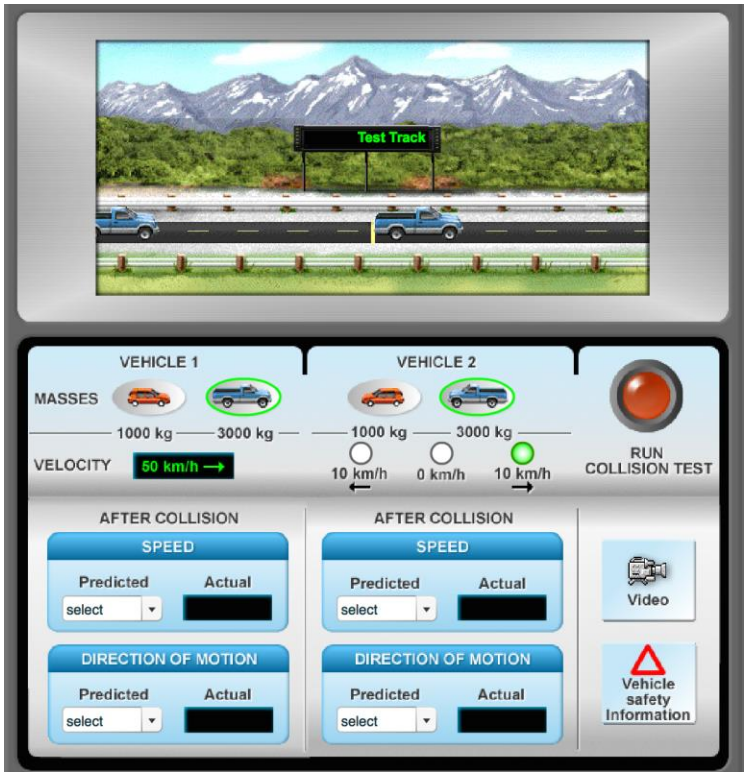
Name _____ Date _____ Period _____

LAB: Conservation of Momentum

CONCEPTUAL PHYSICS: UNIT 3



Background: The law of conservation of momentum states that "if no outside forces act on a group of objects, the momentum of the whole group will never change. "I this lab, this means that the sum of the momentum of vehicle 1 and vehicle 2 before the collision is equal to the sum of vehicle 1 and vehicle 2 after the collision.

The momentum of an object (in this case, a vehicle) is obtained by multiplying the mass of the object by its velocity. When two vehicles collide, the differences in their mass and velocity, as well as the type of collision, will determine the change in velocity after the collision. Velocity has a direction. For something moving in a straight line, one way to show it is moving in a certain direction is by using arrows. An arrow pointing to the right indicates a positive velocity. An arrow pointing to the left indicates a negative velocity. If the velocity is negative, the momentum also will be negative.

In this virtual lab you will compare the velocities and momentums of two vehicles before and after a collision by using experimental data from collision tests at an accident reconstruction center. You will apply the law of conservation of momentum to the data to calculate velocities and accelerations before and after the collision of two vehicles.

Objectives: Predict, describe, and compare the speed and direction of motion of two vehicles after a collision under the following conditions:

- There is no friction.
- Both vehicles are elastic, or "bouncy."
- The masses of the two vehicles may be the same or different.
- The speeds of the two vehicles may be the same or different.
- The direction of motion of the two vehicles before collision may be the same of opposite.

Calculate the momentum of each vehicle before and after the collision.

Taken from: http://www.glencoe.com/sites/common_assets/science/virtual_labs/E24/E24.swf

Procedure:

1. Go to: **http://www.glencoe.com/sites/common_assets/science/virtual_labs/E24/E24.swf**
2. Click on the video button. Watch the video about conservation of momentum. Write your observations in "Journal" section of this lab.
3. Click the up and down arrows to select vehicle masses and vehicle velocities to test. Recall that an arrow pointing to the right indicates a positive velocity and an arrow pointing to the left indicates a negative velocity. If you choose a negative velocity you will see the vehicle change directions. NOTE: Assume all collisions are **elastic**.
4. Predict a speed for vehicle 1 and a speed for vehicle 2 by clicking the up and down arrows.
5. Predict a direction of motion for vehicle 1 and for vehicle 2 by clicking the up and down arrows.
6. Click the "Run Collision" test button to test your predictions. To see a replay of the collision, click the button again.
7. Record your data in **DATA TABLE #1**.
8. Repeat this process until you have collected data for two collisions.
9. Verify the law of conservation of momentum by using the data you obtained and applying the following formula: ***momentum before = momentum after***
10. Go to **Journal section** of lab and complete questions.

DATA TABLE #1

VEHICLE DATA	COLLISION 1	COLLISION 2
Vehicle 1, mass		
Vehicle 1, speed before		
Vehicle 1, speed after		
Vehicle 1, direction of motion before		
Vehicle 1, momentum before		
Vehicle 1, direction of motion after		
Vehicle 1, momentum		
Vehicle 2, mass		
Vehicle 2, speed before		
Vehicle 2, speed after		
Vehicle 2, direction of motion before		
Vehicle 2, momentum before		
Vehicle 2, direction of motion after		
Vehicle 2, momentum		

Taken from: http://www.glencoe.com/sites/common_assets/science/virtual_labs/E24/E24.swf

Journal Questions:

1. In a 50 km/h head-on crash test, the steering column of passenger car 1 moved 3 cm upward and 2 cm rearward. The steering column of passenger car 2 moved 6 cm up and 24 cm toward the rear of the car. Which of the two cars would protect people better in a crash? Explain your answer

2. Why does a properly adjusted head restraint help prevent head and neck injuries to occupants in rear-end collisions? Explain your answer in terms of the law of conservation of momentum.

Taken from: http://www.glencoe.com/sites/common_assets/science/virtual_labs/E24/E24.swf

3. A skater wearing in-line skates (no friction) is standing in the middle of the aisle inside a bus and is not holding on to anything. Which way would the skater move in relation to the bus as it pulls away from the bus stop? Explain your answer.

4. Your drive a bumper car into another bumper car whose driver has a much larger body mass than you do. Who experiences more of a jolt, you or the other driver? Explain your answer.

Taken from: http://www.glencoe.com/sites/common_assets/science/virtual_labs/E24/E24.swf