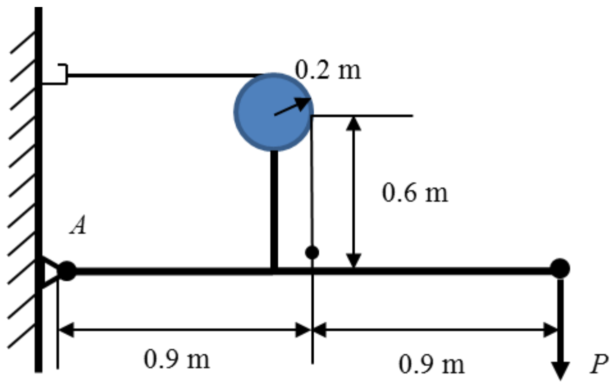
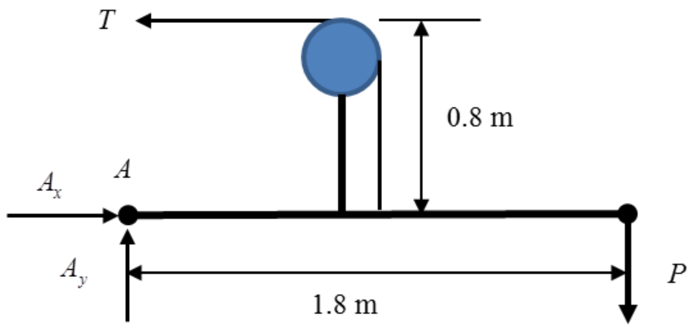
3. The distribution of force P is $N(1000, 50^2)$ N, and the strength of the cable is normally distributed with $T_S \sim N(2200, 250^2)$ N. P and T_S are independent. Determine the distribution of the resultant force at A, and the probability of failure of the cable.



Solution



1)

$$\Sigma M_A = 0;$$

$$T(0.2+0.6) - P(0.9+0.9) = 0$$

$$\Sigma F_X = 0;$$

$$A_X - T = 0$$

$$\Sigma F_Y = 0;$$

$$A_Y - P = 0$$

Thus

$$A_X = T = 2.25P$$

$$A_Y = P$$

$$F_A = \sqrt{(2.25P)^2 + P^2} = \sqrt{6.06P^2} = 2.46P$$

So we have

$$\mu_{F_A} = 2.46\mu_P = 2460 \text{ N}$$

$$\sigma_{F_A} = 2.46\sigma_P = 123 \text{ N}$$

The distribution of the resultant force at A is $F_A \sim N(2460, 123^2)$ N . **Ans.**

2)

From 1), we know $P \sim N(1000, 50^2)$ N

$$T = 2.25P$$

$$\mu_T = 2.25\mu_P = 2250 \text{ N}$$

$$\sigma_T = 2.25\sigma_P = 112.5 \text{ N}$$

So the distribution of T is $T \sim N(2250, 112.5^2)$ N. Also, we know the strength of the cable is normally distributed with $T_S \sim N(2200, 250^2)$ N.

Suppose $Y = T_s - T$, we can find μ_Y and σ_Y

$$\mu_Y = \mu_{T_S} - \mu_T = -50 \text{ N}$$

$$\sigma_Y = \sqrt{\sigma_{T_S}^2 + \sigma_T^2} = 274 \text{ N}$$

$$P(Y < 0) = \Phi\left(\frac{0 - \mu_Y}{\sigma_Y}\right) = \Phi\left(\frac{50}{274}\right) = 0.57$$ **Ans**