Theme C

Wave Behavior

#	Physical Quantity	Definition
	C.1 Simple Harmonic Motion - Includes HL Section	
1	**Wave**	" Is a disturbance that travels in a medium or vacuum transferring energy and momentum from one place to another."
2	**Simple Harmonic Motion (SHM)**	" Is a periodic motion in which the displacement from an equilibrium position and the acceleration are proportional and opposite to each other."
3	**Equilibrium Position**	" Is the position where the object would rest if all energy was removed from the system."
4	**Phase Difference (angle)**	" A phase difference occurs between two similar oscillations if they have the same frequency, but their maximum values (peaks) do not occur at the same time. Phase angle can be between 0 and 2π radians."
5	**Coherent Waves**	" Two waves are said to be coherent if they have a constant phase difference and they have the same frequency."
	C.2 Wave Model	
6	**Mechanical Waves**	" Are waves that require a material medium through which to travel."
7	**Longitudinal Waves**	" Are waves where the displacement (or vibrations) of particles is parallel to the direction of energy transfer (or wave travel)."
8	**Rarefactions**	" Are places where there are reductions in the density and pressure of a medium as a longitudinal wave passes through it."
9	**Compressions**	" Are places where there are increases in the density and pressure of a medium as a longitudinal wave passes through it."
10	**Transverse Waves**	" Are waves where the displacement (or vibrations) of particles is perpendicular to the direction of energy transfer (or wave travel)."
11	**Electromagnetic Waves**	" Are transverse waves that can travel through a vacuum. They are composed of an oscillating electric field that produces an oscillating magnetic field at right angles to each other and both propagate in space at the speed of light."
12	**Frequency, f**	" Is the number of completed oscillations (cycles) per unit time (second). The Unit: Hz or sec^{-1}."
13	**Period, T**	" Is the time taken for a particle to undergo one complete oscillation, sec."
14	**Wavelength, λ**	" Is the shortest distance between two points that are in phase on a wave, i.e. two consecutive crests or two consecutive troughs."
15	**Amplitude, A**	" Is the maximum displacement travelled from the equilibrium (rest) position."
16	**Monochromatic Light**	" Is an electromagnetic wave with a single wavelength or single frequency."
17	**White Light**	" Is light which contains all the colours of the visible spectrum with approximate equal intensity."
18	**Wave Speed**	" Is the speed at which energy is transferred by a wave."
19	**Pitch**	" Is the sensation produced in the human brain by a sound of a certain frequency."
	C.3 Wave Phenomena - Includes HL Section	
20	**Wavefront**	" Is an imaginary surface that connect points on a wave that are in phase."
21	**Ray**	" Is an imaginary line that show the direction of energy transfer in the wave as well as the direction of propagation."

22	**Transmission**	" Is the process by which waves move through a boundary into a different medium, and continue travelling in the new medium."
23	**Opaque**	" A medium through which light cannot be transmitted is described as opaque."
24	**Transparent (Translucent)**	" A medium through which light can be transmitted, and can be seen clearly is described as transparent."
25	**The intensity, I**	" The intensity of a wave at a location is the energy being transferred through a unit area at the location, per unit time. Unit: $W.m^{-2}$."
26	**Refraction**	" Is the change in the direction of propagation when a wave passes from one medium to another due to a change in speed as a result of a change in the optical density of the medium."
27	**Refractive Index, n**	" Is the ration of the speed of waves (light) in vacuum (air) to the speed of waves in a given medium."
28	**The Critical Angle**	" Is the angle of incidence for which the angle of refraction is 90 degrees when the wave moves from more optically dense to a less optically dense medium. "
29	**Total Internal Reflection**	" Is the full reflection that occurs when a wave travelling in an optically dense medium 1 strikes the boundary of a less optically dense medium 2 at an angle of incidence that exceeds the critical angle."
30	**The Law of Reflection**	" States that for a smooth plane reflector all rays obey: the angle of reflection equals the angle of incidence."
31	**Diffraction**	" Is the change in the direction of propagation and the pattern of waves when they pass through a narrow slit (aperture) or when their path is partly blocked by an object."
32	**Interference**	" Is a phenomenon when two or more waves meet they combine to produce a new wave. Interference may be constructive or destructive."
33	**Path Difference**	" Is the difference in the distances travelled from two sources of waves to a particular point (screen)."
34	**The Principle of Superposition**	" When two or more waves meet the total (net) displacement is the vector sum of their individual displacements."
35	**The Diffraction Grating**	" It is a device that is mainly used to separate light into its constituent wavelengths via angular dispersion."
36	**Dispersion of Light**	" Is the separation of white light into different wavelengths (colours) to form a spectrum."

C.4 Standing Waves

37	**Standing Wave - Def.1**	" Is a wave in a medium in which each point on the wave axis has an associated constant amplitude, all points move coherently and there is no transport of energy."
38	**Standing Wave - Def.2**	" Is a special wave formed when two identical traveling waves (of the same speed, wavelength and amplitude) moving in opposite directions meet and then superpose."
39	**Nodes, anti-nodes**	" The locations of zero amplitude are called nodes, and the locations of maximum amplitude are called anti-nodes. Adjacent nodes are separated by $\lambda/2$, where λ is the wavelength.
40	**The First Harmonic**	" Represents the standing wave with the longest wavelength or the lowest pitch (frequency)."
41	**Tuning Fork**	" Is a device that is designed to vibrate at only one precise frequency."
42	**Resonance - Def.1**	" Is the transfer of energy into an oscillating system at its natural frequency."
43	**Resonance - Def.2**	" Is the increase in amplitude and energy of a forced oscillation which occurs when the driving frequency of an external force is equal to the natural frequency of the oscillation."
44	**The Natural Frequency**	" Is the frequency at which a system oscillates when it is disturbed and then left to oscillate without further interference."
45	**Free Oscillation (Vibration)**	" Is one which takes place in the absence of any external forces, other than the one which initiated the motion."
46	**Damping**	" Is produced by the presence of resistive forces which will dissipate all the energy stored in an oscillating system over a period of time."
47	**Underdamped (lightly damped) System**	" In which there is a small amount of damping only. The system will continue to oscillate, but the magnitude of the oscillations decrease exponentially over time."

48	**Overdamped (heavily damped) System**	" In which there is a large amount of damping. The system dissipates all its energy very quickly. It does not oscillate, but returns very slowly to its equilibrium state."
49	**Critically damped System**	" The damping is such that the system returns to its equilibrium state as quickly as possible, without oscillating."
50	**Forced Oscillation (Vibration)**	" Occurs when a system is subject to an external periodic force which may cause it to oscillate at a different frequency to its natural frequency."
51	**Driving Frequency**	" Is the frequency of an oscillating external force acting on a system."
52	**Resonance**	" Is the increase in amplitude and energy of a forced oscillation which occurs when the driving frequency of an external periodic force is equal to the natural frequency of the oscillation. The oscillations of the driving force must be in phase with the natural oscillations of the system."
53	**Frequency-response Graph**	" Is a graph used to show how the amplitude of a system's oscillations responds to different driving frequencies."
	C.5 Doppler Effect - Includes HL Section	
54	**The Doppler Effect**	" The Doppler effect describes the phenomenon of wavelength/frequency shift when relative motion occurs between a source and an observer."
55	**The Double Doppler Effect**	" Describes the case when a source produces a wave that reflects off an object and is received by the source again."
56	**Star**	" Is a massive sphere of plasma held together by the forces of gravity and because of the high temperatures, thermonuclear fusion occurs and radiation is emitted."
57	**Stellar Cluster**	" Is a group of stars of similar age that are physically close together, having condensed from the same nebula, and are gravitationally bound to each other."
58	**Galaxy**	" Is a collection of a very large number of stars and stellar clusters held together by the forces of gravity."
59	**Redshift**	" Is the increase of wavelengths of electromagnetic radiation due to the fact that the distance between the observer and the source is increasing."
60	**Blueshift**	" Is the decrease of wavelengths of electromagnetic radiation due to the fact that the distance between the observer and the source (nearby star) is decreasing."
61	**Recession Speed**	" Is the speed with which a galaxy or star is moving away from Earth."