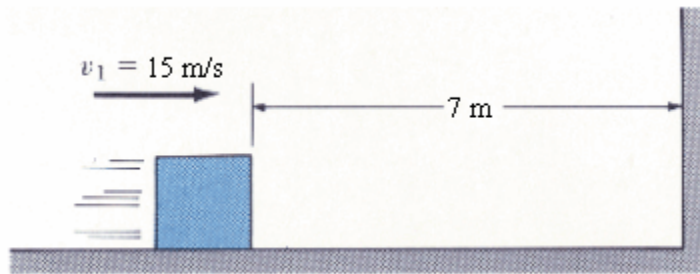


**Engineering Dynamics**  
**Homework 4**

1.

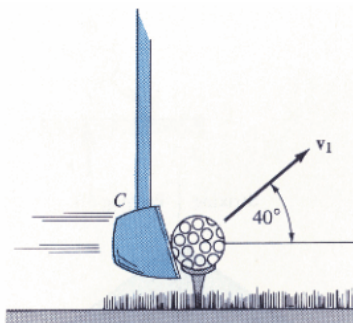
When the 6-kg block is 7 m from the wall, it is sliding at  $v_1 = 15$  m/s. If the coefficient of friction between the block and the horizontal plane is  $\mu = 0.3$ , determine the impulse of the wall on the block necessary to stop the block. Neglect the friction impulse acting on the block during the collision.



$$\int_0^{t_c} F dt = \underline{\hspace{2cm}} \text{ N s}$$

2.

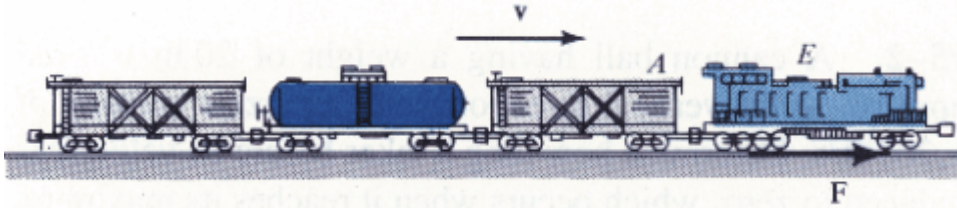
A man hits a 49-g golf ball such that it leaves the tee at an angle of  $40^\circ$  with the horizontal and strikes the ground at the same elevation a distance of 31 m away. Determine the impulse of the club  $C$  on the ball. Neglect the impulse caused by the ball's weight while the club is striking the ball.



$$\int_0^{t_c} F dt = \underline{\hspace{2cm}} \text{ N s}$$

3.

A train consists of a 70-Mg engine and three cars, each having a mass of 30 Mg. If it takes 75 s for the train to increase its speed uniformly to 40 km/h, starting from rest, determine the force  $T$  developed at the coupling between the engine  $E$  and the first car  $A$ . The wheels of the engine provide the resultant frictional tractive force  $F$  which gives the train forward motion, whereas the car wheels roll freely. Determine  $F$  acting on the engine wheels. Neglect the mass of the wheels.

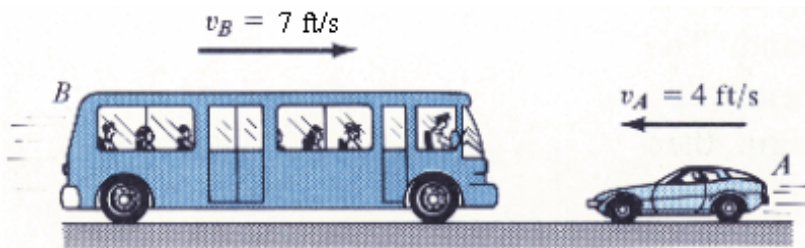


$T =$  \_\_\_\_\_ kN

$F =$  \_\_\_\_\_ kN

4.

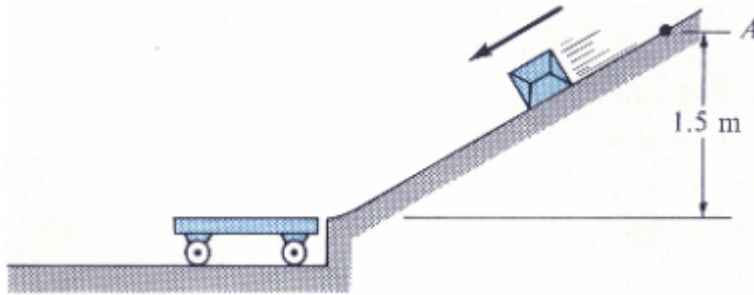
The bus  $B$  has a weight of 16,000 lb and is travelling to the right at 7 ft/s. Meanwhile a 2,100-lb car  $A$  is travelling at 4 ft/s to the left. If the vehicles crash head-on and become entangled, determine their common velocity just after the collision. Assume that the brakes are not applied during the collision.



$v_T =$  \_\_\_\_\_ ft/s

5.

The 13-kg package is released from rest at  $A$  and slides down the smooth ramp onto a cart having a mass of 26 kg. If the coefficient of kinetic friction between the cart and package is  $\mu = 0.5$  determine the final velocity of the cart after the package stops sliding on the cart. Also, calculate the time the package slides on the cart. Neglect the mass of the wheels.

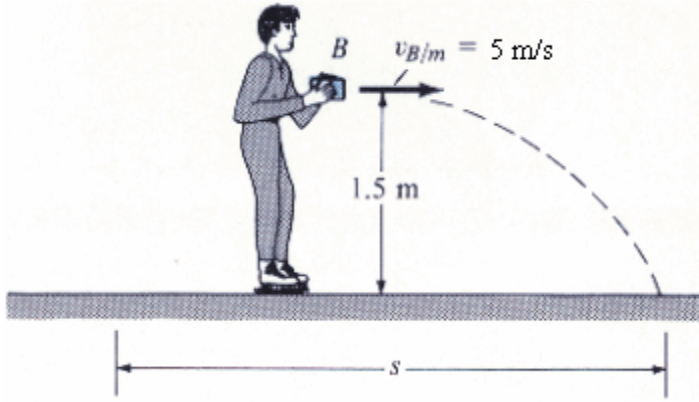


$$v_T = \underline{\hspace{2cm}} \text{ m/s}$$

$$\Delta t = \underline{\hspace{2cm}} \text{ s}$$

6.

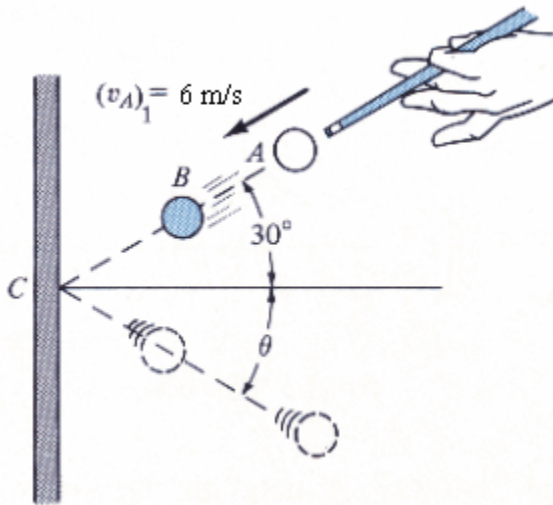
A 69-kg man on ice skates throws the 7-kg block with an initial horizontal velocity of 5 m/s, measured relative to himself, in the direction shown. If he is originally at rest, determine the distance  $s$  he is from the block at the instant the block strikes the ground. Neglect friction, the motion of his arms and the size of the block and man.



$d =$  \_\_\_\_\_ m

7.

The cue ball  $A$  is given an initial velocity  $(v_A)_1 = 6\text{ m/s}$ . If it makes a direct collision with ball  $B$  ( $e = 0.8$ ) determine the velocity of  $B$  and the angle  $\theta$  just after it rebounds from the cushion at  $C$  ( $e' = 0.6$ ). Each ball has a mass of 0.45 kg. Neglect the size of each ball.

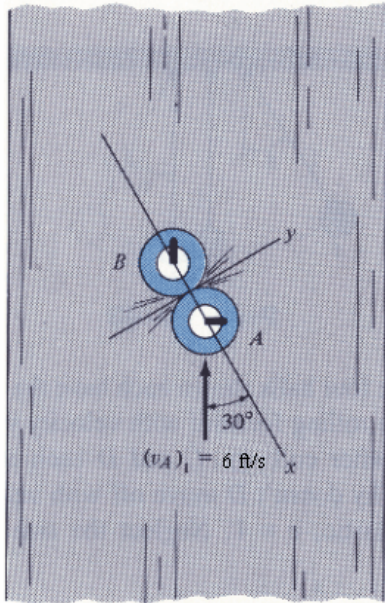


$(v_A)_3 =$  \_\_\_\_\_ m/s

$\theta =$  \_\_\_\_\_ °

8.

The “stone”  $A$  used in the sport of curling is thrown over the ice track and strikes another “stone”  $B$  as shown. If each “stone” has a weight of 46 lb and the coefficient of restitution between the “stones” is  $e = 0.75$  determine their speeds just after collision. Initially  $A$  has a velocity of 6 ft/s and  $B$  is at rest. Neglect friction.

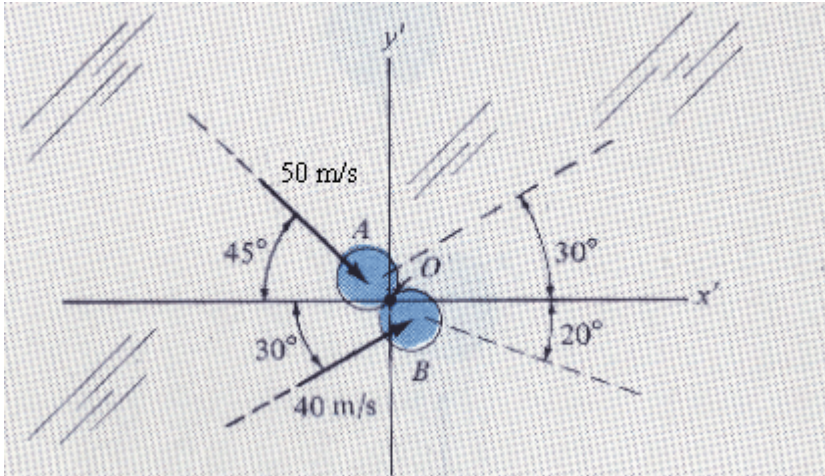


$$(v_A)_2 = \underline{\hspace{2cm}} \text{ ft/s}$$

$$(v_B)_2 = \underline{\hspace{2cm}} \text{ ft/s}$$

9.

The two hockey pucks  $A$  and  $B$  each have a mass of 200 g. If they collide at  $O$  and are deflected along the dashed paths, determine their speeds just after impact. Assume that the icy surface over which they slide is smooth. Hint: Since the  $y'$  axis is not along the line of impact, apply the conservation of momentum along the  $x'$  and  $y'$  axes.

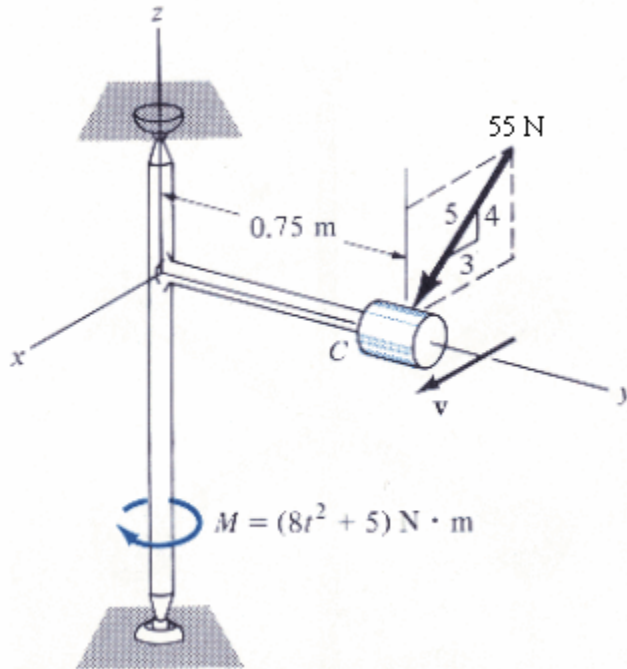


$$(v_A)_2 = \underline{\hspace{2cm}} \text{ m/s}$$

$$(v_B)_2 = \underline{\hspace{2cm}} \text{ m/s}$$

10.

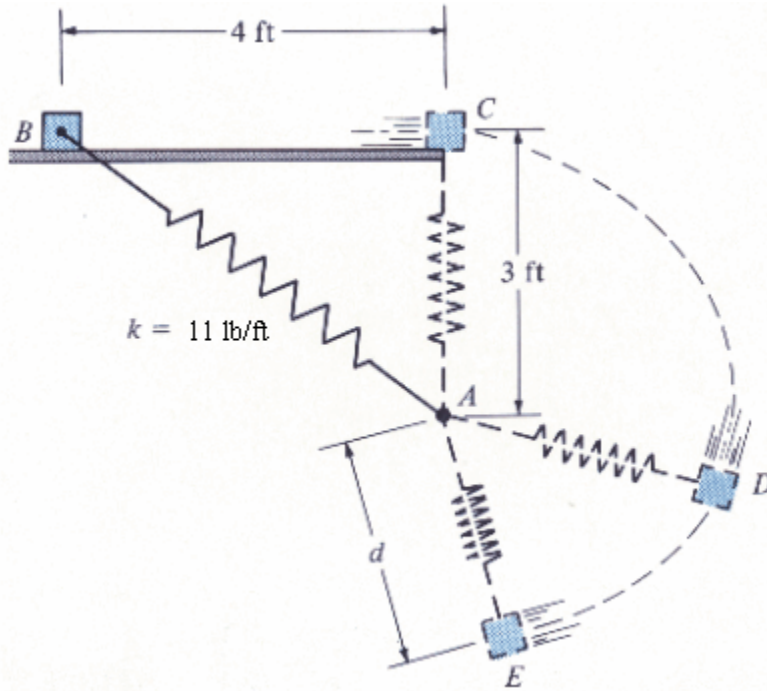
The small cylinder  $C$  has a mass of 12 kg and is attached to the end of a rod whose mass may be neglected. If the frame is subjected to a couple  $M = (8t^2 + 5) \text{ Nm}$  where  $t$  is in seconds, and the cylinder is subjected to a force of 55 N, which is always directed as shown, determine the speed of the cylinder when  $t=1$  s. The cylinder has a speed  $v_0 = 2$  m/s when  $t = 0$ .



$(v_C)_2 = \underline{\hspace{2cm}} \text{ m/s}$

11.

The spring has an unstretched length  $l_0 = 1.45$  ft and a stiffness  $k = 11$  lb/ft. It is attached to a fixed point at  $A$  and a block at  $B$  which has a weight of 1.5 lb. If the block is released from rest from the position shown, determine its speed when it reaches point  $C$  after it slides along the smooth guide. After leaving the guide, it is launched onto the smooth horizontal plane. Determine its speed at  $D$  at the instant the spring becomes unstretched.



$v_C =$  \_\_\_\_\_ ft/s

$v_D =$  \_\_\_\_\_ ft/s