Worksheet 1.1: Electronic Structure & Groups

ChemistrySheets

Specification: GCSE Chemistry (AQA 5.1.1.4 & 5.1.2 / Edexcel SC3 & SC4)

Core Concepts: Electron shells, electron configuration, valence electrons, group number, period number, metallic/non-metallic properties, reactivity trends.

Section A: Key Terms & Concepts

1. Match the following scientific terms to their correct definitions. Write the letter of the definition next to the term.

Term	Definition
Electron shell	A. The outermost electrons of an atom.
Valence electron	B. A horizontal row in the Periodic Table.
Group	C. A vertical column in the Periodic Table.
Period	D. The number of protons in an atom's nucleus.
Atomic number	E. An energy level where electrons orbit the nucleus.

Model Answer:
Electron shell E
Valence electron A
Group C
Period B
Atomic number D

2. Complete the following sentences using the most appropriate scientific terms.

a) Elements in the same **group** have the same number of **valence electrons**.

b) The **period** number of an element indicates the number of **electron shells** it has.

c) Atoms are most stable when their **outer electron shell** is **full**, typically containing eight electrons (or two for the first shell).

Section B: Core Concepts & Explanations

1. Describe the arrangement of electrons within an atom.

Model Answer:
Electrons occupy specific energy levels or shells around the nucleus. Each shell can hold a maximum number of electrons, and electrons fill the lowest energy shells first.

2. Explain how the group number of an element in the Periodic Table is determined by its electronic structure.

Model Answer:
The group number of an element is determined by the number of electrons in its outermost shell, also known as valence electrons. For example, elements in Group 1 have 1 valence electron, and elements in Group 7 have 7 valence electrons. This number dictates their chemical properties.

3. Explain how the period number of an element in the Periodic Table is determined by its electronic structure.

Model Answer:
The period number of an element is determined by the number of occupied electron shells an atom has. For example, elements in Period 2 have 2 occupied electron shells, and elements in Period 3 have 3 occupied electron shells. Each new period represents the filling of a new electron shell.

4. Describe the general trend in reactivity for Group 1 metals as you move down the group, and explain why this trend occurs.

Model Answer:
Group 1 metals become more reactive as you go down the group. This is because the atomic radius increases, meaning the outermost electron is further from the positively charged nucleus. There is also increased shielding from the inner electron shells. Both factors reduce the electrostatic attraction between the nucleus and the valence electron, making it easier to lose and thus increasing reactivity.

Section C: Exam Application & Extended Writing

1. The diagram below shows a simplified Bohr model of an atom.

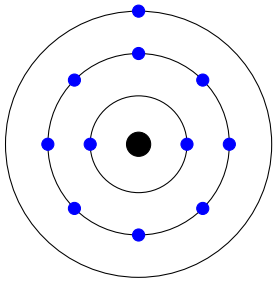

Figure 1: Simplified atomic model

a) Based on the diagram, state the following for this atom:

i) Group number:

Model Answer:
1

ii) Period number:

Model Answer:
3

iii) Identify the element:

Model Answer:
Sodium (Na)

2. Explain and compare the trends in reactivity for Group 1 metals and Group 7 non-metals as you move down their respective groups. You should refer to their electronic structure and how it influences their chemical behaviour. (6 marks)

Model Answer:
Group 1 metals become more reactive down the group. They react by losing their single valence electron to form a positive ion. As you go down Group 1, the atomic radius increases, and there are more inner electron shells, leading to increased shielding. This reduces the electrostatic attraction between the nucleus and the outermost electron, making it easier to lose, hence increasing reactivity.

Group 7 non-metals become less reactive down the group. They react by gaining one electron to achieve a full outer shell, forming a negative ion. As you go down Group 7, the atomic radius increases, and there is increased shielding. This means the incoming electron is further from the nucleus and experiences less attraction. It becomes harder to attract and gain an electron, thus decreasing reactivity.

In summary, Group 1 reactivity increases as it becomes easier to lose an electron, while Group 7 reactivity decreases as it becomes harder to gain an electron, both due to increasing atomic size and shielding.