1.10 Energy Levels Answers

1. a) (i) $Li(g) \rightarrow Li^+(g) + e$ $Na(g) \rightarrow Na^+(g) + e$

(ii) In sodium the electron being removed is further from the nucleus than the electron being removed from lithium. The inner electrons in a sodium atom have a greater shielding effect. There is less attraction between the nucleus and the outer electron, and so less energy is required to remove it.

b) (i) $K(g) \rightarrow K^+(g) + e$ $K^+(g) \rightarrow K^{2+}(g) + e$

(ii) Potassium has an electron arrangement of 2,8,8,1. The first electron being removed is taken from the fourth shell. K^+ has a full stable shell with an electron arrangement of 2,8,8. The electron being removed from K^+ comes from the third shell. The second electron is closer to the nucleus which results in less shielding causing a greater attraction, and thus more energy is required to remove it.

2. a) In any given period the noble gas will have the highest positive nuclear charge. Due to this, the noble gas nuclei will also have the strongest attraction for the outer electrons, which will result in the highest first ionisation energy.

b) As we cross a period the positive nuclear charge increases and hence the attraction from the nucleus to the outer electron increases. Therefore more energy is required to remove the outer electron as we go across a period.

c) (i) Be $1s^2 2s^2$ B $1s^2 2s^2 2p^1$

Beryllium has a slightly higher than expected ionisation energy as it has a completely filled sub-shell. This results in certain stability which means that more energy is required to remove one of its outer electrons.

(ii) N $1s^2 2s^2 2p^3$ O $1s^2 2s^2 2p^4$

The three electrons in the 2p orbitals of nitrogen obey Hund's rule and fill the orbitals singly and with parallel spins. This leads to half-shell stability which means that slightly more energy is required to remove one of its outer electrons.

3. (a) D

(b) A

(c) C

4. a) p-block b) s-block c) f-block d) d-block e) p-block f) d-block