1.1 If the current in an electric conductor is 2.4 A, how many coulombs of charge pass any point in a 30-second interval?

**Solution:**

Current \( I = 2.4 \text{ A} \)

Time Interval \( T = 30 \text{ seconds} \)

Charge \( q = I \times T \)

\[ q = 2.4 \times 30 \]

\[ = 72 \text{ coulomb} \]

1.10. The current that enters an element is shown in Fig. Find the charge that enters the element in the time interval \( 0 < t < 20 \text{ s} \).

**Solution:**

Charge is the area under the curve.

\[ q = \int_{t_1}^{t_2} i(t) dt \]

\[ q = 10 \times 10 + \frac{1}{2} \times 10 \times 10 \]

\[ = 100 + 50 = 150 \text{ mC} = 0.15 \text{ C} \]
The current flowing into a box is given by the waveform shown in Fig. Calculate the following quantities.

a) the amount of charge which has entered the box at $t=1\ s$, $t=3\ s$ and $t=4.5\ s$.

b) the power absorbed by the box at $t=1\ s$, $2.5\ s$, $4.5\ s$ and $5.5\ sec$, and

c) the amount of energy absorbed by the box between 0 and 6 sec.

\[ i(t) \]

\[ n(t) \]

\[ 2V \]

\[ 2 \]

\[ 1 \]

\[ 0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ t(\sec) \]

\[ q_{t=1\sec} = \int_{0}^{1} i(t) dt = 2 \int_{0}^{1} dt = 2 [t]_{0}^{1} = 2(1-0) \]

\[ q_{t=3\sec} = \int_{0}^{3} i(t) dt = \int_{0}^{1} i(t) dt + \int_{1}^{2} i(t) dt + \int_{2}^{3} i(t) dt \]

\[ = 2 + 0 + \int_{2}^{3} (t-1) dt \]

\[ = 2 + 0 + \left[ \frac{t^2}{2} - t \right]_{2}^{3} \]

\[ = 2 + 0 + \left[ \frac{9}{2} - 3 - (2 - 2) \right] = 2 + 0 + \frac{3}{2} = 2 + \frac{3}{2} = \frac{7}{2} \]

\[ q_{t=4.5\sec} = \int_{0}^{4.5} i(t) dt = \int_{0}^{1} i(t) dt + \int_{1}^{2} i(t) dt + \int_{2}^{3} i(t) dt + \int_{3}^{4} i(t) dt + \int_{4}^{4.5} i(t) dt \]

\[ = 1 + 0 + \int_{3}^{4} (t-1) dt + \int_{4}^{4.5} 0 dt \]

\[ = 1 + \left[ \frac{t^2}{2} - t \right]_{3}^{4} + 0 \]

\[ = 1 + \left[ \frac{16}{2} - 4 - (9/2 - 3) \right] = 1 + \frac{10}{2} = 1 + 5 = 6 \]
\[ 4 - 1 + \frac{1}{3} + 0 = \frac{1}{3} - 1 + 0 = 0 \]

\[ P = \frac{V}{I} = \frac{4}{2} = 2 \text{ W} \]

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\[ e) \quad E_{\text{energy}} = \int_{0}^{5} V(t)I(t) dt = \int_{0}^{1} 2x \cdot 2 dt + \int_{1}^{4} 2x \cdot 0 dt + \int_{4}^{5} 2x \cdot (-1) dt + \int_{0}^{5} 2x \cdot 0 dt \]

\[ = 4 \int_{0}^{1} dt + 0 + 2 \int_{1}^{4} dt + 0 + 2 \int_{4}^{5} dt \]

\[ = 4 \left[ t \right]_{0}^{1} + 2 \left[ t \right]_{1}^{4} + 2 \left[ t \right]_{4}^{5} \]

\[ = 4 \left[ 1 - 0 \right] + 2 \left[ 4 - 1 \right] + 2 \left[ 5 - 4 \right] \]

\[ = 4 + 6 + 2 = 12 \text{ Joules} \]
1.18 Determine the amount of power absorbed or supplied by the element in the fig. if

\[ a) \ V_1 = 9 \text{V} \quad \text{and} \quad I = 2 \text{A} \]
\[ b) \ V_1 = 9 \text{V} \quad \text{and} \quad I = -3 \text{A} \]
\[ c) \ V_1 = -12 \text{V} \quad \text{and} \quad I = 2 \text{A} \]
\[ d) \ V_1 = -12 \text{V} \quad \text{and} \quad I = -3 \text{A} \]

\[ P = VI \]
\[ = 9 \times 2 = 18 \text{ W absorbed} \]
\[ b) \ P = VI \]
\[ = 9 \times (-3) = -27 \text{ W supplied} \]
\[ c) \ P = VI \]
\[ = -12 \times 2 = -24 \text{ W supplied} \]
\[ d) \ P = VI \]
\[ = (-12) \times (-3) = 36 \text{ W absorbed} \]

1.24 The elements are connected in series, as shown in Fig. Element 1 supplies 24 W of power. Is element 2 absorbing or supplying power, and how much?
Since element 1 is supplying power \( P = 24 \text{ W} \),

\[ I = \frac{24}{6} = 4 \text{ A}. \]

The power absorbed by element 2 is

\[ 8 \times 4 = 32 \text{ W}. \]

1.29. Find the power that is absorbed or supplied by the circuit elements in fig.

\[ \begin{align*}
\text{(a)} & \\
\text{(b)} & \\
\end{align*} \]

\( \text{(a)} \) Power for current source

\[ = -20 \times 2 = -40 \text{ W supplied} \]

\( \text{Power for element 1,} \)

\[ = 6 \times 2 = 12 \text{ W absorbed} \]
b) Power for current source

\[ = -16 \times 4 = -64 \text{ W supplied} \]

Power for element 1

\[ = 8 \times 4 = 32 \text{ W absorbed} \]

Power for current 8V voltage source

\[ = 2 \times 4 \times 4 \]

\[ = 32 \text{ W absorbed} \]

1.31 Compute the power that is absorbed or supplied by the elements in Fig. 1.

![Diagram of electrical circuit](image)

Power for 36V voltage source

\[ = -36 \times 4 = -144 \text{ W supplied} \]

Power for element 1

\[ = 12 \times 4 = 48 \text{ W absorbed} \]

Power for element 2

\[ = 24 \times 2 = 48 \text{ W absorbed} \]

Power for dependent voltage source

\[ (12) \times 2 = 24 \times 2 = 48 \text{ W supplied} \]
Power for element 3 = 28 x 2 = 56 W

1.37 Is the source $V_s$ in the network in Fig. absorbing or supplying power, and how much?

![Diagram of network with sources and currents]

The source $V_s$ absorbs power.

$P_{ioV} = 10(3) = 30 \text{ W absorbed}$

$P_{6V} = 6(3) = 18 \text{ W absorbed}$

$P_{9A} = 16(-9) = -144 \text{ W}$

$P_{9A} = 144 \text{ W supplied}$

$P_{9s} = V_s(6) = 6V_s \text{ absorbed}$

$P_{8v} = 8(6) = 48 \text{ W absorbed}$

Power supplied = Power absorbed

$P_{9A} = P_{ioV} + P_{6V} + P_{9s} + P_{8v}$

$144 = 30 + 18 + 6V_s + 48$

$144 = 96 + 6V_s$

$24 = 6V_s$

$V_s = 24 - 16 = 8 \text{ V}$

$P_{9s} = 8(6) = 48 \text{ W absorbed}$