

Chapter 8 Momentum and Impulse

Example Problems

8.1 Momentum

- Example 1:
 - A SMART car, driven by a monkey, has a mass of 725 kg, and is moving at 27.8 m/s toward the east. Find the magnitude and direction of its momentum.

What are the givens and unknowns?

Write your formula(s) and show your work

$p =$

$m =$

$v =$

- Example 2:
 - A 5.00-kilogram block slides along a horizontal, frictionless surface at 10.0 meters per second. What is the magnitude of the block's momentum?

What are the givens and unknowns?

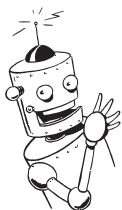
Write your formula(s) and show your work

$p =$

$m =$

$v =$

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- Example 3:
 - Suppose that your mass is 50.0-kg. How fast would you have to be running in order to have the same momentum as a 1,500-kg car driven by a monkey traveling at 26.82 m/s (60 mph)?

What are the givens and unknowns?

Write your formula(s) and show your work

$p =$

$m =$

$v =$

- Example 4:
 - Suppose that your mass is 60.0-kg. How fast would you have to be running in order to have the same momentum as the Titanic 4.23×10^8 -kg right before it hit the iceberg traveling at 11.623 m/s (26 mph)?

What are the givens and unknowns?

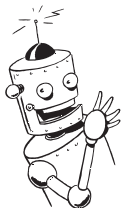
Write your formula(s) and show your work

$p =$

$m =$

$v =$

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Example Problems

8.2 Impulse

- Example 1:
 - Tiger Woods hits a 0.050-kg golf ball, giving it a speed from 0 m/s to 75 m/s. What impulse does he impart to the ball?

What are the givens and unknowns?

Write your formula(s) and show your work

$$J =$$

$$m =$$

$$\Delta v =$$

- Example 2:
 - A hockey player takes a slap shot hitting a 0.17 kg hockey puck changing the speed from 0 m/s to 49.31 m/s. What is the magnitude of the impulse given to the puck?

What are the givens and unknowns?

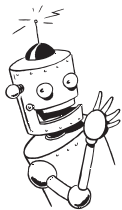
Write your formula(s) and show your work

$$J =$$

$$m =$$

$$\Delta v =$$

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- Example 3:
 - Baseball pitcher throws a fastball with a 100 Ns impulse. If he applied the force in 0.15 seconds, what force did he apply?

What are the givens and unknowns?

Write your formula(s) and show your work

$$J =$$

$$F =$$

$$t =$$

- Example 4:
 -A hockey puck is hit by a hockey player at the goalie. The puck is hit with a 1200 Newton force. The stick made contact for 0.1 seconds. What impulse was given to the puck? If a goalie stopped it with a force that acts for 0.65 seconds, then what force did he apply?

What are the givens and unknowns?

Write your formula(s) and show your work

$$J_p =$$

$$J_g =$$

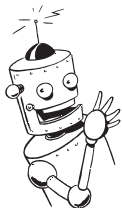
$$F_p =$$

$$F_g =$$

$$t_p =$$

$$t_g =$$

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Example Problems

8.3 FAT-MAV

- Example 1:
 - A 1000 kg car, driven by a monkey, crashed into a bearer. The car changed speed from 30 m/s to 20 m/s in 2 seconds.
 - a) What force did the bearer apply to stop the car?
 - b) What was the change in momentum of the car?
 - c) What was the impulse delivered to the car?

What are the givens and unknowns?

Write your formula(s) and show your work

$\Delta p =$

$m =$

$\Delta v =$

$J =$

$F =$

$t =$

- Example 2:
 - A monkey accelerates a 240.0 kg snowmobile, which results in the speed the snowmobile changing from 6.00 m/s to 28.0 m/s over a time interval of 60.0 s.
 - a) What force did the bearer apply to stop the snowmobile?
 - b) What was the change in momentum of the snowmobile?
 - c) What was the impulse delivered to the snowmobile?

What are the givens and unknowns?

Write your formula(s) and show your work

$\Delta p =$

$m =$

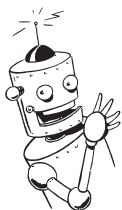
$\Delta v =$

$J =$

$F =$

$t =$

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- Example 3:
 - A 0.144-kg baseball is pitched horizontally at 38.0 m/s. After it is hit by the bat, it moves at the same speed, but in the opposite direction.
 - a) If the bat applied a force to the ball of -13,680 N, how long was the bat in contact with the ball?
 - b) What was the change in momentum of the ball?
 - c) What was the impulse delivered by the bat?

What are the givens and unknowns?

Write your formula(s) and show your work

$\Delta p =$

$m =$

$\Delta v =$

$J =$

$F =$

$t =$

- Example 4:
 - A 0.06 kg tennis ball is hit with a force of -138 N and leaves the racket in the opposite direction from which it came.
 - c) If the 0.060-kg ball is in contact with the racket for 0.020 s, what is the change in velocity of the ball?
 - a) What is the change in momentum of the tennis ball?
 - b) What was the impulse delivered by the racket?

What are the givens and unknowns?

Write your formula(s) and show your work

$\Delta p =$

$m =$

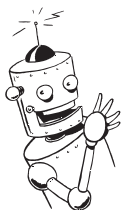
$\Delta v =$

$J =$

$F =$

$t =$

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Student Problems

8.1 Momentum

YOU MUST SHOW ALL WORK! (Formulas, plug in numbers, answer boxed, units)

1. The worlds fastest human Usain Bolts has a mass of 94 kilograms (207 pounds) and can run at a top speed of 12.4 m/s (27.78 mph), calculate Usain Bolts momentum.

What are the givens and unknowns?

Write your formula(s) and show your work

$p =$

$m =$

$v =$

a) _____ ← units

2. The cheetah is the fastest land mammal found today. An adult cheetah has an average mass of 72.57 kg (160 pounds) and can run at 30 m/s (70 mph), calculate the momentum of an adult cheetah running at top speed.

What are the givens and unknowns?

Write your formula(s) and show your work

$p =$

$m =$

$v =$

a) _____ ← units

3. An African elephant has a mass of 5,500-kg (12,125 pounds) and can run at a top speed of 6.71 m/s (15 mph). Calculate the momentum of an elephant.

What are the givens and unknowns?

Write your formula(s) and show your work

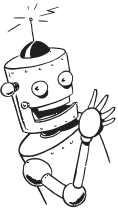
$p =$

$m =$

$v =$

a) _____ ← units

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4. Suppose that you had a mass of 68.03-kg (150 pounds). How fast would you have to run in order to have the same momentum as a 5,500-kg elephant traveling at a speed of 6.71 m/s (15 mph)?

What are the givens and unknowns?

Write your formula(s) and show your work

$p =$

$m =$

$v =$

a) _____ ← units

5. A Porsche (driven by a monkey) has a mass of 1,361-kg (3,000 pounds) and is traveling at 26.82 m/s (60 mph). If your mass is 68.03-kg (150 pounds) how fast would you have to run in order to have the same momentum at the Porsche?

What are the givens and unknowns?

Write your formula(s) and show your work

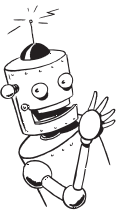
$p =$

$m =$

$v =$

a) _____ ← units

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8.3 Impulse and FAT-MAV

6. A hockey player makes a slap shot, exerting a constant force of 30.0 N on the hockey puck for 0.16 s. What is the magnitude of the impulse given to the puck?

What are the givens and unknowns?

Write your formula(s) and show your work

$J =$

$m =$

$\Delta v =$

a) _____ ← units

7. A 95-kg (210 pounds) football player is running with the ball and has a velocity of 4.2 m/s to the right. What magnitude and the direction of the impulse needed to stop the runner?

What are the givens and unknowns?

Write your formula(s) and show your work

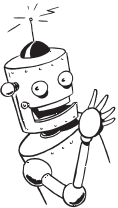
$J =$

$m =$

$\Delta v =$

a) _____ ← units

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8. A pitcher throws a baseball of mass 0.145-kg at 45 m/s (100-mph) to the right. What is the magnitude and direction of the impulse required to stop the ball by the catcher?

What are the givens and unknowns?

Write your formula(s) and show your work

$J =$

$m =$

$\Delta v =$

a) _____ ← units

9. From the same problem above (#8), lets assume the baseball is hit by the batter and the velocity of the baseball is changed from 45 m/s to the right to 33.53 m/s to the left. Calculate the change in velocity of the ball and what is the magnitude and direction of an impulse by the bat? [the baseball has a mass of 0.145-kg]

What are the givens and unknowns?

Write your formula(s) and show your work

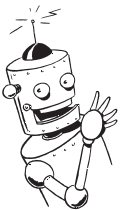
$J =$

$m =$

$\Delta v =$

a) _____ ← units

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10. The fastest a football has ever been thrown was achieved when a quarterback applied an impulse of 11.53 N•s to a 0.43 kg football, what was the velocity of the football.

What are the givens and unknowns?

Write your formula(s) and show your work

$J =$

$m =$

$\Delta v =$

a) _____ ← units

11. The fastest drive of a golf ball was an unbelievable 97.05 m/s (217.1 mph). If a golf ball has a mass of 0.05 kg and the time of contact between the golf club and the golf ball is 0.005 seconds, find the magnitude of the force exerted by the club on the ball?

What are the givens and unknowns?

Write your formula(s) and show your work

$m =$

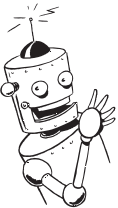
$\Delta v =$

$F =$

$t =$

a) _____ ← units

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12. A top tennis player can hit a serve at 58.12 m/s (130 mph). If the time of contact between the ball and the racket is 0.02-s and the mass of the ball is 0.055-kg, calculate the average force exerted by the racket on the ball?

What are the givens and unknowns?

Write your formula(s) and show your work

$m =$

$\Delta v =$

$F =$

$t =$

a) _____ ← units

13. A 0.05-kg rubber-ball is dropped and strikes the floor with an initial velocity of 10 m/s. It rebounds away from the floor with an final speed of 7-m/s after being in contact with the floor for 0.01 s. Find the magnitude of the force exerted by the floor on the rubber-ball.

What are the givens and unknowns?

Write your formula(s) and show your work

$m =$

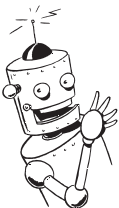
$\Delta v =$

$F =$

$t =$

a) _____ ← units

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14. A monkey is shooting pool. The monkey's cue stick strikes a pool ball, exerting an average force of 50 N over a time of 0.11 seconds. If the cue ball has a mass of 0.20 kg what is the velocity of the cue ball after impact?

What are the givens and unknowns?

Write your formula(s) and show your work

$m =$

$\Delta v =$

$F =$

$t =$

a) _____ ← units

15. A hockey puck has a mass of 0.115 kg and is at rest. A hockey player makes a shot, exerting a constant force of 30.0 N on the puck for 0.16 s. With what speed does the puck head toward the goal?

What are the givens and unknowns?

Write your formula(s) and show your work

$m =$

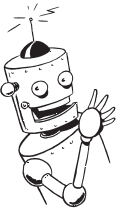
$\Delta v =$

$F =$

$t =$

a) _____ ← units

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