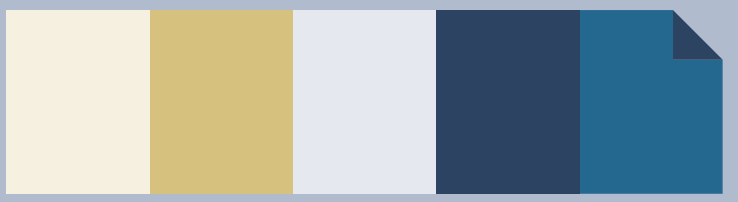
Chapter 1 Solutions SAMPLE for

CIRCUITS

Solutions for all problems and all chapters are provided in the full instructor solutions manual. This document provides a representative sample of the authors thoroughness and completeness. Only partial solutions for problems 1.1, 1.10, 1.14, and 1.25 are shown in this document.



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CHAPTER 1

Sections 1-2 and 1-3: Dimensions, Charge, and Current

Problem 1.1 Use appropriate multiple and submultiple prefixes to express the following quantities:

(a) 3,620 watts (W)

(b) 0.000004 amps (A)

(c) 5.2×10^{-6} ohms (Ω)

(d) 3.9×10^{11} volts (V)

(e) 0.02 meters (m)

(f) 32×10^{5} volts (V)

Solution:

(a) 3,620 W $= 3.62$ kW.

(b) 0.000004 A $= 4\ \mu$A.

(c) $5.2 \times 10^{-6}\ \Omega = 5.2\ \mu\Omega$.

(d) Solution Hidden

(e)

(f)

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Problem 1.10 Determine the net charge ΔQ that flowed through a certain device over the specified time intervals for each of the following currents:

(a) $i(t) = [3t + 6t^3]$ mA, from $t = 0$ to $t = 4$ s

(b) $i(t) = 4\sin(40\pi t)\cos(40\pi t)$ μA, from $t = 0$ to $t = 0.05$ s

(c) $i(t) = [4e^{-t} - 3e^{-2t}]$ A, from $t = 0$ to $t = \infty$

(d) $i(t) = 12e^{-3t}\cos(40\pi t)$ nA, from $t = 0$ to $t = 0.05$ s

Solution:

(a)

$$\Delta Q(0,4) = \int_0^4 i\,dt = \left[\int_0^4 (3t + 6t^3)\,dt \times 10^{-3}\right]$$

$$= \left(\frac{3t^2}{2} + \frac{6t^4}{4}\right)\Big|_0^4 \times 10^{-3} = 408 \qquad \text{(mC)}.$$

(b)

$$\Delta Q(0,0.05) = \int_0^{0.05} i\,dt = \left[\int_0^{0.05} 4\sin 40\pi t\cos 40\pi t\,dt\right] \times 10^{-6}$$

$$= \frac{4}{2\times 40\pi}\sin^2 40\pi t|_0^{0.05} \times 10^{-6} = 0.$$

(c)

$$\Delta Q(0,\infty) = \int_0^\infty i\,dt = \int_0^\infty (4e^{-t} - 3e^{-2t})\,dt = \left(-4e^{-t} + \frac{3}{2}e^{-2t}\right)\Big|_0^\infty = 2.5 \qquad \text{(C)}.$$

(d)

$$\Delta Q(0,0.05) = \int_0^{0.05} i\,dt = \left[\int_0^{0.05} 12e^{-3t}\cos 40\pi t\,dt\right] \times 10^{-9}.$$

From Tables of Integrals,

$$\int e^{ax}\cos bx\,dx = e^{ax}\frac{(a\cos bx + b\sin bx)}{a^2 + b^2}.$$

Hence,

Solution Hidden

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Problem 1.14 Given that the current in mA flowing through a wire is given by

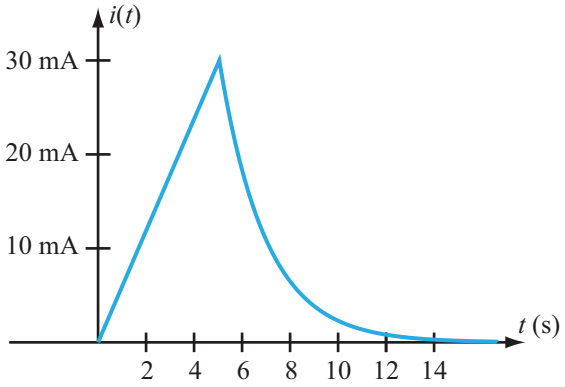
$$i(t) = \begin{cases} 0, & \text{for } t < 0, \\ 6t, & \text{for } 0 \le t \le 5 \text{ s}, \\ 30e^{-0.6(t-5)}, & \text{for } t \ge 5 \text{ s}, \end{cases}$$

(a) Sketch $i(t)$ versus t.

(b) Sketch $q(t)$ versus t.

Solution:

(a)



(b) $q(t) = \int_{-\infty}^{t} i(t)\,dt$.

For $0 \le t \le 5$ s,

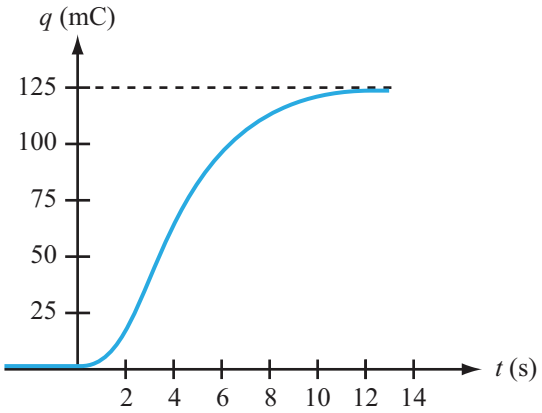
$$q(t) = \left(\int_0^t 6t\,dt \right) \text{Solution Hidden} \quad \text{(mC)}.$$

For $t \ge 5$ s,

$$q(t) = \left[\int_0^5 6t\,dt + \int_5^t 30e^{-0.6(t-5)}\,dt \right] \times 10^{-3}$$

$$= \left[\frac{6t^2}{2}\Big|_0^5 + 30e^{+3} \int_5^t e^{-0.6t}\,dt \right] \times 10^{-3}$$

$$= \text{Solution Hidden} \text{ (mC)}.$$



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Problem 1.25 For the circuit in Fig. P1.25, generate circuit diagrams that include only those elements that have current flowing through them for

(a) $t < 0$

(b) $0 < t < 2$ s

(c) $t > 2$ s

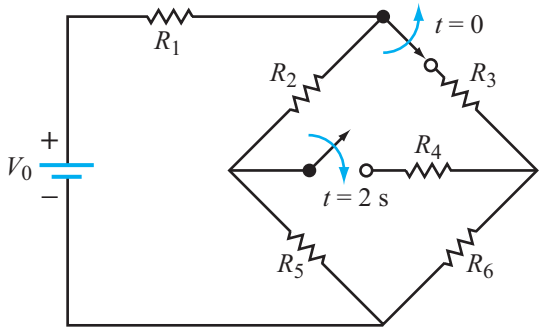
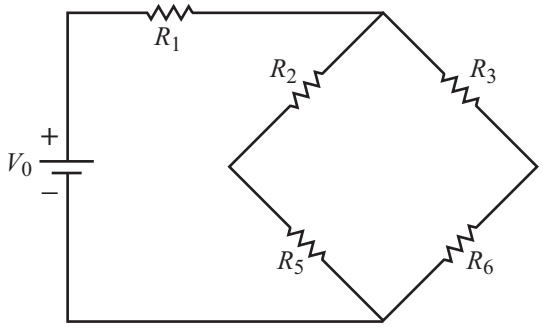


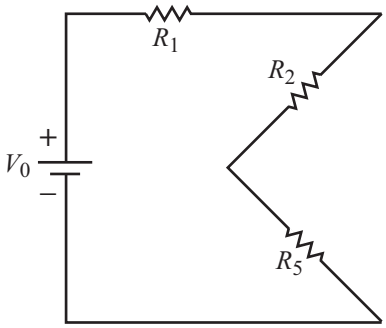
Figure P1.25: Circuit for Problem 1.25.

Solution:

(a) $t < 0$



(b) $0 < t < 2$ s



(c) Solution Hidden

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