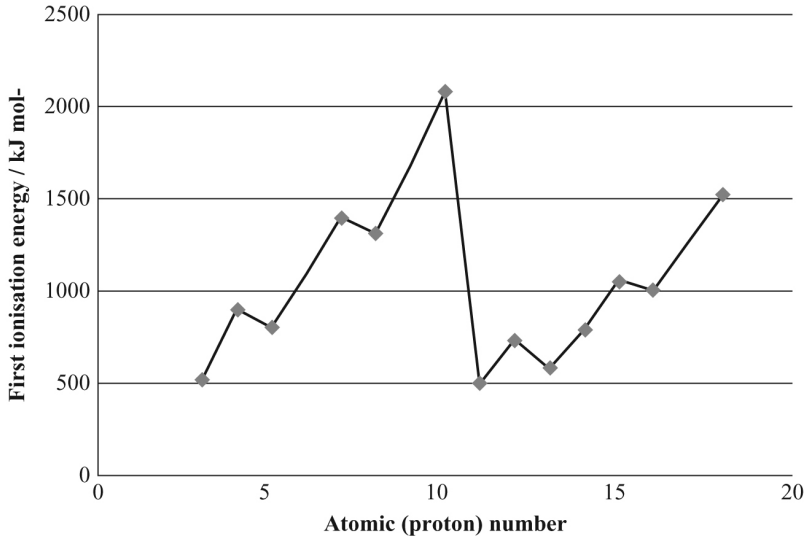
# Chapter 10: Periodicity

## *Homework questions*

**1** This question is about the first ionisation energies of the elements of Periods 2 and 3 of the Periodic Table.
The graph below shows the variation in first ionisation energy with atomic (proton) number for these elements.




**a** Write down the equation for the first ionisation energy of the element carbon. [2]

**b** Explain why the first ionisation energy shows a gradual increase across each period. [4]

**c** Explain the following:

**i** the decrease in first ionisation energy from element 4 to element 5 [2]

**ii** the gradual increase in first ionisation energy from element 5 to element 7 [3]

**iii** the decrease in first ionisation energy from element 7 to element 8. [2]

**d** Explain why first ionisation energy is a periodic property. [2]

**e** The table below shows the values of the first ionisation energies of the Group 1 elements. Use these values to explain why the reactivities of the elements change as the group is descended. [4]

| Element | Li | Na | K | Rb | Cs |
|---|---|---|---|---|---|
| First ionisation energy / kJ $mol^{-1}$ | 520 | 496 | 419 | 403 | 376 |

**f** **i** Describe the bonding in the Group 1 elements. [3]

**ii** Explain why the melting point of lithium is higher than that of caesium. [2]

**g** Rubidium (Rb) reacts with hydrogen gas to form rubidium hydride (RbH).

**i** Give the balanced symbol equation for the reaction. [1]

**ii** Draw a dot-and-cross diagram to show the bonding in rubidium hydride. [3]

**h** When 0.346 g of rubidium hydride is added to water, hydrogen gas is formed along with a solution of rubidium hydroxide.

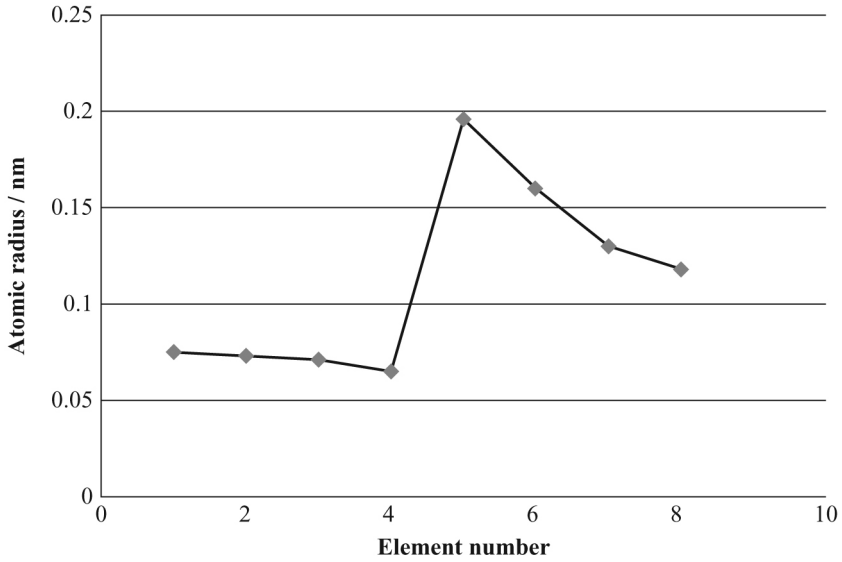
**i** Write the balanced symbol equation for the reaction. [1]

**ii** What volume of hydrogen gas is formed at room temperature and pressure in this reaction? [3]

**iii** What volume of 0.100 mol $dm^{-3}$ hydrochloric acid is required to neutralise the rubidium hydroxide formed? [2]

Total = 34

**2** The graph shows the atomic radii of eight successive elements across Periods 2 and 3 of the Periodic Table. The numbers are *not* the atomic numbers of the elements.




**a** State the number of the element that is a noble gas. Explain your answer. [2]

**b** Explain why the atomic radius decreases across a period. [4]

**c** Explain the following:

**i** the radius of a magnesium ion is less than that of a magnesium atom [2]

**ii** the ionic radius of a $P^{3-}$ ion is greater than that of the phosphorus atom [2]

**iii** Give the formula of magnesium phosphide. [1]

**d** When magnesium phosphide reacts with hydrochloric acid, the hydride of phosphorus, the gas phosphine ($PH_3$), is formed along with magnesium chloride. Write the equation for the reaction. [2]

**e** When phosphine reacts with water, phosphorus(V) oxide is formed. The equation for the reaction is:

$4PH_3 + 8O_2 \rightarrow P_4O_{10} + 6H_2O$

Explain why this is a redox reaction. [4]

**f** Arsenic is in the same group of the Periodic Table as phosphorus. Predict the formula of:

**i** arsenic hydride [1]

**ii** arsenic oxide. [1]

Total = 19