ME 274 – Wagner – Quiz 03   Name___________________________

You may work in groups.   You may use your book. You may not use the internet.

Sprinkler arm OA is pinned to a cart at point O. The cart moves to the right with a speed of v_{cart} with a constant rate of change of speed $\dot{v}_{cart}$ = 2 ft/s^2. Fluid flows through the sprinkler arm at a rate of $\dot{d}$ relative to the arm with a constant rate of change of relative speed $\ddot{d}$ = -3 ft/s^2. The sprinkler arm is being raised at a constant rate of $\dot{\theta}$ = 4 rad/s. As shown in the below figure, an observer and xyz coordinate system are attached to the sprinkler arm. The following equation can be used to find the acceleration of a pellet P that flows with the fluid in the arm:

$$\vec{a}_P = \vec{a}_O + \left(\vec{a}_{P/O}\right)_{rel} + \vec{\alpha} \times \vec{r}_{P/O} + 2\vec{\omega} \times \left(\vec{v}_{P/O}\right)_{rel} + \vec{\omega} \times \left(\vec{\omega} \times \vec{r}_{P/O}\right)$$

Find the numerical values of the below vectors when d = 3 ft, v_{cart} = 3 ft/s, $\dot{d}$ = 5 ft/s, and θ= 90 deg:

$\vec{a}_O = -\dot{v}_{cart}\hat{j} = -2\hat{j}$ [ft/s^2]

$\vec{\omega} = \dot{\theta}\hat{k} = 4\hat{k}$ [rad/s]

$\vec{\alpha} = 0$

$\left(\vec{v}_{P/O}\right)_{rel} = \dot{d}\hat{\imath} = 5\hat{\imath}$ [ft/s]

$\left(\vec{a}_{P/O}\right)_{rel} = \ddot{d}\hat{\imath} = -3\hat{\imath}$ [ft/s^2]