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

\[ \lambda = \frac{v}{f} \]  \hspace{1cm} (1)

Substituting in the known 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} \, \text{Hz}).

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

\[ \lambda = \frac{(3.0 \times 10^8 \, \text{m/s})}{(4.0 \times 10^{13} \, \text{Hz})} = 7.5 \times 10^{-6} \, \text{m} = 7.5 \, \text{µm} \]

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

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

\[ \lambda = \frac{(3.0 \times 10^8 \, \text{m/s})}{(1.0 \times 10^{18} \, \text{Hz})} = 3.0 \times 10^{-10} \, \text{m} = 0.30 \, \text{nm} = 3.0 \, \text{Å} \]

†Problem from Essential University Physics, Wolfson