

$$V_s = 8 \cos(2t - 40^\circ) = 8 \angle -40^\circ \text{ V}$$

$$X_C = \frac{j}{\omega C}$$

$$= -2j$$

$$Z_{eq} = 1 + [(6j)^{-1} + (2 - 2j)^{-1}]^{-1} = 4.6 - 1.2j$$

$$\cancel{I} = \frac{V_s}{Z_{eq}}$$

$$I = i(t) = \frac{V_s}{Z_{eq}} = \frac{8 \angle -40^\circ}{4.6 - 1.2j} = 1.52 - 0.72j = 1.682 \angle -25.346^\circ \text{ A}$$

$$I_1 = i_1(t) = \frac{I \times 6j}{2 - 2j + 6j} = \frac{6j \times (1.52 - 0.72j)}{2 + 4j} = 2.257 \angle 1.219^\circ \text{ A}$$

$$V_{R_1} = I(1) \\ = \cancel{1.682 \angle -25.346^\circ} \\ = 1.682 \angle -25.346^\circ \text{ V}$$

$$V_{R_2} = I_2(2) \\ = 4.514 \angle 1.219^\circ \text{ V}$$

$$P_{Avg_{1\Omega}} = \frac{VI}{2} = \frac{1.682 \times 1.682}{2}$$

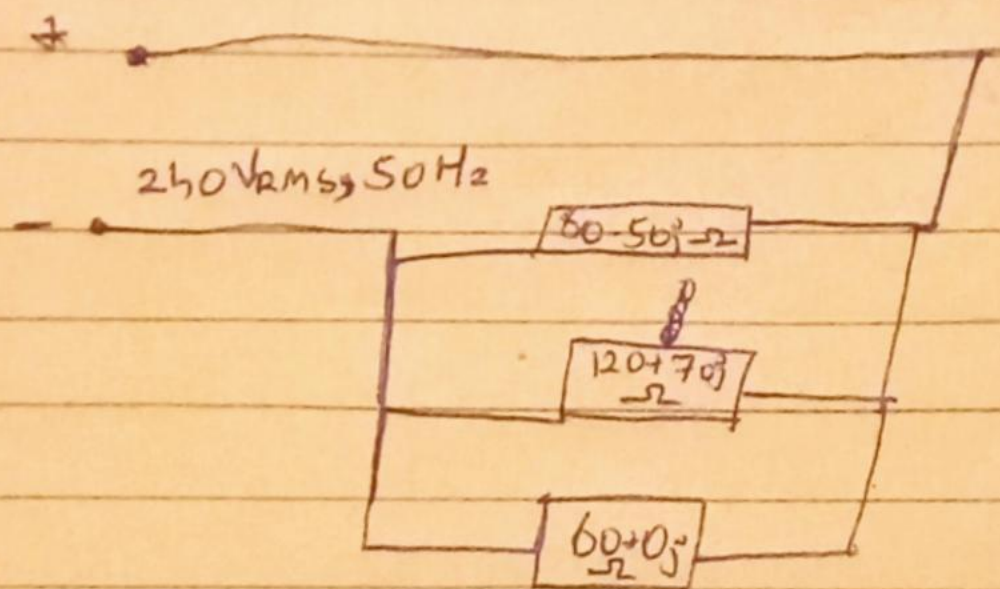
$$\Rightarrow \boxed{P_{Avg_{1\Omega}} = 1.414 \text{ W}}$$

$$P_{Avg_{2\Omega}} = \frac{V_{R_2} I_1}{2} = \frac{4.514 \times 2.257}{2}$$

$$\Rightarrow \boxed{P_{Avg_{2\Omega}} = 5.094 \text{ W}}$$

$$\boxed{P_{Avg_{3H}} = P_{Avg_{0.25F}} = 0}$$

Q15



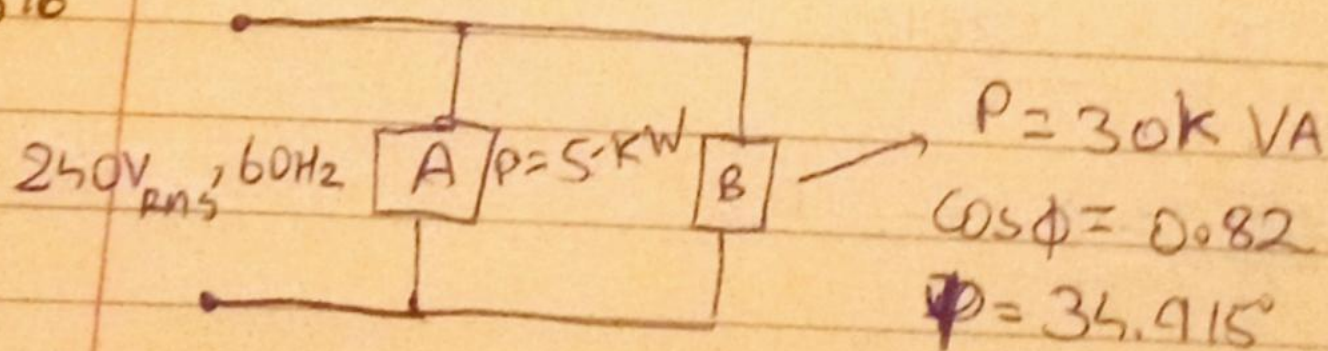
$$Z_{eq} = \left[(80 - 50j)^{-1} + (120 + 70j)^{-1} + (60)^{-1} \right]^{-1}$$

$$= 31.252 + 1.952j \Omega$$

$$p(t) = \frac{(V_{rms})^2}{Z_{eq}} = \boxed{1835.919 - 114.671j}$$

$$\phi = \tan^{-1} \left(\frac{114.671}{1835.919} \right) = \boxed{3.574^\circ}$$

Q16



Power emitted = $P + Q$

$$P = 30,000 \times \cos \phi = 24600 \text{ W}$$

$$Q = 30,000 \times \sin \phi = 17170.81 \text{ VAR}$$

$$\phi = \tan^{-1} \left(\frac{Q}{P} \right) = 34.915^\circ$$

- Apparent power = $24600 + 5000 = 29600 \text{ W}$
- Reactive power = 17170.82 VAR

$$c) \cos(34.915) = 0.820$$

$$\tan \alpha = \frac{Q'}{29600}$$

$$\cos \alpha = 0.9$$

$$\alpha = 25.842$$

$$\Rightarrow 0.484 = \frac{Q'}{29600}$$

$$Q' = 14326.4 \text{ VAR}$$

$$\begin{aligned} \text{Reduced reactive power} &= 17170.82 - 14326.4 \\ &= \boxed{2844.42} \end{aligned}$$

$$d) Q' = \frac{V^2}{X_C} = V^2 (\omega C)$$

$$\Rightarrow C = \frac{Q'}{V^2 \omega}$$

$$\Rightarrow C = \frac{2844.42}{(240)^2 \times 60 \times 2\pi} = \boxed{1.309 \times 10^{-5} \text{ F}}$$