Year 11 Chemistry – Level-up plan 2026- 2027

Below is a rough breakdown of what will be covered in each of the 6 Level-up lessons. Your teacher may slightly change this depending on the needs of your class but all content will be covered in the 2 week block for all classes.

Lesson	Content/activities
1	Introduction to VCE Chem Atomic structure and shell electron configuration
	Subshell electron configuration Introduction to the period table – spdf groups and how to use groups and periods to determine electron configurations Flame tests
2	Critical elements task - Linking to green chemistry principles
	Writing ionic formula review from Year 10 Writing chemical equations
3	Periodic table trends – atomic radius and core charge
4	Periodic table trends – electronegativity, ionisation energy, metallic/non-metallic character and reactivity Na in water demo

1. Periodic table of the elements

1 **H** 1.0 hydrogen																	**2** **He** 4.0 helium
3 **Li** 6.9 lithium	**4** **Be** 9.0 beryllium											**5** **B** 10.8 boron	**6** **C** 12.0 carbon	**7** **N** 14.0 nitrogen	**8** **O** 16.0 oxygen	**9** **F** 19.0 fluorine	**10** **Ne** 20.2 neon
11 **Na** 23.0 sodium	**12** **Mg** 24.3 magnesium											**13** **Al** 27.0 aluminium	**14** **Si** 28.1 silicon	**15** **P** 31.0 phosphorus	**16** **S** 32.1 sulfur	**17** **Cl** 35.5 chlorine	**18** **Ar** 39.9 argon
19 **K** 39.1 potassium	**20** **Ca** 40.1 calcium	**21** **Sc** 45.0 scandium	**22** **Ti** 47.9 titanium	**23** **V** 50.9 vanadium	**24** **Cr** 52.0 chromium	**25** **Mn** 54.9 manganese	**26** **Fe** 55.8 iron	**27** **Co** 58.9 cobalt	**28** **Ni** 58.7 nickel	**29** **Cu** 63.5 copper	**30** **Zn** 65.4 zinc	**31** **Ga** 69.7 gallium	**32** **Ge** 72.6 germanium	**33** **As** 74.9 arsenic	**34** **Se** 79.0 selenium	**35** **Br** 79.9 bromine	**36** **Kr** 83.8 krypton
37 **Rb** 85.5 rubidium	**38** **Sr** 87.6 strontium	**39** **Y** 88.9 yttrium	**40** **Zr** 91.2 zirconium	**41** **Nb** 92.9 niobium	**42** **Mo** 96.0 molybdenum	**43** **Tc** (98) technetium	**44** **Ru** 101.1 ruthenium	**45** **Rh** 102.9 rhodium	**46** **Pd** 106.4 palladium	**47** **Ag** 107.9 silver	**48** **Cd** 112.4 cadmium	**49** **In** 114.8 indium	**50** **Sn** 118.7 tin	**51** **Sb** 121.8 antimony	**52** **Te** 127.6 tellurium	**53** **I** 126.9 iodine	**54** **Xe** 131.3 xenon
55 **Cs** 132.9 caesium	**56** **Ba** 137.3 barium	**57–71** lanthanoids	**72** **Hf** 178.5 hafnium	**73** **Ta** 180.9 tantalum	**74** **W** 183.8 tungsten	**75** **Re** 186.2 rhenium	**76** **Os** 190.2 osmium	**77** **Ir** 192.2 iridium	**78** **Pt** 195.1 platinum	**79** **Au** 197.0 gold	**80** **Hg** 200.6 mercury	**81** **Tl** 204.4 thallium	**82** **Pb** 207.2 lead	**83** **Bi** 209.0 bismuth	**84** **Po** (210) polonium	**85** **At** (210) astatine	**86** **Rn** (222) radon
87 **Fr** (223) francium	**88** **Ra** (226) radium	**89–103** actinoids	**104** **Rf** (261) rutherfordium	**105** **Db** (262) dubnium	**106** **Sg** (266) seaborgium	**107** **Bh** (264) bohrium	**108** **Hs** (267) hassium	**109** **Mt** (268) meitnerium	**110** **Ds** (271) darmstadtium	**111** **Rg** (272) roentgenium	**112** **Cn** (285) copernicium	**113** **Nh** (280) nihonium	**114** **Fl** (289) flerovium	**115** **Mc** (289) moscovium	**116** **Lv** (292) livermorium	**117** **Ts** (294) tennessine	**118** **Og** (294) oganesson

atomic number — **79** — symbol of element
relative atomic mass — **Au** 197.0 — name of element
gold

57 **La** 138.9 lanthanum	**58** **Ce** 140.1 cerium	**59** **Pr** 140.9 praseodymium	**60** **Nd** 144.2 neodymium	**61** **Pm** (145) promethium	**62** **Sm** 150.4 samarium	**63** **Eu** 152.0 europium	**64** **Gd** 157.3 gadolinium	**65** **Tb** 158.9 terbium	**66** **Dy** 162.5 dysprosium	**67** **Ho** 164.9 holmium	**68** **Er** 167.3 erbium	**69** **Tm** 168.9 thulium	**70** **Yb** 173.1 ytterbium	**71** **Lu** 175.0 lutetium

89 **Ac** (227) actinium	**90** **Th** 232.0 thorium	**91** **Pa** 231.0 protactinium	**92** **U** 238.0 uranium	**93** **Np** (237) neptunium	**94** **Pu** (244) plutonium	**95** **Am** (243) americium	**96** **Cm** (247) curium	**97** **Bk** (247) berkelium	**98** **Cf** (251) californium	**99** **Es** (252) einsteinium	**100** **Fm** (257) fermium	**101** **Md** (258) mendelevium	**102** **No** (259) nobelium	**103** **Lr** (262) lawrencium

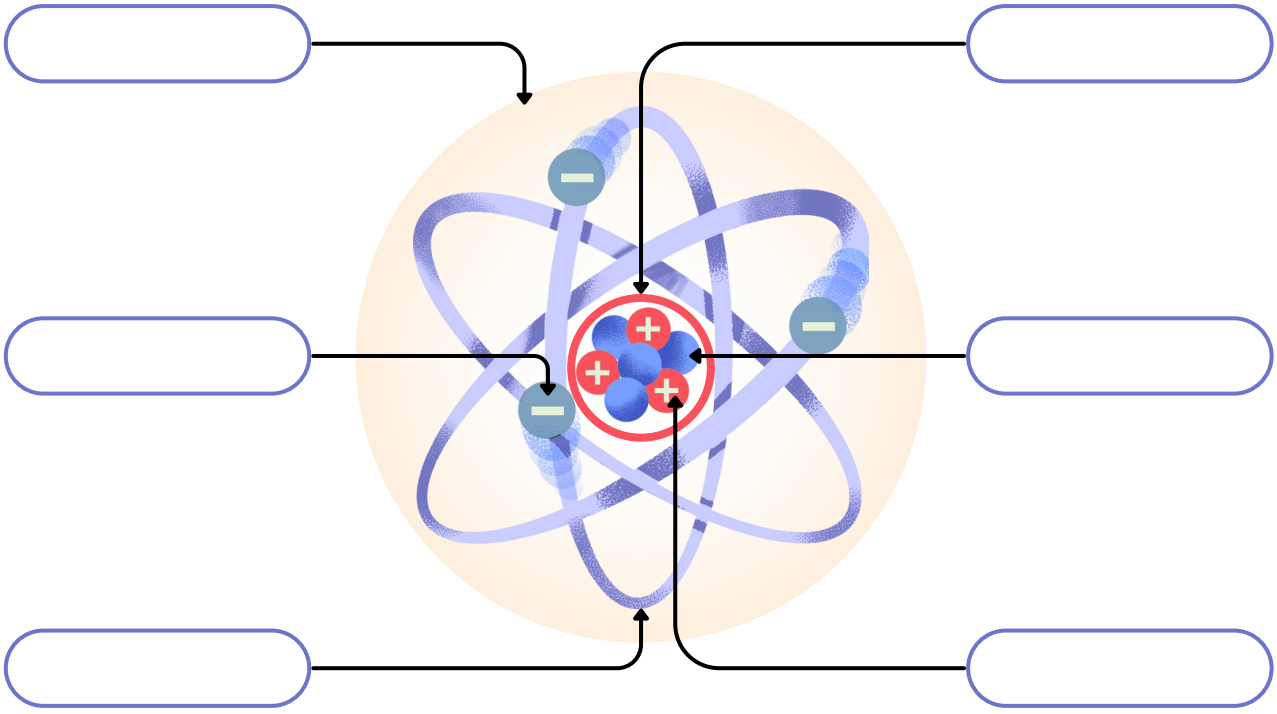
The value in brackets indicates the mass number of the longest-lived isotope.

ATOMIC STRUCTURE

Name:

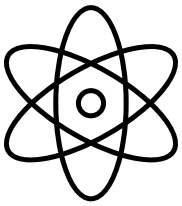
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Exercise 1: Label the structures indicated with their respective names.



Exercise 2: Match the names to the structures described in the following sentences.

Part of the atom that has no charge	
Part of the atom that has a positive charge	
The atomic number is determined by this	
It must have the same number of these particles	
Part of the atom that has a negative charge	
The mass number is determined by this	



Atomic Structure Worksheet

1. Name 3 sub-atomic particles and list their properties.

2. What feature of an atom's structure determines which element it is?

3. What are isotopes?

4. Write the isotope notation for atoms with the following nuclei:

(a) 16 protons and 16 neutrons

(b) 47 protons and 61 neutrons

5. Complete the table by filling in the number of protons, electrons and neutrons:

	Protons	Electrons	Neutrons	Name
${}^{1}_{1}\mathrm{H}$				
${}^{27}_{13}\mathrm{Al}$				
${}^{12}_{6}\mathrm{C}$				
${}^{80}_{35}\mathrm{Br}$				

6. Complete the following table by filling in the missing columns.

	Number of Protons	Number of Electrons	Number of Neutrons	Name
$^{19}_{9}\mathrm{F}$				
	19		21	
			19	chloride

7. Of the following, the pair with approximately the same mass would be:

a) a proton and a hydrogen atom

b) an electron and a hydrogen atom

c) a proton and an electron

d) an electron and a neutron

8. A neutral atom of the isotope $^{28}_{13}\mathrm{Al}$ contains:

a) 13 protons, 15 electrons and 15 neutrons

b) 15 protons, 15 electrons and 13 neutrons

c) 13 protons, 13 electrons and 28 neutrons

d) 13 protons, 13 electrons and 15 neutrons

9. Which of the following pairs of atoms are isotopes of the same element, X?

a. $^{39}_{20}\mathrm{X}$ and $^{39}_{19}\mathrm{X}$

b. $^{19}_{10}\mathrm{X}$ and $^{22}_{10}\mathrm{X}$

c. $^{32}_{71}\mathrm{X}$ and $^{71}_{32}\mathrm{X}$

d. $^{6}_{3}\mathrm{X}$ and $^{12}_{6}\mathrm{X}$

10. Two particles, composed of 11 protons, 11 neutrons and 11 electrons; and 11 protons, 12 neutrons and 11 electrons, respectively, are:

a) the same element

b) isotopes

c) sodium atoms

d) all of these alternatives

11. What is the octet rule?

12. Why is the 4s subshell filled before the 4d subshell is filled?

13. Write the shell **and** subshell electron configurations of the following:

a) Oxygen

b) Silicon

c) Chromium

d) Manganese

e) Nickel

f) Phosphorus

14. Which of the following electron arrangements would be that of an inert or noble gas?

a) 2, 8, 1

b) 2, 2

c) 2, 8, 8

d) 2, 8, 7

15. If an element loses an electron from its atom it becomes

a) a negatively charged metal ion

b) a negatively charged non-metal ion

c) a positively charged metal ion

d) a positively charged non-metal ion

16. Which of the following statements is NOT true?

a) all the atoms in an element have the same atomic number

b) all the molecules in an element contain the one type of atom

c) all the atoms in a compound are identical

d) all the molecules in a compound contain at least two different elements

17. The element of subshell configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ is:

a) Carbon

b) Sulfur

c) Oxygen

d) Phosphorus

18. The mass number of an atom is equal to

a) the number of neutrons in an atom.

b) the number of protons in an atom.

c) the number of electrons in an atom.

d) the sum of the number of protons and electrons in an atom.

19. An element has the shell configuration 2, 8, 8, 2. Which of the following statements is **NOT** true?

a) The element forms a 2+ ion

b) The element is in group IV

c) The element is a metal

d) The element has an atomic number of 20

Year 11 Flame Tests Experiment

The Case of the Contaminated Well

Local commissioners decided it was time for the county to have its own Crime Investigative Service. Since you are a highly decorated chemistry student in high school, you have been hired to start this new crime fighting division. On your first day on the job, you get a call from an elderly woman with a complaint against the "lousy, good-for-nothin' teenagers who lived next door." She reports that these kids contaminated her well with some type of liquid. "I saw them do it! They put something in there and now I am afraid to drink my water!" You decide to take a sample of her well water for analysis. While interviewing the accused, you notice an unmarked container of water sitting on the workbench of the neighbour's garage. Possibly, this contained the liquid that was added to the well. To be sure, you collect a sample to compare to the well sample. Fortunately, you remember a procedure that you conducted in chemistry class, called a flame test. It is a way to identify certain metal ions in a solution. You create a series of known solutions with possible contaminants and test them against both the garage sample and the neighbour's well.

Materials

- Metallic Salt Solutions in labelled 100mL beakers:
  - 1.0M Barium Chloride ($BaCl_2$)
  - 1.0M Calcium Chloride ($CaCl_2$)
  - 1.0M Copper Chloride ($CuCl_2$)
  - 1.0M Lithium Chloride (LiCl)
  - 1.0M Potassium Chloride (KCl)
  - 1.0M Sodium Chloride (NaCl)
  - 1.0M Strontium Chloride ($SrCl_2$)
  - Evidence Sample from Well
  - Evidence Sample from Neighbor's Garage
- 250mL beakers of water (for extinguishing flame)
- Bunsen burners
- Wooden splints

Directions

- Read the given contaminant name in the data table
- Record the contaminant formula from the Materials List above in a data table
- Record the metallic ion and flame colour in the data table for each contaminant
- Complete the forensic analysis section using the CER format (claim, evidence, reasoning)

Safety

- Barium chloride is highly toxic. Do not ingest the salt or solution.
- Always wear safety goggles when handling chemicals in the lab.
- Wash your hands thoroughly before leaving the lab.
- Follow the teacher's instructions for cleanup of materials and disposal of chemicals.
- Always use caution around open flames. Keep flames away from flammable substances.
- Always be aware of an open flame. Open flames can cause burns. Do not reach over it, tie back hair, and secure loose clothing.

Results table:

Draw a results table for your flame tests.

Forensic Analysis

The leading detective of the case is wondering if he should press charges against the teenager who lives next door. **Write a report explaining your test and how he should proceed with the case.**

Be sure to include in your write up:

- Your claim about whether or not the neighbour should be arrested. (The claim answers the driving question (aim).
- A scientific explanation using your that supports your claim – be sure to use evidence from your results AND scientific reasoning.
- Disclaimer – discuss the precision, accuracy, validity and/or reliability of your tests. In this section you should identify a minimum of 2 errors/limitations to the experiment and how they should be improved.

Critical Elements – Task

Some elements that we use in everyday life are considered **critical elements** because they are vital for human use and considered in short supply (will become depleted in 50-100 years if not recycled). As a result, it is important for humans to recycle some of these elements.

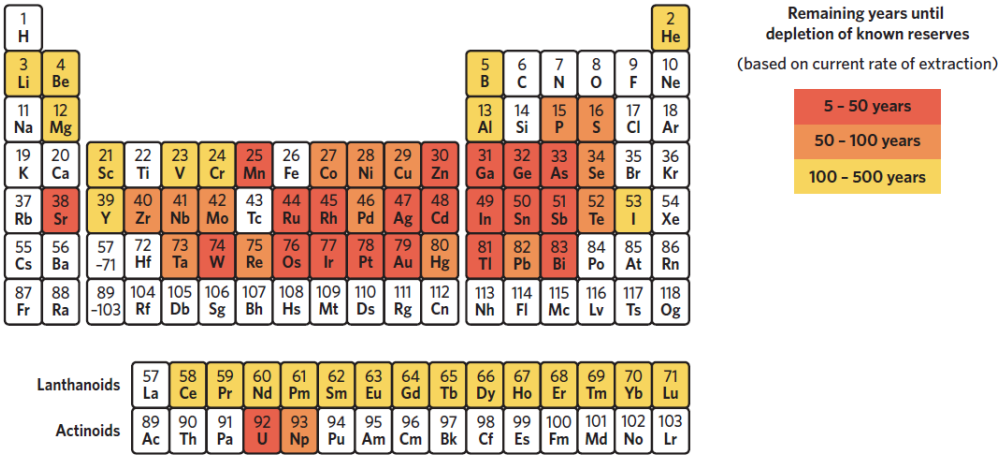


Figure 1 Estimated depletion timescales of critical elements

Society has begun to transition from a **linear economy** towards a **circular economy** as a way to achieve more sustainable development. The diagram below highlights the difference between a linear and circular economy.

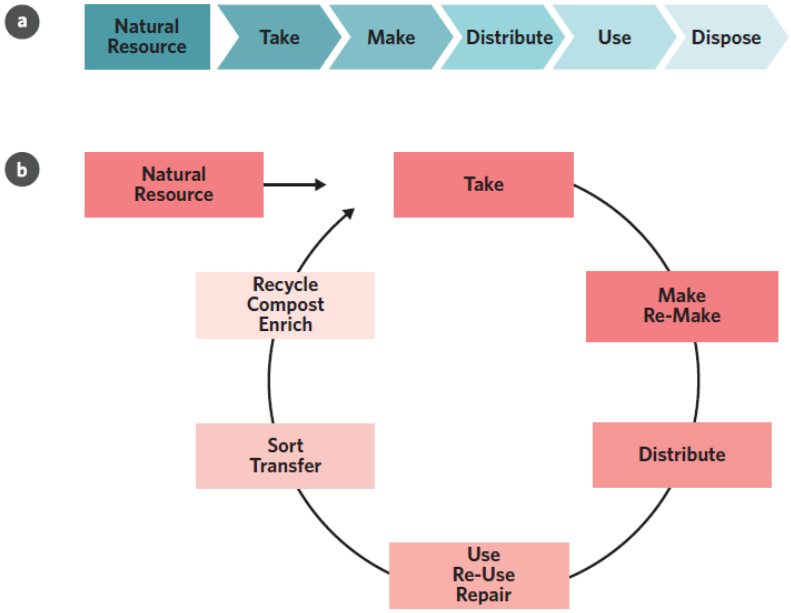


Figure 1 **(a)** Linear economy – open **life cycle** **(b)** Circular economy – closed life cycle

This task will require you to investigate ONE critical element and answer the questions below.

Step 1: Choose an element from the list below

- Helium
- Lithium
- Phosphorus
- Copper
- Cobalt
- Cerium
- Manganese
- Iridium

- Indium
- Platinum
- Palladium
- Samarium
- Uranium
- Lanthanum
- Thulium
- Lutetium

Step 2: Answer the following questions and produce your results onto an A4 or A3 poster page (1-sided poster)

1. What is the name of the element?
2. Where on the periodic table is the element located?
3. Describe the atomic structure of the element, including all isotopes and the number of sub-atomic particles in each.
4. What is the element used for?
5. How is the element recycled (or how is the element disposed of)?
6. Ideas for recycling the element.
7. How does recycling the element benefit society?
8. There are 7 green chemistry principles that will be relevant in VCE Chemistry, some of these are listed below.
    a. Atom economy: Processes/pathways should be designed to maximise incorporation of all reactant materials used in the process into the final product.
    b. Design for degradation: Chemical products should be designed so that at the end of their use they break down into harmless degradation products and do not persist in the environment.
    c. Designing safer chemicals: Chemical products should be designed to achieve their intended function while minimising toxicity.
    d. Prevention of wastes: It is better to prevent waste than to treat or clean up waste after it has been produced.
    e. Use of renewable feedstocks: Raw materials or feedstocks should be made from renewable (mainly plant-based) materials, rather than from fossil fuels, whenever practicable

    From the above list, choose 2 relevant principles and discuss how your element is used/can be used in society to meets these criteria. For example, is it used in a green pathway to ensure less waste is produced or is the energy used to recycle the element from renewable sources.

8. Formulas and charges for selected ions

Cations

1+		2+		3+	
Name	**Formula**	**Name**	**Formula**	**Name**	**Formula**
ammonium	NH_4^+	barium	Ba^{2+}	aluminium	Al^{3+}
copper(I)	Cu^+	calcium	Ca^{2+}	chromium(III)	Cr^{3+}
hydronium	H_3O^+	copper(II)	Cu^{2+}	iron(III)	Fe^{3+}
lithium	Li^+	iron(II)	Fe^{2+}	**4+**	
potassium	K^+	lead(II)	Pb^{2+}	titanium(IV)	Ti^{4+}
silver	Ag^+	magnesium	Mg^{2+}		
sodium	Na^+	mercury(II)	Hg^{2+}		
		nickel(II)	Ni^{2+}		
		tin(II)	Sn^{2+}		
		zinc	Zn^{2+}		

Anions

1−		2−		3−	
Name	**Formula**	**Name**	**Formula**	**Name**	**Formula**
bromide	Br^-	carbonate	CO_3^{2-}	citrate	$C_6H_5O_7^{3-}$
chlorate	ClO_3^-	chromate	CrO_4^{2-}	nitride	N^{3-}
chloride	Cl^-	dichromate	$Cr_2O_7^{2-}$	phosphate	PO_4^{3-}
chlorite	ClO_2^-	monohydrogen phosphate	HPO_4^{2-}		
cyanide	CN^-	oxide	O^{2-}		
dihydrogen phosphate	$H_2PO_4^-$	peroxide	O_2^{2-}		
ethanoate	CH_3COO^-	sulfate	SO_4^{2-}		
fluoride	F^-	sulfide	S^{2-}		
hydrogen carbonate	HCO_3^-	sulfite	SO_3^{2-}		
hydrogen sulfate	HSO_4^-	thiosulfate	$S_2O_3^{2-}$		
hydrogen sulfide	HS^-				
hydrogen sulfite	HSO_3^-				
hydroxide	OH^-				
hypochlorite	ClO^-				
iodide	I^-				
nitrate	NO_3^-				
nitrite	NO_2^-				
perchlorate	ClO_4^-				
permanganate	MnO_4^-				

Ionic Formulas and Chemical Equations

1. If an element loses an electron from its atom it becomes
    a) a negatively charged metal ion
    b) a negatively charged non-metal ion
    c) a positively charged metal ion
    d) a positively charged non-metal ion

2. In an ionic compound the atoms are held together because they
    a) are electrostatically attracted
    b) share electrons
    c) form a crystal lattice
    d) are magnetically attracted

3. The Atomic Number of magnesium is 12. When magnesium reacts to form an ionic compound, the electron configuration of the magnesium ion formed (Mg^{2+}) is
    a) 2, 8
    b) 2, 8, 1
    c) 2, 8, 2
    d) 2, 8, 3

4. The formula for the compound known as aluminium sulphate is
    a) $Al_2(SO_4)_3$
    b) $Al_3(SO_4)_2$
    c) $Al(SO_4)_3$
    d) Al_2SO_4

5. The formula for limestone is $CaCO_3$.
    a) How many different elements make up limestone? _____
    b) How many atoms in total are in one unit of limestone? _____
    c) If calcium were to bond with unknown ion X^{3-} write the resulting chemical formula. _____
    d) What is the name of the anion in $CaCO_3$? _____
    e) Ca is the symbol for the element calcium. Magnesium is also found in the same group as calcium.
        i. Which element is more reactive? _____
        ii. Give a reason for your answer to **i:**

6. Write the formulae of the following compounds

(a) sodium sulfide

(b) potassium nitrate

(c) magnesium carbonate

(d) calcium sulfate

(e) ammonium chloride

(f) ammonium sulfate

(g) copper (II) hydroxide

(h) aluminium nitrate

(i) aluminium sulfate

(j) lithium fluoride

7. Write the correct chemical formula for each of the following compounds

a) silver bromide_____

b) sodium sulphate _____

c) iron (III) carbonate_____

d) calcium dichromate _____

e) ammonium phosphate_____

f) aluminium nitrate _____

8. Iron (II) oxide is a bright red pigment used in paints and glazes for ceramics. Copper (II) oxide makes a brilliant green. Write the formula for these compounds.

9. As a general rule, metals form cations, but only the non-metals in Groups 15,16 and 17 form anions. Explain these observations.

10. Element X has a valency of 1+, element Y has a valency of 2+, and element Z has a valency of 2-.
    (a) Which group of the Periodic Table is each likely to be found in?

    (b) What will be the formula of any compound formed between:

    (i) elements X and Z?

    (ii) elements Y and Z?

    (iii) elements X and Y?

11. We have four elements, A, B, C and D. Their electron configurations are:
    A: 2, 8, 18, 7 B: 2, 8, 18, 8, 2 C: 2, 8, 18, 8 D: 2, 4

    a) Only one combination of these elements forms an ionic compound. Which pair is this? Justify your answer.

    b) What will be the formula of this compound?

12. The sparkling colours of jewels come from trace amounts of ionic substances. The red of rubies and the green of emeralds are both from chromium (III) oxide. What ions are present in chromium (III) oxide?

Chemical Equations

Writing equations for chemical reactions requires:

- Identifying the reactants and products.
- Writing formula for these chemicals **using valencies**.
- Balancing **stoichiometric** coefficients (these indicate the amount, in **mole**, of reactants and products involved in the reaction).
- Writing states of matter for all chemicals in the reaction: (s) solid, (l) liquid, (g) gas, (aq) aqueous.

Write equations for the following reactions:

(Note for some of the reactions you are expected to determine the products based off your knowledge).

1. Aluminium reacts with oxygen gas in air to form aluminium oxide powder.

2. When solid mercury (II) sulfide is heated in air, molten mercury and gaseous sulfur dioxide are produced.

3. At 100^0 C, ammonia gas reacts with oxygen to form gaseous nitrogen monoxide and water vapour.

4. When liquid silicon tetrachloride reacts with a piece of magnesium ribbon, solid silicon and solid magnesium chloride form.

5. Ammonia gas is formed by the reaction between hydrogen and nitrogen gas.

6. During rusting, iron reacts with oxygen to form iron (III) oxide.

7. Magnesium oxide powder reacts with water to form the solid, magnesium hydroxide.

8. Hydrogen peroxide (H_2O_2) may be used as bleach. A solution of this bleach typically contains about 3% hydrogen peroxide that will slowly decompose, releasing oxygen and leaving just water in the bottle.

9. Calcium carbonate (found in limestone and marble) can be decomposed by heating to form calcium oxide solid and carbon dioxide.

10. Magnesium reacts with a solution of copper (II) nitrate to produce red crystals of copper and a solution of magnesium nitrate.

11. Sodium metal reacts vigorously with hydrochloric acid.

12. Pure silver can be obtained from a solution of silver nitrate by reacting it with copper metal.

13. The combustion of methane gas in air.

14. Solutions of sodium chloride and silver nitrate produce a solution of sodium nitrate and a precipitate of silver chloride

15. A solution of hydrochloric acid may be neutralised by a solution of sodium hydroxide forming a salt (ionic compound) and water.

16. A solution of sulfuric acid may be neutralised by a solution of sodium hydroxide forming a salt and water.

17. The reaction between a solution of sulfuric acid and magnesium carbonate powder produces a salt, water and carbon dioxide.

18. A gas is evolved when magnesium reacts with a weak solution of hydrochloric acid. A salt solution also forms.

19. The complete combustion of liquid glycerol, $C_3H_8O_3$.

20. Electricity is produced in car batteries through the reaction between solid lead, solid lead (IV) oxide and sulfuric acid solution. The products of this reaction are solid lead (II) sulfate and water.