Year 13 Mechanics Definitions

1 radian = $\frac{360}{2\pi}$ degrees

For **circular motion** there must be a resultant force acting perpendicular to the velocity of an object and acting towards the centre of the circle. (Centripetal force)

Newton's law of gravitation: Any two point masses attract each other with a force that is directly proportional to the product of their masses and inversely proportional to the square of their separation.

Gravitational field strength (g) at any point is the gravitational force of attraction exerted per unit mass on an object at that point.

Orbital period T is the time taken for an object to complete one orbit or rotation

Frequency is the number of orbits or rotations per unit time.

Angular velocity is the rate of change of angle of an object moving with circular motion.

Kepler's first law: The orbit of a planet is an ellipse with the Sun at one of the two foci.

Kepler's second law: A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time.

Kepler's third law: The square of the period is directly proportional to the cube of the average distance from the Sun. ie $T^2 \propto r^3$

A **geostationary orbit** is the orbit of an artificial satellite which has a period equal to the rotation of the Earth (one day), is on the equatorial plane and is in the same direction as the rotation of the Earth. Hence it remains above the same point on the Earth's equator so from the Earth appears to be stationary.

Gravitational potential at a point is the wok done in bringing unit mass from infinity to the point.

Gravitational potential energy of a mass is the work done in bringing that mass from infinity to the point.

Displacement during an oscillation is the distance moved from the equilibrium position.

The **amplitude** of an oscillation is the maximum displacement from the equilibrium position.

The **period** (T) of an oscillation is the time taken for one complete oscillation.

The **frequency** (f) of an oscillation is the number of oscillations per unit time.

Simple harmonic motion is defined as motion in which the object has acceleration directly proportional to its displacement from its equilibrium position but opposite in direction.

Angular frequency (ω) is the product of 2π and frequency. ie $\omega = 2\pi f$

Phase difference (ϕ) is the fraction of the oscillation difference between the oscillations of two oscillating particles in radians or degrees.

Pressure is the force exerted per unit area.

Internal energy is the sum of the random distribution of kinetic and potential energies of all the atoms or molecules within the system.

Specific latent heat of fusion is the energy required to convert unit mass of a substance from solid to liquid at its melting point.

Specific latent heat of vaporisation is the energy required to convert unit mass of a substance from liquid to gas at its boiling point.

Specific heat capacity is the energy required to raise the temperature of unit mass of a substance by unit temperature.

Absolute zero is the temperature at which any substance has the minimum possible internal energy.
[T (K) = θ (°C) + 273]

The **mean kinetic energy** of an atom or molecule of an ideal gas is directly proportional to the temperature of the gas in kelvin.

Boyles Law: The pressure exerted by a fixed mass of gas is inversely proportional to its volume, as long as the temperature remains constant.
ie $p \propto 1/V$ or pV = constant or $p_1V_1 = p_2V_2$.

The **combined gas law**: pV/T = constant or

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

.

$$\textbf{Number of moles} = \frac{\text{mass (g)}}{\text{molar mass (gmol}^{-1}\text{)}}$$

Linear momentum = mass x velocity

Impulse is the product of a force and the time for which it acts. It is equal to the change in momentum.

The principle of conservation of momentum: In a closed system the total momentum in any direction remains constant.

In a **perfectly elastic collision** kinetic energy is conserved. In an **inelastic collision** some kinetic energy is lost.