



**CHEMISTRY ONLINE**  
— **TUITION** —

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# CHEMISTRY

## Physical Chemistry

Level & Board	OCR (AS-LEVEL)
TOPIC:	ATOMIC STRUCTURE
PAPER TYPE:	QUESTION PAPER 1
TOTAL QUESTIONS	12
TOTAL MARKS	32

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## Atomic Structure and Isotopes

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

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

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(b) A sample of Neon has a relative atomic mass of 20.18. The sample consists of:

- 90.5% Ne-20
- 0.27% Ne-21
- one other isotope.

Find the other isotope of Neon in the sample. [2]

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2. This inquiry pertains to structure and the compounds of Phosphorus, Sulfur and Magnesium. Most elements contain different isotopes.

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

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

Element	Mass number	Protons	Neutrons	Electrons	Charge
		16	16		-2
	31			15	

3. This inquiry is about elements from the p-block of the periodic table. Carbon exists as a mixture of three isotopes,  $^{12}\text{C}$ ,  $^{13}\text{C}$  and  $^{14}\text{C}$ .

**(a)** Complete the table to show the atomic structure of  $^{14}\text{C}$ . [1]

	Protons	Neutrons	Electrons
$^{14}\text{C}$			

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

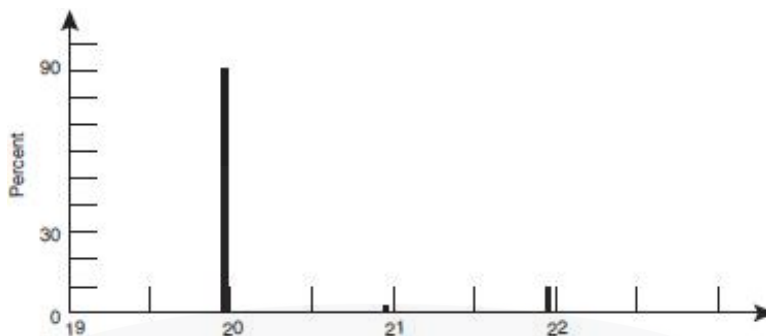
- $^{12}\text{C}$             98.9%
- $^{13}\text{C}$             1.06%
- $^{14}\text{C}$             0.01%

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

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4. This inquiry is about elements from the s-block and p-block of the periodic table.

A sample of Neon is analysed by mass spectrometry. The mass spectrum is shown below



**(a)** The species causing the peaks in the mass spectrum are  $1+$  ions of Ne.

Complete the table to show the number of protons, neutrons and electrons in each  $1+$  ion of Ne. [2]

m / z	protons	neutrons	electrons
20			
21			
22			

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

5. A coin is made from copper and zinc. Copper and zinc 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]

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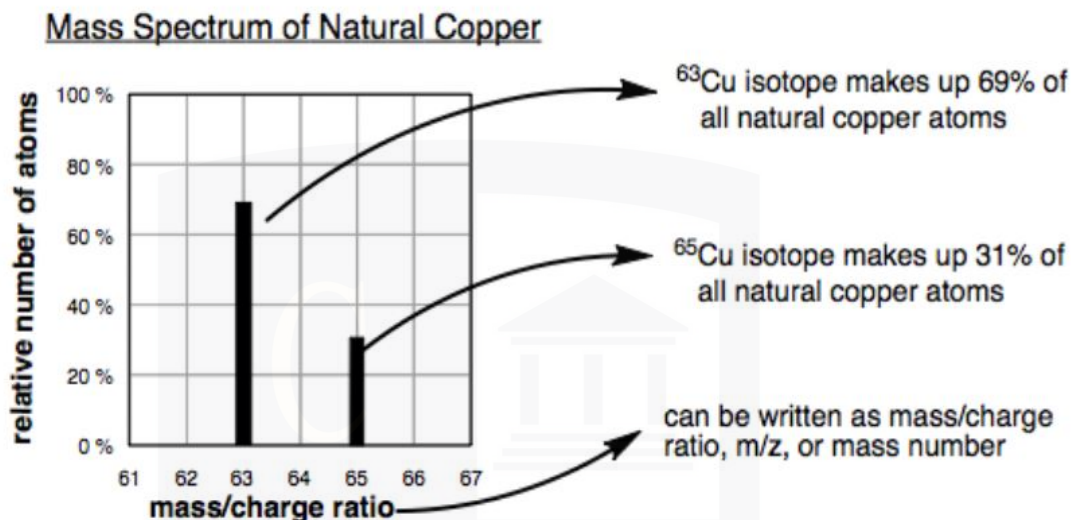


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- (b) The copper is analysed by mass spectrometry. The mass spectrum is shown below.



- Find the relative atomic mass of the copper used to make the coins. Give your answer to two decimal places. [2]
- One coin has a mass of 5.00 g and contains 84.0% of copper, by mass. Calculate the number of copper atoms in one coin. [2]

I am Sorry !!!!!

6. Naturally occurring silver consists of two isotopes:  $^{107}\text{Ag}$  (51.84%) with an isotopic mass of 106.9051 and  $^{109}\text{Ag}$  (48.16%) with an isotopic mass of 108.9048.

(a) Explain relative atomic mass. [3]

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(b) Find the relative atomic mass of silver in this sample. [2]

7. Oxygen is the gas in the atmosphere. Atoms of Oxygen consist of protons, neutrons and electrons. Complete the table below. [2]

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

8. Chlorine has two isotopes, Cl-35 and Cl-37. The relative atomic mass of chlorine is 35.5. Calculate the percentage of Cl-35 atoms in a sample of chlorine. [2]

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9. This question is about the elements with atomic numbers between 58 and 70.

Samarium, atomic number 62, is a metal.

Complete the table to show the relative charge of each particle and the number of each particle found in a  $^{150.36}\text{Sm}^{2+}$  ion. [2]

Particle	Charge	Number of each particle present in a $^{150.36}\text{Sm}^{2+}$ ion
proton		
neutron		
electron		

10. This query is about isotopes.

(a) Gold Au, has an atomic number of 79.

- i. Explain the concept of isotopes in the context of gold. [1]

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- ii. Discuss whether different isotopes of gold have the same chemical properties. [1]

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- iii. Complete the table below to show the atomic structure of  $^{196.97}\text{Au}$  [1]

Protons	Neutrons	Electrons

(b) The relative atomic mass of gold (Au) is 197.0

- i. Explain relative atomic mass. [3]

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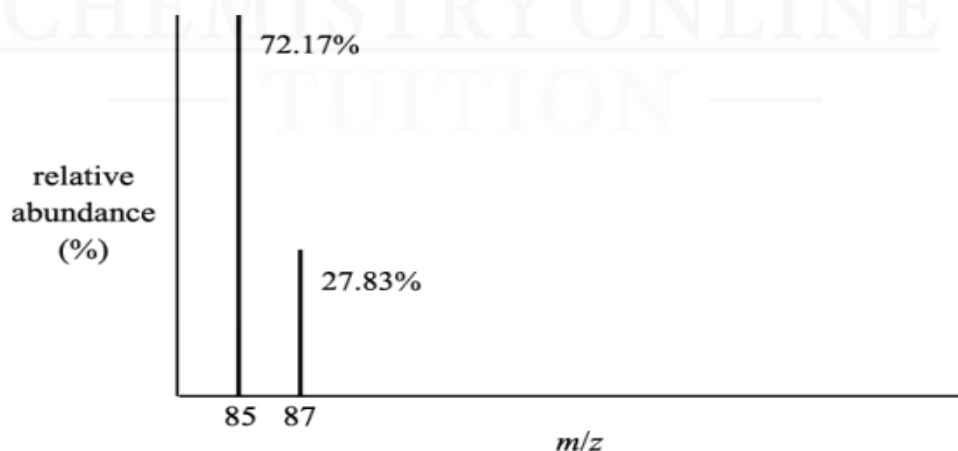
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- ii. A sample of gold,  $A_r = 197.0$ , was analyzed and was found to consist of 90%  $^{197}\text{Au}$  and one other isotope. Determine the mass number of the other isotope in the sample of gold. [1]

11. The only two elements that are liquid at normal temperature and pressure are bromine and mercury, which are both naturally occurring. These two elements' physical characteristics are listed below.

	Appearance at room temperature	Melting point / °C	Boiling point / °C	Electrical conductivity of
Bromine	dark orange liquid	-7.2	58.8	very low
Mercury	shiny silver liquid	-38.8	356.7	good

Element Y melts at temperatures reached on very hot summer days. A sample of element Y was analysed by mass spectrometry. The mass spectrum is shown below





i. Find the relative atomic mass of element Y. [2]

ii. Suggest the identity of element Y. [1]

12. Dysprosium, atomic number 66, has two isotopes,  $^{156}\text{Dy}$  and  $^{158}\text{Dy}$ .

(a) Complete the table to show the number of protons, neutrons, and electrons in the  $^{158}\text{Dy}^{3+}$  ion of dysprosium. [1]

	Protons	Neutrons	Electrons
$^{158}\text{Dy}^{3+}$			

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

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

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

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