# Given The Equation -28cos((/12)t)+32=28 , You Determined Two Potential Solutions: T=5.4522+24n Or T=18.5478+24n.

**Given The Equation -28cos((/12)t)+32=28 , You Determined Two Potential Solutions: T=5.4522+24n Or T=18.5478+24n.**

Understanding and solving trigonometric equations is a fundamental aspect of mathematics, particularly in fields like engineering, physics, and signal processing. The equation -28cos((/12)t)+32=28 exemplifies such a problem, showcasing the process of isolating variables, applying inverse functions, and finding multiple solutions due to the periodic nature of cosine. In this article, we will explore this specific equation in detail, discussing the step-by-step solution process, interpretation of the results, and the significance of the solutions in real-world contexts.

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## Breaking Down the Equation: An Overview

The given equation is:

```
-28cos((/12)t) + 32 = 28
```

At first glance, this appears to be a trigonometric equation involving cosine, a constant multiplier, and shifts. To effectively solve for the variable t, we need to understand the structure of the equation, identify the steps to isolate the cosine term, and then determine the solutions for t.

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## Step-by-Step Solution Process

### 1. Simplify the Equation

Start by isolating the cosine function:

1. Subtract 32 from both sides:
   ```
   -28cos((/12)t) = 28 - 32

   -28cos((/12)t) = -4
   ```

2. Divide both sides by -28:
   ```
   cos((/12)t) = (-4)/(-28) = 4/28 = 1/7
   ```

The simplified form of the equation becomes:

```
cos((/12)t) = 1/7
```

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## 2. Apply the Inverse Cosine Function

To find the principal value of t, take the arccosine (inverse cosine):

```
(/12)t = arccos(1/7)
```

Calculate arccos(1/7):

- Using a calculator, arccos(1/7) ≈ 1.423 radians

Since cosine is positive in the first and fourth quadrants, there are two principal solutions:

- **Principal value:** $t_1$ = (12) 1.423 / 1 (since the equation involves (/12)t, multiply both sides by 12 to isolate t)
- **Secondary value:** $t_2$ = (12) (2π - 1.423)

However, because the original variable is (12)t, and the equation involves (/12)t, let's clarify the steps.

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## 3. Solving for t

Given:

$$(/12)t = \arccos(1/7) + 2\pi n$$

and

$$(/12)t = -\arccos(1/7) + 2\pi n$$

for integer n, since cosine is periodic with period $2\pi$.

Multiplying through by 12:

$$t = 12 \arccos(1/7) + 24\pi n$$

and

$$t = -12 \arccos(1/7) + 24\pi n$$

Now, compute the numerical value:

- $\arccos(1/7) \approx 1.423$ radians

Therefore:

- First solution:

  - **t ≈** $12\ 1.423 + 24\pi n \approx 17.076 + 24\pi n$

- Second solution:

  - **t ≈** $-12\ 1.423 + 24\pi n \approx -17.076 + 24\pi n$

However, the solutions presented in the initial statement are:

- $T = 5.4522 + 24n$
- $T = 18.5478 + 24n$

This suggests that the specific solutions are adjusted or approximated based on the principal solutions and possibly the domain constraints.

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# Interpreting the Solutions

The solutions:

- $T = 5.4522 + 24n$
- $T = 18.5478 + 24n$

are derived from the general solutions, where n is any integer ($n \in Z$). These solutions correspond to the periodic nature of cosine, which repeats every $2\pi$ radians (or 24 units in the context of t, assuming the period is scaled accordingly).

Why are there multiple solutions?

Because cosine is a periodic function with period $2\pi$, the equation has infinitely many solutions, each separated by the period length multiplied by the scaling factor (here, 24). The solutions repeat every 24 units because of the period adjustment in the equation.

Practical implications:

- These solutions can correspond to times, angles, or phases depending on the context.
- For example, in physics or engineering, these solutions could represent points in time when a wave reaches a certain amplitude.

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# Applications of Solving Trigonometric Equations

Understanding and solving equations like -28cos((/12)t)+32=28 is crucial in several real-world scenarios, including:

- Signal Processing: Analyzing periodic signals and their phase shifts.
- Mechanical Vibrations: Determining points in time where oscillations reach specific amplitudes.
- Electromagnetic Waves: Calculating wave peaks and troughs.
- Control Systems: Timing events based on sinusoidal inputs.

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# Additional Considerations in Solving Trigonometric Equations

When working with equations involving cosine or sine, keep in mind:

- Periodicity: Solutions repeat every $2\pi$ radians (or scaled accordingly).
- Principal Values: Always consider the inverse function's principal value, but remember to account for the periodic extensions.
- Domain Restrictions: Sometimes solutions are limited based on the problem's context.
- Multiple Solutions: Expect multiple solutions within the domain, especially for periodic functions.

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# Conclusion

The equation -28cos((/12)t)+32=28 exemplifies the process of solving trigonometric equations involving periodic functions. By isolating the cosine term, applying the inverse cosine function, and considering the periodic nature of cosine, we arrive at the solutions:

- T = 5.4522 + 24n
- T = 18.5478 + 24n

These solutions illustrate the infinite set of solutions due to periodicity, which are valuable in various scientific and engineering applications. Mastery of these techniques enables one to analyze and interpret complex cyclical phenomena effectively.

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# Further Resources

- Trigonometric Equations and Inequalities – Khan Academy
- Understanding Periodic Functions – MIT OpenCourseWare
- Inverse Trigonometric Functions – MathWorld
- Practical Applications of Trigonometry – Coursera Courses

Understanding these concepts deeply enhances your mathematical toolkit, preparing you for advanced problems in science, engineering, and technology.

# Frequently Asked Questions

## What is the primary goal when solving the equation -28cos((π/12)t) + 32 = 28?

The primary goal is to find the values of t that satisfy the equation, which involves isolating t by solving the cosine equation and considering its periodic nature.

## How are the solutions T=5.4522 + 24n and T=18.5478 + 24n derived from the original equation?

These solutions are obtained by solving the cosine equation for its principal solutions and then adding the period (24 units) multiplied by an integer n to account for the periodic nature of the cosine function.

## Why does the solution involve adding 24n to the values T=5.4522 and T=18.5478?

Because cosine is a periodic function with a period of 24 units in this context, adding 24n accounts for all possible solutions at each cycle of the cosine wave.

## What does the value n represent in the solutions T=5.4522 + 24n and T=18.5478 + 24n?

The variable n is an integer that represents different cycles or repetitions of the cosine wave, allowing the solutions to encompass all possible t-values satisfying the original equation.

## How can one verify the solutions T=5.4522 + 24n and T=18.5478 + 24n satisfy the original equation?

By substituting these t-values back into the original equation and confirming that the left side equals 28, verifying the solutions satisfy the equation for all integer values of n.

## What role does the cosine function's period play in determining the solutions to this equation?

The period determines the spacing between solutions; since cosine repeats every 24 units in this problem, solutions are spaced 24 units apart, leading to the general solutions involving +24n.

Is it necessary to consider multiple solutions when solving such equations **involving cosine? Why?**

Yes, because cosine is periodic and has multiple solutions within its cycle, so all solutions are expressed in terms of a fundamental solution plus integer multiples of the period.

# Additional Resources

Mathematical Problem-Solving

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Introduction

In the realm of trigonometry and its applications, solving equations involving cosine functions often emerges as a fundamental skill. The equation -28cos((π/12)t) + 32 = 28 is a classic example where understanding the properties of cosine, as well as algebraic manipulation, plays a crucial role. This article delves deep into the process of solving this equation, exploring the derivation of the solutions T = 5.4522 + 24n and T = 18.5478 + 24n, and unpacking the scientific principles behind these results.

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Understanding the Equation

The Original Equation

The given equation is:

$$
-28 \cos\left(\frac{\pi}{12} t\right) + 32 = 28
$$

Let's analyze its components:

- The cosine function, $\cos\left(\frac{\pi}{12} t\right)$, is a periodic function oscillating between $-1$ and $1$.
- Constants -28 and +32 scale and shift the cosine wave.
- The variable t is the independent variable, often representing time or angle, depending on context.

Objective

Our goal is to solve for t—the values that satisfy the equation—considering the periodic nature of the cosine function.

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Step-by-Step Solution Process

Step 1: Isolate the cosine term

Begin by isolating the cosine component:

$$
-28 \cos\left(\frac{\pi}{12} t\right) = 28 - 32
$$

$$
-28 \cos\left(\frac{\pi}{12} t\right) = -4
$$

Divide both sides by $-28$:

$$
\cos\left(\frac{\pi}{12} t\right) = \frac{-4}{-28} = \frac{1}{7}
$$

Key insight: The cosine of an angle equals $\frac{1}{7}$, a value within the valid range $[-1, 1]$, confirming that solutions exist.

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Step 2: Find the principal solutions

Solve for the angle:

$$
\theta = \frac{\pi}{12} t
$$

such that:

$$
\cos \theta = \frac{1}{7}
$$

Using a calculator or inverse cosine function:

$$
\theta = \arccos \left( \frac{1}{7} \right)
$$

Numerically:

$$
\theta \approx \arccos (0.142857) \approx 1.4278 \text{ radians}
$$

Note: Since cosine is positive in the first and fourth quadrants, the second solution is:

$$
\theta = 2\pi - 1.4278 \approx 4.8554 \text{ radians}
$$

Step 3: Solve for t

Recall:

$$
\frac{\pi}{12} t = \theta
$$

Solve for t:

$$
t = \frac{12}{\pi} \theta
$$

Substitute the two solutions:

- For $\theta \approx 1.4278$:

$$
t_1 = \frac{12}{\pi} \times 1.4278 \approx \frac{12}{3.1416} \times 1.4278 \approx 3.8197 \times 1.4278 \approx 5.4522
$$

- For $\theta \approx 4.8554$:

$$
t_2 = \frac{12}{\pi} \times 4.8554 \approx 3.8197 \times 4.8554 \approx 18.5478
$$

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Recognizing the Periodicity

Cosine functions are periodic with a fundamental period:

$$
T_{period} = \frac{2\pi}{\text{coefficient of } t}
$$

In our case, the coefficient of $t$ inside the cosine is $\frac{\pi}{12}$, so:

$$
T_{period} = \frac{2\pi}{\pi/12} = 2\pi \times \frac{12}{\pi} = 24
$$

This indicates the cosine repeats every 24 units of t.

General Solutions

Because the cosine function is periodic, the solutions repeat every period:

$$
t = t_0 + n \times T_{period}
$$

where:

- $t_0$ is a particular solution (either $5.4522$ or $18.5478$)
- $n$ is any integer ($n \in \mathbb{Z}$)

Thus, the complete set of solutions is:

$$
\boxed{
t = 5.4522 + 24n \quad \text{and} \quad t = 18.5478 + 24n
}
$$

which aligns with the initial statement.

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## Significance of the Solutions

### Practical Implications

These solutions are particularly valuable in fields such as:

- Signal processing, where periodic signals are analyzed over time.
- Engineering, for modeling cyclical phenomena.
- Physics, especially in oscillatory systems like pendulums or wave motion.
- Control systems, where timing of oscillations is critical.

### Mathematical Insights

The solutions confirm the fundamental properties of cosine functions:

- Periodicity: The solutions recur every $24$ units.
- Symmetry: The two solutions correspond to points where the cosine function takes the same value but at different phases.

### Visualizing the Solutions

Plotting the function:

$$
f(t) = -28 \cos \left(\frac{\pi}{12} t \right) + 32
$$

shows it oscillating between 4 and 60, crossing the line $y=28$ at the solutions we derived.

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## Additional Considerations

### Validity of the Solutions

Since $\cos \theta = \frac{1}{7}$ is within the range $[-1, 1]$, the solutions are valid. If the right side of the equation had been outside this range, no real solutions would exist.

### Impact of Constants

- The amplitude of the cosine wave is \(28\), influencing the maximum and minimum values.
- The vertical shift of \(32\) moves the entire wave upward, setting the baseline around which it oscillates.

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Summary

- The original equation simplifies to \(\cos \left(\frac{\pi}{12} t \right) = \frac{1}{7}\).
- Two principal solutions within one period are approximately \( t=5.4522 \) and \( t=18.5478 \).
- Due to the periodic nature of cosine, solutions repeat every 24 units.
- The general solutions are expressed as:

\[
\boxed{
t = 5.4522 + 24n \quad \text{or} \quad t = 18.5478 + 24n, \quad n \in \mathbb{Z}
}
\]

These solutions exemplify the elegance of trigonometric equations and their applications in modeling periodic phenomena.

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Final Thoughts

Mastering the solving process for equations like \(-28 \cos \left(\frac{\pi}{12} t \right) + 32 = 28\) enhances problem-solving capabilities in both academic and practical contexts. Recognizing the periodic nature of cosine, accurately computing angles, and understanding how to generalize solutions form the cornerstone of advanced mathematical analysis. This deep dive not only clarifies the specific solutions but also underscores the importance of a systematic approach to trigonometric equations, a skill crucial for engineers, scientists, and mathematicians alike.

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