Name_____ **Date**_____

Momentum Packet

Directions: Review the videos that I have posted below and then complete the problems to the best of your ability. If you have any questions please e-mail me at evan.worster@maine.edu as I will be checking my e-mail frequently throughout this time.

Linear Momentum:
https://www.khanacademy.org/science/ap-physics-1/ap-linear-momentum/introduction-to-linear-momentum-and-impulse-ap/v/introduction-to-momentum

Angular Momentum:
https://www.khanacademy.org/science/ap-physics-1/ap-torque-angular-momentum/angular-momentum-and-angular-impulse-ap/v/angular-momentum

Equations: p = m * v, FΔt = p2 - p1, pa1 + pb1 = pa2 + pb2, L = m*v(tangential velocity)*r, L= I * w, I = m * r^2, La1 + Lb1 = La2 + Lb2, rad. = ° * π / 180

Momentum Worksheet #1

1. What is the magnitude of the linear momentum of a 7.30 kg bowling ball going down the alley with a speed of 20.0 m/s?

2. The magnitude of the instantaneous momentum of a runner who is moving at 20.0 km/h is 479kg-m/s. What is the runner's mass?

3. A 100.0 kg football player runs straight down the field with a velocity of 4.00 m/s. A 2.00 kg artillery shell leaves the barrel of a gun with a muzzle velocity of 500.0 m/s. Which has the greater momentum? Show your proof.

4. A halfback on an apparent breakaway for a touchdown is tackled from behind. If the halfback has a mass of 80.0 kg and was moving at 4.10 m/s when he was tackled by an 85.0 kg cornerback running at 5.50 m/s, what was their mutual speed immediately after the touchdown saving tackle?

5. A 12,000. kg railroad car travels alone on a level frictionless track with a constant speed of 18.0m/s. A 6000. kg additional load is dropped onto the car. What then will be its speed?

6. A 1.00 x 104kg boxcar traveling at 15.0 m/s strikes a second car. The two stick together and move off with a speed of 4.00 m/s. What is the mass of the second car?

7. How fast, in m/s, would an automobile having a mass of 1.00 x 103 kg have to be going to have the same linear momentum as a truck having a mass of 2.00 x 104kg and traveling along a straight road with a constant speed of 30.0 km/h?

8. A 55.0 kg sailor jumps from a dock into a 25.0 kg rowboat at rest. If the velocity of the sailor is 5.00 m/s as he leaves the dock, what is the velocity of the sailor and the boat?

Challenge

Directions: Take the conservation of momentum experiment that we did during class time, and is included below. Find a surface in your house that is as close as possible to frictionless and develop your own conservation of momentum experiment. Take videos with your phone and send it to your friends or e - mail it to me. Have fun with it!

Name_____ Date_____

Conservation of Momentum Lab

Intro: In this lab we will see how momentum is conserved on a relatively frictionless surface. To do this we are going to use a car that moves at a constant velocity. We are going to use a wooden block that will stick to the car upon collision. We are also going to use stopwatches to determine velocities.

Procedure:

Step 1: Determine the mass of the car and the block

Step 2: Determine the initial velocity of the car with an average of three trials.

Step 3: Calculate what final velocity should be.

Step 3: Set the block up in a way to determine final velocity after collision.

Step 4: Initiate collision

Step 5: Repeat two additional times.

Step 6: Calculate final velocity, and compare to original.

Pre-Lab: Fill in values below.

Object	Mass	Trial 1 (Vi)	Trial 2 (Vi)	Trial 3 (Vi)
Car				
Block				

1. **Calculate the average initial velocity of the car, and the initial momentums of both objects. Fill values in table below.**

2. **What is the equation for the conservation of momentum?**

3. **Calculate what the final velocity of the system should be.**

4. **If we use the table up near the board as our frictionless surface, give me a method for determining the actual v2.**

Lab: Once you have answered question 2 set up the lab. Run three trials to determine the actual V2.

Object(s)	Trial 1	Trial 2	Trial 3	Avg. Vel.

Fill in the table below:

	Car	Block
Mass		
V1		
V2 (calculated)		
V2 (found)		
Pi		
Pf (calculated)		
Pf (found)		

Post Lab: There should be a difference between the velocity and momentum for the system that you calculated and the system that you observed. Write a few sentences where you try to determine why the v2 that we observed was different than the actual.

Name_____ **Date**_____

Angular Momentum/Rotational Inertia

Useful Equations: See above

Problems

1. What is the angular momentum of a 0.25 kg mass rotating on the end of a piece of rope in a circle of radius 0.75m at an angular speed of 12.5 rad/s?

2. A figure skater rotates on ice at a rate of 3.5 rad/s with her arms extended horizontally. When she lowers her arms to her side, she speeds up to 7.5 rad/s. Find the ratio of her moment of inertia in the first case to that in the second case.

3. A disk has a mass of 3.5 kg and radius of 15 cm is rotating with an angular speed of 15 rev/s when a second non-rotating disk of 5.0 kg, mounted on the same shaft is dropped onto it. If the second disk has a diameter of 18 cm and a mass of 5.0 kg, what is the common final angular speed of the system?

4. An object is rotating with an angular velocity of 44 rad/s.A torque of 0.23 N · m is applied to the object, which brings it to a stop in 135 s.What is the moment of inertia of the object? Give your answer to 2 significant figures.

5. An object with a moment of inertia of 3.2 kg·m2 around its axis of rotation initially has an angular velocity of 5.0 rad/s.A torque is applied to the object for 22 s,after which time it has an angular velocity of 48 rad/s.What is the magnitude of the torque applied to the object? Give your answer to 2 significant figures.

6. The wheel of a truck has a moment of inertia around its axis of rotation of 5.8 kg·m2.The wheel is initially rotating at 52 rad/s.The brakes of the truck can apply a maximum torque of 24 kg·m2/s2 to the wheel. What is the minimum time in which the brakes of the truck can be used to stop the wheels from turning? Give your answer to 3 significant figures.