

Exercise walk-through

6.3

Electromagnetic waves (4.6.2.1–4.6.2.4)

AQA · GCSE · Physics

Exercises 2.1·2.3

2.1 Name the EM wave with the longest wavelength and one with the highest frequency. [2]

2.2 Calculate the wavelength of a 1.5 GHz microwave signal. [3]

2.3 Give one use each for infrared and ultraviolet. [2]

Exercises 2.1·2.3

2.1 Name the EM wave with the longest wavelength and one with the highest frequency.[2]

2.1 Radio; gamma.

2.2 Calculate the wavelength of a 1.5 GHz microwave signal. [3]

2.2 Convert: $f = 1.5 \times 10^9$ Hz (C1).

$$\lambda = \frac{3 \times 10^8}{1.5 \times 10^9} = \mathbf{0.20 \text{ m}}$$

(C1, A1)

2.3 Give one use each for infrared and ultraviolet. [2]

2.3 Infrared: remote controls / heaters / night vision. Ultraviolet: fluorescent lamps / sterilising / tanning.

Exercises 3.1·3.2

3.1 Compare radio waves and gamma rays: give three similarities and two differences.[5]

3.2 A hospital compares two scanning methods for a broken arm: X-ray imaging and ultrasound.

(a) Explain why X-rays form an image of the bone. [2]

(b) Explain why ultrasound is preferred for scanning a fetus. [2]

(c) A scan gives a dose of 0.6 mSv; a chest X-ray gives 20 times this. Calculate the chest X-ray dose in mSv. [2]

Exercises 3.1·3.2

3.1 Compare radio waves and gamma rays: give three similarities and two differences.[5]

3.1 Similarities: both transverse; both travel at the same speed in air/vacuum; both transfer energy from a source to an absorber / both can be reflected, refracted, absorbed (any three, B1 each). Differences: gamma has much shorter wavelength and much higher frequency; gamma is ionising and radio is not / different production and detection (any two, B1 each).

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(a) Explain why X-rays form an image of the bone. [2]

(b) Explain why ultrasound is preferred for scanning a fetus. [2]

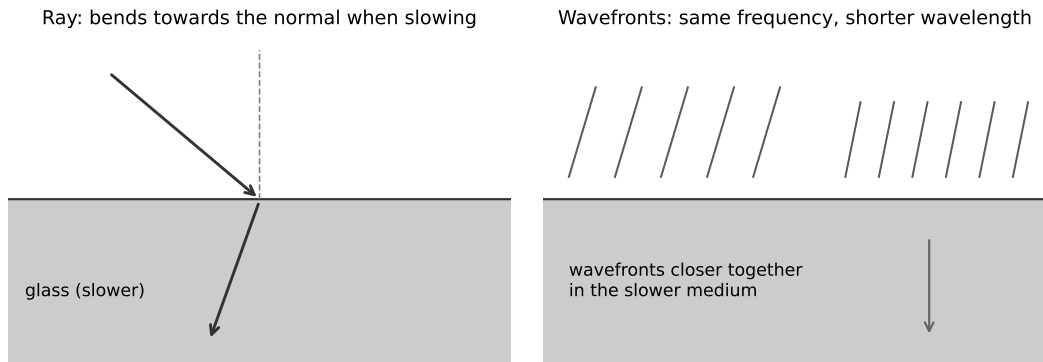
(c) A scan gives a dose of 0.6 mSv; a chest X-ray gives 20 times this. Calculate the chest X-ray dose in mSv. [2]

3.2 (a) X-rays pass through flesh but are absorbed by dense bone, so the shadow of the bone forms the image. (b) Ultrasound is non-ionising, so no risk of mutation to the fetus; it reflects at boundaries giving an image safely. (c) $0.6 \times 20 = \mathbf{12}$ mSv (C1, A1).

Exercise 3.3

3.3 Light passes from air into glass and slows down.

- (a) Explain, in terms of speed, why the light changes direction. [2]
- (b) The wavefront diagram: state what happens to the spacing of wavefronts in the glass and why frequency is unchanged. [3]

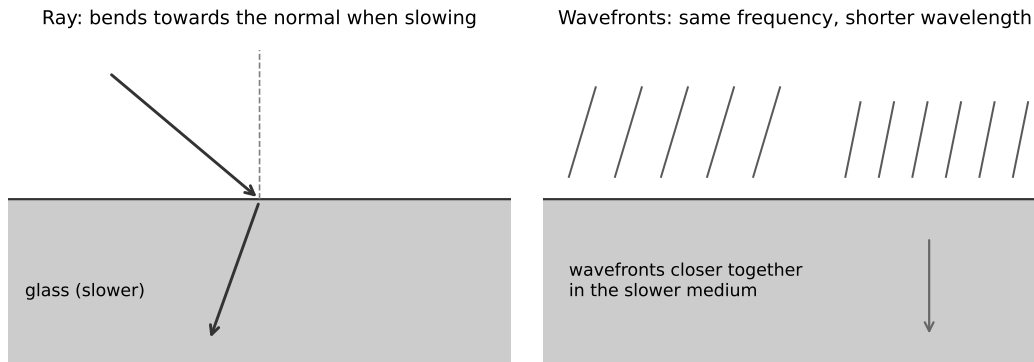


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3.3 (a) One side of each wavefront enters the glass first and slows; the other side, still fast, pivots the front – the ray bends towards the normal. (b) Wavefronts become closer together: the speed falls and $\lambda = v/f$ falls with it; frequency cannot change at the boundary – the same fronts arrive per second.