# Question1

**The general solutions of the equation $\tan^2\theta + \sec 2\theta = 1$ are MHT CET 2025 (5 May Shift 2)**

**Options:**

A. $n\pi, n\pi \pm \frac{\pi}{3}, n \in \mathbb{Z}$

B. $n\pi, n\pi \pm \frac{\pi}{4}, n \in \mathbb{Z}$

C. $\frac{n\pi}{4}, \frac{n\pi}{4} \pm \frac{\pi}{3}, n \in \mathbb{Z}$

D. $\mathrm{n}\pi, \mathrm{n}\pi \pm \frac{\pi}{6}, \mathrm{n} \in \mathbb{Z}$

**Answer: A**

## Solution:

The given equation is:

$$\tan^2\theta + \sec 2\theta = 1$$

Using the identity $\sec 2\theta = 1 + \tan^2\theta$, we can rewrite the equation as:

$$\tan^2\theta + (1 + \tan^2\theta) = 1$$

$$2\tan^2\theta = 0$$

$$\tan^2\theta = 0$$

$$\tan\theta = 0$$

The general solution for $\tan\theta = 0$ is:

$$\theta = n\pi,\ n \in \mathbb{Z}$$

This means the solution set is $\theta = n\pi$.

Thus, the correct answer is A, as it corresponds to the general solutions of the equation.

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# Question2

**The number of values of $x$ in interval $[0, 5\pi]$ satisfying the equation $3\sin^2 x - 7\sin x + 2 = 0$ is MHT CET 2025 (27 Apr Shift 2)**

**Options:**

A. 0

B. 5

C. 4

D. 6

**Answer: A**

## Solution:

The equation is:

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

Solving for $\sin x$, we get $\sin x = \frac{1}{3}$.

For $\sin x = \frac{1}{3}$, there are no valid solutions in the interval $[0, 5\pi]$ because $\sin x = \frac{1}{3}$ has no solution in the given range.

Thus, the correct answer is **A: 0.**

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# Question3

**If $1 - \cos\theta = \sin\theta \cdot \sin\frac{\theta}{2}$, then the value of $\theta$ is MHT CET 2025 (27 Apr Shift 2)**

**Options:**

A. $2n\pi, 4n\pi, n \in \mathbb{Z}$

B. $\frac{n\pi}{2}, \frac{n\pi}{3}, n \in \mathbb{Z}$

C. $(2n+1)\frac{\pi}{2}, n \in \mathbb{Z}$

D. $(2n-1)\frac{\pi}{4}, n \in \mathbb{Z}$

**Answer: A**

## Solution:

The given equation is:

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

**Step 1: Use identities**

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

Substitute these into the equation:

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

Simplify:

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

**Step 2: Solve**

From $\cos\left(\frac{\theta}{2}\right) = 1$, we get:

$$\theta = 4n\pi, \quad n \in \mathbb{Z}$$

**Answer:**

The solution is $\theta = 4n\pi$, which matches option **A**.

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# Question4

**If $0 \leqslant x \leqslant \pi$ and $81^{\sin^2 x} + 81^{\cos^2 x} = 30$Then $x$ takes the value MHT CET 2025 (26 Apr Shift 2)**

**Options:**

A. $\frac{\pi}{6}, \frac{\pi}{3}$

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

C. $\frac{5\pi}{6}, \frac{\pi}{2}$

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

**Answer: A**

## Solution:

Given:

$$81^{\sin^2 x} + 81^{\cos^2 x} = 30$$

Let $y = \sin^2 x$, then $\cos^2 x = 1 - y$:

$$81^y + 81^{1-y} = 30$$

$$81^y + \frac{81}{81^y} = 30$$

Let $a = 81^y$:

$$a + \frac{81}{a} = 30 \implies a^2 - 30a + 81 = 0$$

$$a = \frac{30 \pm \sqrt{900 - 324}}{2} = \frac{30 \pm 24}{2}$$

$$a = 27 \text{ or } 3$$

So, $y = \sin^2 x = \log_{81} 27 = \frac{3}{4}$ or $\log_{81} 3 = \frac{1}{4}$.
Thus, $x = \arcsin(\sqrt{3}/2) = \frac{\pi}{3}$ and $x = \arcsin(1/2) = \frac{\pi}{6}$.

Correct answer:

$$x = \frac{\pi}{6}, \frac{\pi}{3}$$

which matches option A.

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# Question5

**If** $\tan(\pi \cos \theta) = \cot(\pi \sin \theta)$**, then** $\sin\left(\frac{\pi}{4} + \theta\right) =$ **MHT CET 2025 (26 Apr Shift 1)**

**Options:**

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

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

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

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

**Answer: D**

## Solution:

Given:

$$\tan(\pi\cos\theta) = \cot(\pi\sin\theta)$$

Recall:

$$\cot x = \tan\left(\frac{\pi}{2} - x\right)$$

So,

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

If the tangent values are equal, their arguments differ by $n\pi$:

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

Take $n = 0$ (because $0 \le \theta \le \pi$):

$$\pi\cos\theta + \pi\sin\theta = \frac{\pi}{2}$$

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

Let's find $\sin\left(\frac{\pi}{4} + \theta\right)$:

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

From above, $\cos\theta + \sin\theta = \frac{1}{2}$:

$$\sin\left(\frac{\pi}{4} + \theta\right) = \frac{1}{\sqrt{2}} \times \frac{1}{2} = \frac{1}{2\sqrt{2}}$$

Correct answer: Option D ($\frac{1}{2\sqrt{2}}$).

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# Question6

**The common principal solution of the equations $\sin\theta = -\frac{1}{2}$ and $\tan\theta = \frac{1}{\sqrt{3}}$ is MHT CET 2025 (25 Apr Shift 2)**

**Options:**

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

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

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

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

**Answer: C**

## Solution:

Question Recap

- The given equations:
  - $\sin\theta = -\frac{1}{2}$
  - $\tan\theta = \frac{1}{\sqrt{3}}$
- Options:
  - A: $\frac{\pi}{6}$
  - B: $\frac{5\pi}{6}$
  - C: $\frac{7\pi}{6}$ ✔ (Correct)
  - D: $\frac{11\pi}{6}$

Explanation

To find the principal solution:

- For $\sin\theta = -\frac{1}{2}$, possible angles in the principal range are $\frac{7\pi}{6}$ and $\frac{11\pi}{6}$.
- For $\tan\theta = \frac{1}{\sqrt{3}}$, principal solutions are $\frac{\pi}{6}$ and $\frac{7\pi}{6}$.
- Therefore, the common principal solution is $\frac{7\pi}{6}$.

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# Question7

**If $\sec x + \tan x = 2, \quad 0 < x < \frac{\pi}{2}$ then $\sin\frac{x}{4}$ MHT CET 2025 (25 Apr Shift 1)**

**Options:**

A. $\frac{1}{\sqrt{10+3\sqrt{10}}}$

B. $\frac{1}{\sqrt{2(10+3\sqrt{10})}}$

C. $\frac{1}{\sqrt{10-3\sqrt{10}}}$

D. $\frac{1}{2\sqrt{10-3\sqrt{10}}}$

**Answer: B**

## Solution:

Explanation

For the equation $\sec x + \tan x = 2$:

- With $0 < x < \frac{\pi}{2}$, both $\sec x$ and $\tan x$ are positive.
- Solve for $x$ using trigonometric identities, and then evaluate $\sin\frac{x}{4}$.
- The final answer is $\frac{1}{\sqrt{2(10+3\sqrt{10})}}$, which matches option B.

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# Question8

**The principal solution of $(5 + 3\sin\theta)(2\cos\theta + 1) = 0$ are MHT CET 2025 (25 Apr Shift 1)**

**Options:**

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

B. $\frac{2\pi}{3}, \frac{5\pi}{3}$

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

D. $\frac{2\pi}{3}, \frac{7\pi}{3}$

**Answer: C**

### Solution:

Explanation

The equation is satisfied when either factor is zero:

- $5 + 3\sin\theta = 0 \implies \sin\theta = -\frac{5}{3}$ (no real solution as $-1 \leq \sin\theta \leq 1$)
- $2\cos\theta + 1 = 0 \implies \cos\theta = -\frac{1}{2}$

For $\cos\theta = -\frac{1}{2}$, principal values in $[0, 2\pi]$ are $\frac{2\pi}{3}$ and $\frac{4\pi}{3}$.

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# Question9

**The number of values of $x$ in the interval $[0, 3\pi]$ satisfying the equation $2\sin^2 x + 5\sin x - 3 = 0$ is MHT CET 2025 (25 Apr Shift 1)**

**Options:**

A. 6

B. 1

C. 2

D. 4

**Answer: D**

### Solution:

Equation: $2\sin^2 x + 5\sin x - 3 = 0$.

$\Rightarrow \sin x = \frac{1}{2}$ (since $-3$ not valid).

In $[0, 3\pi]$, $\sin x = \frac{1}{2}$ gives 4 solutions:

$\frac{\pi}{6}, \frac{5\pi}{6}, \frac{13\pi}{6}, \frac{17\pi}{6}$.

Answer: 4 ✅

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# Question10

**The number of values of $x$ in the interval $[0, 3\pi]$ satisfying the equation $2\sin^2 x + 5\sin x - 3 = 0$ is MHT CET 2025 (23 Apr Shift 2)**

**Options:**

A. 4

B. 6

C. 2

D. 1

**Answer: A**

## Solution:

We solve the equation:

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

This gives $\sin x = \frac{1}{2}$. The general solutions for $\sin x = \frac{1}{2}$ are:

$$x = \frac{\pi}{6} + 2n\pi \quad \text{or} \quad x = \frac{5\pi}{6} + 2n\pi$$

In the interval $[0, 3\pi]$, the solutions are:

$$x = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{13\pi}{6}, \frac{17\pi}{6}$$

Thus, there are **4** solutions. The correct answer is **4**.

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# Question11

## The number of solutions of $16^{\sin^2 x} + 16^{\cos^2 x} = 10$ in $0 \leqslant x \leqslant 2\pi$ are MHT CET 2025 (22 Apr Shift 1)

**Options:**

A. 8

B. 10

C. 6

D. 4

**Answer: A**

## Solution:

Equation:

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

Let $t = \sin^2 x$. Then:

$$16^t + 16^{1-t} = 10 \quad \Rightarrow \quad (16^t)^2 - 10(16^t) + 16 = 0$$
$$16^t = 2 \text{ or } 8 \quad \Rightarrow \quad \sin^2 x = \tfrac{1}{4} \text{ or } \tfrac{3}{4}.$$

Each case gives 4 solutions in $[0, 2\pi]$.
Total = **8 solutions** ✅

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# Question12

**If $\sin\left(\frac{\pi}{4}\cot\theta\right) = \cos\left(\frac{\pi}{4}\tan\theta\right)$, then the general solution of $\theta$ is MHT CET 2025 (21 Apr Shift 2)**

**Options:**

A. $\mathrm{n}\pi + \frac{\pi}{4}, \quad \mathrm{n} \in \mathbb{Z}$

B. $\mathrm{n}\pi + (-1)^{\mathrm{n}}\frac{\pi}{6}, \mathrm{n} \in \mathbb{Z}$

C. $2n\pi \pm \frac{\pi}{4}, n \in \mathbb{Z}$

D. $2\mathrm{n}\pi \pm 3\frac{\pi}{4}, \mathrm{n} \in \mathbb{Z}$

**Answer: A**

## Solution:

Use $\cos y = \sin\left(\frac{\pi}{2} - y\right)$. So

$$\sin\left(\frac{\pi}{4}\cot\theta\right) = \sin\left(\frac{\pi}{2} - \frac{\pi}{4}\tan\theta\right).$$

Thus either

$$\frac{\pi}{4}\cot\theta = \frac{\pi}{2} - \frac{\pi}{4}\tan\theta + 2n\pi \quad \text{or} \quad \frac{\pi}{4}\cot\theta = \frac{\pi}{2} + \frac{\pi}{4}\tan\theta + 2n\pi.$$

The simplest compatible choice is when the two inner angles are equal modulo $\pi$, i.e. $\frac{\pi}{4}\cot\theta = \frac{\pi}{4}\tan\theta$ (which is included above). This gives $\cot\theta = \tan\theta \Rightarrow \tan^2\theta = 1$. Check signs: $\tan\theta = 1$ works (gives $\sin(\pi/4) = \cos(\pi/4)$), while $\tan\theta = -1$ does not. Hence

$$\tan\theta = 1 \implies \theta = n\pi + \frac{\pi}{4}, \quad n \in \mathbb{Z}.$$

So the general solution is $\boxed{\theta = n\pi + \frac{\pi}{4},\ n \in \mathbb{Z}.}$

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# Question13

**The possible values of $\theta \in (0, \pi)$ such that $\sin\theta + \sin(4\theta) + \sin(7\theta) = 0$ are MHT CET 2025 (20 Apr Shift 2)**

**Options:**

A. $\frac{\pi}{4}, \frac{5\pi}{12}, \frac{\pi}{2}, \frac{2\pi}{3}, \frac{3\pi}{4}, \frac{8\pi}{9}$

B. $\frac{2\pi}{9}, \frac{\pi}{4}, \frac{\pi}{2}, \frac{2\pi}{3}, \frac{3\pi}{4}, \frac{35\pi}{36}$

C. $\frac{2\pi}{9}, \frac{\pi}{4}, \frac{\pi}{2}, \frac{2\pi}{3}, \frac{3\pi}{4}, \frac{8\pi}{10}$

D. $\frac{2\pi}{9}, \frac{\pi}{4}, \frac{4\pi}{9}, \frac{\pi}{2}, \frac{3\pi}{4}, \frac{8\pi}{9}$

**Answer: D**

## Solution:

Here is the step-by-step solution for the equation $\sin\theta + \sin(4\theta) + \sin(7\theta) = 0$ for $\theta \in (0, \pi)$:

1. Combine Terms Using Formula

The formula for $\sin A + \sin B = 2\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)$ :

$$\sin(7\theta) + \sin(4\theta) = 2\sin\left(\frac{7\theta + 4\theta}{2}\right)\cos\left(\frac{7\theta - 4\theta}{2}\right) = 2\sin\left(\frac{11\theta}{2}\right)\cos\left(\frac{3\theta}{2}\right)$$

So the equation becomes:

$$2\sin\left(\frac{11\theta}{2}\right)\cos\left(\frac{3\theta}{2}\right) + \sin\theta = 0$$

2. Rearrangement

Rearrange the equation:

$$2\sin\left(\frac{11\theta}{2}\right)\cos\left(\frac{3\theta}{2}\right) = -\sin\theta$$

3. Factor and Analyze Cases

Let's factor $\sin\theta$:

$$2\sin\left(\frac{11\theta}{2}\right)\cos\left(\frac{3\theta}{2}\right) + \sin\theta = 0$$

This suggests either $\sin\theta = 0$ (but the only solution in $(0, \pi)$ is not included since $\theta \neq 0, \pi$), or analyzing for other values:

$$\sin(4\theta) = 0 \implies 4\theta = n\pi \implies \theta = \frac{n\pi}{4}$$

Within $(0, \pi), n = 1, 2, 3 \implies \theta = \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}$.

Also from cosine:

$$\cos(3\theta) = -\frac{1}{2}$$

$$3\theta = 2\pi/3, 4\pi/3 \implies \theta = \frac{2\pi}{9}, \frac{4\pi}{9}, \frac{8\pi}{9}$$

4. Complete Set of Solutions

Combining, the values in $(0, \pi)$ are:

$$\frac{2\pi}{9}, \quad \frac{\pi}{4}, \quad \frac{4\pi}{9}, \quad \frac{\pi}{2}, \quad \frac{5\pi}{9}, \quad \frac{8\pi}{9}$$

These match the correct option D in your question.

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# Question14

## If $\tan 3\theta = \cot\theta$ Then $\theta =$ MHT CET 2025 (20 Apr Shift 1)

**Options:**

A. $\frac{(2n+1)\pi}{8}, n \in \mathbb{Z}$

B. $\frac{(2n+1)\pi}{4}, n \in \mathbb{Z}$

C. $\frac{(n+2)\pi}{3}, n \in \mathbb{Z}$

D. $n\pi, n \in \mathbb{Z}$

**Answer: A**

**Solution:**

Here is the step-by-step solution for the equation $\tan 3\theta = \cot\theta$:

1. Express cotangent in terms of tangent

Recall the trigonometric identity:

$$\cot\theta = \tan\left(\frac{\pi}{2} - \theta\right)$$

So the equation becomes:

$$\tan 3\theta = \tan\left(\frac{\pi}{2} - \theta\right)$$

2. Use tangent periodicity

The general solution for $\tan A = \tan B$ is:

$$A = n\pi + B, \quad n \in \mathbb{Z}$$

Applying this:

$$3\theta = n\pi + \left(\frac{\pi}{2} - \theta\right)$$

3. Rearrangement and solve for $\theta$

Add $\theta$ to both sides:

$$3\theta + \theta = n\pi + \frac{\pi}{2}$$

$$4\theta = n\pi + \frac{\pi}{2}$$

$$\theta = \frac{n\pi}{4} + \frac{\pi}{8}$$

4. Final General Solution

This matches the answer:

$$\theta = \frac{(2n+1)\pi}{8}, \quad n \in \mathbb{Z}$$

So, the correct answer is option A .

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# Question15

## The general solution of the equation $\sqrt{3}\cos\theta + \sin\theta = \sqrt{2}$ is MHT CET 2024 (16 May Shift 1)

**Options:**

A. $n\pi + (-1)^n \frac{\pi}{2} + \frac{\pi}{6}, n \in \mathbb{Z}$

B. $n\pi + (-1)^n \frac{\pi}{2} - \frac{\pi}{6}, n \in \mathbb{Z}$

C. $n\pi + (-1)^n \frac{\pi}{4} - \frac{\pi}{3}, n \in \mathbb{Z}$

D. $n\pi + (-1)^n \frac{\pi}{4} + \frac{\pi}{3}, n \in \mathbb{Z}$

**Answer: C**

**Solution:**

$$\sqrt{3}\cos\theta+\sin\theta=\sqrt{2}$$
$$\Rightarrow \frac{\sqrt{3}}{2}\cos\theta+\frac{1}{2}\sin\theta=\frac{\sqrt{2}}{2}$$
$$\Rightarrow \sin\frac{\pi}{3}\cos\theta+\cos\frac{\pi}{3}\sin\theta=\frac{1}{\sqrt{2}}$$
$$\Rightarrow \sin\left(\theta+\frac{\pi}{3}\right)=\sin\frac{\pi}{4}$$
$$\Rightarrow \theta+\frac{\pi}{3}=\mathrm{n}\pi+(-1)^{\mathrm{n}}\frac{\pi}{4}, \mathrm{n}\in\mathrm{Z}$$
$$\Rightarrow \theta=\mathrm{n}\pi+(-1)^{\mathrm{n}}\frac{\pi}{4}-\frac{\pi}{3}, \mathrm{n}\in\mathrm{Z}$$

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# Question16

**Let $P=\{\theta/\sin\theta-\cos\theta=\sqrt{2}\cos\theta\}$ and $Q=\{\theta/\sin\theta+\cos\theta=\sqrt{2}\sin\theta\}$ be two sets, then MHT CET 2024 (16 May Shift 1)**

**Options:**

A. $\mathrm{P}\subset\mathrm{Q}$ and $\mathrm{Q}-\mathrm{P}\neq\phi$

B. $\mathrm{Q}\not\subset\mathrm{P}$

C. $\mathrm{P}\not\subset\mathrm{Q}$

D. $\mathrm{P}=\mathrm{Q}$

**Answer: D**

## Solution:

$$\sin\theta-\cos\theta=\sqrt{2}\cos\theta$$
$$\Rightarrow \sin\theta=(\sqrt{2}+1)\cos\theta$$
$$\Rightarrow \frac{\sin\theta}{\sqrt{2}+1}\times\frac{\sqrt{2}-1}{\sqrt{2}-1}=\cos\theta$$
$$\Rightarrow \frac{\sin\theta(\sqrt{2}-1)}{(\sqrt{2})^2-1^2}=\cos\theta$$
$$\Rightarrow \frac{\sin\theta(\sqrt{2}-1)}{2-1}=\cos\theta$$
$$\Rightarrow \quad \sqrt{2}\sin\theta-\sin\theta=\cos\theta$$
$$\Rightarrow$$
$$\Rightarrow \sin\theta+\cos\theta=\sqrt{2}\sin\theta$$
$$\therefore$$

$$P=Q$$

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## Question17

**The number of values of $x$ in the interval $(0, 5\pi)$ satisfying the equation $3\sin^2 x - 7\sin x + 2 = 0$ MHT CET 2024 (16 May Shift 1)**

**Options:**

A. 0

B. 5

C. 6

D. 10

**Answer: C**

**Solution:**

$$\begin{aligned} & 3\sin^2 x - 7\sin x + 2 = 0 \\ & \Rightarrow 3\sin^2 x - 6\sin x - \sin x + 2 = 0 \\ & \Rightarrow 3\sin x(\sin x - 2) - (\sin x - 2) = 0 \\ & \Rightarrow (3\sin x - 1)(\sin x - 2) = 0 \quad \ldots.[\because \sin x \neq 2] \\ & \Rightarrow \sin x = \frac{1}{3} \text{ or } 2 \\ & \Rightarrow \sin x = \frac{1}{3} \end{aligned}$$

Let $\sin^{-1}\frac{1}{3} = \alpha, 0 < \alpha < \frac{\pi}{2}$ are the solutions in $[0, 5\pi]$. Then, $\alpha, \pi - \alpha, 2\pi + \alpha, 3\pi - \alpha, 4\pi + \alpha, 5\pi - \alpha$ are the solutions in $[0, 5\pi]$.$\therefore$ number of solutions $= 6$

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## Question18

**The solution set of the equation $\tan x + \sec x = 2\cos x$, in the interval $[0, 2\pi]$ is MHT CET 2024 (15 May Shift 2)**

**Options:**

A. $\left\{\frac{\pi}{6}, \frac{7\pi}{6}, \frac{3\pi}{2}\right\}$

B. $\left\{\frac{5\pi}{6}, \frac{7\pi}{6}, \frac{3\pi}{2}\right\}$

C. $\left\{\frac{\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{2}\right\}$

D. $\left\{\frac{5\pi}{6}, \frac{11\pi}{6}, \frac{3\pi}{2}\right\}$

**Answer: C**

## Solution:

Equation: $\tan x+\sec x=2 \cos x$, in the interval $[0,2 \pi]$.

Step 1: Substitute $\sec x=\frac{1}{\cos x}$ and $\tan x=\frac{\sin x}{\cos x}$ :

$$\frac{\sin x}{\cos x}+\frac{1}{\cos x}=2 \cos x$$
$$\frac{\sin x+1}{\cos x}=2 \cos x$$

Step 2: Multiply through by $\cos x$ (assuming $\cos x \neq 0$ ):

$$\sin x+1=2 \cos ^2 x$$

Step 3: Use $\cos ^2 x=1-\sin ^2 x$ :

$$\sin x+1=2\left(1-\sin ^2 x\right)$$
$$\sin x+1=2-2 \sin ^2 x$$

Step 4: Rearrange into a quadratic in $\sin x$ :

$$2 \sin ^2 x+\sin x-1=0$$

Step 5: Solve the quadratic equation:

$$\sin x=\frac{-1 \pm \sqrt{1-4(2)(-1)}}{2(2)}$$
$$\sin x=\frac{-1 \pm \sqrt{9}}{4}$$
$$\sin x=\frac{-1+3}{4} \quad \text{or} \quad \sin x=\frac{-1-3}{4}$$
$$\sin x=\frac{1}{2} \quad \text{or} \quad \sin x=-1$$

Step 6: Find solutions in $[0,2 \pi]$ :

- For $\sin x=\frac{1}{2}, x=\frac{\pi}{6}, \frac{5 \pi}{6}$.

- For $\sin x=-1, x=\frac{3 \pi}{2}$.

Answer: $\left\{\frac{\pi}{6}, \frac{5 \pi}{6}, \frac{3 \pi}{2}\right\}$, Option 3.

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# Question19

**In a triangle ABC , with usual notations, $\frac{\cos B+\cos C}{b+c}+\frac{\cos A}{a}$ has the value MHT CET 2024 (15 May Shift 2)**

**Options:**

A. $\frac{1}{\mathrm{b}+\mathrm{c}}$

B. $\cdot \frac{1}{\mathrm{b}}$

C. $\frac{1}{\mathrm{c}}$

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

**Answer: D**

## Solution:

$$\frac{\cos B+\cos C}{b+c}+\frac{\cos A}{a}$$
$$=\frac{a\cos B+a\cos C+b\cos A+c\cos A}{a(b+c)}$$
$$=\frac{(a\cos B+b\cos A)+(a\cos C+c\cos A)}{a(b+c)}$$

$$=\frac{c+b}{a(b+c)}$$
$$=\frac{1}{a}$$

...[By projection rule]

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# Question20

**The number of integral values of k for which the equation $7\cos x+5\sin x=2\mathrm{k}+1$ has a solution, is MHT CET 2024 (15 May Shift 1)**

**Options:**

A. 4

B. 8

C. 10

D. 12

**Answer: B**

## Solution:

$$-\sqrt{7^2+5^2}\leq(7\cos x+5\sin x)\leq\sqrt{7^2+5^2}$$
$$\Rightarrow-\sqrt{74}\leq(7\cos x+5\sin x)\leq\sqrt{74}$$
$$\Rightarrow-8.6\leq 2\mathrm{k}+1\leq 8.6$$
$$\Rightarrow-4.8\leq\mathrm{k}\leq 3.8$$

Integral values of $k$ are $-4,-3,-2,-1,0,1,2,3$

Number of integral values of $k=8$

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# Question21

**Let $a, b, c$ be three non-zero real numbers such that the equation $\sqrt{3}\mathrm{a}\cos x+2b\sin x=c, x\in\left[-\frac{\pi}{2},\frac{\pi}{2}\right]$ has two distinct real roots $\alpha$ and $\beta$ with $\alpha+\beta=\frac{\pi}{3}$. Then the value of $\frac{b}{a}$ is MHT CET 2024 (15 May Shift 1)**

**Options:**

A. $0\cdot 1$

B. 0.5

C. $-0\cdot 5$

D. 1

**Answer: B**

## Solution:

$\alpha$ and $\beta$ are roots of $\sqrt{3}\mathrm{a}\cos x+2\ \mathrm{b}\sin x=\mathrm{c}$

$$\therefore\quad \sqrt{3}a\cos\alpha+2b\sin\alpha=c\ldots(i)$$
$$\sqrt{3}a\cos\beta+2b\sin\beta=c\ldots(ii)$$

Subtracting (ii) from (i), we get

$$\sqrt{3}a(\cos\alpha-\cos\beta)+2b(\sin\alpha-\sin\beta)=0$$
$$\Rightarrow\sqrt{3}a\left[-2\sin\left(\frac{\alpha+\beta}{2}\right)\sin\left(\frac{\alpha-\beta}{2}\right)\right]$$
$$++2b\left[2\cos\left(\frac{\alpha+\beta}{2}\right)\sin\left(\frac{\alpha-\beta}{2}\right)\right]=0$$
$$\Rightarrow-\sqrt{3}a\left[2\sin\left(\frac{\pi}{6}\right)\sin\left(\frac{\alpha-\beta}{2}\right)\right]$$
$$++2b\left[2\cos\left(\frac{\pi}{6}\right)\sin\left(\frac{\alpha-\beta}{2}\right)\right]=0$$
$$\Rightarrow-\sqrt{3}a\sin\left(\frac{\alpha-\beta}{2}\right)+2b\left[\sqrt{3}\sin\left(\frac{\alpha-\beta}{2}\right)\right]=0$$
$$\Rightarrow-\sqrt{3}a+2\sqrt{3}b=0\Rightarrow\frac{b}{a}=\frac{1}{2}=0.5$$

---

# Question22

**If the equation $\cos^4\theta+\sin^4\theta+\lambda=0$. has real solutions for $\theta$, then $\lambda$ lies in the interval MHT CET 2024 (15 May Shift 1)**

**Options:**

A. $\left(-\frac{5}{4},-1\right)$

B. $\left[-\frac{3}{2},-\frac{5}{4}\right]$

C. $\left(-\frac{1}{2},-\frac{1}{4}\right]$.

D. $\left[-1,-\frac{1}{2}\right]$

**Answer: D**

## Solution:

$$\begin{aligned}
&\cos^4\theta+\sin^4\theta+\lambda=0\\
&\Rightarrow\left(\sin^2\theta+\cos^2\theta\right)^2-2\sin^2\theta\cos^2\theta+\lambda=0\\
&\Rightarrow 1-2\sin^2\theta\cos^2\theta+\lambda=0\\
&\Rightarrow\lambda=2\sin^2\theta\cos^2\theta-1\\
&\Rightarrow\lambda=\frac{\sin^2 2\theta}{2}-1
\end{aligned}$$

Since $-1\leq\sin 2\theta\leq 1$,

$$\begin{aligned}
&0\leq\sin^2 2\theta\leq 1\\
&\Rightarrow 0\leq\frac{\sin^2 2\theta}{2}\leq\frac{1}{2}\\
&\Rightarrow -1\leq\frac{\sin^2 2\theta}{2}-1\leq-\frac{1}{2}\\
&\Rightarrow\lambda\in\left[-1,-\frac{1}{2}\right]
\end{aligned}$$

---------------------------------------------------------------------------------------------------

# Question23

**The general solution of $\sin x+\cos x=1$ is MHT CET 2024 (11 May Shift 2)**

**Options:**

A. $x=2\mathrm{n}\pi,\mathrm{n}\in\mathbb{Z}$

B. $x=2\mathrm{n}\pi+\frac{\pi}{2},\mathrm{n}\in\mathbb{Z}$

C. $x=\mathrm{n}\pi+(-1)^{\mathrm{n}}\frac{\pi}{4}-\frac{\pi}{4},\mathrm{n}\in\mathbb{Z}$

D. not existing

**Answer: C**

## Solution:

$$\sin x+\cos x=1$$
$$\sqrt{2}\left[\frac{\sin x}{\sqrt{2}}+\frac{\cos x}{\sqrt{2}}\right]=1$$

$$\sin x\cdot\cos 45^{\circ}+\cos x\cdot\sin 45^{\circ}=\frac{1}{\sqrt{2}}$$
$$\sin\left(x+\frac{\pi}{4}\right)=\sin\left(n\pi+(-1)^{n}\frac{\pi}{4}\right)$$

Hence

$$\mathrm{x}+\frac{\pi}{4}=\mathrm{n}\pi+(-1)^{\mathrm{n}}\frac{\pi}{4}$$
$$\mathrm{x}=\mathrm{n}\pi+(-1)^{\mathrm{n}}\frac{\pi}{4}-\frac{\pi}{4}$$

---

# Question24

**If for certain $x, 3\cos x\neq 2\sin x$, then the general solution of, $\sin^2 x-\cos 2x=2-\sin 2x$, is MHT CET 2024 (10 May Shift 1)**

**Options:**

A. $(2\mathrm{n}+1)\frac{\pi}{2}, \mathrm{n}\in\mathbb{Z}$

B. $(2\mathrm{n}+1)\frac{\pi}{4}, \mathrm{n}\in\mathbb{Z}$

C. $\mathrm{n}\pi+(-1)^{\mathrm{n}}\frac{\pi}{3}, \mathrm{n}\in\mathbb{Z}$

D. $\frac{n\pi}{2}+1, n\in\mathbb{Z}$

**Answer: A**

## Solution:

Given,

$$\sin^2 x-\cos 2x=2-\sin 2x$$
$$\Rightarrow 1-\cos^2 x-\left(2\cos^2 x-1\right)-2+\sin 2x=0$$
$$\Rightarrow 1-3\cos^2 x+1-2+2\sin x\cdot\cos x$$
$$\Rightarrow \cos x(2\sin x-3\cos x)=0$$
$$\Rightarrow \cos x=0 \text{ or } 2\sin x-3\cos x=0$$

But $2\sin x\neq 3\cos x$

...[Given]

$$\Rightarrow \cos x=0$$
$$\Rightarrow x=(2\mathrm{n}+1)\frac{\pi}{2}, \mathrm{n}\in\mathrm{Z}$$

---

# Question25

**The numerical value of $\tan\left(2\tan^{-1}\left(\frac{1}{5}\right)+\frac{\pi}{4}\right)$ MHT CET 2024 (10 May Shift 1)**

**Options:**

A. $\frac{-7}{17}$

B. $\frac{-17}{7}$

C. $\frac{17}{7}$

D. $\frac{7}{17}$

**Answer: C**

## Solution:

$$\text{Let } 2\tan^{-1}\left(\frac{1}{5}\right)=x$$

$$\therefore \quad \tan^{-1}\left(\frac{1}{5}\right)=\frac{x}{2}$$

$$\therefore \quad \tan\frac{x}{2}=\frac{1}{5}$$

Using

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

$$\therefore \quad \tan x=\frac{2\tan\frac{x}{2}}{1-\tan^2\frac{x}{2}}$$

$$\Rightarrow \tan x=\frac{2\times\frac{1}{5}}{1-\frac{1}{25}}$$

$$\Rightarrow \tan x=\frac{5}{12}\ldots(i)$$

$$\text{Consider } \tan\left(2\tan^{-1}\left(\frac{1}{5}\right)+\frac{\pi}{4}\right)$$

$$=\tan\left(x+\frac{\pi}{4}\right)$$

$$=\frac{\tan x+\tan\frac{\pi}{4}}{1-\tan x\cdot\tan\frac{\pi}{4}}$$

$$=\frac{\frac{5}{12}+1}{1-\frac{5}{12}}$$

$$=\frac{\frac{17}{12}}{\frac{7}{12}}=\frac{17}{7}$$

---

# Question26

**Let $2\sin^2 x+3\sin x-2>0$ and $x^2-x-2<0$ ( $x$ is measured in radians).Then $x$ lies in the interval MHT CET 2024 (09 May Shift 2)**

**Options:**

A. $\left(\frac{\pi}{6}, \frac{5\pi}{6}\right)$

B. $\left(-1, \frac{5\pi}{6}\right)$

C. $(-1, 2)$

D. $\left(\frac{\pi}{6}, 2\right)$

**Answer: D**

## Solution:

$$\begin{aligned} \therefore \quad & 2\sin^2 x + 3\sin x - 2 > 0 \\ & (2\sin x - 1)(\sin x + 2) > 0 \\ & \Rightarrow 2\sin x - 1 > 0 \ldots [\because \sin x + 2 > 0 \text{ and } x \in \mathrm{R}] \\ & \Rightarrow \sin x > \frac{1}{2} \\ & \Rightarrow x \in \left(\frac{\pi}{6}, \frac{5\pi}{6}\right) \end{aligned}$$

Also, $x^2 - x - 2 < 0$
$\Rightarrow (x-2)(x+1) < 0$
$\Rightarrow -1 < x < 2$

Since $2 < \frac{5\pi}{6}$

$\therefore \quad x$ must lie in $\left(\frac{\pi}{6}, 2\right)$

---

# Question27

**The number of integral values of $k$, for which the equation $7\cos x + 5\sin x = 2\mathrm{k} + 1$ has a solution, is MHT CET 2024 (09 May Shift 2)**

**Options:**

A. 4

B. 8

C. 10

D. 2

**Answer: B**

## Solution:

$$-\sqrt{7^2+5^2} \leq (7\cos x+5\sin x) \leq \sqrt{7^2+5^2}$$
$$\Rightarrow -\sqrt{74} \leq (7\cos x+5\sin x) \leq \sqrt{74}$$
$$\Rightarrow -8.6 \leq 2\mathrm{k}+1 \leq 8.6$$
$$\Rightarrow -4.8 \leq \mathrm{k} \leq 3.8$$

Integral values of k are $-4,-3,-2,-1,0,1,2,3$

Number of integral values of $k=8$

------------------------------------------------------------------------------------------------

# Question28

**The smallest positive value of $x$ in degrees satisfying the equation $\tan(x+100^\circ)=\tan(x+50^\circ)\tan(x)\tan(x-50^\circ)$ is MHT CET 2024 (09 May Shift 2)**

**Options:**

A. $30^\circ$

B. $15^\circ$

C. $45^\circ$

D. $60^\circ$

**Answer: A**

## Solution:

$$\tan(x+100^\circ)=\tan(x+50^\circ)\tan(x)\tan(x-50^\circ)$$
$$\Rightarrow \frac{\tan(x+100^\circ)}{\tan(x-50^\circ)}=\tan(x+50^\circ)\tan(x)$$
$$\Rightarrow \frac{2\sin(x+100^\circ)\cos(x-50^\circ)}{2\cos(x+100^\circ)\sin(x-50^\circ)}$$

$$=\frac{2\sin(x+50^\circ)\sin x}{2\cos(x+50^\circ)\cos x}$$

$$\Rightarrow \frac{\sin(2x+50)+\sin 150^\circ}{\sin(2x+50)-\sin 150^\circ}$$

$$=\frac{\cos(50^\circ)-\cos(2x+50^\circ)}{\cos(2x+50^\circ)+\cos 50^\circ}$$

By componendo-dividendo, we get

$$\frac{2\sin(2x+50^\circ)}{2\sin(150^\circ)}=\frac{2\cos 50^\circ}{-2\cos(2x+50^\circ)}$$
$$\Rightarrow 2\sin(2x+50^\circ)\cos(2x+50^\circ)$$
$$\Rightarrow= -2\sin(150^\circ)\cos(50^\circ)$$
$$\Rightarrow \sin(4x+100^\circ)=-\cos 50^\circ$$
$$\Rightarrow \sin(4x+100^\circ)=\sin(270^\circ-50^\circ)$$
$$\Rightarrow 4x+100^\circ=220^\circ$$
$$\Rightarrow 4x=120^\circ$$
$$\Rightarrow x=30^\circ$$

---

# Question29

**If $\alpha+\beta=\frac{\pi}{2}$ and $\beta+\gamma=\alpha$, then $\tan\alpha$ equals MHT CET 2024 (09 May Shift 1)**

**Options:**

A. $2(\tan\beta+\tan\gamma)$

B. $\tan\beta+\tan\gamma$

C. $\tan\beta+2\tan\gamma$

D. $2\tan\beta+\tan\gamma$

**Answer: C**

## Solution:

Given, $\alpha=\beta+\gamma$

$$\begin{aligned} \therefore \quad \gamma &= \alpha-\beta \\ \tan\gamma &= \tan(\alpha-\beta) \\ &= \frac{\tan\alpha-\tan\beta}{1+\tan\alpha\cdot\tan\beta} \end{aligned}$$

$$= \frac{\tan\alpha-\tan\beta}{1+\tan\alpha\cdot\tan\left(\frac{\pi}{2}-\alpha\right)} \quad \cdots \left[\begin{array}{l} \alpha+\beta=\frac{\pi}{2} \\ \therefore \beta=\frac{\pi}{2}-\alpha \end{array}\right]$$

$$= \frac{\tan\alpha-\tan\beta}{1+\tan\alpha\cot\alpha}$$

$$= \frac{\tan\alpha-\tan\beta}{2}$$

$$\Rightarrow 2\tan\gamma=\tan\alpha-\tan\beta$$
$$\Rightarrow \tan\alpha=2\tan\gamma+\tan\beta$$

---

# Question30

**The general solution of $\sin x-3\sin 2x+\sin 3x=\cos x-3\cos 2x+\cos 3x$ is MHT CET 2024 (09 May Shift 1)**

**Options:**

A. $x=\mathrm{n}\pi+\frac{\pi}{4}, \mathrm{n}\in\mathbb{Z}$

B. $x=2\mathrm{n}\pi+\frac{\pi}{4}, \mathrm{n}\in\mathbb{Z}$

C. $x=\mathrm{n}\pi+(-1)^{\mathrm{n}}\frac{\pi}{4}, \mathrm{n}\in\mathbb{Z}$

D. $x=\frac{\mathrm{n}\pi}{2}+\frac{\pi}{8}, \mathrm{n}\in\mathbb{Z}$

**Answer: D**

**Solution:**

$$\begin{aligned}&\sin x-3\sin 2x+\sin 3x\\&=\cos x-3\cos 2x+\cos 3x\\&\Rightarrow(\sin x+\sin 3x)-3\sin 2x-(\cos x+\cos 3x)\\&+3\cos 2x=0\\&\Rightarrow 2\sin 2x\cos x-3\sin 2x-2\cos 2x\cos x\\&+3\cos 2x=0\\&\Rightarrow\sin 2x(2\cos x-3)-\cos 2x(2\cos x-3)=0\\&\Rightarrow(\sin 2x-\cos 2x)(2\cos x-3)=0\\&\Rightarrow\cos 2x=\sin 2x\quad\ldots\left[\because\cos x\neq\frac{3}{2}\right]\end{aligned}$$

$$\begin{aligned}&\Rightarrow\cos 2x=\cos\left(\frac{\pi}{2}-2x\right)\\&\Rightarrow 2x=2n\pi\pm\left(\frac{\pi}{2}-2x\right)\end{aligned}$$

Neglecting $(-)$ sign, we get

$x=\frac{n\pi}{2}+\frac{\pi}{8}$

---

# Question31

**The Solution set of the equation $\sin^2\theta-\cos\theta=\frac{1}{4}$ in the interval $[0,2\pi]$ is MHT CET 2024 (04 May Shift 2)**

**Options:**

A. $\left\{\frac{\pi}{6},\frac{5\pi}{6}\right\}$

B. $\left\{\frac{\pi}{3},\frac{5\pi}{3}\right\}$

C. $\left\{\frac{\pi}{3},\frac{2\pi}{3}\right\}$

D. $\left\{\frac{2\pi}{3},\frac{4\pi}{3}\right\}$

**Answer: B**

**Solution:**

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

$$4-4\cos^2\theta-4\cos\theta-1=0$$
$$\Rightarrow 4\cos^2\theta+4\cos\theta-3=0$$
$$\Rightarrow \cos\theta=\frac{-1}{2} \text{ or } \cos\theta=\frac{1}{2}$$
$$\therefore \quad \theta=2\pi-\frac{\pi}{3},\frac{\pi}{3}$$
$$\therefore \quad \theta=\left\{\frac{5\pi}{3},\frac{\pi}{3}\right\}$$

---

## Question32

**If $\mathrm{A}>\mathrm{B}$ and $\tan\mathrm{A}-\tan\mathrm{B}=x$ and $\cot\mathrm{B}-\cot\mathrm{A}=y$, then $\cot(\mathrm{A}-\mathrm{B})=$ MHT CET 2024 (04 May Shift 2)**

**Options:**

A. $\frac{1}{y}-\frac{1}{x}$

B. $\frac{1}{x}-\frac{1}{y}$

C. $\frac{1}{x}+\frac{1}{y}$

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

**Answer: C**

### Solution:

Given, $\tan\mathrm{A}-\tan\mathrm{B}=x$

$\cot\mathrm{B}-\cot\mathrm{A}=y$

$$\Rightarrow \frac{1}{\tan B}-\frac{1}{\tan A}=y$$
$$\Rightarrow \frac{\tan A-\tan B}{\tan A\cdot\tan B}=y$$
$$\Rightarrow \tan A\cdot\tan B=\frac{x}{y}\ldots(i)$$

$$\text{Now, } \cot(A-B)=\frac{1}{\tan(A-B)}$$
$$=\frac{1+\tan A\cdot\tan B}{\tan A-\tan B}$$

$$= \frac{1+\frac{x}{y}}{x}$$
$$= \frac{y+x}{xy}$$
$$= \frac{1}{x}+\frac{1}{y}$$

----------------------------------------------------------------------------------------------------

# Question33

**The number of all values of $\theta$ in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ satisfying the equation $(1-\tan\theta)(1+\tan\theta)\sec^2\theta+2\tan^2\theta=0$ is MHT CET 2024 (03 May Shift 2)**

**Options:**

A. 1

B. 0

C. 2

D. infinitely many.

**Answer: C**

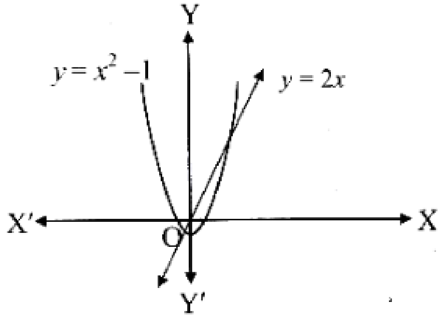
## Solution:

$$(1-\tan\theta)(1+\tan\theta)\sec^2\theta+2\tan^2\theta=0$$
$$\Rightarrow \left(1-\tan^2\theta\right)\left(1+\tan^2\theta\right)+2\tan^2\theta=0$$

Put $\tan^2\theta=x$

$$\Rightarrow (1-x)(1+x)+2x=0$$
$$\Rightarrow 1-x^2+2x=0$$
$$\Rightarrow x^2-1=2x$$

Let us draw graph of $y=x^2-1$ and $y=2x$



From the graph the two curves are intersecting at 2 points.

$\therefore$ There are 2 values of $x$.

Only one value of $x$ exists, for $\theta \in \left(\frac{-\pi}{2}, \frac{\pi}{2}\right)$

$\therefore$ $x = \tan^2 \theta$

$\therefore$ Two values of $\theta$ satisfies above equation

---

# Question34

**Let $2\sin^2 x + 3\sin x - 2 > 0$ and $x^2 - x - 2 < 0$. ( $x$ is measured in radians). The $x$ lies in the interval MHT CET 2024 (03 May Shift 1)**

**Options:**

A. $\left(\frac{\pi}{6}, \frac{5\pi}{6}\right)$

B. $\left(-1, \frac{5\pi}{6}\right)$

C. $(-1, 2)$

D. $\left(\frac{\pi}{6}, 2\right)$

**Answer: D**

## Solution:

$2\sin^2 x + 3\sin x - 2 > 0 \ldots (i)$

Let $y = \sin x$

$\therefore$ Equation (i) becomes

$$2y^2 + 3y - 2 > 0$$
$\therefore$ $2y^2 + 4y - y - 2 > 0$
$\therefore$ $2y(y+2) - 1(y+2) > 0$
$\therefore$ $(2y-1)(y+2) > 0$
$\therefore$ $(2y-1) > 0$ and $(y+2) > 0$ OR
$(2y-1) < 0$ and $(y+2) < 0$

$\therefore$ $y > \frac{1}{2}$ and $y > -2$
$y < \frac{1}{2}$ and $y < -2$
$\therefore$ $\sin x > \frac{1}{2}$ and $\sin x > -2$
$\sin x < \frac{1}{2}$ and $\sin x < -2$

$\therefore$ $x > \frac{\pi}{6}$ and $\sin x > -2$

$\ldots [\because -1 \leq \sin x \leq 1$, second condition is not possible]

$\therefore$ $x > \frac{\pi}{6}$ and $\sin x > -1$ $\ldots [\because -1 \leq \sin x \leq 1]$

$\therefore$ $x \in \left(\frac{\pi}{6}, \infty\right)$
Given that $x^2 - x - 2 < 0$
$\therefore$ $(x-2)(x+1) < 0$
$\therefore$ $(x-2) < 0$ and $(x+1) > 0$ OR
$(x-2) > 0$ and $(x+1) < 0$
$\therefore$ $x < 2$ and $x > -1$
$x > 2$ and $x < -1$
$\therefore$ $x \in (-1, 2)$

OR

...(ii) [ $\because$ second condition is not possible]

$\therefore$ from (i) and (ii), we get

$x \in \left(\frac{\pi}{6}, 2\right)$

---

# Question35

**If $\theta$ and $\alpha$ are not odd multiples of $\frac{\pi}{2}$ then $\tan\theta = \tan\alpha$ implies principal solution is MHT CET 2024 (03 May Shift 1)**

**Options:**

A. $\theta = \alpha + \frac{n\pi}{2}, n \in \mathbb{Z}$

B. $\theta = \alpha + \frac{3n\pi}{2}, n \in \mathbb{Z}$

C. $\theta = n\pi + \alpha, n \in \mathbb{Z}$

D. $\theta = \frac{n\pi}{4} + \alpha, n \in \mathbb{Z}$

Answer: C

### Solution:

$$\begin{aligned} & \tan\theta = \tan\alpha \\ \therefore \quad & \theta = n\pi + \alpha, n \in Z \end{aligned}$$

---

## Question36

**If $\alpha + \beta + \gamma = \pi$, then the expression $\sin^2\alpha + \sin^2\beta - \sin^2\gamma$ has the value MHT CET 2024 (02 May Shift 2)**

**Options:**

A. $2\sin\alpha\sin\beta\sin\gamma$

B. $2\cos\alpha\sin\beta\sin\gamma$

C. $2\sin\alpha\cos\beta\sin\gamma$

D. $2\sin\alpha\sin\beta\cos\gamma$

Answer: D

### Solution:

$$\begin{aligned} & \sin^2\alpha + \sin^2\beta - \sin^2\gamma \\ & = \sin^2\alpha + \sin(\beta+\gamma)\sin(\beta-\gamma) \\ & = \sin^2\alpha + \sin(\pi-\alpha)\sin(\beta-\gamma) \\ & = \sin\alpha[\sin\alpha + \sin(\beta-\gamma)] \\ & = \sin\alpha[\sin(\beta+\gamma) + \sin(\beta-\gamma)] \\ & = 2\sin\alpha\sin\beta\cos\gamma \end{aligned}$$

---

## Question37

**The general solution of $2\sqrt{3}\cos^2\theta = \sin\theta$ is MHT CET 2024 (02 May Shift 2)**

**Options:**

A. $n\pi + (-1)^n\frac{\pi}{3}, n \in \mathbb{Z}$

B. $n\pi+(-1)^n\frac{\pi}{6}, n\in\mathbb{Z}$

C. $n\pi\pm(-1)^n\frac{\pi}{4}, n\in\mathbb{Z}$

D. $n\pi+(-1)^n\frac{2\pi}{3}, n\in\mathbb{Z}$

**Answer: A**

**Solution:**

$$\begin{aligned}
&2\sqrt{3}\cos^2\theta=\sin\theta\\
&\Rightarrow 2\sqrt{3}\left(1-\sin^2\theta\right)=\sin\theta\\
&\Rightarrow 2\sqrt{3}\sin^2\theta+\sin\theta-2\sqrt{3}=0\\
&\Rightarrow (\sqrt{3}\sin\theta+2)(2\sin\theta-\sqrt{3})=0\\
&\Rightarrow \sqrt{3}\sin\theta+2=0 \text{ or } 2\sin\theta-\sqrt{3}=0\\
&\Rightarrow \sin\theta=-\frac{2}{\sqrt{3}}, \text{ which is not possible}\\
&\text{or } \sin\theta=\frac{\sqrt{3}}{2}=\sin\frac{\pi}{3}\\
&\Rightarrow \theta=n\pi+(-1)^n\left(\frac{\pi}{3}\right), n\in Z
\end{aligned}$$

---

# Question38

**The value of $\cos\left(2\cos^{-1}x+\sin^{-1}x\right)$ at $x=\frac{1}{5}$, where $0\le\cos^{-1}x\le\pi$ and $-\frac{\pi}{2}\le\sin^{-1}x\le\frac{\pi}{2}$, is MHT CET 2024 (02 May Shift 1)**

**Options:**

A. $\frac{\sqrt{6}}{5}$

B. $-\frac{\sqrt{6}}{5}$

C. $\frac{2\sqrt{6}}{5}$

D. $-\frac{2\sqrt{6}}{5}$

**Answer: D**

**Solution:**

$$
\begin{aligned}
&\cos\left(2\cos^{-1}x+\sin^{-1}x\right)\\
&=\cos\left[\left(\sin^{-1}x+\cos^{-1}x\right)+\cos^{-1}x\right]\\
&=\cos\left(\frac{\pi}{2}+\cos^{-1}x\right)\\
&=-\sin\left(\cos^{-1}x\right)\\
&=-\sin\left(\sin^{-1}\sqrt{\left(1-x^2\right)}\right)\\
&=-\sqrt{1-x^2}\\
&=-\sqrt{1-\left(\frac{1}{5}\right)^2}\\
&=-\sqrt{\frac{24}{25}}=-\frac{2\sqrt{6}}{5}
\end{aligned}
$$

---

## Question39

**The length of the longest interval, in which the function $3\sin x-4\sin^3 x$ is increasing, is MHT CET 2024 (02 May Shift 1)**

**Options:**

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

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

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

D. $\pi$

**Answer: A**

### Solution:

$$f(x) = 3\sin x - 4\sin^3 x$$
$$\Rightarrow f(x) = \sin 3x$$
$$\Rightarrow f'(x) = 3\cos 3x$$

For $f(x)$ to be increasing,

$$f'(x) \geq 0$$
$$\Rightarrow 3\cos 3x \geq 0$$
$$\Rightarrow \cos 3x \geq 0$$
$$\Rightarrow \frac{-\pi}{2} \leq 3x \leq \frac{\pi}{2}$$
$$\Rightarrow \frac{-\pi}{6} \leq x \leq \frac{\pi}{6}$$

$\therefore$ largest length in which $f(x)$ is increasing

$$= \frac{\pi}{6} - \left(\frac{-\pi}{6}\right) = \frac{\pi}{3}$$

---

# Question40

**If $a\cos 2\theta + b\sin 2\theta = c$ has $\alpha$ and $\beta$ as its roots, then the value of $\tan\alpha + \tan\beta$ is MHT CET 2023 (14 May Shift 2)**

**Options:**

A. $\frac{2b}{c+a}$

B. $\frac{2a}{b+c}$

C. $\frac{b}{c+a}$

D. $\frac{a}{b+c}$

**Answer: A**

**Solution:**

$$\text{We have, } a\cos 2\theta + b\sin 2\theta = c$$
$$\Rightarrow a\left(\frac{1-\tan^2\theta}{1+\tan^2\theta}\right) + b\left(\frac{2\tan\theta}{1+\tan^2\theta}\right) = c$$
$$\Rightarrow a - a\tan^2\theta + 2b\tan\theta = c + c\tan^2\theta$$
$$\Rightarrow -(a+c)\tan^2\theta + 2b\tan\theta + (a-c) = 0$$
$$\therefore \quad \tan\alpha + \tan\beta = -\frac{2b}{-(c+a)} = \frac{2b}{c+a}$$

---

# Question41

**If $\sin(\theta-\alpha), \sin\theta$ and $\sin(\theta+\alpha)$ are in H.P., then the value of $\cos 2\theta$ is MHT CET 2023 (14 May Shift 1)**

**Options:**

A. $1+4\cos^2\frac{\alpha}{2}$

B. $1-4\cos^2\frac{\alpha}{2}$

C. $-1-4\cos^2\frac{\alpha}{2}$

D. $-1+4\cos^2\frac{\alpha}{2}$

**Answer: B**

**Solution:**

$\sin(\theta-\alpha), \sin\theta$ and $\sin(\theta+\alpha)$ are in H.P. $\Rightarrow \frac{1}{\sin(\theta-\alpha)}, \frac{1}{\sin\theta}, \frac{1}{\sin(\theta+\alpha)}$ will be in A.P.

$$\therefore \quad \frac{2}{\sin\theta}=\frac{1}{\sin(\theta-\alpha)}+\frac{1}{\sin(\theta+\alpha)}$$

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

---

## Question42

**The principal solutions of the equation $\sec x+\tan x=2\cos x$ are MHT CET 2023 (14 May Shift 1)**

**Options:**

A. $\frac{\pi}{6}, \frac{5\pi}{6}$

B. $\frac{\pi}{6}, \frac{\pi}{20}$

C. $\frac{\pi}{6}, \frac{2\pi}{3}$

D. $\frac{\pi}{6}, \frac{\pi}{12}$

**Answer: A**

**Solution:**

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

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

---

# Question43

**The solutions of** $\sin x + \sin 5x = \sin 3x$ **in** $\left(0, \frac{\pi}{2}\right)$ **are MHT CET 2023 (13 May Shift 2)**

**Options:**

A. $\frac{\pi}{4}, \frac{\pi}{10}$

B. $\frac{\pi}{6}, \frac{\pi}{3}$

C. $\frac{\pi}{4}, \frac{\pi}{12}$

D. $\frac{\pi}{8}, \frac{\pi}{16}$

**Answer: B**

**Solution:**

$$\sin x+\sin 5x=\sin 3x$$
$$\Rightarrow 2\sin 3x\cos 2x=\sin 3x$$
$$\Rightarrow \sin 3x(2\cos 2x-1)=0$$
$$\Rightarrow \sin 3x=0 \text{ or } \cos 2x=\frac{1}{2}=\cos\frac{\pi}{3}$$
$$\Rightarrow 3x=\mathrm{n}\pi \text{ or } 2x=2\mathrm{n}\pi\pm\frac{\pi}{3}$$
$$\Rightarrow x=\frac{\mathrm{n}\pi}{3} \text{ or } x=\mathrm{n}\pi\pm\frac{\pi}{6}$$

$$\Rightarrow x=\tfrac{\pi}{3},\tfrac{\pi}{6} \qquad \ldots\left[\because x\in\left(0,\tfrac{\pi}{2}\right)\right]$$

---

# Question44

**The value of** $\cos(18^\circ-\mathrm{A})\cdot\cos(18^\circ+\mathrm{A}) - \cos(72^\circ-\mathrm{A})\cos(72^\circ+\mathrm{A})$ is **MHT CET 2023 (13 May Shift 1)**

**Options:**

A. $\cos 72^\circ$

B. $\sin 54^\circ$

C. $\sin 18^\circ$

D. $\cos 54^\circ$

**Answer: B**

**Solution:**

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

---

# Question45

**The general solution of the equation** $3\sec^2\theta=2\operatorname{cosec}\theta$ **is MHT CET 2023 (13 May Shift 1)**

**Options:**

A. $n\pi+\frac{\pi}{4}, n \in Z$

B. $2n\pi+(-1)^{n}\frac{\pi}{12}, n \in Z$

C. $n\pi+(-1)^{n}\frac{\pi}{6}, n \in Z$

D. $n\pi+(-1)^{n}\frac{\pi}{3}, n \in Z$

**Answer: C**

**Solution:**

$$\begin{aligned} & 3\sec^2\theta = 2\operatorname{cosec}\theta \\ & \Rightarrow \frac{3}{\cos^2\theta} = \frac{2}{\sin\theta} \\ & \Rightarrow \frac{3}{1-\sin^2\theta} = \frac{2}{\sin\theta} \\ & \Rightarrow 2\sin^2\theta + 3\sin\theta - 2 = 0 \\ & \Rightarrow (2\sin\theta-1)(\sin\theta+2) = 0 \\ & \Rightarrow \sin\theta = \frac{1}{2} \end{aligned}$$

or $\sin\theta = -2$, which is not possible

$$\begin{aligned} \therefore \quad & \sin\theta = \frac{1}{2} = \sin\frac{\pi}{6} \\ & \Rightarrow \theta = n\pi + (-1)^{n}\frac{\pi}{6}, n \in Z \end{aligned}$$

---

# Question46

**If $\tan\theta = \frac{\sin\alpha-\cos\alpha}{\sin\alpha+\cos\alpha}, 0 \le \alpha \le \frac{\pi}{2}$, then the value of $\cos 2\theta$ is MHT CET 2023 (12 May Shift 1)**

**Options:**

A. $\cos 2\alpha$

B. $\sin\alpha$

C. $\cos\alpha$

D. $\sin 2\alpha$

**Answer: D**

**Solution:**

$$\tan\theta = \frac{\sin\alpha - \cos\alpha}{\sin\alpha + \cos\alpha}$$

$$\frac{\sin\theta}{\cos\theta} = \frac{\sin\alpha - \cos\alpha}{\sin\alpha + \cos\alpha}$$

$\therefore \quad \sin\alpha\sin\theta + \cos\alpha\sin\theta = \sin\alpha\cos\theta - \cos\alpha\cos\theta$

$\therefore \quad \cos\alpha\cos\theta + \sin\alpha\sin\theta = \sin\alpha\cos\theta - \cos\alpha\sin\theta$

$\therefore \quad \cos(\alpha - \theta) = \sin(\alpha - \theta)$

$\therefore \quad \alpha - \theta = \frac{\pi}{4}$

$\therefore \quad \theta = \alpha - \frac{\pi}{4}$

$\therefore \quad 2\theta = 2\alpha - \frac{\pi}{2}$

$\therefore \quad \cos 2\theta = \cos\left(2\alpha - \frac{\pi}{2}\right)$

$= \cos\left[\because 0 \le \alpha \le \frac{\pi}{2}\right]$

$= \cos\left(\frac{\pi}{2} - 2\alpha\right)\Big] \quad \ldots[\because \cos(-\theta) = \cos\theta]$

$\therefore \quad \cos 2\theta = \sin 2\alpha$

---

# Question47

**The solution set of $8\cos^2\theta + 14\cos\theta + 5 = 0$, in the interval $[0, 2\pi]$, is MHT CET 2023 (12 May Shift 1)**

**Options:**

A. $\left\{\frac{\pi}{3}, \frac{2\pi}{3}\right\}$

B. $\left\{\frac{\pi}{3}, \frac{4\pi}{3}\right\}$

C. $\left\{\frac{2\pi}{3}, \frac{4\pi}{3}\right\}$

D. $\left\{\frac{2\pi}{3}, \frac{5\pi}{3}\right\}$

**Answer: C**

**Solution:**

$$8\cos^2\theta + 14\cos\theta + 5 = 0$$

$$\therefore \quad 8\cos^2\theta + 10\cos\theta + 4\cos\theta + 5 = 0$$

$$\therefore \quad 2\cos\theta(4\cos\theta + 5) + 1(4\cos\theta + 5) = 0$$

$$\therefore \quad (2\cos\theta + 1)(4\cos\theta + 5) = 0$$

$$\therefore \quad \cos\theta = \frac{-1}{2} \text{ or } \cos\theta = \frac{-5}{4}$$

But $\cos\theta = \frac{-5}{4}$ is not possible as $\cos\theta \in [-1, 1]$ for all values of $\theta$.

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

$$\therefore \quad \theta \in \left\{\frac{2\pi}{3}, \frac{4\pi}{3}\right\}$$

---

## Question48

**If general solution of $\cos^2\theta - 2\sin\theta + \frac{1}{4} = 0$ is $\theta = \frac{\mathrm{n}\pi}{\mathrm{A}} + (-1)^{\mathrm{n}}\frac{\pi}{\mathrm{B}}, \mathrm{n} \in$ Z, then $\mathrm{A} + \mathrm{B}$ has the value MHT CET 2023 (12 May Shift 1)**

**Options:**

A. 7

B. 6

C. 1

D. -7

**Answer: A**

**Solution:**

$\cos^2\theta - 2\sin\theta + \frac{1}{4} = 0$

$\therefore \quad \left(1 - \sin^2\theta\right) - 2\sin\theta + \frac{1}{4} = 0$

$\therefore \quad \sin^2\theta + 2\sin\theta - \frac{5}{4} = 0$

$\therefore \quad 4\sin^2\theta + 8\sin\theta - 5 = 0$

$\therefore \quad 4\sin^2\theta + 10\sin\theta - 2\sin\theta - 5 = 0$

$\therefore \quad 2\sin\theta(2\sin\theta + 5) - 1(2\sin\theta + 5) = 0$

$\therefore \quad (2\sin\theta - 1)(2\sin\theta + 5) = 0$

$\therefore \quad \sin\theta = \frac{1}{2}$ or $\sin\theta = \frac{-5}{2}$

But $\sin\theta = \frac{-5}{2}$ is not possible as $\sin\theta \in [-1, 1]$ for all values of $\theta$.

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

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

$\therefore \quad \theta = \frac{n\pi}{1} + (-1)^{\mathrm{n}}\frac{\pi}{6}$

$\therefore$ A $\Rightarrow$ A and $B = 6$

$\Rightarrow$ B $= 7$

---

## Question49

**If** a **and** b **are positive number such that** a $>$ b**, then the minimum value of** $a\sec\theta - b\tan\theta\left(0 < \theta < \frac{\pi}{2}\right)$ **is MHT CET 2023 (11 May Shift 2)**

**Options:**

A. $\frac{1}{\sqrt{a^2-b^2}}$

B. $\frac{1}{\sqrt{a^2+b^2}}$

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

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

**Answer: D**

**Solution:**

let $f(\theta) = a\sec\theta - b\tan\theta$

$\therefore \quad f'(\theta) = a\sec\theta\tan\theta - b\sec^2\theta$

$= \sec\theta(a\tan\theta - b\sec\theta)$

$\therefore \quad f'(\theta) = 0 \Rightarrow \sec\theta(a\tan\theta - b\sec\theta) = 0$

$\Rightarrow a\tan\theta - b\sec\theta = 0 \quad \ldots\left[\text{As } 0 < \pi < \frac{\pi}{2}, \sec\theta \neq 0\right]$

$\Rightarrow a\sin\theta - b = 0 \quad \ldots\left[\text{As } 0 < \pi < \frac{\pi}{2}, \cos\theta \neq 0\right]$

$\Rightarrow \sin\theta = \frac{b}{a}$

$\Rightarrow \sec\theta = \frac{a}{\sqrt{a^2 - b^2}}$ and $\tan\theta = \frac{b}{\sqrt{a^2 - b^2}}$

Now,

$f''(\theta) = \sec\theta\tan\theta(a\tan\theta - b\sec\theta)$

$+ \sec\theta\left(a\sec^2\theta - b\sec\theta\tan\theta\right)$

$= a\tan^2\theta\sec\theta - b\sec^2\theta\tan\theta$

$+ a\sec^3\theta - b\sec^2\theta\tan\theta$

$= a\sec\theta\left(\tan^2\theta + \sec^2\theta\right)$

$= a\sec\theta\left(1 + 2\tan^2\theta\right)$

$> 0 \quad \ldots\left[\because \text{ a is positive and } 0 < \theta < \frac{\pi}{2}\right]$

$\therefore$

$f(\theta)$

is minimum when $\sin\theta = \frac{b}{a}$.

$\therefore$ Minimum value of $f(\theta)$

$= a\left(\frac{a}{\sqrt{a^2 - b^2}}\right) - b\left(\frac{b}{\sqrt{a^2 - b^2}}\right) \quad \ldots[\text{From (i)}]$

$= \frac{a^2 - b^2}{\sqrt{a^2 - b^2}}$

$= \sqrt{a^2 - b^2}$

---

# Question50

**If $\cos x + \cos y - \cos(x + y) = \frac{3}{2}$, then MHT CET 2023 (11 May Shift 2)**

**Options:**

A. $x + y = 0$

B. $x = 2y$

C. $x = y$

D. $2x = y$

**Answer: C**

**Solution:**

$\cos x+\cos y-\cos(x+y)=\frac{3}{2}$

$\therefore\quad 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)-\left(2\cos^2\left(\frac{x+y}{2}\right)-1\right)=\frac{3}{2}$

$\ldots\begin{bmatrix}\because \cos\alpha+\cos\beta=2\cos\left(\frac{\alpha+\beta}{2}\right)\cos\left(\frac{\alpha-\beta}{2}\right) \text{ and} \\ \cos\theta=2\cos^2\left(\frac{\theta}{2}\right)-1\end{bmatrix}$

$$\therefore\quad 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)-2\cos^2\left(\frac{x+y}{2}\right)=\frac{3}{2}-1$$

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

$$\therefore\quad 4\cos^2\left(\frac{x+y}{2}\right)-4\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)+1=0$$

Substituting $\cos\left(\frac{x+y}{2}\right)=\mathrm{t}$, we get

$4\mathrm{t}^2-4\mathrm{t}\cos\left(\frac{x-y}{2}\right)+1=0$

As $t$ is real, we get $b^2-4ac\geq 0$

$$\Rightarrow\left[-4\cos\left(\frac{x-y}{2}\right)\right]^2-4\times4\times1\geq0$$

$$\Rightarrow 16\cos^2\left(\frac{x-y}{2}\right)-16\geq0$$

$$\Rightarrow \cos^2\left(\frac{x-y}{2}\right)\geq1$$

$$\Rightarrow \cos^2\left(\frac{x-y}{2}\right)=1$$

$\ldots[\because -1\leq\cos\theta\leq1$, for all values of $\theta]$

$$\Rightarrow\frac{x-y}{2}=0$$

⇒ x = y

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# Question51

**If the general solution of the equation $\frac{\tan 3x-1}{\tan 3x+1}=\sqrt{3}$ is $x=\frac{\mathrm{n}\pi}{\mathrm{p}}+\frac{7\pi}{\mathrm{q}}$, n, p, q, ∈ Z, then $\frac{p}{q}$ is MHT CET 2023 (11 May Shift 2)**

**Options:**

A. 12

B. $\frac{1}{12}$

C. 3

D. 36

**Answer: B**

**Solution:**

$$\frac{\tan 3x-1}{\tan 3x+1}=\sqrt{3}$$

$$\therefore \quad \frac{\tan 3x-\tan \frac{\pi}{4}}{1+(\tan 3x)\left(\tan \frac{\pi}{4}\right)}=\sqrt{3}$$

$$\therefore \quad \tan\left(3x-\frac{\pi}{4}\right)=\tan\left(\frac{\pi}{3}\right)$$

$$\therefore \quad 3x-\frac{\pi}{4}=n\pi+\frac{\pi}{3}$$

$$\therefore \quad 3x=\mathrm{n}\pi+\frac{\pi}{3}+\frac{\pi}{4}$$

$$\therefore \quad 3x=\mathrm{n}\pi+\frac{7\pi}{12}$$

$$\therefore \quad x=\frac{\mathrm{n}\pi}{3}+\frac{7\pi}{36}$$

Comparing with $\frac{\mathrm{n}\pi}{\mathrm{p}}+\frac{7\pi}{\mathrm{q}}$, we get

$$\mathrm{p}=3, \mathrm{q}=36$$

$$\therefore \quad \frac{\mathrm{p}}{\mathrm{q}}=\frac{3}{36}=\frac{1}{12}$$

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# Question52

**The number of possible solutions of $\sin\theta+\sin 4\theta+\sin 7\theta=0, \theta\in(0,\pi)$ are MHT CET 2023 (10 May Shift 1)**

**Options:**

A. 3

B. 4

C. 6

D. 8

**Answer: C**

**Solution:**

$$\sin 7\theta + \sin \theta + \sin 4\theta = 0$$
$$\Rightarrow 2 \sin 4\theta \cos 3\theta + \sin 4\theta = 0$$
$$\Rightarrow \sin 4\theta(2 \cos 3\theta + 1) = 0$$
$$\Rightarrow \sin 4\theta = 0 \quad \text{or} \quad \cos 3\theta = \frac{-1}{2}$$
$$\Rightarrow \sin 4\theta = 0 \quad \text{or} \quad \cos 3\theta = \cos\left(\frac{2\pi}{3}\right)$$
$$\Rightarrow 4\theta = \text{n}\pi \quad \text{or } 3\theta = 2\text{n}\pi \pm \frac{2\pi}{3}$$
$$\Rightarrow \theta = \frac{\text{n}\pi}{4} \quad \text{or} \quad \theta = \frac{2\text{n}\pi}{3} \pm \frac{2\pi}{9}$$
$$\theta = \frac{2\pi}{9}, \frac{\pi}{4}, \frac{4\pi}{9}, \frac{\pi}{2}, \frac{3\pi}{4}, \frac{8\pi}{9} \ldots [\because \theta \in (0, \pi)]$$

$\therefore$ Number of solutions $= 6$

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# Question53

**The number of solutions of $\tan x + \sec x = 2 \cos x$ in $[0, 2\pi]$ are MHT CET 2023 (10 May Shift 1)**

**Options:**

A. 6

B. 4

C. 3

D. 2

**Answer: D**

## Solution:

The given equation is defined for $x \neq \frac{\pi}{2}, \frac{3\pi}{2}$.

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

$\Rightarrow \frac{\sin x}{\cos x} + \frac{1}{\cos x} = 2 \cos x$

$\Rightarrow (\sin x + 1) = 2 \cos^2 x$

$\Rightarrow (\sin x + 1) = 2\left(1 - \sin^2 x\right)$

$\Rightarrow (\sin x + 1) = 2(1 - \sin x)(1 + \sin x)$

$\Rightarrow (1 + \sin x)[2(1 - \sin x) - 1] = 0$

$\Rightarrow 2(1 - \sin x) - 1 = 0$

$\ldots \left[\begin{array}{r}\because \sin x \neq -1 \text{ otherwise } \cos x = 0 \text{ and} \\ \tan x, \sec x \text{ will be undefined}\end{array}\right]$

$\Rightarrow \sin x = \frac{1}{2}$

$\Rightarrow x = \frac{\pi}{6}, \frac{5\pi}{6}$ in $(0, 2\pi)$

$\therefore$ number of solutions $= 2$

---

# Question54

**If $\cos^{-1} x - \cos^{-1} \frac{y}{3} = \alpha$, where $-1 \leq x \leq 1, -3 \leq y \leq 3, x \leq \frac{y}{3}$, then for all $x, y$ $9x^2 - 6xy \cos \alpha + y^2$ is equal to MHT CET 2023 (09 May Shift 1)**

**Options:**

A. $\sin^2 \alpha$

B. $3 \sin^2 \alpha$

C. $9 \sin^2 \alpha$

D. $\frac{4}{9} \sin^2 \alpha$

**Answer: C**

## Solution:

$$\cos^{-1} a-\cos^{-1} b=\cos^{-1}\left(ab+\sqrt{1-a^2}\cdot\sqrt{1-b^2}\right)$$

$$\therefore \quad \cos^{-1} x-\cos^{-1}\frac{y}{3}$$

$$=\cos^{-1}\left(\frac{xy}{3}+\sqrt{1-x^2}\cdot\sqrt{1-\frac{y^2}{9}}\right)=\alpha$$

$$\therefore \quad \frac{xy}{3}+\frac{\sqrt{1-x^2}\cdot\sqrt{9-y^2}}{3}=\cos\alpha$$

$$xy+\sqrt{1-x^2}\cdot\sqrt{9-y^2}=3\cos\alpha$$

$$xy-3\cos\alpha=-\sqrt{1-x^2}\cdot\sqrt{9-y^2}$$

squaring on both sides, we get

$$x^2y^2-6xy\cos\alpha+9\cos^2\alpha=\left(1-x^2\right)\left(9-y^2\right)$$
$$x^2y^2-6xy\cos\alpha+9\cos^2\alpha=9-y^2-9x^2+x^2y^2$$

i.e., $9x^2-6xy\cos\alpha+y^2=9\sin^2\alpha$

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# Question55

**The set of all possible values of $\theta$ in the interval $(0,\pi)$ for which the points $(1,2)$ and $(\sin\theta,\cos\theta)$ lie on the same side of the line $x+y=1$, is ——**
**. MHT CET 2022 (11 Aug Shift 1)**

**Options:**

A. $\left(0,\frac{\pi}{2}\right)$

B. $\left(0,\frac{\pi}{4}\right)$

C. $\left(0,\frac{3\pi}{4}\right)$

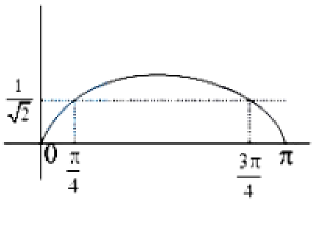
D. $\left(\frac{\pi}{4},\frac{3\pi}{4}\right)$

**Answer: A**

## Solution:

for lying on the same side $(\sin\theta+\cos\theta-1)(1+2-1)>0$

$$\Rightarrow \sin\theta+\cos\theta>1$$
$$\Rightarrow \frac{1}{\sqrt{2}}\sin\theta+\frac{1}{\sqrt{2}}\cos\theta>\frac{1}{\sqrt{2}}$$



$$\Rightarrow \sin\left(\theta+\frac{\pi}{4}\right)>\frac{1}{\sqrt{2}}$$
$$\Rightarrow \frac{\pi}{4}<\theta+\frac{\pi}{4}<\frac{3\pi}{4}$$
$$\Rightarrow 0<\theta<\frac{\pi}{2}$$

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## Question56

**The principal solutions of the equation $\sqrt{3}\operatorname{cosec} X+2=0$ are MHT CET 2022 (11 Aug Shift 1)**

**Options:**

A. $\frac{2\pi}{3}, \frac{5\pi}{3}$

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

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

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

**Answer: B**

**Solution:**

$$\sqrt{3}\operatorname{cosec} x+2$$
$$\Rightarrow \sin x=-\frac{\sqrt{3}}{2}=-\sin\frac{\pi}{3}$$
$$\Rightarrow x=\pi+\frac{\pi}{3} \text{ or } 2\pi-\frac{\pi}{3}$$
$$\Rightarrow x=\frac{4\pi}{3} \text{ or } \frac{5\pi}{3}$$

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## Question57

**If $\tan A=\frac{1}{2}, \tan B=\frac{1}{3}$ then $\tan(A+2B)$ has the value MHT CET 2022 (11 Aug Shift 1)**

**Options:**

A. 2

B. 3

C. 4

D. 1

Answer: A

**Solution:**

$\tan A=\frac{1}{2}, \tan B=\frac{1}{3}$

[given] we have $\tan 2B=\frac{2\tan B}{1-\tan^2 B}=\frac{3}{4}$

$\because \tan(A+2B)=\frac{\tan A+\tan 2B}{1-\tan A\cdot\tan 2B}=\frac{\frac{1}{2}+\frac{3}{4}}{1-\frac{1}{2}\times\frac{3}{4}}=\frac{\frac{5}{4}}{\frac{5}{8}}=2$

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# Question58

**The principal solutions of $\cot x+\sqrt{3}=0$ are MHT CET 2022 (10 Aug Shift 2)**

**Options:**

A. $\frac{5\pi}{6}, \frac{11\pi}{6}$

B. $\frac{\pi}{6}, \frac{7\pi}{6}$

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

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

Answer: A

**Solution:**

$$\cot x+\sqrt{3}=0$$
$$\Rightarrow \cot x=-\sqrt{3}$$
$$\Rightarrow x=\pi-\frac{\pi}{6} \text{ or } 2\pi-\frac{\pi}{6}$$
$$\Rightarrow x=\frac{5\pi}{6} \text{ or } \frac{11\pi}{6}$$

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# Question59

**If $\sin\left(\cot^{-1}(x+1)\right)=\cos\left(\tan^{-1} x\right)$, then the value of $x$ is equal to MHT CET 2022 (10 Aug Shift 2)**

**Options:**

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

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

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

D. $\frac{1}{3}$

Answer: A

**Solution:**

$$\sin\left(\cot^{-1}(x+1)\right) = \cos\left(\tan^{-1} x\right)$$
$$\Rightarrow \sin\sin^{-1}\left\{\frac{1}{\sqrt{(x+1)^2+1}}\right\} = \cos\cos^{-1}\left\{\frac{1}{\sqrt{x^2+1}}\right\}$$
$$\Rightarrow \sqrt{x^2+1} = \sqrt{x^2+2x+2}$$
$$\Rightarrow x = \frac{-1}{2}$$

---

# Question60

$\tan\left\{\frac{1}{2}\cos^{-1}\frac{\sqrt{5}}{3}\right\}$ **has the value MHT CET 2022 (08 Aug Shift 2)**

**Options:**

A. $\frac{\sqrt{5}}{6}$

B. $\frac{\sqrt{5}}{6}$

C. $\frac{3-\sqrt{5}}{2}$

D. $\frac{3+\sqrt{5}}{2}$

Answer: C

**Solution:**

Let $\frac{1}{2}\cos^{-1}\frac{\sqrt{5}}{3} = \theta$

$\cos 2\theta = \frac{\sqrt{5}}{3}$

Now $\tan\left\{\frac{1}{2}\cos^{-1}\frac{\sqrt{5}}{3}\right\}$

$$= \tan\theta = \sqrt{\frac{1-\cos 2\theta}{1+\cos 2\theta}} = \sqrt{\frac{1-\frac{\sqrt{5}}{3}}{1+\frac{\sqrt{5}}{3}}} = \sqrt{\frac{3-\sqrt{5}}{3+\sqrt{5}}}$$
$$= \sqrt{\frac{3-\sqrt{5}}{3+\sqrt{5}} \times \frac{3-\sqrt{5}}{3+\sqrt{5}}} = \sqrt{\frac{(3-\sqrt{5})^2}{3^2-5}} = \frac{3-\sqrt{5}}{2}$$

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## Question61

**The value of $\cos^{-1}\left(\tan\left(\frac{7\pi}{4}\right)\right)$ is MHT CET 2022 (07 Aug Shift 2)**

**Options:**

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

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

C. $\pi$

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

**Answer: C**

**Solution:**

$$\cos^{-1}\left(\tan\frac{7\pi}{4}\right)=\cos^{-1}\tan\left(2\pi-\frac{\pi}{4}\right)=\cos -1\left(-\tan\frac{\pi}{4}\right)$$
$$=\cos^{-1}(-1)$$
$$=\pi$$

---

## Question62

**The value of $4\cos^3 20^\circ$ is MHT CET 2022 (07 Aug Shift 2)**

**Options:**

A. $-\frac{1}{2}-\cos 20^\circ$

B. $-\frac{1}{2}+3\cos 20^\circ$

C. $\frac{1}{2}+3\cos 20^\circ$

D. $\frac{1}{2}-3\cos 20^\circ$

**Answer: C**

**Solution:**

$$4\cos^3 20^\circ=\cos(3\times 20^\circ)+3\cos 20^\circ\ \left[\because 4\cos^3\theta=\cos 3\theta+3\cos\theta\right]$$
$$\Rightarrow 4\cos^3 20^\circ=\cos 60^\circ+3\cos 20^\circ=\frac{1}{2}+3\cos 20^\circ$$

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## Question63

**The principal solutions of $\tan 3\theta = -1$ are MHT CET 2022 (07 Aug Shift 1)**

**Options:**

A. $\left\{\frac{\pi}{4}, \frac{7\pi}{12}, \frac{11\pi}{12}, \frac{5\pi}{4}, \frac{19\pi}{12}, \frac{23\pi}{12}\right\}$

B. $\left\{\frac{\pi}{4}, \frac{7\pi}{12}, \frac{11\pi}{12}, \frac{\pi}{16}, \frac{19\pi}{12}, \frac{23\pi}{24}\right\}$

C. $\left\{\frac{\pi}{4}, \frac{\pi}{12}\right\}$

D. $\left\{\frac{\pi}{4}, \frac{\pi}{12}, \frac{13\pi}{12}, \frac{7\pi}{4}, \frac{19\pi}{4}, \frac{23\pi}{12}\right\}$

**Answer: A**

**Solution:**

$$\tan 3\theta = -1 = \tan \frac{3\pi}{4}$$
$$\Rightarrow 3\theta = n\pi \pm \frac{3\pi}{4}$$
$$\Rightarrow \theta = \frac{n\pi}{3} \pm \frac{\pi}{4}$$
$$\Rightarrow \theta \in \left\{\frac{\pi}{4}, \frac{7\pi}{12}, \frac{11\pi}{12}, \frac{15\pi}{2}, \frac{19\pi}{12}, \frac{23\pi}{12}\right\}$$

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# Question64

**Let $\cos(\alpha+\beta) = \frac{4}{5}$ and $\sin(\alpha-\beta) = \frac{5}{13}$, where $0 \leq \alpha, \beta \leq \frac{\pi}{4}$, then $\tan 2\alpha =$ MHT CET 2022 (07 Aug Shift 1)**

**Options:**

A. $\frac{19}{12}$

B. $\frac{56}{33}$

C. $\frac{25}{16}$

D. $\frac{20}{7}$

**Answer: B**

**Solution:**

$$\cos(\alpha+\beta)=\frac{4}{5} \Rightarrow \tan(\alpha+\beta)=\frac{3}{4}$$
$$\sin(\alpha-\beta)=\frac{5}{13} \Rightarrow \tan(\alpha-\beta)=\frac{5}{12}$$
$$\tan 2\alpha=\tan\{(\alpha+\beta)+(\alpha-\beta)\}=\frac{\tan(\alpha+\beta)+\tan(\alpha-\beta)}{1-\tan(\alpha+\beta)\cdot\tan(\alpha-\beta)}$$
$$=\frac{\frac{3}{4}+\frac{5}{12}}{1-\frac{3}{4}\times\frac{5}{12}}=\frac{56}{33}$$

---

## Question65

**If $\cot(A+B)=0$, then $\sin(A+2B)$ is equal to MHT CET 2022 (06 Aug Shift 2)**

**Options:**

A. $\sin 2A$

B. $\cos A$

C. $\sin A$

D. $\cos 2A$

**Answer: C**

### Solution:

$\cot(A+B)=0 \Rightarrow A+B=(2n+1)\frac{\pi}{2} \Rightarrow B=(2n+1)\frac{\pi}{2}-A$

Now, $\sin(A+2B)=\sin(A+(2n+1)\pi-2A)$

$=\sin((2n+1)\pi-A)=\sin A$

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## Question66

**The value of $\theta$, satisfying both the equation $\cos\theta=\frac{1}{\sqrt{2}}$ and $\tan\theta=-1$ in $[0,2\pi]$, is MHT CET 2022 (06 Aug Shift 1)**

**Options:**

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

B. $\left(\frac{5\pi}{4}\right)$

C. $\left(\frac{7\pi}{4}\right)$

D. $\left(\frac{3\pi}{4}\right)$

**Answer: C**

**Solution:**

$$\cos\theta = \frac{1}{\sqrt{2}} \text{ and } \tan\theta = -1 \theta \in [0, 2\pi]$$
$$\Rightarrow \theta = \frac{\pi}{4} \text{ or } \frac{7\pi}{4} \text{ and } \theta = \frac{3\pi}{4} \text{ or } \frac{7\pi}{4}$$
$$\Rightarrow \theta = \frac{7\pi}{4}$$

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# Question67

**The value of** $\cos^2 10^\circ - \cos 10^\circ \cdot \cos 50^\circ + \cos^2 50^\circ$ **MHT CET 2022 (05 Aug Shift 2)**

**Options:**

A. $\frac{3}{2} + \cos 20^\circ$

B. $\frac{3}{4}(1 + \cos 20^\circ)$

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

D. $\frac{3}{4}$

**Answer: D**

**Solution:**

$$\cos^2 10^\circ - \cos 10^\circ \cdot \cos 50^\circ + \cos^2 50^\circ = \frac{\cos^3 10^\circ + \cos^3 50^\circ}{\cos 10^\circ + \cos^\circ}$$

$$= \frac{\frac{3\cos 10^\circ + \cos 30^\circ}{4} + \frac{3\cos 50^\circ + \cos 150^\circ}{4}}{\cos 10^\circ + \cos 50^\circ}$$

$$\left[\because \cos^3 \mathrm{~A} = \frac{3\cos \mathrm{A} + \cos 3\mathrm{~A}}{4}\right]$$

$$= \frac{\frac{3}{4}\left(\cos 10^\circ + \frac{\cos 30^\circ}{3} + \cos 50^\circ - \frac{\cos 30^\circ}{4}\right)}{\cos 10^\circ + \cos 50^\circ}$$

$$= \frac{3}{4} \frac{(\cos 10^\circ + \cos 50^\circ)}{(\cos 10^\circ + \cos 50^\circ)}$$

$$= \frac{3}{4}$$

---

## Question68

**The principal solution of** $\cot x = \sqrt{3}$ **are MHT CET 2021 (24 Sep Shift 1)**

**Options:**

A. $\frac{\pi}{6}, \frac{5\pi}{6}$

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

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

D. $\frac{\pi}{3}, \frac{7\pi}{3}$

**Answer: C**

**Solution:**

$$\cot x = \sqrt{3} \quad \Rightarrow \quad \tan x = \frac{1}{\sqrt{3}}$$

$$\therefore \frac{1}{\sqrt{3}} = \tan\left(\pi + \frac{\pi}{6}\right) = \tan\left(\frac{\pi}{6}\right)$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \tan\left(\frac{7\pi}{6}\right) = \tan\left(\frac{\pi}{6}\right)$$

---

## Question69

**If $\tan^{-1}\left[\frac{\sqrt{1+x^2}-\sqrt{1-x^2}}{\sqrt{1+x^2}+\sqrt{1-x^2}}\right]=\alpha$, then the value of $\sin 2\alpha$ is MHT CET 2021 (23 Sep Shift 2)**

**Options:**

A. $x^3$

B. $\sqrt{\mathrm{x}}$

C. x

D. $\mathrm{x}^2$

**Answer: D**

### Solution:

We have $\tan\alpha=\left[\frac{\sqrt{1+x^2}-\sqrt{1-x^2}}{\sqrt{1+x^2}+\sqrt{1-x^2}}\right]$

Put $x^2=\cos\theta$

$$\therefore \tan\alpha=\frac{\sqrt{2\cos^2\frac{\theta}{2}-\sqrt{2\sin^2\frac{\theta}{2}}}}{\sqrt{2\cos^2\frac{\theta}{2}+\sqrt{2\sin^2\frac{\theta}{2}}}}$$
$$\therefore \tan\alpha=\frac{\cos\frac{\theta}{2}-\sin\frac{\theta}{2}}{\cos\frac{\theta}{2}-\sin\frac{\theta}{2}}=\frac{1-\tan\frac{\theta}{2}}{1+\tan\frac{\theta}{2}}=\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)$$
$$\therefore \alpha=\frac{\pi}{4}-\frac{\theta}{2}\Rightarrow 2\alpha=\frac{\pi}{2}-\theta$$
$$\therefore \sin 2\alpha=\sin\left(\frac{\pi}{2}-\theta\right)=\cos\theta=x^2$$

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## Question70

**If $3\sin\theta=2\sin 3\theta$ and $0<\theta<\pi$, then $\sin\theta=$ MHT CET 2021 (23 Sep Shift 2)**

**Options:**

A. $\frac{\sqrt{2}}{\sqrt{5}}$

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

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

D. $\frac{\sqrt{3}}{\sqrt{5}}$

**Answer: B**

### Solution:

$$\begin{aligned} 3\sin\theta &= 2\sin 3\theta \\ &= 2\left(3\sin\theta - 4\sin^2\theta\right) \\ \therefore 8\sin^3\theta - 3\sin\theta &= 0 \\ \therefore \sin\theta\left(8\sin^2\theta - 3\right) &= 0 \\ \therefore \sin\theta = 0 \text{ or } \sin\theta &= \pm\sqrt{\frac{3}{8}} = \pm\frac{\sqrt{3}}{2\sqrt{2}} \end{aligned}$$

Since, $0 < \theta < \pi$, we write $\sin\theta = \frac{\sqrt{3}}{2\sqrt{2}}$

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## Question71

**If $\mathrm{a}\sin\theta = \mathrm{b}\cos\theta$, where $\mathrm{a}, \mathrm{b} \neq 0$, then $\mathrm{a}\cos 2\theta + \mathrm{b}\sin 2\theta =$ MHT CET 2021 (23 Sep Shift 1)**

**Options:**

A. ab

B. a

C. b

D. $\frac{\mathrm{a}}{\mathrm{b}}$

**Answer: B**

**Solution:**

$$a\sin\theta = b\cos\theta \Rightarrow \tan\theta = \frac{b}{a}$$

$$\begin{aligned} & a\cos 2\theta + b\sin 2\theta \\ & = a\left(\frac{1-\tan^2\theta}{1+\tan^2\theta}\right) + b\left(\frac{2\tan\theta}{1+\tan^2\theta}\right) \\ & = a\left[\frac{1-\left(\frac{b^2}{a^2}\right)}{1+\left(\frac{b^2}{a^2}\right)}\right] + b\left[\frac{2\left(\frac{b}{a}\right)}{1+\left(\frac{b^2}{a^2}\right)}\right] = a\left(\frac{a^2-b^2}{a^2+b^2}\right) + b\left(\frac{2b}{a}\times\frac{a^2}{a^2+b^2}\right) \\ & = \frac{a\left(a^2-b^2\right)}{a^2+b^2} + \frac{b(2ab)}{a^2+b^2} = \frac{a^3-ab^2+2ab^2}{a^2+b^2} \\ & = \frac{a^3+ab^2}{a^2+b^2} = \frac{a\left(a^2+b^2\right)}{a^2+b^2} = a \end{aligned}$$

---

## Question72

**If $2\cos\theta = x + \frac{1}{x}$, then $2\cos 3\theta =$ MHT CET 2021 (22 Sep Shift 2)**

**Options:**

A. $x^3 - \frac{1}{x^3}$

B. $\left(\mathrm{x} + \frac{1}{\mathrm{x}}\right)^3$

C. $x + \frac{1}{x}$

D. $x^3 + \frac{1}{x^3}$

**Answer: D**

**Solution:**

$$\text{We have } \cos\theta = \frac{1}{2}\left(x + \frac{1}{x}\right)$$

$$2\cos 3\theta$$

$$= 2\left[4\cos^3\theta - 3\cos\theta\right] = 2\left\{4\left[\left(\frac{1}{2}\right)\left(x + \frac{1}{x}\right)\right]^3 - \left[3\left(\frac{1}{2}\right)\left(x + \frac{1}{x}\right)\right]\right\}$$

$$= 2\left[\left(\frac{1}{2}\right)\left(x^3 + \frac{1}{x^3}\right) + 3\left(x + \frac{1}{x}\right)\right] - 3\left(x + \frac{1}{x}\right) = x^3 + \frac{1}{x^3}$$

---

## Question73

**If $2\sin\left(\theta + \frac{\pi}{3}\right) = \cos\left(\theta - \frac{\pi}{6}\right)$, then $\tan\theta$ MHT CET 2021 (21 Sep Shift 1)**

**Options:**

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

B. $-\sqrt{3}$

C. $\sqrt{3}$

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

**Answer: B**

**Solution:**

$$2\sin\left(\theta+\frac{\pi}{3}\right)=\cos\left(\theta-\frac{\pi}{6}\right)$$
$$2\left[\sin\theta\cos\frac{\pi}{3}+\cos\theta\sin\frac{\pi}{3}\right]=\left(\cos\theta\cos\frac{\pi}{6}+\sin\theta\sin\frac{\pi}{6}\right)$$
$$\therefore 2\left(\frac{\sin\theta}{2}+\frac{\sqrt{3}\cos\theta}{2}\right)=\left(\frac{\sqrt{3}\cos\theta}{2}+\frac{\sin\theta}{2}\right)$$
$$\therefore\left(\frac{\sin\theta}{2}+\frac{\sqrt{3}\cos\theta}{2}\right)=0\Rightarrow\sin\theta+\sqrt{3}\cos\theta=0\Rightarrow\tan\theta=-\sqrt{3}$$

---

## Question74

**If $\frac{\cos(A+B)}{\cos(A-B)}=\frac{\sin(C+D)}{\sin(C-D)}$, then $\tan A\tan B\tan C=$ MHT CET 2021 (21 Sep Shift 1)**

**Options:**

A. 0

B. tan D

C. $\cot D$

D. $-\tan D$

**Answer: D**

**Solution:**

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

By Componendo - Dividendo, we write

$$\frac{\cos(A+B)+\cos(A-B)}{\cos(A+B)-\cos(A-B)}=\frac{\sin(C+D)+\sin(C-D)}{\sin(C+D)-\sin(C-D)}$$
$$\frac{2\cos A\cos B}{-2\sin A\sin B}=\frac{2\sin C\cos D}{2\cos C\sin D}$$
$$\therefore\frac{1}{-\tan A\tan B}=\frac{\tan C}{\tan D}\Rightarrow\tan A\tan B\tan C=-\tan D$$

---

## Question75

**The principal solutions of $\sqrt{3}\sec x+2=0$ are MHT CET 2021 (20 Sep Shift 2)**

**Options:**

A. $\frac{\pi}{6}, \frac{5\pi}{6}$

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

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

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

**Answer: B**

**Solution:**

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

---

# Question76

**If $\sec x=\frac{25}{24}$ and $x$ lies in first quadrant, then $\sin\frac{x}{2}+\cos\frac{x}{2}=$ MHT CET 2021 (20 Sep Shift 2)**

**Options:**

A. $\frac{6}{5\sqrt{2}}$

B. $\frac{8}{5\sqrt{2}}$

C. $\frac{7}{5\sqrt{2}}$

D. $\frac{1}{5\sqrt{2}}$

**Answer: B**

**Solution:**

We have $\cos x=\frac{24}{25} \Rightarrow \sin x=\frac{7}{25} \ldots [\because x$ lies in $1^{\text{st}}$ quadrant $]$ Also $\left(\sin\frac{x}{2}+\cos\frac{x}{2}\right)^2=1+\sin x=1+\frac{7}{25}=\frac{32}{25}$

$$\therefore \sin\frac{x}{2}+\cos\frac{x}{2}=\sqrt{\frac{32}{25}}=\frac{4\sqrt{2}}{5}=\frac{8}{5\sqrt{2}}$$

---

## Question77

**If $x \in \left(0, \frac{\pi}{2}\right)$ and $x$ satisfies the equation $\sin x \cos x = \frac{1}{4}$, then the values of $x$ are MHT CET 2021 (20 Sep Shift 1)**

**Options:**

A. $\frac{\pi}{12}, \frac{5\pi}{12}$

B. $\frac{\pi}{8}, \frac{3\pi}{8}$

C. $\frac{\pi}{8}, \frac{\pi}{4}$

D. $\frac{\pi}{6}, \frac{\pi}{12}$

**Answer: A**

**Solution:**

$$\sin x \cos x = \frac{1}{4}$$
$$\therefore 2 \sin x \cos x = \frac{2}{4} = \frac{1}{2} \Rightarrow \sin 2x = \frac{1}{2} = \sin 30^\circ$$
$$\therefore 2x = 30^\circ = \frac{\pi}{6} \Rightarrow x = \frac{\pi}{12}$$
$$\therefore x = \frac{\pi}{2} \pm \frac{\pi}{12} \Rightarrow x = \frac{\pi}{2} + \frac{\pi}{12} \text{ or } x = \frac{\pi}{2} - \frac{\pi}{12}$$
$$\therefore x = \frac{7\pi}{12} \text{ or } \frac{5\pi}{12} \Rightarrow x = \frac{\pi}{12}, \frac{\pi}{12} \quad \ldots \left[\because x \in \left(0, \frac{\pi}{2}\right)\right]$$

---

## Question78

**The general solution of $\frac{1-\cos 2x}{1+\cos 2x} = 3$ is MHT CET 2020 (20 Oct Shift 1)**

**Options:**

A. $x = 2n\pi \pm \frac{\pi}{3}, n \in Z$

B. $x = n\pi \pm \frac{\pi}{6}, n \in Z$

C. $x = 2\text{n}\pi \pm \frac{\pi}{6}, \text{n} \in \text{Z}$

D. $x = \text{n}\pi \pm \frac{\pi}{3}, \text{n} \in \text{z}$

**Answer: D**

**Solution:**

$\frac{1-\cos 2x}{1+\cos 2x}=3 \Rightarrow \frac{2\sin^2 x}{2\cos^2 x}=3$

$\therefore \tan^2 x=3 \Rightarrow \tan^2 x=\tan^2 \frac{\pi}{3} \Rightarrow x=n\pi \pm \frac{\pi}{3}$

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# Question79

**If $2\cos^2\theta+3\cos\theta=2$, then permissible value of $\cos\theta$ is MHT CET 2020 (19 Oct Shift 2)**

**Options:**

A. 0

B. 1

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

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

**Answer: C**

## Solution:

We have $2\cos^2\theta+3\cos\theta=2$

$2\cos^2\theta+4\cos\theta-\cos\theta-2=0 \Rightarrow 2\cos\theta(\cos\theta+2)-1(\cos\theta+2)=0$

$(2\cos\theta-1)(\cos\theta+2)=0$

$\therefore \cos\theta=\frac{1}{2},-2(\text{ Impossible }) \Rightarrow \cos\theta=\frac{1}{2}$

---

# Question80

**The principal solutions of $\cot x=\sqrt{3}$ are MHT CET 2020 (19 Oct Shift 2)**

**Options:**

A. $\frac{\pi}{4}, \frac{5\pi}{4}$

B. $\frac{\pi}{6}, \frac{7\pi}{6}$

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

D. $\frac{\pi}{3}, \frac{7\pi}{3}$

**Answer: B**

## Solution:

The given equation is $\cot\theta = \sqrt{3}$ which is same $\tan\theta = \frac{1}{\sqrt{3}}$.

We know that, $\tan\frac{\pi}{6} = \frac{1}{\sqrt{3}}$ and $\tan(\pi+\theta) = \tan\theta$

$\therefore \tan\frac{\pi}{6} = \tan\left(\pi + \frac{\pi}{6}\right) = \tan\frac{7\pi}{6}$

---

# Question81

**The principal solutions of $\cos 2x = \frac{-1}{2}$ are MHT CET 2020 (19 Oct Shift 1)**

**Options:**

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

B. $x = \frac{\pi}{3}, \quad x = \frac{2\pi}{3}$

C. $x = \frac{-\pi}{3}, \quad x = \frac{5\pi}{6}$

D. $x = \frac{\pi}{3}, \quad x = \frac{7\pi}{6}$

**Answer: B**

**Solution:**

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

$$\text{(B)} \therefore \frac{-1}{2} = \cos\left(\pi - \frac{\pi}{3}\right) - \cos\left(\pi + \frac{\pi}{3}\right) \Rightarrow \frac{-1}{2} - \cos\frac{2\pi}{3} - \cos\frac{4\pi}{3}$$

$$\therefore 2x = \frac{2\pi}{3} \text{ or } 2x = \frac{4\pi}{3} \Rightarrow x = \frac{\pi}{3} \text{ or } \frac{2\pi}{3}$$

---

# Question82

**If $3\sin^2 x - 8\sin x + 4 = 0, x \in \left(\frac{\pi}{2}, \pi\right)$, then $\tan x =$ MHT CET 2020 (19 Oct Shift 1)**

**Options:**

A. $-\frac{\sqrt{5}}{2}$

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

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

D. $\frac{\sqrt{5}}{2}$

**Answer: C**

### Solution:

$3\sin^2 x - 8\sin x + 4 = 0$

$\sin x - 2)\left(\sin x - \frac{2}{3}\right) = 0$

$\sin x = 2$

$x$

$\sin x = \frac{2}{3}$

$\tan x = \frac{2}{\sqrt{5}}$ when $x \in (\pi/2, \pi)$

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# Question83

**The general solutions of $\sin^2 x \cdot \sec x = \tan x - \sin x + 1$ is MHT CET 2020 (19 Oct Shift 1)**

**Options:**

A. $x = n\pi + (-1)^n \frac{\pi}{4}$ or $x = m\pi + \frac{3\pi}{4}; m, n \in z$

B. $x = n\pi + (-1)^n \frac{\pi}{2} \quad$ or $\quad x = m\pi + \frac{3\pi}{4}; \quad m, n \in z$

C. $x = n\pi + (-1)^n \frac{\pi}{2} \quad$ or $\quad x = m\pi + \frac{5\pi}{4}; m, n \in z$

D. $x = n\pi + (-1)^n \frac{\pi}{4}$ or $x = m\pi + \frac{5\pi}{4}; m, n \in z$

**Answer: B**

### Solution:

$\sin^2 x \sec x = \tan x - \sin x + 1$

$\therefore \quad \frac{\sin x \cdot \sin x}{\cos x} = \frac{\sin x}{\cos x} - \sin x + 1$

$\therefore \quad \sin x \cdot \sin x = \sin x - \sin x \cos x + \cos x$

$\therefore \sin x(\sin x + \cos x) = \sin x + \cos x$

$\therefore \sin x(\sin x + \cos x) - (\sin x + \cos x) = 0$

$\therefore (\sin x + \cos x)(\sin x - 1) = 0$

$\therefore \sin x + \cos x = 0$ or $\sin x = 1$

$\therefore \tan x = -1$

$\therefore x = \sin \pi + \frac{3\pi}{4}$ or $x = n\pi + (-1)^n \frac{\pi}{2} \ldots \mathrm{m, n} \in \mathrm{Z}$

---

# Question84

**If $\sin(x+y) + \cos(x+y) = \sin\left[\cos^{-1}\left(\frac{1}{3}\right)\right]$, then $\frac{dy}{dx} =$ MHT CET 2020 (16 Oct Shift 2)**

**Options:**

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

B. -1

C. 1

D. 0

**Answer: B**

## Solution:

Let $\cos^{-1}\left(\frac{1}{3}\right) = \theta \Rightarrow \cos\theta = \frac{1}{3} \Rightarrow \sin\theta = \sqrt{1 - \frac{1}{9}} = \frac{2\sqrt{2}}{3}$

$\therefore \sin(x+y) + \cos(x+y) = \sin\left[\sin^{-1}\left(\frac{2\sqrt{2}}{3}\right)\right] \Rightarrow \sin(x+y) + \cos(x+y) = \frac{2\sqrt{2}}{3}$

Differentiating both sides. w.r.t. x

$\cos(x+y)\left(1 + \frac{dy}{dx}\right) - s$

$x + y = \tan^{-1}(1) = \frac{\pi}{4}$

Differentiating w.r.t. $x$, we get

$1 + \frac{dy}{dx} = 0 \Rightarrow \frac{dy}{dx} = -1$

---

# Question85

**If $\sin x + \sin^2 x = 1$, then $\cos^8 x + 2\cos^6 x + \cos^4 x$ is MHT CET 2020 (15 Oct Shift 2)**

**Options:**

A. 3

B. 2

C. 1

D. 4

**Answer: C**

## Solution:

Given $\sin x+\sin^2 x=1 \Rightarrow \sin x=1-\sin^2 x$

$$\therefore \sin x=\cos^2 x \Rightarrow \sin^2 x=\cos^4 x$$

$$\begin{aligned}\cos^8 x+2\cos^6 x+\cos^4 x &= \left(\cos^4 x+\cos^2 x\right)^2 \\ &= \left(\sin^2 x+\cos^2 x\right)^2=1\end{aligned}$$

---

# Question86

**If $\operatorname{cosec}\theta+\cot\theta=5$, then $\sin\theta=$ MHT CET 2020 (14 Oct Shift 1)**

**Options:**

A. $\frac{1}{5}$

B. $\frac{5}{26}$

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

D. $\frac{1}{13}$

**Answer: C**

## Solution:

Given $\operatorname{cosec}\theta+\cot\theta=5$

We know that $\operatorname{cosec}^2\theta-\cot^2\theta=1$

$\Rightarrow(\operatorname{cosec}\theta-\cot\theta)(\operatorname{cosec}\theta+\cot\theta)=1\Rightarrow\operatorname{cosec}\theta-\cot\theta=\frac{1}{5}$

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

$2\operatorname{cosec}\theta=5+\frac{1}{5}=\frac{26}{5}$

$\therefore\operatorname{cosec}\theta=\frac{13}{5}\Rightarrow\sin\theta=\frac{5}{13}$

---

# Question87

**If $\frac{1-\tan\theta}{1+\tan\theta}=\frac{1}{\sqrt{3}}$, where $\theta\in\left(0,\frac{\pi}{2}\right)$, then $\theta=$ MHT CET 2020 (14 Oct Shift 1)**

**Options:**

A. $\frac{\pi}{12}$

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

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

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

**Answer: A**

## Solution:

Given $\frac{1-\tan\theta}{1+\tan\theta}=\frac{1}{\sqrt{3}}$

$\therefore\tan\left(\frac{\pi}{4}-\theta\right)=\frac{1}{\sqrt{3}}$

Comparing with $\tan\frac{\pi}{6}=\frac{1}{\sqrt{3}}$, we write

$$\frac{\pi}{4}-\theta=\frac{\pi}{6}$$
$$\therefore\theta=\frac{\pi}{4}-\frac{\pi}{6}=\frac{\pi}{12}$$

---

# Question88

**The general solution of $\tan\theta+\tan2\theta=\tan3\theta$ is MHT CET 2020 (13 Oct Shift 2)**

**Options:**

A. $\theta=(2n+1)\frac{\pi}{2},n\in Z$

B. $\theta = n\pi, n \in Z$ or $\theta = \frac{p\pi}{3}, p \in Z$

C. $\theta = \frac{n\pi}{5}, n \in Z$

D. $\theta = (2n-1)\frac{\pi}{3}, n \in Z$

**Answer: B**

### Solution:

$\tan 3\theta = \tan(2\theta + \theta) = \tan\theta + \tan 2\theta$

$\therefore \frac{\tan 2\theta + \tan\theta}{1 - \tan 2\theta \tan\theta} = \tan\theta + \tan 2\theta$

$\therefore 1 - \tan 2\theta \tan\theta = 1 \Rightarrow \tan 2\theta \tan\theta = 0 \Rightarrow \tan\theta = 0$

$\therefore \theta = \mathrm{n}\pi, \mathrm{n} \in \mathrm{Z}$

---

# Question89

**For $\theta \in \left(0, \frac{\pi}{2}\right)$, $\tan 3\theta \cdot \tan 2\theta \cdot \tan\theta + \tan 2\theta + \tan\theta = 1$, then $\theta =$ MHT CET 2020 (13 Oct Shift 2)**

**Options:**

A. $\frac{\pi^c}{12}$

B. $\frac{\pi^c}{4}$

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

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

**Answer: A**

### Solution:

We have, $\tan 3\theta = \tan(2\theta + \theta)$

$\tan 3\theta = \frac{\tan 2\theta + \tan\theta}{1 - \tan 2\theta \tan\theta}$

$\therefore \tan 3\theta - \tan 3\theta \tan 2\theta \tan\theta = \tan 2\theta + \tan\theta$

$\therefore \tan 3\theta \tan 2\theta \tan\theta \quad = \tan 3\theta - \tan 2\theta - \tan\theta$ ...(1)

We have $\tan 3\theta \cdot \tan 2\theta \tan\theta + \tan 2\theta + \tan\theta = 1$

$\therefore \tan 3\theta - \tan 2\theta - \tan\theta + \tan\theta + \tan 2\theta = 1 \Rightarrow \tan 3\theta = 1$

$\therefore \tan 3\theta = \tan\frac{\pi}{4} = 3\theta = \frac{\pi}{4} \Rightarrow \theta = \frac{\pi}{12}$

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## Question90

**If $2\sin^2 x + 7\cos x = 5$, then permissible value of $\cos x$ is MHT CET 2020 (12 Oct Shift 2)**

**Options:**

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

B. 0

C. 1

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

**Answer: A**

### Solution:

We have $2\cos^2\theta + 3\cos\theta = 2$

$2\cos^2\theta + 4\cos\theta - \cos\theta - 2 = 0 \Rightarrow 2\cos\theta(\cos\theta + 2) - 1(\cos\theta + 2) = 0$

$(2\cos\theta - 1)(\cos\theta + 2) = 0$

$\therefore \cos\theta = \frac{1}{2}, -2$ (Impossible) $\Rightarrow \cos\theta = \frac{1}{2}$

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## Question91

**If $3\cos x \neq 2\sin x$, then the general solution of $\sin^2 x - \cos 2x = 2 - \sin 2x$ is MHT CET 2020 (12 Oct Shift 2)**

**Options:**

A. $x = n\pi + \frac{\pi}{2}, \quad n \in Z$

B. $x = n\left(\frac{\pi}{2}\right) + \pi, \quad n \in Z$

C. $x = n\left(\frac{\pi}{2}\right) + \frac{\pi}{3}, \quad n \in Z$

D. $x = (2n+1)\pi, \quad n \in Z$

**Answer: A**

### Solution:

Given $\sin^2 x - \cos 2x = 2 - \sin 2x$

$\therefore \sin^2 x - 1 + 2\sin^2 x = 2 - \sin 2x \quad \ldots [\because \cos 2\theta = 1 - 2\sin^2\theta]$

$3\sin^2 x \quad = 3 - \sin 2x \Rightarrow \sin 2x = 3\left(1 - \sin^2 x\right)$

$2\sin x \cos x = 3\cos^2 x \Rightarrow \cos x(3\cos x - 2\sin x) = 0$

$\therefore \cos x = 0$ or $3\cos x = 2\sin x$

But $3\cos x \neq 2\sin x$ as per condition given

$\therefore \cos \mathrm{x} = 0 \Rightarrow \mathrm{x} = \mathrm{n}\pi + \frac{\pi}{2}, \mathrm{n} \in \mathrm{Z}$

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# Question92

**If $\sec x + \tan x = 3, x \in \left(0, \frac{\pi}{2}\right)$ then, $\sin x =$ MHT CET 2020 (12 Oct Shift 1)**

**Options:**

A. $\frac{3}{5}$

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

C. $-1$

D. $\frac{1}{5}$

**Answer: B**

## Solution:

We have $\sec x + \tan x = 3$ ...(1)

We know that $\sec^2 x - \tan^2 x = 1$

$\therefore (\sec x - \tan x)(\sec x + \tan x) = 1 \Rightarrow \sec x - \tan x = \frac{1}{3}$ ...(2)

Adding (1) and (2)

$2\sec x = \frac{10}{3} \Rightarrow \sec x = \frac{5}{3} \Rightarrow \cos x = \frac{3}{5} \Rightarrow \sin x = \sqrt{1 - \cos^2 x} = \frac{4}{5}$

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# Question93

**If $\frac{\sin(A+B)}{\sin(A-B)} = \frac{\cos(C+D)}{\cos(C-D)}$, then $\tan A \cot B =$ MHT CET 2020 (12 Oct Shift 1)**

**Options:**

A. $\cot C \cot D$

B. $-\tan C \tan D$

C. $\tan C \tan D$

D. $-\cot C \cot D$

**Answer: D**

### Solution:

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

$\therefore \frac{\sin(A+B)+\sin(A-B)}{\sin(A+B)-\sin(A-B)} = \frac{\cos(C+D)+\cos(C-D)}{\cos(C+D)-\cos(C-D)}$

$\therefore \frac{2\sin A \cos B}{2\cos A \sin B} = \frac{2\cos C \cos D}{-2\sin C \sin D}$

$\tan A \cot B = -\cot C \cot D$

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## Question94

**The values of $x$ in $\left(0, \frac{\pi}{2}\right)$ satisfying the equation $\sin x \cos x = \frac{1}{4}$ are ________ MHT CET 2019 (02 May Shift 1)**

**Options:**

A. $\frac{\pi}{6}, \frac{\pi}{12}$

B. $\frac{\pi}{12}, \frac{5\pi}{12}$

C. $\frac{\pi}{8}, \frac{3\pi}{8}$

D. $\frac{\pi}{8}, \frac{\pi}{4}$

**Answer: B**

### Solution:

Given: Equation $\sin x . \cos x = \frac{1}{4}$

then $\sin 2x = \frac{1}{2}$

$2x = \frac{\pi}{6}, 5\frac{\pi}{6} \Rightarrow x = \frac{\pi}{12}, \frac{5\pi}{12}$

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## Question95

**The number of solutions of $\sin^2\theta = \frac{1}{2}$ in $[0, \pi]$ is ________ MHT CET 2019 (02 May Shift 1)**

**Options:**

A. three

B. four

C. two

D. one

**Answer: C**

**Solution:**

Given: Equation $\sin^2\theta = \frac{1}{2}$ $\theta \in (0, \pi)$
$\sin\theta = \pm\frac{1}{\sqrt{2}}$ but $\theta \in (0, \pi)$
Then, $\theta = \frac{\pi}{4}, \frac{3\pi}{4}$

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# Question96

**Which of the following equation has no solution? MHT CET 2019 (02 May Shift 1)**

**Options:**

A. $\sec\theta = 23$

B. $\cos\theta = \sqrt{2}$

C. $\tan\theta = 2019$

D. $\sin\theta = -\frac{1}{5}$

**Answer: B**

**Solution:**

Since, $\sin\theta \in [-1, 1], \cos\theta \in [-1, 1]$
$\sec\theta \in (-\infty, -1] \cup [1, \infty)$
$\tan\theta \in R$

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# Question97

**Which of the following function has period 2? MHT CET 2019 (Shift 1)**

**Options:**

A.

$\cos\left[\left(\frac{\pi}{3}\right)x\right]$

B.

$\cos\left[\left(\frac{\pi}{2}\right)x\right]$

C.

cos(2πx)

D.

cos(πx)

**Answer: D**

## Solution:

Key Idea Use period of $\cos k\theta$ is $\frac{2\pi}{k}$.

$\therefore$ Period of $\cos(\pi x)$ is $\frac{2\pi}{\pi} = 2$

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# Question98

**The number of solutions of $\sin x + \sin 3x + \sin 5x = 0$ in the interval $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$ is MHT CET 2018**

**Options:**

A. 2

B. 3

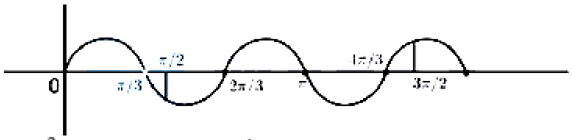
C. 4

D. 5

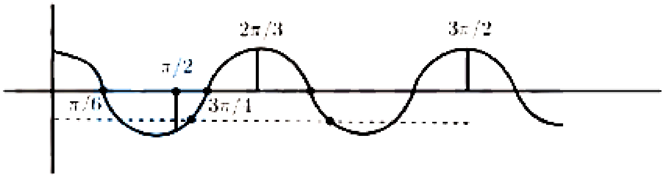
**Answer: B**

## Solution:

$(\sin x + \sin 5x) + \sin 3x = 0$
$2 \sin 3x \cos 2x + \sin 3x = 0$
$\sin 3x(2 \cos 2x + 1) = 0$
$\sin 3x = 0$ and $2 \cos 2x + 1 = 0$
$\sin 3x = 0$
Graph f(x) = sin 3x




$x = \frac{2\pi}{3}$ or $x = \pi$ or $x = \frac{4\pi}{3}$,
$\therefore \sin 3x = 0$ have 3 solutions
Graph f(x) = cos 2x




$\cos 2x = -\frac{1}{2}$
$\therefore x = \frac{2\pi}{3}$ $and \frac{4\pi}{3}$
So the solution of given equation in $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$ are $\frac{2\pi}{3}$ $and$ $\frac{4\pi}{3}$

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# Question99

**The number of principle solutions of $\tan 2\theta = 1$ is MHT CET 2017**

**Options:**

A. One

B. Two

C. Three

D. Four

**Answer: D**

**Solution:**

given equation is
$\tan 2\theta = 1 \quad (+ive)$
$\Rightarrow 2\theta = \frac{\pi}{4}, \frac{5\pi}{4}, \frac{9\pi}{4}, \frac{13\pi}{4}$
$\Rightarrow \theta = \frac{\pi}{8}, \frac{5\pi}{8}, \frac{9\pi}{8}, \frac{13\pi}{8}$
Hence 4 principle solutions are present

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# Question100

**The solution of the equation $\sin 2x + \cos 2x = 0$, where $\pi < x < 2\pi$ are MHT CET 2016**

**Options:**

A. $\frac{7\pi}{8}, \frac{11\pi}{8}$

B. $\frac{9\pi}{8}, \frac{13\pi}{8}$

C.

$\frac{11\pi}{8}, \frac{15\pi}{8}$

D. $\frac{15\pi}{8}, \frac{19\pi}{8}$

**Answer: C**

### Solution:

Given,

$\sin 2x + \cos 2x = 0$ .

Multiplying by $\frac{1}{\sqrt{2}}$ on both side,

$\therefore \frac{1}{\sqrt{2}}\sin 2x + \frac{1}{\sqrt{2}}\cos 2x = 0$

$\Rightarrow \sin\left(\frac{\pi}{4} + 2x\right) = 0$

$\Rightarrow 2x + \frac{\pi}{4} = n\pi$

$\Rightarrow x = \frac{(4n-1)\pi}{8}$

$\therefore x = \frac{11\pi}{8}$ and $\frac{15\pi}{8}$

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# Question101

**The general solution of the equation $\tan^2 x = 1$ is MHT CET 2016**

**Options:**

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

B. $n\pi - \frac{\pi}{4}$

C. $n\pi \pm \frac{\pi}{4}$

D. $2n\pi \pm \frac{\pi}{4}$

**Answer: C**

### Solution:

$\tan^2 x = 1$

$\therefore \tan x = \pm 1$

$= x = n\pi \pm \frac{\pi}{4}$

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