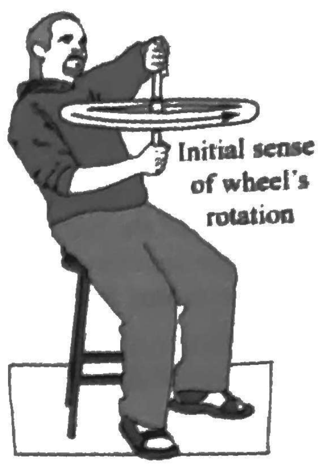
Name ______________________

1. In tutorial, you observed the following three experiments involving a student sitting at rest on a stool, holding a spinning bicycle wheel as shown at right:

Experiment 1: The student places his arm against the side of the wheel, slowing it to half its initial angular speed.

Experiment 2: The student places his arm against the side of the wheel, bringing it to a stop.

Experiment 3: The student quickly flips the wheel over (so that it is spinning clockwise when viewed from above, with the *same* angular speed it had initially).



a. You observed that the final angular speed of the *student* in experiment 3 is *greater than* that in experiment 2. Account for this result using the ideas developed in the tutorial.

b. Rank the experiments according to final kinetic energy of the *wheel,* from largest to smallest. If the final kinetic energy of the wheel is the same in any two experiments, state so explicitly. (*Hint:* Can kinetic energy ever be negative?) Explain.

c. Rank the experiments according to final kinetic energy of the *student,* from largest to smallest. If the final kinetic energy of the student is the same in any two experiments, state so explicitly. Explain.

d. Rank the following *four* quantities from largest to smallest: the initial kinetic energy of the wheel (K_{Wi}) and the final kinetic energy of the student-wheel system in experiments 1, 2, and 3 (K_{S1f}, *etc.*). Explain. (*Hint:* It may be helpful to think about changes in energy *other than* mechanical energy.)

2. The diagram below illustrates four hypothetical collisions that take place on a level, frictionless surface. The collisions are shown from a top-view perspective. All pucks are identical. If a linear or angular velocity is not specified, it is zero. If distances appear to be equal, assume that they are.

For each hypothetical collision:

a. Specify the direction of the angular momentum of the rod-puck(s) system with respect to the center of the rod both before and after the collision. If necessary, use the convention that a vector into the page is represented by the symbol ⊗ and a vector out of the page is represented by the symbol ⊙.

b. Specify the direction of the linear momentum of the rod-puck(s) system, both before and after the collision.

c. On the basis of your answers above, state whether each hypothetical collision *could* or *could not* occur. If a particular hypothetical collision could not occur, state whether it violates (1) the principle of conservation of linear momentum, (2) the principle of conservation of angular momentum, or (3) both.