Second Midterm Exam
Physics 120-9115
Diablo Valley College, Fall 2025

Name:_____

Centripetal (radial) acceleration:
Work-Energy principle:
Mechanical Energy Conservation: KEi + PEi = KEf + PEf = E (total energy)
Work:
Kinetic Energy: ;
Gravitational Potential Energy: mgy
Power:
Momentum: mv
Impulse:
Torque = (lever arm)
(: angular velocity)

The rotational inertia of an object

1)

2) A 60 g arrow is fired from a bow whose string exerts an average force of 100N on the arrow over a distance of 80cm. (a) What is the speed of the arrow as it leaves the bow? (b) What is the power given to the arrow?

3) A pendulum consists of a mass M hanging at the bottom end of a massless rod of length , which has a frictionless pivot at its top end. A mass m, moving as shown in the figure with velocity , impacts M and becomes embedded. What is the smallest value of v sufficient to cause the pendulum (with embedded mass m) to swing clear over the top of its arc?

The swinging motion will conserve mechanical energy. Take the zero level for gravitational potential energy to be at the bottom of the arc. For the pendulum to swing exactly to the top of the arc, the potential energy at the top of the arc must be equal to the kinetic energy at the bottom.

Momentum will be conserved in the totally inelastic collision at the bottom of the arc. We assume that the pendulum does not move during the collision process.

4) A novice skier, starting from rest, slides down a frictionless 13.0o incline whose vertical height is 125m. How fast is she going when she reaches the bottom?
Use two approaches (a) Newton's 2nd law and kinematics equations (2) Energy conservation to solve this problem. These two approaches result in the same answer.

5) Calculate the net torque about the axle of the wheel shown in the figure. Assume that a friction torque of 0.60 m·N opposes the motion.

Each force is oriented so that it is perpendicular to its lever arm. Call counterclockwise torques positive. The torque due to the three applied forces is given by the following:

Since this torque is clockwise, we assume the wheel is rotating clockwise, so the frictional torque is counterclockwise. Thus the net torque is as follows:

6) A ball of radius r rolls on the inside of a track of radius R (see the figure). If the ball starts from rest at the vertical edge of the track, what will be its speed when it reaches the lowest point of the track, rolling without slipping?

Use conservation of mechanical energy to equate the energy at points A and B. Call the zero level for gravitational potential energy the lowest point on which the ball rolls. Since the ball rolls without slipping,

Or mgr is not necessary if R-r = y =0