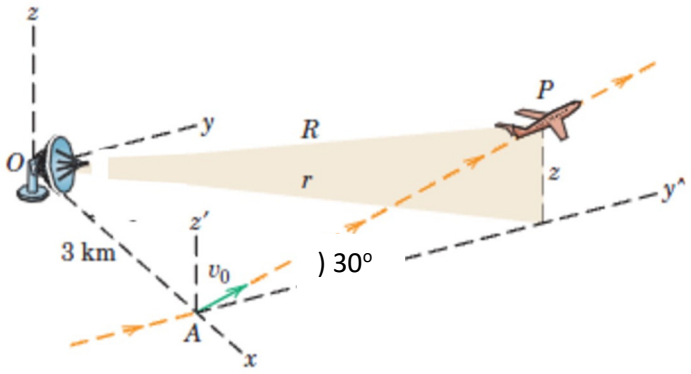
1. A particle moves in a plane with constant radial velocity, $\dot{r}$ = 4 m/s. The angular velocity is constant and has magnitude $\dot{\theta}$ = 2 rad/s. When the particle is 3 m from the origin, find the magnitude of (a) the velocity and (b) the acceleration.

2. A particle is moving in a circle of radius 12 m. Starting from the rest the, 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. A = $(1/\pi)$ m/rad. θ increases in time according to $\theta = \alpha t^2/2$, where α is a constant.
   a. Sketch the motion qualitatively.
   b. Show that the radial acceleration is zero when $\theta = 1/\sqrt{2}$ 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^o 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, (b) cylindrical (r, θ, z) and spherical polar (r, θ, φ) 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 $(\hat{r}, \hat{\theta}, \hat{k})$.