**Rotation Review- Free Response 2015** Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hr.\_\_\_\_\_\_\_\_\_

1. 50 N of force is applied at a 30° to the edge of a Disk which has a radius of .75 m and a mass of 100 kg for 3 sec in order to speed the disk rate of rotation. The disk is initially rotating at .5 rev/min A) What is it angular acceleration? B What is its final angular velocity? D) What is its final linear velocity E) What is its linear acceleration? F) How many revolutions does the object go through while accelerating? G) How much energy is required to get the object rotate at its final velocity?



2. A planet has the following characteristics: **Mass: 7E24 kg, Radius: 1.2 E7 m, Rate of Rotation: 5 Rev/3days** A) What is the planet’s rate of rotation? B) What is the planet’s local gravity at pole? C) What is the planet’s local gravity at the equator? D) What is the planet’s local gravity at 50°S latitude? E) What is the orbital speed for an object placed in a circular orbit 300 km above the planet? F) How fast would the planet need to rotate to make an object weightless at the equator. **Hint: Local Gravity is reduced by the centripetal acceleration due to the tendency of objects to move tangent to the circle.**

3. 12. A 15 kg disk is placed on a 5 m long ramp that make a 30° angle with the horizontal and rolls down the ramp without slipping. A) What is the linear speed of the disk at the bottom of the ramp? B) What is the disk’s angular velocity?

 4. A pendulum consists of a small object of mass m fastened to the end of an inextensible cord of length L. Initially, the pendulum is drawn aside through an angle of 60° with the vertical and held by a horizontal string as shown in the diagram above. This string is burned so that the pendulum is released to swing to and fro. A) In the space below draw a force diagram identifying all of the forces acting on the object while it is held by the string. B. Determine the tension in the cord before the string is burned. C) Show that the cord, strong enough to support the object before the string is burned, is also strong enough to support the object as it passes through the bottom of its swing.



5. The wheels on a car are rotating at 80 rev/min. A) The radius of wheels is 63 cm. The car had started off at rest and accelerated to its current speed in 5.2 sec. What is the angular speed of the wheel? B) What is the car’s linear speed? C) What is its linear acceleration? D) What is its angular acceleration? E) How many revolutions has the tire gone through while the car is accelerating?

6. A 20 kg ladder with a length of 15m is resting against a wall at an angle of 70° with the horizontal. A) What is the minimum coefficient of friction the ladder can have with the floor if the uk of the wall is zero? B) If the uk is .2+ukmin, What distance can an 90kg man travel up the ladder safely?

7. A 4.2 m uniform beam (mass of 10.0 kg) is attached to a wall by a hinge and supported by a rope. A 50 kg mass hangs from the beam 3.8 m from the hinge. A) Find the tension in the rope which is attached to the beam 1.1 m from the wall and making a 30° with the beam. B) What is the reactionary force in x? C) What is the reactionary force in y? D) What is the overall reactionary force?

8. A 2188 kg van is moving around a circular racetrack with a radius of 320m. The car is moving at 80 rev/hr. A) What is the van’s angular velocity? B) What is the van’s linear velocity? C) What is its centripetal acceleration? D) What is the centripetal force? E) If the uk=.90 what is the maximum speed of the track? F)\* If the track was banked at a 38° angle how fast could the van go?

9. A bucket of water is swung around in a vertical circle with a radius of .35m. What is the minimum speed that the bucket can be moving in order for the water not fall out of the bucket?

10. A roller coaster is at the top of a circular loop that has a radius of 35m and is 10m above the ground. A) What is the minimum speed that the coaster can be going and still remain on the track? B) How high does the starting hill need to be to accomplish this task?

11. In a popular amusement park ride the riders are placed in a vertical cylinder. The cylinder is brought up to a certain speed. The floor of the cylinder is allowed to drop out. Leaving the rider suspended on the wall. A) If the cylinder has a radius of 5m what is the minimum speed it can be going at to accomplish this task? The minimum coefficient of friction for clothing is about .3.

12. The sun will become a White Dwarf star in about 10 billion years. The sun has the following characteristics

Mass: 2E30 kg Radius: 6.96E8 m Rotation period: 25.05 days. When the sun becomes a White Dwarf it will shrink to a radius of 6.37E6 m. A) What will be the White Dwarf’s angular velocity? B) What will be the White Dwarf’s tangential velocity at the equator? C) What will be its period of rotation?



13. A mass (*M*1 = 5.0 kg) is connected by a light cord to a mass (*M*2 = 4.0 kg) which slides on a smooth surface (uk= 0), as shown in the figure. The pulley has a mass of 3 kg and a radius of 0.20 m rotates about a frictionless axle. A) If the pulley was massless what would be the acceleration of the system? B) If the pulley was massless what would be the tension in the rope attached to m1? C) If the pulley was massless what would be the tension in the rope attached to m2? D) What is the real acceleration of this system? E) What is the real tension in the rope attached to m1? F) What is the real tension in the rope attached to m2? G) What is the angular velocity of the pulley?

14. A system of point masses is held together by rods of negligible mass as follows: Point A 50 kg (-3, 0)

 Point B 80 kg (4, 0)

 Point C 45 kg (0, 8)

 Point D 60 kg (0, -7)

A) Find Center of Mass B) Find Ix C) Find Iy  D) Find Iz E) Find the inertia through the y-axis that crosses through the center of mass. F) Use your data from this problem to prove the parallel axis theorem. G) Use your data from this problem to prove the perpendicular axis theorem?

15. A) What is the formula for the Inertia of a disk rotated on its edge? What is the formula for a disk rotated through its diameter through the y-axis?