Advanced Higher: Atomic Structure

Atomic structure at Advanced Higher focuses on refining your understanding of electrons and their placement within the atom.

Wave-particle duality

Electrons can act as a particle as you are familiar with. However, they can also act as wave. This is known as wave-particle duality.

Orbitals

The wave-particle duality allows us to define orbitals for electrons. Orbitals are mathematical representations of where electrons can be found _____% of the time. Each orbital can hold a maximum of ____ electrons.

Orbitals have different names and shapes

S-orbitals

P-orbitals

D-orbitals

F-orbitals (7 orbitals, don't need to know their shapes)

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Quantum numbers

Each electron in an atom has a unique ‘address’ which is represented by four _____ _____

Quantum number	Description	Letter	Possible values

Each electron has to have 4 different quantum numbers.

Representing electron arrangements

National 5/Higher recap

Advanced higher level

Electron configurations can be represented more accurately using orbital box notation or spectroscopic notation.

There are some rules to follow when doing this:

Aufbau Principle

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Hund's Rule

Pauli exclusion principle

The orbitals within a sub shell (p or d) are _____. This means they have the same energy.

Examples:

Carbon

Chlorine

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?

Write the orbital box and spectroscopic notation for:

A) lithium

B) Aluminium

C) neon

D) iron

Identifying Quantum Numbers

Carbon

$1s^2\ 2s^2\ 2p^2$

Electron	n	l	m_l	m_s

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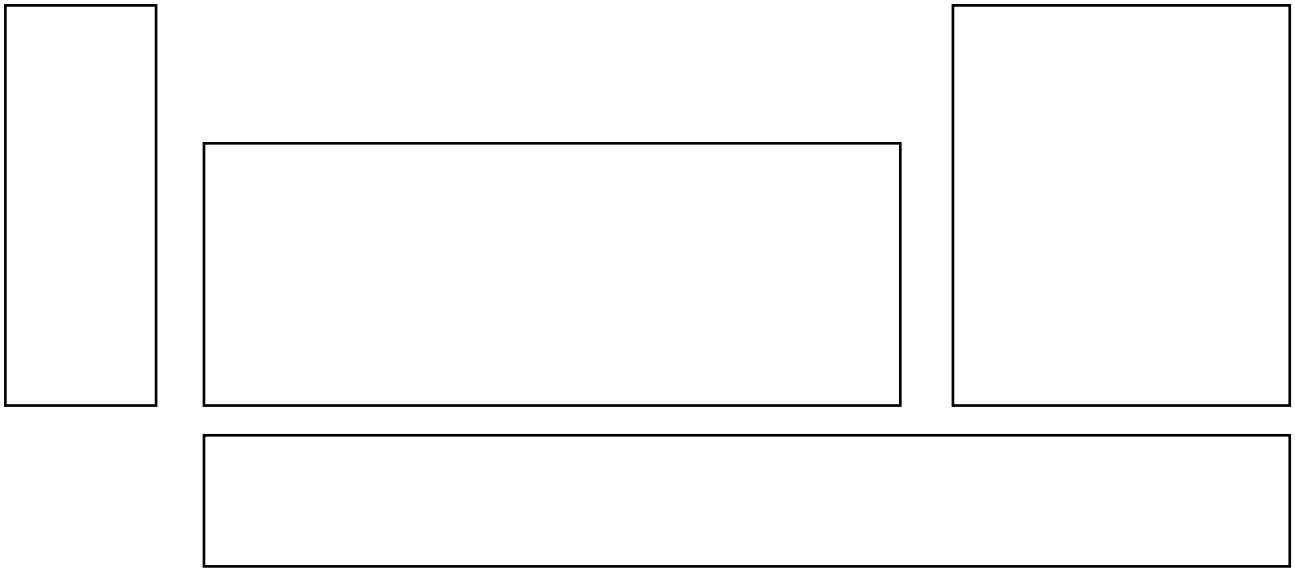
Complete the table to identify quantum numbers for the electrons in fluorine. $1s^2\ 2s^2\ 2p^5$

Electron	n	l	m_l	m_s

Periodic table

The periodic table can be split up into regions according to the last orbital that an electron fills.



?

What block of the periodic table would an ion with 3+ charge and 60 electrons be found in?

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Ionisation energy

There is a special stability associated with full or half-full sub shells. This can lead to anomalous ionisation energies due to stability of electronic arrangement.

E.g. nitrogen vs oxygen

Nitrogen electronic configuration
Nitrogen first ionisation

Oxygen electronic configuration
Oxygen first ionisation energy

Explanation

Valence Shell Electron Pair Repulsion (VSEPR) Theory

VSEPR theory allows us to use electrons to predict the shape of molecules or polyatomic group ions.

Rules:

Number of electrons on central atom
+ number of atoms bonded
- charge
Divide by 2 = electron pairs
- number of atoms bonded = non-bonding pairs

You need to be able to state the shape of the electron pairs and the overall shape of the molecule.

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Electron pairs	Shape of electron pairs	Diagram of shape
2		
3		
4		
5		
6		

The shape of a molecule is determined by the number of electron pairs and how many of those are non-bonding pairs. Electron pairs will repel to be as far apart as possible. However, this repulsion depends on the type of electron pair.

Non-bonding/Non-bonding > non-bonding/bonding > bonding/bonding

_____
repulsion

_____
repulsion

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Electron pairs	Number of non-bonding pairs	Shape of molecule	Diagram
2	0		
3	0		
4	0		
5	0		
6	0		
2	2		
3	1		
3	2		
4	2		

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Example (find the shape of the electron pairs and molecule)

NH_3

SF_6

?

Find the shape of the electron pairs and the molecule

SH_2

NH_4^+

ICl_4^-

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