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## Differentiation of cosine from first principles

$$\text{let } y = \cos \theta$$

$$\cos(A+B) = \cos A \cos B - \sin A \sin B$$

$$\therefore y + \delta y = \cos(\theta + \delta\theta)$$

Given as  $h \rightarrow 0$

$$\therefore \delta y = \cos(\theta + \delta\theta) - y$$

$$\frac{\sin h}{h} \rightarrow 1, \frac{\cos h - 1}{h} \rightarrow 0$$

$$\therefore \delta y = \cos \theta \cos \delta\theta - \sin \theta \sin \delta\theta - \cos \theta$$

$$\therefore \frac{\delta y}{\delta\theta} = \cos \theta \frac{(\cos \delta\theta - 1)}{\delta\theta} - \sin \theta \frac{\sin \delta\theta}{\delta\theta}$$

$$\text{As } \delta\theta \rightarrow 0, \frac{\delta y}{\delta\theta} \rightarrow \frac{dy}{d\theta} \quad \frac{\cos \delta\theta - 1}{\delta\theta} \rightarrow 0, \frac{\sin \delta\theta}{\delta\theta} \rightarrow 1$$

$$\therefore \frac{dy}{d\theta} = -\sin \theta$$

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