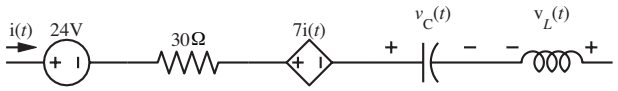
Solution of ECE 300 Test 1 S09

1. A current $\mathrm{i}(t) = 4\sin(200\pi t)$ flows through each element in the partial circuit below. If $\mathrm{v}_C(t) = -8\cos(200\pi t)$ and $\mathrm{v}_L(t) = -4\cos(200\pi t)$ find the power being absorbed by each circuit element



$P_{24\mathrm{V}} = 24\mathrm{V} \times 4\sin(200\pi t) = 96\sin(200\pi t)$ W

At $t = 2$ ms $P_{24\mathrm{V}} = 96\sin(0.4\pi) = 91.301$ W

$P_{30\Omega} = \left[30\Omega \times 4\sin(200\pi t)\right] \times 4\sin(200\pi t) = 480\sin^2(200\pi t)$ W

At $t = 2$ ms $P_{30\Omega} = 480\sin^2(0.4\pi)$ W $= 434.164$ W

$P_{7\mathrm{i}(t)} = 7 \times 4\sin(200\pi t) \times 4\sin(200\pi t)$ W $= 112\sin^2(200\pi t)$ W

At $t = 2$ ms $P_{7\mathrm{i}(t)} = 112\sin^2(0.4\pi)$ W $= 101.305$ W

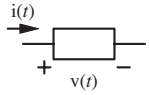
$P_C = -8\cos(200\pi t) \times 4\sin(200\pi t)$ W $= -32\cos(200\pi t)\sin(200\pi t)$ W

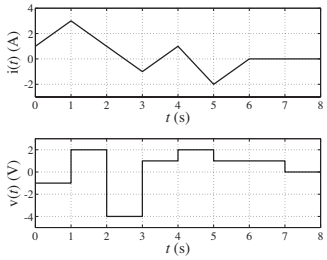
At $t = 2$ ms $P_C = -32\cos(0.4\pi)\sin(0.4\pi)$ W $= -9.4046$ W

$P_L = -\left[-4\cos(200\pi t) \times 4\sin(200\pi t)\right]$ W $= 16\cos(200\pi t)\sin(200\pi t)$ W

At $t = 2$ ms $P_L = 16\cos(0.4\pi)\sin(0.4\pi)$ W $= 4.7023$ W

2. A current $\mathrm{i}(t)$ flows through and a voltage $\mathrm{v}(t)$ exists across the circuit element below. Given the graphs of $\mathrm{i}(t)$ and $\mathrm{v}(t)$ and the fact that no current flowed before time $t = 0$, answer the following questions.





(a) How much numerical charge passes through the element between times $t = 1$ and $t = 5$?

$$Q = \int_1^5 \mathrm{i}(t)\,dt = 2\mathrm{A} \times 1\mathrm{s} + 0\mathrm{A} \times 1\mathrm{s} + 0\mathrm{A} \times 1\mathrm{s} - (1/2)\mathrm{A} \times 1\mathrm{s} = 1.5\ \mathrm{C}$$

(b) How much numerical energy does the element absorb between times $t = 3$ and $t = 8$?

$$E = \int_3^8 \mathrm{i}(t)\mathrm{v}(t)\,dt = 0\mathrm{A} \times 1\mathrm{V} \times 1\mathrm{s} + (-1/2)\mathrm{A} \times 2\mathrm{V} \times 1\mathrm{s} - 1\mathrm{A} \times 1\mathrm{V} \times 1\mathrm{s} + 0\mathrm{A} \times 1\mathrm{V} \times 1\mathrm{s} + 0\mathrm{A} \times 0\mathrm{V} \times 1\mathrm{s} = -2\ \mathrm{J}$$

Solution of ECE 300 Test 1 S09

1. A current $\mathrm{i}(t) = 4\sin(300\pi t)$ flows through each element in the partial circuit below. If $\mathrm{v}_C(t) = -8\cos(300\pi t)$ and $\mathrm{v}_L(t) = -4\cos(300\pi t)$ find the power being absorbed by each circuit element at time $t = 2$ ms.

$$P_{24\mathrm{V}} = 24\mathrm{V} \times 4\sin(300\pi t) = 96\sin(300\pi t) \text{ W}$$

At $t = 2$ ms $P_{24\mathrm{V}} = 96\sin(0.6\pi) = 91.3014$ W

$$P_{30\Omega} = \left[30\Omega \times 4\sin(300\pi t)\right] \times 4\sin(300\pi t) = 480\sin^2(300\pi t) \text{ W}$$

At $t = 2$ ms $P_{30\Omega} = 480\sin^2(0.6\pi)$ W $= 434.1641$ W

$$P_{7\mathrm{i}(t)} = 7 \times 4\sin(300\pi t) \times 4\sin(300\pi t) \text{ W} = 112\sin^2(300\pi t) \text{ W}$$

At $t = 2$ ms $P_{7\mathrm{i}(t)} = 112\sin^2(0.6\pi)$ W $= 101.305$ W

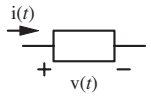
$$P_C = -8\cos(300\pi t) \times 4\sin(300\pi t) \text{ W} = -32\cos(300\pi t)\sin(300\pi t) \text{ W}$$

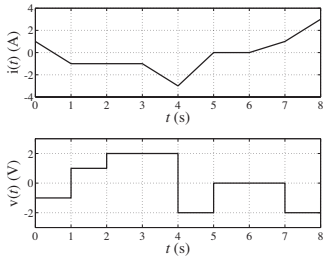
At $t = 2$ ms $P_C = -32\cos(0.6\pi)\sin(0.6\pi)$ W $= 9.4046$ W

$$P_L = -\left[-4\cos(300\pi t) \times 4\sin(300\pi t)\right] \text{ W} = 16\cos(300\pi t)\sin(300\pi t) \text{ W}$$

At $t = 2$ ms $P_L = 16\cos(0.6\pi)\sin(0.6\pi)$ W $= -4.7023$ W

2. A current $\mathrm{i}(t)$ flows through and a voltage $\mathrm{v}(t)$ exists across the circuit element below. Given the graphs of $\mathrm{i}(t)$ and $\mathrm{v}(t)$ and the fact that no current flowed before time $t = 0$, answer the following questions.





(a) How much numerical charge passes through the element between times $t = 1$ and $t = 5$?

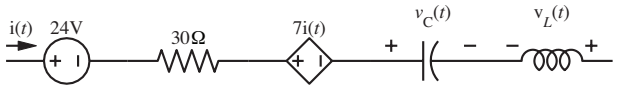
$$Q = \int_1^5 \mathrm{i}(t)\,dt = -1\mathrm{A} \times 1\mathrm{s} - 1\mathrm{A} \times 1\mathrm{s} - 2\mathrm{A} \times 1\mathrm{s} - (3/2)\mathrm{A} \times 1\mathrm{s} = -5.5\ \mathrm{C}$$

(b) How much numerical energy does the element absorb between times $t = 3$ and $t = 8$?

$$E = \int_3^8 \mathrm{i}(t)\mathrm{v}(t)\,dt = -2\mathrm{A} \times 2\mathrm{V} \times 1\mathrm{s} + (-3/2)\mathrm{A} \times (-2\mathrm{V}) \times 1\mathrm{s} + 0\mathrm{A} \times 0\mathrm{V} \times 1\mathrm{s} + (1/2)\mathrm{A} \times 0\mathrm{V} \times 1\mathrm{s} + 2\mathrm{A} \times (-2\mathrm{V}) \times 1\mathrm{s} = -5\ \mathrm{J}$$

Solution of ECE 300 Test 1 S09

1. A current $\mathrm{i}(t) = 4\sin(600\pi t)$ flows through each element in the partial circuit below. If $\mathrm{v}_C(t) = -8\cos(600\pi t)$ and $\mathrm{v}_L(t) = -4\cos(600\pi t)$ find the power being absorbed by each circuit element at time $t = 2$ ms.



$$P_{24\mathrm{V}} = 24\mathrm{V} \times 4\sin(600\pi t) = 96\sin(600\pi t)\ \mathrm{W}$$

At $t = 2$ ms $P_{24\mathrm{V}} = 96\sin(1.2\pi) = -56.4274$ W

$$P_{30\Omega} = \left[30\Omega \times 4\sin(600\pi t)\right] \times 4\sin(600\pi t) = 480\sin^2(600\pi t)\ \mathrm{W}$$

At $t = 2$ ms $P_{30\Omega} = 480\sin^2(1.2\pi)\ \mathrm{W} = 165.8359$ W

$$P_{7\mathrm{i}(t)} = 7 \times 4\sin(600\pi t) \times 4\sin(600\pi t)\ \mathrm{W} = 112\sin^2(600\pi t)\ \mathrm{W}$$

At $t = 2$ ms $P_{7\mathrm{i}(t)} = 112\sin^2(1.2\pi)\ \mathrm{W} = 38.695$ W

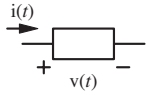
$$P_C = -8\cos(600\pi t) \times 4\sin(600\pi t)\ \mathrm{W} = -32\cos(600\pi t)\sin(600\pi t)\ \mathrm{W}$$

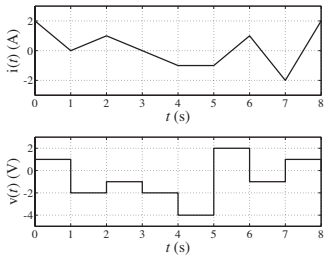
At $t = 2$ ms $P_C = -32\cos(1.2\pi)\sin(1.2\pi)\ \mathrm{W} = -15.2169$ W

$$P_L = -\left[-4\cos(600\pi t) \times 4\sin(600\pi t)\right]\ \mathrm{W} = 16\cos(600\pi t)\sin(600\pi t)\ \mathrm{W}$$

At $t = 2$ ms $P_L = 16\cos(1.2\pi)\sin(1.2\pi)\ \mathrm{W} = 7.6085$ W

2. A current $\mathrm{i}(t)$ flows through and a voltage $\mathrm{v}(t)$ exists across the circuit element below. Given the graphs of $\mathrm{i}(t)$ and $\mathrm{v}(t)$ and the fact that no current flowed before time $t = 0$, answer the following questions.





(a) How much numerical charge passes through the element between times $t = 1$ and $t = 5$?

$$Q = \int_1^5 \mathrm{i}(t)\,dt = (1/2)\mathrm{A} \times 1\mathrm{s} + (1/2)\mathrm{A} \times 1\mathrm{s} - (1/2)\mathrm{A} \times 1\mathrm{s} - 1\mathrm{A} \times 1\mathrm{s} = -0.5\ \mathrm{C}$$

(b) How much numerical energy does the element absorb between times $t = 3$ and $t = 8$?

$$E = \int_3^8 \mathrm{i}(t)\mathrm{v}(t)\,dt = -(1/2)\mathrm{A} \times (-2\mathrm{V}) \times 1\mathrm{s} - 1\mathrm{A} \times (-4\mathrm{V}) \times 1\mathrm{s} + 0\mathrm{A} \times 2\mathrm{V} \times 1\mathrm{s} - (1/2)\mathrm{A} \times (-1\mathrm{V}) \times 1\mathrm{s} + 0\mathrm{A} \times 1\mathrm{V} \times 1\mathrm{s} = 5.5\ \mathrm{J}$$