

## Chapter 14 Problem 19 †

### Given

$$v = 3.0 \times 10^8 \text{ m/s}$$

### Solution

a) Find the wavelength of a 1.0 MHz AM wave.

The relationship between wavelength and frequency is

$$v = f\lambda$$

Solving for wavelength gives

$$\lambda = \frac{v}{f} \tag{1}$$

Substituting in the know values gives

$$\lambda = \frac{(3.0 \times 10^8 \text{ m/s})}{(1.0 \times 10^6 \text{ Hz})} = 300 \text{ m}$$

b) Find the wavelength of channel 9 (190 MHz).

Use equation 1 given above and substitute in the known values.

$$\lambda = \frac{(3.0 \times 10^8 \text{ m/s})}{(190 \times 10^6 \text{ Hz})} = 1.58 \text{ m}$$

c) Find the wavelength of police radar (10 GHz).

Use equation 1 given above and substitute in the known values.

$$\lambda = \frac{(3.0 \times 10^8 \text{ m/s})}{(10 \times 10^9 \text{ Hz})} = 3.0 \times 10^{-2} \text{ m} = 3.0 \text{ cm}$$

d) Find the wavelength of IR radiation ( $4.0 \times 10^{13}$  Hz).

Use equation 1 given above and substitute in the known values.

$$\lambda = \frac{(3.0 \times 10^8 \text{ m/s})}{(4.0 \times 10^{13} \text{ Hz})} = 7.5 \times 10^{-6} \text{ m} = 7.5 \text{ }\mu\text{m}$$

e) Find the wavelength of green light ( $6.0 \times 10^{14}$  Hz).

Use equation 1 given above and substitute in the known values.

$$\lambda = \frac{(3.0 \times 10^8 \text{ m/s})}{(6.0 \times 10^{14} \text{ Hz})} = 5.0 \times 10^{-7} \text{ m} = 500 \text{ nm}$$

f) Find the wavelength of X-rays ( $1.0 \times 10^{18}$  Hz).

Use equation 1 given above and substitute in the known values.

$$\lambda = \frac{(3.0 \times 10^8 \text{ m/s})}{(1.0 \times 10^{18} \text{ Hz})} = 3.0 \times 10^{-10} \text{ m} = 0.30 \text{ nm} = 3.0 \text{ \AA}$$

---

†Problem from Essential University Physics, Wolfson