Mock Exam #3 Answer Sheet

Please write all responses (and show all work) on this answer sheet. Nothing you write on the exam itself will be graded.

Multiple Choice Problems are worth 4 points each.

1. a b c d

2. a b c d

3. a b c d e

4. a b c d

5. a b c d e

Short Answer questions are worth 5 points. Please show all of your work, and clearly designate your answer. Partial credit may be given.

6: Satellite

7: Potter's wheel

8: Scales

9: Get your motor running

Long Answer Problem is worth 10 points. Please show your work, and clearly designate your answer. Partial credit may be given.

10: Falling Hoop (a.k.a., Don't Drop the Charmin)

Name:_____

PHYSICS 2010 Mock Exam #3

Professor Chisholm

- You are allowed the use of **one** 3"x5" note card with inscriptions of your choosing.
- You are allowed the use of a free-standing calculator.
- Clearly designate all answers on the **answer sheet.** You may write on the back, but if your answer(s) appear(s) there, please indicate that.
- You may write on this exam copy, but nothing on it will be graded.
- All books, notes, cell phones, cameras, and other such devices are to be securely stowed away.
- Exam is out of 50 points, and there are 50 minutes for the exam. Pace appropriately.

Some possibly useful data:

Standard free-fall acceleration:	$g = 9.80\ \mathrm{m/s^2}$
Gravitational constant:	$G = 6.67 \times 10^{-11}\ \mathrm{N \cdot m^2/kg^2}$
Mass of the Earth	$M_E = 5.98 \times 10^{24}\ \mathrm{kg}$
Radius of the Earth	$R_E = 6.37 \times 10^{6}\ \mathrm{m}$
Moments of Inertia (extended objects)	
Solid cylinder or disk (about center)	$I = \frac{1}{2}MR^2$
Cylindrical hoop (about center)	$I = MR^2$
Solid sphere (about diameter)	$I = \frac{2}{5}MR^2$
Spherical shell (about diameter)	$I = \frac{2}{3}MR^2$
Thin rod or slab (about center)	$I = \frac{1}{12}ML^2$
Thin rod or slab (about edge)	$I = \frac{1}{3}ML^2$

Multiple Choice Problems are worth 4 points each. Please unambiguously circle the correct answer.

1. A person ties a rock to a string and whirls it around in a vertical circle such that sometimes the rock is going straight upward and sometimes the rock is going straight downward. She whirls the rock at the minimum (linear) speed (constant in time) such that the string is always taut (no sag). If she were to use a longer string, she would have to whirl the rock at a

- **a.** The same speed.
- **b.** A higher speed
- **c.** A lower speed.
- **d.** The necessary speed depends upon the mass of the rock.

2. A tire is rolling along a road, without slipping, with a center-of-mass speed *v*. A piece of tape is attached to the tire along the edge. When the tape is opposite the road (at the top of the tire), its velocity with respect to the road is

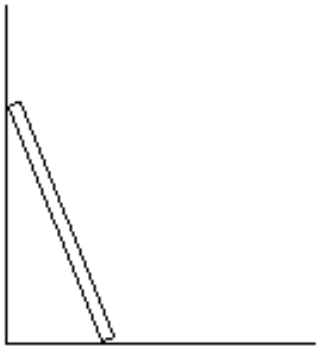
- **a.** *v*
- **b.** 1.5*v*
- **c.** 2*v*
- **d.** The velocity depends on the radius of the tire

3. A disk and a sphere are released simultaneously at the top of an inclined plane. They roll down without slipping. Which will reach the bottom first?

- **a.** The one of smallest diameter
- **b.** The one of greatest mass
- **c.** The disk
- **d.** The sphere
- **e.** They will reach the bottom at the same time

4. A tall ladder is leaning at an angle against a wall. There is no friction between the wall and the ladder, but there is (a small amount of) friction between the ladder and the floor. As a painter climbs up the ladder, at which location along the ladder should the painter be most worried about making the ladder slip?

- **a.** Near the top of the ladder
- **b.** Near the middle of the ladder
- **c.** Near the bottom of the ladder
- **d.** Anywhere -- the risk is the same at all points



5. Suppose that a heavy person and a light person are balanced on a teeter-totter made of a plank of wood. Each person now moves in toward the fulcrum a distance of 25 cm. What effect will this have on the balance of the teeter-totter?
    a. The teeter-totter will remain in balance
    b. The heavy person's end will go down
    c. The light person's end will go down
    d. One cannot tell whether either end will rise or fall without knowing the relative mass of the plank.
    e. Only if the plank has significant mass will the light person's end go down.

Short Answer questions are worth 5 points. Please show all of your work, and clearly designate your answer. Partial credit may be given.

6. A satellite is in orbit around a planet. The orbital radius is 34.0 km and the gravitational acceleration at that height is 2.3 m/s^2. What is the satellite's orbital speed?

7. A potter's wheel (a solid, uniform disk) of mass 7.0 kg and radius 0.65 m spins about its central axis. A 2.1 kg lump of clay is dropped onto the wheel at a distance 0.41 from the axis. Calculate the moment of inertia of this system about the central axis.

8. An irregularly shaped object 10. m long is placed with each end on a scale. If the scale on the right reads 74 N and the scale on the left reads 93 N, how far from the left is the center of mass?

9. A particular motor can provide a maximum of 110.0 N·m of torque. Assuming that all of this torque is used to accelerate a solid disk of mass 10.0 kg and radius 3.00 m, how long will it take for the disk to accelerate from rest to 8.13 rad/s?

Long Answer Question is worth 10 points. Please show all of your work, and clearly designate your answers to all portions. Partial credit may be given.

10. A length of thin, massless, inextendible rope is wrapped around the edge of a cylindrical hoop (mass of 1.32 kg, radius of 0.150 m). One end of the rope is secured to the ceiling (see diagram). The hoop is then dropped downward (the rope unwinds without slipping).

(another way to visualize this is to imagine holding the end of a roll of toilet paper, and letting the rest of the roll fall)

a. Draw a Free-Body Diagram for the hoop, as well as a force diagram showing torques.
b. What is the acceleration of the hoop's center of mass?
c. What is the angular acceleration of the hoop?