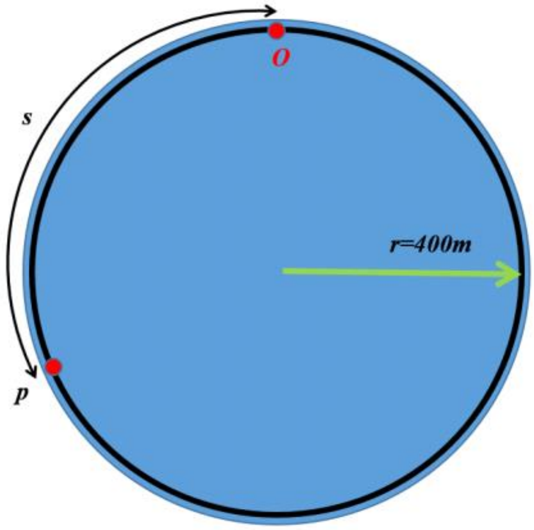
The motorcycle in Figure starts from rest at $t = 0$ on a circular track of 400 m radius. The tangential component of its acceleration is $a_t = (2 + 0.2t)\ m/s^2$. At t=10s, determine: (a) The distance it has moved along the track; (b) the magnitude of its acceleration (c) obtain the vector of acceleration.



$$a_t = \frac{dv}{dt} = (2+0.2t)\ \frac{m}{s^2} \Rightarrow dv = (2+0.2t)\,dt \Rightarrow \int_{v_0=0}^{v} dv = \int_0^t (2+0.2t)\,dt$$

$$a_t = \frac{dv}{dt} = (2+0.2t)\ \tfrac{m}{s^2} \Rightarrow dv = (2+0.2t)\,dt \Rightarrow \int_{v_0=0}^{v} dv = \int_0^t (2+0.2t)\,dt$$

$$\Rightarrow v - v_0 = (2t + 0.1t^2)\Big|_0^t \Rightarrow \boxed{v = (2t + 0.1t^2)\ \tfrac{m}{s}}$$

$$v = \frac{ds}{dt} = 2t + 0.1t^2 \Rightarrow ds = (2t + 0.1t^2)\,dt \Rightarrow \int_{s_0}^{s} ds = \int_0^t (2t + 0.1t^2)\,dt$$

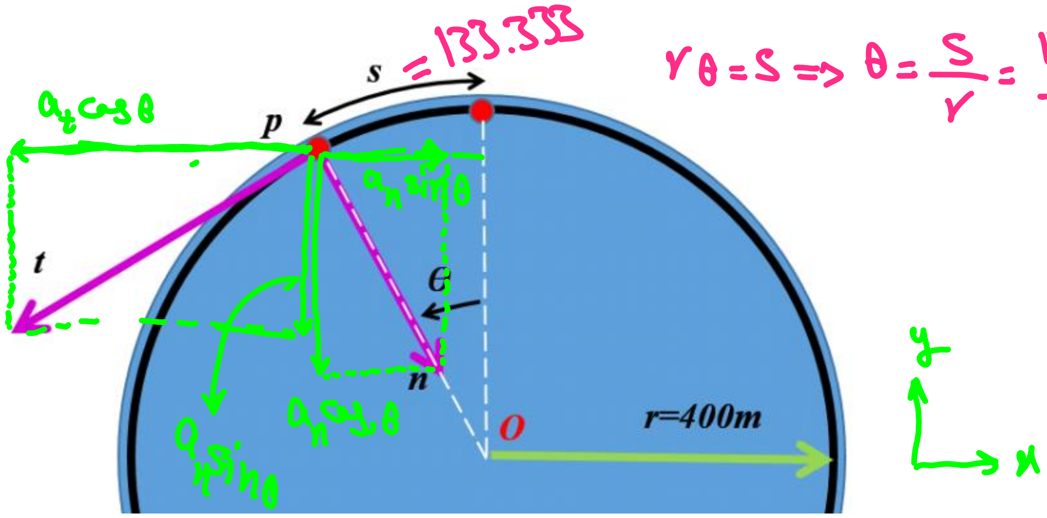
$$s\Big|_{s_0=0}^{s} = \left(t^2 + \frac{0.1}{3}t^3\right)\Big|_0^t \Rightarrow \boxed{s = t^2 + \frac{1}{30}t^3}$$

$$@\ t = 10\,s \Rightarrow \begin{cases} s\big|_{t=10s} = 10^2 + \frac{1}{30}\times 10^3 = 133.333\ m \\ v\big|_{t=10} = 2\times 10 + 0.1\times 10^2 = 30\ \tfrac{m}{s} \end{cases}$$

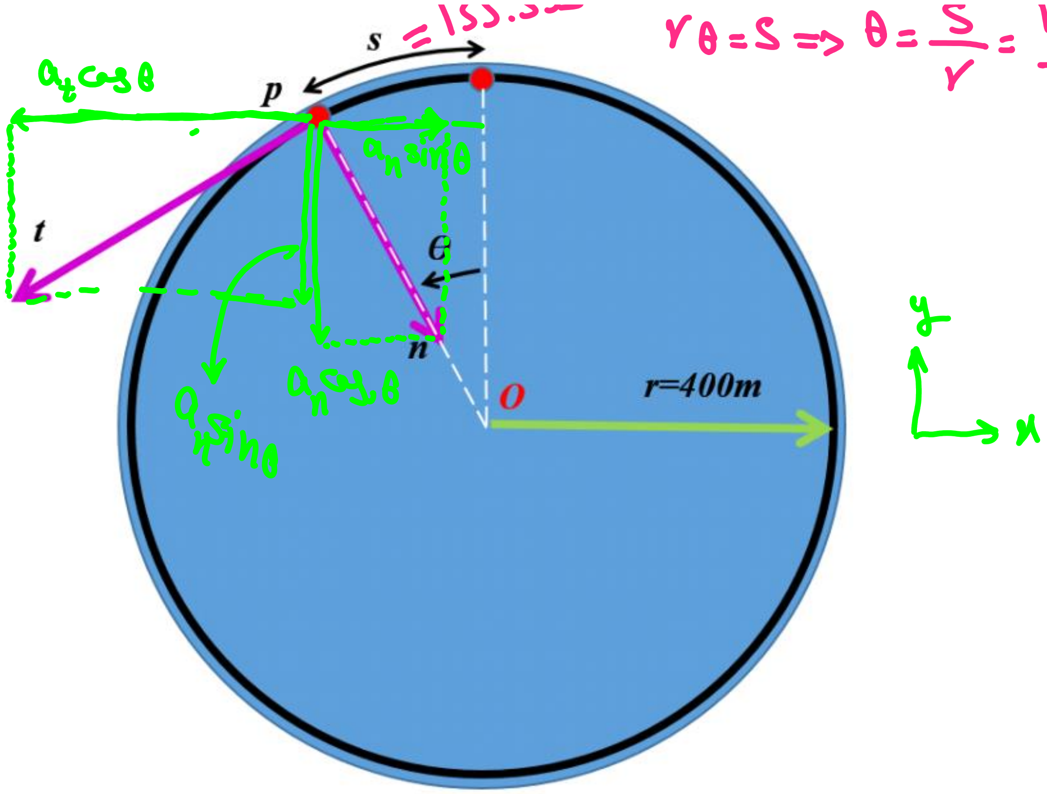
$$a_t\big|_{t=10} = 2 + 0.2\times 10 = 4\ \tfrac{m}{s^2}$$

$$a_n = \frac{v^2}{r} = \frac{30^2}{400} = 2.25\ \tfrac{m}{s^2} \Rightarrow |\vec{a}| = \sqrt{a_t^2 + a_n^2} = \sqrt{4^2 + 2.25^2} = 4.5894\ \tfrac{m}{s^2}$$

$$r\theta = S \Rightarrow \theta = \frac{S}{r} = \frac{133.333}{400} = 0.3333\ \text{Rad}$$



$$r\theta = S \Rightarrow \theta = \frac{S}{r} = \frac{133.333}{400} = 0.3333 \text{ Rad}$$



$$\theta = 0.3333 \text{ rad} = 19.0986^\circ$$

$$a = a_n(\sin\theta\,\hat{i} - \cos\theta\,\hat{j}) + a_t(-\cos\theta\,\hat{i} - \sin\theta\,\hat{j})$$

$$= 2.25(\sin 19.0986\,\hat{i} - \cos 19.0986\,\hat{j}) + 4(-\cos 19.0986\,\hat{i} - \sin 19.0986\,\hat{j})$$

$$\Rightarrow \vec{a} = -3.0436\,\hat{i} - 3.4349\,\hat{j} \quad \left(\frac{m}{s^2}\right)$$