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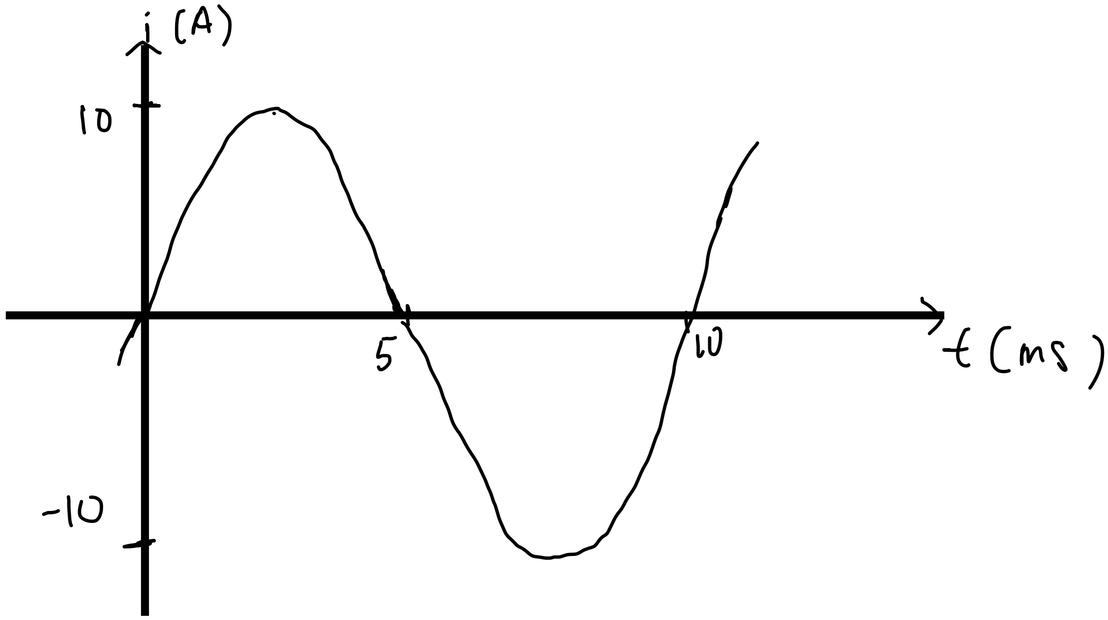
Problem 1

P1.12: Given $i(t) = 10 \sin(200\pi t)$ (A)

$\Rightarrow \omega = 2\pi f = 200\pi \Rightarrow 2f = 200 \Rightarrow f = 100$ (Hz)

$\Rightarrow T = \frac{1}{100Hz} = 0.01$ (s) $= 10$ (ms).

a) Sketch $i(t)$ to scale versus time.



b) Determine the net charge that passes through the element between $t=0$ & $t = 5ms$ $\Leftrightarrow t_0 = 0ms$ & $t = 5ms$ =

We have: $i(t) = \frac{dq(t)}{dt}$ or $q = \int_{t_0}^{t} i(t)\, dt = \int_0^{0.005} 10 \sin(200\pi t) dt$

$= \frac{10}{200\pi} \left[\cos(200\pi t) \right] \Big|_0^{0.005} = \frac{1}{20\pi} \cos(200\pi t) \Big|_{0.005}^{0}$

$$= \frac{1}{20\pi}\left[\cos 0 - \cos(200\pi \times 0.005)\right] = \frac{1}{20\pi}\left[1 - (-1)\right]$$

$$= \frac{2}{20\pi} = \frac{1}{10\pi} \approx 0.0318\ (C) \approx \boxed{31.83\ mC}$$

c) Repeat with $t_0 = 0\ ms \rightarrow t = 10ms$.

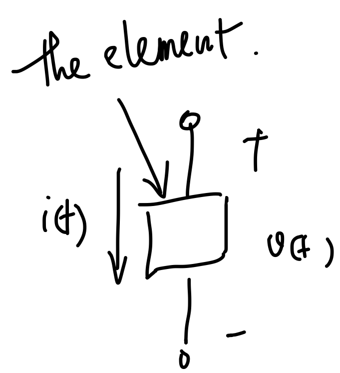
Based on b, we have the charge:

$$q = \int_0^{0.01} 10\sin(200\pi t)\,dt = \frac{1}{20\pi}\cos(200\pi t)\Big|_{0.01}^{0}$$

$$= \frac{1}{20\pi}\left[\cos 0 - \cos 2\pi\right] = \frac{1}{20\pi}\left[1 - 1\right] = \boxed{0\ (C)}$$

Problem 2:

P1.24: Given $\begin{cases} v(t) = 10\ V \\ i(t) = 2e^{-t}\ A. \end{cases}$



* Compute the power for the circuit:

We have the power: $P(t) = v(t) \times i(t) = 10 \times 2e^{-t} = \boxed{20e^{-t}\ (W)}$

$\Rightarrow$ The energy transferred between $t_0 = 0 \rightarrow t = \infty$: $E = \int_{t_0}^{t} P(t)\,dt$

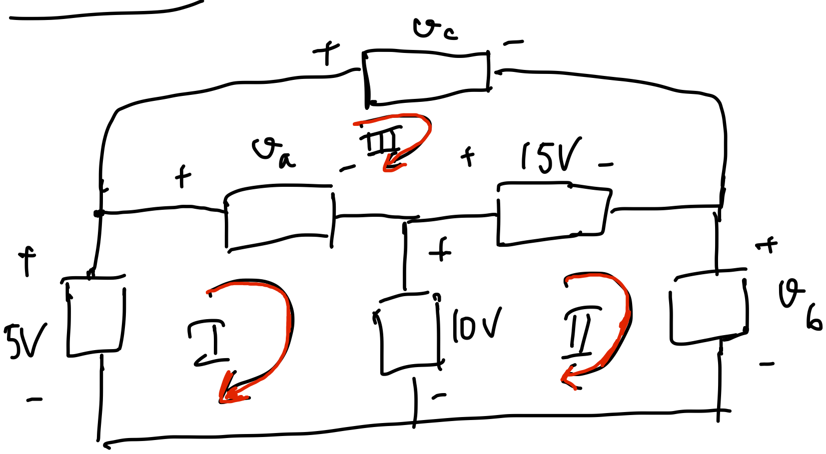
$$\Rightarrow E = \int_0^{\infty} 20e^{-t}\,dt = -20e^{-t}\Big|_0^{\infty} = 20e^{-t}\Big|_{\infty}^{0}$$

$$= 20(e^{0} - e^{-\infty}) = 20(1-0) = \boxed{20\ (J)}$$

Because the energy $E = 20\,(J) > 0$, the energy is absorbed by the element.

Problem 3

P1.42: Use KVL to solve the voltage V_a, V_b & V_c.



Check for loop I, then applying KVL, we have:

$$-5V + v_a + 10V = 0 \Rightarrow v_a = 5 - 10 = -5V \Rightarrow \boxed{v_a = -5V}$$

Applying the KVL for loop II,

$$-10V + 15V + v_b = 0 \Rightarrow v_b = 10 - 15 = -5V$$

$$\Rightarrow \boxed{v_b = -5V}$$

Also applying the KVL for loop III.

$$-v_a + v_c - 15 = 0 \Rightarrow v_c = 15 + v_a = 15 - 5 = 10V$$

$$\Rightarrow \boxed{v_c = 10V}$$

Problem 4

P1.55: Given $P = 100W$, $V = 100V$ $\Rightarrow$ find the resistance.

We have $P = V.I = V.\frac{V}{R} = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P}$

$$\Rightarrow R = \frac{(100V)^2}{100W} = \frac{100^2}{100} = \boxed{100(\Omega)}$$

Then suppose the voltage is reduced by 10% (to 90V)

$\Rightarrow$ What percentage the power is reduced?

(assume the R remains constant)

We have: $P_{new} = \frac{V_{new}^2}{R} = \frac{(90V)^2}{100\Omega} = \frac{90^2}{100} = 81(W)$

$\Rightarrow \Delta P = P - P_{new} = 100 - 81 = 19W$

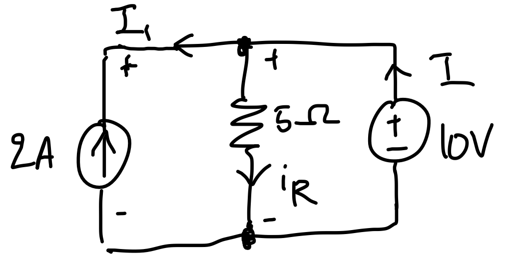
$\Leftrightarrow$ the power is reduced 19W (to 81W)

$\Rightarrow$ percentage the power is reduced:

$$\frac{\Delta P}{P} \times 100 = \frac{19W}{100W} \times 100 = \boxed{19\%}$$

Problem 5

P1.63: Find the current i_R through the resistor.



Based on the circuit, we have

$V_R = 10V \Rightarrow i_R = \frac{V_R}{R} = \frac{10V}{5\Omega} = \boxed{2A}$

Then find the power of each element in the circuit.

<u>* For the 5Ω resistor:</u>

$P_R = V_R . I_R = 10V . 2A = \boxed{20(W) > 0}$

$\Rightarrow$ the resistor is receiving power, or the energy is absorbed by it.

<u>* For the current source:</u>

Based on the circuit, applying the KCL, we have:

$I = i_R + I_1 = 2 + I_1$, also $I_1 = -2A$.

$\Rightarrow I = 0\ (A)$

$\Rightarrow$ the power for the current source:

$P = V I_1 = 10.(-2) = \boxed{-20\ (W) < 0}$

$\Rightarrow$ the current source supplies the energy or not receiving power.

<u>* For the voltage source:</u>

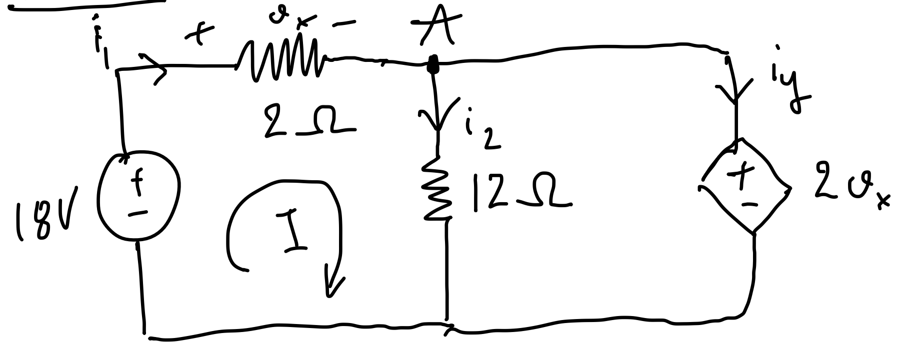
$P = V.I = (-10).\ 0 = \boxed{0\ (W)}$

$\Rightarrow$ the voltage source is not receiving the power

$\boxed{\text{Finally, the resistor is receiving power.}}$

Problem 6

P1.71: Determine the value of v_x & i_y in the circuit.



Firstly, we apply the KVL to the outer loop, we have:

$-18V + v_x + 2V_x = 0 \Rightarrow 3V_x = 18V \Rightarrow \boxed{V_x = 6V}$

Also, $i_1 \times 2\Omega = v_x \Rightarrow i_1 = \frac{V_x}{2\Omega} = \frac{6V}{2\Omega} = 3A.$

We continue applying the KVL for loop I, we have:

$-18V + v_x + 12 i_2 = 0 \Rightarrow 12 i_2 = 18V - V_x = 18 - 6 = 12V$

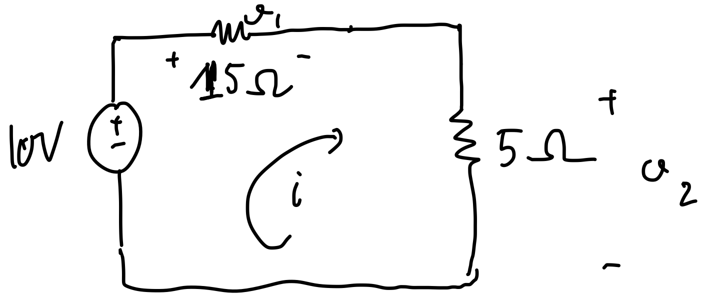
$\Rightarrow i_2 = 1A.$

Apply the KCL at A, we have:

$i_1 = i_2 + i_y \Rightarrow i_y = i_1 - i_2 = 3A - 1A = \boxed{2A}$

Problem 7:

P1.74 Given the circuit:



a) Use KVL to write an equation relating the voltages

Apply the KVL, we have: $-10V + v_1 + v_2 = 0$

$\Rightarrow \boxed{v_1 + v_2 = 10V}$ (1)

b) we have $V = IR$ (Ohm's Law)

$\Rightarrow \boxed{\begin{cases} v_1 = 15i \ (V) \\ v_2 = 5i \ (V) \end{cases}}$ (2)

c) From (1) & (2), we have: $v_1 + v_2 = 10V \Leftrightarrow 15i + 5i = 10V$

$\Rightarrow 20i = 10V \rightarrow i = \frac{10V}{20} = 0.5A \rightarrow \boxed{i = 0.5A}$

d) We have:

* For v_1: $v_1 = 15\Omega \times i = 0.5 \times 15 = 7.5 (V)$

$P_1 = v_1 \times i = 7.5V \times 0.5A = \boxed{3.75 (W)} > 0$

$\Rightarrow$ The 15Ω-resistor absorbed the energy

* For v_2: $v_2 = 5\Omega \times i = 5\Omega \times 0.5A = 2.5(V)$

$\Rightarrow P_2 = v_2 \times i = 2.5V \times 0.5A = \boxed{1.25 (W)} > 0$

$\Rightarrow$ the 5Ω-resistor absorbed the energy

* For voltage source: $P = V \times I = -10V \times 0.5A = \boxed{-5(W)} < 0$

$\Rightarrow$ the voltage source delivered the power.

From above, we have the total power:

$\Sigma P = P_1 + P_2 + P = 3.75 + 1.25 + (-5) = 0 \,(W)$

$\Rightarrow$ $\boxed{\text{the power is conserved}}$ (because the power delivered by the voltage source is equal to the power absorbed by 2 resistors: $15\,\Omega$ & $5\,\Omega$)