Answer on Question #49471-Physics-Mechanics-Kinematics-Dynamics

A 20 kg block starts from rest at the top of a 60 degree incline and slides down the incline. There is a 0.1 coefficient of friction on the ramp. The block then continues to slide along the horizontal surface where there is a 0.3 coefficient of friction. The block then slows, due to friction, until it comes to rest at point B.

a. (2) What is the magnitude of the force due to gravity (i.e. the weight) of the block on the incline?

b. (2) What is the magnitude of the Normal Force on the block on the incline?

c. (2) What is the magnitude of the frictional force on the block on the incline?

d. (2) What is the magnitude of the acceleration of the block down the incline?

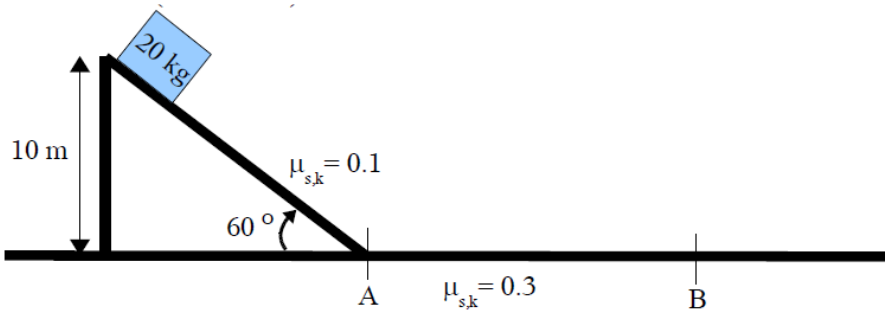
e. (3) What is the velocity of the block at Point A?

f. (3) What is the magnitude of the force of friction on the block on the horizontal?

g. (3) What is the acceleration of the block along the horizontal?

h. (3) What is the distance between Point A and Point B?

Solution



a.) $w = mg = 20\ kg \cdot 9.8\frac{m}{s^2} = 196\ N.$

b.) $\sum F_y = ma_y$

$F_N - mg\cos\theta = 0$

$F_N = mg\cos\theta = 196\ N\cos 60 = 98\ N.$

c.) $f = \mu F_N = 0.1 \cdot 98\ N = 9.8\ N.$

d.) $mg\sin\theta - f = ma$

$196\ N\sin 60 - 9.8\ N = 20\ kg \cdot a$

$a = 8.00\frac{m}{s^2}.$

e.) $\sin\theta = \frac{h}{\Delta x}$

$\Delta x = \frac{h}{\sin\theta} = \frac{10m}{\sin 60} = 11.55m.$

$v^2 = v_0^2 + 2a\Delta x$

$|v| = \sqrt{2a\Delta x} = \sqrt{2 \cdot 8.00 \frac{m}{s^2} \cdot 11.55m} = 13.59 \frac{m}{s}.$

f.) $f = \mu mg = 0.3 \cdot 20\ kg \cdot 9.8 \frac{m}{s^2} = 58.8\ N$

g.) $a_x = -\frac{58.8N}{20kg} = -2.94 \frac{m}{s^2}.$

h.) $v^2 = v_0^2 + 2a_x\Delta x$

$\Delta x = \frac{v^2 - v_0^2}{2a_x} = \frac{0 - \left(13.59 \frac{m}{s}\right)^2}{2\left(-2.94 \frac{m}{s^2}\right)} = 31.41m.$