P1. $I = 10\angle 0° A = I_1 + I_2$

$$\frac{1}{Z} = \frac{1}{Z_1} + \frac{1}{Z_2}$$

$$= \frac{1}{8+j6} - \frac{1}{j6}$$

$$= \frac{2}{25} + \frac{8}{75}j$$

i.e. $Z = \frac{8}{2} - j6 = \frac{15}{2}\angle -53.13°$

$V = IZ = 75\angle -53.13°$

$I_1 = \frac{V}{Z_1} = 7.5\angle -90°$

$I_2 = \frac{V}{Z_2} = 12.5\angle 36.87°$

P2. a) $V = 277\angle 30°$

$v(t) = 277\sqrt{2}\cos(\omega t + 30°)$ For $\omega = 2\pi \cdot f = 120\pi$

$= 391.74\cos(120\pi t + \frac{\pi}{6})$

b) $i(t) = \frac{v(t)}{R} = 19.58\cos(120\pi t + \frac{\pi}{6})$

$I = 13.85\angle 30°$

c) $I = \frac{V}{jX_L} = \frac{V}{j\omega L} = \frac{277\angle 30°}{j(120\pi \cdot 60 \times 10^{-3})} = 73.48\angle -60°$

$i(t) = 103.9\cos(120\pi t - \frac{\pi}{3})$

d) $X = \frac{V}{jX_C} = -\frac{V}{j}$

$I = \frac{V}{-jX_C} = -\frac{V}{j25} = \frac{277}{25}\angle -\frac{1}{3}\pi = 11.08\angle -60°$

$i(t) = 15.67\cos(120\pi t - \frac{\pi}{3})$

P3.

$V = \frac{359.3}{\sqrt{2}}\angle 0^\circ = 254\angle 0^\circ V$

$Z = 10 - j25\ \Omega$

$I = \frac{V}{Z} = \frac{254\angle 0^\circ}{10 - j25} = 9.43\angle 68.2^\circ A$

$i(t) = 13.3\cos(\omega t + 68.2^\circ)$

a) $V_R = IR = 94.3\angle 68.2^\circ V$

$V_R(t) = 133.4\cos(\omega t + 68.2^\circ)$

$P_R(t) = V_R(t) i(t) = \boxed{774.2\cos^2(\omega t + 68.2^\circ)}$

b) ~~$V_C I(t) i(t)$~~

Similarly $V_C = I(-X_C) = 235.8\angle -21.8^\circ V$

~~$V_C(t)$~~ ~~$P_R(t)$~~ $Q_C(t) = V_C(t) i(t)$

$= 333.5\cos(\omega t - 21.8^\circ) \cdot 13.3\cos(\omega t + 68.2^\circ)$

$= \frac{4446}{2}\cos(\omega t - 21.8^\circ)\cos(\omega t + 68.2^\circ)$

$= \frac{4446}{2}\sin(2\omega t + 136.4^\circ)$

$= \boxed{2223.1\sin(2\omega t - 43.6^\circ)}$

c) $P_R = I^2 R = \boxed{889.2\ V\cdot A}$

d) $Q_C = I^2 X_C = \boxed{2223.1\ V\cdot A}$

e) $\cos\varphi = \frac{R}{Z} = \frac{10}{\sqrt{10^2+25^2}} = 0.37$ lagging

a)

P4. For $f = 60\,Hz$

$\omega = 2\pi f = 120\pi$

a). For $v(t) = 4\cos(\omega t + 60^\circ)$

i.e. $V = \frac{4}{\sqrt{2}} \angle 60^\circ = 2\sqrt{2} \angle 60^\circ$ volts.

$I = \frac{V}{Z} = \frac{2\sqrt{2}\angle 60^\circ}{2\angle 30^\circ} = \sqrt{2}\angle 30^\circ$

i.e. $i(t) = 2\cos(\omega t + 30^\circ) = 2\cos(120\pi t + 30^\circ)$

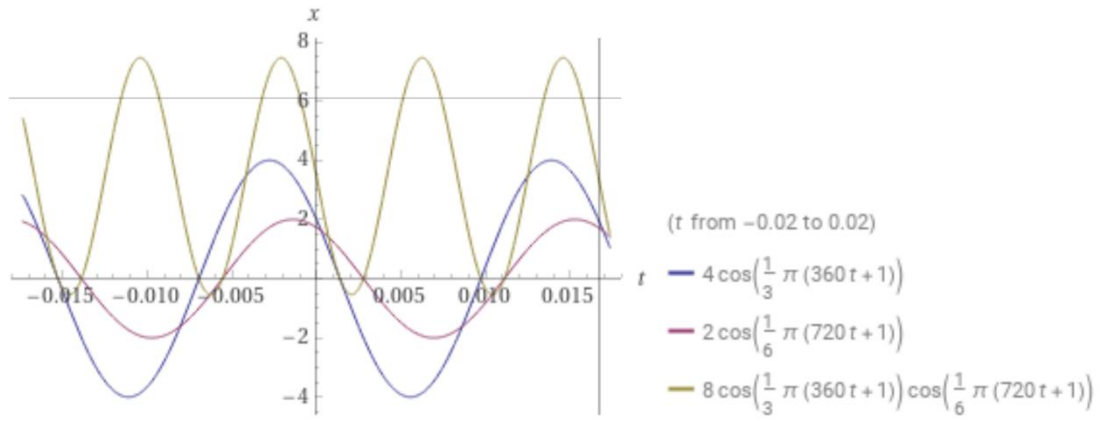
$= 2\cos(120\pi t + \frac{\pi}{6})$

$P(t) = v(t) \cdot i(t)$

$= 4\cos(120\pi t + \frac{\pi}{3}) \cdot 2\cos(120\pi t + \frac{\pi}{6})$

$= 8\cos(120\pi t + \frac{\pi}{3})\cos(120\pi t + \frac{\pi}{6})$

$= 2\sqrt{3} - 4\sin(240\pi t)$



b).

(c) ~~$f = \frac{\omega}{2\pi} = \frac{240\pi}{2\pi} = 120\,Hz$~~.

Average value $= 2\sqrt{3}$

P5. a) $v(t) = 150\cos(\omega t + 10°)$

$V = 106\angle 10°$

$i(t) = 5\cos(\omega t - 50°)$

$I = 3.536\angle -50°$

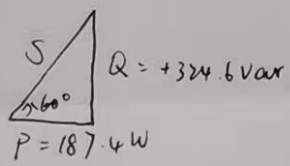
$S = VI^* = [106\angle 10°][3.536\angle 50°]$

$= 374.8\angle 60° = 187.4 + j324.6$

$P = Re[S] = 187.4\ W$

$Q = Im[S] = +324.6\ var$

Power triangle.



b) $p.f = \cos 60° = \frac{1}{2} = 0.5$ lagging

c) $S = 187.4 + j324.6$

$\varphi_{required} = \cos^{-1} 0.9 = 25.8°$

$S_{new} = 187.4 + j(324.6 - Q_{cap})$

$$\frac{324.6 - Q_{cap}}{187.4} = \tan 25.8°$$

$324.6 - Q_{cap} = 90.59$

$Q_{cap} = 234.01\ kvar.$