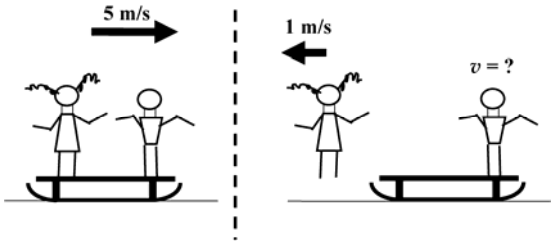
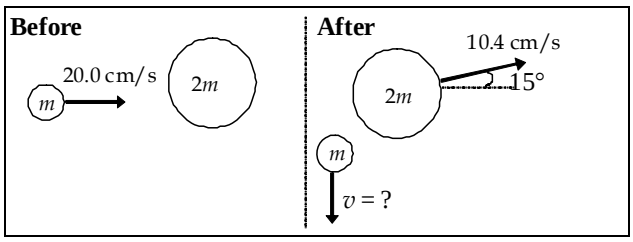
Trajectories – Physics
Winter – Quiz 2, Tuesday

Name:_____

1) Rebecca (mass 20 kg) and Arlo (mass 15 kg) are on a sled (mass 5 kg) moving to the right across a flat icy field (neglect friction between sled and ground) with speed 5 m/s (with respect to the ground), as shown in the sketch. Rebecca jumps out the back of the sled, moving to the left with a speed of 1 m/s (with respect to the ground), leaving Arlo in the sled. What speed is Arlo moving (with respect to the ground) after Rebecca jumps out?

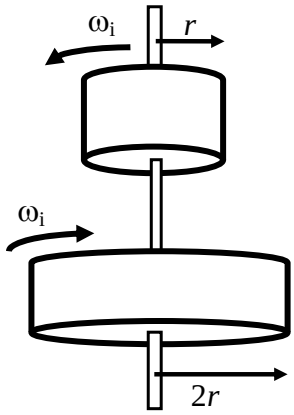


2) A small ball (mass m) collides with a larger ball (mass $2m$) on a horizontal table, as shown in the bird's-eye view. Before the collision, the small ball is moving at a speed of 20.0 cm/s to the right, while the larger ball is motionless. After the collision, the large ball is observed moving off at an angle of 15° with a speed 10.4 cm/s, and the small ball moves perpendicular to its original velocity (going down), as shown. Determine the speed v of the small ball after the collision.



3) An ice skater spins with essentially no friction on ice. She begins with her arms out and then brings her arms in. With arms out, her moment of inertia is 3.2 kg•m^2, and she spins at 8 rad/s. When she brings her arms in, her moment of inertia is 0.80 kg•m^2. How fast does she spin after bringing her arms in?

4) Two solid wheels of identical mass m but different radii (r and $2r$) are spinning on the same axle (on very smooth bearings). The wheels are spinning in opposite directions, but with the same angular speed ω_i, as shown in the figure. The two wheels are slowly brought together, and the resulting frictional interaction between the touching surfaces eventually brings the wheels to a common angular speed ω_f. The moment of inertia of a solid wheel is $\frac{1}{2}mr^2$.



a) Determine ω_f in terms of ω_i.

b) What direction are the wheels rotating when they reach their common angular speed? (circle one)

Wheels now rotate in the direction the small wheel was originally rotating

Wheels now rotate in the direction the large wheel was originally rotating

Wheels are not rotating at all

Not enough information to decide which direction the wheels are now rotating

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Name:_____

1) Two skaters directly approach each other on ice (i.e. no friction). One skater with mass 75.0 kg has a speed 1.50 m/s directly to the right and the other skater with mass 52.0 kg has a speed 5.00 m/s directly to the left. When the skaters meet, they grab each other and continue moving together.

a) With what speed do the combined skaters travel immediately after colliding?

b) In what direction do the skaters travel after colliding? (circle one)

to the right	to the left	not moving after collision	not enough information to tell

2) A firecracker of mass 5*m* explodes into 3 pieces, mass *m*, 2*m*, and another 2*m*. Immediately after the explosion, mass *m* moves due south at 3 m/s and mass 2*m* moves due west at 2 m/s. Determine the speed with which the other 2*m* mass moves immediately after the explosion.

3) You are sitting in a chair that is free to rotate without friction, similar to one used in lab and lecture.

a) Your lab partner hands you a bicycle wheel spinning clockwise as viewed from above, and makes sure you and your chair are at rest. You now carefully flip the bicycle wheel over so that it spins in the opposite direction. Predict YOUR motion after you flip the wheel over. (circle one)

You turn to your left You turn to your right You remain stationary not enough information to tell

b) Your lab partner hands you a bicycle wheel spinning clockwise as viewed from above, and makes sure you and your chair are at rest. You now put your hand on the edge of the wheel and let friction bring it to a stop. Predict YOUR motion after you bringing the wheel to a stop. (circle one)

You turn to your left You turn to your right You remain stationary not enough information to tell

c) Your lab partner hands you a bicycle wheel spinning in a vertical plane, and makes sure you and your chair are at rest. You turn the wheel from its vertical orientation so that it is now spinning clockwise as viewed from above. Predict YOUR motion after you turn the wheel. (circle one)

You turn to your left You turn to your right You remain stationary not enough information to tell

4) A turntable (mass 2.0 kg, radius 0.10 m, moment of inertia 0.01 kg•m^2) rotates at 10 rad/s. A ball of clay (mass 0.25 kg) fall straight down and sticks to the turntable, a distance of 0.05 m from the center. Determine the angular speed of the turntable just after this happens.