Pearson
Edexcel

Mark Scheme (Results)

Summer 2024

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

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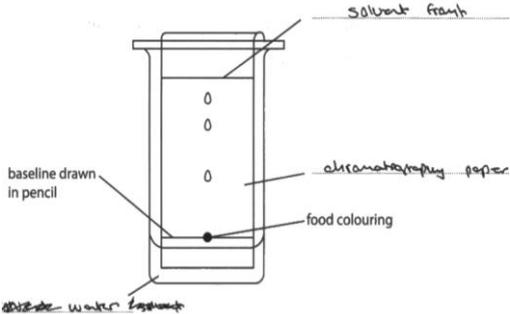
General Marking Guidance

- 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	ACCEPT atoms/elements of silicon and oxygen	2
			M2 joined / bonded together	REJECT M2 intermolecular forces / ionic bonds	
	(c)	(i)	5 / five		1
		(ii)	788		1
	(d)		M1 (3 ÷ 18) × 100		2
			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.	
				total for question = 8	

Question number		Answer	Notes	Marks
4 (a)		any two from:		2
		M1 floats	M1 and M2 moves on the surface	
		M2 moves		
		M3 melts / turns into a ball /sphere		
		M4 gets smaller / disappears	ALLOW sodium dissolves	
		M5 white trail	IGNORE effervescence / bubbling / fizzing	
(b)		M1 do a flame test	ALLOW a description of the flame test	2
		M2 yellow (flame)	ALLOW orange (flame)	
(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	ACCEPT Na$^+$Cl$^-$ / ClNa	3
			M2 ZnO	ACCEPT Zn^{2+}O^{2-} / OZn	
			M3 $(NH_4)_2SO_4$	ACCEPT $(NH_4^+)_2SO_4^{2-}$ /$SO_4(NH_4)_2$	
				REJECT any incorrect charges	
				Penalise once only for incorrect case or subscripts / superscripts	
		(ii)	zinc sulfate		1
	(b)	(i)	M1 2 bonding electrons	ALLOW dots, crosses or any combination	2
			M2 rest of the molecule correct	M2 dep on M1	
		(ii)	M1 magnesium ion	ALLOW dots, crosses or any combination	3
				Only 1 mark max in M1 and M2 if they only show the outer electrons, as the question requires the electronic configurations	
			M2 chloride ion		
			M3 Mg^{2+} and Cl$^-$		
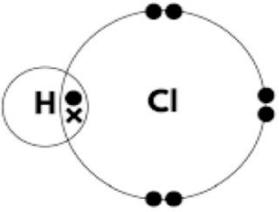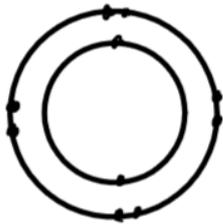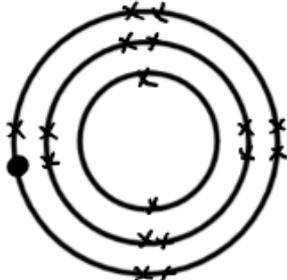
(iii)	An explanation that links any 5 of the following points			5
	M1 hydrogen chloride is simple molecular / simple covalent	ALLOW molecular covalent		
	M2 magnesium chloride is giant ionic / ionic lattice	ALLOW giant structure if ions are mentioned		
	M3 strong electrostatic attraction between (oppositely charged) ions	ALLOW strong ionic bonds No M3 if any mention of covalent bonds or intermolecular forces in magnesium chloride		
	M4 in hydrogen chloride there are weak intermolecular forces / weak forces between molecules	REJECT weak forces between bonds		
	M5 (much) more energy is required to break the (ionic) bonds in $MgCl_2$ than to overcome the (intermolecular) forces in HCl	REJECT any reference to breaking covalent bonds in HCl or $MgCl_2$		
	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		2
		M2 and nuclei	do not accept nucleus nuclei must be plural	
		OR		
		M1 a shared pair of electrons		
		M2 and (attraction between) nuclei	do not accept nucleus nuclei must be plural	
(c)	(i)	M1 delocalised electrons	No marks if mention of ions / molecules in graphite	2
		M2 (electrons) can move / flow (throughout the structure)		
	(ii)	M1 (diamond is hard because) it has a 3D lattice/rigid lattice /tetrahedral lattice /every carbon is bonded to four other carbons	ALLOW 3D/ rigid/ tetrahedral structure	4
		M2 in diamond, the bonds need a lot of energy to break	REJECT mention of intermolecular forces in diamond for M1 and M2	
		M3 (graphite is soft because) it has layers	ALLOW sheets	
		M4 which can slide over one another	IGNORE intermolecular forces in graphite	
			M4 dep on M3	
(d)		M1 calculation M_r of C_x		3
		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	ALLOW any number of significant figures from 2	
		M2 $842.8 \div 12$ (= 70.23)	ALLOW ECF if division by atomic number 6	
		M3 70	Answer of 70 without working scores 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)		3
			M2 1 267 000 ÷ 181 and 1 243 000 ÷ 35.5	ALLOW calculation done in kilomoles e.g. 1267 ÷ 181 and 1243 ÷ 35.5	
			M3 7000 moles of tantalum and 35 014 moles of chlorine (so 1:5 ratio)	e.g. ratio 7 : 35 moles M3 subsumes M1 and M2 no M2 or M3 for upside down calculation or use of atomic numbers	
	(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	(12 × 2000 =) 24 000 g	2	
	M2 (10 000 × 12 =) 120 000 g of carbon is needed (which is less than 500 000 g)	(5 × 24 000 =) 120 000 g of carbon is needed		
	OR			
	M1 (500 000 ÷ 12) of carbon is 41 667 moles	(500 000 ÷ 5) is 100 000 g		
	M2 which is enough to react with (41 667 ÷ 5 =) 8333 moles of tantalum oxide	which is enough to react with (100 000 ÷ 12 =) 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			
(iii)	M1 (2 × 2000 =) 4000 moles of tantalum		2	
	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		
		total for question = 11		