2.1 Groups and the air

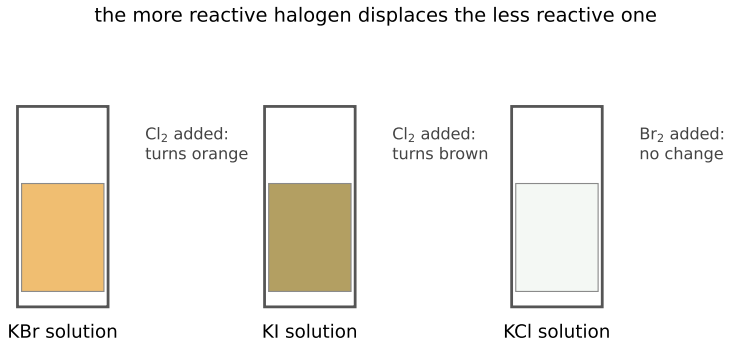
Name: _____ Class: _____ Date: _____ **Total: 23 marks**

Objective

Cover Group 1, Group 7 and the air (2.1–2.14): water and air reactions of the alkali metals, halogen displacement, air composition and oxygen-percentage practicals, combustion and thermal decomposition. Original IGCSE-level practice.

1 Key knowledge and worked examples

■ Two families, two trends



Group 1 (Li, Na, K) with water: hydroxide + hydrogen, increasingly vigorous – lithium fizzes, sodium melts and darts, potassium ignites with a lilac flame. (C) The outer electron is lost more easily further down. Group 7: Cl_2 pale green gas, Br_2 orange liquid, I_2 dark solid; a more reactive halogen displaces a less reactive one from its salt.

■ Air and what burns in it

78 % N_2, 21 % O_2, 0.96 % Ar, 0.04 % CO_2. Oxygen percentage by rusting iron or burning phosphorus over water: the water rises ~one-fifth. Combustion: Mg → white MgO; H_2 → steam with a pop; S → SO_2 with a blue flame. $CuCO_3 \rightarrow CuO + CO_2$ on heating.

2 Practice

2.1 Write the word equation for sodium reacting with water, and name the gas. [2]

2.2 Describe the trend in reactivity down Group 1, with the observations for potassium as evidence. [2]

2.3 State the colours and physical states of chlorine, bromine and iodine at room temperature. [3]

2.4 Give the percentages by volume of nitrogen and oxygen in dry air. [2]

2.5 Write the balanced equation for the thermal decomposition of copper(II) carbonate. [2]

3 Exam-style questions

3.1 Explain how damp iron wool in a measuring cylinder over water measures the percentage of oxygen in air, including the expected result. [3]

3.2 Chlorine is bubbled into potassium bromide solution. State what is seen and explain it as a displacement reaction, writing the ionic equation. [4]

3.3 (C) Explain, in terms of electronic configuration, why reactivity decreases down Group 7. [2]

3.4 In an experiment, 100 cm^3 of air is passed over heated copper and the final gas volume is 79 cm^3. Calculate the percentage of oxygen in the air sample, and state one reason the answer may be slightly low. [3]

Solutions

2.1 sodium + water → sodium hydroxide + hydrogen; hydrogen.

2.2 Reactivity increases down the group; potassium ignites/melts with a lilac flame – more vigorous than sodium and lithium.

2.3 Chlorine – pale green gas; bromine – orange-brown liquid; iodine – grey-black/dark solid.

2.4 Nitrogen ≈78 %, oxygen ≈21 %.

2.5 $CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$.

3.1 The iron reacts with the oxygen in the trapped air, forming rust; water rises to replace the used oxygen; the rise is about one-fifth (≈21 %) of the air's volume.

3.2 The colourless solution turns orange: chlorine is more reactive than bromine, so it displaces bromine from the bromide; the bromine formed dissolves giving the orange colour; $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$.

3.3 (C) Down the group the outer shell is further from the nucleus, so an incoming electron is attracted less strongly and gained less easily – reactivity falls.

3.4 Oxygen used = $100 - 79 = 21$ cm^3, so oxygen = $21/100 \times 100 = 21\%$. Slightly low if not all the oxygen reacted (not enough copper / copper oxide already coating the copper).