1. A 17.5 kg mass experiences a 426 N force. Find the acceleration (f = ma) in units of:
   (a) m/s²
   \[ a = \frac{f}{m} = \frac{426 \text{ N}}{17.5 \text{ kg}} = 24.3 \text{ m/s}² \]
   (b) ft/s²
   \[ a = \frac{f}{m} = \frac{426 \text{ N}}{17.5 \text{ kg}} \times \frac{0.0254 \text{ m}}{1 \text{ in}} \times \frac{12 \text{ in}}{1 \text{ ft}} = 79.9 \text{ ft/s}² \]

2. A 17.5 slug mass experiences a 426 lbf force. Find the acceleration (f = ma) in units of:
   (a) ft/s²
   \[ a = \frac{f}{m} = \frac{426 \text{ lbf}}{17.5 \text{ slug}} = 24.3 \text{ ft/s}² \]
   (b) m/s²
   \[ a = \frac{f}{m} = \frac{426 \text{ lbf}}{17.5 \text{ slug}} \times \frac{0.0254 \text{ m}}{1 \text{ in}} \times \frac{12 \text{ in}}{1 \text{ ft}} = 7.42 \text{ m/s}² \]

3. A 17.5 lbm mass experiences a 426 lbf force. Find the acceleration (f = ma) in units of:
   (a) ft/s²
   \[ a = \frac{f}{m} = \frac{426 \text{ lbf}}{17.5 \text{ lbm}} = 783 \text{ ft/s}² \]
   (b) m/s²
   \[ a = \frac{f}{m} = \frac{426 \text{ lbf}}{17.5 \text{ lbm}} \times \frac{0.0254 \text{ m}}{1 \text{ in}} \times \frac{12 \text{ in}}{1 \text{ ft}} = 239 \text{ m/s}² \]

4. A bullet weighing 1.25 oz. Av. has a velocity of \( V = 1079 \text{ ft/s} \). Find the bullet’s kinetic energy, KE, where \( KE = \frac{mV^2}{2} \), in units of:
   (a) ft-lbf
   \[ KE = \frac{mV^2}{2} = \frac{1.25 \text{ oz} \times 1079 \text{ ft/s} \times 1079 \text{ ft/s}}{2 \times 32.178 \text{ ft-lbm}} = 1.41E+03 \text{ ft-lbf} \]
   (b) Btu
   \[ 1.41E+03 \text{ ft-lbf} \times \frac{1 \text{ Btu}}{778 \text{ ft-lbf}} = 1.82 \text{ Btu} \]
   (c) kJ
   \[ 1.82 \text{ Btu} \times \frac{1 \text{ kJ}}{0.94781 \text{ Btu}} = 1.92 \text{ kJ} \]

5. A rotating mass creates an unbalanced force given by the formula \( F = m r \omega^2 \). With mass, \( m = 0.306 \text{ lbm} \), radius, \( r = 0.567 \text{ inch} \), and speed, \( \omega = 1775 \text{ RPM} \), determine the unbalanced force \( F \) in units of:
   (a) lbf
   \[ \omega = \frac{1775 \text{ rev}}{\text{min}} \times \frac{2\pi \text{ rad}}{1 \text{ rev}} \times \frac{1 \text{ min}}{60 \text{ s}} = 185.9 \text{ rad/s} \]
   \[ F = m r \omega^2 = \frac{0.306 \text{ lbm} \times 0.567 \text{ in}}{1 \text{ s}} \times 185.9 \text{ rad} \times 185.9 \text{ rad} \times \frac{1 \text{ lbf-s}²}{1 \text{ ft}} \times \frac{0.0254 \text{ m}}{1 \text{ in}} = 15.5 \text{ lbf} \]
   (b) N
   \[ 15.5 \text{ lbf} \times \frac{1 \text{ N}}{4.448 \text{ lbf}} = 69.1 \text{ N} \]
6. Determine the volume of a cylinder with diameter 0.456±0.004 meters and height 0.789±0.006 meters. Using the uncertainties (tolerances) above, determine the
   • minimum possible volume,
   • nominal volume, and
   • maximum possible volume.
   • how many of the digits given for the nominal volume are “significant”?

   \[
   V_{\text{min}} = \frac{\pi d^2 h}{4} = \frac{\pi}{4} (0.452 \text{ m}) (0.783 \text{ m}) = 0.1256 \text{ m}^3
   \]

   \[
   V_{\text{nom}} = \frac{\pi d^2 h}{4} = \frac{\pi}{4} (0.456 \text{ m}) (0.789 \text{ m}) = 0.1289 \text{ m}^3
   \]

   \[
   V_{\text{max}} = \frac{\pi d^2 h}{4} = \frac{\pi}{4} (0.460 \text{ m}) (0.795 \text{ m}) = 0.1321 \text{ m}^3
   \]

   Nominal volume = 0.13 m³. Two “significant” digits – the 1 is not in question, but the 3 is.

7. A rectangular piece of metal measures 36.78 ± 0.12 inches by 77.45 ± 0.18 inches. A round hole of diameter 16.57 ± 0.12 inches is cut out near the center. Using the uncertainties (tolerances) given, find the
   • minimum possible area of the metal piece,
   • nominal area of the metal piece, and
   • maximum possible area of the metal piece.
   • how many of the digits given for the nominal area are “significant”?

   Rectangular Plate
   \[
   A_{\text{min}} = wh = 36.66 \text{ in} \times 77.27 \text{ in} = 2832.7 \text{ in}^2
   \]

   Circular Holes
   \[
   A_{\text{min}} = \frac{\pi d^2}{4} = \frac{\pi}{4} (16.45 \text{ in}) (16.45 \text{ in}) = 212.5 \text{ in}^2
   \]

   \[
   A_{\text{nom}} = wh = 36.78 \text{ in} \times 77.45 \text{ in} = 2848.6 \text{ in}^2
   \]

   \[
   A_{\text{nom}} = \frac{\pi d^2}{4} = \frac{\pi}{4} (16.57 \text{ in}) (16.57 \text{ in}) = 215.6 \text{ in}^2
   \]

   \[
   A_{\text{max}} = wh = 36.90 \text{ in} \times 77.63 \text{ in} = 2864.5 \text{ in}^2
   \]

   \[
   A_{\text{max}} = \frac{\pi d^2}{4} = \frac{\pi}{4} (16.69 \text{ in}) (16.69 \text{ in}) = 218.8 \text{ in}^2
   \]

   Minimum Area = 2832.7 in² - 218.8 in² = 2614 in²

   Nominal Area = 2848.6 in² - 215.6 in² = 2633 in²

   Maximum Area = 2864.5 in² - 212.5 in² = 2652 in²

   Nominal area = 2630 in². Three “significant digits” – the 2 and 6 are not in question, but the 3 is.