Exercises in Physics
Assignment # 5

Date Given: May 12, 2022
Date Due: May 19, 2022

P1. (2 points) Find an equation in polar coordinates that has the same graph as the given equation in rectangular coordinates.

(a) $\left(x - \frac{3}{2}\right)^2 + y^2 = \frac{9}{4}$

(b) $\sqrt{(x^2+y^2)^3} = 3(x^2 - y^2)$

P2. (2 points) Sketch the curves

(a) $r = 3\cos\theta$

(b) $r = 3\cos 2\theta$

P3. (2 points) A jet plane flying at a constant speed v at an altitude $h = 10$km is being tracked by radar located at O directly below the line of flight. If the angle θ is decreasing at the rate 0.02 rad/s when $\theta = 60^\circ$, determine the value of $\ddot{r}$ at this instant and the magnitude of the velocity $\boldsymbol{v}$ of the plane.

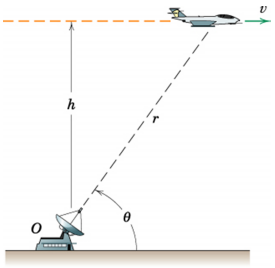

Figure 1: Illustration to Problem 3.

P4. (4 points) The slider P can be moved inward by means of the string S as the bar OA rotates about the pivot O. The angular position of the bar is given by $\theta(t) = 0.4 + 0.12t + 0.06t^3$, where θ is in radians and t is in seconds. The position of the slider is given by $r(t) = 0.8 - 0.1t - 0.05t^2$, where r is in meters and t is in seconds.

(a) Determine the velocity $\boldsymbol{v}$ and acceleration $\boldsymbol{a}$ (in terms of $\boldsymbol{e}_r$ and $\boldsymbol{e}_\theta$) of the slider at time $t = 2$s.

(b) Find the angles which $\boldsymbol{v}$ and $\boldsymbol{a}$ make with the positive x-axis (that is the angles between $\boldsymbol{v}$ and $\boldsymbol{i}$ and between $\boldsymbol{a}$ and $\boldsymbol{i}$).

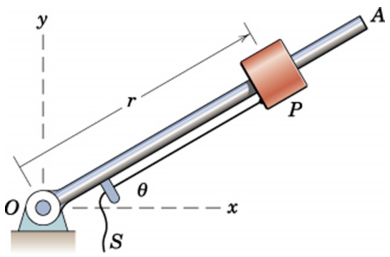

Figure 2: Illustration to Problem 4.