

**SCIENCE
CHEMISTRY**

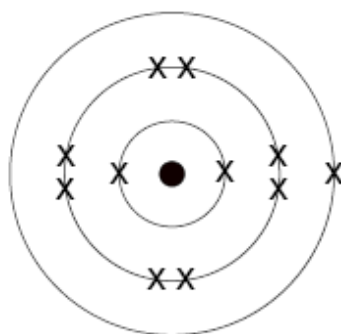
Core – Learning Outcomes

1. ATOMIC STRUCTURE and ELEMENTS

Candidates should:

- (a) know that atoms consist of a central nucleus containing protons and neutrons surrounded by 'orbiting' electrons
- (b) use data, given in the form 11 Na , to represent the electronic structure of elements with atomic numbers 1 to 20 inclusive, in the following form: (w(i)a)

for sodium



- (c) understand that elements are the basic building blocks of all substances and cannot be broken down into simpler substances by chemical means.
- (d) use data to establish the relationship between electronic structure and the position of the element in the first three rows of the modern periodic table (w(i)a)
- (e) be aware that MendeléeV, in developing the modern form of the periodic table, observed recurring patterns in the properties of elements when arranged in order of increasing relative atomic mass, but used creative thought to realise that he needed to leave gaps for elements that had not been discovered at that time; this enabled him to predict the properties of the undiscovered elements (w(i)b,c;(iv)c)

**SCIENCE
CHEMISTRY**

Core – Learning Outcomes

2. THE PERIODIC TABLE.

- (a) use and interpret given data to distinguish between metals and non-metals (w(i)a)
- (b) use data about the physical properties of elements in Group 1 and Group 7 to establish trends within each group and to make predictions based on these trends (w(i)a)
- (c) investigate the chemical reactions of Group 1 elements with oxygen in the air, with water and with Group 7 elements, by observation or using secondary sources, in order to draw conclusions about patterns of similarity and difference within the group and be able to write and interpret word and balanced symbol equations for the reactions (w(i)a)
- (d) investigate the displacement reactions of Group 7 elements in order to establish the trend in reactivity within the group, be able to make predictions based on this trend and write and interpret word and balanced symbol equations for the reactions (w(i)a)
- (e) be able to use flame tests and silver nitrate solution to distinguish between sodium chloride, sodium iodide, potassium chloride and potassium iodide
- (f) examine evidence that has led to the fluoridation of the water supply in some areas, including how data is collected (survey technique), and be able to discuss the factors involved in decision-making, including ethical issues (w(i)a,d;(iv)a,b)

- (g) understand that the uses of a material depend on its properties
- (h) be able to link the common uses of chlorine, iodine, helium, neon and argon to their properties

**SCIENCE
CHEMISTRY**

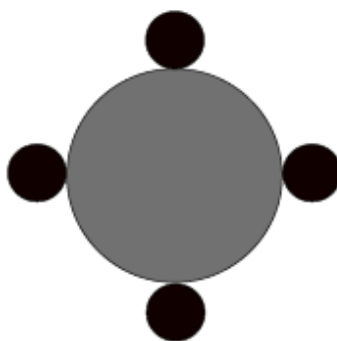
Core – Learning Outcomes

3. COMPOUNDS

Candidates should:

- (a) know that new substances called compounds are formed when two or more different elements combine together and that each compound has its own chemical formula.
- (b) be able to interpret a given formula, name the elements and number the atoms present
- (c) be able to write formulae for simple binary compounds formed between Group 1 or 2 elements and elements of Group 6 or 7, using the formulae of the ions that they contain. (w(i)c)
- (d) **be able to write formulae for ionic compounds containing hydroxide, nitrate, sulphate or carbonate ions, using the formulae of the ions that they contain.** (w(i)c)
- (e) be able to draw and interpret space filler type diagrams for simple molecules using a key, (w(i)c)

e.g. for methane



**SCIENCE
CHEMISTRY**

Core – Learning Outcomes

4. RATES OF CHEMICAL CHANGE

Candidates should:

- (a) know that chemical reactions use up reactants and produce new substances called products.
- (b) explore the effects of changing concentration, temperature, and particle size on the rates of chemical reactions, using ICT where appropriate; this should include:
 - planning the collection of reliable data, analysing the data, drawing conclusions and evaluating the procedures used,
 - understanding the advantages of using ICT tools, in terms of recording, continuous monitoring and instantaneous display,
 - explaining the outcomes in terms of particle theory. (w(i)a-c;(iv)a)
- (c) understand the meaning of the term catalyst and know that the development of better catalysts is extremely important as it can lead to new ways of making materials that may use less energy, use renewable raw materials or use fewer steps. (w(iv)a)

**SCIENCE
CHEMISTRY**

Core – Learning Outcomes

5. USING CHEMICAL REACTIONS TO MAKE NEW MATERIALS

Candidates should:

- (a) know that the chemical industry obtains raw materials from the earth, sea and air and that chemical reactions are then used to change raw materials into useful products, such as fuels, plastics, medicines, fertilisers, metals, etc.
- (b) know that in a chemical reaction, atoms are rearranged but no new atoms are produced nor are any atoms destroyed.
- (c) recognise that signs of a chemical change occurring may include colour change, formation of a precipitate, gas evolution and temperature change.
- (d) know that reactions in which the temperature rises are exothermic and that reactions in which the temperature falls are endothermic.
- (e) **know that breaking a chemical bond requires energy and making a chemical bond releases energy. (w(i)c)**

- (f) **understand that if energy released from forming new bonds is greater than energy needed to break existing bonds, the reaction is exothermic and vice-versa for an endothermic reaction. (w(i)c)**
- (g) **use given data (energy needed to break bonds), to predict whether a reaction is exothermic or endothermic and calculate the overall energy change (w(i)c)**

**SCIENCE
CHEMISTRY**

Core – Learning Outcomes

6. ACIDS, BASES and SALTS

Candidates should:

- (a) interpret given data about indicators (colour/pH) and to recognise acidic, alkaline and neutral substances and the relative strength of acids and alkalis.
- (b) name the products and write word equations that represent the characteristic reactions of dilute acids with:
 - metals
 - bases (including alkalis)
 - carbonates
- (c) understand that alkalis are soluble bases
- (d) identify hydrogen gas from the metal and acid reaction, by its action on a burning splint.
- (e) use given data on the reactivity series to predict which metals will react with dilute acids to produce hydrogen and a salt

- (f) identify carbon dioxide gas from the carbonate and acid reaction, by its action with limewater.
- (g) describe the preparation of salts by:
 - insoluble base/metal/carbonate reacting with dilute sulphuric acid
 - alkali (sodium hydroxide) reacting with dilute hydrochloric and sulphuric acid
- (f) drawing conclusions about the patterns that exist and using these patterns to make predictions, test for carbonates and plan procedures to distinguish between named substances, e.g. sodium chloride and sodium carbonate (w(i)a)

SCIENCE

CHEMISTRY

Core – Learning Outcomes

7. NANOSCIENCE

What is a nanoparticle?

What are the potential benefits and drawbacks of advances in nanotechnology?

Candidates should:

- (a) understand the concept of nanometre and appreciate that nano-science involves the study and use of particles that have sizes in the range 1-100 nm.
- (b) be aware that reducing the size of particles to the nano-scale can produce new properties in a material, which may lead to new uses, e.g. the antibacterial, antiviral and antifungal properties of nano-sized silver particles used in sterilising sprays to clean operating theatres in hospitals and to coat the inner surfaces of refrigerators.

- (c) discuss the potential benefits, risks and drawbacks associated with developments in nanoscience (w(i)d;(iv)a,b)

**SCIENCE
CHEMISTRY**

Core – Learning Outcomes

8. THE PRODUCTION AND USE OF FUELS

How do we make fuels?

What are the drawbacks of using fossil fuels?

Why is the amount of carbon dioxide in the atmosphere increasing slightly and why are scientists worried about this?

Candidates should:

- (a) understand the principles involved in the fractional distillation of crude oil
- (b) use the combustion of hydrocarbons to recognise that new substances are produced in a chemical reaction as a result of the making and breaking of bonds and that the combustion of a

hydrocarbon involves the breaking of the C–C and C–H bonds followed by the formation of bonds with oxygen atoms. (w(i)c)

- (c) explain the environmental effects of the combustion of fossil fuels and evaluate the social, economic and environmental impact (w(i)ad;(iv)a,b)
- (d) know that there is debate in the scientific community on the issue of global warming and be aware that many scientists attribute the main cause of global warming to the increase in carbon dioxide in the atmosphere caused by the combustion of fossil fuels (w(i)d;(iv)b,c)
- (e) examine and evaluate given data on global warming (w(i)a)
- (f) appreciate some effects and consequences of global warming
- (g) evaluate given data with regard to proposed solutions to the problem of global warming (w(i)a,d;(iv)a,b)
- (h) evaluate given data with regard to proposed solutions to the problem of acid rain (w(i)a,d;(iv)a,b)

SCIENCE

CHEMISTRY

Core – Learning Outcomes

9. EVOLUTION AND MAINTENANCE OF THE ATMOSPHERE and GEOLOGICAL PROCESSES

Candidates should:

- (a) investigate data on the composition of the atmosphere over geological time in order to draw conclusions about the changes in composition that have taken place (w(i)a)
- (b) be aware of the accepted explanation for the origin of the atmosphere and the changes that have occurred over geological time (w(i)d)

- (c) understand the roles of respiration, combustion and photosynthesis in the maintenance of the levels of oxygen and carbon dioxide in the atmosphere
- (d) use the development of the theory of continental drift to display their understanding that observations, through creative thought, lead to an idea to explain them but the explanation may not be accepted until sufficient evidence exists, as follows:
- in 1915, Alfred Wegener suggested that the Earth's continents were once joined and had moved apart to their present positions;
 - he based his idea on the close fit of coastlines, and the similar patterns of rocks and fossils, of continents separated by large oceans;
 - he was unable to convincingly explain how the continents could move;
 - the current theory of plate tectonics became widely accepted in the 1960's, by which time other scientists had found evidence to show that it is the Earth's plates that move and that they do so as a result of convection currents in the mantle. (w(i)a-c;(iv)c)
- (e) use evidence about the location of earthquakes and volcanoes to appreciate that the Earth's lithosphere is composed of a number of large pieces called plates, which are moving very slowly, and know that this movement drives the rock cycle (w(i)a,c)
- (f) know that rocks can be:
- formed where tectonic plates move apart and magma rises to fill the gap producing new igneous rock
 - deformed and/or recycled where tectonic plates move towards each other driving down the denser plate which may melt to form magma that on cooling forms igneous rock.