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IDENTITY REMINDER

$$\tan \theta = \sin \theta / \cos \theta \quad \bullet \quad \sin^2 \theta + \cos^2 \theta = 1 \quad \bullet \quad \sin(2\theta) = 2 \sin \theta \cos \theta$$

LEVEL 1 - RECOGNIZE THE IDENTITY

Match familiar forms with the correct identity family.

1 IDENTIFY THE FAMILY**Which identity family contains**

$$1 + \tan^2 \theta = \sec^2 \theta ?$$

Choices: Reciprocal Quotient Pythagorean

2 MATCH EQUIVALENT FORMS**Which expression is equivalent to $\sec \theta$?**Choices: $1/\sin \theta$ $1/\cos \theta$ $\sin \theta / \cos \theta$

3 RECOGNIZE A REARRANGEMENT**Which expression is equivalent to $1 - \cos^2 \theta$?**Choices: $\sin^2 \theta$ $\tan^2 \theta$ $\sec^2 \theta$

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LEVEL 2 - REWRITE AND SIMPLIFY

Use reciprocal, quotient, and Pythagorean identities.

4 SIMPLIFY**Simplify:**

$\tan \theta / \sec \theta$

5 SIMPLIFY**Simplify:**

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

6 SIMPLIFY**Simplify:**

$(\sec^2 \theta - 1) / \tan \theta$

LEVEL 3 - SUM AND DIFFERENCE IDENTITIES

Find exact values and rewrite expressions.

7 EXACT VALUE**Find the exact value of**

$\sin 75^\circ.$

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8 EXACT VALUE**Find the exact value of**

$\cos 15^\circ$

using a difference identity.

9 USE TANGENT SUMRewrite $\tan(A + B)$ in terms of $\tan A$ and $\tan B$.

LEVEL 4 - DOUBLE, HALF, AND POWER REDUCTION

Practice angle multiplication and reduction identities.

10 DOUBLE ANGLE**Rewrite**

$2 \sin \theta \cos \theta$

as a single trig function.

11 DOUBLE ANGLE**Rewrite**

$2 \cos^2 \theta - 1$

as a single trig function.

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12 HALF ANGLE

Find the exact value of
 $\cos 15^\circ$
using a half-angle identity.

13 POWER REDUCTION

Rewrite
 $\sin^2 \theta$
using a power-reduction identity.

LEVEL 5 - VERIFY AND MIX IDENTITIES

Transform one side until it matches the other.

14 VERIFY AN IDENTITY

Verify:
 $\tan \theta \cos \theta = \sin \theta.$

15 VERIFY AN IDENTITY

Verify:
 $(1 - \cos^2 \theta) / \sin \theta = \sin \theta.$

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16 MIXED IDENTITY**Simplify:**

$$[(1 - \cos(2\theta)) / 2] \cdot \csc^2\theta$$

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1 IDENTIFY THE FAMILY

The equation is one of the Pythagorean identities.

$$1 + \tan^2\theta = \sec^2\theta$$

Answer: Pythagorean identity

2 MATCH EQUIVALENT FORMS

Secant is the reciprocal of cosine.

$$\sec \theta = 1 / \cos \theta$$

Answer: $1 / \cos \theta$

3 RECOGNIZE A REARRANGEMENT

Start with $\sin^2\theta + \cos^2\theta = 1$.

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

Answer: $\sin^2\theta$

4 SIMPLIFY

Rewrite tangent and secant using sine and cosine.

$$(\sin \theta / \cos \theta) / (1 / \cos \theta) = \sin \theta$$

Answer: $\sin \theta$

5 SIMPLIFY

Use $1 - \cos^2\theta = \sin^2\theta$.

$$\sin^2\theta / \sin \theta = \sin \theta$$

Answer: $\sin \theta$

6 SIMPLIFY

Use $\sec^2\theta - 1 = \tan^2\theta$.

$$\tan^2\theta / \tan \theta = \tan \theta$$

Answer: $\tan \theta$

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7 EXACT VALUE

Write $75^\circ = 45^\circ + 30^\circ$ and use the sine sum identity.

$$\sin 75^\circ = \sin 45^\circ \cos 30^\circ + \cos 45^\circ \sin 30^\circ$$

$$= (\sqrt{6} + \sqrt{2}) / 4$$

$$\text{Answer: } (\sqrt{6} + \sqrt{2}) / 4$$

8 EXACT VALUE

Write $15^\circ = 45^\circ - 30^\circ$.

$$\cos 15^\circ = \cos 45^\circ \cos 30^\circ + \sin 45^\circ \sin 30^\circ$$

$$= (\sqrt{6} + \sqrt{2}) / 4$$

$$\text{Answer: } (\sqrt{6} + \sqrt{2}) / 4$$

9 USE TANGENT SUM

Use the tangent sum identity.

$$\tan(A + B) = (\tan A + \tan B) / (1 - \tan A \tan B)$$

$$\text{Answer: } (\tan A + \tan B) / (1 - \tan A \tan B)$$

10 DOUBLE ANGLE

Recognize the sine double-angle identity.

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

$$\text{Answer: } \sin(2\theta)$$

11 DOUBLE ANGLE

Use a cosine double-angle form.

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

$$\text{Answer: } \cos(2\theta)$$

12 HALF ANGLE

Since $15^\circ = 30^\circ / 2$, use the cosine half-angle identity.

$$\cos 15^\circ = \sqrt{(1 + \cos 30^\circ) / 2}$$

$$= \sqrt{(2 + \sqrt{3})} / 2$$

$$\text{Answer: } \sqrt{(2 + \sqrt{3})} / 2$$

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13 POWER REDUCTION

Use the sine-squared power-reduction identity.

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

Answer: $[1 - \cos(2\theta)] / 2$

14 VERIFY AN IDENTITY

Work on the left side and rewrite tangent.

$$\tan \theta \cos \theta = (\sin \theta / \cos \theta) \cos \theta = \sin \theta$$

Verified: the left side simplifies to $\sin \theta$.

15 VERIFY AN IDENTITY

Use the Pythagorean identity on the numerator.

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

Verified: the two sides match.

16 MIXED IDENTITY

Use power reduction first.

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

$$\sin^2\theta \cdot \csc^2\theta = \sin^2\theta \cdot (1/\sin^2\theta) = 1$$

Answer: 1