

Grade 8 checklist

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

Energy

- ☐ **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)

Electricity

- ☐ **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)
- ☐ **Explain sparking using electric fields** A very strong field ionises the air, so charge can flow through the air as a spark. (Electric fields)

Particle model of matter

- ☐ **Find specific latent heat from experimental data** Use $E = Pt$ for the energy supplied and the mass that changed state, then $L = E \div m$. (Specific latent heat)
- ☐ **Explain when $pV = \text{constant}$ does not apply** It only works for a fixed mass of gas at constant temperature; if the gas heats up or leaks, the prediction is wrong. (Pressure in gases)
- ☐ **Explain why fast compression heats more** There is less time for energy to be transferred away by heating, so more of the work done stays in the gas as internal energy. (Increasing the pressure of a gas)
- ☐ **Explain why pressure rises more than pV predicts** The temperature rises as well, so the molecules hit the walls more often and harder than they would at constant temperature. (Increasing the pressure of a gas)

Atomic structure

- ☐ **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 random decay)

- ☐ **Compare activities of samples with different half-lives** For the same number of nuclei, the isotope with the shorter half-life has the higher activity. (Different half-lives of radioactive isotopes)
- ☐ **Evaluate risks and benefits using data** Compare the dose and its risk with the benefit of diagnosis or treatment, and reach a conclusion. (Uses of nuclear radiation)
- ☐ **Compare fission and fusion in detail** Compare what happens, the nuclei involved, the conditions needed and where each is used. (Nuclear fusion)

Forces

- ☐ **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)
- ☐ **Solve moment problems with several forces** Add up all the clockwise moments and all the anticlockwise moments, then set the totals equal. (Moments, levers and gears)
- ☐ **Use density to predict floating or sinking** An object less dense than the liquid floats; an object denser than the liquid sinks. (Pressure with depth and upthrust)
- ☐ **Calculate the pressure difference between two depths** Pressure difference = difference in depth $\times \rho \times g$. (Pressure with depth and upthrust)
- ☐ **Explain effects of pressure differences** A resultant force acts from the higher-pressure side towards the lower-pressure side, e.g. a sealed bottle being squashed. (Atmospheric pressure)
- ☐ **Link changing velocity to acceleration and force** A changing velocity is an acceleration, so there must be a resultant force on the object. (Velocity)
- ☐ **Find speed at an instant using a tangent** Draw a tangent to the curve at that time and calculate its gradient. (Distance–time graphs)
- ☐ **Count squares to find area under curves** Count the squares under a curved line and multiply by the distance one square represents. (Acceleration and velocity–time graphs)
- ☐ **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)
- ☐ **Explain why braking distance increases fastest** For the same braking force, braking distance is proportional to speed squared, because kinetic energy is. (Stopping distance)
- ☐ **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)
- ☐ **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)
- ☐ **Estimate braking forces for typical road vehicles** Use typical masses and speeds with $F = m a$ or work done = kinetic energy. (Braking forces and deceleration)
- ☐ **Calculate a change in momentum, including direction** For a rebound, change in momentum = $m v - m u$ with the correct signs. (Momentum of moving objects)

- ☐ **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)
- ☐ **Rearrange to find a time or velocity change** $\Delta t = m \Delta v \div F$ and $\Delta v = F \Delta t \div m$. (Changes in momentum)
- ☐ **Compare forces for different stopping times** The same change in momentum over a longer time gives a proportionally smaller force. (Changes in momentum)

Waves

- ☐ **Explain seismic evidence for a liquid outer core** S-waves are not detected on the far side of the Earth from an earthquake, so part of the core must be liquid. (Waves for detection and exploration)
- ☐ **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. (EM waves: production and hazards)
- ☐ **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 EM waves)
- ☐ **Predict the image for any object position** E.g. an object closer to a convex lens than F gives a virtual, upright, magnified image. (Lenses)
- ☐ **Explain colours using absorption, transmission and reflection** Follow the light from source to object to filter to eye, saying which wavelengths are reflected, absorbed or transmitted at each stage. (Visible light)
- ☐ **Explain what controls the Earth's temperature (HT)** The rates of absorption and emission of radiation, and how much radiation is reflected into space. (Perfect black bodies and radiation)

Magnetism and electromagnetism

- ☐ **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)
- ☐ **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)
- ☐ **Contrast a loudspeaker with a microphone** They have the same parts, but a loudspeaker uses the motor effect (current → movement) and a microphone uses the generator effect (movement → current). (Loudspeakers)
- ☐ **Explain how the induced current opposes the change** The induced current makes a magnetic field that opposes the movement, e.g. the coil repels a magnet being pushed in. (Induced potential)
- ☐ **Predict graph changes for faster rotation** Faster rotation gives a higher peak pd and a shorter time for each cycle (a higher frequency). (Uses of the generator effect)
- ☐ **Compare a microphone with a loudspeaker** Both have a coil in a magnet's field; a microphone uses the generator effect and a loudspeaker the motor effect. (Microphones)
- ☐ **Explain why high-pd transmission is efficient** For the same power, a higher pd means a smaller current, so less energy is wasted heating the cables. (Transformers)

Space physics

- ☐ **Link orbital speed and orbit radius (HT)** A stable orbit with a smaller radius needs a higher speed, so if the speed changes the radius must change. (Orbital motion and satellites)
 - ☐ **Explain what is not yet understood** Since 1998, galaxies have been observed receding ever faster, and dark mass and dark energy are still not understood. (Red-shift)
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