1. At room temperature, the states of chlorine, bromine and iodine are:

   ☐ all gases

   ☐ liquid, solid, gas

   ☐ all solids

   ☐ gas, liquid, solid

2. A halogen acts as an oxidising agent because it:

   ☐ gives away protons

   ☐ gains a proton

   ☐ gains an electron to form a 1− ion

   ☐ loses an electron

3. The reducing power of the halide ions increases down the group because:

   ☐ a larger ion holds its outer electron less tightly, so it is given up more easily

   ☐ the nuclear charge falls

   ☐ they gain electrons

   ☐ a larger ion holds its electron more tightly

4. Chlorine with cold, dilute sodium hydroxide forms:

   ☐ sodium chloride only

   ☐ sodium chloride and sodium chlorate(I)

   ☐ sodium chlorate(V) only

   ☐ sodium oxide

5. Volatility decreases down Group 17 because:

   ☐ the molecules get smaller, so they pack more tightly

   ☐ the halogens become ionic further down the group

   ☐ the covalent bonds inside the molecules get stronger

   ☐ larger molecules with more electrons have stronger London forces

6. A more reactive halogen will _____ a less reactive one from solution.

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8. In the reaction of chlorine with sodium hydroxide, chlorine is only reduced.

   ☐ True ☐ False

9. The halogens exist as diatomic molecules.

   ☐ True ☐ False

10. Chlorine reacts with water to form a mixture used to disinfect water supplies.

    ☐ True ☐ False

1. **gas, liquid, solid**

   Chlorine is a gas, bromine a liquid and iodine a solid – volatility falls down the group.

2. **gains an electron to form a 1− ion**

   Halogens gain an electron (so they oxidise other species); this power falls down the group.

3. **a larger ion holds its outer electron less tightly, so it is given up more easily**

   Reducing means losing an electron; bigger ions lose theirs more easily, so reducing power rises down the group.

4. **sodium chloride and sodium chlorate(I)**

   $Cl_2 + 2NaOH \rightarrow NaCl + NaClO + H_2O$ (chlorate(I)); hot concentrated NaOH gives chlorate(V) instead.

5. **larger molecules with more electrons have stronger London forces**

   More electrons give stronger instantaneous/induced dipole (London) forces, raising the boiling point.

6. **displace**

   e.g. chlorine displaces bromine.

7. **halide**

   Different halides give different coloured precipitates.

8. **False**

   False. Chlorine is both oxidised (to ClO^- or $ClO_3{}^-$) and reduced (to Cl^-), which makes it a disproportionation reaction.

9. **True**

   They form X_2 molecules: Cl_2, Br_2, I_2.

10. **True**

    It forms chloric(I) acid, which kills microbes.

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