

SUBJECT: Science

UNIT: P6 Waves



Key Equations

Time Period

$$t = \frac{1}{f}$$

Wave Speed

$$v = f \times \lambda$$

Quantities and Units

t = Time (s)

f = Frequency (Hz)

v = Velocity (m/s)

λ = Wavelength (m)

Transverse and Longitudinal Waves

Transverse waves oscillate perpendicular to the direction of energy transfer.

Longitudinal waves oscillate parallel to the direction of energy transfer.

Ambitious Vocabulary

Transverse

Longitudinal

Radiation Oscillate

Electromagnetic Spectrum

Increasing Frequency
Increasing Wavelength

Radio waves: Use: communication with satellites and TV and radio. Danger: harmless if absorbed.

Microwaves: Use: heating food. Danger: burns.

Infrared: Use: short-range communication, electrical heater. Danger: burns to skin.

Visible Light: Use: photography. Danger: blindness

Ultraviolet: Use: detecting forged bank notes. Danger: skin cancer.

X-Rays: Use: imaging broken bones. Danger: can cause cancer.

Gamma Rays: Use: sterilising medical equipment or food and treating cancer. Danger: can cause cancer.

Energy Transfer

When waves travel, energy is transferred but the matter itself does not move.

Temperature of the Earth

The temperature of the Earth depends on the rate at which light and infrared radiation are emitted and absorbed by the atmosphere and surface. When there is more energy absorbed the temperature increases.

Reflection

When a wave meets a surface, it can reflect. Specular reflection occurs when a wave hits a smooth surface. The angle of incidence is equal to the angle of reflection. Diffuse reflection occurs when a wave hits a rough surface.

Required Practical: Radiation

Independent Variable: type of surface.

Dependent Variable: temperature change

Control Variable: distance of infrared thermometer, time between readings.

Conclusion: Dark and matt surfaces emit and absorb the most radiation. Light and shiny surfaces emit and absorb the least radiation.

Colour

The visible light spectrum is: red, orange, yellow, green, blue, indigo, violet. White light is a combination of all colours. Black is the absence of light. If an object is red, it will absorb all colours except red, which it reflects.

Refraction

When a wave meets a boundary of a material with a different density it slows down and therefore changes direction. If the material is denser it will move towards the normal.

Required Practical: Waves

Use an oscillator to create waves in a shallow tank of water. Place a ruler next to the ripple tank and take a picture and a video for 10s. Count how many waves pass a point in the video and divide by 10 to find the frequency. Measure 10 wavelengths using the ruler and divide by 10 to find the wavelength. Multiply the wavelength by the frequency to find the speed of the wave.

Required Practical: Light

Shine a single ray of light at a glass block, draw the incident, reflected, and emergent rays. Use a protractor and measure these angles including the angle of refraction.

Sound Waves

Travel at 330m/s and can't travel through a vacuum. Human hearing range is 20Hz-20kHz. Vibrations travel through the ear canal to the auditory nerve where signals are sent to the brain.

Black Body Radiation

All objects emit and absorb infrared radiation. An object which absorbs all radiation it is exposed to is called a 'perfect black body'. No radiation is reflected or transmitted through it. An object that emits more radiation than it absorbs will decrease in temperature. An object that absorbs more radiation than it emits will increase in temperature. If the rates are the same, it will be a constant temperature.

Waves for Detection and Exploration

Sonar: used for deep sea exploration using high frequency sound waves.

Seismic: Volcanoes, earthquakes and explosions cause seismic waves travel through the Earth. There are two types of waves: P and S waves. P-waves are longitudinal and travel through solids and liquids. S-waves are transverse and travel only through solids.

Seismic waves can change direction when they travel into materials of different densities.

Ultrasound: High frequency sound waves that are used for medical and industrial imaging. They reflect at boundaries between different materials.