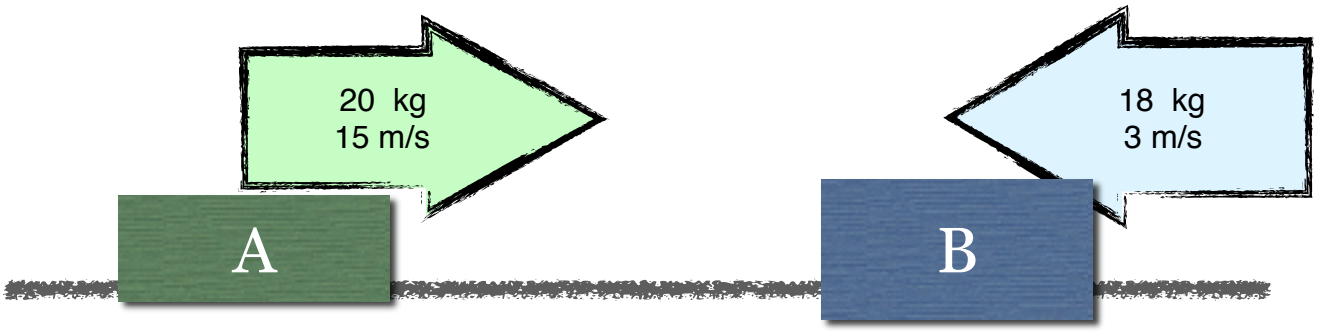
Academic Physics Work and Momentum Summary Name _____

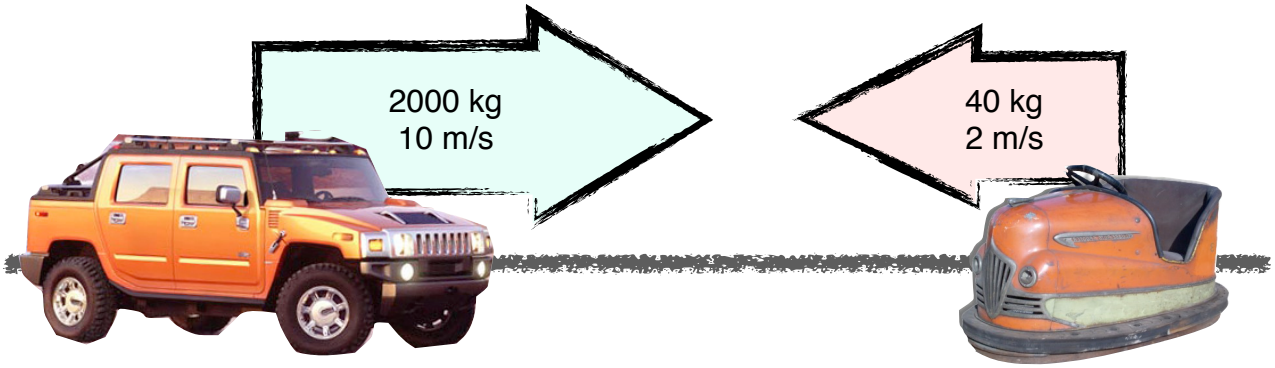
1. A child with a mass of 23kg rides a bike with a mass of 5.5 kg at a velocity of 4.5 m/s to the south. Compare the momentum of the child and the momentum of the bike.
   a) Both the child and the bike have the same momentum.
   b) The bike has a greater momentum than the child.
   c) The child has a greater momentum than the bike.
   d) Neither the child nor the bike has momentum.
2. A roller coaster climbs up a hill at 4 m/s and then zips down the hill at 30 m/s. Throughout the ride, the momentum of the roller coaster
   a) remained the same.
   b) was zero.
   c) was greater up the hill than down the hill.
   d) was greater down the hill than up the hill.
3. The change in an object's momentum is equal to
   a) the product of the mass of the object and the time interval.
   b) the product of the force applied to the object and the time interval.
   c) the time interval divided by the net external force.
   d) the net external force divided by the time interval.
4. The impulse experienced by a body is equivalent to the body's change in
   a) velocity.
   b) kinetic energy.
   c) momentum.
   d) force.
5. A large moving ball collides with a small stationary ball. The momentum
   a) of the large ball decreases, and the momentum of the small ball increases.
   b) of the small ball decreases, and the momentum of the large ball increases.
   c) of the large ball increases, and the momentum of the small ball decreases.
   d) does not change for either ball.
6. Two skaters stand facing each other. One skater's mass is 60 kg, and the other's mass is 72 kg. If the skaters push away from each other,
   a) the 60 kg skater travels at a lower momentum.
   b) their momenta are equal but opposite.
   c) their total momentum doubles.
   d) their total momentum decreases.
7. Two objects move separately after colliding, and both the total momentum and total kinetic energy remain constant. Identify the type of collision.
   a) elastic
   b) perfectly elastic
   c) inelastic
   d) perfectly inelastic

8. After colliding, objects are deformed and lose some kinetic energy. Identify the type of collision.
   a) elastic
   b) perfectly elastic
   c) inelastic
   d) perfectly inelastic
9. A billiard ball collides with a stationary identical billiard ball in an elastic head-on collision. After the collision, which is true of the first ball?
   a) It maintains its initial velocity.
   b) It has one-half its initial velocity.
   c) It comes to rest.
   d) It moves in the opposite direction.
10. A bullet with a mass of $5.00 \times 10{-}3$ kg is loaded into a gun. The loaded gun has a mass of 0.52 kg. The bullet is fired, causing the empty gun to recoil at a speed of 2.1 m/s. What is the speed of the bullet?
    a) 48 m/s
    b) 220 m/s
    c) 120 m/s
    d) 360 m/s
11. A 65.0 kg ice skater standing on frictionless ice throws a 0.15 kg snowball horizontally at a speed of 32.0 m/s. At what velocity does the skater move backward?
    a) 0.07 m/s
    b) 0.30 m/s
    c) 0.15 m/s
    d) 1.20 m/s
12. A bowling ball with a mass of 7.0 kg strikes a pin that has a mass of 2.0 kg. The pin flies forward with a velocity of 6.0 m/s, and the ball continues forward at 4.0 m/s. What was the original velocity of the ball?
    a) 4.0 m/s
    b) 5.7 m/s
    c) 6.6 m/s
    d) 3.3 m/s
13. A 2 kg mass moving to the right makes an elastic head-on collision with a 4 kg mass moving to the left at 4 m/s. The 2 kg mass reverses direction after the collision and moves at 3 m/s. The 4 kg mass moves 1 m/s to the left. What was the initial velocity of the 4 kg mass?
    a) 3m/s to the right
    b) 1 m/s to the left
    c) 4m/s to the left
    d) 4 m/s to the right

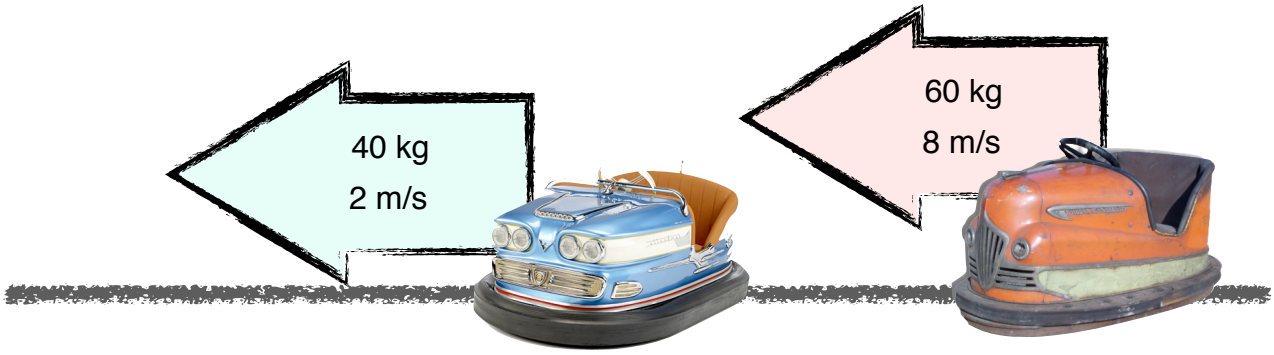


14. In the perfectly inelastic collision above... find the final velocities of EACH of the blocks.

15. The H3 driver has a head on collision with a bumper car as shown. The new velocity of the bumper car is 18 m/s to the right. Find the velocity of the truck and the coefficient of restitution for the collision.



16. The bumper car tries again with another car. They collide as shown above with a 1.0 coefficient of restitution. What are the final velocities of the two vehicles?



17. In 1976, a 53 kg helicopter was built in Denmark. Suppose this helicopter flew east with a speed of 60.0 m/s and the total momentum of the helicopter and pilot was 7200 kg•m/s to the east. What was the mass of the pilot?

18. One of the smallest planes ever flown was the Bumble Bee II, which had a mass of 180 kg. If the pilot's mass was 70 kg, what was the velocity of both plane and pilot if their momentum was 20 800 kg•m/s to the west?

19. The first human-made satellite, Sputnik I, had a mass of 83.6 kg and a momentum with a magnitude of 663 000 kg•m/s. What was the satellite's speed?

20. A net force of 10.0 N to the right pushes a 3.0 kg book across a table. If the force acts on the book for 5.0 s, what is the book's final velocity? Assume the book to be initially at rest.

21. A child riding a sled is pulled down a snowy hill by a force of 75 N. If the child and sled have a combined mass of 55 kg, what is their speed after 7.5 s? Assume the child and sled are initially at rest.

22. A billiard ball with a mass of 0.195 kg and a velocity of 0.850 m/s to the right is deflected by the cushioned edge of the billiard table. The cushion exerts a force of 3.50 N to the left for 0.0750 s. What is the ball's final velocity?

23. A 5.00 g projectile has a velocity of 255 m/s to the right. What force is required to stop this projectile in 1.45 s?

24. A 1550 kg torpedo strikes a 770 kg target that is initially at rest. If the combined torpedo and target move forward with a speed of 9.44 m/s, what is the initial velocity of the torpedo? Assume that no resistance is provided by the water.

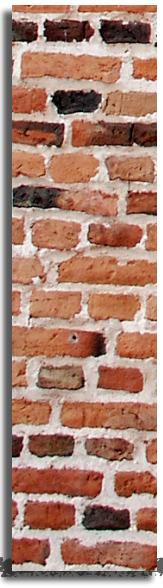
25. An ice hockey puck with a mass of 0.17 kg collides inelastically with a 0.75 kg snowball that is sliding to the left with a speed of 0.50 m/s. The combined puck and snowball slide along the ice with a velocity of 4.2 m/s to the right. What is the velocity of the hockey puck before the collision?

26. A railway car with a mass of 8500 kg and a velocity of 4.5 m/s to the right collides inelastically with a railway car with a mass of 9800 kg and a velocity of 3.9 m/s to the left. What is the final velocity of the combined cars?

27. A 25.0 kg sled carrying a 42.0 kg child is moving with a speed of 3.50 m/s when it collides with a snowman that is initially at rest. If the speed of the snowman, sled, and child is 2.90 m/s, what is the snow- man's mass?

28. A dump truck used in Canada has a mass of 5.50×105 kg when loaded and 2.30×105 kg when empty. Suppose two such trucks, one loaded and one empty, crash into each other at a monster truck show. The trucks are supplied with special bumpers that make a collision almost perfectly elastic. If the trucks hit each other at equal speeds of 5.00 m/s and the less massive truck recoils to the right with a speed of 9.10 m/s, what is the velocity of the full truck after the collision?

29. A 250g baseball is thrown into a wall with a velocity of 20 m/s. It hits the wall and recoils with a velocity of 14 m/s. This collision takes 0.015 seconds.



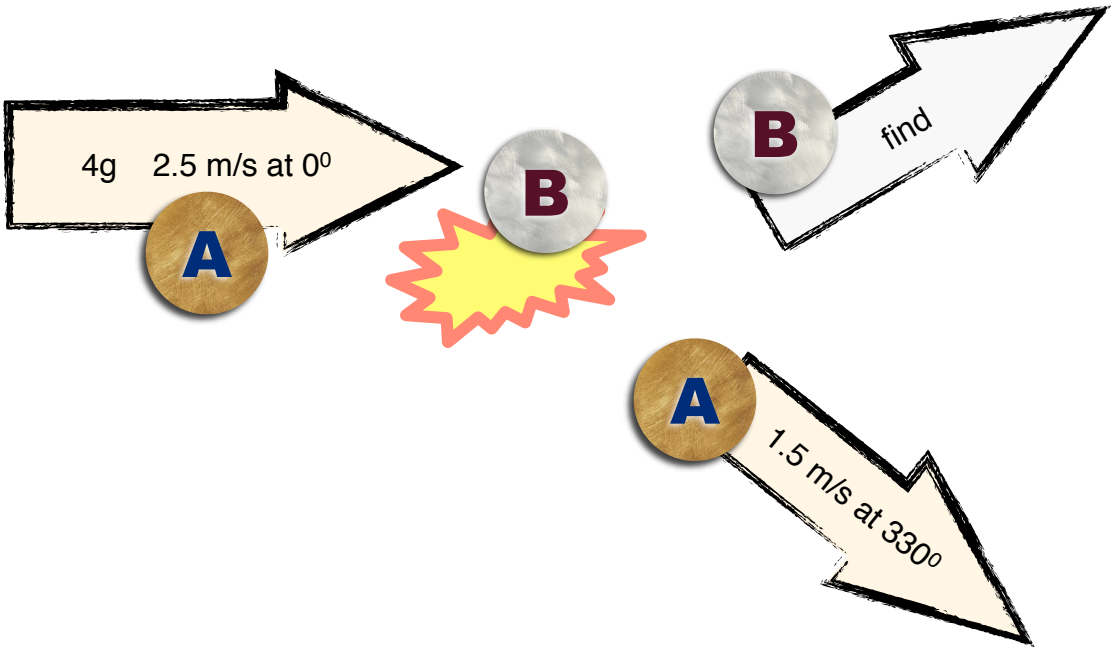
a) What is the initial momentum of the ball?

b)What is the momentum after it hits?

c) What is the impulse on the ball?

d)What is the force on the ball?

30. In a lab exercise, two marbles are used in a collision. Marble "A" has a mass of 4g, and an initial velocity of 2.5 m/s. Marble "B" has a mass of 8g, and is at rest. After the collision, "A" has a velocity of 1.5 m/s at 330o. What is the final velocity of "B"?



31. 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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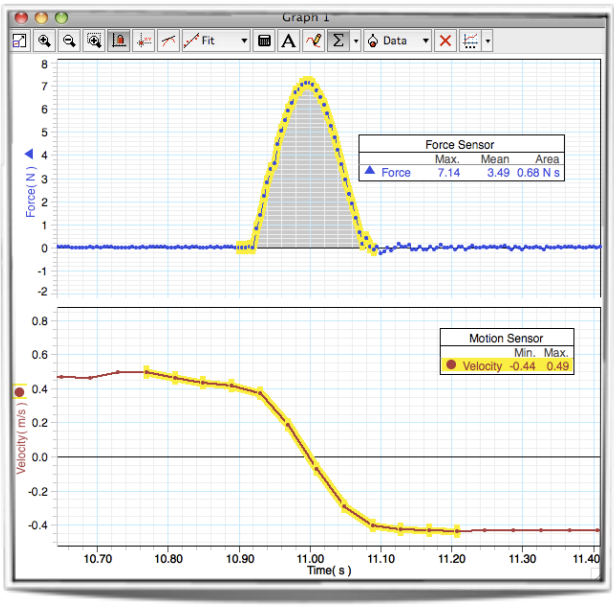
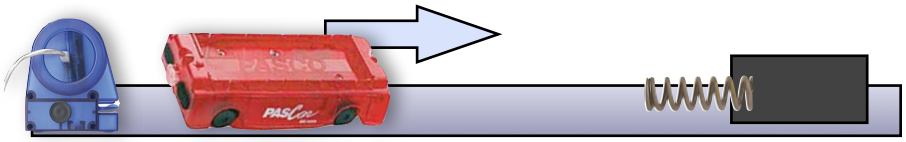
A student in this class forgot to finish all of their labs. You can trust the numbers they have written, but please complete all of the missing parts.



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

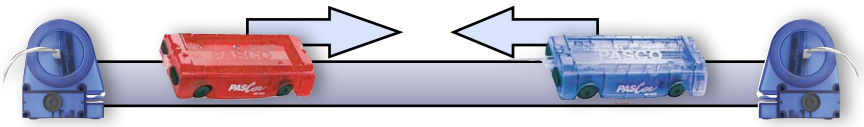
a) What is shown by the area under the Force/Time graph?

_____

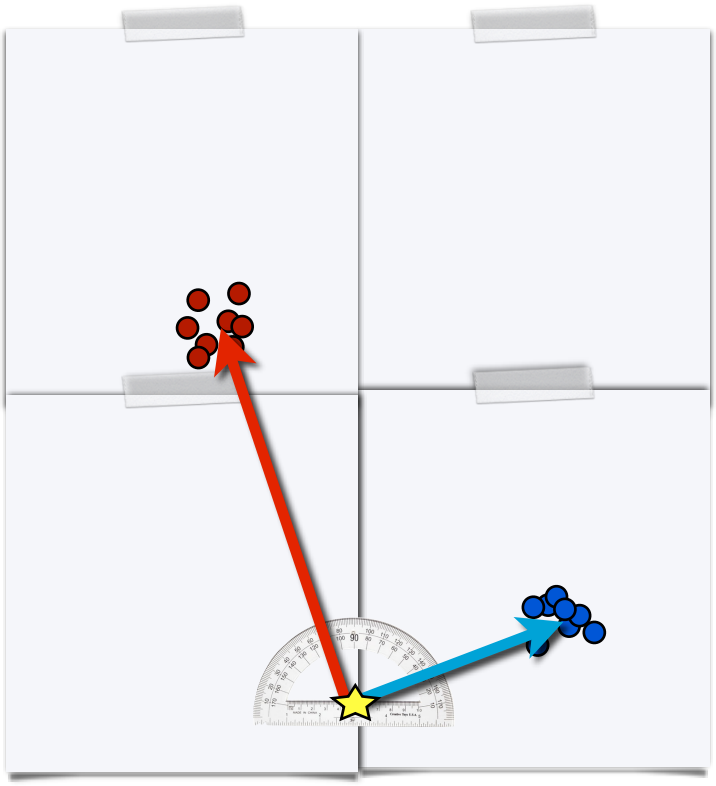


Area of Force Graph	Average Force	Min Velocity	Max Velocity	Impulse	Change in Momentum	Change in Velocity	Mass
0.68 Ns	**3.49 N**	**-0.44**	**0.49**				

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



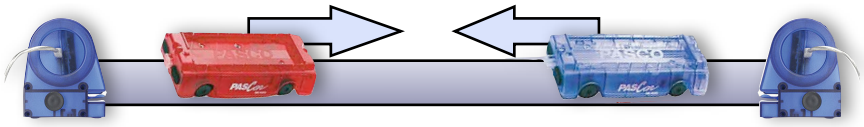
Mass A	Mass B	Velocity A_i	Velocity B_i	Velocity A_f	Velocity B_f
0.5 kg	0.75 kg	9.0 m/s	-6.0 m/s		



34. 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.

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

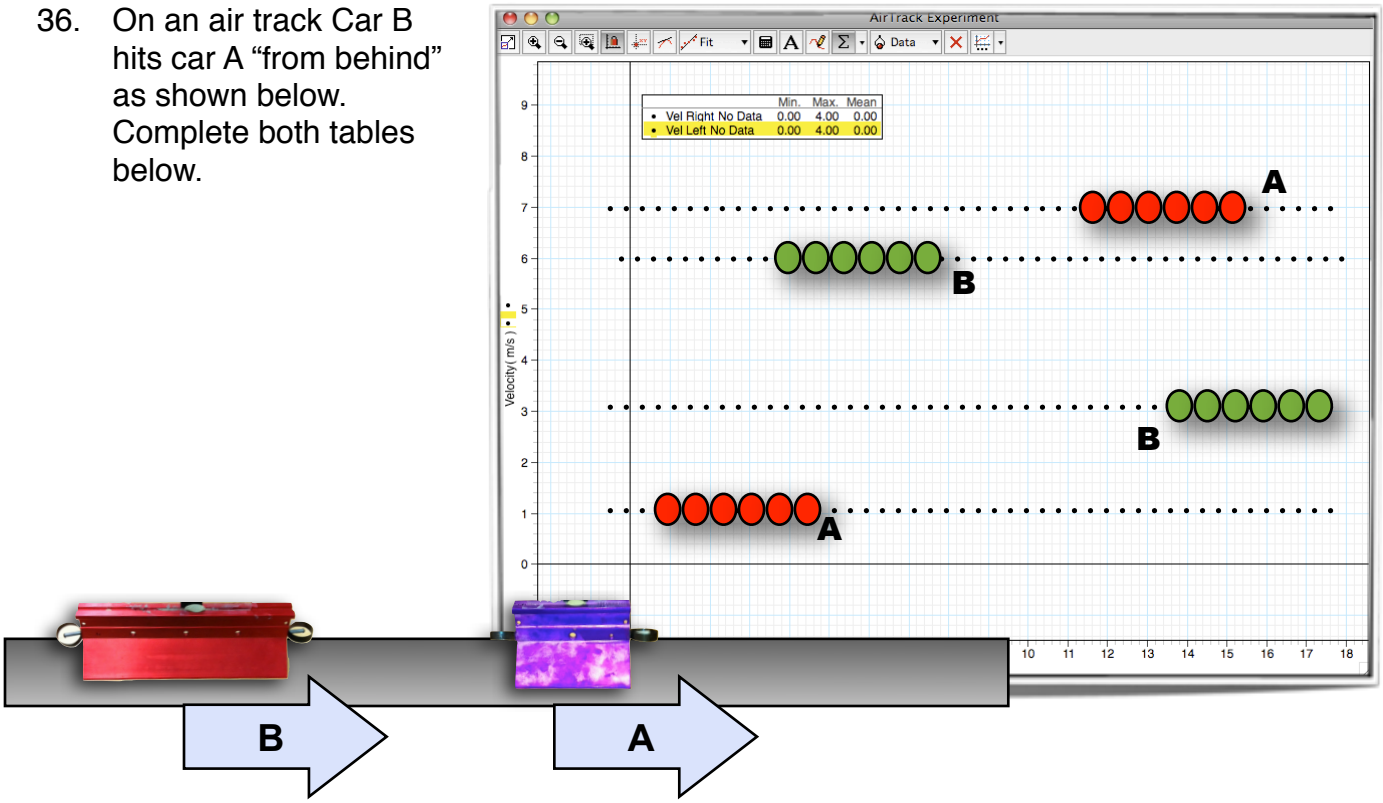
35. In the **inelastic** collision two cars approach as shown. Complete the table with your results.



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	

Momentum A_i	**Momentum B_i**	**Momentum A_f**	**Momentum B_f**	**Initial Momentum**	**Final Momentum**

36. On an air track Car B hits car A "from behind" as shown below. Complete both tables below.



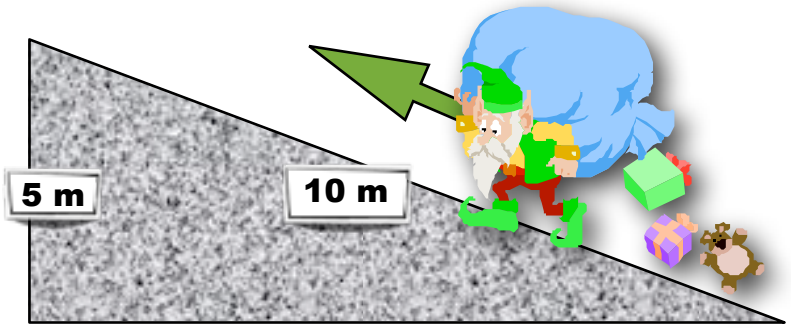
Mass A	Mass B	V A_i	V B_i	V A_f	V B_f
0.3 kg	0.6 kg				

Momentum A_i	Momentum B_i	Momentum A_f	Momentum B_f	Initial Momentum	Final Momentum

37. How much did the momentum of car A change?

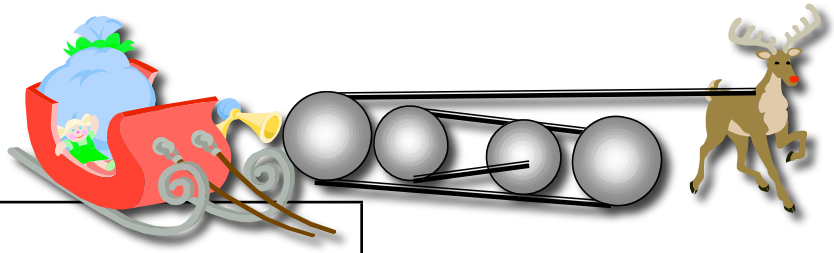
38. What was the impulse on car A?

39. If the collision took 0.03 seconds, what was the Force acting on car A?



Work Input	
Work Output	
IMA	
AMA	
Elf Power	

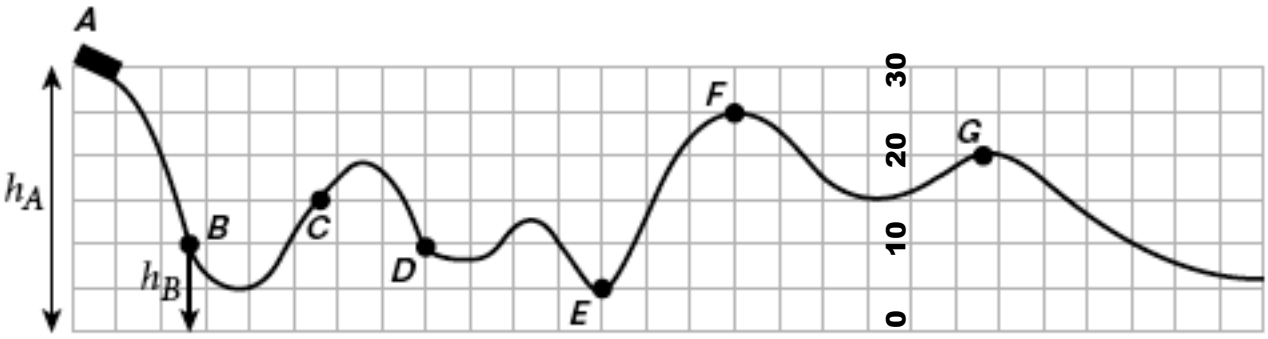
40. An elf can push the toys up the **10 m** incline with a force of **500 N** in **30 seconds** with an efficiency of **80**%. Complete the table



Work Input	
Work Output	
IMA	
AMA	
Reindeer Power	

41. 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.

42. The rolling car has a mass of 700 kg, and starts from a height of 30 m. It is released from the top with negligible velocity. Complete the table below for any three points.



Point	H	PE	KE	TE	V
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___					
___					