

Key

Sample Questions

1. A person stands on a 100 kg board with the end of the spring (length 1.2 meters) on the ground. The 1.2 meter board is attached to another 100 kg board, which is attached to the end of the spring and goes to the ground. For simplicity, find the following:

- a. What is the spring force?

$$F_{\text{spring}} = M \cdot g = (150 \text{ kg})(10 \text{ m/s}^2) = 1500 \text{ N}$$

- b. What force does the spring exert on the board on the ground?

$$F_{\text{spring}} = F_{\text{spring}} = \frac{F_{\text{spring}} \cdot \Delta x}{\Delta x} = 300 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{spring}} \Delta x_{\text{spring}} = F_{\text{spring}} \Delta x = 1950 \text{ J}$$

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

$$MA = \frac{F_{\text{out}}}{F_{\text{in}}} = \frac{1500 \text{ N}}{300 \text{ N}} = 5:1$$

- e. How much does it lift?

$$P = \frac{W}{t} = \frac{1950 \text{ J}}{7.8 \text{ s}} = 250 \text{ W}$$

2. Using a pulley system, a person lifts a 75 kg weight. The pulley is made of 10 kg weight. If the pulley is 1.2 meters, 10 meters from the ground and 1 meter it is lifted. How much work does it do?

- a. What is the spring force?

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

- b. What force does the spring exert on the board on the ground?

$$F_{\text{spring}} = F_{\text{spring}} = \frac{F_{\text{spring}} \cdot \Delta x}{\Delta x} = 150 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{spring}} \Delta x_{\text{spring}} = F_{\text{spring}} \Delta x = 180 \text{ J}$$

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

$$MA = \frac{F_{\text{out}}}{F_{\text{in}}} = \frac{750 \text{ N}}{150 \text{ N}} = 5$$

- e. How much does it lift?

$$P = \frac{W}{t} = \frac{180 \text{ J}}{0.5 \text{ s}} = 376 \text{ W}$$

3. Through a pulley system, a person lifts a 100 kg weight. If the pulley is 1.2 meters, 10 meters from the ground and 1.2 meters, find

- a. What is the spring force?

$$F_{\text{spring}} = M \cdot g = 1000 \text{ N}$$

- b. What force does the spring exert on the board on the ground?

$$F_{\text{spring}} = F_{\text{spring}} = \frac{F_{\text{spring}} \cdot \Delta x}{\Delta x} = 200 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{spring}} \Delta x_{\text{spring}} = F_{\text{spring}} \Delta x = 660 \text{ J}$$