5.4 Multiple Angle Identities

Obj: 1. Apply double-angle, power-reducing, and half-angle identities.

Double angle

$$\sin 2u = 2\sin u\cos u$$

$$\cos 2u = \begin{cases} \cos^2 u - \sin^2 u \\ 2\cos^2 u - 1 \\ 1 - 2\sin^2 u \end{cases}$$

$$\tan 2u = \frac{2\tan u}{1 - \tan^2 u}$$

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Use the sum & diff. identities to prove:

$$\sin 2u = 2\sin u\cos u$$

$\sin(u+u)$

$\sin u\cos u + \cos u\sin u$

$2\sin u\cos u$

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Prove: $\cos 2u = 2\cos^2 u - 1$

$\cos(u+u)$

$\cos u \cos u - \sin u \sin u$

$\cos^2 u - \sin^2 u$

$\cos^2 u - (1 - \cos^2 u)$

$\cos^2 u - 1 + \cos^2 u$

$2\cos^2 u - 1$

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Power Reducing

$$\sin^2 u = \frac{1-\cos 2u}{2}$$

$$\cos^2 u = \frac{1+\cos 2u}{2}$$

$$\tan^2 u = \frac{1-\cos 2u}{1+\cos 2u}$$

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Prove $\cos^4\theta - \sin^4\theta = \cos 2\theta$

$(\cos^2\theta + \sin^2\theta)(\cos^2\theta - \sin^2\theta)$

$1(\cos^2\theta - \sin^2\theta)$

$\cos 2\theta$

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Half Angle

$$\sin\frac{u}{2} = \pm\sqrt{\frac{1-\cos u}{2}}$$

$$\cos\frac{u}{2} = \pm\sqrt{\frac{1+\cos u}{2}}$$

$$\tan\frac{u}{2} = \begin{cases} \pm\sqrt{\frac{1-\cos u}{1+\cos u}} \\ \frac{1-\cos u}{\sin u} \\ \frac{\sin u}{1+\cos u} \end{cases}$$

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Find the exact value:

$$\sin 15^\circ = \pm\sqrt{\frac{1-\cos 30^\circ}{2}}$$

$$\sin\frac{u}{2} = \pm\sqrt{\frac{1-\cos u}{2}}$$

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