

Grade 12 Chemistry: Essentials of Physical, Inorganic and Organic Chemistry

Chemistry rewards people who connect ideas instead of memorising lists. This note walks through the main areas of Grade 11-12 chemistry with the key relations, so you can see how the topics fit together.

Chapters, reactions and marks follow your current NEB syllabus and textbook. Use this note to revise and to find weak areas.

1. Mole concept and stoichiometry

- 1 mole contains 6.022×10^{23} particles (Avogadro's number).
- Moles = mass / molar mass = number of particles / 6.022×10^{23} . For a gas at STP, 1 mole occupies 22.4 L.
- Percentage composition, empirical formula and limiting reagent questions all start with converting mass to moles.
- Molarity = moles of solute / volume of solution in litres.

Example: How many moles are in 36 g of water? Molar mass of H_2O is 18 g/mol, so $36 / 18 = 2$ mol.

2. Gas laws

- Boyle: PV is constant at fixed temperature. Charles: V/T is constant at fixed pressure (T in kelvin).
- Ideal gas equation $PV = nRT$.
- Always convert temperature to kelvin: $K = \text{degrees Celsius} + 273$.

3. Atomic structure and periodic trends

- Electron filling follows the Aufbau order: 1s, 2s, 2p, 3s, 3p, 4s, 3d, and so on. Each orbital holds at most two electrons.
- Across a period, atomic size decreases and ionisation energy and electronegativity generally increase. Down a group, atomic size increases and ionisation energy decreases.

4. Chemical bonding

- Ionic bond: transfer of electrons (NaCl). Covalent bond: sharing of electrons (H₂O). Metallic bond: sea of electrons.
- VSEPR shapes: CH₄ tetrahedral, NH₃ pyramidal, H₂O bent, BF₃ trigonal planar, CO₂ linear.

5. Chemical equilibrium and acids

- For $aA + bB \rightleftharpoons cC + dD$, $K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$.
- Le Chatelier's principle: a system at equilibrium shifts to oppose any change in concentration, pressure or temperature.
- $pH = -\log[H^+]$; $pH + pOH = 14$ at 25 degrees Celsius. A strong acid is fully ionised; a weak acid only partly.

Example: The pH of 0.001 M HCl is $-\log(10^{-3}) = 3$.

6. Electrochemistry and redox

- Oxidation is loss of electrons; reduction is gain (OIL RIG).
- In a galvanic cell, oxidation takes place at the anode and reduction at the cathode; electrons flow from anode to cathode through the external wire.
- Faraday's first law: mass deposited is proportional to the charge passed ($m = ZIt$).

7. Thermochemistry and rates

- Exothermic reactions release heat (the enthalpy change is negative); endothermic reactions absorb it.
- Hess's law: the total enthalpy change is the same by any route.
- Rate of reaction rises with concentration, temperature, surface area and a catalyst, which lowers the activation energy.

8. Organic chemistry basics

- Prefixes for chain length: meth (1), eth (2), prop (3), but (4), pent (5), hex (6).
- Alkanes (single bonds, -ane), alkenes (double bond, -ene), alkynes (triple bond, -yne).
- Functional groups: alcohol (-OH), aldehyde (-CHO), ketone (C=O in the chain), carboxylic acid (-COOH), amine (-NH₂).
- Typical reactions: alkanes undergo substitution; alkenes undergo addition (for example with bromine water, which gets decolourised, a classic test).
- Combustion of a hydrocarbon gives carbon dioxide and water.

How to revise chemistry

1. Keep a reactions notebook with the equation, conditions and one use or test for each.
2. Practise balancing equations and mole calculations daily.
3. Draw the periodic table trends as arrows on a blank table.
4. Learn named tests (litmus, bromine water, Tollens' test) with colour changes.

Practice questions

1. How many grams are in 0.5 mol of NaOH (Na 23, O 16, H 1)?
2. What is the pH of a solution with $[H^+] = 10^{-5} \text{ M}$?
3. State Le Chatelier's principle in one line.
4. Name the organic compound $\text{CH}_3\text{CH}_2\text{OH}$.

Answers: 1) Molar mass 40, so 20 g. 2) 5. 3) A system at equilibrium shifts so as to oppose any change made to it. 4) Ethanol.

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