

Trig Identities Worksheet

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Algebra 2 & Precalculus · simplify using the identities · no calculator

Name _____ Date _____ Score _____ / 30

PART A Simplify to a single function

Use the reciprocal, quotient and Pythagorean identities. Write 1 where the expression simplifies to 1.

- | | |
|---|---|
| 1 $\sin \theta \cdot \csc \theta =$ _____ | 6 $\cot \theta \cdot \sin \theta =$ _____ |
| 2 $\tan \theta \cdot \cos \theta =$ _____ | 7 $\sin \theta \cdot \sec \theta =$ _____ |
| 3 $\sec \theta / \csc \theta =$ _____ | 8 $\cos^2 \theta \cdot \sec^2 \theta =$ _____ |
| 4 $1 - \cos^2 \theta =$ _____ | 9 $1 + \cot^2 \theta =$ _____ |
| 5 $\sec^2 \theta - 1 =$ _____ | 10 $\tan \theta \cdot \csc \theta =$ _____ |

PART B Factor, expand and combine

Factor or combine first, then simplify. Watch for a difference of squares.

- | | |
|---|--|
| 11 $(1 + \sin \theta)(1 - \sin \theta) =$ _____ | 15 $1/(1 + \cos \theta) + 1/(1 - \cos \theta) =$ _____ |
| 12 $(\sec \theta - \tan \theta)(\sec \theta + \tan \theta) =$ _____ | 16 $\sin^2 \theta / (1 - \cos \theta) =$ _____ |
| 13 $\sin^4 \theta - \cos^4 \theta =$ _____ | 17 $(\sin \theta + \cos \theta)^2 =$ _____ |
| 14 $\tan \theta + \cot \theta =$ _____ | 18 $\cos \theta (\sec \theta - \cos \theta) =$ _____ |

PART C Double and half angle

Rewrite each expression using a double-angle, half-angle or power-reducing identity.

- | | |
|--|--|
| 19 $2 \sin \theta \cos \theta =$ _____ | 23 $\sin 2\theta / (1 + \cos 2\theta) =$ _____ |
| 20 $\cos^2 \theta - \sin^2 \theta =$ _____ | 24 $2 \sin(\theta/2) \cos(\theta/2) =$ _____ |
| 21 $1 - 2 \sin^2 \theta =$ _____ | 25 $(1 - \cos 2\theta) / 2 =$ _____ |
| 22 $2 \tan \theta / (1 - \tan^2 \theta) =$ _____ | 26 $\cos^2 4\theta - \sin^2 4\theta =$ _____ |

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Verifying identities — show every step of your working.

PART D Verify the identity

Start with one side — usually the messier one — and transform it until it matches the other side.

27 $(\sec \theta - \cos \theta) / \tan \theta = \sin \theta$

28 $\csc \theta \sec \theta - \cot \theta = \tan \theta$

29 $\cot^2 \theta - \cos^2 \theta = \cot^2 \theta \cdot \cos^2 \theta$

30 $\sin \theta / (1 + \cos \theta) + (1 + \cos \theta) / \sin \theta = 2 \csc \theta$

Never move terms across the equals sign — work on one side at a time.

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Answer Key

All 30 answers, each checked against sin, cos and tan at build time.

PART A

Simplified form

- | | |
|--|---|
| 1. $\sin \theta \cdot \csc \theta = 1$ | 6. $\cot \theta \cdot \sin \theta = \cos \theta$ |
| 2. $\tan \theta \cdot \cos \theta = \sin \theta$ | 7. $\sin \theta \cdot \sec \theta = \tan \theta$ |
| 3. $\sec \theta / \csc \theta = \tan \theta$ | 8. $\cos^2 \theta \cdot \sec^2 \theta = 1$ |
| 4. $1 - \cos^2 \theta = \sin^2 \theta$ | 9. $1 + \cot^2 \theta = \csc^2 \theta$ |
| 5. $\sec^2 \theta - 1 = \tan^2 \theta$ | 10. $\tan \theta \cdot \csc \theta = \sec \theta$ |

PART B

Factored or combined

- 11. $(1 + \sin \theta)(1 - \sin \theta) = \cos^2 \theta$
- 12. $(\sec \theta - \tan \theta)(\sec \theta + \tan \theta) = 1$
- 13. $\sin^4 \theta - \cos^4 \theta = \sin^2 \theta - \cos^2 \theta$
- 14. $\tan \theta + \cot \theta = \sec \theta \cdot \csc \theta$
- 15. $1/(1 + \cos \theta) + 1/(1 - \cos \theta) = 2 \csc^2 \theta$
- 16. $\sin^2 \theta / (1 - \cos \theta) = 1 + \cos \theta$
- 17. $(\sin \theta + \cos \theta)^2 = 1 + 2 \sin \theta \cos \theta$
- 18. $\cos \theta (\sec \theta - \cos \theta) = \sin^2 \theta$

PART C

Double and half angle

- | | |
|--|---|
| 19. $2 \sin \theta \cos \theta = \sin 2\theta$ | 23. $\sin 2\theta / (1 + \cos 2\theta) = \tan \theta$ |
| 20. $\cos^2 \theta - \sin^2 \theta = \cos 2\theta$ | 24. $2 \sin(\theta/2) \cos(\theta/2) = \sin \theta$ |
| 21. $1 - 2 \sin^2 \theta = \cos 2\theta$ | 25. $(1 - \cos 2\theta) / 2 = \sin^2 \theta$ |
| 22. $2 \tan \theta / (1 - \tan^2 \theta) = \tan 2\theta$ | 26. $\cos^2 4\theta - \sin^2 4\theta = \cos 8\theta$ |

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Answer Key — Part D

One worked route through each identity. Other valid routes exist.

27. $(\sec \theta - \cos \theta) / \tan \theta = \sin \theta$

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

$$\text{Divide by } \tan \theta = \sin \theta / \cos \theta: (\sin^2 \theta / \cos \theta) \cdot (\cos \theta / \sin \theta) = \sin \theta \checkmark$$

28. $\csc \theta \sec \theta - \cot \theta = \tan \theta$

$$\csc \theta \sec \theta - \cot \theta = 1/(\sin \theta \cos \theta) - \cos \theta / \sin \theta$$

$$\text{Common denominator } \sin \theta \cos \theta: (1 - \cos^2 \theta)/(\sin \theta \cos \theta) = \sin^2 \theta / (\sin \theta \cos \theta) = \tan \theta \checkmark$$

29. $\cot^2 \theta - \cos^2 \theta = \cot^2 \theta \cdot \cos^2 \theta$

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

$$= \cos^2 \theta \cdot \cos^2 \theta / \sin^2 \theta = \cot^2 \theta \cos^2 \theta \checkmark$$

30. $\sin \theta / (1 + \cos \theta) + (1 + \cos \theta) / \sin \theta = 2 \csc \theta$

$$\text{Common denominator } \sin \theta (1 + \cos \theta): [\sin^2 \theta + (1 + \cos \theta)^2] / [\sin \theta (1 + \cos \theta)]$$

$$\text{Numerator} = \sin^2 \theta + 1 + 2\cos \theta + \cos^2 \theta = 2 + 2\cos \theta = 2(1 + \cos \theta)$$

$$\text{So it is } 2(1 + \cos \theta) / [\sin \theta (1 + \cos \theta)] = 2/\sin \theta = 2 \csc \theta \checkmark$$

Common slips when verifying an identity

- Treating it like an equation. An identity is not solved — you transform one side until it matches the other.
- Moving a term across the equals sign. Everything you do stays on the side you chose.
- Cancelling across a sum. In $(1 + \cos \theta)/\cos \theta$ the $\cos \theta$ terms do not cancel.
- Forgetting the $\pm$ on a half-angle. The sign comes from the quadrant that $\theta/2$ lands in.
- Stopping early. Keep going until both sides are written in exactly the same form.

Marking tip: any route that turns one side into the other is correct — the steps above are only one way.

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