Physics 211 **Week 8**

Rotational Kinematics and Energy: Space Station

A space station is constructed in the shape of a wheel 22m in diameter, with essentially all its weight (5.0×10^5 kg) at the rim. Once the space station is completed, it is set rotating at a rate such that an object at the rim experiences a radial acceleration equal to the Earth's gravitational acceleration g, thus simulating Earth's gravity. To accomplish this, two small rockets are attached on opposite sides of the rim, each able to provide a 100N force. How long will it take to reach the desired rotation rate and how many revolutions will the space station make in this time?

The space station will start from rest. Torque from the rockets will cause an angular acceleration until the desired rate of rotation is achieved. Begin by finding the desired rotation rate where the centripetal acceleration is equal to the earth's acceleration. Next, set the torque created by the applied force of the rockets equal to the moment of inertia times the angular acceleration to find the acceleration of the wheel; you may ignore the mass of the rockets. Then you can use rotational kinematics with the angular acceleration and angular velocity to find the time it takes and the number of revolutions the station will make to reach the desired rate of rotation. You should obtain a time of 2.6×10^4 seconds and a total of 1.95×10^3 revolutions.