

Grade 8 checklist

60 skills. Tick each one when you can do it. For grade 8 you need the skills for the grades below it too.

Atomic structure and the periodic table

- ☐ **Write half equations (Higher tier)** Show the electrons lost or gained by one substance, with atoms and charges balanced, e.g. $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$. (Atoms, elements and compounds)
- ☐ **Find an unknown abundance from A_r** Call one abundance x and the other $(100 - x)$, then solve the equation. (Relative atomic mass)
- ☐ **Write ionic equations for displacement (Higher tier)** Leave out the spectator metal ions, e.g. $\text{Cl}_2 + 2\text{I}^- \rightarrow 2\text{Cl}^- + \text{I}_2$. (Group 7)

Bonding, structure and the properties of matter

- ☐ **Give limitations of each type of diagram** For example, dot and cross diagrams and displayed formulae do not show the 3D shape of a molecule. (Covalent bonding)
- ☐ **Compare melting points using the charges on ions** Ions with bigger charges (e.g. Mg^{2+} and O^{2-}) attract each other more strongly, so more energy is needed to separate them. (Properties of ionic compounds)
- ☐ **Compare the structures and properties of diamond and graphite** Four bonds in a rigid 3D network compared with three bonds, layers and delocalised electrons. (Graphite)
- ☐ **Explain why C_{60} has a lower melting point** C_{60} is molecular, so melting overcomes weak intermolecular forces, not covalent bonds. (Graphene and fullerenes)
- ☐ **Explain why nanoparticles behave differently from bulk material** Their very high surface area to volume ratio can change their properties, and smaller quantities can be effective. (Sizes of particles and their properties)
- ☐ **Evaluate a use of nanoparticles with a judgement** Weigh benefits against risks using the information given, and reach a justified conclusion. (Uses of nanoparticles)

Quantitative chemistry

- ☐ **Balance ionic and half equations (HT)** Atoms and total charge must both be equal on each side, e.g. $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$. (Conservation of mass and balanced equations)
- ☐ **Use M_r to identify an unknown element** Work backwards, e.g. if XCl_2 has M_r 111, $X = 111 - 71 = 40$, so X is calcium. (Relative formula mass)
- ☐ **Predict the size of a mass change (HT)** Use moles, e.g. 100 g (1 mol) of CaCO_3 loses 44 g (1 mol) of CO_2 when heated. (Mass changes when a reactant or product is a gas)
- ☐ **Use uncertainties to compare sets of results** A smaller uncertainty means more precise results; check whether a value lies within $\text{mean} \pm \text{uncertainty}$. (Chemical measurements and uncertainty)
- ☐ **Calculate numbers of particles** number of particles = moles $\times 6.02 \times 10^{23}$. (Moles)

- ☐ **Calculate the reactant mass needed** Start from the mass of product you want and work back through the mole ratio. (Amounts of substances in equations)

- ☐ **Turn a non-whole ratio into whole numbers** If you get 1 : 1.5, multiply every number by 2 to get 2 : 3. (Using moles to balance equations)

- ☐ **Calculate product mass from the limiting reactant** Use only the moles of the limiting reactant in the reacting-mass method. (Limiting reactants)

- ☐ **Solve multi-step concentration problems** Rearrange the equation, e.g. find the volume of solution that contains a given mass. (Concentration of solutions)

- ☐ **Solve multi-step percentage yield problems (HT)** Find the theoretical yield from the reactant mass first, then the percentage yield. (Percentage yield)

- ☐ **Evaluate reaction pathways using several factors (HT)** Compare atom economy, yield, rate, equilibrium position and whether by-products are useful. (Atom economy)

- ☐ **Find a concentration from titration results** Moles of the known solution → mole ratio → moles of the unknown → divide by its volume. (Concentrations in mol/dm³)

- ☐ **Find reacting volumes of gases from equations** Gas volumes are in the same ratio as the balancing numbers. (Volumes of gases)

Chemical changes

- ☐ **Write ionic equations for displacement reactions** Leave out the spectator ions, e.g. $\text{Mg} + \text{Cu}^{2+} \rightarrow \text{Mg}^{2+} + \text{Cu}$. (Oxidation and reduction in terms of electrons)

- ☐ **Write ionic and half equations for them** For example, $\text{Mg} + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{H}_2$, with the acid's negative ion left out as a spectator. (Reactions of acids with metals)

- ☐ **Solve titrations with a 1 : 2 ratio** For example, sulfuric acid reacts with sodium hydroxide in a 1 : 2 ratio, so double the moles of acid. (Titrations)

- ☐ **Relate pH changes to H⁺ concentration** Each decrease of 1 pH unit means the H⁺ concentration is 10 times greater. (Strong and weak acids)

- ☐ **Write half equations for aluminium extraction** $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$ at the cathode and $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$ at the anode. (Using electrolysis to extract metals)

- ☐ **Explain which ions remain in solution** Ions that are not discharged stay behind, e.g. Na⁺ and OH⁻ ions form sodium hydroxide solution. (Electrolysis of aqueous solutions)

- ☐ **Write the half equation for oxygen** From hydroxide ions in solution: $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$. (Half equations at electrodes)

- ☐ **Complete and balance supplied half equations** Balance the atoms first, then add electrons so the total charge is equal on both sides. (Half equations at electrodes)

Energy changes

- ☐ **Explain why exothermic reactions keep going once started** The energy released gives more particles at least the activation energy, so the reaction continues without further heating. (Reaction profiles)

- ☐ **Calculate energy changes involving many bonds** Multiply each bond energy by the number of bonds in a molecule and by the balancing number, e.g. for a combustion reaction. (Energy change of reactions (bond energies))
- ☐ **Estimate voltages for new pairs of metals** If two metals were each tested against the same third metal, the difference between their voltages estimates the voltage of a cell made from the two. (Cells and batteries)
- ☐ **Write half equations for the hydrogen fuel cell** Negative electrode: $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$; positive electrode: $\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$. (Fuel cells)

The rate and extent of chemical change

- ☐ **Plan a rates investigation from a hypothesis** Give a testable hypothesis, a step-by-step method with a range of values and repeats, and say how the results test it. (Factors which affect the rate of reaction)
- ☐ **Use proportionality to predict changes in rate** E.g. doubling the concentration doubles the frequency of collisions, so the rate doubles. (Collision theory and activation energy)
- ☐ **Explain a prediction fully using Le Chatelier** Say what the change is, how the system counteracts it, which way the position shifts and what happens to the product. (Changing conditions and equilibrium)
- ☐ **Interpret colour changes and given data** Use the colours or concentrations in the question to decide which way the position moved. (Effect of changing concentration)
- ☐ **Describe all concentration changes after a disturbance** An added substance falls a little but stays higher than before; the other concentrations change until constant again. (Effect of changing concentration)
- ☐ **Explain colour changes caused by temperature** Link the direction of the shift to the colour of the substance that increases. (Effect of temperature changes)
- ☐ **Weigh yield against rate when choosing temperature** A lower temperature gives more product for an exothermic reaction, but the rate is slower. (Effect of temperature changes)
- ☐ **Use pressure data to test an equation** E.g. if the yield rises with pressure, the product side must have fewer gas molecules. (Effect of pressure changes)

Organic chemistry

- ☐ **Compare addition and condensation polymerisation** Compare the monomers, the number of products and how the repeating unit relates to the monomers. (Condensation polymerisation)
- ☐ **Calculate the Mr of a repeating unit** Add the M_r values of the monomers and subtract 18 for each water molecule lost. (Condensation polymerisation)
- ☐ **Explain why one amino acid can polymerise alone** Each molecule has two different groups that react with each other, so no second monomer is needed. (Amino acids)
- ☐ **Calculate masses and water lost for peptides** A chain of x amino acids has x – 1 links, so x – 1 water molecules are lost. (Amino acids)

Chemistry of the atmosphere

- ☐ **Describe the atmosphere's main changes and causes** Write a logically ordered account linking each change in carbon dioxide, oxygen and nitrogen to its cause. (How carbon dioxide decreased)

- ☐ **Evaluate a model of the greenhouse effect** Compare an experiment or model with the real atmosphere and judge what it does and does not show. (Greenhouse gases)

- ☐ **Evaluate the quality of a climate report** Judge the amount of data, how it was collected, peer review, possible bias and whether the conclusion fits the evidence. (Human activities that increase greenhouse gases)

- ☐ **Discuss scale, risk and environmental implications** Weigh how widespread, how likely and how serious an effect is, and who is least able to adapt. (Global climate change)

- ☐ **Evaluate ways to reduce a carbon footprint** Weigh how much each action saves, its cost and its limitations to reach a justified judgement. (The carbon footprint and its reduction)

- ☐ **Predict combustion products from fuel information** Use the elements in the fuel and the conditions (oxygen supply, temperature) to predict and explain every product. (Atmospheric pollutants from fuels)

Using resources

- ☐ **Use orders of magnitude to judge data** Compare powers of ten (10^9 is a thousand times 10^6) to decide whether a difference is significant. (Using resources and sustainable development)

- ☐ **Evaluate biological extraction methods using given data** Weigh up using low-grade ores without digging up rock against slow rates, small yields and possible pollution. (Alternative methods of extracting metals)

- ☐ **Explain how selective LCAs can be misused** Leaving out stages or impacts can support a conclusion decided in advance, for example in advertising. (Life cycle assessment)

- ☐ **Compare sacrificial and barrier protection when scratched** A scratched paint or tin coating exposes iron, which then rusts; a scratched zinc coating still protects it. (Corrosion and its prevention)

- ☐ **Select materials by comparing data quantitatively** Use values such as density, strength and softening temperature to justify the best material for a use. (Ceramics, polymers and composites)

- ☐ **Explain the temperature compromise** A lower temperature gives a higher yield but is too slow; about 450 °C gives a fast enough rate with a reasonable yield. (The Haber process)

- ☐ **Interpret graphs of yield against conditions** Describe the trends with data and use them to justify the conditions chosen. (The Haber process)

- ☐ **Compare industrial and laboratory production** Industry: large scale, continuous, concentrated reactants made on site; laboratory: small scale, batch, dilute reactants, titration and crystallisation. (Production and uses of NPK fertilisers)

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