HL Questions on Electrons in atoms
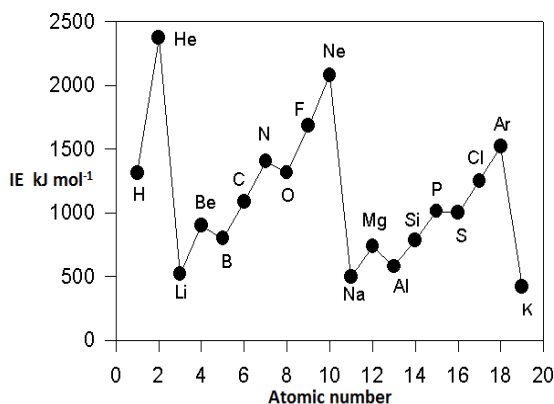
1. The graph below shows a plot of first ionization energy against atomic number.

**(a)** Explain how the graph provides evidence for:

   i. the maximum number of electrons in the 2p sub-level is six.

   ii. the 3s sub-level is lower in energy than the 3p sub-level.

   iii. the 4s sub-level is lower in energy than the 3d sub-level.

   iv. Hund's rule

First Ionization Energy versus Atomic Number

(b) Describe how the graph of 2nd Ionization energy against atomic number would differ to the graph above.

2. The fourth ionization energy of vanadium is 4600 kJ mol^{-1}, the fifth ionization energy of vanadium is 6280 kJ mol^{-1} and the sixth ionization energy of vanadium is 12400 kJ mol^{-1}.

i. Explain why the 5th ionization energy for vanadium is higher than the 4th ionization energy.

ii. Explain why the difference between the 5th and 6th ionization energies is much larger than the difference between the 4th and 5th ionization energies of vanadium.

3. The lines in the ultraviolet emission spectrum of hydrogen gas converge at 9.12 x 10^{-8} m.
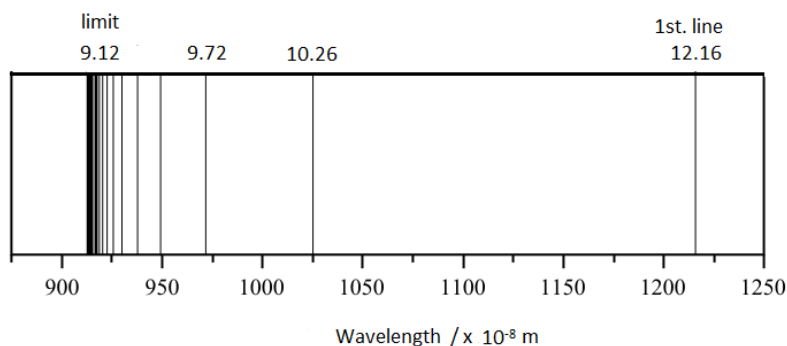
i. Use this value to calculate the ionization energy of hydrogen in kJ mol^{-1}.

ii. Explain why the convergence line in the ultraviolet spectrum must be used to calculate the ionization energy rather the convergence line in the visible spectrum.