Edexcel IAL Chemistry A-Level

Topic 2 - Atomic Structure and the Periodic Table

Flashcards

What are the three subatomic particles in an atom?

What are the three subatomic particles in an atom?

Protons

Neutrons

Electrons

Describe the structure of an atom

Describe the structure of an atom

- A small central nucleus made up of protons and neutrons (positively charged)
- Electrons orbit the nucleus in shells (negatively charged)

Where is the mass of the atom concentrated?

Where is the mass of the atom concentrated?

In the nucleus

What are the relative masses of a proton, neutron and electron?

What are the relative masses of a proton, neutron and electron?

Proton: 1

Neutron: 1

Electron: 1/1836

What are the relative charges of a proton, neutron and electron?

What are the relative charges of a proton, neutron and electron?

Proton: +1

Neutron: 0

Electron: -1

What does the atomic number tell you about an element?

What does the atomic number tell you about an element?

The atomic number is unique to each element and tells you the number of protons an element has.

What is the mass number?

What is the mass number?

The combined total of the number of protons and neutrons in an atom of an element.

What are isotopes?

What are isotopes?

Atoms of the same element with the same number of protons but a different number of neutrons.

How does the atomic number and mass number differ between isotopes of the same element?

How does the atomic number and mass number differ between isotopes of the same element?

Atomic number is the same as an element always has the same number of protons.

Mass number is different as there are different numbers of neutrons.

Why do atoms contain equal numbers of protons and electrons?

Why do atoms contain equal numbers of protons and electrons?

Atoms have a stable overall charge of 0.

Protons are positively charged and electrons are negatively charged so they must be present in equal numbers for charges to balance.

How can you calculate the number of neutrons, given the mass number and atomic number of an element?

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Number of neutrons =

mass number - atomic number

Boron has the atomic number 5 and mass number 11. How many protons, electrons and neutrons does boron have?

Boron has the atomic number 5 and mass number 11. How many protons, electrons and neutrons does boron have?

5 protons

5 electrons

6 neutrons

Sodium has the atomic number 11 and mass number 23. How many protons, electrons and neutrons does the Na^+ ion have?

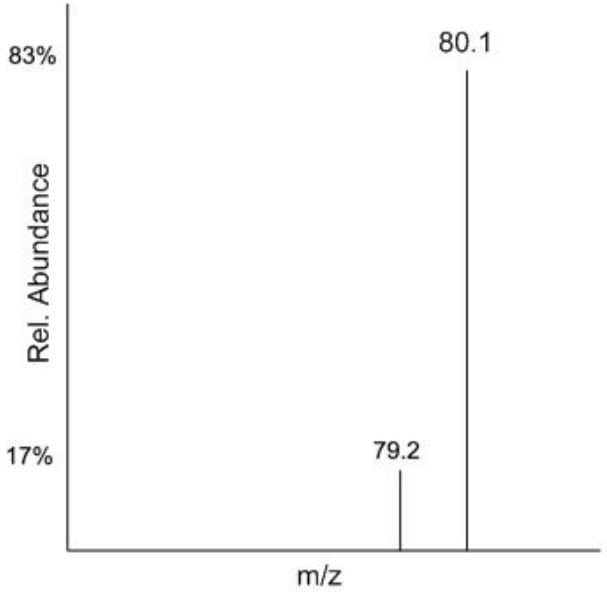
Sodium has the atomic number 11 and mass number 23. How many protons, electrons and neutrons does the Na^+ ion have?

11 protons

10 electrons (one has been lost to form the positive ion)

12 neutrons

Use the graph to calculate the relative atomic mass of this substance

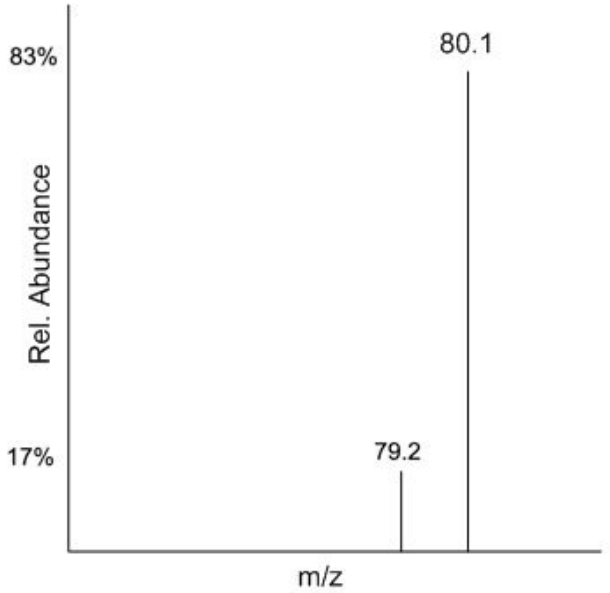


Use the graph to calculate the relative atomic mass of this substance

$$[(79.2 \times 17) + (80.1 \times 83)]$$

$$\div 100$$

$$= 79.95 \text{ g mol}^{-1}$$



How can you use a mass spectrum to deduce the relative molecular mass of a sample of a compound?

How can you use a mass spectrum to deduce the relative molecular mass of a sample of a compound?

The peak with the highest m/z value (the molecular ion peak, M^+) is caused by the whole molecule, therefore that m/z value = molecular mass.

‘Ions in a mass spectrometer can have a 2+ charge’
True or False?

‘Ions in a mass spectrometer can have a 2+ charge’ True or False?

TRUE

Ions in a mass spectrometer can have a 2+ charge, but the 1+ charge is more common.

Chlorine has two possible isotopes, Cl^{35} with a 75% abundance and Cl^{37} with a 25% abundance. Predict what the mass spectrum would look like for the diatomic molecule

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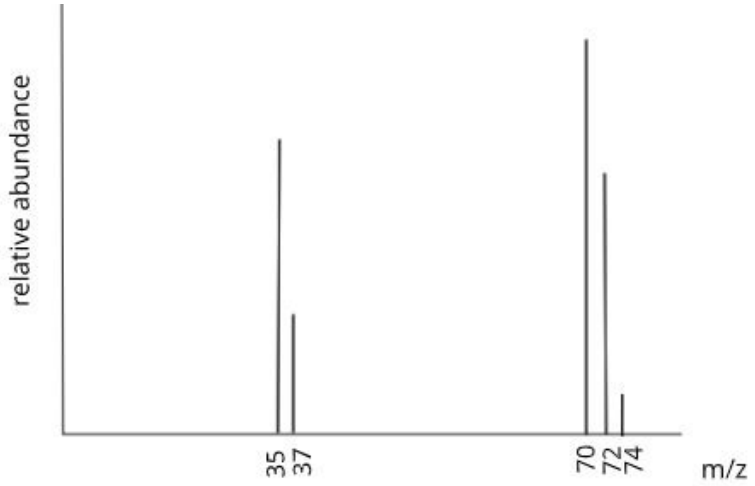
Possible combinations of the Cl_2^+ :

- 35+35=70
- 35+37=72
- 37+37=74



The 70:72:74 is in the ratio 9:6:1.

Some fragmentation occurs so there are also peaks at m/z 35 and 37.

What is first ionisation energy?

What is first ionisation energy?

First ionisation energy is the energy required to remove one electron from from one mole of gaseous atoms to form one mole of gaseous ions.

What is second ionisation energy?

What is second ionisation energy?

Second ionisation energy is the energy required to remove one electron from from one mole of gaseous 1+ ions to form one mole of gaseous 2+ ions.

Is ionisation energy exothermic or endothermic?

Is ionisation energy exothermic or endothermic?

Endothermic

What factors influence ionisation energy?

What factors influence ionisation energy?

- The number of protons in the nucleus
- The subshell from which the electron is removed
- Electron shielding

How do successive ionisation energies tell you which group an element belongs to?

How do successive ionisation energies tell you which group an element belongs to?

A large increase between two different successive ionisation energies i.e. between 7th and 8th ionisation energy suggests the 8th electron is being taken from a new, full, stable shell (and hence this requires more energy to remove).

There is therefore 7 electrons in its outer shell so the element belongs to group 7.

What does first ionisation energy of successive elements provide evidence for?

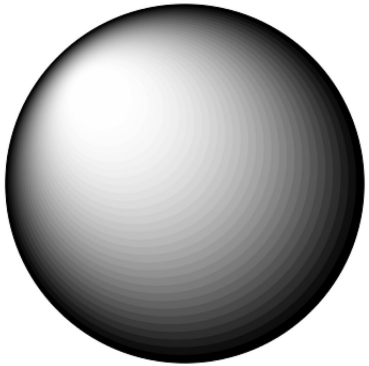
What does first ionisation energy of successive elements provide evidence for?

Electron subshells.

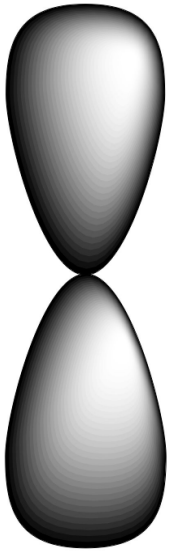
What do s and p orbitals look like?

What do s and p orbitals look like?

s-orbital



p-orbital



What is an orbital?

What is an orbital?

The space in which up to two electrons with opposite spins are likely to be found.

What is a subshell?

What is a subshell?

A division of electron shells separated by orbitals.

Subshells are called s, p, d, and f.

What rules do electrons follow when filling up orbitals?

What rules do electrons follow when filling up orbitals?

- Electrons always enter the lowest energy orbital available
- Electrons prefer to occupy orbitals on their own and will only pair up if there is no empty orbital of the same energy available

How many orbitals (and therefore the maximum number of electrons) are there in each type of subshell?

How many orbitals (and therefore the maximum number of electrons) are there in each type of subshell?

- s-subshell: 1 orbital (2 electrons)
- p-subshell: 3 orbitals (6 electrons)
- d-subshell: 5 orbitals (10 electrons)
- f-subshell: 7 orbitals (14 electrons)

What subshells do the shells from 1-4 contain?

What subshells do the shells from 1-4 contain?

Shell	Subshell(s)	Total number of electrons present (if full)
1	s	2
2	s, p	8
3	s, p, d	18
4	s, p, d, f	32

Why are the 4s orbitals generally filled before the 3p orbitals?

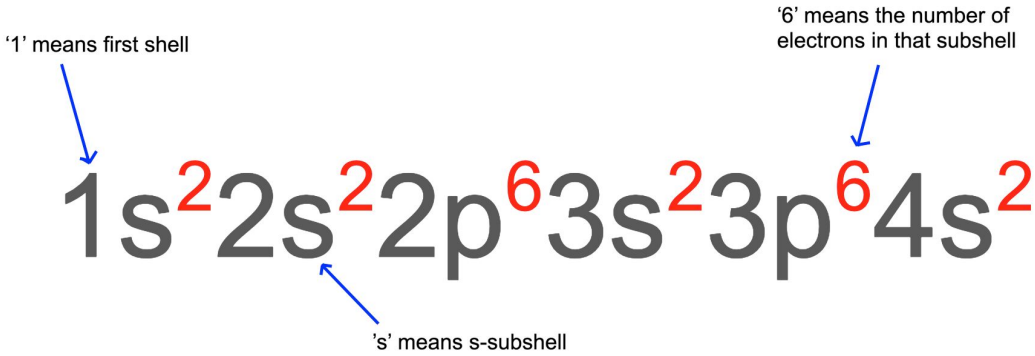
Why are the 4s orbitals generally filled before the 3p orbitals?

The 4s orbitals are at a lower energy level so they are filled first.

What is the electron configuration of calcium?

What is the electron configuration of calcium?

A calcium atom has 20 electrons.



What is box notation? How do you write the electron configuration of calcium in box notation?

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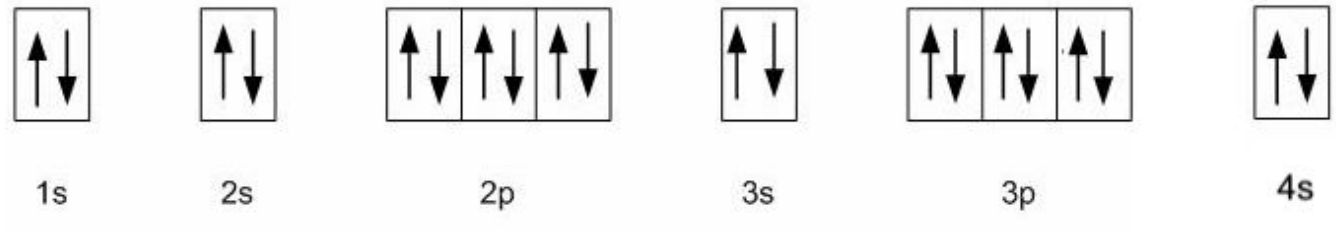
Each arrow is an electron:



Which two elements in the periodic table are exceptions to the rule that the 4s orbital is filled before the 3p orbital?

Which two elements in the periodic table are exceptions to the rule that the 4s orbital is filled before the 3p orbital?

Chromium and copper. The 4s orbital only fills with one electron as this gives them a more stable configuration in the 3d orbital.

Chromium: $[Ar]4s^1 3d^5$

Copper: $[Ar]4s^1 3d^{10}$

What determines the chemical properties of an element?

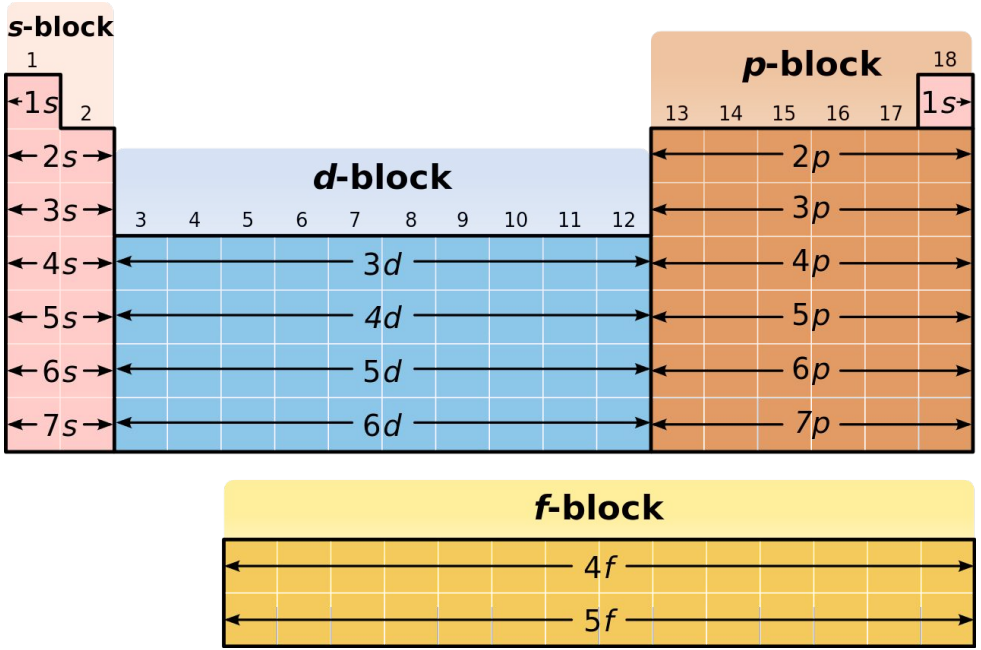
What determines the chemical properties of an element?

Electron configuration

How is the periodic table divided up, in terms of subshells?

How is the periodic table divided up, in terms of subshells?

- Into s, p, d and f blocks.
- The block denotes the subshell the elements' valence electrons are in.



What is a periodic property?

What is a periodic property?

Recurring trends in physical and chemical characteristics across a period.

What is the general trend in first ionisation energy across Period 2 and Period 3?

What is the general trend in first ionisation energy across Period 2 and Period 3?

As you go along the period first ionisation energy increases.

Explain the reason for the drop in ionisation energy between nitrogen and oxygen

Explain the reason for the drop in ionisation energy between nitrogen and oxygen

The electron being removed from oxygen is removed from an electron pair so is removed more easily due to repulsion between the two electrons.

Explain the reason behind the drop in ionisation energy between magnesium and aluminium

Explain the reason behind the drop in ionisation energy between magnesium and aluminium

The electron being removed from aluminium is in the 3p orbital rather than 3s. The 3p orbital is at a slightly higher energy level and the electron is found further from the nucleus. Aluminium has a lower ionisation energy as the electron is less attracted to the nucleus due to the increased distance and shielding from the 3s orbital.

Why does first ionisation energy increase across a period?

Why does first ionisation energy increase across a period?

- Nuclear charge increases
- Atomic radius decreases
- Shielding remains the same

Explain the trend in ionisation energy down a group in the periodic table

Explain the trend in ionisation energy down a group in the periodic table

Ionisation energy decreases down the group. This is because the amount of shielding increases along with atomic radius, so the outer electron is attracted more weakly to the nucleus, making it easier to remove.