IB PHYSICS OSCILLATIONS AND WAVES DEFINITIONS AND CONCEPTS

OSCILLATION: A repeated back and forth motion.

CYCLE: One complete oscillation.

DISPLACEMENT (x): The distance of the oscillating object measured from its equilibrium position

AMPLITUDE (x_0): The maximum displacement from the equilibrium position

FREQUENCY (f): The number of oscillations completed in a second (unit is hertz, Hz)

ANGULAR FREQUENCY: (ω in rad s^{-1})

$$\omega = \frac{2\pi}{T}$$

PERIOD (T): The time taken for an oscillation. f=1/T; T=1/f

PHASE DIFFERENCE (ϕ): Two oscillations which are not in step have a phase difference (expressed as an angle). A phase difference of one oscillation is 2π radians.

SIMPLE HARMONIC MOTION: A motion where the acceleration is proportional to the displacement at all times but is oppositely directed.

SHM FORMULAS: Displacement, velocity and acceleration are all trigonometric functions when plotted against time. t = 0 can be taken to be when either x = 0 or x = x_0.

$$x = x_0 \sin \omega t; \quad x = x_0 \cos \omega t$$

$$v = v_0 \cos \omega t; \quad v = -v_0 \sin \omega t$$

$$v = \pm\omega\sqrt{(x_0^2 - x^2)}$$

SHM DEFINING FORMULA (not in data book): $a = -\omega^2 x$

RESTORING FORCE: The force directed towards the center of the SHM which opposes the displacement at all times.

ENERGY IN SHM: The energy of an oscillating system continually exchanges between KE and PE.

$$E_K = \tfrac{1}{2} m\omega^2 (x_0^2 - x^2)$$

$$E_{K(max)} = \tfrac{1}{2} m\omega^2 x_0^2$$

$$E_T = \tfrac{1}{2} m\omega^2 x_0^2$$

DAMPING: The loss of energy of oscillations due to work against friction or viscous medium. Can be heavy, light or critical.

NATURAL FREQUENCY: The frequency at which a system will oscillate naturally.

FORCED OSCILLATIONS: Oscillations of a system which is being driven at another frequency than its natural one.

RESONANCE: When the driving oscillation has the same frequency as the natural frequency of the system, the amplitude of the system will increase.

TRAVELLING WAVE: A disturbance moving from a source and transferring energy from one point to another.

TRANSVERSE WAVE: Where the disturbance is at right angles to the direction of travel of the wave.

LONGITUDINAL WAVE: Where the disturbance is perpendicular to the direction of travel of the wave.

WAVEFRONT: A line of surface which joins all points which have the same displacement at the same moment (they are all in phase).

RAY: A line at right angles to the wavefronts which shows the direction of energy travel of the wave.

CREST AND TROUGH: For a transverse water wave, the maximum and minimum displacements.

COMPRESSION AND RAREFACTION: For a longitudinal wave, points of maximum and minimum density of the medium.

DISPLACEMENT: The distance of the disturbance measured from its equilibrium position.

AMPLITUDE: The maximum displacement from the equilibrium position

FREQUENCY: The number of oscillations completed in a second (hertz)

PERIOD: The time taken for an oscillation. f=1/T; T=1/f

WAVELENGTH: The distance between consecutive points on the wave which are in step (ie in phase)

WAVE SPEED: The speed of travel of the energy of the wave.

$$v = f\lambda$$

INTENSITY: The rate of flow of energy through unit area perpendicular to the direction of travel of a wave. Unit: Wm^{-2}

SNELL'S LAW: For two particular media, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant. This is also equal to the ratio of their speeds.

$$\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1} = \frac{v_2}{v_1}$$

DIFFRACTION: The spreading of waves when they pass through an opening or round an obstacle.

SUPERPOSITION: When two waves pass the same point at the same time, their displacements are added together to calculate the resultant displacement.

INTERFERENCE: Superposition of coherent sources resulting in an interference pattern.

CONSTRUCTIVE/ DESTRUCTIVE: Interference in which the resultant is reinforced/ cancelled.

$$\text{path difference} = n\lambda$$

$$\text{path difference} = \left(n + \tfrac{1}{2}\right)\lambda$$

COHERENT: Sources of waves with a constant phase difference are coherent.