1–1. Round off the following numbers to three significant figures: (a) 4.65735 m, (b) 55.578 s, (c) 4555 N, and (d) 2768 kg.

a) 4.66 m b) 55.6 s c) 4.56 kN d) 2.77 Mg **Ans**

1–2. Represent each of the following combinations of units in the correct SI form using an appropriate prefix: (a) μMN, (b) N/μm, (c) MN/ks^2, and (d) kN/ms.

(a) $\mu\text{MN} = 10^{-6}(10^6)\ \text{N} = \text{N}$ **Ans**

(b) $\dfrac{\text{N}}{\mu\text{m}} = \dfrac{\text{N}}{10^{-6}\ \text{m}} = 10^6\ \text{N/m} = \text{MN/m}$ **Ans**

(c) $\dfrac{\text{MN}}{\text{ks}^2} = \dfrac{10^6\ \text{N}}{(10^3)^2\ \text{s}^2} = \text{N/s}^2$ **Ans**

(d) $\dfrac{\text{kN}}{\text{ms}} = \dfrac{10^3\ \text{N}}{10^{-3}\ \text{s}} = 10^6\ \dfrac{\text{N}}{\text{s}} = \text{MN/s}$ **Ans**

1–3. Represent each of the following quantities in the correct SI form using an appropriate prefix: (a) 0.000431 kg, (b) 35.3(10^3) N, and (c) 0.00532 km.

a) $0.000431\ \text{kg} = 0.000431(10^3)\ \text{g} = 0.431\ \text{g}$ **Ans**

b) $35.3(10^3)\ \text{N} = 35.3\ \text{kN}$ **Ans**

c) $0.00532\ \text{km} = 0.00532(10^3)\ \text{m} = 5.32\ \text{m}$ **Ans**

***1–4.** Represent each of the following combinations of units in the correct SI form: (a) Mg/ms, (b) N/mm, and (c) mN/(kg $\cdot$ μs).

(a) $\dfrac{\text{Mg}}{\text{ms}} = \dfrac{10^3\ \text{kg}}{10^{-3}\ \text{s}} = 10^6\ \text{kg/s} = \text{Gg/s}$ **Ans**

(b) $\dfrac{\text{N}}{\text{mm}} = \dfrac{1\ \text{N}}{10^{-3}\ \text{m}} = 10^3\ \text{N/m} = \text{kN/m}$ **Ans**

(c) $\dfrac{\text{mN}}{(\text{kg}\cdot\mu\text{s})} = \dfrac{10^{-3}\ \text{N}}{10^{-6}\ \text{kg}\cdot\text{s}} = \text{kN/(kg}\cdot\text{s)}$ **Ans**

1–5. Represent each of the following combinations of units in the correct SI form using an appropriate prefix: (a) kN/μs, (b) Mg/mN, and (c) MN/(kg · ms).

a) $\text{kN}/\mu\text{s} = \dfrac{(10^3)\ \text{N}}{(10^{-6})\ \text{s}} = \dfrac{(10^9)\ \text{N}}{\text{s}} = \text{GN/s}$ **Ans**

b) $\text{Mg/mN} = \dfrac{(10^6)\ \text{g}}{(10^{-3})\ \text{N}} = \dfrac{(10^9)\ \text{g}}{\text{N}} = \text{Gg/N}$ **Ans**

c) $\text{MN}/(\text{kg}\cdot\text{ms}) = \dfrac{(10^6)\ \text{N}}{\text{kg}\cdot(10^{-3})\ \text{s}} = \dfrac{(10^9)\ \text{N}}{\text{kg}\cdot\text{s}} = \text{GN}/(\text{kg}\cdot\text{s})$ **Ans**

1–6. Represent each of the following to three significant figures and express each answer in SI units using an appropriate prefix: (a) 45 320 kN, (b) $568(10^5)$ mm, and (c) 0.005 63 mg.

(a) $45\ 320\ \text{kN} = 45.3(10^6)\ \text{N} = 45.3\ \text{MN}$ **Ans**

(b) $568\ (10^5)\ \text{mm} = 56.8(10^6)(10^{-3})\ \text{m} = 56.8\ \text{km}$ **Ans**

(c) $0.005\ 63\ \text{mg} = 5.63(10^{-6})\ \text{g} = 5.63\ \mu\text{g}$ **Ans**

1–7. A rocket has a mass of $250(10^3)$ slugs on earth. Specify (a) its mass in SI units and (b) its weight in SI units. If the rocket is on the moon, where the acceleration due to gravity is $g_m = 5.30\ \text{ft/s}^2$, determine to three significant figures (c) its weight in SI units and (d) its mass in SI units.

FPO

***1–8.** If a car is traveling at 55 mi/h, determine its speed in kilometers per hour and meters per second.

FPO

1–9. The *pascal* (Pa) is actually a very small unit of pressure. To show this, convert 1 Pa = 1 N/m^2 to lb/ft^2. Atmospheric pressure at sea level is 14.7 lb/in^2. How many pascals is this?

FPO

1–10. What is the weight in newtons of an object that has a mass of: (a) 10 kg, (b) 0.5 g, and (c) 4.50 Mg? Express the result to three significant figures. Use an appropriate prefix.

(a) $W = (9.81\ \text{m/s}^2)(10\ \text{kg}) = 98.1\ \text{N}$ **Ans**

(b) $W = (9.81\ \text{m/s}^2)(0.5\ \text{g})(10^{-3}\ \text{kg/g}) = 4.90\ \text{mN}$ **Ans**

(c) $W = (9.81\ \text{m/s}^2)(4.5\ \text{Mg})(10^3\ \text{kg/Mg}) = 44.1\ \text{kN}$ **Ans**

1–11. Evaluate each of the following to three significant figures and express each answer in SI units using an appropriate prefix: (a) 354 mg(45 km)/(0.0356 kN), (b) (0.004 53 Mg)(201 ms), and (c) 435 MN/23.2 mm.

a) $$(354\ \text{mg})(45\ \text{km})/0.0356\ \text{kN} = \frac{[354(10^{-3})\ \text{g}][45(10^3)\ \text{m}]}{0.0356(10^3)\ \text{N}} = \frac{0.447(10^3)\ \text{g}\cdot\text{m}}{\text{N}} = 0.447\ \text{kg}\cdot\text{m/N}$$ **Ans**

b) $$(0.00453\ \text{Mg})(201\ \text{ms}) = [4.53(10^{-3})(10^3)\ \text{kg}][201(10^{-3})\ \text{s}] = 0.911\ \text{kg}\cdot\text{s}$$ **Ans**

c) $$435\ \text{MN}/23.2\ \text{mm} = \frac{435(10^6)\ \text{N}}{23.2(10^{-3})\ \text{m}} = \frac{18.75(10^9)\ \text{N}}{\text{m}} = 18.8\ \text{GN/m}$$ **Ans**

***1–12.** The specific weight (wt./vol.) of brass is 520 lb/ft^3. Determine its density (mass/vol.) in SI units. Use an appropriate prefix.

$$520\ \text{lb/ft}^3 = \left(\frac{520\ \text{lb}}{\text{ft}^3}\right)\left(\frac{\text{ft}}{0.3048\ \text{m}}\right)^3\left(\frac{4.448\ \text{N}}{1\ \text{lb}}\right)\left(\frac{1\ \text{kg}}{9.81\ \text{N}}\right) = 8.33\ \text{Mg/m}^3$$ **Ans**

1–13. Convert each of the following to three significant figures: (a) 20 lb · ft to N · m, (b) 450 lb/ft^3 to kN/m^3, and (c) 15 ft/h to mm/s.

Using Table 1-2, we have

a) $20\ \text{lb}\cdot\text{ft} = (20\ \text{lb}\cdot\text{ft})\left(\frac{4.448\ \text{N}}{1\ \text{lb}}\right)\left(\frac{0.3048\ \text{m}}{1\ \text{ft}}\right)$

$= 27.1\ \text{N}\cdot\text{m}$ **Ans**

b) $450\ \text{lb/ft}^3 = \left(\frac{450\ \text{lb}}{\text{ft}^3}\right)\left(\frac{4.448\ \text{N}}{1\ \text{lb}}\right)\left(\frac{1\ \text{kN}}{1000\ \text{N}}\right)\left(\frac{1\ \text{ft}^3}{0.3048^3\ \text{m}^3}\right)$

$= 70.7\ \text{kN/m}^3$ **Ans**

c) $15\ \text{ft/h} = \left(\frac{15\ \text{ft}}{\text{h}}\right)\left(\frac{304.8\ \text{mm}}{1\ \text{ft}}\right)\left(\frac{1\ \text{h}}{3600\ \text{s}}\right) = 1.27\ \text{mm/s}$ **Ans**

1–14. The density (mass/volume) of aluminum is 5.26 slug/ft^3. Determine its density in SI units. Use an appropriate prefix.

$5.26\ \text{slug/ft}^3 = \left(\frac{5.26\ \text{slug}}{\text{ft}^3}\right)\left(\frac{\text{ft}}{0.3048\ \text{m}}\right)^3\left(\frac{14.59\ \text{kg}}{1\ \text{slug}}\right)$

$= 2.71\ \text{Mg/m}^3$ **Ans**

1–15. Water has a density of 1.94 slug/ft^3. What is the density expressed in SI units? Express the answer to three significant figures.

$\rho_w = \left(\frac{1.94\ \text{slug}}{\text{ft}^3}\right)\left(\frac{14.59\ \text{kg}}{1\ \text{slug}}\right)\left(\frac{1\ \text{ft}^3}{0.3048^3\ \text{m}^3}\right)$

$= 999.8\ \text{kg/m}^3 = 1.00\ \text{Mg/m}^3$ **Ans**

***1–16.** Two particles have a mass of 8 kg and 12 kg, respectively. If they are 800 mm apart, determine the force of gravity acting between them. Compare this result with the weight of each particle.

$F = G\frac{m_1 m_2}{r^2}$

Where $G = 66.73(10^{-12})\ \text{m}^3/(\text{kg}\cdot\text{s}^2)$

$F = 66.73(10^{-12})\left[\frac{8(12)}{(0.8)^2}\right] = 10.0(10^{-9})\ \text{N} = 10.0\ \text{nN}$ **Ans**

$W_1 = 8(9.81) = 78.5\ \text{N}$ **Ans**

$W_2 = 12(9.81) = 118\ \text{N}$ **Ans**

1–17. Determine the mass in kilograms of an object that has a weight of (a) 20 mN, (b) 150 kN, and (c) 60 MN. Express the answer to three significant figures.

Applying Eq. 1 – 3, we have

a) $m = \frac{W}{g} = \frac{20(10^{-3})\ \text{kg}\cdot\text{m/s}^2}{9.81\ \text{m/s}^2} = 2.04\ \text{g}$ **Ans**

b) $m = \frac{W}{g} = \frac{150(10^{3})\ \text{kg}\cdot\text{m/s}^2}{9.81\ \text{m/s}^2} = 15.3\ \text{Mg}$ **Ans**

c) $m = \frac{W}{g} = \frac{60(10^{6})\ \text{kg}\cdot\text{m/s}^2}{9.81\ \text{m/s}^2} = 6.12\ \text{Gg}$ **Ans**

1–18. Evaluate each of the following to three significant figures and express each answer in SI units using an appropriate prefix: (a) $(200\ \text{kN})^2$, (b) $(0.005\ \text{mm})^2$, and (c) $(400\ \text{m})^3$.

(a) $(200\ \text{kN})^2 = 40\,000(10^6)\ \text{N}^2 = 0.04(10^{12})\ \text{N}^2 = 0.04\ \text{MN}^2$ **Ans**

(b) $(0.005\ \text{mm})^2 = 25(10^{-12})\ \text{m}^2 = 25\ \mu\text{m}^2$ **Ans**

(c) $(400\ \text{m})^3 = 0.064(10^9)\ \text{m}^3 = 0.064\ \text{km}^3$ **Ans**

1–19. Using the base units of the SI system, show that Eq. 1–2 is a dimensionally homogeneous equation which gives F in newtons. Determine to three significant figures the gravitational force acting between two spheres that are touching each other. The mass of each sphere is 200 kg and the radius is 300 mm.

Using Eq. 1 – 2.

$$F = G\frac{m_1 m_2}{r^2}$$

$$\text{N} = \left(\frac{\text{m}^3}{\text{kg}\cdot\text{s}^2}\right)\left(\frac{\text{kg}\cdot\text{kg}}{\text{m}^2}\right) = \frac{\text{kg}\cdot\text{m}}{\text{s}^2} \qquad (Q.E.D.)$$

$$F = G\frac{m_1 m_2}{r^2}$$

$$= 66.73(10^{-12})\left[\frac{200(200)}{0.6^2}\right]$$

$$= 7.41(10^{-6})\ \text{N} = 7.41\ \mu\text{N} \qquad \textbf{Ans}$$

***1–20.** Evaluate each of the following to three significant figures and express each answer in SI units using an appropriate prefix: (a) (0.631 Mm)/(8.60 kg)^2, and (b) (35 mm)^2(48 kg)^3.

(a) $0.631\ \text{Mm}/(8.60\ \text{kg})^2 = \left(\dfrac{0.631(10^6)\ \text{m}}{(8.60)^2\ \text{kg}^2}\right) = \dfrac{8532\ \text{m}}{\text{kg}^2}$

$= 8.53(10^3)\,\text{m/kg}^2 = 8.53\ \text{km/kg}^2$ **Ans**

(b) $(35\ \text{mm})^2(48\ \text{kg})^3 = \left[35(10^{-3})\ \text{m}\right]^2(48\ \text{kg})^3 = 135\ \text{m}^2\text{kg}^3$ **Ans**

1–21. Evaluate (204 mm)(0.00457 kg)/(34.6 N) to three significant figures and express the answer in SI units using an appropriate prefix.

$(204\ \text{mm})(0.004\,57\ \text{kg})/(34.6\ \text{N}) = \left(\dfrac{\left[204(10^{-3})\ \text{m}\right]\left[4.57(10^{-3})\ \text{kg}\right]}{34.6\ \text{N}}\right)$

$= \left(\dfrac{26.9(10^{-6})\ \text{m}\cdot\text{kg}}{1\ \text{N}}\right)$

$= 26.9\ \mu\text{m}\cdot\text{kg/N}$ **Ans**