1. Use appropriate multiple/submultiple prefixes to express the following quantities:

a) 3620 watts (W) = 3.62 kW (kilowatts)

b) 6.60064 amps (A) = 6.60064 mA (microamps)

c) 5.2 × 10^{-6} ohms (Ω) = 5.2 μΩ (micro-ohms)

d) 3.9 × 10^{11} volts (V) = 390 GV

e) 0.02 meters (m) = 2 cm (centimeters)

f) 32 × 10^{5} Volts (V) = 3.2 MV

1.5

16V

\[ \begin{array}{ccc}
    1Ω & 1Ω & 3Ω \\
    4Ω & 5Ω \\
\end{array} \]

a) Identify and label all distinct nodes:

n1

n2

n3

n4

Node: Connection between 2 or more elements

b) Which of these are extraordinary nodes?

Extraordinary node: Node connecting more than 2 elements

16V

\[ \begin{array}{ccc}
    1Ω & 3Ω & 2Ω \\
    4Ω & 5Ω \\
\end{array} \]

C) Identify all combinations of 2 or more circuit elements that are connected in series.
\[ (6V - 1.2\, \text{C}) \]
\[ 3.52 - (4.21/5.2) \, \text{C} \]
\[ C1 - (2.52/1.2) \, \text{C} \]

d) Identify all combinations that are connected in parallel

\[ 4.21/15.2 \, \text{P1} \]
\[ 2.52/(3.2 + \text{P1}) \, \text{P2} \]
\[ 1.6V / (1.2 + \text{P2}) \]

1.14 Determine the current \( i(t) \) flowing through a resistor if the cumulative charge that has flowed through it up to time \( t \) is given by

a) \( q(t) = 3.6t \, \text{mC} \)

\[ i(t) = \frac{dq}{dt} = 3.6 \, \text{mAM} \]

b) \( q(t) = 55 \sin(377t) \, \text{mC} \)

\[ i(t) = \frac{dq}{dt} = 5(377t \cos(377t)) \, \text{mA} = 1885 \cos(377t) \, \text{mA} \]

c) \( q(t) = 6.3[1 - e^{-0.4t}] \, \text{pC} \)

\[ i(t) = \frac{dq}{dt} = 0.12e^{-0.4t} \, \text{pA} \]

d) \( q(t) = 6.2t \sin(120t + \theta) \, \text{nC} \)

\[ i(t) = \frac{dq}{dt} = 0.2 \sin(120t + \theta) + 6.2t \cdot 120 \cos(120t + \theta) \, \text{nA} \]
$$\frac{dQ}{dt} = 0.2 \sin(120\pi t) + 0.2t \cdot 120 \cos(120\pi t) \text{mA}$$

$$= 0.2 \sin(120\pi t) + 24t \cos(120\pi t) \text{mA}$$

1.6 Determine the net charge $Q$ that flowed through a resistor over the specified time interval for each of the following currents

a) $i(t) = 6.36 \text{mA}$ from $t = 0$ to $t = 3s$
$$Q = \int_0^3 i(t) \, dt = \int_0^3 6.36 \, dt = 6.36 (3-0) = 19.08 \text{mA}$$

b) $i(t) = (4t + 8) \text{mA}$ from $t = 1s$ to $t = 12s$
$$Q = \int_{1}^{12} i(t) \, dt = \int_{1}^{12} (4t + 8) \, dt \text{mA} = 20t^2 + 8t \bigg|_{1}^{12}$$
$$= 288 + 96 - (2 + 8) = 294 \text{mA} = 0.2948 \text{C}$$

c) $i(t) = 5 \sin(4\pi t) \text{mA}$ from $t = 0$ to $t = 4.65s$
$$Q = \int_{0}^{4.65} i(t) \, dt = \int_{0}^{4.65} 5 \sin(4\pi t) \, dt \text{mA} = - \frac{5 \cos(4\pi t)}{4\pi} \bigg|_{0}^{4.65}$$
$$= - \frac{5 \cos(4\pi (4.65))}{4\pi} + \frac{5 \cos(0)}{4\pi} = 0.076 \text{mA}$$

d) $i(t) = 12e^{-0.3t} \text{mA}$ from $t = 0$ to $t = \infty$
$$Q = \int_{0}^{\infty} i(t) \, dt = \int_{0}^{\infty} 12e^{-0.3t} \, dt \text{mA} = 40e^{-0.3t} \bigg|_{0}^{\infty}$$
$$= 40e^{-0\infty} + 40e^0 = 40 \text{mA}$$

1.25

$$V_2 = 32 \text{V} \quad R_2$$

$$\frac{V_2}{R_2} = \frac{V}{R}$$

$$V = 20 \text{V}$$
a) What is voltage at node $V_2$?

$V_2 = 48V$

b) What is the voltage difference $V_{32} = V_3 - V_2 = 32 - 48 = -16V$

c) What are the voltages at node $1, 3, 4, 5$ if node 2 is selected as ground node.

\[
\begin{align*}
V_1 &= -48V \\
V_3 &= 32 - 48 = -16V \\
V_4 &= 16 - 48 = -32V \\
V_5 &= 20 - 48 = -28V
\end{align*}
\]

1.29 An electric oven operates at 120V. If its power rating is 0.6kW, what amount of current does it draw, and maximum number does it consume in
amount of current does it draw, and how much energy does it consume in 12 min of operation?

\[ P = V \cdot I = \frac{P}{V} = \frac{6.6\text{ kW}}{120} = 54\text{ A} \]

\[ W = \int_0^{120} 0.64\text{ kW} \, dt = 0.6(120) = 72\text{ kJ} \]

1.3) The voltage across and current through a certain device are given by:

\[ V(t) = 5\cos(4\pi t) \text{ V} \quad i(t) = 0.1\cos(4\pi t) \text{ A} \]

Determine:

a) instantaneous power \( p(t) \) at \( t = 0 \) and \( t = 25s \)

\[ P = VI \quad t = 0 \quad P = 5\cos(0) \cdot 0.1\cos(0) = 0.5\text{ W} \]

\[ P = VI \quad t = 25 \quad P = 5\cos(4\pi(25)) \cdot 0.1\cos(4\pi(25)) = 0.5\text{ W} \]

b) The average power, \( P_{av} \), defined as the average value of \( p(t) \) over a full time period of cosine \( 0 \) to \( 655 \)

\[ p(t) = v(t) \cdot i(t) = 5\cos(4\pi t) \cdot 0.1\cos(4\pi t) \\
= 0.5\cos(4\pi t) \]

\[ P_{av} = \frac{1}{0.5} \int_0^{0.5} 0.5\cos^2(4\pi t) \, dt \]
\[
= 2 \cdot \left( \frac{\sin(4\pi t)}{2\pi} + \frac{6}{4} \right) \\
= 2 \cdot \left( 0 + \frac{6}{4} \right) = 2 \cdot \frac{3}{2} = 3 \text{ W}
\]