

Definitions and Concepts for CAIE Physics IGCSE

Topic 2: Thermal Physics

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

2.1 Kinetic Particle Model of Matter

2.1.1 States of Matter

Gases: A state of matter in which the particles are spread apart and have high kinetic energies. Any intermolecular forces acting between the particles are very weak.

Liquids: A state of matter in which the particles are in contact, but can flow over each other. Intermolecular forces act between the particles.

Solids: A state of matter in which the particles are tightly packed together and can only vibrate about their fixed positions. Strong intermolecular forces act between the particles.

2.1.2 Particle Model

Brownian motion: It is the random motion of particles suspended in a medium

Gas temperature: The temperature of a gas is directly proportional to the average kinetic energy of its molecules.

Kinetic molecular model of matter: States that matter is made up of particles that are constantly moving.

Pressure of a gas: The perpendicular force (rate of change of momentum) per unit area acting on the surfaces of a container as a result of the gas particles colliding with it.

Suspension: A state in which particles are dispersed throughout a fluid.

2.1.3 Gases and The Absolute Scale of Temperature

Evaporation: It is the process of changing from a liquid or solid state into vapor due to the escape of more-energetic molecules from the surface of a liquid. **It is influenced by temperature, surface area and draught over a surface.**

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Evaporative cooling: It is cooling due to evaporation due to the escape of more-energetic molecules from the surface of a liquid. **As a result, a body in contact with an evaporating liquid also experiences a loss in temperature.**

Kelvin: The absolute scale of temperature, where absolute zero refers to the minimum possible temperature (0 kinetic energy) of a substance.

Molecule: It is a particle made up of two or more atoms that are chemically bonded together.

Temperature: A measure of the average kinetic energy of the particles in a substance. An increase in temperature will result in an increase in the particles' kinetic energies and velocities.

Volume of a gas: It is the quantity of three-dimensional space occupied by a gas.

2.2 Thermal Properties and Temperature

2.2.1 Thermal Expansion of Solids, Liquids and Gases

Application: The action of putting something into operation.

Magnitude: A numerical quantity or value.

Thermal expansion: Thermal expansion is the increase, or decrease, of the size (length, area, or volume) of a body due to a change in temperature.

2.2.2 Specific Heat Capacity

Fixed points: A well-defined reproducible temperature which can be used as a reference point.

Liquid-in-glass thermometer: An instrument for measuring and indicating temperature in which the thermally sensitive element is a liquid contained in a graduated glass envelope, which uses the thermal expansion of the liquid to measure readings.

Linearity of a thermometer: It is the property in a thermometer defined as the same distance between all degree intervals.

Measurement: It is the process of associating numbers with physical quantities.

Physical property: is any property that is measurable, whose value describes a state of a physical system.



Range of a thermometer: It is the difference between the maximum and minimum temperatures that the thermometer can read.

Sensitivity of a thermometer: It is defined as the increase in the length of the mercury column per unit increase in temperature.

Thermocouple: A device for measuring temperature in which a pair of wires of dissimilar metals (such as copper and iron) are joined and the free ends of the wires are connected to an instrument (such as a voltmeter) that measures the difference in potential created at the junction of the two metals.

2.2.3 Melting, Boiling and Evaporation

Boiling: It is the physical process that results in the transition of a substance from a liquid to a gas state without change in temperature.

Boiling point: It is the temperature at which a substance changes state from a liquid to a gas.

Condensation: The changing from vapour state to a liquid state, when a substance is cooled. As the molecules lose heat, they lose energy and slow down.

Evaporation: Is the process by which an element or compound transitions from its liquid state to its gaseous state below the temperature at which it boils.

Change in Thermal Energy: The product of the mass, specific heat capacity and temperature change of a substance.

Internal energy: The energy stored by the atoms and molecules that make up a system. It is equal to the sum of the total kinetic and potential energies of the particles in the system.

Specific heat capacity: The amount of energy needed to increase the temperature of one kilogram of a given substance by one degree Celsius.

Thermal capacity: It is defined as the amount of heat to be supplied to a given mass of a material to produce a unit change in its temperature.

Latent heat: The energy required for a substance to change state.

Melting: It is the physical process that results in the transition of a substance from a solid to a liquid state without change in temperature.

Melting point: It is the temperature at which a substance changes state from solid to liquid.



Solidification: It is a phase transition in which a liquid turns into a solid when its temperature is lowered to or below its freezing point. As the molecules lose heat, they lose their kinetic energy and band together.

Specific latent heat of vaporisation: The amount of energy needed to change the state of one kilogram of a substance from liquid state to vapour state, whilst held at constant temperature.

Specific latent heat of fusion: The amount of energy needed to change the state of one kilogram of a substance from solid state to liquid state, whilst held at constant temperature.

Specific latent heat: The amount of energy needed to change the state of one kilogram of a substance, whilst held at constant temperature.

2.3 Transfer of Thermal Energy

2.3.1 Conduction

Conduction: The transfer of heat energy through the vibrations of particles in a medium.

Electron: A stable subatomic particle with a charge of negative electricity, found in all atoms

Lattice Vibration: The oscillations of atoms in a solid about the equilibrium position

Thermal conductor: It is a material that allows energy in the form of heat, to be transferred within the material, without any movement of the material itself.

2.3.2 Convection

Convection: The transfer of heat energy through convection currents in a fluid.

Density: It is a property of the substance, also known as mass per unit volume.

2.3.3 Radiation

Absorption: The transfer of the energy of a wave to matter as the wave passes through it.

Electromagnetic spectrum: A group of transverse waves that cover a large range of frequencies and wavelengths. The highest frequency waves in the spectrum are gamma-rays and the lowest are radio waves.



Infrared radiation: A type of radiation that all objects emit and absorb. **The hotter an object is, the greater the infrared radiation it emits in a given time.**

Medium: Is defined as the substance that transfers energy from one substance to another substance.

Reflection: The bouncing back of a wave at a boundary.

Thermal energy: The store of energy that all objects with a temperature contain. The higher the temperature, the greater its thermal energy store.

2.3.4 Consequences of Thermal Energy Transfer

Conduction: The transfer of heat energy through the vibrations of particles in a medium.

Convection: The transfer of heat energy through convection currents in a fluid.

Radiation: The emission of energy as electromagnetic waves or as moving subatomic particles.

