FIFTH EDITION

Fundamentals of Electric Circuits

INSTRUCTOR SOLUTIONS MANUAL

Charles K. Alexander | Matthew N. O. Sadiku

Chapter 1, Solution 1

(a) $q = 6.482 \times 10^{17} \times [-1.602 \times 10^{-19}\ C]$ = **–103.84 mC**

(b) $q = 1.24 \times 10^{18} \times [-1.602 \times 10^{-19}\ C]$ = **–198.65 mC**

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

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

Chapter 1, Solution 2

(a) i = dq/dt = 3 mA
(b) i = dq/dt = (16t + 4) A
(c) i = dq/dt = $(-3e^{-t} + 10e^{-2t})$ nA
(d) i=dq/dt = $1200\pi \cos 120\pi t$ pA
(e) i =dq/dt = $-e^{-4t}(80\cos 50t + 1000\sin 50t)\ \mu\mathbf{A}$

Chapter 1, Solution 3

(a) $q(t) = \int i(t)dt + q(0) = \underline{(3t + 1)\ \ C}$

(b) $q(t) = \int (2t + s)\,dt + q(v) = \underline{(t^2 + 5t)\ \ mC}$

(c) $q(t) = \int 20\cos\left(10t + \pi/6\right) + q(0) = \underline{(2\sin(10t + \pi/6) + 1)\mu C}$

(d)
$$q(t) = \int 10e^{-30t}\sin 40t + q(0) = \frac{10e^{-30t}}{900 + 1600}(-30\sin 40t - 40\cos t)$$
$$= \underline{-e^{-30t}(0.16\cos 40\,t + 0.12\ \sin\ 40t)\ C}$$

Chapter 1, Solution 4

$q = it = 7.4 \times 20 =$ **<u>148 C</u>**

Chapter 1, Solution 5

$$q = \int i dt = \int_0^{10} \frac{1}{2} t dt = \frac{t^2}{4} \Big|_0^{10} = \underline{25\ \text{C}}$$

Chapter 1, Solution 6

(a) At t = 1ms, $i = \frac{dq}{dt} = \frac{30}{2} =$ **<u>15 A</u>**

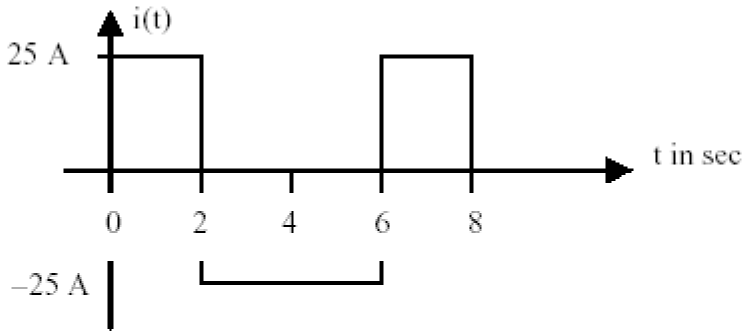
(b) At t = 6ms, $i = \frac{dq}{dt} =$ **<u>0 A</u>**

(c) At t = 10ms, $i = \frac{dq}{dt} = \frac{-30}{4} =$ **<u>–7.5 A</u>**

Chapter 1, Solution 7

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

which is sketched below:



Chapter 1, Solution 8

$$q = \int i dt = \frac{10 \times 1}{2} + 10 \times 1 = \underline{15\ \mu C}$$

Chapter 1, Solution 9

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

Chapter 1, Solution 10

$q = it = 10x10^{3}x15x10^{-6} =$ **150 mC**

Chapter 1, Solution 11

$q = it = 90 \times 10^{-3} \times 12 \times 60 \times 60 = $ **3.888 kC**

$E = pt = ivt = qv = 3888 \times 1.5 = $ **5.832 kJ**

Chapter 1, Solution 12

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,

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

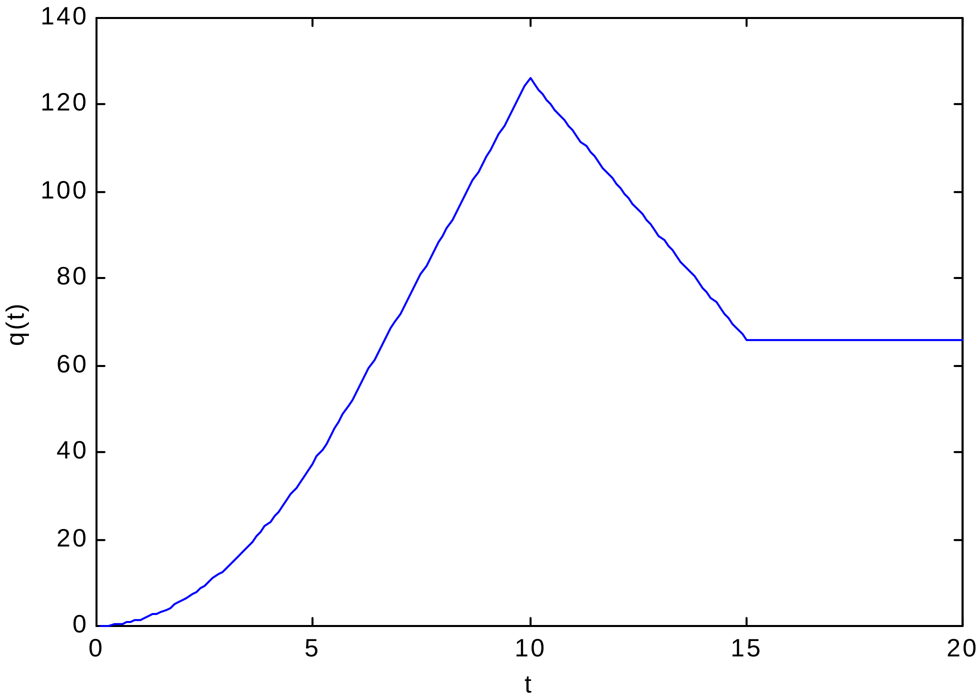
At t=15, q(15) = -12x15 + 246 = 66
For 15<t<20s,

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

Thus,

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

The plot of the charge is shown below.



140
120
100
80
60
40
20
0
q(t)
0
5
10
15
20
t

Chapter 1, Solution 13

(a) $i = [dq/dt] = 20\pi\cos(4\pi t)$ mA

$p = vi = 60\pi\cos^2(4\pi t)$ mW

At t=0.3s,

$$p = vi = 60\pi\cos^2(4\pi 0.3)\text{ mW} = \mathbf{123.37\ mW}$$

(b) $W = \int p\,dt = 60\pi\int_0^{0.6}\cos^2(4\pi t)dt = 30\pi\int_0^{0.6}[1+\cos(8\pi t)]dt$

$$W = 30\pi[0.6+(1/(8\pi))[\sin(8\pi 0.6)-\sin(0)]] = \mathbf{58.76\ mJ}$$

Chapter 1, Solution 14

(a) $q = \int i dt = \int_0^1 0.02\left(1 - e^{-0.5t}\right)dt = 0.02\left(t + 2e^{-0.5t}\right)\Big|_0^1 = 0.02\left(1 + 2e^{-0.5} - 2\right) =$ **4.261 mC**

(b) $p(t) = v(t)i(t)$

$p(1) = 10\cos(2) \times 0.02(1 - e^{-0.5}) = (-4.161)(0.007869)$

$=$ **–32.74 mW**

Chapter 1, Solution 15

(a) $q = \int i dt = \int_0^2 0.006e^{-2t} dt = \frac{-0.006}{2} e^{2t} \Big|_0^2$

$= -0.003(e^{-4} - 1) =$

2.945 mC

(b) $v = \frac{10di}{dt} = -0.012e^{-2t}(10) = -0.12e^{-2t}$ V this leads to p(t) = v(t)i(t) =

$(-0.12e^{-2t})(0.006e^{-2t})$ = $\mathbf{-720e^{-4t}}$ **μW**

(c) $w = \int pdt = -0.72\int_0^3 e^{-4t}\, dt = \frac{-720}{-4} e^{-4t} 10^{-6} \Big|_0^3$ = **–180 μJ**

Chapter 1, Solution 16

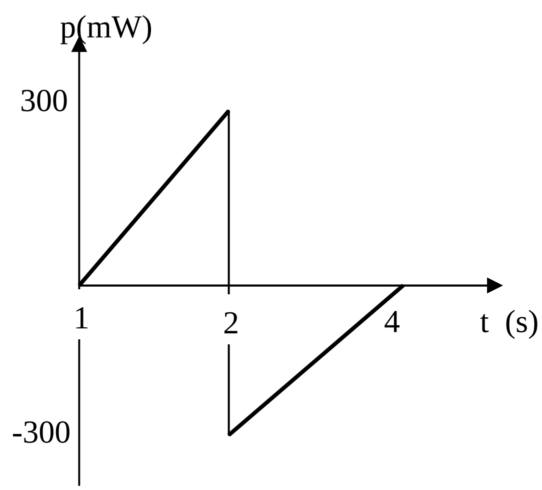
(a)

$$i(t) = \begin{cases} 30t \text{ mA}, & 0 < t < 2 \\ 120\text{-}30t \text{ mA}, & 2 < t < 4 \end{cases}$$

$$v(t) = \begin{cases} 5 \text{ V}, & 0 < t < 2 \\ -5 \text{ V}, & 2 < t < 4 \end{cases}$$

$$p(t) = \begin{cases} 150t \text{ mW}, & 0 < t < 2 \\ -600+150t \text{ mW}, & 2 < t < 4 \end{cases}$$

which is sketched below.



(b) From the graph of p,

$$W = \int_0^4 p\,dt = \underline{0 \text{ J}}$$

Chapter 1, Solution 17

Σ p = 0 $\rightarrow$ -205 + 60 + 45 + 30 + p_3 = 0

p_3 = 205 – 135 = 70 W

Thus element 3 receives **70 W.**

Chapter 1, Solution 18

p_1 = 30(-10) = **-300 W**
p_2 = 10(10) = **100 W**
p_3 = 20(14) = **280 W**
p_4 = 8(-4) = **-32 W**
p_5 = 12(-4) = **-48 W**