School of Electrical Engineering & Telecommunications

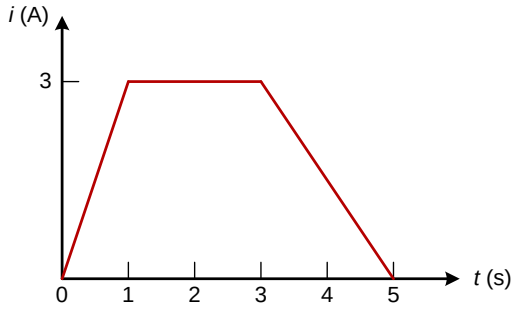
ELEC1111

Topic 1: Circuit Basics

1. Determine the total charge flowing through an element for $0 \leq t \leq 2$ seconds when the current entering the positive terminal is $i(t) = e^{-2t}$ mA.

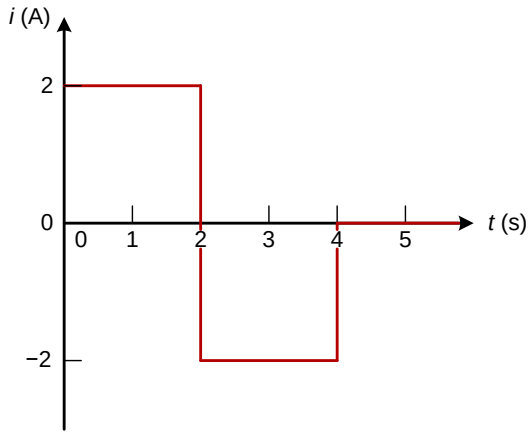
   Answer: 0.4908 mC

2. The current flowing through an element is shown in the graph below. Assuming charge entering the element before $t = 0$ is zero, i.e., $q(0) = 0$, calculate the charge that has entered the element at the following times,
   (a) $t = 1$ s
   (b) $t = 3$ s
   (c) $t = 5$ s



   Answer: 1.5 C, 7.5 C, 10.5 C

3. If the voltage $v(t)$ across an element is 10 V, and the current through the element $i(t)$ is shown in the following figure, calculate the power and energy and plot their time functions.



Answer: $p = vi = 10i = \begin{cases} 20\text{ W}, & 0 < t \leq 2 \\ -20\text{ W}, & 2 < t \leq 4 \\ 0\text{ W}, & t > 4 \end{cases}$

$w(t) = \begin{cases} 20t\text{ J}, & 0 < t \leq 2 \\ -20t + 80\text{ J}, & 2 < t \leq 4 \\ 0\text{ J}, & t > 4 \end{cases}$

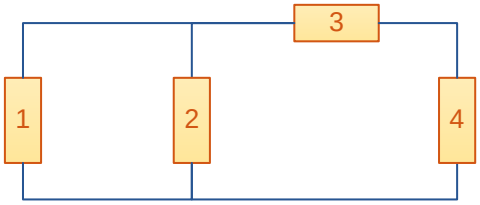
4. How much energy does a 100 W electric bulb consume in one day?

   Answer: 2.4 kWh = 8.640 MJ

5. The current entering the positive terminal of a device is $i(t) = 6e^{-2t}$ mA and the voltage across the device is $v(t) = 10\ di/dt$ V.
   (a) Calculate the power absorbed.
   (b) Determine the energy absorbed in 3 s.

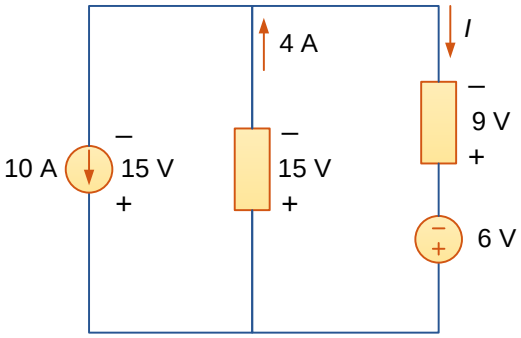
   Answer: $-720\text{e}^{-4\text{t}}\ \mu\text{W}, -180\ \mu\text{J}$

6. The figure below shows a circuit with four elements, $P_1 = 60$ W absorbed, $P_3 = -145$ W absorbed, and $P_4 = 75$ W absorbed.
   (a) How many watts does element 2 absorb?
   (b) Is element 2 an active element or passive element?



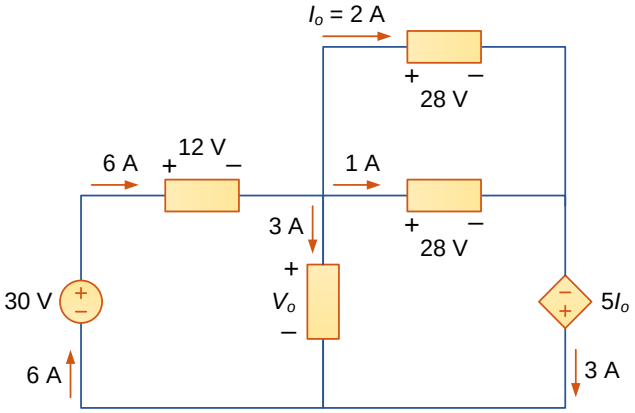
   Answer: 10 W absorbed, unknown

7. In the circuit below, find the current I and the power absorbed by each element.



Answer: $-150\text{ W}, 60\text{ W}, 54\text{ W}, 36\text{ W}$

8. In the circuit below, find V_o and the power absorbed by each element.



Answer: $-180\text{ W}, 72\text{ W}, 56\text{ W}, 28\text{ W}, -30\text{ W}, 54\text{ W}$