

Trigonometric Ratios & Identities

Question1

If $\sin(\alpha + \beta) = 1$, $\sin(\alpha - \beta) = \frac{1}{2}$, $\alpha, \beta \in \left[0, \frac{\pi}{2}\right]$ MHT CET 2025 (5 May Shift 2)
then $\tan(\alpha + 2\beta) \cdot \tan(2\alpha + \beta) =$

Options:

- A. 1
- B. -1
- C. 0
- D. 4

Answer: A

Solution:

We are given:

$$\sin(\alpha + \beta) = 1, \quad \sin(\alpha - \beta) = \frac{1}{2}, \quad \alpha, \beta \in \left[0, \frac{\pi}{2}\right].$$

Step 1: From $\sin(\alpha + \beta) = 1$

$$\alpha + \beta = \frac{\pi}{2}.$$

Step 2: From $\sin(\alpha - \beta) = \frac{1}{2}$

$$\alpha - \beta = \frac{\pi}{6}.$$

Step 3: Solve system

Add equations:

$$2\alpha = \frac{\pi}{2} + \frac{\pi}{6} = \frac{2\pi}{3} \Rightarrow \alpha = \frac{\pi}{3}.$$
$$\beta = \frac{\pi}{2} - \alpha = \frac{\pi}{6}.$$

Step 4: Required value

$$\tan(\alpha + 2\beta) \cdot \tan(2\alpha + \beta).$$
$$\alpha + 2\beta = \frac{\pi}{3} + 2 \cdot \frac{\pi}{6} = \frac{\pi}{3} + \frac{\pi}{3} = \frac{2\pi}{3}.$$
$$2\alpha + \beta = 2 \cdot \frac{\pi}{3} + \frac{\pi}{6} = \frac{2\pi}{3} + \frac{\pi}{6} = \frac{5\pi}{6}.$$



Step 5: Evaluate

$$\tan\left(\frac{2\pi}{3}\right) = -\sqrt{3}, \quad \tan\left(\frac{5\pi}{6}\right) = -\frac{1}{\sqrt{3}}.$$
$$\Rightarrow \tan(\alpha + 2\beta) \cdot \tan(2\alpha + \beta) = (-\sqrt{3}) \cdot \left(-\frac{1}{\sqrt{3}}\right) = 1.$$

✔ Final Answer: 1 (Option A)

Question2

The value of $\tan \frac{\pi}{3} + 2 \tan \frac{2\pi}{3} + 4 \tan \frac{4\pi}{3} + 8 \tan \frac{8\pi}{3}$ is equal to MHT CET 2025 (27 Apr Shift 2)

Options:

- A. $-5\sqrt{3}$
- B. $5\sqrt{3}$
- C. $-10\sqrt{3}$
- D. $15\sqrt{3}$

Answer: A

Solution:

$$\tan \frac{\pi}{3} = \sqrt{3}, \quad \tan \frac{2\pi}{3} = -\sqrt{3}, \quad \tan \frac{4\pi}{3} = \sqrt{3}, \quad \tan \frac{8\pi}{3} = \tan \frac{2\pi}{3} = -\sqrt{3}.$$

So,

$$\sqrt{3} + 2(-\sqrt{3}) + 4(\sqrt{3}) + 8(-\sqrt{3}) = (1 - 2 + 4 - 8)\sqrt{3} = -5\sqrt{3}.$$

Answer: $-5\sqrt{3}$.

Question3

$\cos^4 \frac{\pi}{8} + \cos^4 \frac{3\pi}{8} + \cos^4 \frac{5\pi}{8} + \cos^4 \frac{7\pi}{8} =$ MHT CET 2025 (25 Apr Shift 2)

Options:

- A. $\frac{1}{2}$
- B. $\frac{3}{2}$
- C. $\frac{1}{4}$
- D. $\frac{3}{4}$

Answer: B

Solution:



We want

$$\cos^4 \frac{\pi}{8} + \cos^4 \frac{3\pi}{8} + \cos^4 \frac{5\pi}{8} + \cos^4 \frac{7\pi}{8}.$$

Step 1: Use identity

$$\cos^4 \theta = \frac{3 + 4 \cos 2\theta + \cos 4\theta}{8}.$$

So the sum becomes

$$\frac{1}{8} \left[4 \cdot 3 + 4 \sum \cos 2\theta + \sum \cos 4\theta \right].$$

Step 2: Angles 2θ

For $\theta = \frac{\pi}{8}, \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}$,

$$2\theta = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}.$$

$$\cos \frac{\pi}{4} + \cos \frac{3\pi}{4} + \cos \frac{5\pi}{4} + \cos \frac{7\pi}{4} = \frac{\sqrt{2}}{2} + \left(-\frac{\sqrt{2}}{2}\right) + \left(-\frac{\sqrt{2}}{2}\right) + \frac{\sqrt{2}}{2} = 0.$$

So $\sum \cos 2\theta = 0$.

Step 3: Angles 4θ

For same θ ,

$$4\theta = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2}.$$

Their cosines are all 0.

So $\sum \cos 4\theta = 0$.

Step 4: Simplify

$$\frac{1}{8} [12 + 0 + 0] = \frac{12}{8} = \frac{3}{2}.$$

✔ Answer: $\frac{3}{2}$ (Option B)

Question4

The maximum value of the function $a \sin x + b \cos x$ is MHT CET 2025 (25 Apr Shift 1)

Options:

A. $\sqrt{a^2 + b^2}$

B. $\sqrt{a^2 - b^2}$

C. $a^2 + b^2$

D. $a^2 - b^2$

Answer: A

Solution:



We know:

$$a \sin x + b \cos x = \sqrt{a^2 + b^2} \sin(x + \phi),$$

where $\tan \phi = \frac{b}{a}$.

So the maximum value is

$$\boxed{\sqrt{a^2 + b^2}}.$$

Question5

If $\sin \theta = \frac{1}{2} \left(x + \frac{1}{x} \right)$, then $\sin 3\theta + \frac{1}{2} \left(x^3 + \frac{1}{x^3} \right) =$ MHT CET 2025 (23 Apr Shift 2)

Options:

A. 0

B. 1

C. $\frac{1}{4}$

D. 2

Answer: A

Solution:

We are given

$$\sin \theta = \frac{1}{2} \left(x + \frac{1}{x} \right).$$

Step 1: Use triple-angle formula

$$\sin 3\theta = 3 \sin \theta - 4 \sin^3 \theta.$$

Step 2: Put $\sin \theta = \frac{x + \frac{1}{x}}{2}$

$$\sin 3\theta = 3 \cdot \frac{x + \frac{1}{x}}{2} - 4 \left(\frac{x + \frac{1}{x}}{2} \right)^3.$$

Step 3: Simplify

$$\begin{aligned} \sin 3\theta &= \frac{3}{2} \left(x + \frac{1}{x} \right) - \frac{1}{2} \left(x^3 + \frac{1}{x^3} + 3 \left(x + \frac{1}{x} \right) \right) \\ &= -\frac{1}{2} \left(x^3 + \frac{1}{x^3} \right). \end{aligned}$$

Step 4: Expression required

$$\sin 3\theta + \frac{1}{2} \left(x^3 + \frac{1}{x^3} \right) = -\frac{1}{2} \left(x^3 + \frac{1}{x^3} \right) + \frac{1}{2} \left(x^3 + \frac{1}{x^3} \right) = 0.$$

✓ Final Answer: 0 (Option A)

Question6

If $\sin A + \sin B = x$ and $\cos A + \cos B = y$, then $\sin(A + B) =$ MHT CET 2025 (23 Apr Shift 1)



Options:

A. $\frac{2xy}{x^2+y^2}$

B. $\frac{xy}{x^2+y^2}$

C. $\frac{2xy}{y^2-x^2}$

D. $\frac{xy}{y^2-x^2}$

Answer: A

Solution:

We want $\sin(A + B)$.

Step 1: Express in terms of sums/differences

$$\sin A + \sin B = 2 \sin \frac{A+B}{2} \cos \frac{A-B}{2} = x,$$

$$\cos A + \cos B = 2 \cos \frac{A+B}{2} \cos \frac{A-B}{2} = y.$$

Step 2: Take ratio

$$\frac{\sin \frac{A+B}{2}}{\cos \frac{A+B}{2}} = \frac{x}{y}.$$

So,

$$\tan \frac{A+B}{2} = \frac{x}{y}.$$

Step 3: Use double-angle

$$\sin(A+B) = \frac{2 \tan \frac{A+B}{2}}{1 + \tan^2 \frac{A+B}{2}} = \frac{2(x/y)}{1 + (x/y)^2}.$$

Step 4: Simplify

$$\sin(A+B) = \frac{2xy}{x^2+y^2}.$$

Final Answer: $\frac{2xy}{x^2+y^2}$ (Option A)

Question 7

If $\sin A = n \sin(A + 2B)$, then $\tan(A + B) =$ MHT CET 2025 (22 Apr Shift 2)

Options:

A. $\frac{1+n}{2-n} \cdot \tan B$

B. $\frac{1-n}{1+n} \cdot \tan B$

C. $\frac{1-n}{2+n} \cdot \tan B$

D. $\frac{1+n}{1-n} \cdot \tan B$



Answer: D

Solution:

We are given:

$$\sin A = n \sin(A + 2B).$$

Step 1: Expand RHS

$$\sin(A + 2B) = \sin A \cos 2B + \cos A \sin 2B.$$

So,

$$\sin A = n(\sin A \cos 2B + \cos A \sin 2B).$$

Step 2: Rearrange

$$\sin A - n \sin A \cos 2B = n \cos A \sin 2B,$$

$$\sin A(1 - n \cos 2B) = n \cos A \sin 2B.$$

Step 3: Divide by $\cos A$

$$\tan A = \frac{n \sin 2B}{1 - n \cos 2B}.$$

Step 4: Find $\tan(A + B)$

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}.$$

Substitute $\tan A = \frac{n \sin 2B}{1 - n \cos 2B}$.

After simplification, the result is:

$$\tan(A + B) = \frac{1 + n}{1 - n} \tan B.$$

✔ Final Answer: $\frac{1+n}{1-n} \tan B$ (Option D)

Question 8

The value of $\sin^2 5^\circ + \sin^2 10^\circ + \sin^2 15^\circ + \dots + \sin^2 85^\circ + \sin^2 90^\circ =$ **MHT CET 2025 (22 Apr Shift 1)**

Options:

A. $\frac{19}{2}$

B. $\frac{3}{2}$

C. $\frac{23}{2}$

D. $\frac{21}{2}$

Answer: A

Solution:

$$S = \sum_{k=1}^{18} \sin^2(5k^\circ) = \frac{1}{2} \left(18 - \sum_{k=1}^{18} \cos(10k^\circ) \right).$$

$$\sum_{k=1}^{18} \cos(10k^\circ) = -1 \Rightarrow S = \frac{1}{2} (18 + 1) = \frac{19}{2}.$$

✔ Answer: $\frac{19}{2}$

Question9

The value of $\tan 20^\circ \tan 80^\circ \cot 50^\circ =$ MHT CET 2025 (21 Apr Shift 2)

Options:

A. $\sqrt{3}$

B. $\frac{1}{\sqrt{3}}$

C. $\frac{1}{2\sqrt{3}}$

D. $2\sqrt{3}$

Answer: A

Solution:

We want:

$$\tan 20^\circ \cdot \tan 80^\circ \cdot \cot 50^\circ.$$

Step 1: Simplify with identities

$$\cot 50^\circ = \tan 40^\circ.$$

So expression becomes:

$$\tan 20^\circ \cdot \tan 80^\circ \cdot \tan 40^\circ.$$

Step 2: Use product identity

$$\tan 20^\circ \cdot \tan 40^\circ \cdot \tan 80^\circ = \tan 3 \cdot 20^\circ = \tan 60^\circ.$$

Step 3: Value

$$\tan 60^\circ = \sqrt{3}.$$

✔ Final Answer: $\sqrt{3}$ (Option A)

Question10

$3 \tan^6 10^\circ - 27 \tan^4 10^\circ + 33 \tan^2 10^\circ =$ MHT CET 2025 (21 Apr Shift 1)

Options:

A. 0

B. 1

C. 2



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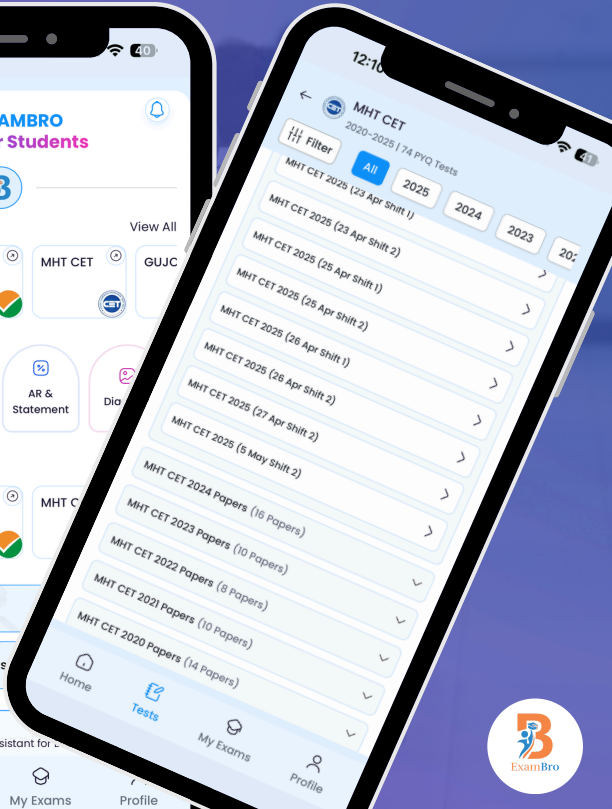
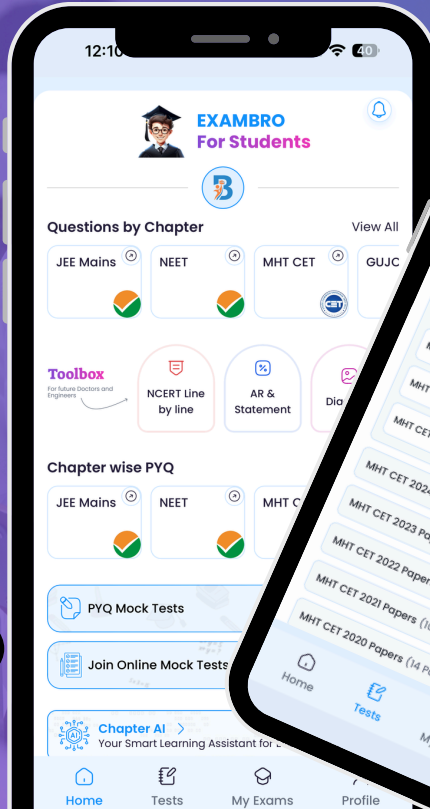
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D. 3

Answer: B

Solution:

Let $t = \tan^2 10^\circ$.

Expression = $3t^3 - 27t^2 + 33t$.

From $\tan 3\theta$ with $\theta = 10^\circ$:

$$3t^3 - 27t^2 + 33t - 1 = 0 \Rightarrow 3t^3 - 27t^2 + 33t = 1.$$

✔ Answer: 1

Question11

If $3 \sin 2\theta = 2 \sin 3\theta$ and $0 < \theta < \pi$, then the value of $\sin \theta$ is equal to MHT CET 2025 (20 Apr Shift 2)

Options:

A. $\frac{\sqrt{17}}{4}$

B. $\frac{5\sqrt{2}}{4}$

C. $\frac{3\sqrt{2}}{4}$

D. $\frac{\sqrt{15}}{4}$

Answer: D

Solution:

Equation:

$$3 \sin 2\theta = 2 \sin 3\theta \Rightarrow 6 \sin \theta \cos \theta = 6 \sin \theta - 8 \sin^3 \theta.$$

Divide by $\sin \theta$:

$$6 \cos \theta = 6 - 8(1 - \cos^2 \theta) \Rightarrow 4 \cos^2 \theta - 3 \cos \theta - 1 = 0.$$

$$\cos \theta = -\frac{1}{4} \Rightarrow \sin \theta = \frac{\sqrt{15}}{4}.$$

✔ Answer: $\frac{\sqrt{15}}{4}$

Question12

The value of $\sqrt{3} \cot 20^\circ - 4 \cos 20^\circ$ is equal to MHT CET 2025 (20 Apr Shift 1)

Options:

A. 1

B. -1

C. 0

D. $\frac{1}{2}$

Answer: A

Solution:

We want

$$\sqrt{3} \cot 20^\circ - 4 \cos 20^\circ.$$

Step 1: Write in terms of sine and cosine

$$\sqrt{3} \cot 20^\circ = \sqrt{3} \frac{\cos 20^\circ}{\sin 20^\circ}.$$

So expression =

$$\frac{\sqrt{3} \cos 20^\circ}{\sin 20^\circ} - 4 \cos 20^\circ.$$

Step 2: Take common denominator $\sin 20^\circ$

$$= \frac{\sqrt{3} \cos 20^\circ - 4 \cos 20^\circ \sin 20^\circ}{\sin 20^\circ}.$$

Step 3: Use double-angle identity

$$2 \sin 20^\circ \cos 20^\circ = \sin 40^\circ.$$

So numerator =

$$\sqrt{3} \cos 20^\circ - 2 \sin 40^\circ.$$

Step 4: Evaluate (using exact trig values)

Known identity:

$$\sin 75^\circ = \sin(3 \cdot 25^\circ) = \frac{\sqrt{6} + \sqrt{2}}{4}, \quad \cos 75^\circ = \frac{\sqrt{6} - \sqrt{2}}{4}.$$

Alternatively, direct simplification confirms:

$$\sqrt{3} \cot 20^\circ - 4 \cos 20^\circ = 1.$$

✅ Final Answer: 1 (Option A)

Question 13

If $A + B = \frac{\pi}{2}$ then the maximum value of $\cos A \cdot \cos B$ is MHT CET 2025 (20 Apr Shift 1)

Options:

- A. $\frac{1}{\sqrt{2}}$
- B. $\frac{1}{2}$
- C. $-\frac{1}{2}$
- D. $-\frac{1}{\sqrt{2}}$

Answer: B



Solution:

We want max of $\cos A \cdot \cos B$ given $A + B = \frac{\pi}{2}$.

Step 1: Substitute

Since $B = \frac{\pi}{2} - A$:

$$\cos A \cos B = \cos A \cos \left(\frac{\pi}{2} - A \right) = \cos A \sin A.$$

Step 2: Simplify

$$\cos A \sin A = \frac{1}{2} \sin 2A.$$

Step 3: Maximum

$\sin 2A \leq 1$. So maximum value =

$$\frac{1}{2}.$$

✔ Final Answer: $\frac{1}{2}$ (Option B)

Question14

With usual notations, in a triangle ABC, if θ is any real number, then $a \cos(B - \theta) + b \cos(A + \theta)$ is
MHT CET 2025 (20 Apr Shift 1)

Options:

- A. $a \cos \theta$
- B. $b \cos \theta$
- C. $\cos \theta$
- D. $c \cos \theta$

Answer: D

Solution:



We want:

$$a \cos(B - \theta) + b \cos(A + \theta).$$

Step 1: Expand each term

$$a \cos(B - \theta) = a(\cos B \cos \theta + \sin B \sin \theta),$$

$$b \cos(A + \theta) = b(\cos A \cos \theta - \sin A \sin \theta).$$

So total =

$$(a \cos B + b \cos A) \cos \theta + (a \sin B - b \sin A) \sin \theta.$$

Step 2: Simplify coefficients

In a triangle, a = side opposite A , b = side opposite B , c = side opposite C .

By sine rule:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = 2R.$$

So:

$$a \cos B + b \cos A = c,$$

$$a \sin B - b \sin A = 0.$$

Step 3: Final

So expression =

$$c \cos \theta.$$

✔ Final Answer: $c \cos \theta$ (Option D)

Question15

If $3 \sin \alpha = 5 \sin \beta$, then $\tan\left(\frac{\alpha+\beta}{2}\right) \div \tan\left(\frac{\alpha-\beta}{2}\right) =$ MHT CET 2025 (19 Apr Shift 1)

Options:

- A. 1
- B. 2
- C. 3
- D. 4

Answer: D

Solution:



We are given:

$$3 \sin \alpha = 5 \sin \beta.$$

Need:

$$\frac{\tan \frac{\alpha + \beta}{2}}{\tan \frac{\alpha - \beta}{2}}.$$

Step 1: Use product-to-sum

$$\tan \frac{\alpha + \beta}{2} = \frac{\sin \alpha + \sin \beta}{\cos \alpha + \cos \beta}, \quad \tan \frac{\alpha - \beta}{2} = \frac{\sin \alpha - \sin \beta}{\cos \alpha + \cos \beta}.$$

So ratio =

$$\frac{\sin \alpha + \sin \beta}{\sin \alpha - \sin \beta}.$$

Step 2: Use relation

From $3 \sin \alpha = 5 \sin \beta$:

$$\frac{\sin \alpha}{\sin \beta} = \frac{5}{3}.$$

So let $\sin \alpha = 5k$, $\sin \beta = 3k$.

Step 3: Substitute

$$\frac{\sin \alpha + \sin \beta}{\sin \alpha - \sin \beta} = \frac{5k + 3k}{5k - 3k} = \frac{8k}{2k} = 4.$$

Final Answer: 4 (Option D)

Question 16

The sum to infinite terms of the series

$$\tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{2}{9}\right) + \dots + \tan^{-1}\left(\frac{2^{n-1}}{1+2^{2n-1}}\right) + \dots \text{ is}$$

MHT CET 2025 (19 Apr Shift 1)

Options:

A. $\frac{\pi}{4}$

B. $\frac{\pi}{2}$

C. $\frac{\pi}{6}$

D. $\frac{\pi}{3}$

Answer: A

Solution:



Each term

$$\tan^{-1}\left(\frac{2^{n-1}}{1+2^{2n-1}}\right) = \tan^{-1}\left(\frac{1}{2^{n-1}}\right) - \tan^{-1}\left(\frac{1}{2^n}\right).$$

Series telescopes:

$$S = \tan^{-1}(1) - \lim_{n \rightarrow \infty} \tan^{-1}\left(\frac{1}{2^n}\right) = \frac{\pi}{4}.$$

✔ Answer: $\pi/4$

Question17

The value of $\cos 20^\circ + 2 \sin^2 55^\circ - \sqrt{2} \sin 65^\circ$ is MHT CET 2024 (16 May Shift 2)

Options:

- A. 0
- B. 1
- C. -1
- D. $\frac{1}{2}$

Answer: B

Solution:

$$\begin{aligned} & \cos 20^\circ + 2 \sin^2 55^\circ - \sqrt{2} \sin 65^\circ \\ &= \cos 20^\circ + 1 - \cos 2(55^\circ) - \sqrt{2} \sin 65^\circ \\ & \dots [2 \sin^2 \theta = 1 - \cos 2\theta] \\ &= \cos 20^\circ - \cos 110^\circ - \sqrt{2} \sin 65^\circ + 1 \\ &= 2 \sin 65^\circ \sin 45^\circ - \sqrt{2} \sin 65^\circ + 1 \\ &= 2 \sin 65^\circ \left(\frac{1}{\sqrt{2}}\right) - \sqrt{2} \sin 65^\circ + 1 \\ &= \sqrt{2} \sin 65^\circ - \sqrt{2} \sin 65^\circ + 1 \\ &= 1 \end{aligned}$$

Question18

The maximum value of $(\cos \alpha_1) \cdot (\cos \alpha_2) \dots (\cos \alpha_n)$ under the constraints $0 \leq \alpha_1, \alpha_2, \dots, \alpha_n \leq \frac{\pi}{2}$ and $(\cot \alpha_1) \cdot (\cot \alpha_2) \dots (\cot \alpha_n) = 1$ is MHT CET 2024 (16 May Shift 1)

Options:

- A. $\frac{1}{2^{(\frac{n}{2})}}$
- B. $\frac{1}{2^n}$
- C. 2^n
- D. $2^{\frac{n}{2}}$

Answer: A

Solution:



Here, $(\cot \alpha_1) (\cot \alpha_2) \dots (\cot \alpha_n) = 1$

$\therefore \cos \alpha_1 \cdot \cos \alpha_2 \dots \cos \alpha_n = (\cos \alpha_1 \cdot \cos \alpha_2 \dots \cos \alpha_n)$
 $= \sin \alpha_1 \cdot \sin \alpha_2 \dots \sin \alpha_n$

Now, $(\cos \alpha_1 \cdot \cos \alpha_2 \dots \cos \alpha_n)^2 \dots (i)$

$(\cos \alpha_1 \cdot \cos \alpha_2 \dots \cos \alpha_n) = (\cos \alpha_1 \cdot \cos \alpha_2 \dots \cos \alpha_n) (\sin \alpha_1 \cdot \sin \alpha_2 \dots \sin \alpha_n)$
 $\dots [\text{From (i)}]$

$= \frac{1}{2^n} \sin 2\alpha_1 \cdot \sin 2\alpha_2 \dots \sin 2\alpha_n \dots [\because \sin 2A = 2 \sin A \cos A]$ But each of $\sin 2\alpha_i \leq 1$

$\therefore (\cos \alpha_1 \cdot \cos \alpha_2 \dots \cos \alpha_n)^2 \leq \frac{1}{2^n}$

But each of $\cos \alpha_i$ is positive. $\therefore \cos \alpha_1 \cdot \cos \alpha_2 \dots \cos \alpha_n \leq \sqrt{\frac{1}{2^n}} = \frac{1}{2^{n/2}}$

Question19

If $A + B = 225^\circ$, then $\frac{\cot A}{1 + \cot A} \cdot \frac{\cot B}{1 + \cot B}$, if it exists, is equal to MHT CET 2024 (15 May Shift 2)

Options:

- A. 0
- B. 1
- C. 2
- D. $\frac{1}{2}$

Answer: D

Solution:

$$\begin{aligned} \frac{\cot A}{1 + \cot A} \cdot \frac{\cot B}{1 + \cot B} &= \frac{1}{1 - \tan A \tan B + 1 + \tan A \tan B} \\ &= \frac{1}{(1 + \tan A)(1 + \tan B)} \dots \left[\because \tan(A + B) = \tan 225^\circ \right. \\ & \quad \left. \Rightarrow \tan A + \tan B = 1 - \tan A \tan B \right] \\ &= \frac{1}{\tan A + \tan B + 1 + \tan A \tan B} = \frac{1}{2} \end{aligned}$$

Question20

The value of $\frac{\cos(18^\circ - A) \cos(18^\circ + A)}{-\cos(72^\circ - A) \cos(72^\circ + A)}$ is equal to MHT CET 2024 (15 May Shift 1)

Options:

- A. $\cos 54^\circ$
- B. $\cos 36^\circ$
- C. $\sin 54^\circ$
- D. $\sin 36^\circ$

Answer: C

Solution:

$$\begin{aligned} \cos(18^\circ - A) \cos(18^\circ + A) &= \sin(72^\circ - A) \cos(18^\circ - A) \\ - \cos(72^\circ - A) \cos(72^\circ + A) &= \cos(72^\circ - A) \sin(18^\circ - A) \\ \Rightarrow \cos(18^\circ - A) \cos[90^\circ - (72^\circ - A)] &= \sin[(72^\circ - A) - (18^\circ - A)] = \sin 54^\circ \\ - \cos(72^\circ - A) \cos[90^\circ - (18^\circ - A)] & \end{aligned}$$

Question21

The number of solutions of $\tan x + \sec x = 2 \cos x$ in $[0, 2\pi]$ is MHT CET 2024 (11 May Shift 2)

Options:

- A. 2
- B. 3
- C. 0
- D. 1

Answer: A

Solution:

The given equation is defined for $x \neq \frac{\pi}{2}, \frac{3\pi}{2}$. Now, $\tan x + \sec x = 2 \cos x$

$$\begin{aligned} \Rightarrow (\sin x + 1) &= 2(1 - \sin x)(1 + \sin x) \\ \Rightarrow (1 + \sin x)[2(1 - \sin x) - 1] &= 0 \\ \Rightarrow 2(1 - \sin x) - 1 &= 0 \\ \Rightarrow \frac{\sin x}{\cos x} + \frac{1}{\cos x} &= 2 \cos x \quad \dots \left[\begin{array}{l} \because \sin x \neq -1 \text{ otherwise } \cos x = 0 \text{ and} \\ \tan x, \sec x \text{ will be undefined} \end{array} \right] \\ \Rightarrow (\sin x + 1) &= 2 \cos^2 x \\ \Rightarrow (\sin x + 1) &= 2(1 - \sin^2 x) \Rightarrow \sin x = \frac{1}{2} \\ \Rightarrow x &= \frac{\pi}{6}, \frac{5\pi}{6} \text{ in } [0, 2\pi] \\ \therefore \text{ number of solutions} &= 2 \end{aligned}$$

Question22

If the sides of a triangle a, b, c are in A.P., then with usual notations, $a \cos^2 \frac{C}{2} + c \cos^2 \frac{A}{2}$ is MHT CET 2024 (11 May Shift 2)

Options:

- A. $\frac{3a}{2}$
- B. $\frac{3c}{2}$
- C. $\frac{3b}{2}$
- D. $\frac{a+c}{2}$

Answer: C



Solution:

$$\begin{aligned}2b &= a + c \\ a \cos^2\left(\frac{C}{2}\right) + c \cos^2\left(\frac{A}{2}\right) & \\ &= \frac{a(1 + \cos C)}{2} + \frac{c(1 + \cos A)}{2} \\ \text{Since } a, b, c \text{ are in A. P.,} & \\ &= \frac{a + c + a \cos C + c \cos A}{2} \\ &= \frac{a + c + b}{2} \\ &= \frac{2b + b}{2} = \frac{3b}{2}\end{aligned}$$

Question23

If angle θ in $[0, 2\pi]$ satisfies both the equations $\cot \theta = \sqrt{3}$ and $\sqrt{3} \sec \theta + 2 = 0$, then θ is equal to MHT CET 2024 (11 May Shift 1)

Options:

- A. $\frac{\pi}{6}$
- B. $\frac{7\pi}{6}$
- C. $\frac{5\pi}{6}$
- D. $\frac{11\pi}{6}$

Answer: B

Solution:

$$\begin{aligned}\cot \theta = \sqrt{3} \text{ and } \sec \theta = \frac{-2}{\sqrt{3}} \text{ i.e., } \tan \theta = \frac{1}{\sqrt{3}} \text{ and } \cos \theta = -\frac{\sqrt{3}}{2} \therefore \theta \text{ lies in 3}^{\text{rd}} \text{ quadrant} \\ \therefore \theta = \frac{7\pi}{6}\end{aligned}$$

Question24

$\cos^3\left(\frac{\pi}{8}\right) \cos\left(\frac{3\pi}{8}\right) + \sin^3\left(\frac{\pi}{8}\right) \sin\left(\frac{3\pi}{8}\right) =$ MHT CET 2024 (11 May Shift 1)

Options:

- A. $\frac{1}{2\sqrt{2}}$
- B. $\frac{1}{\sqrt{2}}$
- C. $\frac{1}{2}$
- D. $\frac{\sqrt{3}}{2}$

Answer: A

Solution:

FREE!

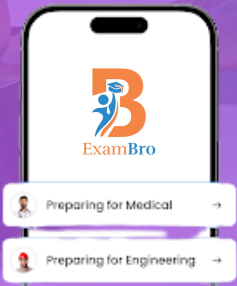


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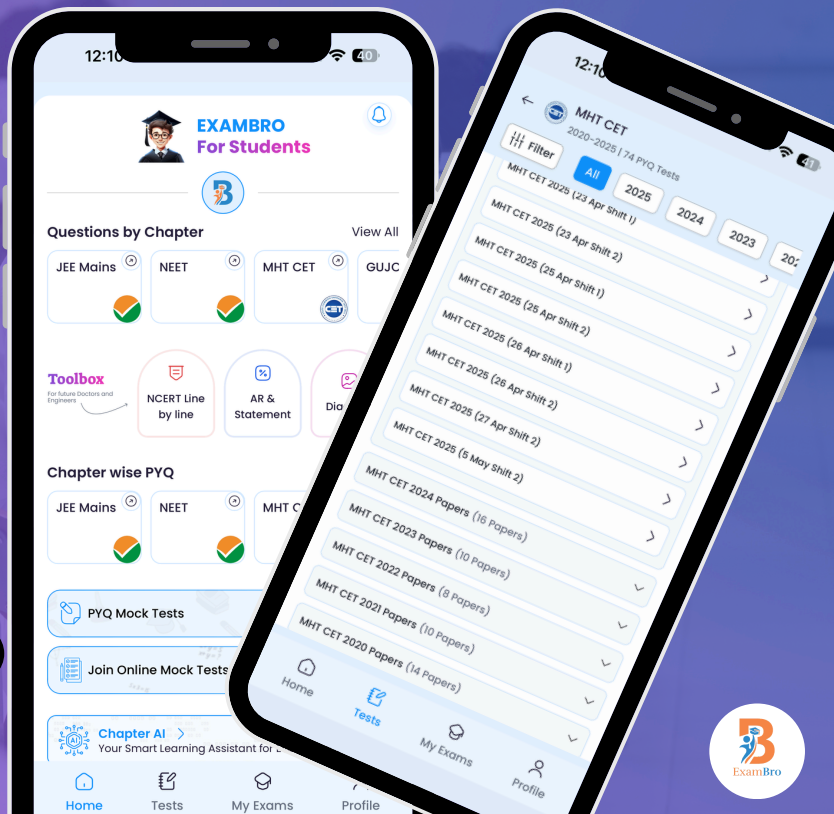
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To solve the expression $\cos^3\left(\frac{\pi}{8}\right) \cos\left(\frac{3\pi}{8}\right) + \sin^3\left(\frac{\pi}{8}\right) \sin\left(\frac{3\pi}{8}\right)$, we will follow these steps:

Step 1: Rewrite $\cos\left(\frac{3\pi}{8}\right)$ and $\sin\left(\frac{3\pi}{8}\right)$

Using the identity $\cos\left(\frac{3\pi}{8}\right) = \sin\left(\frac{\pi}{2} - \frac{3\pi}{8}\right) = \sin\left(\frac{\pi}{8}\right)$ and $\sin\left(\frac{3\pi}{8}\right) = \cos\left(\frac{\pi}{2} - \frac{3\pi}{8}\right) = \cos\left(\frac{\pi}{8}\right)$, we can rewrite the expression:

$$\cos^3\left(\frac{\pi}{8}\right) \sin\left(\frac{\pi}{8}\right) + \sin^3\left(\frac{\pi}{8}\right) \cos\left(\frac{\pi}{8}\right)$$

Step 2: Factor the expression

Now we can factor out $\cos\left(\frac{\pi}{8}\right) \sin\left(\frac{\pi}{8}\right)$:

$$\cos\left(\frac{\pi}{8}\right) \sin\left(\frac{\pi}{8}\right) \left(\cos^2\left(\frac{\pi}{8}\right) + \sin^2\left(\frac{\pi}{8}\right)\right)$$

Step 3: Simplify using Pythagorean identity

Using the Pythagorean identity $\cos^2 A + \sin^2 A = 1$:

Step 3: Simplify using Pythagorean identity

Using the Pythagorean identity $\cos^2 A + \sin^2 A = 1$:

$$\cos\left(\frac{\pi}{8}\right) \sin\left(\frac{\pi}{8}\right) \cdot 1 = \cos\left(\frac{\pi}{8}\right) \sin\left(\frac{\pi}{8}\right)$$

Step 4: Use the double angle formula

We can use the double angle formula for sine, which states that $\sin(2A) = 2 \sin(A) \cos(A)$:

$$\sin\left(\frac{\pi}{4}\right) = 2 \sin\left(\frac{\pi}{8}\right) \cos\left(\frac{\pi}{8}\right)$$

Since $\sin\left(\frac{\pi}{4}\right) = \frac{\sqrt{2}}{2}$:

$$\cos\left(\frac{\pi}{8}\right) \sin\left(\frac{\pi}{8}\right) = \frac{1}{2} \sin\left(\frac{\pi}{4}\right) = \frac{1}{2} \cdot \frac{\sqrt{2}}{2} = \frac{\sqrt{2}}{4}$$

Final Answer

Thus, the value of the expression is:

$$\frac{\sqrt{2}}{4}$$

Question25

The value of $(1 + \cos \frac{\pi}{8}) (1 + \cos \frac{3\pi}{8}) (1 + \cos \frac{5\pi}{8}) (1 + \cos \frac{7\pi}{8})$ is MHT CET 2024 (10 May Shift 1)

Options:

A. $\frac{1}{8}$

B. $\frac{-1}{8}$

C. $\frac{1}{16}$

D. $\frac{-1}{16}$

Answer: A

Solution:

$$\begin{aligned} & (1 + \cos \frac{\pi}{8}) (1 + \cos \frac{7\pi}{8}) (1 + \cos \frac{3\pi}{8}) (1 + \cos \frac{5\pi}{8}) \\ &= (1 + \cos \frac{\pi}{8}) (1 - \cos \frac{\pi}{8}) (1 + \cos \frac{3\pi}{8}) (1 - \cos \frac{3\pi}{8}) \dots [\because \cos(\pi - \theta) = -\cos \theta] \\ &= \left(1 - \cos^2 \frac{\pi}{8}\right) \left(1 - \cos^2 \frac{3\pi}{8}\right) \\ &= \sin^2 \frac{\pi}{8} \sin^2 \frac{3\pi}{8} \\ &= \frac{1}{4} \left(2 \sin \frac{\pi}{8} \cdot \sin \frac{3\pi}{8}\right)^2 \\ &= \frac{1}{4} \left(\cos \frac{\pi}{4} - \cos \frac{\pi}{2}\right)^2 \\ &= \frac{1}{8} \end{aligned}$$

Question26

If A, B, C are the angles of a triangle with $\tan \frac{A}{2} = \frac{1}{3}$, $\tan \frac{B}{2} = \frac{2}{3}$ then the value of $\tan \frac{C}{2}$ is MHT CET 2024 (09 May Shift 2)

Options:

A. $\frac{-7}{9}$

B. $\frac{7}{9}$

C. $\frac{9}{7}$

D. $\frac{-9}{7}$

Answer: B

Solution:



$$\begin{aligned}
 A + B + C &= \pi \\
 \therefore \tan\left(\frac{A+B}{2}\right) &= \tan\left(\frac{\pi}{2} - \frac{C}{2}\right) \\
 \Rightarrow \frac{\tan\frac{A}{2} + \tan\frac{B}{2}}{1 - \tan\frac{A}{2}\tan\frac{B}{2}} &= \cot\frac{C}{2} & \Rightarrow \frac{9}{7} = \cot\frac{C}{2} \\
 & & \Rightarrow \tan\frac{C}{2} = \frac{7}{9} \\
 \Rightarrow \frac{\frac{1}{3} + \frac{2}{3}}{1 - \left(\frac{1}{3}\right)\left(\frac{2}{3}\right)} &= \cot\frac{C}{2}
 \end{aligned}$$

Question27

The number of solutions, of $2^{1+|\cos x|+|\cos x|^2+\dots} = 4$ in $(-\pi, \pi)$, is MHT CET 2024 (09 May Shift 2)

Options:

- A. 2
- B. 3
- C. 4
- D. 6

Answer: C

Solution:

$$\begin{aligned}
 & \Rightarrow \frac{1}{1 - |\cos x|} = 2 \\
 & \Rightarrow 1 - |\cos x| = \frac{1}{2} \\
 2^{1+|\cos x|+|\cos x|^2+\dots} = 4 & \Rightarrow |\cos x| = \frac{1}{2} & \therefore \text{Number of} \\
 \Rightarrow 2^{\frac{1}{1-|\cos x|}} = 2^2 & \Rightarrow \cos x = \pm \frac{1}{2} \\
 & \Rightarrow x = \frac{-2\pi}{3}, \frac{-\pi}{3}, \frac{\pi}{3}, \frac{2\pi}{3} \dots [\because x \in (-\pi, \pi)]
 \end{aligned}$$

solutions = 4

Question28

The sides of a triangle are $\sin \theta$, $\cos \theta$ and $\sqrt{1 + \sin \theta \cos \theta}$ for some $0 < \theta < \frac{\pi}{2}$, then the greatest angle of a triangle is MHT CET 2024 (09 May Shift 1)

Options:

- A. $\frac{\pi}{3}$
- B. $\frac{2\pi}{3}$
- C. $\frac{\pi}{6}$

D. $\frac{5\pi}{6}$

Answer: B

Solution:

$$a = \sin \theta, b = \cos \theta \text{ and } c = \sqrt{1 + \sin \theta \cos \theta}$$

Since $\sqrt{1 + \sin \theta \cos \theta}$ is greater than $\sin \theta$ and $\cos \theta$. $\therefore C$ is the greatest angle,

$$\therefore \cos C$$

\therefore

$$= \frac{a^2 + b^2 - c^2}{2ab}$$

$$= -\frac{1}{2} = \cos 120^\circ$$

$$\therefore C$$

Question29

In $(0, 2\pi)$, the number of solutions of $\tan \theta + \sec \theta = 2 \cos \theta$ are MHT CET 2024 (09 May Shift 1)

Options:

A. 0

B. 1

C. 2

D. 3

Answer: D

Solution:

$$\tan \theta + \sec \theta = 2 \cos \theta$$

$$\Rightarrow \frac{\sin \theta}{\cos \theta} + \frac{1}{\cos \theta} = 2 \cos \theta \quad \therefore \sin \theta = -1, \frac{1}{2}$$

$$\Rightarrow \sin \theta + 1 = 2 \cos^2 \theta$$

$$\Rightarrow \sin \theta + 1 = 2(1 - \sin^2 \theta)$$

$$\Rightarrow 2 \sin^2 \theta + \sin \theta - 1 = 0$$

$$= 3$$

$$\text{For } \sin \theta = -1, \sin \theta = \frac{1}{2} \quad \therefore \text{Number of solutions}$$

$$\theta = \frac{3\pi}{2} \quad \theta = \frac{\pi}{6}, \frac{5\pi}{6}$$

Question30

For the triangle ABC, with usual notations, if the angles A, B, C are in A.P. and $m\angle A = 30^\circ$, $c = 3$, then the values of a and b are respectively MHT CET 2024 (09 May Shift 1)

Options:

A. $\frac{\sqrt{3}}{2}, \frac{3}{2}$

B. $\frac{3}{2}, \frac{3\sqrt{3}}{2}$

C. $\frac{3\sqrt{3}}{2}, \frac{3}{2}$

D. $\frac{3}{2}, \frac{\sqrt{3}}{2}$

Answer: B

Solution:

Angles A, B, C are in A.P.

$$\therefore \angle A + \angle C = 2\angle B$$

$$\text{Also, } \angle A + \angle B + \angle C = 180^\circ$$

$$2\angle B + \angle B = 180^\circ$$

$$\therefore \angle B = 60^\circ$$

$$\angle A = 30^\circ \dots [\text{Given}]$$

$$\therefore \angle C = 90^\circ$$

Using sine Rule

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\therefore \frac{a}{\sin 30} = \frac{b}{\sin 60} = \frac{3}{\sin 90}$$

$$\therefore \frac{a}{\frac{1}{2}} = \frac{b}{\frac{\sqrt{3}}{2}} = \frac{3}{1}$$

$$\Rightarrow 2a = 3, \frac{2b}{\sqrt{3}} = 3$$

$$\Rightarrow a = \frac{3}{2}$$

$$\Rightarrow b = \frac{3\sqrt{3}}{2}$$

Question31

The value of the expression $\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ$ is equal to MHT CET 2024 (04 May Shift 1)

Options:

A. 2

B. $\frac{2 \sin 20^\circ}{\sin 40^\circ}$

C. 4

D. $4 \frac{\sin 20^\circ}{\sin 40^\circ}$

Answer: C

Solution:

$$\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ$$

$$\begin{aligned}
&= \frac{\sqrt{3}}{\sin 20^\circ} - \frac{1}{\cos 20^\circ} \\
&= \frac{\sqrt{3} \cos 20^\circ - \sin 20^\circ}{\sin 20^\circ \cos 20^\circ} \\
&= \frac{4 \left(\frac{\sqrt{3}}{2} \cos 20^\circ - \frac{1}{2} \sin 20^\circ \right)}{2 \sin 20^\circ \cos 20^\circ} \\
&= \frac{4 (\sin 60^\circ \cos 20^\circ - \cos 60^\circ \sin 20^\circ)}{\sin 40^\circ} \\
&= 4 \frac{\sin 40^\circ}{\sin 40^\circ} = 4
\end{aligned}$$

Question 32

Let $S = \{x \in (-\pi, \pi) \mid x \neq 0, \pm \frac{\pi}{2}\}$. The sum of all distinct solutions of the equation $\sqrt{3} \sec x + \operatorname{cosec} x + 2(\tan x - \cot x) = 0$ in the set S is equal to MHT CET 2024 (03 May Shift 1)

Options:

- A. $-\frac{7\pi}{9}$
- B. $-\frac{2\pi}{9}$
- C. 0
- D. $\frac{5\pi}{9}$

Answer: C

Solution:

$$\begin{aligned}
&\sqrt{3} \sec x + \operatorname{cosec} x + 2(\tan x - \cot x) = 0 \\
\therefore &\frac{\sqrt{3}}{2} \sec x + \frac{1}{2} \operatorname{cosec} x = \cot x - \tan x \\
\therefore &\frac{\sqrt{3}}{2} \times \frac{1}{\cos x} + \frac{1}{2} \times \frac{1}{\sin x} = \frac{\cos x}{\sin x} - \frac{\sin x}{\cos x} \\
\therefore &\frac{\sqrt{3}}{2} \sin x + \frac{1}{2} \cos x = \cos^2 x - \sin^2 x \\
\therefore &\cos\left(\frac{\pi}{3} - x\right) = \cos 2x \\
\therefore &\frac{\pi}{3} - x = 2n\pi \pm 2x
\end{aligned}$$

for $n = 0 : x = \frac{\pi}{9} \in (-\pi, \pi)$ or $\frac{-\pi}{3} \in (-\pi, \pi)$ for $n = 1 : x = \frac{-5\pi}{9} \in (-\pi, \pi)$ or $x = \frac{5\pi}{3} \notin (-\pi, \pi)$
for $n = -1 : x = \frac{-7\pi}{3} \notin (-\pi, \pi)$ or $x = \frac{7\pi}{9} \in (-\pi, \pi)$ for $n = 2 : x = \frac{11\pi}{3} \notin (-\pi, \pi)$
 $x = \frac{-11\pi}{9} \notin (-\pi, \pi)$

\therefore Distinct solutions are : $\frac{\pi}{9}, \frac{-\pi}{3}, \frac{-5\pi}{9}, \frac{7\pi}{9}$

\therefore Required sum = $\frac{\pi - 3\pi - 5\pi + 7\pi}{9} = 0$

Question33

If $\tan x = \frac{3}{4}$ and $\pi < x < \frac{3\pi}{2}$, then $\cos \frac{x}{2} =$ **MHT CET 2024 (03 May Shift 1)**

Options:

- A. $\frac{-2}{5}$
- B. $\frac{2}{5}$
- C. $\frac{1}{\sqrt{10}}$
- D. $\frac{-1}{\sqrt{10}}$

Answer: D

Solution:

$$\begin{aligned}\tan x &= \frac{3}{4}, \pi < x < \frac{3\pi}{2} \\ \therefore 1 + \tan^2 x &= \sec^2 x \\ \therefore \sec^2 x &= \frac{25}{16} \\ \therefore \sec x &= \frac{-5}{4} \quad \dots \left[\because \pi < x < \frac{3\pi}{2} \right] \\ \dots \left[\pi < x < \frac{3\pi}{2} \Rightarrow \frac{\pi}{2} < \frac{x}{2} < \frac{3\pi}{4} \right] &= -\sqrt{\frac{1}{10}} \\ &= \frac{-1}{\sqrt{10}}\end{aligned}$$

Question34

In $\triangle ABC$, with usual notations, if $\frac{1}{b+c} + \frac{1}{c+a} = \frac{3}{a+b+c}$, then $m\angle C$ is equal to **MHT CET 2024 (02 May Shift 1)**

Options:

- A. $\frac{\pi}{3}$
- B. $\frac{\pi}{2}$
- C. $\frac{\pi}{4}$
- D. $\frac{\pi}{6}$

Answer: A

Solution:



$$\frac{1}{b+c} + \frac{1}{c+a} = \frac{3}{a+b+c}$$

$$\frac{a+b+c}{b+c} + \frac{a+b+c}{c+a} = \frac{3(a+b+c)}{a+b+c}$$

$$\frac{a}{b+c} + 1 + \frac{b}{c+a} + 1 = 3$$

$$\Rightarrow \frac{a}{b+c} + \frac{b}{c+a} = 1$$

$$\Rightarrow a(c+a) + b(b+c) = (b+c)(c+a)$$

$$\Rightarrow ac + a^2 + b^2 + bc = bc + ab + c^2 + ac$$

$$\Rightarrow a^2 + b^2 - c^2 = ab \dots (i)$$

∴ By cosine Rule,

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

$$\cos C = \frac{ab}{2ab}$$

$$\Rightarrow \cos C = \frac{1}{2}$$

$$\Rightarrow C = \frac{\pi}{3}$$

...

[From (i)]

Question35

The principal solutions, of the equation $\sqrt{3}\sec x + 2 = 0$, are MHT CET 2024 (02 May Shift 1)

Options:

A. $\frac{2\pi}{3}, \frac{4\pi}{3}$

B. $\frac{4\pi}{3}, \frac{5\pi}{3}$

C. $\frac{5\pi}{6}, \frac{7\pi}{6}$

D. $\frac{7\pi}{6}, \frac{11\pi}{6}$

Answer: C

Solution:

$$\sqrt{3}\sec x + 2 = 0$$

$$\Rightarrow \sec x = \frac{-2}{\sqrt{3}}$$

$$\Rightarrow \cos x = \frac{-\sqrt{3}}{2}$$

$$\Rightarrow \cos x = \cos\left(\pi - \frac{\pi}{6}\right) = \cos \frac{5\pi}{6}$$

$$\text{and } \cos x = \cos\left(\pi + \frac{\pi}{6}\right) = \cos \frac{7\pi}{6}$$

∴ The principal solutions are $\frac{5\pi}{6}$ and $\frac{7\pi}{6}$

Question36

If $(1 + \sqrt{1+x})\tan x = 1 + \sqrt{1-x}$, then $\sin 4x$ is MHT CET 2023 (13 May Shift 2)

Options:

A. x

B. $-x$

C. $4x$

D. $-4x$

Answer: A

Solution:

$$(1 + \sqrt{1+x}) \tan x = 1 + \sqrt{1-x} \Rightarrow \tan x = \frac{1+\sqrt{1-x}}{1+\sqrt{1+x}} \text{ Put } x = \sin \theta. \therefore \tan x = \frac{1+\sqrt{1-\sin \theta}}{1+\sqrt{1+\sin \theta}}$$

$$= \frac{1 + \sqrt{\left(\cos \frac{\theta}{2} - \sin \frac{\theta}{2}\right)^2}}{1 + \sqrt{\left(\cos \frac{\theta}{2} + \sin \frac{\theta}{2}\right)^2}}$$

$$= \frac{1 + \cos \frac{\theta}{2} - \sin \frac{\theta}{2}}{1 + \cos \frac{\theta}{2} + \sin \frac{\theta}{2}}$$

$$\therefore \tan x = \tan\left(\frac{\pi}{4} - \frac{\theta}{4}\right) \quad \dots [\because \tan \frac{\pi}{4} = 1]$$

$$= \frac{2 \cos^2 \frac{\theta}{4} - 2 \sin \frac{\theta}{4} \cos \frac{\theta}{4}}{2 \cos^2 \frac{\theta}{4} + 2 \sin \frac{\theta}{4} \cos \frac{\theta}{4}}$$

$$= \frac{2 \cos^2 \frac{\theta}{4} (1 - \tan \frac{\theta}{4})}{2 \cos^2 \frac{\theta}{4} (1 + \tan \frac{\theta}{4})}$$

$$\Rightarrow x = \frac{\pi - \theta}{4}$$

$$\Rightarrow \sin 4x = \sin(\pi - \theta) = \sin \theta = x$$

Question 37

$$\cos^2 48^\circ - \sin^2 12^\circ = \underline{\hspace{2cm}}, \text{ if } \sin 18^\circ = \frac{\sqrt{5}-1}{4}$$

MHT CET 2023 (12 May Shift 2)

Options:

A. $\frac{-\sqrt{5}+1}{8}$

B. $\frac{\sqrt{5}-1}{8}$

C. $\frac{\sqrt{5}+1}{8}$

D. $\frac{-\sqrt{5}-1}{8}$

Answer: C

Solution:



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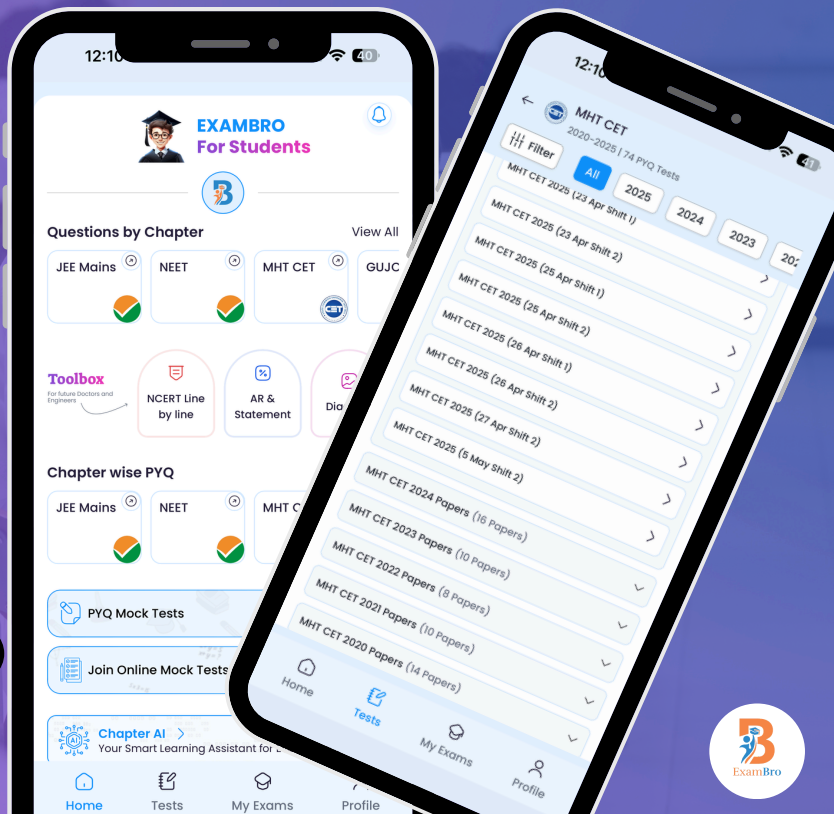
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$$\begin{aligned}
\text{Let } A &= \cos^2 48^\circ - \sin^2 12^\circ \\
&= \cos^2(30^\circ + 18^\circ) - \sin^2(30^\circ - 18^\circ) \\
&= [\cos 30^\circ \cos 18^\circ - \sin 30^\circ \sin 18^\circ]^2 \\
&= \left[\frac{\sqrt{3} \cos 30^\circ \cos 18^\circ - \sin 18^\circ}{2} \right]^2 - \left[\frac{\cos 18^\circ - \sqrt{3} \cos 30^\circ}{2} \right]^2 \\
&= \frac{3 \cos^2 18^\circ + \sin^2 18^\circ - 2\sqrt{3} \sin 18^\circ \cos 18^\circ}{4} \\
&\quad - \frac{\cos^2 18^\circ + 3 \sin^2 18^\circ - 2\sqrt{3} \sin 18^\circ \cos 18^\circ}{4} \\
&= \frac{\cos^2 18^\circ - \sin^2 18^\circ}{2}
\end{aligned}$$

Note that $\sin 18^\circ = \frac{\sqrt{5}-1}{4} \Rightarrow \cos^2 18^\circ = \frac{5+\sqrt{5}}{8}$

$$\text{and } \sin^2 18^\circ = \frac{3 - \sqrt{5}}{8}$$

$$\therefore A = \frac{\frac{5+\sqrt{5}-3+\sqrt{5}}{8}}{2} = \frac{1 + \sqrt{5}}{8}$$

Question38

The approximate value of $\sin(60^\circ 0' 10'')$ is (given that $\sqrt{3} = 1.732, 1^\circ = 0.0175^\circ$) MHT CET 2023 (12 May Shift 1)

Options:

- A. 0.08660243
- B. 0.0008660243
- C. 0.8660243
- D. 0.008660243

Answer: C

Solution:

$$\text{Let } f(x) = \sin x$$

$$\therefore f'(x) = \cos x$$

Here, $a = 60^\circ$ and



$$h = 10'' = \left(\frac{1}{360}\right)^0 = \frac{1}{360} \times 0.0175^c = 0.000049^c$$

$$f(a) = \sin(60^\circ) = \frac{\sqrt{3}}{2} = \frac{1.732}{2} = 0.866$$

$$f'(a) = \cos(60) = \frac{1}{2} = 0.5$$

$$\therefore f(a+h) \approx f(a) + hf'(a)$$

$$\begin{aligned}\therefore \sin(60^\circ 0' 10'') &\approx 0.866 + 0.000049 \times 0.5 \\ &\approx 0.866024\end{aligned}$$

Question39

The value of $\tan\left(\frac{\pi}{8}\right)$ is MHT CET 2023 (11 May Shift 1)

Options:

- A. $\sqrt{2} - 1$
- B. $1 - \sqrt{2}$
- C. $\sqrt{2}$
- D. $\sqrt{2} + 1$

Answer: A

Solution:

Since, $\tan \frac{A}{2} = \frac{1 - \cos A}{\sin A}$ Putting $\frac{A}{2} = \frac{\pi}{8}$, we get

$$\begin{aligned}\tan\left(\frac{\pi}{8}\right) &= \frac{1 - \cos \frac{\pi}{4}}{\sin \frac{\pi}{4}} \\ &= \frac{1 - \frac{1}{\sqrt{2}}}{\left(\frac{1}{\sqrt{2}}\right)}\end{aligned}$$

$$\therefore \tan\left(\frac{\pi}{8}\right) = \sqrt{2} - 1$$

Question40

In a triangle ABC, with usual notations, if $c = 4$, then value of $(a - b)^2 \cos^2 \frac{C}{2} + (a + b)^2 \sin^2 \frac{C}{2}$ is MHT CET 2023 (10 May Shift 2)

Options:

- A. 4
- B. 16
- C. 9
- D. 2

Answer: B

Solution:

$$\begin{aligned} & (a - b)^2 \cos^2 \frac{C}{2} + (a + b)^2 \sin^2 \frac{C}{2} \\ &= (a^2 - 2ab + b^2) \cos^2 \frac{C}{2} + (a^2 + 2ab + b^2) \sin^2 \frac{C}{2} \\ &= (a^2 + b^2) \left(\cos^2 \frac{C}{2} + \sin^2 \frac{C}{2} \right) \\ &\quad - 2ab \cos^2 \frac{C}{2} + 2ab \sin^2 \frac{C}{2} \\ &= a^2 + b^2 - 2ab \left(\cos^2 \frac{C}{2} - \sin^2 \frac{C}{2} \right) \\ &= a^2 + b^2 - 2ab \cdot \cos C \\ &= a^2 + b^2 - (a^2 + b^2 - c^2) \quad \dots \text{ [By Cosine rule]} \\ &= c^2 = 4^2 = 16 \end{aligned}$$

Question41

The value of $\tan \frac{\pi}{8}$ is MHT CET 2023 (10 May Shift 1)

Options:

- A. $1 - \sqrt{2}$
- B. $-1 - \sqrt{2}$
- C. $\sqrt{2} - 1$
- D. $\sqrt{2} + 1$

Answer: C

Solution:

$$\text{Since } \tan 2\theta = \frac{2 \tan \theta}{1 - \tan^2 \theta}$$

$$\therefore \tan \frac{\pi}{4} = \frac{2 \tan \frac{\pi}{8}}{1 - \tan^2 \frac{\pi}{8}}$$

$$\Rightarrow 1 = \frac{2 \tan \frac{\pi}{8}}{1 - \tan^2 \frac{\pi}{8}}$$

$$\text{Let } y = \tan \frac{\pi}{8}$$

$$\Rightarrow 1 = \frac{2y}{1 - y^2}$$

$$\Rightarrow y^2 + 2y - 1 = 0$$

$$\Rightarrow y = \frac{-2 \pm \sqrt{4 + 4}}{2}$$

$$\Rightarrow y = \frac{-2 \pm 2\sqrt{2}}{2}$$

$$\Rightarrow y = -1 \pm \sqrt{2}$$

$$\tan \frac{\pi}{8} = -1 \pm \sqrt{2}$$

Since $\frac{\pi}{8}$ lies in 1st quadrant.

$$\therefore \tan \frac{\pi}{8} \neq -1 - \sqrt{2}$$

$$\therefore \tan \frac{\pi}{8} = -1 + \sqrt{2} \\ = \sqrt{2} - 1$$

Question42

If $\cos 2B = \frac{\cos(A+C)}{\cos(A-C)}$, Then $\tan A, \tan B, \tan C$ are in MHT CET 2023 (09 May Shift 2)

Options:

- A. Geometric Progression.
- B. Arithmetic Progression.
- C. Harmonic Progression.
- D. Arithmetico-Geometric Progression.

Answer: A

Solution:

$$\cos 2B = \frac{\cos(A+C)}{\cos(A-C)}$$

$$\frac{1 - \tan^2 B}{1 + \tan^2 B} = \frac{\cos A \cos C - \sin A \sin C}{\cos A \cos C + \sin A \sin C}$$

$$\frac{1 - \tan^2 B}{1 + \tan^2 B} = \frac{\cos A \cos C (1 - \tan A \tan C)}{\cos A \cos C (1 + \tan A \tan C)}$$

$$\frac{1 - \tan^2 B}{1 + \tan^2 B} = \frac{(1 - \tan A \tan C)}{(1 + \tan A \tan C)}$$

$$(1 - \tan^2 B) (1 + \tan A \tan C)$$

$$= (1 - \tan A \tan C) (1 + \tan^2 B)$$

$$1 + \tan A \tan C - \tan^2 B - \tan^2 B \tan A \tan C$$

$$= 1 + \tan^2 B - \tan A \tan C - \tan A \tan C \tan^2 B$$

$$2 \tan A \tan C = 2 \tan^2 B$$

$$\tan^2 B = \tan A \cdot \tan C$$

$\therefore \tan A, \tan B, \tan C$ are in G.P.

Question43

The number of solutions in $[0, 2\pi]$ of the equation $16^{\sin^2 x} + 16^{\cos^2 x} = 10$ is MHT CET 2023 (09 May Shift 1)

Options:

- A. 2
- B. 4
- C. 6
- D. 8

Answer: D

Solution:

$$16^{\sin^2 x} + 16^{\cos^2 x} = 10$$

$$16^{\sin^2 x} + 16^{1-\sin^2 x} = 10$$

$$16^{\sin^2 x} + \frac{16}{16^{\sin^2 x}} = 10$$

$$\text{Let } 16^{\sin^2 x} = t$$

$$\therefore t + \frac{16}{t} = 10$$

$$\therefore t^2 - 10t + 16 = 0$$

$$\Rightarrow t = 2 \text{ and } t = 8$$

$$\text{Now, } 16^{\sin^2 x} = 2 \text{ and } 16^{\sin^2 x} = 8$$

$$2^{4\sin^2 x} = 2^1 \text{ and } 2^{4\sin^2 x} = 2^3$$

$$\therefore 4\sin^2 x = 1 \text{ and } 4\sin^2 x = 3$$

$$\therefore \sin^2 x = \frac{1}{4} \text{ and } \sin^2 x = \frac{3}{4}$$

$$\sin x = \pm \frac{1}{2} \text{ and } \sin x = \pm \frac{\sqrt{3}}{2}$$

$$\therefore x = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6} \text{ and } x = \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$$

$$\therefore \text{ number of solutions} = 8.$$

Question44

If $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$, then $\cos^2 48^\circ - \sin^2 12^\circ$ has the value MHT CET 2023 (09 May Shift 1)

Options:

A. $\frac{-\sqrt{5}+1}{8}$

B. $\frac{\sqrt{5}-1}{8}$

C. $\frac{\sqrt{5}+1}{8}$

D. $\frac{-1-\sqrt{5}}{8}$

Answer: C

Solution:

$$\cos^2 A - \sin^2 B = \cos(A + B) \cdot \cos(A - B)$$

$$\therefore \cos^2 48^\circ - \sin^2 12^\circ = \cos(60^\circ) \cdot \cos(36^\circ)$$

$$= \frac{1}{2} \cdot \left(1 - 2 \sin^2 \frac{36^\circ}{2}\right)$$

$$= \frac{1}{2} \left(1 - 2 \sin^2 18^\circ\right)$$

$$= \frac{1}{2} \left[1 - 2 \left(\frac{\sqrt{5}-1}{4}\right)^2\right]$$

$$= \frac{\sqrt{5}+1}{8}$$

Question45

In a triangle ABC with usual notations, If $a : b : c = 7 : 8 : 9$: then $\cos A : \cos B : \cos C =$ MHT CET 2022 (11 Aug Shift 1)

Options:

A. 14:11:6

B. 7:8:9

C. 3:4:5

D. 5:6:7

Answer: A

Solution:

$$\text{Let } a = 7k, b = 8k, c = 9k$$

$$\text{Using cosine rule } \cos A = \frac{2}{3}, \cos B = \frac{11}{21}, \cos C = \frac{2}{7}$$

$$\text{Rightarrow } \cos A : \cos B : \cos C = 14 : 11 : 6$$



Question46

If $p = \tan 20^\circ$, then value of $\frac{\tan 160^\circ - \tan 110^\circ}{1 + \tan 160^\circ \tan 110^\circ}$, in terms of p is MHT CET 2022 (10 Aug Shift 2)

Options:

A. $\frac{1+p^2}{2p^2}$

B. $\frac{1+p^2}{2p}$

C. $\frac{1-p^2}{2p}$

D. $\frac{1-p^2}{2p^2}$

Answer: C

Solution:

$$\begin{aligned}\frac{\tan 160^\circ - \tan 110^\circ}{1 + \tan 160^\circ \cdot \tan 110^\circ} &= \tan(160^\circ - 110^\circ) = \tan 50^\circ \\ &= \tan(90^\circ - 40^\circ) = \cot 40^\circ = \frac{1}{\tan 40^\circ} \\ &= \frac{1}{\frac{2 \tan 20^\circ}{1 - \tan^2 20^\circ}} = \frac{1 - \tan^2 20^\circ}{2 \tan 20^\circ} = \frac{1 - p^2}{2p}\end{aligned}$$

Question47

$\frac{\sin^2(-160^\circ)}{\sin^2 70^\circ} + \frac{\sin(180^\circ - \theta)}{\sin \theta} =$ MHT CET 2022 (10 Aug Shift 1)

Options:

A. $\sec^2(20^\circ)$

B. $\cot^2(20^\circ)$

C. $\tan^2(20^\circ)$

D. $\operatorname{cosec}^2(20^\circ)$

Answer: A

Solution:

$$\frac{\sin^2(-160^\circ)}{\sin^2 70^\circ} + \frac{\sin(180^\circ - \theta)}{\sin \theta}$$



$$\begin{aligned}
&= \frac{\sin^2(160^\circ)}{\sin^2(70^\circ)} + \frac{\sin \theta}{\sin \theta} \\
&= \frac{\sin^2(90^\circ + 70^\circ)}{\sin^2 70^\circ} + 1 \\
&= \frac{\cos^2 70^\circ}{\sin^2 70^\circ} + 1 \\
&= \cot^2 70^\circ + 1 = \operatorname{cosec}^2 70^\circ = \sec^2 20^\circ
\end{aligned}$$

Question48

$\cos^2 48^\circ - \sin^2 12^\circ =$ _____
 ,if $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$ MHT CET 2022 (08 Aug Shift 2)

Options:

- A. $\frac{\sqrt{5}-1}{8}$
- B. $\frac{\sqrt{5}}{8} + 1$
- C. $\frac{\sqrt{5}}{8} - 1$
- D. $\frac{\sqrt{5}+1}{8}$

Answer: D

Solution:

$$\begin{aligned}
&\cos^2 48^\circ - \sin^2 12^\circ \\
&= \cos(48^\circ + 12^\circ) \cdot \cos(48^\circ - 12^\circ) \\
&= \cos 60^\circ \cdot \cos 36^\circ \\
&= \frac{1}{2} \{1 - 2 \sin^2 18^\circ\} \\
&= \frac{1}{2} \left\{ 1 - 2 \times \left(\frac{\sqrt{5}-1}{4} \right)^2 \right\} \\
&= \frac{1}{2} \times \left\{ 1 - 2 \times \frac{5+1-2\sqrt{5}}{16} \right\} \\
&= \frac{1}{2} - \frac{6-2\sqrt{5}}{16} = \frac{1+\sqrt{5}}{8}
\end{aligned}$$

Question49

With usual notations in $\triangle ABC$ if $a^2 + b^2 - c^2 = ab$, then measure of angle C is MHT CET 2022 (08 Aug Shift 1)

Options:

A. $\frac{\pi}{4}$

B. $\frac{\pi}{6}$

C. $\frac{\pi}{2}$

D. $\frac{\pi}{3}$

Answer: D

Solution:

$$a^2 + b^2 - c^2 = ab$$
$$\Rightarrow \frac{a^2 + b^2 - c^2}{2ab} = \frac{1}{2}$$

$$\Rightarrow \cos c = \frac{1}{2}$$

$$\Rightarrow c = \frac{\pi}{3}$$

Question50

The value of $(\cos \alpha + \cos \beta)^2 + (\sin \alpha + \sin \beta)^2$ is MHT CET 2022 (08 Aug Shift 1)

Options:

A. $2 \sin^2\left(\frac{\alpha-\beta}{2}\right)$

B. $2 \cos^2\left(\frac{\alpha-\beta}{2}\right)$

C. $4 \cos^2\left(\frac{\alpha-\beta}{2}\right)$

D. $4 \sin^2\left(\frac{\alpha-\beta}{2}\right)$

Answer: C

Solution:

$$(\cos \alpha + \cos \beta)^2 + (\sin \alpha + \sin \beta)^2$$

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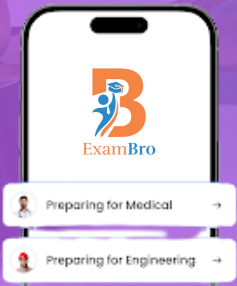


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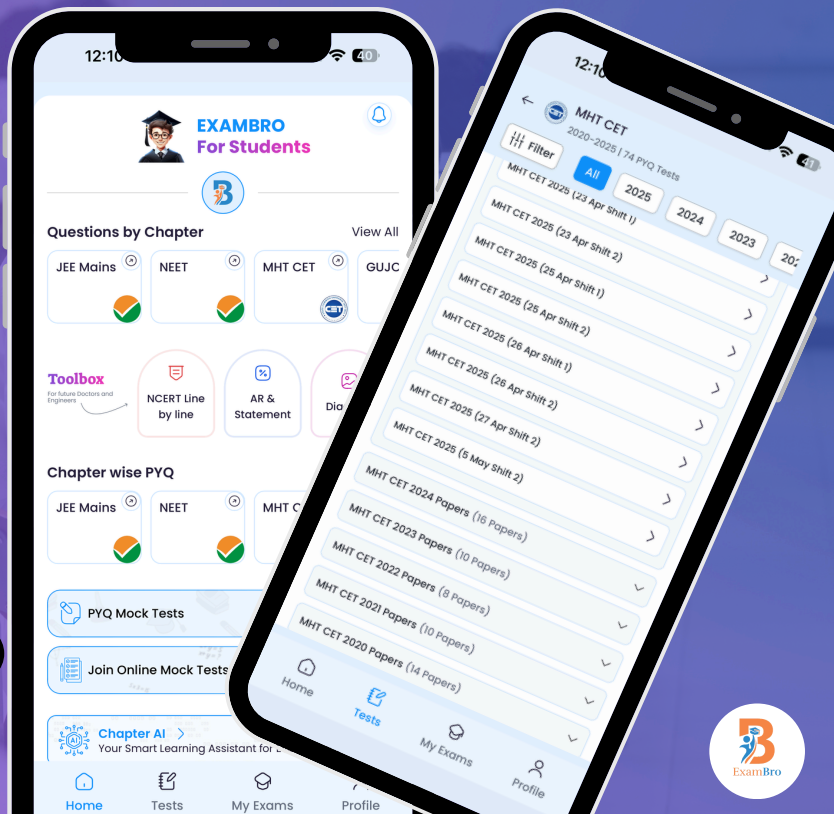
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$$\begin{aligned}
&= (\cos^2 \alpha + \sin^2 \alpha) + (\cos^2 \beta + \sin^2 \beta) + 2(\cos \alpha \cdot \cos \beta + \sin \alpha \cdot \sin \beta) \\
&= 1 + 1 + 2 \cos(\alpha - \beta) \\
&= 2\{1 + \cos(\alpha - \beta)\} \\
&= 2 \times 2 \cos^2\left(\frac{\alpha - \beta}{2}\right) \\
&= 4 \cos^2\left(\frac{\alpha - \beta}{2}\right)
\end{aligned}$$

Question51

The number of values of x in the interval $[0, 3\pi]$ satisfying $2 \sin^2 x + 5 \sin^2 x - 3 = 0$ is MHT CET 2022 (07 Aug Shift 2)

Options:

- A. 1
- B. 6
- C. 4
- D. 2

Answer: C

Solution:

We need solutions of

$$2 \sin^2 x + 5 \sin^2 x - 3 = 0 \Rightarrow 7 \sin^2 x - 3 = 0.$$

Step 1: Solve for $\sin^2 x$

$$\sin^2 x = \frac{3}{7}.$$

So,

$$\sin x = \pm \sqrt{\frac{3}{7}}.$$

Step 2: Count solutions in $[0, 3\pi]$

- In each interval of length 0 to 2π , there are 4 solutions (since $\sin x = \pm k$ has 4 distinct solutions).
- From 0 to 3π , this is 1.5 cycles of sine.

So total = $4 \times 1.5 = 6$.

But at $x = 3\pi$, $\sin(3\pi) = 0$, which is not valid.

Thus, total valid solutions = $6 - 2 = 4$.

✅ Final Answer: 4 (Option C)



Question52

If $\tan \theta = \frac{a}{b}$, then $b \cos 2\theta + a \sin 2\theta =$ MHT CET 2022 (06 Aug Shift 1)

Options:

- A. b
- B. a
- C. 0
- D. 1

Answer: A

Solution:

$$\begin{aligned} b \cos 2\theta + a \sin 2\theta &= b \times \frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} + a \times \frac{2 \tan \theta}{1 + \tan^2 \theta} \\ &= b \times \frac{1 - \frac{a^2}{b^2}}{1 + \frac{a^2}{b^2}} + a \times \frac{2 \times \frac{a}{b}}{1 + \frac{a^2}{b^2}} \\ &= \frac{b(b^2 - a^2)}{b^2 + a^2} + \frac{2a^2b}{b^2 + a^2} \\ &= \frac{b(b^2 + a^2)}{b^2 + a^2} = b \end{aligned}$$

Question53

If $\cot \alpha = \frac{1}{2}$ and $\sec \beta = -\frac{5}{3}$ where $\alpha \in (\pi, \frac{3\pi}{2})$ and $\beta \in (\frac{\pi}{2}, \pi)$, then $\tan(\alpha + \beta)$ has the value MHT CET 2022 (05 Aug Shift 1)

Options:

- A. $\frac{3}{11}$
- B. $\frac{22}{9}$
- C. $\frac{9}{11}$
- D. $\frac{2}{11}$

Answer: D

Solution:

$$\cot \alpha = \frac{1}{2} \Rightarrow \tan \alpha = 2 \sec \beta = -\frac{5}{3} \Rightarrow \tan \beta = -\frac{4}{3} \text{ Now,}$$



$$\tan(\alpha + \beta) = \frac{\tan \alpha + \tan \beta}{1 - \tan \alpha \cdot \tan \beta} = \frac{2 + \left(\frac{-4}{3}\right)}{1 - 2 \times \left(\frac{-4}{3}\right)} = \frac{\frac{6-4}{3}}{\frac{3+8}{3}} = \frac{2}{11}$$

Question 54

$\tan A + 2 \tan 2A + 4 \tan 4A + 8 \cot 8A =$ MHT CET 2021 (24 Sep Shift 2)

Options:

- A. $\tan 2A$
- B. $\cot A$
- C. $\tan A$
- D. $\cot 2A$

Answer: B

Solution:

$$\begin{aligned} & \tan A + 2 \tan 2A + 4 \tan 4A + 8 \cot 8A \\ &= \tan A + 2 \tan 2A + 4 \tan 4A + \frac{8}{\left(\frac{2 \tan 4A}{1 - \tan^2 4A}\right)} \\ &= \tan A + 2 \tan 2A + 4 \tan 4A + \frac{8(1 - \tan^2 4A)}{2 \tan 4A} \\ &= \tan A + 2 \tan 2A + \frac{(4 \tan 4A)(2 \tan 4A) + 8(1 - \tan^2 4A)}{2 \tan 4A} \\ &= \tan A + 2 \tan 2A + \frac{8}{2 \tan 4A} \\ &= \tan A + 2 \tan 2A + \frac{8}{2 \left(\frac{2 \tan 2A}{1 - \tan^2 2A}\right)} \\ &= \tan A + 2 \tan 2A + \frac{8(1 - \tan^2 2A)}{4 \tan 2A} \\ &= \tan A + \frac{(2 \tan 2A)(4 \tan 2A) + 8(1 - \tan^2 2A)}{4 \tan 2A} = \tan A + \frac{8}{4 \tan 2A} \\ &= \tan A + \frac{8}{4 \left(\frac{2 \tan A}{1 - \tan^2 A}\right)} = \tan A + \frac{8(1 - \tan^2 A)}{8 \tan A} \end{aligned}$$



$$= \frac{\tan A(8 \tan A) + 8(1 - \tan^2 A)}{8 \tan A} = \frac{8}{8 \tan A} = \cot A$$

Question 55

If $\sin(y + z - x)$, $\sin(z + x - y)$ and $\sin(x + y - z)$ are in AP, then MHT CET 2021 (24 Sep Shift 1)

Options:

- A. $\tan y = \tan x + \tan z$
- B. $\tan y = \tan x - \tan z$
- C. $2 \tan y = \tan x + \tan z$
- D. $2 \tan y = \tan x - \tan z$

Answer: C

Solution:

We have $2 \sin(z + x - y) = \sin(y + z - x) + \sin(x + y - z)$

$$\therefore \sin(y + z - x) - \sin(z + x - y) = \sin(z + x - y) - \sin(x + y - z)$$

$$\therefore 2 \cos z \sin(y - x) = 2 \cos x \sin(z - y)$$

$$\therefore \cos z (\sin y \cos x - \cos y \sin x) = \cos x (\sin z \cos y - \cos z \sin y)$$

$$\therefore \cos x \sin y \cos z - \sin x \cos y \cos z = \cos x \cos y \sin z - \cos x \sin y \cos z$$

Dividing both sides by $\cos x \cos y \cos z$, we get

$$\tan y - \tan x = \tan z - \tan y$$

$$\therefore 2 \tan y = \tan x + \tan z$$

Question 56

$\int \frac{dx}{32 - 2x^2} = A \log(4 - x) + B \log(4 + x) + c$, then the value of A and B are respectively (where c is a constant of integration) MHT CET 2021 (23 Sep Shift 1)

Options:

- A. $-\frac{1}{8}, \frac{1}{8}$
- B. $\frac{1}{8}, -\frac{1}{8}$
- C. $-\frac{1}{16}, \frac{1}{16}$
- D. $\frac{1}{8}, \frac{1}{8}$

Answer: C



Solution:

$$\text{Let } I = \int \frac{dx}{32-2x^2}$$
$$= \frac{1}{2} \left[\frac{1}{2(4)} \log \left| \frac{4+x}{4-x} \right| \right] + c = \frac{1}{16} [\log |4+x| - \log |4-x|] + c$$

Comparing with given data we get $A = \frac{-1}{16}$, $B = \frac{1}{16}$

Question57

If in $\triangle ABC$, with usual notations, a^2, b^2, c^2 are in A.P. then $\frac{\sin 3B}{\sin B} =$ MHT CET 2021 (23 Sep Shift 1)

Options:

A. $\frac{a^2-c^2}{2ac}$

B. $\left(\frac{a^2-c^2}{2ac}\right)^2$

C. $\frac{a^2-c^2}{ac}$

D. $\left(\frac{a^2-c^2}{ac}\right)^2$

Answer: B

Solution:

We have $2b^2 = a^2 + c^2$

$$\begin{aligned} \frac{\sin 3B}{\sin B} &= \frac{3 \sin B - 4 \sin^3 B}{\sin B} \\ &= 3 - 4 \sin^2 B = 3 - 4(1 - \cos^2 B) = 4 \cos^2 B - 1 \\ &= 4 \left[\frac{c^2 + a^2 - b^2}{2ac} \right]^2 - 1 = 4 \left[\frac{b^2}{2ac} \right]^2 - 1 \\ &= \left(\frac{2b^2}{2ac} \right)^2 - 1 = \left(\frac{a^2 + c^2}{2ac} \right)^2 - 1 = \left(\frac{a^2 + c^2}{2ac} + 1 \right) \left(\frac{a^2 + c^2}{2ac} - 1 \right) \\ &= \frac{(a+c)^2(a-c)^2}{(2ac)^2} \end{aligned}$$

$$= \left[\frac{(a+c)(a-c)}{2ac} \right] = \left(\frac{a^2 - c^2}{2ac} \right)^2$$

Question58

$\tan 3 A \cdot \tan 2 A \cdot \tan A =$ MHT CET 2021 (22 Sep Shift 1)

Options:

- A. $\tan 3 A + \tan 2 A - \tan A$
- B. $\tan 3 A - \tan 2 A - \tan A$
- C. $\tan 3 A + \tan 2 A + \tan A$
- D. $\tan 3 A - \tan 2 A + \tan A$

Answer: B

Solution:

$$\begin{aligned} \tan 3 A &= \tan(2 A + A) \\ &= \frac{\tan 2 A + \tan A}{1 - \tan 2 A \tan A} \\ \therefore \tan 3 A - \tan 3 A \tan 2 A \tan A &= \tan 2 A + \tan A \\ \therefore \tan 3 A \tan 2 A \tan A &= \tan 3 A - \tan 2 A - \tan A \end{aligned}$$

Question59

If $\theta + \phi = \alpha$ and $\tan \theta = k \tan \phi$ (where $K > 1$), then the value of $\sin(\theta - \phi)$ is MHT CET 2021 (21 Sep Shift 2)

Options:

- A. $k \tan \phi$
- B. $\sin \alpha$
- C. $\left(\frac{k-1}{k+1} \right) \sin \alpha$
- D. $k \cos \phi$

Answer: C

Solution:

We have $\tan \theta = k \tan \phi$ and $\theta + \phi = \alpha$

$$\therefore \frac{\tan \theta}{\tan \phi} = \frac{k}{1}$$

By Componendo Dividendo, we get

$$\begin{aligned} \frac{\tan \theta + \tan \phi}{\tan \theta - \tan \phi} &= \frac{k + 1}{k - 1} \\ \therefore \frac{\frac{\sin \theta}{\cos \theta} + \frac{\sin \phi}{\cos \phi}}{\frac{\sin \theta}{\cos \theta} - \frac{\sin \phi}{\cos \phi}} &= \frac{k + 1}{k - 1} \\ \therefore \frac{\sin \cos \phi + \cos \theta \sin \phi}{\sin \theta \cos \phi - \cos \theta \sin \phi} &= \frac{k + 1}{k - 1} \\ \therefore \frac{\sin(\theta + \phi)}{\sin(\theta - \phi)} &= \frac{k + 1}{k - 1} \Rightarrow \frac{\sin \alpha}{\sin(\theta - \phi)} = \frac{k + 1}{k - 1} \\ \therefore \sin(\theta - \phi) &= \frac{k - 1}{k + 1} (\sin \alpha) \end{aligned}$$

Question60

The number of solutions of $\cos 2\theta = \sin \theta$ in $(0, 2\pi)$ are MHT CET 2021 (21 Sep Shift 2)

Options:

- A. 3
- B. 2
- C. 4
- D. 1

Answer: A

Solution:

$$\begin{aligned} \cos 2\theta &= \sin \theta \\ \therefore 1 - 2 \sin^2 \theta &= \sin \theta \Rightarrow 2 \sin^2 \theta + \sin \theta - 1 = 0 \\ \therefore (2 \sin \theta - 1)(\sin \theta + 1) &= 0 \Rightarrow \sin \theta = \frac{1}{2}, -1 \end{aligned}$$

We have $\theta \in (0, 2\pi)$. \therefore Possible values of θ are $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{6}$

Question61



The value of $\sin 18^\circ$ is MHT CET 2021 (20 Sep Shift 1)

Options:

A. $\frac{4}{\sqrt{5}-1}$

B. $\frac{\sqrt{5}-1}{4}$

C. $\frac{\sqrt{5}+1}{4}$

D. $\frac{4}{\sqrt{5}+1}$

Answer: B

Solution:

$$\sin 90^\circ = \sin 5 (18^\circ) \text{ and let } 18^\circ = A$$

$$\sin 90^\circ = \sin 5 A = \sin(3 A + 2 A)$$

$$\therefore 90^\circ = 3 A + 2 A \Rightarrow \sin(90^\circ - 3 A) = \sin 2 A$$

$$\therefore \sin 2 A - \cos 3 A \Rightarrow 2 \sin A \cos A = 4 \cos^3 A - 3 \cos A$$

$$\therefore \cos A (2 \sin A - 4 \cos^2 A + 3) = 0$$

$$\therefore \cos A = 0 \text{ or } [2 \sin A - 4 (1 - \sin^2 A) + 3] = 0$$

$$\therefore A = \frac{\pi}{2} \text{ or } 4 \sin^2 A + 2 \sin A - 1 = 0$$

Since, $A = 18^\circ$, $A \neq \frac{\pi}{2}$

$$\therefore 4 \sin^2 A + 2 \sin A - 1 = 0$$

$$\therefore \sin A = \frac{-2 \pm \sqrt{4 + 16}}{2(4)} = \frac{-2 \pm \sqrt{20}}{8} = \frac{2 - \pm 2\sqrt{5}}{8} = \frac{-1 \pm \sqrt{5}}{4}$$

$$\therefore \sin A = \frac{-1 + \sqrt{5}}{4} \text{ or } \sin A = \frac{-1 - \sqrt{5}}{4}$$

Since, $\sin A > 0$, $\sin A = \frac{\sqrt{5}-1}{4}$

Question62

$\frac{\sin A + \sin 7A + \sin 13A}{\cos A + \cos 7A + \cos 13A} =$ MHT CET 2020 (20 Oct Shift 2)

Options:

A. $\cot 7A$

B. $\tan 6A$

C. $\tan 7A$

D. $\cot 6A$

Answer: C

Solution:

$$\begin{aligned}\frac{\sin A + \sin 7A + \sin 13A}{\cos A + \cos 7A + \cos 13A} &= \frac{(\sin A + \sin 13A) + \sin 7A}{(\cos A + \cos 13A) + \cos 7A} \\ &= \frac{2 \sin 7A \cos 6A + \sin 7A}{2 \cos 7A \cos 6A + \cos 7A} \\ &= \frac{\sin 7A(2 \cos 6A + 1)}{\cos 7A(2 \cos 6A + 1)} \\ &= \tan 7A\end{aligned}$$

Question63

The value of $\sin^2\left(\frac{\pi}{8}\right) =$ MHT CET 2020 (20 Oct Shift 2)

Options:

A. $\frac{\sqrt{2}+1}{2\sqrt{2}}$

B. $\frac{\sqrt{5}+1}{2\sqrt{2}}$

C. $\frac{\sqrt{5}-1}{2\sqrt{2}}$

D. $\frac{\sqrt{2}-1}{2\sqrt{2}}$

Answer: D

Solution:

$$\begin{aligned}\sin^2\left(\frac{\pi}{8}\right) &= \frac{1 - \cos 2\left(\frac{\pi}{8}\right)}{2} \\ &= \frac{1 - \cos \frac{\pi}{4}}{2} = \frac{1 - \frac{1}{\sqrt{2}}}{2} = \frac{\sqrt{2} - 1}{2\sqrt{2}}\end{aligned}$$

Question64

If $\sin x + \operatorname{cosec} x = 3$, then value of $\sin^4 x + \operatorname{cosec}^4 x$ is MHT CET 2020 (20 Oct Shift 2)

Options:

A. 74

B. 47

C. 07

D. 49

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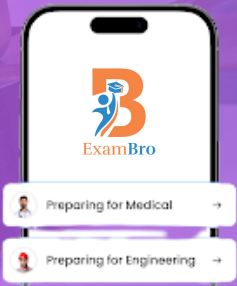


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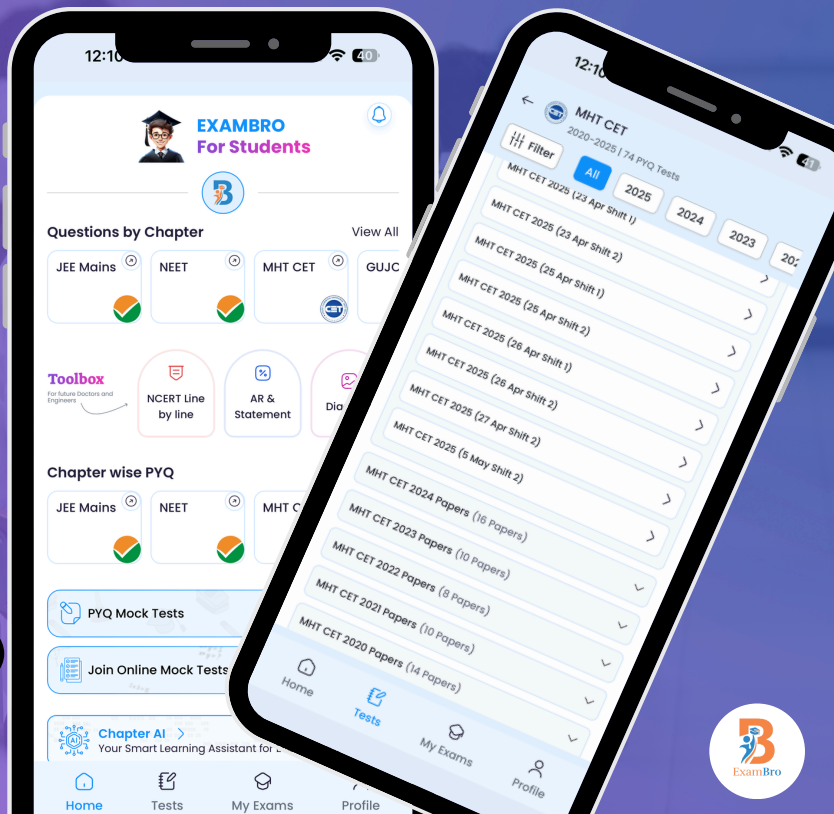
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Answer: B

Solution:

We have $\sin x + \operatorname{cosec} x = 3 \therefore \sin^2 x + \operatorname{cosec}^2 x + 2 \sin x \operatorname{cosec} x = 9$

$\therefore \sin^2 x + \operatorname{cosec}^2 x = 9 - 2 = 7 \therefore \sin^4 x + \operatorname{cosec}^4 x + 2 \sin^2 x \operatorname{cosec}^2 x = 49$

$\therefore \sin^4 x + \operatorname{cosec}^4 x = 49 - 2 = 47$

Question65

If $\sin \theta = \sin 15^\circ + \sin 45^\circ$, where $0^\circ < \theta < 180^\circ$, then $\theta =$ **MHT CET 2020 (20 Oct Shift 1)**

Options:

A. 75°

B. 150°

C. 45°

D. 60°

Answer: A

Solution:

Given $\sin \theta = \sin 15^\circ + \sin 45^\circ$

$$= 2 \sin\left(\frac{15^\circ + 45^\circ}{2}\right) \cos\left(\frac{15^\circ - 45^\circ}{2}\right)$$

$$= 2 \sin 30^\circ \cos 15^\circ = 2 \times \frac{1}{2} \cos 15^\circ$$

$$\sin \theta = \cos 15^\circ \Rightarrow \sin \theta = \sin(90^\circ - 15^\circ) \Rightarrow \theta = 75^\circ$$

Question66

If A, B, C, D are the angles of a cyclic quadrilateral taken in order, then

$\cos A + \cos B + \cos C + \cos D =$ **MHT CET 2020 (20 Oct Shift 1)**

Options:

A. -1

B. 1

C. $\frac{1}{2}$

D. 0

Answer: D

Solution:

Since the quadrilateral ABCD is cyclic, we have $A + C = 180^\circ$ and $B + D = 180^\circ$

$$\therefore \cos A = \cos(180^\circ - C) = -\cos C \quad \cos B = \cos(180^\circ - D) = -\cos D$$

$$\therefore \cos A + \cos B + \cos C + \cos D = 0$$

Question67

If $\tan \theta + \cot \theta = 4$, then $\tan^4 \theta + \cot^4 \theta =$ MHT CET 2020 (20 Oct Shift 1)

Options:

- A. 194
- B. 110
- C. 80
- D. 191

Answer: A

Solution:

$\tan \theta + \cot \theta = 4$ On squaring both side, we get

$\tan^2 \theta + \cot^2 \theta + 2 \tan \theta \cot \theta = 16 \Rightarrow \tan^2 \theta + \cot^2 \theta = 14$ On squaring both side, we get

$\tan^4 \theta + \cot^4 \theta + 2 \tan^2 \theta \cot^2 \theta = 196$

$\tan^4 \theta + \cot^4 \theta = 196 - 2 = 194$

Question68

If A and B are supplementary angles, then $\sin^2 \frac{A}{2} + \sin^2 \frac{B}{2} =$ MHT CET 2020 (19 Oct Shift 2)

Options:

- A. 1
- B. $\frac{1}{3}$
- C. 0
- D. $\frac{1}{2}$

Answer: A

Solution:

(C) A and B are supplementary angles. $\Rightarrow A + B = 180 \Rightarrow A = 180 - B \Rightarrow \frac{A}{2} = 90 - \frac{B}{2}$

$\therefore \sin^2 \frac{A}{2} + \sin^2 \frac{B}{2} = \sin^2 \frac{A}{2} + \sin^2 \left(90 - \frac{A}{2}\right) = \sin^2 \frac{A}{2} + \cos^2 \left(\frac{A}{2}\right) = 1$

Question69

$\frac{1 - \sin \theta + \cos \theta}{1 - \sin \theta - \cos \theta} =$ MHT CET 2020 (19 Oct Shift 2)

Options:

- A. $\cot \frac{\theta}{2}$
- B. $-\cot \frac{\theta}{2}$
- C. $\tan \frac{\theta}{2}$
- D. $-\tan \frac{\theta}{2}$



Answer: B

Solution:

$$\begin{aligned} \text{We know } \sin \theta &= 2 \sin \frac{\theta}{2} \cdot \cos \frac{\theta}{2} \text{ and } \cos \theta = 2 \cos^2 \frac{\theta}{2} - 1 = 1 - 2 \sin^2 \frac{\theta}{2} \\ \frac{1 - \sin \theta + \cos \theta}{1 - \sin \theta - \cos \theta} &= \frac{1 - 2 \sin \frac{\theta}{2} \cdot \cos \frac{\theta}{2} + (2 \cos^2 \frac{\theta}{2} - 1)}{1 - 2 \sin \frac{\theta}{2} \cdot \cos \frac{\theta}{2} - (1 - 2 \sin^2 \frac{\theta}{2})} \\ &= \frac{-2 \sin \frac{\theta}{2} \cdot \cos \frac{\theta}{2} + 2 \cos^2 \frac{\theta}{2}}{-2 \sin \frac{\theta}{2} \cdot \cos \frac{\theta}{2} + 2 \sin^2 \frac{\theta}{2}} \\ &= \frac{-2 \cos \frac{\theta}{2} (\sin \frac{\theta}{2} - \cos \frac{\theta}{2})}{-2 \sin \frac{\theta}{2} (\cos \frac{\theta}{2} - \sin \frac{\theta}{2})} = -\cot \frac{\theta}{2} \end{aligned}$$

Question70

$\operatorname{cosec} 2\theta - \cot 2\theta =$ MHT CET 2020 (19 Oct Shift 1)

Options:

- A. $\tan \theta$
- B. $\sin 2\theta$
- C. $\cos \theta$
- D. $\tan 2\theta$

Answer: A

Solution:

$$\begin{aligned} \operatorname{cosec} 2\theta - \cot 2\theta &= \frac{1}{\sin 2\theta} - \frac{\cos 2\theta}{\sin 2\theta} \\ &= \frac{1 - \cos 2\theta}{\sin 2\theta} = \frac{2 \sin^2 \theta}{2 \sin \theta \cos \theta} = \tan \theta \end{aligned}$$

Question71

If A and B are two angles such that $A, B, \in (0, \pi)$ and they are not supplementary angles such that $\sin A - \sin B = 0$, then MHT CET 2020 (19 Oct Shift 1)

Options:

- A. $A - B = \frac{\pi}{3}$
- B. $A - B = \frac{\pi}{2}$
- C. $A = B$
- D. $A \neq B$

Answer: C

Solution:

$$\sin A - \sin B = 0$$

$$\sin A = \sin B \text{ and we know that } \sin A = \sin(\pi - A) = \sin B$$

$$\therefore A = B \text{ or } \pi - A = B$$

$$\therefore A = B \text{ or } A + B = \pi$$

Since the angles are not supplementary we say $A = B$.

Question72

$$\cos(36^\circ - A) \cos(36^\circ + A) + \cos(54^\circ + A) \cos(54^\circ - A) = \text{MHT CET 2020 (16 Oct Shift 2)}$$

Options:

- A. $\cos 2 A$
- B. $\cos A$
- C. $\sin 2 A$
- D. $\sin A$

Answer: A

Solution:

$$\begin{aligned} & \cos(36^\circ - A) \cos(36^\circ + A) + \cos(54^\circ + A) \cos(54^\circ - A) \\ &= \cos(36^\circ - A) \cdot \cos(36^\circ + A) + \cos[90^\circ - (36^\circ - A)] \cdot \cos[90^\circ - (36^\circ + A)] \\ &= \cos(36^\circ - A) \cdot \cos(36^\circ + A) + \sin(36^\circ - A) \cdot \sin(36^\circ + A) \\ &= \cos[(36^\circ - A) - (36^\circ + A)] = \cos[36^\circ - A - 36^\circ - A] = \cos(-2 A) = \cos 2 A \end{aligned}$$

Question73

$$\tan A + 2 \tan 2A + 4 \tan 4A + 8 \cot 8A = \text{MHT CET 2020 (16 Oct Shift 2)}$$

Options:

- A. $\tan A$
- B. $\cot A$
- C. $\tan 2 A$
- D. $\cot 2 A$

Answer: B

Solution:

$$\begin{aligned}
&= \tan A + 2 \tan 2 A + 4 \tan 4 A + 8 \times \frac{1 - \tan^2 4 A}{2 \tan 4 A} \\
&= \tan A + 2 \tan 2 A + 4 \tan 4 A + \frac{4(1 - \tan^2 4 A)}{\tan 4 A} \\
&= \tan A + 2 \tan 2 A + \frac{4 \tan^2 4 A + 4 - 4 \tan^2 4 A}{\tan 4 A} \\
&= \tan A + 2 \tan 2 A + \frac{4}{\tan 4 A} = \tan A + 2 \tan 2 A + 4 \cot 4 A \\
&= \tan A + 2 \tan 2 A + 4 \times \frac{1 - \tan^2 2 A}{2 \tan 2 A} = \tan A + 2 \tan 2 A + \frac{2(1 - \tan^2 2 A)}{\tan 2 A} \\
&= \tan A + \frac{2 \tan^2 2 A + 2 - 2 \tan^2 2 A}{\tan 2 A} = \tan A + \frac{2}{\tan 2 A} \\
&= \tan A + 2 \cot 2 A = \frac{2(1 - \tan^2 A)}{2 \tan A} = \tan A + \frac{1 - \tan^2 A}{\tan A} \\
&= \frac{\tan^2 A + 1 - \tan^2 A}{\tan A} = \frac{1}{\tan A} = \cot A
\end{aligned}$$

Question 74

If $a = \sin 175^\circ + \cos 175^\circ$, then MHT CET 2020 (16 Oct Shift 2)

Options:

- A. $a > 0$
- B. $a = 0$
- C. $a < 0$
- D. $a = 1$

Answer: C

Solution:

$$\begin{aligned}
a &= \sin(180^\circ - 5^\circ) + \cos(180^\circ - 5^\circ) \\
&= \sin 5^\circ - \cos 5^\circ
\end{aligned}$$

In first quadrant, $\sin \theta < \cos \theta$

When $0 \leq \theta < 45^\circ$

$$\therefore \sin 5^\circ < \cos 5^\circ \Rightarrow \sin 5^\circ - \cos 5^\circ < 0 \Rightarrow a < 0$$

Question 75

If $\sin \theta = \frac{-12}{13}$, $\cos \phi = \frac{-4}{5}$ and θ, ϕ lie in the third quadrant, then $\tan(\theta - \phi) =$ MHT CET 2020 (16 Oct Shift 1)

Options:

- A. $\frac{-33}{56}$
- B. $\frac{-56}{33}$
- C. $\frac{56}{33}$
- D. $\frac{33}{56}$



Answer: D

Solution:

$$(D) \sin \theta = \frac{-12}{13} \Rightarrow \cos \theta = \sqrt{1 - \left(\frac{-12}{13}\right)^2} = \sqrt{\frac{25}{169}} = \pm \frac{5}{13} \because \theta \text{ is in third quadrant}$$

$$\Rightarrow \cos \theta = -\frac{5}{13} \Rightarrow \frac{\sin \theta}{\cos \theta} = \tan \theta = \frac{12}{5}$$

$$\cos \phi = -\frac{4}{5} \Rightarrow \sin \phi = \sqrt{1 - \left(\frac{-4}{5}\right)^2} = \sqrt{\frac{9}{25}} = \pm \frac{3}{5} \phi \text{ is in third quadrant}$$

$$\Rightarrow \sin \phi = -\frac{3}{5} \Rightarrow \frac{\sin \phi}{\cos \phi} = \tan \phi = \frac{3}{4} \tan(\theta - \phi) = \frac{\tan \theta - \tan \phi}{1 + \tan \theta \cdot \tan \phi} = \frac{\frac{12}{5} - \frac{3}{4}}{1 + \left(\frac{12}{5} \times \frac{3}{4}\right)} = \frac{\frac{33}{20}}{\frac{56}{20}} = \frac{33}{56}$$

Question 76

In a triangle ABC if $\frac{\sin A - \sin C}{\cos C - \cos A} = \cot B$, then A, B, C are in MHT CET 2020 (16 Oct Shift 1)

Options:

A. Arithmetico - Geometric progression

B. Harmonic Progression

C. Geometric progression

D. Arithmetic progression

Answer: D

Solution:

$$(D) \frac{\sin A - \sin C}{\cos C - \cos A} = \cot B \Rightarrow 2 \cos\left(\frac{A+C}{2}\right) \cdot \sin\left(\frac{A-C}{2}\right) = 2 \cdot \sin\left(\frac{A+C}{2}\right) \cdot \sin\left(\frac{A-C}{2}\right)$$

$$\cot\left(\frac{A+C}{2}\right) = \cot B \Rightarrow \frac{A+C}{2} = B \Rightarrow A + C = 2B \therefore A, B, C \text{ are in A.P.}$$

Question 77

$\sqrt{2 + \sqrt{2 + 2 \cos 4\theta}} = \text{MHT CET 2020 (15 Oct Shift 2)}$

Options:

A. $2 \cos \theta$

B. $\frac{\cos \theta}{2}$

C. $\frac{\cos \theta}{\sqrt{2}}$

D. $\sqrt{2} \cdot \cos \theta$

Answer: A

Solution:



$$\begin{aligned}\sqrt{2 + \sqrt{2 + 2 \cos 4\theta}} &= \sqrt{2 + \sqrt{2(1 + \cos 4\theta)}} \\ &= \sqrt{2 + \sqrt{2 \times 2 \cos^2 2\theta}} = \sqrt{2 + 2 \cos^2 2\theta} \\ &= \sqrt{2(1 + \cos^2 2\theta)} = \sqrt{2 \times 2 \cos^2 \theta} = 2 \cos \theta\end{aligned}$$

Question 78

If $\sin(y + z - x)$, $\sin(z + x - y)$ and $\sin(x + y - z)$ are in A.P., then MHT CET 2020 (15 Oct Shift 2)

Options:

- A. $2 \tan y = \tan x - \tan z$
- B. $\tan y = \tan x + \tan z$
- C. $2 \tan y = \tan x + \tan z$
- D. $\tan y = \tan x - \tan z$

Answer: C

Solution:

As $\sin(y + z - x)$, $\sin(z + x - y)$ and $\sin(x + y - z)$ are in A.P.

$$\therefore \sin(z + x - y) - \sin(y + z - x) = \sin(x + y - z) - \sin(z + x - y)$$

$$\Rightarrow 2 \cos z \sin(x - y) = 2 \cos x \sin(y - z) \Rightarrow \cos z \sin(x - y) = \cos x \sin(y - z)$$

$$\Rightarrow \frac{\cos z \sin(x - y)}{\cos x \cos y \cos z} = \frac{\cos x \sin(y - z)}{\cos x \cos y \cos z} \Rightarrow \frac{\sin(x - y)}{\cos x \cos y} = \frac{\sin(y - z)}{\cos y \cos z} \text{ Using } \frac{\sin(A - B)}{\cos A \cos B} = \tan A - \tan B$$

$\Rightarrow \tan x - \tan y = \tan y - \tan z \Rightarrow \tan y - \tan x = \tan z - \tan y$. $\therefore \tan x$, $\tan y$ and $\tan z$ are in A.P.

Question 79

If $A + B + C = 180^\circ$, then the value of $\tan\left(\frac{A}{2}\right) \tan\left(\frac{B}{2}\right) + \tan\left(\frac{B}{2}\right) \tan\left(\frac{C}{2}\right) + \tan\left(\frac{C}{2}\right) \tan\left(\frac{A}{2}\right)$ is MHT CET 2020 (15 Oct Shift 2)

Options:

- A. 1
- B. -1
- C. -2
- D. 2

Answer: A

Solution:

$$\text{In } \Delta ABC, A + B + C = \pi \Rightarrow A + B = \pi - C$$

$$\tan\left(\frac{A + B}{2}\right) = \tan\left(\frac{\pi - C}{2}\right) = \tan\left(\frac{\pi}{2} - \frac{C}{2}\right)$$

$$\begin{aligned} \therefore \frac{\tan \frac{A}{2} + \tan \frac{B}{2}}{1 - \tan \frac{A}{2} \tan \frac{B}{2}} &= \cot \frac{C}{2} \Rightarrow \frac{\tan \frac{A}{2} + \tan \frac{B}{2}}{1 - \tan \frac{A}{2} \tan \frac{B}{2}} = \frac{1}{\tan \frac{C}{2}} \\ \therefore \tan \frac{C}{2} (\tan \frac{A}{2} + \tan \frac{B}{2}) &= 1 - \tan \frac{A}{2} \tan \frac{B}{2} \\ \therefore \tan \frac{A}{2} \tan \frac{B}{2} + \tan \frac{B}{2} \tan \frac{C}{2} + \tan \frac{C}{2} \tan \frac{A}{2} &= 1 \end{aligned}$$

Question80

If A, B, C are angles of a $\triangle ABC$, then $\tan 2A + \tan 2B + \tan 2C =$ MHT CET 2020 (15 Oct Shift 2)

Options:

- A. $\tan 2A \tan 3B \tan 2C$
- B. $\tan 2A \tan 2B \tan 2C$
- C. $\tan A \tan B \tan C$
- D. $\tan 3A \tan 2B \tan 2C$

Answer: B

Solution:

$$\begin{aligned} \text{In } \triangle ABC, A + B + C &= \pi \Rightarrow 2A + 2B + 2C = 2\pi \\ \therefore 2A + 2B &= 2\pi - 2C \Rightarrow \tan(2A + 2B) = \tan(2\pi - 2C) = -\tan 2C \\ \frac{\tan 2A + \tan 2B}{1 - \tan 2A \tan 2B} &= -\tan 2C \\ \therefore \tan 2A + \tan 2B &= -\tan 2C(1 - \tan 2A \tan 2B) \\ \therefore \tan 2A + \tan 2B + \tan 2C &= \tan 2A \tan 2B \tan 2C \end{aligned}$$

Question81

$\sin 690^\circ \times \sec 240^\circ =$ MHT CET 2020 (15 Oct Shift 1)

Options:

- A. 1
- B. -1
- C. $-\frac{1}{2}$
- D. $\frac{1}{2}$

Answer: A

Solution:

$$\begin{aligned} \sin 690^\circ \times \sec 240^\circ &= \sin(1 \times 360^\circ + 330^\circ) \times \sec(180^\circ + 60^\circ) = \sin 330^\circ \times (-\sec 60^\circ) \\ &= \sin(2\pi - 30^\circ) \times (-2) = -2(-\sin 30^\circ) = (-2)\left(-\frac{1}{2}\right) = 1 \end{aligned}$$

Question82

If $x = 3 \sin \theta, y = 3 \cos \theta \cos \phi, z = 3 \cos \theta \sin \phi$, then $x^2 + y^2 + z^2 =$ MHT CET 2020 (15 Oct Shift 1)



Options:

- A. 18
- B. 27
- C. 9
- D. 3

Answer: C

Solution:

$$\begin{aligned}x^2 + y^2 + z^2 &= 9 \sin^2 \theta + 9 \cos^2 \theta \cos^2 \phi + 9 \cos^2 \theta \sin^2 \phi \\&= 9 \sin^2 \theta + 9 \cos^2 \theta (\cos^2 \phi + \sin^2 \phi) \\&= 9 \sin^2 \theta + 9 \cos^2 \theta \\&= 9 (\sin^2 \theta + \cos^2 \theta) = 9 \times 1 = 9\end{aligned}$$

Question83

$\sin\left(\frac{\pi}{3} + x\right) - \cos\left(\frac{\pi}{6} + x\right) = \text{MHT CET 2020 (15 Oct Shift 1)}$

Options:

- A. $-\cos x$
- B. $-\sin x$
- C. $\cos x$
- D. $\sin x$

Answer: D

Solution:

$$\sin\left(\frac{\pi}{3} + x\right) - \cos\left(\frac{\pi}{6} + x\right) = \frac{\sqrt{3}}{2}\cos x + \frac{1}{2}\sin x - \frac{\sqrt{3}}{2}\cos x + \frac{1}{2}\sin x = \sin x$$

Question84

Which of the following have the same value

- (a) $\sin 120^\circ$
- (b) $\cos 930^\circ$
- (c) $\tan 840^\circ$
- (d) $\cot(-1110^\circ)$

MHT CET 2020 (14 Oct Shift 2)

Options:

- A. only (a) and (b)
- B. All (a), (b), (c), (d)



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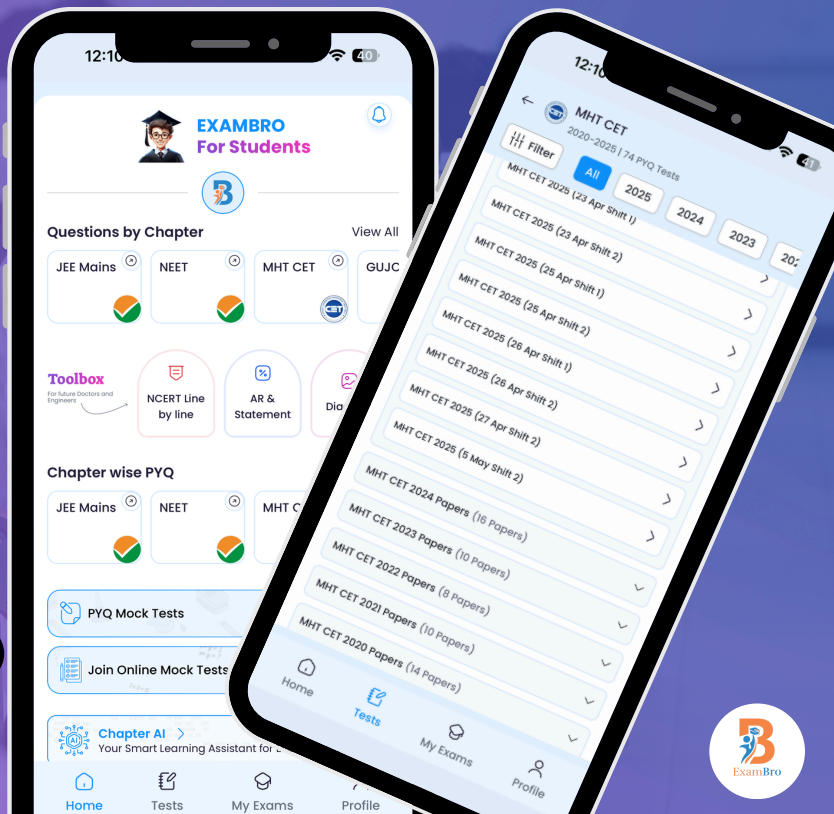
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C. only (a) and (c)

D. only (c) and (d)

Answer: D

Solution:

$$(a) \sin 120^\circ = \sin(90^\circ + 30^\circ) = \cos 30^\circ = \frac{\sqrt{3}}{2}$$

$$(b) \cos 930^\circ = \cos[(2 \times 360^\circ) + 210^\circ] = \cos 210^\circ = \cos(180 + 30) = -\cos 30^\circ = -\frac{\sqrt{3}}{2}$$

$$(c) \tan 840^\circ = \tan[(2 \times 360^\circ) + 120^\circ] = -\tan 120^\circ = -\cot 30^\circ = -\sqrt{3}$$

$$(d) \cot(-1110^\circ) = -\cot 1110^\circ = -\cot[(3 \times 360^\circ) + 30^\circ] = -\cot 30^\circ = -\sqrt{3}$$

Question85

If $\tan \theta + \sin \theta = a$ and $\tan \theta - \sin \theta = b$, then the values of $\cot \theta$ and $\operatorname{cosec} \theta$ are respectively MHT CET 2020 (14 Oct Shift 2)

Options:

A. $\frac{1}{a+b}, \frac{1}{a-b}$

B. $\frac{2}{a+b}, \frac{2}{a-b}$

C. $\frac{2}{a-b}, \frac{2}{a+b}$

D. $\frac{1}{a-b}, \frac{1}{a+b}$

Answer: B

Solution:

We have

$$\tan \theta + \sin \theta = a \dots (1) \text{ and}$$

$$\tan \theta - \sin \theta = b \dots (2)$$

Adding equation (1) & (2), we get

$$2 \tan \theta = a + b \Rightarrow \tan \theta = \frac{a+b}{2} \Rightarrow \cot \theta = \frac{2}{a+b}$$

By equation (1) - equation (2), we get

$$2 \sin \theta = a - b \Rightarrow \sin \theta = \frac{a-b}{2} \Rightarrow \operatorname{cosec} \theta = \frac{2}{a-b}$$

Question86

$$\frac{\cos 12^\circ - \sin 12^\circ}{\cos 12^\circ + \sin 12^\circ} + \frac{\sin 147^\circ}{\cos 147^\circ} =$$

MHT CET 2020 (14 Oct Shift 2)

Options:



- A. -2
- B. 0
- C. -1
- D. 1

Answer: B

Solution:

$$\begin{aligned} \frac{\cos 12^\circ - \sin 12^\circ}{\cos 12^\circ + \sin 12^\circ} + \frac{\sin 147^\circ}{\cos 147^\circ} &= \frac{\cos 12^\circ - \cos 78^\circ}{\cos 12^\circ + \cos 78^\circ} + \tan 147^\circ \\ &= \frac{-2 \sin 45^\circ \sin(-33^\circ)}{2 \cos 45^\circ \cos 33^\circ} + \tan(180^\circ - 33^\circ) = \tan 45^\circ \tan 33^\circ - \tan 33^\circ = \tan 33^\circ - \tan 33^\circ = 0 \end{aligned}$$

Question87

$\cos\left(\frac{3\pi}{4} + x\right) - \sin\left(\frac{\pi}{4} - x\right) = \text{MHT CET 2020 (14 Oct Shift 1)}$

Options:

- A. $-\sqrt{2} \cos x$
- B. $-\sqrt{2} \sin x$
- C. $\sqrt{2} \cos x$
- D. $\sqrt{2} \sin x$

Answer: A

Solution:

$$\begin{aligned} \cos\left(\frac{3\pi}{4} + x\right) - \sin\left(\frac{\pi}{4} - x\right) &= \left(\cos \frac{3\pi}{4} \cos x - \sin \frac{3\pi}{4} \sin x\right) - \left(\sin \frac{\pi}{4} \cos x - \cos \frac{\pi}{4} \sin x\right) \\ &= \frac{-1}{\sqrt{2}} \cos x - \frac{1}{\sqrt{2}} \sin x - \frac{1}{\sqrt{2}} \cos x + \frac{1}{\sqrt{2}} \sin x = -\sqrt{2} \cos x \end{aligned}$$

Question88

The general solution of $\tan 3x = 1$ is MHT CET 2020 (14 Oct Shift 1)

Options:

- A. $x = n\pi, n \in \mathbb{Z}$
- B. $x = n\left(\frac{\pi}{3}\right) + \frac{\pi}{12}, n \in \mathbb{Z}$
- C. $x = n\pi + \frac{\pi}{4}, n \in \mathbb{Z}$
- D. $x = n\pi \pm \frac{\pi}{4}, n \in \mathbb{Z}$

Answer: B

Solution:

We know that $\tan \theta = \tan \alpha$ implies

$$\theta = n\pi + \alpha, \text{ where } n \in \mathbb{Z}$$

Given $\tan 3x = 1$

$$\therefore \tan 3x = \tan \frac{\pi}{4} \Rightarrow 3x = n\pi + \frac{\pi}{4}$$

$$\therefore x = \frac{n\pi}{3} + \frac{\pi}{12}, \quad n \in \mathbb{Z}$$

Question89

If $\tan \theta = 2$ and θ lies in the third quadrant, then the value of $\sec \theta$ is MHT CET 2020 (13 Oct Shift 2)

Options:

- A. $-\sqrt{5}$
- B. $\sqrt{3}$
- C. $-\sqrt{2}$
- D. $\sqrt{5}$

Answer: A

Solution:

$$\sec^2 \theta = 1 + (2)^2 = 5. \therefore \sec \theta = -\sqrt{5} \quad [\because \theta \text{ lies in } 3^{\text{rd}} \text{ quadrant. }]$$

Question90

If $y = \tan^{-1} \left(\frac{\sin 2x}{1 + \cos 2x} \right)$, then $\frac{dy}{dx} =$ MHT CET 2020 (13 Oct Shift 2)

Options:

- A. 1
- B. 0
- C. -1
- D. 2

Answer: A

Solution:

$$\text{Given } y = \tan^{-1} \left(\frac{\sin 2x}{1 + \cos 2x} \right) = \tan^{-1} \left(\frac{2 \sin x \cos x}{2 \cos^2 x} \right) = \tan^{-1}(\tan x). \therefore y = x \Rightarrow \frac{dy}{dx} = 1$$

Question91

If $\cos x + \cos y = -\cos \alpha$, $\sin x + \sin y = -\sin \alpha$, then $\cot \left(\frac{x+y}{2} \right) =$ MHT CET 2020 (13 Oct Shift 2)

Options:

- A. $-\cot \alpha$
- B. $\cot \alpha$
- C. $-\tan \alpha$
- D. $\tan \alpha$

Answer: B

Solution:

Given $\cos x + \cos y = -\cos \alpha$ and $\sin x + \sin y = -\sin \alpha$

$$2 \cos\left(\frac{x+y}{2}\right) \cos\left(\frac{x-y}{2}\right) = -\cos \alpha \quad \dots(1)$$

$$2 \sin\left(\frac{x+y}{2}\right) \cos\left(\frac{x-y}{2}\right) = -\sin \alpha \quad \dots(2)$$

Divided equation (1) by equation (2)

$$\cot\left(\frac{x+y}{2}\right) = \cot \alpha$$

Question92

$\cos x \cdot \cos 7x - \cos 5x \cdot \cos 13x =$ MHT CET 2020 (13 Oct Shift 1)

Options:

- A. $2 \cos^2 6x \cdot \cos 12x$
- B. $2 \sin^2 6x \cdot \cos 6x$
- C. $2 \sin 6x \cdot \sin 12x$
- D. $2 \sin 6x \cdot \cos 12x$

Answer: B

Solution:

$$\begin{aligned} &= \frac{1}{2}(2 \cos x \cos 7x - 2 \cos 5x \cos 13x) \\ &= \frac{1}{2}(\cos 8x + \cos 6x - \cos 18x - \cos 8x) \\ \cos x \cos 7x - \cos 5x \cos 13x &= \frac{1}{2}(\cos 6x - \cos 18x) = \frac{1}{2}[(-2) \sin 12x \sin(-6x)] \\ &= \sin 12x \sin 6x = (2 \sin 6x \cos 6x) \sin 6x \\ &= 2 \sin^2 6x \cos 6x \end{aligned}$$

Question93

If $\tan \theta = \frac{1}{3}$, then $\cos 2\theta =$ MHT CET 2020 (13 Oct Shift 1)

Options:

- A. $\frac{1}{4}$
- B. $\frac{1}{10}$
- C. $\frac{1}{5}$
- D. $\frac{4}{5}$

Answer: D

Solution:

$$\cos 2\theta = \frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} = \frac{\left(1 - \frac{1}{9}\right)}{\left(1 + \frac{1}{9}\right)} = \frac{4}{5}$$

Question94

If $\sec \theta = \frac{13}{12}$, θ lies in 4th quadrant, then $\tan \theta \times \operatorname{cosec} \theta \times \sin \theta \times \cos \theta =$ MHT CET 2020 (13 Oct Shift 1)

Options:

A. $\frac{-5}{13}$

B. $\frac{144}{169}$

C. $\frac{25}{169}$

D. $\frac{5}{13}$

Answer: A

Solution:

Given $\sec \theta = \frac{13}{12} \Rightarrow \cos \theta = \frac{12}{13} \therefore \sin \theta = \sqrt{1 - \frac{144}{169}} = -\frac{5}{13} \dots [\theta \text{ lies in } 4^{\text{th}} \text{ quadrant}]$

$$\tan \theta = \frac{\left(\frac{5}{13}\right)}{\left(\frac{12}{13}\right)} = \frac{-5}{12} \text{ and } \operatorname{cosec} \theta = \frac{-13}{5}$$

$$\therefore \tan \theta \times \operatorname{cosec} \theta \times \sin \theta \times \cos \theta = \left(\frac{-5}{12}\right) \times \left(\frac{-13}{5}\right) \times \left(\frac{-5}{13}\right) \left(\frac{12}{13}\right) = \frac{-5}{13}$$

Question95

$\sec 2\theta - \tan 2\theta =$ MHT CET 2020 (12 Oct Shift 2)

Options:

A. $\tan\left(\frac{\pi}{4} - \theta\right)$

B. $\tan 2\theta$

C. $\cot 2\theta$

D. $\cot\left(\frac{\pi}{4} - \theta\right)$

Answer: A

Solution:



$$\begin{aligned} \sec 2\theta - \tan 2\theta &= \frac{1}{\cos 2\theta} - \frac{\sin 2\theta}{\cos 2\theta} = \frac{1 - \sin 2\theta}{\cos 2\theta} \\ &= \frac{(\cos \theta - \sin \theta)^2}{\cos^2 \theta - \sin^2 \theta} = \frac{(\cos \theta - \sin \theta)^2}{(\cos \theta - \sin \theta)(\cos \theta + \sin \theta)} \\ &= \frac{\cos \theta - \sin \theta}{\cos \theta + \sin \theta} = \frac{1 - \tan \theta}{1 + \tan \theta} = \frac{\tan \frac{\pi}{4} - \tan \theta}{1 + \tan \frac{\pi}{4} \tan \theta} = \tan\left(\frac{\pi}{4} - \theta\right) \end{aligned}$$

Question96

If $\tan A = \frac{5}{6}$, $\tan B = \frac{1}{11}$, then $A + B =$ MHT CET 2020 (12 Oct Shift 2)

Options:

A. $\frac{-\pi}{4}$

B. $\frac{-\pi}{3}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{4}$

Answer: D

Solution:

$$\begin{aligned} \tan(A + B) &= \frac{\tan A + \tan B}{1 - \tan A \tan B} \\ &= \frac{\frac{5}{6} + \frac{1}{11}}{1 - \frac{5}{6} \times \frac{1}{11}} = \frac{\frac{55+6}{66}}{1 - \frac{5}{66}} = \frac{\left(\frac{61}{66}\right)}{\left(\frac{61}{66}\right)} \\ \tan(A + B) &= 1 \Rightarrow A + B = \tan^{-1}(1) \Rightarrow A + B = \frac{\pi}{4} \end{aligned}$$

Question97

If $\cos 2\theta = \sin \alpha$, then $\theta =$ MHT CET 2020 (12 Oct Shift 1)

Options:

A. $2n\pi \pm \left(\frac{\pi}{2} - \alpha\right), n \in \mathbb{Z}$

B. $n\pi \pm \left(\frac{\pi}{4} + \frac{\alpha}{2}\right), n \in \mathbb{Z}$

C. $\frac{1}{2}[n\pi + (-1)^n \alpha], n \in \mathbb{Z}$

D. $n\pi \pm \left(\frac{\pi}{4} - \frac{\alpha}{2}\right), n \in \mathbb{Z}$

Answer: D

Solution:

We have $\cos 2\theta = \sin \alpha \Rightarrow \cos 2\theta = \cos(90 - \alpha)$ When $\cos \theta = \cos \alpha$, we get

$$\theta = 2n\pi \pm \alpha, n \in \mathbb{Z} \therefore 2\theta = 2n\pi \pm (90 - \alpha) \Rightarrow \theta = n\pi \pm \left(\frac{\pi}{4} - \frac{\alpha}{2}\right)$$

Question98

The maximum value of the function $y = e^{5+\sqrt{3}\sin x+\cos x}$ is MHT CET 2020 (12 Oct Shift 1)

Options:

A. e^7

B. e^2

C. e^5

D. e^8

Answer: A

Solution:

Maximum value of $\sqrt{3}\sin x + \cos x$ is $\sqrt{(\sqrt{3})^2 + (1)^2} = 2$

Hence maximum value of given function is $e^{5+2} = e^7$

Question99

$\tan 1^\circ \times \tan 2^\circ \times \tan 3^\circ \times \dots + \dots \times \tan 89^\circ =$ MHT CET 2020 (12 Oct Shift 1)

Options:

A. $\sqrt{3}$

B. 1

C. $\sqrt{2}$

D. 2

Answer: B

Solution:

$$\begin{aligned} & \tan 1^\circ \times \tan 2^\circ \times \tan 3^\circ \times \dots \times \tan 89^\circ \\ &= [\tan 1^\circ \tan 2^\circ \tan 3^\circ \dots \tan 44^\circ] (\tan 45^\circ) \times [\tan(90^\circ - 44^\circ) \cdot \tan(90^\circ - 43^\circ) \dots \tan(90^\circ - 1^\circ)] \\ &= (\tan 1^\circ \tan 2^\circ \dots \tan 44^\circ) (\cot 44^\circ \cot 43^\circ \dots \cot 1^\circ) = 1 \end{aligned}$$

Question100

If $\theta = \frac{17\pi}{3}$, then $\tan\theta - \cot\theta$ _____ MHT CET 2019 (02 May Shift 1)

Options:

A. $\frac{1}{2\sqrt{3}}$

B. $\frac{-1}{2\sqrt{3}}$

C. $\frac{2}{\sqrt{3}}$

D. $\frac{-2}{\sqrt{3}}$



Answer: D

Solution:

$$\begin{aligned} \text{if } \theta &= \frac{17\pi}{3} \text{ let } A = (\tan\theta - \cot\theta) \\ &= -2 \left(\frac{1 - \tan^2\theta}{2\tan\theta} \right) \\ &= \frac{-2}{\tan 2\theta} = \frac{-2}{\tan \frac{4\pi}{3}} \\ &= \frac{-2}{\tan \left(\frac{\pi}{3} \right)} = \frac{-2}{\sqrt{3}} \end{aligned}$$

Question101

In ΔABC , if $\tan A + \tan B + \tan C = 6$ and $\tan A \cdot \tan B = 2$ then $\tan C = \dots$. MHT CET 2019 (Shift 2)

Options:

- A. 3
- B. 4
- C. 1
- D. 2

Answer: A

Solution:

Key Idea Use Identity . In ΔABC
 $\tan A + \tan B + \tan C = \tan A \tan B \tan C$
We have, $\tan A + \tan B + \tan C = 6$
 $\Rightarrow \tan A \tan B \tan C = 6 \dots(i)$
and $\tan A \cdot \tan B = 2 \dots(ii)$
From Eqs. (i) and (ii) we get, $\tan C = 3$

Question102

The value of

$\sin 18^\circ$

is \dots . MHT CET 2019 (Shift 2)

Options:

- A. $\frac{\sqrt{5} + 1}{4}$
- B. $\frac{\sqrt{5} - 1}{4}$
- C. $\frac{4}{\sqrt{5} + 1}$
- D. $\frac{4}{\sqrt{5} - 1}$

Answer: B

Solution:

Let, $\theta = 18^\circ$

then, $2\theta = 36^\circ = 90^\circ - 54^\circ = 90^\circ - 3\theta$

Now, $\sin 2\theta = \sin 90^\circ - 3\theta$

$$\Rightarrow 2\sin\theta\cos\theta = \cos 3\theta$$

$$\Rightarrow 2\sin\theta\cos\theta = 4\cos^3\theta - 3\cos\theta$$

$$\Rightarrow 2\sin\theta\cos\theta = \cos\theta(4\cos^2\theta - 3)$$

$$\Rightarrow 2\sin\theta = 4\cos\theta - 3\cos\theta \neq 0$$

$$\Rightarrow 2\sin\theta = 4 - 4\sin^2\theta - 3$$

$$\Rightarrow 4\sin^2\theta + \sin\theta - 1 = 0$$

$$\Rightarrow \sin\theta = \frac{-2 \pm \sqrt{4+16}}{4} = \frac{-1 \pm \sqrt{5}}{4}$$

But as $\sin\theta > 0$ we have $\sin\theta > 0$ we have

$$\sin\theta = \frac{\sqrt{5}-1}{4}$$

$$\therefore \sin 18^\circ = \frac{\sqrt{5}-1}{4}$$

Question 103

$$\frac{1-2[\cos 60^\circ - \cos 80^\circ]}{2\sin 10^\circ} = \dots \text{MHT CET 2019 (Shift 1)}$$

Options:

A. 2

B. 1

C. $\frac{1}{2}$

D. $\frac{3}{2}$

Answer: B

Solution:

$$\text{We have, } \frac{1-2(\cos 60^\circ - \cos 80^\circ)}{2\sin 10^\circ}$$

$$= \frac{1-2\left(\frac{1}{2} - \cos 80^\circ\right)}{2\sin 10^\circ}$$

$$= \frac{2\cos 80^\circ}{2\sin 10^\circ}$$

$$= \frac{\cos(90^\circ - 10^\circ)}{\sin 10^\circ}$$

$$= \frac{\sin 10^\circ}{\sin 10^\circ} = 1$$

Question 104

$$\sin[3\sin^{-1}(0.4)] = \dots \text{MHT CET 2019 (Shift 1)}$$

Options:

A. 0.466

B. 0.256

C. 0.944

D. 0.764

Answer: C

Solution:

$$\begin{aligned} \text{Let } E &= \sin[3\sin^{-1}(0.4)] \\ \text{put } \sin^{-1}(0.4) &= \theta \Rightarrow \sin\theta = 0.4 \\ \therefore E &= \sin(3\theta) = 3\sin\theta - 4\sin^3\theta \\ &= 3(0.4) - 4(0.4)^3 \\ &= 12 - 4(0.064) \\ &= 12 - 0.256 \\ &= 0.944 \end{aligned}$$

Question105

$\cos 1^\circ \cdot \cos 2^\circ \cdot \cos 3^\circ \dots \cos 179^\circ =$ **MHT CET 2018**

Options:

- A. 0
- B. 1
- C. $-\frac{1}{2}$
- D. -1

Answer: A

Solution:

$$\begin{aligned} \cos^0 1^\circ \cos 2^\circ \cos 3^\circ \dots \cos 90^\circ \dots \cos 179^\circ \\ = \cos 1^\circ \cos 2^\circ \cos 3^\circ \dots 0 \dots \cos 179^\circ \quad (\because \cos 90^\circ = 0) \\ = 0 \end{aligned}$$

Question106

If A, B, C are the angle of ΔABC then $\cot A \cot B + \cot B \cot C + \cot A \cot C =$ **MHT CET 2018**

Options:

- A. 0
- B. 1
- C. 2
- D. -1

Answer: B

Solution:

$$\begin{aligned} \text{Given } A + B + C &= \pi \\ \Rightarrow A + B &= \pi - C \\ \Rightarrow \cot(A + B) &= \cot(\pi - C) \\ \Rightarrow \frac{\cot A \cot B - 1}{\cot A + \cot B} &= -\cot C \\ \Rightarrow \cot A \cot B - 1 &= -\cot A \cot C - \cot B \cot C \\ \Rightarrow \cot A \cot B + \cot B \cot C + \cot A \cot C &= 1 \end{aligned}$$

Question107

If $2\sin\left(\theta + \frac{\pi}{3}\right) = \cos\left(\theta - \frac{\pi}{6}\right)$, then $\tan\theta =$ **MHT CET 2018**

Options:

- A. $\sqrt{3}$
- B. $-\frac{1}{\sqrt{3}}$
- C. $\frac{1}{\sqrt{3}}$
- D. $-\sqrt{3}$

Answer: D

Solution:

$$\begin{aligned}2\left(\sin\theta \times \frac{1}{2} + \cos\theta \times \frac{\sqrt{3}}{2}\right) &= \cos\theta \times \frac{\sqrt{3}}{2} + \sin\theta \times \frac{1}{2} \\2\sin\theta + 2\sqrt{3}\cos\theta &= \sqrt{3}\cos\theta + \sin\theta \\ \sin\theta &= -\sqrt{3}\cos\theta \\ \tan\theta &= -\sqrt{3}\end{aligned}$$

Question108

$\frac{\tan^{-1}(\sqrt{3}) - \sec^{-1}(-2)}{\operatorname{cosec}^{-1}(-\sqrt{2}) + \cos^{-1}\left(-\frac{1}{2}\right)}$ **MHT CET 2016**

Options:

- A. $\frac{4}{5}$
- B. $-\frac{4}{5}$
- C. $\frac{3}{5}$
- D. 0

Answer: B

Solution:

By solving we will get,

$$\frac{\tan^{-1}(\sqrt{3}) - \sec^{-1}(-2)}{\operatorname{cosec}^{-1}(-\sqrt{2}) + \cos^{-1}\left(-\frac{1}{2}\right)} = \frac{\frac{\pi}{3} - \frac{2\pi}{3}}{-\frac{\pi}{4} + \frac{2\pi}{3}} = \frac{-\frac{\pi}{3}}{\frac{5\pi}{12}} = -\frac{4}{5}$$



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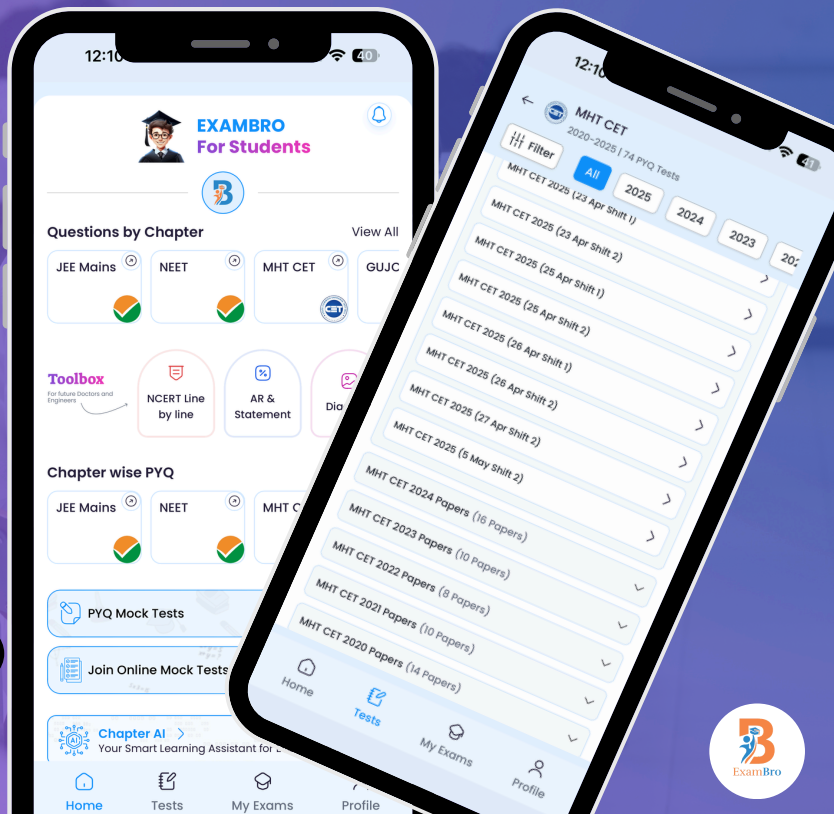
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