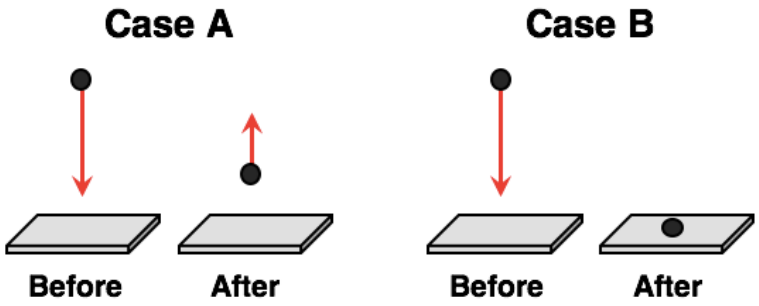
Case Studies in Collisions

Question Group 1

Question 1:

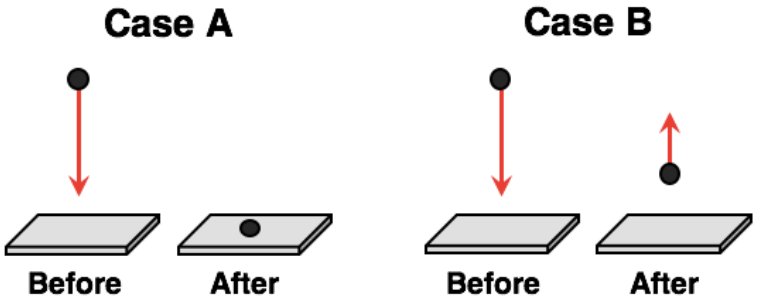
Compare the collision between two balls and the floor.
Case A: A "happy ball" collides with the floor moving at 2 m/s and rebounds upward at 1 m/s.
Case B: A "sad ball" with the same mass collides the floor moving at 2 m/s and stops.
The collision time is the same for each case.



Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question 2:

Compare the collision between two balls and the floor.
Case A: A "sad ball" collides the floor moving at 2 m/s and stops.
Case B: A "happy ball" with the same mass collides with the floor moving at 2 m/s and rebounds upward at 1 m/s.
The collision time is the same for each case.



Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

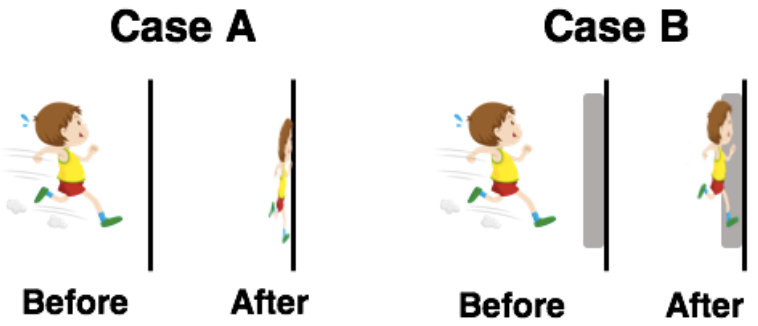
Question Group 2
Question 3:
Compare the collision between two baseballs and a catcher's mitt.
Case A: A baseball pitched at 40 m/s collides with a catcher's mitt and is brought to a stop. The catcher holds the mitt rather rigidly and retracts backwards very little as the ball strikes the mitt.
Case B: An identical baseball pitched at 40 m/s collides with a catcher's mitt and is brought to a stop. The catcher holds the mitt with a relaxed arm and reracts backwards 30 cm as the ball strikes the mitt.

Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question 4:
Compare the collision between two baseballs and a catcher's mitt.
Case A: A baseball pitched at 40 m/s collides with a catcher's mitt and is brought to a stop. The catcher holds the mitt rather rigidly and retracts backwards very little as the ball strikes the mitt.
Case B: An identical baseball pitched at 40 m/s collides with a catcher's mitt and is brought to a stop. The catcher holds the mitt with a relaxed arm and reracts backwards 30 cm as the ball strikes the mitt.

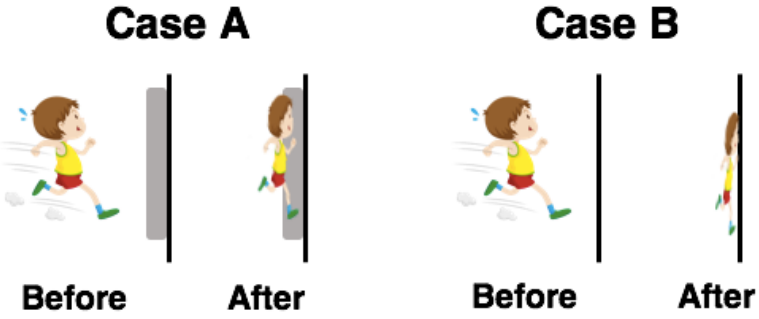
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question Group 3
Question 5:
Compare these two collisions of a PE student with a wall.
Case A: A 75-kg PE student moving at 8 m/s collides with an unpadded wall and stops.
Case B: The same 75-kg PE student moving at 8 m/s collides with a padded wall and stops.



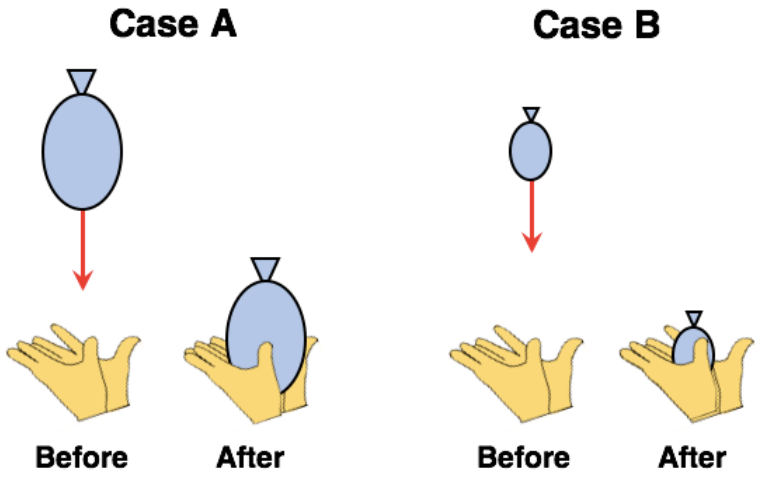
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question 6:
Compare these two collisions of a PE student with a wall.
Case A: A 75-kg PE student moving at 8 m/s collides with a padded wall and stops.
Case B: The same 75-kg PE student moving at 8 m/s collides with an unpadded wall and stops



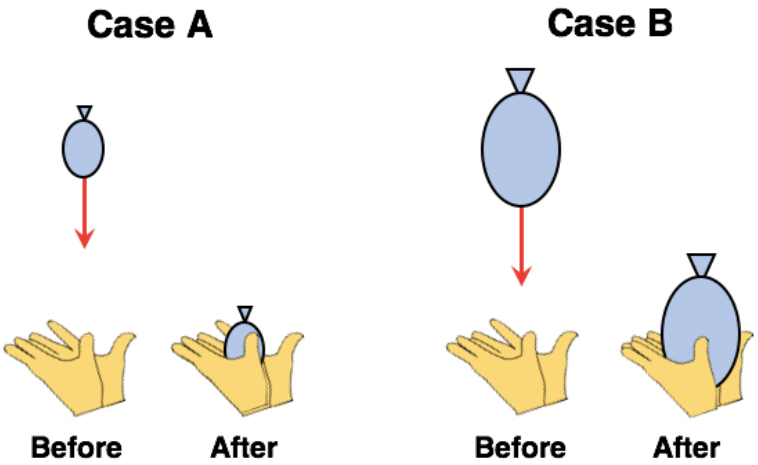
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question Group 4
Question 7:
Compare the catching of two different water balloons.
Case A: A 600-mL water balloon moving at 8 m/s is caught and brought to a stop.
Case B: A 150-mL water balloon moving at 8 m/s is caught with the same technique and brought to a stop.
The collision time is the same for each case.



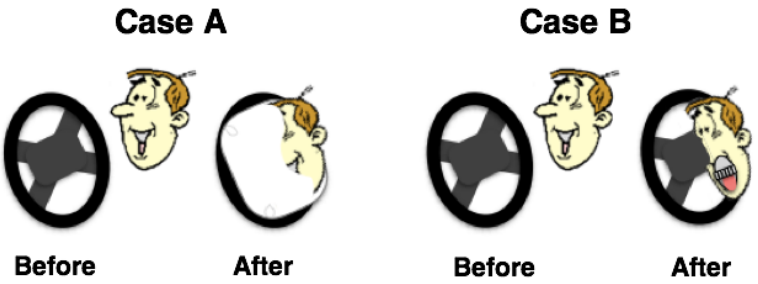
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question 8:
Compare the catching of two different water balloons.
Case A: A 150-mL water balloon moving at 8 m/s is caught and brought to a stop.
Case B: A 600-mL water balloon moving at 8 m/s is caught with the same technique and brought to a stop.
The collision time is the same for each case.



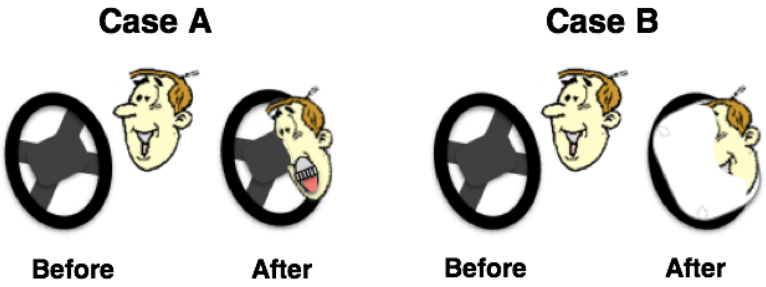
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question Group 5
Question 9:
Compare these two collisions of a driver in a car.
Case A: A 50-kg car driver moving at 12 m/s is stopped by an air bag during a front-end collision.
Case B: The same 50-kg car driver moving at 12 m/s is stopped by a dashboard during a front-end collision.



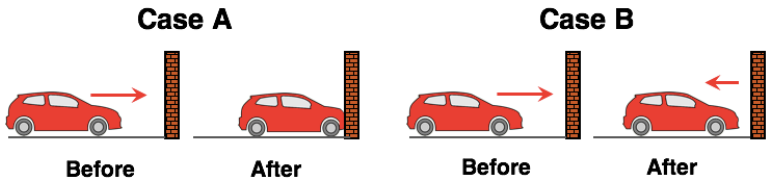
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question 10:
Compare these two collisions of a driver in a car.
Case A: A 50-kg car driver moving at 12 m/s is stopped by a dashboard during a front-end collision.
Case B: The same 50-kg car driver moving at 12 m/s is stopped by an air bag during a front-end collision.



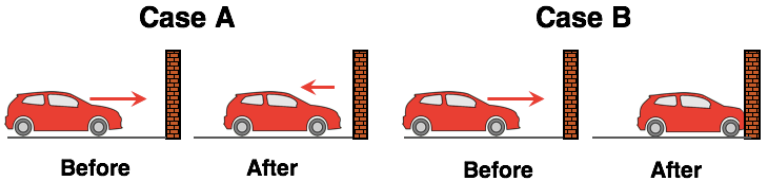
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question Group 6
Question 11:
Compare these two collisions of a car during a crash test.
Case A: A 1200-kg car moving at 18 m/s collides with a barrier and crumples up as it stops.
Case B: The same 1200-kg car moving at 18 m/s collides with a barrier and bounces backward with a speed of 6 m/s.



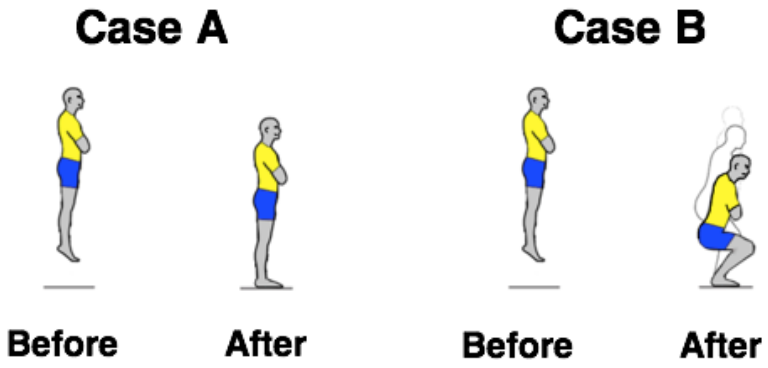
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?
The collision time is the same for each case.

Question 12:
Compare these two collisions of a car during a crash test.
Case A: A 1200-kg car moving at 18 m/s collides with a barrier and bounces backward with a speed of 6 m/s.
Case B: The same 1200-kg car moving at 18 m/s collides with a barrier and crumples up as it stops.



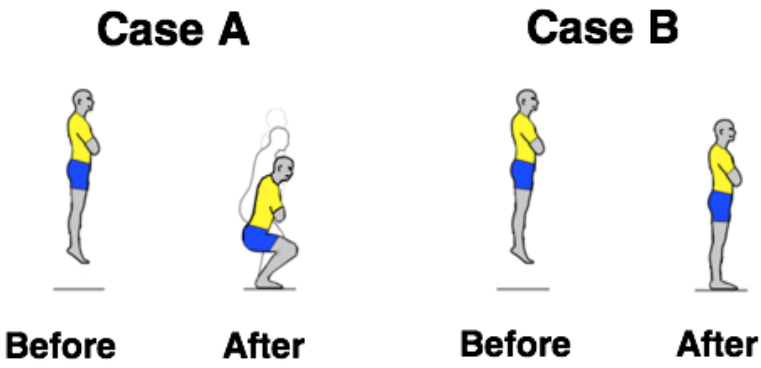
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?
The collision time is the same for each case.

Question Group 7
Question 13:
Compare the collision of a gymnast with the floor using two different landing strategies.
Case A: A gymnast strikes the floor with a speed of 12 m/s with relatively stiff knees as she comes to a stop.
Case B: The same gymnast strikes the floor with a speed of 12 m/s with relaxed knees and some bending as she comes to a stop.



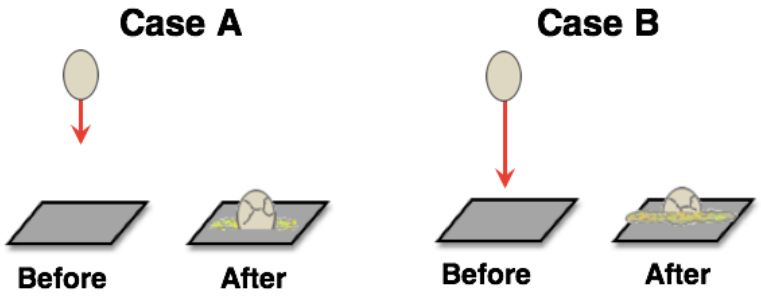
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question 14:
Compare the collision of a gymnast with the floor using two different landing strategies.
Case A: A gymnast strikes the floor with a speed of 12 m/s with relaxed knees and some bending as she comes to a stop.
Case B: The same gymnast strikes the floor with a speed of 12 m/s with relatively stiff-knees as she comes to a stop.



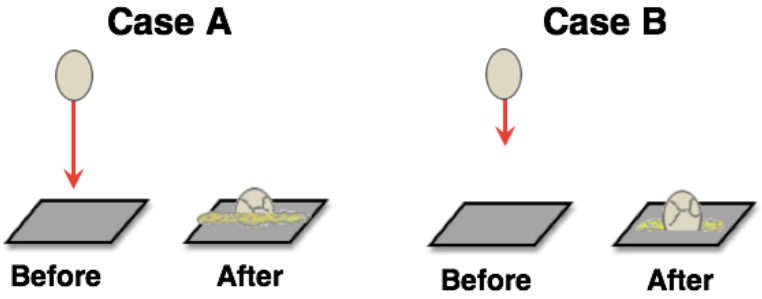
Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question Group 8
Question 15:
Compare these two collisions of an egg with the floor.
Case A: A Jumbo egg is released from a 1-meter height; it falls to the ground and stops.
Case B: The same Jumbo egg is released from a 5-meter height; it falls to the ground and stops.
The collision time is the same for each case.



Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?

Question 16:
Compare these two collisions of an egg with the floor.
Case A: A Jumbo egg is released from a 5-meter height; it falls to the ground and stops.
Case B: The same Jumbo egg is released from a 1-meter height; it falls to the ground and stops.
The collision time is the same for each case.



Which variable is different for these two cases?
Which case involves the greatest momentum change? … the greatest impulse? … the greatest force?