

Name (Print): \_\_\_\_\_

Pledged (Signed): \_\_\_\_\_

This test should be completed during one regular 50 min class period.

Your problem solving approach counts! Be sure and show all work including basic formulas and **diagrams**.

Do all of the following problems. Start each problem on a fresh page or the back of a page. Clearly label the problem number. Place the answers in order and staple the sheets as you turn in the test. Sign and **pledge** this sheet.

1. (20 pts) (a) Objects of mass  $M$  and  $m$  collide head-on and stick together. Mass  $M$  is stationary and mass  $m$  is moving to the right with speed  $v$  before the collision. What is the velocity after the collision? What fraction of the initial kinetic energy is converted to heat?

(5 pts) (b) What is the velocity of the center of mass before and after the collision?

2. (25 pts)

a) A particle moving along the  $x$  axis is acted on (pushed) by a force

$$F(x) = -4x + 8.$$

How much work does this force do as the particle moves from  $x = 2$  to  $x = 4$ ?

How much work does this force do as the particle moves from  $x = 0$  to  $x = 4$ ?

b) A particle moving along the  $x$  axis is acted on by this same force. Derive a potential energy function assuming that potential energy is zero when  $x=0$ . Sketch the potential energy function and describe the motion of particle released with zero velocity from the point  $x=0$ .

- 3) (25 Points) A uniform disk of mass  $M$  is free to rotate on a shaft through its center. It is given a push by a force  $F$  for a time  $T$  at its rim. In a second experiment it is given a push by the same force  $F$  for double the time,  $2T$ . The disk was at rest before either push. Ignore friction.

a) What is the ratio of the final angular momentum in the first experiment to the second experiment?

b) What is the ratio of the final kinetic energies?

- 4) (25 points) A 3 kg box is pulled up 2 m using a frictionless pulley with a mass of 2 kg as shown. The initial speed is zero and the final speed is 4 m/s. How much work is done by gravity? How much work is done by the tension in the string tied to the box? How much work was done by the person pulling the rope? Be sure and pay attention to the sign when you give your answers.

