ME562 – Spring 2019
Purdue University
West Lafayette, IN

Homework Set No. 1

Assignment date: Thursday, January 16
Due date: Thursday, January 23, 11:59pm

- Please include this cover sheet as the first page of your homework submission.
- Submit homework file on Gradescope.

Name _____

PUID _____

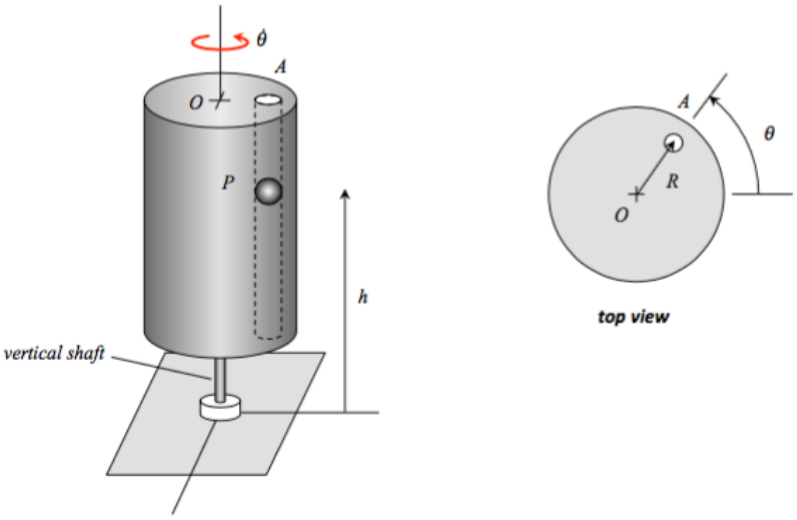
Problem 1.1 _____

Problem 1.2 _____

Problem 1.3 _____

TOTAL _____

Problem 1.1



A cylinder rotates about a vertical axis with a rate of $\dot{\theta}$, where $\dot{\theta}(0)=0$ and $\ddot{\theta}=constant$. At time $t=0$, particle P is dropped from rest into a smooth, vertical tube that is cut into the cylinder, with $h=h_0$. At the instant when $h=h_0/2$:

a) Determine the velocity and acceleration of P as vectors in terms of cylindrical coordinates.

b) Determine the speed and rate of change of speed of P.

c) Determine the radius of curvature of the path of P.

Use the following: $\ddot{\theta}=2rad/s^2$, $h_0=10\,ft$ and $R=0.5\,ft$.

Problem 1.2

A particle P moves in 3-D space with the following Cartesian coordinates (in meters):

$$x = \frac{t^3}{3}$$

$$y = -cos2\pi t$$

$$z = x^2 y$$

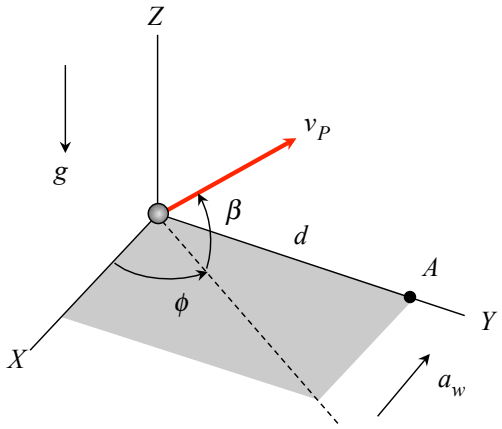
where t is in seconds. At time $t = 1\,\text{sec}$:

a) Determine the velocity and acceleration of P. Write your answers as vectors with Cartesian components.

d) Determine the speed and rate of change of speed of P.

e) Determine the radius of curvature of the path of P.

Problem 1.3



A projectile is launched with a speed of v_P at the origin of a set of *XYZ* axes in the direction shown. After launching, the projectile experiences a downward acceleration of *g*, as well as an acceleration in the negative *X*-direction of $a_w = 0.4g$. The target for the projectile is point A on the Y-axis at a distance of *d* from the launching point.

a) Determine the launch angle β and the initial velocity v_P required for the projectile to land at A.
b) Determine the velocity vector (in Cartesian components), the rate of change of speed and the radius of curvature of the projectile immediately before it lands at A.

Use the following: $\phi = 53.13°$ and $d = 2000\,ft$.