	Marks
• Write a balanced equation for the dissolution of $Ca_5(PO_4)_3OH$, hydroxyapatite, the mineral component of teeth, in water.	1
$Ca_5(PO_4)_3OH(s) \rightarrow 5Ca^{2+}(aq) + 3PO_4^{3-}(aq) + OH^-(aq)$	
• Briefly explain why transition metal ions are often found in biological enzyme systems.	2
The transition metal ions provide binding sites for substrates that readily accommodate changes in geometry. Depending on the metal, they can also allow for redox reactions, such as Fe^{2+}/Fe^{3+} and Cu^{2+}/Cu^+, for oxidizing or reducing substrates.	

Marks

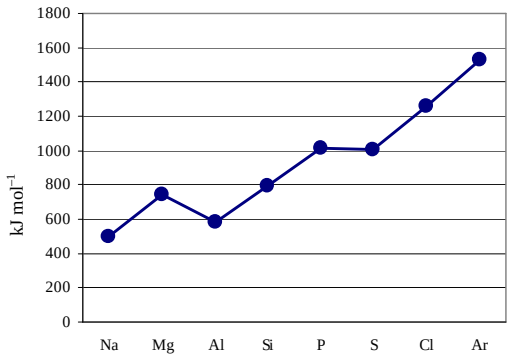
- In general terms, which elements in the periodic table are likely to be essential elements for living species and which ones are likely to be toxic. Explain.

2

Most of the lighter elements (at. no. up to 20) are essential elements. They are readily available in nature, so more likely to be utilised by organisms. Similarly most of the lighter *d*-block elements (Sc - Zn) are essential (utilised in redox and electron transport systems in the body) whereas the heavier transition metals are generally toxic.

- The diagram below shows the general trend for the first ionisation energy for some *s* and *p* block elements.

3



How will the general trend differ for the second ionisation energy of these elements (*i.e.* $X^+(g) \rightarrow X^{2+}(g) + e^-$)? Explain.

The second ionisation of Na will be off the scale as a core electron is ionised. (Actual value > 4500 kJ mol^{-1})

Mg^+ is isoelectronic with Na, Al^+ is isoelectronic with Mg, *etc*., so the second ionisations of the other elements follow the same trends as the first ionisations (for exactly the same reasons), but displaced one atomic number to the right and at a slightly higher energy (as Z_{eff} is greater).