

- 21** In an experiment, 0.600 mol of chlorine gas, Cl_2 , is reacted with an excess of hot aqueous sodium hydroxide. One of the products is NaClO_3 .

Which mass of NaClO_3 is formed?

- A** 21.3g **B** 44.7g **C** 63.9g **D** 128g

- 22** An excess of chlorine gas is bubbled into hot potassium hydroxide solution.

Which chlorine-containing species are present in the final solution?

- A** Cl^- and ClO^-
B Cl^- and ClO_3^-
C ClO^- and ClO_3^-
D ClO_3^- only

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 $I_2(g)$ and $H_2(g)$ 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