Here is your complete, exam-ready summary of the chapter.

Title Block

- **Chapter:** 2: Atoms, elements and compounds
- **Book/PDF:** Chapter-02.pdf
- **Pages:** 2–30
- **Exam level:** Cambridge IGCSE (0610)

1) Big-picture overview (100–150 words)

This chapter introduces the fundamental building blocks of all matter. You'll learn that everything is made of tiny particles called **atoms** (p. 2) and that a substance made of only one type of atom is an **element** (p. 2). We explore how elements are classified as metals or non-metals based on their properties (p. 2). You'll see how atoms of different elements can chemically bond to form **compounds** (p. 5), which have properties different from their original elements. We'll also look at **mixtures**, where substances are combined without a chemical reaction (p. 9). A key part of the chapter is looking inside the atom itself to understand its structure—a central **nucleus** with protons and neutrons, surrounded by electrons in shells (p. 12). This knowledge helps explain why different elements behave the way they do, how **ions** form (p. 14), and what **isotopes** are (p. 15).

2) Syllabus mapping

Outcome description	Where covered (page)
Describe the differences between elements, compounds and mixtures.	2, 5, 9, 10
Use symbols for atoms.	3, 4
State the formulae of common elements and compounds.	4, 7
Define the molecular formula of a compound.	7
Deduce the formula of a simple compound from a model or diagram.	5, 7

Outcome description	Where covered (page)
Construct word and balanced symbol equations, including state symbols.	5, 8
Define oxidation as oxygen gain and reduction as oxygen loss.	6
Identify redox reactions and the role of oxidising/reducing agents.	6
Describe the atom as a nucleus (protons, neutrons) and electrons in shells.	12
State the relative charges and masses of protons, neutrons, and electrons.	12
Define proton number (Z) and mass number (A).	12, 13
Determine the electronic configuration of elements with proton numbers 1 to 20.	17, 18
Describe the formation of positive ions (cations) and negative ions (anions).	14
State what isotopes are and that they have the same chemical properties.	15
Calculate the relative atomic mass (A_r) from isotopic abundances.	16

3) Key terms and definitions

Term	One-sentence definition	First appears (page)	Example/application
Element	A pure substance made up of only one kind of atom (p. 2).	2	Copper (Cu), Oxygen (O).
Atom	The smallest part of an element that shares its chemical properties (p. 2).	2	A single atom of sodium (Na).

Term	One-sentence definition	First appears (page)	Example/application
Molecule	A small group of atoms joined together (p. 4).	4	A molecule of water (H_2O) or oxygen (O_2).
Compound	A pure substance formed when two or more elements chemically combine (p. 5).	5	Sodium chloride (NaCl).
Mixture	A substance containing more than one element and/or compound that are not chemically bonded (p. 9).	9	Air (a mixture of nitrogen, oxygen, etc.).
Oxidation	The gain of oxygen during a chemical reaction (p. 6).	6	Magnesium burning in air: $2Mg + O_2 \rightarrow 2MgO$.
Reduction	The loss of oxygen during a chemical reaction (p. 6).	6	Extracting iron: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$.
Proton	A positively charged sub-atomic particle found in the nucleus of an atom (p. 12).	12	A hydrogen atom has 1 proton.
Neutron	A neutral (no charge) sub-atomic particle found in the nucleus of an atom (p. 12).	12	A helium atom has 2 neutrons.
Electron	A negatively charged sub-atomic particle found in shells orbiting the nucleus (p. 12).	12	A neutral atom has an equal number of electrons and protons.
Proton number (Z)	The number of protons in the nucleus of an atom (p. 12).	12	The proton number of Carbon is 6.

Term	One-sentence definition	First appears (page)	Example/application
Mass number (A)	The total number of protons and neutrons in the nucleus of an atom (p. 13).	13	Carbon-12 has a mass number of 12 (6 protons + 6 neutrons).
Ion	An electrically charged particle formed when an atom gains or loses electrons (p. 14).	14	Na^+, Cl^-.
Isotopes	Atoms of the same element with the same number of protons but different numbers of neutrons (p. 15).	15	Carbon-12 and Carbon-14 are isotopes of carbon.
Electronic configuration	The arrangement of electrons in the different shells of an atom (p. 17).	17	The electronic configuration of Sodium (11 electrons) is 2,8,1.

4) Core concepts explained

Elements, Metals, and Non-metals (p. 2)

- All matter is made of **elements**, which are pure substances consisting of only one type of atom (p. 2).
- There are 118 identified elements, 98 of which occur naturally (p. 2).
- Elements can be classified as **metals** or **non-metals** based on their physical properties (p. 2).
- Chemists use unique one or two-letter symbols for each element, like H for hydrogen and Na for sodium (from its Latin name, *natrium*) (p. 3).

Property	Metal	Non-metal	Exam note
Appearance	Shiny (lustrous)	Dull	(p. 2)

Property	Metal	Non-metal	Exam note
State at room temp.	Usually solid (except Mercury)	Solid, liquid, or gas	(p. 2)
Density	Usually high	Usually low	(p. 2)
Malleability	Good (can be hammered into shape)	Poor (brittle or soft)	(p. 2)
Ductility	Good (can be drawn into wires)	Poor	(p. 2)
Conductivity	Good (thermal and electrical)	Very poor	(p. 2)

Molecules (p. 4)

- In some elements, atoms join together in small groups called **molecules** (p. 4).
- **Diatomic molecules** consist of two atoms joined together, such as oxygen (O_2), hydrogen (H_2), and chlorine (Cl_2) (p. 4).
- Some elements exist as individual, separate atoms and are called **monatomic**, like helium (He) and neon (Ne) (p. 4).
- Molecules can also be formed from atoms of different elements, like water (H_2O) (p. 5).

Compounds and Chemical Reactions (p. 5)

- Compounds are pure substances formed when two or more elements **chemically combine** in fixed proportions (pp. 5, 8).
- This combination is a **chemical reaction**, which creates a new substance with properties different from the original elements (p. 6).
- The formula of a compound, like CO_2, shows the symbols and ratio of atoms present (one carbon atom for every two oxygen atoms) (p. 7).
- **Word equations** show the names of reactants and products: `magnesium + oxygen → magnesium oxide` (p. 6).
- **Balanced symbol equations** use chemical formulae and show that no atoms are created or destroyed: `$2Mg(s) + O_2(g) \rightarrow 2MgO(s)` (p. 8). The numbers in front are coefficients, and the letters (s, g) are state symbols.

Oxidation and Reduction (p. 6)

- **Oxidation** is the **gain** of oxygen by a substance in a reaction (p. 6).
- **Reduction** is the **loss** of oxygen from a substance in a reaction (p. 6).
- A reaction that involves both oxidation and reduction is called a **redox reaction** (p. 6).
- An **oxidising agent** is a substance that oxidises another substance (by giving it oxygen) and gets reduced itself (p. 6).
- A **reducing agent** is a substance that reduces another substance (by taking its oxygen) and gets oxidised itself (p. 6).

Mixtures (p. 9)

- A mixture contains more than one substance (elements or compounds) that are **not chemically bonded** (p. 9).
- The composition of a mixture can vary (is not fixed) (p. 10).
- No new chemical substance is formed when a mixture is made (p. 10).
- The components of a mixture keep their original properties and can be separated by physical means (like using a magnet to separate iron from sulfur) (pp. 9-10).

Feature	Mixture (Iron + Sulfur)	Compound (Iron(II) Sulfide)
Formation	No chemical change, just mixing.	Chemical reaction (heating required).
Composition	Can be in any ratio.	Fixed ratio (1 atom Fe to 1 atom S).
Properties	Retains properties of both iron and sulfur.	New properties, different from Fe and S.
Separation	Can be separated by physical means (e.g., magnet).	Can only be separated by another chemical reaction.

Table adapted from pp. 9-10

Atomic Structure (p. 12)

- Atoms are made of three main sub-atomic particles: **protons, neutrons, and electrons** (p. 12).

- The **nucleus** is the dense, central part of the atom containing protons and neutrons (p. 12).
- **Electrons** are much smaller particles that move very quickly around the nucleus in specific energy levels called **electron shells** (p. 12).
- Atoms are electrically **neutral** because they have an equal number of positive protons and negative electrons (p. 12).

Particle	Relative Mass (amu)	Relative Charge	Location
Proton (p)	1	+1	Nucleus
Neutron (n)	1	0	Nucleus
Electron (e)	1/1837 (negligible)	-1	Shells

Table data from p. 12

Proton Number, Mass Number, and Isotopes (pp. 12-15)

- **Proton Number (Z)**: The number of protons in an atom. It defines the element (e.g., any atom with 6 protons is carbon) (p. 12).
- **Mass Number (A)**: The total number of protons and neutrons in an atom (p. 13).
- **Notation**: An element is represented as $^{A} * ZX$, where X is the symbol (p. 13). For example, Carbon-12 is $^{12} * 6C$.
- **Isotopes**: Atoms of the same element (same number of protons) but with a different number of neutrons (and therefore a different mass number) (p. 15).
- Isotopes of an element have the **same chemical properties** because they have the same number of electrons and the same electronic configuration (p. 15).

Ions (p. 14)

- An **ion** is a charged particle formed when a neutral atom loses or gains electrons (p. 14).
- **Cations** are **positive ions** formed when an atom **loses** one or more electrons. Metals tend to form cations (e.g., Na $rightarrow Na^{+} + e^{-}$) (p. 14).
- **Anions** are **negative ions** formed when an atom **gains** one or more electrons. Non-metals tend to form anions (e.g., $Cl + e^{-}$ $rightarrow Cl^{-}$) (p. 14).

Electron Arrangement (p. 17)

- Electrons fill shells starting from the one closest to the nucleus (p. 17).
- The maximum number of electrons in each shell is:
  - First shell: **2** electrons (p. 17).
  - Second shell: **8** electrons (p. 17).
  - Third shell: **8** electrons (before the fourth shell starts to fill) (p. 17).
- The **electronic configuration** is a shorthand for this arrangement (e.g., Sodium with 11 electrons is 2,8,1) (pp. 17, 18).
- An element's chemical reactivity is largely determined by the number of electrons in its outermost shell (p. 18).
- Elements with a full outer shell (like Neon: 2,8 and Argon: 2,8,8) are very stable and unreactive (p. 18).

5) Diagrams and micrographs (figures)

- **Figure 2.4 (p. 4):** Shows a model of a diatomic chlorine molecule (Cl_2). To redraw, draw two circles touching or slightly overlapping to represent the two chlorine atoms bonded together.
- **Figure 2.5 (p. 5):** Shows the reaction of hydrogen and oxygen. To redraw, show several separate H_2 molecules (two small circles bonded) and O_2 molecules (two larger circles bonded). Then draw an arrow pointing to several H_2O molecules (one large circle bonded to two small circles).
- **Figure 2.13 (p. 12):** Shows a general diagram of an atom. To redraw, draw a central circle labeled "Nucleus, containing neutrons and protons." Then draw one or more large concentric circles around it labeled "Electron shells."
- **Figure 2.14 (p. 12):** Shows an atom of helium (${}^{4}\_2He$). To redraw, draw a nucleus with 2 blue circles (Protons) and 2 yellow circles (Neutrons). Draw one shell around the nucleus containing 2 green circles (Electrons).
- **Figure 2.15 (p. 15):** Shows the nuclei of two chlorine isotopes. To redraw:
  - For Chlorine-35 (${}^{35}\_17Cl$): Draw a nucleus with 17 blue circles (protons) and 18 yellow circles (neutrons).
  - For Chlorine-37 (${}^{37}\_17Cl$): Draw a nucleus with 17 blue circles (protons) and 20 yellow circles (neutrons).
- **Figure 2.19 (p. 17):** Shows the electron arrangement of an oxygen atom (${}^{16}\_8O$). To redraw, draw a central nucleus labeled "8p, 8n". Draw a first shell with 2 'x' marks on it. Draw a second,

outer shell with 6 'x' marks on it.

6) Processes and cycles

1. Forming a Compound (Iron(II) sulfide) (p. 10)

1. **Start:** A physical mixture of iron filings (dark grey powder) and sulfur powder (yellow) is created. They can be separated by a magnet.
2. **Input:** Heat energy is supplied to start the reaction.
3. **Process:** A chemical reaction occurs. It is an **exothermic reaction**, meaning it gives out heat energy as new chemical bonds are formed.
4. **Output:** A new compound, iron(II) sulfide (FeS), is formed. This is a black solid that is not magnetic.
5. **Word Equation:** `iron + sulfur → iron(II) sulfide` (p. 10).

2. Forming an Ion (Ionisation) (p. 14)

- **Cation formation (e.g., Sodium):**
  i. A neutral sodium atom (Na) has 11 protons (+) and 11 electrons (-). Its electronic configuration is 2,8,1.
  ii. During a chemical reaction, it loses the single electron from its outer shell to achieve a stable, full outer shell.
  iii. It now has 11 protons (+) but only 10 electrons (-).
  iv. The result is a sodium ion with an overall charge of +1, written as Na^+.
- **Anion formation (e.g., Oxygen):**
  i. A neutral oxygen atom (O) has 8 protons (+) and 8 electrons (-). Its electronic configuration is 2,6.
  ii. During a chemical reaction, it gains two electrons to achieve a stable, full outer shell of 8.
  iii. It now has 8 protons (+) but 10 electrons (-).
  iv. The result is an oxide ion with an overall charge of -2, written as O^{2-}.

7) Formulae and calculations

Quantity	Formula	Units	Typical values	Worked example (with page ref)
Number of neutrons	Number of neutrons = Mass number (A) - Proton number (Z)	(none)	0–146+	**Find the number of neutrons in $^{24}\_12Mg$:** Neutrons = 24 - 12 = 12 (p. 13).
Relative Atomic Mass (A_r)	ParseError: KaTeX parse error: Expected '}', got 'EOF' at end of input: …_2) + ...}{100}	amu (atomic mass units) or none	1.0–250+	**Find the A_r of chlorine, which is 75% ^{35}Cl and 25% ^{37}Cl:** $A\_r = frac(75times35) + (25times37)100 = frac2625 + 925100 = 35.5$ (p. 16).

8) Required practicals / experiments

Heating copper in air (p. 7)

- **Aim:** To find out what happens when copper is heated in air.
- **Apparatus:** Crucible, tongs, Bunsen burner, heatproof mat, tripod, pipe-clay triangle, mass balance.
- **Method:**
  i. Measure the mass of an empty crucible.
  ii. Add a piece of copper to the crucible and measure the total mass.
  iii. Place the crucible on the pipe-clay triangle and tripod. Heat it strongly with a Bunsen burner for about two minutes.
  iv. Allow the crucible to cool completely.
  v. Measure the final mass of the crucible and its contents.
- **Variables:**

    - **IV:** Presence of heat.
    - **DV:** Change in mass and appearance of the copper.
    - **Controls:** Using the same piece of copper and mass balance throughout.
- **Safety:** Wear eye protection. Handle hot apparatus with tongs (p. 7).
- **Sources of error:** Incomplete reaction of copper; loss of solid if heating is too vigorous; measurement errors on the balance.
- **Improvements:** Placing a lid on the crucible (but lifting it occasionally to allow air in) would prevent any loss of the product. Heating until a constant mass is achieved ensures the reaction is complete.
- **Expected results:** The copper turns into a black substance (copper(II) oxide) and the total mass increases because oxygen atoms from the air have combined with the copper atoms (p. 7). The word equation is `copper + oxygen → copper(II) oxide`.

9) Data handling and graphing

- This chapter primarily uses **tables** to present data, such as:
    - **Table 2.1 (p. 2):** Physical data (density, melting/boiling points) for metals and non-metals. You may be asked to identify trends from this data (e.g., metals generally have high melting points).
    - **Table 2.2 (p. 2):** A summary of comparative properties. Exam questions often ask you to use these properties to classify a substance.
    - **Table 2.9 (p. 13):** Shows the number of sub-atomic particles for various elements. You must be able to calculate any missing values.
    - **Table 2.12 (p. 18):** Electronic configurations for the first 20 elements. You should be able to deduce these from the proton number.
- No graphs are required for analysis in the core content of this chapter.

10) Common misconceptions and exam tips

- **Misconception:** In a balanced equation like $2H\_2O$, the '2's mean the same thing.
    - **Correct understanding:** The subscript 2 in H_2 means two hydrogen atoms are bonded in one molecule. The coefficient 2 in front means there are two separate water molecules.
    - **Quick tip: Sub**scripts are for inside the molecule; **Co**efficients are for counting the molecules. Never change subscripts to balance an equation.

- **Misconception:** Isotopes are different elements because they have different masses.
  - **Correct understanding:** Isotopes are atoms of the *same* element. The element is defined by the proton number, which is identical for all isotopes of that element.
  - **Quick tip: Iso**topes have the **sa**me number of **p**rotons. `iso-p` .
- **Misconception:** The mass of an atom is just the mass of the protons.
  - **Correct understanding:** The mass is determined by protons **and** neutrons in the nucleus. Electrons have a negligible mass.
  - **Quick tip:** Mass number is the "massy" particles: protons + neutrons.
- **Misconception:** When an atom becomes an ion, its nucleus changes.
  - **Correct understanding:** Ionisation only involves the loss or gain of electrons from the outer shells. The number of protons and neutrons in the nucleus remains unchanged.
  - **Quick tip:** Losing negative electrons makes an ion **p**ositive (a **p**ussycat-ion/cation!). Gaining negative electrons makes an ion negative.

11) Exam-style practice

Multiple Choice Questions (MCQs)

1. Which substance is an element?
   A) Water
   B) Air
   C) Copper
   D) Salt
2. An atom has 13 protons, 14 neutrons and 13 electrons. What is its mass number?
   A) 13
   B) 14
   C) 26
   D) 27
3. What is the electronic configuration of a calcium atom (proton number = 20)?
   A) 2,8,10
   B) 2,8,8,2
   C) 20
   D) 2,8,2,8
4. How is a negative ion (anion) formed?
   A) By gaining protons
   B) By losing protons

C) By gaining electrons

D) By losing electrons

5. The reaction `zinc oxide + carbon → zinc + carbon dioxide` is a redox reaction. What happens to the zinc oxide?

   A) It is oxidised

   B) It is reduced

   C) It is neutralised

   D) It is melted

6. Which statement correctly compares metals and non-metals?

   A) Metals are dull, non-metals are shiny.

   B) Metals are poor electrical conductors, non-metals are good.

   C) Metals are malleable, non-metals are brittle.

   D) Metals have low density, non-metals have high density.

7. What do the isotopes ^{35}Cl and ^{37}Cl have in common?

   A) The same number of neutrons.

   B) The same mass number.

   C) The same number of electrons.

   D) The same density.

8. What is the correct balanced equation for the reaction between lithium and oxygen?

   A) $Li + O\_2$
   $rightarrow LiO\_2$

   B) $2Li + O$
   $rightarrow Li\_2O$

   C) $Li\_2 + O\_2$
   $rightarrow 2LiO$

   D) $4Li + O\_2$
   $rightarrow 2Li\_2O$

9. Which of the following is a mixture?

   A) Iron(II) sulfide

   B) Sea water

   C) Ammonia

   D) Carbon dioxide

10. A substance has a fixed composition, and its components can only be separated by chemical reactions. What is this substance?

    A) A mixture

    B) An element

    C) An alloy

    D) A compound

MCQ Answers:

1. **C)** Copper is made of only copper atoms.
2. **D)** Mass number = protons + neutrons = 13 + 14 = 27.
3. **B)** Electrons fill shells 2 (full), 8 (full), 8 (stable), then 2 in the fourth shell.
4. **C)** Gaining negative electrons results in an overall negative charge.
5. **B)** Zinc oxide loses oxygen to become zinc, which is reduction.
6. **C)** Malleability is a key property of metals; non-metals are typically brittle.
7. **C)** As neutral atoms, they have the same proton number (17), so they also have 17 electrons.
8. **D)** This equation has the same number of Li atoms (4) and O atoms (2) on both sides.
9. **B)** Sea water contains water, salts, and dissolved gases not chemically bonded.
10. **D)** This is the definition of a compound.

Short-Answer Questions

1. **Define the term *isotope* using the element carbon ($^{12} * 6C$ and $^{14} * 6C$) as an example.**
   - **Answer:** Isotopes are atoms of the same element that have the same number of protons but a different number of neutrons (p. 15). For example, both ^{12}C and ^{14}C have 6 protons, but ^{12}C has 6 neutrons while ^{14}C has 8 neutrons.
2. **State two physical properties that can be used to distinguish between the metal zinc and the non-metal sulfur.**
   - **Answer:** 1. Appearance: Zinc is shiny, while sulfur is dull. 2. Electrical conductivity: Zinc is a good conductor, while sulfur is a very poor conductor (p. 2). (Other valid answers: malleability, density, melting point).
3. **Explain, in terms of sub-atomic particles, why an atom of sodium is electrically neutral.**
   - **Answer:** A sodium atom has 11 protons in its nucleus, each with a +1 charge, giving a total positive charge of +11 (p. 13, Table 2.9). It also has 11 electrons orbiting the nucleus, each with a -1 charge, giving a total negative charge of -11 (p. 12). The positive and negative charges cancel each other out, so the atom has no overall charge (is neutral) (p. 12).
4. **Write a balanced chemical equation, including state symbols, for the formation of magnesium oxide from magnesium and oxygen.**
   - **Answer:** $2Mg(s) + O\_2(g)$ $rightarrow 2MgO(s)$ (p. 8).
5. **A sample of boron contains 20% of the isotope ^{10}B and 80% of the isotope ^{11}B. Calculate its relative atomic mass.**
   - **Answer:** $A\_r =$

$frac(20times10) + (80times11)100$ (1 mark). $A\_r =$
$frac200 + 880100 =$
$frac1080100 = 10.8$ (1 mark).

Structured Questions

1. The table below shows information about five different particles.

Particle	Number of Protons	Number of Neutrons	Number of Electrons
A	17	18	17
B	11	12	10
C	17	20	17
D	18	22	18
E	9	10	10

```
a.  **Identify** which particle (A–E) is a positive ion. **Explain** your answer. [2]
b.  **Identify** which two particles are isotopes of the same element. **Explain** your
c.  **Identify** which particle is an atom of a noble gas. [1]
d.  **State** the mass number of particle C. [1]

***Marking Points:***
a.  Particle **B** (1). It has more protons (11) than electrons (10), giving it an over
b.  Particles **A and C** (1). They have the same number of protons (17) but different
c.  Particle **D** (1). (It has 18 protons, making it Argon, which has a full outer she
d.  Mass number is protons + neutrons = 17 + 20 = **37** (1).
```

2. Iron can be extracted from iron(III) oxide in a blast furnace. The overall redox reaction is shown by the word equation:
   `iron(III) oxide + carbon monoxide → iron + carbon dioxide` (p. 6).
   a. **Define** the term *reduction* in terms of oxygen transfer. [1]
   b. **Identify** the substance that is reduced in this reaction. [1]
   c. **Identify** the reducing agent in this reaction. **Explain** your choice. [2]
   d. The properties of iron (a metal) are very different from the properties of sulfur (a non-metal). **Describe** the difference between a mixture of iron and sulfur and the compound iron(II) sulfide. [2]

Marking Points:

a. Reduction is the **loss** of oxygen (1) (p. 6).

b. **Iron(III) oxide** (1) (p. 6).

c. The reducing agent is **carbon monoxide** (1). It removes oxygen from the iron(III) oxide (and becomes oxidised to carbon dioxide itself) (1) (p. 6).

d. A mixture of iron and sulfur retains the properties of both and can be separated physically (e.g. by a magnet) (1). The compound iron(II) sulfide is a new substance with different properties (e.g. not magnetic) and its elements cannot be separated physically (1) (pp. 9-10).

12) Quick revision checklist

- ☐ I can define element, compound, and mixture and give an example of each.
- ☐ I can list three key differences between metals and non-metals.
- ☐ I can state the relative mass and charge of a proton, neutron, and electron.
- ☐ I can explain that an atom is neutral because it has an equal number of protons and electrons.
- ☐ I can define proton number (Z) and mass number (A).
- ☐ I can calculate the number of protons, neutrons, and electrons in any atom given its $^{A}\_ZX$ notation.
- ☐ I can define isotopes and explain why they have identical chemical properties.
- ☐ I can calculate the relative atomic mass (A_r) from the abundances of two isotopes.
- ☐ I can draw the electronic configuration for any of the first 20 elements.
- ☐ I can explain how positive cations and negative anions are formed by losing or gaining electrons.
- ☐ I can write a simple word equation and balance a simple chemical equation.
- ☐ I can define oxidation as oxygen gain and reduction as oxygen loss.
- ☐ I can identify the substance being oxidised/reduced in a redox reaction.

13) Flashcards (ready-to-use)

Question	Answer
What is an element?	A pure substance containing only one type of atom (p. 2).
What is a compound?	A pure substance made of two or more elements chemically bonded together in a fixed ratio (p. 5).

Question	Answer
What is the charge of a proton, neutron, and electron?	Proton: +1, Neutron: 0, Electron: -1 (p. 12).
What is the mass number (A)?	The total number of protons and neutrons in the nucleus (p. 13).
What is the proton number (Z)?	The number of protons in the nucleus; it identifies the element (p. 12).
What are isotopes?	Atoms of the same element with the same number of protons but different numbers of neutrons (p. 15).
How is a positive ion (cation) formed?	When a neutral atom loses one or more electrons (p. 14).
What is the electronic configuration of Magnesium (12 protons)?	2,8,2 (p. 18).
What is oxidation?	The gain of oxygen in a chemical reaction (p. 6).
What is reduction?	The loss of oxygen in a chemical reaction (p. 6).
What is the key difference between a mixture and a compound?	In a mixture, substances are not chemically bonded. In a compound, elements are chemically bonded (p. 10).
How do you balance the equation: $H_2 + O_2 rightarrow H_2O$?	$2H_2 + O_2 rightarrow 2H_2O$.
How many atoms are in one molecule of sulfuric acid, H_2SO_4?	2 Hydrogen, 1 Sulfur, 4 Oxygen (Total = 7 atoms).
What does malleable mean?	It can be hammered or pressed into different shapes without breaking. It is a property of metals (p. 2).
Why are noble gases like Neon unreactive?	They have a full outer shell of electrons, which is a very stable arrangement (p. 18).

14) 60-second recap

This chapter covers the basics of matter. All matter is made of atoms, which contain a central nucleus of positive protons and neutral neutrons. Negative electrons orbit the nucleus in shells. A substance with only one type of atom is an element, like copper. Elements chemically bond to form compounds, like water (H_2O), in fixed ratios. Substances that are just mixed without bonding are called mixtures, like air. We can classify elements as metals (shiny, good conductors) or non-metals (dull, poor conductors). The number of protons defines an element, but the number of neutrons can vary, creating isotopes. Atoms gain or lose electrons to form charged ions. Finally, chemical reactions, like oxidation (gaining oxygen) and reduction (losing oxygen), create new substances.

15) References to pages

16) Excluded "Going further" sections (not summarized)

Section title	Pages
Instrumental techniques	9
Other types of mixtures	11
The mass spectrometer	16
Relative atomic mass (details using the mass spectrometer)	16
Total excluded:	**4**