Test1 for PHYS 2130 section 091
Date: 16th March 2007

Student First Name: Student Last Name:
Student Rocket ID:

You may use the backside of all pages. No calculators are allowed.

Questions 1: In three situations, a briefly applied horizontal force changes the velocity of a hockey puck that slides over frictionless ice. The overhead views shown in Fig. 1 indicate, for each situation, the puck's initial speed v_i, its final speed v_f, and the directions of the corresponding velocity vectors. It is given that the total mechanical energy of the puck remains constant throughout its motion. Rank the situations according to the change in potential energy of the puck, most positive first and most negative last. Explain your result with a simple numerical computation. (**1 point**)

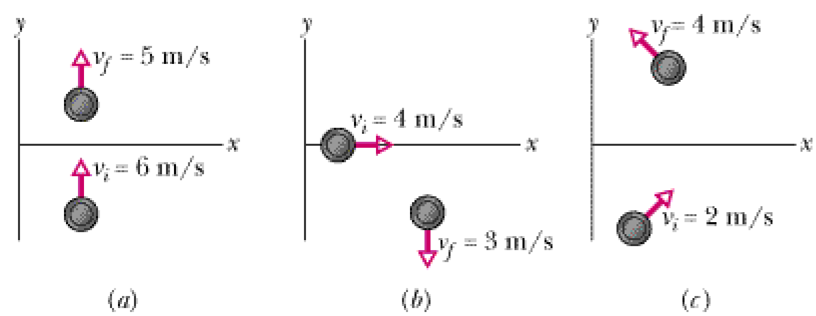

Fig. 1

Question 2: Fig. 2 below shows three situations involving a plane that is not frictionless and a block sliding along the plane. The block begins with the same speed in all three situations and slides until the kinetic frictional force has stopped it. Rank the situations according to the increase in thermal energy due to the sliding, greatest first. (**1 point**)

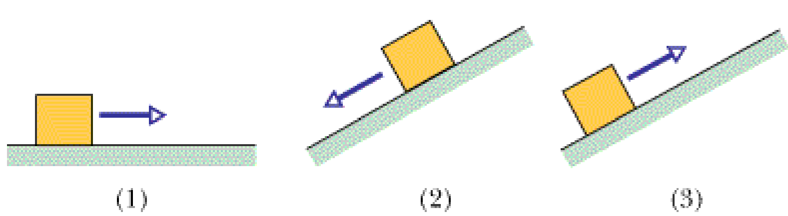

Fig. 2

Question 3: Fig. 3 shows four groups of three or four identical particles that move parallel to either the x axis or the y axis, at identical speeds. Rank the groups according to center-of-mass speed, greatest first. (**1 point**)

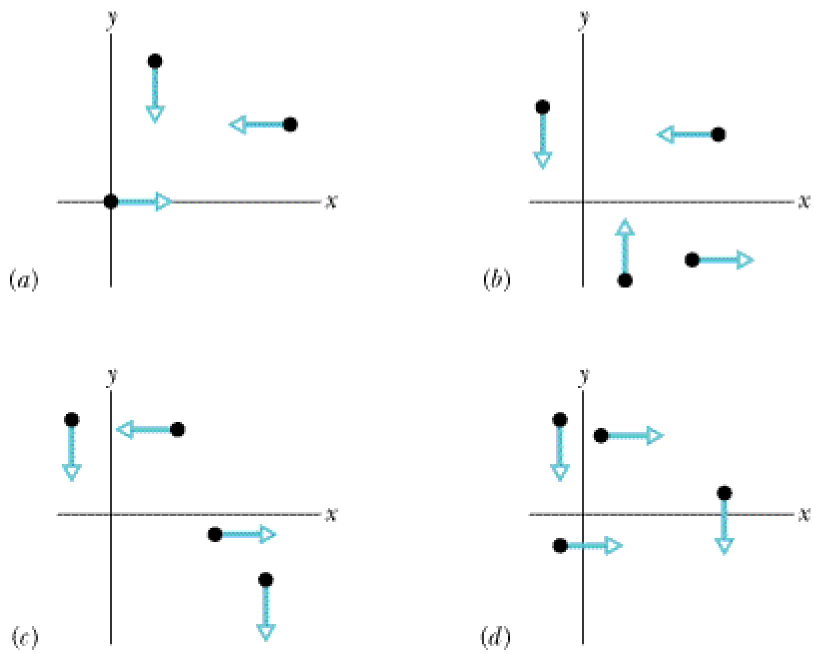

Fig. 3

Question 4: A bug rides the rim of a rotating merry-go-round by standing still on it at one place. If the angular speed of this system (merry-go-round + bug) is decreasing, which of these statements is true? (**1 point**)

(a) There is no radial acceleration of the bug with respect to the earth.

(b) There is tangential angular acceleration of the bug with respect to the earth.

(c) There is no tangential angular acceleration of the bug with respect to the earth.
(d) There is linear acceleration of the bug towards the center of the earth.
(e) None of the above statements is true.

Question 5: In Fig. 4, a package of mass m slides along a floor with speed v_1. It then runs into and compresses a spring, until the package momentarily stops. Its path to the initially relaxed spring is frictionless, but as it compresses the spring, a kinetic friction force from the floor, of magnitude f_k, acts on it. The spring constant is k. By what distance d is the spring compressed when the package stops? (**2 points**)

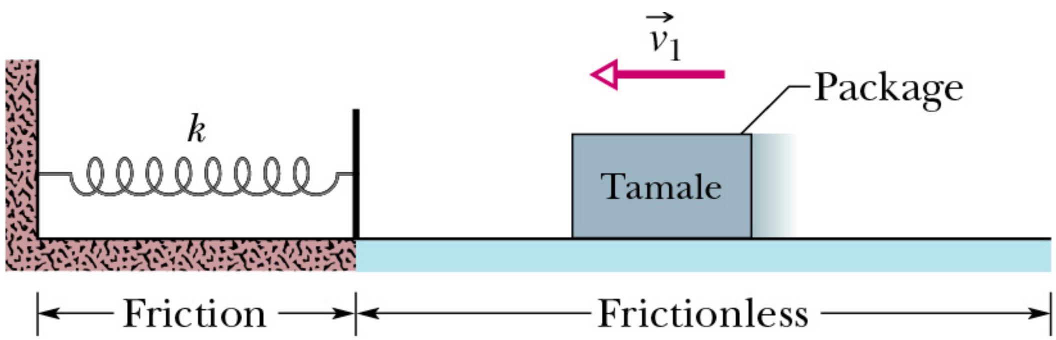

Fig. 4

Question 6: Two bodies, *A* and *B*, of equal masses collide. The velocities before the collision are $\vec{v}_A = (15\hat{i} + 30\hat{j})$ m/s and $\vec{v}_B = (-10\hat{i} + 5.0\hat{j})$ m/s. After the collision, $\vec{v}'_A = (-5.0\hat{i} + 20\hat{j})$ m/s. What is the final velocity of *B*. (**2 points**)

Question 7: A uniform spherical shell of mass *M* and radius *R* can rotate about a vertical axis on frictionless bearings (Fig. 5). A massless cord passes around the equator of the shell, over a pulley of rotational inertia *I* and radius *r*, and is attached to a small object of mass *m*. There is no friction on the pulley's axle; the cord does not slip on the pulley. What is the ratio of the angular speeds of the shell and the pulley as the object falls? If the speed of the object is v what is the angular speed of the shell? (**2 points**)

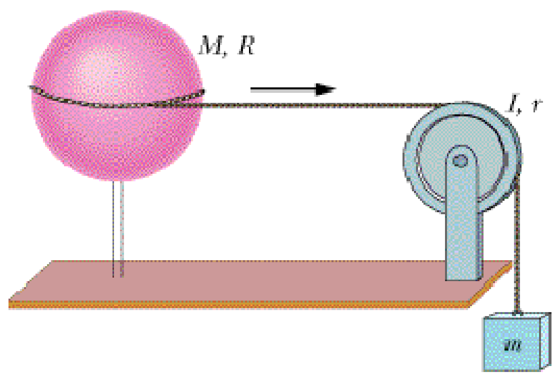

Fig. 5