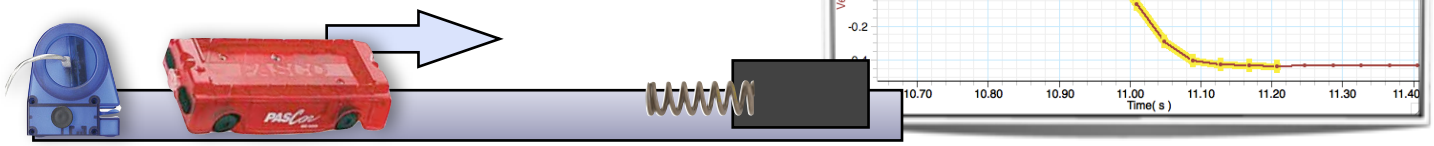
Momentum And Energy - Honors Summary Name _____

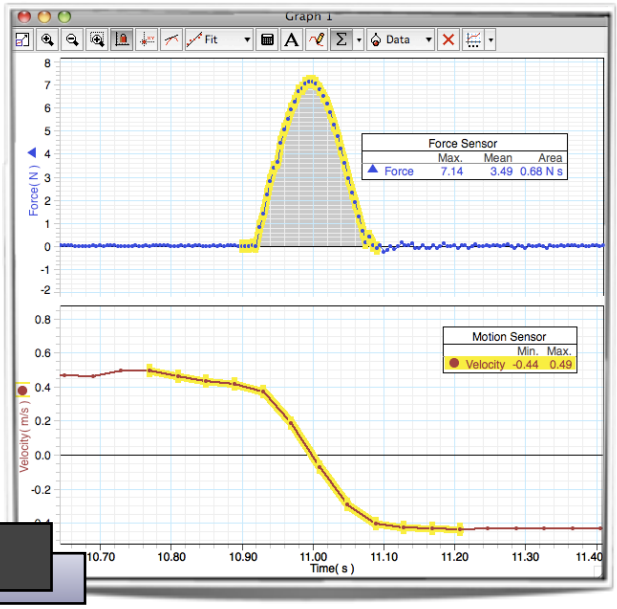
A student in this class forgot to finish all of their labs. You can trust the numbers they have written, but please complete all of the missing parts.

1. A car is pushed into a force sensor as demonstrated in class.

   a) What is shown by the area under the Force/Time graph?

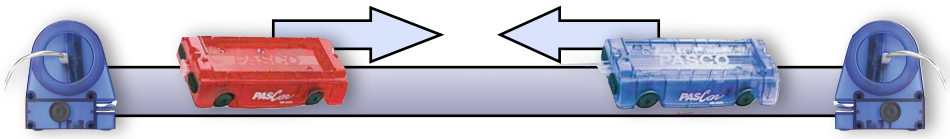
   _____



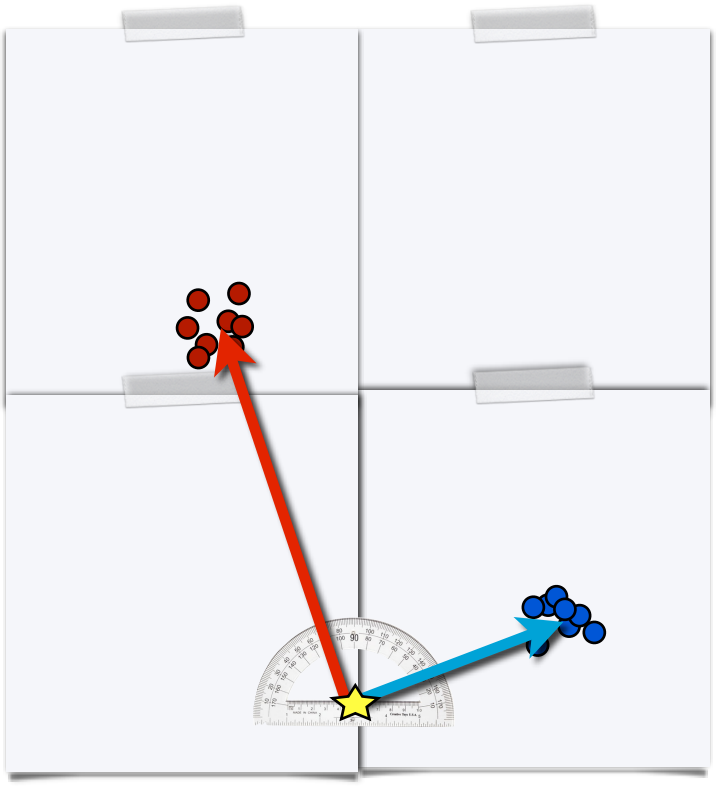


Area of Force Graph	*Average Force*	*Min Velocity*	*Max Velocity*	*Impulse*	*Change in Momentum*	*Change in Velocity*	*Mass*
0.68 Ns	**3.49 N**	**-0.44**	**0.49**				

2. In a **perfectly inelastic** collision two cars collide as shown. What is the final velocity of the two cars?



Mass A	*Mass B*	*Velocity Ai*	*Velocity Bi*	*Velocity Af*	*Velocity Bf*
500g	**1000g**	**2.4 m/s**	**-6 m/s**		

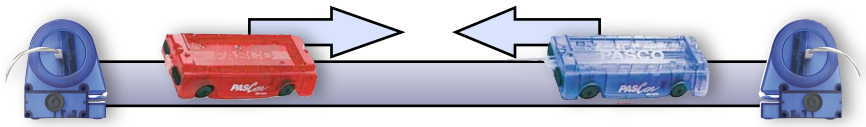


3. In a collision between 2 marbles, a student group graphed the final momentum of each marble as shown. They forgot to find the initial momentum (before a collision). Show the initial momentum on the diagram.

Also, solve for the resultant vector as done in your lab experiment.

Marble Collision		
	Length	**Angle**
P_{af}	21.0 cm	115
P_{bf}	13.5 cm	25
P_i		

4. In the **inelastic** collision two cars approach as shown. Complete the table with your results.



Mass A	*Mass B*	*Velocity A_i*	*Velocity B_i*	*Velocity A_f*	*Velocity B_f*
1.5 kg	**2.0 kg**	**4 m/s**	**-8 m/s**	**-6 m/s**	

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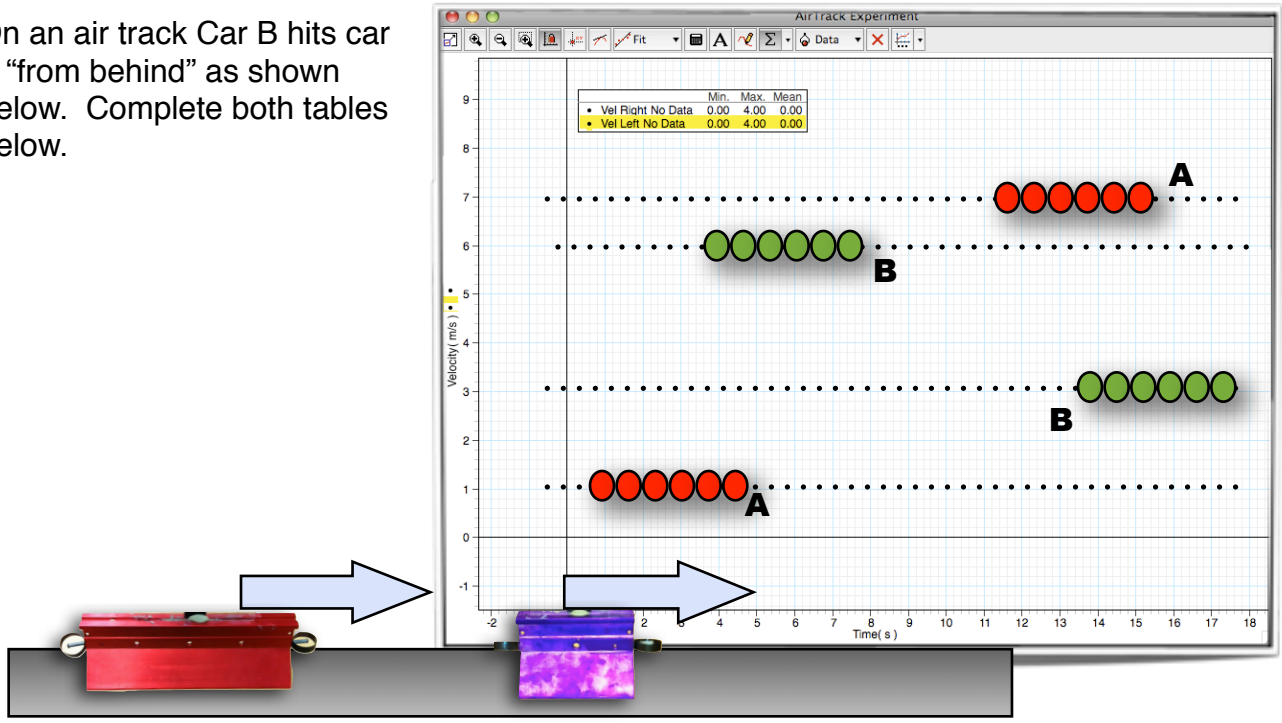
5. On an air track Car B hits car A “from behind” as shown below. Complete both tables below.



Mass A	Mass B	V Ai	V Bi	V Af	V Bf
0.3 kg					

Momentum Ai	Momentum Bi	Momentum Af	Momentum Bf	Initial Momentum	Final Momentum

a) What is the mass of car B ?

b) What was the impulse on car A?

c) If the collision took 0.03 seconds, what was the Force acting on car A?

d) What is the elasticity (coefficient of restitution) for the collision?

6. A student completes a lab experiment to understand Hooke's Law. The carefully recorded data is below. What is the spring constant for this experiment? As done in class, the length is the total of the spring and the mass hanger.

Test Spring			
#	**mass**	**weight**	**length**
1	200g		0.65m
2	300g		0.70m
3	500g		0.81m
4	800g		0.94m
5	1000g		1.05m
6	1500g		1.31m

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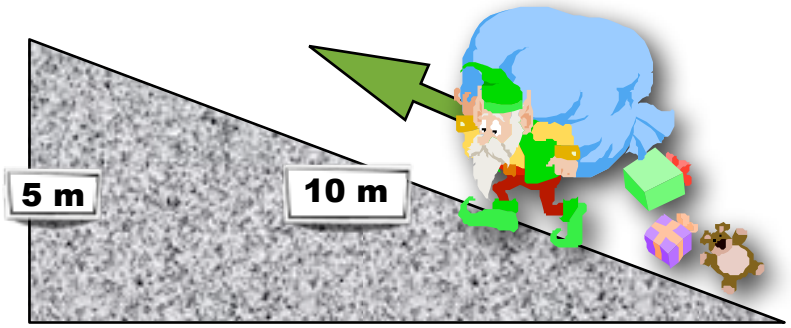
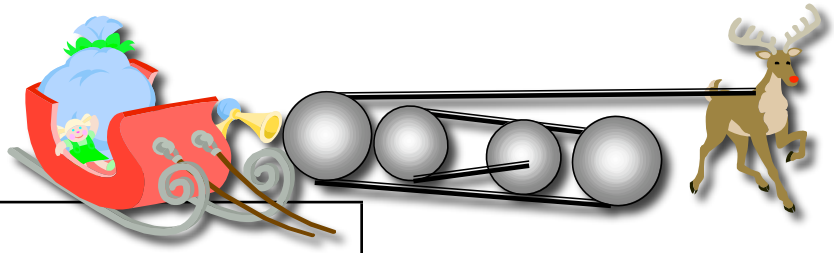


Work Input	
Work Output	
IMA	
AMA	
Elf Power	

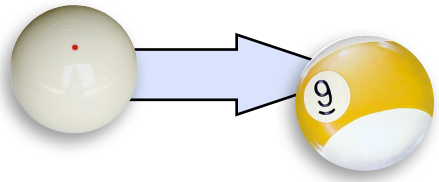
7. An elf can push the toys up the **10 m** incline with a force of **500 N** in **30 seconds** with an efficiency of **80**%. Complete the table

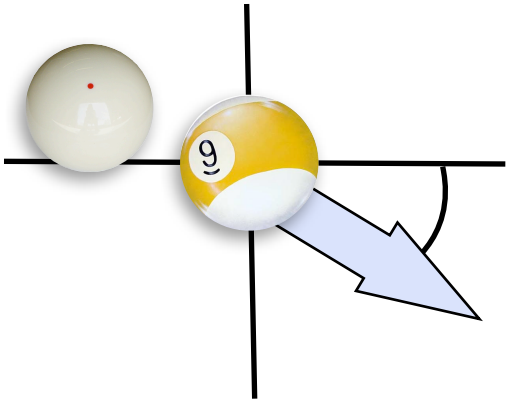


Work Input	
Work Output	
IMA	
AMA	
Reindeer Power	

8. A ***"HOLIDAY"*** sled is stuck, so ***Randolph*** the physics reindeer uses a set of pulleys with **four** ropes to try to get the sled out of the snow. He found that he exerts a force of only **400 N** to apply **1000 N** to the sled! The sled moves **3 m** across the snow in one minute.

9. Two balls collide in an inelastic collision as shown. The 600g white cue ball travels at 14m/s and hits the 500g 9-ball (initially at rest). The 9 ball leaves this collision with a velocity of 11 m/s 25° below the x axis. What is the final velocity of the cue ball?





10. In a physics experiment two 3 kg watermelons are dropped from the top of a 10 meter platform. One hits the ground and stops in 0.4 seconds, the second one hits the water and stops in 3.2 seconds.

a) Use conservation of Energy to find the velocity on impact of each watermelon.

b) What is the change in momentum for each melon?

c) What is the impulse on each melon?

d) What is the force on the melon in the water?

11. Car A hits car B “from behind” as shown below. Complete both tables below.

Mass A	*Mass B*	*Velocity Ai*	*Velocity Bi*	*Velocity Af*	*Velocity Bf*
600 kg	**90 kg**	**20 m/s**	**5 m/s**	**16 m/s**	

Momentum Ai	*Momentum Bi*	*Momentum Af*	*Momentum Bf*	*Initial Momentum*	*Final Momentum*

a) What was the impulse on car A?

b) If the collision took 0.03 seconds, what was the Force acting on car A?

c) What is the elasticity (coefficient of restitution) for the collision?

12. How long must a force of 5.00 N act on a block of 3.00-kg mass in order to give it a velocity of 4.00 m/s?

13. A 10.0-g bullet is fired from a 5.00-kg rifle with a velocity of 300 m/s. What is the recoil velocity of the rifle?

14. A cannon of 3.50 X 10^3 kg fires a shell of 2.50 kg with a muzzle speed of 300 m/s. What is the recoil velocity of the cannon?

15. If a gas molecule of mass 5.30 X 10^{-26} kg and an average speed of 425 m/s collides perpendicularly with a wall of a room and rebounds at the same speed,

    a) What is its change of momentum?

    b) What impulse is imparted to the wall?

16. A 150-g ball moving at a velocity of 25.0 cm/s to the right collides with a 250-g ball moving at a velocity of 18.5 cm/s to the left. The collision has a coefficient of restitution of 0.65.

    a) Find the velocity of each ball after the collision

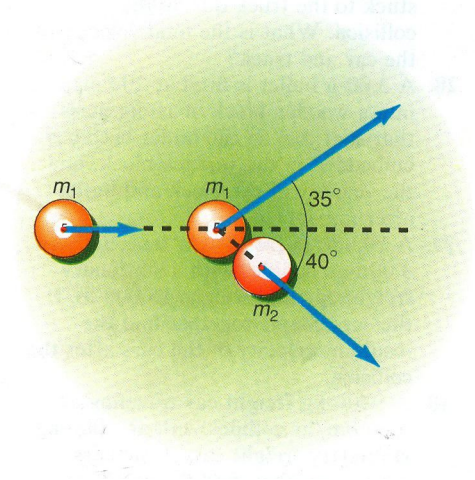
    b) Find the kinetic energy before the collision

    c) Find the kinetic energy after the collision

    d) Find the percentage of energy lost in the collision.

17. A 10,000 kg truck enters an intersection heading north at 45 km/hr when it makes a perfectly inelastic collision with a 1000 kg car traveling at 90 km/hr due east. What is the final velocity of the car and truck?

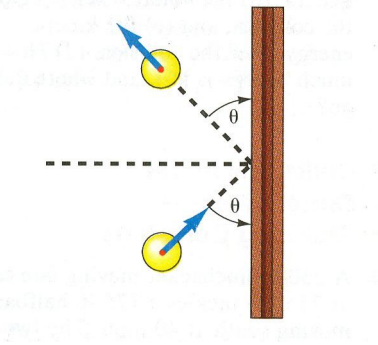
18. Billiard ball 2 is at rest when it is hit with a glancing collision by ball 1 moving at a velocity of 50.0 cmls toward the right. After the collision ball 1 moves off at an angle of 35.0° from the original direction while ball 2 moves at an angle of 40.0°, as shown in the diagram. The mass of each billiard ball is 0.17 kg. Find the final velocity of each ball after the collision.



19. A 0.150-kg ball, moving at a speed of *25.0 mis,* makes an elastic collision with a wall at an angle of 40.0° , and rebounds at an angle of 40.0°. The diagram is a view from the top.

    a) Find the change in momentum of the ball

    b) Find the magnitude and direction of the momentum imparted to the wall.



20. A 200-g ball is dropped from the top of a building. If the speed of the ball before impact is 40.0 *mis,* and right after impact it is 25.0 *mls,*

    a) Find the momentum of the ball before impact,

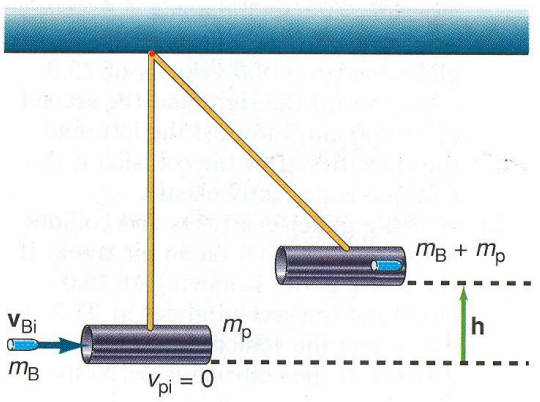
    b) Find the momentum of the ball after impact,

    c) Find the kinetic energy of the ball before impact,

    d) Find the kinetic energy of the ball after impact,

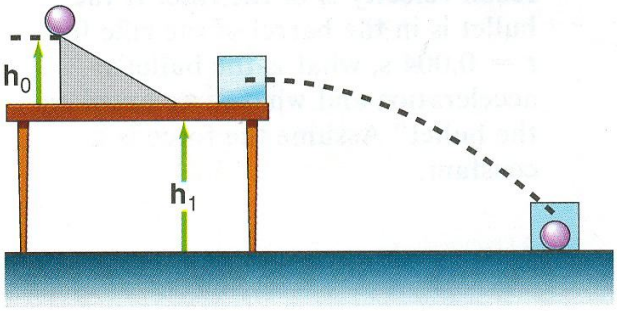
    e) Find the coefficient of restitution of the ball.

21. A 25.0-g bullet strikes a 5.00-kg ballistic pendulum that is initially at rest. The pendulum rises to a height of 14.0 cm. What is the initial speed of the bullet?



22. An 80-kg caveman, standing on a branch of a.tree 5 m high, swings on a vine and catches a 60 kg cave-girl at the bottom of the swing. How high will both of them rise?

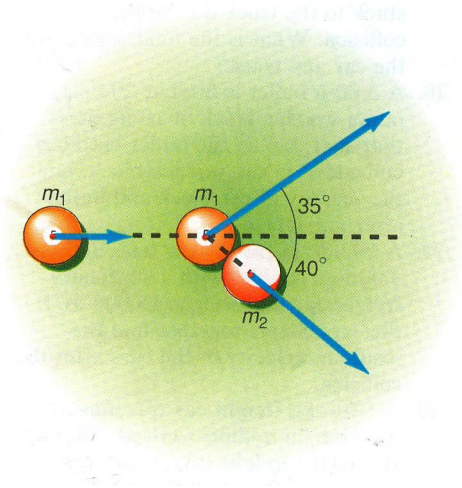
23. A 25-g ball slides down a smooth inclined plane, 0.850 m high, that makes an angle of 35.0° with the horizontal. The ball slides into an open box of 200-g mass and the ball and box slide off the end of a table 1.00 m high. How far from the base of the table will the combined ball and box hit the ground?



24. A bomb of mass M_{total} = 2.50 kg, moving in the x-direction at a speed of 10.5 *mis,* explodes into three pieces. One fragment, m_1 = 0.850 kg, at a velocity of 3.5 mls at an angle of 30.0°. A second fragment m_2 = 0.750 kg, at an angle of 43.5° below the positive x-axis, and a third fragment at an angle of 150°.

    a) Find the velocities of *m2* and *m3.*

25. How long must a force of 5.00 N act on a block of 3.00-kg mass in order to give it a velocity of 4.00 m/s? (N5)
26. A 10.0-g bullet is fired from a 5.00-kg rifle with a velocity of 300 m/s. What is the recoil velocity of the rifle? (7)
27. 10. A cannon of 3.50 X 103 kg fires a shell of 2.50 kg with a muzzle speed of 300 m/s. What is the recoil velocity of the cannon?
28. 16. A boy kicks a football with an average force of 20.0 Ib for a time of 0.200 s. (a) What is the impulse?
(b) What is the change in momentum of the football? (c) If the football has a mass of 250 g, what is the velocity of the football as it leaves the kicker's foot?
29. 20. If a gas molecule of mass 5.30 X 10-26 kg and an average speed of 425 m/s collides perpendicularly with a wall of a room and rebounds at the same speed, what is its change of momentum? What impulse is imparted to the wall?
30. 21. Two gliders moving toward each other, one of mass 200 g and the other of 250 g, collide on a frictionless air track. If the first glider has an initial velocity of 25.0 cm/s toward the right and the second of - 35.0 cm/s toward the left, find the velocities after the collision if the collision is perfectly elastic.
31. 25. A 150-g ball moving at a velocity of 25.0 cm/s to the right collides with a 250-g ball moving at a velocity of 18.5 cm/s to the left. The collision is imperfectly elastic with a coefficient of restitution of 0.65. Find (a) the velocity of each ball after the collision, (b) the kinetic energy
32. before the collision, (c) the kinetic energy after the collision, and (d) the percentage of energy lost in the collision.
33. 27. A II50-kg car traveling at 110 km/hr collides "head-on" with a 9500-kg truck traveling toward the car at 40.0 km/hr. The car becomes stuck to the truck during the collision. What is the final velocity of the car and truck?
34. 30. A 9500-kg freight car traveling at 5.50 km/hr collides with an 8000-kg stationary freight car. If the cars couple together, find the resultant velocity of the cars after the collision.
35. 33. A IO,OOO-kg truck enters an inter- section heading north at 45 km/hr when it makes a perfectly inelastic collision with a 1000-kg car traveling at 90 km/hr due east. What is the final velocity of the car and truck?
36. 34. Billiard ball 2 is at rest when it is hit with a glancing collision by ball 1 moving at a velocity of 50.0 *cm/s* toward the right. After the collision ball 1 moves off at an angle of 35.0° from the original direction while ball 2 moves at an angle of 40.0°, as shown in the diagram. The mass of each billiard ball is 0.017 kg. Find the final velocity of each ball after the collision.



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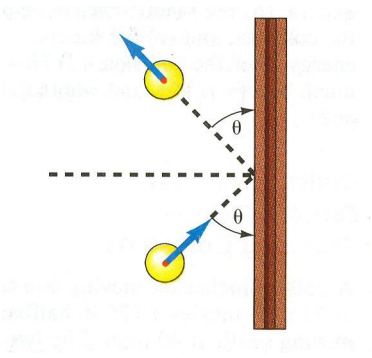
39. 35. A 0.150-kg ball, moving at a speed of *25.0 mis,* makes an elastic collision with a wall at an angle of 40.0° , and rebounds at an angle of 40.0°. Find (a) the change in momentum of the ball and (b) the magnitude and direction of the momentum imparted to the wall. The diagram is a view from the top.



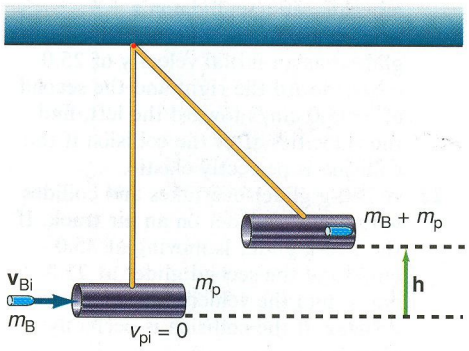
40.

41. 37. A 200-g ball is dropped from the top of a building. If the speed of the ball before impact is 40.0 *mis,* and right after impact it is 25.0 *cmls,* find

42. (a) the momentum of the ball before impact, (b) the momentum of the ball after impact, (c) the kinetic energy of the ball before impact,

43. (d) the kinetic energy of the ball after impact, and (e) the coefficient of restitution of the ball.

44. 40. A 25.0-g bullet strikes a 5.00-kg ballistic pendulum that is initially at rest. The pendulum rises to a height of 14.0 cm. What is the initial speed of the bullet?

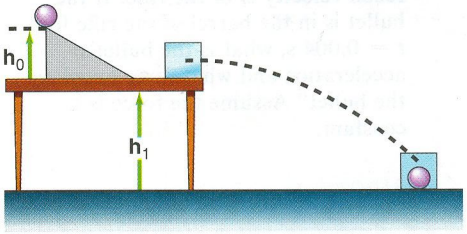


45.

46. 42. An 80-kg caveman, standing on a branch of a.tree 5 m high, swings on a vine and catches a 60 kg cave-girl at the bottom of the swing. How high will both of them rise?

47. 62. A 25-g ball slides down a smooth inclined plane, 0.850 m high, that makes an angle of 35.0° with the horizontal. The ball slides into an open box of 200-g mass and the ball and box slide off the end of a table

48. 1.00 m high. How far from the base of the table will the combined ball and box hit the ground?



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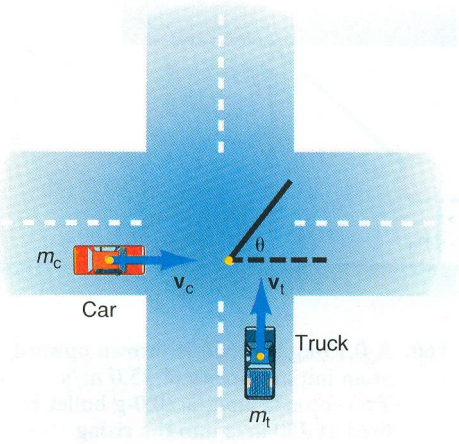
51. 63. A 1300-kg car collides with a 15,000-kg truck at an intersection and they couple together and move off as one leaving a skid mark 5 m long that makes an angle of 30.00 with the original direction of the car. If $\mu_k = 0.700$, find the initial velocities of the car and truck before the collision.



52.

53. 64. Abomb ofmass $M = 2.50$ kg, moving in the x-direction at a speed of 10.5 *mis,* explodes into three
pieces. One fragment, $m. = 0.850$
kg, flies off at a velocity of 3.5 *mls* at an angle of 30.00 above the x-axis. Fragment $m2 = 0.750$ kg, flies off at an angle of 43.50 below the positive x-axis, and the third fragment flies off at an angle of 1500 with respect
to the positive x-axis. Find the velocities of *m2* and *m3.*