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:

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

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:

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

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

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 $a\sin x+\mathrm{b}\cos x$ 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

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

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)

Question7

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)

Question8

The value of $\sin^2 5^\circ + \sin^2 10^\circ + \sin^2 15 + \ldots\ldots\ldots\ldots\ldots\ldots + \sin^2 85^\circ + \sin^2 90^\circ =$ **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:

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

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

✅ 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

D. 3

Answer: B

Solution:

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

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

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

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

✅ 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:

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

Divide by $\sin\theta$:

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

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

✅ 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)**

Question13

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)**

Question16

The sum to infinite terms of the series

$\tan^{-1}\left(\frac{1}{3}\right) + \tan^{-1}\left(\frac{2}{9}\right) + \ldots\ldots\ldots\ldots + \tan^{-1}\left(\frac{2^{n-1}}{1+2^{2n-1}}\right) + \ldots\ldots\ldots$ 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:

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

✅ 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:

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

Question18

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

Options:

A. $\frac{1}{2^{\left(\frac{n}{2}\right)}}$

B. $\frac{1}{2^n}$

C. 2^n

D. $2^{\frac{n}{2}}$

Answer: A

Solution:

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

$\therefore$ $\cos\alpha_1\cdot\cos\alpha_2\ldots\cos\alpha_n$ $=(\cos\alpha_1\cdot\cos\alpha_2\ldots\cos\alpha_n)$

$=\sin\alpha_1\cdot\sin\alpha_2\ldots\sin\alpha_n$

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

$(\cos\dot{\alpha}_1\cdot\cos\alpha_2\ldots\cos\alpha_n)=(\cos\alpha_1\cdot\cos\alpha_2\ldots\cos\alpha_n)(\sin\alpha_1\cdot\sin\alpha_2\ldots\sin\alpha_n)$ $\ldots[\text{From }(i)]$

$=\frac{1}{2^n}\sin2\alpha_1\cdot\sin2\alpha_2\ldots\sin2\alpha_n\ldots[\because\sin2\text{ A}=2\sin\text{ A}\cos\text{ A}]$But each of $\sin2\alpha_i\leq1$

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

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

Question19

If $\mathrm{A}+\mathrm{B}=225^\circ$, then $\frac{\cot\mathrm{A}}{1+\cot\mathrm{A}}\cdot\frac{\cot\mathrm{B}}{1+\cot\mathrm{B}}$, 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:

$$\frac{\cot A}{1+\cot A}\cdot\frac{\cot B}{1+\cot B}=\frac{1}{1-\tan A\tan B+1+\tan A\tan B}$$

$$=\frac{1}{(1+\tan A)(1+\tan B)}\quad\ldots\left[\begin{array}{l}\because\tan(A+B)=\tan225^\circ\\\Rightarrow\tan A+\tan B=1-\tan A\tan B\end{array}\right]$$

$$=\frac{1}{\tan A+\tan B+1+\tan A\tan B}=\frac{1}{2}$$

Question20

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

Options:

A. $\cos54^\circ$

B. $\cos36^\circ$

C. $\sin54^\circ$

D. $\sin36^\circ$

Answer: C

Solution:

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

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, $\tan x+\sec x=2\cos x$

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

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:

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

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:

$\cot\theta=\sqrt{3}$ and $\sec\theta=\frac{-2}{\sqrt{3}}$ i.e., $\tan\theta=\frac{1}{\sqrt{3}}$ and $\cos\theta=-\frac{\sqrt{3}}{2}\therefore\quad\theta$ lies in 3^{rd} quadrant

$\therefore\quad\theta=\frac{7\pi}{6}$

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:

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 $\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)$ **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:

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

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:

$$A+B+C=\pi$$

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

$$\Rightarrow \frac{\tan\frac{A}{2}+\tan\frac{B}{2}}{1-\tan\frac{A}{2}\tan\frac{B}{2}}=\cot\frac{C}{2}$$

$$\Rightarrow \frac{\frac{1}{3}+\frac{2}{3}}{1-\left(\frac{1}{3}\right)\left(\frac{2}{3}\right)}=\cot\frac{C}{2}$$

$$\Rightarrow \frac{9}{7}=\cot\frac{C}{2}$$

$$\Rightarrow \tan\frac{C}{2}=\frac{7}{9}$$

Question27

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

Options:

A. 2

B. 3

C. 4

D. 6

Answer: C

Solution:

$$2^{1+|\cos x|+|\cos x|^2+\ldots}=4$$

$$\Rightarrow 2^{\frac{1}{1-|\cos x|}}=2^2$$

$$\Rightarrow \frac{1}{1-|\cos x|}=2$$

$$\Rightarrow 1-|\cos x|=\frac{1}{2}$$

$$\Rightarrow |\cos x|=\frac{1}{2}$$

$$\Rightarrow \cos x=\pm\frac{1}{2}$$

$$\Rightarrow x=\frac{-2\pi}{3},\frac{-\pi}{3},\frac{\pi}{3},\frac{2\pi}{3} \quad \ldots[\because x\in(-\pi,\pi)]$$

$\therefore$ Number of 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:

$\mathrm{a}=\sin\theta, \mathrm{b}=\cos\theta$ and $\mathrm{c}=\sqrt{1+\sin\theta\cos\theta}$
Since $\sqrt{1+\sin\theta\cos\theta}$ is greater than $\sin\theta$ and $\cos\theta$.$\therefore$ C is the greatest angle,
$\therefore \quad \cos C$
$\therefore$

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

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

$\therefore \quad C$

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:

$$\tan\theta+\sec\theta=2\cos\theta$$
$$\Rightarrow \frac{\sin\theta}{\cos\theta}+\frac{1}{\cos\theta}=2\cos\theta$$
$$\Rightarrow \sin\theta+1=2\cos^2\theta$$
$$\Rightarrow \sin\theta+1=2\left(1-\sin^2\theta\right)$$
$$\Rightarrow 2\sin^2\theta+\sin\theta-1=0$$

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

For $\sin\theta=-1, \sin\theta=\frac{1}{2}$

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

$\therefore$ Number of solutions $=3$

Question30

For the triangle ABC , with usual notations, if the angles A, B, C are in A.P. and $\mathrm{m}\angle\mathrm{A}=30^{\circ}, \mathrm{c}=3$, 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.

$$\begin{aligned}
\therefore \quad & \angle A + \angle C = 2\angle B \\
& \text{Also}, \angle A + \angle B + \angle C = 180^\circ \\
& 2\angle B + \angle B = 180^\circ \\
\therefore \quad & \angle B = 60^\circ \\
& \angle A = 30^\circ \ldots [Given] \\
\therefore \quad & \angle C = 90^\circ
\end{aligned}$$

Using sine Rule

$$\begin{aligned}
& \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \\
\therefore \quad & \frac{a}{\sin 30} = \frac{b}{\sin 60} = \frac{3}{\sin 90} \\
\therefore \quad & \frac{a}{\frac{1}{2}} = \frac{b}{\frac{\sqrt{3}}{2}} = \frac{3}{1} \\
& \Rightarrow 2a = 3, \frac{2b}{\sqrt{3}} = 3
\end{aligned}$$

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

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:

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

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

Question32

Let S $= \left\{x \in (-\pi, \pi) \mid x \neq 0, \pm\frac{\pi}{2}\right\}$. 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:

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

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

$\therefore$ 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:

$$\tan x = \frac{3}{4}, \pi < x < \frac{3\pi}{2}$$

$$\therefore \quad 1 + \tan^2 x = \sec^2 x$$

$$\therefore \quad \sec^2 x = \frac{25}{16}$$

$$\therefore \quad \sec x = \frac{-5}{4} \quad \ldots \left[\because \pi < x < \frac{3\pi}{2}\right]$$

$$\therefore \quad \cos x = \frac{-4}{5} \therefore \quad \cos \frac{x}{2} = -\sqrt{\frac{1+\cos x}{2}}$$

$$\ldots \left[\pi < x < \frac{3\pi}{2} \Rightarrow \frac{\pi}{2} < \frac{x}{2} < \frac{3\pi}{4}\right]$$

$$= -\sqrt{\frac{1}{10}}$$

$$= \frac{-1}{\sqrt{10}}$$

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:

$$\frac{1}{b+c}+\frac{1}{c+a}=\frac{3}{a+b+c}$$
$$\frac{a+b+c}{b+c}+\frac{a+b+c}{c+a}=\frac{3(a+b+c)}{a+b+c}$$
$$\frac{a}{b+c}+1+\frac{b}{c+a}+1=3$$
$$\Rightarrow \frac{a}{b+c}+\frac{b}{c+a}=1$$
$$\Rightarrow a(c+a)+b(b+c)=(b+c)(c+a)$$
$$\Rightarrow ac+a^2+b^2+bc=bc+ab+c^2+ac$$
$$\Rightarrow a^2+b^2-c^2=ab\ldots(i)$$

$\therefore$ By cosine Rule,
$$\cos C=\frac{a^2+b^2-c^2}{2ab}$$
$$\cos C=\frac{ab}{2ab}$$ ...
[From (i)]
$$\Rightarrow \cos C=\frac{1}{2}$$
$$\Rightarrow C=\frac{\pi}{3}$$

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:

$$\sqrt{3}\sec x+2=0$$
$$\Rightarrow \sec x=\frac{-2}{\sqrt{3}}$$
$$\Rightarrow \cos x=\frac{-\sqrt{3}}{2}$$
$$\Rightarrow \cos x=\cos\left(\pi-\frac{\pi}{6}\right)=\cos\frac{5\pi}{6}$$
$$\text{and }\cos x=\cos\left(\pi+\frac{\pi}{6}\right)=\cos\frac{7\pi}{6}$$

$\therefore$ 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:

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

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

$$=\frac{1+\cos\frac{\theta}{2}-\sin\frac{\theta}{2}}{1+\cos\frac{\theta}{2}+\sin\frac{\theta}{2}} \qquad \therefore \quad \tan x=\tan\left(\frac{\pi}{4}-\frac{\theta}{4}\right) \quad \ldots\left[\because \tan\frac{\pi}{4}=1\right]$$

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

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

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

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

Question37

$\cos^2 48^\circ-\sin^2 12^\circ=$ ______, 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:

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

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

$$\text{and } \sin^2 18^\circ = \frac{3-\sqrt{5}}{8}$$
$$\therefore \quad \text{A} = \frac{\frac{5+\sqrt{5}-3+\sqrt{5}}{8}}{2} = \frac{1+\sqrt{5}}{8}$$

Question38

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

Options:

A. 0.08660243

B. 0.0008660243

C. 0.8660243

D. 0.008660243

Answer: C

Solution:

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

$$\therefore \quad \text{f}'(x) = \cos x$$

Here, $\text{a} = 60^\circ$ and

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

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

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

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

$$\therefore \quad \sin(60^\circ 0' 10'' \approx 0.866 + 0.000049 \times 0.5$$

$$\approx 0.866024$$

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

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

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

Question40

In a triangle ABC, with usual notations, if $\mathrm{c} = 4$, 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:

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

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:

$$\begin{aligned}
&\text{Since }\tan 2\theta=\frac{2\tan\theta}{1-\tan^2\theta}\\
&\therefore\quad\tan\frac{\pi}{4}=\frac{2\tan\frac{\pi}{8}}{1-\tan^2\frac{\pi}{8}}\\
&\Rightarrow 1=\frac{2\tan\frac{\pi}{8}}{1-\tan^2\frac{\pi}{8}}\\
&\text{Let } y=\tan\frac{\pi}{8}\\
&\Rightarrow 1=\frac{2y}{1-y^2}\\
&\Rightarrow y^2+2y-1=0\\
&\Rightarrow y=\frac{-2\pm\sqrt{4+4}}{2}
\end{aligned}$$

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

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

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

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:

$$\cos 2B=\frac{\cos(A+C)}{\cos(A-C)}$$
$$\frac{1-\tan^2 B}{1+\tan^2 B}=\frac{\cos A\cos C-\sin A\sin C}{\cos A\cos C+\sin A\sin C}$$
$$\frac{1-\tan^2 B}{1+\tan^2 B}=\frac{\cos A\cos C(1-\tan A\tan C)}{\cos A\cos C(1+\tan A\tan C)}$$
$$\frac{1-\tan^2 B}{1+\tan^2 B}=\frac{(1-\tan A\tan C)}{(1+\tan A\tan C)}$$
$$\left(1-\tan^2\text{ B}\right)(1+\tan\text{A}\tan\text{C})$$
$$=(1-\tan\text{A}\tan\text{C})\left(1+\tan^2\text{ B}\right)$$
$$1+\tan\text{A}\tan\text{C}-\tan^2\text{ B}-\tan^2\text{ B}\tan\text{A}\tan\text{C}$$
$$=1+\tan^2\text{ B}-\tan\text{A}\tan\text{C}-\tan\text{A}\tan\text{C}\tan^2\text{ B}$$
$$2\tan\text{A}\tan\text{C}=2\tan^2\text{ B}$$
$$\tan^2\text{ B}=\tan\text{A}\cdot\tan\text{C}$$
$$\therefore \quad \tan\text{A}, \tan\text{B}, \tan\text{C}\text{ are in G.P.}$$

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:

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

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

$\therefore \quad \mathrm{t} + \frac{16}{\mathrm{t}} = 10$
$\therefore \quad \mathrm{t}^2 - 10\mathrm{t} + 16 = 0$
$\Rightarrow \mathrm{t} = 2$ and $\mathrm{t} = 8$

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

$2^{4\sin^2 x} = 2^1$ and $2^{4\sin^2 x} = 2^3$
$\therefore \quad 4\sin^2 x = 1$ and $4\sin^2 x = 3$
$\therefore \quad \sin^2 x = \frac{1}{4}$ and $\sin^2 x = \frac{3}{4}$
$\sin x = \pm\frac{1}{2}$ and $\sin x = \pm\frac{\sqrt{3}}{2}$
$\therefore \quad x = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$ and $x = \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$

$\therefore$ 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:

$$
\begin{aligned}
& \cos^2\ \mathrm{A}-\sin^2\ \mathrm{B}=\cos(\mathrm{A}+\mathrm{B}) \cdot \cos(\mathrm{A}-\mathrm{B}) \\
\therefore \quad & \cos^2 48^{\circ}-\sin^2 12^{\circ}=\cos(60^{\circ}) \cdot \cos(36^{\circ}) \\
& =\frac{1}{2} \cdot\left(1-2 \sin^2 \frac{36}{2}\right) \\
& =\frac{1}{2}\left(1-2 \sin^2 18^{\circ}\right) \\
& =\frac{1}{2}\left[1-2\left(\frac{\sqrt{5}-1}{4}\right)^2\right] \\
& =\frac{\sqrt{5}+1}{8}
\end{aligned}
$$

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:

Let $a=7k, b=8k, c=9k$

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

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

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:

$$\frac{\tan 160^\circ - \tan 110^\circ}{1 + \tan 160^\circ \cdot \tan 110^\circ} = \tan(160^\circ - 110^\circ) = \tan 50^\circ$$

$$= \tan(90^\circ - 40^\circ) = \cot 40^\circ = \frac{1}{\tan 40^\circ}$$

$$= \frac{1}{\frac{2 \tan_2 0^\circ}{1-\tan^2 20^\circ}} = \frac{1 - \tan^2 20^\circ}{2 \tan 20^\circ} = \frac{1 - p^2}{2p}$$

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:

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

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

$$= \frac{\sin^2(90^\circ + 70^\circ)}{\sin^2 70^\circ} + 1$$

$$\frac{\cos^2 70^\circ}{\sin^2 70^\circ} + 1$$

$$= \cot^2 70^\circ + 1 = \operatorname{cosec}^2 70^\circ = \sec^2 20^\circ$$

Question48

$\mathrm{Cos}^2 48^\circ - \sin^2 12^\circ =$ ______

,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:

$$\cos^2 48^\circ - \sin^2 12^\circ$$

$$= \cos(48^\circ + 12^\circ) \cdot \cos(48^\circ - 12^\circ)$$

$$= \cos 60^\circ \cdot \cos 36^\circ$$

$$= \frac{1}{2}\{1 - 2\sin^2 18^\circ\}$$

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

$$= \frac{1}{2} \times \left\{1 - 2 \times \frac{5 + 1 - 2\sqrt{5}}{16}\right\}$$

$$= \frac{1}{2} - \frac{6 - 2\sqrt{5}}{16} = \frac{1 + \sqrt{5}}{8}$$

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:

$$\begin{aligned}&a^2+b^2-c^2=ab\\&\Rightarrow \frac{a^2+b^2-c^2}{2ab}=\frac{1}{2}\\&\Rightarrow \cos c=\frac{1}{2}\\&\Rightarrow c=\frac{\pi}{3}\end{aligned}$$

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:

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

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

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

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

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

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

So,

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

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:

$$b\cos 2\theta + a\sin 2\theta = b \times \frac{1-\tan^2\theta}{1+\tan^2\theta} + a \times \frac{2\tan\theta}{1+\tan^2\theta}$$

$$= b \times \frac{1-\frac{a^2}{b^2}}{1+\frac{a^2}{b^2}} + a \times \frac{2\times\frac{a}{b}}{1+\frac{a^2}{b^2}}$$

$$= \frac{b\left(b^2-a^2\right)}{b^2+a^2} + \frac{2a^2b}{b^2+a^2}$$

$$= \frac{b\left(b^2+a^2\right)}{b^2+a^2} = b$$

Question53

If $\cot\alpha = \frac{1}{2}$ and $\sec\beta = -\frac{5}{3}$ where a $\in \left(\pi, \frac{3\pi}{2}\right)$ and $\beta \in \left(\frac{\pi}{2}, \pi\right)$, 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:

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

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

Question54

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

Options:

A. tan 2 A

B. cot A

C. tan A

D. cot 2 A

Answer: B

Solution:

$$\tan A+2\tan 2A+4\tan 4A+8\cot 8A$$

$$=\tan \mathrm{A}+2\tan 2\mathrm{~A}+4\tan 4\mathrm{~A}+\frac{8}{\left(\frac{2\tan 4\mathrm{~A}}{1-\tan^2 4\mathrm{~A}}\right)}$$

$$=\tan \mathrm{A}+2\tan 2\mathrm{~A}+4\tan 4\mathrm{~A}+\frac{8\left(1-\tan^2\mathrm{~A}\right)}{2\tan 4\mathrm{~A}}$$

$$=\tan \mathrm{A}+2\tan 2\mathrm{~A}+\frac{(4\tan 4\mathrm{~A})(2\tan 4\mathrm{~A})+8\left(1-\tan^2 4\mathrm{~A}\right)}{2\tan 4\mathrm{~A}}$$

$$=\tan \mathrm{A}+2\tan 2\mathrm{~A}+\frac{8}{2\tan 4\mathrm{~A}}$$

$$=\tan \mathrm{A}+2\tan 2\mathrm{~A}+\frac{8}{2\left(\frac{2\tan \mathrm{A}}{1-\tan^2 2\mathrm{~A}}\right)}$$

$$=\tan \mathrm{A}+2\tan 2\mathrm{~A}+\frac{8\left(1-\tan^2 2\mathrm{~A}\right)}{4\tan 2\mathrm{~A}}$$

$$=\tan \mathrm{A}+\frac{(2\tan 2\mathrm{~A})(4\tan 2\mathrm{~A})+8\left(1-\tan^2 2\mathrm{~A}\right)}{4\tan 2\mathrm{~A}}=\tan \mathrm{A}+\frac{8}{4\tan 2\mathrm{~A}}$$

$$=\tan \mathrm{A}+\frac{8}{4\left(\frac{2\tan \mathrm{A}}{1-\tan^2\mathrm{~A}}\right)}=\tan \mathrm{A}+\frac{8\left(1-\tan^2\mathrm{~A}\right)}{8\tan \mathrm{A}}$$

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

Question55

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

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

Question56

$\int \frac{dx}{32-2x^2} = A\log(4-x) + B\log(4+x) + c$, 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:

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 $A\triangle ABC$, 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 $2b^2 = a^2 + c^2$

$$\frac{\sin 3B}{\sin B} = \frac{3\sin B - 4\sin^2 B}{\sin B}$$
$$= 3 - 4\sin^2 B = 3 - 4\left(1 - \cos^2 B\right) = 4\cos^2 B - 1$$

$$= 4\left[\frac{c^2 + a^2 - b^2}{2ac}\right]^2 - 1 = 4\left[\frac{b^2}{2ac}\right] - 1$$
$$= \left(\frac{2b^2}{2ac}\right) - 1 = \left(\frac{a^2+c^2}{2ac}\right) - 1 = \left(\frac{a^2+c^2}{2ac} + 1\right)\left(\frac{a^2+c^2}{2ac} - 1\right)$$
$$= \frac{(a+c)^2(a-c)^2}{(2ac)^2}$$

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

Question58

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

Options:

A. $\tan 3A + \tan 2A - \tan A$

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

C. $\tan 3A + \tan 2A + \tan A$

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

Answer: B

Solution:

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

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

$$\frac{\tan\theta + \tan\phi}{\tan\theta - \tan\phi} = \frac{\mathrm{k}+1}{\mathrm{k}-1}$$

$$\therefore \frac{\frac{\sin\theta}{\cos\theta} + \frac{\sin\phi}{\cos\phi}}{\frac{\sin\theta}{\cos\theta} - \frac{\sin\phi}{\cos\phi}} = \frac{k+1}{k-1}$$

$$\therefore \frac{\sin\cos\phi + \cos\theta\sin\phi}{\sin\theta\cos\phi - \cos\theta\sin\phi} = \frac{k+1}{k-1}$$

$$\therefore \frac{\sin(\theta+\phi)}{\sin(\theta-\phi)} = \frac{\mathrm{k}+1}{\mathrm{k}-1} \Rightarrow \frac{\sin\alpha}{\sin(\theta-\phi)} = \frac{\mathrm{k}+1}{\mathrm{k}-1}$$

$$\therefore \sin(\theta-\phi) = \frac{\mathrm{k}-1}{\mathrm{k}+1}(\sin\alpha)$$

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:

$$\cos 2\theta = \sin\theta$$

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

$$\therefore (2\sin\theta - 1)(\sin\theta + 1) = 0 \Rightarrow \sin\theta = \frac{1}{2}, -1$$

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:

$$\begin{aligned}
&\sin 90^{\circ}=\sin 5\left(81^{\circ}\right) \text{ and let } 18^{\circ}=\mathrm{A} \\
&\sin 90^{\circ}=\sin 5 \mathrm{~A}=\sin (3 \mathrm{~A}+2 \mathrm{~A}) \\
&\therefore 90^{\circ}=3 \mathrm{~A}+2 \mathrm{~A} \Rightarrow \sin \left(90^{\circ}-3 \mathrm{~A}\right)=\sin 2 \mathrm{~A} \\
&\therefore \sin 2 \mathrm{~A}-\cos 3 \mathrm{~A} \Rightarrow 2 \sin \mathrm{A} \cos \mathrm{A}=4 \cos ^{3} \mathrm{~A}-3 \cos \mathrm{A} \\
&\therefore \cos \mathrm{A}\left(2 \sin \mathrm{A}-4 \cos ^{2} \mathrm{~A}+3\right)=0 \\
&\therefore \cos \mathrm{A}=0 \text{ or } \left[2 \sin \mathrm{A}-4\left(1-\sin ^{2} \mathrm{~A}\right)+3\right]=0 \\
&\therefore \mathrm{A}=\frac{\pi}{2} \text{ or } 4 \sin ^{2} \mathrm{~A}+2 \sin \mathrm{A}-1=0
\end{aligned}$$

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

$$\begin{aligned}
&\therefore 4 \sin ^{2} \mathrm{~A}+2 \sin \mathrm{A}-1=0 \\
&\therefore \sin \mathrm{A}=\frac{-2 \pm \sqrt{4+16}}{2(4)}=\frac{-2 \pm \sqrt{20}}{8}=\frac{2- \pm 2 \sqrt{5}}{8}=\frac{-1 \pm \sqrt{5}}{4} \\
&\therefore \sin \mathrm{A}=\frac{-1+\sqrt{5}}{4} \text{ or } \sin \mathrm{A}=\frac{-1+\sqrt{5}}{4}
\end{aligned}$$

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

Question62

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

Options:

A. $\cot 7 A$

B. $\tan 6 A$

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

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:

$$\begin{aligned}
\text{Given } \sin \theta &= \sin 15^{\circ}+\sin 45^{\circ} \\
&= 2 \sin \left(\frac{15^{\circ}+45^{\circ}}{2}\right) \cos \left(\frac{15^{\circ}-45^{\circ}}{2}\right) \\
&= 2 \sin 30^{\circ} \cos 15^{\circ} = 2 \times \frac{1}{2} \cos 15^{\circ} \\
\sin \theta &= \cos 15^{\circ} \Rightarrow \sin \theta=\sin \left(90^{\circ}-15^{\circ}\right) \Rightarrow \theta=75^{\circ}
\end{aligned}$$

Question66

If $\mathrm{A}, \mathrm{B}, \mathrm{C}, \mathrm{D}$ are the angles of a cyclic quadrilateral taken in order, then $\cos A+\cos B+\operatorname{Cos} C+\operatorname{Cos} D=$ 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 $\mathrm{A}+\mathrm{C}=180^{\circ}$ and $\mathrm{B}+\mathrm{D}=180^{\circ}$
$\therefore \cos \mathrm{A}=\cos \left(180^{\circ}-\mathrm{C}\right)=-\cos \mathrm{C} \cos \mathrm{B}=\cos \left(180^{\circ}-\mathrm{D}\right) \quad=-\cos \mathrm{D}$
$\therefore \cos \mathrm{A}+\cos \mathrm{B}+\cos \mathrm{C}+\cos \mathrm{D}=0$

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:

We know $\sin\theta = 2\sin\frac{\theta}{2}\cdot\cos\frac{\theta}{2}$ and $\cos\theta = 2\cos^2\frac{\theta}{2} - 1 = 1 - 2\sin^2\frac{\theta}{2}$

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

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

$$= \frac{-2\cos\frac{\theta}{2}\left(\sin\frac{\theta}{2}-\cos\frac{\theta}{2}\right)}{-2\sin\frac{\theta}{2}\left(\cos\frac{\theta}{2}-\sin\frac{\theta}{2}\right)} = -\cot\frac{\theta}{2}$$

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 supplementaryangles 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:

$\sin A - \sin B = 0$

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

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

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

Since the angles are not supplementary we say $\mathrm{A} = \mathrm{B}$.

Question72

$\operatorname{Cos}(36^\circ - \mathrm{A}) \cos(36^\circ + \mathrm{A}) + \cos(54^\circ + \mathrm{A}) \cos(54^\circ - \mathrm{A}) =$ **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:

$$\cos(36^\circ - \mathrm{A}) \cos(36^\circ + \mathrm{A}) + \cos(54^\circ + \mathrm{A}) \cos(54^\circ - \mathrm{A})$$
$$= \cos(36^\circ - \mathrm{A}) \cdot \cos(36^\circ + \mathrm{A}) + \cos[90^\circ - (36^\circ - \mathrm{A})] \cdot \cos[90^\circ - (36^\circ + \mathrm{A})]$$

$$= \cos(36^\circ - \mathrm{A}) \cdot \cos(36^\circ + \mathrm{A}) + \sin(36^\circ - \mathrm{A}) \cdot \sin(36^\circ + \mathrm{A})$$

$$= \cos[(36^\circ - \mathrm{A}) - (36^\circ + \mathrm{A})] = \cos[36^\circ - \mathrm{A} - 36^\circ - \mathrm{A}] = \cos(-2\,\mathrm{A}) = \cos 2\,\mathrm{A}$$

Question73

$\tan A + 2\tan 2A + 4\tan 4A + 8\operatorname{Cot} 8A =$ **MHT CET 2020 (16 Oct Shift 2)**

Options:

A. $\tan A$

B. $\operatorname{Cot} A$

C. tan 2 A

D. Cot 2 A

Answer: B

Solution:

$= \tan A + 2\tan 2A + 4\tan 4A + 8 \times \frac{1-\tan^2 4A}{2\tan 4A}$

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

$= \tan A + 2\tan 2A + \frac{4\tan^2 4A + 4 - 4\tan^2 4A}{\tan 4A}$

$= \tan A + 2\tan 2A + \frac{4}{\tan 4A} = \tan A + 2\tan 2A + 4\cot 4A$

$= \tan A + 2\tan 2A + 4 \times \frac{1-\tan^2 2A}{2\tan 2A} = \tan A + 2\tan 2A + \frac{2(1-\tan^2 2A)}{\tan 2A}$

$= \tan A + \frac{2\tan^2 2A + 2 - 2\tan^2 2A}{\tan 2A} = \tan A + \frac{2}{\tan 2A}$

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

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

Question74

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:

$a = \sin(180^\circ - 5^\circ) + \cos(180^\circ - 5^\circ)$
$= \sin 5^\circ - \cos 5^\circ$

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

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

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

Question75

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:

$$(D) \sin\theta = \frac{-12}{13} \Rightarrow \cos\theta = \sqrt{1-\left(\frac{-12}{13}\right)^2} = \sqrt{\frac{25}{169}} = \pm\frac{5}{13} \because \theta \text{ is in third quadrant}$$
$$\Rightarrow \cos\theta \quad = -\frac{5}{13} \Rightarrow \frac{\sin\theta}{\cos\theta} = \tan\theta = \frac{12}{5}$$
$$\cos\phi = -\frac{4}{5} \Rightarrow \sin\phi = \sqrt{1-\left(\frac{-4}{5}\right)^2} = \sqrt{\frac{9}{25}} = \pm\frac{3}{5}\phi \text{ is in third quadrant}$$
$$\Rightarrow \sin\phi = \frac{-3}{5} \Rightarrow \frac{\sin\phi}{\cos\phi} = \tan\phi = \frac{3}{4} \tan(\theta-\phi) = \frac{\tan\theta-\tan\phi}{1+\tan\phi\cdot\tan\phi} = \frac{\frac{12}{5}-\frac{3}{4}}{1+\left(\frac{12}{5}\times\frac{3}{4}\right)} = \frac{\frac{33}{20}}{\frac{56}{20}} = \frac{33}{56}$$

Question76

In a triangle ABC **if** $\frac{\sin \mathrm{A}-\sin \mathrm{C}}{\cos \mathrm{C}-\cos \mathrm{A}} = \cot \mathrm{B}$**, then** $\mathrm{A}, \mathrm{B}, \mathrm{C}$ **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:

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

Question77

$\sqrt{2+\sqrt{2+2\cos 4\theta}} =$ **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:

$$\sqrt{2+\sqrt{2+2\cos 4\theta}}=\sqrt{2+\sqrt{2(1+\cos 4\theta)}}$$
$$=\sqrt{2+\sqrt{2\times 2\cos^2 2\theta}}=\sqrt{2+2\cos^2 2\theta}$$
$$=\sqrt{2\left(1+\cos^2 2\theta\right)}=\sqrt{2\times 2\cos^2\theta}=2\cos\theta$$

Question78

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.
$\therefore \sin(z+x-y)-\sin(y+z-x)=\sin(x+y-z)-\sin(z+x-y)$
$\Rightarrow 2\cos z\sin(x-y)=2\cos x\sin(y-z)\Rightarrow \cos z\sin(x-y)=\cos x\sin(y-z)$
$\Rightarrow \frac{\cos z\sin(x-y)}{\cos x\cos y\cos z}=\frac{\cos x\sin(y-z)}{\cos x\cos y\cos z}\Rightarrow \frac{\sin(x-y)}{\cos x\cos y}=\frac{\sin(y-z)}{\cos y\cos z}$ Using $\frac{\sin(A-B)}{\cos A\cos B}=\tan A-\tan B$
$\Rightarrow \tan x-\tan y=\tan y-\text{taz}\Rightarrow \tan y-\tan x=\tan z-\tan y.\therefore \tan x,\tan y$ and $\tan z$ are in A.P.

Question79

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:

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

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

$\therefore \frac{\tan\frac{A}{2}+\tan\frac{B}{2}}{1-\tan\frac{A}{2}\tan\frac{B}{2}} = \cot\frac{C}{2} \Rightarrow \frac{\tan\frac{A}{2}+\tan\frac{B}{2}}{1-\tan\frac{A}{2}\cdot\tan\frac{B}{2}} = \frac{1}{\tan\frac{C}{2}}$
$\therefore \tan\frac{C}{2}\left(\tan\frac{A}{2}+\tan\frac{B}{2}\right) = 1-\tan\frac{A}{2}\tan\frac{B}{2}$
$\therefore \tan\frac{A}{2}\tan\frac{B}{2}+\tan\frac{B}{2}\tan\frac{C}{2}+\tan\frac{C}{2}\tan\frac{A}{2} = 1$

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:

$$\text{In } \Delta ABC, A+B+C=\pi \Rightarrow 2A+2B+2C=2\pi$$
$$\therefore 2A+2B=2\pi-2C \Rightarrow \tan(2A+2B)=\tan(2\pi-2C)=-\tan 2C$$
$$\frac{\tan 2A+\tan 2B}{1-\tan 2A\tan 2B}=-\tan 2C$$
$$\therefore \tan 2A+\tan 2B=-\tan 2C(1-\tan 2A\tan 2B)$$
$$\therefore \tan 2A+\tan 2B+\tan 2C=\tan 2A\tan 2B\tan 2C$$

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:

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

Question82

If $x=3\sin\theta, y=3\cos\theta\cos\phi, z=3\cos\theta\sin\emptyset$, 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:

$$\begin{aligned} x^2+y^2+z^2 &= 9\sin^2\theta+9\cos^2\theta\cos^2\phi+9\cos^2\theta\sin^2\phi \\ &= 9\sin^2\theta+9\cos^2\theta\left(\cos^2\phi+\sin^2\phi\right) \\ &= 9\sin^2\theta+9\cos^2\theta \\ &= 9\left(\sin^2\theta+\cos^2\theta\right)=9\times1=9 \end{aligned}$$

Question83

$\sin\left(\frac{\pi}{3}+x\right)-\cos\left(\frac{\pi}{6}+x\right)=$ **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 $(a),(b),(c),(d)$

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

$\tan\theta+\sin\theta=a\ldots(1)$ and

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

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

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

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:

$$\frac{\cos 12^{\circ}-\sin 12^{\circ}}{\cos 12^{\circ}+\sin 12^{\circ}}+\frac{\sin 147^{\circ}}{\cos 147^{\circ}}=\frac{\cos 12^{\circ}-\cos 78^{\circ}}{\cos 12^{\circ}+\cos 78^{\circ}}+\tan 147^{\circ}$$
$$=\frac{-2 \sin 45^{\circ} \sin \left(-33^{\circ}\right)}{2 \cos 45^{\circ} \cos 33^{\circ}}+\tan \left(180^{\circ}-33^{\circ}\right)=\tan 45^{\circ} \tan 33^{\circ}-\tan 33^{\circ}=\tan 33^{\circ}-\tan 33^{\circ}=0$$

Question87

$\cos \left(\frac{3 \pi}{4}+x\right)-\sin \left(\frac{\pi}{4}-x\right)=$ **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:

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

Question88

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

Options:

A. $x=n \pi, n \in Z$

B. $x=n\left(\frac{\pi}{3}\right)+\frac{\pi}{12}, n \in Z$

C. $x=n \pi+\frac{\pi}{4}, n \in Z$

D. $x=n \pi \pm \frac{\pi}{4}, n \in Z$

Answer: B

Solution:

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

$\theta = n\pi + \alpha$, where $n \in Z$

Given $\tan 3x = 1$

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

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

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:

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

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:

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

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. $-\cot \propto$

B. $\cot \propto$

C. $-\tan \propto$

D. $\tan \propto$

Answer: B

Solution:

Given $\cos x+\cos y=-\cos \alpha$ and $\sin x+\sin y=-\sin \alpha 2 \cos \left(\frac{x+y}{2}\right) \cos \left(\frac{x-y}{2}\right)=-\cos \alpha$ ...(1) and2 $\sin \left(\frac{x+y}{2}\right) \cos \left(\frac{x-y}{2}\right)=-\sin \alpha$ ...(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:

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

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 $\sec\theta=\frac{13}{12},\theta$ **lies in** 4^{th} **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:

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

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

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

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:

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

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:

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

Question97

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

Options:

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

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

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

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

Answer: D

Solution:

We have $\cos 2\theta = \sin\alpha \Rightarrow \cos 2\theta = \cos(90 - \alpha)$ When $\cos\theta = \cos\alpha$, we get
$\theta = 2n\pi \pm \alpha, n \in Z \therefore \quad 2\theta = 2n\pi \pm (90 - \alpha)\theta = \frac{2n\pi}{2} \pm \left(\frac{90-\alpha}{2}\right) \Rightarrow \theta = n\pi \pm \left(\frac{\pi}{4} - \frac{\alpha}{2}\right)$

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

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

Options:

A. $\sqrt{3}$

B. 1

C. $\sqrt{2}$

D. 2

Answer: B

Solution:

$$\tan 1^\circ \times \tan 2^\circ \times \tan 3^\circ \times \ldots \times \tan 89^\circ$$
$$= [\tan 1^\circ \tan 2^\circ \tan 3^\circ \ldots \tan 44^\circ] (\tan 45^\circ) \times [\tan(90^\circ - 44^\circ) \cdot \tan(90^\circ - 43^\circ) \ldots \tan(90^\circ$$
$$= (\tan 1^\circ \tan 2^\circ \ldots \tan 44^\circ) (\cot 44^\circ \cot 43^\circ \ldots \cot 1^\circ) = 1$$

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:

$$\text{if } \theta=\frac{17\pi}{3} \text{ let } A=(\tan\theta-\cot\theta)$$
$$=-2\left(\frac{1-\tan^2\theta}{2\tan\theta}\right)$$
$$=\frac{-2}{\tan2\theta}=\frac{-2}{\tan\frac{4\pi}{3}}$$
$$=\frac{-2}{\tan\left(\frac{\pi}{3}\right)}=\frac{-2}{\sqrt{3}}$$

Question101

In ΔABC , if tan A + tan B + tan C = 6 and tan A.tan B = 2 then tan C = …… 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
$\Rightarrow \tan A\tan B\tan C=6$ ….(i)
and tan A. tan B = 2 …..(ii)
From Eqs. (i) and (ii) we get, tanC =3

Question102

The value of

sin18°

is ….. 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 , $\theta = 18^o$

then, $2\theta = 36^o = 90^o - 54^o = 90^0 - 3\theta$

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

$\Rightarrow 2\sin\theta\cos\theta = \cos 3\theta$
$\Rightarrow 2\sin\theta\cos\theta = 4\cos^3\theta - 3\cos\theta$
$\Rightarrow 2\sin\theta\cos\theta = \cos\theta 4\cos^2\theta - 3$
$\Rightarrow 2\sin\theta = 4\cos\theta - 3as\cos^2\theta \neq 0$
$\Rightarrow 2\sin\theta = 4 - 4\sin^2\theta - 3$
$\Rightarrow 4\sin^2 + \theta + 2\sin^2\theta - 1 = 0$
$\Rightarrow \sin\theta = \frac{-2 \pm \sqrt{4+16}}{24} = \frac{-1 \pm \sqrt{5}}{4}$

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

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

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

Question103

$\frac{1-2[\cos 60^o - \cos 80^o]}{2\sin 10^o} = \cdots$ **MHT CET 2019 (Shift 1)**

Options:

A. 2

B. 1

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

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

Answer: B

Solution:

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

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

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

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

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

Question104

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

Options:

A. 0.466

B. 0.256

C. 0.944

D. 0.764

Answer: C

Solution:

Let $E = \sin\left[3\sin^{-1}(0.4)\right]$
put $\sin^{-1}(0.4) = \theta \Rightarrow \sin\theta = 0.4$
$\therefore E = \sin(3\theta) = 3\sin\theta - 4\sin^3\theta$
$= 3(0.4) - 4(0.4)^3$
$= 12 - 4(0.064)$
$= 12 - 0.256$
$= 0.944$

Question105

$\cos 1^o . \cos 2^o . \cos 3^o \ldots . \cos 179^o =$ **MHT CET 2018**

Options:

A. 0

B. 1

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

D. -1

Answer: A

Solution:

$$\begin{aligned} &\cos^o 1^o \cos 2^o \cos 3^o \ldots \cos 90^o \ldots \cos 179^o \\ &= \cos 1^o \cos 2^o \cos 3^o \ldots 0 \ldots \cos 179^o \qquad (\because \cos 90^o = 0) \\ &= 0 \end{aligned}$$

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:

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

Question108

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

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