

Paper 1 (4CH1/1C and 4SD0/1C)

Question number	Answer	Mark
1(a)	Nucleus	1

Question number	Answer	Mark
1(b)	Proton	1

Question number	Answer	Additional guidance	Mark
1(c)	Equal numbers of protons and electrons	accept equal numbers of positive and negative particles/charges	1

Question number	Answer	Mark
1(d)	5	1

Question number	Answer	Mark
1(e)	Lithium	1

Total for Question 1 = 5 marks

Question number	Answer	Additional guidance	Mark
2(a)(i)	An explanation that makes reference to the following two points: <ul style="list-style-type: none"> boxes 1 and 2 (1) because they both have only one type of atom/molecule (1) 	accept other indications, e.g. only He and only H-H accept species in place of atom/molecule second mark can be awarded if only box 1 or box 2 identified	2

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation that makes reference to the following two points: <ul style="list-style-type: none"> boxes 3 and 5 (1) because they both have two different molecules (1) 	second mark can be awarded if only box 3 or box 5 identified	2

Question number	Answer	Mark
2(b)(i)	Simple distillation	1

Question number	Answer	Mark
2(b)(ii)	Chromatography	1

Question number	Answer	Mark
2(b)(iii)	Crystallisation	1

Total for Question 2 = 7 marks

Question number	Answer	Mark
3(a)	Reversible arrow	1

Question number	Answer	Additional guidance	Mark
3(b)(i)	<ul style="list-style-type: none"> (X) ammonium chloride (1) (Y) ammonia and hydrogen chloride (1) 	accept formulae	2

Question number	Answer	Mark
3(b)(ii)	D (subliming)	1

Question number	Answer	Additional guidance	Mark
3(c)	<p>An explanation that makes reference to the following three points:</p> <ul style="list-style-type: none"> C (1) because ammonia molecules have lower mass or smaller M_r (hence travel faster) (1) and so travel further in the same time (1) 	accept reverse arguments for hydrogen chloride	3

Total for Question 3 = 7 marks

Question number	Answer	Additional guidance	Mark
4(a)	<ul style="list-style-type: none"> • 35 (1) • 41 (1) 	final answer consequential on syringe readings	2

Question number	Answer	Additional guidance	Mark
4(b)	<ul style="list-style-type: none"> • Calculation of volume of oxygen used • Calculation of original volume of air • Calculation of percentage <p>Example calculation: $80 - 43 = 37 \text{ (cm}^3\text{)} (1)$ $100 + 10 + 80 = 190 \text{ (cm}^3\text{)} (1)$ $(37 \times 100) \div 190 (= 19.47\%)$ $= 19\% (1)$</p>	accept 19.47% or 19.5%	3

question number	answer	mark
4(c)	<ul style="list-style-type: none"> • Decreased (1) • Decreased (1) • No effect (1) 	3

Total for Question 4 = 8 marks

Question number	Answer	Mark
5(a)	Any two of: <ul style="list-style-type: none"> concentration of copper(II) sulfate solution (1) volume of copper(II) sulfate solution (1) particle size of metal (1) 	2

Question number	Answer	Additional guidance	Mark
5(b)(i)	<ul style="list-style-type: none"> (G) 5.5 (°C) (1) (H) 11.5 (°C) (1) 	accept 5.47	2

Question number	Answer	Mark
5(b)(ii)	An explanation that makes reference to the following two points: <ul style="list-style-type: none"> H (1) because of the biggest temperature increase (1) 	2

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that makes reference to the following two points: <ul style="list-style-type: none"> F (1) because there is no temperature increase (1) 	accept there is no reaction	2

Total for Question 5 = 8 marks

Question number	Answer	Additional guidance	Mark
6(a)	The atoms of both elements have one electron in the outer shell	accept highest energy level in place of outer shell	1

Question number	Answer	Additional guidance	Mark
6(b)(i)	<p>A description that makes reference to any two of the following points:</p> <ul style="list-style-type: none"> sodium floats/moves across the water (1) sodium melts (1) sodium disappears/gets smaller (1) effervescence/fizzing/bubbles/gas given off (1) white trail (1) 	<p>accept forms a ball accept sodium dissolves ignore name of gas</p>	2

Question number	Answer	Additional guidance	Mark
6(b)(ii)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> (final colour is) purple/blue (1) because the solution is alkaline (1) 	<p>accept sodium hydroxide forms/ solution has high pH</p>	2

Question number	Answer	Mark
6(b)(iii)	D (12)	1

Question number	Answer	Mark
6(c)	Lithium	1

Question number	Answer	Additional guidance	Mark
6(d)	Potassium catches fire	accept lilac/purple/violet flame	1

Question number	Answer	Additional guidance	Mark
6(e)	$2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$ (1)	accept multiples and fractions	1

Total for Question 6 = 9 marks

Question number	Answer	Mark
7(a)(i)	B and E	1

Question number	Answer	Mark
7(a)(ii)	(the only one that shows) All atoms and all bonds	1

Question number	Answer	Mark
7(a)(iii)	<ul style="list-style-type: none"> D and F (1) they have the same molecular formula/the same number of each type of atom (1) but different structures/atoms joined together in different ways/different structural formulae (1) 	3

Question number	Answer	Mark
7(a)(iv)	4	1

Question number	Answer	Mark
7(b)(i)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> incomplete combustion/lack of oxygen (1) leads to the formation of carbon monoxide (1) 	2

Question number	Answer	Mark
7(b)(ii)	It reduces the capacity of blood to transport oxygen	1

Question number	Answer	Additional guidance	Mark
7(c)	<p>An explanation that makes reference to the following points:</p> <ul style="list-style-type: none"> nitrogen in the air and oxygen react (1) at high temperatures (1) which causes the formation of nitrogen oxide(s) (1) oxides then react with water (vapour) in the atmosphere to form nitric acid (1) 	<p>accept equation and formulae such as NO/NO₂/NO_x accept nitrous acid and formulae</p>	4

Total for Question 7 = 13 marks

Question number	Answer	Mark
8(a)	One reaction product is a gas and so escapes from the flask	1

Question number	Answer	Mark
8(b)(i)	Any one of: <ul style="list-style-type: none"> balance reading recorded too late acid concentration greater than recorded 	1

Question number	Answer	Mark
8(b)(ii)	Loss in mass directly proportional to acid concentration	1

Question number	Answer	Additional guidance	Mark
8(c)	An explanation that makes reference to the following two points: <ul style="list-style-type: none"> more particles in the same volume (1) so collide more frequently (with malachite) (1) 	accept particles closer together	2

Total for Question 8 = 5 marks

Question number	Answer	Mark
9(a)	<p>A description that makes reference to five of the following points:</p> <ul style="list-style-type: none"> • crude oil is heated/vaporised (1) • the vapour enters the lower part of the column (1) • there is a temperature gradient up the column (1) • the vapour in the diesel fraction rises up the column until it condenses (1) • at a height where its boiling point is lower than the temperature in the column (1) • so the diesel fraction is removed (1) 	5

Question number	Answer	Additional guidance	Mark
9(b)	<p>An explanation that makes reference to the following three points:</p> <ul style="list-style-type: none"> • dodecane contains hydrogen and carbon (1) • only/and no other elements (1) • and contains only single bonds (1) 	accept does not contain double bonds/multiple bonds	3

Question number	Answer	Mark
9(c)	C	1

Question number	Answer	Mark
9(d)	C ₈ H ₁₈	1

Question number	Answer	Additional guidance	Mark
9(e)(i)	Ultraviolet radiation	accept ultraviolet light	1

Question number	Answer	Mark
9(e)(ii)	HCl	1

Question number	Answer	Additional guidance	Mark
9(e)(iii)	<ul style="list-style-type: none"> All 6 atoms with a dot and cross representing each bonding pair of electrons (1) 3 lone pairs of electrons on Cl and none on any of the H atoms (1) 	accept 2 dots or 2 crosses for each bond accept any combination of dots and crosses	2

Question number	Answer	Mark
9(e)(iv)	Substitution	1

Question number	Answer	Mark
9(f)(i)	D	1

Question number	Answer	Mark																				
9(f)(ii)	<ul style="list-style-type: none"> Dividing percentages by atomic masses (1) Dividing results by smallest value OR obtaining ratio (1) Writing empirical formula (1) <p>Example calculation:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>C</td> <td>H</td> <td>Br</td> <td>O</td> </tr> <tr> <td><u>25.9</u></td> <td><u>5.0</u></td> <td><u>57.6</u></td> <td><u>11.5</u></td> </tr> <tr> <td>12</td> <td>1</td> <td>80</td> <td>16</td> </tr> <tr> <td>2.16</td> <td>5.0</td> <td>0.72</td> <td>0.72</td> </tr> <tr> <td>3</td> <td>7</td> <td>1</td> <td>1</td> </tr> </table> <p>C₃H₇BrO</p> <p>accept symbols in any order</p>	C	H	Br	O	<u>25.9</u>	<u>5.0</u>	<u>57.6</u>	<u>11.5</u>	12	1	80	16	2.16	5.0	0.72	0.72	3	7	1	1	3
C	H	Br	O																			
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12	1	80	16																			
2.16	5.0	0.72	0.72																			
3	7	1	1																			

Total for Question 9 = 19 marks

Question number	Answer	Mark
10(a)	<ul style="list-style-type: none"> • Increment in volume smaller/more precise (1) • Avoids refilling the measuring cylinder (1) 	2

Question number	Answer	Additional guidance	Mark						
10(b)	<table border="1"> <tr> <td>thermometer reading at end/°C</td> <td>(26.8)</td> </tr> <tr> <td>thermometer reading at start/°C</td> <td>18.7</td> </tr> <tr> <td>temperature rise/°C</td> <td>8.1</td> </tr> </table>	thermometer reading at end/°C	(26.8)	thermometer reading at start/°C	18.7	temperature rise/°C	8.1	1 mark for temperature at start 1 mark for temperature rise consequential on readings	2
thermometer reading at end/°C	(26.8)								
thermometer reading at start/°C	18.7								
temperature rise/°C	8.1								

Question number	Answer	Mark
10(c)(i)	29.5	1

Question number	Answer	Mark
10(c)(ii)	20.8	1

Question number	Answer	Mark
10(d)	<ul style="list-style-type: none"> • Calculation of volume/mass of mixture • Calculation of temperature increase • Substitution of values into $q=mc\Delta T$ • Calculation of heat energy released with unit <p>Example calculation: $20.0 + 20.0 = 40.0 \text{ (cm}^3\text{)} (1)$ $30.0 - 18.5 = 11.5 \text{ (}^\circ\text{C)} (1)$ $q = 40.0 \times 4.2 \times 11.5 (1)$ $q = 1900 \text{ J} (1) \text{ (accept } 1932 \text{ J)}$</p>	4

Question number	Answer	Mark
10(e)	<ul style="list-style-type: none"> • Setting out of ΔH calculation • Division by 1000 to obtain answer in kJ/mol <p>Example calculation: $1600 \div 0.040 (1)$ $= -40 \text{ (kJ/mol)} (1)$</p>	2

Total for Question 10 = 12 marks

Question number	Answer	Mark									
11(a)	1 mark for each box completed correctly	4									
	<table border="1"> <thead> <tr> <th>Reactants</th> <th>Name of salt formed</th> <th>Other product(s)</th> </tr> </thead> <tbody> <tr> <td>(zinc + hydrochloric acid)</td> <td>zinc chloride</td> <td>hydrogen</td> </tr> <tr> <td>(calcium carbonate + nitric acid)</td> <td>calcium nitrate</td> <td>water + carbon dioxide</td> </tr> </tbody> </table>		Reactants	Name of salt formed	Other product(s)	(zinc + hydrochloric acid)	zinc chloride	hydrogen	(calcium carbonate + nitric acid)	calcium nitrate	water + carbon dioxide
	Reactants		Name of salt formed	Other product(s)							
(zinc + hydrochloric acid)	zinc chloride	hydrogen									
(calcium carbonate + nitric acid)	calcium nitrate	water + carbon dioxide									

Question number	Answer	Mark
11(b)(i)	<ul style="list-style-type: none"> Use excess aluminium hydroxide (1) Stir (thoroughly) (1) 	2

Question number	Answer	Mark
11(b)(ii)	To remove unreacted aluminium hydroxide/solid	1

Question number	Answer	Mark
11(b)(iii)	<p>Any one of:</p> <ul style="list-style-type: none"> leave in a warm place (1) use filter paper or paper towel (1) 	1

Question number	Answer	Mark
11(c)	<ul style="list-style-type: none"> Calculation of M_r of aluminium hydroxide Calculation of amount of aluminium hydroxide Reference to 2 : 3 ratio in equation AND statement that sulfuric acid is in excess <p>Example calculation: $27 + (3 \times 17) = 78$ (1) $3.9 \div 78 = 0.05 \text{ mol}$ (1)</p> <p>This is more than 3/2 times amount of aluminium hydroxide, so sulfuric acid is in excess (1) (accept other valid methods of calculation)</p>	3

Question number	Answer	Mark
11(d)	Calculation of M_r of aluminium sulfate setting out calculation of mass final answer Example calculation: $(27 \times 2) + (32 \times 3) + (16 \times 12) = 342$ (1) mass = 342×0.25 (1) 85.5 g (1)	3

Question number	Answer	Additional guidance	Mark
11(e)	<ul style="list-style-type: none"> • Calculation of amount of lead(II) nitrate • Percentage method • Percentage answer Example calculation: $209 \div 331 = 0.631$ mol (1) $\frac{0.631 \times 100}{0.75}$ (1) = 84% (1)	allow full credit for calculations using masses	3

Total for Question 11 = 17 marks

TOTAL FOR PAPER = 110 MARKS

