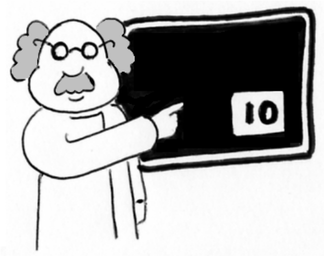


STARTER FOR 10...

2.2. Isoelectronic species

For each of the species below, write out the full electronic configuration and then identify an anion and a cation which is isoelectronic with the initial species.

e.g. neon, Ne; $1s^2 2s^2 2p^6$

Isoelectronic anion; F^- Isoelectronic cation; Mg^{2+}

(1 mark for each correct electronic configuration, 1 mark for each correct isoelectronic anion and cation)

1. helium, He; ....

Isoelectronic anion; .... Isoelectronic cation; ....

2. krypton, Kr; ....

Isoelectronic anion; .... Isoelectronic cation; ....

3. calcium ion, Ca^{2+}; ....

Isoelectronic anion; .... Isoelectronic cation; ....

BONUS 10th mark Identify a pair of common transition metal ions that are isoelectronic;

....

STARTER FOR 10...

Chapter 2: Atomic structure answers

2.1. Development of theories about atomic structure

Approx. year of discovery	Scientist	Addition made to our current understanding of atomic structure
1803	John Dalton	Proposed that all matter is made up of tiny particles called atoms
1897	J. J. Thomson	Realised that atoms are divisible and contain very tiny, negatively charged particles called electrons
1911	Ernest Rutherford	Discovered that an atom is made up of a nucleus and an extra-nuclear part. The central nucleus is positively charged and the negative electrons revolve around this central nucleus.
1915	Niels Bohr	Proposed that the electrons orbit around the nucleus in orbits with a set size and energy
1924	Wolfgang Pauli	Proposed the concept of electron spin
1932	James Chadwick	Discovered that atoms contain neutral particles called neutrons in their nucleus

(1 mark for each correct row; 4 marks for the correct order of statements [3 marks if one statement in incorrect position, 2 marks if two statements in incorrect position, 1 mark if any pair of statements follow on correctly from each other)

BONUS MARK: Niels Bohr was indeed a keen football player and was the goalkeeper in the Danish team Akademisk Boldklub. Although Akademisk Boldklub were, at the time, one of the best clubs in Denmark, he never made it to the national team.

2.2. Isoelectronic species

1. **helium, He**; $1s^2$

   Isoelectronic anion; H^- Isoelectronic cation; Li^+, Be^{2+}

2. **krypton, Kr**; $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^2$, $3d^{10}$, $4p^6$

   Isoelectronic anion; Se^{2-}, Br^- Isoelectronic cation; Rb^+, Sr^{2+}, In^{3+}, Sn^{4+}

3. **calcium ion, Ca^{2+}**; $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$

   Isoelectronic anion; S^{2-}, Cl^- Isoelectronic cation; K^+, Ga^{3+}

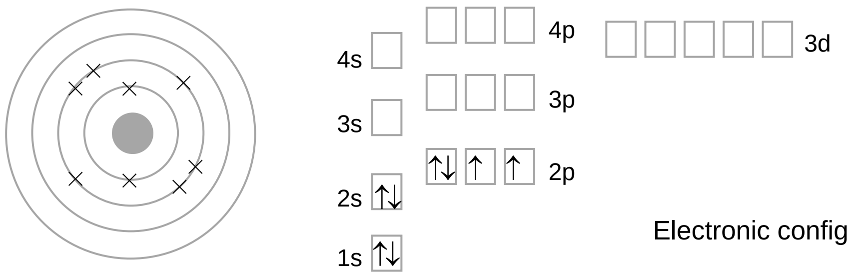
4. Fe^{3+} and Mn^{2+}; $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^0$, $3d^5$

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).