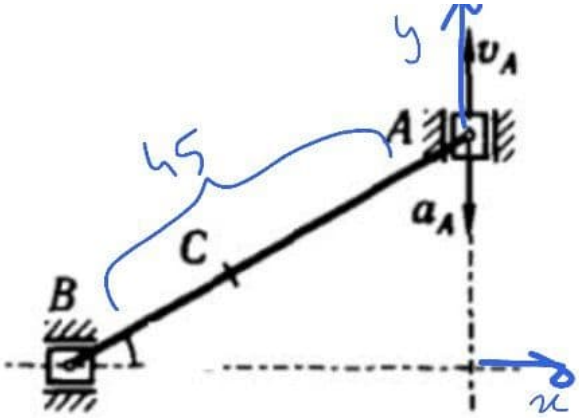
Homework of Week 1

Task 3



Link to the simulation

First, we need to find the positions of points A, B, C respectively.

According to the axis shown in the figure above with the given magnitudes:

$$y_A(t) = 22.5 + 10sin(\frac{\pi t}{5})$$

$$t \in [0, 10]$$

$$x_A(t) = 0$$

$$x_B(t) = -\sqrt{AB^2 - y_A(t)^2} = -\sqrt{45^2 - (22.5^2 + 45 \times 10 \times sin(\frac{\pi t}{5}) + 100sin^2(\frac{\pi t}{5}))}$$

$$y_B(t) = 0$$

$$x_c = x_B + \frac{1}{3}(x_A - x_B) = \frac{2}{3}x_B$$

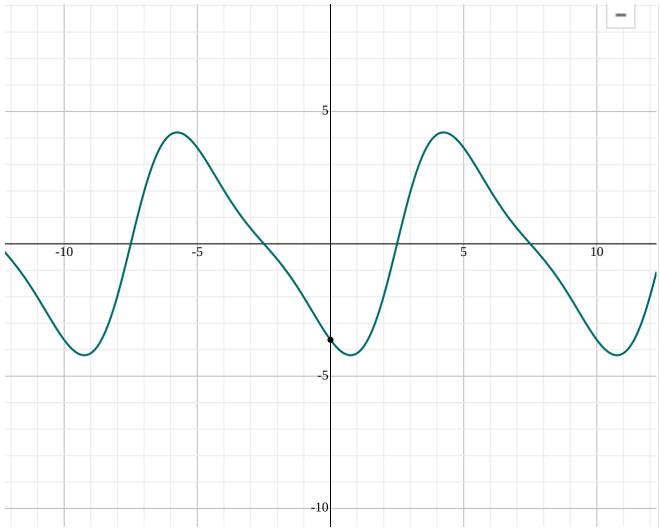
$$y_c(t) = y_B(t) + \frac{1}{3}(y_A - y_B)$$

Now we can derive the previous posistion equations for the first and second time to obtain velocities and accelerations.

$$V_B(t) = x'_B = \frac{-125.66370\ldots\sin(0.62831\ldots t)\cos(0.62831\ldots t) - 282.74333\ldots\cos(0.62831\ldots t)}{2\sqrt{-100\sin^2(0.62831\ldots t) - 450\sin(0.62831\ldots t) + 1518.75}}$$

$$V_C(t) = x'_c = \frac{2}{3}x_B = \frac{0.33333\ldots(-125.66370\ldots\sin(0.62831\ldots t)\cos(0.62831\ldots t) - 282.74333\ldots\cos(0.62831\ldots t))}{\sqrt{-100\sin^2(0.62831\ldots t) - 450\sin(0.62831\ldots t) + 1518.75}}$$

The following is the plot for velocity of B , C.



and derive once again to find the acceleration:

$$a_B(t) = V_B'(t) = \frac{(-78.95683\ldots\cos(1.25663\ldots t) + 177.65287\ldots\sin(0.62831\ldots t))\left(-100\sin^2(0.62831\ldots t) - 450\sin(0.62831\ldots t) + 1518.75\right) - 0.5(-125.66370\ldots\sin(0.62831\ldots t)\cos(0.62831\ldots t) - 282.74333\ldots\cos(0.62831\ldots t))^2}{2\left(-100\sin^2(0.62831\ldots t) - 450\sin(0.62831\ldots t) + 1518.75\right)\sqrt{-100\sin^2(0.62831\ldots t) - 450\sin(0.62831\ldots t) + 1518.75}}$$

$$a_c(t) = V_C'(t) = \frac{0.33333\ldots\left((-78.95683\ldots\cos(1.25663\ldots t) + 177.65287\ldots\sin(0.62831\ldots t))\left(-100\sin^2(0.62831\ldots t) - 450\sin(0.62831\ldots t) + 1518.75\right) - 0.5(-125.66370\ldots\sin(0.62831\ldots t)\cos(0.62831\ldots t) - 282.74333\ldots\cos(0.62831\ldots t))^2\right)}{\left(-100\sin^2(0.62831\ldots t) - 450\sin(0.62831\ldots t) + 1518.75\right)\sqrt{-100\sin^2(0.62831\ldots t) - 450\sin(0.62831\ldots t) + 1518.75}}$$

plot for accelerations: