Atomic Structure Worksheet | CIE | A-Level Chapter 1 Chemistry

Objective

This worksheet is designed to test your understanding of the fundamental concepts of atomic structure. After completing this worksheet, you should be able to define key terms, calculate the composition of atoms and ions, and explain the properties of isotopes.

Section 1: Key Definitions

Instructions: Match the term on the left with the correct definition on the right.

Term		Definition
1. Proton	A	The total number of protons and neutrons in the nucleus.
2. Isotope	B	A positively charged subatomic particle found in the nucleus.
3. Atomic Number (Z)	C	Atoms of the same element with different numbers of neutrons.
4. Electron	D	A subatomic particle with a negligible mass and a -1 charge.
5. Mass Number (A)	E	The number of protons in an atom's nucleus.
6. Neutron	F	An uncharged subatomic particle found in the nucleus.

Section 2: Subatomic Particles in Atoms and Ions

Instructions: Complete the following table. You will need to refer to a Periodic Table to find the atomic numbers.

Species Name	Symbol	Atomic Number (Z)	Mass Number (A)	No. of Protons	No. of Neutrons	No. of Electrons
Sodium atom	^{23}Na	11	23			
Calcium ion	$^{40}Ca^{2+}$				20	
Oxide ion	$^{16}O^{2-}$	8				10
Iron atom	^{56}Fe			26		
Bromide ion	$^{81}Br^{-}$	35	81			
Aluminium ion	$^{27}Al^{3+}$		27	13		

Section 3: Understanding Isotopes

Instructions: Answer the following questions in the spaces provided.

1. Define the term isotope in terms of subatomic particles.
2. Chlorine has two common isotopes: Chlorine-35 (^{35}Cl) and Chlorine-37 (^{37}Cl).
   a. State the number of protons, neutrons, and electrons in a neutral atom of each isotope.
   b. Explain why both isotopes have the same chemical properties.
   c. State one physical property that would be different between these two isotopes and explain why.

Section 4: Structured Questions

Instructions: Answer the following questions, showing your working where necessary.

Question 1
An atom of strontium is represented by the symbol $^{88}_{38}Sr$.

a. State the number of protons, neutrons, and electrons in a neutral atom of strontium.
b. A strontium atom can lose two electrons to form an ion. Write the symbol for this ion, including its mass number, atomic number, and charge.
c. State the number of protons, neutrons, and electrons in the strontium ion from part (b).

Question 2
A beam of protons, a beam of neutrons, and a beam of electrons, all traveling at the same velocity, are passed through an electric field between two charged parallel plates (one positive, one negative).
a. Describe the path taken by the beam of neutrons. Explain your answer.
b. Describe the path taken by the beam of protons. Explain your answer.
c. Describe the path taken by the beam of electrons. Explain why its path differs from that of the proton beam.

Section 5: Multiple Choice Questions

Instructions: For each question, circle the letter corresponding to the best answer.

1. Which particle has the smallest relative mass?
   A. Proton
   B. Neutron
   C. Electron
   D. Nucleus
2. An atom of an element has 26 protons, 26 electrons, and 30 neutrons. What is its mass number (A)?
   A. 26
   B. 52
   C. 56
   D. 82
3. The ion F^- has the same number of electrons as which one of the following?
   A. A neutral atom of Ne
   B. A Li^+ ion
   C. A neutral atom of Ar
   D. An O^- ion
4. How do the chemical properties of isotopes of the same element compare?
   A. They are identical.
   B. They are slightly different.
   C. They are very different.
   D. It depends on the number of neutrons.

Answer Key

Section 1: Key Definitions

1. **B**
2. **C**
3. **E**
4. **D**
5. **A**
6. **F**

Section 2: Subatomic Particles in Atoms and Ions

Species Name	Symbol	Atomic Number (Z)	Mass Number (A)	No. of Protons	No. of Neutrons	No. of Electrons
Sodium atom	^{23}Na	11	23	**11**	**12**	**11**
Calcium ion	$^{40}Ca^{2+}$	**20**	**40**	**20**	20	**18**
Oxide ion	$^{16}O^{2-}$	8	**16**	**8**	**8**	10
Iron atom	^{56}Fe	**26**	**56**	26	**30**	**26**
Bromide ion	$^{81}Br^{-}$	35	81	**35**	**46**	**36**
Aluminium ion	$^{27}Al^{3+}$	**13**	27	13	**14**	**10**

Section 3: Understanding Isotopes

1. **Isotopes** are atoms of the same element that have the same number of protons but different numbers of neutrons.
2. a. ^{35}Cl: 17 protons, 18 neutrons, 17 electrons. ^{37}Cl: 17 protons, 20 neutrons, 17 electrons.
   b. Chemical properties are determined by the electron configuration. Since both isotopes have 17 electrons (in a neutral atom), they have the same electron

configuration and therefore the same chemical properties.
c. Mass or density. These properties would be different because ^{37}Cl has two more neutrons than ^{35}Cl, making it heavier and denser.

Section 4: Structured Questions

Question 1

a. Protons = 38, Neutrons = 88 - 38 = 50, Electrons = 38.
b. $^{88}_{38}Sr^{2+}$
c. Protons = 38, Neutrons = 50, Electrons = 38 - 2 = 36.

Question 2

a. The beam of neutrons passes straight through the electric field without any deflection. This is because neutrons have no charge.
b. The beam of protons is deflected towards the negative plate. This is because protons are positively charged and are attracted to the opposite charge.
c. The beam of electrons is deflected towards the positive plate because they are negatively charged. The deflection is greater (the path is more curved) than that of the protons because electrons have a much smaller mass and are therefore deflected more easily by the same electric field.

Section 5: Multiple Choice Questions

1. **C** (Electron)
2. **C** (Mass number = protons + neutrons = 26 + 30 = 56)
3. **A** (F has 9 protons. F^- has 10 electrons. Ne has 10 protons and 10 electrons)
4. **A** (They are identical because they have the same electron configuration)