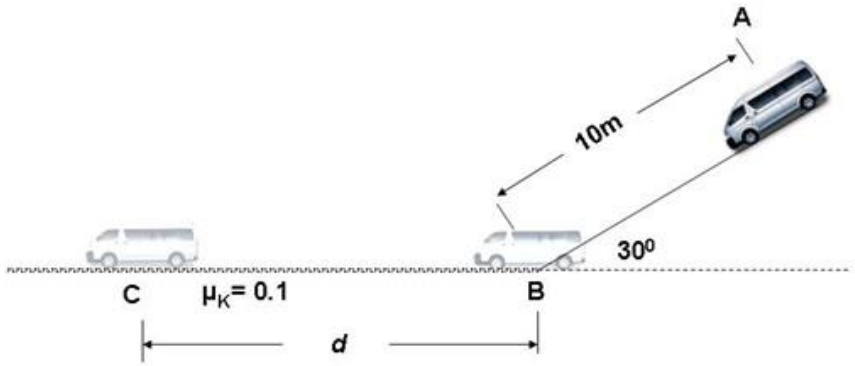
Answer on Question #41006, Physics, Mechanics

The ambulance (mass 3000kg) shown in the Figure slides (wheels locked) down a frictionless incline that is 10 m long. It starts from rest at point A, and continues along a rough surface until it comes to a complete stop at point C. If the coefficient of kinetic friction between the ambulance and the horizontal rough surface is 0.1.

(a) Calculate the speed of the ambulance at point B.

(b) Compute the distance d the ambulance slides on the horizontal rough surface before stopping



Solution:

(a)

Mechanical energy E is the sum of the potential and kinetic energies of an object.

$$E = U + K$$

The total mechanical energy in any isolated system of objects remains constant if the objects interact only through conservative forces:

$$U_f + K_f = U_i + K_i$$

$$0 + \frac{1}{2}mv_f^2 = mgh + 0$$

$$v_f = \sqrt{2gh}$$

$$h = L\sin 30°$$

Thus,

$$v_B = \sqrt{2gh} = \sqrt{2gL\sin 30°} = \sqrt{2 \cdot 9.8 \cdot 10 \cdot \sin 30°} = 9.9 \text{ m/s}$$

b)

The force of kinetic friction is given by

$$F_k = \mu N$$

where F_k is the force of kinetic friction, μ is the coefficient of kinetic friction, and N is the normal force that presses the sliding object to the surface.

If the object is sliding on a level surface, $N = mg$.

The equation of motion is

$$ma = -F_k$$

Thus,

$$ma = -\mu mg$$

The distance is

$$d = \frac{v_C^2 - v_B^2}{2a} = \frac{v_C^2 - v_B^2}{-2\mu g} = \frac{0 - 9.9^2}{-2 \cdot 0.1 \cdot 9.8} = 50 \text{ m}.$$

Answer. a) $v_f = 9.9$ m/s,

b) $d = 50$ m.