Ap physics impulse and momentum worksheet

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Momentum & Impulse Worksheet 1

1. A deer with a mass of 146 kg is running head on toward you with a speed of 17 m/s. You are going north. Find the momentum of the deer.

2. A .5 kg football is thrown with a velocity of 15 m/s to the right. A stationary receiver catches the ball and brings it to rest in .02 seconds. What is the force exerted on the ball by the receiver?

3. A 2500 kg car traveling to the north is slowed down uniformly from an initial velocity of 20 m/s by a 6250 N braking force acting opposite the car's motion. (Hint – force is negative 6250 not positive). Use the impulse momentum theorem to answer the following questions:
   a. What is the car's velocity after 2.5 s?

   b. How far does the car move during 2.5 s?

   c. How long does it take the car to come to a complete stop (final velocity now equals zero)?

4. A 63 kg astronaut is on a spacewalk when the tether line to the shuttle breaks. The astronaut is able to throw a spare 10 kg oxygen tank in a direction away from the shuttle with a speed of 12 m/s, propelling the astronaut back to the shuttle. Assuming the astronaut starts from rest with respect to the shuttle, find the astronaut's final speed with respect to the shuttle after the tank is thrown.

7. Momentum and Impulse WKSHT 7.1

Force_and_Momentum_Problems_Worksheet

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Force and Momentum Problems Worksheet

- Complete the Data Table

Measurement	Unit	Measurement	Unit
Mass		Time	
Momentum		Acceleration	
Distance		Velocity	
Force		Weight	

- For the problems; SHOW YOUR WORK and BOX YOUR ANSWERS.
- Formulas that you may need: F = m * a N kg·m/s²
  p = m * v kg·m/s

1.) How much force is needed to accelerate a 100 kg mass at a rate of 2.5 m/s²?

2.) What is the force acting on a 0.5 kg object moving at a rate of 100 m/s²?

3.) What is the mass of an object that is accelerating at a rate of 25 m/s² and is using 15 N of

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Momentum Packet 2

Newton's Third Law and Momentum Conservation

Read from **Lesson 2** of the **Momentum and Collisions** chapter at **The Physics Classroom**:

MOP Connection: Momentum and Collisions: sublevels 4, 5 and 6

Newton's Third Law and Collisions: In a collision between object 1 and object 2, both objects encounter a force resulting from their mutual interaction with each other. The force on object 1 (F_1) is equal to and opposite in direction as the force on object 2 (F_2).

Plus a Little Logic: The forces which these two objects experience endure for the same amount of time. Since $F_1 = F_2$ and $t_1 = t_2$ it stands to reason that $F_1 * t_1 = F_2 * t_2$. This is to say that each object encounters the same impulse. If this is the case, then one can also reason that each object must experience the same momentum change.

Use the above principles to answer the next four questions.

1. The club head (m=0.170 kg) of a golf club collides with a golf ball (m=0.046 kg) at rest upon a tee.
   a. Which object experiences the greatest force? club head golf ball both the same
   b. Which object experiences the greatest impulse? club head golf ball both the same
   c. Which object experiences the greatest Δmomentum? club head golf ball both the same
   d. Which object experiences the greatest acceleration? club head golf ball both the same

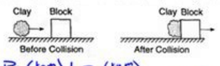
2. A woman (m = 45 kg) is kneeling on the shoulders of a man (m = 70 kg) in pair figure skating. The man gracefully tosses the woman forward through the air.
   a. Which object experiences the greatest force? man woman both the same
   b. Which object experiences the greatest impulse? man woman both the same
   c. Which object experiences the greatest Δmomentum? man woman both the same
   d. Which object experiences the greatest acceleration? man woman both the same

3. A moving cue ball collides head-on with the eight ball that is at rest upon the pool table. Assume the balls have the same mass.
   a. Which object experiences the greatest force? cue ball 8-ball both the same
   b. Which object experiences the greatest impulse? cue ball 8-ball both the same
   c. Which object experiences the greatest Δmomentum? cue ball 8-ball both the same
   d. Which object experiences the greatest acceleration? cue ball 8-ball both the same

4. A large truck and a Volkswagen (VW) beetle have a head-on collision.
   a. Which object experiences the greatest force? truck VW both the same
   b. Which object experiences the greatest impulse? truck VW both the same
   c. Which object experiences the greatest Δmomentum? truck VW both the same
   d. Which object experiences the greatest acceleration? truck VW both the same

Conservation of Momentum – Group Problems

1. A 0.5 kg ball of clay travelling at 6.0 m/s collides with a 1 kg wooden block sitting on a frictionless surface. After the collision the clay and the block stick together. How fast are they moving after the collision?



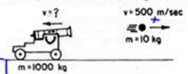
$m_c = 0.5\,kg$, $v_c = 6.0\,m/s$, $m_B = 1\,kg$, $v_B = 0\,m/s$, $v' = ?$

	$P_i\left(\frac{kg\,m}{s}\right)$	$P_f\left(\frac{kg\,m}{s}\right)$
Clay	$0.5 \cdot 6 = 3$	$(0.5+1)v'$
Block	0	
Total	3	$= 1.5v'$

$v' = \frac{3}{1.5} = 2\,m/s$

$v' = 2\,m/s$

2. A 10 kg ball is fired with a velocity of 500 meters per second form a 1,000 kg cannon. What is the recoil velocity of the cannon?



Objects	$P_i\left(\frac{kg\,m}{s}\right)$	$P_f\left(\frac{kg\,m}{s}\right)$
Cannon		$1000\,v_c'$
Ball	0	$10 \cdot 500 = 5000$
Total		$= 1000v_c' + 5000$

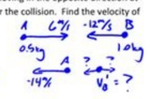
$v_c' = 5\,m/s \leftarrow$

$v_c' = \frac{-5000}{1000} = -5\,m/s$

A B

3. A 0.5 kg ball travelling at 6.0 m/s collides head-on with a 1.0 kg ball moving in the opposite direction at a velocity of -12 m/s. The 0.5 kg ball moves away with a -14 m/s after the collision. Find the velocity of the second ball.

A



Objects	$P_i\left(\frac{kg\,m}{s}\right)$	$P_f\left(\frac{kg\,m}{s}\right)$
Ball A	$0.5 \cdot 6.0 = 3$	$0.5 \cdot (-14) = -7$
Ball B	$1 \cdot (-12) = -12$	$1\,v_B'$
Total	$3 + (-12) = -7 + v_B'$	

$-9 + 7 = v_B'$

$v_B' = -2\,m/s$

Work & Energy Word Problems Calculating Work

Work has a special meaning in science. It is the product of the force applied to an object and the distance the object moves. The unit of work is the Joule (J).
Work = Force x Distance
W = F x d Work = joules (J) Force = newtons (N) Distance = meters (m)

1. A book weighing 1.0 newton is lifted 2 meters. How much work was done?
2. A force of 25 newtons is used to push a box along the floor a distance of 3 meters. How much work was done?
3. 25 rock 50 joules to push a chair 5 meters across the floor. With what force was the chair pushed?
4. A force of 100 newtons was necessary to lift a rock. A total of 250 joules of work was done. How far was the rock lifted?
5. 25 rock 500 newtons of force to push a car 4 meters. How much work was done?
6. A young man exerted a force of 9,000 N on a stalled car but was unable to move it. How much work was done?

Calculating Power

Power is the amount of work done per unit of time. The unit for power, joules/second, is the watt. Power = work/time work = joules time = seconds
1. A set of pulleys is used to lift a piano weighing 1,000 newtons. The piano is lifted 3 meters in 60 seconds. How much power is used?
2. How much power is used if a force of 35 newtons is used to push a box a distance of 10 meters in 5 seconds?
3. What is the power of a kitchen blender if it can perform 3,750 joules of work in 15 seconds?
4. How much work is done using a 900 watt microwave oven for 5 minutes.
5. How much work is done using a 60 watt light bulb for 1 hour?

Calculating Efficiency

The amount of work obtained from a machine is always less than the amount of work put into it. This is because some of the work is lost due to friction. The efficiency of a machine can be calculated using the following formula
percent efficiency = work output / work input x 100

1. A man expends 100 J of work to move a box up an inclined plane. The amount of work produced is 80J.
2. A box weighing 2 newtons is pushed up an inclined plane that is 5 meters long. It takes a force of 75 newtons to push it to the top, which has a height of 3 meters.
3. Using a lever, a person applies 90 newtons of force and moves the lever 3 meter. This moves a 200 newton rock of the other end by 0.2 meters.
4. A person in a wheelchair exerts a force of 25 newtons to go up a ramp that is 10 meters long. The weight of the person and wheelchair is 60 newtons and the height of the ramp is 3 meters.
5. A toy pushes a lever down 2 meters with a force of 75 newtons. The box at the other end with a weight of 50 newtons moves up 2.5 meters.
6. A pulley system operates with 40% efficiency. If the work put in is 200 joules, how much useful work is produced?

What is impulse and momentum in physics. What is the principle of impulse and momentum. Ap physics worksheet impulse and momentum answers. Facts about momentum and impulse.

← Previous 1 2 3 4 5 6 7 8 9 Next → In a billiards game, one player hits the cue ball towards another ball. The cue ball has a mass of 0.1kg and hits the other ball with a velocity of . If the collision is completely elastic and the cue ball travels with a velocity of after the collision, what is the mass and velocity of the other ball? Possible Answers: Correct answer: Explanation: Since the collision is completely elastic, we know that both momentum and kinetic energy are conserved. We can write the following equations (initial momentum and energy of the second ball are neglected since it is not moving: Rearrange the first equation for and the second for . We can rewrite the second equation as: Substitute our equation for into the second equation: Rearranging, we get: Plug in our values for the initial and final velocities: To solve for mass, we'll use our earlier expression for : Two sumo wrestlers are in a match. At the start of the match, they both lunge at each other. They hit and miraculously come to a stand still. One wrestler was 200kg and traveling at a velocity of at the instance of collision. If the other wrestler was traveling at , what is his mass? Possible Answers: Correct answer: Explanation: It does not matter whether the collision is elastic or inelastic (although it would be best to assume that it's inelastic). Momentum is conserved in either type of collision, and is the only value needed for our calculation. Since they come to a standstill, their momentums at the moment of collision are equal and opposite: Rearrange to solve for : Plug in the given values from the question and solve: One car with a mass of 400kg is traveling east at and collides with a car of mass 800kg traveling west at . Assuming the collision is completely inellastic, what is velocity of the first car after the collision? Possible Answers: Correct answer: Explanation: Since the collision is completely inelastic, momentum is conserved but energy is not. Furthermore, the two cars stick to each other and travel as one. The equation for conservation of momentum is as follows: There are two inital masses with different velocities and one final mass with a single velocity. Therefore, we can write: Rearranging for final velocity, we get: At this point, we can denote which direction is positive and which is negative. Since the car traveling west has more momentum, we will consider west to be positive. Substituting our values into the equation, we get: Since this value is positive, the final answer is West. A marble of mass falls off a bed with a height of . What is the impulse on the marble as it hits the ground? Possible Answers: Correct answer: Explanation: Impulse can be written as either of two popular expressions: From the problem statement, we can determine the velocity of the marble as it hits the floor, allowing us to use the latter expression. To determining the velocity of the marble, we can use the equation for conservation of energy: Assuming the final height is zero, we can eliminate initial kinetic energy and final potential energy. Therefore, we can write: Canceling out mass and rearranging for final velocity, we get: We know these variables, allowing us to solve for the velocity: Plugging this value into the expression for impulse, we get: Consider the following system: If the block has a mass of , the angle measures , and there is no friction between the block and slope, what is the momentum of the block after it has traveled a horizontal distance of ? Possible Answers: Correct answer: Explanation: To calculate the momentum of the block, we first need to know the velocity of the block. This can be found using the equation for the conservation of momentum: If we assume that the final height is zero, we can eliminate initial kinetic energy and final potential energy, getting: Substituting expressions for each term, we get: Cancel out mass and rearrange to solve for velocity: We can use the horizontal distance traveled and the angle of the slope to determine the initial height: Now that we have the initial height, we can solve for final velocity: Finally, we can now use the equation for momentum to solve the problem: Two astronauts in space are traveling directly towards each other. Astronaut A has a mass of and a velocity of and Astronaut B has a mass of and a velocity of . When the astronauts collide, they grab onto each other. What is the velocity of the two astronauts after the collision as they continue to grab onto each other? Possible Answers: Correct answer: Explanation: Momentum is always conserved. Equation for conservation of momentum: There is only one velocity on the right since the two astronauts grab onto each other, thus they move together at the same velocity. Solve. A rock flying through the air is traveling at a velocity of when it collides into and sticks to a stationary bean bag, weighing . What is the velocity of the two objects? Possible Answers: Correct answer: Explanation: The equation for momentum is: To maintain conservation of momentum, a new state must have the same momentum as a previous state: Since the rock and the bean bag move together after the collision, . And since the bean bag is initially stationary, Plug in known values and solve. A 150g baseball is thrown with a speed of . If it takes 0.7s for the baseball to come to rest in the catcher's glove, what is the average force the catcher experiences due to the ball? Possible Answers: Correct answer: Explanation: To solve this problem, we need to consider the change in the ball's momentum. To do so, we'll use the following equation. Rearrange the above equation to solve for the average force. Joe, of mass 90kg, jumps straight up. To do so, he bends his knees and produces an upwards force that results in a constant upward net force of 100N. If Joe experiences this force for 0.9s before leaving the ground, what is Joe's velocity immediately after he leaves the ground? Possible Answers: Correct answer: Explanation: To solve this problem we need to use the relationship between force and impulse, which is given by the following equation: This equation represents that the rate of change of momentum with respect to time is equal to the net force that causes said change in momentum. Thus: Note that Joe must have an initial velocity of before he begins to apply the upwards Force that accelerates him upwards, therefore our equation simplifies to: Solve for : Which of the following explains why when we land on our feet, we instinctively bend our knees? Hint: think about the relationship between force, impulse, and time. Possible Answers: By bending our knees we extend the time it takes us to stop, which increases the impact force When we bend our knees we extend the time in which we apply the force that stops us, so our impulse is greater By bending our knees we extend the time it takes us to stop, which diminishes the impact force When we bend our knees we extend the time in which we apply the force that stops us, so our impulse is smaller By bending our knees we use a greater force to stop, which makes the impulse smaller Correct answer: By bending our knees we extend the time it takes us to stop, which diminishes the impact force Explanation: Say that, when we hit the ground, we have a velocity , which is predetermined by whatever happens before the impact. When we hit the ground you will experience a force for some time. This force will cause the acceleration that reduces our velocity to zero and gets us to stop. Note that, regardless of how much time it takes us to stop, the change in momentum (impulse) is fixed, since it directly depends on how much our velocity changes: (since we come to a stop) Note that the initial momentum does not depend on the impact force nor on how much time it takes to stop. The initial momentum depends on the velocity we have when we first hit the ground. This velocity is given by whatever happened before we hit the ground, which no longer concerns us since we only care about what happens from the moment we first hit the ground till the moment we stop. Yes, the time that passes for you to stop is very small, but it is impossible for it to be zero. So we have that the change in momentum (impulse) is a constant: , since is predetermined. Remember that any change in momentum for a given mass occurs because its velocity changes. The velocity of the mass changes due to an acceleration and an acceleration is caused by a force. This gives us a relationship between force and impulse: In our scenario, would be the impact force that stops us and the time it takes us to stop. From the equation above, it is easy to see that, since is fixed, when gets larger gets smaller, and the other way around. Therefore, we bend our knees to effectively increase the time it takes us to stop. Thus, diminishing the impact force as to avoid hurting ourselves. ← Previous 1 2 3 4 5 6 7 8 9 Next → Bruce Certified Tutor North Carolina A T State University, Bachelor of Science, Engineering Physics. North Carolina A T State University, Master ... Michael Certified Tutor The University of Texas at Austin, Bachelors, Physics. Quinn Certified Tutor Florida Gulf Coast University, Bachelor of Science, Chemistry. If you've found an issue with this question, please let us know. With the help of the community we can continue to improve our educational resources. 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