For each reaction in questions 1–3, add curly arrows to show the movement of electron pairs to produce the products shown. In question 3 add the other product of the reaction into the box.

1) \[
\begin{align*}
\text{H}_3\text{O}^+ \quad \text{H}^+ \quad \text{H}_2\text{O} \\
\end{align*}
\]

(2 marks)

2) \[
\begin{align*}
\text{Nu} \quad \text{Nu} \\
\end{align*}
\]

(5 marks)

3) \[
\begin{align*}
\text{Br}^--\text{Br}^- \\
\end{align*}
\]

(3 marks)

4) Ammonia is able to act as a nucleophile. When it reacts with a H⁺ ion it forms an ammonium ion.
(a) Draw the shape of ammonia and of the ammonium ion. Indicate the bond angle(s)

<table>
<thead>
<tr>
<th>Ammonia</th>
<th>Ammonium ion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Ammonia structure" /></td>
<td><img src="image" alt="Ammonium structure" /></td>
</tr>
<tr>
<td>Bond angle(s)</td>
<td>107°</td>
</tr>
</tbody>
</table>

(4 marks)
(b) State how ammonia is able to act as a nucleophile
Lone pair of electrons on nitrogen which can be donated to another atom

(c) Outline the mechanism by which ammonia reacts with a H⁺ ion to form the ammonium ion

For questions 5-8 draw the structures of the products formed in the boxes.

5)

6)

7)

8)