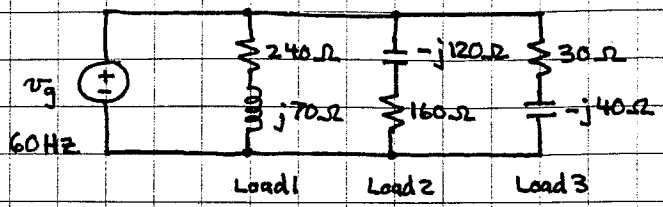

a) Give power factor and reactive factor of each load.

Soln: $\omega = 2\pi f = 2\pi \cdot 60 = 377$ rad/s

$V = IZ \quad \therefore \angle V - \angle I = \theta_v - \theta_i = \angle Z$

Load 1: $\angle\ 240\Omega + j70\Omega = \tan^{-1} 70/240 = 16.3^\circ$

power factor = $\cos 16.3^\circ = 0.96$ lagging
reactive factor = $\sin 16.3^\circ = 0.28$

Load 2: $\angle\ 160\Omega - j120\Omega = \tan^{-1} -120/160 = -36.9^\circ$

power factor = $\cos -36.9^\circ = 0.8$ leading
reactive factor = $\sin -36.9^\circ = 0.6$

Load 3: $\angle\ 30\Omega - j40\Omega = \tan^{-1} -40/30 = -53.1^\circ$

power factor = $\cos -53.1^\circ = 0.6$ leading
reactive factor = $\sin -53.1^\circ = 0.8$ lagging

b) Give power factor and reactive factor of total load.

Soln:

$$Z_{tot} = \frac{1}{\frac{1}{240+j70} + \frac{1}{160-j120} + \frac{1}{30-j40}}\ \Omega$$

$$= \frac{10}{\frac{1}{24+j7} + \frac{1}{16-j12} + \frac{1}{3-j4}}$$

$$= \frac{10}{\frac{24-j7}{25^2} + \frac{16+j12}{20^2} + \frac{3+j4}{5^2}}$$

$$Z_{tot} = \frac{10 \cdot 5^2 \cdot 5^2 \cdot 4^2}{(24-j7)\cdot 4^2 + (16+j12)\,5^2 + (3+j4)\cdot 5^2 \cdot 4^2}$$

$$= \frac{10 \cdot 5^2 \cdot 5^2 \cdot 4^2}{384 + 400 + 1200 + j(-112 + 300 + 1600)}$$

$$= \frac{10 \cdot 5^2 \cdot 5^2 \cdot 4^2}{1984 + j\,1788}$$

$$= 10 \cdot 5^2 \cdot 5^2 \cdot 4^2 \; \frac{1984 - j\,1788}{7133200}$$

$$= 1.4 \cdot 10^{-2} \cdot (1984 - j\,1788)$$

$$= 1.4 \cdot 10^{-2} \cdot 2670.8\, e^{-j42^\circ}$$

$$Z_{tot} = 37.4 \angle -42^\circ$$

$$\therefore \theta_v - \theta_i = -42^\circ$$

power factor = cos -42° = 0.74 leading
reactive factor = sin -42° = -0.67