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General Physics-I, Quiz 1s
PHYS1000AA, Fall Semester-107
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Chapter 8
A 5.00-kg block is set into motion up an inclined plane with an initial speed of v_i = 8.00 m/s (Fig. P8.23). The block comes to rest after traveling d = 3.00 m along the plane, which is inclined at an angle of θ = 30.0° to the horizontal. For this motion, determine (a) the change in the block's kinetic energy, (b) the change in the potential energy of the block-Earth system, and (c) the friction force exerted on the block (assumed to be constant). (d) What is the coefficient of kinetic friction?

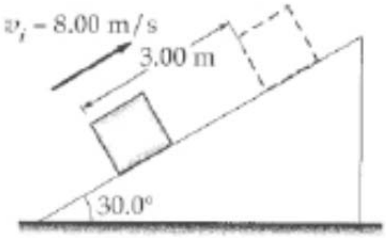
Ans:

We consider the block-plane-planet system between an initial point just after the block has been given its shove and a final point when the block comes to rest.

(a) The change in kinetic energy is

$$\Delta K = K_f - K_i = \frac{1}{2}m\upsilon_f^2 - \frac{1}{2}m\upsilon_i^2$$

$$= 0 - \frac{1}{2}(5.00\text{ kg})(8.00\text{ m/s})^2 = \boxed{-160\text{ J}}$$



ANS. FIG. P8.23

(b) The change in gravitational potential energy is

$$\Delta U = U_f - U_i = mgh$$

$$= (5.00\text{ kg})\left(9.80\text{ m/s}^2\right)(3.00\text{ m})\sin 30.0° = \boxed{73.5\text{ J}}$$

(c) The nonisolated system energy model we write as

$$\Delta K + \Delta U = \sum W_{\text{other forces}} - f_k d = 0 - f_k d$$

The force of friction is the only unknown, so we may find it from

$$f_k \frac{\Delta K - \Delta U}{d} = \frac{+160\text{ J} - 73.5\text{ J}}{3.00\text{ m}} = \boxed{28.8\text{ N}}$$

(d) The forces perpendicular to the incline must add to zero.

$$\sum F_y = 0: \qquad +n - mg\cos 30.0° = 0$$

Evaluating, $n = mg\cos 30.0° = (5.00\text{ kg})\left(9.80\text{ m/s}^2\right)\cos 30.0° = 42.4\text{ N}$

Now $f_k = \mu_k n$ gives $\mu_k = \dfrac{f_k}{n} = \dfrac{28.8\ \text{N}}{42.4\ \text{N}} = \boxed{0.679}$

Chapter 9
The front 1.20 m of a 1 400-kg car is designed as a “crumple zone” that collapses to absorb the shock of a collision. If a car traveling 25.0 m/s stops uniformly in 1.20 m, (a) how long does the collision last, (b) what is the magnitude of the average force on the car, and (c) what is the acceleration of the car? Express the acceleration as a multiple of the acceleration due to gravity.
Ans:

(a) From the kinematic equations,

$$\Delta t = \frac{\Delta x}{\upsilon_{\text{avg}}} = \frac{2\Delta x}{\upsilon_f + \upsilon_i} = \frac{2(1.20\,\text{m})}{0 + 25.0\,\text{m/s}} = \boxed{9.60\times10^{-2}\,\text{s}}$$

(b) We find the average force from the momentum-impulse theorem:

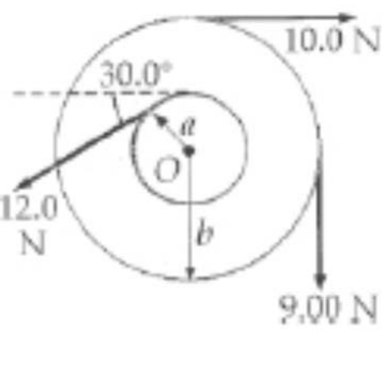
$$F_{\text{avg}} = \frac{\Delta p}{\Delta t} = \frac{m\Delta\upsilon}{\Delta t} = \frac{(1\,400\,\text{kg})(25.0\,\text{m/s} - 0)}{9.60\times10^{-2}\,\text{s}} = \boxed{3.65\times10^{5}\,\text{N}}$$

(c) Using the particle under constant acceleration model,

$$a_{\text{avg}} = \frac{\Delta\upsilon}{\Delta t} \frac{25.0\,\text{m/s} - 0}{9.60\times10^{-2}\,\text{s}} = (260\,\text{m/s}^2)\left(\frac{1g}{9.80\,\text{m/s}^2}\right) = \boxed{26.5g}$$

Chapter 10
Find the net torque on the wheel in Figure P10.27 about the axle through O, taking a = 10.0 cm and b = 25.0 cm.
Ans:
To find the net torque, we add the individual torques, remembering to apply the convention that a torque producing clockwise rotation is negative and a counterclockwise rotation is positive.

$$\begin{aligned}\sum\tau &= (0.100\ \text{m})(120\,\text{N}) \\ &\quad -(0.250\ \text{m})(9.00\ \text{N}) \\ &\quad -(0.250\ \text{m})(10.0\ \text{N}) \\ &= \boxed{-3.35\ \text{N}\cdot\text{m}}\end{aligned}$$



The thirty-degree angle is unnecessary information.

ANS. FIG. P10.27