
Complete the following problems. Show all work to receive full credit.

1. If a force of 90 N stretches a spring 1 m beyond its natural length, how much work does it take to stretch the spring 5 m beyond its natural length?

$$F = kx$$

$$90 = k \cdot 1$$

$$k = 90$$

Therefore, $F = 90x$ and

$$\begin{aligned} W &= \int_0^5 90x \, dx \\ &= 45x^2 \Big|_0^5 \\ &= 45(5^2) - 45 \cdot 0 \\ &= 1125 \, J \end{aligned}$$

2. A mountain climber is about to haul up a 50 m length of hanging rope. How much work will it take if the rope weighs 0.624N/m?

$$\begin{aligned} W &= \int_0^{50} 0.624x \, dx \\ &= 0.312x^2 \Big|_0^{50} \\ &= 0.312(50)^2 - 0 \\ &= 780 \, J \end{aligned}$$

Notice that the following does NOT work because the weight of the rope changes as you pull it up - the rope you have already lifted is not still being lifted.

The rope weighs

$$0.624N/m (50m) = 31.2N = F$$

$$W = F \cdot d = 31.2 \cdot 50 = 1,560J$$