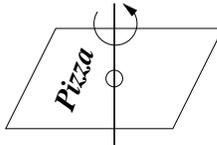# Practice Exam 4 – Physics 151
## Momentum and Rotation

1. (10%) A flat pizza box is stuffed full of cardboard so that it has uniform density, a mass of $1.0kg$, a width of $40cm$, and a length of $50cm$. It is spinning about its center at a rate of $\omega = 100rad/s$. What is the kinetic



   energy of the box?

2. (30%) Ben has two identical cars. Each are frictionless and have a mass of $20g$.

   (a) He takes a $50g$ wad of silly putty and throws it directly at the back of the car with a speed of $10m/s$. It sticks to the car and the whole mess rolls away. What is the speed of the car?

   (b) Next he takes $50g$ steel marble and throws it straight at the back of the second little car. It collides with the car totally elastically and the car rolls away. What is the speed of the second car?

3. (30%) Ben and Sophie go to the playground and use a massless frictionless teeter-totter which has a length of $3.0m$. Ben has a mass of 15kg and sits $1.25m$ from the pivot. Sophie has a mass of $60kg$ and sits $0.75m$ from the pivot on the other side of the teeter-totter. In this problem treat each person as though they are point masses.

   (a) What is the torque due to Ben?

   (b) What is the torque due to Sophie?

   (c) Is there an angular acceleration? Justify your answer.
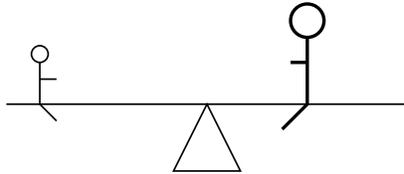
4. (30%) David, whose mass is $M$, stands on the rim of a frictionless merry-go-round of radius $R$ and rotational inertia $I$ that is not moving. He throws a tomato of mass $m$ horizontally in a direction that is tangent to the outer edge of the merry-go-round. The speed of the tomato, relative to the ground, is $v$. Afterward:

   (a) What is the angular speed of the merry-go-round?
   (b) What is David's linear speed?