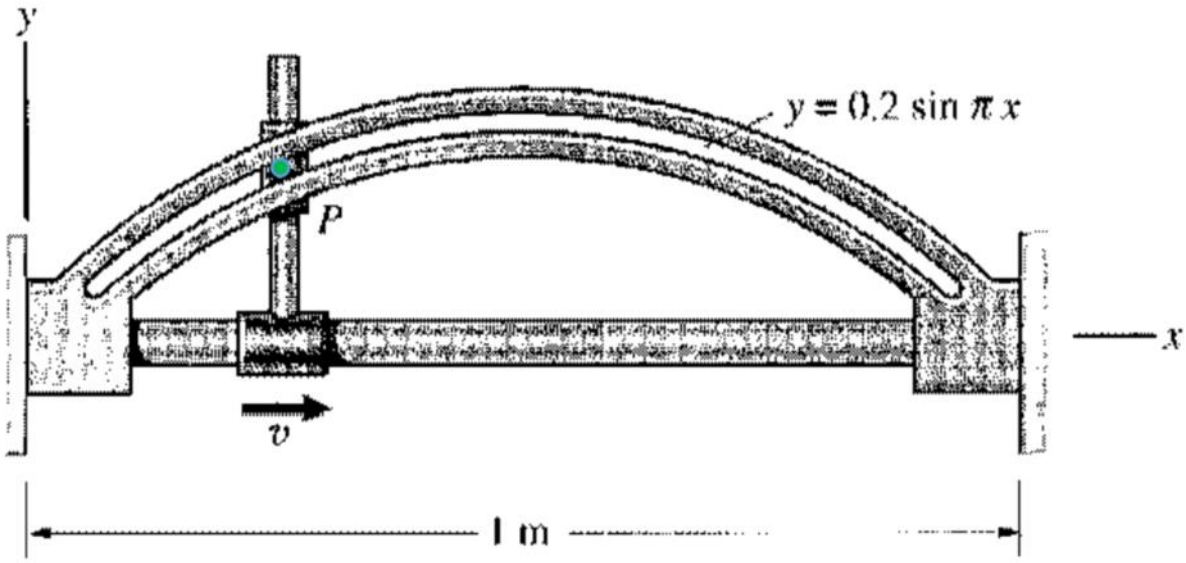
Dynamics midterm q1

Thursday, December 2, 2021 5:47 PM

The constant velocity $v = 2$ m/s. What are the magnitudes of the velocity and acceleration of point P when $x = 0.25$ m?



$$y = 0.2 \sin \pi x \qquad (1)$$

$$(1) \rightarrow \dot{y} = \frac{dy}{dt} = 0.2\pi \frac{dx}{dt} \cos \pi x \Rightarrow \dot{y} = 0.2\pi \dot{x} \cos \pi x \qquad (2)$$

$$(2)\ \ddot{y} = \frac{d^2y}{dt^2} = 0.2\pi \frac{d^2x}{dt^2} \cos \pi x - 0.2\pi^2 \left(\frac{dx}{dt}\right)^2 \sin \pi x \Rightarrow$$

$$\ddot{y} = 0.2\pi \ddot{x} \cos \pi x - 0.2\pi^2 (\dot{x})^2 \sin \pi x \qquad (3)$$

$$\begin{cases} x = 0.25 \text{ m} \\ \dot{x} = 2 \frac{m}{s} \end{cases} \Rightarrow \ddot{x} = 0 \qquad (4)$$

$$(4) \text{ into } (2) \Rightarrow \dot{y} = 0.2\pi (2) \cos(0.25\pi) = 0.8886 \frac{m}{s}$$

$$\boxed{\dot{y} = 0.8886 \frac{m}{s}}$$

$$@\ x = 0.25 \text{ m} \begin{cases} v_x = \dot{x} = 2 \frac{m}{s} \\ v_y = \dot{y} = 0.8886 \frac{m}{s} \end{cases} \qquad |v|_{x=0.25m} = \sqrt{v_x^2 + v_y^2}$$

$\dot{y} = \dot{y} = \ldots$ s $x = 0.25$ m

$\Rightarrow |v|_{x=0.25\,m} = \sqrt{2^2 + 0.8886^2} = 2.1885 \frac{m}{s} \Rightarrow$ $|v|\Big|_{x=0.25} = 2.1885$ m/s

$$\vec{v}\Big|_{x=0.25\,m} = 2\hat{i} + 0.8886\,\hat{j}\ \frac{m}{s}$$

(4) into (3) $\ddot{y} = 0.2\pi \times (0)\cos(0.25\pi) - 0.2\pi^2 (2)^2 \sin(0.25\pi)$

$= -5.5831 \frac{m}{s^2}$

$$\ddot{y}\Big|_{x=0.25\,m} = -5.5831 \frac{m}{s^2}$$

$$\vec{a}\Big|_{x=0.25\,m} = -5.5831\,\hat{j}\ \frac{m}{s^2}$$

$$|a|\Big|_{x=0.25\,m} = 5.5831 \frac{m}{s^2}$$