Website: contoureducation.com.au | **Phone:** 1800 888 300
Email: hello@contoureducation.com.au

VCE Chemistry ½
AOS 1 Revision I [1.12]
Workbook

Outline:

Section A: [1.1] – Models of Atoms (19 Marks)

Sub-Section: Recap

Cheat Sheet

[1.1.1] – Describe the composition of an atom, and write the isotopic symbol of an element/ion & use it to identify an element's/ion's atomic and mass number

- Atoms are made up of _____ subatomic particles.
- Protons are [positively] / [negatively] charged and are found in the _____.
- Neutrons have [positive] / [negative] / [no] charge and are also found within the **nucleus.**
- Electrons are [positively] / [negatively] **charged** and significantly [smaller] / [bigger] in size and mass than nucleons.
- Rutherford's gold experiment saw him firing _____ particles at a **thin gold sheet,** where the majority [rebounded] / [passed through], proving that atoms are mostly comprised of _____ .
- Atoms are identified by their [atomic] / [mass] number.
- Atoms can gain or lose electrons, forming [isotopes] / [ions].
- The mass number is the number of [protons] / [neutrons] / [electrons] / [nucleons] present in an atom.
- Isotopic symbol Representation *(Label Below)*

$$\rightarrow A$$
$$E \leftarrow \text{symbol for element}$$
$$\rightarrow Z$$

- Isotopes are two or more of the same elements with the [same] / [different] number of **protons**, but [same] / [different] number of **neutrons**, and therefore, [same] / [different] mass numbers.

[1.1.2] – Describe Bohr's model of the atom & draw shell model diagrams & apply emission spectra to Bohr's model of the atom

- Key Ideas from Bohr's Model:
- Electrons exist in [discrete] / [variable] energy levels, called _____ .
- _____ model diagrams show the number of electrons within each shell.
- Electrons [can] / [cannot] move between energy levels.
- When energy is inputted, electrons are _____ to a [lower] / [higher] energy level.
- Electrons eventually drop back down - as they always want to be in the [lowest] / [highest] energy state - whereby energy is released in the form of _____, which [is] / [is not] unique to each element.

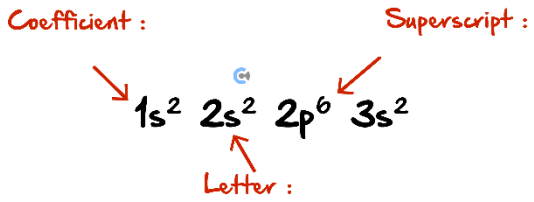
[1.1.3] – Explain Schrödinger's model of the atom and identify differences between his model and Bohr's model

- An **orbital** is a region of space in which electrons exist [in discrete energy levels] / [randomly].
- Each orbital can hold up to _____ electrons.
- There are 4 different types of orbitals:_____, which respectively hold _____ electrons.
- Each shell n contains n subshells. For example, shell 2 contains _____ subshells: 2s and 2_____.

Cheat Sheet

[1.1.4] – Write electron configurations of elements and ions, in both ground and excited states, using both Bohr and Schrödinger models (including Cu and Cr exceptions and condensed notation)

- Electron shells are filled in order from the nucleus, with the [innermost] / [outermost] shells fully filled before moving on.
- Each shell can hold up to _____ electrons, where n is the shell number.
- The octet rule states that the valence electron shell can only hold a maximum of _____ electrons.
- Schrodinger representation:



- Due to it having a lower energy level, the 4s subshell fills before the _____ subshell.
- If electrons are found to be in higher energy levels without the lower ones being filled first, they are in the [ground] / [excited] state.
- Cu and Cr Schrodinger electron configurations are:

Chromium $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

Copper $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$

- Condensed notation: _____ gas in square brackets, as they have _____ outer shells.

Let's walkthrough together!

Question 1 [1.1.2] Walkthrough.

Draw the shell model diagram of aluminium.

Question 2 [1.1.4] Walkthrough.

Write the Schrödinger's electronic configuration for potassium (K).

_____

Space for Personal Notes

Sub-Section: Question Set

INSTRUCTION: 19 Marks. 11 Minutes Writing.

Question 3 (1 mark) **[1.1.1]**

An isotope of carbon has 6 protons and 8 neutrons. What is its correct notation?

A. $^{12}_{6}C$

B. $^{14}_{6}C$

C. $^{14}_{8}C$

D. $^{12}_{8}C$

Question 4 (3 marks)

For the following, write the Schrödinger electron configuration:

a. Lithium. (1 mark) **[1.1.4]**

_____

b. Nitrogen. (1 mark) **[1.1.4]**

_____

c. Neon. (1 mark) **[1.1.4]**

_____

Space for Personal Notes

Question 5 (2 marks)

Write the condensed Schrödinger configuration of:

a. Aluminium. (1 mark) **[1.1.4]**

_____

b. Rubidium. (1 mark) **[1.1.4]**

_____

Question 6 (2 marks) **[1.1.3]**

Explain the main difference between Schrödinger's model and Bohr's model regarding electron orbit.

_____

_____

_____

_____

Space for Personal Notes

Question 7 (6 marks)

Emily decides to expand on her Chemistry knowledge by examining an atom of magnesium.

a. Outline the main observation obtained from Rutherford's Gold Foil experiment. (1 mark) **[1.1.2]**

_____

_____

b.

i. State the number of neutrons in a magnesium atom if it has a mass number of 25 and 12 electrons present. (1 mark) **[1.1.1]**

_____

_____

ii. Write the isotopic symbol for this magnesium atom. (1 line) **[1.1.1]**

_____

_____

c. Magnesium is known to emit a white light when burned. What exactly determines the colour of light emitted by an element? (2 marks) **[1.1.2]**

_____

_____

_____

d. Draw the shell model diagram for Mg. (1 mark) **[1.1.2]**

Check off any learning objectives obtained full marks from the "Contour Check" booklet!

Sub-Section: Additional Questions

Question 8 (2 marks) **[1.1.4]**

Briefly explain why we observe copper's electron configuration to be atypical and write it out.

Question 9 (3 marks)

For the following electron configurations, write the element that corresponds to them:

a. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$. (1 mark) **[1.1.4]**

b. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$. (1 mark) **[1.1.4]**

c. $1s^2 2s^2 2p^6 3s^2 3p^4$. (1 mark) **[1.1.4]**

Space for Personal Notes

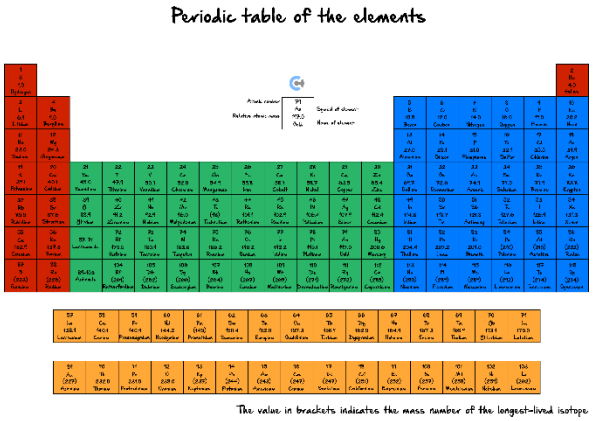
Section B: [1.2] – Trends in the Periodic Table (16 Marks)

Sub-Section: Recap

Cheat Sheet

[1.2.1] – Explain why the periodic table is arranged the way it is, with respect to blocks, periods and groups

- There are 7 horizontal rows in the periodic table called _____.
- The period number represents how many _____ the element has.
- The periodic table can be thought of as being separated into the following blocks (Label below):



- The 18 vertical columns of elements are called _____ .
- The groups (only for groups 1-2 & 13-18) correlate to the number of _____.
- Elements in group 18 are known as the _____.
- They have _____ outer shells, and are, therefore, [reactive] / [inert].

[1.2.2] – Explain what the terms 'electronegativity, 'atomic radius', 'first ionisation energy', 'metallic character' and 'non-metallic character' mean, and explain how they vary across a period and down a group

- _____is the ability of an atom to attract electrons toward itself.
- The _____ character is the tendency of an element to gain electrons and form [anions] / [cations].
- The _____ is a measurement of the size of the atom.
- The _____ is the tendency of an element to lose electrons and form [anions] / [cations].
- The _____ is the energy required to remove one electron from an element.

	Across a period	Down a group
First ionisation energy	[increases] / [decreases]	[increases] / [decreases]
Electronegativity	[increases] / [decreases]	[increases] / [decreases]
Atomic radius	[increases] / [decreases]	[increases] / [decreases]
Metallic character	[increases] / [decreases]	[increases] / [decreases]
Non-metallic character	[increases] / [decreases]	[increases] / [decreases]

Cheat Sheet

[1.2.3] – Find the effective nuclear/core charge of an element, explain how it varies across a period and down a group, and apply it to other trends observed in the periodic table

- The _____ is a measure of the attractive force 'felt' by the valence electrons.
- It is calculated by: core charge = number of _____- number of _____.
- Effective nuclear charge/core charge can be found by simply counting the number of _____ electrons.
- Effective nuclear charge [increases] / [decreases] / [stays the same] going down a group.
- Effective nuclear charge [increases] / [decreases] / [stays the same] across a period.
- The core charge can be thought of as the amount of **shielding** provided to the valence electrons from the nucleus by the _____ electrons.

Let's walkthrough together!

Question 10 (3 marks) **Walkthrough.**

Fluorine gas is a common chemical used in water treatment, dental care and cleaning.

a. Complete the following information regarding fluorine:

i. Period: **[1.2.1]**

ii. Group: **[1.2.1]**

iii. Block: **[1.2.1]**

b. Hence or otherwise, state:

i. How many valence electrons does fluorine have? **[1.2.1 & 1.2.3]**

ii. How many electron shells does fluorine have? **[1.2.1 & 1.2.3]**

iii. Fluorine's core charge: **[1.2.1 & 1.2.3]**

c. Would you expect fluorine or neon to have a higher first ionisation energy? Explain your answer. (3 marks) **[1.2.2 & 1.2.3]**

_____

_____

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Space for Personal Notes

Sub-Section: Questions Set

INSTRUCTION: 13 Marks. 13 Minutes Writing.

Question 11 (4 marks)

Consider the following elements:

a. State the effective nuclear charge of each of the following atoms:

i. Cl. (1 mark) **[1.2.3]**

_____

ii. Na. (1 mark) **[1.2.3]**

_____

iii. B. (1 mark) **[1.2.3]**

_____

b. Rank these in terms of increasing electronegativity. (1 mark) **[1.2.2]**

_____

Space for Personal Notes

Question 12 (2 marks) **[1.2.2]**

Determine whether oxygen or sulphur has a greater atomic radius. Briefly justify your answer.

_____

_____

_____

Question 13 (3 marks) **[1.2.2 & 1.2.3]**

Compare the metallic character of francium with barium. Explain your answer with reference to trends in the periodic table.

_____

_____

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_____

_____

Question 14 (2 marks) **[1.2.1]**

Explain why the second period only contains 8 elements.

_____

_____

Check off any learning objectives obtained full marks from the "Contour Check" booklet!

Sub-Section: Additional Questions

Question 15 (2 marks) **[1.2.1]**

Explain how an atom of calcium will gain a full valence shell according to the Octet Rule.

_____

_____

_____

Question 16 [1.2.2 & 1.2.3]

Explain what is meant by non-metallic character, and list 2 other trends in the periodic table which have a direct correlation to it.

_____

_____

_____

Space for Personal Notes

Section C: [1.3 – 1.4] – Metals & Covalent Lattices + Metal Reactions & Recycling (25 Marks)

Sub-Section: Recap

Cheat Sheet

[[1.3.1] – Explain the metallic bonding model

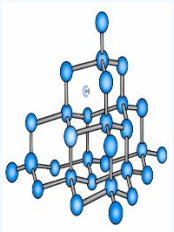
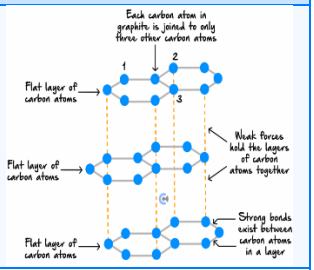
- Metallic bonding is caused by _____ between metal cations and the electrons lost.
- The lost electrons group together in a '_____ **electrons**.
- The metal cations are arranged within a _____.

[1.3.2] – Identify properties of metals (High MP/BP, electrical & thermal conductivity, malleability & ductility, lustre)

- Metals are **[good] / [bad]** conductors of electricity and heat due to the presence of _____.
- Metals are malleable and ductile when struck, the lattice structure of a metal. _____ , but _____ due to electrostatic attraction between the cations and delocalised electrons.
- As delocalised electrons can reflect light, metals are _____.
- Metallic bonding is **strong, hard, and dense** due to the strong _____ between metal cations and the sea of delocalised electrons.
- A **[higher] / [lower]** charge of metal results in stronger metallic bonding.
- Within the same group, metals with smaller atomic radii will have **[greater] / [weaker]** electrostatic attraction, and therefore, **[stronger] / [weaker]** metallic bonding.
- Melting point → Intermolecular bonds are _____.
- Boiling point → Intermolecular bonds are _____.

[1.3.3] – Explain the covalent lattice structures bonding & properties of diamond and graphite

- Diamond and Graphite are both _____ of carbon.

Diamonds	Graphite
	
Strength: **[High] / [Low]**	**Strength:** Vertical Strength: **[High] / [Low]** as it bonds via _____. Horizontal Strength: **[High] / [Low]** as it bonds via _____.
Melting Point: **[High] / [Low]**	Melting Point: **[High] / [Low]**
Conductivity of Electricity: **[High] / [Low]**	Conductivity of Electricity: **[High] / [Low]**
Conductivity of Heat: **[High] / [Low]**	Conductivity of Heat: **[High] / [Low]**

Cheat Sheet

[1.4.1] – Write balanced equations for the reactions between a metal and oxygen and between a metal and water, and explain any relevant implications of these reactions

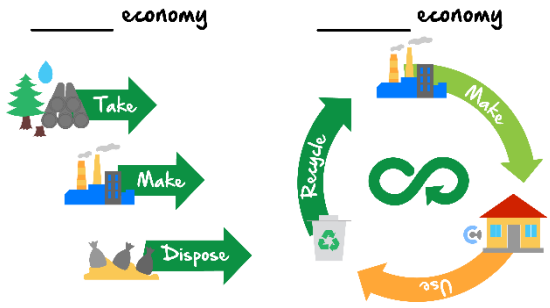
- Metals [gain] / [lose] electrons when reacting to gain a full outer shell.
- The worded equation for metals reacting in air is: $\text{Metal(s)} +$
- Consequently, the outside of a metal turns into its [pure] / [oxide] form, which is [shiny] / [dull].
- The inside, however, [has] / [has no] contact with atmospheric oxygen, and so remains as the pure, [shiny] / [dull] metal.
- The worded equation for metals reacting in water is: $\text{Metal(s)} + \text{Water(l)} \rightarrow$
- This produces hydrogen gas, which is _____, and hence, can cause an explosion.

[1.4.2] – Apply trends in the periodic table to metal reactivity

- Metal reactivity has a direct correlation with [metallic] / [non-metallic] character & first ionisation energy.
- Metal reactivity [increases] / [decreases] down a group but [increases] / [decreases] across a period.
- Expensive metals are all fairly [reactive] / [unreactive] and thus exist in their usual metallic form, remaining [shiny] / [dull].
- To prevent reactive metals from reacting with oxygen in the air, they are usually stored in _____ or _____.

[1.4.3] – Explain how metals are obtained and recycled, and their associated advantages and disadvantages

- Metals are typically found in their stable, [atomic] / [ionic] form.
- After the metal ore is extracted, the pure metal is obtained by heating it at high temperatures with carbon, which is a process called _____.
- Mining process uses land that needs to be cleared by deforestation which can lead to habitat _____.
- The processes used to extract the pure metal from the ground uses large amounts of _____.
- This increasing use of energy is typically provided by [renewable] / [fossil] fuels which leads to more _____ emissions.
- The 2 major types of economies are *(Label Below):*



- The more reactive a metal is, the [more] / [less] energy it requires to extract the metal and store it safely.
- Group 1 and Group 2 metals generally [are] / [are not] used to construct things, as they [are] / [are not] very reactive and dangerous, and thus are generally **not recycled** due to their scarce use.
- The recycling of metals uses [clean] / [scrap] metal, which is first collected and _____.
- It is then classified into _____ and non-_____ groups, before being _____ and finally, _____.

Let's Walkthrough Together!

Question 17 (2 marks) **[1.3.1 & 1.4.2] Walkthrough.**

Out of sodium and magnesium, which one of the two is expected to have stronger metallic bonding? Explain your answer.

_____

_____

_____

_____

Question 18 [1.4.1] Walkthrough.

Write the reaction which occurs between aluminium metal and oxygen in the air.

_____

_____

Space for Personal Notes

Question 19 (4 marks) **Walkthrough.**

A chemist wants to have a closer look at sodium metal.

a. The chemist takes a block of sodium and cuts it down the middle to reveal a fresh shiny surface. However, after 2 minutes the surface loses its shine and becomes matte in appearance. Explain these observations. (2 marks) **[1.4.1]**

_____

_____

_____

_____

b. Write the equation for the reaction that occurs between water and pure sodium. (1 mark) **[1.4.1]**

_____

c. Suggest why this reaction may be a safety hazard inside of a lab. (1 mark) **[1.4.1]**

_____

Space for Personal Notes

Sub-Section: Questions Set

INSTRUCTION: 13 Marks. 13 Minutes Writing.

Question 20 (4 marks)

Consider iron, one of the most commonly used metals in the world.

a. Iron is typically shaped into different sizes for a wide variety of uses. State what property of it allows this and explain why it exists. (2 marks). **[1.3.1 & 1.3.2]**

_____

_____

_____

_____

b. A stainless steel bucket made mostly of iron is let out to sit in the sun after Vihaan forgot to bring it in. Now when he goes back, he touches it and immediately lets go because it is too hot. Explain this phenomenon using chemistry. (2 marks) **[1.3.1 & 1.3.2]**

_____

_____

_____

_____

Question 21 (1 mark) **[1.4.1]**

Write the equation for the reaction between magnesium and water.

_____

Question 22 (6 marks)

Consider the metal of lithium which is often used in batteries.

a. Give its reaction when exposed to air. (1 mark) **[1.4.1]**

_____

b. Compared to a metal such as potassium, explain which one would be more reactive. (2 marks) **[1.4.2]**

_____

_____

_____

c.

i. In a phone, would it be feasible to extract all metals within it successfully such as lithium? Explain your answer. (2 marks) **[1.4.3]**

_____

_____

_____

ii. Explain which type of economy metal recycling contributes to. (1 mark) **[1.4.3]**

_____

_____

Space for Personal Notes

Question 23 (3 marks) **[1.3.3]**

With reference to its structure, explain why graphite is used in pencil lead.

_____

_____

_____

_____

_____

Check off any learning objectives obtained full marks from the "Contour Check" booklet!

Space for Personal Notes

Sub-Section: Additional

Question 24 (5 marks)

Sodium is a metal which is a good conductor of electricity and heat with low density. It is found all across the world, but is not found as a free metal in nature typically.

a. Draw a diagram to show metallic bonding which is occurring inside a block of pure sodium. (2 marks) **[1.3.1]**

b. Explain why metals such as sodium are electrically conductive. (2 marks) **[1.3.2]**

_____

_____

_____

c. Suggest how sodium would be stored in a school lab. (1 mark) **[1.4.2]**

_____

Space for Personal Notes

Section D: [1.5] – Ionic Compounds (14 Marks)

Sub-Section: Recap

Cheat Sheet

[1.5.1] – Write the formula of simple & complex (containing polyatomic and transition metal ions) ionic compounds and be able to name them

- A _____ ion is an ion which contains multiple atoms.
- A _____ (a number in front of the compound) represents how many of the **entire compound** there is.
- A _____ (like y in the expression x_y) represents how many of the **individual atoms/polyatomic ions** are there in a compound.
- The _____ of an ion is just another name for the **charge** on an ion.
- There are **two** ways to figure out the charge on an ion with multiple electro-valencies:
  - _____ Numerals.
  - Using charges from an _____ compound.
- To name an ionic compound:
  - The [cation] / [anion] is written first, followed by the [cation] / [anion].
  - Cation names are [changed] / [unchanged].
  - Anions are usually changed in the way in which they are named, typically ending in _____.
- To write the formula of an ionic compound:
  - Ensure the charges on the cation and anion cancel out to make the overall compound _____.

[1.5.2] – Explain the structure of ionic compounds and be able to draw electron transfer diagrams

- When one atom gives its electron to the other atom, an _____ bond is formed.
- The cation is usually a [metal] / [non-metal] and binds with an anion – usually a [metal] / [non-metal] – to form an ionic compound.
- This bond arises from _____ between the positive and negative ions.
- A _____ structure exists between the cations and anions within an ionic compound.
- An _____ diagram shows how the electrons are **transferred** when an ionic bond is formed.

Cheat Sheet

[1.5.3] – Explain the properties of ionic compounds (hardness, high MP/BP, brittleness, electrical conductivity in various states), with reference to their structure and bonding

- Ionic compounds have very [high] / [low] melting/boiling points.
- This is due to the [strong] / [weak] electrostatic attraction present within the lattice structure.
- Ionic compounds are [hard] / [soft] due to their **strong** lattice structures.
- When the lattice structure is **misaligned** due to an external force, electrostatic [attraction] / [repulsion] occurs, resulting in the entire ionic lattice structure to [stay intact] / [shatter], making ionic compounds [brittle] / [malleable].
- In a solid state, ionic compounds comprise of ions [moving] / [trapped] in a lattice, and consequently, [can] / [cannot] conduct electricity.
- In a molten/aqueous state, ionic compounds exist such that their ions are [free to move] / [trapped], and so they [can] / [cannot] conduct electricity.

Let's Walkthrough Together!

Question 25 [1.5.1] Walkthrough.

State the formula of the ionic compound formed between ammonium ions and sulphide ions.

_____

_____

Question 26 (5 marks) **Walkthrough**.

a. Draw the electron transfer diagram taking place when sodium metal reacts with oxygen. (3 marks) **[1.5.2]**

b. State whether the resulting compound would have a high or low melting point. Briefly justify your answer. (2 marks) **[1.5.3]**

_____

_____

_____

Sub-Section: Questions Set

INSTRUCTION: 9 Marks. 9 Minutes Writing.

Question 27

Name each of the following ionic compounds:

a. $AlBr_3$. **[1.5.1]**

b. Na_2O. **[1.5.1]**

Question 28

Determine the formula of the following ionic compounds:

a. Calcium fluoride. **[1.5.1]**

b. Magnesium cyanide. **[1.5.1]**

c. Aluminium thiosulphate. **[1.5.1]**

Space for Personal Notes

Question 29 (3 marks)

Consider the metal barium and the ion sulphate.

a. State the most likely formula of the ionic compound formed between these two species. (1 mark) **[1.5.1]**

_____

b. Can the resulting compound conduct electricity as it is? Explain why/why not. If not, state what conditions would be required. (2 marks) **[1.5.3]**

_____

_____

_____

_____

Question 30 (3 marks)

You are in a heated argument with your best friend regarding the charge of iron in FeO. They argue that it is +1 as the subscript on oxygen is +1, but you are trying to convince them that they are incorrect.

a. State what the charge of iron is. Show/explain your working. (2 marks) **[1.5.1]**

_____

_____

_____

b. Hence, name the compound. (1 mark) **[1.5.1]**

_____

Check off any learning objectives obtained full marks for from the "Contour Check" booklet!

Sub-Section: Additional

Question 31 (3 marks) **[1.5.1 & 1.5.2]**

If zoomed in on, explain what a crystal of table salt, sodium chloride, would look like. Justify your answer, and use a diagram to aid your response.

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