16.61 Handout #3
Prof. J. P. How Feb 6, 2003
Prof. J. Deyst **Due:** Feb 13, 2003

16.61 Homework Assignment #1

1. A wheel of radius $2r$ is moving along a horizontal surface such that its hub travels at a speed $v = 3At$ (where A is a constant). Find the expression for the acceleration $a(t)$ of the point that was at the top of the wheel at time $t = 0$.
   - Use the FARM approach, and clearly define all coordinate frames of interest in the problem.
   - Give your final answer in terms of the components in the inertial frame.
   - Using A=1/3, plot $a(t)$ for the first 10 seconds. Does your result make physical sense?

2. Given a Frame B rotating with respect to inertial space at rate $\vec{\Omega}$, use the transport theorem to show that
$$\dot{\vec{\Omega}}^I \equiv \dot{\vec{\Omega}}^B$$
   Please provide a physical interpretation of this result. What are the implications of this result when using the FARM approach?

3. For the 3 cases on Page 2-4 in the notes, use the formula on Page 1-7 in the notes to calculate the absolute accelerations for the mass. Use these results to specify the magnitude and direction of the Coriolis accelerations. Use a rotating cylindrical coordinate frame, as outlined on Page 2-7. Confirm that these results agree with the answers given in class.

4. An new experimental vehicle travels due North from the equator to the Pole along a railway track. The vehicle moves at a constant speed v relative to the Earth (which you can assume is fixed, but rotating at rate Ω). Determine the Coriolis acceleration a_{cor} as a function of latitude θ. If $v = 500$ km/h, what is the magnitude of a_{cor} at the equator and at the pole?

5. Who was the Coriolis effect named after? Describe something that you commonly do in which the Coriolis effect plays an important role.