Solution of ECE 300 Test 1 F08

1. A current $\mathrm{i}(t)$ graphed below flows through a resistor. It is periodic with period 6 ms.

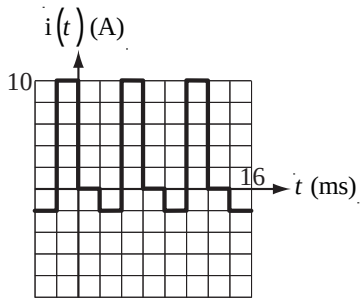
   (a) What is the numerical average current through the resistor, in amperes?

$$\text{Average Current} = \frac{0\text{A} \times 2\text{ms} - 2\text{A} \times 2\text{ms} + 10\text{A} \times 2\text{ms}}{6\text{ms}} = (8/3)\text{A} = 2.667\text{A}$$

   (b) What is the numerical value of the total charge that has flowed through the resistor between 2ms and

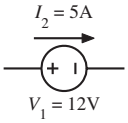
$$\text{Total charge} = -2\text{A} \times 2\text{ms} + 10\text{A} \times 2\text{ms} + 0\text{A} \times 2\text{ms} - 2\text{A} \times 2\text{ms}$$

$$\text{Total charge} = -4\text{mC} + 20\text{mC} + 0\text{mC} - 4\text{mC} = 12\text{mC} = 0.012\text{C}$$



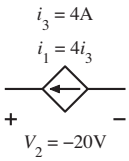
2. Find the numerical value of the power absorbed by each of these circuit elements, in watts.

   (a)



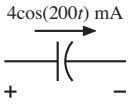
$$P_{abs} = 12\text{V} \times 5\text{A} = 60\text{W}$$

   (b)



$$P_{abs} = -V_2 \times i_1 = -(-20\text{V}) \times 16\text{A} = 320\text{W}$$

   (c)



$t = 3$ ms

$$P_{abs} = 4\cos\left(200\frac{\text{radians}}{\text{s}} \times 3\text{ms}\right)\text{mA} \times 12\sin\left(200\frac{\text{radians}}{\text{s}} \times 3\text{ms}\right)\text{V}$$

$$P_{abs} = 22.37\text{mW} = 0.02237\text{W}$$

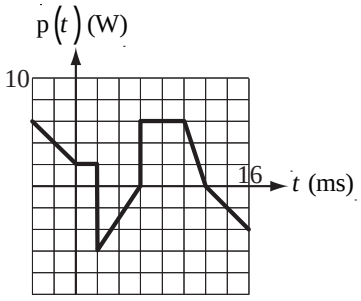
3. Below is a graph of power $\mathrm{p}(t)$ absorbed by a circuit element as a function of time.

(a) What is the numerical energy in joules absorbed by the circuit element between times $t = 4$ ms and $t = 8$ ms?

$$E_{abs} = \frac{-3\text{W} \times 2\text{ms}}{2} + 6\text{W} \times 2\text{ms} = -3\text{mJ} + 12\text{mJ} = 9\text{mJ} = 0.009\text{J}$$

(b) What is the numerical energy in joules supplied by the circuit element between times $t = 0$ ms and $t = 6$ ms?

$$E_{supp} = -\left[2\text{W} \times 2\text{ms} + \frac{-6\text{W} \times 4\text{ms}}{2} \right] = -\left[4\text{mJ} - 12\text{mJ} \right] = 8\text{mJ} = 0.008\text{J}$$



Solution of ECE 300 Test 1 F08

1. A current $\mathrm{i}(t)$ graphed below flows through a resistor. It is periodic with period 6 ms.

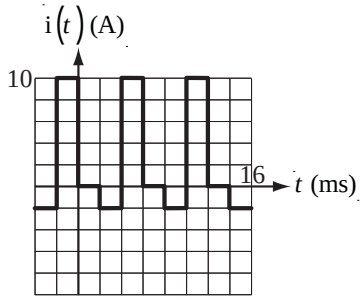
   (a) What is the numerical average current through the resistor, in amperes?

$$\text{Average Current} = \frac{0\text{A} \times 2\text{ms} - 2\text{A} \times 2\text{ms} + 10\text{A} \times 2\text{ms}}{6\text{ms}} = (8/3)\text{A} = 2.667\text{A}$$

   (b) What is the numerical value of the total charge that has flowed through the resistor between 4ms and 12 ms, in coulombs?

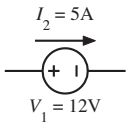
$$\text{Total charge} = 10\text{A} \times 2\text{ms} + 0\text{A} \times 2\text{ms} - 2\text{A} \times 2\text{ms} + 10\text{A} \times 2\text{ms}$$

$$\text{Total charge} = 20\text{mC} + 0\text{mC} - 4\text{mC} + 20\text{mC} = 36\text{mC} = 0.036\text{C}$$



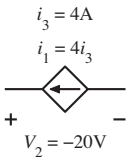
2. Find the numerical value of the power absorbed by each of these circuit elements, in watts.

   (a)



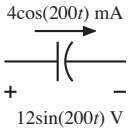
$$P_{abs} = 12\text{V} \times 5\text{A} = 60\text{W}$$

   (b)



$$P_{abs} = -V_2 \times i_1 = -(-20\text{V}) \times 16\text{A} = 320\text{W}$$

   (c)



$t = 7$ ms

$$P_{abs} = 4\cos\left(200\frac{\text{radians}}{s} \times 7\text{ms}\right)\text{mA} \times 12\sin\left(200\frac{\text{radians}}{s} \times 7\text{ms}\right)\text{V}$$

$$P_{abs} = 8.04\text{mW} = 0.00804\text{W}$$

3. Below is a graph of power $\mathrm{p}(t)$ absorbed by a circuit element as a function of time.

(a) What is the numerical energy in joules absorbed by the circuit element between times $t = 6$ ms and $t = 12$ ms?

$$E_{abs} = 6\text{W} \times 4\text{ms} + \frac{6\text{W} \times 2\text{ms}}{2} = 24\text{mJ} + 6\text{mJ} = 30\text{mJ} = 0.03\text{J}$$

(b) What is the numerical energy in joules supplied by the circuit element between times $t = 10$ ms and $t = 16$ ms?

$$E_{supp} = -\left[\frac{6\text{W} \times 2\text{ms}}{2} - \frac{4\text{W} \times 4\text{ms}}{2}\right] = -\left[6\text{mJ} - 8\text{mJ}\right] = 2\text{mJ} = 0.002\text{J}$$