AS level Chemistry A

H032/02 Depth in chemistry

Question Set 9

1. This question is about halogens.

(a) Bromine is used to extract iodine from a solution containing iodide ions.

(i) Write an ionic equation for the reaction. **[1]**

$Br_2 + 2I^- \rightarrow I_2 + 2Br^-$

(ii) Explain why iodine is less reactive than bromine. **[3]**

iodine has a larger atomic radius than bromine so there's a weaker electrostatic attraction between the nucleus and outer shell of iodine as iodine has more shielding so it's harder for iodine to gain an outer electron.

(b) Iodine can be used for the small-scale purification of drinking water.

(i) Iodine reacts with water as shown below.

$$I_2 + H_2O \rightleftharpoons HI + HIO$$

Using oxidation numbers, explain why this reaction is a disproportionation. **[3]**

iodine is both reduced and oxidised in the same reaction

$$\overset{0}{I_2} + H_2O \rightleftharpoons \overset{-1}{H}I + \overset{+1}{H}IO$$

I in HI = −1

I in HIO = +1

(ii) Chlorine is used to purify water on a large scale.

State **one** disadvantage of using chlorine for the purification of drinking water. **[1]**

chlorine is toxic

(c) Hydrogen reacts with chlorine to form hydrogen chloride, HCl:

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g) \qquad \Delta H = -184\ kJ\ mol^{-1}$$

Table 3.1 shows bond enthalpies.

Bond	Bond Enthalpy/kJ mol^{-1}
H–H	+436
Cl–Cl	+243

Table 3.1

Calculate the bond enthalpy, in kJ mol^{-1}, for the H–C*l* bond from the information above. **[2]**

$H_2 + Cl_2 \rightarrow 2HCl \quad \Delta H = -184 \text{ kJmol}^{-1}$

$[H-H + Cl-Cl] - [2(H-Cl)] = -184$

$(436 + 243) - 2x = -184$

$2x = 863$

$x = 431.5$

$H-Cl = 432 \text{ kJmol}^{-1}$

(d) 'Enthalpy change of vaporisation' is the enthalpy change when one mole of a substance changes from a liquid to a gas at its boiling point.

(i) Write an equation, including state symbols, to represent the enthalpy change of vaporisation of bromine. **[1]**

$Br_{2\,(l)} \rightarrow Br_{2\,(g)}$

(ii) Suggest whether the enthalpy change of vaporisation of bromine is exothermic or endothermic.

Explain your answer. **[1]**

endothermic because energy is required to break the induced dipole-dipole forces

Total Marks for Question Set 3: 12