

## 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 on the other side. The person has found out that the spring will give a force of 1000 N for every 100 kg of mass.

- a. What is the weight force?

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

- b. What force does the spring exert to pull the board up the spring?

$$F_{\text{spring}} = \frac{F_{\text{spring}}}{\Delta x} \cdot \Delta x = \frac{1000 \text{ N}}{1.2 \text{ m}} \cdot 1.2 \text{ m} = 1000 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{spring}} \Delta x_{\text{spring}} = F_{\text{spring}} \Delta x = 1200 \text{ J}$$

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

$$MA = \frac{F_{\text{out}}}{F_{\text{in}}} = \frac{1000 \text{ N}}{1500 \text{ N}} = 0.67$$

- e. How much does it lift?

$$P = \frac{W}{t} = \frac{1200 \text{ J}}{5 \text{ s}} = 240 \text{ W}$$

2. A person stands on a board attached to a spring. The spring has a mass of 75 kg and the board is 1.2 meters long. If the spring is 1000 N for every 100 kg of mass, how much work does it do?

- 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 spring exert to pull the board up the spring?

$$F_{\text{spring}} = \frac{F_{\text{spring}}}{\Delta x} \cdot \Delta x = \frac{1000 \text{ N}}{1.2 \text{ m}} \cdot 1.2 \text{ m} = 1000 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{spring}} \Delta x_{\text{spring}} = F_{\text{spring}} \Delta x = 1200 \text{ J}$$

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

$$MA = \frac{F_{\text{out}}}{F_{\text{in}}} = \frac{1000 \text{ N}}{750 \text{ N}} = 1.33$$

- e. How much does it lift?

$$P = \frac{W}{t} = \frac{1200 \text{ J}}{3.5 \text{ s}} = 343 \text{ W}$$

3. The spring is 1000 N for every 100 kg of mass. If the spring is 1000 N for every 100 kg of mass, how much work does it do?

- a. What is the weight force?

$$F_{\text{grav}} = m \cdot g = 1500 \text{ N}$$

- b. What force does the spring exert to pull the board up the spring?

$$F_{\text{spring}} = \frac{F_{\text{spring}}}{\Delta x} \cdot \Delta x = \frac{1000 \text{ N}}{1.2 \text{ m}} \cdot 1.2 \text{ m} = 1000 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{spring}} \Delta x_{\text{spring}} = F_{\text{spring}} \Delta x = 1200 \text{ J}$$