given that $x = 3\cos\theta - \cos 3\theta$, $y = 3\sin\theta - \sin 3\theta$

show that $\dfrac{dy}{dx} = \tan 2\theta$

$$x = 3\cos\theta - \cos 3\theta \qquad y = 3\sin\theta - \sin 3\theta$$

$$\frac{dx}{d\theta} = -3\sin\theta + 3\sin 3\theta \ , \qquad \frac{dy}{d\theta} = 3\cos\theta - 3\cos 3\theta$$

$$\frac{dy}{dx} = \frac{dy}{d\theta}.\frac{dx}{d\theta} = 3\cos\theta - 3\cos 3\theta.\frac{1}{-3\sin\theta + 3\sin 3\theta}$$

$$\frac{dy}{dx} = \frac{3\cos\theta - 3\cos 3\theta}{3\sin 3\theta - 3\sin\theta} = \frac{\cos\theta - \cos 3\theta}{\sin 3\theta - \sin\theta}$$

but $\cos(A+B) - \cos(A-B) = -2\sin A\sin B$

$\therefore \quad \cos(2\theta + \theta) - \cos(2\theta - \theta) = -2\sin 2\theta \sin\theta$

$\Longrightarrow \quad \cos(3\theta) - \cos(\theta) = -2\sin 2\theta \sin\theta$

$\Longrightarrow \quad \cos(\theta) - \cos(3\theta) = 2\sin 2\theta \sin\theta$

also $\sin(A+B) - \sin(A-B) = 2\cos A\sin B$

$\therefore \quad \sin(2\theta + \theta) - \sin(2\theta - \theta) = 2\cos 2\theta \sin\theta$

$\Longrightarrow \quad \sin(3\theta) - \sin(\theta) = 2\cos\theta \sin\theta$

$$\therefore \frac{dy}{dx} = \frac{2\sin 2\theta \sin\theta}{2\cos 2\theta \sin\theta}$$

$$= \underline{\tan 2\theta}$$