1. The pin at A can support a maximum force of 3.2 kN. What is the corresponding maximum load $L$, which can be supported by the bracket?

Solution:

\[ \Sigma M_B = 0; 160A_x - 240L = 0, A_x = \frac{3}{2}L \]

\[ \Sigma F_y = 0; A_y = L \]

\[ A = 3.2 = \sqrt{\left(\frac{3L}{2}\right)^2 + L^2} = L\sqrt{\frac{13}{2}} \]

\[ L = \frac{3.2(2)}{\sqrt{13}} = 1.775 \text{ kN} \]

Alternative solution:

The bracket is a three force body, meaning that the line of action of the reaction at A passes through the intersection of lines of action of $L$ and the reaction at B.

\[ \tan \theta = \frac{240}{160} \Rightarrow \theta \approx 56.31^\circ \]

\[ L_{max} = A_{max} \cos \theta = 3.2 \text{ kN} \cos 56.31^\circ = 1.775 \text{ kN} \]
2. A 60-kg heavy-duty table is tested by application of a 5-kN vertical force as shown. If instruments reveal the normal reaction force under leg A to be 2000 N, determine the normal forces at B, C, and D. Assume that the normal forces act at the outer corners of the legs.

Solution:

\[
\begin{align*}
\sum F_x &= 0 : 2000 + N_B + N_C + N_D - 5000 - 60(1.81) = 0 \\
\sum M_x &= 0 : N_B(1) + N_C(1) - 5000(0.4) - 60(1.81)(0.5) = 0 \\
\sum M_y &= 0 : -N_C(2) - N_B(2) + 5000(0.4) + 60(1.81)(1) = 0
\end{align*}
\]

Solution:

\[
\begin{align*}
N_B &= 1294 \text{ N} \\
N_C &= 1000 \text{ N} \\
N_D &= 1294 \text{ N}
\end{align*}
\]

3. Calculate the forces in members AB, BH, and BG. Members BF and CG are cables, which can support tension only.

Solution:

\[
\begin{align*}
\sum F_y &= 0 : -AH \sin 60^\circ + 4.67 = 0 \\
&\quad \therefore AH = 5.39 \text{ kN} \\
\sum F_x &= 0 : 5.31 \cos 60^\circ - AB = 0 \\
&\quad \therefore AB = 2.69 \text{ kN}
\end{align*}
\]

Assume CG goes slack, \( BG = 0 \)

Since BF is in tension, assumption that CG is slack is valid.
4. Locate the centroid of the shaded area shown.

Solution:

\[ A = \int x \, dy = \int_{0}^{5} \sqrt{5(y-5)} \, dy = \sqrt{5} \left[ -\frac{2}{3} (y-5)^{3/2} \right]_{0}^{5} = \frac{14}{3} \]

\[ \overline{x} = \frac{1}{A} \int_{0}^{5} x \, dy = \frac{1}{14/3} \int_{0}^{5} \frac{2}{3} (y-5)^{3/2} \, dy = \frac{75}{4} \left( \frac{1}{15} \right) = \frac{1.75}{3} \]

\[ \overline{y} = \frac{1}{A} \int_{0}^{5} y \, dy = \frac{1}{14/3} \int_{0}^{5} \frac{y}{15} \, dy = \frac{164}{15} \left( \frac{1}{15} \right) = \frac{2.34}{3} \]

5. Calculate the supporting reactions at A and B for the beam subjected to the two linearly distributed loads.

Solution:

\[ R_1 = 4 \times 16 = 64 \, \text{kN} \]
\[ R_2 = \frac{1}{2} \times 4 \times 4 = 8 \, \text{kN} \]
\[ R_3 = \frac{1}{2} \times 8 \times 3 = 12 \, \text{kN} \]
\[ R_4 = \frac{1}{2} \times 2 \times 3 = 6 \, \text{kN} \]

\[ \sum M_A = 0 : 7R_6 - 16(2) - 8 \left( \frac{3}{4} \right) - 12(4) = 0 \]
\[ -6(4+1.5) = 0 \]
\[ R_6 = 20.9 \, \text{kN} \]

\[ \sum F = 0 : \frac{R_A}{4} + 20.9 - (16+8+12+6) = 0 \]
\[ R_A = 21.1 \, \text{kN} \]