

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?

$$F_{\text{spring}} = \frac{F_{\text{spring}}}{\Delta x} \cdot \Delta x = \frac{1000 \text{ N}}{100 \text{ kg}} \cdot 150 \text{ kg} = 1500 \text{ N}$$

- c. How much work does it do?

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

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

$$MA = \frac{F_{\text{out}}}{F_{\text{in}}} = \frac{1500 \text{ N}}{368 \text{ N}} = 4.08$$

- e. How much power does it use?

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

2. A dog pulls a sled backwards with its tongue. The sled has a mass of 75 kg and the force is 1.2 meters long. If the sled is pulled back 75 meters from the sled and a force of 1000 N is used to pull the sled, 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 sled up the spring?

$$F_{\text{spring}} = \frac{F_{\text{spring}}}{\Delta x} \cdot \Delta x = \frac{1000 \text{ N}}{1.2 \text{ m}} \cdot 75 \text{ m} = 163 \text{ N}$$

- c. How much work does it do?

$$W = F_{\text{spring}} \Delta x = F_{\text{grav}} \Delta x = 188 \text{ N}$$

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

$$MA = \frac{F_{\text{out}}}{F_{\text{in}}} = \frac{750 \text{ N}}{188 \text{ N}} = 4$$

- e. How much power does it use?

$$P = \frac{W}{t} = \frac{188 \text{ J}}{0.5 \text{ s}} = 376 \text{ W}$$

3. Through a pulley system, 80 kg of bricks are raised 100 kg. If the pulley system is used to raise the bricks 1.2 meters in 0.2 seconds, find:

- 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?

$$F_{\text{spring}} = \frac{F_{\text{spring}}}{\Delta x} \cdot \Delta x = \frac{1500 \text{ N}}{1.2 \text{ m}} \cdot 1.2 \text{ m} = 1500 \text{ N}$$

- c. How much work does it do?

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