

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

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

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

Question number	Answer	Mark
<b>2(b)(ii)</b>	Chromatography	<b>1</b>

Question number	Answer	Mark
<b>2(b)(iii)</b>	Crystallisation	<b>1</b>

**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"> <li>(X) ammonium chloride (1)</li> <li>(Y) ammonia and hydrogen chloride (1)</li> </ul>	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"> <li>C (1)</li> <li>because ammonia molecules have lower mass or smaller <math>M_r</math> (hence travel faster) (1)</li> <li>and so travel further in the same time (1)</li> </ul>	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"> <li>• 35 (1)</li> <li>• 41 (1)</li> </ul>	final answer consequential on syringe readings	2

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

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

**Total for Question 4 = 8 marks**

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

Question number	Answer	Additional guidance	Mark
5(b)(i)	<ul style="list-style-type: none"> <li>(G) 5.5 (°C) (1)</li> <li>(H) 11.5 (°C) (1)</li> </ul>	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"> <li>H (1)</li> <li>because of the biggest temperature increase (1)</li> </ul>	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"> <li>F (1)</li> <li>because there is no temperature increase (1)</li> </ul>	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"> <li>sodium floats/moves across the water (1)</li> <li>sodium melts (1)</li> <li>sodium disappears/gets smaller (1)</li> <li>effervescence/fizzing/bubbles/gas given off (1)</li> <li>white trail (1)</li> </ul>	<p>accept forms a ball</p> <p>accept sodium dissolves</p> <p>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"> <li>(final colour is) purple/blue (1)</li> <li>because the solution is alkaline (1)</li> </ul>	<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"> <li>D and F (1)</li> <li>they have the same molecular formula/the same number of each type of atom (1)</li> <li>but different structures/atoms joined together in different ways/different structural formulae (1)</li> </ul>	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"> <li>incomplete combustion/lack of oxygen (1)</li> <li>leads to the formation of carbon monoxide (1)</li> </ul>	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"> <li>nitrogen in the air and oxygen react (1)</li> <li>at high temperatures (1)</li> <li>which causes the formation of nitrogen oxide(s) (1)</li> <li>oxides then react with water (vapour) in the atmosphere to form nitric acid (1)</li> </ul>	<p>accept equation and formulae such as NO/NO<sub>2</sub>/NO<sub>x</sub></p> <p>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"> <li>balance reading recorded too late</li> <li>acid concentration greater than recorded</li> </ul>	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"> <li>more particles in the same volume (1)</li> <li>so collide more frequently (with malachite) (1)</li> </ul>	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"> <li>• crude oil is heated/vaporised (1)</li> <li>• the vapour enters the lower part of the column (1)</li> <li>• there is a temperature gradient up the column (1)</li> <li>• the vapour in the diesel fraction rises up the column until it condenses (1)</li> <li>• at a height where its boiling point is lower than the temperature in the column (1)</li> <li>• so the diesel fraction is removed (1)</li> </ul>	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"> <li>• dodecane contains hydrogen and carbon (1)</li> <li>• only/and no other elements (1)</li> <li>• and contains only single bonds (1)</li> </ul>	accept does not contain double bonds/multiple bonds	3

Question number	Answer	Mark
9(c)	C	1

Question number	Answer	Mark
9(d)	C <sub>8</sub> H <sub>18</sub>	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"> <li>All 6 atoms with a dot and cross representing each bonding pair of electrons (1)</li> <li>3 lone pairs of electrons on Cl and none on any of the H atoms (1)</li> </ul>	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"><li>Dividing percentages by atomic masses (1)</li><li>Dividing results by smallest value OR obtaining ratio (1)</li><li>Writing empirical formula (1)</li></ul> <p>Example calculation:</p> <table><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>C<sub>3</sub>H<sub>7</sub>BrO</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																			
<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																			

**Total for Question 9 = 19 marks**

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

Question number	Answer	Additional guidance	Mark						
10(b)	<table><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"> <li>Calculation of volume/mass of mixture</li> <li>Calculation of temperature increase</li> <li>Substitution of values into <math>q=mc\Delta T</math></li> <li>Calculation of heat energy released with unit</li> </ul> <p>Example calculation:  <math>20.0 + 20.0 = 40.0 \text{ (cm}^3\text{)} (1)</math>  <math>30.0 - 18.5 = 11.5 \text{ (}^\circ\text{C)} (1)</math>  <math>q = 40.0 \times 4.2 \times 11.5 (1)</math>  <math>q = 1900 \text{ J } (1) \text{ (accept } 1932 \text{ J)}</math></p>	4

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

**Total for Question 10 = 12 marks**

Question number	Answer	Mark									
11(a)	<p>1 mark for each box completed correctly</p> <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	4
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"> <li>Use excess aluminium hydroxide (1)</li> <li>Stir (thoroughly) (1)</li> </ul>	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"> <li>leave in a warm place (1)</li> <li>use filter paper or paper towel (1)</li> </ul>	1

Question number	Answer	Mark
11(c)	<ul style="list-style-type: none"> <li>Calculation of <math>M_r</math> of aluminium hydroxide</li> <li>Calculation of amount of aluminium hydroxide</li> <li>Reference to 2 : 3 ratio in equation AND statement that sulfuric acid is in excess</li> </ul> <p>Example calculation:  <math>27 + (3 \times 17) = 78</math> (1)  <math>3.9 \div 78 = 0.05 \text{ mol}</math> (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
<b>11(d)</b>	<p>Calculation of <math>M_r</math> of aluminium sulfate setting out calculation of mass final answer</p> <p>Example calculation:  <math>(27 \times 2) + (32 \times 3) + (16 \times 12) = 342</math> (1)  mass = <math>342 \times 0.25</math> (1)  85.5 g (1)</p>	<b>3</b>

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

**Total for Question 11 = 17 marks**

**TOTAL FOR PAPER = 110 MARKS**