

Solutions

2.1 Radio; gamma.

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

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).

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) $0.6 \times 20 = \mathbf{12 \text{ mSv}}$ (C1, A1).

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.