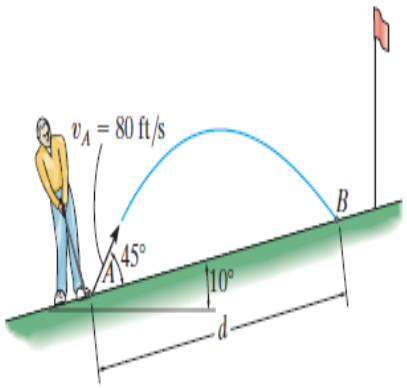
A golf ball is struck with a velocity of 80 ft/s as shown. Determine the speed at which it strikes the ground at B and the time of flight from A to B.



SOLUTION

$$(v_A)_x = 80\cos 55° = 44.886$$

$$(v_A)_y = 80\sin 55° = 65.532$$

$$\left(\stackrel{+}{\rightarrow}\right)\ s = s_0 + v_0 t$$

$$d\cos 10° = 0 + 45.886t$$

$$\left(+\uparrow\right)\ s = s_0 + v_0 t + \frac{1}{2}a_c t^2$$

$$d\sin 10° = 0 + 65.532\,(t) + \frac{1}{2}(-32.2)\left(t^2\right)$$

$$d = 166\text{ ft}$$

$$t = 3.568 = 3.57\text{ s}$$ **Ans.**

$$(v_B)_x = (v_A)_x = 45.886$$

$$\left(+\uparrow\right)\ v = v_0 + a_c t$$

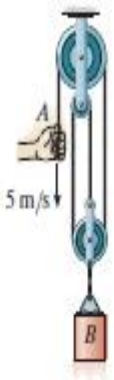
$$(v_B)_y = 65.532 - 32.2(3.568)$$

$$(v_B)_y = -49.357$$

$$v_B = \sqrt{(45.886)^2 + (-49.357)^2}$$

$$v_B = 67.4\text{ ft/s}$$ **Ans.**

If the end of the cable at A is pulled down with a speed of 5 m/s, determine the speed at which block B rises.



SOLUTION

Position Coordinate. The positions of pulley B and point A are specified by position coordinates s_B and s_A, respectively, as shown in Fig. *a*. This is a single-cord pulley system. Thus,

$$s_B + 2(s_B - a) + s_A = l$$

$$3s_B + s_A = l + 2a \qquad \textbf{(1)}$$

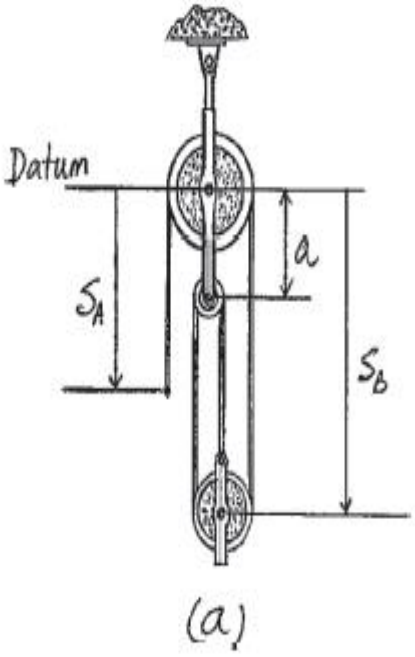
Time Derivative. Taking the time derivative of Eq. (1),

$$3v_B + v_A = 0 \qquad \textbf{(2)}$$

Here $v_A = +5$ m/s, since it is directed toward the positive sense of s_A. Thus,

$$3v_B + 5 = 0 \qquad v_B = -1.667 \text{ m/s} = 1.67 \text{ m/s}\uparrow \qquad \textbf{Ans.}$$

The negative sign indicates that v_B is directed toward the negative sense of s_B.



(a)

The 2-Mg truck is traveling at 15 m/s when the brakes on all its wheels are applied, causing it to skid for a distance of 10 m before coming to rest. Determine the constant horizontal force developed in the coupling C, and the frictional force developed between the tires of the truck and the road during this time. The total mass of the boat and trailer is 1 Mg.

SOLUTION

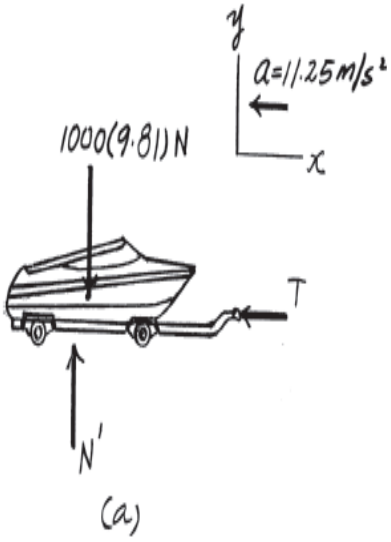
Kinematics: Since the motion of the truck and trailer is known, their common acceleration **a** will be determined first.

$$\left(\pm\right) \quad v^2 = v_0^2 + 2a_c(s - s_0)$$

$$0 = 15^2 + 2a(10 - 0)$$

$$a = -11.25\ \text{m/s}^2 = 11.25\ \text{m/s}^2 \leftarrow$$

Free-Body Diagram: The free-body diagram of the truck and trailer are shown in Figs. (a) and (b), respectively. Here, **F** represents the frictional force developed when the truck skids, while the force developed in coupling C is represented by **T**.



Equations of Motion: Using the result of **a** and referrning to Fig. (a),

$$\pm \Sigma F_x = ma_x; \qquad -T = 1000(-11.25)$$

$$T = 11\,250\ \text{N} = 11.25\ \text{kN} \qquad \textbf{Ans.}$$

Using the results of **a** and **T** and referring to Fig. (b),

$$+\uparrow \Sigma F_x = ma_x; \qquad 11\,250 - F = 2000(-11.25)$$

$$F = 33\,750\ \text{N} = 33.75\ \text{kN} \qquad \textbf{Ans.}$$