

2.18 Polyethylene with $\epsilon_r = 2.25$ is used as the insulating material in a lossless coaxial line with characteristic impedance of 50Ω . The radius of the inner conductor is 1.2 mm.

- (a) What is the radius of the outer conductor?
- (b) What is the phase velocity of the line?

Solution: Given a lossless coaxial line, $Z_0 = 50 \Omega$, $\epsilon_r = 2.25$, $a = 1.2$ mm:

- (a) From Table 2-2, $Z_0 = (60/\sqrt{\epsilon_r}) \ln(b/a)$ which can be rearranged to give

$$b = a \exp Z_0 \sqrt{\epsilon_r} / 60 = (1.2 \text{ mm}) \exp 50 \sqrt{2.25} / 60 = 4.2 \text{ mm}.$$

- (b) Also from Table 2-2,

$$u_p = \frac{c}{\sqrt{\epsilon_r}} = \frac{3 \times 10^8 \text{ m/s}}{\sqrt{2.25}} = 2.0 \times 10^8 \text{ m/s}.$$
