

Cambridge (CIE) A Level Chemistry



Your notes

Chemical Periodicity of Other Elements

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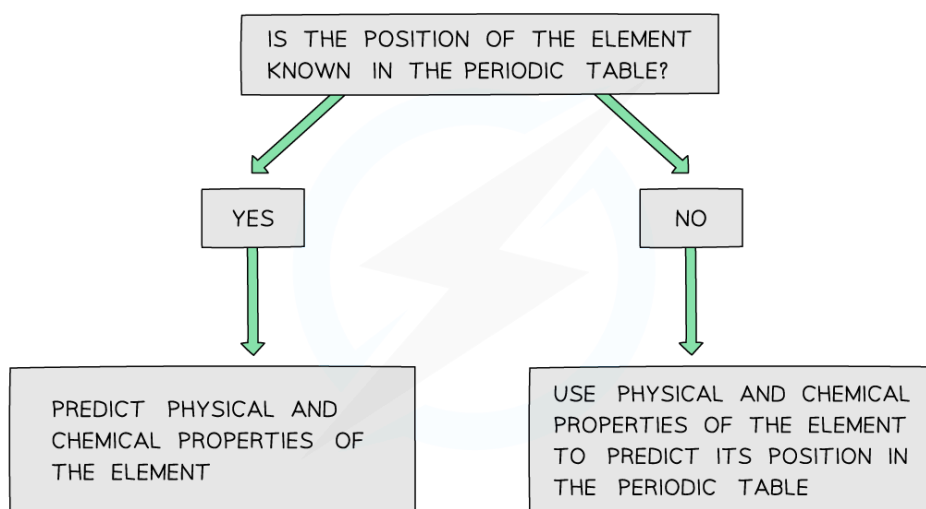
- * Chemical Periodicity of Other Elements



Periodicity: Predicting Position & Properties

- If the **chemical** and **physical properties** of an element are known, the **position** of that element in the Periodic Table can be predicted
- Similarly, predictions can be made about the **physical** and **chemical properties** of elements if the **position** of the element in the Periodic Table is known

The diagram shows a flowchart to make predictions about an element's behaviour



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The flowchart shows how to use the position and / or properties of an element to make predictions about its behaviour



Worked Example

Deducing the position of an element in the Periodic Table

Element **X** forms a chloride which reacts with water to form a solution of pH 1.0.

It forms an oxide which has a melting point of 1610 °C.

The oxide does not dissolve in or react with aqueous sodium hydroxide.

Deduce the possible position of element **X** in the Periodic Table.

Answer

- Break the question down and systematically approach the question



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- **Step 1:** 'Element **X** forms a chloride, which reacts with water to form a solution of pH 1'
 - The low pH of the solution formed suggests that the chloride is a non-metallic chloride (group 13 to 17)
- **Step 2:** 'The oxide does not dissolve in or react with cold aqueous sodium hydroxide'
 - Since aluminium oxide does react with sodium hydroxide, element **X** cannot be Group 13
- **Step 3:** 'It forms an oxide which has a melting point of 1610 °C'
 - This suggests a giant molecular (covalent) structure which corresponds to Group 14
- **Step 4:**
 - Element **X** cannot be carbon (which is in Group 14) as carbon dioxide is a gas whereas the element X oxide is a solid (with a melting point of 1610 °C)
- **Step 5:**
 - Element **X** is therefore a Group 14 element in Period 3 or lower
- Note that this is an example of predicting the position of an element based on its physical and chemical properties



Worked Example

Predicting physical and chemical properties of selenium

Selenium is in Group 16 and Period 4 of the Periodic Table.

Predict some physical and chemical properties of selenium.

Answer

- **Step 1:** Selenium is a non-metal in Group 16
 - If compared to sulfur, its structure is predicted to be a **simple molecular structure**
- **Step 2: Physical properties**
 - Simple molecular structures have **low melting points, do not conduct electricity** and are **insoluble** in water
- **Step 3: Chemical properties** are:
 - Reaction with **water**
 - Simple molecules do not react with water
 - Reaction with **oxygen**
 - Simple molecules react with oxygen
 - So, selenium could form an oxide of SeO_2 (if compared with sulfur)
 - Reaction with **chlorine**

- Simple molecules react with chlorine
- So, selenium could form a simple molecule of SeCl_2 which can react with the water vapour in the air to form hydrogen chloride (if compared with sulfur)
- Note that this is an example of predicting the chemical and physical properties of an element based on its position in the Periodic Table



Your notes



Worked Example

Determining an unknown chloride compound

The chloride of unknown element **Y** is a liquid at 20 °C.

This chloride reacts with water, releasing white fumes and leaving an acidic solution.

1. Does element **Y** belong to Group 1, Group 2 or Group 15 of the Periodic Table?
2. What type of reaction takes place between the chloride of **Y** and water?
3. Identify the white fumes given off when the chloride of **Y** reacts with water.

Answer

▪ Answer 1:

- Group 1 and Group 2 chlorides react with water to form colourless solutions of pH 6.5 – 7.0
- Group 15 chlorides on the other hand react with water to form strong acidic solutions
- Element **Y** therefore belongs to Group 15 of the Periodic Table

▪ Answer 2:

- Group 15 chlorides get hydrolysed in water, therefore this is a hydrolysis reaction

▪ Answer 3:

- The white fumes that are given off during this reaction are hydrogen chloride gas