Homework 5: Accelerating Reference Frames
Taylor Ch. 9

1. A donut-shaped space station (outer radius R) arranges for artificial gravity by spinning on the axis of the donut with angular velocity ω.

   (a) Sketch the forces on, and accelerations of, an astronaut standing in the station as seen from an inertial frame outside the station.

   (b) Repeat the previous part as seen in the astronaut's personal rest frame (which has a centripetal acceleration $A = \omega^2 R$ as seen in the inertial frame). What angular velocity is needed if $R = 40$ meters and the apparent gravity is to equal the usual value of about 10 m/s^2?

   (c) What is the percentage difference between the perceived g at a six-foot astronaut's feet ($R = 40$ m) and at his head ($R = 38$ m)?

2. Find the directions of the centrifugal and Coriolis forces on a person moving

   (a) south near the North Pole.

   (b) east on the equator.

   (c) south across the equator.

3. *Non-uniform rotation*

$$m\ddot{\vec{r}} = \vec{F} + 2m\dot{\vec{r}} \times \vec{\Omega} + m(\vec{\Omega} \times \vec{r}) \times \vec{\Omega} \tag{1}$$

   The derivation of the equation of motion (Eq. **??** above) for a rotating frame made the assumption that the angular velocity Ω was constant. Show that if $\dot{\Omega} \neq 0$ then there is a third "fictitious force," sometimes called the azimuthal force, on the right side of the equation of motion equal to $m\vec{r} \times \dot{\Omega}$.