

(a) **Method 2**

Consider the situation before the break occurs. In general there are two waves on the line, one propagating in the positive z -direction and one propagating in the negative z -direction.

$$V(z) = V_o = V_+ + V_-$$

$$I(z) = I_o = \frac{1}{Z_o}(V_+ - V_-)$$

Solving for V_+ and V_- we get,

$$V_+ = \frac{1}{2}(V_o + Z_o I_o)$$

$$V_- = \frac{1}{2}(V_o - Z_o I_o)$$

At the point of the break there is an open circuit at which the V_+ and V_- waves will be reflected generating $V'_- = \Gamma V_+$ and $V'_+ = \Gamma V_-$ respectively, where $\Gamma = 1$.

To determine the current, we can use the above analysis to relate, V'_+ to I'_+ and V'_- to I'_- .

(b) The current, I_o can be found from

$$P_{dc} = I_o V_o = 1 \times 10^9 W$$

$$\Rightarrow I_o = \frac{1 \times 10^9}{6 \times 10^5} = \frac{1}{6} \times 10^4 A$$

The peak voltage is then given by,

$$V_{peak} = V_o + Z_o I_o = 1433 \text{ kV}$$

Solution P4.4

(a) We can find the length of the transmission by,

$$\ell = \frac{(3 \times 10^8 \text{ m/s})(10^{-8} \text{ s})}{2} = 1.5 \text{ m}$$

(b) Since the transmission line extends to infinity, we can terminate the line with an impedance of Z_0 without introducing reflection. The terminal load, instead of R_f , becomes $Z_L = R_f || Z_0$

$$\text{Since } V = V_+(1 + \Gamma_L)$$

$$V = 0.25V \quad V_+ = 0.5V$$

$$\text{Hence } \Gamma_L = -\frac{1}{2} = \frac{Z_L - Z_0}{Z_L + Z_0}$$

$$Z_L = \frac{1}{3}Z_0, \quad \frac{R_L Z_0}{R_L + Z_0} = \frac{Z_0}{3}$$

$$R_L = \frac{Z_0}{2}$$

(c)

