

2. (a) For visible light

$$f_{\min} = \frac{c}{\lambda_{\max}} = \frac{3.0 \times 10^8 \text{ m/s}}{700 \times 10^{-9} \text{ m}} = 4.3 \times 10^{14} \text{ Hz}$$

and

$$f_{\max} = \frac{c}{\lambda_{\min}} = \frac{3.0 \times 10^8 \text{ m/s}}{400 \times 10^{-9} \text{ m}} = 7.5 \times 10^{14} \text{ Hz} .$$

(b) For radio waves

$$\lambda_{\min} = \frac{c}{\lambda_{\max}} = \frac{3.0 \times 10^8 \text{ m/s}}{300 \times 10^6 \text{ Hz}} = 1.0 \text{ m}$$

and

$$\lambda_{\max} = \frac{c}{\lambda_{\min}} = \frac{3.0 \times 10^8 \text{ m/s}}{1.5 \times 10^6 \text{ Hz}} = 2.0 \times 10^2 \text{ m} .$$

(c) For X rays

$$f_{\min} = \frac{c}{\lambda_{\max}} = \frac{3.0 \times 10^8 \text{ m/s}}{5.0 \times 10^{-9} \text{ m}} = 6.0 \times 10^{16} \text{ Hz}$$

and

$$f_{\max} = \frac{c}{\lambda_{\min}} = \frac{3.0 \times 10^8 \text{ m/s}}{1.0 \times 10^{-11} \text{ m}} = 3.0 \times 10^{19} \text{ Hz} .$$