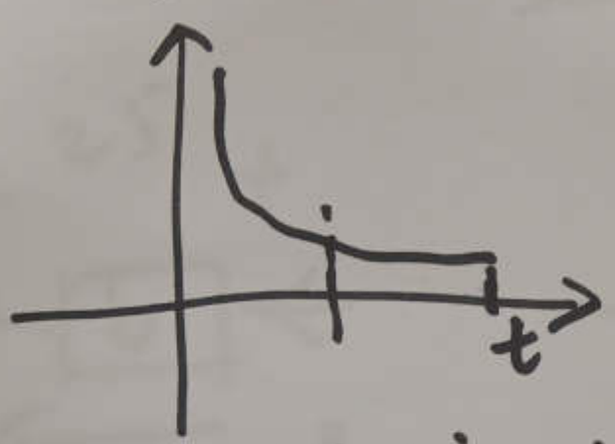
Tutorial 1. Problem 1



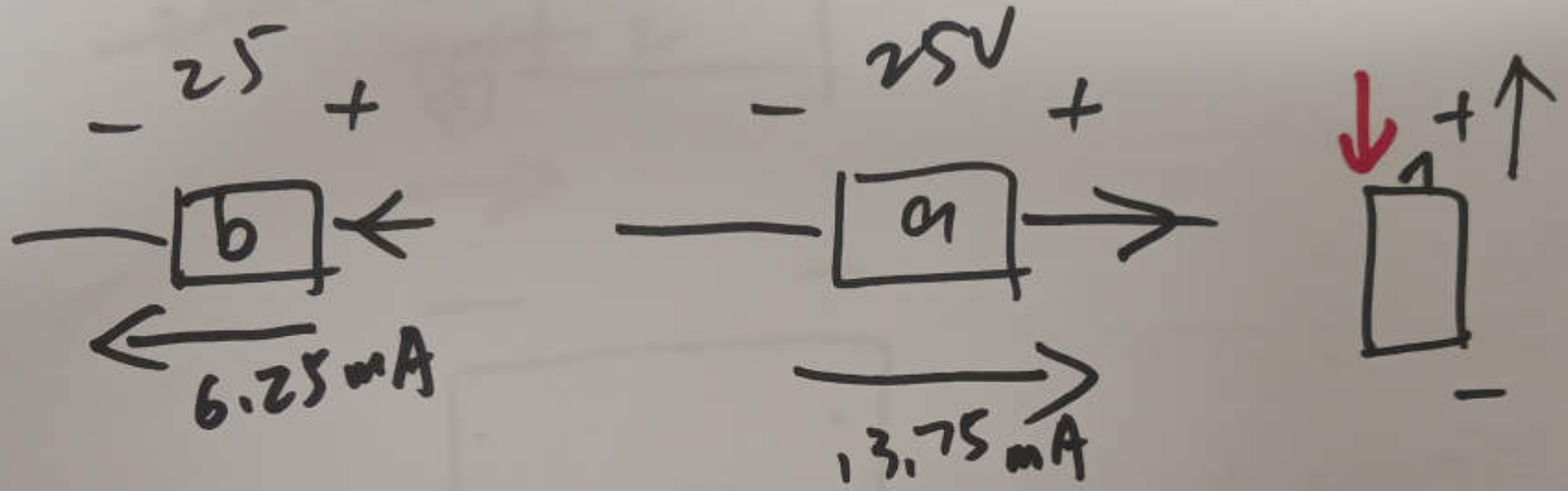
e^{-0t}

$$p(t) = vi = 15e^{-250t} \cdot 0.04 \cdot e^{-250t} = 0.6e^{-500t}$$

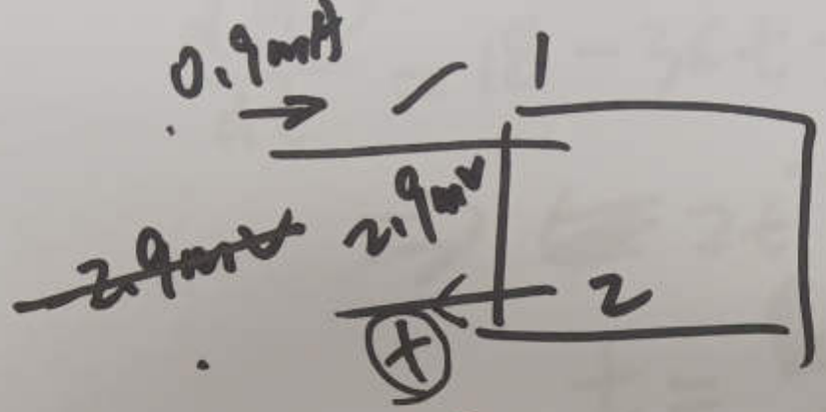
$$\int_0^{\infty} p(t)dt = \int_0^{\infty} 0.6e^{-500t}\,dt$$

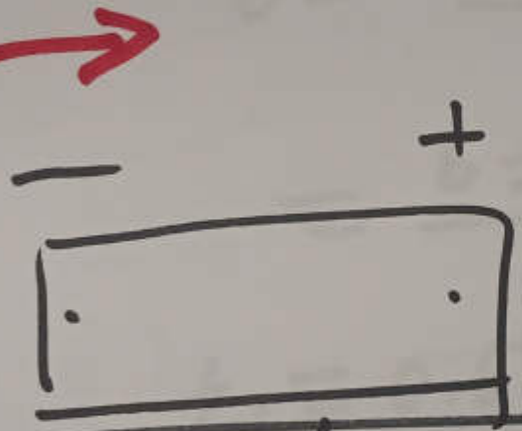
$$= \frac{0.6}{-500} e^{-500t} \Big|_0^{\infty} = 0 + \frac{0.6}{500} = 1.2\text{mJ}$$

$$0.6\,mJ = \int_0^t 0.6\, e^{-500t}\,dt \Big|_0^t$$



(2)





$$\begin{cases} v = t(3-t)\ V \quad 0<t<3s \\ i = (6-4t)\ mA \quad 0<t<3s \end{cases}$$

$$P = vi,\ P(t) = v(t)\cdot i(t) = (3t-t^2)\cdot(6-4t)\ mW$$

$$= 18t - 12t^2 - 6t^2 + 4t^3 \quad mW$$

$$= 18t - 18t^2 + 4t^3$$

(3)

$$\frac{d\,p(t)}{dt} = 18 - 36t + 12t^2 = 0$$

$$\Rightarrow 2t^2 - 6t + 3 = 0$$

$$t = \frac{6 \pm \sqrt{36 - 4 \cdot 2 \cdot 3}}{4}$$

$$= \frac{6 \pm \sqrt{12}}{4} = \frac{3 \pm \sqrt{3}}{2}$$

$t_1 = 0.634\ s$ $\quad t_2 = 2.366\ s$

$p(t_1) = 5.196\ mW$ $\quad p(t_2) = -5.196\ mW$

(4)

$E(t) = \int_0^3 (18t - 18t^2 + 4t^3)\,dt$

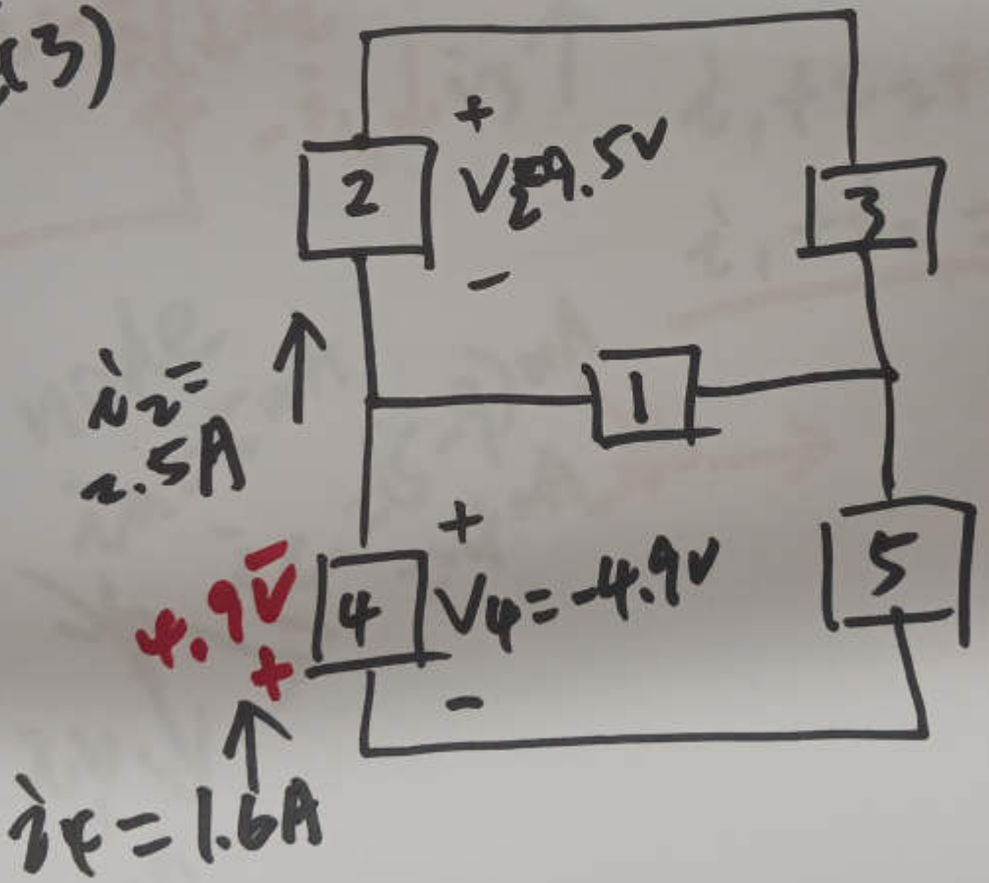
$\begin{cases} \bullet\ 0 < t < 15\ ks \\ \bullet\ 15 < t < 20\ ks \end{cases}$

$E(0)$

$E(1)$

$E(2)$

$E(3)$



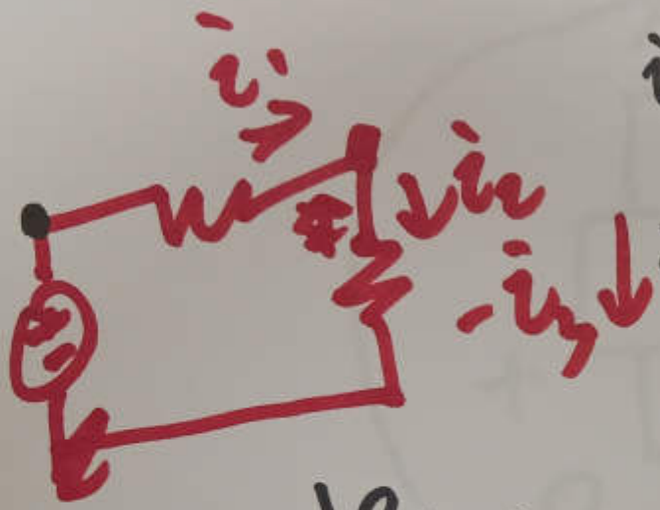
$P_2 = -9.5V \cdot 2.5A$

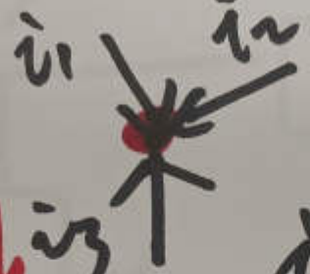
$P_4 = 4.9V \cdot 1.6A$

$\therefore \sum P = 0$

(5)

KCL: Kirchhoff's Current Law





$$\sum i = 0$$

$$i_1 + i_2 + i_3 = 0$$

$$i_1 + i_2 = -i_3$$

node

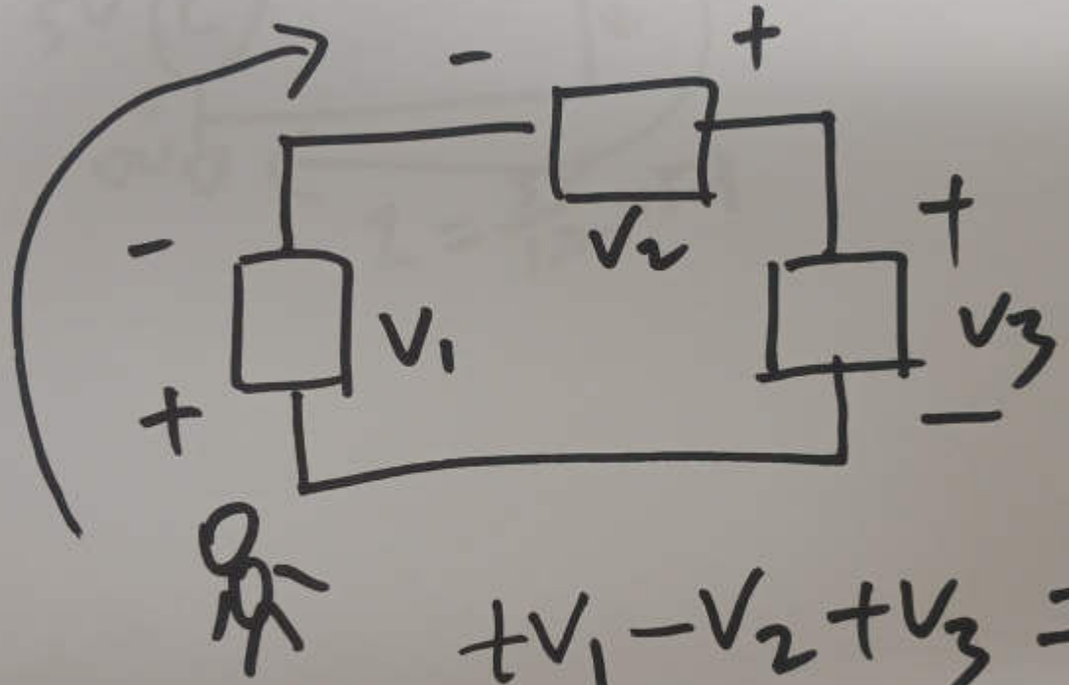
$i_a = 5\,mA$

$i_c = (5-9)\,mA$

$= -4\,mA$

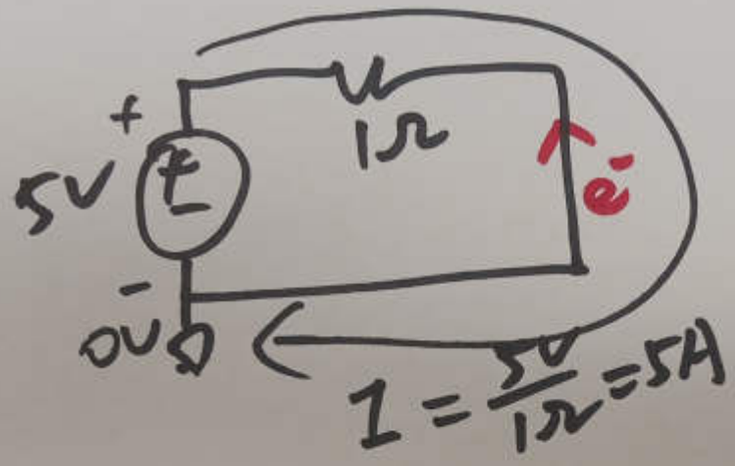
$i_b = 9\,mA$

KVL : Kirchoff's Voltage Law



$$+V_1 - V_2 + V_3 = 0$$

(2)


+
5V
1Ω
e⁻
0V
I = 5V/1Ω = 5A