Electronic Configurations 1.2

1. The electron configuration of an aluminium atom may be written:

$$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$$

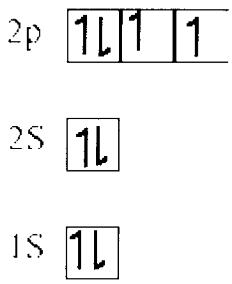
Write the corresponding electron configuration for the

(a) Al^{3+} ion. (b) a boron atom

(c) an oxygen atom (d) Ca^{2+} ion

(e) a fluoride ion (f) an atom of helium

2. The electronic configuration of an oxygen atom may be represented by the diagram below:



(a) Use a similar representation to show
 (i) a sodium atom
 (ii) a carbon atom
(b) (i) State Hund's Rule of Maximum Multiplicity.
 (ii) Show how the diagrammatic representation above for oxygen illustrates Hund's Rule.
(c) (i) State the Pauli Exclusion Principle.
 (ii) Show how the diagrammatic representation above for oxygen illustrates Pauli's Principle
(d) (i) State the Aufbau Principle.
 (ii) Show how the diagrammatic representation above for oxygen illustrates the aufbau Principle
(e) The three 2p orbitals are degenerate
 (i) Explain what is meant by *degenerate*.
 (ii) Name the three 2p orbitals
 (iii) Draw diagrams which show the 3 dimensional arrangement of the three 2p orbitals.

3. Heisenberg's uncertainty principle leads us way from the idea of exact electron orbits to regions of probability for orbiting electrons.
Explain this statement.

Ex 1.2

1. (a) $1s^2 2s^2 2p^6$

(b) $1s^2 2s^2 2p^1$

(c) $1s^2 2s^2 2p^4$

(d) $1s^2 2s^2 2p^6 3s^2 3p^6$

(e) $1s^2 2s^2 2p^6$

(f) $1s^2$

(2) (a)

3s [↑]

2p [↑↓|↑↓|↑↓]

2s [↑↓]

1s [↑↓]

SODIUM ATOM

2p [↑|↑|]

2s [↑↓]

1s [↑↓]

CARBON ATOM

(b)(i) HUND'S RULE of maximum multiplicity states that when degenerate orbitals are available, electrons fill each singly keeping their spins parallel before electron pairing occurs.

(ii) Each 2p orbital (degenerate orbitals) get one electron with their spins parallel before the 4^{th} p electron fills one of the orbitals.

(c)(i) PAULI Exclusion principle states that if two electrons occupy the same orbital then they will have opposite spins.

(ii) Each orbital that contains 2 electrons show opposite spins ie in the 1s, 2s and one of the 2p orbitals.

(d)(i) The Aufbau Principle states that orbitals are filled in order of increasing energy

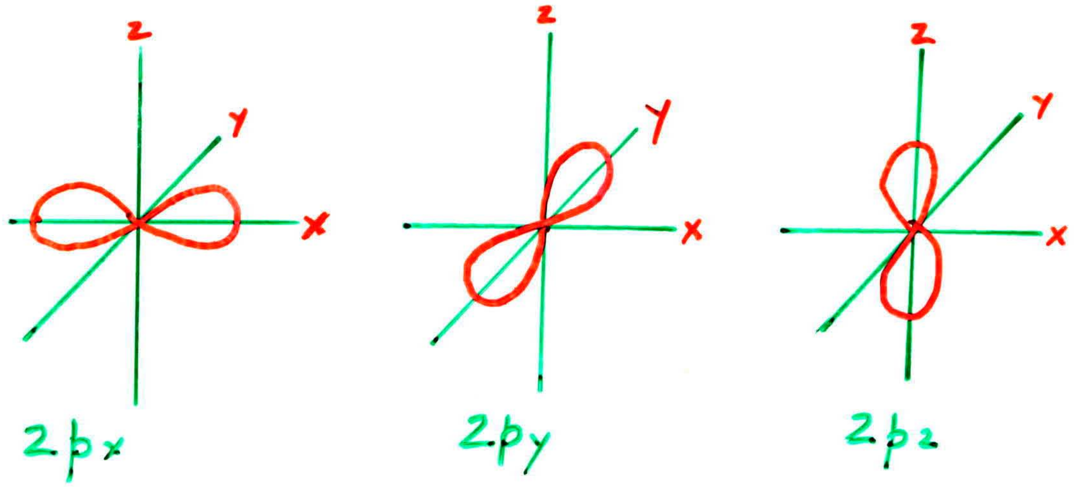
(ii) The order of orbital energy is 1s, 2s, 2p (increasing →). The only gaps are shown in the 2p orbital not in the lower energy orbitals.

(2) cont

(e) (i) Degenerate orbitals are orbitals that have equal energy

(ii) $2p_x$, $2p_y$, $2p_z$

(iii)



3. Heisenberg's uncertainty principal states that $\Delta p \Delta_x \geq \frac{h}{2\pi}$

where Δp is the uncertainty in the momentum
" Δx " in the position

this means that it impossible to know precisely both momentum and the position of an electron orbiting a nucleus.

Since momentum is mass + velocity then momentum is therefore related to the energy of the electron.
Heisenberg's uncertainty principal also tell us that it is impossible to know both the energy and position of and electron precisely.
However the above equation shows that the energy can be precisely known provided the uncertainty in position is large. This means that if you try to decribe an electron in an orbital of a certain energy you can not ever know its precise position but can only give a probability of finding it within a certain area.