

Definitions and Concepts for CAIE Physics IGCSE

Topic 1: Motion, Forces and Energy

*Definitions in **bold** are for extended students only*

1.1 Physical quantities and measurement techniques

Analogue device: A measuring device that requires the user to read from a scale to obtain the measurement.

Digital device: A measuring device that displays the measurement on a display, rather than requiring the user to read from a scale.

Magnitude: a measure of size.

Micrometre screw gauge: A measuring implement used to accurately measure very small distances.

Pendulum: A pendulum is a weight suspended from a pivot, that swings freely.

Resultant vector: a single vector with the same effect as the sum of all the individual vectors.

Scalar: a quantity with magnitude only.

Vector: a quantity with magnitude and direction.

Volume: The amount of space that a substance or object occupies.

1.2 Motion

Acceleration: When an object's speed is changing; it is represented by a non-zero gradient on a speed-time graph. **Defined as the rate of change of velocity, it can be calculated from the gradient of a velocity-time graph.**

Acceleration of free fall: The approximately constant acceleration (of approximately 9.8m/s^2) with which objects free fall, when close to the earth.

Air resistance: A force opposing an object's direction of motion through air. **It is a form of friction due to the air particles colliding with the object.**

Average speed: The average speed is calculated by dividing the distance travelled by the time taken.

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Deceleration: Negative acceleration.

Distance: A measure of how far an object moves. **It is a scalar quantity.**

Distance–time graph: A plot of how an object's distance changes over time. The gradient of the graph at any point equals the object's speed at that point.

Displacement: A measure of how far an object moves in a certain direction (its overall change in position), calculated by the difference between final and initial readings. **It is a vector quantity.**

Free fall: Motion under the force of gravity alone, without air/liquid resistance.

Liquid resistance: A force opposing an object's direction of motion through liquid. **It is a form of friction due to the liquid particles colliding with the object.**

Speed: A measure of the rate of change of distance. **It is a scalar quantity.**

Speed–time graph: A plot of how an object's speed changes over time. The gradient of the graph at any point equals the object's acceleration at that point. The area under the graph represents the distance travelled.

Terminal velocity: The constant speed achieved by an object falling through a gas or liquid.

Gravitational field: A region where a mass will experience gravitational force. All matter produces a gravitational field around it, and the greater its mass, the stronger the field.

Velocity: The speed in a given direction. **It measures the rate of change of displacement, considering magnitude and direction, so is a vector quantity.**

1.3 Mass and weight

Balance: A piece of apparatus that can compare different weights and masses.

Gravitational field strength: The amount of gravitational force (weight) acting on an object, per unit of its mass. It is equivalent to acceleration of free fall (g) as it is 9.8 N/kg on Earth.

Mass: A measurement of how much matter is in an object. **Mass is the property of an object that resists change in motion. It is a scalar quantity.**



Weight: The gravitational force that acts on an object with mass (**the effect of a gravitational field on a mass**). It is equal to the product of the object's mass and the gravitational field strength at its location. **It is a vector quantity.**

1.4 Density

Density: The mass per unit volume of an object.

1.5 Forces

1.5.1 Effects of forces

Elastic solid: Objects that can be deformed when force is applied and will return to their original shape and size when the force is removed.

Extension: The lengthening of an object as a result of applied force.

Load-extension graphs: A graph that shows how the extension of an object varies with the force(load) applied.

Friction: A resistive contact force that acts to oppose the relative motion between two surfaces. Some energy of the object in contact is lost as heat in the process.

Limit of proportionality: **The point beyond which the extension of an elastic object is no longer directly proportional to the force applied to it.**

Resultant force: A single force with the same effect as the sum of all the individual forces acting on an object (taking into account direction).

Spring constant: **A measure of a spring's stiffness. The higher the spring constant, the smaller the extension is for a given force.**

1.5.2 Turning effect of forces

Equilibrium: An object in equilibrium has a zero resultant force and a zero resultant moment.

Moment of a force: The turning effect of a force, equal to the product of the magnitude of the force and the perpendicular distance from the pivot to the line of action of the force.

Perpendicular distance: The shortest distance from the line in which a force acts, to the pivot point. If perpendicular to the object, perpendicular distance is the length of the object.

Pivot point: the point which the object can rotate about.



1.5.4 Centre of gravity

Centre of gravity: The single point through which all the mass of an object can be said to act.

Line of action of weight: A line which geometrically represents where the force of weight acts on an object.

Plane lamina: A body whose mass is concentrated in a single plane.

Plumb line: a piece of thread used in the experiment to measure centre of gravity.

Stability: A measure of the likelihood of an object toppling. An object is unstable if the object's line of action of weight lies outside of its base.

1.6 Momentum

Conservation of momentum: The total momentum of a system before an event is always equal to the total momentum of the system after the event.

Impulse: The change of a system's momentum as a result of a force acting over a period of time.

Momentum: The product of an object's mass and velocity.

1.7 Energy, Work and Power

1.7.1 Energy

Chemical energy: A store of energy found in things such as batteries, fuels and food.

Elastic potential (strain) energy: The store of energy that stretched or compressed objects contain.

Electrical current: An electric current is a flow of electric charge in a circuit.

Flow diagram: A diagram demonstrating the flow of energy during an event or process.

Gravitational potential energy: The store of energy that all raised matter has. It is directly proportional to the mass of the object, the distance that it is raised, and the gravitational field strength at that point.

Internal energy: It is defined as the energy associated with the random, disordered motion of molecules.



Kinetic energy: The store of energy that all moving matter has. **It is directly proportional to the object's mass and to the square of its velocity.**

Nuclear energy: Non-renewable energy generated from the energy stored in the nuclei of radioactive isotopes. It is released in processes known as nuclear fission.

Principle of conservation of energy: The law that energy can be transferred, stored or dissipated but never created or destroyed.

Sankey diagram: A diagram demonstrating the flow of energy during an event or process. Unlike flow diagrams, it differentiates useful output and waste energy, and shows amount of energy transferred to each source.

1.7.2 Work

Work done: Work is done on an object when a force causes it to move through a distance. It is equal to the product of the distance travelled and the magnitude of the force in the direction of motion.

1.7.3 Energy Resources

Efficiency: The ratio of useful output energy transfer to total energy input. It can never exceed 100%, due to the conservation of energy.

Geothermal energy: Renewable energy generated from the conversion of the thermal energy found below the Earth's surface into electrical energy.

Hydroelectric power: Renewable energy generated by water stored at a height, and released through a turbine. The turbine turns a generator which converts the kinetic energy into electrical energy.

Nuclear fission: The process of splitting a single heavy nucleus (part of an atom) into two lighter nuclei, releasing energy.

Nuclear fusion: The process of making a single heavy nucleus (part of an atom) from two lighter nuclei.

Renewable energy resource: An energy resource that can be replenished whilst it is being used.

Solar energy: Renewable energy generated by converting the energy of the sun into electrical energy, usually by using a solar panel.

Tidal energy: Renewable energy is generated by trapping water when at high tide, and then releasing it through a turbine. The turbine turns a generator which converts the kinetic energy into electrical energy.



Wind energy: Refers to the process of creating electricity using the wind.

1.7.4 Power

Power: The rate at which energy is transferred, or the rate at which work is done. It is calculated by dividing the work done by the time taken.

1.8 Pressure

Normal: Acting at a right angle to a boundary or surface.

Pressure: The force acting perpendicular to a surface, per unit area.

