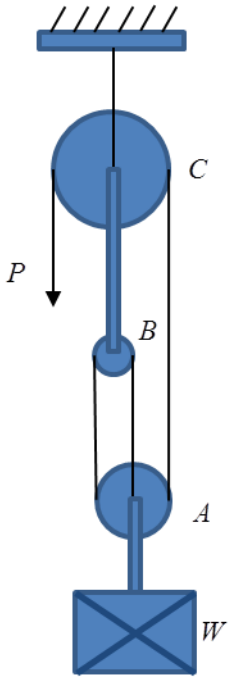
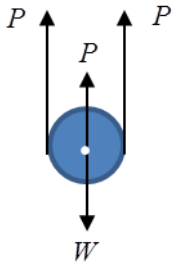
4. A frictionless pulley system supports a box as shown in the figure. The weight of the box follows a normal distribution $W \sim N(900, 9^2)$ N. Determine the distribution of the tension in the cables and also the distribution of the force P.



Solution

Pulley A



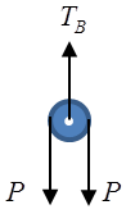
$$\Sigma F_y = 0; \quad 3P - W = 0$$

$$\mu_P = \frac{\mu_W}{3} = \frac{900}{3} = 300 \text{ N}$$

$$\mu_P = \frac{\sigma_W}{3} = \frac{9}{3} = 3 \text{ N}$$

Thus, the distribution of the force P is $P \sim N(300, 3^2)$ N. **Ans.**

Pulley B



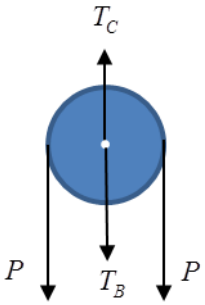
$$\Sigma F_y = 0;\ \ T_B - 2P = 0$$

$$\mu_{T_B} = 2\mu_P = 2(300) = 600 \text{ N}$$

$$\sigma_{T_B} = 2\sigma_P = 2(3) = 6 \text{ N}$$

Thus, the distribution of the force T_B is $T_B \sim N(600, 6^2)$ N. **Ans.**

Pulley *C*



$$\Sigma F_y = 0;\ \ T_C - T_B - 2P = 0$$

$$\mu_{T_C} = \mu_{T_B} + 2\mu_P = 600 + 2(300) = 1200 \text{ N}$$

$$\sigma_{T_C} = \sqrt{\sigma_{T_B}{}^2 + (2\sigma_P)^2} = \sqrt{6^2 + 6^2} = 8.48 \text{ N}$$

Thus, the distribution of the force T_C is $T_C \sim N(1200, 8.48^2)$ N. **Ans.**