Chapter 1, Solution 1

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

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

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

(d) $q = 1.628\text{x}10^{20}$ x $[-1.602\text{x}10^{-19}\ \text{C}] =$ **-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) $i = dq/dt = -e^{-4t}(80\cos 50t + 1000\sin 50t)\ \mu\text{A}$

Chapter 1, Solution 3

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

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

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

(d) $q(t) = \int 10e^{-30t}\sin 40t + q(0) = \dfrac{10e^{-30t}}{900 + 1600}(-30\sin 40t - 40\cos t)$

$= \underline{-e^{-30t}(0.16\cos 40t + 0.12\sin 40t)\ \text{C}}$

Chapter 1, Solution 4

$$q = \int i\,dt = \int 5\sin 6\pi t\,dt = \frac{-5}{6\pi}\cos 6\pi t\Big|_0^{10}$$

$$= \frac{5}{6\pi}(1 - \cos 0.06\pi) = \underline{4.698\ \text{mC}}$$

Chapter 1, Solution 5

$$q = \int i\,dt = \int e^{-2t}\,dt \text{ mC} = -\frac{1}{2}e^{-2t}\Big|_0^2$$

$$= \frac{1}{2}(1 - e^{4}) \text{ mC} = \underline{490\ \mu C}$$

Chapter 1, Solution 6

(a) At t = 1ms, $i = \frac{dq}{dt} = \frac{80}{2} = \underline{40 \text{ mA}}$

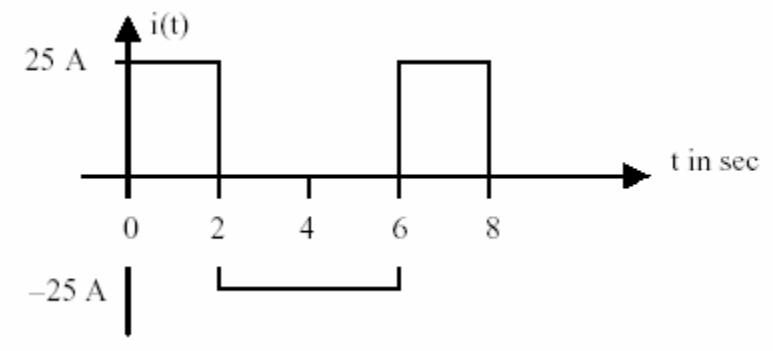
(b) At t = 6ms, $i = \frac{dq}{dt} = \underline{0 \text{ mA}}$

(c) At t = 10ms, $i = \frac{dq}{dt} = \frac{80}{4} = \underline{-20 \text{ mA}}$

Chapter 1, Solution 7

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

which is sketched below:



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

(b) $$q = \int_0^3 i dt = 10 \times 1 + \left(10 - \frac{5 \times 1}{2}\right) + 5 \times 1$$
$$= 15 + 10 - 25 = \underline{22.5\ C}$$

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

Chapter 1, Solution 10

$$q = ixt = 8x10^{3}\, x15x10^{-6} = 120\ \mu\mathbf{C}$$

Chapter 1, Solution 11

$q = it = 85\ x10^{-3}\ x\ 12\ x\ 60\ x\ 60 = 3{,}672\ C$

$E = pt = ivt = qv = 3672\ x1.2 = 4406.4\ J$

Chapter 1, Solution 12

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

$$q(t) = \int_0^t i dt + q(0) = \int_0^t 3t dt + 0 = 1.5t^2$$

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

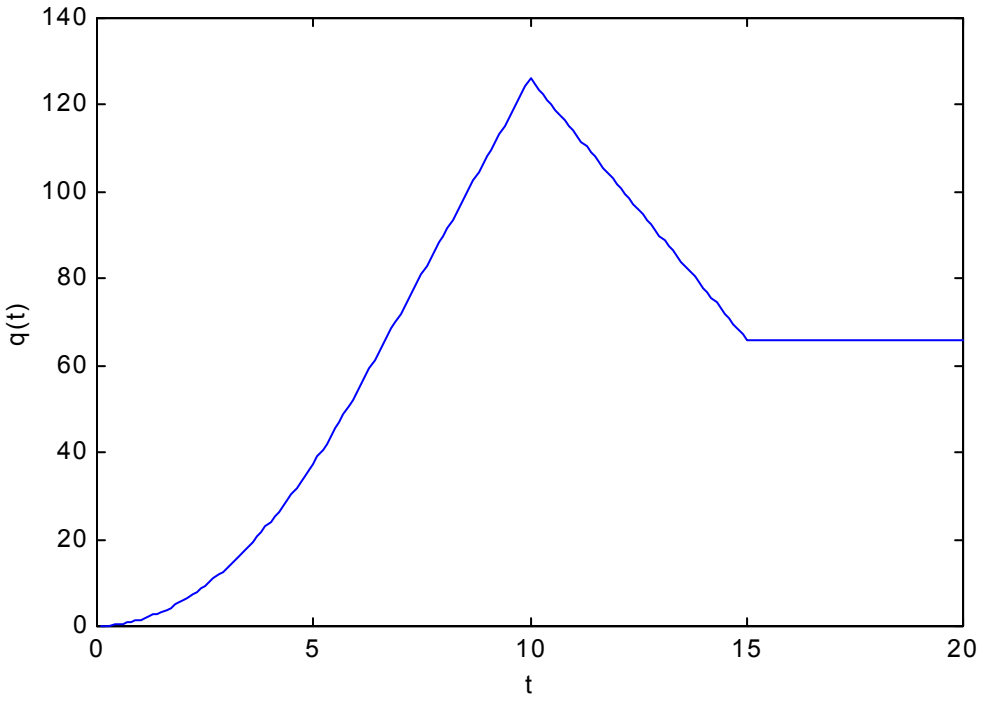
For 15<t<20s,

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

Thus,

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

The plot of the charge is shown below.



Chapter 1, Solution 13

$$w = \int_0^2 vi\,dt = \int_0^2 1200\cos^2 4t\,dt$$

$$= 1200\int_0^2 (2\cos 8t - 1)dt \text{ (since, } \cos^2 x = 2\cos 2x - 1)$$

$$= 1200\left(\frac{2}{8}\sin 8t - t\right)_0^2 = 1200\left(\frac{1}{4}\sin 16 - 2\right)$$

$$= \underline{-2.486 \text{ kJ}}$$

Chapter 1, Solution 14

(a) $$q = \int i\,dt = \int_0^1 10\left(1 - e^{-0.5t}\right)dt = 10\left(t + 2e^{-0.5t}\right)\Big|_0^1$$

$$= 10\left(1 + 2e^{-0.5} - 2\right) = \underline{2.131 \text{ C}}$$

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

$$p(1) = 5\cos 2 \cdot 10(1 - e^{-0.5}) = (-2.081)(3.935)$$

$$= \underline{\mathbf{-8.188 \text{ W}}}$$

Chapter 1, Solution 15

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

$$= -1.5\left(e^{-2} - 1\right) = \underline{1.297 \text{ C}}$$

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

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

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

Chapter 1, Solution 16

$$i(t) = \begin{cases} 25t \text{ mA} & 0 < t < 2 \\ 100 - 25t \text{ mA} & 2 < t < 4 \end{cases}, \quad v(t) = \begin{cases} 10t \text{ V} & 0 < t < 1 \\ 10 \text{ V} & 1 < t < 3 \\ 40 - 10t \text{ V} & 3 < t < 4 \end{cases}$$

$$w = \int v(t)i(t)dt = \int_0^1 10 + (25t)dt + \int_1^2 10(25t)dt + \int_2^3 10(100 - 25t)dt + \int_3^4 (40 - 10t)(100 - 25t)\text{mJ}$$

$$= \frac{250}{3}t^3\Big|_0^1 + \frac{250}{2}\Big|_1^2 + 250\left(4t - \frac{t^2}{2}\right)\Big|_2^3 + \int_3^4 250(4 - t)^2 dt$$

$$= \frac{250}{3} + \frac{250}{2}(3) + 250\left(12 - \frac{9}{2} - 8 + 2\right) + 250\left(16t - 4t^2 + \frac{t^2}{3}\right)\Big|_3^4$$

$$= \underline{916.7 \text{ mJ}}$$

Chapter 1, Solution 17

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

$p_3 = 205 - 135 = 70$ 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**

Chapter 1, Solution 19

$$\sum p = 0 \quad \longrightarrow \quad -4I_s - 2x6 - 13x2 + 5x10 = 0 \quad \longrightarrow \quad I_s = 3 \text{ A}$$

Chapter 1, Solution 20

Since Σ p = 0

$-30\times6 + 6\times12 + 3V_0 + 28 + 28\times2 - 3\times10 = 0$

$72 + 84 + 3V_0 = 210$ or $3V_0 = 54$

$V_0 =$ **18 V**

Chapter 1, Solution 21

$$i = \frac{\Delta q}{\Delta t} = 4\times10^{11}\left(\frac{\text{photon}}{\text{sec}}\right)\cdot\frac{1}{8}\left(\frac{\text{electron}}{\text{photon}}\right)\cdot1.6\times10^{19}(\text{C / electron})$$

$$= \frac{4}{8}\times10^{11}\times1.6\times10^{-19}\,\text{C/s} = 0.8\times10^{-8}\,\text{C/s} = \underline{8\,\text{nA}}$$

Chapter 1, Solution 22

It should be noted that these are only typical answers.

(a)	Light bulb	**60 W, 100 W**
(b)	Radio set	**4 W**
(c)	TV set	**110 W**
(d)	Refrigerator	**700 W**
(e)	PC	**120 W**
(f)	PC printer	**18 W**
(g)	Microwave oven	**1000 W**
(h)	Blender	**350 W**

Chapter 1, Solution 23

(a) $i = \frac{p}{v} = \frac{1500}{120} = \underline{12.5\text{ W}}$

(b) $w = pt = 1.5\times10^3\times45\times60\cdot\text{J} = 1.5\times\frac{45}{60}\,\text{kWh} = \underline{1.125\text{ kWh}}$

(c) Cost = 1.125 × 10 = **11.25 cents**

Chapter 1, Solution 24

$$p = vi = 110 \times 8 = 880 \text{ W}$$

Chapter 1, Solution 25

$$\text{Cost} = 1.2\,\text{kW} \times \frac{4}{6}\text{hr} \times 30 \times 9 \text{ cents/kWh} = \underline{21.6 \text{ cents}}$$

Chapter 1, Solution 26

(a) $i = \dfrac{0.8\text{A} \cdot \text{h}}{10\text{h}} = \underline{80 \text{ mA}}$

(b) $p = vi = 6 \times 0.08 = \mathbf{\underline{0.48 \text{ W}}}$

(c) $w = pt = 0.48 \times 10 \text{ Wh} = \mathbf{\underline{0.0048 \text{ kWh}}}$

Chapter 1, Solution 27

(a) Let $T = 4\text{h} = 4 \times 36005$

$$q = \int i\,dt = \int_0^T 3\,dt = 3T = 3 \times 4 \times 3600 = \underline{43.2 \text{ kC}}$$

(b) $$W = \int p\,dt = \int_0^T vi\,dt = \int_0^T (3)\left(10 + \frac{0.5t}{3600}\right)dt$$

$$= 3\left(10t + \frac{0.25t^2}{3600}\right)\Bigg|_0^{4\times3600} = 3[40 \times 3600 + 0.25 \times 16 \times 3600]$$

$$= \underline{475.2 \text{ kJ}}$$

(c) $W = 475.2\,\text{kWs}, \quad (\text{J} = \text{Ws})$

$$\text{Cost} = \frac{475.2}{3600}\text{kWh} \times 9 \text{ cent} = \underline{1.188 \text{ cents}}$$

Chapter 1, Solution 28

(a) $i = \frac{P}{V} = \frac{30}{120} = \underline{0.25\ \text{A}}$

(b) $\text{W} = \text{pt} = 30 \times 365 \times 24\ \text{Wh} = 262.8\ \text{kWh}$

$\text{Cost} = \$0.12 \times 262.8 = \underline{\$31.54}$

Chapter 1, Solution 29

$$w = pt = 1.2\text{kW}\frac{(20+40+15+45)}{60}\text{hr} + 1.8\,\text{kW}\left(\frac{30}{60}\right)\text{hr}$$

$$= 2.4 + 0.9 = 3.3\,\text{kWh}$$

$\text{Cost} = 12\ \text{cents} \times 3.3 = \underline{39.6\ \text{cents}}$

Chapter 1, Solution 30

Energy = (52.75 – 5.23)/0.11 = 432 kWh

Chapter 1, Solution 31

Total energy consumed = 365(4 +8) W

Cost = \$0.12 x 365 x 12 = \$526.60

Chapter 1, Solution 32

$$w = pt = 1.2\text{kW}\frac{(20+40+15+45)}{60}\text{hr} + 1.8\,\text{kW}\left(\frac{30}{60}\right)\text{hr}$$

$$= 2.4 + 0.9 = 3.3\,\text{kWh}$$

$\text{Cost} = 12\ \text{cents} \times 3.3 = \underline{39.6\ \text{cents}}$

Chapter 1, Solution 33

$$i = \frac{dq}{dt} \rightarrow q = \int i dt = 2000 \times 3 \times 10^3 = \underline{6\ \text{C}}$$

Chapter 1, Solution 34

(b) Energy $= \sum pt = 200 \text{ x } 6 + 800 \text{ x } 2 + 200 \text{ x } 10 + 1200 \text{ x } 4 + 200 \text{ x } 2$
$= 10{,}000 \text{ kWh}$

(c) Average power $= 10{,}000/24 = 416.67 \text{ W}$

Chapter 1, Solution 35

(a) $\text{W} = \int p(t)dt = 400 \times 6 + 1000 \times 2 + 200 \times 12 \times 1200 \times 2 + 400 \times 2$
$= 7200 + 2800 = \underline{10.4 \text{ kWh}}$

(b) $\frac{10.4 \text{ kW}}{24 \text{ h}} = \underline{433.3 \text{ W/h}}$

Chapter 1, Solution 36

(a) $\text{i} = \frac{160\text{A} \cdot \text{h}}{40} = \underline{4 \text{ A}}$

(b) $\text{t} = \frac{160\text{Ah}}{0.001\text{A}} = \frac{160{,}000\text{h}}{24\text{h / day}} = \underline{6{,}667 \text{ days}}$

Chapter 1, Solution 37

$\text{q} = 5 \times 10^{20}\left(-1.602 \times 10^{-19}\right) = -80.1\,\text{C}$
$\text{W} = qv = -80.1 \times 12 = \underline{-901.2 \text{ J}}$

Chapter 1, Solution 38

$P = 10 \text{ hp} = 7460 \text{ W}$

$W = pt = 7460 \times 30 \times 60 \text{ J} = \underline{\mathbf{13.43 \times 10^6 \text{ J}}}$

Chapter 1, Solution 39

$$p = vi \rightarrow i = \frac{p}{v} = \frac{2 \times 10^3}{120} = \underline{16.667 \text{ A}}$$