First name and Last name printed correctly as seen on ROSI (1 mark)
Legibility and neatness (1 mark)

Quiz number 1d : Jan 15, 2015

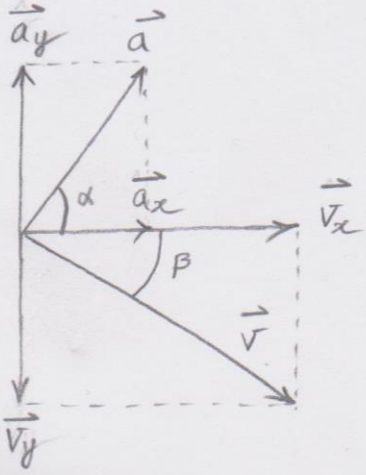
Solution :

at $t = 0 \longrightarrow (x, y) = (-3, 8)$

$(\dot{x}, \dot{y}) = (4, -3)$

$(\ddot{x}, \ddot{y}) = (2, 3)$

a) at $t = 0 \longrightarrow a_n = ?$



$\vec{a}_n$ is the component of $\vec{a}$ perpendicular to the path.

$|\vec{a}_n| = |\vec{a}| \sin(\alpha - \beta)$

$\alpha = \tan^{-1}\left(\frac{a_y}{a_x}\right) = \tan^{-1}\left(\frac{3}{2}\right)$

$\Rightarrow \quad \alpha = 56.31^\circ$

$\beta = \tan^{-1}\left(\frac{V_y}{V_x}\right) = \tan^{-1}\left(\frac{-3}{4}\right) \Rightarrow \beta = -36.87^\circ$

$|\vec{a}| = \sqrt{a_x^2 + a_y^2} = \sqrt{4 + 9} = 3.61 \ m/s^2$

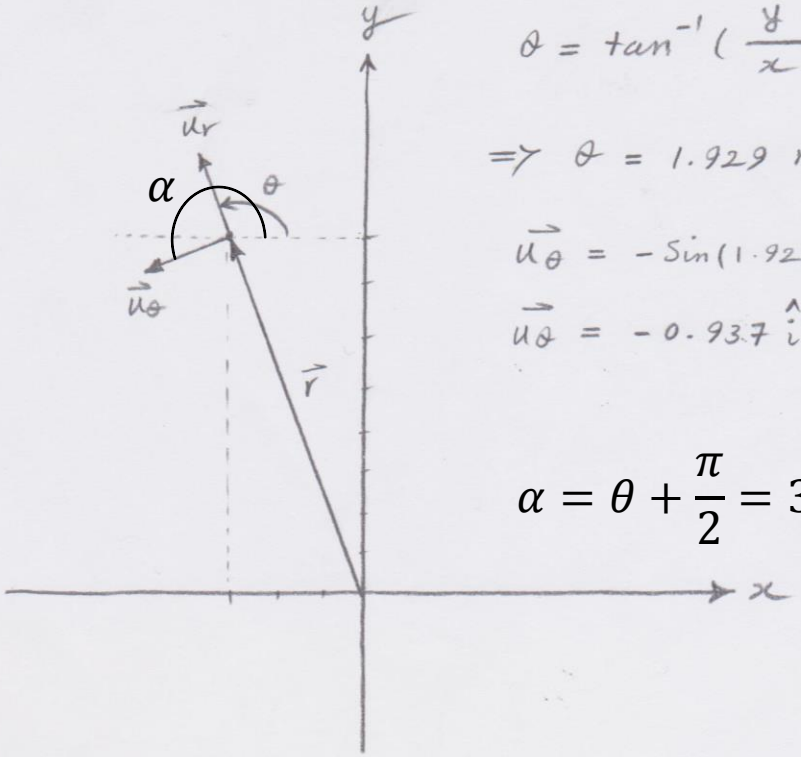
$\Rightarrow |\vec{a}_n| = (3.61) \sin(56.31^\circ - (-36.87^\circ)) = (3.61) \sin(93.18^\circ)$

$\Rightarrow \boxed{|\vec{a}_n| = 3.605 \ m/s^2}$ 2 marks

Yes, the normal component of the acceleration changes with time. 1 marks

b) at $t=0 \longrightarrow \hat{u}_\theta = ?$

$$\vec{u}_\theta = -|\vec{u}_\theta| \sin\theta\, \hat{i} + |\vec{u}_\theta| \cos\theta\, \hat{j}$$



$$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{8}{-3}\right)$$

$$\Rightarrow \theta = 1.929 \text{ radians}$$

$$\vec{u}_\theta = -\sin(1.929)\,\hat{i} + \cos(1.929)\,\hat{j}$$

$$\vec{u}_\theta = -0.937\,\hat{i} - 0.351\,\hat{j}$$

1 mark

$$\alpha = \theta + \frac{\pi}{2} = 3.5\ rad$$ 1 mark

c) at $t = 3\ s \longrightarrow r = ?$

$$x = x_0 + \bar{V}_{0x} t + \frac{1}{2} a_x t^2 \Rightarrow x = -3 + 4t + t^2$$

$$y = y_0 + \bar{V}_{0y} t + \frac{1}{2} a_y t^2 \Rightarrow y = 8 - 3t + 1.5\,t^2$$

at $t = 3s \Rightarrow x = -3 + 4(3) + 9 = 18\ m$

$$y = 8 - 3(3) + (1.5)(9) = 12.5\ m$$

$$r = \sqrt{x^2 + y^2} \Rightarrow r = \sqrt{18^2 + 12.5^2} = 21.91\ m$$ 3 marks