

## PHY3110 Homework Assignment 6

1. (15 points) Obtain the general rotation matrix in terms of the Euler angles by performing an explicit multiplication of the three successive rotation matrices. Verify that the matrix multiplication is associative.

2. (15 points) Consider the rotation in the following order: first rotate around the  $x$  axis by an angle  $\theta$ , then around the  $z'$  axis by an angle  $\psi$ , and finally around the old  $z$  axis by an angle  $\phi$ . Does this lead to the same transformation matrix as that in Assignment 1? Do you have an explanation for this?

3. (20 points) A particle is thrown up vertically with initial speed  $v_0$ , reaches a maximum height and falls back to the ground. Show that the Coriolis deflection when it again reaches the ground is opposite in direction, and four times greater in magnitude, than the Coriolis deflection when it is dropped at rest from the same maximum height.

3. (25 points) Prove that for a general rigid body motion about a fixed point, the kinetic energy  $T$  satisfies

$$\frac{dT}{dt} = \boldsymbol{\omega} \cdot \mathbf{N}, \quad (1)$$

where  $\boldsymbol{\omega}$  is the angular velocity,  $\mathbf{N}$  is the external torque.

4. (25 points) A uniform sphere of mass  $M$  and radius  $R$  rotates around an axis through its center of mass. How is the kinetic energy of the sphere related to the angular velocity?