

Grade 8 checklist

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

Biology

- ☐ **Give real sizes in standard form** e.g. a real size of 0.000012 m is 1.2×10^{-5} m. (Microscopy)
- ☐ **Evaluate the benefits and drawbacks of vaccination** Weigh the protection of individuals and populations against the fact that vaccines do not always work and can cause mild side effects. (Vaccination)
- ☐ **Evaluate greenhouse costs against extra yield (HT)** Use data to decide whether the value of the extra crop from adding heat, light or carbon dioxide is more than the extra cost. (Rate of photosynthesis)
- ☐ **Explain fast breathing after exercise (HT)** Breathing and heart rate stay high to supply the extra oxygen needed to repay the oxygen debt. (Response to exercise)
- ☐ **Explain insulin and glucagon in negative feedback** The two hormones act in opposite directions, returning glucose to normal whenever it rises or falls. (Control of blood glucose concentration)
- ☐ **Explain why the cycle restarts without pregnancy** Progesterone falls, the lining breaks down, and FSH is no longer inhibited, so another egg matures. (Hormones in human reproduction)
- ☐ **Evaluate IVF from different points of view** Weigh benefits against risks for patients and doctors, including ethical issues such as unused embryos. (The use of hormones to treat infertility (HT only))
- ☐ **Interpret simple negative feedback diagrams** Follow the arrows to predict and explain what happens when a hormone level rises or falls. (Feedback systems (HT only))
- ☐ **Deduce genotypes from family tree evidence** For example, two unaffected parents with an affected child must both be heterozygous. (Genetic inheritance)
- ☐ **Evaluate embryo screening with a justified conclusion** Weigh the benefits against the costs and concerns, and make a judgement supported by the information. (Inherited disorders)
- ☐ **Apply natural selection to unfamiliar examples** Use the details given (predators, climate, food) in a logical chain of cause and effect. (Evolution)
- ☐ **Evaluate genetic engineering in agriculture and medicine** Weigh the benefits against the risks and objections to reach a justified conclusion. (Genetic engineering)
- ☐ **Explain unfamiliar adaptations from given information** Use the description or data to link each feature to a specific survival problem in that habitat. (Adaptations)
- ☐ **Evaluate a conservation method using given data** Weigh the evidence of success against costs and limitations, then reach a justified conclusion. (Maintaining biodiversity)

Chemistry

- ☐ **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)
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- ☐ **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)
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- ☐ **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)
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- ☐ **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)
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- ☐ **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)
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- ☐ **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 chemical equations)
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- ☐ **Use M_r to identify an unknown element** Work backwards, e.g. if XCl_2 has M_r 111, $\text{X} = 111 - 71 = 40$, so X is calcium. (Relative formula mass)
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- ☐ **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)
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- ☐ **Use uncertainties to compare sets of results** A smaller uncertainty means more precise results; check whether a value lies within mean $\pm$ uncertainty. (Chemical measurements)
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- ☐ **Calculate numbers of particles** number of particles = moles $\times 6.02 \times 10^{23}$. (Moles (HT only))
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- ☐ **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 (HT only))
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- ☐ **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 (HT only))
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- ☐ **Calculate product mass from the limiting reactant** Use only the moles of the limiting reactant in the reacting-mass method. (Limiting reactants (HT only))
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- ☐ **Solve multi-step concentration problems** Rearrange the equation, e.g. find the volume of solution that contains a given mass. (Concentration of solutions)
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- ☐ **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 (HT only))
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- ☐ **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)
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- ☐ **Relate pH changes to H^+ concentration** Each decrease of 1 pH unit means the H^+ concentration is 10 times greater. (Strong and weak acids (HT only))
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- ☐ **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)
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- ☐ **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)
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- ☐ **Write the half equation for oxygen** From hydroxide ions in solution: $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$.
(Representation of reactions at electrodes as half equations (HT only))
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- ☐ **Complete and balance supplied half equations** Balance the atoms first, then add electrons so the total charge is equal on both sides. (Representation of reactions at electrodes as half equations (HT only))
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- ☐ **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)
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- ☐ **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. (The energy change of reactions (HT only))
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- ☐ **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 rates of chemical reactions)
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- ☐ **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)
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- ☐ **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. (The effect of changing conditions on equilibrium (HT only))
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- ☐ **Interpret colour changes and given data** Use the colours or concentrations in the question to decide which way the position moved. (The effect of changing concentration (HT only))
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- ☐ **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. (The effect of changing concentration (HT only))
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- ☐ **Explain colour changes caused by temperature** Link the direction of the shift to the colour of the substance that increases. (The effect of temperature changes on equilibrium (HT only))
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- ☐ **Weigh yield against rate when choosing temperature** A lower temperature gives more product for an exothermic reaction, but the rate is slower. (The effect of temperature changes on equilibrium (HT only))
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- ☐ **Use pressure data to test an equation** E.g. if the yield rises with pressure, the product side must have fewer gas molecules. (The effect of pressure changes on equilibrium (HT only))
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- ☐ **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)
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- ☐ **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)
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- ☐ **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 which contribute to an increase in greenhouse gases in the atmosphere)
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- ☐ **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)
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- ☐ **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)

- ☐ **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 the Earth's 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 (HT only))

- ☐ **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)

Physics

- ☐ **Link energy stores in multi-step problems** Use 'energy lost from one store = energy gained by another' to find a speed or a height. (Changes in energy)

- ☐ **Find c from a temperature–time graph** With a heater of constant power P, the gradient is $P \div (m \times c)$, so $c = P \div (m \times \text{gradient})$. (Energy changes in systems)

- ☐ **Evaluate energy resources using data** Weigh up reliability, cost and environmental impact, then give a conclusion with a reason. (National and global energy resources)

- ☐ **Solve parallel problems using branch currents** Each branch has the full supply pd; find each branch current with $I = V \div R$ and add them. (Series and parallel circuits)

- ☐ **Combine power equations with $V = IR$** Link $P = VI$, $P = I^2 R$ and $V = IR$ in multi-step problems. (Power)

- ☐ **Calculate power wasted in transmission cables** Find the current with $I = P \div V$, then the heating loss with $P = I^2 R$. (The National Grid)

- ☐ **Find specific latent heat from experimental data** Use $E = Pt$ for the energy supplied and the mass that changed state, then $L = E \div m$. (Changes of state and specific latent heat)

- ☐ **Link ionising power to range** The more strongly a radiation ionises, the faster it loses energy, so the shorter its range. (Radioactive decay and nuclear radiation)

- ☐ **Work through a chain of decays** Apply several alpha and beta decays in turn to find the final nucleus. (Nuclear equations)

- ☐ **Find the net decline as a ratio** After n half-lives, $(1/2)^n$ of the original remains, so the net decline is the rest (Higher tier). (Half-lives and the random nature of radioactive decay)

- ☐ **Resolve a force into two perpendicular components** Draw the force to scale and complete a right-angled triangle to measure its horizontal and vertical components. (Resultant forces)

- ☐ **Use vector diagrams for equilibrium** If three forces are in equilibrium, their arrows drawn tip-to-tail form a closed triangle. (Resultant forces)

- ☐ **Link changing velocity to acceleration and force** A changing velocity is an acceleration, so there must be a resultant force on the object. (Velocity)

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- ☐ **Find speed at an instant using a tangent** Draw a tangent to the curve at that time and calculate its gradient. (The distance–time relationship)
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- ☐ **Count squares to find area under curves** Count the squares under a curved line and multiply by the distance one square represents. (Acceleration)
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- ☐ **Explain inertial mass** Inertial mass is a measure of how difficult it is to change an object's velocity: force $\div$ acceleration. (Newton's Second Law)
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- ☐ **Explain why braking distance increases fastest** For the same braking force, braking distance is proportional to speed squared, because kinetic energy is. (Stopping distance)
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- ☐ **Calculate a reaction time from ruler-drop distance** Use $v^2 - u^2 = 2 a s$ with $a = 9.8 \text{ m/s}^2$ to find v , then $t = v \div a$. (Reaction time)
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- ☐ **Explain why braking distance depends on speed squared** Braking force $\times$ braking distance $= \frac{1}{2} m v^2$, so for a constant force, distance $\propto v^2$. (Factors affecting braking distance 1)
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- ☐ **Estimate braking forces for typical road vehicles** Use typical masses and speeds with $F = m a$ or work done = kinetic energy. (Factors affecting braking distance 2)
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- ☐ **Calculate a change in momentum, including direction** For a rebound, change in momentum $= m v - m u$ with the correct signs. (Momentum is a property of moving objects)
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- ☐ **Solve collisions with objects moving in opposite directions** Use + and – for direction; the sign of the answer gives the direction of motion. (Conservation of momentum)
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- ☐ **Explain how radio waves are received (HT)** Radio waves absorbed by an aerial can induce an alternating current with the same frequency as the waves. (Properties of electromagnetic waves 2)
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- ☐ **Explain why gamma rays treat cancer (HT)** Gamma rays are ionising and carry a lot of energy, so a carefully aimed beam can kill cancer cells. (Uses and applications of electromagnetic waves)
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- ☐ **Predict how changes affect the force** e.g. reversing both the current and the field leaves the direction unchanged; doubling I and halving l leaves F unchanged. (Fleming's left-hand rule (HT only))
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- ☐ **Explain why the coil keeps turning past vertical** When the coil is vertical the forces give no turning effect, but its momentum carries it past, just as the commutator reverses the current. (Electric motors (HT only))
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