2.9 $\dfrac{50 \times 15 \times 2\ \text{m}^3}{} \left| \dfrac{35.3145\ \text{ft}^3}{1\ \text{m}^3} \right| \dfrac{85.3\ \text{lb}_m}{1\ \text{ft}^3} \left| \dfrac{32.174\ \text{ft}}{1\ \text{s}^2} \right| \dfrac{1\ \text{lb}_f}{32.174\ \text{lb}_m / \text{ft}\cdot\text{s}^2} = \underline{\underline{4.5 \times 10^6\ \text{lb}_f}}$

2.14 $1\ \text{lb}_f = 1\ \text{slug}\cdot\text{ft}/\text{s}^2 = 32.174\ \text{lb}_m\cdot\text{ft}/\text{s}^2 \Rightarrow 1\ \text{slug} = 32.174\ \text{lb}_m$

$\left\{ 1\ lb_f = 32.174\ lb_m \cdot ft/s^2 \right\}$

$1\ \text{poundal} = 1\ \text{lb}_m \cdot \text{ft}/\text{s}^2 = \dfrac{1}{32.174}\ \text{lb}_f$

(a) (i) On the earth:

$$M = \frac{175\ \text{lb}_m}{} \left| \frac{1\ \text{slug}}{32.174\ \text{lb}_m} \right. = \underline{\underline{5.44\ \text{slugs}}}$$

$$W = \frac{175\ \text{lb}_m}{} \left| \frac{32.174\ \text{ft}}{\text{s}^2} \right| \frac{1\ \text{poundal}}{1\ \text{lb}_m\cdot\text{ft}/\text{s}^2} = \underline{\underline{5.63 \times 10^3\ \text{poundals}}}$$

(ii) On the moon

$$M = \frac{175\ \text{lb}_m}{} \left| \frac{1\ \text{slug}}{32.174\ \text{lb}_m} \right. = \underline{\underline{5.44\ \text{slugs}}}$$

$$W = \frac{175\ \text{lb}_m}{} \left| \frac{32.174\ \text{ft}}{6\ \ \text{s}^2} \right| \frac{1\ \text{poundal}}{1\ \text{lb}_m\cdot\text{ft}/\text{s}^2} = \underline{\underline{938\ \text{poundals}}}$$

(b) $F = ma \Rightarrow a = F/m = \dfrac{355\ \text{poundals}}{25.0\ \text{slugs}} \left| \dfrac{1\ \text{lb}_m\cdot\text{ft}/\text{s}^2}{1\ \text{poundal}} \right| \dfrac{1\ \ \text{slug}}{32.174\ \text{lb}_m} \left| \dfrac{1\ \text{m}}{3.2808\ \text{ft}} \right.$

$= \underline{\underline{0.135\ \text{m}/\text{s}^2}}$

2.16 (a) $\approx (3)(9) = \underline{\underline{27}}$

$(2.7)(8.632) = \underline{\underline{23}}$

(b) $\approx \dfrac{40 \times 10^{-5}}{45} \approx \dfrac{5 \times 8 \times 10^{-5}}{5 \times 9} \approx \underline{\underline{1 \times 10^{-5}}}$

$(3.600 \times 10^{-4}) / 45 = \mathbf{8.0 \times 10^{-6}}$

(c) $\approx 2 + 125 = \underline{\underline{127}}$

$2.365 + 125.2 = \underline{\underline{127.5}}$

(d) $\approx 50 \times 10^3 - 1 \times 10^3 \approx 49 \times 10^3 \approx \underline{\underline{5 \times 10^4}}$

$4.753 \times 10^4 - 9 \times 10^2 = \underline{\underline{5 \times 10^4}}$

2.18 (a)

A: $R = 73.1 - 72.4 = \underline{\underline{0.7^\circ\text{C}}}$

$$\overline{X} = \frac{72.4 + 73.1 + 72.6 + 72.8 + 73.0}{5} = \underline{\underline{72.8^\circ\text{C}}}$$

$$s = \sqrt{\frac{(72.4-72.8)^2 + (73.1-72.8)^2 + (72.6-72.8)^2 + (72.8-72.8)^2 + (73.0-72.8)^2}{5-1}}$$

$= \underline{\underline{0.3^\circ\text{C}}}$

B: $R = 103.1 - 97.3 = \underline{\underline{5.8^\circ\text{C}}}$

$$\overline{X} = \frac{97.3 + 101.4 + 98.7 + 103.1 + 100.4}{5} = \underline{\underline{100.2^\circ\text{C}}}$$

$$s = \sqrt{\frac{(97.3-100.2)^2 + (101.4-100.2)^2 + (98.7-100.2)^2 + (103.1-100.2)^2 + (100.4-100.2)^2}{5-1}}$$

$= \underline{\underline{2.3^\circ\text{C}}}$

(b) Thermocouple B exhibits a higher degree of scatter and is also more accurate.

Q.5 $$Q = c\,\frac{\Delta P \cdot r^4}{\mu \cdot L}$$

(a) Dimensions: l: length, t: time, m: mass

$$Q : \frac{\text{Volume}}{\text{time}} : \frac{l^3}{t}$$

c: dimensionless

$$\Delta P : \frac{\text{force}}{\text{area}} : \frac{\text{mass} \cdot \text{acceleration}}{\text{area}} : \frac{m \cdot l/t^2}{l^2} : m/l\,t^2$$

$r : l$

$L : l$

$$\Rightarrow \frac{l^3}{t} = \frac{m/l\,t^2 \cdot l^4}{\mu \cdot l} \Rightarrow \mu : \frac{\frac{m}{l\,t^2} \cdot l^4 \cdot t}{l \cdot l^3}$$

$$: \frac{m}{l\,t} : \boxed{\frac{\text{mass}}{\text{length} \cdot \text{time}}}$$

(b) Units:

	mass	length	time
SI:	kg	m	s
CGS:	g	cm	s
American:	lb_m	ft	s

$$\Rightarrow \boxed{\begin{array}{l} \mu : \dfrac{kg}{m \cdot s} \text{ in SI units} \\ \\ \dfrac{g}{cm \cdot s} \text{ in CGS units} \\ \\ \dfrac{lb_m}{ft \cdot s} \text{ in American units} \end{array}}$$