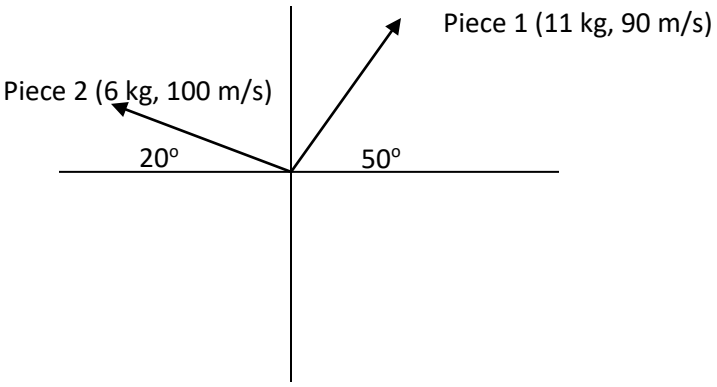
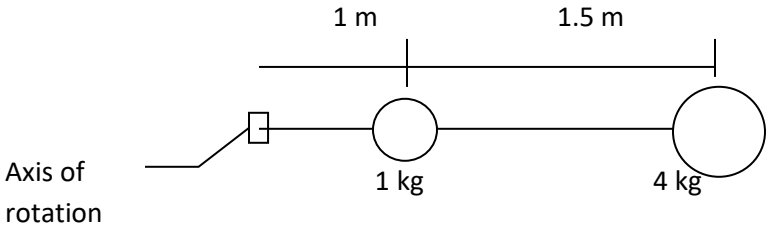
Midterm #2 Review Questions

1. A rocket is traveling straight upwards with a momentum of 900 kg m/s and a kinetic energy of 20.25 kJ. It explodes into three pieces. Piece 1 has a mass of 11 kg, a velocity of 90 m/s, and a direction to the right and 50 degrees above the x axis. Piece 2 has a mass of 6.00 kg, a velocity of 100 m/s, and a direction to the left and 20 degrees above the x axis. Find the mass, direction, and velocity of piece 3.

   Hints: You have to find mass first. What is the initial mass of the rocket? Use conservation of momentum in 2 dimensions.



2. A father pushes his son on a merry go round. The merry go round has a 2 meter diameter and is a disk of mass of 60 kg. The child is halfway between the axis of rotation and the edge and weighs 196 N. The father exerts a force at the edge of the merry go round at an angle 30° from the perpendicular. If the merry go round starts from rest and the father's force is (20 + 2t)N where t is in seconds, find L, α, and ω after 5 seconds.
3. A rod of negligible mass with one end fixed to a pivot has 2 masses attached as shown. A 5 kg mass is attached so that the system's center of mass is now 0.1 meters closer to the axis of rotation.
   An 11.5 N force is applied perpendicularly to the rod at the location of the 1 kg mass. If the rod starts from rest, what is the angular velocity after 6 seconds?



4. A truck driver is going 21 m/s down a road. The driver sees a car 20 meters behind him moving towards him at a constant velocity. After a time the two vehicles collide and intertwine. The

truck has a mass of 2700 kg and the car has a mass of 1800 kg. If their final velocity is 25 m/s what was the length of time between the truck driver seeing the car and the collision? What if the problem was the same except both the truck's initial velocity and the combined final velocity is reduced by 5 m/s? 10 m/s? 21 m/s?

5. A 1 kg mass is moving to the right at an initial velocity. A 3 kg object is moving to the left at half the speed of the 1 kg mass. After a perfectly elastic collision the 1kg mass moves to the left at 6 m/s. Find: $(V_1)_i$, $(V_2)_i$, and $(V_2)_f$
6. The big ben clock tower has minute hands which can be treated rods of uniform mass of 100 kg and are 4.2 meters long. What is the angular momentum of the minute hand on the south face of the clock? (hint: the moment of inertia of a rod rotated around its end is 1/3 $m*L^2$)

Answers:

1) 3kg, to the left and 41.24 degrees below the x axis, 32.16 m/s

2) 108.25 kg m^2/s, .742 rad/s^2, 3.093 rad/s

3) 1.5 rad/s

4) 2 seconds regardless of which version of the problem is solved. Why?

5) $(V_1)_i$ =4.8 m/s, $(V_2)_i$ = -2.4 m/s, and $(V_2)_f$= 1.2 m/s

6) 1.026 kg m^2/s north