IB · DP · Chemistry

1 hour 12 questions

Structured Questions: Paper 2

3.2 Oxides, Group 1 & Group 17

3.2.1 Periodic Trends: Oxides Across a Period / 3.2.2 Periodic Trends: Group 1 - The Alkali Metals / 3.2.3 Periodic Trends: Group 17 - The Halogens

Easy (3 questions)	/16
Medium (5 questions)	/48
Hard (4 questions)	/25
Total Marks	**/89**

Scan here to return to the course
or visit savemyexams.com

Easy Questions

1 (a) State the changes in the acid-base nature of the oxides across period 3 (from Na_2O to Cl_2O_7).

.....

(1 mark)

(b) Write an equation for the reaction of sodium oxide with water.

.....

(1 mark)

(c) Predict how the pH of water will change when phosphorus(V) oxide is added.

.....

(1 mark)

(d) What is the product when SO_3 reacts with water.

.....

(1 mark)

2 (a) State the equation for the reaction of sodium metal with water.

.....

(1 mark)

(b) Describe **two** changes that could be observed during the reaction of sodium metal with water.

.....

.....

(2 marks)

(c) Predict the relative reaction rates of lithium, sodium and potassium with water.

.....

(1 mark)

(d) State **two** differences between the reactions of sodium and potassium with water.

.....

.....

(2 marks)

3 (a) State the balanced chemical equation for the reaction of potassium bromide, KBr (aq), with chlorine, Cl_2 (g).

.....

(1 mark)

(b) Describe the colour change likely to be observed in the previous reaction.

.....

(1 mark)

State the equation for the reaction between potassium and chlorine.

(c) .....

(1 mark)

(d) Explain the trend in reactivity of the halogens.

.....

.....

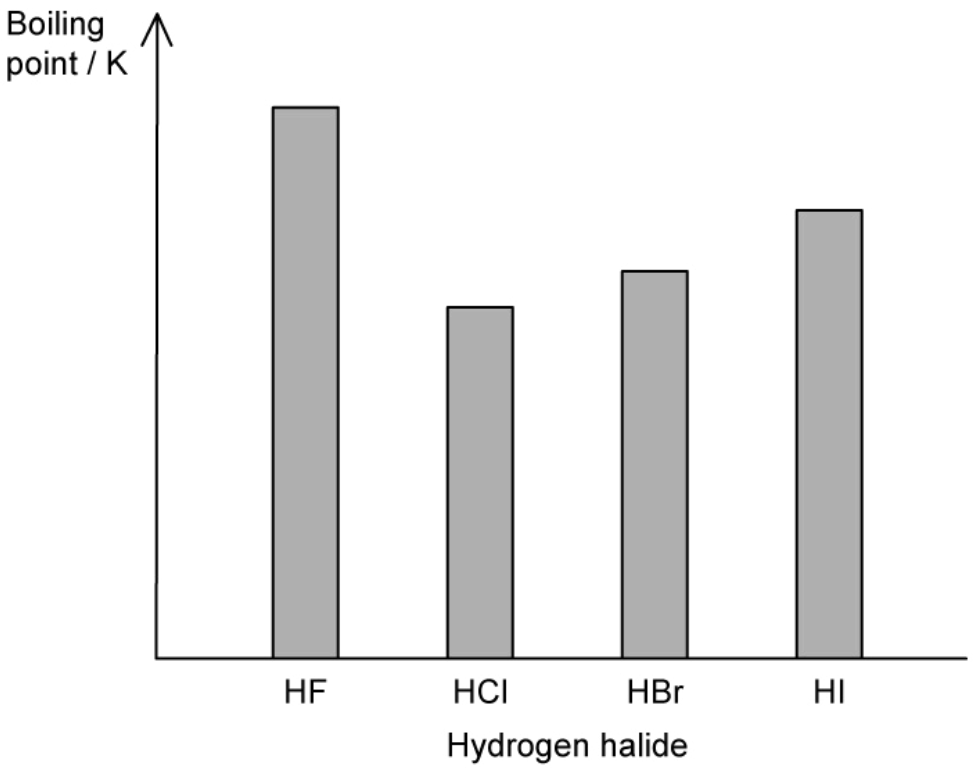
.....

(3 marks)

Medium Questions

1 (a) The hydrogen halides do not show perfect periodicity. A bar chart of boiling points, as seen in Figure 1, shows that the boiling point of hydrogen fluoride, HF, is much higher than periodic trends would indicate.

Figure 1



Explain why the boiling point of HF is much higher than the boiling point of the other hydrogen halides.

.....

.....

(2 marks)

(b) There is an increase in boiling point moving from HCl to HI.

Explain this trend in boiling points of the hydrogen halides.

(2 marks)

(c) A student adds a solution containing silver ions to two test tubes containing chloride and bromide ions. The student observes that both solutions turn cloudy.

Explain the observation the student made upon carrying out the experiment.

(2 marks)

(d) Write equations for the reactions happening in the two test tubes.

(2 marks)

2 (a) A student dissolves the oxides of potassium and selenium in water and tests the resulting solutions with litmus paper.

Explain what the student would expect to observe.

(3 marks)

(b) Magnesium and silicon(V) oxides melt at high temperatures, unlike phosphorus(V) oxide and sulfur trioxide, which do so at lower temperatures.

State whether each of the four oxides would conduct electricity in their molten state.

(2 marks)

(c) For the solutions formed by dissolving the oxides in water in part (b), identify each as acidic, alkaline, or neutral.

(2 marks)

(d) Write equations for each of the reactions when the oxides of magnesium, phosphorus, and sulfur in part b) are dissolved in water.

(3 marks)

3 (a) Sodium oxide and silicon dioxide are two compounds of period 3 elements that react with water. Write equations for their separate reactions with water.

(2 marks)

(b) Suggest the pH of the resulting solutions when both sodium oxide and phosphorus(V) oxide react with water.

(2 marks)

(c) Aluminium oxide can react as both an acid and as a base.

i) State the name given to this type of oxide.

ii) Write an equation for the reaction of aluminium oxide with hydrochloric acid.

iii) State whether aluminium oxide is behaving as an acid or base in this reaction.

(3 marks)

(d) Outline the acid-base nature of the oxides of the elements in period 3 from sodium to chlorine

(3 marks)

4 (a) Potassium is an element found in group 1 of the periodic table.

State how potassium reacts with water and write a balanced equation for the reaction including state symbols.

.....

.....

(2 marks)

(b) A student has a sample of lithium and sodium which he drops into a beaker of distilled water.

Compare the reactivity of lithium and sodium with water and state what the student would see in each reaction.

.....

.....

.....

(3 marks)

(c) The student continues to react various group 1 metals with water and observes a change in reactivity as they move down the group.

Explain the trend in reactivity that would be observed.

.....

.....

.....

(3 marks)

(d) From only the first three elements in each of group 1 and group 17, state which group 1 element and group 17 element would show the most vigorous reaction when they react together.

Write a balanced equation for the reaction.

.....

.....

(2 marks)

5 (a) Chlorine is a greenish-yellow gas, bromine is a dark red liquid, and iodine is a dark grey solid.

State and explain the property which most directly causes these differences in volatility.

.....

.....

.....

(3 marks)

(b) Explain why Cl_2 rather than Br_2 would react more vigorously with a solution of I^-.

.....

.....

(2 marks)

(c) Describe what happens when aqueous bromine solution is added to separate solutions of sodium chloride and sodium iodide.

Include balanced equations for any reactions that occur.

.....

.....

.....

(3 marks)

(d) Astatine, At, is the rarest naturally occurring element in the Earth's crust. Before it was discovered in 1940 scientists could only predict its existence and properties.

Suggest the basis for these predictions.

.....

.....

(2 marks)

Hard Questions

1 (a) An acid base reaction occurs for the reaction between solid potassium bromide and concentrated sulfuric acid. The equation for this is:

$$2H_2SO_4\,(aq) + 2KBr\,(s) \rightarrow K_2SO_4\,(aq) + SO_2\,(g) + Br_2\,(g) + 2H_2O\,(l)$$

In this reaction redox products are also formed. List all of the **redox** products produced from the reaction between solid potassium bromide and concentrated sulfuric acid **and** give observations for any products.

(2 marks)

(b) Explain why the reaction between solid potassium iodide and concentrated sulfuric acid produces hydrogen sulfide whereas the reaction between solid potassium bromide, and concentrated sulfuric acid does not.

(4 marks)

(c) Hydrogen halides, H-X, are formed from the reaction of hydrogen and a halogen, X_2. In solution hydrogen fluoride is classed as a weak acid, whereas HCl is classed as a strong acid. Explain this difference.

(2 marks)

2 (a) Describe the trends in first ionisation energy and atomic radius as you move up Group 1.

.....

(1 mark)

Explain the connection between first ionisation energy and atomic radius seen in the alkali metals.

.....

.....

(b) **(2 marks)**

(c) Potassium reacts with water to form hydrogen gas. Using sections 1 and 2 of the data booklet, determine the volume, in cm^3, of hydrogen gas that could theoretically be produced at 273 K and 1.01105 Pa when 0.0587 g of potassium reacts with excess water.

.....

.....

.....

(3 marks)

3 (a) Write equations for the separate reactions of lithium oxide and carbon dioxide with excess water and differentiate between the solutions formed.

Lithium oxide.....

Carbon dioxide.....

Differentiation.....

.....

.....

.....

(3 marks)

(b) Suggest why it is surprising that dinitrogen monoxide dissolves in water to give a neutral solution.

.....

(1 mark)

(c) Calcium carbide reacts with water to form ethyne, C_2H_2, and one other product.

Estimate the pH of the resultant solution.

.....

(1 mark)

4 (a) Impurities cause phosphine to ignite spontaneously in the air to form an oxide of phosphorus and water.

The oxide formed in the reaction with air contains 56.3 % phosphorus by mass. Determine the empirical formula of the oxide, showing your method.

.....

.....

.....

(3 marks)

(b) The molar mass of the oxide is approximately 220 g mol^{-1}. Determine the molecular formula of the oxide.

.....

(1 mark)

(c) State the equation for the reaction of this oxide of phosphorus with water.

.....

(1 mark)

(d) Predict how dissolving an oxide of phosphorus would affect the electrical conductivity of water.

.....

(1 mark)