



Pearson
Edexcel

Mark Scheme (Results)

Summer 2022

Pearson Edexcel International GCSE

In Science Double Award (4SD0) Paper 1C

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Summer 2022

Question Paper Log Number P70945A

Publications Code 4SD0_1C_2206_MS

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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)	nucleus	ACCEPT nuclei	1
	(b) 11 / eleven		1
	(c) 1 / one / group 1		1
	(d) 3 / three / period 3		1
	(e) +1 / 1+	ACCEPT + / Na ⁺ / positive 1 IGNORE positive alone	1
			Total 5

Question number	Answer		Notes	Marks										
2 (a)	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th data-bbox="360 253 740 389">Change</th> <th data-bbox="740 253 975 389">Change of state</th> </tr> </thead> <tbody> <tr> <td data-bbox="360 389 740 450">water to ice</td> <td data-bbox="740 389 975 450">freezing</td> </tr> <tr> <td data-bbox="360 450 740 510">steam to water</td> <td data-bbox="740 450 975 510">condensation</td> </tr> <tr> <td data-bbox="360 510 740 571">solid wax to liquid wax</td> <td data-bbox="740 510 975 571">melting</td> </tr> <tr> <td data-bbox="360 571 740 674">iodine crystals to iodine vapour</td> <td data-bbox="740 571 975 674">sublimation</td> </tr> </tbody> </table>		Change	Change of state	water to ice	freezing	steam to water	condensation	solid wax to liquid wax	melting	iodine crystals to iodine vapour	sublimation	<p>ALLOW condensing</p> <p>ALLOW subliming</p>	4
Change	Change of state													
water to ice	freezing													
steam to water	condensation													
solid wax to liquid wax	melting													
iodine crystals to iodine vapour	sublimation													
(b) (i)	<p>M1 heat</p> <p>M2 stir / mix</p>		<p>ALLOW use hot water</p> <p>IGNORE add more water</p> <p>ALLOW grind / crush the solid / mixture</p>	2										
(ii)	filter		ALLOW a description of filtration	1										
				4										

(iii)	<p>A description that refers to four of the following points:</p> <p>M1 heat / boil (the solution)</p> <p>M2 evaporate some of the water</p> <p>M3 leave / cool (the solution to crystallise)</p> <p>M4 pour off excess liquid OR filter (to obtain crystals)</p> <p>M5 suitable method of drying the crystals</p>	<p>IGNORE any steps before heating the solution</p> <p>ALLOW until crystals form on the end of a glass rod ALLOW until crystals first start to form ALLOW until the solution is saturated</p> <p>M3 dep on M1</p> <p>M4 dep on crystals having been formed</p> <p>IGNORE references to washing</p> <p>e.g. place in an oven / leave to dry / use filter paper / kitchen towel / / desiccator / heat to dryness</p> <p>If solution heated until all the water evaporates / heated until all the water has been removed / heated to dryness award M1 and M5</p> <p>If the solution is left to evaporate all of the water only M5 can be awarded.</p>	<p>Total 11</p>
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Question number	Answer	Notes	Marks	
3	(a) (i)	(crude oil/it is) heated / vapourised	ALLOW evaporated / boiled REJECT melted	1
	(ii)	gasoline	ALLOW petrol	1
	(iii)	road (surfacing) / roofs / tarmac		1
	(b) (i)	M1 silica / alumina (catalyst) M2 600 to 700 °C	ACCEPT SiO ₂ /Al ₂ O ₃ / silicon dioxide / aluminium oxide /aluminosilicates / zeolites	2
	(ii)	Any two from: M1 shorter-chain <u>alkanes</u> are in high(er) demand / more useful / used for petrol / more flammable M2 <u>alkenes</u> are needed / used to make polymers	ALLOW C ₈ H ₁₈ is in high(er) demand (than C ₁₃ H ₂₈) / more useful / used for petrol / more flammable IGNORE shorter-chain alkanes are used as fuels ALLOW C ₂ H ₄ / C ₃ H ₆ are needed / used to make polymers / plastics shorter chain hydrocarbons / the products are in high(er) demand / more useful / more flammable scores 1 if no other mark awarded to create shorter alkanes and alkenes scores 1 if no other mark awarded	2

(c)	<p>An explanation that links the following three points:</p> <p>M1 sulfur dioxide produced when fuel is burned</p> <p>M2 (sulfur dioxide) dissolves in / reacts with rain / water</p> <p>M3 (causing) acid rain</p>	<p>ALLOW sulfur / fuel reacts with oxygen / oxidises forming sulfur dioxide IGNORE sulfur trioxide and sulfur oxide</p> <p>ACCEPT (sulfur oxide / sulfur trioxide) dissolves in / reacts with rain / water IGNORE mixes</p>	3
			Total 10

Question number	Answer	Notes	Marks						
4 (a) (i)	water is needed for iron to rust / react	ALLOW reaction needs water (and oxygen) ALLOW increases rate of reaction	1						
(ii)	brown (coating on iron)	ALLOW red-brown / orange-brown / orange / orange-red IGNORE red alone	1						
(iii)	Fe ₂ O ₃		1						
(iv)	An explanation that links the following two points M1 (the powder has) a larger surface area M2 so the iron will rust quicker/ the reaction will be faster / the results are (obtained) more quickly	ALLOW (the powder has) higher surface area:volume IGNORE references to the collision theory	2						
(b)	<table border="1"> <tr> <td>syringe reading at start</td> <td>81</td> </tr> <tr> <td>syringe reading at end</td> <td>16</td> </tr> <tr> <td>change in volume in cm³</td> <td>65</td> </tr> </table>	syringe reading at start	81	syringe reading at end	16	change in volume in cm ³	65	ALLOW ecf on syringe reading at start if syringe reading at end read incorrectly correct volumes the wrong way round scores 1	2
syringe reading at start	81								
syringe reading at end	16								
change in volume in cm ³	65								
(c)	M1 (volume of oxygen =) 90 – 22 OR 68 (cm ³) M2 (total volume at start =) 260 + 90 OR 350 (cm ³) M3 $\frac{68 \times 100}{350} = 19.4$ (%)	correct answer without working scores 3 ALLOW ecf on M1 and M2 in M3 as long as the answer is less than 100% ACCEPT any number of sig figs except 1 26.2 (%) scores 2 25.7 (%) scores 2 75.6 (%) scores 2 34.6 (%) scores 1	3						
			Total 10						

Question number	Answer	Notes	Marks
5 (a) (i)	<p>M1 (compounds with) same molecular formula</p> <p>M2 different structural / displayed formulae</p> <p>(ii) $(5 \times 12 + 12 \times 1 =) 72$</p> <p>(iii) pentane</p> <p>(iv) M1</p> <pre> H H-C-H H-C-C-C-C-H H H H H </pre> <p>M2</p> <pre> H H-C-H H-C-C-C-H H H H </pre>	<p>ALLOW same number of carbons and hydrogens / atoms of each element</p> <p>ALLOW different structures / arrangement of atoms</p> <p>spelling must be correct</p> <p>either order</p>	<p>2</p> <p>1</p> <p>1</p> <p>1</p> <p>2</p>

(b)	<p>A description that refers to any five of the following points:</p> <p>M1 ethane needs UV (radiation) to react</p> <p>M2 ethane produces bromoethane</p> <p>M3 ethane produces hydrogen bromide / HBr</p> <p>M4 reaction with ethane involves breaking C-H bond / reaction with ethene involves breaking C=C bond</p> <p>M5 ethane reaction is substitution</p> <p>M6 ethene produces dibromoethane</p> <p>M7 ethene reaction is addition</p>	<p>IGNORE any colour changes given</p> <p>IGNORE UV for ethene</p> <p>IGNORE any references to temperature and pressure</p> <p>ALLOW formulae</p> <p>ALLOW formula</p> <p>M1, M2, M3 and M6 can be scored from word or chemical equations</p>	<p>5</p> <p>Total 11</p>
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Question number	Answer	Notes	Marks
6 (a)	(i) $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$	IGNORE state symbols even if incorrect	1
	(ii) (squeaky) pop with lighted splint		1
	(iii) M1 amount of magnesium = $0.090 \div 24$ OR 0.00375 (mol) M2 amount of HCl needed = $2 \times 0.00375 = 0.0075$ (mol) (which is less than 0.025) OR M1 amount of magnesium needed = $0.025 \div 2$ OR 0.0125 (mol) M2 mass of magnesium needed = $0.0125 \times 24 = 0.3$ (g) (there is less magnesium than needed)	ALLOW any number of significant figures	2
(b)	(i) all points plotted correctly to the nearest grid line		
	(ii) best fit curve starting at 0 and levelling off at 88 cm^3		1
	(iii) M1 vertical line on grid from 10 seconds to curve M2 volume correctly read from their graph to the nearest grid line	ALLOW any mark at correct position on curve / either axis expected value 25 to 30 cm^3	2
	(iv) An explanation that links the following two points M1 concentration (of HCl) is greatest (at the start) M2 more collisions per unit time / more frequent collisions	REJECT incorrect references to energy ALLOW more particles (of HCl / more H^+ ions) ALLOW more HCl molecules / greater surface area of Mg IGNORE greater mass / more Mg IGNORE references to the graph	2

(c)	(i)	<p>M1 curve starting at 0 and steeper than original curve</p> <p>M2 curve levelling off at same volume as original curve</p>	<p>ALLOW a curve starting within 1 small square of the original</p>	2
	(ii)	<p>An explanation that links the following three points</p> <p>M1 particles gain more (kinetic) energy</p> <p>M2 more collisions have energy greater than the activation energy</p> <p>M3 collision frequency increases OR rate of reaction increases</p>		<p>ALLOW particles move faster</p> <p>ACCEPT more collisions are successful</p> <p>ACCEPT more (successful) collisions per unit time</p>
				Total 15

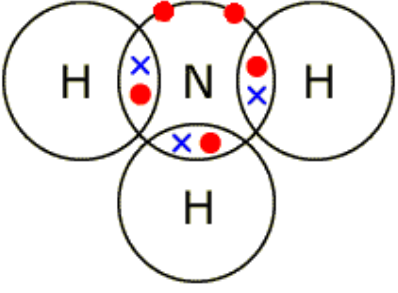
Question number	Answer	Notes	Marks
7 (a) (i)	M1 <u>atoms</u> of the same element / <u>atoms</u> with the same number of protons / <u>atoms</u> with the same atomic number	REJECT different number of electrons IGNORE same number of electrons	2
	M2 (with a) different number of neutrons / different mass number		
	(ii)	correct answer without working scores 3	3
	M1 (63 x 69.5) + (65 x 30.5) OR 6361		
	M2 their M1 ÷ 100 OR 63.61		
	M3 63.6	ALLOW answer to M2 to 3 sig figs	
	(b) (i) A decomposition	63.61 without working scores 2	
	B is incorrect as it is not a neutralisation reaction C is incorrect as it is not an oxidation reaction D is incorrect as it is not a reduction reaction		1
	(ii) C green to black		1
	A is incorrect as copper(II) carbonate is not blue B is incorrect as copper(II) carbonate is not blue and copper(II) oxide is not white D is incorrect as copper(II) oxide is not orange		
	(c) (i) (28.20 – 20.52 =) 7.68		1
	(ii) (31.77 – 28.20 =) 3.57		1

(iii)	<p>M1 $7.68 \div 159.5$ OR 0.04815</p> <p>M2 $3.57 \div 18$ OR 0.1983</p> <p>M3 $0.1983 \div 0.04815$ OR 4.12</p>	<p>correct answer without working scores 3</p> <p>ALLOW ecf from (i) and/or (ii) for M1 and M2; and M3 provided the answer rounds to 4</p> <p>REJECT incorrect rounding in M1 or M2</p> <p>ALLOW any number of sig figs in M1 and M2 except 1</p> <p>Penalise 1 sig fig once only</p>	3
(iv)	not all the water was removed (from the hydrated copper(II) sulfate)	<p>ALLOW the (hydrated copper(II) sulfate) was not heated for long enough</p> <p>ALLOW not all the water left the tube (that was being heated)</p> <p>ALLOW not all the (hydrated copper sulfate) reacts</p>	1
Total			13

Question number	Answer	Notes	Marks
8 (a)	<p>M1 diamond has a tetrahedral (structure) OR in diamond each (carbon) atom is (covalently) bonded to 4 other (carbon) atoms</p> <p>M2 graphite has a hexagonal (structure) / has layers OR in graphite each (carbon) atom is (covalently) bonded to 3 other (carbon) atoms</p> <p>M3 diamond does not conduct electricity OR graphite conducts electricity</p> <p>M4 diamond has no delocalised electrons OR graphite has delocalised electrons</p> <p>M5 diamond is hard OR graphite is soft</p> <p>M6 in diamond the strong (C-C) bonds need to be broken OR in graphite the layers can slide over each other OR graphite has weak forces between layers</p>	<p>REJECT ions / metallic once in M1 or M2</p> <p>REJECT diamond is soft / graphite is hard</p> <p>REJECT reference to intermolecular</p>	6
(b)	<p>An explanation that links the following four points:</p> <p>M1 C₆₀ fullerene has weak forces between the molecules /weak intermolecular forces</p> <p>M2 little / less energy needed to break / overcome the forces /separate the molecules</p> <p>M3 diamond and graphite have many / strong (covalent) bonds (between atoms)</p> <p>M4 large amount of /more energy needed to break /overcome the (covalent) bonds</p>	<p>no M1 or M2 if reference to breaking bonds in fullerene</p> <p>no M3 or M4 if reference to intermolecular forces in diamond and graphite</p> <p>If M1 and M3 are not scored allow 1 mark for covalent bonds (in diamond and graphite) need to be broken / overcome AND intermolecular forces need to be broken / overcome in fullerene</p>	4
			Total 10

Question number	Answer	Notes	Marks
9 (a) (i)	$\text{PbO(s)} + \text{H}_2\text{(g)} \rightarrow \text{Pb(s)} + \text{H}_2\text{O(l OR g)}$	ALLOW upper case letters for state symbols	1
(ii)	D 2+ A is incorrect as the charge on the lead ion is not 1- B is incorrect as the charge on the lead ion is not 1+ C is incorrect as the charge on the lead ion is not 2-		1
(iii)	An explanation that links either pair of the two points M1 lead oxide is reduced and hydrogen is oxidised M2 lead oxide loses oxygen and hydrogen gains oxygen OR M1 lead oxide loses oxygen so is reduced M2 hydrogen gains oxygen so is oxidised	ACCEPT lead oxide is the oxidising agent and hydrogen is the reducing agent ACCEPT lead ions gain electrons and hydrogen loses electrons ACCEPT lead ions gain electrons so are reduced ACCEPT hydrogen loses electrons so is oxidised ALLOW oxidation number of lead / Pb^{2+} decreases from +2 to 0 so is reduced for M1 Oxidation number of hydrogen increases from 0 to +1 so is oxidised for M2	2
(iv)	A description that refers to the following two points: M1 measure the boiling point (of the water) M2 (boiling point is) 100 °C	ALLOW boil it / measure the freezing point / freeze it ACCEPT (freezing point is) 0 °C	2

(b) (i)	<p>An explanation that links the following two points:</p> <p>M1 heat the crucible</p> <p>M2 repeat until constant mass is obtained</p>	<p>ALLOW repeat the experiment</p> <p>heat to constant mass scores 2</p>	2
(ii)	<p>M1 (moles of Pb_3O_4 =) $5.48 \div 685$ OR 0.008(00)</p> <p>M2 (moles of PbO =) $0.008(00) \times 3$ OR 0.024(0)</p> <p>M3 (mass of PbO =) $0.024 \times 223 = 5.352$ (g)</p>	<p>correct final answer without working scores 3</p> <p>ALLOW ecf as long as an attempt has been made to find moles</p> <p>ALLOW answer to M1 (if no M2) or M2 x 223</p> <p>ALLOW any number of sig figs except 1</p>	3
Total 11			

Question number	Answer	Notes	Marks				
10 (a)	 <p>M1 3 bonding pairs M2 rest of molecule fully correct</p>	<p>M2 dep on M1 ALLOW any combination of dots and crosses</p>	2				
(b) (i)	<table border="1" data-bbox="427 846 903 1003"> <tr> <td>M1 ammonium chloride</td> <td>ammonium carbonate</td> </tr> <tr> <td>NH₄Cl</td> <td>M2 (NH₄)₂CO₃</td> </tr> </table>	M1 ammonium chloride	ammonium carbonate	NH ₄ Cl	M2 (NH ₄) ₂ CO ₃		2
M1 ammonium chloride	ammonium carbonate						
NH ₄ Cl	M2 (NH ₄) ₂ CO ₃						
(ii)	$2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$	<p>ALLOW multiples IGNORE state symbols even if incorrect</p>	1				
(iii)	<p>M1 add sodium hydroxide (solution)</p> <p>M2 test (gas / ammonia) with (damp) red litmus paper / (damp) universal indicator paper</p> <p>M3 (red litmus) turns blue / universal indicator) turns blue / purple</p>	<p>REJECT if solution / ammonium (sulfate) tested with litmus / universal indicator paper</p>	3				

(c) (i)	<p>M1 $2 \times 14 \div 80$ OR 0.35</p> <p>M2 $(0.35 \times 100 =)$ 35 (%)</p>	<p>correct answer without working scores 2</p> <p>ALLOW 1 mark for 17 / 17.5 / 18 (%)</p>	2
(ii)	<p>An answer that links any 4 points:</p> <p>M1 (NH₃) higher % of N OR ((NH₄)₂SO₄) lower % of N</p> <p>M2 (NH₄)₂SO₄ easy to use (to soil) / easy for the plants to absorb / less wastage OR (NH₃) difficult to use (to soil) / difficult for the plants to absorb / more wastage / has to be dissolved (in water) first</p> <p>M3 (NH₄)₂SO₄ pH close to that of (rain) water / will not alter the pH (of the soil/water)</p> <p>M4 NH₃ will cause (the soil/water) to become alkaline / will raise the pH (of the soil/water) / neutralise (the water / soil) / may stunt growth of plants / may damage / kill plants</p> <p>M5 NH₃ and or (NH₄)₂SO₄ soluble so runoff / wastage of fertiliser / water pollution / eutrophication / leaching</p>	<p>REJECT NH₃ has a pH close to rainwater</p> <p>REJECT ammonia causes the soil / water to become acidic</p>	4
			Total 14

