

Typical Homework Question with Answers

Bumper Cars

Bumper cars are a popular ride at many amusement parks. You drive about an enclosed area in a small, electrically powered vehicle. This vehicle has a large rubber bumper wrapped all the way around its exterior.



a. Half the fun of driving a bumper car is crashing into other people's cars. When you drive forward at a high speed and slam into the car in front of you, you find yourself thrown forward in your car. Which way is your car accelerating?

Key: a. The bumper car is accelerating in the direction opposite of its initial velocity because the bumper car is slowing down when it slams into the other car.

b. When you are stopped and someone else slams into the front of your car, you find yourself thrown forward in your car. Which way is your car accelerating?

Key: b. The bumper car is accelerating backwards because when the other car strikes the front of your car your velocity increases in the backwards direction.

c. What would happen to the forces between the bumpers of the cars if hard, steel bumpers replaced the soft rubber bumpers?

Key: c. The forces would be greater. The velocity would change in a far shorter period of time due to the incompressibility, or stiffness, of the metal bumpers, so the acceleration would be greater and as force is directly related to acceleration the forces on the cars would be greater as well.

d. Suppose that all of the cars are traveling at 10 km/h in various directions, as viewed by the people waiting in line for a turn. You crash first into a car that's heading about the same direction as yours and feel a gentle thud. You then crash into a car that's heading toward you and experience a tremendous jolt. Explain briefly why these two collisions are different.

Key: d. When the two cars are going in opposite directions and collide, then the total momentum change during the collision is greater and therefore the force is greater.

e. If you were to fill your car with metal bars so that its mass were 10 times that of any other bumper car, how would it affect the jolts you experience during crashes, as compared to riding in a normal car?

Key: e. If your mass increases 10 times by adding the steel bars to inside your car, then your inertia increases 10 times and for the same velocity your momentum increases 10 times. During a collision your car's tendency to keep on going forward will also have increased 10 times. This means when you collide with another car your car will not slow down as much. You will most likely keep on going. Therefore, you will not feel much of a jolt.