# Quiz 01: Chapter 12 Due: Tuesday 24 Jan 23

Examine the solved problem below. There are four errors in the solution below. Your task is to locate and identify those errors, then correct them and calculate the proper result. If the same error occurs more than once, only count it as a single error, even if you have to correct it in more than one instance.

Each correctly identified error is worth 4 points, and the re-calculated result is worth 4 points as well. You must save your work in pdf format and submit via the Quiz 01 Assignment in the Chapter 12 folder in the Quizzes folder of the Online Classroom in Blackboard. Please do not use any other file format than pdf.

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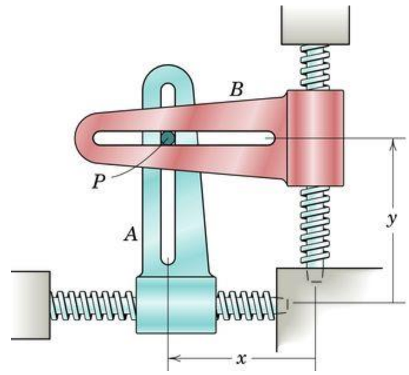
The $x$- and $y$-motions of guides A and B with right angle slots control the curvilinear motion of the connecting pin P, which slides in both slots. For a short interval, the motions are governed by $x = 20 - \frac{2}{3}t^3$ and $y = 15 + \frac{3}{4}t^2$, where x and y are in millimeters and t is in seconds. Calculate the magnitudes and directions of the velocity v and acceleration a of the pin for $t = 3\text{s}$.




A) Determine the time derivatives of $x$ and $y$.

$$x = 20 - \frac{2}{3}t^3 \qquad y = 15 + \frac{3}{4}t^2$$

$$\dot{x} = 0 - \frac{2}{9}t^2 \qquad \dot{y} = 0 + \frac{3}{8}t$$

$$\ddot{x} = -\frac{2}{18}t = -\frac{1}{9}t \qquad \ddot{y} = \frac{3}{8}$$

B) Calculate the velocity components $v_x$ and $v_y$ at $t = 3\text{s}$.

$$v_x = \dot{x} = \frac{2}{9}(3) = \left(\frac{2}{3}\right)\frac{\text{m}}{\text{s}} \qquad v_y = \dot{y} = \frac{3}{8}(3) = \left(\frac{9}{8}\right)\frac{\text{m}}{\text{s}}$$

C) Calculate the magnitude $v$ and direction $\theta_v$ of the velocity.

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{\left(0.667\frac{\text{m}}{\text{s}}\right)^2 + \left(1.125\frac{\text{m}}{\text{s}}\right)^2}$$

$$v = \sqrt{1.71}\frac{\text{m}}{\text{s}} = 1.31\frac{\text{m}}{\text{s}}$$

$$\theta_v = \tan^{-1}\left(\frac{v_x}{v_y}\right) = \tan^{-1}\left(\frac{0.667}{1.125}\right)$$

$$\theta_v = 30.6°$$

D) Calculate the acceleration components $a_x$ and $a_y$ at $t = 3\text{s}$.

$$a_x = \ddot{x} = -0.111(3) = -0.333\frac{\text{m}}{\text{s}^2} \qquad a_y = \ddot{y} = 0.375\frac{\text{m}}{\text{s}^2}$$

E) Calculate the magnitude $a$ and direction $\theta_a$ of the acceleration.

$$a = \sqrt{a_x^2 + a_y^2} = \sqrt{\left(-0.333\frac{\text{m}}{\text{s}^2}\right)^2 + \left(0.375\frac{\text{m}}{\text{s}^2}\right)^2}$$

$$a = \sqrt{0.0297}\frac{\text{m}}{\text{s}^2} = 0.172\frac{\text{m}}{\text{s}^2}$$

$$\theta_a = \tan^{-1}\left(\frac{a_y}{a_x}\right) = \tan^{-1}\left(\frac{0.375}{-0.333}\right)$$

$$\theta_a = 131.6°$$