Physics Class 9 Notes - Complete Chapter-wise Study Notes for Punjab Students (2026-27)

9th Class - Punjab Board - Session 2026-27

Original study notes by Zahid Notes for revision. These are summaries, not the official textbook.

Introduction

These physics class 9 notes are written to help a class 9 student revise the whole book chapter by chapter. Each chapter below gives a short summary in simple words, the key definitions and ideas, important short questions with brief answers, important long questions with fuller answers, and a set of practice MCQs with an answer key. Where a chapter involves numerical problems, the method is explained in plain words and an original worked example is given. The examples use round, made-up numbers chosen for practice only; they are not taken from any textbook exercise.

How to use these notes: read the summary first, then try to answer the short questions without looking, and only then check the answers. For numerical chapters, practise by changing the numbers in the worked examples and solving again. Reading the summary alone is not enough - writing answers by hand is what turns reading into exam preparation.

Chapter 1: Physical Quantities and Measurements

Summary

Physics studies things that can be measured, such as length, mass, time and temperature. Anything that can be measured is called a physical quantity. A measurement always compares an unknown quantity with a chosen standard unit, and the result is written as a number followed by the unit.

Some quantities stand on their own and are called base quantities. In the international system (SI), there are seven base quantities, including length (metre), mass (kilogram), time (second), electric current (ampere), temperature (kelvin), amount of substance (mole) and luminous intensity (candela). Other quantities, such as speed, area and force, are built from base quantities and are called derived quantities. Their units are built the same way - for example, speed is distance divided by time, so its unit is metre per second.

Very large and very small numbers are written more easily with prefixes. Common prefixes include kilo (thousand), centi (hundredth), milli (thousandth), micro (millionth) and nano (thousand-millionth). Scientific notation is another short way of writing such numbers, using powers of ten.

Measuring tools must match the size of the object. A metre rule measures lengths to about a millimetre. A vernier calliper measures small lengths more precisely, down to a fraction of a millimetre, using a main scale and a sliding vernier scale. A screw gauge (micrometer) measures very small thicknesses, such as the thickness of a wire, using a rotating thimble. A stopwatch measures time, a measuring cylinder measures volume, and a physical balance compares masses.

No measurement is perfectly exact. The smallest value an instrument can measure is its least count. Zero error happens when an instrument does not read zero with nothing being measured, and it must be subtracted or added as appropriate. Significant figures show how precise a measurement is: all certain digits plus one estimated digit count as significant, and the answer to a calculation should not claim more precision than the least precise measurement used.

Key definitions and concepts

- **Physics:** The branch of science that studies matter, energy and how they interact.
- **Physical quantity:** Any quantity that can be measured, such as length, mass or time.
- **Base quantity:** A quantity that is defined independently and is not built from other quantities.
- **Derived quantity:** A quantity built from base quantities, such as speed or density.
- **Unit:** A standard amount of a quantity used for comparison in measurement.
- **Least count:** The smallest measurement an instrument can make.
- **Zero error:** The reading an instrument shows when it should read zero; it is corrected before recording a result.

- **Significant figures:** The digits in a measurement that carry real meaning about its precision.
- **Vernier constant (least count of a vernier calliper):** The difference between one main-scale division and one vernier-scale division.
- **Pitch of a screw gauge:** The distance the spindle moves forward in one complete turn of the thimble.

Important short questions

Q1. What is a physical quantity? Give two examples.

A physical quantity is anything that can be measured. Length and mass are two examples.

Q2. What is the difference between a base quantity and a derived quantity?

A base quantity is defined on its own, such as length or time. A derived quantity is formed by combining base quantities, such as speed, which comes from length and time.

Q3. Name the SI units of length, mass and time.

Length is measured in metres, mass in kilograms and time in seconds.

Q4. What is meant by the least count of an instrument?

It is the smallest value the instrument can measure. A metre rule, for example, usually has a least count of one millimetre.

Q5. Why is a screw gauge used instead of a metre rule for a thin wire?

A metre rule is not precise enough for very small thicknesses. A screw gauge can measure to a hundredth of a millimetre, so it suits thin wires.

Q6. What is zero error, and how is it handled?

Zero error is a non-zero reading when the instrument should read zero. It is corrected by subtracting a positive zero error from, or adding a negative zero error to, the observed reading.

Q7. Convert 2.5 kilometres into metres.

2.5 km = 2.5 × 1000 m = 2500 m.

Q8. What are significant figures?

They are the digits in a number that are known reliably plus one estimated digit. They show how precise a measurement is.

Important long questions

Q1. Explain base and derived quantities with examples, and show how the unit of speed is derived.

Base quantities are the seven independent quantities of the SI system: length, mass, time, electric current, temperature, amount of substance and luminous intensity. Derived quantities are formed from them. Speed is defined as distance travelled divided by time taken. Distance is a length, measured in metres, and time is measured in seconds, so the unit of speed becomes metre per second (m/s). In the same way, area is length times length, giving square metres, and density is mass divided by volume, giving kilograms per cubic metre.

Q2. Describe how a vernier calliper works and how its reading is taken.

A vernier calliper has a fixed main scale and a sliding jaw carrying a shorter vernier scale. When an object is held between the jaws, the main-scale reading is read up to the zero of the vernier scale. Then the vernier division that lines up exactly with a main-scale division is found, and it is multiplied by the vernier constant. The total reading is the main-scale reading plus this vernier part. The vernier scale lets the user read a fraction of a main-scale division, which is why the instrument is more precise than a plain rule.

Q3. Explain the common sources of error in measurement and how to reduce them.

Errors come from the instrument itself (such as zero error or a worn scale), from the observer (such as reading a scale at an angle, called parallax error), and from the conditions (such as temperature changes). Zero error is corrected by noting the zero reading first. Parallax error is reduced by keeping the eye directly in front of the mark being read. Random variation is reduced by repeating the measurement several times and taking the average. Choosing an instrument with a suitable least count also matters - a coarse instrument cannot give a fine result.

Numerical guidance

Most numericals in this chapter are unit conversions and readings, not long calculations. The safe method is: (1) write the quantity with its unit, (2) multiply or divide by the conversion factor step by step, (3) check that the final unit makes sense. For instrument readings, always add the main-scale reading and the fractional part separately, then apply the zero correction.

Original worked example: A vernier calliper has a vernier constant of 0.01 cm. The main-scale reading is 3.2 cm and the 7th vernier division coincides with a main-scale division. Observed reading = 3.2 + (7 × 0.01) = 3.27 cm. If the zero error is +0.02 cm, the corrected reading = 3.27 - 0.02 = 3.25 cm.

MCQs

1. Which of the following is a base quantity?

   (a) Speed (b) Force (c) Mass (d) Area

2. The SI unit of temperature is:

   (a) Degree Celsius (b) Kelvin (c) Fahrenheit (d) Joule

3. One millisecond is equal to:

   (a) 10^{-2} s (b) 10^{-3} s (c) 10^{-6} s (d) 10^{-9} s

4. Which instrument is most suitable for measuring the diameter of a thin wire?

   (a) Metre rule (b) Measuring cylinder (c) Screw gauge (d) Stopwatch

5. The prefix "micro" stands for:

   (a) 10^{-3} (b) 10^{-6} (c) 10^{3} (d) 10^{6}

Answer key: 1-(c), 2-(b), 3-(b), 4-(c), 5-(b)

Chapter 2: Kinematics

Summary

Kinematics is the study of motion without asking what causes it. A body is at rest if it does not change its position relative to its surroundings, and in motion if its position changes. Motion can be straight-line (translatory), spinning about a fixed point (rotatory), or back-and-forth about a mean position (vibratory). A body can also show more than one type at once, such as a rolling wheel.

Motion is described with a few linked quantities. Distance is the total path length travelled, while displacement is the straight-line change of position from start to finish, including direction. Speed is distance divided by time; velocity is displacement divided by time, so velocity has direction and speed does not. Acceleration is the rate of change of velocity - it is positive when velocity increases and negative (retardation) when it decreases.

Graphs are a powerful way to describe motion. In a distance-time graph, the slope gives speed, and a straight line means uniform speed. In a velocity-time graph, the slope gives acceleration, and the area under the graph gives the distance travelled. A horizontal line on a velocity-time graph means constant velocity, so acceleration is zero.

When acceleration is constant, motion follows three standard equations: final velocity equals initial velocity plus acceleration times time; distance equals initial velocity times time plus half acceleration times time squared; and final velocity squared equals initial velocity squared plus twice acceleration times distance. Falling bodies under gravity are a special case: near the Earth's surface, a freely falling body accelerates downward at about 10 m/s² (the exact value is not needed for the method, and students should use the value their teacher gives).

Key definitions and concepts

- **Rest:** A body is at rest when its position does not change with respect to its surroundings.
- **Motion:** A body is in motion when its position changes with respect to its surroundings.
- **Distance:** The total length of the path travelled; a scalar quantity.
- **Displacement:** The shortest straight-line distance from the starting point to the finishing point, with direction; a vector quantity.
- **Speed:** Distance travelled per unit time; measured in m/s.
- **Velocity:** Displacement per unit time; it has both size and direction.
- **Acceleration:** The rate of change of velocity; measured in m/s².
- **Uniform velocity:** Velocity that does not change in size or direction.
- **Scalar quantity:** A quantity with size only, such as distance or speed.
- **Vector quantity:** A quantity with size and direction, such as displacement or velocity.
- **Gravitational acceleration:** The acceleration of a freely falling body due to Earth's gravity.

Important short questions

Q1. What is the difference between distance and displacement?

Distance is the total path covered, while displacement is the straight-line distance from start to finish in a stated direction. Distance can never be less than the size of displacement.

Q2. Is speed a scalar or a vector? Why?

Speed is a scalar because it has size only and no direction. Velocity, which includes direction, is a vector.

Q3. What does a straight horizontal line on a velocity-time graph mean?

It means velocity is constant, so acceleration is zero.

Q4. Define acceleration and give its SI unit.

Acceleration is the change in velocity per unit time. Its SI unit is metre per second squared (m/s^2).

Q5. A car travels 120 km in 2 hours. What is its average speed?

Average speed = 120 ÷ 2 = 60 km/h.

Q6. What is meant by retardation?

Retardation is negative acceleration - velocity decreasing with time, as when brakes are applied.

Important long questions

Q1. Explain, with a daily-life example, the difference between uniform and non-uniform motion, and between speed and velocity.

A car moving on an empty straight road at a steady 60 km/h shows uniform motion, because it covers equal distances in equal times. The same car in city traffic, speeding up and slowing down, shows non-uniform motion. Speed tells only how fast the car goes, for example 60 km/h. Velocity adds the direction, for example 60 km/h towards the north. Two cars can have the same speed but different velocities if they move in different directions, and a car turning a corner at steady speed changes its velocity because its direction changes.

Q2. Interpret a velocity-time graph: what do its slope and area tell us?

The slope of a velocity-time graph gives acceleration, because slope is change in velocity divided by change in time. A rising slope means acceleration, a falling slope means retardation, and a flat line means zero acceleration. The area under the graph between two times gives the distance travelled in that interval. For a rectangle, the area is velocity times time; for a triangle, it is half base times height. This is why graphs are useful: one picture gives both acceleration and distance.

Q3. A body starts from rest and moves with uniform acceleration. Derive the relation between distance, acceleration and time in your own words.

Starting from rest means initial velocity is zero. In each second, velocity grows by the acceleration, so after time t the final velocity is acceleration times time. The average velocity during this motion is half the final velocity, because velocity grows steadily from zero. Distance is average velocity multiplied by time, which gives half times acceleration times time squared. This reasoning shows where the familiar equation comes from rather than asking students to memorise it blindly.

Numerical guidance

The standard method is: list what is given (initial velocity u, final velocity v, acceleration a, time t, distance s), choose the equation that contains the unknown without needing an extra unknown, substitute with consistent units, and check the answer's size and unit. Convert km/h to m/s by multiplying by 5/18, and minutes to seconds by multiplying by 60, before substituting.

Original worked example: A cyclist starts from rest and accelerates uniformly at 2 m/s² for 5 s. Final velocity $v = u + at = 0 + 2 \times 5 = 10$ m/s. Distance $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 2 \times 25 = 25$ m.

MCQs

1. Which quantity has both magnitude and direction?

   (a) Speed (b) Distance (c) Velocity (d) Time

2. A body moving with uniform velocity has:

   (a) Zero acceleration (b) Increasing acceleration (c) Decreasing velocity (d) Zero speed

3. The slope of a distance-time graph gives:

   (a) Acceleration (b) Speed (c) Force (d) Displacement

4. A car covers 90 km in 1.5 hours. Its average speed is:

   (a) 45 km/h (b) 60 km/h (c) 75 km/h (d) 135 km/h

5. The area under a velocity-time graph gives:

   (a) Acceleration (b) Distance (c) Force (d) Momentum

Answer key: 1-(c), 2-(a), 3-(b), 4-(b), 5-(b)

Chapter 3: Dynamics

Summary

Dynamics studies motion together with its causes - forces. Force is a push or pull that can change a body's state of rest or motion, its speed, its direction, or its shape. The SI unit of force is the newton (N).

Newton's first law says a body keeps its state of rest or uniform motion unless an unbalanced force acts on it. This property is called inertia: heavier bodies have more inertia and resist change more. A seat belt is a daily example - when a car stops suddenly, the passenger's body tends to keep moving forward.

Newton's second law links force, mass and acceleration: force equals mass times acceleration (F = ma). The same force produces less acceleration in a heavier body. Momentum is the product of mass and velocity, and it measures how hard it is to stop a moving body. Newton's second law can also be stated as: force equals the rate of change of momentum.

Newton's third law says every action has an equal and opposite reaction. When a rocket pushes exhaust gases downward, the gases push the rocket upward. Action and reaction always act on different bodies, which is why they do not cancel each other.

Friction is the force that opposes relative motion between surfaces in contact. It lets us walk and lets vehicles grip the road, but it also wears out parts and wastes energy as heat. Friction can be reduced with lubricants, smooth surfaces, ball bearings, or by streamlining. The force of friction between two surfaces depends on how rough they are and how hard they are pressed together, not on the area of contact for ordinary sliding.

Two special forces appear often in this chapter: weight, which is the Earth's gravitational pull on a body (weight = mass × gravitational acceleration), and tension, the pull transmitted through a string or rope. Mass stays the same everywhere, but weight changes with gravity - a body weighs less on the Moon because the Moon's gravity is weaker.

Key definitions and concepts

- **Force:** A push or pull that can change a body's motion or shape.
- **Inertia:** The tendency of a body to resist a change in its state of rest or motion.
- **Mass:** The amount of matter in a body; it measures inertia and stays constant everywhere.
- **Weight:** The gravitational force on a body; it equals mass times gravitational acceleration and is measured in newtons.
- **Momentum:** Mass times velocity; a vector quantity measured in kg m/s.
- **Friction:** The force opposing motion between surfaces in contact.
- **Newton (N):** The SI unit of force; one newton accelerates a one-kilogram mass at one metre per second squared.
- **Tension:** The pulling force transmitted along a stretched string, rope or cable.
- **Unbalanced force:** A net force that is not zero and therefore changes a body's motion.

Important short questions

Q1. State Newton's first law of motion.

A body remains at rest or in uniform motion in a straight line unless an unbalanced force acts on it.

Q2. What is the difference between mass and weight?

Mass is the amount of matter and is constant everywhere. Weight is the gravitational force on that mass and changes with the strength of gravity.

Q3. Define momentum and give its unit.

Momentum is mass multiplied by velocity. Its unit is kilogram metre per second (kg m/s).

Q4. Why do passengers lurch forward when a bus stops suddenly?

Because of inertia: their bodies tend to continue moving forward even though the bus has stopped.

Q5. State Newton's third law with one example.

To every action there is an equal and opposite reaction. Example: a swimmer pushes water backward, and the water pushes the swimmer forward.

Q6. Why is friction sometimes useful and sometimes a problem?

It is useful because it lets us walk and grip the road. It is a problem because it causes wear and wastes energy as heat.

Important long questions

Q1. Explain Newton's second law and show how force, mass and acceleration are related.

Newton's second law states that the acceleration of a body is directly proportional to the net force acting on it and inversely proportional to its mass, in the direction of the force. In symbols, F = ma. This means doubling the force doubles the acceleration, while doubling the mass halves it. The law also explains momentum change: a force acting for a time changes momentum, which is why a cricket fielder pulls his hands back while catching - spreading the same momentum change over more time reduces the force on the hands.

Q2. Explain inertia with daily-life examples and say why mass measures inertia.

Inertia is the resistance to change in motion. A book on a table stays still until pushed. A passenger in a moving bus leans backward when the bus starts, because the lower body moves with the bus while the upper body tends to stay at rest. A heavier object needs a larger force to produce the same change in motion, which is why mass is the measure of inertia: more mass means more resistance to acceleration.

Q3. Discuss friction: its causes, advantages, disadvantages and methods of reducing it.

Friction arises because surfaces, even smooth-looking ones, have tiny irregularities that interlock. Its advantages include walking, writing, gripping and braking. Its disadvantages include wear of machine parts, loss of energy as heat, and extra fuel use. Friction is reduced by lubricants such as oil, by polishing surfaces, by using ball bearings that turn sliding friction into rolling friction, and by streamlining moving bodies. It is increased where grip is needed, for example by treads on tyres and shoes.

Numerical guidance

Most numericals use F = ma, momentum p = mv, or weight W = mg. Always convert mass to kilograms and velocity to m/s first. For momentum-change problems, force equals change in momentum divided by time - this is the same second law written in another form.

Original worked example: A force of 20 N acts on a 4 kg trolley. Acceleration a = F ÷ m = 20 ÷ 4 = 5 m/s². If the trolley moves at 3 m/s, its momentum is p = mv = 4 × 3 = 12 kg m/s.

MCQs

1. The SI unit of force is:

   (a) Joule (b) Watt (c) Newton (d) Pascal

2. If the mass of a body doubles while the force stays the same, its acceleration becomes:

   (a) Double (b) Half (c) Four times (d) Unchanged

3. Momentum is the product of:

   (a) Mass and acceleration (b) Mass and velocity (c) Force and time (d) Weight and height

4. Which of these is an example of Newton's third law?

   (a) A book resting on a table (b) A rocket moving upward as gases push downward (c) A ball rolling on the ground (d) A car parked on a slope

5. Friction can be reduced by:

   (a) Increasing roughness (b) Using lubricants (c) Increasing weight (d) Increasing contact area

Answer key: 1-(c), 2-(b), 3-(b), 4-(b), 5-(b)

Chapter 4: Turning Effects of Forces

Summary

A force can do more than push a body in a straight line - it can also turn it. The turning effect of a force is called its moment, or torque. The moment of a force about a point equals the force multiplied by the perpendicular distance from that point to the line of the force. The unit is newton-metre (N m). A longer spanner turns a nut more easily because the same force acts at a larger distance, giving a larger moment.

A couple is a pair of equal, opposite forces that do not act along the same line. A couple produces rotation without any net push - turning a steering wheel or opening a tap are examples.

A body is in equilibrium when it is not accelerating and not rotating. Two conditions must hold: the sum of all forces must be zero, and the sum of all moments about any point must be zero. The first condition keeps the body from moving bodily; the second keeps it from rotating.

The centre of mass is the point where the whole weight of a body can be considered to act. For a uniform ruler it is the middle; for irregular objects it can be found by hanging. A body's stability depends on the position of its centre of mass and the size of its base: a low centre of mass and a wide base make a body stable, while a high centre of mass and a narrow base make it easy to topple. That is why racing cars are built low and wide, and why a person leans forward when carrying a heavy load on the back.

Key definitions and concepts

- **Moment of a force (torque):** Force multiplied by the perpendicular distance from the pivot; measured in N m.
- **Pivot (fulcrum):** The fixed point about which turning takes place.
- **Couple:** Two equal and opposite forces acting along different lines, producing rotation only.
- **Equilibrium:** The state in which the net force and the net moment on a body are both zero.
- **Centre of mass:** The point at which the entire weight of a body may be taken to act.
- **Stable equilibrium:** A body returns to its place after a small disturbance.
- **Unstable equilibrium:** A body moves further away after a small disturbance.

- **Neutral equilibrium:** A body stays in its new position after a small disturbance.

Important short questions

Q1. Define the moment of a force and give its unit.

Moment = force × perpendicular distance from the pivot. Its unit is newton-metre (N m).

Q2. Why is a long spanner more effective than a short one?

Because the moment depends on distance: the same force at a larger distance gives a larger turning effect.

Q3. What is a couple? Give one example.

A couple is two equal, opposite, non-parallel forces producing rotation. Turning a steering wheel is an example.

Q4. State the two conditions of equilibrium.

The sum of forces must be zero, and the sum of moments about any point must be zero.

Q5. Where is the centre of mass of a uniform metre rule?

At its midpoint, the 50 cm mark.

Q6. Why are racing cars built low and wide?

A low centre of mass and a wide base make them more stable and less likely to topple when turning.

Important long questions

Q1. Explain the principle of moments with an example.

The principle of moments states that a body in equilibrium has its clockwise moments equal to its anticlockwise moments about any point. On a balanced seesaw, a heavier child sits closer to the pivot and a lighter child sits further away, so that force times distance is equal on both sides. This is the same principle used in beam balances and in checking that a loaded beam will not rotate.

Q2. Explain the three states of equilibrium with examples.

In stable equilibrium, a small push is followed by a return to the original position - a ball in a bowl, or a cone standing on its base. In unstable equilibrium, a small push moves the body further away - a ball balanced on top of a hill, or a cone balanced on its tip. In neutral equilibrium, the body stays wherever it is pushed - a ball on a flat table, or a cone lying on its side. The difference depends on whether the centre of mass rises, falls or stays level when disturbed.

Q3. How does the position of the centre of mass affect stability? Give practical examples.

A body topples when the vertical line through its centre of mass falls outside its base. Lowering the centre of mass and widening the base both increase stability. A loaded truck is less stable than an empty one because its centre of mass is higher. A person carrying a heavy backpack leans forward to keep the combined centre of mass over the feet. A tightrope walker uses a long pole to lower the centre of mass and steady the balance.

Numerical guidance

Moment problems need care with the perpendicular distance, not just any distance along the beam. Steps: (1) choose the pivot, (2) find each force's perpendicular distance from it, (3) take clockwise and anticlockwise moments with opposite signs, (4) set them equal for equilibrium and solve for the unknown.

Original worked example: A 30 N force acts at a perpendicular distance of 0.4 m from a pivot. Moment = 30 × 0.4 = 12 N m. To balance it, a 20 N force on the other side needs a distance of 12 ÷ 20 = 0.6 m from the pivot.

MCQs

1. The moment of a force is:

   (a) Force × time (b) Force × perpendicular distance (c) Force ÷ distance (d) Mass × distance

2. The unit of moment is:

   (a) N (b) N m (c) J (d) kg m/s

3. A body in equilibrium has:

   (a) Net force zero only (b) Net moment zero only (c) Both net force and net moment zero (d) Neither zero

4. A cone standing on its base is in:

   (a) Unstable equilibrium (b) Stable equilibrium (c) Neutral equilibrium (d) No equilibrium

5. Stability increases when the centre of mass is:

   (a) Higher (b) Lower (c) At the top (d) Outside the body

Answer key: 1-(b), 2-(b), 3-(c), 4-(b), 5-(b)

Chapter 5: Work, Energy and Power

Summary

Work is done when a force moves a body in the direction of the force. Work equals force multiplied by the distance moved in the direction of the force, and its unit is the joule (J). No work is done if there is no displacement, or if the force acts at right angles to the motion - carrying a bag while walking on level ground does no work on the bag in the physics sense, because the lifting force is vertical while the motion is horizontal.

Energy is the capacity to do work, and it is also measured in joules. Kinetic energy is the energy of a moving body and depends on its mass and the square of its speed: doubling the speed makes the kinetic energy four times larger. Potential energy is stored energy due to position or state - a body raised above the ground has gravitational potential energy equal to its weight times its height, and a stretched spring has elastic potential energy.

Energy is never created or destroyed, only changed from one form to another. This is the law of conservation of energy. A falling body loses potential energy and gains kinetic energy by the same amount (ignoring air resistance), so its total mechanical energy stays constant. Other forms of energy include heat, light, sound, electrical, chemical and nuclear energy.

Power is the rate of doing work - work divided by time - and its unit is the watt (W). One watt is one joule per second. A more powerful machine does the same work in less time. Efficiency compares useful output energy with input energy, expressed as a percentage; no real machine is 100% efficient because some energy is always lost, usually as heat due to friction.

Key definitions and concepts

- **Work:** Force × distance moved in the direction of the force; unit joule (J).
- **Energy:** The capacity of a body to do work; unit joule (J).
- **Kinetic energy:** Energy due to motion; depends on mass and speed squared.
- **Potential energy:** Stored energy due to position or condition, such as height above the ground.
- **Law of conservation of energy:** Energy cannot be created or destroyed; it only changes form.

- **Power:** Rate of doing work; unit watt (W), where 1 W = 1 J/s.
- **Efficiency:** Useful energy output divided by total energy input, multiplied by 100%.
- **Joule:** The SI unit of work and energy; one joule is the work done when a force of one newton moves a body one metre in the force's direction.

Important short questions

Q1. Define work and give its unit.

Work = force × distance moved in the direction of the force. Its unit is the joule (J).

Q2. Why is no work done when a person carries a bag horizontally?

Because the lifting force is vertical while the displacement is horizontal; no distance is covered in the direction of the force.

Q3. State the law of conservation of energy.

Energy can neither be created nor destroyed; it can only be converted from one form to another.

Q4. What happens to kinetic energy when speed doubles?

It becomes four times larger, because kinetic energy depends on the square of speed.

Q5. Define power and its unit.

Power is work done per unit time. Its unit is the watt (W).

Q6. Why can no machine be 100% efficient?

Because some input energy is always lost, usually as heat due to friction, so useful output is always less than input.

Important long questions

Q1. Explain kinetic and potential energy with examples, and describe the energy changes in a falling body.

A moving car has kinetic energy because of its motion; a book on a high shelf has gravitational potential energy because of its height. When the book falls, its height decreases so its potential energy decreases, while its speed increases so its kinetic energy increases. The total stays the same if air resistance is ignored - energy is converted, not lost. When the book hits the ground, its kinetic energy becomes sound and heat.

Q2. Derive the idea of gravitational potential energy in simple terms.

Lifting a body of weight W through a height h requires work against gravity equal to force times distance, which is W × h. This work is stored in the body as gravitational potential energy. Since weight equals mass times gravitational acceleration, the stored energy is mass × gravitational acceleration × height. The higher or heavier the body, the more energy it stores, which is why water stored in a high dam can drive turbines below.

Q3. Explain efficiency and why energy is "lost" in machines.

Efficiency is the ratio of useful output energy to input energy, as a percentage. In a motor, some electrical energy becomes useful motion, but some becomes heat in the wires and moving parts. That heat is not destroyed - it is energy converted into a form that is not useful for the machine's purpose. Reducing friction with lubrication and better design raises efficiency, but it can never reach 100% in a real machine.

Numerical guidance

Use consistent units: force in newtons, distance in metres, time in seconds, mass in kilograms. For energy problems, first decide which form is involved (kinetic or potential), write its relation, then substitute. For power, divide the work by the time; for efficiency, divide useful output by input and multiply by 100.

Original worked example: A 2 kg ball moves at 3 m/s. Its kinetic energy = ½ × mass × speed² = ½ × 2 × 9 = 9 J. The same ball held 4 m above the ground (using g = 10 m/s²) has potential energy = mass × g × height = 2 × 10 × 4 = 80 J.

MCQs

1. The SI unit of work is:

   (a) Watt (b) Newton (c) Joule (d) Pascal

2. Kinetic energy depends on:

   (a) Mass only (b) Speed only (c) Mass and speed squared (d) Height only

3. A machine does 200 J of work in 10 s. Its power is:

   (a) 10 W (b) 20 W (c) 200 W (d) 2000 W

4. Which is a form of potential energy?

   (a) A moving car (b) Water stored in a dam (c) Sound from a speaker (d) A glowing bulb

5. Efficiency is calculated as:

   (a) Input ÷ output (b) Useful output ÷ input × 100% (c) Input × output (d) Work × time

Answer key: 1-(c), 2-(c), 3-(b), 4-(b), 5-(b)

Chapter 6: Mechanical Properties of Matter

Summary

Matter exists in three common states - solid, liquid and gas - and its behaviour under forces is described by a few properties. Density is mass per unit volume and tells how tightly matter is packed; its unit is kg/m³. A solid keeps its shape and volume, a liquid keeps its volume but takes the shape of its container, and a gas spreads to fill its container completely.

Pressure is force per unit area, measured in pascals (Pa), where one pascal is one newton per square metre. The same force produces more pressure on a smaller area, which is why a sharp knife cuts better than a blunt one and why wide tyres sink less on soft ground.

In a liquid at rest, pressure increases with depth because of the weight of the liquid above. It acts equally in all directions at a given depth, and it depends on depth and on the liquid's density, not on the shape of the container. This is why dams are built thicker at the bottom. Atmospheric pressure is the pressure of the air around us; it decreases with height and is measured with a barometer. A simple mercury barometer balances the weight of a mercury column against atmospheric pressure.

Buoyancy is the upward force a fluid exerts on a body placed in it. Archimedes' principle states that this upthrust equals the weight of the fluid displaced by the body. A body floats when its average density is less than the fluid's density, and sinks when it is greater. Ships float because their hollow shape gives them a low average density even though they are made of steel.

Elasticity is the property of a material to return to its original shape after a deforming force is removed. Hooke's law states that, within the elastic limit, the extension of a spring is directly proportional to the stretching force. Beyond the elastic limit, the material stays permanently deformed.

Key definitions and concepts

- **Density:** Mass per unit volume; unit kg/m³.
- **Pressure:** Force per unit area; unit pascal (Pa).
- **Atmospheric pressure:** Pressure exerted by the atmosphere, caused by the weight of air above.
- **Barometer:** An instrument for measuring atmospheric pressure.

- **Upthrust (buoyant force):** The upward force exerted by a fluid on a body immersed in it.
- **Archimedes' principle:** Upthrust equals the weight of fluid displaced by the body.
- **Elasticity:** The ability of a material to return to its original shape after deformation.
- **Hooke's law:** Within the elastic limit, extension is directly proportional to the applied force.
- **Elastic limit:** The maximum force beyond which a material does not return to its original shape.

Important short questions

Q1. Define density and give its SI unit.

Density is mass divided by volume. Its SI unit is kilogram per cubic metre (kg/m^3).

Q2. Why does a sharp knife cut better than a blunt one?

Because pressure equals force divided by area. The sharp edge has a much smaller area, so the same force gives much larger pressure.

Q3. State Archimedes' principle.

When a body is immersed in a fluid, it experiences an upthrust equal to the weight of the fluid it displaces.

Q4. Why do dams have thicker walls at the bottom?

Because liquid pressure increases with depth, so the bottom of the dam faces the greatest pressure.

Q5. What is atmospheric pressure, and how is it measured?

It is the pressure exerted by the weight of air above a point. It is measured with a barometer.

Q6. State Hooke's law.

Within the elastic limit, the extension of a spring is directly proportional to the force applied to it.

Important long questions

Q1. Explain why liquid pressure depends on depth and density but not on the shape of the container.

Imagine a column of liquid above a point: the pressure at that point comes from the weight of that column. A deeper point has a taller column above it, so more weight and more pressure. A denser liquid has more mass in the same column, so it also gives more pressure. The shape of the container does not matter because only the vertical height of the column counts - two containers with the same liquid height give the same pressure at the bottom even if one is wide and the other narrow.

Q2. Explain floating and sinking using density and upthrust.

When a body is placed in a fluid, its weight pulls it down and the upthrust pushes it up. By Archimedes' principle, the upthrust equals the weight of the displaced fluid. If the body's average density is less than the fluid's, it displaces a weight of fluid equal to its own weight before it is fully submerged, so it floats partly above the surface. If its density is greater, the maximum upthrust (when fully submerged) is still less than its weight, so it sinks. A steel ship floats because its hollow shape encloses air, making its average density less than water.

Q3. Describe an experiment to verify Hooke's law.

Hang a spring from a stand and note its original length. Add known weights one by one and record the extension each time. Plot extension against applied force: the graph is a straight line through the origin while the spring stays within its elastic limit, showing direct proportionality. Adding too much weight bends the line and leaves a permanent stretch, showing the elastic limit has been passed.

Numerical guidance

Pressure problems use pressure = force ÷ area, with area in square metres. Density problems use density = mass ÷ volume, with volume in cubic metres for SI units. Upthrust problems use the weight of displaced fluid, not the volume alone - density must be included. Watch units carefully: cm^3 must be converted to m^3 (divide by one million) when using SI density.

Original worked example: A force of 60 N acts on an area of 0.03 m^2. Pressure = 60 ÷ 0.03 = 2000 Pa. A block of mass 4 kg and volume 0.002 m^3 has density = 4 ÷ 0.002 = 2000 kg/m^3.

MCQs

1. The SI unit of pressure is:

   (a) Newton (b) Joule (c) Pascal (d) Watt

2. Density is defined as:

   (a) Mass × volume (b) Mass ÷ volume (c) Volume ÷ mass (d) Weight × volume

3. Liquid pressure at a point depends on:

(a) Shape of the container (b) Depth and density (c) Area of the surface (d) Colour of the liquid

4. A body floats when its density is:

(a) Greater than the fluid (b) Equal to the fluid (c) Less than the fluid (d) Zero

5. Hooke's law holds:

(a) Always (b) Only within the elastic limit (c) Only for liquids (d) Only at high temperature

Answer key: 1-(c), 2-(b), 3-(b), 4-(c), 5-(b)

Chapter 7: Thermal Properties of Matter

Summary

Heat is energy transferred because of a temperature difference, while temperature measures how hot or cold a body is. Temperature is measured in kelvin in SI, but Celsius is used in everyday life. The two scales are related simply: a temperature in kelvin equals the Celsius value plus 273.

When most solids, liquids and gases are heated, they expand; when cooled, they contract. This thermal expansion has practical effects: railway tracks are laid with small gaps, bridges have expansion joints, and the liquid in a thermometer rises as it warms. Water is an unusual exception: between 0 °C and 4 °C it contracts as it warms, so water is densest at 4 °C. This protects aquatic life in winter, because the coldest water stays on top as ice while denser water below remains liquid.

Heat changes the state of matter as well as temperature. Melting, boiling, freezing and condensation happen at fixed temperatures for a pure substance. During a change of state, the temperature stays constant even though heat is being supplied or removed - the energy goes into changing the arrangement of particles, not into raising temperature. The heat absorbed to melt a substance without a temperature change is its latent heat of fusion; for boiling it is the latent heat of vaporisation.

Heat travels in three ways. Conduction passes heat through a material without the material itself flowing - it works best in metals. Convection carries heat by the movement of the fluid itself, as in boiling water or sea breezes. Radiation transfers heat as waves that need no medium, which is how the Sun's heat reaches Earth. Good conductors, such as copper, are used in cooking pots; insulators, such as wood, plastic and trapped air, slow heat loss and are used in thermos flasks and building insulation.

Key definitions and concepts

- **Heat:** Energy transferred from a hotter body to a colder one due to a temperature difference.
- **Temperature:** A measure of the average kinetic energy of particles; it indicates hotness or coldness.
- **Thermal expansion:** The increase in size of a substance when heated.
- **Specific heat capacity:** The heat needed to raise the temperature of one kilogram of a substance by one kelvin.
- **Latent heat of fusion:** Heat absorbed to melt a substance at its melting point without temperature change.
- **Latent heat of vaporisation:** Heat absorbed to boil a liquid at its boiling point without temperature change.
- **Conduction:** Heat transfer through a material without bulk movement of the material.
- **Convection:** Heat transfer by the bulk movement of a fluid.
- **Radiation:** Heat transfer by waves, needing no medium.
- **Anomalous expansion of water:** Water contracts when warmed from 0 °C to 4 °C, reaching maximum density at 4 °C.

Important short questions

Q1. What is the difference between heat and temperature?

Heat is energy transferred due to a temperature difference. Temperature measures how hot or cold a body is.

Q2. Convert 25 °C into kelvin.

25 + 273 = 298 K.

Q3. Why are gaps left between railway tracks?

Because the rails expand in summer heat. Without gaps, the expansion would bend or buckle the track.

Q4. Why does temperature stay constant during melting?

Because the heat supplied is used to break the bonds holding particles in the solid structure, not to increase their motion.

Q5. Name the three methods of heat transfer and give one example of each.

Conduction - heat through a metal spoon in hot soup. Convection - hot water rising in a heated pot. Radiation - heat from the Sun reaching Earth.

Q6. Why is water densest at 4 °C?

Because of its anomalous expansion: water contracts as it warms from 0 °C to 4 °C, so its density is greatest at 4 °C.

Important long questions

Q1. Explain thermal expansion and its practical consequences.

Heating increases the vibration of particles, so they take up more space and the material expands. Engineers must allow for this: bridges have expansion joints, railway tracks have gaps, and overhead power lines sag more in summer. A tight metal lid on a jar loosens when run under hot water because the metal expands more than the glass. Bimetallic strips, made of two metals that expand differently, bend when heated and are used in thermostats.

Q2. Explain specific heat capacity and why water is used in cooling systems.

Specific heat capacity is the heat required to raise one kilogram of a substance by one kelvin. Water has a high specific heat capacity, so it absorbs a lot of heat with only a small temperature rise. This makes it ideal for car radiators and central heating: it carries heat away steadily without itself becoming very hot very quickly. It also explains why coastal areas have milder climates - the sea warms and cools slowly.

Q3. Describe the three methods of heat transfer and say where each matters in daily life.

Conduction needs a material and works best in metals: cooking pans have metal bases to conduct heat to food, and handles are made of insulators to protect hands. Convection needs a moving fluid: room heaters warm air that rises and circulates, and sea breezes form when land heats faster than the sea. Radiation needs no medium: the Sun warms Earth through space, dark surfaces absorb more radiation than shiny ones (which is why white clothes feel cooler in summer), and a thermos flask uses a shiny, evacuated double wall to cut all three methods at once.

Numerical guidance

Thermal numericals mostly use: heat = mass × specific heat capacity × temperature change. Keep mass in kilograms and temperature change in kelvin or Celsius degrees - a change of 1 °C equals a change of 1 K, so either works for differences (but not for absolute temperatures). For change-of-state problems, heat = mass × latent heat, and no temperature change is involved.

Original worked example: How much heat is needed to raise 2 kg of water by 10 °C? Using specific heat capacity of water 4200 J/kg °C: heat = 2 × 4200 × 10 = 84,000 J. (The value 4200 is the standard textbook value used in class; students should use the value given by their teacher.)

MCQs

1. The SI unit of temperature is:

   (a) Celsius (b) Fahrenheit (c) Kelvin (d) Joule

2. 0 °C is equal to:

   (a) 0 K (b) 100 K (c) 273 K (d) 373 K

3. Water has maximum density at:

   (a) 0 °C (b) 4 °C (c) 10 °C (d) 100 °C

4. Heat from the Sun reaches Earth by:

   (a) Conduction (b) Convection (c) Radiation (d) All three equally

5. During boiling, the temperature of a pure liquid:

   (a) Keeps rising (b) Keeps falling (c) Stays constant (d) Doubles

Answer key: 1-(c), 2-(c), 3-(b), 4-(c), 5-(c)

Chapter 8: Magnetism

Summary

A magnet attracts iron, nickel and cobalt - these are magnetic materials. Other materials, such as wood, plastic and copper, are not attracted and are called non-magnetic. Every magnet has two poles, north and south. Like poles repel each other and unlike poles attract. A freely suspended magnet always points roughly north-south, which is the basis of the compass.

Breaking a magnet in half does not separate its poles: each piece becomes a complete magnet with its own north and south poles. This shows that magnetism comes from tiny magnetic regions, called domains, inside the material. In an unmagnetised piece of iron the domains point in random directions and cancel out; magnetising lines them up so their effects add together. Heating or hammering disturbs the alignment and can demagnetise a magnet.

The region around a magnet where its force can be felt is its magnetic field. Field lines are drawn to show this field: they leave the north pole and enter the south pole outside the magnet, they never cross each other, and they are closer together where the field is stronger. The Earth's own magnetic field makes the planet behave like a giant magnet, which is why a compass needle aligns with it.

Magnets are used in many devices: compasses for direction, electric motors and generators, magnetic door catches, credit-card strips, and loudspeakers. Temporary magnets, such as a nail magnetised by stroking, lose their magnetism easily. Permanent magnets, such as those made from steel, keep it for a long time. Electromagnets - coils carrying current around an iron core - can be switched on and off and made stronger by increasing the current or the number of turns.

Key definitions and concepts

- **Magnet:** A body that attracts magnetic materials and has two poles.
- **Magnetic pole:** A region of a magnet where its attraction is strongest; every magnet has a north and a south pole.
- **Magnetic field:** The space around a magnet where magnetic force acts.
- **Magnetic field lines:** Imaginary lines showing the direction and strength of a magnetic field.
- **Magnetic material:** A material attracted by a magnet, such as iron, nickel or cobalt.
- **Domain:** A tiny region inside a magnetic material in which atomic magnets point the same way.
- **Temporary magnet:** A magnet that loses its magnetism easily, such as soft iron.
- **Permanent magnet:** A magnet that keeps its magnetism for a long time, such as steel.
- **Electromagnet:** A magnet produced by electric current in a coil, which can be switched on and off.
- **Compass:** An instrument using a small freely suspended magnet to show direction.

Important short questions

Q1. Name three magnetic materials.

Iron, nickel and cobalt.

Q2. State the law of magnetic poles.

Like poles repel each other; unlike poles attract each other.

Q3. What happens when a bar magnet is broken into two pieces?

Each piece becomes a complete magnet with its own north and south poles. Poles cannot be separated.

Q4. What are magnetic field lines?

Imaginary lines that show the direction and strength of a magnetic field. They leave the north pole and enter the south pole outside the magnet.

Q5. How can a magnet be demagnetised?

By heating it strongly or by hammering it, both of which disturb the alignment of its domains.

Q6. Why does a compass needle point north?

Because the Earth has its own magnetic field, and the freely suspended needle aligns with it.

Important long questions

Q1. Explain the domain theory of magnetism.

Inside a magnetic material there are tiny regions called domains, each acting like a small magnet. In an unmagnetised material the domains point in random directions, so their magnetic effects cancel and the material shows no overall magnetism. When the material is magnetised - for example by stroking with a magnet - the domains rotate to line up in the same direction, and their effects add up to give a strong magnet. Heating or hammering shakes the domains back into random directions, which destroys the magnetism. Steel holds the alignment well and makes permanent magnets; soft iron loses it quickly and is used for temporary magnets and electromagnet cores.

Q2. Describe the properties of magnetic field lines.

Magnetic field lines are a way of picturing a magnetic field. Outside a magnet they run from the north pole to the south pole. They never cross each other, because at any point the field has only one direction. They are closer together where the field is stronger, such as near the poles, and further apart where it is weaker. Inside the magnet they run from south to north, forming closed loops. Iron filings sprinkled near a magnet arrange themselves along these lines, making the pattern visible.

Q3. Compare permanent magnets and electromagnets, with uses of each.

A permanent magnet keeps its magnetism without any power supply and is used in compasses, fridge magnets, door catches and loudspeakers. Its strength is fixed. An electromagnet works only while current flows through its coil, and its strength can be changed by changing the current or the number of turns, and its poles can be reversed by reversing the current. Electromagnets are used in cranes for lifting scrap iron, in electric bells, in motors and in relays. The switchable strength is their main advantage; the need for a power supply is their main limitation.

Numerical guidance

This chapter has few calculations at class 9 level. The emphasis is on describing patterns and comparing strengths. If a question asks about field strength, answer qualitatively: field is stronger where lines are closer together, and weaker where they spread apart. For electromagnets, state the relationship rather than a formula: more current or more turns gives a stronger magnet.

MCQs

1. Which of the following is a magnetic material?

   (a) Copper (b) Aluminium (c) Nickel (d) Plastic

2. Like magnetic poles:

   (a) Attract (b) Repel (c) Have no effect (d) Cancel each other

3. Magnetic field lines outside a magnet run from:

   (a) South to north (b) North to south (c) East to west (d) In circles only

4. Which material is best for a permanent magnet?

   (a) Soft iron (b) Steel (c) Copper (d) Wood

5. An electromagnet can be switched off by:

   (a) Heating it (b) Stopping the current (c) Hammering it (d) Painting it

Answer key: 1-(c), 2-(b), 3-(b), 4-(b), 5-(b)

Chapter 9: Nature of Science

Summary

Science is a way of understanding the natural world through observation, evidence and testing. It is not a collection of fixed facts to memorise: scientific ideas are accepted when evidence supports them and revised or replaced when better evidence appears. This willingness to change with evidence is a strength of science, not a weakness.

A scientific investigation usually follows a pattern. It begins with a question or a problem, often from an observation. A hypothesis is a testable, reasoned guess that could answer the question. Experiments are then designed to test the hypothesis fairly: variables are controlled so that only one factor changes at a time, measurements are recorded honestly, and the experiment is repeated to check the result. If the results support the hypothesis repeatedly, it may grow into a theory - a well-tested explanation that fits a large body of evidence. A scientific law, by contrast, describes a pattern in nature, often in mathematical form, without explaining why it happens.

Good scientific practice also includes honesty and care: recording what actually happened rather than what was expected, reporting results fully, giving credit to earlier work, and considering safety and the effect of the work on people and the environment. Measurement skills from Chapter 1 - choosing the right instrument, noting precision, and repeating readings - are part of this practice.

Science connects to technology and society. Scientific knowledge leads to technologies such as medicines, transport and communication, and those technologies in turn raise questions for society about safety, cost and fairness. A scientifically literate person can weigh evidence, spot unsupported claims, and make better decisions - for example, checking whether a product's claimed benefit is backed by real tests rather than by advertising alone.

Key definitions and concepts

- **Science:** The study of the natural world based on observation, evidence and testing.
- **Observation:** Careful noticing of events or properties, using senses or instruments.
- **Hypothesis:** A testable explanation or prediction that can be checked by experiment.

- **Experiment:** A controlled test designed to check a hypothesis.
- **Variable:** A factor that can change in an experiment; the independent variable is changed deliberately, the dependent variable is measured, and controlled variables are kept constant.
- **Theory:** A well-tested explanation supported by a large body of evidence.
- **Scientific law:** A statement describing a pattern in nature, often expressed mathematically.
- **Evidence:** Observations and measurements that support or challenge an idea.
- **Technology:** The application of scientific knowledge to make tools, devices and processes.

Important short questions

Q1. What is a hypothesis?

A hypothesis is a testable, reasoned guess that offers a possible answer to a scientific question.

Q2. What is the difference between a scientific theory and a scientific law?

A theory explains why something happens and is supported by much evidence. A law describes a pattern in nature, often as a mathematical relation, without explaining the reason behind it.

Q3. Why must variables be controlled in an experiment?

So that any change in the result can be attributed to the one factor being tested, rather than to something else that changed at the same time.

Q4. Why is repeating an experiment important?

Repetition checks whether the result is reliable and not a one-off error or coincidence.

Q5. Give one example of science affecting daily life through technology.

Scientific understanding of electricity led to electric lighting, which changed homes, work and safety after dark. (Other valid examples: medicines, transport, communication.)

Q6. Why do scientific ideas sometimes change?

Because new evidence or better instruments can show that an older idea is incomplete or wrong, and science revises ideas to fit the evidence.

Important long questions

Q1. Describe the steps of a scientific investigation, using an example.

Suppose a student notices that plants near a window grow taller than plants in a dark corner. The question is whether light affects growth. A hypothesis could be: plants given more light grow taller. The experiment grows two sets of the same plants with the same soil, water and temperature, but different light - light is the independent variable, height is the dependent variable, and the rest are controlled. Heights are measured over several weeks and the experiment is repeated. If the lit plants consistently grow taller, the hypothesis is supported. If not, it is revised. Results are recorded honestly, including any plants that did not grow as expected.

Q2. Explain why scientific knowledge is reliable yet open to change.

It is reliable because it rests on evidence that others can repeat and check, not on opinion or authority. A claim that survives many independent tests earns trust. It is open to change because new evidence, better instruments or new reasoning can reveal limits in an old idea. When that happens, the idea is corrected rather than defended. This combination - evidence-based trust plus willingness to revise - is what makes science self-correcting over time.

Q3. Discuss the relationship between science, technology and society.

Science produces knowledge about nature; technology applies that knowledge to build tools and systems; society decides how those tools are used. Better medical science leads to new treatments, but society must weigh their cost, safety and fair availability. Transport technology saves time but raises questions about pollution. Because of this link, scientific work carries responsibility: researchers should consider safety, honesty and environmental effects, and citizens benefit from understanding evidence well enough to judge claims about new products and policies.

Numerical guidance

This chapter has no standard numerical problems. Questions here test understanding of method: identifying variables, judging whether a test is fair, and interpreting simple results. Practise by taking any experiment described in class and naming its independent variable, dependent variable and controlled variables.

MCQs

1. A testable, reasoned guess in science is called a:

    (a) Law (b) Theory (c) Hypothesis (d) Fact

2. In a fair experiment, the factor deliberately changed is the:

    (a) Dependent variable (b) Independent variable (c) Controlled variable (d) Result

3. A scientific theory is:

(a) A wild guess (b) A well-tested explanation supported by evidence (c) A rule that never changes (d) An opinion

4. Repeating an experiment mainly checks:

(a) Speed (b) Reliability of the result (c) Cost (d) Popularity

5. Which of these shows science being self-correcting?

(a) Never changing old ideas (b) Revising ideas when new evidence appears (c) Accepting claims without tests (d) Hiding unexpected results

Answer key: 1-(c), 2-(b), 3-(b), 4-(b), 5-(b)