Mark Scheme (Results)

Summer 2024

Pearson Edexcel International GCSE
In Chemistry (4CH1) Paper 1CR

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General Marking Guidance

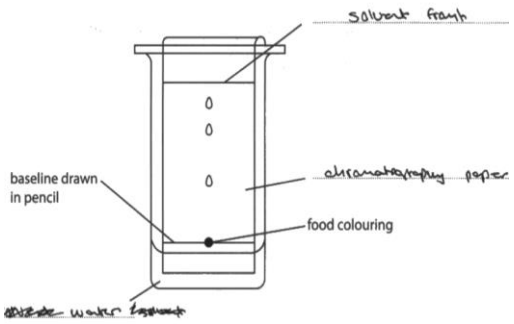
- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should 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)	W		1
(ii)	V		1
(iii)	Z		1
(b) (i)	the number of protons (in the nucleus)	IGNORE reference to electrons ALLOW amount of protons	1
(ii)	(the sum of) the number of protons and neutrons (in the nucleus)	ALLOW amount of protons and neutrons	1
			total for question = 5

Question number	Answer	Notes	Marks
2 (a)	oxygen	ALLOW O_2	1
(b)	M1 carbon dioxide / CO_2 M2 water / H_2O	answers can be in either order ACCEPT water vapour ALLOW steam	2
(c) (i)	there is a limited supply of air / oxygen OWTTE	ALLOW not enough air/oxygen	1
(ii)	carbon monoxide reduces the capacity of blood to transport oxygen OWTTE	ACCEPT correct references to haemoglobin ALLOW produces carboxyhaemoglobin	1
(d)	substitution	ALLOW redox (reaction)	1
			total for question = 6

Question number	Answer	Notes	Marks
3 (a) (i)	filtration		1
(ii)	fractional distillation		1
(b)	M1 (two) different atoms / elements M2 joined / bonded together	ACCEPT atoms/elements of silicon and oxygen REJECT M2 intermolecular forces / ionic bonds	2
(c) (i)	5 / five		1
(ii)	788		1
(d)	M1 (3 ÷ 18) × 100 M2 16.7%	 ALLOW ecf from M1 e.g. (3 ÷ 15) × 100 = 20% scores 1 mark ALLOW 2 or more sig figs as long as a percentage sum and correctly rounded.	2
			total for question = 8

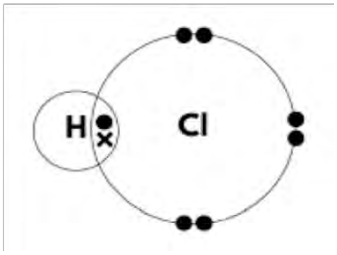
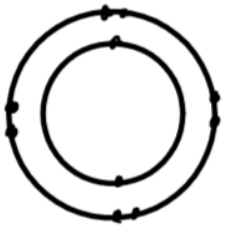
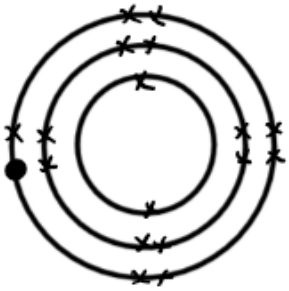
Question number	Answer	Notes	Marks
4 (a)	any two from: M1 floats M2 moves M3 melts / turns into a ball /sphere M4 gets smaller / disappears M5 white trail	 M1 and M2 moves on the surface ALLOW sodium dissolves IGNORE effervescence / bubbling / fizzing	2
(b)	M1 do a flame test M2 yellow (flame)	ALLOW a description of the flame test ALLOW orange (flame)	2
(c) (i)	(they have the) same number of outer shell electrons / one outer shell electron		1
(ii)	as the atomic radius increases they get more reactive OWTTE		1
			total for question = 6

Question number	Answer	Notes	Marks
5 (a) (i)	clockwise from bottom left M1 solvent M2 solvent front M3 chromatography paper  Diagram 1	 ALLOW water ALLOW paper ALLOW chromatogram	3
(ii)	pencil is not soluble / insoluble	ACCEPT pencil will not dissolve ALLOW pencil will not run (up the chromatogram)	1
(b) (i)	B (W and Y) A is not the correct answer because W and X do not have a spot at the same height C is not the correct answer because X and Z do not have a spot at the same height D is not the correct answer because Y and Z do not have a spot at the same height		1
(ii)	M1 distance moved by the dye from 1.1 to 1.4 (cm) distance moved by the solvent 6.5 (cm) M2 distance moved by the dye ÷ distance moved by the solvent and correctly evaluated	 e.g. 0.17 / 0.18 / 0.2(0) / 0.22 ALLOW any number of sig figs as long as it is correctly rounded. ALLOW ECF from M1	2
			total for question = 7

Question number	Answer	Notes	Marks
6 (a)	M1 (a substance/a fuel that) when burned M2 releases heat (energy) / thermal energy	ALLOW burns / combusts /catches fire	2
(b) (i)	temperature at the start = 20.4 °C highest temperature reached = 77.6 °C	ALLOW ECF from incorrect temperature reading	2
(ii)	M1 150 × 4.2 × 57.2 M2 36 036 (J)	 ALLOW 36 000 if M1 is scored 36 036 with no working scores 2 ALLOW ECF from M1 as long as the 3 values are multiplied	2
(iii)	M1 36.036 kJ M2 amount of ethanol = 2.3 ÷ 46 OR 0.05 (mol) M3 36.036 ÷ 0.05 OR 720.720 (kJ) OR M3 36036 ÷ 0.05 (J) M4 −720 (kJ/mol)	ALLOW 36 kJ M3 subsumes M1 and M2 ALLOW M3 to 2 sig figs ALLOW ECF M4 with 2 sig figs and a − sign Correct answer without working scores 4 marks	4
(c)	any one from heat absorbed by the metal can incomplete combustion heat lost to the surroundings	 ALLOW heat loss	1
			total for question = 11

Question number	Answer	Notes	Marks
7 (a) (i)	measuring cylinder	ALLOW burette / pipette / syringe REJECT gas syringe	1
(ii)	(the) zinc / Zn / it is in excess		1
(iii)	so as little gas as possible is lost	ACCEPT to keep as much gas as possible ALLOW to avoid loss of gas / so gas does not escape	1
(iv)	any one from no further effervescence / bubbles / fizzing no more gas collects in the syringe	 ALLOW gas syringe does not move	1
(b) (i)	M1 calculation of gradient OR 50 ÷ 150 M2 0.33 M3 units cm^3/s	triangle needs to be drawn on graph for M1 ALLOW ECF from M1 ACCEPT $cm^3\,s^{-1}$	3
(ii)	from 0 to 60 s M1 gradient is steepest M2 because there are most acid particles (per unit volume) / most collisions (per unit time) / most frequent collisions from 60 to 150 s M3 the curve becomes less steep M4 because there are fewer particles (per unit volume) / fewer collisions (per unit time) / fewer frequent collisions from 150 to 240 s M5 the reaction has stopped / curve levels off/becomes flat/plateaus M6 because the (sulfuric) acid has been used up	 ACCEPT because concentration is greatest / highest ACCEPT because concentration is lower ALLOW the volume of gas becomes constant	6
			total for question = 13

Question number	Answer	Notes	Marks
8 (a)	a description that links any 4 of the following points M1 crude oil is heated / vapourised M2 the vapour enters the lower part / bottom of the column M3 there is a temperature gradient in the column M4 the vapours rise up the column until they condense M5 at a height where the boiling point of the vapour is lower than the temperature in the column	 ALLOW boiled ACCEPT cooler at the top and hotter at the bottom ALLOW the fractions are separated according to their boiling point	4
(b)	an explanation that links any 4 of the following points M1 fractional distillation of crude oil produces more long chain hydrocarbons than can be used directly M2 (cracking) produces shorter (chain) alkanes M3 which are more flammable/ more useful as fuels M4 (cracking) produces alkenes M5 which are used to make polymers/plastics	 ALLOW is a lower demand for long chain hydrocarbons / a higher demand for short chain hydrocarbons ALLOW petrol / gasoline M3 dep on M2 M5 dep on M4	4
(c)	M1 fuels contain sulfur M2 which burns producing sulfur dioxide M3 causing acid rain	IGNORE C / CO / CO_2 and any reference to global warming etc. REJECT nitrogen for M1 ALLOW effects of acid rain M3 dep on M1 or M2 or NO_2 or SO_3	3
			total for question = 11

Question number	Answer	Notes	Marks
9 (a) (i)	M1 NaCl M2 ZnO M3 $(NH_4)_2SO_4$	ACCEPT Na^+Cl^- / ClNa ACCEPT $Zn^{2+}O^{2-}$ / OZn ACCEPT $(NH_4^+)_2SO_4^{2-}$ / $SO_4(NH_4)_2$ REJECT any incorrect charges Penalise once only for incorrect case or subscripts / superscripts	3
(ii)	zinc sulfate		1
(b) (i)	M1 2 bonding electrons M2 rest of the molecule correct  	ALLOW dots, crosses or any combination M2 dep on M1	2
(ii)	M1 magnesium ion  M2 chloride ion  M3 Mg^{2+} and Cl^-	ALLOW dots, crosses or any combination Only 1 mark max in M1 and M2 if they only show the outer electrons, as the question requires the electronic configurations	3

(iii)	An explanation that links any 5 of the following points M1 hydrogen chloride is simple molecular / simple covalent M2 magnesium chloride is giant ionic / ionic lattice M3 strong electrostatic attraction between (oppositely charged) ions M4 in hydrogen chloride there are weak intermolecular forces / weak forces between molecules M5 (much) more energy is required to break the (ionic) bonds in $MgCl_2$ than to overcome the (intermolecular) forces in HCl	 ALLOW molecular covalent ALLOW giant structure if ions are mentioned ALLOW strong ionic bonds No M3 if any mention of covalent bonds or intermolecular forces in magnesium chloride REJECT weak forces between bonds REJECT any reference to breaking covalent bonds in HCl or $MgCl_2$	5
			total for question = 14

Question number	Answer	Notes	Marks
10 (a)	M1 a catalyst provides an alternative pathway / route M2 of lower activation energy		2
(b) (i)	conical flask	ALLOW flask	1
(ii)	M1 filter out the manganese(IV) oxide M2 allow it to dry M3 reweigh the catalyst, the same mass should be left / mass is still 1 g		3
			total for question = 6

Question number	Answer	Notes	Marks
11 (a)	has only one type of atom	ACCEPT only made up of carbon atoms	1
(b)	M1 (attraction between) a shared pair of electrons M2 and nuclei OR M1 a shared pair of electrons M2 and (attraction between) nuclei	 do not accept nucleus nuclei must be plural do not accept nucleus nuclei must be plural	2
(c) (i)	M1 delocalised electrons M2 (electrons) can move / flow (throughout the structure)	No marks if mention of ions / molecules in graphite	2
(ii)	M1 (diamond is hard because) it has a 3D lattice/rigid lattice /tetrahedral lattice /every carbon is bonded to four other carbons M2 in diamond, the bonds need a lot of energy to break M3 (graphite is soft because) it has layers M4 which can slide over one another	ALLOW 3D/ rigid/ tetrahedral structure REJECT mention of intermolecular forces in diamond for M1 and M2 ALLOW sheets IGNORE intermolecular forces in graphite M4 dep on M3	4
(d)	M1 calculation M_r of C_x M2 $M_r \div 12$ M3 answer given as an integer exemplar M1 $1.40 \times 10^{-21} \times 6.02 \times 10^{23}$ OR 842.8 M2 842.8 ÷ 12 (= 70.23) M3 70	 ALLOW any number of significant figures from 2 ALLOW ECF if division by atomic number 6 Answer of 70 without working scores 3	3
			total for question = 12

Question number	Answer	Notes	Marks
12 (a)	$2TaCl_5(s) + 5H_2(g) \rightarrow 2Ta(s) + 10HCl(g)$	ALLOW multiples or fractions	1
(b) (i)	the last (3) masses are the same	ALLOW mass does not change / mass becomes constant	1
(ii)	M1 mass of chlorine = 1243 (kg) M2 1 267 000 ÷ 181 and 1 243 000 ÷ 35.5 M3 7000 moles of tantalum and 35 014 moles of chlorine (so 1:5 ratio)	ALLOW calculation done in kilomoles e.g. 1267 ÷ 181 and 1243 ÷ 35.5 e.g. ratio 7 : 35 moles M3 subsumes M1 and M2 no M2 or M3 for upside down calculation or use of atomic numbers	3
(c) (i)	M1 carbon is oxidised and tantalum oxide is reduced M2 carbon gains oxygen and tantalum oxide loses oxygen OR M1 carbon gains oxygen and is oxidised M2 tantalum oxide loses oxygen and is reduced	Penalise tantalum is reduced or tantalum loses oxygen once only REJECT tantalum loses oxygen and is reduced ALLOW correct symbols and formulae throughout ACCEPT correct changes in oxidation numbers	2

(ii)	M1 (5 × 2000 =) 10 000 moles of carbon is needed M2 (10 000 × 12 =) 120 000 g of carbon is needed (which is less than 500 000 g) OR M1 (500 000 ÷ 12) of carbon is 41 667 moles M2 which is enough to react with (41 667 ÷ 5 =) 8333 moles of tantalum oxide OR M1 (5 × 2000 =) 10 000 moles of carbon is needed M2 (500 000 ÷ 12) is more than 41 667 moles of carbon	(12 × 2000 =) 24 000 g (5 × 24 000 =) 120 000 g of carbon is needed (500 000 ÷ 5) is 100 000 g which is enough to react with (100 000 ÷ 12 =) 8333 moles of tantalum oxide	2
(iii)	M1 (2 × 2000 =) 4000 moles of tantalum M2 (4000 × 181=) 724 000 g of tantalum	ALLOW ECF for incorrect moles e.g. 2000 × 181 = 362 000 scores 1 1000 × 181 = 181 000 scores 1 4000 × 362 = 1 448 000 scores 1	2
			total for question = 11