

Question:

A dockworker wants to slide a 10 kg box down an inclined ramp so that it just barely reaches the bottom of the ramp. The ramp is 4 m long and inclined at a 30 degree angle (wrt horizontal). The box and ramp have a coefficient of kinetic friction $\mu_k = 95 \cdot 10^{-2}$. What is the maximum amount of kinetic energy that the dockworker can transfer to the box?

Numerical Answer: About 127J

Reasoning:

This is a work-energy theorem question. The dockworker performs positive work upon the crate, and gravity performs positive work upon the crate, while friction performs negative work upon the crate. Since the crate arrives at the bottom of the ramp with a velocity of zero, we conclude that it has no kinetic energy. Thus, the net work done is zero.

$$K_0 - W_{friction} + W_{gravity} = 0$$

$$K_0 = W_{friction} - W_{gravity}$$

$$K_0 = \mu mg \cos \theta L - mg \sin \theta L$$

$$K_0 = mgL(\mu \cos \theta - \sin \theta)$$

$$K_0 = 10kg(9.81m/s^2)(4m)[(0.95)(\cos 30) - (\sin 30)]$$

$$K_0 = 392.4J[(.95)(.866) - (.5)]$$

$$K_0 = 126.6 \sim 127J$$