ME 274 – Spring 2024 – 11:30 – Quiz 4

Problem 1

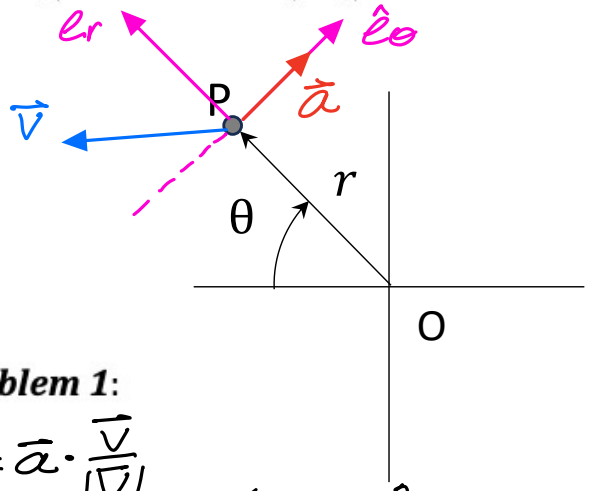
A forward-traveling automobile P has its velocity and acceleration expressed in terms of a set of polar coordinates of: $\bar{v} = \left(15\hat{e}_r - 20\hat{e}_\theta\right) m/s$ and $\vec{a} = \left(6\hat{e}_\theta\right) m/s^2$, respectively. From this, it is known that:

a) P is turning left.

b) P is turning right.

c) P is traveling on a straight path.

d) More information is needed.



Problem 2

For the velocity and acceleration of P given in ***Problem 1***:

a) P is increasing speed.

b) P is decreasing speed.

c) P is traveling at a constant speed.

d) More information is needed.

$$\dot{v} = \vec{a} \cdot \frac{\vec{v}}{|\vec{v}|} = (6\hat{e}_\theta) \cdot \frac{15\hat{e}_r - 20\hat{e}_\theta}{\sqrt{15^2+20^2}} = -\frac{120}{25}\ m/s^2 < 0$$

Problem 3

Two bodies, A and B, are connected by a cable-pulley system. The motions of A and B are represented by the finite distances of s_A and s_B, respectively, and the length of the inextensible cable is known to be $L = 3s_B + 2\sqrt{s_A^2 + h^2} + constants$, where h = constant. Let v_A and v_B be the speeds of A and B, respectively.

a) $v_A > v_B$

b) $v_A = v_B$

c) $v_A < v_B$

d) More information is needed.

$$L = 3s_B + 2\sqrt{s_A^2 + h^2} + constants$$

$$\frac{dL}{dt} = 0 = 3\dot{s}_B + \frac{(2)(2)}{2}\frac{s_A \dot{s}_A}{\sqrt{s_A^2+h^2}}$$

$$\rightarrow\ v_B = \underbrace{\left[\frac{2}{3}\frac{s_A}{\sqrt{s_A^2+h^2}}\right]}_{<1} v_A$$