

Find the length of  $\gamma$  if Find  $\varphi$  at  $\theta = \pi/2$ .

$$\gamma = a(1-\cos\theta) \text{ at } \theta = \pi/2 \quad \gamma = a(1-\cos\theta)$$

$$= a(1-\cos\pi/2)$$

$$= a(1-0) \quad \dots (1)$$

$$\boxed{\gamma = a} \quad \dots (1)$$

$$\sin\varphi = \sin\theta/2 = \sin(\pi/2/2) = \sin\pi/4$$

$$\boxed{\sin\varphi = \frac{1}{\sqrt{2}} - \tau^2}$$

$$P = \gamma \sin\varphi \quad \dots (3)$$

Substitute (1) and (2) values in (3)

$$\begin{aligned} P &= a \times \frac{1}{\sqrt{2}} = \boxed{P = \frac{a}{\sqrt{2}}} \\ \text{Let } \varphi &= \theta/2 \end{aligned}$$

$$\begin{aligned} \Rightarrow \frac{1}{\gamma} \frac{d\gamma}{d\theta} &= 0 + \frac{\pm \sin\theta}{\sin\theta} \\ \Rightarrow \frac{1}{\gamma} \frac{dr}{d\theta} &= \frac{(1-\cos\theta)}{2\sin^2\theta/2} \end{aligned}$$

$$\Rightarrow \boxed{\varphi = \theta/2}$$

$$\gamma^2 = a^2 \sec 2\theta \text{ at } \theta = \pi/6 \quad \sin \varphi = \sin \left(\frac{\pi}{2} - 2\theta\right)$$

$$\gamma^2 = \frac{a^2}{\cos 2\theta}$$

Final.  
log b/s.

$$2 \log \gamma = 2 \log a - \log \cos 2\theta$$

$$\Rightarrow \text{Diff w.r.t. } \theta$$

$$2 \cdot \frac{1}{\gamma} \frac{d\gamma}{d\theta} = 0 - \frac{-2 \sin 2\theta}{\cos 2\theta}$$

$$2 \cdot \frac{1}{\gamma} \frac{d\gamma}{d\theta} = 2 \tan 2\theta$$

$$\text{at } \theta = \pi/2 - 2\theta \Rightarrow (\theta = \pi/2 - 2\theta)$$

$$\gamma = a \sec \theta \text{ at } \theta = \pi/3$$

$$= \cos(2\theta)$$

$$= \cos(2 \times \pi/6)$$

$$= \cos \pi/3$$

$$\boxed{\sin \varphi = \frac{1}{2}} \quad \dots \quad (1)$$

$$\gamma^2 = a^2 \sec 2\theta$$

$$\gamma^2 = a^2 \cdot 2 \Rightarrow \boxed{\gamma = a\sqrt{2}} \quad \dots \quad (2)$$

$$P = \gamma \sin \varphi \quad \dots \quad (3)$$

Substitute (1) and (2) in equation (3).

$$P = a\sqrt{2} \times \frac{1}{2} = \frac{a\sqrt{2}}{2} = \frac{a}{\sqrt{2}} \quad \boxed{P = \frac{a}{\sqrt{2}}}$$

$$\gamma = a \sec(\theta/2) \text{ at } \theta = \pi/3.$$

$$\sin \varphi = \sin\left(\frac{\pi}{2} - \theta/2\right).$$

$$\gamma = \frac{a}{\cos^2 \theta/2}$$

$$\gamma = \frac{2a}{\cos \theta + 1}$$

$$\log \gamma = \log 2a - \log(\cos \theta + 1)$$

$$\frac{1}{\gamma} \frac{d\gamma}{d\theta} = 0 - \frac{(-\sin \theta)}{(\cos \theta + 1)}$$

$$\frac{1}{\gamma} \frac{d\gamma}{d\theta} = \frac{\sin \theta}{1 + \cos \theta} \Rightarrow \frac{x \sin \theta/2 \cos \theta/2}{x \cos^2 \theta/2} = \frac{\tan \theta/2}{\cos^2(\pi/2 - \theta/2)} = \frac{\tan \theta/2}{\cos^2(\pi/2 - \theta/2)}$$

$$\begin{aligned} 2\omega^2 \theta/2 &= \cos \theta + 1 \\ \cos \theta &= \cos \theta/2 \\ \cos \theta/2 &= \frac{\cos \theta + 1}{2} \\ \sin \varphi &= \frac{\sqrt{3}}{2} \end{aligned}$$

... (1)

$$\begin{aligned} \gamma &= a \sec^2(\theta/2) \\ (\theta = \pi/3) \quad &= a \sec^2(\pi/6) \end{aligned}$$

$$\gamma = a \cdot \frac{4}{3} = \frac{4a}{3} \quad \dots (2)$$

$$\begin{aligned} P &= \gamma \sin \varphi \quad \dots (3) \\ \text{Substitute } \varphi \text{ from (2) in (3)} \\ P &= 2 \frac{4a}{3} \times \frac{\sqrt{3}}{2} = \frac{2a}{\sqrt{3}} \Rightarrow P = \frac{2a}{\sqrt{3}} \end{aligned}$$

$$\frac{2a}{\gamma} \approx (1 - \cos \theta) \text{ at } \theta = \frac{\pi}{2}. \quad \begin{aligned} \sin \varphi &= \sin(-\theta/2) \\ &= -\sin(\pi/4) \end{aligned}$$

Find  $\varphi$ :

Take log.

$$\log 2a - \log \gamma = \log(1 - \cos \theta).$$

D.P.F w.r.t.  $\theta$ .

$$\Rightarrow 0 - \frac{1}{\gamma} \frac{d\gamma}{d\theta} = \frac{\sin \theta}{(1 - \cos \theta)}.$$

$$-\cot \varphi = \frac{(\omega + \theta)_2}{\omega + (\theta)_2} = \frac{\cancel{\sin \theta}_2 \cos \theta_2}{\cancel{\sin \theta}_2} \Rightarrow \boxed{\varphi = -\theta/2}$$

$$\boxed{\sin \varphi = -\frac{1}{\sqrt{2}}}. \quad \text{--- (1)}$$

$$\frac{2a}{\gamma} = 1 - \cos \pi/2.$$

$$\frac{2a}{\gamma} = 1 - 0 \Rightarrow \frac{2a}{\gamma} = 1 \Rightarrow \boxed{\gamma = 2a} \quad \text{--- (2)}$$

$$P = \gamma \sin \varphi \quad \text{--- (3)}$$

Substitute (1) and (2) in (3).

$$P = -2a \times \frac{1}{\sqrt{2}} = -\frac{a}{\sqrt{2}} \quad P = -\frac{a\sqrt{2}}{\cancel{\sqrt{2}}}$$

$$\text{S.Q.B.S} \Rightarrow \boxed{P^2 = 2a^2}$$

$$\rho = \frac{(1+y_1)^{3/2}}{y_2} \text{ on } \frac{(1+x_1^2)^{3/2}}{x_2}.$$

$$y_1 = \frac{dy}{dx}, \quad y_2 = \frac{d^2y}{dx^2}, \quad x_1 = \frac{dx}{dy}, \quad x_2 = \frac{d^2x}{dy^2}$$

$$\text{at } (0, 2a) \quad (2a, 0)$$

$$\gamma = \sin \theta = y = 2x^2 + 3$$

$$\frac{dy}{dx} = \frac{1}{2x}(2x^2 + 3) \quad (2x^2 + 3)$$

$$y_1 = 4x \quad (2a, 0) \quad (0, 2a)$$

$$y_1 = 4x \times 2a = 8a$$

$$y_2 = \frac{d}{dx}(4x) \\ = 4, \quad 3/2$$

$$\rho = \frac{(1+y_1^2)^{3/2}}{y_2} \\ = \frac{(1+8a^2)^{3/2}}{4}$$

$$y^2 = u \dot{a}^2 \left( \frac{2a-x}{x} \right)$$

$$0 = u \dot{a}^2 \left( \frac{2a-x}{x} \right).$$

$$\Rightarrow x = 2a.$$

$$2y \cdot \frac{dy}{dx} \stackrel{!}{=} \left( \frac{8a^3}{x} - u \dot{a}^2 \right)$$

$$2y \cdot y_1 = 8a^3 \cdot \frac{-1}{x^2} - 0$$

$$= 2y \cdot y_1 = -\frac{8a^3}{x^2} \Rightarrow y_1 = \frac{y^3}{2x^2 \cdot y}$$

$$= y_1 = -\frac{y^3}{2x^2} (2a, 0)$$

at  $x = 2a$

$$\frac{dx}{dy} = \frac{y^2}{u \dot{a}^3}$$

$$x_1 = 0$$

$$x'' = \frac{d(x)}{dy}$$

$$\frac{1}{u \dot{a}^3} \left[ x \cdot 1 + y \cdot 2x \cdot \frac{dy}{da} \right]$$

$$\left( = \frac{(1+x_1)^{3/2}}{x_2} \right)$$