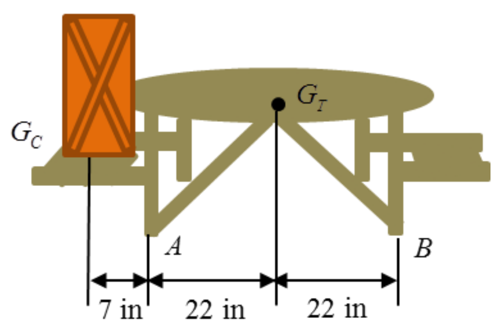
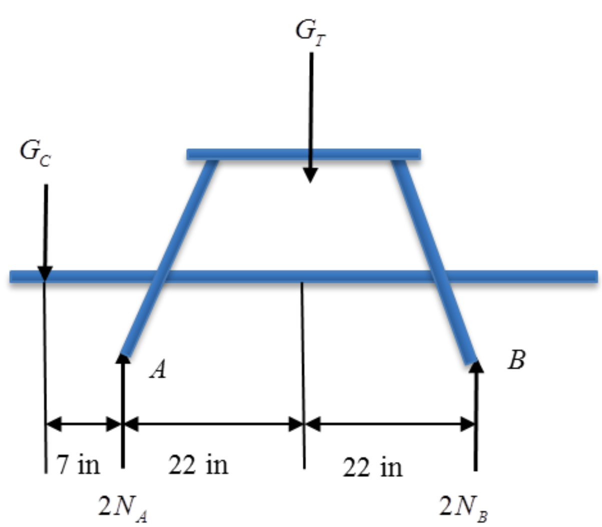
2. 1) A table has a weight of 55 lb with its center of gravity at G_T. A crate with a weight of W_C is put in the position shown, and the center of gravity is G_C. To keep the table from tipping over, what is the largest weight of the crate?

2) After the measurement of several crates, W_C is known to follow a normal distribution $W_C \sim (150, 20^2)$ lb, and due to manufacturing imprecision, W_T also follows a normal distribution $W_T \sim (75, 1^2)$ lb. What is the probability that the table will tip over? W_C and W_T are independently distributed.



Solution



1)

$$\sum M_A = 0$$

$$2N_B(44) + W_C(7) - W_T(22) = 0$$

We suppose $N_B = 0$ lb; this is the minimum vertical reaction force required to keep the table from tipping over. $W_T = 55$ lb . From above equation,

$$W_C = 172.86 \text{ lb}$$ **Ans.**

2)

$$2N_B(44) + W_C(7) - W_T(22) = 0$$

We know $W_T \sim (75, 1^2)$ lb and $W_C \sim (150, 20^2)$ lb, so we can find μ_{N_B} and σ_{N_B}

$$\mu_{N_B} = \frac{\mu_{W_T}(22) - \mu_{W_C}(7)}{2(44)} = 6.82 \text{ lb}$$

$$\sigma_{N_B} = \frac{1}{2(44)}\sqrt{22^2\sigma_{W_T}^2 + 7^2\sigma_{W_C}^2} = 1.61 \text{ lb}$$

If the table will tip over, $N_B < 0$. The probability is

$$P(N_B < 0) = \Phi\left(\frac{-\mu_{N_B}}{\sigma_{N_B}}\right) = 1 - \Phi\left(\frac{6.82}{1.61}\right) = 1.15\times10^{-5}$$ **Ans.**