Grade 9 Integrated Science

CBC NOTES | Terms 1, 2 and 3 - notes for 9 topics

IN EVERY TOPIC

- What you will learn, the key words and key terms explained.
- Clear notes under headings and subheadings, with labelled pictures and step-by-step procedures.
- Comparison tables, and advantages and disadvantages where methods are compared.
- Key points to remember, then multiple-choice and structured questions.
- All the answers and a glossary at the back.

TOPICS IN THESE NOTES

Topic	Name	Term
1.1	Structure of the atom	1
1.2	Metals and Alloys	1
1.3	Water hardness	1
2.1	Nutrition in plants	2
2.2	Nutrition in animals	2
2.3	Reproduction in plants	2
2.4	The interdependence of life	3
3.1	Curved mirrors	3
3.2	Waves	3

A TASTE OF THE FIRST TOPIC

Structure of the atom

Everything around us, from the air we breathe to the iron sheets on our roofs, is made of tiny particles called atoms. In this topic we study what an atom is made of, how to find its atomic number and mass number, how electrons are arranged, how to draw atoms with dot and cross diagrams, and how electron arrangement tells us whether an element is a metal or a non-metal.

CONTENTS

Topic	Name	Term	Page
1.1	Structure of the atom	1	3
1.2	Metals and Alloys	1	7
1.3	Water hardness	1	11
2.1	Nutrition in plants	2	15
2.2	Nutrition in animals	2	19
2.3	Reproduction in plants	2	23
2.4	The interdependence of life	3	27
3.1	Curved mirrors	3	31
3.2	Waves	3	35
	Answers		39
	Glossary		43

Elimu254
Learn • Grow • Build Tomorrow

Strand 1.0 Mixtures, Elements and Compounds | Term 1

1.1 Structure of the atom

WHAT YOU WILL LEARN

By the end of this topic you should be able to:

- describe the structure of the atom
- determine the mass number of elements
- draw the electron arrangement in atoms using dot or cross diagrams
- classify elements into metals and non-metals

KEY WORDS

atom, element, proton, neutron, electron, nucleus, energy level, atomic number, mass number, electron arrangement.

Everything around us, from the air we breathe to the iron sheets on our roofs, is made of tiny particles called atoms. In this topic we study what an atom is made of, how to find its atomic number and mass number, how electrons are arranged, how to draw atoms with dot and cross diagrams, and how electron arrangement tells us whether an element is a metal or a non-metal.

1. Atoms and elements

Element
A substance made of only one kind of atom, such as copper, oxygen or carbon.

Atom
The smallest particle of an element that can take part in a chemical change.

Some elements and their symbols

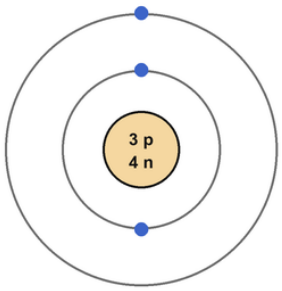
Element	Symbol	Element	Symbol
Hydrogen	H	Sodium	Na
Carbon	C	Magnesium	Mg
Oxygen	O	Chlorine	Cl
Nitrogen	N	Calcium	Ca

2. Particles in an atom

The three sub-atomic particles

Particle	Charge	Relative mass	Where found
Proton	+1	1	Nucleus
Neutron	0 (no charge)	1	Nucleus
Electron	-1	about 1/1840 (very small)	Energy levels (shells) around the nucleus

In a neutral atom the number of electrons equals the number of protons, so the charges cancel.



Lithium atom

Nucleus: 3 protons, 4 neutrons

Shells: 2 electrons, then 1

Electron arrangement: 2.1

A lithium atom: 3 protons and 4 neutrons in the nucleus; electrons 2 and 1

3. Atomic number and mass number

Atomic number

The number of protons in an atom. It also equals the number of electrons in a neutral atom.

Mass number

The number of protons plus neutrons in an atom.

Number of neutrons = mass number - atomic number. In notation, the mass number is written at the top left of the symbol and the atomic number at the bottom left.

Protons, neutrons and electrons

Element	Atomic no.	Mass no.	Protons	Neutrons	Electrons
Carbon	6	12	6	12 - 6 = 6	6
Sodium	11	23	11	23 - 11 = 12	11
Magnesium	12	24	12	24 - 12 = 12	12
Potassium	19	39	19	39 - 19 = 20	19

Elimu254 Learn • Grow • Build Tomorrow

4. Electron arrangement

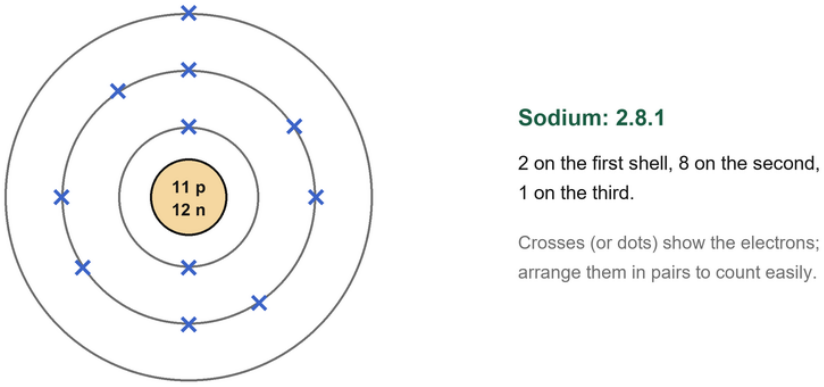
For the first 20 elements, the first energy level holds up to 2 electrons, the second up to 8, the third up to 8, and any more go into the fourth.

Electron arrangements of some of the first 20 elements

Element	Arrangement	Element	Arrangement
H (1)	1	Na (11)	2.8.1
He (2)	2	Mg (12)	2.8.2
Li (3)	2.1	Al (13)	2.8.3
C (6)	2.4	P (15)	2.8.5
O (8)	2.6	Cl (17)	2.8.7
Ne (10)	2.8	Ca (20)	2.8.8.2

Drawing a dot and cross diagram (sodium)

1. Draw the nucleus and write 11p and 12n inside it.
2. Draw three circles (energy levels) around it.
3. Put 2 crosses on the first, 8 on the second and 1 on the third.
4. Arrange the electrons in pairs so they are easy to count.



Dot and cross diagram of a sodium atom (2.8.1)

5. Metals and non-metals

Classifying elements by outer electrons

Outer electrons	Usually	Examples
1, 2 or 3	Metals	lithium, sodium, magnesium, aluminium, potassium, calcium
4 to 8	Non-metals	carbon, nitrogen, oxygen, phosphorus, sulphur, chlorine, argon

EXCEPTIONS

Hydrogen (1 outer electron) and helium (2) are non-metals; boron (3) and silicon (4) are metalloids, between metals and non-metals.

Metals around us: aluminium sufurias, copper wires, iron nails and sheets. Non-metals: oxygen we breathe, carbon in charcoal and pencils, chlorine in water treatment. Knowing atomic structure helps scientists make medicines, fertilisers, batteries and electronics.

KEY POINTS TO REMEMBER

- An atom has protons (+) and neutrons (0) in the nucleus and electrons (-) in energy levels.
- Atomic number = protons; mass number = protons + neutrons; neutrons = mass no. - atomic no.
- Shells hold 2, 8, 8 electrons for the first 20 elements: Na is 2.8.1, Ca is 2.8.8.2.
- Atoms with 1-3 outer electrons are mostly metals; 4-8 mostly non-metals.

Elimu254 Learn • Grow • Build Tomorrow

CHECK YOURSELF: MULTIPLE CHOICE

Choose the correct answer: A, B, C or D. The answers are at the back.

1. Which particle has no charge?

A. Proton
B. Neutron
C. Electron
D. Nucleus

2. An atom has mass number 27 and atomic number 13. How many neutrons does it have?

A. 14
B. 13
C. 27
D. 40

3. What is the electron arrangement of chlorine (atomic number 17)?

A. 2.8.8
B. 2.7.8
C. 2.8.7
D. 8.8.1

4. An element has the arrangement 2.8.2. It is most likely

A. a gas.
B. a non-metal.
C. a metalloid.
D. a metal.

5. The atomic number of an element is the number of

A. neutrons.
B. protons.
C. shells.
D. protons plus neutrons.

ANSWER THESE

1. Copy and complete: an atom of aluminium has atomic number 13 and mass number 27. Protons = ..., neutrons = ..., electrons = ..., arrangement = ... (4 marks)

2. Draw a dot and cross diagram of an oxygen atom (8 protons, 8 neutrons). (3 marks)

3. Classify as metal or non-metal and give a reason: (a) potassium 2.8.8.1 (b) sulphur 2.8.6. (4 marks)

4. Explain why a neutral atom has no overall charge. (2 marks)

Elimu254 Learn • Grow • Build Tomorrow

Strand 1.0 Mixtures, Elements and Compounds | Term 1

1.2 Metals and Alloys

WHAT YOU WILL LEARN

By the end of this topic you should be able to:

- describe the physical properties of metals
- describe the composition of alloys
- identify the uses of metals and alloys in day to day life
- explain the effects of rusting of metals

KEY WORDS

metal, lustre, malleable, ductile, conductor, alloy, steel, brass, bronze, duralumin, rusting, galvanising.

Iron sheets, sufurias, electric wires and padlocks are all made of metals or alloys. In this topic we investigate the physical properties of metals, learn what alloys are and what they are made of, link metals and alloys to their uses, and study rusting: what causes it, its effects and how to prevent it.

1. Physical properties of metals

Physical properties of metals

Property	Meaning	Test or example
State	Solid at room temperature (except mercury, a liquid)	Iron nail, copper wire
Lustre	Shiny when clean	Freshly cleaned aluminium shines
Sonority	Rings when struck	A tapped iron rod rings
Malleability	Can be hammered into sheets without breaking	Aluminium flattens; charcoal crumbles
Ductility	Can be drawn into wires	Copper wire
Electrical conductivity	Conducts electricity	A bulb lights with an iron nail in the circuit
Thermal conductivity	Conducts heat	Wax melts first on a copper rod

Physical properties of metals

Property	Test	Result
Lustre	Look at a cleaned metal	Shiny
Sonority	Tap it gently	Rings
Malleability	Hammer aluminium (and charcoal)	Metal flattens; charcoal crumbles
Ductility	Bend and stretch copper wire	Can be drawn into wires
Electrical conduction	Put it in a circuit with a bulb	Bulb lights
Thermal conduction	Wax on heated rods	Wax melts first on copper

Physical properties of metals and how to test them

SAFETY
Use only dry cells for conductivity tests, never mains electricity. Do not touch heated rods; keep fingers clear of the hammer.

2. Metals and non-metals compared

Metals compared with non-metals

Property	Metals	Non-metals
State	Usually solid	Many gases (oxygen) or brittle solids (sulphur)
Appearance	Shiny	Dull
Hammering	Malleable	Brittle
Conduction	Good conductors	Poor conductors (except graphite)

3. Alloys

Alloy
A mixture of a metal with one or more other elements (usually metals, sometimes carbon), made by melting and mixing them to improve their properties.

Common alloys

Alloy	Made of	Properties	Uses
Steel	iron + a little carbon	strong, hard	buildings, bridges, vehicles, tools
Stainless steel	iron + chromium + nickel (+ carbon)	does not rust	cutlery, sinks, surgical tools, tanks
Brass	copper + zinc	yellow, does not rust, easy to shape	taps, locks, door handles, instruments
Bronze	copper + tin	hard, resists corrosion	medals, statues, bells
Duralumin	aluminium + copper, magnesium, manganese	light but strong	aircraft, bicycle frames

What common alloys are made of

Alloy	Made of	Use
Steel	iron + carbon	buildings, bridges
Stainless steel	iron + chromium + nickel	cutlery, sinks
Brass	copper + zinc	taps, locks
Bronze	copper + tin	medals, statues
Duralumin	aluminium + copper, magnesium, manganese	aircraft

What common alloys are made of