

## 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?

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

- 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?

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

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

$$MA = \frac{F_{\text{out}}}{F_{\text{in}}} = \frac{1000 \text{ N}}{1000 \text{ N}} = 1.0$$

- e. How much power does it use?

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

2. A person stands on a board attached with a spring. The spring has a mass of 75 kg and the board is 1.2 meters long. If the spring is attached to a wall that exerts a force of 1000 N on the board, 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 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?

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

- 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 power does it use?

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

3. Through a pulley system, 100 kg of mass is lifted a 100 kg mass. If the pulley system is used to lift the mass 1.2 meters in 0.5 seconds, find

- a. What is the weight force?

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

- 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?

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