Marks
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- The Periodic Table as arranged by Mendeleev allows us to make predictions about the behaviours of elements based on those around them. Briefly describe why the Periodic Table works.

The Periodic Table groups atoms into:

- **Groups (columns) based on the number of valence electrons they have, and**
- **Periods (rows) based on the shell and sub-shell.**

Chemical reactivity is based on the number of valence electrons and the size of the element. Elements in the same group have similar chemical properties as they have the same number of valence electrons. Differences in the reactivity of elements in the same group are due to their size – elements get larger down each group leading to decreased electronegativity.

Silicon and tin have the same structure as diamond. Use the information in the following table to predict the density of tin.

Element	Atomic Mass	Density (g cm^{-3})	Bond length (pm)
Si	28	2.329	233
Sn	118		280

Density depends on the mass and the volume:

$$\text{density} = \text{mass} / \text{volume}$$

The volume of a crystal will increase as the cube of the bond length:

$$\text{volume of tin} = (280 / 233)^3 \times \text{volume of silicon}$$

The mass will increase as the atomic mass increases:

$$\text{mass of tin} = (118 / 28) \times \text{mass of silicon}$$

As the density of silicon is 2.329 g cm^{-3}, the density of tin will therefore be:

$$\text{density of tin} = \text{density of silicon} \times (118 / 28) / (280 / 233)^3$$
$$= 2.329 \text{ g cm}^{-3} \times (118 / 28) / (280 / 233)^3 = 5.7 \text{ g cm}^{-3}$$

Answer: **5.7 g cm^{-3}**