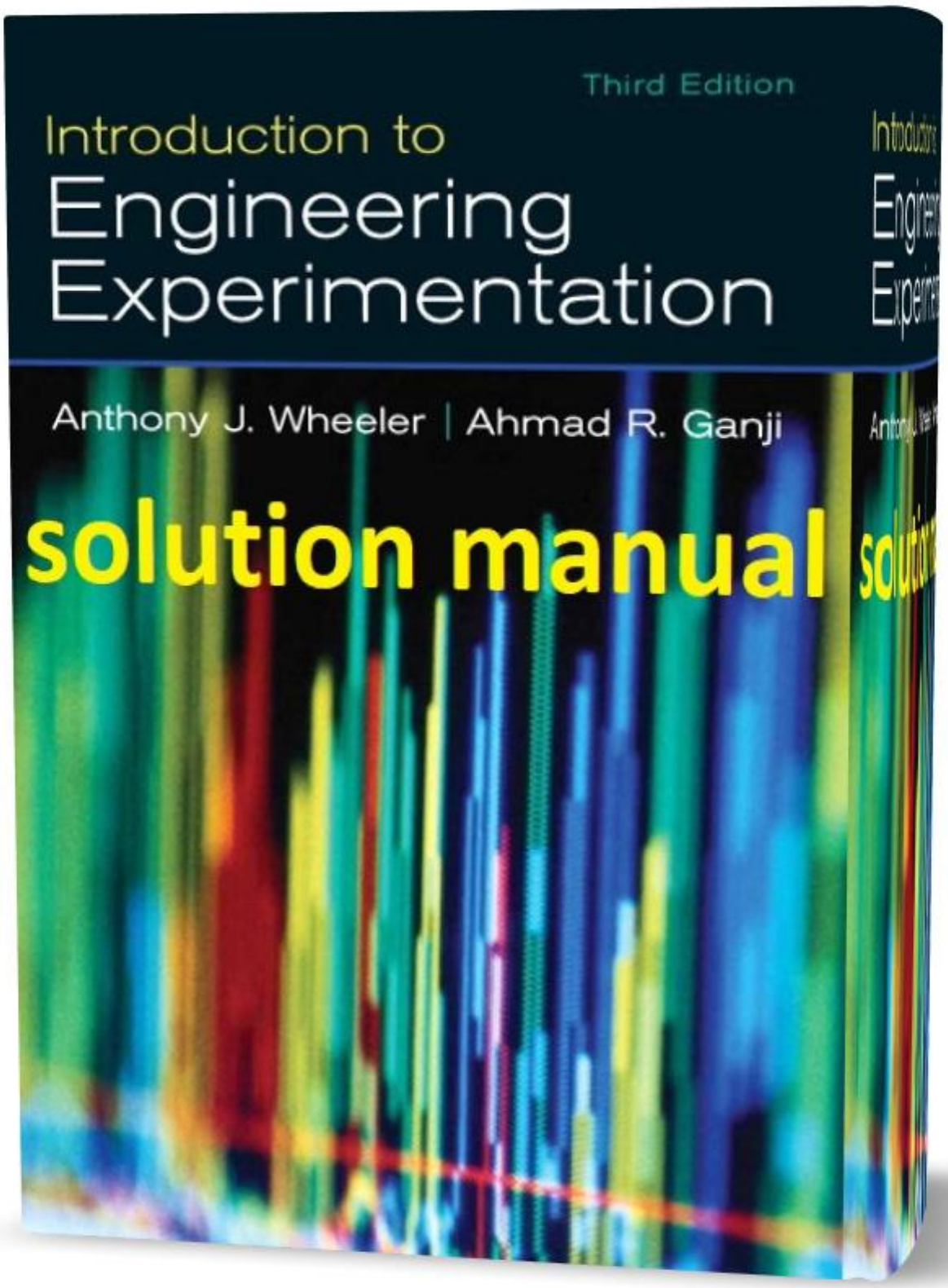

CHAPTER 1

1.1 (a) The weight of a person is 175 pounds which is equivalent to 778 Newtons.

$175lbf * \frac{4.4482N}{1lbf}$ = 778 Newtons

(b) The magnetic force of 1,200 dynes is equivalent to 0.0027 pounds or 0.012 Newtons.

$1200dyn * \frac{10^{-5}N}{1dyn}$ = 0.012 Newtons

$1200dyn * \frac{10^{-5}N}{1dyn} * \frac{1lbf}{4.4482N}$ = 0.0027 pounds

(c) The force exerted by the spring is 10 Newtons which is equivalent to 1,000,000 dynes or 2.248 pounds

$10N * \frac{1dyn}{10^{-5}N}$ = 1,000,000 dyne

$10N * \frac{1lbf}{4.4482N}$ = 2.248 pounds

1.2 (a) The tire pressure is 30 psig which is equivalent to 2.069 bars or 2.041 atm.
Note: 1 psig is considered to be = 1 psi

$30psig * \frac{1atm}{14.696psi}$ = 2.041 atm

$30psig * \frac{6.895kPa}{1psi} * \frac{1bar}{100kPa}$ = 2.069 bars

(b) The compressed air at 10 bars is equivalent to 145 psig or 9.87 atm or 295.3 inches of mercury or 102 meters of water

$10bars * \frac{100kPa}{1bar} * \frac{1psi}{6.895kPa}$ = 145 psi

$10bars * \frac{100kPa}{1bar} * \frac{1psi}{6.895kPa} * \frac{1atm}{14.696psi}$ = 9.87 atm

$10bars * \frac{100kPa}{1bar} * \frac{1psi}{6.895kPa} * \frac{1atm}{14.696psi} * \frac{76cmHG}{1atm} * \frac{1in}{2.54cm}$ = 295.3 in of Hg

$10bars * \frac{100kPa}{1bar} * \frac{1psi}{6.895kPa} * \frac{1atm}{14.696psi} * \frac{1033.2cmWater}{1atm} * \frac{1m}{100cm}$ = 102 meters water

(c) 50 cm of water is equivalent to 0.0490 bars or 0.711 psi or 1.45 inches of mercury

$50cmWater * \frac{1atm}{1033.2cmWater} * \frac{101.325kPa}{1atm} * \frac{1bar}{100kPa}$ = 0.0490 bars

$50cmWater * \frac{1atm}{1033.2cmWater} * \frac{101.325kPa}{1atm} * \frac{1psi}{6.895kPa}$ * = 0.711 psi

$50cmWater * \frac{1atm}{1033.2cmWater} * \frac{76cmHG}{1atm} * \frac{1in}{2.54cm}$ = 1.45 in of Hg

1.3 (a) The household energy use of 750 kWh is equivalent to 2,559,241.71 Btu or 645,007 kCal or 2,700,000,000 joules

$$750kWh * \frac{3600kJ}{1kWh} * \frac{1000J}{1kJ} * \frac{1Btu}{1055J} = 2{,}559{,}241.71 \text{ Btu}$$

$$750kWh * \frac{3600kJ}{1kWh} * \frac{1000J}{1kJ} * \frac{1cal}{4.186J} * \frac{1kcal}{1000cal} = 645{,}007 \text{ kcal}$$

$$750kWh * \frac{3600kJ}{1kWh} * \frac{1000J}{1kJ} = 2{,}700{,}000{,}000 \text{ J}$$

(b) The gas water heater uses 50,000 Btu or 52,750,000 joules or 12,601.5 kcal or 38,908,386 ft.lbf

$$50000Btu * \frac{1055J}{1Btu} = 52{,}750{,}000 \text{ joules}$$

$$50000Btu * \frac{1055J}{1Btu} * \frac{1cal}{4.186J} * \frac{1kcal}{1000cal} = 12{,}601.5 \text{ kcal}$$

$$50000Btu * \frac{1ft.lbf}{0.00128507Btu} = 38{,}908{,}386 \text{ ft.lbf}$$

(c) The amount of heat required is 250 kCal which is equivalent to 992 Btu or 250,000 Cal or 1,046,500 joules

$$250kcal * \frac{1000cal}{1kcal} * \frac{4.186J}{1cal} * \frac{1Btu}{1055J} = 992 \text{ Btu}$$

$$250kcal * \frac{1000cal}{1kcal} = 250{,}000 \text{ cal}$$

$$250kcal * \frac{1000cal}{1kcal} * \frac{4.186J}{1cal} = 1{,}046{,}500 \text{ J}$$

1.4 (a) The automobile rating of 150 hp is equivalent to 112 kW or 82,500 ft.lbf/sec or 106.02 Btu/sec

$$150hp * \frac{745.7W}{1hp} * \frac{1kW}{1000W} = 112 \text{ kW}$$

$$150hp * \frac{550\frac{ft.lbf}{s}}{1hp} = 82{,}500 \text{ ft.lbf/sec}$$

$$150hp * \frac{745.7W}{1hp} * \frac{1\frac{Btu}{s}}{1055.04W} = 106.02 \text{ Btu/sec}$$

(b) The truck rating of 400 kW is equivalent to 536 hp or 295,025 ft.lbf/sec or 379 Btu/sec

$$400kW * \frac{1000W}{1kW} * \frac{1hp}{745.7W} = 536 \text{ hp}$$

$$400kW * \frac{1000W}{1kW} * \frac{1hp}{745.7W} * \frac{550\frac{ft.lbf}{s}}{1hp} = 295{,}025 \text{ ft.lbf/sec}$$

$$400kW * \frac{1000W}{1kW} * \frac{1\frac{Btu}{s}}{1055.04W} = 379 \text{ Btu/sec}$$

(c) The water heater rating of 40,000 Btu/hr is equivalent to 11.72 kW

$$40000\frac{Btu}{hr} * \frac{0.293W}{1\frac{Btu}{hr}} * \frac{1kW}{1000W} = 11.72 \text{ kW}$$

1.5 **(a)** 50 °F is equivalent to 10 °C

$(\frac{5}{9})(50 - 32) = 10\ ^{o}C$

(b) 150 °C is equivalent to 302 °F

$(\frac{9}{5})(150\ ^{o}C) + 32 = 302\ ^{o}F$

(c) The water temperature increase of 40 °C is equivalent to a change of 40 K or 72 °F or 72 °R

$(40\ ^{o}C) * \frac{1°K}{1°C} = 40\ K$

$(40\ ^{o}C) * \frac{1.8°F}{1°C} = 72\ ^{o}F$

$(40\ ^{o}C) * \frac{1.8°R}{1°C} = 72\ ^{o}R$

(d) The air temperature change of 30 °F is equivalent to a change of 16.7 K or 16.7 °C or 30 °R

$(30\ ^{o}F) * \frac{0.556°K}{1°F} = 16.7\ K$

$(30\ ^{o}F) * \frac{0.556°C}{1°F} = 16.7\ ^{o}C$

$(30\ ^{o}F) * \frac{1°R}{1°F} = 30\ ^{o}R$

1.6 **(a)** 4 gallons is equivalent to 15.1 liter or 15,142 cm^3 or 0.535 ft^3

$$4gal * \frac{0.0037854m^3}{1gal} * \frac{1Liter}{10^{-3}m^3} = 15.1 \text{ liter}$$

$$4gal * \frac{0.0037854m^3}{1gal} * \frac{1cm^3}{10^{-6}m^3} = 15{,}142 \text{ cm}^3$$

$$4gal * \frac{0.0037854}{1gal} * \frac{1ft^3}{0.02832m^3} = 0.535 \text{ ft}^3$$

(b) 10 liters is equivalent to 2.64 gallons or 10,000 cm^3 or 0.353 ft^3

$$10Liter * \frac{10^{-3}m^3}{1liter} * \frac{1gal}{0.0037854m^3} = 2.64 \text{ gallons}$$

$$10Liter * \frac{10^{-3}m^3}{1liter} * \frac{1cm^3}{10^{-6}m^3} = 10{,}000 \text{ cm}^3$$

$$10Liter * \frac{10^{-3}m^3}{1liter} * \frac{1ft^3}{0.02832m^3} = 0.353 \text{ ft}^3$$

(c) 5 ft^3 is equivalent to 37.4 gallons or 141,600 cm^3 or 142 liters

$$5ft^3 * \frac{1gal}{0.13368ft^3} = 37.4 \text{ gallons}$$

$$5ft^3 * \frac{0.02832m^3}{1ft^3} * \frac{1cm^3}{10^{-6}m^3} = 141{,}600 \text{ cm}^3$$

$$5ft^3 * \frac{0.02832m^3}{1ft^3} * \frac{1liter}{10^{-3}m^3} = 142 \text{ liters}$$

1.7 The air gas constant of 53.34 ft.lbf/lbm.^{o}R is equivalent to 0.0685 Btu/lbm.^{o}R or 287 joules/kg.K or 0.0686 kcal/kg.K

$$53.34\frac{ft.lbf}{lbm°R} * \frac{0.00128507Btu}{1ft.lbf} = 0.0685 \text{ Btu/lbm.}^o\text{R}$$

$$53.34\frac{ft.lbf}{lbm°R} * \frac{0.00128507Btu}{1ft.lbf} * \frac{1055J}{1Btu} * \frac{1lbm}{0.4536kg} * \frac{1°R}{\frac{5}{9}°K} = 287 \text{ J/kg.K}$$

$$53.34\frac{ft.lbf}{lbm°R} * \frac{0.00128507Btu}{1ft.lbf} * \frac{1055J}{1Btu} * \frac{1cal}{4.186J} * \frac{1kcal}{1000cal} * \frac{1lbm}{0.4536kg} * \frac{1°R}{\frac{5}{9}°K} =$$

$$0.0685\frac{kcal}{kg°K}$$

1.8 The universal gas constant is 1.986 Btu/lb mole.^oR which is equivalent to 1.986 kCal.kg mole.K or 1,545 ft.lbf/lb mole.^oR or 8,314 joules/kg mole.K

$$1.986\frac{Btu}{lbmole°R} * \frac{1055J}{1Btu} * \frac{1cal}{4.186J} * \frac{1kcal}{1000cal} * \frac{1lbm}{0.4536kg} * \frac{1°R}{\frac{5}{9}°K} = 1.986 \text{ kCal.kg mole.K}$$

$$1.986\frac{Btu}{lbmole°R} * \frac{1ft.lbf}{0.00128507Btu} = 1{,}545 \text{ ft.lbf/lb mole.}^oR$$

$$1.986\frac{Btu}{lbmole°R} * \frac{1055J}{1Btu} * \frac{1lbm}{0.4536kg} * \frac{1°R}{\frac{5}{9}°K} = 8{,}314 \text{ J/kg mole.K}$$

1.9 The thermal conductivity is 200 W/m.^{o}C or 116 Btu/hr/ft/^{o}F or 0.048 kcal/sec.m.^{o}C

$$200\frac{W}{m°C} * \frac{1\frac{Btu}{hr.ft.°F}}{1.7307\frac{W}{m°C}} = 116 \text{ Btu/hr/ft/}^oF$$

$$200\frac{W}{m°C} * \frac{1\frac{Btu}{s}}{1055.04W} * \frac{1055J}{1Btu} * \frac{1cal}{4.186J} * \frac{1kcal}{1000cal} = 0.048 \text{ kcal/sec.m.}^oC$$

1.10 The thermal conductivity is 50 Btu/hr.ft.^{o}F or 86.54 W/m.^{o}C or 20.7 Cal/sec.m.^{o}C

$$50\frac{Btu}{hr.ft°F} * \frac{1.7307\frac{W}{m°C}}{1\frac{Btu}{hr.ft°F}} = 86.54 \text{ W/m.}^oC$$

$$50\frac{Btu}{hr.ft°F} * \frac{1.7307\frac{W}{m°C}}{1\frac{Btu}{hr.ft°F}} * \frac{1\frac{Btu}{s}}{1055.04W} * \frac{1055J}{1Btu} * \frac{1cal}{4.186J} = 20.7 \text{ cal/sec.m.}^oC$$