

Question Number	Answers	Acceptable Answers	Mark
<b>1 (a)</b>	<b>D</b> is inert		<b>(1)</b>

Question Number	Answers	Acceptable Answers	Mark
<b>1 (b)</b>	<p>An explanation linking</p> <ul style="list-style-type: none"> <li>• { atoms/cations/ions} are in { layers /sheets} <b>(1)</b></li> <li>• { layers/sheets} can { slide/slip/ move/roll} (over each other) (1)</li> </ul>	<p>Any mention of intermolecular forces/covalent bonds/ionic bonds (0)</p> <p>Accept a diagram showing layers with labelled { atoms/cations/ions} Ignore rows /lines/ lattice</p> <p>Do not allow electrons can slide/slip/move over each other Ignore references to delocalised electrons</p>	<b>(2)</b>

Question Number	Answers	Acceptable Answers	Mark															
<b>1 (c)</b>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"></td> <td style="text-align: center;">P</td> <td style="text-align: center;">Br</td> </tr> <tr> <td>mass</td> <td style="text-align: center;">3.1/31 (= 0.1)</td> <td style="text-align: center;">24/80 (= 0.3) <b>(1)</b></td> </tr> <tr> <td><math>A_r</math></td> <td style="text-align: center;">1</td> <td style="text-align: center;">3</td> </tr> <tr> <td>ratio <b>(1)</b></td> <td></td> <td></td> </tr> <tr> <td>formula <b>(1)</b></td> <td style="text-align: center;">PBr<sub>3</sub></td> <td></td> </tr> </table>		P	Br	mass	3.1/31 (= 0.1)	24/80 (= 0.3) <b>(1)</b>	$A_r$	1	3	ratio <b>(1)</b>			formula <b>(1)</b>	PBr <sub>3</sub>		<p>Allow PBr<sub>3</sub> with no working or incorrect working <b>(1)</b></p> <p>PBr<sub>3</sub> with some correct working <b>(3)</b> Accept Br<sub>3</sub>P</p> <p>Allow TE for second and third marks e.g. P    Br</p> <p>31/3.1 (= 10)      80/24 (= 3.33) <b>(0)</b></p> <p style="margin-left: 40px;">3    1    <b>(1)</b></p> <p style="margin-left: 40px;">P<sub>3</sub>Br    <b>(1)</b></p> <p style="margin-left: 40px;">P<sub>3</sub>Br with no working <b>(0)</b></p>	<b>(3)</b>
	P	Br																
mass	3.1/31 (= 0.1)	24/80 (= 0.3) <b>(1)</b>																
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Question Number	Indicative content	Mark
<b>QWC 1(d)</b>	<p>A description / explanation including some of the following points</p> <p><b>Description</b></p> <ul style="list-style-type: none"> <li>• effervescence / fizzing / bubbles</li> <li>• float /on surface</li> <li>• move</li> <li>• produce hydrogen (may be shown in word or balanced equation)</li> <li>• {an alkaline/metal hydroxide} solution (may be shown in word or balanced equation)</li> <li>• gets smaller / disappears / dissolves</li> <li>• reactivity increases with {increasing atomic number/ down the group} / potassium effervesces more than sodium and lithium / potassium moves faster than sodium or lithium</li> <li>• sodium and potassium melt/form a (silver-coloured) ball</li> <li>• hydrogen burns when potassium/ sodium react</li> <li>• potassium gives a lilac flame/sodium gives a yellow flame</li> <li>• Universal Indicator added to water turns blue/purple</li> </ul> <p><b>Explanation</b></p> <ul style="list-style-type: none"> <li>• (group 1 metals) react by losing one electron</li> <li>• electron is more easily lost with {increasing atomic number/ down the group}</li> <li>• {electron/ outer shell} is further away from nucleus/ atomic radius increases/ there are more electron shells with {increasing atomic number/ down the group}</li> <li>• {more shielding (of outer electron)/ less attraction between nucleus and outer electron/ more shells between outer electron and nucleus} with {increasing atomic number/down the group}</li> </ul>	<b>(6)</b>
Level	0	No rewardable material
<b>1</b>	<b>1-2</b>	<ul style="list-style-type: none"> <li>• a limited description of one or two points describing the reactions or explaining them e.g. reactivity increases down the group.</li> <li>• the answer communicates ideas using simple language and uses limited scientific terminology.</li> <li>• spelling, punctuation and grammar are used with limited accuracy.</li> </ul>
<b>2</b>	<b>3-4</b>	<ul style="list-style-type: none"> <li>• a simple description of at least three points describing the reactions OR a combination of three points from the description and explanation e.g. they all float on water, fizz and potassium gives a lilac flame.</li> <li>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately.</li> <li>• spelling, punctuation and grammar are used with some accuracy.</li> </ul>
<b>3</b>	<b>5-6</b>	<ul style="list-style-type: none"> <li>• a detailed description and explanation of at least five points describing the reactions <b>and</b> explaining the pattern of reactivity e.g. the metals all fizz, float and produce hydrogen, the reactivity increases down the group because the outer electron is more easily lost.</li> <li>• the answer communicates ideas clearly and coherently and uses scientific terminology accurately.</li> <li>• spelling, punctuation and grammar are used with few errors.</li> </ul>

Question number	Answer	Mark
2(a)	Candidates relate information given to order of elements in the periodic table to predict: dark grey/black <b>and</b> solid/crystals	(1)

Question number	Indicative content	Mark
*2(b)	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <p style="text-align: center;"><b>AO1 (6 marks)</b></p> <ul style="list-style-type: none"> <li>• order of reactivity: chlorine &gt; bromine &gt; iodine</li> </ul> <p>The order of reactivity supported by suitable experiments from:</p> <ul style="list-style-type: none"> <li>• add (aqueous) chlorine to a solution of potassium bromide</li> <li>• the solution turns orange/yellow</li> <li>• bromine is produced / <math>\text{Cl}_2 + 2\text{KBr} \rightarrow \text{Br}_2 + 2\text{KCl}</math> / <math>\text{Cl}_2 + 2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{Cl}^-</math></li> <li>• (so) chlorine is more reactive than/displaces bromine /oxidises bromide ions</li> </ul> <ul style="list-style-type: none"> <li>• add (aqueous) bromine to a solution of potassium iodide</li> <li>• the solution turns yellow/red/ brown</li> <li>• iodine is produced / <math>\text{Br}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KBr}</math> / <math>\text{Br}_2 + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Br}^-</math></li> <li>• (so) bromine is more reactive than/displaces iodine/ oxidises iodide ions</li> </ul> <ul style="list-style-type: none"> <li>• add (aqueous) chlorine to a solution of potassium iodide</li> <li>• the solution turns yellow/red/ brown</li> <li>• iodine is produced / <math>\text{Cl}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KCl}</math> / <math>\text{Cl}_2 + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Cl}^-</math></li> <li>• (so) chlorine is more reactive than/displaces iodine/oxidises iodide ions</li> </ul> <p>Allow use of suggested reactions which do not produce a displacement reaction, e.g. add (aqueous) bromine to a solution of a potassium chloride with suitable conclusion/explanation</p>	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> <li>Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas, enquiry, techniques and procedures lacks detail. (AO1)</li> <li>Presents an explanation with some structure and coherence. (AO1)</li> </ul>
Level 2	3–4	<ul style="list-style-type: none"> <li>Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1)</li> <li>Presents an explanation that has a structure, which is mostly clear, coherent and logical. (AO1)</li> </ul>
Level 3	5–6	<ul style="list-style-type: none"> <li>Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1)</li> <li>Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)</li> </ul>

Question number	Answer	Additional guidance	Mark															
<b>2(c)(i)</b>	<ul style="list-style-type: none"> <li>calculates mol of Fe (1)</li> <li>calculates mol of Br<sup>2</sup> (1)</li> <li>determines simplest ratio/LHS of equation (1)</li> <li>deduces formula of iron bromide produced/RHS of equation (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>divides mass by relative atomic mass (1)</li> <li>simplest ratio (1)</li> <li>empirical formula (1)</li> <li>deduces LHS to obtain balanced equation (1)</li> </ul>	<p><u>Example of calculation</u></p> $\text{mol Fe} = \frac{5.6}{56} = 0.1$ $\text{mol Br}_2 = \frac{24}{(2 \times 80)} = 0.15$ <p>ratio Fe:Br<sub>2</sub> = 2 : 3/ 2Fe + 3Br<sub>2</sub></p> <p>2FeBr<sub>3</sub>/Fe<sub>2</sub>Br<sub>6</sub></p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>Fe</td> <td></td> <td>Br</td> </tr> <tr> <td><u>5.6</u></td> <td>:</td> <td><u>24</u></td> </tr> <tr> <td>56</td> <td>:</td> <td>80</td> </tr> <tr> <td>0.1</td> <td>:</td> <td>0.3</td> </tr> <tr> <td>1</td> <td>:</td> <td>3</td> </tr> </table> <p>FeBr<sub>3</sub></p> $2\text{Fe} + 3\text{Br}_2 \rightarrow 2\text{FeBr}_3$	Fe		Br	<u>5.6</u>	:	<u>24</u>	56	:	80	0.1	:	0.3	1	:	3	<b>(4)</b>
Fe		Br																
<u>5.6</u>	:	<u>24</u>																
56	:	80																
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1	:	3																

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<b>2(c)(ii)</b>	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): <ul style="list-style-type: none"><li>• bromine atoms are reduced (1)</li><li>• because electrons are gained to form bromide ions (1)</li></ul>	<b>(2)</b>