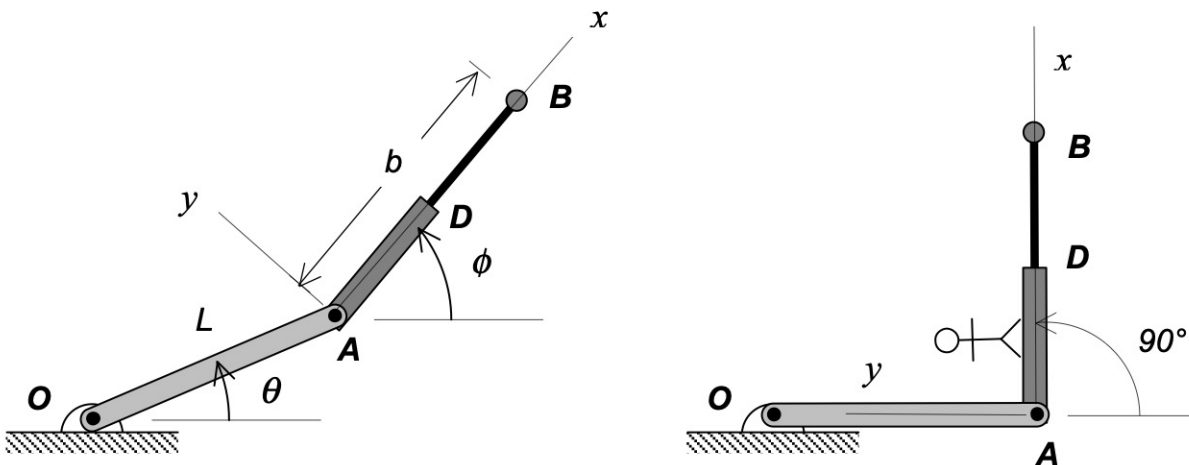


**Homework H.3.A**

**Given:** A robotic manipulator is made up of two links OA and ADB as shown in the figure below left. Link OA has a fixed length of  $L$ , and the length link ADB is changing at a constant rate of  $\dot{b}$ .

**Find:** For the position shown below right with  $\theta = 0^\circ$  and  $\phi = 90^\circ$ , determine the acceleration of point B on the manipulator.



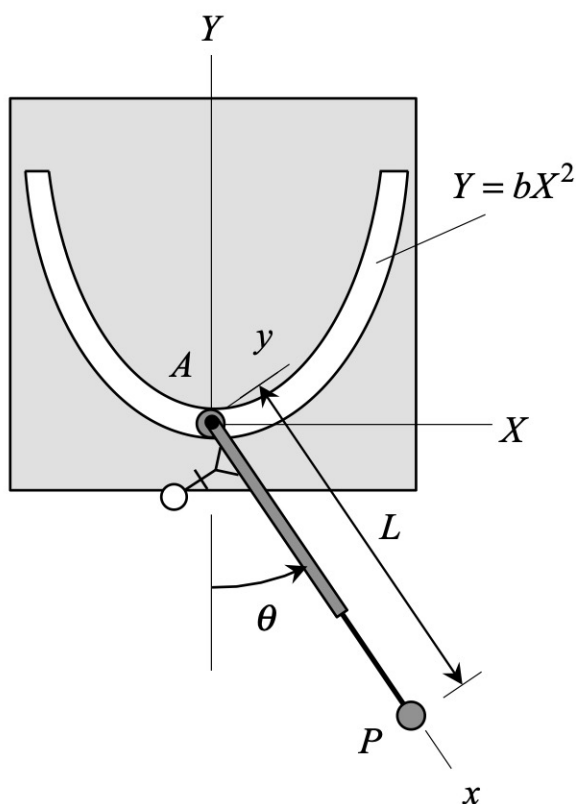
Use the following parameters in your analysis:  $b = 3$  ft,  $\dot{b} = 6$  ft/s = constant,  $\dot{\theta} = 2$  rad/s = constant,  $\dot{\phi} = 3$  rad/s = constant and  $L = 4$  ft.

**Homework H.3.B**

**Given:** End A of the telescoping rod AP is constrained to move within a curved slot that defines a path of  $Y = bX^2$  for A, where  $X$  and  $Y$  are given in feet. A is known to move through the slot with a constant  $x$ -component of velocity of  $\dot{X}$ . In addition, AP rotates with a constant rate of  $\dot{\theta}$ , and AP extends at a constant rate  $\dot{L}$ . At the instant shown, A is located at  $X = 0$ . A set of  $xyz$ -coordinate axes are attached to AP, as shown.

**Find:** At the instant shown, determine the velocity and acceleration of P. Write your answers in terms of their  $x$ - and  $y$ -components.

**HINT:** Consider using an observer attached to the non-extending section of arm AP, as shown in the figure.



Use the following parameters in your analysis:  $b = 2/\text{ft}$ ,  $\dot{X} = 6 \text{ ft/s}$ ,  $\theta = 30^\circ$ ,  $\dot{\theta} = 5 \text{ rad/s}$ ,  $L = 2 \text{ ft}$  and  $\dot{L} = 10 \text{ ft/s}$ .