1. \[(25 \times 10^3 \text{ C/s}) (30 \times 10^6 \text{ s}) = 0.75 \text{ C}\]

2. \[\begin{align*}
A & \quad - \quad V_i \quad + \quad \text{B} \\
\text{Energy absorbed} &= 150 \text{ J}, \\
\text{4 e of charge,} \\
\frac{(150 \text{ J})}{(4 \text{ e})} &= 37.5 \text{ V. But since energy is} \\
given up by the charge moving A to B, point A \\
is at the higher energy level. So, \[V_i = -37.5 \text{ V}\]
\end{align*}\]

3a. \[\begin{align*}
& \quad + \quad V_2 \quad - \\
\quad 4 \text{ mA} \\
\text{V_2 and current are not in} \\
\text{passive sign arrangement,} \\
\text{so P_{abs} = -(V_2)(4 \text{ mA}) = -(-7)(4 \text{ mA}) = 28 \text{ mW}}
\end{align*}\]

3b. \[\begin{align*}
& \quad + \quad V \quad - \\
\quad 10 \text{ mA} \\
\text{Voltage e. current references are} \\
\text{in passive sign arrangement,} \\
\text{so P_{abs} = (V)(10 \text{ mA}) = 10 \text{ mW}}
\end{align*}\]

4. \[\begin{align*}
\text{neg charge} & \rightarrow I_1 \\
\text{pos charge} & \leftarrow I_2 \\
\text{mag of current:} \\
(9 \times 10^9 \text{ electrons/s}) (1.6 \times 10^{-19} \text{ C/electron}) \\
= 14.4 \times 10^{-10} \text{ C/s} = 1.44 \text{ nA}
\end{align*}\]

a) Conv. current moving in same direction as I_1, ref., 
so \[I_1 = 1.44 \text{ nA}\]

b) \[I_2 = -I_1 = -1.44 \text{ nA} = I_2\]
5a. \[ V_x = 12 \text{ V} \Rightarrow 5V_x = 60 \text{ V} \]

\[ VR = 20 \text{ V} \]

\[ a), \quad P_A = (VR)(5V_x) = (20)(60) = 1200 \text{ W} \]

\[ P_{VS} = -(V_x)(5V_x) = -(12)(60) = -720 \text{ W} \]

\[ P_{CS} = -(8V)(5V_x) = -(8)(60) = -480 \text{ W} \]

Sum = 0 W \quad \text{-----> part b)}

5b.

\[ A + \frac{V_1}{W} - B \]

\[ 5 \text{ V} \text{ k} \Omega \]

\[ I_y \]

\[ a), \quad V_1 \text{ and } I_x \text{ are in passive sign}: \quad I_x = \frac{V_1}{R} = \frac{4}{5 \text{ k} \Omega} = 0.78 \text{ mA} \]

\[ b), \quad V_1 \text{ and } I_y \text{ are not in passive sign}: \quad I_y = -\frac{10}{5 \text{ k} \Omega} = 1.96 \text{ mA} = I_y \]

\[ c), \quad V_1 \text{ and } I_x \text{ are in passive sign}: \quad V_1 = I_x R = (-50 \text{ mA})(5 \text{ k} \Omega) \]

\[ V_1 = -5 \text{ V} \]

6. Let the current flowing in each element be \( I \), with reference direction clockwise around the circuit.

Power conservation: \[ I V_S = I^2 R_1 + I^2 R_2 \]

Divide by \( I \): \[ V_S = I R_1 + I R_2 \]

Ohm's Law: \[ I = \frac{V R_2}{R_2} \quad (I \text{ and } V R_2 \text{ are in passive sign}) \]

Substitute: \[ V_S = \frac{(V R_2)(R_1)}{R_2} + \frac{V R_2(B_2)}{R_2} = \frac{V R_2 (R_1+B_2)}{R_2} \]

Algebra: \[ V R_2 = V_S \frac{R_2}{R_1+B_2} \]
7. \[ + \frac{V_z}{15k\Omega} = IV \text{ and } I_w \text{ not in passive sign: } V_z = -I_w(15k) \]

a) \[ V_z = 7V \quad I_v = \frac{-V_z}{15k} = \frac{-7V}{15k} = -0.47 \text{ mA} \]
\[ P_v = V_z^2/15k = 49/15k = 3.27 \text{ mW} \]

b) \[ V_z = -7V \quad I_v = \frac{-V_z}{15k} = \frac{7V}{15k} = 0.47 \text{ mA} \]
\[ P_v = V_z^2/15k = 49/15k = 3.27 \text{ mW} \]

8. Total resistance: \( (0.64 \Omega/1000 \text{ ft}) \times (5280 \text{ ft/mi}) \times (1.5 \text{ mi}) \)
\[ R_w = 51.07 \Omega \quad I = 30A \]

a) \[ V_R = I \cdot R = (30A) \times (51.07 \Omega) = 1532 \text{ V} \]

b) \[ V_k = I \cdot R = (30A) \times (5.07 \Omega) = 152.1 \text{ V} \]

Since \( V_k \) has + ref at East and value is positive, the East end of the wire has higher potential.

c) \[ P_e = I^2 \cdot R = (30)^2 \times (5.07) = 456 \text{ kW} \]

9. a) Nodes: 4 (in red)
   b) Elements: 7
   c) Branches: 6

A branch is a 2-terminal element and it has 2 nodes. The 2Ω resistor has both terminals connected to the same node, so it is not a branch.
10. b) \[2A \quad 3A \quad I \quad 3A\]

**KCL at top node:** \[2A = 3A + I + 3A \Rightarrow I = -4A\]

I have replaced resistors by unspecified elements because it is not possible for those elements to all be resistors and have those currents.

\[A \quad \text{super-node} \quad B\]

**KCL at B:** \[I_1 + I_2 = I\]

**KCL at A:** \[9A = I_1 + I_3 \Rightarrow I_1 = 9 - I_3\]

**KCL at C:** \[I_3 = I_2 + 9 \Rightarrow I_2 = I_3 - 9\]

Sub into KCL at B: \[9 - I_3 + (I_3 - 9) = I = 0\]

2nd way: KCL at super-node \[9A = I + 9A \Rightarrow I = 0\]

11. \[-2V \quad R_1 \quad R_2 \quad R_3 \quad 7A\]

**KCL at top right node:** \[IA = I_2 + (-3A) + 7A \Rightarrow I_2 = -3A\]

12. \[-2V \quad 2V \quad I_2 \quad 3I_2 \quad 1A\]

**Power at top node:** \[P_{top} = (I_5)(2V) = 16W \Rightarrow I_5 = 8A\]

**KCL at bottom node:** \[I_2 + 1A + 3I_2 = I_6 = 8A\]

\[4I_2 = 7A \Rightarrow I_2 = \frac{7}{4}A = 1.75A = I_2\]