Instructor's Resource Manual
to accompany

Introductory Circuit Analysis

Eleventh Edition

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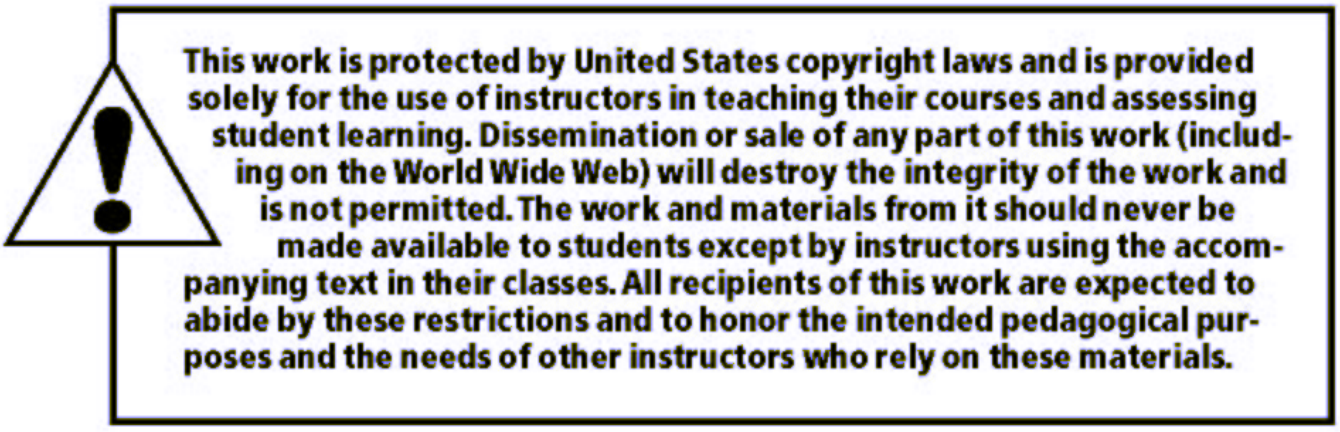
PEARSON
Prentice Hall

Upper Saddle River, New Jersey
Columbus, Ohio



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Chapter 1

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4. $$\upsilon = \frac{d}{t} = \frac{20{,}000\,\text{ft}}{10\,\text{s}}\left[\frac{1\,\text{mi}}{5{,}280\,\text{ft}}\right]\left[\frac{60\,\text{s}}{1\,\text{min}}\right]\left[\frac{60\,\text{min}}{1\,\text{h}}\right] = \mathbf{1363.64\ mph}$$

5. $$4\,\text{min}\left[\frac{1\,\text{h}}{60\,\text{min}}\right] = \mathbf{0.067\ h}$$
$$\upsilon = \frac{d}{t} = \frac{31\,\text{mi}}{1.067\,\text{h}} = \mathbf{29.05\ mph}$$

6. a. $$\frac{95\,\text{mi}}{1\,\text{h}}\left[\frac{5{,}280\,\text{ft}}{1\,\text{mi}}\right]\left[\frac{1\,\text{h}}{60\,\text{min}}\right]\left[\frac{1\,\text{min}}{60\,\text{s}}\right] = \mathbf{139.33\ ft/s}$$
b. $$t = \frac{d}{\upsilon} = \frac{60\,\text{ft}}{139.33\,\text{ft/s}} = \mathbf{0.431\ s}$$
c. $$\upsilon = \frac{d}{t} = \frac{60\,\text{ft}}{1\,\text{s}}\left[\frac{60\,\text{s}}{1\,\text{min}}\right]\left[\frac{60\,\text{min}}{1\,\text{h}}\right]\left[\frac{1\,\text{mi}}{5{,}280\,\text{ft}}\right] = \mathbf{40.91\ mph}$$

7. –

8. –

9. –

10. MKS, CGS, °C = $\frac{5}{9}(°\text{F} - 32) = \frac{5}{9}(68 - 32) = \frac{5}{9}(36) = \mathbf{20°}$
SI: K = 273.15 + °C = 273.15 + 20 = **293.15**

11. $$1000\,\text{J}\left[\frac{0.7378\,\text{ft - lb}}{1\,\text{J}}\right] = \mathbf{737.8\ ft\text{-}lbs}$$

12. $$0.5\,\text{yd}\left[\frac{3\,\text{ft}}{1\,\text{yd}}\right]\left[\frac{12\,\text{in.}}{1\,\text{ft}}\right]\left[\frac{2.54\,\text{cm}}{1\,\text{in.}}\right] = \mathbf{45.72\ cm}$$

13. a. $\mathbf{10^4}$ b. $\mathbf{10^6}$ c. $\mathbf{10^3}$ d. $\mathbf{10^{-3}}$ e. $\mathbf{10^0}$ f. $\mathbf{10^{-1}}$

14. a. $\mathbf{15 \times 10^3}$ b. $\mathbf{30 \times 10^{-3}}$ c. $\mathbf{2.4 \times 10^6}$ d. $\mathbf{150 \times 10^3}$
e. $\mathbf{4.02 \times 10^{-4}}$ f. $\mathbf{2 \times 10^{-10}}$

15. a. $4.2 \times 10^3 + 48.0 \times 10^3 = 52.2 \times 10^3 = \mathbf{5.22 \times 10^4}$
b. $90 \times 10^3 + 360 \times 10^3 = 450 \times 10^3 = \mathbf{4.50 \times 10^5}$
c. $50 \times 10^{-5} - 6 \times 10^{-5} = 44 \times 10^{-5} = \mathbf{4.4 \times 10^{-4}}$
d. $1.2 \times 10^3 + 0.05 \times 10^3 - 0.6 \times 10^3 = 0.65 \times 10^3 = \mathbf{6.5 \times 10^2}$

16. a. $(10^2)(10^3) = 10^5 = \mathbf{100 \times 10^3}$
b. $(10^{-2})(10^3) = 10^1 = \mathbf{10}$
c. $(10^3)(10^6) = \mathbf{1 \times 10^9}$
d. $(10^2)(10^{-5}) = \mathbf{1 \times 10^{-3}}$
e. $(10^{-6})(10 \times 10^6) = \mathbf{10}$
f. $(10^4)(10^{-8})(10^{28}) = \mathbf{1 \times 10^{24}}$

17. a. $(50 \times 10^3)(3 \times 10^{-4}) = 150 \times 10^{-1} = \mathbf{1.5 \times 10^1}$
b. $(2.2 \times 10^3)(2 \times 10^{-3}) = 4.4 \times 10^0 = \mathbf{4.4}$
c. $(82 \times 10^6)(2.8 \times 10^{-6}) = 229.6 = \mathbf{2.296 \times 10^2}$
d. $(30 \times 10^{-4})(4 \times 10^{-3})(7 \times 10^8) = 840 \times 10^1 = \mathbf{8.40 \times 10^3}$

18. a. $10^2/10^4 = 10^{-2} = \mathbf{10 \times 10^{-3}}$
b. $10^{-2}/10^3 = 10^{-5} = \mathbf{10 \times 10^{-6}}$
c. $10^4/10^{-3} = 10^7 = \mathbf{10 \times 10^6}$
d. $10^{-7}/10^2 = \mathbf{1.0 \times 10^{-9}}$
e. $10^{38}/10^{-4} = \mathbf{1.0 \times 10^{42}}$
f. $\sqrt{100}\,/10^{-2} = 10^1/10^{-2} = \mathbf{1 \times 10^3}$

19. a. $(2 \times 10^3)/(8 \times 10^{-5}) = 0.25 \times 10^8 = \mathbf{2.50 \times 10^7}$
b. $(4 \times 10^{-3})/(60 \times 10^4) = 4/60 \times 10^{-7} = 0.667 \times 10^{-7} = \mathbf{6.67 \times 10^{-8}}$
c. $(22 \times 10^{-5})/(5 \times 10^{-5}) = 22/5 \times 10^0 = \mathbf{4.4}$
d. $(78 \times 10^{18})/(4 \times 10^{-6}) = \mathbf{1.95 \times 10^{25}}$

20. a. $(10^2)^3 = \mathbf{1.0 \times 10^6}$ b. $(10^{-4})^{1/2} = \mathbf{10.0 \times 10^{-3}}$
c. $(10^4)^8 = \mathbf{100.0 \times 10^{30}}$ d. $(10^{-7})^9 = \mathbf{1.0 \times 10^{-63}}$

21. a. $(4 \times 10^2)^2 = 16 \times 10^4 = \mathbf{1.6 \times 10^5}$
b. $(6 \times 10^{-3})^3 = 216 \times 10^{-9} = \mathbf{2.16 \times 10^{-7}}$
c. $(4 \times 10^{-3})(6 \times 10^2)^2 = (4 \times 10^{-3})(36 \times 10^4) = 144 \times 10^1 = \mathbf{1.44 \times 10^3}$
d. $((2 \times 10^{-3})(0.8 \times 10^4)(0.003 \times 10^5))^3 = (4.8 \times 10^3)^3 = (4.8)^3 \times (10^3)^3$
$= 110.6 \times 10^9 = \mathbf{1.11 \times 10^{11}}$

22. a. $(-10^{-3})^2 = \mathbf{1.0 \times 10^{-6}}$
b. $\dfrac{(10^2)(10^{-4})}{10^3} = 10^{-2}/10^3 = \mathbf{1.0 \times 10^{-5}}$
c. $\dfrac{(10^{-3})^2(10^2)}{10^4} = \dfrac{(10^{-6})(10^2)}{10^4} = \dfrac{10^{-4}}{10^4} = \mathbf{1.0 \times 10^{-8}}$
d. $\dfrac{(10^3)(10^4)}{10^{-4}} = 10^7/10^{-4} = \mathbf{1.0 \times 10^{11}}$

e. $(1 \times 10^{-4})^3(10^2)/10^6 = (10^{-12})(10^2)/10^6 = 10^{-10}/10^6 = \mathbf{1.0 \times 10^{-16}}$

f. $$\frac{\left[(10^2)(10^{-2})\right]^{-3}}{\left[(10^2)^2\right]\left[10^{-3}\right]} = \frac{1}{(10^4)(10^{-3})} = \frac{1}{10} = \mathbf{1.0 \times 10^{-1}}$$

23. a. $$\frac{(3\times10^2)^2(10^2)}{3\times10^4} = (9 \times 10^4)(10^2)/(3 \times 10^4) = (9 \times 10^6)/(3 \times 10^4) = 3 \times 10^2 = \mathbf{300}$$

b. $$\frac{(4\times10^4)^2}{(20)^3} = \frac{16\times10^8}{8\times10^3} = 2 \times 10^5 = \mathbf{200.0 \times 10^3}$$

c. $$\frac{(6\times10^4)^2}{(2\times10^{-2})^2} = \frac{36\times10^8}{4\times10^{-4}} = \mathbf{9.0 \times 10^{12}}$$

d. $$\frac{(27\times10^{-6})^{1/3}}{2\times10^5} = \frac{3\times10^{-2}}{2\times10^5} = 1.5 \times 10^{-7} = \mathbf{150.0 \times 10^{-9}}$$

e. $$\frac{(4\times10^3)^2(3\times10^2)}{2\times10^{-4}} = \frac{(16\times10^6)(3\times10^2)}{2\times10^{-4}} = \frac{48\times10^8}{2\times10^{-4}} = \mathbf{24.0 \times 10^{12}}$$

f. $(16 \times 10^{-6})^{1/2}(10^5)^5(2 \times 10^{-2}) = (4 \times 10^{-3})(10^{25})(2 \times 10^{-2}) = 8 \times 10^{20}$
$= \mathbf{800.0 \times 10^{18}}$

g. $$\frac{\left[(3\times10^{-3})^3\right]\left[1.60\times10^2\right]^2\left[(2\times10^2)(8\times10^{-4})\right]^{1/2}}{(7\times10^{-5})^2}$$
$$= \frac{(27\times10^{-9})(2.56\times10^4)(16\times10^{-2})^{1/2}}{49\times10^{-10}}$$
$$= \frac{(69.12\times10^{-5})(4\times10^{-1})}{49\times10^{-10}} = \frac{276.48\times10^{-6}}{49\times10^{-10}}$$
$= 5.64 \times 10^4 = \mathbf{56.4 \times 10^3}$

24. a. $6 \times 10^3 = \underline{0.006} \times 10^{+6}$ (+3 over the exponents, −3 under the exponents)

b. $4 \times 10^{-3} = \underline{4000} \times 10^{-6}$ (−3 over the exponents, +3 under the exponents)

c. $50 \times 10^5 = \underline{5000} \times 10^3 = \underline{5} \times 10^6 = \underline{0.005} \times 10^9$ (−2, +3, +3 over the exponents; +2, −3, −3 under the exponents)

d. $30 \times 10^{-8} = \underline{0.0003} \times 10^{-3} = \underline{0.3} \times 10^{-6} = \underline{300} \times 10^{-9}$

+5, −3, −3 / −5, +3, +3

25. a. $0.05 \times 10^{0}\ \text{s} = \underline{50} \times 10^{-3}\ \text{s} = \mathbf{50\ ms}$

−3 / +3

b. $2000 \times 10^{-6}\ \text{s} = \underline{2} \times 10^{-3}\ \text{s} = \mathbf{2\ ms}$

+3 / −3

c. $0.04 \times 10^{-3}\ \text{s} = \underline{40} \times 10^{-6}\ \text{s} = \mathbf{40\ \mu s}$

−3 / +3

d. $8400 \times 10^{-12}\ \text{s} \Rightarrow \underline{0.0084} \times 10^{-6}\ \text{s} = \mathbf{0.0084\ \mu s}$

+6 / −6

e. $4 \times 10^{-3} \times 10^{3}\ \text{m} = 4 \times 10^{0}\ \text{m} = \underline{4000} \times 10^{-3}\ \text{m} = \mathbf{4000\ mm}$

−3 / +3

f. $260 \times 10^{3} \times 10^{-3}\ \text{m} = \underline{0.26} \times 10^{3}\ \text{m} = \mathbf{0.26\ km}$

10^0, increase by 3 / −3

26. a. $1.5\ \text{min}\left[\dfrac{60\ \text{s}}{1\ \text{min}}\right] = \mathbf{90\ s}$

b. $0.04\ \text{h}\left[\dfrac{60\ \text{min}}{1\ \text{h}}\right]\left[\dfrac{60\ \text{s}}{1\ \text{min}}\right] = \mathbf{144\ s}$

c. $0.05\ \text{s}\left[\dfrac{1\ \mu\text{s}}{10^{-6}\ \text{s}}\right] = \mathbf{0.05 \times 10^{6}\ \mu s = 50 \times 10^{3}\ \mu s}$

d. $0.16\ \text{m}\left[\dfrac{1\ \text{mm}}{10^{-3}\ \text{m}}\right] = 0.16 \times 10^{3}\ \text{mm} = \mathbf{160\ mm}$

e. $1.2 \times 10^{-7}\,\cancel{s}\left[\frac{1\text{ ns}}{10^{-9}\,\cancel{s}}\right] = 1.2 \times 10^{2}\text{ ns} = \mathbf{120\text{ ns}}$

f. $3.62 \times 10^{6}\,\cancel{s}\left[\frac{1\,\cancel{\text{min}}}{60\,\cancel{s}}\right]\left[\frac{1\,\cancel{h}}{60\,\cancel{\text{min}}}\right]\left[\frac{1\text{ day}}{24\,\cancel{h}}\right] = \mathbf{41.90\text{ days}}$

27. a. $0.1\,\cancel{\mu\text{F}}\left[\frac{10^{-6}\,\cancel{F}}{1\,\cancel{\mu\text{F}}}\right]\left[\frac{1\text{ pF}}{10^{-12}\,\cancel{F}}\right] = 0.1 \times 10^{-6} \times 10^{12}\text{ pF} = \mathbf{10^{5}\text{ pF}}$

b. $80 \times 10^{-3}\,\cancel{m}\left[\frac{100\text{ cm}}{1\,\cancel{m}}\right] = 8000 \times 10^{-3}\text{ cm} = \mathbf{8\text{ cm}}$

c. $60\,\cancel{\text{cm}}\left[\frac{1\,\cancel{m}}{100\,\cancel{\text{cm}}}\right]\left[\frac{1\text{ km}}{1000\,\cancel{m}}\right] = \mathbf{60 \times 10^{-5}\text{ km}}$

d. $3.2\,\cancel{h}\left[\frac{60\,\cancel{\text{min}}}{1\,\cancel{h}}\right]\left[\frac{60\,\cancel{s}}{1\,\cancel{\text{min}}}\right]\left[\frac{1\text{ ms}}{10^{-3}\,\cancel{s}}\right] = \mathbf{11.52 \times 10^{6}\text{ ms}}$

e. $0.016\,\cancel{\text{mm}}\left[\frac{10^{-3}\,\cancel{m}}{1\,\cancel{\text{mm}}}\right]\left[\frac{1\,\mu\text{m}}{10^{-6}\,\cancel{m}}\right] = 0.016 \times 10^{3}\ \mu\text{m} = \mathbf{16\ \mu m}$

f. $60\,\cancel{\text{cm}^2}\left[\frac{1\text{ m}}{100\,\cancel{\text{cm}}}\right]\left[\frac{1\text{ m}}{100\,\cancel{\text{cm}}}\right] = \mathbf{60 \times 10^{-4}\text{ m}^2}$

28. a. $100\,\cancel{\text{in.}}\left[\frac{1\text{ m}}{39.37\,\cancel{\text{in.}}}\right] = \mathbf{2.54\text{ m}}$

b. $4\,\cancel{\text{ft}}\left[\frac{12\,\cancel{\text{in.}}}{1\,\cancel{\text{ft}}}\right]\left[\frac{1\text{ m}}{39.37\,\cancel{\text{in.}}}\right] = \mathbf{1.22\text{ m}}$

c. $6\,\cancel{\text{lb}}\left[\frac{4.45\text{ N}}{1\,\cancel{\text{lb}}}\right] = \mathbf{26.7\text{ N}}$

d. $60 \times 10^{3}\,\cancel{\text{dynes}}\left[\frac{1\,\cancel{\text{N}}}{10^{5}\,\cancel{\text{dynes}}}\right]\left[\frac{1\text{ lb}}{4.45\,\cancel{\text{N}}}\right] = \mathbf{0.13\text{ lb}}$

e. $150{,}000\,\cancel{\text{cm}}\left[\frac{1\,\cancel{\text{in.}}}{2.54\,\cancel{\text{cm}}}\right]\left[\frac{1\text{ ft}}{12\,\cancel{\text{in.}}}\right] = \mathbf{4921.26\text{ ft}}$

f. $0.002\,\cancel{\text{mi}}\left[\frac{5280\,\cancel{\text{ft}}}{1\,\cancel{\text{mi}}}\right]\left[\frac{12\,\cancel{\text{in.}}}{1\,\cancel{\text{ft}}}\right]\left[\frac{1\text{ m}}{39.37\,\cancel{\text{in.}}}\right] = \mathbf{3.22\text{ m}}$

29. **5280 ft**, $5280\ \cancel{ft}\left[\frac{1\text{ yd}}{3\ \cancel{ft}}\right] = \mathbf{1760\ yds}$

$5280\ \cancel{ft}\left[\frac{12\ \cancel{in.}}{1\ \cancel{ft}}\right]\left[\frac{1\text{ m}}{39.37\ \cancel{in.}}\right] = \mathbf{1609.35\ m,\ 1.61\ km}$

30. $299{,}792{,}458\ \frac{\cancel{m}}{\cancel{s}}\left[\frac{39.37\ \cancel{in.}}{1\ \cancel{m}}\right]\left[\frac{1\ \cancel{ft}}{12\ \cancel{in.}}\right]\left[\frac{1\text{ mi}}{5280\ \cancel{ft}}\right]\left[\frac{60\ \cancel{s}}{1\ \cancel{min}}\right]\left[\frac{60\ \cancel{min}}{1\text{ h}}\right]$

$= 670{,}615{,}288.1\text{ mph} \cong \mathbf{670.62 \times 10^6\ mph}$

31. $100\ \cancel{yds}\left[\frac{3\ \cancel{ft}}{1\ \cancel{yd}}\right]\left[\frac{1\text{ mi}}{5{,}280\ \cancel{ft}}\right] = 0.0568\text{ mi}$

$\frac{60\text{ mi}}{\cancel{h}}\left[\frac{1\ \cancel{h}}{60\ \cancel{min}}\right]\left[\frac{1\ \cancel{min}}{60\text{ s}}\right] = 0.0167\text{ mi/s}$

$t = \frac{d}{\upsilon} = \frac{0.0568\text{ mi}}{0.0167\text{ mi/s}} = \mathbf{3.40\ s}$

32. $\frac{30\ \cancel{mi}}{\cancel{h}}\left[\frac{5280\ \cancel{ft}}{1\ \cancel{mi}}\right]\left[\frac{12\ \cancel{in.}}{1\ \cancel{ft}}\right]\left[\frac{1\text{ m}}{39.37\ \cancel{in.}}\right]\left[\frac{1\ \cancel{h}}{60\ \cancel{min}}\right]\left[\frac{1\ \cancel{min}}{60\text{ s}}\right] = \mathbf{13.41\ m/s}$

33. $\frac{50\ \cancel{yd}}{\cancel{min}}\left[\frac{60\ \cancel{min}}{1\text{ h}}\right]\left[\frac{3\ \cancel{ft}}{1\ \cancel{yd}}\right]\left[\frac{1\text{ mi}}{5{,}280\ \cancel{ft}}\right] = 1.705\text{ mi/h}$

$t = \frac{d}{\upsilon} = \frac{3000\text{ mi}}{1.705\text{ mi/h}} = 1760\ \cancel{h}\left[\frac{1\text{ day}}{24\ \cancel{h}}\right] = \mathbf{73.33\ days}$

34. $10\ \cancel{km}\left[\frac{1000\ \cancel{m}}{1\ \cancel{km}}\right]\left[\frac{39.37\ \cancel{in.}}{1\ \cancel{m}}\right]\left[\frac{1\ \cancel{ft}}{12\ \cancel{in.}}\right]\left[\frac{1\text{ mi}}{5280\ \cancel{ft}}\right] = 6.214\text{ mi}$

$\upsilon = \frac{1\text{ mi}}{6.5\text{ min}}$, $t = \frac{d}{\upsilon} = \frac{6.214\ \cancel{mi}}{\frac{1\ \cancel{mi}}{6.5\text{ min}}} = \mathbf{40.39\ min}$

35. $100\ \cancel{yds}\left[\frac{3\ \cancel{ft}}{1\ \cancel{yd}}\right]\left[\frac{12\text{ in.}}{1\ \cancel{ft}}\right] = 3600\text{ in} \Rightarrow \mathbf{3600\ quarters}$

36. 60 mph: $t = \frac{d}{\upsilon} = \frac{100\text{ mi}}{60\text{ mi/h}} = 1.67\text{ h} = \mathbf{1\ h{:}40.2\ min}$

75 mph: $t = \frac{d}{\upsilon} = \frac{100\text{ mi}}{75\text{ mi/h}} = 1.33\text{ h} = \mathbf{1h{:}19.98\ min}$

difference = **20.22 minutes**

37. $d = \upsilon t = \left[600\frac{\text{cm}}{\cancel{s}}\right][0.016\cancel{h}]\left[\frac{60\ \cancel{\text{min}}}{1\cancel{h}}\right]\left[\frac{60\ \cancel{s}}{1\ \cancel{\text{min}}}\right]\left[\frac{1\ \cancel{\text{m}}}{100\ \cancel{\text{cm}}}\right] = \mathbf{345.6\ m}$

38. $d = 86\ \cancel{\text{stories}}\left[\frac{14\ \cancel{\text{ft}}}{\cancel{\text{story}}}\right]\left[\frac{1\ \text{step}}{\frac{9}{12}\cancel{\text{ft}}}\right] = 1605\ \text{steps}$

$\upsilon = \frac{d}{t} \Rightarrow t = \frac{d}{\upsilon} = \frac{1605\ \text{steps}}{\frac{2\ \text{steps}}{\text{second}}} = 802.5\ \cancel{\text{seconds}}\left[\frac{1\ \text{minute}}{60\ \cancel{\text{seconds}}}\right] = \mathbf{13.38\ minutes}$

39. $d = (86\ \cancel{\text{stories}})\left[\frac{14\ \text{ft}}{\cancel{\text{story}}}\right] = 1204\ \cancel{\text{ft}}\left[\frac{1\ \text{mile}}{5{,}280\ \cancel{\text{ft}}}\right] = 0.228\ \text{miles}$

$\frac{\text{min}}{\text{mile}} = \frac{10.7833\ \text{min}}{0.228\ \text{miles}} = \mathbf{47.30\ min/mile}$

40. $\frac{5\ \text{min}}{\text{mile}} \Rightarrow \frac{1\ \cancel{\text{mile}}}{5\ \text{min}}\left[\frac{5{,}280\ \text{ft}}{1\ \cancel{\text{mile}}}\right] = \frac{1056\ \text{ft}}{\text{minute}}$, distance $= 86\ \cancel{\text{stories}}\left[\frac{14\ \text{ft}}{\cancel{\text{story}}}\right] = 1204\ \text{ft}$

$\upsilon = \frac{d}{t} \Rightarrow t = \frac{d}{\upsilon} = \frac{1204\ \text{ft}}{1056\frac{\text{ft}}{\text{min}}} = \mathbf{1.14\ minutes}$

41. a. $5\cancel{J}\left[\frac{1\ \text{Btu}}{1054.35\cancel{J}}\right] = \mathbf{4.74 \times 10^{-3}\ Btu}$

b. $24\ \cancel{\text{ounces}}\left[\frac{1\ \cancel{\text{gallon}}}{128\ \cancel{\text{ounces}}}\right]\left[\frac{1\ \text{m}^3}{264.172\ \cancel{\text{gallons}}}\right] = \mathbf{7.1 \times 10^{-4}\ m^3}$

c. $1.4\ \cancel{\text{days}}\left[\frac{86{,}400\ \text{s}}{1\ \cancel{\text{day}}}\right] = \mathbf{1.21 \times 10^{5}\ s}$

d. $1\ \cancel{\text{m}^3}\left[\frac{264.172\ \cancel{\text{gallons}}}{1\ \cancel{\text{m}^3}}\right]\left[\frac{8\ \text{pints}}{1\ \cancel{\text{gallon}}}\right] = \mathbf{2113.38\ pints}$

42. $6(4 + 8) = \mathbf{72}$

43. $(20 + 32)/4 = \mathbf{13}$

44. $\sqrt{(8^2 + 12^2)} = \mathbf{14.42}$

45. MODE = DEGREES: $\cos 50° = \mathbf{0.64}$

46. MODE = DEGREES: $\tan^{-1}(3/4) = \mathbf{36.87°}$

47. $\sqrt{\left(400/(6^2+10)\right)}$ = **2.95**

48. **205×10^{-6}**

49. **1.20×10^{12}**

50. $6.667 \times 10^6 + 0.5 \times 10^6$ = **7.17×10^6**

Chapter 2

1. –

2. a. $F = k\dfrac{Q_1Q_2}{r^2} = \dfrac{(9\times10^9)(1\text{ C})(2\text{ C})}{(1\text{ m})^2} = \mathbf{18\times10^9\ N}$

   b. $F = k\dfrac{Q_1Q_2}{r^2} = \dfrac{(9\times10^9)(1\text{ C})(2\text{ C})}{(3\text{ m})^2} = \mathbf{2\times10^9\ N}$

   c. $F = k\dfrac{Q_1Q_2}{r^2} = \dfrac{(9\times10^9)(1\text{ C})(2\text{ C})}{(10\text{ m})^2} = \mathbf{0.18\times10^9\ N}$

   d. Exponentially, $\dfrac{r_3}{r_1} = \dfrac{10\text{ m}}{1\text{ m}} = 10$ while $\dfrac{F_1}{F_2} = \dfrac{18\times10^9\text{ N}}{0.18\times10^9\text{ N}} = \mathbf{100}$

3. a. $r = 1$ mi:

   $$1\text{ mi}\left[\frac{5280\text{ ft}}{1\text{ mi}}\right]\left[\frac{12\text{ in.}}{1\text{ ft}}\right]\left[\frac{1\text{ m}}{39.37\text{ in.}}\right] = 1609.35\text{ m}$$

   $$F = \frac{kQ_1Q_2}{r^2} = \frac{(9\times10^9)(8\times10^{-6}\text{ C})(40\times10^{-6}\text{ C})}{(1609.35\text{ m})^2} = \frac{2880\times10^{-3}}{2.59\times10^6}$$

   $$= \mathbf{1.11\ \mu N}$$

   b. $r = 10$ ft:

   $$10\text{ ft}\left[\frac{12\text{ in.}}{1\text{ ft}}\right]\left[\frac{1\text{ m}}{39.37\text{ in.}}\right] = 3.05\text{ m}$$

   $$F = \frac{kQ_1Q_2}{r^2} = \frac{2880\times10^{-3}}{(3.05\text{ m})^2} = \frac{2880\times10^{-3}}{9.30} = \mathbf{0.31\ N}$$

   c. $$\frac{1\text{ in.}}{16}\left[\frac{1\text{ m}}{39.37\text{ in.}}\right] = 1.59\text{ mm}$$

   $$F = \frac{kQ_1Q_2}{r^2} = \frac{2880\times10^{-3}}{(1.59\times10^{-3}\text{ m})^2} = \frac{2880\times10^{-3}}{2.53\times10^{-6}} = 1138.34\times10^3\text{ N}$$

   $$= \mathbf{1138.34\ kN}$$

4. –

5. $F = \dfrac{kQ_1Q_2}{r^2} \Rightarrow r = \sqrt{\dfrac{kQ_1Q_2}{F}} = \sqrt{\dfrac{(9\times10^9)(20\times10^{-6})^2}{3.6\times10^4}} = \mathbf{10\ mm}$

6. $F = \dfrac{kQ_1Q_2}{r^2} \Rightarrow 1.8 = \dfrac{kQ_1Q_2}{(2\text{ m})^2} \Rightarrow kQ_1Q_2 = 4(1.8) = 7.2$

a. $F = \dfrac{kQ_1Q_2}{r^2} = \dfrac{7.2}{(10)^2} = \mathbf{72\ mN}$

b. $Q_1/Q_2 = 1/2 \Rightarrow Q_2 = 2Q_1$

$7.2 = kQ_1Q_2 = (9 \times 10^9)(Q_1)(2Q_1) = 9 \times 10^9\left(2Q_1^2\right)$

$\dfrac{7.2}{18\times10^9} = Q_1^2 \Rightarrow Q_1 = \sqrt{\dfrac{7.2}{18\times10^9}} = \mathbf{20\ \mu C}$

$Q_2 = 2Q_1 = 2(2 \times 10^{-5}\text{ C}) = \mathbf{40\ \mu C}$

7. $V = \dfrac{W}{Q} = \dfrac{1.2\text{ J}}{0.4\text{ mC}} = \mathbf{3\ kV}$

8. $W = VQ = (60\text{ V})(8\text{ mC}) = \mathbf{0.48\ J}$

9. $Q = \dfrac{W}{V} = \dfrac{96\text{ J}}{16\text{ V}} = \mathbf{6\ C}$

10. $Q = \dfrac{W}{V} = \dfrac{72\text{ J}}{9\text{ V}} = \mathbf{8\ C}$

11. $I = \dfrac{Q}{t} = \dfrac{12\text{ mC}}{2.8\text{ s}} = \mathbf{4.29\ mA}$

12. $I = \dfrac{Q}{t} = \dfrac{312\text{ C}}{(2)(60\text{ s})} = \mathbf{2.60\ A}$

13. $Q = It = (40\text{ mA})(0.8)(60\text{ s}) = \mathbf{1.92\ C}$

14. $Q = It = (250\text{ mA})(1.2)(60\text{ s}) = \mathbf{18.0\ C}$

15. $t = \dfrac{Q}{I} = \dfrac{6\text{ mC}}{2\text{ mA}} = \mathbf{3\ s}$

16. $21.847 \times 10^{18}\ \cancel{\text{electrons}}\left[\dfrac{1\text{ C}}{6.242\times10^{18}\ \cancel{\text{electrons}}}\right] = 3.5\text{ C}$

$I = \dfrac{Q}{t} = \dfrac{3.5\text{ C}}{12\text{ s}} = 0.29\text{ A}$

17. $Q = It = (4\text{ mA})(90\text{ s}) = 360\text{ mC}$

$360\ \text{m}\cancel{\text{C}}\left[\dfrac{6.242\times10^{18}\text{ electrons}}{1\ \cancel{\text{C}}}\right] = \mathbf{2.25 \times 10^{18}\ electrons}$

18. $I = \dfrac{Q}{t} = \dfrac{86\text{ C}}{(1.2)(60\text{ s})} = 1.194\text{ A} > 1\text{ A}$ **(yes)**

19. $0.84 \times 10^{16}\ \cancel{\text{electrons}}\left[\dfrac{1\text{ C}}{6.242\times10^{18}\ \cancel{\text{electrons}}}\right] = 1.346\text{ mC}$

$I = \dfrac{Q}{t} = \dfrac{1.346\text{ mC}}{60\text{ ms}} =$ **22.43 mA**

20. a. $Q = It = (2\text{ mA})(0.01\ \mu\text{s}) = 2 \times 10^{-11}\text{ C}$

$2 \times 10^{-11}\ \cancel{\text{C}}\left[\dfrac{6.242\times10^{18}\ \cancel{\text{electrons}}}{1\ \cancel{\text{C}}}\right]\left[\dfrac{1\ \cancel{¢}}{\cancel{\text{electron}}}\right]$

$= 1.25 \times 10^{8}\ ¢ = \$1.25 \times 10^{6} =$ **1.25 million**

b. $Q = It = (100\ \mu\text{A})(1.5\text{ ns}) = 1.5 \times 10^{-13}\text{ C}$

$1.5 \times 10^{-13}\ \cancel{\text{C}}\left[\dfrac{6.242\times10^{18}\ \cancel{\text{electrons}}}{1\ \cancel{\text{C}}}\right]\left[\dfrac{\$1}{\cancel{\text{electron}}}\right] =$ **0.94 million**

(a) > (b)

21. $Q = It = (200 \times 10^{-3}\text{ A})(30\text{ s}) = 6\text{ C}$

$V = \dfrac{W}{Q} = \dfrac{40\text{ J}}{6\text{ C}} =$ **6.67 V**

22. $Q = It = \left[\dfrac{420\text{ C}}{\cancel{\text{min}}}\right](0.5\ \cancel{\text{min}}) = 210\text{ C}$

$V = \dfrac{W}{Q} = \dfrac{742\text{ J}}{210\text{ C}} =$ **3.53 V**

23. $Q = \dfrac{W}{V} = \dfrac{0.4\text{ J}}{24\text{ V}} = 0.0167\text{ C}$

$I = \dfrac{Q}{t} = \dfrac{0.0167\text{ C}}{5\times10^{-3}\text{ s}} =$ **3.34 A**

24. $I = \dfrac{\text{Ah rating}}{t(\text{hours})} = \dfrac{200\text{ Ah}}{40\text{ h}} =$ **5 A**

25. Ah = (0.8 A)(75 h) = **60.0 Ah**

26. $t(\text{hours}) = \dfrac{\text{Ah rating}}{I} = \dfrac{32\text{ Ah}}{1.28\text{ A}} =$ **25 h**