

Key

Sample Questions

1. A person stands on a 100 kg beam and the end of the beam (length 1.2 meters) is suspended by a 2.2 meter rope. How much force does the rope exert on the beam and how much force does the beam exert on the rope? Assume the rope is massless and the beam is horizontal.

- a. What is the weight force?

$$F_{\text{grav}} = m \cdot g = (100 \text{ kg})(10 \text{ m/s}^2) = 1000 \text{ N}$$

- b. What force does the rope exert on the beam and vice versa?

$$F_{\text{rope}} = F_{\text{beam/rope}} = \frac{(1000 \text{ N})(1.2 \text{ m})}{2.2 \text{ m}} = 545 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{rope}} \Delta x_{\text{rope}} = F_{\text{beam}} \Delta x_{\text{beam}} = 1950 \text{ J}$$

- d. What is the mechanical advantage of the system?

$$MA = \frac{F_{\text{load}}}{F_{\text{input}}} = \frac{1000 \text{ N}}{545 \text{ N}} = 1.83$$

- e. How much power does it do?

$$P = \frac{W}{t} = \frac{1950 \text{ J}}{7.5 \text{ s}} = 260 \text{ W}$$

2. A person stands on a beam suspended vertically by a rope. The rope has a mass of 75 kg and the beam is 1.2 meters long. If the person is 1.2 meters from the bottom of the rope and 1 meter from the top of the beam, find:

- a. What is the weight force?

$$F_{\text{grav}} = m \cdot g = (75 \text{ kg})(10 \text{ m/s}^2) = 750 \text{ N}$$

- b. What force does the rope exert on the beam and vice versa?

$$F_{\text{rope}} = F_{\text{beam/rope}} = \frac{(750 \text{ N})(1.2 \text{ m})}{2.1 \text{ m}} = 429 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{rope}} \Delta x_{\text{rope}} = F_{\text{beam}} \Delta x_{\text{beam}} = 189 \text{ J}$$

- d. What is the mechanical advantage of the system?

$$MA = \frac{F_{\text{load}}}{F_{\text{input}}} = \frac{750 \text{ N}}{429 \text{ N}} = 1.75$$

- e. How much power does it do?

$$P = \frac{W}{t} = \frac{189 \text{ J}}{0.5 \text{ s}} = 378 \text{ W}$$

3. Through a pulley system, 800 newtons raises a 100 kg mass. If the rope is 1.2 meters of rope to raise the mass 1.2 meters in 0.2 seconds, find:

- a. What is the weight force?

$$F_{\text{grav}} = m \cdot g = 1000 \text{ N}$$

- b. What force does the rope exert on the mass and vice versa?

$$F_{\text{rope}} = F_{\text{mass/rope}} = \frac{(1000 \text{ N})(1.2 \text{ m})}{0.2 \text{ m}} = 6000 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{rope}} \Delta x_{\text{rope}} = F_{\text{mass}} \Delta x_{\text{mass}} = 600 \text{ J}$$