Question 22 (Answer: **D**)

- A halogen displaces only the halide ions *below* it in the group.
- Iodine sits below bromine, so it is the weaker oxidising agent.
- It cannot oxidise bromide ions, so nothing happens.

Question 23 (Answer: **B**)

- Ammonia is a weak base, so its solution holds both NH_3 and the NH_4^+ formed from it.
- NH_4^+ can donate a proton, which is the Brønsted–Lowry definition of an acid.
- Nitrogen is unreactive because of a strong *triple* bond, and it does have a lone pair – so A and C fail.

<table>
<tr><td>1(a)(i)</td><td>(halogens can) remove electron(s) (from a reactant)</td></tr>
<tr><td>1(a)(ii)</td><td>$2Al + 3Cl_2 \rightarrow 2AlCl_3$</td></tr>
<tr><td>1(a)(iii)</td><td>purple (gas) disappears</td></tr>
<tr><td>1(b)(i)</td><td>M1 Br—Br is weaker (than Cl—Cl) AND Br atoms are larger

M2 less (significant) overlap of orbitals (in Br-Br)</td></tr>
<tr><td>1(b)(ii)</td><td>HCl is more thermally stable</td></tr>
<tr><td>1(b)(iii)</td><td>M1 (enthalpy change / energy change) when one mole of a compound / substance is formed

M2 from its (constituent) elements in their standard state(s)</td></tr>
<tr><td>1(b)(iv)</td><td>M1 (6 × –92) – (2 × –46) =

M2 –460 (kJ mol^{-1})</td></tr>
<tr><td>1(b)(v)</td><td>M1 (trigonal) pyramidal

M2 three bonding pairs AND one lone pair (of electrons)</td></tr>
<tr><td>1(c)(i)</td><td>
<table>
<tr><th></th><th>NaCl</th><th>NaBr</th><th>NaI</th></tr>
<tr><td>with $Ag^+(aq)$</td><td>white precipitate</td><td>M1 cream / off-white ppt</td><td>M2 yellow ppt</td></tr>
<tr><td>with conc. H_2SO_4</td><td>acid – base</td><td>acid – base,
then redox</td><td>acid – base,
then redox</td></tr>
<tr><td>observations with conc. H_2SO_4</td><td>M3 steamy fumes
OR
fizzing</td><td>M4 brown liquid
OR
fizzing</td><td>• black solid
• yellow solid
• effervescence</td></tr>
</table>
</td></tr>
<tr><td>1(c)(ii)</td><td>M1 black solid = iodine / I_2 AND yellow solid = sulfur / $S_{(8)}$

M2 effervescence = hydrogen sulfide / $H_2S(g)$</td></tr>
<tr><td>1(d)(i)</td><td>M1 $MgCl_2$ (is ionic and) has mobile ions

M2 $SiCl_4$ is covalent AND no charge carriers
OR (no ions and) no delocalised electrons
OR no mobile / moving ions</td></tr>
<tr><td>1(d)(ii)</td><td>M1 $MgCl_2$ pH = 7

M2 $SiCl_4$ pH 0 – 4</td></tr>
</table>