

22 What happens when iodine solution is added to a solution of sodium bromide?

- A** A reaction occurs without changes in oxidation state.
- B** Bromide ions are oxidised; iodine atoms are reduced.
- C** Bromide ions are reduced; iodine atoms are oxidised.
- D** No reaction occurs.

23 Which statement is correct?

- A** Nitrogen is unreactive due to the absence of lone pairs in the molecule.
- B** Aqueous ammonia contains both $\text{NH}_3(\text{aq})$ and $\text{NH}_4^+(\text{aq})$. The $\text{NH}_4^+(\text{aq})$ ion is a Brønsted–Lowry acid.
- C** High temperatures are needed to supply the energy to break the strong double bonds in nitrogen molecules when they react.
- D** Atmospheric SO_2 reacts with unburnt hydrocarbons to form a component of photochemical smog.

1 The Group 17 elements are oxidising agents.

(a) (i) Explain how the Group 17 elements act as oxidising agents.

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..... [1]

(ii) Write an equation to show the reaction in which Cl_2 oxidises aluminium metal.

..... [1]

(iii) A student heats equal amounts of $\text{I}_2(\text{g})$ and $\text{H}_2(\text{g})$ in a sealed flask. The student leaves the contents to cool.

State what you would observe during the reaction.

..... [1]

(b) Cl_2 and Br_2 can each react with NH_3 to give N_2 and a hydrogen halide, HX .



The relative bond strengths of X-X and H-X determine the difference in enthalpy change of the two reactions.

(i) Describe and explain the difference in the X-X bond strengths of Cl_2 and Br_2 .

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..... [2]

(ii) Describe the relative thermal stabilities of HCl and HBr .

..... [1]

(iii) Define enthalpy change of formation, ΔH_f .

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..... [2]

(iv) Table 1.1 gives data relevant to the reaction of $Cl_2(g)$ with $NH_3(g)$.

Table 1.1

compound	enthalpy change of formation, $\Delta H_f / \text{kJ mol}^{-1}$
$NH_3(g)$	–46
$HCl(g)$	–92

Use the data in Table 1.1 to calculate the enthalpy change of the reaction of $Cl_2(g)$ with $NH_3(g)$.

enthalpy change of reaction = kJ mol^{-1} [2]

(v) I_2 reacts with NH_3 to form NI_3 .

Predict the shape of a molecule of NI_3 . Explain your answer.

shape

explanation

..... [2]

(c) Table 1.2 shows some information about reactions of NaCl , NaBr and NaI .

Table 1.2

	NaCl	NaBr	NaI
observation with $\text{Ag}^+(\text{aq})$	white precipitate		
type of reaction with concentrated H_2SO_4	acid–base	acid–base, then redox	acid–base, then redox
observations with concentrated H_2SO_4			• black solid • yellow solid • effervescence

(i) Complete Table 1.2. [4]

(ii) Suggest an identity for the species that produces each observation in the reaction of NaI with concentrated H_2SO_4 .

black solid

yellow solid

effervescence [2]

(d) Table 1.3 gives some information about MgCl_2 and SiCl_4 .

Table 1.3

	MgCl_2	SiCl_4
electrical conductivity when liquid	conducts	does not conduct
observation when added to water	dissolves	vigorous reaction

(i) Explain the difference between the electrical conductivity of liquid MgCl_2 and of liquid SiCl_4 . Refer to bonding and relevant particles in your answer.

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..... [2]

(ii) Suggest the pH of the solutions that form when each chloride is added to water.

MgCl_2 SiCl_4