1.17 The charge that enters a BOX is shown in Fig. P1.17. Calculate and sketch the current flowing into and the power absorbed by the BOX between 0 and 9 milliseconds. Also calculate the energy absorbed by the BOX between 0 and 9 milliseconds.

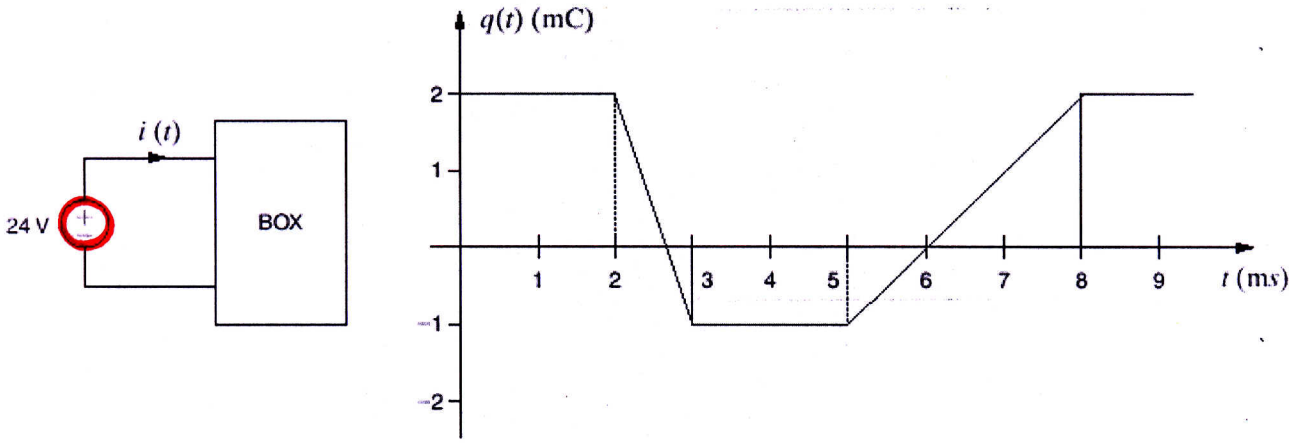


Figure P1.17

SOLUTION:

$$i(t) = \frac{dq(t)}{dt}$$

$q(t) = 2, \quad 0 \leq t \leq 2\text{ms}$

$$m = \frac{-1-2}{3-2} = \frac{-3}{1} = -3$$

$q(t) = m(t) + b$

$q(t) = -3t + b$

$2 = -3(2) + b$

$b = 8$

$q(t) = -3t + 8, \quad 2\text{ms} \leq t \leq 3\text{ms}$

$q(t) = -1, \quad 3\text{ms} \leq t \; 5\text{ms}$

$q(t) = mt + b$

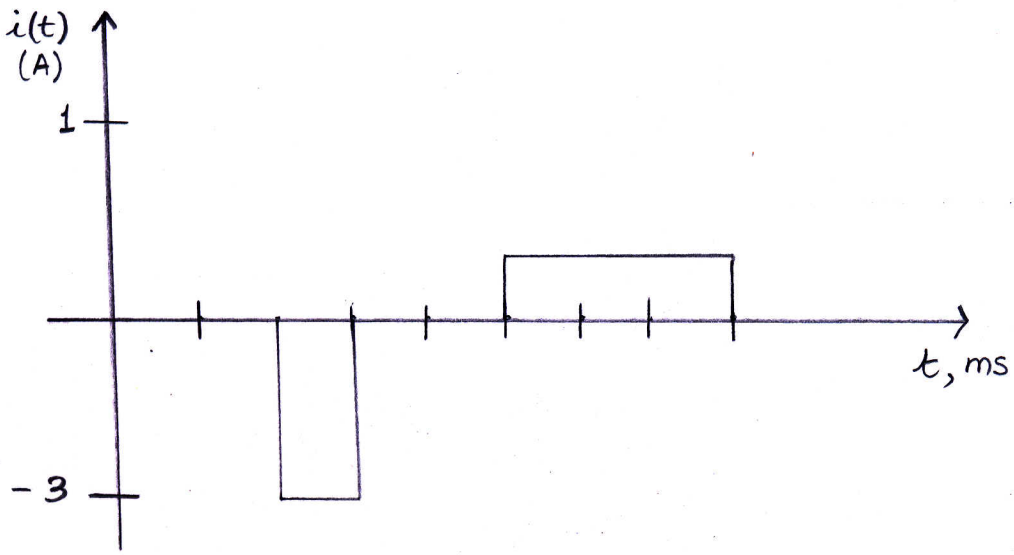
$$m = \frac{2+1}{8-5} = 1$$

$q(t) = t + b$

$2 = 8 + b$

$b = -6$

$$q(t) = t - 6, \quad 5\text{ms} \le t \le 8\text{ms}$$
$$q(t) = 2, \quad 8\text{ms} \le t \le 9\text{ms}$$



$$i(t) = \begin{cases} 0, & 0 \le t \le 2\text{ms} \\ -3, & 2\text{ms} \le t \le 3\text{ms} \\ 0, & 3\text{ms} \le t \le 5\text{ms} \\ 1, & 5\text{ms} \le t \le 8\text{ms} \end{cases}$$

$$p(t) = v(t)\, i(t)$$

$$p(t) = \begin{cases} 0\ \text{W}, & 0 \le t \le 2\text{ms} \\ -72\ \text{W}, & 2\text{ms} \le t \le 3\text{ms} \\ 0\ \text{W}, & 3\text{ms} \le t \le 5\text{ms} \\ 24\ \text{W}, & 5\text{ms} \le t \le 8\text{ms} \end{cases}$$

$$w(t) = \int_0^9 p(t)\, dt$$

$$= 0 + (-72) \times 1 + 0 + 24 \times 3 = 0\ \text{J}$$