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$$\cos 3\theta \equiv 4 \cos^3 \theta - 3 \cos \theta$$

$$\cos 3\theta = \cos (2\theta + \theta)$$

$$[\text{using } \cos (A+B) = \cos A \cos B - \sin A \sin B]$$

$$\cos 3\theta = \cos 2\theta \cos \theta - \sin 2\theta \sin \theta$$

$$= [2 \cos^2 \theta - 1] [\cos \theta] - 2 \sin \theta \cos \theta \sin \theta$$

$$[\text{using } \cos 2\theta = 2 \cos^2 \theta - 1 \text{ and } \sin 2\theta = 2 \sin \theta \cos \theta]$$

$$= 2 \cos^3 \theta - \cos \theta - 2 \sin^2 \theta \cos \theta$$

$$= 2 \cos^3 \theta - \cos \theta - 2 [1 - \cos^2 \theta] \cos \theta$$

$$[\text{using } \sin^2 \theta + \cos^2 \theta = 1]$$

$$= 2 \cos^3 \theta - \cos \theta - 2 \cos \theta + 2 \cos^3 \theta$$

$$= 4 \cos^3 \theta - 3 \cos \theta$$