Classical Mechanics (PH211 + PH403)

Tutorial VI-A

Also See Tutorial # VI-B

1. Find the Coriolis deflection of a stone dropped from a tower (of height h, and situated at a latitude λ) as it hits the ground. What's the direction of the deflection. Make suitable approximations.

2. A small toy car of mass m moves outward (in a straight line) with uniform speed u_0 from the centre of a turn table. If the turn table takes τ second to complete one rotation, find the forces acting on the car, when it is at a distance r from the centre of the table. What's the velocity of the car at this point for a stationery observer.

3. The trajectory of a particle of mass m on a turn table is $r(t) = \alpha\, t$ and $\theta(t) = \beta\, t$, in polar coordinates. α and β are constants. The turn table rotates about an axis perpendicular to the plane of the table at a uniform angular velocity $\omega\hat{z}$. Find the linear velocity and angular velocity of the particle for an observer in an inertial frame. Find the inertial forces acting on the particle at time t.

   All the quantities should be expressed in terms of $\hat{r}$, $\hat{\theta}$ and $\hat{z}$, where $\hat{r}$ and $\hat{\theta}$ are unit vectors of the plane polar coordinates defined on the table.

4. The structure of a CH_4 molecule may be viewed as: the C sitting at the centre of a cube and H's at alternate corners of the cube. Find the inertia tensor for a CH_4 molecule with the centre of the "enveloping" cube placed at the origin, and axes along three of it's face centres. Mass of H and C-H bond lengths can be taken as unity.

5. Find the inertia tensor for a cone of height h and base radius R, with its apex at the origin and its axis along the z-axis of the coordinate system. Using suitable transformation find the inertia tensor in the coordinate frame with its origin at the centre of mass, but having the same orientation as the original frame.