CHEMISTRY ONLINE
TUITION

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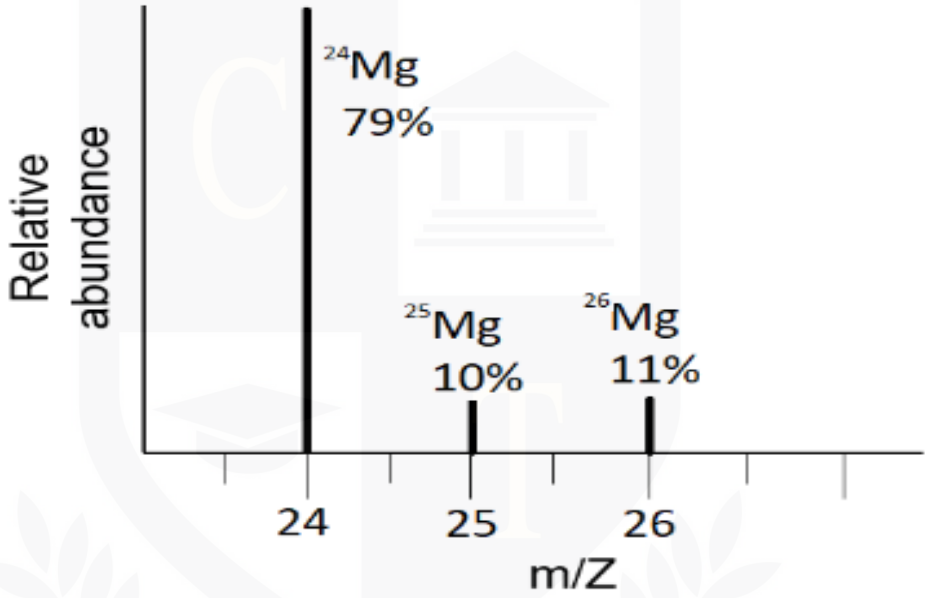
# CHEMISTRY

## Physical Chemistry

| | |
|---|---|
| Level & Board | OCR (A-LEVEL) |
| TOPIC: | ATOMIC STRUCTURE |
| PAPER TYPE: | QUESTION PAPER 4 |
| TOTAL QUESTIONS | 12 |
| TOTAL MARKS | 41 |

# Atomic Structure and Isotopes

**1.** This inquiry is about elements from the s-block and p-block of the periodic table.
A sample of Magnesium is analyzed by mass spectrometry.
The mass spectrum is shown below




**(a)** The particle causing the peaks in the mass spectrum are 2+ ions of Mg.
Complete the table to show the number of protons, neutrons, and electrons in each 2+ ion of Mg. [2]

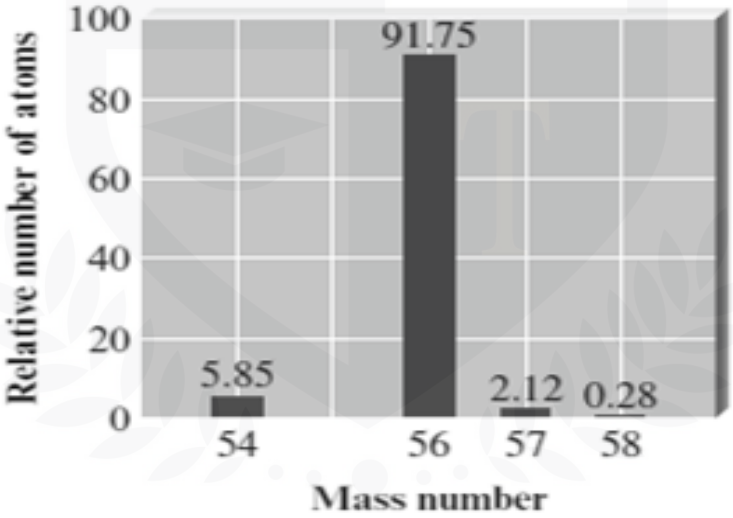
| m / z | protons | neutrons | electrons |
|---|---|---|---|
| 24 | | | |
| 25 | | | |
| 26 | | | |

**(b)** Calculate the relative atomic mass of the Magnesium in the sample.
Give your answer to two decimal places. [2]

**2.** A metal piece is made from iron and nickel. Iron and nickel exist as a mixture of isotopes.

**(a)** Give examples of how the atomic structures of various isotopes of the same element differ and are similar. [2]

**(b)** The iron is analyzed by mass spectrometry. The mass spectrum is shown below.




**i.** Find the relative atomic mass of the iron used to make the alloy. Give your answer to two decimal places. [2]

**ii.** One piece of alloy has a mass of 10.00 g and contains 90.0% of iron, by mass.
Calculate the number of iron atoms in this alloy. [2]

**3.** Naturally occurring chlorine consists of two isotopes: $^{35}Cl$ (75.77%) with an isotopic mass of 34.9689 and $^{37}Cl$ (24.23%) with an isotopic mass of 36.9659.

**(a)** Explain relative atomic mass. [3]

**(b)** Find the relative atomic mass of chlorine. [2]

**4.** Helium is a noble gas. Atoms of helium consist of protons, neutrons, and electrons.
Write a table with relevant information about helium atoms. [2]

| Particle | Relative mass | Relative charge | Position within the atom |
|---|---|---|---|
| Proton | | | |
| Neutron | | | |
| Electron | | | shell |

**5.** This question is about chemicals, elements and their characteristics.

**(a)** Zinc (Zn) is a metal, with an atomic number of 30.

**i.** Clarify the concept of isotopes in the context of zinc. [1]

**ii.** Describe why different isotopes of zinc exhibit same chemical properties. [1]

**iii.** Fill in the table below to explain the atomic structure of $^{65.38}Zn$ [1]

| Protons | Neutrons | Electrons |
|---|---|---|
| | | |

**(b)** The relative atomic mass of zinc (Zn) is 65.38

**i.** Explain relative atomic mass. [3]

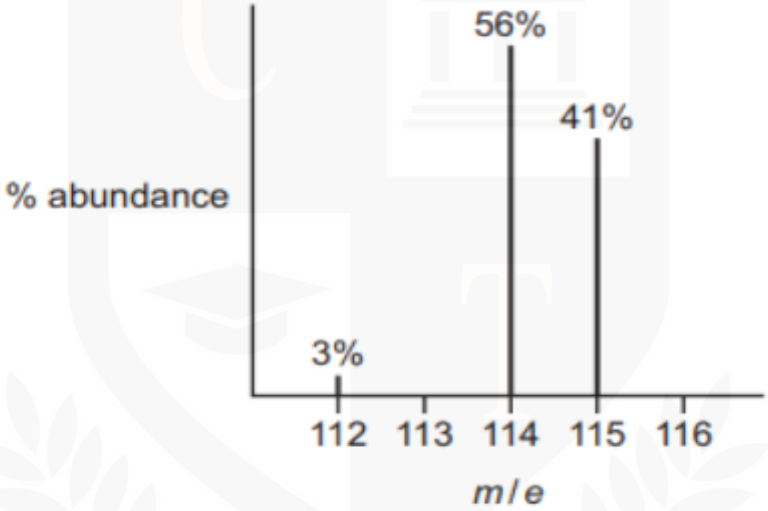
**ii.** After analyzing a sample of zinc with an Ar of 65.38, it was determined to consist of 85% $^{65}Zn$ and one other isotope.



Determine the mass number of the other isotope present in the zinc sample. [1]

**6.** A sample of element X was analysed by mass spectrometry. The mass spectrum is shown below




**(a)** Find the relative atomic mass of element X. [2]

**(b)** Suggest the identity of element X. [1]

**7.** Erbium, atomic number 68, has isotopes, $^{166}Er$, $^{167}Er$, $^{168}Er$ and $^{170}Er$.

**(a)** Complete the table to show the number of protons, neutrons, and electrons in the $^{166}Er^{2+}$ ion of erbium. [1]

| | Protons | Neutrons | Electrons |
|---|---|---|---|
| $^{166}Er^{2+}$ | | | |

**(b)** Atoms of erbium have electrons in orbitals within the first five shells. The first three shells of erbium are full.

Complete the table to show the number of electrons in the following regions of an erbium atom. [3]

| | number of electrons |
|---|---|
| the 1s sub-shell | |
| a 3p orbital | |
| the 3rd shell | |

**8.** This question relates to the characteristics and reactions of the element hydrogen.
Using a mass spectrometer, it is possible to calculate the relative atomic mass of hydrogen.

**(a)** Discuss what the term "relative atomic mass of an element" means. [2]

**(b)** A sample of hydrogen has a relative atomic mass of 1.008. The sample consists of:

- 99.98% $^{1}H$ (protium)
- one other isotope.

Find the mass number of the other isotope in the sample. [2]

I am Sorry !!!!!

**9.** This question is about the structure and compounds of Carbon, Oxygen, and Hydrogen. Most elements contain different isotopes.

**(a)** Give two examples how two isotopes of the same element differ. [1]

**(b)** Complete the table for an atom and an ion of two different elements. [1]

| Element | Mass number | Protons | Neutrons | Electrons | Charge |
|---|---|---|---|---|---|
| | | 8 | 8 | | -2 |
| | 12 | | | 6 | |

**10.** This question is about elements from the d-block of the periodic table.
Titanium exists as a mixture of three isotopes, $^{46}Ti$, $^{47}Ti$, and $^{48}Ti$.

**(a)** Complete the table to show the atomic structure of $^{48}Ti$. [1]

| | Protons | Neutrons | Electrons |
|---|---|---|---|
| $^{48}Ti$ | | | |

**(b)** A sample of titanium is analyzed by mass spectrometry. The mass spectrum shows peaks with the relative abundances below.

- $^{46}Ti$ 18.81%
- $^{47}Ti$ 7.47%
- $^{48}Ti$ 73.72%

Calculate the relative atomic mass of titanium in the sample. Give your answer to two decimal places. [2]



**11.** Sulfur has two isotopes, S-32 and S-34.
The relative atomic mass of sulfur is 32.1.

Calculate the percentage of S-32 atoms in a sample of sulfur. [2]

**12.** This question is about the elements with atomic numbers between 13 and 25.
Vanadium, atomic number 23, is a transition metal.
Complete the table to show the number of each particle found in a $^{50.94}V^{3+}$ ion. [2]

| Particle | Number of each particle present in a $^{50.94}V^{3+}$ ion |
|---|---|
| proton | |
| neutron | |
| electron | |



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