Practice problem 1: Determine the current i(t) flowing through an element if the charge is given by:

$$q(t) = e^{-3t}(3t^2 - 2t + 2\sin 4t)\ \ C$$

Solution:

$$i(t) = \frac{dq}{dt} = -3e^{-3t}(3t^2 - 2t + 2\sin 4t) + e^{-3t}(6t - 2 + 8\cos 4t)\ \ A$$

Practice problem 2: Determine the charge q(t) flowing through an element if q(0)=2C and the current is given by

$$i(t) = (-4t - 4\cos 2t + 2e^{-2t})A$$

Solution:

$$q(t) = \int_0^t i(t)dt + q(0) = \int_0^t (-4t - 4cos2t + 2e^{-2t})dt + 2\ C$$

$$= (-2t^2 - 2sin2t - e^{-2t})|_0^t + 2\ C$$

$$= (-2t^2 - 2sin2t - e^{-2t} + 3)C$$

Practice problem 3: Determine the current i(t) flowing through an element if the charge is given by:

$$q(t) = t^3(e^{-2t} + 4\sin(\tfrac{1}{2}t + \pi))C$$

Solution:

$$i(t) = \frac{dq}{dt} = 3t^2\left(e^{-2t} + 4\sin(\tfrac{1}{2}t + \pi)\right) + t^3\left(-2e^{-2t} + 2\cos(\tfrac{1}{2}t + \pi)\right)\text{ A}$$

Practice problem 4: Determine the charge q(t) flowing through an element if q(0)=1.5C and the current is given by

$$i(t) = \left(2e^{-4t} + 3\,t^2 + 4\sin(2t + \frac{\pi}{2})\right)A$$

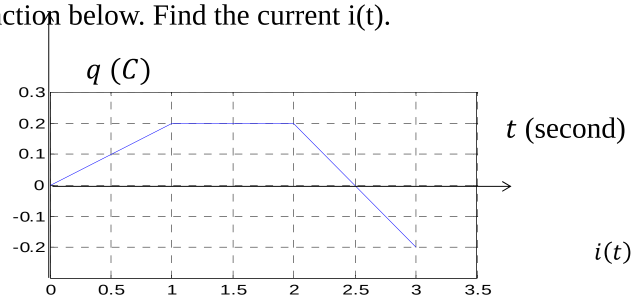
Solution:

$$q(t) = \int_0^t i(t)dt + q(0) = \int_0^t \left(2e^{-4t} + 3\,t^2 + 4\sin(2t + \frac{\pi}{2})\right)dt + 1.5\ C$$

$$= (-\tfrac{1}{2}e^{-4t} + t^3 - 2\cos(2t + \tfrac{\pi}{2}))|_0^t + 1.5\ C$$

$$= \left(-\tfrac{1}{2}e^{-4t} + t^3 - 2\cos(2t + \tfrac{\pi}{2}) + 2\right)C$$

Practice 5: The charge q(t) is given by a piecewise linear function below. Find the current i(t).



$$i(t) = \begin{cases} ?, & t \in [0,1] \\ ?, & t \in [1,2] \\ ?, & t = [2,3] \end{cases}$$

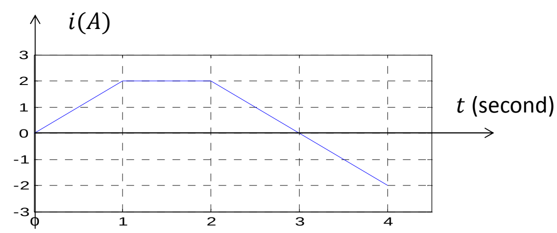
Solution:

$t \in [0,1]$ i=dq/dt=0.2/1 A = 0.2A

$t \in [1,2]$ i=dq/dt=0/1 A=0A

$t \in [2,3]$ i=dq/dt=(-0.4)/1 A=-0.4A

Practice 6: The current i(t) is given by a piecewise linear function below. Find the total charge over the interval [0,4]



Solution:

$$q(t) = \int_0^4 i = \int_0^1 i + \int_1^2 i + \int_2^3 i + \int_3^4 i$$

$$= \frac{1}{2} \times 1 \times 2 + 1 \times 2 + \frac{1}{2} \times 1 \times 2 - \frac{1}{2} \times 1 \times 2 \ = 3C$$

Practice 7: Given $v(t) = \cos 3t\ V,\ i(t) = \sin 3t\ A.$

Find the total energy over time period [0, 0.2] second. Assume passive sign convention.

Solution:

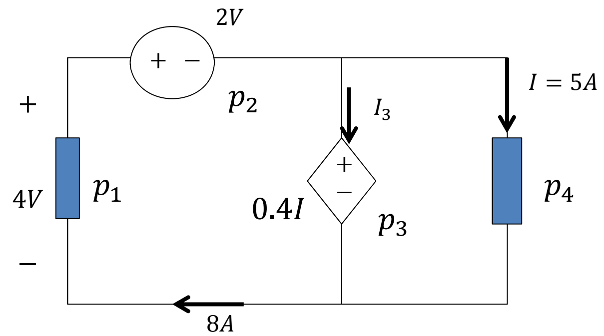
$$p = vi = cos3t \cdot sin3t\ W = \frac{1}{2} sin6t\ W$$

$$w = \int_0^{0.2} pdt = \int_0^{0.2} \frac{1}{2} sin6t\ dt = -\frac{1}{12} cos6t \Big|_0^{0.2}\ J$$

$$= -\frac{1}{12}(cos1.2 - cos0)J$$

$$= 0.0531J$$

Practice 8: Find the power of each element. I_3 =?

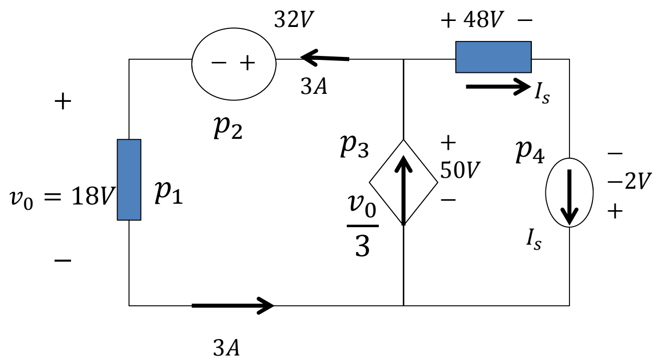


Solution: $\sum p = 0$

$$-4 \times 8 + 2 \times 8 + 5 \times 0.4 \times 5 + 0.4 \times 5 I_3 = 0$$

$$I_3 = 3A$$

Practice 9: Find the power of each element. I_s =?



Solution: $\sum p = 0$

$$18 \times 3 + 32 \times 3 - \frac{18}{3} \times 50 + (48 + 2)I_s = 0$$

$$I_s = 3A$$