NCERT Solutions Class 11 Maths
Chapter 3: Trigonometric Functions
EXERCISE 3.3

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Quick Summary: In NCERT Solutions Class 11 Maths Chapter 3 Exercise 3.3, students learn to apply trigonometric functions of sum and difference formulas to solve complex problems. This exercise covers fundamental trigonometric identities and their proofs, which are essential for CBSE board exams and competitive entrance tests like JEE Main.

Key Takeaways:

- Master sum and difference formulas: $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$
- Learn to prove trigonometric identities using standard angle values like $\sin\left(\frac{\pi}{6}\right) = \frac{1}{2}$ and $\cos\left(\frac{\pi}{4}\right) = \frac{1}{\sqrt{2}}$
- Apply compound angle formulas to find exact values of angles like 75° and 105°
- Develop problem-solving techniques for verifying trigonometric equations using algebraic manipulation

Complete Solutions

Question 1

QUESTION

Prove that \sin^2\left((π)/(6)\right) + \cos^2\left((π)/(3)\right) - \tan^2\left((π)/(4)\right) = -\tfrac(1)/(2).

SOLUTION

We need to prove that . This involves evaluating trigonometric functions at specific angles and then simplifying the expression.

Step 1: Evaluate

We know that radians is equal to 30 degrees. Therefore, .

Step 2: Evaluate

We know that radians is equal to 60 degrees. Therefore, .

Step 3: Evaluate

We know that radians is equal to 45 degrees. Therefore, .

Step 4: Substitute the values into the expression

Substituting the values we found in the previous steps:

Step 5: Simplify the expression

Final Answer:

Therefore, we have proven that .

Question 2

QUESTION

Prove that 2\sin^2\left((π)/(6)\right) + \csc^2\left((7π)/(6)\right) \cos^2\left((π)/(3)\right) = \tfrac(3)/(2).

SOLUTION

We need to prove the trigonometric identity .

Step 1: Evaluate

We know that .

Step 2: Evaluate

We know that .

Step 3: Evaluate

First, we can rewrite as . Therefore, .

Since , we have .

We know that . Thus, .

Step 4: Substitute the values into the expression

Now, substitute the values we found into the left-hand side of the equation:

Step 5: Simplify the expression

Final Answer:

Therefore, , which is the right-hand side of the equation. Hence, the identity is proven.

Question 3

QUESTION

Prove that \cot^2\left((π)/(6)\right) + \csc\left((5π)/(6)\right) + 3\tan^2\left((π)/(6)\right) = 6.

SOLUTION

We need to prove that .

Step 1: Evaluate

Recall that . Also, .

Therefore, .

So, .

Step 2: Evaluate

Recall that . We can write .

Then, .

Therefore, .

Step 3: Evaluate

We know that .

So, .

Therefore, .

Step 4: Substitute the values into the expression

Now we have:

.

Final Answer:

Hence, .

Question 4

QUESTION

Prove that 2\sin^2\left((3π)/(4)\right) + 2\cos^2\left((π)/(4)\right) + 2\sec^2\left((π)/(3)\right) = 10.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Evaluate

We know that is in the second quadrant, where sine is positive. We can write . Therefore,

Step 2: Evaluate

We know that

Step 3: Evaluate

We know that . Therefore,

Step 4: Substitute the values into the expression

Now, substitute these values into the given expression:

Step 5: Simplify the expression

Final Answer:

Therefore, .

Question 5

QUESTION

Find the value of:

(i) \sin 75^\circ

(ii) \tan 15^\circ

SOLUTION

This question requires us to find the values of and using trigonometric identities for compound angles.

(i) Finding

Step 1: Express as a sum of known angles

We can write as . Both and are standard angles with known trigonometric values.

Step 2: Apply the sine addition formula

The sine addition formula is:

In our case, and . So,

Step 3: Substitute the known values

We know that , , , and .

Substituting these values, we get:

Step 4: Simplify

Final Answer:

(ii) Finding

Step 1: Express as a difference of known angles

We can write as .

Step 2: Apply the tangent subtraction formula

The tangent subtraction formula is:

In our case, and . So,

Step 3: Substitute the known values

We know that and .

Substituting these values, we get:

Step 4: Simplify

Rationalize the denominator by multiplying both numerator and denominator by :

Final Answer:

ANSWER

(i) \sin 75^\circ = √3+12√2

(ii) \tan 15^\circ = 2 - √3

Question 6

QUESTION

Prove that \cos\left((π)/(4) - x\right) \cos\left((π)/(4) - y\right) - \sin\left((π)/(4) - x\right) \sin\left((π)/(4) - y\right) = \sin(x + y).

SOLUTION

We need to prove the trigonometric identity .

Step 1: Recognize the Cosine Addition Formula

The left-hand side (LHS) of the equation resembles the cosine addition formula:

Step 2: Apply the Cosine Addition Formula

Let and . Then, the LHS can be rewritten as:

Step 3: Simplify the Argument of the Cosine Function

Simplify the expression inside the cosine function:

So, we have:

Step 4: Apply the Complementary Angle Identity

We know that . Therefore:

Step 5: State the Conclusion

Thus, we have shown that:

Question 7

QUESTION

Prove that (\tan\left(π)/(4) + x\right)(\tan\left(π)/(4) - x\right) = \left((1 + \tan x)/(1 - \tan x) \right)^2.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Expand the numerator using the tangent addition formula

Recall the tangent addition formula: .

Applying this to the numerator, we have:

Since , we get:

Step 2: Expand the denominator using the tangent subtraction formula

Recall the tangent subtraction formula: .

Applying this to the denominator, we have:

Since , we get:

Step 3: Substitute the expanded forms into the original expression

Now we substitute the results from Step 1 and Step 2 into the left-hand side of the equation:

Step 4: Simplify the expression

Dividing by a fraction is the same as multiplying by its reciprocal:

Step 5: Conclusion

We have shown that , which is what we wanted to prove.

Question 8

QUESTION

Prove that (\cos(π + x) \cos(-x))/(\sin(π - x) \cos\left(π)2 + x\right) = \cot^2 x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Simplify each trigonometric term using allied angles.

Recall the following trigonometric identities:

-
-
-
-

Step 2: Substitute the simplified terms into the given expression.

Substituting these values into the left-hand side (LHS) of the equation, we get:

Step 3: Simplify the expression.

Step 4: Use the definition of cotangent.

Recall that . Therefore, .

Step 5: Conclude the proof.

Thus, we have:

Therefore, . Hence Proved.

Question 9

QUESTION

Prove that $\cos\left((3\pi)/(2) + x\right) \cos(2\pi + x) \left[\cot\left((3\pi)/(2) - x\right) + \cot(2\pi + x) \right] = 1$.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Simplify the trigonometric functions using allied angles.

Recall the following identities:

Step 2: Substitute the simplified trigonometric functions into the given expression.

Substituting these into the left-hand side (LHS) of the equation, we get:

Step 3: Express tan(x) and cot(x) in terms of sin(x) and cos(x).

We know that and .

Substituting these into the expression, we have:

Step 4: Simplify the expression inside the brackets.

Step 5: Use the trigonometric identity .

Step 6: Cancel out the common terms.

Step 7: Conclude.

Therefore, .

Question 10

QUESTION

Prove that \sin(n + 1)x \sin(n + 2)x + \cos(n + 1)x \cos(n + 2)x = \cos x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Recognize the trigonometric identity

The left-hand side (LHS) of the equation resembles the cosine subtraction formula:

Step 2: Apply the cosine subtraction formula

Let and . Then the LHS of the given equation can be rewritten as:

Step 3: Simplify the argument of the cosine function

Simplify the expression inside the cosine function:

So, we have:

Step 4: Use the property of cosine function

The cosine function is an even function, which means .

Therefore:

Step 5: Conclude the proof

We have shown that the left-hand side of the equation simplifies to , which is equal to the right-hand side (RHS) of the equation.

Therefore, the given trigonometric identity is proven:

Question 11

QUESTION

Prove that $\cos\left((3\pi)/(4) + x\right) - \cos\left((3\pi)/(4) - x\right) = -\sqrt{2} \sin x$.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Recall the Cosine Subtraction Formula

We will use the trigonometric identity for the difference of cosines:

Step 2: Apply the Formula

Let and . Then,

Step 3: Simplify the Arguments of the Sine Functions

First argument:

Second argument:

Step 4: Substitute the Simplified Arguments

Now we have:

Step 5: Evaluate

We know that

Step 6: Substitute the Value and Simplify

Final Answer:

Question 12

QUESTION

Prove that \sin^2 6x - \sin^2 4x = \sin 2x \sin 10x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Start with the left-hand side (LHS)

LHS =

Step 2: Use the identity

Applying this identity, we get:

LHS =

Step 3: Apply the sum-to-product trigonometric identities

We use the following identities:

Step 4: Apply the identities to our expression

Step 5: Substitute these back into the LHS

LHS =

LHS =

Step 6: Use the double angle identity

We can rewrite the LHS as:

LHS =

LHS =

Step 7: Compare with the right-hand side (RHS)

RHS =

Step 8: Conclude

Since LHS = and RHS = , and multiplication is commutative, LHS = RHS.

Therefore, is proven.

Question 13

QUESTION

Prove that \cos^2 2x - \cos^2 6x = \sin 4x \sin 8x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Start with the left-hand side (LHS)

LHS =

Step 2: Use the identity

We can rewrite the LHS as:

LHS =

Step 3: Apply the sum-to-product trigonometric identities

Recall the following identities:

Applying these identities to our expression:

Step 4: Substitute back into the LHS

LHS =

Step 5: Simplify using and

LHS =

LHS =

LHS =

Step 6: Apply the double angle identity

LHS =

Step 7: Rearrange to match the right-hand side (RHS)

LHS =

RHS =

Final Answer:

Therefore, the identity is proven.

Question 14

QUESTION

Prove that \sin 2x + 2 \sin 4x + \sin 6x = 4 \cos^2 x \sin 4x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Start with the left-hand side (LHS)

LHS =

Step 2: Group the sine terms with similar angles

LHS =

Step 3: Apply the sum-to-product trigonometric identity

Recall that . Applying this to , we get:

Step 4: Substitute back into the LHS

LHS =

Step 5: Factor out the common term

LHS =

Step 6: Use the double-angle identity for cosine

Recall that . Therefore, .

Step 7: Substitute back into the LHS

LHS =

Step 8: Simplify

LHS =

Step 9: Compare with the right-hand side (RHS)

RHS =

Step 10: Conclusion

Since LHS = RHS, the identity is proven.

Question 15

QUESTION

Prove that \cot 4x \left(\sin 5x + \sin 3x \right) = \cot x \left(\sin 5x - \sin 3x \right).

SOLUTION

We need to prove the trigonometric identity .

Step 1: Apply the sum-to-product formulas

We will use the following trigonometric identities:

Applying these to the left-hand side (LHS) and right-hand side (RHS) of the equation:

Step 2: Simplify the LHS

LHS:

Step 3: Simplify the RHS

RHS:

Step 4: Compare LHS and RHS

We have shown that:

LHS

RHS

Since LHS = RHS, the identity is proven.

Final Answer:

Question 16

QUESTION

Prove that (\cos 9x - \cos 5x)/(\sin 17x - \sin 3x) = -(\sin 2x)/(\cos 10x).

SOLUTION

We need to prove the trigonometric identity .

Step 1: Apply the sum-to-product formulas

We'll use the following trigonometric identities:

Step 2: Apply the formulas to the numerator

For the numerator, , we have and . Thus:

Step 3: Apply the formulas to the denominator

For the denominator, , we have and . Thus:

Step 4: Substitute back into the original expression

Now we have:

Step 5: Simplify the expression

We can cancel out the common factor of from the numerator and denominator:

Step 6: Conclusion

Therefore, we have proven that .

Question 17

QUESTION

Prove that (\sin 5x + \sin 3x)/(\cos 5x + \cos 3x) = \tan 4x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Apply the sum-to-product formulas

We will use the following trigonometric identities:

In our case, and .

Step 2: Apply the formulas to the numerator

Step 3: Apply the formulas to the denominator

Step 4: Substitute the results into the original expression

Step 5: Simplify the expression

We can cancel out the common factors of 2 and :

Step 6: Use the definition of tangent

We know that . Therefore:

Final Answer:

Thus, we have proven that .

Question 18

QUESTION

Prove that (\sin x - \sin y)/(\cos x + \cos y) = \tan (x - y)/(2).

SOLUTION

We are asked to prove the trigonometric identity . This question tests our understanding of trigonometric transformations, specifically the sum-to-product formulas.

Step 1: Apply the sum-to-product formulas

We will use the following formulas:

Step 2: Substitute the formulas into the left-hand side (LHS) of the equation

Step 3: Simplify the expression

Notice that appears in both the numerator and the denominator, so we can cancel it out, assuming .

Step 4: Use the definition of tangent

Recall that . Therefore:

Step 5: Conclude

We have shown that:

Thus, the given identity is proven.

Question 19

QUESTION

Prove that (\sin x + \sin 3x)/(\cos x + \cos 3x) = \tan 2x.

SOLUTION

We are asked to prove the trigonometric identity .

Step 1: Apply the sum-to-product formulas

We will use the following trigonometric identities:

Applying these formulas to the numerator and denominator of the left-hand side (LHS) of the given equation, we have:

Numerator:

Denominator:

Step 2: Simplify the expression

Now, we can rewrite the LHS as:

Since , we can simplify the expression further:

We can cancel out the common factors of 2 and from the numerator and the denominator:

Step 3: Use the definition of tangent

We know that . Therefore:

Step 4: Conclusion

Thus, we have shown that:

This completes the proof.

Question 20

QUESTION

Prove that (\sin x - \sin 3x)/(\sin^2 x - \cos^2 x) = 2 \sin x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Simplify the numerator using the trigonometric identity for sin 3x

Recall the triple angle identity: . Substituting this into the numerator:

So, the numerator becomes:

Step 2: Simplify the denominator using the identity

We have in the denominator. Notice that this is the negative of :

Step 3: Rewrite the expression

Now we can rewrite the entire expression as:

Step 4: Use the identity

We can rewrite as , so .

Substituting this into our expression:

Step 5: Cancel the common factor

We can cancel the common factor from the numerator and the denominator:

Final Answer:

Therefore, .

Question 21

QUESTION

Prove that (\cos 4x + \cos 3x + \cos 2x)/(\sin 4x + \sin 3x + \sin 2x) = \cot 3x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Group the terms

We group the terms and in the numerator and and in the denominator. This is done to apply the sum-to-product trigonometric identities.

Step 2: Apply sum-to-product formulas

We use the following formulas:

Applying these to the numerator:

Applying these to the denominator:

Step 3: Substitute back into the original expression

Substituting these results into the left-hand side of the original equation, we get:

Step 4: Factor out common terms

We factor out from the numerator and from the denominator:

Step 5: Simplify

We can cancel the common factor from the numerator and the denominator:

Step 6: Use the definition of cotangent

Since , we have:

Final Answer:

Therefore, .

Question 22

QUESTION

Prove that \cot x \cot 2x - \cot 2x \cot 3x - \cot 3x \cot x = 1.

SOLUTION

We are asked to prove the trigonometric identity .

Step 1: Start with a known identity

We know that . Let's use this in the cotangent function:

Step 2: Apply the cotangent addition formula

Recall the cotangent addition formula: . Applying this to our equation:

Step 3: Rearrange the equation

Multiply both sides by :

Step 4: Isolate the '1' term

Add 1 to both sides and subtract from both sides:

Step 5: Rearrange to match the target expression

Rearranging the terms, we get:

Final Answer:

Therefore, is proven.

Question 23

QUESTION

Prove that \tan 4x = (4 \tan x \left(1 - \tan^2 x\right))/(1 - 6 \tan^2 x + \tan^4 x).

SOLUTION

We need to prove the trigonometric identity .

Step 1: Express as

We can rewrite as to use the double angle formula for tangent.

Step 2: Apply the double angle formula for tangent:

Let . Then,

Step 3: Apply the double angle formula for again

We know . Substitute this into the expression for :

Step 4: Simplify the expression

Step 5: Further simplification by multiplying numerator and denominator by

Step 6: Expand and simplify the denominator

Final Answer:

Thus, we have proven that .

Question 24

QUESTION

Prove that \cos 4x = 1 - 8 \sin^2 x \cos^2 x.

SOLUTION

We need to prove the trigonometric identity .

Step 1: Start with the left-hand side (LHS)

We begin with and aim to transform it into the right-hand side (RHS).

Step 2: Use the double angle formula for cosine

Recall the double angle formula: . We can rewrite as .

Applying the double angle formula, we have:

Step 3: Apply the double angle formula for sine

We know that . Substitute this into the equation:

Step 4: Simplify the expression

Now, we simplify the expression:

Step 5: Compare with the right-hand side (RHS)

We have now transformed the LHS into the RHS:

Final Answer:

Conclusion:

By applying the double angle formulas for cosine and sine, we successfully proved the given trigonometric identity. This method works by breaking down a complex angle (4x) into simpler angles (2x and x) and using known trigonometric identities to manipulate the expression.

Question 25

QUESTION

Prove that $\cos 6x = 32 \cos^6 x - 48 \cos^4 x + 18 \cos^2 x - 1$.

SOLUTION

We need to prove the trigonometric identity . We will start with the left-hand side (LHS) and use trigonometric identities to arrive at the right-hand side (RHS).

Step 1: Express as

We can rewrite as to use the double angle formula for cosine.

Step 2: Apply the double angle formula

Using the double angle formula, we have:

Step 3: Apply the triple angle formula

Now, we substitute the triple angle formula for :

Step 4: Expand and simplify the expression

Expanding the square, we get:

Distributing the 2, we have:

Step 5: Compare with the RHS

The expression we obtained is exactly the right-hand side (RHS) of the given identity.

Final Answer:

Thus, we have proven the identity by starting with and using trigonometric identities to arrive at the expression .

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Key Formulas

Important Formulas for Exercise 3.3

Formula / Concept	Description
Sum and Difference Identities	These formulas are used to find the trigonometric functions of the sum or difference of two angles.
$\cos(x + y) = \cos x \cos y - \sin x \sin y$	Cosine of sum of two angles.
$\cos(x - y) = \cos x \cos y + \sin x \sin y$	Cosine of difference of two angles.
$\sin(x + y) = \sin x \cos y + \cos x \sin y$	Sine of sum of two angles.
$\sin(x - y) = \sin x \cos y - \cos x \sin y$	Sine of difference of two angles.
$\tan(x + y) = (\tan x + \tan y)/(1 - \tan x \tan y)$	Tangent of sum of two angles.
$\tan(x - y) = (\tan x - \tan y)/(1 + \tan x \tan y)$	Tangent of difference of two angles.
Double-Angle Identities	These formulas express trigonometric functions of double angles (e.g., 2x) in terms of functions of the single angle (x).
$\sin(2x) = 2 \sin x \cos x = (2 \tan x)/(1 + \tan^2 x)$	Double angle formula for sine.
$\cos(2x) = \cos^2 x - \sin^2 x = 2 \cos^2 x - 1 = 1 - 2 \sin^2 x = (1 - \tan^2 x)/(1 + \tan^2 x)$	Double angle formulas for cosine.
$\tan(2x) = (2 \tan x)/(1 - \tan^2 x)$	Double angle formula for tangent.
Sum-to-Product Formulas	These formulas are used to express the sum or difference of sines and cosines as a product.
$\sin x + \sin y = 2 \sin\left((x+y)/(2)\right) \cos\left((x-y)/(2)\right)$	Converts the sum of two sines into a product.
$\sin x - \sin y = 2 \cos\left((x+y)/(2)\right) \sin\left((x-y)/(2)\right)$	Converts the difference of two sines into a product.
$\cos x + \cos y = 2 \cos\left((x+y)/(2)\right) \cos\left((x-y)/(2)\right)$	Converts the sum of two cosines into a product.
$\cos x - \cos y = -2 \sin\left((x+y)/(2)\right) \sin\left((x-y)/(2)\right)$	Converts the difference of two cosines into a product.
Product-to-Sum Formulas	These formulas are used to express the product of sines and cosines as a sum or difference.

Formula / Concept	Description
$2 \cos x \cos y = \cos(x+y) + \cos(x-y)$	Converts the product of two cosines into a sum.
$2 \sin x \sin y = \cos(x-y) - \cos(x+y)$	Converts the product of two sines into a difference.
$2 \sin x \cos y = \sin(x+y) + \sin(x-y)$	Converts the product of a sine and a cosine into a sum.
$2 \cos x \sin y = \sin(x+y) - \sin(x-y)$	Converts the product of a cosine and a sine into a difference.
Pythagorean Identities	Fundamental identities based on the Pythagorean theorem.
$\sin^2 x + \cos^2 x = 1$	Relates sine and cosine.
$1 + \tan^2 x = \sec^2 x$	Relates tangent and secant.
$1 + \cot^2 x = \csc^2 x$	Relates cotangent and cosecant.

❓ Top FAQs

Q1. How many questions are in NCERT Solutions Class 11 Maths Chapter 3 Trigonometric Functions Exercise 3.3?

Exercise 3.3 of NCERT Solutions Class 11 Maths Chapter 3 Trigonometric Functions contains exactly 25 questions. These questions focus on trigonometric functions of sum and difference formulas, trigonometric identities, and their applications. Students preparing for CBSE board exam 2025-26 should practice all 25 questions with step by step solutions for better conceptual clarity.

Q2. Where can I download free PDF of NCERT Solutions for Class 11 Maths Chapter 3 Trigonometric Functions Exercise 3.3?

You can download the free PDF of NCERT Solutions for Class 11 Maths Chapter 3 Trigonometric Functions Exercise 3.3 from the official NCERT website or various educational portals offering CBSE study materials. The PDF includes detailed step by step solutions for all 25 questions, updated according to the latest CBSE syllabus for session 2025-26. These solutions are prepared by subject experts to help students understand sum and difference formulas of trigonometric functions effectively.

Q3. How many marks does Trigonometric Functions Chapter 3 carry in CBSE Class 11 Maths board exam 2025-26?

Trigonometric Functions Chapter 3 carries approximately 7 marks in CBSE Class 11 Maths board exam 2025-26 as part of Unit I - Sets and Functions. Exercise 3.3 specifically covers sum and difference formulas which are crucial for solving complex trigonometric problems. Students should thoroughly practice NCERT Solutions for Class 11 Maths Chapter 3 Exercise 3.3 to score well in board examinations.

Q4. Which is the most difficult question in NCERT Solutions Class 11 Maths Chapter 3 Trigonometric Functions Exercise 3.3?

Questions 18 to 25 in Exercise 3.3 of NCERT Solutions Class 11 Maths Chapter 3 Trigonometric Functions are considered most challenging as they involve complex applications of sum and difference formulas combined with multiple trigonometric identities. These questions require strong conceptual understanding and practice with step by step solutions. Students preparing for CBSE board exam 2025-26 should focus on these problems to master advanced trigonometric concepts.

Q5. What are Trigonometric Identities explained in NCERT Solutions Class 11 Maths Chapter 3 Exercise 3.3?

Trigonometric Identities in NCERT Class 11 Maths Chapter 3 Exercise 3.3 include sum and difference formulas such as sin(A+B), sin(A-B), cos(A+B), cos(A-B), tan(A+B), and tan(A-B). These identities are fundamental for solving complex trigonometric equations and are extensively used in higher mathematics and competitive exams like JEE. The exercise provides step by step solutions to help students understand the application of these formulas in various problems.

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