Key Elements: Wave Motion and Geometrical Optics

Estimated Time: 18–22 hours

By the end of this course, students will understand reflection and refraction of light and its wave nature.

Vocabulary

amplitude, angle of incidence, angle of reflection, centre and radius of curvature, critical angle, diffraction, Doppler shift, focal length, focal point, frequency, image and object distance, incident ray, index of refraction, interference (superposition principle), normal, period, phase, polarization, principal axis, reflected ray, reflection, refraction, total internal reflection, wavelength, wave speed

Knowledge

- wave properties
- universal wave equation
- wave phenomena and conditions
- visible light portion of the electromagnetic spectrum
- the law of reflection
- images produced by mirrors (plane, converging, and diverging)
- curved mirrors (concave or convex)
- focal length of a concave mirror
- Snell's law
- lens (convex or concave)
- images produced by converging and diverging lenses
- focal length of a convex lens

Skills and Attitudes

- conduct appropriate experiments
- systematically gather and organize data from experiments
- produce and interpret graphs (e.g., slope and intercept)
- verify relationships (e.g., linear, inverse, square, and inverse square) between variables
- apply models (e.g., physics formulae, diagrams, graphs) to solve a variety of problems
- use appropriate units and metric prefixes

WAVE MOTION AND GEOMETRICAL OPTICS

Prescribed Learning Outcomes	Suggested Achievement Indicators
It is expected that students will:	*The following set of indicators may be used to assess student achievement for each corresponding prescribed learning outcome.* *Students who have fully met the prescribed learning outcome are able to:*
B1 analyse the behaviour of light and other waves under various conditions, with reference to the properties of waves and using the universal wave equation	❑ describe the properties associated with waves, including amplitude, frequency, period, wavelength, phase, speed, and types of waves ❑ use the universal wave equation to solve problems involving speed, frequency (period), and wavelength ❑ describe and give examples of the following wave phenomena and the conditions that produce them: – reflection – refraction – diffraction – interference (superposition principle) – Doppler shift – polarization ❑ identify from an appropriate diagram the visible light portion of the electromagnetic spectrum
B2 use ray diagrams to analyse situations in which light reflects from plane and curved mirrors	❑ state the law of reflection ❑ identify the following on appropriate diagrams: – incident ray – reflected ray – angle of incidence – angle of reflection – normal ❑ show how an image is produced by a plane mirror ❑ describe the characteristics of an image produced by a plane mirror ❑ identify a curved mirror as converging (concave) or diverging (convex) ❑ identify the following on appropriate diagrams: – principal axis – centre and radius of curvature – image and object distance – focal point and focal length ❑ draw accurate scale diagrams for both concave and convex mirrors to show how an image is produced ❑ describe the characteristics of images produced by converging and diverging mirrors ❑ conduct an experiment to determine the focal length of a concave mirror

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Prescribed Learning Outcomes	Suggested Achievement Indicators
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B3 analyse situations in which light is refracted	❑ identify the following from appropriate diagrams: – incident ray – refracted ray – normal – angle of incidence – angle of reflection ❑ use Snell's law to solve a range of problems involving – index of refraction – angle of incidence – angle of reflection ❑ define *critical angle* and *total internal reflection* ❑ solve problems involving critical angles ❑ identify a lens as converging (convex) or diverging (concave) ❑ for a lens, identify the following from appropriate diagrams: – principal axis – focal point (primary and secondary) – focal length – image and object distance ❑ draw accurate scale diagrams for both convex and concave lenses to show how an image is produced ❑ describe the characteristics of images produced by converging and diverging lenses ❑ conduct an experiment to determine the focal length of a convex lens