STARTER FOR 10...

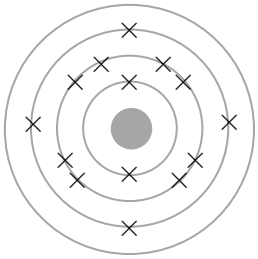
2.3. Electrons and orbitals

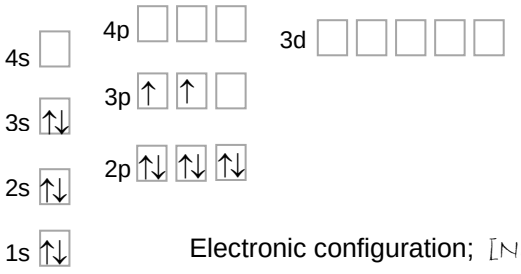
Aufbau's principle states that "*electrons fill orbitals starting with the lowest energy orbital first*"

Hund's rule states that "*when filling a set of orbitals of identical energy, electrons are added with parallel spins to different orbitals rather than pairing two electrons in the same orbital*"

For each of the elements, draw the electrons in the atom as you would have represented them at GCSE level (1 mark) followed by an A-level representation (1 mark) and a short hand form of the electronic configuration (1 mark);

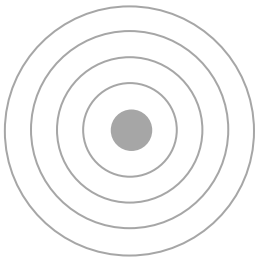
e.g. silicon, Si;

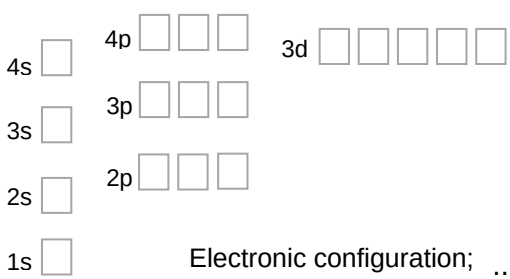




Electronic configuration; [Ne] $3s^2\ 3p^2$

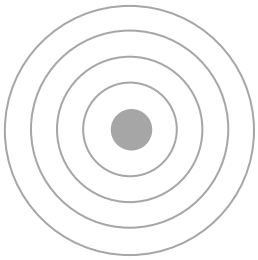
1. oxygen, O;

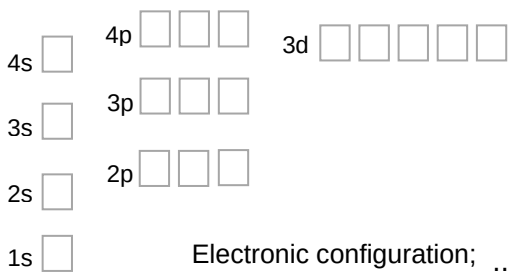




Electronic configuration; .....

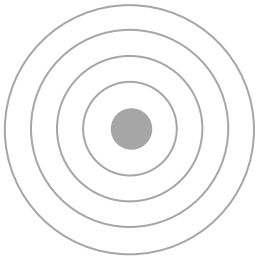
2. calcium, Ca;

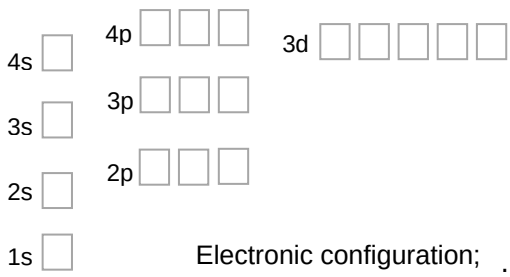




Electronic configuration; .....

3. iron, Fe;





Electronic configuration; .....

Give one limitation of the way you were taught to draw electrons in atoms at GCSE level (1 mark)

.....

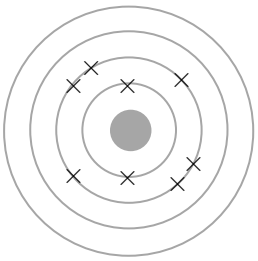
4. Fe^{3+} and Mn^{2+}; $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^0$, $3d^5$

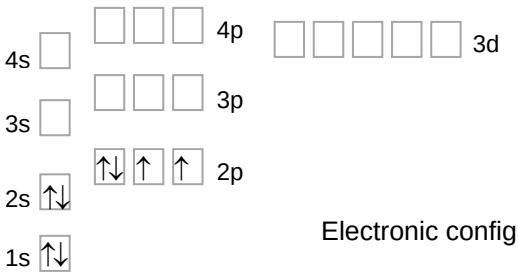
Fe^{2+} and Co^{3+}; $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^0$, $3d^6$

Zn^{2+} and Cu^{+}; $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^0$, $3d^{10}$

2.3. Electrons and orbitals

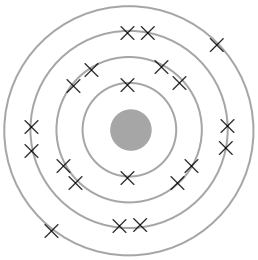
Oxygen

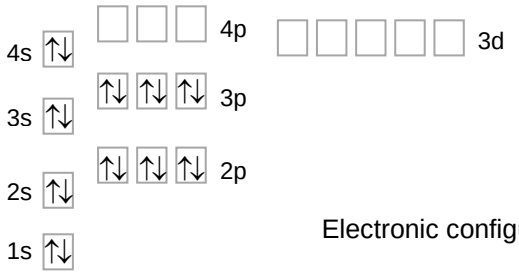




Electronic configuration; [He] $2s^2$ $2p^4$

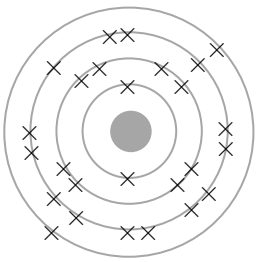
Calcium

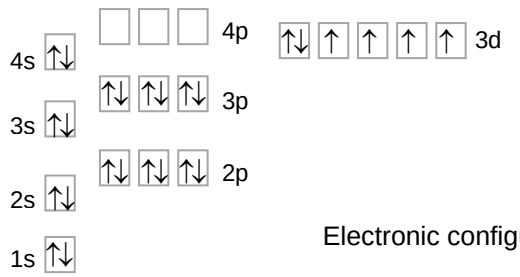




Electronic configuration; [Ar] $4s^2$

Iron





Electronic configuration; [Ar] $4s^2$ $3d^6$

Possible limitations of the GCSE representation of electronic structure (1 mark for any sensible point);

1. The GCSE representation doesn't account for d-orbitals. At GCSE electron shells occupy a maximum of 8 electrons (hence why we only ever go as high as atomic number 20).
2. The GCSE diagram doesn't allow for the fact that the 3d orbital is higher in energy than the 4s orbital and hence the 4s orbital is filled first.
3. The GCSE model gives no indication of electron spin (important when trends in ionisation energies are discussed).