Tutorial # 1

Instructors: Santabrata Das and Uday Narayan Maity

PH 101: Physics I (2019)

Due on:31st July, 2019

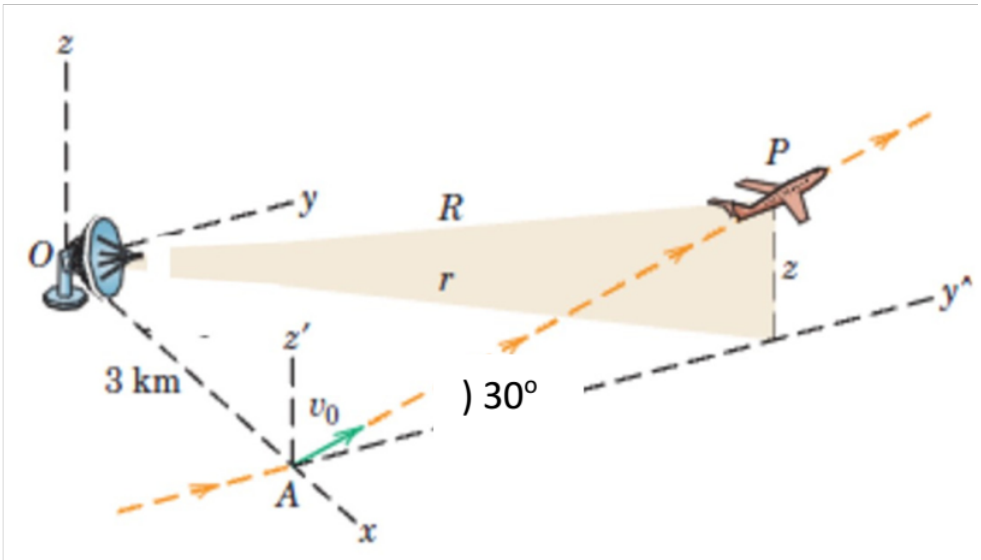
---

1. A particle moves in a plane with constant radial velocity, $\dot{r} = 4$m/s. The angular velocity is constant and has magnitude $\dot{\theta} = 2$ rad/s. When the particle is at a distance of 3 m from the origin, find the magnitude of (a) the velocity and (b) the acceleration.

2. A particle is moving in a circle of radius 12 m. Starting from the rest, its speed increases at a constant rate of 3 m/s^2 . Calculate its acceleration after 4 s.

3. The trajectory of a particle moving in a plane is given by $r = A\theta$, where A is a constant and $A = \frac{1}{\pi}$ m/rad. Here, θ increases in time according to $\theta = \frac{\alpha t^2}{2}$, where α is a constant. (a) Sketch the motion qualitatively. (b) Show that the radial acceleration is zero when $\theta = \frac{1}{\sqrt{2}}$ rad. (c) At what angles do the radial and tangential accelerations have equal magnitude?

4. A combat aircraft P takes off at A with an initial speed of 100 m/s in the vertical plane $y' - z'$ (see figure below) making an angle of 30° with the y' axis. It maintains a constant acceleration of 2 m/s^2 along its flight path. Obtain the position and velocity of the aircraft in (a) Cartesian (x, y, z) and (b) cylindrical (r, θ, z) coordinates as measured by the radar at O, sixty seconds later it took off.



5. A car is ascending a parking garage ramp in the form of a cylindrical helix of 7.2 m radius, and rising 3 m every half turns. At some point the speed of the car is 25 km/h, and is decreasing at the rate of 3 km/h per second. Determine the acceleration of the car in terms of ($\hat{r}$, $\hat{\theta}$, $\hat{z}$).

6. A bead rests at the top of a fixed frictionless hoop of radius R that lies in a vertical plane. The bead is given a tiny push so that it slides down and around the hoop. At what points on the hoop is the bead's acceleration vertical? What is this vertical acceleration? (Note: Use the fact that the bead's speed after it has fallen a height h is given by $v = \sqrt{2gh}$.)

7.