Lab Activity – Center of Mass PhET Activity Name: Key

Physics Date: (If you used default values)

1. Go to PhET website for physics: http://phet.colorado.edu/en/simulations/category/physics/motion
2. Open the "Collision Lab" found on the left column and hit "Run Now"
3. Click "Advanced", "1 Dimension" at the top, and make sure all the boxes to the right are checked.
4. Drag the green ball all the way to the right. Observe the "X". What does the X represent? CM
5. Which ball must be more massive? M2 How do you know (other than the fact that it tells you at the bottom)?
   CM is closer to M2
6. Hit Play and Observe the X, Pause it when the X changes direction. What happened that made the X change direction?
   object hit wall
7. Reset the animation. Click 1 Dimensional again. Click the button that says "More Data"
8. Drag the red ball all the way to the left, and the green ball all the way to the right.
9. Hit Play, but Hit Pause before the balls collide.
10. If you were an observer on the red ball, what would the velocity of green ball be relative to you (include a direction)?
    1.25 m/s toward you
11. If you were an observer on the green ball, what would the velocity of red ball be relative to you (include a direction)?
    1.25 m/s toward you

For all Calculations, **Show Your Work**. Be careful about signs. Use the data in the simulation to check yourself.

12. Calculate: $p = mv$ $KE = \frac{1}{2}mv^2$ $m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

    The initial momentum of mass 1: 0.50 kgm/s

    The initial momentum of mass 2: −0.75 kg m/s

    Total initial momentum of both objects combined: −0.25 kgm/s

    $m_1v_1 + m_2v_2 = (m_1 + m_2)v'$

    The initial kinetic energy of mass 1: 0.25 J

    The initial kinetic energy of mass 2: 0.19 J

    Total initial kinetic energy of both objects combined: 0.445

13. Hit play again, but hit pause immediately after the collision (don't allow a ball to hit a wall)
14. Calculate:

    The final momentum of mass 1: −0.63 kgm/s

    The final momentum of mass 2: 0.388 kgm/s

    Change in momentum ($\Delta p = p_f - p_i$) for mass 1 only: 1.13 kgm/s

Change in momentum ($\Delta p = p_f - p_i$) for mass 2 only: 1.13 kg m/s

Is momentum conserved for each individual object? No: there's a change in momentum

Total final momentum of both objects combined: $-0.63 + 0.38 = -0.25$ kg m/s

Is momentum conserved for the system of both masses as a whole? Yes: same total momentum before + after

The final kinetic energy of mass 1: 0.39 J

The final kinetic energy of mass 2: 0.05 J

Total final kinetic energy: 0.44 J

15. What can you conclude about the momentums and kinetic energies of the system?

Both are conserved: same before + after collision

16. What type of collision is this? perfectly elastic

17. Reset, select 1 Dimension again, and set the elasticity = 0

18. Hit play and pause before and immediately after the collision (don't allow a ball to hit a wall)

19. Calculate:

The initial momentum of mass 1: 0.5 kg m/s

The initial momentum of mass 2: -0.75 kg m/s

Total initial momentum: -0.25 kg m/s

The initial kinetic energy of mass 1: 0.25 J

The initial kinetic energy of mass 2: 0.19 J

Total initial kinetic energy: 0.44 J

The final momentum of mass 1: -0.063 kg m/s

The final momentum of mass 2: -0.187 kg m/s

Total final momentum: 0.24 kg m/s

The final kinetic energy of mass 1: 0.0036 J

The final kinetic energy of mass 2: 0.0108 J

Total final kinetic energy: 0.0144 J

20. What can you conclude about the momentums and kinetic energies of the system?

momentum is conserved, but kinetic energy isn't

21. What type of collision is this? perfectly inelastic