1. The graph below shows a current waveform at a reference point in a circuit since \( t = 0 \). Sketch the graph of the charge that has passed the same reference point out to the 6 sec point. [6 pts]

2. Write true or false to the statements below:

a. If two resistors have the same current through them, they are in parallel. **FALSE** [3 pts]

b. If two resistors have the same voltage across them, they are in series. **FALSE** [3 pts]

3. A 12 ohm resistor draws 20 watts from a voltage source. How much power would a 3 ohm resistor draw from the same source? [6 pts]

   \[ V = 12 \text{V}, \quad P = I^2R, \quad 20 = I^2(12), \quad I = 1.29, \quad V = 15.49 \]

   \[ P = 80 \text{W} \]

[Diagram with current and voltage waveforms]
4. In the circuit below, determine the equivalent resistance $R_{eq}$ between points A and B and the voltage $V_x$. [4 pts]

\[
\begin{align*}
V_x &= -11.61 \text{ V} \\
R_{eq} &= 8.31 \Omega
\end{align*}
\]

5. How much power is dissipated by each source in the circuit below?

- 2V source: $P_{diss} = -10 \text{ W}$
- 5A source: $P_{diss} = (78)(-5) = -390 \text{ W}$

\[
\begin{align*}
P_{diss}(2V) &= -10 \text{ W} \quad [4 \text{ pts}] \\
P_{diss}(5A) &= -390 \text{ W} \quad [4 \text{ pts}]
\end{align*}
\]
6. Determine \( V_A \) and \( V_B \) using nodal analysis. [24 pts]

\[
\begin{align*}
\text{KCL at SW} : & \quad -2 - I_1 - I_2 - I_3 - I_4 = 0 \quad \text{(const eq)} : \quad V_A = V_B + 3V_0 \\
\text{KVL at Sub} : & \quad - V_A - \left( \frac{V_A - 12}{4} \right) + \frac{V_0}{4} - \left( \frac{V_B - 12}{8} \right) = 2 \quad \text{(A)} \quad -8V_A - 2V_A + 24 - 2V_B - V_0 + 12 = 16 \quad \text{(A)} \quad V_A = 4V_B \quad \text{(A)} \\
& \quad -10(4V_B) - 3V_B = -20 \\
& \quad -40V_B - 3V_B = -20 \\
& \quad -43V_B = -20 \\
& \quad V_B = -\frac{20}{43} = 0.47 \\
& \quad V_A = 4(0.47) = 1.86V \\
\end{align*}
\]

\[
\begin{align*}
V_A &= 1.86V \\
V_B &= 0.47V
\end{align*}
\]

checked by Spice
7. Using mesh analysis find io below.

**KVL E SM:**

\[ 6i_1 + 4(i_1 - i_2) + 8(i_3 - i_2) + 240 = 0 \]

\[ 6i_1 + 4i_1 - 4i_2 + 8i_3 - 8i_2 = -240 \]

\[ 10i_1 - 12i_2 + 8i_3 = -240 \]

**KVL E i_2**

\[ 2i_2 + 120 + 8(i_2 - i_3) + 4(i_2 - i_1) = 0 \]

\[ 2i_2 + 8i_2 - 8i_3 + 4i_2 - 4i_1 = -120 \]

\[ -8i_3 + 14i_2 - 4i_1 = -120 \]

**Const eq:**

\[ i_3 - i_1 = 40 \]

\[
\begin{bmatrix}
10 & -12 & 8 \\
-4 & 14 & -8 \\
-1 & 0 & 1
\end{bmatrix}
\begin{bmatrix}
i_1 \\
i_2 \\
i_3
\end{bmatrix}
= 
\begin{bmatrix}
-240 \\
-120 \\
40
\end{bmatrix}
\]

\[ i_1 = -50.37 \]

\[ i_2 = -28.89 \]

\[ i_3 = -10.37 \]

\[ i_0 = i_1 - i_2 \]

\[ = -50.37 - (-28.89) \]

\[ = -21.48 \text{ A} \]

\[ i_0 = -21.48 \text{ A} \]