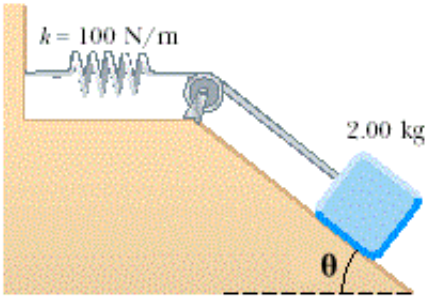
Answer on Question 58240, Physics, Mechanics | Relativity

Question:

A $2\,kg$ block is situated on a rough incline is connected to a light spring of force constant $100\,N/m$. The pulley is frictionless. The block is released from rest when the spring is unstretched. The block moves $20\,cm$ down the incline before coming to rest.Find the coefficient of the kinetic friction between the block and the plane.

Solution:



To find the coefficient of the kinetic friction, we apply the Work-Energy theorem. The work, which the friction force does in slide the block down the incline, is equal to the gravitational potential energy of the block plus potential energy of the spring:

$$-F_{k.fr.}d = -mgdsin\theta + \frac{1}{2}kd^2,$$

$$-\mu_k Nd = -mgdsin\theta + \frac{1}{2}kd^2,$$

$$-\mu_k mgdcos\theta = -mgdsin\theta + \frac{1}{2}kd^2,$$

$$\mu_k mgdcos\theta = mgdsin\theta - \frac{1}{2}kd^2,$$

$$\mu_k mgcos\theta = mgsin\theta - \frac{1}{2}kd.$$

We can find the coefficient of the kinetic friction between the block and the plane from the last formula (here, θ is the angle of inclination, but unfortunately, it is absent in the condition of the question and we take it, say, $\theta = 40^{\circ}$)

$$\mu_k = \frac{mgsin\theta - \frac{1}{2}kd}{mgcos\theta} = \frac{2.0\ kg \cdot 9.8\ \frac{m}{s^2} \cdot sin40^\circ - \frac{1}{2} \cdot 100\ \frac{N}{m} \cdot 0.2\ m}{2.0\ kg \cdot 9.8\ \frac{m}{s^2} \cdot cos40^\circ} = 0.173.$$

Answer:

$\mu_k = 0.173.$