

Physics 3.3 : Demonstrate understanding of wave systems

Level 3 Credits 4

This achievement standard involves knowledge and understanding of phenomena, concepts, principles and/or relationships related to wave systems, and the use of appropriate methods to solve related problems.

Phenomena, concepts and principles of wave systems:

Interference (quantitative) of electromagnetic and sound waves, including multi-slit interference and diffraction gratings; standing waves in strings and pipes; harmonics and overtones; resonance; beats; Doppler Effect (stationary observer).

Relationships:

$$d \sin \theta = n \lambda$$

$$n \lambda = \frac{dx}{L}$$

$$f' = f \frac{V_w}{V_w \pm V_s}$$

WAVES: Wave Motion

By the end of this unit students should be able to:

- Identify transverse/longitudinal waves and their properties.
- Define Velocity, frequency, period, wavelength, amplitude and phase of transverse and longitudinal waves (e.g. electromagnetic, seismic, sound, water, waves in springs and strings)
- Use the equations $v = f\lambda$ and $f = 1/T$ to calculate unknowns in a wave system.
- Understand factors affecting the speed of waves in elastic media
- Construct a graphical description of travelling waves i.e. displacement-position graphs at a fixed time and displacement-time graphs at a given position
- Describe the electromagnetic spectrum.

WAVES: Wave effects

By the end of this unit students should be able to:

- Describe the reflection of pulses from free and fixed ends.
- Produce graphs of the superposition of two travelling waves; standing waves (nodes and antinodes)
- Describe Standing waves in strings and pipes. Explain how standing waves can be produced by: a string fixed at both ends, a column of air open at one end, a column of air open at both ends
- Use the terms “fundamental frequency”, “harmonics” and “resonance” to describe modes of vibration of a standing wave.
- Analyse interference patterns using the ideas of constructive and destructive interference.
- Understand the terms diffraction, and double source interference of electromagnetic waves and sound
- Calculate the fringe spacing for Young’s experiment.
- Consider multiple source interference of electromagnetic waves; diffraction grating.
- Investigate interference of light within thin films
- Understand the beat frequency as a special case of interference and calculate the beat frequency
- Explain the Doppler effect for a stationary observer using wave theory.
- Calculate the observed frequency/wavelength of light or sound that has undergone a Doppler shift
- Discuss applications of the Doppler effect.