

Exercise walk-through

3.1

Wave properties and the EM spectrum

OxfordAQA · International GCSE · Physics

1. Waves: carrying energy and information

Waves: carrying energy and information

Waves move energy from a source to a receiver without moving matter — light to an eye, sound to an ear, radio to a phone

This topic builds the wave model (frequency, wavelength, speed), then applies it across the electromagnetic spectrum, to sound and (P) ultrasound, reflection, refraction with total internal reflection, and (P) lenses and the eye

2. General properties of waves

General properties of waves

Transverse : oscillations perpendicular to travel — electromagnetic and water waves

Longitudinal : oscillations parallel, as compressions and rarefactions — sound; mechanical waves may be either

3. The electromagnetic spectrum

The electromagnetic spectrum

One continuous family, all transverse, all at the same speed in vacuum, ordered from radio (10^4 m and beyond) down to gamma (10^{-15} m)

Visible light is the narrow band our eyes detect — different wavelengths are different colours

Exercises 2.1·2.3

2.1 Name one transverse and one longitudinal wave. [2]

2.2 A wave has wavelength 2.5 m and frequency 60 Hz. Calculate its speed. [2]

2.3 State what happens to a wave at a boundary between two materials. [2]

Exercises 2.1·2.3

2.1 Name one transverse and one longitudinal wave. [2]

2.1 Transverse – light/water waves; longitudinal – sound.

2.2 A wave has wavelength 2.5 m and frequency 60 Hz. Calculate its speed. [2]

2.2 $v = 60 \times 2.5 = 150 \text{ m/s}$.

2.3 State what happens to a wave at a boundary between two materials. [2]

2.3 Reflected, transmitted or absorbed (or a combination).

Exercises 2.4·3.1

2.4 When does a gap diffract waves strongly? [1]

2.5 Name the EM family used for satellite TV. [1]

3.1 A radio station broadcasts at 200 MHz. Calculate the wavelength (speed 3×10^8 m/s). [3]

Exercises 2.4·3.1

2.4 When does a gap diffract waves strongly? [1]

2.4 When the gap width is comparable to the wavelength.

2.5 Name the EM family used for satellite TV. [1]

2.5 Microwaves.

3.1 A radio station broadcasts at 200 MHz. Calculate the wavelength (speed 3×10^8 m/s). [3]

3.1 $\lambda = v/f = (3 \times 10^8)/(200 \times 10^6) = 1.5 \text{ m}.$

Exercises 3.2-3.3

3.2 Explain why radio reception is often possible behind hills, using diffraction. [2]

3.3 Give one use and one hazard each of ultraviolet and X-rays. [4]

Exercises 3.2-3.3

3.2 Explain why radio reception is often possible behind hills, using diffraction. [2]

3.2 Radio wavelengths are comparable to the hill's size, so the waves diffract around it and reach the far side.

3.3 Give one use and one hazard each of ultraviolet and X-rays. [4]

3.3 UV: use – security marking; hazard – skin cancer/blindness. X-rays: use – medical imaging; hazard – high doses kill cells (ionising).