1) a) Given: \( i(t) = 2 \sin(\omega t) \)

Determine the RMS value of \( i(t) \).

Remember:

\[
I_{\text{RMS}} = \sqrt{\frac{1}{T} \int_{t_0}^{t_0+T} i^2(t) \, dt}
\]

Remember:

\[\cos(2\alpha) = 1 - 2 \sin^2(\alpha)\]

b) Given:

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\hline
\text{t} & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\
\hline
i_2(t) & -2 & -1 & -1 & -2 & 2 & 3 & 4 & 5 \\
\hline
\end{array}
\]

periodic with \( T = 8 \text{ sec} \)
Determine the RMS value of $i_2(t)$.

C) Consider a transmission line

\[ i(t) \quad L_T = 0.1 \, \text{H} \]
\[ R_T = 60 \, \Omega \]

1. Let: $i(t) = i_1(t)$. What is the power dissipated by the transmission line?

2. Let: $i(t) = i_2(t)$. How large is the power dissipated by the transmission line?
2) A business receives three-phase power of 208 V line to neutral. The business needs two-phase power of 120 V line to neutral in its office building.

In order to generate the two-phase power, they employ an ideal transformer.

![Transformer Diagram]

The primary side is placed between two phases of the balanced three-phase circuit. The secondary side uses a take-off in the middle of the coil to produce the two-phase power.

How large is a?
3) Given the following circuit:

\[ V_L = 12\angle 90^\circ \, V_{eff} \]

The load consumes the following complex power:

\[ S_L = 24\angle 0^\circ + j6\angle 0^\circ \, \text{VA} \]

How large do you need to make \( V_{s\,eff} \) in polar coordinates?
4) Given the following three-phase circuit:

The effective voltage at the three load terminals (A, B, C) towards neutral is 10000 V eff. The frequency is 60 Hz. The circuit is balanced.

a) How large do we need to select the three capacitors in order to compensate for the inductances of the load and the transmission line?

b) How large is the effective voltage at the three source terminals (a, b, c)?
c) How large is the complex power generated by the three-phase source?

5) Given \( f(t) \) with its Laplace transform:
\[
\mathcal{L} \{ f(t) \} = F(s).
\]

a) Find the Laplace transform of
\[
g(t) = e^{j\omega t} f(t).
\]

b) Let \( u(t) \) be the step function. Find the Laplace transform of
\[
x(t) = e^{j\omega t} u(t).
\]

c) Find the Laplace transforms of
\[
y_1(t) = \cos(\omega t) \cdot u(t)
y_2(t) = \sin(\omega t) \cdot u(t)
\]
Remember: \[ e^{j\omega t} = \cos(\omega t) + j \cdot \sin(\omega t) \]

6) Given \( i_2(t) \) from problem 1b.

a) Determine a mathematical expression for:

\[ f(t) = i_2(t) \cdot [u(t) - u(t - 8)] \]

as a superposition of step functions.

b) Determine the Laplace transform of \( f(t) \).