ME 274: Basic Mechanics II – Spring 2024 ***Name*** _____

Exam 1 – February 14

Equation sheet

$$\begin{aligned}
\vec{v}_P &= \dot{x}\hat{\imath} + \dot{y}\hat{\jmath} \\
&= v_P \hat{e}_t \\
&= \dot{r}\hat{e}_r + r\dot{\theta}\hat{e}_\theta \\
&= \vec{v}_B + \vec{\omega} \times \vec{r}_{P/B} \\
&= \vec{v}_B + \left(\vec{v}_{P/B}\right)_{rel} + \vec{\omega} \times \vec{r}_{P/B} \\
&= \vec{v}_B + \vec{v}_{P/B}
\end{aligned}$$

$$\begin{aligned}
\vec{a}_P &= \ddot{x}\hat{\imath} + \ddot{y}\hat{\jmath} \\
&= \dot{v}_P \hat{e}_t + \frac{v^2}{\rho}\hat{e}_n \\
&= \left(\ddot{r} - r\dot{\theta}^2\right)\hat{e}_r + \left(r\ddot{\theta} + 2\dot{r}\dot{\theta}\right)\hat{e}_\theta \\
&= \vec{a}_B + \vec{\alpha} \times \vec{r}_{P/B} - \omega^2 \vec{r}_{P/B} \\
&= \vec{a}_B + \left(\vec{a}_{P/B}\right)_{rel} + \vec{\alpha} \times \vec{r}_{P/B} + 2\vec{\omega} \times \left(\vec{v}_{P/B}\right)_{rel} + \vec{\omega} \times \left(\vec{\omega} \times \vec{r}_{P/B}\right) \\
&= \vec{a}_B + \vec{a}_{P/B}
\end{aligned}$$