Learn Chemistry

Starter for Ten

2. Atomic Structure

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STARTER FOR 10...

2. ATOMIC STRUCTURE

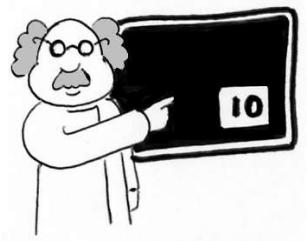
2.1. Development of theories about atomic structure

2.2. Isoelectronic species

2.3. Electrons and orbitals

2.4. Trends in ionisation energies

Atomic structure answers



STARTER FOR 10...

2.1. Development of theories about atomic structure

Our current understanding of atomic structure is a result of the discoveries of several scientists over many years, each scientist adding to the model.

Complete the table below by adding the name of the scientist and the discovery made. Choose from the lists below the table. (9 marks)

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		
1911		
1915		
1924		
1932		

Scientists:

Ernest Rutherford; Wolfgang Pauli; J. J. Thomson; James Chadwick; Niels Bohr

Discoveries;

Proposed that the electrons orbit around the nucleus in orbits with a set size and energy

Discovered that atoms contain neutral particles called neutrons in their nucleus

Realised that atoms are divisible and contain very tiny, negatively charged particles called electrons

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.

Proposed the concept of electron spin

BONUS MARK: Which of the scientists listed above was a famous football goalkeeper in his country?

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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;

.....

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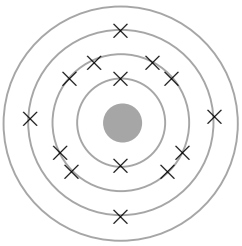
2.3. Electrons and orbitals

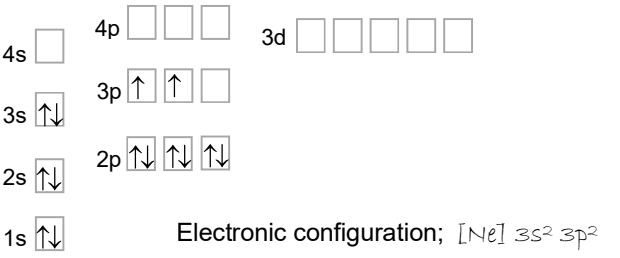
Aufbau's principle states that "*electrons fill orbitals starting with the lowest energy orbital first*"

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);

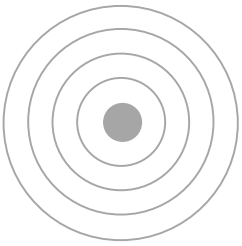
e.g. silicon, Si;

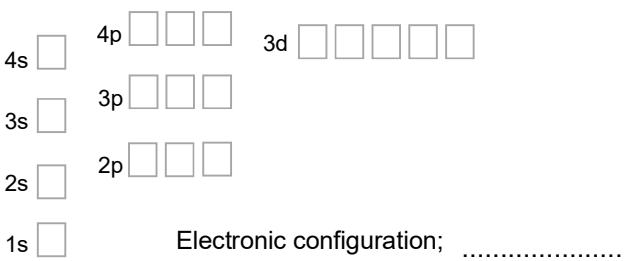




Electronic configuration; [Ne] $3s^2$ $3p^2$

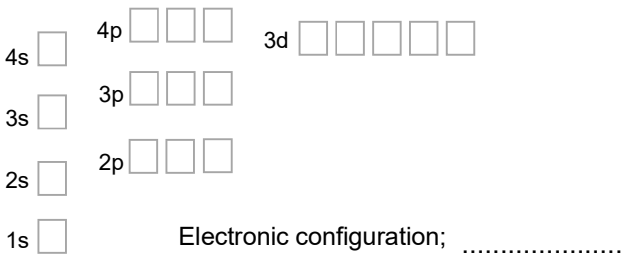
1. oxygen, O;





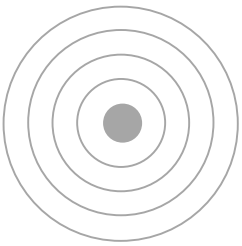
Electronic configuration; .....

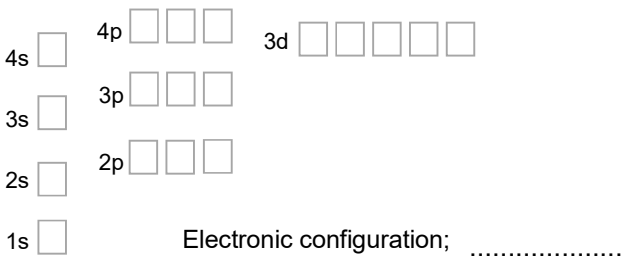
2. calcium, Ca;



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)

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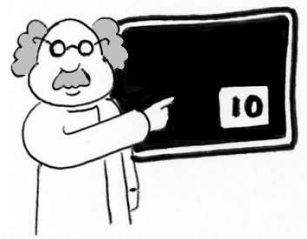

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2.4. Trends in ionisation energy

An atom's **ionisation energy** is defined as;

'The amount of energy required to remove one mole of electrons from one mole of atoms in the gaseous state'

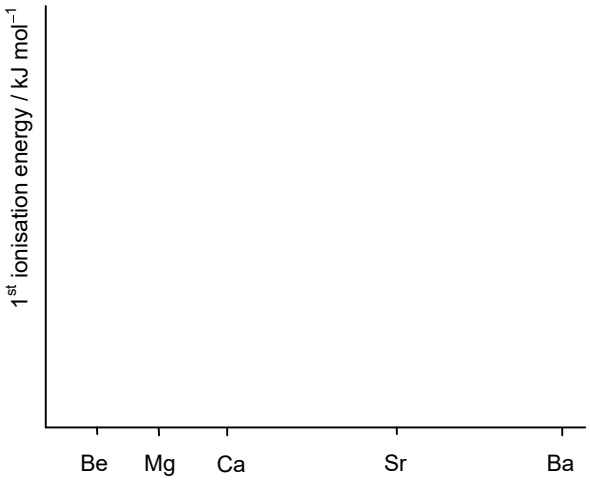
The **first ionisation energy** is the energy required to remove the first electron [$X(g) \rightarrow X^{+}(g) + 1\ e^{-}$].

1. (a) Sketch a plot of the first ionisation energies of the elements of group 2

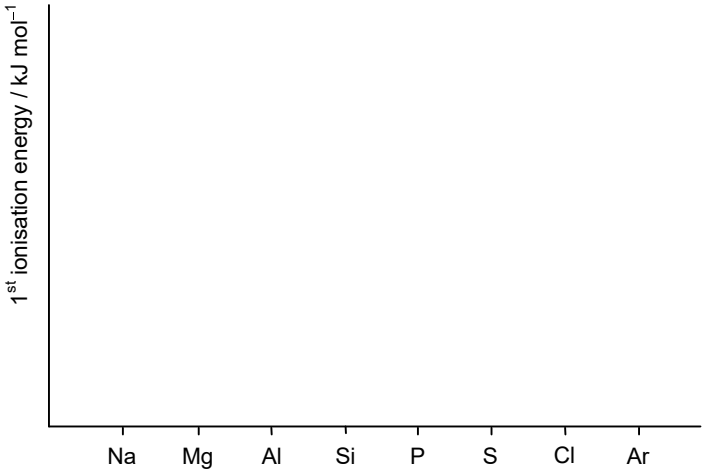
(1 mark)

(b) Explain the general trend shown using your understanding of atomic structure and electron configurations

(2 marks)



2.



(a) Sketch a plot of the first ionisation energies of the elements across period 3

(2 marks)

(b) Explain the general trend shown using your understanding of electronic structure

(2 marks)

(c) Explain any anomalies from the general trend using your understanding of electronic structure.

(2 marks)

(d) Which anomaly provides evidence for Hund's rule?

(1 mark)