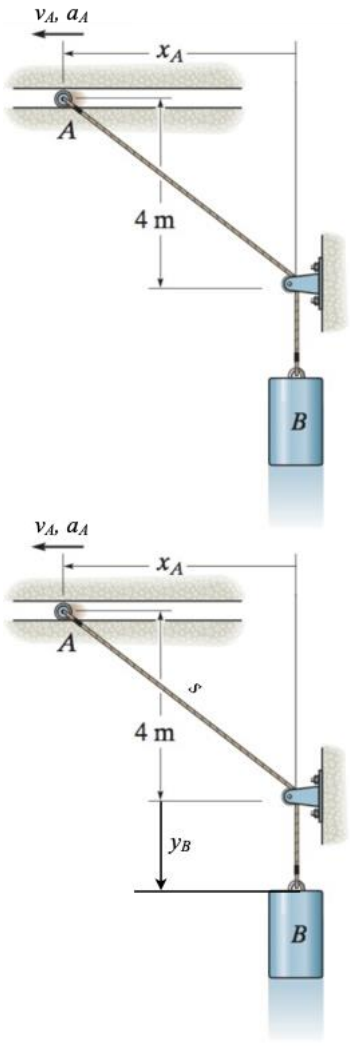
Quiz 02: Chapter 12 Due: Friday 26 Jan 24

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 02 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.

The roller at A is moving with a velocity of $v_A = 2\frac{\text{m}}{\text{s}}$ and has an acceleration of $a_A = 4\frac{\text{m}}{\text{s}^2}$ when $x_A = 3\text{m}$. Determine the velocity v_B and acceleration a_B of block B at this instant.



A) Calculate the length l of cord AB:

$$l = s + y_B = \sqrt{x_A^2 + 4} + y_B = \text{constant}$$

B) Take the time derivative $\dot{l} = 0$ to determine the relationship between v_A and v_B:

$$\dot{l} = \frac{1}{2}(x_A^2 + 4)^{\frac{3}{2}}(2x_A\dot{x}_A) + \dot{y}_B = (x_A\dot{x}_A)(x_A^2 + 4)^{\frac{3}{2}} + \dot{y}_B = 0$$

$$(x_A v_A)(x_A^2 + 4)^{\frac{3}{2}} + v_B = 0$$

C) Calculate v_B when $v_A = 2\frac{\text{m}}{\text{s}}$:

$$v_B = -(x_A v_A)(x_A^2 + 4)^{\frac{3}{2}} = -(3\text{m})\left(2\frac{\text{m}}{\text{s}}\right)(9 + 4)^{\frac{3}{2}} = -33.2\frac{\text{m}}{\text{s}}$$

D) Take the second time derivative $\ddot{l} = 0$ to determine the relationship between a_A and a_B.

$$\dot{l} = (x_A\dot{x}_A)(x_A^2 + 4)^{\frac{3}{2}} + \dot{y}_B = 0$$

$$\ddot{l} = (\dot{x}_A)^2(x_A^2 + 4)^{\frac{3}{2}} + (x_A\dot{x}_A)\left[\frac{3}{2}(x_A^2 + 4)^{\frac{1}{2}}(2x_A\dot{x}_A)\right] + \ddot{y}_B = 0$$

$$(\dot{x}_A)^2(x_A^2 + 4)^{\frac{3}{2}} + 3(x_A\dot{x}_A)^2(x_A^2 + 4)^{\frac{1}{2}} + \ddot{y}_B = 0$$

E) Calculate the acceleration a_B when $a_A = 4\frac{\text{m}}{\text{s}^2}$:

$$a_B = -(\dot{x}_A)^2(x_A^2 + 4)^{\frac{3}{2}} - 3(x_A\dot{x}_A)^2(x_A^2 + 4)^{\frac{1}{2}}$$

$$a_B = -(v_A)^2(x_A^2 + 4)^{\frac{3}{2}} - 3(x_A v_A)^2(x_A^2 + 4)^{\frac{1}{2}}$$

$$a_B = -(2)^2(9 + 4)^{\frac{3}{2}} - 3(3 \times 2)^2(9 + 4)^{\frac{1}{2}} = -577\frac{\text{m}}{\text{s}^2}$$