Quiz03-Q1

Question C1.7

A polar description with variables r and θ is used to describe the kinematics of point P. For a position with $r = 0.5$ m and $\theta = 2$ radians, the velocity and acceleration vectors for P are known to be:

$$\vec{v}_P = (-6\hat{e}_r + 2\hat{e}_\theta) \text{ m/s}$$

$$\vec{a}_P = (10\hat{e}_r) \text{ m/s}^2$$

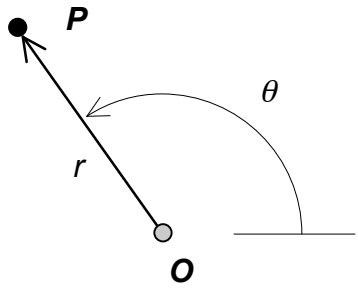
respectively. Circle the item below that most accurately describes the speed of P:

(a) The speed of P is increasing.

(b) The speed of P is not changing.

(c) The speed of P is decreasing.

Provide a justification for your answer.



$$\dot{V}_P = \vec{a}_P \cdot \hat{e}_t = \vec{a}_P \cdot \frac{\vec{V}_P}{|\vec{V}_P|} = (10\hat{e}_r) \cdot \left[\frac{-6\hat{e}_r + 2\hat{e}_\theta}{\sqrt{6^2+2^2}}\right]$$

$$= -\frac{60}{\sqrt{40}} \frac{m}{s^2} < 0 \Rightarrow \text{decreasing speed}$$

Quiz03-Q2

Question C1.9

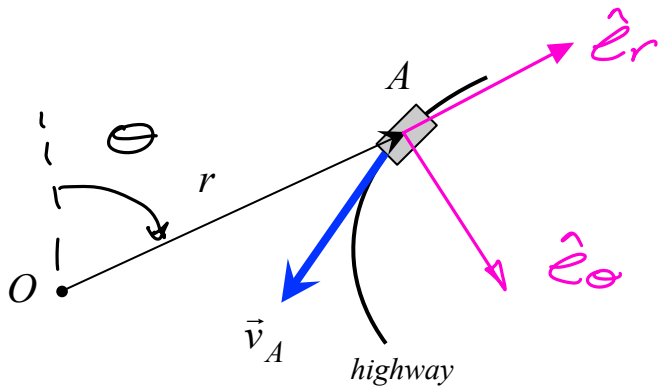
An automobile A travels along a highway with a speed of v_A. A police officer, at point O and a distance of r from A, accurately measures $\dot{r}$ (the time derivative of the distance r) with a hand-held radar device. Circle the item below that most accurately describes the size of $|\dot{r}|$ as compared to the speed v_A:

(a) $|\dot{r}| > v_A$ (the officer overestimates the speed of the automobile)

(b) $|\dot{r}| = v_A$ (the officer accurately measures the speed of the automobile)

(c) $|\dot{r}| < v_A$ (the officer underestimates the speed of the automobile)

Provide a written justification for your answer.



$$\vec{V}_A = \dot{r}\hat{e}_r + r\dot{\theta}\hat{e}_\theta$$

$$\hookrightarrow V_A = \sqrt{\dot{r}^2 + (r\dot{\theta})^2} > \dot{r}$$

Quiz03-Q3

Question C1.12

Blocks A and B are connected by an inextensible cable, as shown in the figure below. Assume that the radius of the pulley is small compared to the other dimensions of the problem. Block A moves along a horizontal path, and block B moves along a vertical path. At the instant shown, B is moving downward with a speed of v_B. Circle the answer below that most accurately describes the speed of A, v_A, as compared to the speed of B:

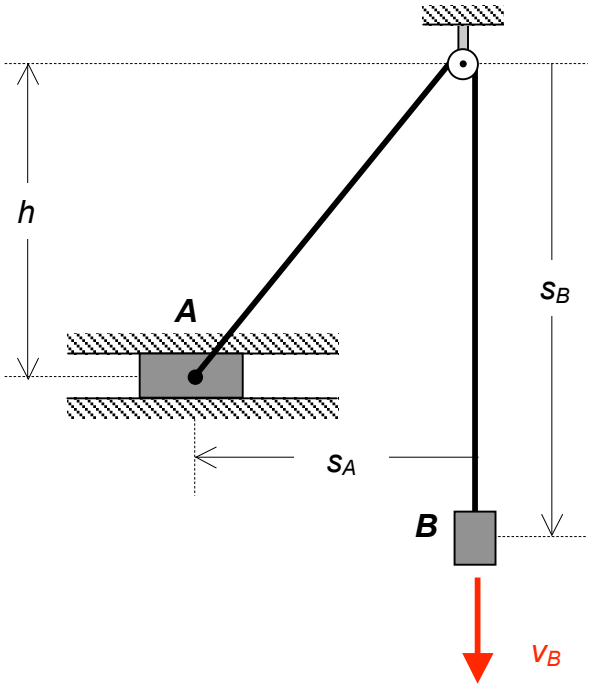
(a) $v_A > v_B$

(b) $v_A = v_B$

(c) $v_A < v_B$

(d) More information is needed about the problem in order to answer this question.

Provide an mathematical justification for your answer.



L = cable length

$= \sqrt{s_A^2 + h^2} + s_B + \text{constant} = \text{constant}$

$\therefore \quad \frac{dL}{dt} = \frac{1}{2} \frac{2 s_A \dot{s}_A}{\sqrt{s_A^2 + h^2}} + \dot{s}_B = \left[\frac{s_A}{\sqrt{s_A^2 + h^2}} \right] \dot{s}_A + \dot{s}_B = 0$

$\therefore \quad v_B = \underbrace{\left(\frac{s_A}{\sqrt{s_A^2 + h^2}} \right)}_{\leq 1} v_A \leq v_A$