Boise State University
Electrical Engineering Department

EE 210: Circuits I
Spring 2017 Due Date: Wed. 1/18/2017

Solution 1

(a) $q = 6.482\text{x}10^{17} \text{ x } [-1.602\text{x}10^{-19} \text{ C}] =$ **-0.10384 C**

(b) $q = 1.24\text{x}10^{18} \text{ x } [-1.602\text{x}10^{-19} \text{ C}] =$ **-0.19865 C**

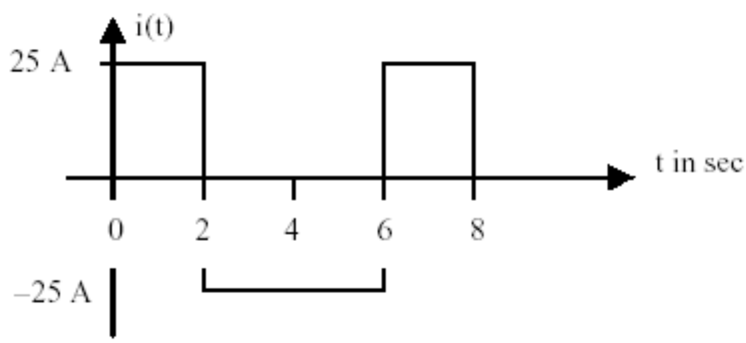
(c) $q = 2.46\text{x}10^{19} \text{ x } [-1.602\text{x}10^{-19} \text{ C}] =$ **-3.941 C**

(d) $q = 1.628\text{x}10^{20} \text{ x } [-1.602\text{x}10^{-19} \text{ C}] =$ **-26.08 C**

Solution 2

$$i = \frac{dq}{dt} = \begin{cases} 25\text{A}, & 0 < t < 2 \\ -25\text{A}, & 2 < t < 6 \\ 25\text{A}, & 6 < t < 8 \end{cases}$$

which is sketched below:



Solution 3

(a) $q = \int i dt = \int_0^1 10\, dt = \underline{10\text{ C}}$

(b) $q = \int_0^3 i dt = 10 \times 1 + \left(10 - \frac{5 \times 1}{2}\right) + 5 \times 1$
$= 15 + 7.5 + 5 = \underline{22.5\text{C}}$

(c) $q = \int_0^5 i dt = 10 + 10 + 10 = \underline{30\text{ C}}$

Solution 4

Charge=10^4 C/s *15x10^-6s=1.5x10^-1 C

Solution 5

For 0 < t < 6s, assuming q(0) = 0,

$$q(t) = \int_0^t idt + q(0) = \int_0^t 3tdt + 0 = 1.5t^2$$

At t=6, $q(6) = 1.5(6)^2 = 54$
For 6 < t < 10s,

$$q(t) = \int_6^t idt + q(6) = \int_6^t 18dt + 54 = 18t - 54$$

At t=10, q(10) = 180 – 54 = 126
For 10<t<15s,

$$q(t) = \int_{10}^t idt + q(10) = \int_{10}^t (-12)dt + 126 = -12t + 246$$

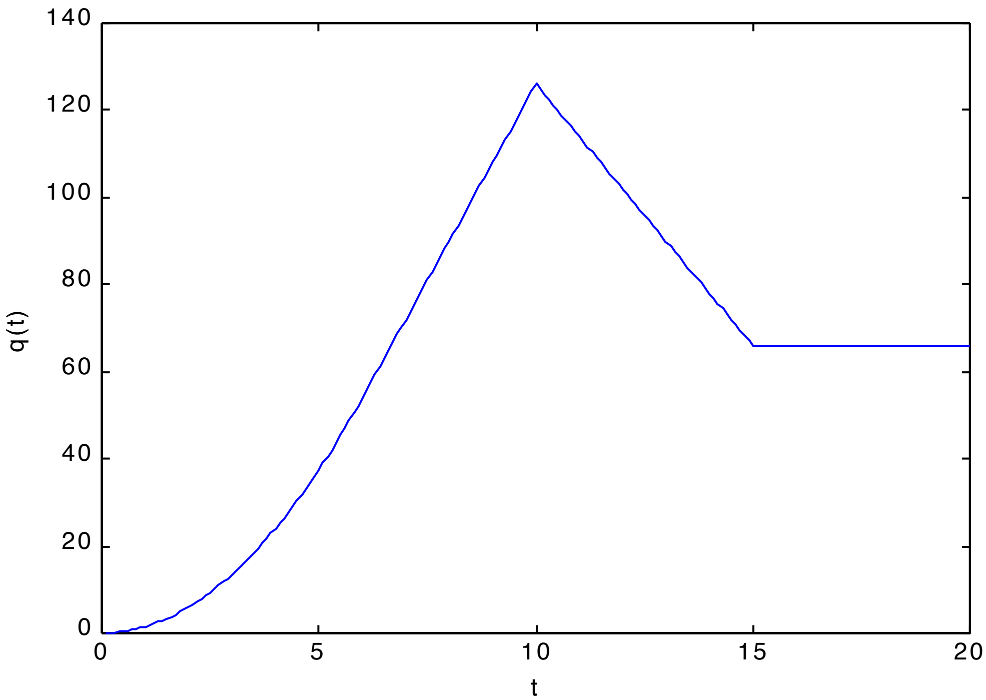
At t=15, q(15) = -12x15 + 246 = 66
For 15<t<20s,

$$q(t) = \int_{15}^t 0dt + q(15) = 66$$

Thus,

$$q(t) = \begin{cases} 1.5t^2 \ \mathbf{C}, & \mathbf{0 < t < 6s} \\ 18t - 54 \ \mathbf{C}, & \mathbf{6 < t < 10s} \\ -12t + 246 \ \mathbf{C}, & \mathbf{10 < t < 15s} \\ 66 \ \mathbf{C}, & \mathbf{15 < t < 20s} \end{cases}$$

The plot of the charge is shown below.



Solution 6

(a) $$i = \frac{dq}{dt} = 40\pi \cos 4\pi t \text{ mA}$$

$$p = vi = 80\pi \cos^2 4\pi t \text{ mW}$$

At t=0.3s,

$$p = 80\pi \cos^2 (4\pi x 0.3) = \underline{164.5 \text{ mW}}$$

(b) $$W = \int p dt = 80\pi \int_0^{0.6} \cos^2 4\pi t dt = 40\pi \int_0^{0.6} [1 + \cos 8\pi t] dt \text{ mJ}$$

$$W = 40\pi \left[0.6 + \frac{1}{8\pi} \sin 8\pi t \Big|_0^{0.6} \right] = \underline{78.34 \text{ mJ}}$$

Solution 7

$$q = \int i dt = \int_0^2 3e^{-2t} dt = \frac{-3}{2} e^{2t} \Big|_0^2$$

(a) $$= -1.5\left(e^{-4} - 1\right) =$$

$$\underline{\textbf{1.4725 C}}$$

$$v = \frac{5di}{dt} = -6e^{2t}(5) = -30e^{-2t}$$

(b) $p = vi = \underline{-90\,e^{-4t}W}$

(c) $$w = \int pdt = -90\int_0^3 e^{-4t}\,dt = \frac{-90}{-4}e^{-4t}\Big|_0^3 = \underline{-22.5\text{ J}}$$

Solution 8

Σ p = 0 → -205 + 60 + 45 + 30 + p_3 = 0

p_3 = 205 – 135 = 70 W

Thus element 3 receives <u>70 W.</u>

Solution 9

I = 4 –1 = <u>3 A</u>
Or using power conservation,
9x4 = 1x9 + 3I + 6I = 9 + 9I
4 = 1 + I or I = <u>3 A</u>

Solution 10

W = pt = 600x4 = 2.4 kWh
C = 10cents x2.4 = <u>24 cents</u>