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1.

(a) TRUE

(b) FALSE

(c) FALSE

(d) TRUE

(e) TRUE

2. (a) $\bar{V} = V_{RMS} \angle \theta_v$ $\quad \bar{I} = I_{RMS} \angle \theta_i$

$= \frac{\sqrt{2} \cdot 100}{\sqrt{2}} = 100 \angle 0° \text{ V}$ $\quad = \frac{\sqrt{2}}{\sqrt{2}} = 1 \angle -60° \text{ A}$

(b) . Active Power $\quad \phi = \theta_v - \theta_i$

$P = |\bar{S}| \cos(\phi)$ $\quad |\bar{S}| = V_{RMS} I_{RMS} = 100$

$= 100 \cos(60°)$ $\quad 0 - (-60°) = 60°$

$\boxed{P = 50 \text{ var}}$

• Apparent Power = 100 var

$\boxed{S = 100 \text{ var}}$

• Reactive power

$Q = |\bar{S}| \sin(\phi)$

$= 100 \sin(60°)$

$\boxed{Q = 86.6 \text{ var}}$

(c) Power factor $= \cos(\phi)$

$= \cos(60°) = 0.5$

$\sin(60°) = 0.866$ $\quad Q = 86.6$

Power Factor = 0.5

Since $\sin(\phi)$ and Q are Positive, the Current is $\boxed{\text{Lagging.}}$

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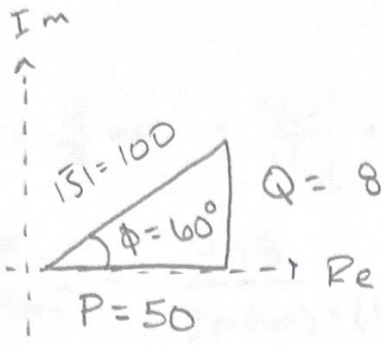
2.

2. (d)



Power factor = 0.5

(e) $\bar{Z} = \frac{\bar{V}}{\bar{I}} = \frac{100\angle 0^\circ}{1\angle -60^\circ} = 100\angle 60^\circ$

$\bar{Z} = 100\angle 60^\circ$ var

$Z = R + jX$

$R = 100\cos(60^\circ)$

$X = 100\sin(60^\circ)$

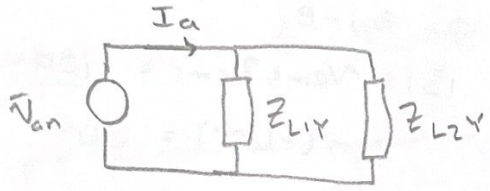
$Z = 50 + j\,86.6$

$R = 50$

$X = 86.6$

The network is INDUCTIVE

3. (a)



$\Delta - Y = Z_{L1} = \frac{9\angle 30^\circ\,\Omega}{3}$

$Z_{L1Y} = 3\angle 30^\circ\,\Omega$

$Z_{L2} = \frac{18\angle 30^\circ\,\Omega}{3} = 6\angle 30^\circ\,\Omega$

$Z_{L2Y} = 6\angle 30^\circ\,\Omega$

(b) $V_{LL} = 207.85\text{V}$ $\quad Z = 9\angle 60^\circ\,\Omega$

$V_{an} = \frac{207.85\text{V}\angle 0^\circ}{\sqrt{3}} = 120\angle 0^\circ \rightarrow I_a = \frac{120\angle 0^\circ}{9\angle 60^\circ} = 13.3\angle -60^\circ$

$V_{bn} = 120\angle -120^\circ$

$V_{cn} = 120\angle 120^\circ$

$I_a = 13.3\angle -60^\circ$

$I_b = 13.3\angle -180^\circ$

$I_c = 13.3\angle 60^\circ$

(c) $S_{tot} = 3 \cdot V_{an} I^*_a$

$= 3 \times (120\angle 0)(13.3\angle 60^\circ)$

$S_{TOT} = 1596\angle 60^\circ$ Var

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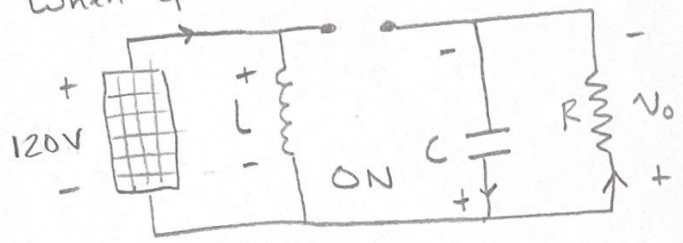
3. (d) $PF = 1$

$$Q_{cap} = \frac{X}{3} V_{ar} = \frac{V_{an}^2}{1/\omega C} \qquad V_{an} = \frac{V_{LL}}{\sqrt{3}}$$

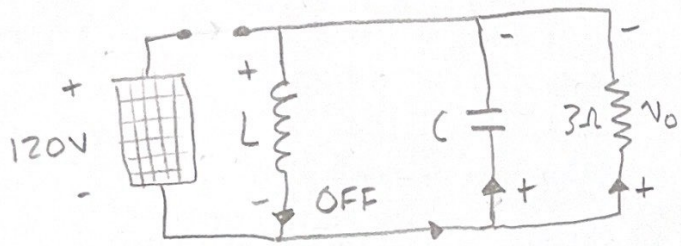
$$C = \frac{Q_{cap}}{2\pi f V_{an}^2} = \frac{798}{2\pi(60)\times(120^2)} = \boxed{1.47 \times 10^{-4}\ F}$$

4. (a)

When $q(t) = 1$ (switch ON) $\quad V_L(t) = q(t) V_{in}$



When $q(t) = 0$ (switch off)



$$V_L(t) = -V_{out}(t)$$

(b) THIS IS A BUCK-BOOST CONVERTER.

when $q(t) = 1$, $V_L(t) = V_{in} = V_m$

when $q(t) = 0$, $V_L(t) = -V_{out}(t) = -V_L$

$$\boxed{V_L = \frac{D}{1-D} V_m}$$

(c) $R_L = 3\Omega$, $V_m = 120V$, $I_m = 10A$

$P_m = 1200\,w$

$V = IR = (10A)(3\Omega)$

$V = 30V$

$$\rightarrow 30 = \frac{D}{1-D}(120)$$

$$30 - 30D = 120D \quad (+30D,\ +30)$$

$$30 = 150D$$

~~$D = 0.2$~~

To achieve max Power, D should be > 0.5