ELG2331: Chapter 7

7.2) The resistance of the heating element is

$$R = \frac{\widetilde{V}^2}{P} = \frac{240^2}{1000} = 57.6\,\Omega$$

7.5) The power dissipated by the circuit is

$$P = VI\cos\theta = 110 \times 4 \times \cos 60^o = 220\ \text{W}$$

$$\text{PF} = \cos 60^o = 0.5$$

7.6) The rms current is

$$\widetilde{I} = \frac{P}{\widetilde{V}\cos\theta} = \frac{1200}{120 \times 0.8} = 12.5$$

$$\theta = \cos^{-1}(0.8) = 36.87^o \text{ (The phase angle)}$$

$$Z = \frac{\widetilde{V}}{\widetilde{I}} = \frac{120}{12.5} = 9.6\,\Omega$$

$$R = Z\cos\theta = 9.6 \times 0.8 = 7.68\,\Omega$$

7.15 a) The apparent power supplied by the source

$$S = \frac{\widetilde{V}^2}{Z} = \frac{\widetilde{V}_2}{\sqrt{(R+R_L)^2 + X_L^2}} = \frac{230^2}{\sqrt{26^2 + 37.7^2}} = 1.155\ \text{VA}$$

b) In order to find the power delivered to the load we should find first the current through the load which is same as the current I_s

$$\widetilde{I}_S^2 = \frac{\widetilde{V}}{Z} = \frac{230}{26^2 + 37.7} = 5\ \text{A}$$

Now find the apparent power through the load

$$S_L = \widetilde{I}_S^2 Z_L = (5)^2 \times \sqrt{25^2 + 37.7^2} = 1.141\,\text{kVA}$$

c) The power factor of the load may be calculated from the impedance triangle

$$\text{PF} = \cos\theta = \frac{R_L}{Z_L} = \frac{25}{45.2} = 0.55$$

This power factor is quite low!

7.16 a) Find first X_L and X_C. Both are equal to 26.6 ohms

$$S = \frac{\widetilde{V}^2}{Z} = \frac{\widetilde{V}^2}{\sqrt{(R+R_L)^2 + (X_L - X_C)^2}} = \frac{230^2}{\sqrt{26^2 + (26.5 - 26.5)^2}} = 2\,\text{kVA}$$

b) Since $X_L = X_C$

$$P = \frac{\widetilde{V}^2}{25+1} = \frac{230^2}{26} = 2\,\text{kW}$$

c) Since $X_L = X_C$, it means we have a resistive load, accordingly the power factor is 1!

7.17) The apparent power is

$$S = \frac{\widetilde{V}^2}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} = \frac{50^2}{\sqrt{20^2 + 26.5^2}} = 75.3\,\text{VA}$$

The real power is

$$P = S.\cos\theta = 75.3 \times \frac{20}{33.2} = 45.36\,\text{W}$$

The reactive power is

$$Q = \sqrt{S^2 - P^2} = \sqrt{75.3^2 - 45.36^2} = -60\,\text{VAR}$$

The angle is

$$\theta = \cos^{-1}\left(\frac{R}{Z}\right) = 53^o$$

The power triangle is shown