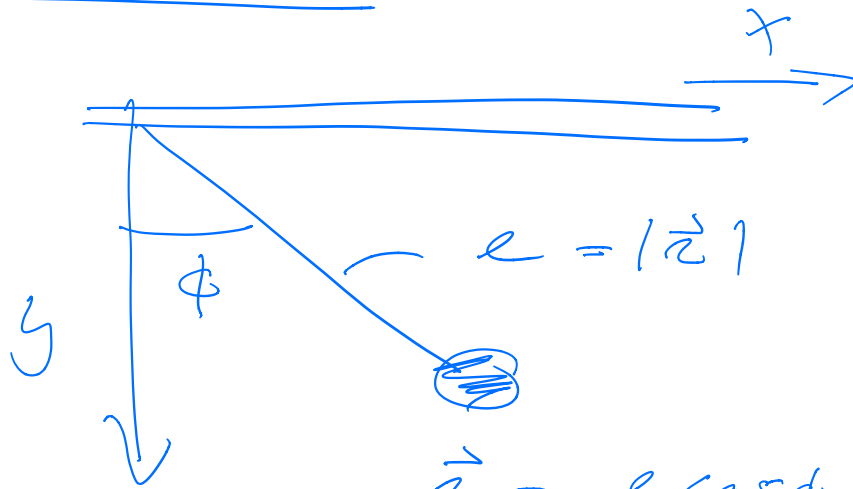


Last project



$$\vec{r} = l \cos \phi \hat{y} + l \sin \phi \hat{x}$$

$$\begin{matrix} \dot{x} & \dot{y} \\ \ddot{x} & \ddot{y} \end{matrix} \rightarrow \frac{1}{2} m (\dot{x}^2 + \dot{y}^2)$$

$$\begin{matrix} \ddot{x} & \ddot{y} \end{matrix} \rightarrow \ddot{r}, \ddot{\phi}$$

$$\dot{r} = \dot{r} = 0$$

$$\ddot{\phi} = \frac{d^2 \phi}{dt^2} = - \frac{g}{l} \sin \phi$$

$$\omega_0^2 = g/l$$

$$\boxed{\ddot{\phi} = -\omega_0^2 \sin \phi} \quad (\text{hw 6 + Midterm 1})$$

$$\frac{d\phi}{dt} = \dot{\phi} \quad \wedge \quad \frac{d\dot{\phi}}{dt} = \ddot{\phi} = -\omega_0^2 \sin \phi$$

$$\phi \ll 1 \Rightarrow$$

$$\nabla^2 \phi \approx \phi \Rightarrow$$

$$\boxed{\ddot{\phi} = -\omega_J^2 \phi} \quad (\text{HWS + Mid 1})$$