acid **A** is not correct because phenolphthalein is not orange in alkali and red in acid **B** is not correct because phenolphthalein is not yellow in alkali and red in acid **D** is not correct because phenolphthalein is not colourless in alkali and pink in acid		1 comp

Question number	Answer	Notes	Marks
(c) (i)	M1 ammonium ion is charged 1^+ / NH_4^+ AND sulfate ion is charged 2^- /SO_4^{2-} M2 so charges balance/cancel (each other) OWTTE	ALLOW so that ammonium sulfate has no overall charge M2 not dep on M1	2 grad
(ii)	[[2x(14+4) + 32 + (4x16)] =] 132		1 exp
(iii)	Example calculation M1 132(g) ammonium sulfate contains 28(g) nitrogen / 1(g) ammonium sulfate contains (28÷132) (g) nitrogen M2 1000(g) ammonium sulfate contains 1000 x (28÷132) (g) nitrogen M3 = 212(.12) (g) **OR** M1 (moles of ammonium sulfate =) 1000 ÷ 132 **OR** 7.58 M2 (mass of nitrogen =) 28 x 1000 ÷ 132 **OR** 7.58 x 28 M3 = 212 (g)	mark CQ from (i) 212 without working scores 3 marks If 7.58 used in calculation answer is 212.24 If 14 used instead of 28 answer of 106.(06) scores 2 marks with or without working ALLOW any number of sig figs except 1	3 exp

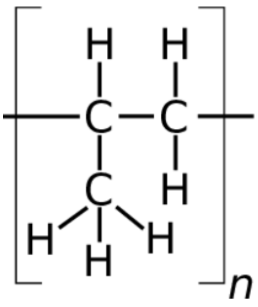
Total for Q4 = 10

Question number	Answer	Notes	Marks
5 (a)	Any two from M1 all in Group 7/same group M2 because all have 7/same number of electrons in outer shell M3 the number of shells determines the Period they are in		2 Grad
(b) (i)	Ultraviolet radiation	ALLOW UV radiation ALLOW ultraviolet light /UV light/ultraviolet rays/UV rays	1 cler
(ii)	$Cl_2 + CH_4 \rightarrow CH_3Cl + HCl$	ALLOW multiples	1 Grad
(iii)	M1 attraction between shared pair of electrons M2 and nuclei of the two/both atoms (in the bond) **OR** M1 bonding/shared pair of electrons M2 attracted to (both) nuclei of atoms (in the bond)	ALLOW M1 attraction of (two) nuclei M2 for shared/bonded pair of electrons (between them)	2 Exp
(iv)	M1 the four shared pairs of electrons between carbon and the other four atoms M2 rest of molecule correct including the three lone pairs of electrons around chlorine atom	M2 DEP M1 ALLOW any combination of dots and crosses	2 Grad
(v)	M1 weak forces of attraction between molecules/weak intermolecular forces M2 little (heat) energy needed to overcome them	ALLOW weak bonds between molecules /weak intermolecular bonds IGNORE less energy 0 marks if implication is that covalent bonds are weak/broken	2 Exp

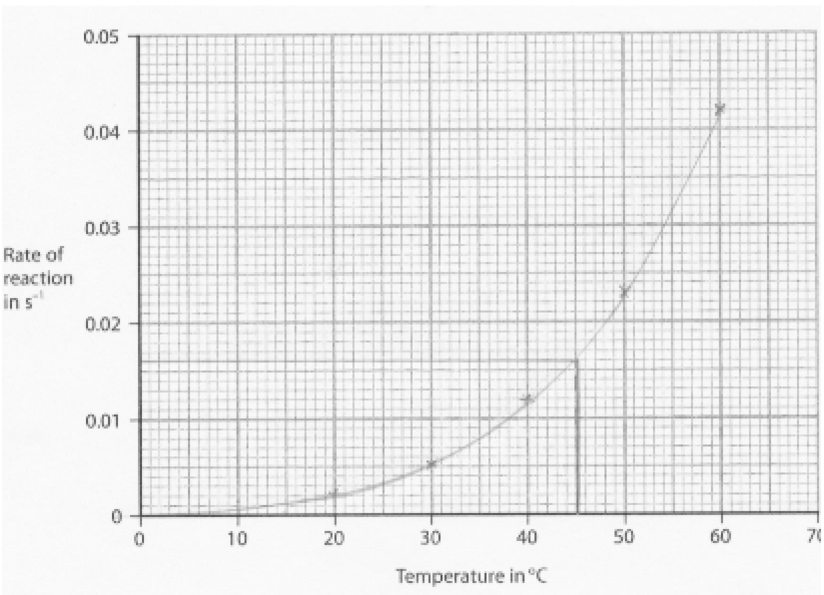
(c)	Explanation including M1 (one) electron (per carbon atom) delocalised M2 (so) free to move (between layers)	IGNORE sea of electrons /free electrons M2 DEP on mention of electrons 0 marks if mention of ions in graphite	2 Exp

Total Q5 = 12

Question number	Answer	Notes	Marks
6 (a) (i)	M1 alkanes M2 because fits general formula C_nH_{2n+2}	 M2 not dep on M1	2 Grad
(ii)	D	ALLOW C_3H_8	1 cler
(iii)	M1 (compounds of F with same molecular formula /C_4H_{10}) but different structural/displayed formulae M2 structural/displayed formula of butane M3 structural/displayed formulae of methylpropane		3 Exp
(b)	a description including the following points M1 heat/vapourise crude oil M2 pass into (fractionating) column/tower M3 fractions/compounds/molecules/hydrocarbons separate because of different boiling points M4 compound D collected at top of column/in refinery gas fraction	 ALLOW boil ALLOW idea of temperature gradient All marks could be scored from a suitably labelled diagram MAX 3 if description of lab process If confusion with cracking only M1 can be awarded	4 Exp

Question number	Answer	Notes	Marks
6 (c) (i)	addition (polymer)	REJECT additional	1 Cler
(ii)	poly(propene) / polypropene	ALLOW polypropylene	1 grad
(iii)	 M1 correct repeat unit M2 brackets and n and extension bonds	Ignore bond angles ALLOW use of CH_3 M2 DEP M1	2 Exp

Total for Q6 = 14

Question number	Answer	Notes	Marks
7 (a)	Sulfur	ALLOW sulphur	1 cler
(b)	any two from M1 concentration of hydrochloric acid M2 concentration of sodium thiosulfate M3 height of eye above flask OWTTE M4 same size of flask	ALLOW same colour/darkness /size of cross /use same cross	2 exp
(c)	any one from M1 the thiosulfate/solution would cool down/not remain at required temperature M2 larger (percentage) errors in values of times (as they become smaller)	IGNORE references to some of solution might evaporate ALLOW too short a time leads to less accurate readings OWTTE	1 exp
(d)	M1 all points plotted correctly (to the nearest grid line) M2 curve of best fit drawn 	IGNORE curve below 20 and above 60	2 exp

7	(e)	(i)	M1 line on graph from 45 °C to curve M2 candidate value of rate from graph at 45 °C (expected value approx. 0.016/7)	ALLOW mark on curve at 45 °C ACCEPT value to +/– 0.0005	2 exp
		(ii)	M1 substitute answer from (i) into (time = 1 ÷ rate) M2 correct value	ACCEPT answers to 2 or more sig figs rate = 0.016 time = 62.5 rate = 0.0165 time = 60.6 rate = 0.017 time = 58.8	2 exp
		(iii)	as temperature increases rate of reaction increases	ORA ALLOW positive correlation REJECT linear/directly proportional	1 grad
	(f)		explanation including following points (when temperature increases) M1 (mean) kinetic energy of particles increases M2 (so) more successful collisions per second/unit time / more frequent successful collisions M3 rate (of reaction) increases	ALLOW particles move faster IGNORE vibrate more/faster ALLOW reference to more frequent collisions between particles having energy ≥ activation energy ALLOW reaction is faster /speeds up	3 exp

Total Q7 =14

Question number	Answer	Notes	Marks
8 (a) (i)	measuring cylinder	ALLOW pipette/burette	1 cler
(ii)	to ensure temperature same throughout solution OWTTE	ACCEPT to ensure heat evenly distributed throughout solution OWTTE	1 grad
(iii)	blue	IGNORE qualifiers eg light/dark REJECT blue-green	1 cler
8 (b)	<table><tr><td>**Maximum temperature in ºC**</td><td>27.3</td></tr><tr><td>**Initial temperature in ºC**</td><td>24.4</td></tr><tr><td>**Increase in temperature in ºC**</td><td>2.9</td></tr></table> M1 27.3 M2 24.4 M3 2.9	If readings are correct but in reverse order award 1 mark for M1 and M2 ALLOW ECF for M3 if M1 and/or M2 incorrect	3 grad

Question number	Answer	Notes	Marks
8 (c) (i)	• substitution into $Q = mc\Delta T$ • calculation of heat energy in Joules Example calculation **M1** Q = 50 x 4.2 x 3.3 **M2** 693 J	 693 without working scores 2 marks	2 exp
(ii)	• calculate the amount, in moles, of $CuSO_4$ • divide Q by the amount in moles • conversion to KJ • give the correct sign Example calculation **M1** 1.70 ÷ 159.5 **OR** 0.0107 **M2** 693 ÷ 0.0107 **OR** 64766 (J/mol) **M3** 64.8 (kJ/mol) **M4** – 64.8 (kJ/mol)	ALLOW any number of SF throughout except one Mark CQ from (i) ALLOW use of 700 use of 700 gives -65.02 693 & 0.011 gives -63 700 & 0.011 gives -63.64 correct answer with correct sign and without working scores 4 correct answer without sign or incorrect sign and without working scores 3	exp 4
8 (d)	M1 temperature decreases/falls M2 (so) endothermic		2 grad

Total Q8 = 14

Question number			Answer	Notes	Marks
9	(a)	(i)	**B** decomposition **A** is not correct because when sodium hydrogencarbonate is heated combustion does not take place C is not correct because when sodium hydrogencarbonate is heated oxidation does not take place D is not correct because when sodium hydrogencarbonate is heated reduction does not take place		1 comp
		(ii)	(because) carbon dioxide/gas is produced/given off		1 grad
9	(b)	(i)	to obtain a constant mass OWTTE / to show the reaction is complete OWTTE	ACCEPT to ensure only Na_2CO_3 is left (in crucible) ACCEPT to ensure all the $NaHCO_3$ has reacted /decomposed	1 exp
		(ii)	M1 advantage: to stop any solid/Na_2CO_3/$NaHCO_3$ spitting out/being lost M2 disadvantage: the gas(es)/CO_2/H_2O/steam could not easily escape OWTTE	REJECT references to stopping gases escaping	2 exp

Question number			Answer	Notes	Marks
9	(c)	(i)	3.25 (g)		1 exp
		(ii)	• calculate moles of $NaHCO_3$ • use equation to determine moles of Na_2CO_3 • multiply by M_r to find mass of Na_2CO_3 Example calculation: M1 3.25 ÷ 84 **OR** 0.0387 (mol) M2 0.0387 ÷ 2 **OR** 0.01935 (mol) M3 0.01935 x 106 = 2.05 (g) **OR** • use of equation to relate mass of $NaHCO_3$ to mass of Na_2CO_3 • shows how to find mass of Na_2CO_3 using 3.25g $NaHCO_3$ • correct evaluation of answer Example calculation: M1 (2x84)/168 (g) $NaHCO_3$ → 106 (g) Na_2CO_3 M2 3.25 (g $NaHCO_3$)→ (106÷168) x 3.25 (g Na_2CO_3) M3 2.05 (g Na_2CO_3)	mark CQ on (i) ALLOW any number of sig figs except 1 2.05 (g) without working scores 3 marks 4.1 (g) without working scores 2 marks mark CQ on (i)	3 exp
9	(d)	(i)	M1 percentage yield = 4.2÷4.8 **OR** 0.875 M2 = (0.875 x 100) = 87.5 (%)	ACCEPT 88 (%) Correct answer without working scores 2	2 grad
		(ii)	any one from M1 sodium hydrogencarbonate was impure M2 not all sodium hydrogencarbonate reacted/decomposed		1 grad

Total Q9 = 12 marks

Question number	Answer	Notes	Marks
10 (a)	M1 red lead oxide → lead(II) oxide + M2 oxygen	must have (II) ACCEPT answers in either order If formulae given allow 1 mark for O_2 even if formula for lead(II) oxide is incorrect	2 grad
10 (b)	• dividing percentages by A*r* • correct results of divisions • divide by smallest to obtain correct ratio/EF Example of calculation: Pb O M1 86.6÷207 13.4÷16 M2 0.42 0.84 M3 (0.42÷0.42 =)1 (0.84÷0.42 =) 2	0 marks if division by atomic numbers or calculation upside down ACCEPT alternative methods	3 exp
(c) (i)	M1 Pb_3O_4 (s) + $4HNO_3$ (aq) M2 $2Pb(NO_3)_2$(aq) + $2H_2O$	both state symbols required ALLOW upper case letters for state symbols both numbers required	2 grad

10 (c) (ii)	description that makes reference to the following three points: M1 warm/heat (nitric) acid M2 add/mix/react (red) lead oxide (and stir) M3 filter to obtain lead(II) nitrate solution **AND** three of the following points: M4 heat/boil (lead(II) nitrate) solution/filtrate M5 until crystals form in a cooled sample/on a glass rod OWTTE M6 leave solution to cool / leave solution for more crystals to form M7(and then) filter off crystals/lead nitrate M8 suitable method of drying the crystals eg using filter paper/using paper towel/in a warm oven	REJECT boil IGNORE references to adding excess(red) lead oxide ALLOW to remove lead(IV) oxide/PbO_2 ALLOW to remove (unreacted/excess) red lead oxide/Pb_3O_4 If heat to dryness only M4 can be scored ACCEPT to crystallisation point/to form a saturated solution /until crystals start to form /to remove some of the water M5 DEP M4 ACCEPT decant off the solution M7 DEP M6 IGNORE references to washing REJECT hot oven or any method of direct heating eg Bunsen ALLOW leave to dry but not just dry the crystals No M8 if crystals are washed after drying	6 exp

Total for Q10 = 13 marks

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