

Grade 7 checklist

114 skills. Tick each one when you can do it. For grade 7 you need the skills for the grades below it too.

Energy

- ☐ **Use calculations to compare energy stores** Calculate the energy in each store before and after a change to show how the total energy is shared out. (Energy stores and systems)
- ☐ **Rearrange to find speed, height or extension** E.g. $h = E_p \div (m \times g)$, or $v = \sqrt{2E_k \div m}$, taking the square root last. (Changes in energy)
- ☐ **Explain why the measured value is too high** Energy is dissipated to the surroundings, so more energy is supplied than the block gains. (Energy changes in systems)
- ☐ **Combine power with work done or energy** Find the work done or gravitational potential energy gained first, then divide by the time. (Power)
- ☐ **Plan the thermal insulation practical** Compare how fast hot water cools when wrapped in different materials, keeping the other variables the same. (Energy transfers in a system)
- ☐ **Rearrange to find the input or output** Useful output = efficiency $\times$ total input; total input = useful output $\div$ efficiency. (Efficiency)
- ☐ **Describe ways to increase efficiency** Reduce the wasted transfers, e.g. lubricate moving parts, streamline, insulate (Higher tier only). (Efficiency)
- ☐ **Explain trends in energy resource use** Use data and reasons such as cutting carbon dioxide emissions and the falling cost of renewables. (National and global energy resources)

Electricity

- ☐ **Analyse resistance against length results** A straight line through the origin shows resistance is directly proportional to length. (Current, resistance and potential difference)
- ☐ **Find resistance at a point on I–V graph** Read V and I at that point and use $R = V \div I$, not the gradient. (Resistors)
- ☐ **Explain thermistor and LDR sensing circuits** Link a change in temperature or light to a change in resistance, current and the pd across each component. (Resistors)
- ☐ **Solve multi-step series circuit problems** Find the total resistance, then $I = V \div R$, then the pd across each resistor with $V = I R$. (Series and parallel circuits)
- ☐ **Find frequency from a pd–time graph** Read the time for one complete cycle and use frequency = $1 \div$ time period. (Direct and alternating potential difference)
- ☐ **Explain why touching the live wire is dangerous** Your body is at 0 V, so there is a large pd across you and a current flows through you. (Mains electricity)
- ☐ **Explain dangers even when a switch is open** The live wire is still connected to the supply, so it is still at about 230 V. (Mains electricity)
- ☐ **Find current or resistance from $P = I^2 R$** Use $I = \sqrt{P \div R}$ or $R = P \div I^2$. (Power)

- ☐ **Combine $E = QV$ with $Q = It$** Find the charge first, then the energy, in multi-step problems. (Energy transfers in everyday appliances)
- ☐ **Explain why the National Grid is efficient** A lower current means less heating of the cables, so less energy is wasted. (The National Grid)
- ☐ **Describe how a spark is produced** Charge builds up until the pd is large enough for charge to jump through the air to a nearby earthed conductor. (Static charge)
- ☐ **Explain how the force changes with distance** Closer objects are in a stronger part of each other's field, so the force is bigger. (Electric fields)

Particle model of matter

- ☐ **Solve multi-step density problems** For example, find a volume from dimensions in cm, convert it to m^3 , then use a density in kg/m^3 to find the mass. (Density of materials)
- ☐ **Explain energy changes during a change of state** The energy supplied increases the potential energy of the particles, so internal energy rises but the temperature does not. (Internal energy)
- ☐ **Use heater power and time in calculations** Find the energy supplied with $E = Pt$, then use it in $\Delta E = mc\Delta\theta$. (Specific heat capacity)
- ☐ **Explain why a measured c is too high** Energy is transferred to the surroundings, so the temperature rise is smaller and $c = \Delta E \div (m\Delta\theta)$ comes out larger. (Specific heat capacity)
- ☐ **Do multi-step heating and melting calculations** Work out each stage separately with $\Delta E = mc\Delta\theta$ or $E = mL$, then add the energies. (Specific latent heat)
- ☐ **Apply the particle model to real situations** For example, explain why a sealed can may burst if heated, or why tyre pressure falls on a cold night. (Particle motion in gases)
- ☐ **Test data against $pV = \text{constant}$** Multiply $p \times V$ for each result: if the products are the same, the data fit $pV = \text{constant}$. (Pressure in gases)
- ☐ **Interpret graphs of pressure against volume** p against V is a curve (inverse proportion); p against $1/V$ is a straight line through the origin. (Pressure in gases)
- ☐ **Explain why a bicycle pump gets warm** Work done on the air increases its internal energy, so the average kinetic energy of the molecules and the temperature rise. (Increasing the pressure of a gas)

Atomic structure

- ☐ **Identify isotopes and ions from data** Use particle numbers in a table to decide which atoms are isotopes of the same element and which particles are charged. (Mass number, atomic number and isotopes)
- ☐ **Explain why the plum pudding model was replaced** It predicted only tiny deflections, so large deflections needed a new model with a concentrated, charged nucleus. (Development of the model of the atom)
- ☐ **Explain how new evidence changes models** When experiments give results a model cannot explain, scientists change or replace the model. (Development of the model of the atom)
- ☐ **Choose the best radiation for a use** Justify the choice using penetration and ionising power, and say why the others are unsuitable. (Radioactive decay and nuclear radiation)

- ☐ **Identify the decay type from an equation** Compare the mass and atomic numbers before and after to see what was emitted. (Nuclear equations)

- ☐ **Correct count rates for background radiation** Subtract the background count rate from each reading before finding the half-life. (Half-lives and random decay)

- ☐ **Explain which radiation is most hazardous where** Outside the body beta and gamma are more hazardous; inside the body alpha is most hazardous. (Radioactive contamination)

- ☐ **Convert and compare doses in sieverts** Use $1 \text{ Sv} = 1000 \text{ mSv}$ to compare doses given as data. (Background radiation)

- ☐ **Choose an isotope with a suitable half-life** E.g. a few hours for a medical tracer; years for a smoke alarm or thickness gauge. (Different half-lives of radioactive isotopes)

- ☐ **Explain why beams come from several directions** The tumour gets a large dose while each part of the healthy tissue gets a much smaller dose. (Uses of nuclear radiation)

- ☐ **Explain how a reactor controls fission** Control rods absorb neutrons so that, on average, one neutron from each fission causes another. (Nuclear fission)

- ☐ **Explain why fusion needs extreme conditions** Very high temperatures and pressures let positive nuclei overcome their repulsion and get close enough to fuse. (Nuclear fusion)

Forces

- ☐ **Explain scalar–vector pairs such as speed and velocity** Two objects can have the same speed but different velocities if they move in different directions. (Scalar and vector quantities)

- ☐ **Use the proportionality between weight and mass** $W \propto m$, so a graph of weight against mass is a straight line through the origin with a gradient equal to g . (Gravity)

- ☐ **Find a resultant using a scale drawing** Draw the two forces tip-to-tail to scale; the resultant is the arrow from the start of the first to the end of the second. (Resultant forces)

- ☐ **Link work done to changes in energy stores** Work done by brakes equals the kinetic energy lost; work done lifting an object equals its gain in gravitational potential energy. (Work done and energy transfer)

- ☐ **Calculate elastic potential energy stored** Use $E_e = 0.5 \times k \times e^2$, up to the limit of proportionality. (Forces and elasticity)

- ☐ **Link work done to energy stored** If the spring is not inelastically deformed, the work done stretching it equals the elastic potential energy stored. (Forces and elasticity)

- ☐ **Explain how levers act as force multipliers** A small effort far from the pivot gives the same moment as a large load close to the pivot. (Moments, levers and gears)

- ☐ **Explain how gears change speed and moment** A small gear driving a larger gear makes it turn more slowly but with a larger moment. (Moments, levers and gears)

- ☐ **Convert areas and pressures to SI units** $1 \text{ m}^2 = 10\,000 \text{ cm}^2$, so divide cm^2 by 10 000; $1 \text{ kPa} = 1000 \text{ Pa}$. (Pressure in a fluid ($p = F/A$))

- ☐ **Explain how area affects pressure and force** The same force on a smaller area gives a greater pressure; the same pressure on a larger area gives a greater force. (Pressure in a fluid ($p = F/A$))

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- ☐ **Explain what causes upthrust** The pressure on the bottom surface of a submerged object is greater than on its top surface, giving a resultant upward force. (Pressure with depth and upthrust)
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- ☐ **Explain floating and sinking using forces** An object floats when the upthrust equals its weight; it sinks if its weight is greater than the upthrust when fully submerged. (Pressure with depth and upthrust)
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- ☐ **Explain why pressure decreases with altitude** There are fewer air molecules, and so a smaller weight of air, above a surface the higher it is. (Atmospheric pressure)
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- ☐ **Calculate forces due to atmospheric pressure** Use $F = p \times A$, e.g. 100 000 Pa on 0.50 m^2 gives 50 000 N. (Atmospheric pressure)
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- ☐ **Find the displacement for a right-angled journey** Use a scale drawing (or Pythagoras): 30 m north then 40 m east is 50 m at about 53° east of north. (Distance and displacement)
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- ☐ **Estimate speeds, distances and times** For example, walking 1 km at $\sim 1.5 \text{ m/s}$ takes about 670 s, roughly 11 minutes. (Speed)
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- ☐ **Explain circular motion: constant speed, changing velocity** The direction of motion changes all the time, so the velocity changes even though the speed stays the same. (Velocity)
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- ☐ **Recognise acceleration and deceleration on the graph** A curve getting steeper shows acceleration; a curve getting less steep shows deceleration. (Distance–time graphs)
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- ☐ **Estimate the size of everyday accelerations** For example, a car reaching 30 m/s in about 10 s accelerates at about 3 m/s^2 . (Acceleration and velocity–time graphs)
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- ☐ **Find distance from area under v–t graph** Split the area into rectangles and triangles and add them. (Acceleration and velocity–time graphs)
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- ☐ **Define and use the idea of inertia** Inertia is the tendency of objects to continue in their state of rest or of uniform motion. (Newton's First Law)
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- ☐ **Estimate forces in everyday road transport** For example, a car of mass $\sim 1000 \text{ kg}$ decelerating at $\sim 6 \text{ m/s}^2$ needs $\sim 6000 \text{ N}$. (Newton's Second Law)
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- ☐ **Distinguish Third Law pairs from balanced forces** Balanced forces act on the same object; a Third Law pair acts on two different objects. (Newton's Third Law)
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- ☐ **Apply the Third Law to equilibrium situations** A book on a table pushes down on the table, and the table pushes up on the book with an equal force. (Newton's Third Law)
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- ☐ **Interpret stopping distance data and graphs** Thinking distance rises in proportion to speed; braking distance rises more and more steeply. (Stopping distance)
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- ☐ **Evaluate factors affecting thinking distance from data** Compare thinking distances with and without a factor, at the same speed. (Reaction time)
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- ☐ **Estimate stopping distances at typical speeds** A car on a dry road needs roughly 25 m to stop from 13 m/s and roughly 100 m from 31 m/s. (Factors affecting braking distance)
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- ☐ **Calculate a braking force from kinetic energy** Braking force $\times$ braking distance $= \frac{1}{2} m v^2$. (Braking forces and deceleration)
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- ☐ **Explain that momentum is a vector** Momentum has the same direction as the velocity; opposite directions have opposite signs. (Momentum of moving objects)
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- ☐ **Compare the momentum of different objects** A slow, heavy object can have more momentum than a fast, light one. (Momentum of moving objects)

- ☐ **Calculate the velocity after objects join** Total momentum before = $(m_1 + m_2) \times v$ after. (Conservation of momentum)

- ☐ **Explain explosions and recoil using momentum** The total momentum is zero before, so the parts move apart with equal and opposite momentum. (Conservation of momentum)

- ☐ **Explain what a closed system is** No external forces act on the system, so its total momentum cannot change. (Conservation of momentum)

- ☐ **Derive the rate-of-change-of-momentum equation** Substitute $a = \Delta v \div \Delta t$ into $F = m a$ to get $F = m \Delta v \div \Delta t$. (Changes in momentum)

- ☐ **Explain how safety features reduce injury** They increase the time taken for the momentum to change, so the force is smaller. (Changes in momentum)

Waves

- ☐ **Explain how particles move in a sound wave** Air particles vibrate backwards and forwards about fixed positions, parallel to the direction of travel, passing energy on to their neighbours. (Transverse and longitudinal waves)

- ☐ **Describe the ripple tank and string practical** Measure across several wavelengths, find the frequency, use $v = f \lambda$, and explain why the apparatus suits each measurement. (Properties of waves)

- ☐ **Explain how sound changes in a new medium** The frequency stays the same, so if the speed increases the wavelength increases in proportion ($\lambda = v \div f$). (Properties of waves)

- ☐ **Describe the reflection and refraction practical** Use a ray box, a mirror or glass block, paper and a protractor to measure angles for several angles of incidence. (Reflection of waves)

- ☐ **Explain how to make the angles accurate** Use a narrow ray in a darkened room, mark the ray with crosses far apart, and measure every angle from the normal. (Reflection of waves)

- ☐ **Explain why hearing has a limited range** The conversion of sound waves into vibrations of the eardrum and other parts of the ear only works over a limited frequency range. (Sound waves)

- ☐ **Explain how ultrasound produces an image** Pulses are partially reflected at each boundary between media, and the echo times give the distance to each boundary. (Waves for detection and exploration)

- ☐ **Explain why higher frequency means shorter wavelength** All EM waves have the same speed, so a higher frequency means a proportionally shorter wavelength. (Types of electromagnetic waves)

- ☐ **Explain refraction using wave fronts (HT)** The part of a wave front that reaches the slower medium first slows down first, so the wave front changes direction. (EM waves: refraction and absorption)

- ☐ **Explain how radio waves are produced (HT)** Oscillations (an alternating current) in an electrical circuit produce radio waves of the same frequency. (EM waves: production and hazards)

- ☐ **Explain why microwaves suit satellite communications (HT)** Microwaves pass through the Earth's atmosphere, so they can reach satellites in space. (Uses and applications of EM waves)

- ☐ **Explain why X-rays suit imaging bones (HT)** X-rays pass through soft tissue but are absorbed by bone, so bones show up on the image. (Uses and applications of EM waves)

- ☐ **Explain real and virtual images** A real image forms where rays actually meet and can be shown on a screen; a virtual image is where rays only appear to come from. (Lenses)
- ☐ **Draw a ray diagram for a concave lens** The parallel ray spreads out as if it came from F on the object's side; the image is always virtual. (Lenses)
- ☐ **Predict colours seen through filters** E.g. a blue object seen through a red filter looks black, because no light from it gets through. (Visible light)
- ☐ **Explain why a black body emits best** A good absorber is also a good emitter, so a perfect absorber would be the best possible emitter. (Emission and absorption of infrared radiation)
- ☐ **Explain constant temperature using absorption and emission (HT)** A body at constant temperature absorbs radiation at the same rate as it emits radiation. (Perfect black bodies and radiation)
- ☐ **Explain why a body warms or cools (HT)** It warms up if it absorbs radiation faster than it emits it, and cools down if it emits faster than it absorbs. (Perfect black bodies and radiation)

Magnetism and electromagnetism

- ☐ **Explain how to test for a magnet** Only repulsion proves an object is a permanent magnet, because a magnetic material is attracted to both poles. (Poles of a magnet)
- ☐ **Explain the compass evidence for Earth's magnetic core** A compass lines up in a fixed direction even far from any magnet, so the Earth must have a magnetic field, which comes from its core. (Magnetic fields)
- ☐ **Explain how solenoids and iron cores strengthen fields** The fields of all the turns add together inside the coil, and an iron core becomes magnetised, making the field much stronger. (Electromagnetism)
- ☐ **Explain how an electromagnetic device works** e.g. in a relay, a small current magnetises an electromagnet, which attracts an iron armature and closes the contacts of a second circuit. (Electromagnetism)
- ☐ **Rearrange $F = BIl$ after converting units** e.g. find B in tesla when the length is given in mm or cm. (Fleming's left-hand rule)
- ☐ **Explain the role of the split-ring commutator** It reverses the current in the coil every half turn, so the coil keeps turning in the same direction. (Electric motors)
- ☐ **Link the frequency of the current to pitch** The cone vibrates at the same frequency as the current, so the sound has that frequency. (Loudspeakers)
- ☐ **Link the size of the current to loudness** A bigger current gives a bigger force, so the cone vibrates with a bigger amplitude and the sound is louder. (Loudspeakers)
- ☐ **Explain why a still magnet induces nothing** With no relative movement the field through the coil does not change, so no pd is induced. (Induced potential)
- ☐ **Describe the job of a dynamo's commutator** It swaps the connections every half turn, so the output pd is always in the same direction. (Uses of the generator effect)
- ☐ **Sketch pd–time graphs for both generators** Alternator: a wave going above and below zero. Dynamo: humps that are all on the same side of zero. (Uses of the generator effect)
- ☐ **Explain how an alternating current is produced** The coil moves back and forth in the field, so the induced pd keeps changing direction. (Microphones)

- ☐ **Link frequency and loudness to the current** The current has the same frequency as the sound; a louder sound gives a bigger current. (Microphones)

 - ☐ **Explain how a transformer works** Alternating current in the primary → changing magnetic field in the core → alternating pd induced in the secondary. (Transformers)

 - ☐ **Use the transformer power equation** For a 100% efficient transformer, find the current drawn from the supply for a given power output. (Transformers)
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Space physics

- ☐ **Explain how gravitational collapse starts fusion** As the cloud collapses its particles gain kinetic energy, so the core heats up until nuclei move fast enough to fuse. (Our solar system)

 - ☐ **Explain how elements from stars reach planets** A supernova scatters elements through the universe, and new stars and planets form from clouds containing them. (The life cycle of a star)

 - ☐ **Compare two life cycles in a 6-mark answer** Give both paths in order, compare them stage by stage and include the processes at each stage. (The life cycle of a star)

 - ☐ **Explain changing velocity at constant speed (HT)** Gravity acts at right angles to the motion, so it changes the direction, and so the velocity, but not the speed. (Orbital motion and satellites)

 - ☐ **Explain red-shift as evidence for expansion** More distant galaxies move away faster, which shows that space itself is expanding and supports the Big Bang theory. (Red-shift)
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