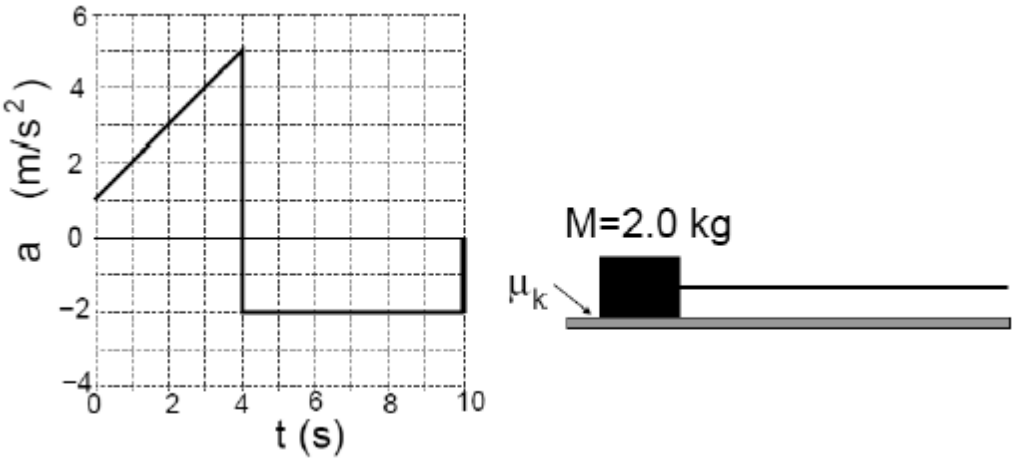
Answer on Question #74799-Physics-Mechanics-Relativity

You have a 2.0 kg block that moves on a linear path on a horizontal surface. The block is initially moving to the right. The coefficient of kinetic friction between the block and the path is μk. Attached to the block is a horizontally mounted massless string as shown in the figure below. The block includes an accelerometer which records acceleration vs. time. As you increase the tension in the rope the block experiences an increasingly positive acceleration. At some point in time the rope snaps and then the block slides to a stop (at a time of 10 seconds). Gravity, with g = 10. m/s2, acts downward.



1) At what time does the string break?

2) What speed did the block have when the string broke?

3) What is the value of μk?

4) Using μk above, what was the tension in the string at t = 2.0 seconds?

Solution

1) This time is

$$t = 4\ s.$$

2)

$$v(10) = 0\frac{m}{s}$$

From 4 to 10 s:

$$a = -2\frac{m}{s^2}.$$

So, the speed of the block when the string broke is

$$v(4) = 0 - (-2)6 = 12\frac{m}{s}.$$

3)

$$\sum F_x = ma_x = -f_k = -\mu_k N$$

$$\sum F_y = 0 = mg - N \rightarrow N = mg$$

$$ma_x = -\mu_k mg$$

$$\mu_k = -\frac{a_x}{g} = -\frac{-2}{10} = 0.2.$$

4)

$$\sum F_x = ma_x = -f_k + T$$

$$\sum F_y = 0 = mg - N \rightarrow N = mg$$

$$T = f_k + ma_x = (0.2(2)(10) + 2(3)) = 10\ N.$$