

MODULE C4: CHEMICAL PATTERNS

C4.1 What are the patterns in the properties of elements?

1. recall that atoms of each element have different proton numbers;
2. understand that arranging the elements in order of their proton numbers gives repeating patterns in the properties of elements;
3. be able to use the Periodic Table to obtain the names, symbols, relative atomic masses and proton numbers of elements;
4. recall that a group of elements is a vertical column in the Periodic Table and that the elements have similar properties;
5. recall that a period is a row of elements in the Periodic Table;
6. be able to use the Periodic Table to classify an element as a metal or non-metal;
7. be able to use patterns in the Periodic Table to interpret data and predict properties of elements;
- ① Candidates will be given a copy of the Periodic Table (as in Appendix G) with the examination paper.
8. recall and recognise the chemical symbols for the group 1 metals: lithium, sodium and potassium;
9. recall that the alkali metals tarnish rapidly in moist air but are shiny when freshly cut;
10. be able to use qualitative and quantitative data to identify patterns and make predictions about the properties of group 1 metals (for example melting point, boiling point, density, formulae of compounds and relative reactivity);
11. describe the reactions of lithium, sodium and potassium with cold water;
12. recall that alkali metals react with water to form hydrogen and an alkaline solution of a hydroxide with the formula MOH;
13. recall that alkali metals react vigorously with chlorine to form colourless, crystalline salts with the formula MCl;
14. understand and be able to give examples to show that the alkali metals become more reactive as the group is descended;

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15. recall the main hazard symbols and be able to give the safety precautions for handling hazardous chemicals (limited to harmful, toxic, irritant, corrosive, oxidizing, highly flammable);
16. explain the precautions necessary when working with group 1 metals and alkalis;
17. recall and recognise the chemical symbols for the atoms and molecules of the group 7 elements: chlorine, bromine and iodine;
18. recall the states of the halogens at room temperature and pressure;
19. recall the colours of the halogens in their normal physical state at room temperature and as gases;
20. recall that the halogens consist of diatomic molecules;
21. recall that the halogens can bleach dyes and kill bacteria in water;
22. be able to use qualitative and quantitative data to identify patterns and make predictions about the properties of the group 7 elements (for example melting point, boiling point, formulae of compounds and relative reactivity);
23. recall and be able to give examples to show that the halogens become less reactive as the group is descended;
24. explain the safety precautions necessary when working with the halogens;
25. recall the formulae of:
 - hydrogen, water and halogen molecules;
 - the halides and hydroxides of group 1 metals;
26. **be able to balance unbalanced symbol equations;**
27. **be able to write balanced equations to describe the chemical reactions of group 1 metals with water and halogens;**
28. recall and use state symbols: (s), (l), (g) and (aq) in equations.

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C4.2 How do chemists explain the patterns in the properties of the elements?

1. describe the structure of an atom in terms of protons and neutrons in a very small central nucleus with electrons arranged in shells around the nucleus;
2. recall the relative masses and charges of protons, neutrons and electrons;
3. recall that in any atom the number of electrons equals the number of protons;
4. recall that all the atoms of the same element have the same number of protons;
5. recall that the elements in the modern Periodic Table are arranged in order of proton number;
6. recall that some elements emit distinctive flame colours when heated (for example lithium, sodium and potassium);
7. understand that the light emitted from an element gives a characteristic line spectrum;
8. understand that the study of spectra has helped chemists to discover new elements;
9. understand that the discovery of some elements depended on the development of new practical techniques (for example spectroscopy);
10. be able to use simple conventions (for example 2.8.1 or dots in circles) to represent the electron arrangements in the atoms of the first 20 elements in the Periodic Table;
11. recall that a shell (or energy level) fills across a period;
12. **understand that the chemical properties of an element are determined by its electron arrangement, illustrated by the electron configurations of the atoms of elements in groups 1 and 7.**

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C4.3 How do chemists explain the properties of compounds of Group 1 and Group 7 elements?

1. recall that molten compounds of metals with non-metals conduct electricity and that this is evidence that they are made up of charged particles called ions;
2. recall that an ion is an atom (or group of atoms) that has gained or lost electrons and so has an overall charge;
3. account for the charge on the ions of group 1 and group 7 elements by comparing the number and arrangement of the electrons in the atoms and ions of these elements;
4. **work out the formulae of ionic compounds given the charges on the ions;**
5. **work out the charge on one ion given the formula of a salt and the charge on the other ion;**
6. recall that compounds of group 1 metals and group 7 elements are ionic;
7. understand that solid ionic compounds form crystals because the ions are arranged in a regular lattice;
8. describe what happens to the ions when an ionic crystal melts or dissolves in water;
9. **explain that ionic compounds conduct electricity when molten or when dissolved in water because the ions are charged and they are able to move around independently in the liquid.**