Analysis:

1. The inductor is part of the load. Define the load impedance.

$$Z_L = R_L \| j\omega L = \frac{10 \times j6}{10 + j6} = 5.145\angle 1.03\ \Omega$$

insert an equal sign here

e load voltage and current:

$$\tilde{\mathbf{V}}_L = \frac{Z_L}{R_S + Z_L}\tilde{\mathbf{V}}_S = \frac{5.145\angle 1.03}{4 + 5.145\angle 1.03} \times 110 = 70.9\angle 0.444\ \text{V}$$

$$\tilde{\mathbf{I}}_L = \frac{\tilde{\mathbf{V}}_L}{Z_L} \frac{70.9\angle 0.444}{5.145\angle 1.03} = 13.8\angle(-0.586)\ \text{A}$$

Finally, we compute the complex power, as defined in equation 7.28:

$$S_a = \tilde{\mathbf{V}}_L\tilde{\mathbf{I}}_L^* = 70.9\angle 0.444 \times 13.8\angle 0.586 = 978\angle 1.03$$
$$= 503 + j839\ \text{W}$$

Therefore

$$P_{\text{av}a} = 503\ \text{W} \qquad Q_a = +839\ \text{VAR}$$

2. The inductor is removed from the load (Figure 7.15). Define the load impedance:

$$Z_L = R_L = 10$$

Next, compute the load voltage and current:

$$\tilde{\mathbf{V}}_L = \frac{Z_L}{R_S + Z_L}\tilde{\mathbf{V}}_S = \frac{10}{4 + 10} \times 110 = 78.6\angle 0\ \text{V}$$

$$\tilde{\mathbf{I}}_L = \frac{\tilde{\mathbf{V}}_L}{Z_L} = \frac{78.6\angle 0}{10} = 7.86\angle 0\ \text{A}$$

Finally, we compute the complex power, as defined in equation 7.28:

$$S_b = \tilde{\mathbf{V}}_L\tilde{\mathbf{I}}_L^* = 78.6\angle 0 \times 7.86\angle 0 = 617\angle 0 = 617\ \text{W}$$

Therefore

$$P_{\text{av}b} = 617\ \text{W} \qquad Q_b = 0\ \text{VAR}$$

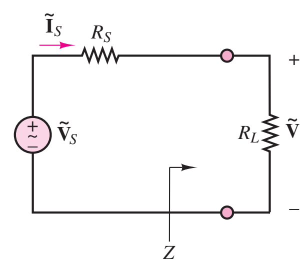

Figure 7.15

3. Compute the percent power transfer in each case. To compute the power transfer we must first compute the power delivered by the source in each case, $S_S = \tilde{\mathbf{V}}_S\tilde{\mathbf{I}}_S^*$. For Case 1:

$$\tilde{\mathbf{I}}_S = \frac{\tilde{\mathbf{V}}_S}{Z_{\text{total}}} = \frac{\tilde{\mathbf{V}}_S}{R_S + Z_L} = \frac{110}{4 + 5.145\angle 1.03} = 13.8\angle(-0.586)\ \text{A}$$

$$S_{Sa} = \tilde{\mathbf{V}}_S\tilde{\mathbf{I}}_S^* = 110 \times 13.8\angle -(-0.586) = 1{,}264 + j838\ \text{VA} = P_{Sa} + jQ_{Sa}$$

and the percent real power transfer is:

$$100 \times \frac{P_a}{P_{Sa}} = \frac{503}{1{,}264} = 39.8\%$$

For Case 2:

$$\tilde{\mathbf{I}}_S = \frac{\tilde{\mathbf{V}}_S}{Z_{\text{total}}} = \frac{\tilde{\mathbf{V}}}{R_S + R_L} = \frac{110}{4 + 10} = 7.86\angle 0\ \text{A}$$

$$S_{Sb} = \tilde{\mathbf{V}}_S\tilde{\mathbf{I}}_S^* = 110 \times 7.86 = 864 + j0\ \text{W} = P_{Sb} + jQ_{Sb}$$