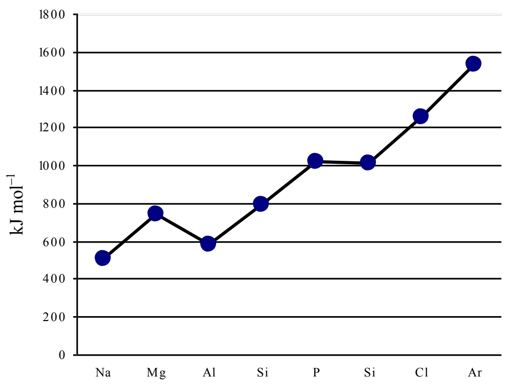
Marks
4

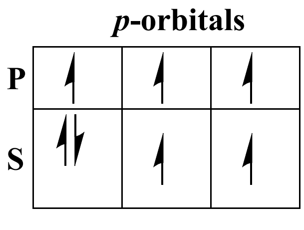
- The graph shows the first ionisation energies for third row elements of the periodic table.



Explain the general trend and both anomalies.

There are a number of factors to explain:

- **There is an overall *increase* in ionization energy across the period. This is due to the increase in effective nuclear charge (Z_{eff}) which leads to greater pull from the nucleus and an increase in the energy required to remove an electron.**
- **There is a *decrease* in ionization between Mg and Al *despite* the latter having a higher Z_{eff}. Mg has an atomic configuration of [Ne] $3s^2$ and Al has an atomic configuration of [Ne] $3s^2$ $3p^1$. Thus, the electron being ionized in Mg is a 3*s* electron and the electron being ionized in Al is a 3*p* electron. The orbit of the 3*p* electron is, on average, greater than that of a 3*s* electron so the electron is held less tightly. Thus, Al has a lower ionization energy than Mg despite having a higher nuclear charge. Although a 3*p* electron is also being removed in Si, it has a higher ionization energy than Mg because the increase in nuclear charge is more than enough to compensate for the sub-shell change.**
- **Between P and S there is also a drop in ionization *despite* the latter having a higher Z_{eff}. Between P and S, the extra electron *has* to pair up:**



Electrons which are paired and occupy the same orbital are forced to be close to one another in space, leading to higher repulsion. Because of this, the electron which is paired up is easier to remove and the ionization energy is lower.