# Trigonometric Ratios & Identities

## Question1

$\sin\frac{\pi}{12}\sin\frac{2\pi}{12}\sin\frac{3\pi}{12}\sin\frac{4\pi}{12}\sin\frac{5\pi}{12}\sin\frac{6\pi}{12} =$

### AP EAPCET 2025 - 26th May Morning Shift

**Options:**

A.

$\frac{\sqrt{3}}{16\sqrt{2}}$

B.

$\frac{\sqrt{3}}{8\sqrt{2}}$

C.

$\frac{1}{32}$

D.

$\frac{1}{16}$

**Answer: A**

## Solution:

$$\begin{aligned} &\sin\frac{\pi}{12}\cdot\sin\frac{2\pi}{12}\cdot\sin\frac{3\pi}{12}\cdot\sin\frac{4\pi}{12}\cdot\sin\frac{5\pi}{12}\cdot\sin\frac{6\pi}{12} \\ &= \sin 15^\circ\cdot\sin 30^\circ\cdot\sin 45^\circ\cdot\sin 60^\circ \sin 75^\circ\cdot\sin 90^\circ \end{aligned}$$

$$= \frac{\sqrt{6}-\sqrt{2}}{4}\times\frac{1}{2}\times\frac{1}{\sqrt{2}}\times\frac{\sqrt{3}}{2}\times\frac{\sqrt{6}+\sqrt{2}}{4}\times 1$$

$$= \frac{(\sqrt{6})^2-(\sqrt{2})^2}{4\times 4}\times\frac{\sqrt{3}}{4\sqrt{2}}$$

$$= \frac{1}{4}\times\frac{\sqrt{3}}{4\sqrt{2}} = \frac{\sqrt{3}}{16\sqrt{2}}$$

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# Question2

**If $A+B+C+D=2\pi$, then $\sin A+\sin B+\sin C+\sin D=$**

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**Options:**

A.

$4\sin\left(\frac{A+B}{4}\right)\sin\left(\frac{A+C}{4}\right)\sin\left(\frac{A+D}{4}\right)$

B.

$4\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A+C}{4}\right)\cos\left(\frac{A+D}{4}\right)$

C.

$4\sin\left(\frac{A+B}{2}\right)\sin\left(\frac{A+C}{2}\right)\sin\left(\frac{A+D}{2}\right)$

D.

$4\sin\left(\frac{A+B}{2}\right)\sin\left(\frac{A+C}{4}\right)\sin\left(\frac{A+D}{4}\right)$

**Answer: C**

## Solution:

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

$\because A+B+C+D=2\pi$
$\Rightarrow B+C=2\pi-(A+D)$

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

$$=2\sin\left(\frac{A+D}{2}\right)\left[\cos\left(\frac{A-D}{2}\right)+\cos\left(\frac{B-C}{2}\right)\right]$$

$$=2\sin\left(\frac{A+D}{2}\right)\left[2\cos\left(\frac{\left(\frac{A-D+B-C}{2}\right)}{2}\right)\cos\left(\frac{\left(\frac{A-D-B+C}{2}\right)}{2}\right)\right]$$

$$=4\sin\left(\frac{A+D}{2}\right)\left[\cos\left(\frac{A+B-(C+D)}{4}\right)\cos\left(\frac{A+C-(B+D)}{4}\right)\right]$$

$\because \quad C+D=2\pi-(A+B)$
and $B+D=2\pi-(A+C)$

$$=4\sin\left(\frac{A+D}{2}\right)\left[\cos\left(\frac{\pi}{2}-\left(\frac{A+B}{2}\right)\right)\cos\left(\frac{\pi}{2}-\left(\frac{A+C}{2}\right)\right)\right]$$
$$=4\sin\left(\frac{A+B}{2}\right)\sin\left(\frac{A+C}{2}\right)\sin\left(\frac{A+D}{2}\right)$$

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# Question3

$$\left(4\cos^2\frac{\pi}{20}-1\right)\left(4\cos^2\frac{3\pi}{20}-1\right)$$
$$\left(4\cos^2\frac{5\pi}{20}+1\right)\left(4\cos^2\frac{7\pi}{20}-1\right)\left(4\cos^2\frac{9\pi}{20}-1\right)=$$

### AP EAPCET 2025 - 26th May Evening Shift

**Options:**

A.

1

B.

1/2

C.

2

D.

3

**Answer: D**

## Solution:

We have,

$$\left(4\cos^2\frac{\pi}{20}-1\right)\left(4\cos^2\frac{3\pi}{20}-1\right)$$
$$\left(4\cos^2\frac{5\pi}{20}+1\right)\left(4\cos^2\frac{7\pi}{20}-1\right)\left(4\cos^2\frac{9\pi}{20}-1\right)$$

$$=\left(4\cos^2\frac{\pi}{20}-1\right)\left(4\cos^2\frac{3\pi}{20}-1\right)\left(4\times\frac{1}{2}+1\right)$$
$$\left(4\cos^2\frac{7\pi}{20}-1\right)\left(4\cos^2\frac{9\pi}{20}-1\right)$$
$$=3\left(4\cos^2\frac{\pi}{20}-1\right)\left(4\cos^2\frac{9\pi}{20}-1\right)$$
$$\left(4\cos^2\frac{3\pi}{20}-1\right)\left(4\cos^2\frac{7\pi}{20}-1\right)$$
$$=3\left(4\cos^2\frac{\pi}{20}-1\right)\left(4\sin^2\frac{\pi}{20}-1\right)$$
$$\left(4\cos^2\frac{3\pi}{20}-1\right)\left(4\sin^2\frac{3\pi}{20}-1\right)$$
$$=3\left(16\cos^2\frac{\pi}{20}\cdot\sin^2\frac{\pi}{20}-4+1\right)\left(16\sin^2\frac{3\pi}{20}\cos^2\frac{3\pi}{20}-4-1\right)$$

$$= 3\left(4\sin^2\frac{\pi}{10} - 3\right)\left(4\sin^2\frac{3\pi}{10} - 3\right)$$
$$= \frac{3}{\sin\frac{\pi}{10}\cdot\sin\frac{3\pi}{10}}\left(4\sin^3\frac{\pi}{10} - 3\sin\frac{\pi}{10}\right)\left(4\sin^3\frac{3\pi}{10} - 3\sin\frac{3\pi}{10}\right)$$
$$= \frac{3}{\sin\frac{\pi}{10}\sin\frac{3\pi}{10}}\cdot\sin\frac{3\pi}{10}\cdot\sin\left(\frac{9\pi}{10}\right)$$
$$= 3 \quad \left(\because \sin\left(\frac{9\pi}{10}\right) = \sin\left(\pi - \frac{\pi}{10}\right) = \sin\frac{\pi}{10}\right)$$

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# Question4

**If $A$ and $B$ are the values such that $(A+B)$ and $(A-B)$ are not odd multiples of $\frac{\pi}{2}$ and $2\tan(A+B) = 3\tan(A-B)$, then $\sin A\cos A =$**

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**Options:**

A.

$\sin B\cos B$

B.

$5\sin B\cos B$

C.

$\sin 2B$

D.

$\cos 2B$

**Answer: B**

## Solution:

Given,

$2\tan(A+B)=3\tan(A-B)$

$\Rightarrow \dfrac{\tan(A+B)}{\tan(A-B)}=\dfrac{3}{2}$

$\Rightarrow \dfrac{\tan(A+B)+\tan(A-B)}{\tan(A+B)-\tan(A-B)}=\dfrac{3+2}{3-2}$

$\Rightarrow \dfrac{[\sin(A+B)\cos(A-B)}{[\sin(A+B)\cos(A-B)}-\sin(A-B)\cos(A+B)]$

$\Rightarrow \dfrac{\sin(A+B+A-B)}{\sin(A+B-A+B)}=5$

$\Rightarrow \sin 2A=5\sin 2B$

$\Rightarrow \sin A\cos A=5\sin B\cos B$

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# Question5

**If $\cos^3 80^\circ+\cos^3 40^\circ-\cos^3 20^\circ=k$, then $\frac{4k}{3}=$**

## AP EAPCET 2025 - 26th May Evening Shift

**Options:**

A.

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

B.

$\cos\left(\frac{2\pi}{3}\right)$

C.

$\tan\left(\frac{\pi}{3}\right)$

D.

$\sec\left(\frac{2\pi}{3}\right)$

**Answer: B**

## Solution:

We have,

$\cos^3 80^\circ + \cos^3 40^\circ - \cos^3 20^\circ = k$

$(\cos 80^\circ + \cos 40^\circ)\left((\cos 80^\circ + \cos 40^\circ)^2 - 3\cos 80^\circ \cos 40^\circ\right) - \cos^3 20^\circ = k$

$$\Rightarrow \quad 2\cos 60^\circ \cos 20^\circ \left((2\cos 60^\circ \cos 20^\circ)^2 - \frac{3}{2}(\cos 120^\circ + \cos 40^\circ)\right] - \cos^3 20^\circ = k$$

$$\Rightarrow \quad \cos 20^\circ \left(\cos^2 20^\circ - \frac{3}{2}\left(-\frac{1}{2} + \cos 40^\circ\right) - \cos^3 20^\circ = k\right)$$

$$\Rightarrow \quad \cos^3 20^\circ - \frac{3}{2}\cos 20^\circ \left(-\frac{1}{2} + \cos 40^\circ\right) - \cos^3 20^\circ = k$$

$$\Rightarrow \quad \frac{3}{4}\cos 20^\circ - \frac{3}{2}\cos 20^\circ \cos 40^\circ = k$$

$$\Rightarrow \quad \frac{3}{4}\cos 20^\circ - \frac{3}{4}(\cos 60^\circ + \cos 20^\circ) = k$$

$$\Rightarrow \quad \frac{3}{4}\cos 20 - \frac{3}{4} \times \frac{1}{2} - \frac{3}{4}\cos 20^\circ = k$$

$$\Rightarrow \quad k = -\frac{3}{8} \Rightarrow \frac{4k}{3} = \frac{-1}{2} = \cos\frac{2\pi}{3}$$

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# Question6

$\cos 13^\circ \sin 17^\circ \sin 21^\circ \cos 47^\circ =$

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**Options:**

A.

$\frac{1}{32}(1 + \sqrt{2} - \sqrt{3})$

B.

$\frac{1}{16}(1 + \sqrt{3} + \sqrt{5})$

C.

$\frac{1}{16}(2 + \sqrt{3} - \sqrt{5})$

D.

$\frac{1}{32}(1 + 2\sqrt{3} - \sqrt{5})$

**Answer: D**

## Solution:

$$\cos 13^\circ \cdot \sin 17^\circ \cdot \sin 21^\circ \cdot \cos 47^\circ$$
$$= (\cos 13^\circ \cos 47^\circ) \cdot (\sin 17^\circ \sin 21^\circ)$$
$$= \tfrac{1}{2}[\cos(34^\circ) + \cos(60^\circ)] \cdot \tfrac{1}{2}[\cos(4^\circ) - \cos(38^\circ)]$$
$$[\because \sin A \sin B = \tfrac{1}{2}[\cos(A-B) - \cos(A+B) \text{ and } \cos A \cos B = \tfrac{1}{2}[\cos(A-B) + \cos(A+B)]$$
$$= \tfrac{1}{4}\left[\cos 34^\circ + \tfrac{1}{2}\right]\left[\cos 4^\circ - \cos 38^\circ\right]$$
$$= \tfrac{1}{4}\left[\cos 34^\circ \cos 4^\circ - \cos 34^\circ \cos 38^\circ + \tfrac{1}{2}\cos 4^\circ - \tfrac{1}{2}\cos 38^\circ\right]$$
$$= \frac{1}{4}\left[\frac{1}{2}\{\cos(30^\circ) + \cos(38^\circ)\} - \frac{1}{2}\{\cos(4^\circ) + \cos(72^\circ)\} + \frac{1}{2}\cos 4^\circ - \frac{1}{2}\cos 38^\circ\right]$$
$$= \frac{1}{4}\left[\frac{1}{2}\left(\frac{\sqrt{3}}{2} + \cos 38^\circ\right) - \frac{1}{2}(\cos 4^\circ + \cos 72^\circ) + \frac{1}{2}\cos 4^\circ - \frac{1}{2}\cos 38^\circ\right]$$
$$= \frac{1}{8}\left[\frac{\sqrt{3}}{2} - \cos 72^\circ\right] = \frac{\sqrt{3}}{16} - \frac{\cos 72^\circ}{8}$$
$$= \frac{\sqrt{3}}{16} - \frac{\sqrt{5}-1}{4} \times \frac{1}{8}\left(\because \cos 72^\circ = \frac{\sqrt{5}-1}{4}\right)$$
$$= \frac{\sqrt{3}}{16} - \frac{\sqrt{5}-1}{32} = \frac{2\sqrt{3}-\sqrt{5}+1}{32} = \frac{1}{32}(2\sqrt{3}-\sqrt{5}+1)$$

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# Question7

$$\sin\frac{\pi}{5} + \sin\frac{2\pi}{5} + \sin\frac{3\pi}{5} + \sin\frac{4\pi}{5} =$$

## AP EAPCET 2025 - 24th May Morning Shift

**Options:**

A.

1

B.

$\sqrt{5}$

C.

$\frac{1}{4}(\sqrt{5}+1)(\sqrt{10+2\sqrt{5}})$

D.

$\frac{1}{4}(\sqrt{5}-1)(\sqrt{10+2\sqrt{5}})$

**Answer: C**

## Solution:

$$\sin\frac{\pi}{5}+\sin\frac{2\pi}{5}+\sin\frac{3\pi}{5}+\sin\frac{4\pi}{5}$$
$$=\sin\frac{\pi}{5}+\sin\frac{2\pi}{5}+\sin\left(\pi-\frac{2\pi}{5}\right)+\sin\left(\pi-\frac{\pi}{5}\right)$$
$$=\sin\frac{\pi}{5}+\sin\frac{2\pi}{5}+\sin\frac{2\pi}{5}+\sin\frac{\pi}{5}=2\sin\frac{\pi}{5}+2\sin\frac{2\pi}{5}$$
$$=2\left[\sin\frac{\pi}{5}+\sin\frac{2\pi}{5}\right]=4\sin\frac{3\pi}{10}\cos\frac{\pi}{10}$$
$$=4\frac{(\sqrt{5}+1)}{4}\frac{(\sqrt{10+2\sqrt{5}})}{4}=\frac{1}{4}(\sqrt{5}+1)(\sqrt{10+2\sqrt{5}})$$

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# Question8

$\operatorname{cosec} 48^\circ+\operatorname{cosec} 96^\circ+\operatorname{cosec} 192^\circ+\operatorname{cosec} 384^\circ=$

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**Options:**

A.

$4\sqrt{3}$

B.

$-4\sqrt{3}$

C.

0

D.

1

**Answer: C**

## Solution:

$\operatorname{cosec} 48^\circ+\operatorname{cosec} 96^\circ+\operatorname{cosec} 192^\circ+\operatorname{cosec} 384^\circ$

$$\begin{aligned}
\because\quad \operatorname{cosec}\theta &= \cot\theta/2-\cot\theta\\
\therefore \operatorname{cosec} 48^\circ &= \cot 24^\circ-\cot 48^\circ\\
\operatorname{cosec} 96^\circ &= \cot 48^\circ-\cot 96^\circ\\
\operatorname{cosec} 192^\circ &= \cot 96^\circ-\cot 192^\circ\\
\operatorname{cosec} 384^\circ &= \operatorname{cosec} 24^\circ\\
&= \cot 24^\circ-\cot 48^\circ+\cot 48^\circ-\cot 96^\circ+\cot 96^\circ-\cot 192^\circ+\cos 24^\circ
\end{aligned}$$

$= \cot 24^{\circ} - \cot 192^{\circ} + \cos 24^{\circ}$
and $\operatorname{cosec} 24^{\circ} = \cot 12^{\circ} - \cot 24^{\circ}$
$= \cot 24^{\circ} - \cot 192^{\circ} + \cot 12^{\circ} - \cot 24^{\circ}$
$= \cot 12^{\circ} - \cot 192^{\circ}$
$= \cot 12^{\circ} - \cot (180 + 12^{\circ})$
$= \cot 12^{\circ} - \cot 12^{\circ} = 0$

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# Question9

**If $\cos \theta = \frac{-3}{5}$ and $\theta$ does not lie in second quadrant, then $\tan \frac{\theta}{2} =$**

## AP EAPCET 2025 - 23rd May Evening Shift

**Options:**

A.

2

B.

1

C.

-2

D.

-1

**Answer: C**

## Solution:

$\because \cos \theta = -\frac{3}{5} < 0$ and $\theta$ does not lie in second quadrant.

Thus, $\theta$ lies is third quadrant.

So, $\theta/2$ must be lie in second quadrant.

There $\tan \theta/2$ must be negative.

then, $\cos \theta = \frac{3}{5} = \frac{B}{H}$

$\therefore \quad \tan \theta = \frac{4}{3}$

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

let $\tan \theta/2 = x$

$$\Rightarrow \quad \frac{4}{3}=\frac{2x}{1-x^2} \Rightarrow 4-4x^2=6x$$
$$\Rightarrow \quad 2x^2+3x-2=0$$
$$\Rightarrow \quad 2x^2+4x-x-2=0$$
$$\Rightarrow \quad (2x-1)(x+2)=0$$

Therefore,

$$x=1/2 \text{ or } x=-2$$
$$\Rightarrow \quad \tan\theta/2=1/2 \text{ or } \tan\theta/2=-2$$

$\because \tan\theta/2$ is negative

Hence, $\tan\theta/2=-2$

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# Question10

**If $\alpha$ is the maximum value and $\beta$ is the minimum value of $\cos^2\frac{x}{4}+\sin\frac{x}{4}, x\in R$, then $\alpha-\beta=$**

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**Options:**

A.

$\frac{1}{4}$

B.

$\frac{9}{4}$

C.

2

D.

3

**Answer: B**

## Solution:

$$\begin{aligned} Let\ f(x) &= \cos^2\left(\frac{x}{4}\right) + \sin\left(\frac{x}{4}\right) \\ &= 1 - \sin^2\left(\frac{x}{4}\right) + \sin\left(\frac{x}{4}\right) \\ &= -\sin^2\left(\frac{x}{4}\right) + \sin\left(\frac{x}{4}\right) + 1 \\ &= \frac{5}{4} - \left(\sin\left(\frac{x}{4}\right) - \frac{1}{2}\right)^2 \end{aligned}$$

$$\therefore f(x)|_{\max} = \alpha = \frac{5}{4} \text{ when } \sin\frac{x}{4} = \frac{1}{2}$$

$$\text{and } f(x)|_{\min} = \beta = -1 \text{ when } \sin\frac{x}{4} = -1$$

$$\therefore \alpha - \beta = \frac{5}{4} - (-1) = \frac{9}{4}$$

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# Question11

**If $A$ and $B$ are positive acute angles satisfying $3\cos^2 A + 2\cos^2 B = 4$ and $\frac{3\sin A}{\sin B} = \frac{2\cos B}{\cos A}$, then $A + 2B =$**

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**Options:**

A.

$30^\circ$

B.

$45^\circ$

C.

$60^\circ$

D.

$90^\circ$

**Answer: D**

## Solution:

$$3\cos^2 A + 2\cos^2 B = 4$$
$$\Rightarrow 3\left(1 - \sin^2 A\right) + 2\left(1 - \sin^2 B\right) = 4$$

Now, $3\sin A \cdot \cos A = 2\sin B \cdot \cos B$ (given)

$$\Rightarrow \quad 3\sin 2A = 2\sin 2B \qquad \ldots(i)$$

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

$= \cos A \cdot 3\sin^2 A - \sin A \cdot \frac{3}{2} \cdot 2\sin A \cos A \quad (fromEq.(i))$

$= 3\cos A \sin^2 A - 3\cos A \sin^2 A = 0$

$\therefore A + 2B = 90^\circ$

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# Question12

**If $\sin x - \sin y = \frac{27}{65}$ and $\cos x - \cos y = \frac{-21}{65}$, then $\sin(x+y) =$**

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**Options:**

A.

$-\frac{63}{65}$

B.

$\frac{16}{65}$

C.

$\frac{63}{65}$

D.

$-\frac{16}{65}$

**Answer: C**

## Solution:

Given, $\sin x - \sin y = 27/65$ and

$\cos x - \cos y = \frac{-21}{65}$

$2\sin\left(\frac{x-y}{2}\right)\cos\left(\frac{x+y}{2}\right) = \frac{27}{65}$ and

$2\sin\left(\frac{x+y}{2}\right)\sin\left(\frac{x-y}{2}\right) = \frac{21}{65}$

$\therefore \tan\left(\frac{x+y}{2}\right) = \frac{21}{27} = \frac{7}{9}$

$\sin(x+y) = \frac{2\tan\left(\frac{x+y}{2}\right)}{1+\tan^2\frac{x+y}{2}} = \frac{2\times\frac{7}{9}}{1+\frac{49}{81}}$

$\sin(x+y) = \frac{63}{65}$

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# Question13

**If $\alpha, \beta$ are the acute angles such that $\frac{\sin \alpha}{\sin \beta} = \frac{6}{5}$ and $\frac{\cos \alpha}{\cos \beta} = \frac{9}{5\sqrt{5}}$, then $\sin \alpha =$**

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**Options:**

A.

$\frac{4}{5}$

B.

$\frac{3}{5}$

C.

$\frac{3}{4}$

D.

$\frac{2}{3}$

**Answer: A**

## Solution:

$$\sin \beta = \frac{5}{6} \sin \alpha$$
$$\Rightarrow \cos \beta = \frac{5\sqrt{5}}{9} \cos \alpha$$
$$\Rightarrow \sin^2 \beta + \cos^2 \beta = 1$$
$$\Rightarrow \left(\frac{5}{6} \sin \alpha\right)^2 + \left(\frac{5\sqrt{5}}{9} \cos \alpha\right)^2 = 1$$
$$\Rightarrow \frac{25}{36} \sin^2 \alpha + \frac{125}{81} \cos^2 \alpha = 1$$
$$\Rightarrow \frac{25}{36} \sin^2 \alpha + \frac{125}{81} - \frac{125}{81} \sin^2 \alpha = 1$$
$$\Rightarrow \left(\frac{225 - 500}{324}\right) \sin^2 \alpha = \frac{81 - 125}{81}$$
$$\Rightarrow \sin^2 \alpha = \frac{-44}{81} \times \frac{324}{-275}$$
$$\Rightarrow \sin^2 \alpha = \frac{4}{9} \times \frac{11}{9} \times \frac{4}{25} \times \frac{81}{11}$$
$$\Rightarrow \sin^2 \alpha = \frac{16}{25} \Rightarrow \sin \alpha = \frac{4}{5}$$

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# Question14

**If $\left(\frac{\sin 3\theta}{\sin \theta}\right)^2 - \left(\frac{\cos 3\theta}{\cos \theta}\right)^2 = a \cos b\theta$, then $a : b =$**

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**Options:**

A.

$4 : 1$

B.

$8 : 1$

C.

$3 : 2$

D.

$2 : 1$

**Answer: A**

### Solution:

$$\left(\frac{\sin 3\theta}{\sin \theta}\right)^2 - \left(\frac{\cos 3\theta}{\cos \theta}\right)^2 = a \cos b\theta$$
$$\Rightarrow \left(\frac{3 \sin \theta - 4 \sin^3 \theta}{\sin \theta}\right) - \left(\frac{4 \cos^3 \theta - 3 \cos \theta}{\cos \theta}\right) = a \cos b\theta$$
$$\Rightarrow \left(3 - 4 \sin^2 \theta\right)^2 - \left(4 \cos^2 \theta - 3\right)^2 = a \cos b\theta$$
$$\Rightarrow 9 + 16 \sin^4 \theta - 24 \sin^2 \theta - 16 \cos^4 \theta - 9 + 24 \cos^2 \theta = a \cos b\theta$$
$$\Rightarrow 24 \left(\cos^2 \theta - \sin^2 \theta\right) - 16 \left(\cos^4 \theta - \sin^4 \theta\right) = a \cos^b \theta$$
$$\Rightarrow 8 \left(\cos^2 \theta - \sin^2 \theta\right) \left(3 - 2 \left(\cos^2 \theta + \sin^2 \theta\right)\right) = a \cos b\theta \quad ,$$
$$\Rightarrow 8 \cos 2\theta(3 - 2) = a \cos b\theta$$
$$\Rightarrow 8 \cos 2\theta = a \cos b\theta \Rightarrow a = 8, b = 2$$
$$\therefore a : b = 8 : 2 = 4 : 1$$

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# Question15

**An aeroplane is flying at a constant speed, parallel to the horizontal ground at a height of 5 kms . A person on the ground observed that the angle of elevation of the plane is changed from $15^\circ$ to $30^\circ$ in the duration of 50 seconds, then the speed of the plane (in kmph ) is**

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**Options:**

A.

100

B.

720

C.

360

D.

540

**Answer: B**

## Solution:

Let $x_1$ be the initial horizontal distance

$\tan 15^\circ = \frac{5}{x_1} \Rightarrow x_1 = \frac{5}{\tan 15^\circ}$

Let $x_2$ be the final horizontal distance

$$\begin{aligned} \tan 30^\circ &= \frac{5}{x_2} \\ \Rightarrow \quad x_2 &= \frac{5}{\tan 30^\circ} \end{aligned}$$

The distance travelled is $d = x_1 - x_2$

$$d = \frac{5}{\tan 15^\circ} - \frac{5}{\tan 30^\circ}$$
$$d \approx 5(3.732 - 1.732)$$
$$d \approx 5 \times 2$$
$$d = 10 \text{ km}$$

$$\begin{aligned} \text{speed } &= \frac{d}{t} = \frac{10}{50} = 0.2 \text{ km/s} \\ &= 3600 \times 0.2 \text{ km/h} = 720 \text{ km/h} \\ \Rightarrow &\text{ The speed of the plane is } 720 \text{ km/h} \end{aligned}$$

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# Question16

## If $A + B = \frac{\pi}{4}$, then $\frac{\cos B - \sin B}{\cos B + \sin B} =$

### AP EAPCET 2025 - 22nd May Morning Shift

**Options:**

A.

$\sin A$

B.

$\cos A$

C.

$\tan A$

D.

$\cot A$

**Answer: C**

## Solution:

We have,

$$A+B=\frac{\pi}{4}$$

$$\Rightarrow \frac{\cos B-\sin B}{\cos B+\sin B}=\frac{\sin\left(\frac{\pi}{4}+A\right)-\sin\left(\frac{\pi}{4}-A\right)}{\sin\left(\frac{\pi}{4}+A\right)+\sin\left(\frac{\pi}{4}-A\right)}$$

$$=\frac{2\cos\frac{\pi}{4}\sin A}{2\sin\frac{\pi}{4}\cos A}=\tan A$$

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# Question17

**If $7\cos\theta-\sin\theta=5$ and $\tan\theta>0$, then $\tan\theta=$**

### AP EAPCET 2025 - 22nd May Morning Shift

**Options:**

A.

$\frac{7}{12}$

B.

$\frac{3}{4}$

C.

$\frac{4}{3}$

D.

$\frac{12}{7}$

**Answer: B**

## Solution:

$7\cos\theta - \sin\theta = 5, \tan\theta > 0$

$7 - \tan\theta = 5\sec\theta$

Squaring both sides, we get

$$\begin{aligned}
&\Rightarrow 49 + \tan^2\theta - 14\tan\theta = 25\left(1 + \tan^2\theta\right) \\
&\Rightarrow 24\tan^2\theta + 14\tan\theta - 24 = 0 \\
&\Rightarrow 12\tan^2\theta + 7\tan\theta - 12 = 0 \\
&\Rightarrow 12\tan^2\theta + 16\tan\theta - 9 \cdot \tan\theta - 12 = 0 \\
&\Rightarrow (3\tan\theta + 4)(4\tan\theta - 3) = 0 \\
&\quad \tan\theta = \frac{3}{4}
\end{aligned}$$

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

# Question18

$\sin^3 10^\circ + \sin^3 50^\circ - \sin^3 70^\circ =$

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**Options:**

A.

$\frac{-3}{8}$

B.

$\frac{3}{4}$

C.

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

D.

$\frac{-1}{3}$

**Answer: A**

## Solution:

$\sin^3 10^\circ + \sin^3 50^\circ - \sin^3 70^\circ$

$\Rightarrow \quad \sin 3x = 3\sin x - 4\sin^3 x$

$\Rightarrow \quad \sin^3 x = \frac{1}{4}(3\sin x - \sin 3x)$

$\Rightarrow \quad \frac{1}{4}[3\sin 10^\circ - \sin 30^\circ + 3\sin 50^\circ - \sin 150^\circ - 3\sin 70^\circ + \sin 210^\circ]$

$\Rightarrow \quad \frac{1}{4}\left[3\sin 10^\circ + 3\sin 50^\circ - 3\sin 70^\circ - \frac{1}{2} - \frac{1}{2} - \frac{1}{2}\right]$

$\Rightarrow \frac{3}{4}\left[\sin 10^\circ + \sin 50^\circ - \sin 70^\circ - \frac{1}{2}\right]$

$\Rightarrow \frac{3}{4}\left[2\sin 30^\circ \cos 20^\circ - \sin 70^\circ - \frac{1}{2}\right]$

$\Rightarrow \frac{3}{4}\left[\cos 20^\circ - \sin 70^\circ - \frac{1}{2}\right]$

$\Rightarrow \frac{3}{4}\left[\sin 70^\circ - \sin 70^\circ - \frac{1}{2}\right] = -\frac{3}{8}$

---

# Question19

$$\frac{1}{\sin 1^\circ \sin 2^\circ} + \frac{1}{\sin 2^\circ \sin 3^\circ} + \frac{1}{\sin 3^\circ \sin 4^\circ} + \frac{1}{\sin 89^\circ \sin 90^\circ} =$$

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**Options:**

A.

$\frac{\sin 1^\circ}{\tan 1^\circ}$

B.

$\frac{1}{\sin^2 \varphi}$

C.

$\frac{\cot 1^\circ}{\sin 1^\circ}$

D.

$\frac{\tan 1^\circ}{\cos 1^\circ}$

**Answer: C**

## Solution:

We have, $\sum_{r=1}^{89} \frac{1}{\sin r^\circ \cdot \sin(r+1)^\circ}$

$\Rightarrow \frac{1}{\sin 1^\circ} \sum_{r=1}^{89} \frac{\sin\left((r^\circ + 1^\circ) - r^\circ\right)}{\sin r^\circ \cdot \sin\left(r^\circ + 1^\circ\right)}$

$\Rightarrow \frac{1}{\sin 1^\circ} \sum_{r=1}^{89} \frac{\sin(r+1)^\circ \cos r^\circ}{\sin r^\circ \cdot \sin(r+1)^\circ}$

$\Rightarrow \frac{1}{\sin 1^\circ} \sum_{r=1^\circ}^{89} \cot r^\circ - \cot(r+1)^\circ$

$\Rightarrow \frac{1}{\sin 1^\circ}[\cot 1^\circ - \cot 90^\circ] = \frac{\cot 1^\circ}{\sin 1^\circ}$

---

# Question20

$\cos^3 \frac{\pi}{8} \cos \frac{3\pi}{8} + \sin^3 \frac{\pi}{8} \sin \frac{3\pi}{8} =$

## AP EAPCET 2025 - 21st May Evening Shift

**Options:**

A.

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

B.

$\frac{1}{2}$

C.

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

D.

$\frac{1}{4}$

**Answer: A**

## Solution:

Given,

$$\cos^3\frac{\pi}{8}\cdot\cos\frac{3\pi}{8}+\sin^3\frac{\pi}{8}\cdot\sin\frac{3\pi}{8}$$

Using $\frac{3\pi}{8}=\frac{\pi}{2}-\frac{\pi}{8}$

$$\Rightarrow \cos\frac{3\pi}{8}=\sin\frac{\pi}{8} \text{ and } \sin\frac{3\pi}{8}=\cos\frac{\pi}{8}$$

$$\Rightarrow \cos^3\frac{\pi}{8}\cdot\sin\frac{\pi}{8}+\sin^3\frac{\pi}{8}\cdot\cos\frac{\pi}{8}$$

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

$$=\frac{1}{2}2\sin\frac{\pi}{8}\cos\frac{\pi}{8}$$

$$=\frac{1}{2}\sin\frac{\pi}{4}=\frac{1}{2\sqrt{2}}$$

---

# Question21

**If $A+B+C=\frac{\pi}{4}$, then $\sin 4A+\sin 4B+\sin 4C=$**

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**Options:**

A.

$4\cos 2A\cos 2B\cos 2C$

B.

$4\sin 2A\sin 2B\sin 2C$

C.

$1+4\sin 2A\sin 2B\sin 2C$

D.

$1+4\cos 2A\cos 2B\cos 2C$

**Answer: A**

## Solution:

Given, $A+B+C=\frac{\pi}{4}$
$\therefore 2A+2B+2C=\frac{\pi}{2}$
Now, $\sin 4A+\sin 4B+\sin 4C$
$2\sin(2A+2B)\cdot\cos(2A-2B)+2\sin 2C$
$=2\sin\left(\frac{\pi}{2}-2C\right)\cdot\cos 2C+2\sin 2C\cdot\cos 2C$
$=2\cos 2C\cdot\cos(2A-2B)+2\sin 2C\cdot\cos 2C$
$=2\cos 2C\{\cos(2A-2B)+\sin 2C\}$
$=2\cos 2C[\cos(2A-2B)+\cos(2A+2B)]$
$=2\cos 2C[2\cos 2A\cdot\cos 2B]$
$=4\cos 2A\cdot\cos 2B\cdot\cos 2C$

---

# Question22

**If $630^\circ<\theta<810^\circ$ and $\tan\theta=-\frac{7}{24}$, then $\cos\left(\frac{\theta}{4}\right)=$**

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**Options:**

A.

$-\sqrt{\frac{7+5\sqrt{2}}{10\sqrt{2}}}$

B.

$\sqrt{\frac{7+5\sqrt{2}}{2\sqrt{2}}}$

C.

$-\sqrt{\frac{5\sqrt{2}-7}{10\sqrt{2}}}$

D.

$\sqrt{\frac{5\sqrt{2}-7}{2\sqrt{2}}}$

**Answer: A**

## Solution:

Given, $630^\circ<\theta<810^\circ$ and

$\tan\theta=\frac{-7}{24}$

$\therefore\theta$ lies IV quadrant

$$\therefore \quad \cos\theta = \frac{24}{25} \quad 315^\circ < \frac{\theta}{2} < 405^\circ$$

$$2\cos^2\frac{\theta}{2} - 1 = \frac{24}{25} \quad 157\frac{1}{2} < \frac{\theta}{4} < 2.02\frac{1}{2}$$

$$2\cos^2\frac{\theta}{2} = \frac{49}{25} \quad \frac{\theta}{4} \text{ lies III quadrant}$$

$$\Rightarrow \quad \cos\frac{\theta}{2} = \frac{7}{5\sqrt{2}} \Rightarrow 2\cos^2\frac{\theta}{4} - 1 = \frac{7}{5\sqrt{2}}$$

$$\Rightarrow 2\cos^2\frac{\theta}{4} = 1 + \frac{7}{5\sqrt{2}} = \frac{7+5\sqrt{2}}{5\sqrt{2}}$$

$$\Rightarrow \quad \cos\frac{\theta}{4} = -\sqrt{\frac{7+5\sqrt{2}}{10\sqrt{2}}}$$

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

# Question23

**For $\theta \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ if $2\cos\theta + \sin\theta = 1$ and $7\cos\theta + 6\sin\theta = k$, then the possible values of $k$ are**

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**Options:**

A.

8,-2

B.

6,2

C.

12,4

D.

7,6

**Answer: B**

## Solution:

We have,

$2\cos\theta + \sin\theta = 1 \quad \theta \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

Squaring both sides, we get

$$\Rightarrow \quad (2\cos\theta)^2 = (1-\sin\theta)^2$$
$$\Rightarrow \quad 4\cos^2\theta = 1+\sin^2\theta - 2\sin\theta$$
$$\Rightarrow \quad 5\sin^2\theta - 2\sin\theta - 3 = 0$$
$$\Rightarrow \quad (\sin\theta - 1)(5\sin\theta + 3) = 0$$
$$\Rightarrow \quad \sin\theta = 1 \text{ and } -\frac{3}{5}$$
$$\Rightarrow \quad \cos\theta = 0 \text{ and } +\frac{4}{5}$$
$$\because \quad 7\cos\theta + 6\sin\theta = k, \text{ when } \sin\theta = 1$$
$$\Rightarrow \quad 7(0) + 6(1) = k \Rightarrow k = 6$$

When, $\sin\theta = -\frac{3}{5}$ and $\cos\theta = \frac{4}{5}$

$$k = 7\left(\frac{4}{5}\right) - 6\left(\frac{3}{5}\right) = \frac{28-18}{5} = \frac{10}{5} = 2$$

---

# Question24

$$\sum_{k=0}^{12} \frac{1}{\sin\left((k+1)\frac{\pi}{6}+\frac{\pi}{4}\right)\sin\left(\frac{k\pi}{6}+\frac{\pi}{4}\right)} =$$

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**Options:**

A.

$2(\sqrt{3}+1)$

B.

$2(3-\sqrt{3})$

C.

$2(2-\sqrt{3})$

D.

$2(\sqrt{3}-1)$

**Answer: D**

## Solution:

$$\sum_{k=0}^{12} \frac{1}{\sin\left((k+1)\frac{\pi}{6}+\frac{\pi}{4}\right) \cdot \sin\left(\frac{k\pi}{6}+\frac{\pi}{4}\right)}$$

Multiplying $N^r$ and $D^r$ by $\sin \pi/6$,

$$\frac{1}{\sin\frac{\pi}{6}} \sum_{k=0}^{12} \frac{\sin\left\{\left((k+1)\frac{\pi}{6}+\frac{4}{\pi}\right)-\left(\frac{k\pi}{6}+\frac{\pi}{4}\right)\right\}}{2\sum_{k=0}^{12}\left((k+1)\frac{\pi}{6}+\frac{\pi}{4}\right) \cdot \sin\left(\frac{k\pi}{6}+\frac{\pi}{4}\right)}$$

$$= 2\left[\cot\left(\frac{k\pi}{6}+\frac{\pi}{4}\right) - \cot\left((k+1)\frac{\pi}{6}+\frac{\pi}{4}\right)\right\}$$

$$+\left\{\cot\left(\frac{\pi}{6}+\frac{\pi}{4}\right) - \cot\left(\frac{\pi}{6}+\frac{\pi}{4}\right)\right\}$$

$$+\ldots+\left\{\cot\left(\frac{12\pi}{6}+\frac{\pi}{4}\right) - \cot\left(\frac{13\pi}{6}+\frac{\pi}{4}\right)\right\}$$

$$= 2\left[\cot\frac{\pi}{4} + \cot\left(\frac{\pi}{6}+\frac{\pi}{4}\right)\right]$$

$$= 2\left[1 - \frac{\sqrt{3}-1}{\sqrt{3}+1}\right] = 2\left(\frac{2}{\sqrt{3}+1}\right) = \frac{4(\sqrt{3}-1)}{2}$$

$$= 2(\sqrt{3}-1)$$

---

# Question25

### If $\cos\alpha = \sec h\beta$, then $\beta =$

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**Options:**

A.

$\log(\sec\alpha + \tan\alpha)$

B.

$\log(\sec\alpha - \tan\alpha)$

C.

$\log(\sin\alpha + \cos\alpha)$

D.

$\log(\cos\alpha + \cot\alpha)$

**Answer: A**

### Solution:

Given $\cos \alpha=\sec h \beta$

or $\quad \cos h \beta=\sec \alpha$

$\Rightarrow \quad \beta=\cos h^{-1}(\sec \alpha)$

$\Rightarrow \quad \beta=\log \left(\sec \alpha+\sqrt{\sec ^2 \alpha-1}\right)$

$\left[\because \cos h^{-1} x=\log \left(x+\sqrt{x^2-1}\right)\right]$

$\beta=\log (\sec \alpha+\tan \alpha)$

---

# Question26

$\tan ^2 \frac{\pi}{16}+\tan ^2 \frac{2 \pi}{16}+\tan ^2 \frac{3 \pi}{16}+\tan ^2 \frac{4 \pi}{16}$

$+\tan ^2 \frac{5 \pi}{16}+\tan ^2 \frac{6 \pi}{16}+\tan ^2 \frac{7 \pi}{16}$ **is equal to**

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**Options:**

A. 35

B. 41

C. 37

D. 33

**Answer: A**

## Solution:

$$\tan ^2 \frac{\pi}{16}+\tan ^2 \frac{2 \pi}{16}+\tan ^2 \frac{3 \pi}{16}+\tan ^2 \frac{4 \pi}{16}+\tan ^2 \frac{5 \pi}{16}+\tan ^2 \frac{6 \pi}{16}$$

$$+\tan ^2 \frac{7 \pi}{16}=\left(\sec ^2 \frac{\pi}{16}-1\right)+\left(\sec ^2 \frac{2 \pi}{16}-1\right)+\left(\sec ^2 \frac{3 \pi}{16}-1\right)+1+\tan ^2\left(\frac{\pi}{2}-\frac{3 \pi}{16}\right)+\tan ^2\left(\frac{\pi}{2}-\frac{2 \pi}{16}\right)+\tan ^2\left(\frac{\pi}{2}-\frac{\pi}{16}\right)$$

$$\left(\sec ^2 \frac{\pi}{16}-1\right)+\left(\sec ^2 \frac{2 \pi}{16}-1\right)+\left(\sec ^2 \frac{3 \pi}{16}-1\right)+1$$

$$+\cot ^2\left(\frac{3 \pi}{16}\right)+\cot ^2\left(\frac{2 \pi}{16}\right)+\cot ^2\left(\frac{\pi}{16}\right)$$

$$=\left(\sec ^2 \frac{\pi}{16}-1\right)+\left(\sec ^2 \frac{2 \pi}{16}-1\right)+\left(\sec ^2 \frac{3 \pi}{16}-1\right)+1+\left(\operatorname{cosec}^2 \frac{3 \pi}{16}-1\right)+\left(\operatorname{cosec}^2 \frac{2 \pi}{16}-1\right)+\left(\operatorname{cosec}^2 \frac{\pi}{16}-1\right)$$

$$=\left(\sec ^2 \frac{\pi}{16}+\operatorname{cosec}^2 \frac{\pi}{16}\right)+\left(\sec ^2 \frac{2 \pi}{16}+\operatorname{cosec}^2 \frac{2 \pi}{16}\right)+\left(\sec ^2 \frac{3 \pi}{16}+\operatorname{cosec}^2 \frac{3 \pi}{16}\right)-6+1$$

$$= \frac{1}{\sin^2 \frac{\pi}{16} \cos^2 \frac{\pi}{16}} + \frac{1}{\sin^2 \frac{2\pi}{16} \cos^2 \frac{2\pi}{16}}$$
$$+ \frac{1}{\sin^2 \frac{3\pi}{16} \cos^2 \frac{3\pi}{16}} - 5$$
$$= \frac{4}{\sin^2 \frac{\pi}{8}} + \frac{4}{\sin^2 \frac{\pi}{4}} + \frac{4}{\sin^2 \frac{3\pi}{8}} - 5$$
$$= 4\left(\frac{1}{\sin^2 \frac{\pi}{8}} + \frac{1}{\cos^2 \frac{\pi}{8}}\right) + 4 \times 2 - 5$$
$$= 4\left(\frac{1}{\sin^2 \frac{\pi}{8} \cos^2 \frac{\pi}{8}}\right) + 3 = \frac{4 \times 4}{\sin^2 \frac{\pi}{4}} + 3$$
$$= 2 \times 16 + 3 = 35$$

---

# Question27

$\sin^2 18^\circ + \sin^2 24^\circ + \sin^2 36^\circ + \sin^2 42^\circ + \sin^2 78^\circ$
$+ \sin^2 90^\circ + \sin^2 96^\circ + \sin^2 102^\circ + \sin^2 138^\circ + \sin^2 162^\circ$ is equal to

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**Options:**

A. $\frac{11}{2}$

B. $\frac{9}{2}$

C. 5

D. 4

**Answer: A**

## Solution:

$$\sin^2 18^\circ + \sin^2 24^\circ + \sin^2 36^\circ + \sin^2 42^\circ + \sin^2 78^\circ + \sin^2 90^\circ$$
$$+ \sin^2 96^\circ + \sin^2 102^\circ + \sin^2 138^\circ + \sin^2 162^\circ$$
$$\because \sin^2 \theta = \sin^2 (180^\circ - \theta)$$

$\therefore \sin^2 18^\circ + \sin^2 24^\circ + \sin^2 36^\circ + \sin^2 42^\circ + \sin^2 78^\circ + 1 + \sin^2 84^\circ + \sin^2 78^\circ + \sin^2 42^\circ + \sin^2 18^\circ$
$= 2\sin^2 18^\circ + 2\sin^2 42^\circ + 2\sin^2 78^\circ + \sin^2 24^\circ + \sin^2 36^\circ + \sin^2 84^\circ + 1$
$= 2\sin^2 18^\circ + 2\sin^2 42^\circ + 2\cos^2 12^\circ + \sin^2 24^\circ + \sin^2 36^\circ + \cos^2 6^\circ + 1$
$2\left[\cos^2 12^\circ + \sin^2(30^\circ - 12^\circ) + \sin^2(30^\circ + 12^\circ)\right]$
$+\left[\cos^2 6^\circ + \sin^2(30^\circ + 6^\circ) + \sin^2(30^\circ - 6^\circ)\right] + 1$
$\because \cos^2\theta + \sin^2(30^\circ + \theta) + \sin^2(30^\circ - \theta) = 0$

$$\cos^2\theta + [\sin 30^\circ \cos\theta + \cos 30^\circ \sin\theta]^2$$
$$+[\sin 30^\circ \cos\theta - \cos 30^\circ \sin\theta]^2$$

Using $(a+b)^2 + (a-b)^2 = 2\left(a^2 + b^2\right)$

$\Rightarrow \cos^2\theta + 2\left[\sin^2 30^\circ \cos^2\theta \quad + \cos^2 30^\circ \sin^2\theta\right]$
$\Rightarrow \cos^2\theta + 2\left[\frac{1}{4}\cos^2\theta + \frac{3}{4}\sin^2\theta\right]$
$\Rightarrow \cos^2\theta + \frac{1}{2}\cos^2\theta + \frac{3}{2}\sin^2\theta$
$\Rightarrow 3/2 \quad \left[\because \cos^2\theta + \sin^2\theta = 1\right]$

Using this result in Eq. (i), we get
$2\left(\frac{3}{2}\right) + \frac{3}{2} + 1 = \frac{11}{2}$

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

# Question28

**If $AB$ and $C$ are the angles of a triangle, then $\frac{\sin A + \sin B + \sin C}{\sin^2 \frac{A}{2} - \sin^2 \frac{B}{2} + \sin^2 \frac{C}{2} - 1}$ is equal to**

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**Options:**

A. $-2\tan\frac{B}{2}$

B. $-2\cot\frac{B}{2}$

C. $2\tan\frac{B}{2}$

D. $2\cot\frac{B}{2}$

**Answer: B**

## Solution:

We have,

$$\frac{\sin A+\sin B+\sin C}{\sin^2\frac{A}{2}+\sin^2\frac{B}{2}+\sin^2\frac{C}{2}-1}$$
$$=\frac{2\sin\left(\frac{A+C}{2}\right)\cos\left(\frac{A-C}{2}\right)+2\sin\frac{B}{2}\cos\frac{B}{2}}{\sin^2\frac{A}{2}-\cos^2\frac{C}{2}+\sin^2\frac{B}{2}}$$
$$=\frac{2\cos\frac{B}{2}\cos\frac{A-C}{2}+2\sin\frac{B}{2}\cos\frac{B}{2}}{-\cos\left(\frac{A+C}{2}\right)\cos\left(\frac{A-C}{2}\right)+\sin^2\frac{B}{2}}$$
$[\because \sin^2 A-\cos^2 B=-\cos(A+B)\cos(A-B)]$
$$=\frac{2\cos\frac{B}{2}\left[\cos\left(\frac{A-C}{2}\right)+\sin\frac{B}{2}\right]}{-\sin\frac{B}{2}\left[\cos\left(\frac{A-C}{2}\right)+\sin\frac{B}{2}\right]}$$
$$=-2\cot\frac{B}{2}$$

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

# Question29

**If $\cos\alpha+4\cos\beta+9\cos\gamma=0$ and $\sin\alpha+4\sin\beta+9\sin\gamma=0$, then 81 $\cos(2\gamma-2\alpha)-16\cos(2\beta-2\alpha)$ is equal to**

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**Options:**

A. $1+8\cos(\beta-\alpha)$

B. $\cos(\beta-\alpha)$

C. $1-36\cos(\beta-\alpha)$

D. $1+6\cos(\beta-\alpha)$

**Answer: A**

## Solution:

We start with the given equations:

$$\cos\alpha+4\cos\beta+9\cos\gamma=0 \quad \ldots(i)$$
$$\sin\alpha+4\sin\beta+9\sin\gamma=0 \quad \ldots(ii)$$

Combine these equations using the complex form of the equations. Multiply both expressions:

$$\cos\theta+i\sin\theta=e^{i\theta}$$

Thus, combining both equations, we have:

$$(\cos\alpha+i\sin\alpha)+4(\cos\beta+i\sin\beta)+9(\cos\gamma+i\sin\gamma)=0$$
$$e^{i\alpha}+4e^{i\beta}+9e^{i\gamma}=0$$
$$\Rightarrow 1+4e^{i(\beta-\alpha)}=-9e^{i(\gamma-\alpha)}$$

Substitute using Euler's formula:

$$1+[4\cos(\beta-\alpha)+4i\sin(\beta-\alpha)]=-[9\cos(\gamma-\alpha)+9i\sin(\gamma-\alpha)]$$

Next, square both sides and compare the real parts:

$$[1+4\cos(\beta-\alpha)]^2-16\sin^2(\beta-\alpha)$$
$$=[9\cos(\gamma-\alpha)]^2-[9\sin(\gamma-\alpha)]^2$$
$$=1+8\cos(\beta-\alpha)+16[\cos^2(\beta-\alpha)-\sin^2(\beta-\alpha)]$$
$$=81[\cos^2(\gamma-\alpha)-\sin^2(\gamma-\alpha)]$$

Use the identities for double angles:

$$\Rightarrow 81\cos 2(\gamma-\alpha)-16\cos 2(\beta-\alpha)$$
$$=1+8\cos(\beta-\alpha)$$

Therefore, the expression $81\cos(2\gamma-2\alpha)-16\cos(2\beta-2\alpha)$ simplifies to:

$1+8\cos(\beta-\alpha)$

---

# Question30

## $\tan\alpha+2\tan 2\alpha+4\tan 4\alpha+8\cot 8\alpha$ is equal to

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**Options:**

A. $\sin\alpha$

B. $\cos\alpha$

C. $\tan\alpha$

D. $\cot\alpha$

**Answer: D**

## Solution:

We have,

$$\tan\alpha+2\tan 2\alpha+4\tan 4\alpha+8\cot 8\alpha$$
$$=\tan\alpha+2\tan 2\alpha+4\tan 4\alpha+8\times\frac{1-\tan^2 4\alpha}{2\tan 4\alpha}$$
$$=\tan\alpha+2\tan 2\alpha+\frac{8\tan^2 4\alpha+8-8\tan^2 4\alpha}{2\tan 4\alpha}$$
$$=\tan\alpha+2\tan 2\alpha+\frac{8}{2\left(\frac{2\tan 2\alpha}{1-\tan^2 2\alpha}\right)}$$
$$=\tan\alpha+2\tan 2\alpha+\frac{4\left(1-\tan^2 2\alpha\right)}{2\tan 2\alpha}$$
$$=\tan\alpha+\frac{4\tan^2 2\alpha+4-4\tan^2 2\alpha}{2\tan 2\alpha}$$
$$=\tan\alpha+\frac{2}{\tan 2\alpha}=\tan\alpha+\frac{2\left(1-\tan^2\alpha\right)}{2\tan\alpha}$$
$$=\frac{2\tan^2\alpha+2-2\tan^2\alpha}{2\tan\alpha}=\frac{1}{\tan\alpha}=\cot\alpha$$

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# Question31

$\tan 9^{\circ}-\tan 27^{\circ}-\tan 63^{\circ}+\tan 81^{\circ}$ **is equal to**

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**Options:**

A. 4

B. 3

C. 2

D. 1

**Answer: A**

## Solution:

$$\begin{aligned}
&\tan 9^{\circ}-\tan 27^{\circ}-\tan 63^{\circ}+\tan 81^{\circ}\\
&=\left(\tan 9^{\circ}+\tan 81^{\circ}\right)-\left(\tan 27^{\circ}+\tan 63^{\circ}\right)\\
&=\left(\tan 9^{\circ}+\cot 9^{\circ}\right)-\left(\tan 27^{\circ}+\cot 27^{\circ}\right)
\end{aligned}$$

$$=\left(\frac{\cos 9^{\circ}}{\sin 9^{\circ}}+\frac{\sin 9^{\circ}}{\cos 9^{\circ}}\right)-\left(\frac{\sin 27^{\circ}}{\cos 27^{\circ}}+\frac{\cos 27^{\circ}}{\sin 27^{\circ}}\right)$$

$$\begin{aligned}
&=\frac{\cos ^2 9^{\circ}+\sin ^2 9^{\circ}}{\sin 9^{\circ} \cdot \cos 9^{\circ}}-\frac{\sin ^2 27^{\circ}+\cos ^2 27^{\circ}}{\cos 27^{\circ} \cdot \sin 27^{\circ}}\\
&=\frac{1}{\sin 9^{\circ} \cdot \cos 9^{\circ}}-\frac{1}{\cos 27^{\circ} \cdot \sin 27^{\circ}}\\
&=\frac{2}{2 \sin 9^{\circ} \cos 9^{\circ}}-\frac{2}{2 \cos 27^{\circ} \sin 27^{\circ}}\\
&=\frac{2}{\sin 18^{\circ}}-\frac{2}{\sin 54^{\circ}}=\left(\frac{\sin 54^{\circ}-\sin 18^{\circ}}{\sin 18^{\circ} \cdot \sin 54^{\circ}}\right)\\
&=2 \cdot \frac{2 \cos 36^{\circ} \cdot \sin 18^{\circ}}{\cos 36^{\circ} \cdot \sin 18^{\circ}}=4
\end{aligned}$$

---

# Question32

$\cos 6^{\circ} \sin 24^{\circ} \cos 72^{\circ}$ **is equal to**

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**Options:**

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

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

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

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

**Answer: C**

## Solution:

$$\begin{aligned}
&\cos 6^{\circ} \cdot \sin 24^{\circ} \cos 72^{\circ} \\
&=\frac{1}{2} \cdot 2 \cos 6^{\circ} \sin 24^{\circ} \cos 72^{\circ} \\
&=\frac{1}{2}\left(\sin 30^{\circ}+\sin 18^{\circ}\right) \cos 72^{\circ} \\
&=\frac{1}{2}\left[\left(\frac{1}{2}+\frac{\sqrt{5}-1}{4}\right)\left(\frac{\sqrt{5}-1}{4}\right)\right]=\frac{1}{8}
\end{aligned}$$

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# Question33

**If $\sinh x=\frac{\sqrt{21}}{2}$, then $\cosh 2x+\sinh 2x$ is equal to**

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**Options:**

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

B. $\frac{25}{2}$

C. $\frac{23+5\sqrt{21}}{2}$

D. $\frac{32+5\sqrt{23}}{2}$

**Answer: C**

## Solution:

Given, $\sin h(x)=\frac{\sqrt{21}}{2}$

$$\begin{aligned}
&\Rightarrow \cosh x=\sqrt{1+\sinh^2 x}=\sqrt{1+\frac{21}{4}} \\
&\Rightarrow \cosh x=\frac{5}{2}
\end{aligned}$$

Now, $\cosh 2x+\sinh 2x=1+2\sinh^2 x+2\sinh x \cosh$

$$\begin{aligned}
&=1+2 \cdot \frac{21}{4}+2 \times \frac{\sqrt{21}}{2} \times \frac{5}{2} \\
&=\frac{23}{2}+\sqrt{21} \times \frac{5}{2}=\frac{23+5\sqrt{21}}{2}
\end{aligned}$$

---

# Question34

**If $M_1$ and $M_2$ are the maximum values of $\frac{1}{11\cos 2x+60\sin 2x+69}$ and $3\cos^2 5x+4\sin^2 5x$ respectively, then $\frac{M_1}{M_2}=$**

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**Options:**

A. $\frac{65}{2}$

B. $\frac{1}{32}$

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

D. 2

**Answer: B**

## Solution:

$\frac{1}{11\cos 2x+60\sin 2x+69}$

denominator $11\cos 2x+60\sin 2x+69$

To find extrema of denominator

$11\cos 2x+60\sin 2x=\sqrt{11^2+60^2}\sin(2x+\theta)$

where, $\theta=\tan^{-1}\frac{11}{60}$

$=61\sin(2x+\theta)$

This minimum value is -61 and the maximum value is 61 .

Therefore, $11\cos 2x+60\sin 2x+69$

$=69-61=8$ to $69+61=130$

The maximum value is 130 and minimum is 8 of denominator

Hence, $M_1=\frac{1}{8}$

For, $3\cos^2 5x+4\sin^2 5x$

$=3\left(1-\sin^2 5x\right)+4\sin^2 5x$
$=3+\sin^2 5x$

The maximum value of $\sin^2 5x$ is 1 , hence

$3+\sin^2 5x=3+1=4$

because the range of (sine) $^2$ is between 0 and 1

The minimum value of $\sin^2 5x$ is 0 .

Hence, $3+\sin^2 5x \geq 3+0=3$

Thus, the maximum value $M_2=4$

Finally the ratio is

$\frac{M_1}{M_2}=\frac{\frac{1}{8}}{4}=\frac{1}{8\times 4} \Rightarrow \frac{M_1}{M_2}=\frac{1}{32}$

---

# Question35

$4 \cos \frac{\pi}{7} \cos \frac{\pi}{5} \cos \frac{2\pi}{7} \cos \frac{2\pi}{5} \cos \frac{4\pi}{7}=$

## AP EAPCET 2024 - 22th May Morning Shift

**Options:**

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

B. $\frac{1}{32}$

C. $-\frac{1}{32}$

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

**Answer: A**

## Solution:

To solve the expression:

$4 \cos \frac{\pi}{7} \cos \frac{\pi}{5} \cos \frac{2\pi}{7} \cos \frac{2\pi}{5} \cos \frac{4\pi}{7}$

we can use known trigonometric identities and values. Direct computation might be cumbersome, so we leverage a known result for products of cosines.

Here is the important formula:

$\cos\left(\frac{\pi}{7}\right) \cos\left(\frac{2\pi}{7}\right) \cos\left(\frac{3\pi}{7}\right)=\frac{1}{8}$

Given the symmetry properties of cosine, specifically that:

$\cos\left(\frac{4\pi}{7}\right)=-\cos\left(\frac{3\pi}{7}\right)$,

we can deduce:

$\cos \frac{\pi}{7} \cos \frac{2\pi}{7} \cos \frac{4\pi}{7}=\frac{-1}{8}$

Additionally, using the identity for the product of cosines:

$\cos\frac{\pi}{5}\cos\frac{2\pi}{5}=\frac{1}{4}$

Combining these results from equations (i) and (ii):

$$4\cos\frac{\pi}{7}\cos\frac{\pi}{5}\cos\frac{2\pi}{7}\cos\frac{2\pi}{5}\cos\frac{4\pi}{7}=4\times\left(-\frac{1}{8}\right)\times\frac{1}{4}$$
$$=\frac{-1}{8}$$

Hence, the value of the expression is $-\frac{1}{8}$.

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# Question36

## If $\tanh x=\operatorname{sech} y=\frac{3}{5}$ and $e^{x+y}$ is an integer, then $e^{x+y}=$

## AP EAPCET 2024 - 22th May Morning Shift

**Options:**

A. 2

B. 8

C. 1

D. 6

**Answer: D**

## Solution:

**Step 1: Solve for $\tanh x=\frac{3}{5}$:**

The hyperbolic tangent function is defined as:

$\tanh x=\frac{\sinh x}{\cosh x}=\frac{3}{5}$

This implies:

$\sinh x=\frac{3}{5}\cosh x$

Let $\cosh x=z$, then:

$\sinh x=\frac{3}{5}z$

Using the identity:

$\cosh^2 x-\sinh^2 x=1$

Substitute the values:

$z^2-\left(\frac{3}{5}z\right)^2=1$

Solve this equation:

$z^2-\frac{9}{25}z^2=1$

$\frac{16}{25} z^2 = 1 \quad \Rightarrow \quad z^2 = \frac{25}{16}$

Thus,

$z = \frac{5}{4} \quad \Rightarrow \quad \cosh x = \frac{5}{4}, \sinh x = \frac{3}{4}$

**Step 2: Solve for $\operatorname{sech} y = \frac{3}{5}$:**

The hyperbolic secant is defined as:

$\operatorname{sech} y = \frac{1}{\cosh y} = \frac{3}{5}$

Therefore:

$\cosh y = \frac{5}{3}$

Using the identity for hyperbolic functions:

$\cosh^2 y - \sinh^2 y = 1$

Calculate $\sinh y$:

$\left(\frac{5}{3}\right)^2 - 1 = \sinh^2 y$

$\sinh^2 y = \frac{16}{9} \quad \Rightarrow \quad \sinh y = \frac{4}{3}$

**Step 3: Calculate $e^{x+y}$:**

We need to find $e^x \cdot e^y$.

For $e^x$:

$e^x = \cosh x + \sinh x = \frac{5}{4} + \frac{3}{4} = 2$

For $e^y$:

$e^y = \cosh y + \sinh y = \frac{5}{3} + \frac{4}{3} = 3$

Thus:

$e^{x+y} = e^x \cdot e^y = 2 \cdot 3 = 6$

Therefore, the value of $e^{x+y}$ is 6.

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# Question37

## If $A, B, C$ are the angles of triangle, then $\sin 2A - \sin 2B + \sin 2C =$

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**Options:**

A. $4 \cos A \cos B \sin C$

B. $4 \cos A \sin B \cos C$

C. $4 \cos A \sin B \cos C - 1$

D. $4 \sin A \cos B \sin C$

**Answer: B**

## Solution:

Given that $A, B$ and $C$ are the angle of triangle

$$\begin{aligned} A+B+C&=\pi \\ 2A+2B+2C&=2\pi \quad \ldots(i) \end{aligned}$$

Now, $\sin 2A - \sin 2B + \sin 2C$

$$\begin{aligned} &= \sin 2A + \sin 2C - \sin 2B \\ &= 2\sin\left(\frac{2A+2C}{2}\right)\cos\left(\frac{2A-2C}{2}\right) - \sin[2\pi - 2(A+C)] \end{aligned}$$

[from Eq. (i)]

$$\begin{aligned} &= 2\sin(A+C)\cos(A-C) + \sin 2(A+C) \\ &= 2\sin(A+C)\cos(A-C) + 2\sin(A+C)\cos(A+C) \\ &= 2\sin(A+C)[\cos(A-C)+\cos(A+C)] \\ &= 2\sin(\pi-B)[2\cos A\cos C] \\ &= 4\cos A\sin B\cos C \end{aligned}$$

---

# Question38

**Assertion (A) : If $A=10^\circ, B=16^\circ$ and $C=19^\circ$, then $\tan 2A\tan 2B+\tan 2B\tan 2C+\tan 2C\tan 2A=1$**

**Reason (R) : If $A+B+C=180^\circ, \cot\frac{A}{2}+\cot\frac{B}{2}+\cot\frac{C}{2}$**

**$=\cot\frac{A}{2}\cot\frac{B}{2}\cot\frac{C}{2}$**

**Which of the following is correct ?**

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**Options:**

A. Both $(A)$ and $(R)$ are true and $(R)$ is the correct explanation of (A)

B. Both $(A)$ and $(R)$ are true and $(R)$ is not correct explanationot (A)

C. (A) is true, ( $R$ ) is false

D. (A) is false, (R) is true.

**Answer: A**

## Solution:

In case of assertion, if $A=10^{\circ}$,

$B=16^{\circ}$ and $C=19^{\circ}$

$$\because \quad A+B+C=180^{\circ}$$
$$\Rightarrow \quad 2A+2B+2C=\frac{\pi}{2}$$
$$\Rightarrow \quad 2A+2B=\frac{\pi}{2}-2C$$

On taking tan both sides, we get

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

So, assertion is true.

In case of reason,

Since, $A+B+C=180^{\circ}$

$$\frac{A}{2}+\frac{B}{2}+\frac{C}{2}=\frac{\pi}{2}$$
$$\Rightarrow \quad \frac{A}{2}+\frac{B}{2}=\frac{\pi}{2}-\frac{C}{2}$$

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

So, reason is true.

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# Question39

## If $\alpha$ is in the 3rd quadrant, $\beta$ is in the 2nd quadrant such that $\tan\alpha=\frac{1}{7}$, $\sin\beta=\frac{1}{\sqrt{10}}$, then $\sin(2\alpha+\beta)=$

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**Options:**

A. $\frac{3\times\sqrt{10}}{25}$

B. $\frac{3}{\sqrt{10}}$

C. $\frac{3}{25\sqrt{10}}$

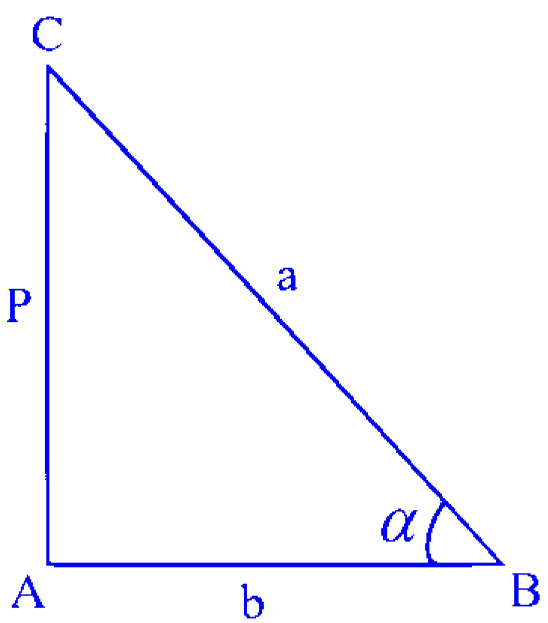
D. $\frac{\sqrt{10}}{3\times 25}$

**Answer: C**

## Solution:

Given, $\tan\alpha = \frac{1}{7}, \sin\beta = \frac{1}{\sqrt{10}}$

$tan\,\alpha = \frac{p}{b} = \frac{1}{7}$




Using Pythagoras theorem,

$$P^2 + b^2 = a^2 \Rightarrow a = \sqrt{1^2 + 7^2} = \sqrt{50}$$

$$\sin\alpha = \frac{1}{\sqrt{50}} \text{ and } \cos\alpha = \frac{7}{\sqrt{50}}$$

$$\text{and } \sin\beta = \frac{1}{\sqrt{10}}$$

$$\cos^2\beta = 1 - \left(\frac{1}{\sqrt{10}}\right)^2 \quad [\because \sin^2\alpha + \cos^2\alpha = 1]$$

$$\Rightarrow \cos^2\beta = \frac{9}{10} \Rightarrow \cos\beta = -\frac{3}{\sqrt{10}}$$

[ $\because \beta$ is in 3rd quadrant ]

Now, $\sin(2\alpha + \beta) = \sin 2\alpha \cos\beta + \cos 2\alpha \sin\beta$

$\sin 2\alpha = 2\sin\alpha\cos\alpha = 2 \cdot \frac{1}{\sqrt{50}} \cdot \frac{7}{\sqrt{50}} = \frac{14}{50}$

$\cos 2\alpha = \cos^2\alpha - \sin^2\alpha = \frac{49}{50} - \frac{1}{50} = \frac{48}{50}$

On putting all these values in Eq. (i), we gac

$$\sin(2\alpha + \beta) = \frac{14}{50} \cdot \left(-\frac{3}{\sqrt{10}}\right) + \frac{48}{50} \cdot \frac{1}{\sqrt{10}}$$

$$= -\frac{42}{50\sqrt{10}} + \frac{48}{50\sqrt{10}} = \frac{1}{50\sqrt{10}}(48 - 42)$$

$$= \frac{3}{25\sqrt{10}}$$

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# Question40

**If the period of the function $f(x) = \frac{\tan 5x \cos 3x}{\sin 6x}$ is $\alpha$, then $f\left(\frac{\alpha}{8}\right) =$**

## AP EAPCET 2024 - 21th May Morning Shift

**Options:**

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

B. -1

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

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

**Answer: C**

## Solution:

Let $f(x) = \frac{\tan(5x) \cos 3x}{\sin 6x}$

1.Period of $\tan(5x) = \frac{\pi}{5}$

2.Period of $\cos 3x = \frac{2\pi}{3}$

3.Period of $\sin 6x = \frac{\pi}{3}$

The period of $f(x)$ is the least common multiple of $\frac{\pi}{5}$, $\frac{2\pi}{3}$ and $\frac{\pi}{3}$.

LCM $\left(\frac{\pi}{3}, \frac{2\pi}{3}, \frac{\pi}{3}\right) = 2\pi$

$\therefore \alpha = 2\pi$

$$\begin{aligned} Now,\ f\left(\frac{\alpha}{8}\right) = f\left(\frac{\pi}{4}\right) &= \frac{\tan\left(\frac{5\pi}{4}\right) \cos \frac{3\pi}{4}}{\sin \frac{3\pi}{2}} \\ &= \frac{\tan \frac{\pi}{4} \cdot \left(-\cos \frac{\pi}{4}\right)}{-\sin \frac{\pi}{2}} \\ &= \sin \frac{\pi}{4} = \frac{1}{\sqrt{2}} \end{aligned}$$

---

# Question41

**If $\sin x + \sin y = \alpha, \cos x + \cos y + \beta$, then $\operatorname{cosec}(x + y) =$**

## AP EAPCET 2024 - 21th May Morning Shift

**Options:**

A. $\frac{\beta^2-\alpha^2}{\beta^2+\alpha^2}$

B. $\frac{2\beta\alpha}{\beta^2-\alpha^2}$

C. $\frac{\beta^2+\alpha^2}{2\beta\alpha}$

D. $\frac{2a\beta}{\beta^2+\alpha^2}$

**Answer: C**

## Solution:

If $\sin x+\sin y=\alpha$

$\cos x+\cos y=\beta$

$\operatorname{cosec}(x+y)=?$

From Eq. (i), we get

$$2\sin\left(\frac{x+y}{2}\right)\cdot\cos\left(\frac{x-y}{2}\right)=\alpha$$
$$\left(\because\sin C+\sin D=2\sin\frac{(C+D)}{2}\cos\frac{(C-D)}{2}\right)$$

and using Eq. (ii)

$$2\cos\left(\frac{x-y}{2}\right)\cdot\cos\left(\frac{x+y}{2}\right)=\beta$$
$$\left(\because\cos C+\cos D=2\cos\left(\frac{C-D}{2}\right)\cdot\cos\left(\frac{C+D}{2}\right)\right)$$

On dividing Eq. (iii) by Eq. (iv), we get

$$\tan\left(\frac{x+y}{2}\right)=\frac{\alpha}{\beta}$$
$$\left(\because\tan^2\theta=\sec^2\theta-1\text{ and }\sec\theta=\frac{1}{\cos\theta}\right)$$

So, $\cos\left(\frac{x+y}{2}\right)=\left[\frac{\beta^2}{\alpha^2+\beta^2}\right]^{\frac{1}{2}}$

$$\sin\left(\frac{x+y}{2}\right)=\left(1-\cos^2\left(\frac{x+y}{2}\right)\right)^{\frac{1}{2}}$$
$$=\left[\frac{\alpha^2}{\alpha^2+\beta^2}\right]^{\frac{1}{2}}$$

$\sin(x+y)=2\sin\left(\frac{x+y}{2}\right)\cdot\cos\left(\frac{x+y}{2}\right)$
$\left(\because\sin A=\frac{2\sin A}{2}\cos\frac{A}{2}\right)$

From Eqs. (vi) and (vii), we get

$$\sin(x+y)=\frac{2\alpha}{(\alpha^2+\beta^2)^{\frac{1}{2}}}\cdot\frac{\beta}{(\alpha^2+\beta^2)^{\frac{1}{2}}}$$
$$=\frac{2\alpha\beta}{(\alpha^2+\beta^2)}\left(\because \operatorname{cosec}\theta=\frac{1}{\sin\theta}\right)$$
$$\operatorname{cosec}(x+y)=\frac{1}{\sin(x+y)}$$
$$=\frac{1}{\frac{2\alpha\beta}{(\alpha^2+\beta^2)}}=\frac{\alpha^2+\beta^2}{2\alpha\beta}$$

---

# Question42

**If $P+Q+P=\frac{\pi}{4}$, then $\cos\left(\frac{\pi}{8}-P\right)+\cos\left(\frac{\pi}{8}-Q\right)+\cos\left(\frac{\pi}{8}-R\right)=$**

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**Options:**

A. $4\cos\frac{P}{2}\cos\frac{Q}{2},\cos\frac{R}{2}-\cos\frac{\pi}{8}$

B. $4\cos\frac{P}{2}\cos\frac{Q}{2}\cdot\sin\frac{R}{2}+\cos\frac{\pi}{8}$

C. $4\sin\frac{P}{2}\cos\frac{Q}{2},\sin\frac{R}{2}-\cos\frac{\pi}{8}$

D. $4\sin\frac{P}{2}\cos\frac{Q}{2},\sin\frac{R}{2}-\cos\frac{\pi}{8}$

**Answer: A**

## Solution:

Given, $P+Q+R=\frac{\pi}{4}$

$\therefore \frac{P}{2}+\frac{Q}{2}+\frac{R}{2}=\frac{\pi}{8}$

Now, $\cos\left(\frac{\pi}{8}-P\right)+\cos\left(\frac{\pi}{8}-Q\right)+\cos\left(\frac{\pi}{8}-R\right)$

$$= 2\cos\left(\frac{\left(\frac{\pi}{8}-P\right)+\left(\frac{\pi}{8}-Q\right)}{2}\right)$$

$$\cos\left(\frac{\left(\frac{\pi}{8}-P\right)-\left(\frac{\pi}{8}-Q\right)}{2}\right)+\cos\left(\frac{\pi}{8}-R\right)$$

$$= 2\cos\left(\frac{\pi}{8}-\frac{P}{2}-\frac{Q}{2}\right)\cos\left(\frac{Q}{2}-\frac{P}{2}\right)+\cos\left(\frac{\pi}{8}-R\right)$$

$$= 2\cos\left(\frac{R}{2}\right)\cos\left(\frac{Q}{2}-\frac{P}{2}\right)+\cos\left(\frac{P}{2}+\frac{Q}{2}-\frac{R}{2}\right)$$

$$= 2\cos\left(\frac{R}{2}\right)\cos\left(\frac{Q}{2}-\frac{P}{2}\right)+\cos\left(\frac{P}{2}+\frac{Q}{2}\right)$$

$$= 2\cos\left(\frac{R}{2}\right)+\sin\left(\frac{P}{2}+\frac{Q}{2}\right)\sin\left(\frac{R}{2}\right)$$

$$-\cos\left(\frac{Q}{2}-\frac{P}{2}\right)+\cos\left(\frac{P}{2}+\frac{Q}{2}\right)\Big)\Big]$$

$$= 2\cos\left(\frac{R}{2}+\frac{Q}{2}\right)\cos\left(\frac{R}{2}\right)+\sin\left(\frac{P}{2}+\frac{Q}{2}\right)\sin\left(\frac{R}{2}\right)$$

$$-\left[\cos\left(\frac{P}{2}+\frac{P}{2}+\frac{Q}{2}\right)\cos\left(\frac{R}{2}\right)-\cos\left(\frac{Q}{2}-\frac{P}{2}\right)\right]$$

$$= 2\cos\left(\frac{R}{2}\right)\left[2\cos\left(\frac{Q}{2}\right)\cos\left(\frac{P}{2}\right)\right]-\cos\left(\frac{P}{2}+\frac{Q}{2}+\frac{R}{2}\right)$$

$$= 4\cos\left(\frac{P}{2}\right)\cos\left(\frac{Q}{2}\right)\cos\left(\frac{R}{2}\right)-\cos\left(\frac{\pi}{8}\right)$$

---

# Question43

## If $\theta$ is an acute angle, $\cosh x = K$ and $\sinh x = \tan\theta$, then $\sin\theta =$

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**Options:**

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

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

C. $\frac{\sqrt{k^2-1}}{k}$

D. $\frac{\sqrt{k^2-1}}{\sqrt{k^2+1}}$

**Answer: C**

## Solution:

Given that $\theta$ is an acute angle, $\cosh x = k$, and $\sinh x = \tan\theta$, we can establish the following relationships:

First, note that:

$\tan\theta = \sinh x$

Squaring both sides, we obtain:

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

We also have the trigonometric identity:

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

Substituting $\sinh^2 x$ for $\tan^2 \theta$ gives:

$\sec^2 \theta = 1 + \sinh^2 x$

Next, recall the identity for hyperbolic functions:

$\cosh^2 x - \sinh^2 x = 1$

This implies:

$\cosh^2 x = 1 + \sinh^2 x$

Given $\cosh x = k$, it follows that

$\cosh^2 x = k^2$

Thus:

$\sec^2 \theta = \cosh^2 x = k^2$

Taking the reciprocal to find $\cos^2 \theta$:

$\cos^2 \theta = \frac{1}{k^2}$

Using the Pythagorean identity:

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

Substitute the expression for $\cos^2 \theta$:

$1 = \sin^2 \theta + \frac{1}{k^2}$

Rearranging for $\sin^2 \theta$ gives:

$\sin^2 \theta = 1 - \frac{1}{k^2}$

This simplifies to:

$\sin^2 \theta = \frac{k^2-1}{k^2}$

Taking the square root, given that $\theta$ is an acute angle (which ensures $\sin \theta$ is positive), we find:

$\sin \theta = \frac{\sqrt{k^2-1}}{k}$

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# Question44

## If $\sec \theta + \tan \theta = \frac{1}{3}$, then the quadrant in which $2\theta$ lies is

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**Options:**

A. 1st quadrant

B. 2nd quadrant

C. 3rd quadrant

D. 4th quadrant

**Answer: C**

## Solution:

Given:

$\sec\theta + \tan\theta = \frac{1}{3} \quad ...(i)$

We know the identity:

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

This can be rewritten as:

$(\sec\theta + \tan\theta)(\sec\theta - \tan\theta) = 1$

Substituting the given value from equation (i):

$\frac{1}{3}(\sec\theta - \tan\theta) = 1$

Solving for $\sec\theta - \tan\theta$:

$\sec\theta - \tan\theta = 3 \quad ...(ii)$

Using equations (i) and (ii), we solve for $\sec\theta$ and $\tan\theta$:

$$\sec\theta = \frac{5}{3}$$
$$\tan\theta = \frac{-4}{3}$$

Now, we find $\sin\theta$:

$\sin\theta = \frac{\tan\theta}{\sec\theta} = \frac{\frac{-4}{3}}{\frac{5}{3}} = \frac{-4}{5}$

Here, both $\sin\theta$ and $\tan\theta$ are negative, indicating that $\theta$ lies in the IVth quadrant.

Calculating $\sin 2\theta$:

$\sin 2\theta = 2\sin\theta\cos\theta = 2 \times \frac{-4}{5} \times \frac{3}{5} = \frac{-24}{25}$

Next, calculating $\tan 2\theta$:

$\tan 2\theta = \frac{2\tan\theta}{1-\tan^2\theta} = \frac{24}{7}$

Since $\sin 2\theta$ is negative and $\tan 2\theta$ is positive, $2\theta$ lies in the IIIrd quadrant.

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# Question45

### If $540^\circ < A < 630^\circ$ and $|\cos A| = \frac{5}{13}$, then $\tan\frac{A}{2}\tan A =$

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**Options:**

A. $\frac{18}{5}$

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

C. $-\frac{8}{5}$

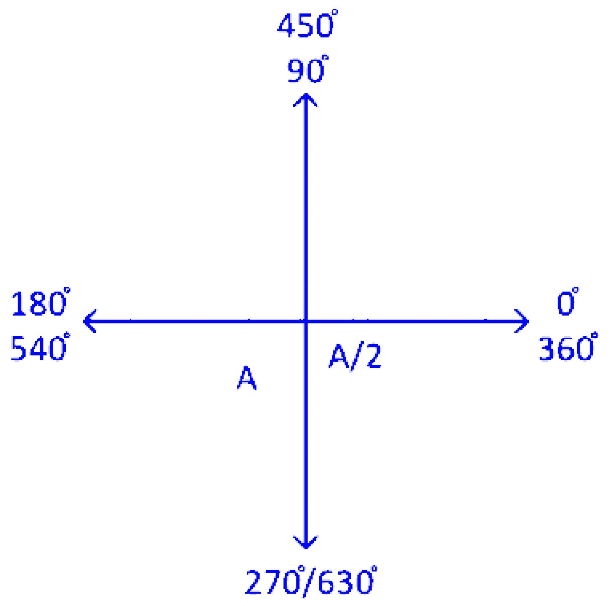
D. $-\frac{18}{5}$

**Answer: D**

## Solution:

Since, $540^\circ < A < 630^\circ$

$\therefore \quad 270^\circ < \frac{A}{2} < 315^\circ$




Since, $A$ lies in IIIrd quadrant $\therefore$ $\tan A$ is positive and $\frac{A}{2}$ lies in IVth quadrant $\therefore$ $\tan \frac{A}{2}$ is negative.

Now, $\cos A = \frac{5}{13}$

$\Rightarrow \quad \tan A = \frac{12}{5}$

Also, $\tan A = \frac{2\tan\frac{A}{2}}{1-\tan^2\frac{A}{2}}$

$\Rightarrow \quad \frac{12}{5} - \frac{12}{5}\tan^2\frac{A}{2} = 2\tan\frac{A}{2}$

$\Rightarrow \quad 6\tan^2\frac{A}{2} + 5\tan\frac{A}{2} - 6 = 0$

$\Rightarrow \quad \tan\frac{A}{2} = \frac{-3}{2}$

$\therefore \quad \tan\frac{A}{2}\tan A = \frac{-18}{5}$

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# Question46

**If $(\alpha+\beta)$ is not a multiple of $\frac{\pi}{2}$ and $3\sin(\alpha-\beta)=5\cos(\alpha+\beta)$, then $\tan\left(\frac{\pi}{4}+\alpha\right)+4\tan\left(\frac{\pi}{4}+\beta\right)=$**

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**Options:**

A. 0

B. 1

C. 4

D. 2

**Answer: A**

## Solution:

Given, $3\sin(\alpha-\beta)=5\cos(\alpha+\beta)$

$$\frac{\sin(\alpha-\beta)}{\cos(\alpha+\beta)}=\frac{5}{3}$$
$$\frac{\sin\alpha\cos\beta-\cos\alpha\sin\beta}{\cos\alpha\cos\beta-\sin\alpha\sin\beta}=\frac{5}{3}$$

Divide both numerator and denominator by $\cos\alpha\cos\beta$

$$\frac{\tan\alpha-\tan\beta}{1-\tan\alpha\tan\beta}=\frac{5}{3}$$
$$\Rightarrow 3\tan\alpha-3\tan\beta=5-5\tan\alpha\tan\beta$$
$$\Rightarrow 3\tan\alpha-3\tan\beta-5+5\tan\alpha\tan\beta=0$$

Now, $\tan\left(\frac{\pi}{4}+\alpha\right)+4\tan\left(\frac{\pi}{4}+\beta\right)$

$$=\frac{1+\tan\alpha}{1-\tan\alpha}+4\left(\frac{1+\tan\beta}{1-\tan\beta}\right)$$
$$=\frac{(1-\tan\beta+\tan\alpha-\tan\alpha\tan\beta+4}{(1-\tan\alpha)(1-\tan\beta)}$$
$$=\frac{3\tan\beta-3\tan\alpha+5-5\tan\alpha\tan\beta}{(1-\tan\alpha)(1-\tan\beta)}$$
$$=\frac{-(3\tan\alpha-3\tan\beta-5+5\tan\alpha\tan\beta)}{(1-\tan\alpha)(1-\tan\beta)}$$
$$=0$$

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# Question47

**If $\cos\alpha+\cos\beta+\cos\gamma=\sin\alpha+\sin\beta+\sin\gamma=0$, then $\left(\cos^3\alpha+\cos^3\beta+\cos^3\gamma\right)^2+\left(\sin^3\alpha+\sin^3\beta+\sin^3\gamma\right)^2=$**

## AP EAPCET 2024 - 20th May Morning Shift

**Options:**

A. 1

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

C. $\frac{9}{16}$

D. $\frac{9}{8}$

**Answer: C**

## Solution:

We have,

$\cos\alpha + \cos\beta + \cos\gamma = \sin\alpha + \sin\beta + \sin\gamma = 0$ then,

$$\left(\cos^3\alpha + \cos^3\beta + \cos^3\gamma\right)^2 + \left(\sin^3\alpha + \sin^3\beta + \sin^3\gamma\right)^2$$
$$= (3\cos\alpha\cos\beta\cos\gamma)^2 + (3\sin\alpha\sin\beta\sin\gamma)^2$$
$$\begin{bmatrix} \because \text{ If } x+y+z=0 \\ \therefore x^3+y^3+z^3 = 3xyz \end{bmatrix}$$
$$= 9(\cos\alpha\cos\beta\cos\gamma)^2 + 9(\sin\alpha\sin\beta\sin\gamma)^2$$

So, let $\alpha = \theta, \beta = \theta + \frac{2\pi}{3}$ and $\gamma = \theta + \frac{4\pi}{3}$

then, $\cos\alpha\cos\beta\cos\gamma = \cos\theta\cos\left(\theta + \frac{2\pi}{3}\right)$

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

Similarly,

$\sin\alpha\sin\beta\sin\gamma = \frac{3}{4}\sin\theta\cos^2\theta - \frac{1}{4}\sin^3\theta$

From Eqs. (ii) and (iii) in Eq. (i), we get

$$\left(\cos^3\alpha + \cos^2\beta + \cos^3\gamma\right)^2 + \left(\sin^3\alpha + \sin^3\beta + \sin^3\gamma\right)^2$$

$$= \frac{9\left(\frac{1}{4}\cos^3\theta - \frac{3}{4}\cos\theta\sin^2\theta\right)^2 + 9}{}$$

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

$$= \frac{9}{16}\left[\left(\cos^3\theta - 3\cos\theta\sin^2\theta\right)^2\right.$$

$$\left. + \left(3\sin\theta\cos^2\theta - \sin^3\theta\right)^2\right]$$

$$= \frac{9}{16}\left[\cos^6\theta + 9\cos^2\theta\sin^4\theta\right.$$

$$-6\cos^4\theta\sin^2\theta + 9\sin^2\theta\cos^4\theta$$

$$= \frac{9}{16}\left[\cos^6\theta + \sin^6\theta - 6\cos^2\theta\sin^4\theta\right]$$

$$= \frac{9}{16}\left[\left(\cos^2\theta\right)^3\theta\sin^4\theta\right.$$

$$= \left(\sin^2\theta\right)^3 + 3\cos^2\theta$$

$$= \frac{9}{16}\left(\cos^2\theta + \sin^2\theta\right)^3$$

$$= \frac{9}{16} \times (1)^3 = \frac{9}{16}$$

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# Question48

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

## AP EAPCET 2024 - 20th May Morning Shift

**Options:**

A. $\tan 35^\circ$

B. $\tan 55^\circ$

C. $\tan 20^\circ$

D. $\tan 70^\circ$

**Answer: B**

## Solution:

To solve the given expression:

$\frac{\cos 10^\circ + \cos 80^\circ}{\sin 80^\circ - \sin 10^\circ}$

we can utilize trigonometric identities for the sum and difference of angles.

Start with the identity for the sum of cosines:

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

For $\cos 10^\circ + \cos 80^\circ$, set $A = 10^\circ$ and $B = 80^\circ$:

$\cos 10^\circ + \cos 80^\circ = 2\cos\left(\frac{10^\circ+80^\circ}{2}\right)\cos\left(\frac{10^\circ-80^\circ}{2}\right) = 2\cos 45^\circ \cos(-35^\circ)$

For the difference of sines, use the identity:

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

For $\sin 80^\circ - \sin 10^\circ$, set $A = 80^\circ$ and $B = 10^\circ$:

$\sin 80^\circ - \sin 10^\circ = 2\cos\left(\frac{80^\circ+10^\circ}{2}\right)\sin\left(\frac{80^\circ-10^\circ}{2}\right) = 2\cos 45^\circ \sin 35^\circ$

Substitute these results back into the original expression:

$\frac{2\cos 45^\circ \cos(-35^\circ)}{2\cos 45^\circ \sin 35^\circ}$

Cancel the common factor $2\cos 45^\circ$:

$\frac{\cos 35^\circ}{\sin 35^\circ} = \cot 35^\circ = \tan(90^\circ - 35^\circ) = \tan 55^\circ$

Therefore, the expression evaluates to $\tan 55^\circ$.

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# Question49

$\frac{\sin 1^\circ + \sin 2^\circ + \ldots\ldots + \sin 89^\circ}{2(\cos 1^\circ + \cos 2^\circ + \ldots + \cos 44^\circ) + 1} =$

## AP EAPCET 2024 - 20th May Morning Shift

### Options:

A. $\sqrt{2}$

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

C. 2

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

**Answer: B**

## Solution:

To solve the given problem, we start by simplifying the expression:

$\frac{\sin 1^\circ + \sin 2^\circ + \ldots + \sin 89^\circ}{2(\cos 1^\circ + \cos 2^\circ + \ldots + \cos 44^\circ) + 1}$

First, we recognize that the sum in the numerator can be grouped as follows:

$(\sin 89^\circ + \sin 1^\circ) + (\sin 88^\circ + \sin 2^\circ) + \ldots + \sin 45^\circ$

Utilizing the identity $\sin A + \sin B = 2\sin\left(\frac{A+B}{2}\right)\cos\left(\frac{A-B}{2}\right)$, each paired term becomes:

$2\sin\left(\frac{89+1}{2}\right)\cos\left(\frac{89-1}{2}\right) + \ldots + 2\sin\left(\frac{46+44}{2}\right)\cos\left(\frac{46-44}{2}\right) + \sin 45^\circ$

This can be written as:

$2(\sin 45^\circ \cos 44^\circ + \sin 45^\circ \cos 43^\circ + \ldots + \sin 45^\circ \cos 1^\circ) + \sin 45^\circ$

The denominator can also be broken down nicely:

$2(\cos 1^\circ + \cos 2^\circ + \ldots + \cos 44^\circ) + 1$

Now, extracting $\sin 45^\circ$ from the numerator terms gives us:

$2 \sin 45^\circ(\cos 44^\circ + \cos 43^\circ + \ldots + \cos 1^\circ + 1)$

The entire expression simplifies to:

$\frac{2 \sin 45^\circ(\cos 44^\circ + \cos 43^\circ + \ldots + \cos 1^\circ + 1)}{2(\cos 1^\circ + \cos 2^\circ + \ldots + \cos 44^\circ) + 1}$

Since $\sin 45^\circ = \frac{1}{\sqrt{2}}$, the expression becomes:

$\frac{\sin 45^\circ}{\cos 45^\circ} = \frac{1}{\sqrt{2}}$

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# Question50

## The value of $5 \cos \theta + 3 \cos \left(\theta + \frac{\pi}{3}\right) + 3$ lies between

## AP EAPCET 2024 - 19th May Evening Shift

**Options:**

A. -2 and 5

B. -1 and 8

C. -3 and 6

D. -4 and 10

**Answer: D**

## Solution:

Let's analyze the expression $5 \cos \theta + 3 \cos \left(\theta + \frac{\pi}{3}\right) + 3$.

First, we expand the cosine term using the cosine addition formula:

$\cos(\theta + \frac{\pi}{3}) = \cos \theta \cos \frac{\pi}{3} - \sin \theta \sin \frac{\pi}{3}$.

Substitute this back into the original expression:

$5 \cos \theta + 3 \left(\cos \theta \cos \frac{\pi}{3} - \sin \theta \sin \frac{\pi}{3}\right) + 3$.

Simplify by plugging in the values for $\cos \frac{\pi}{3} = \frac{1}{2}$ and $\sin \frac{\pi}{3} = \frac{\sqrt{3}}{2}$:

$= 5 \cos \theta + \frac{3}{2} \cos \theta - \frac{3\sqrt{3}}{2} \sin \theta + 3$.

$= \frac{1}{2}(13 \cos \theta - 3\sqrt{3} \sin \theta) + 3$.

Now, let's express this in the form $r \cos(\alpha + \theta)$ such that:

$13 = r \cos \alpha \quad \text{and} \quad 3\sqrt{3} = r \sin \alpha.$

We find $r$ by:

$r = \sqrt{13^2 + (3\sqrt{3})^2} = \sqrt{169 + 27} = \sqrt{196} = 14.$

Substitute $r$ back into:

$= \frac{1}{2}[r \cos(\alpha + \theta)] + 3 = \frac{1}{2}[14 \cos(\alpha + \theta)] + 3 = 7 \cos(\alpha + \theta) + 3.$

The range of the cosine function is $-1 \leq \cos(\alpha + \theta) \leq 1$. Therefore:

$-7 + 3 \leq 7 \cos(\alpha + \theta) + 3 \leq 7 + 3.$

$-4 \leq 7 \cos(\alpha + \theta) + 3 \leq 10.$

Thus, the value of the expression lies within the interval $[-4, 10]$.

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# Question51

## Statement $(\mathrm{S1}) \sin 55^{\circ} + \sin 53^{\circ} - \sin 19^{\circ} - \sin 17^{\circ} = \cos 2^{\circ}$

## Statement (S2) Range of $\frac{1}{3-\cos 2x}$ is $\left[\frac{1}{4}, \frac{1}{2}\right]$

## Which one of the following is correct?

### AP EAPCET 2024 - 19th May Evening Shift

**Options:**

A. Both (S1) and (S2) are true.

B. Both ( S 1 ) and ( S 2 ) are false.

C. (S1) is true, (S2) is false.

D. (S1) is false, (S2) is true.

**Answer: D**

## Solution:

#### Clarification of Statements S1 and S2

### Statement S1:

We need to verify the equation:

$\sin 55^{\circ} + \sin 53^{\circ} - \sin 19^{\circ} - \sin 17^{\circ} = \cos 2^{\circ}$

**Derivation:**

Use the sum-to-product identities:

$\sin 55^\circ + \sin 53^\circ = 2\sin 54^\circ \cos 1^\circ$

$\sin 19^\circ + \sin 17^\circ = 2\sin 18^\circ \cos 1^\circ$

Subtract the two results:

$2\sin 54^\circ \cos 1^\circ - 2\sin 18^\circ \cos 1^\circ = 2\cos 1^\circ(\sin 54^\circ - \sin 18^\circ)$

Apply the difference of sines identity:

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

$\sin 54^\circ - \sin 18^\circ = \cos 36^\circ - \sin 18^\circ$

Use known trigonometric values:

$\cos 36^\circ = \frac{\sqrt{5}+1}{4}, \quad \sin 18^\circ = \frac{\sqrt{5}-1}{4}$

$\cos 36^\circ - \sin 18^\circ = \frac{\sqrt{5}+1}{4} - \frac{\sqrt{5}-1}{4} = \frac{1}{2}$

Substitute back:

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

Therefore, S1 is false because the left expression simplifies to $\cos 1^\circ$, not $\cos 2^\circ$.

### Statement S2:

We need to find the range of:

$\frac{1}{3-\cos 2x}$

**Derivation:**

The range of $\cos 2x$ is $[-1, 1]$.

Translate the range:

$3 - \cos 2x \Rightarrow [2, 4]$

The range of the reciprocal:

$\frac{1}{3-\cos 2x} \Rightarrow \left[\frac{1}{4}, \frac{1}{2}\right]$

Therefore, S2 is true.

In conclusion, Statement S1 is false, and Statement S2 is true.

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# Question52

$\tan 6^\circ + \tan 42^\circ + \tan 66^\circ + \tan 78^\circ =$

## AP EAPCET 2024 - 18th May Morning Shift

**Options:**

A. 0

B. 1

C. 2

D. 3

**Answer: B**

## Solution:

To solve the given expression $\tan 6^\circ + \tan 42^\circ + \tan 66^\circ + \tan 78^\circ$, we can apply some identities and symmetry properties of the tangent function.

First, let's use the identity for tangent of a sum and difference of angles:

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

This can be simplified to:

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

Now, substitute $A = 60^\circ$ and $B = 18^\circ$ into equation (i):

$\tan 78^\circ \times \tan 42^\circ = \frac{\tan^2 60^\circ-\tan^2 18^\circ}{1-\tan^2 60^\circ\tan^2 18^\circ} = \frac{3-\tan^2 18^\circ}{1-3\tan^2 18^\circ}$

Simplifying:

$= \frac{1}{\tan 18^\circ}\left[\frac{3\tan 18^\circ-\tan^3 18^\circ}{1-3\tan^2 18^\circ}\right]$

So,

$\tan 78^\circ \tan 42^\circ = \frac{\tan 54^\circ}{\tan 18^\circ} \quad \ldots(ii)$

Next, substitute $A = 60^\circ$ and $B = 54^\circ$ in equation (i):

$\tan 114^\circ \times \tan 6^\circ = \frac{3-\tan^2 54^\circ}{1-3\tan^2 54^\circ} = \frac{1}{\tan 54^\circ}\left[\frac{3\tan 54^\circ-\tan^3 54^\circ}{1-3\tan^2 54^\circ}\right]$

This gives:

$= \frac{\tan 162^\circ}{\tan 54^\circ}$

Since $\tan 114^\circ = \tan(180^\circ - 66^\circ) = -\tan 66^\circ$ and $\tan 162^\circ = \tan(180^\circ - 18^\circ) = -\tan 18^\circ$, we have:

$\tan 66^\circ \times \tan 6^\circ = \frac{\tan 18^\circ}{\tan 54^\circ} \quad \ldots(iii)$

Multiplying equations (ii) and (iii):

$\tan 6^\circ \tan 42^\circ \tan 66^\circ \tan 78^\circ = \frac{\tan 54^\circ}{\tan 18^\circ} \times \frac{\tan 18^\circ}{\tan 54^\circ} = 1$

Therefore, $\tan 6^\circ + \tan 42^\circ + \tan 66^\circ + \tan 78^\circ$ sums up to a neat result based on symmetrical properties of angles and tangent function identities.

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# Question53

### The maximum value of $12\sin x - 5\cos x + 3$ is

### AP EAPCET 2024 - 18th May Morning Shift

**Options:**

A. 18

B. 13

C. 16

D. 10

**Answer: C**

## Solution:

To find the maximum value of the expression $12\sin x - 5\cos x + 3$, we start by considering the form $a\sin x + b\cos x$, which achieves its maximum value at $\sqrt{a^2 + b^2}$.

For our specific expression, we have $a = 12$ and $b = -5$.

The calculation for the maximum value of $12\sin x - 5\cos x$ is:

$$\sqrt{12^2 + (-5)^2} = \sqrt{144 + 25} = \sqrt{169} = 13$$

Therefore, the maximum value of the entire expression $12\sin x - 5\cos x + 3$ is:

$$13 + 3 = 16$$

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# Question54

$\sin^2 16^\circ - \sin^2 76^\circ =$

## AP EAPCET 2024 - 18th May Morning Shift

**Options:**

A. 0

B. 1

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

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

**Answer: D**

## Solution:

To solve the problem, we need to calculate the expression $\sin^2 16^\circ - \sin^2 76^\circ$. We start by using the identity for the difference of squares:

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

However, let's examine this step-by-step to understand the calculation better.

Given that:

$\sin^2 76^\circ = \sin^2(90^\circ - 14^\circ) = \cos^2 14^\circ$

And $\sin^2 16^\circ$ remains as it is. Using the trigonometric identity $\sin^2\theta = 1 - \cos^2\theta$, we have:

$\sin^2 16^\circ - \sin^2 76^\circ = \sin^2 16^\circ - \cos^2 14^\circ$

Since $\cos^2 14^\circ = 1 - \sin^2 14^\circ$:

$\sin^2 16^\circ - (1 - \sin^2 14^\circ) = \sin^2 16^\circ - 1 + \sin^2 14^\circ$

Now, recall that $\sin(90^\circ - \theta) = \cos\theta$, hence:

$\sin^2 16^\circ = \cos^2 74^\circ = 1 - \sin^2 74^\circ$

Putting this together, you arrive at:

$\sin^2 16^\circ + \sin^2 74^\circ = 1$

Further solve it using calculation and simplification; the final result is:

$\sin^2 16^\circ - \sin^2 76^\circ = \frac{3}{4}$

Therefore, the value of $\sin^2 16^\circ - \sin^2 76^\circ$ is $\frac{3}{4}$.

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# Question55

## By considering $1' = 0.0175$, he approximate value of $\cot 45^\circ 2'$ is

## AP EAPCET 2024 - 18th May Morning Shift

**Options:**

A. 1.07

B. 0.965

C. 1.035

D. 0.93

**Answer: D**

## Solution:

We have.

$\cot 457 = \cot\,(45^\circ + 2)$

$$\begin{aligned} &\text{Let } y = \cot x \\ &\frac{dy}{dx} = -\operatorname{cosec}^2 x \\ y + \Delta y &= \cot 45\% - \cot(x + \Delta x) \end{aligned}$$

Where, $\Delta x = 2 = 2 \times 0.0175 = 0.035$

$$\begin{aligned} \text{Let } x &= 45^\circ \\ y &= \cot 45^\circ = 1 \end{aligned}$$

$\frac{dy}{dx}$ at $x=45=-\operatorname{cosec}^2 45=-2$

$\Delta y=\frac{dy}{dx}\times\Delta x=-2\times 0.035=-07$

$\therefore cot 45^{\circ} z=y+\Delta y=1-0.7=0.93$

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# Question56

**If $\sin^4\theta\cos^2\theta=\sum\limits_{n=0}^{\infty} a_{2n}\cos 2n\theta$, then the least $n$ for which $a_{2n}=0$ is**

## AP EAPCET 2022 - 5th July Morning Shift

**Options:**

A. 1

B. 2

C. 3

D. 4

**Answer: A**

## Solution:

Given, $\sin^4\theta\cos^2\theta=\sum\limits_{n=0}^{\infty} a_{2n}\cos 2n\theta$

$\Rightarrow\left(\sin^2\theta\right)^2\cos^2\theta=\sum\limits_{n=0}^{\infty} a_{2n}\cos 2n\theta$

$\Rightarrow\left(1-\cos^2\theta\right)^2\cos^2\theta=\sum\limits_{n=0}^{\infty} a_{2n}\cos 2n\theta$

$\Rightarrow\left(1+\cos^4\theta-2\cos^2\theta\right)\cos^2\theta=\sum\limits_{n=0}^{\infty} a_{2n}\cos 2n\theta$

$\therefore\cos^2\theta+\cos^4\theta\cos^2\theta-2\cos^4\theta$

$=\sum\limits_{n=0}^{\infty} a_{2n}\cos 2n\theta$

$\Rightarrow\left(\frac{\cos 2\theta+1}{2}\right)+\left(\frac{\cos 2\theta+1}{2}\right)^2\left(\frac{1+\cos 2\theta}{2}\right)$

$-2\left(\frac{\cos 2\theta+1}{2}\right)^2=\sum\limits_{n=0}^{\infty} a_{2n}\cos 2n\theta$

On comparing both sides, we get minimum value of n is 1.

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# Question57

**If** $\sin \theta = -\frac{3}{4}$**, then** $\sin 2\theta =$

## AP EAPCET 2022 - 5th July Morning Shift

**Options:**

A. $\frac{3\sqrt{7}}{8}$

B. $-\frac{3\sqrt{7}}{8}$

C. $\frac{2\sqrt{3}}{7}$

D. $-\frac{2\sqrt{3}}{7}$

**Answer: B**

## Solution:

$$\begin{aligned}
\sin \theta &= \frac{-3}{4} \\
\cos \theta &= \sqrt{1-\sin^2 \theta} \\
\cos \theta &= \sqrt{1-\left(\frac{-3}{4}\right)^2} \\
\cos \theta &= \sqrt{\frac{16-9}{4}} = \sqrt{\frac{7}{16}} \\
\therefore \quad \sin 2\theta &= 2 \sin \theta \cdot \cos \theta \\
&= 2 \times \left(\frac{-3}{4}\right)\left(\frac{\sqrt{7}}{4}\right) = \frac{-3\sqrt{7}}{8}
\end{aligned}$$

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# Question58

$$\frac{1}{\sin 1^\circ \sin 2^\circ} + \frac{1}{\sin 2^\circ \sin 3^\circ} + \ldots + \frac{1}{\sin 89^\circ + \sin 90^\circ} =$$

## AP EAPCET 2022 - 5th July Morning Shift

**Options:**

A. $\frac{\cos 1^\circ}{\sin 1^\circ}$

B. $\frac{\cos 1^{\circ}}{\sin^{2} 1^{\circ}}$

C. $\frac{\sin 1^{\circ}}{\cos 1^{\circ}}$

D. $\frac{\sin^{2} 1^{\circ}}{\cos 1^{\circ}}$

**Answer: B**

## Solution:

Here,

$$\frac{1}{\sin 1^{\circ} \sin 2^{\circ}}+\frac{1}{\sin 2^{\circ} \sin 3^{\circ}}+\ldots+\frac{1}{\sin 89^{\circ} \sin 90^{\circ}}$$
$$=\frac{1}{\sin 1^{\circ}}\left[\frac{\sin(2^{\circ}-1^{\circ})}{\sin 1^{\circ} \sin 2^{\circ}}+\frac{\sin(3^{\circ}-2^{\circ})}{\sin 2^{\circ} \sin 3^{\circ}}+\ldots . .+\frac{\sin(90^{\circ}-89^{\circ})}{\sin 89^{\circ} \sin 90^{\circ}}\right]$$

We know that

$\sin(A-B)=\sin A \cdot \cos B-\cos A \cdot \sin B$

$$=\frac{1}{\sin 1^{\circ}}\left[\frac{\sin 2^{\circ} \cdot \cos 1^{\circ}-\cos 2^{\circ} \cdot \sin 1^{\circ}}{\sin 1^{\circ} \cdot \sin 2^{\circ}}+\frac{\sin 3^{\circ} \cdot \cos 2^{\circ}-\cos 3^{\circ} \cdot \sin 2^{\circ}}{\sin 3^{\circ} \cdot \sin 2^{\circ}}+\ldots . \ldots . .+\frac{\sin 90^{\circ} \cdot \cos 89^{\circ}-\cos .90^{\circ} \cdot \sin 89^{\circ}}{\sin 89^{\circ} \cdot \sin 90^{\circ}}\right]$$

$$=\frac{1}{\sin 1^{\circ}}[\cot 1^{\circ}-\cot 2^{\circ}+\cot 2^{\circ}-\cot 3^{\circ}+\ldots . +\quad+\cot 89^{\circ}-\cot 90^{\circ}]$$
$$=\frac{1}{\sin 1^{\circ}}[\cot 1^{\circ}-\cot 90^{\circ}]=\frac{\cot 1^{\circ}}{\sin 1^{\circ}}=\frac{\cos 1^{\circ}}{\sin^{2} 1^{\circ}}$$

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# Question59

### Which of the following trigonometric values are negative?

**I.** $\sin(-292^{\circ})$

**II.** $\tan(-190^{\circ})$

**III.** $\cos(-207^{\circ})$

**IV.** $\cot(-222^{\circ})$

### AP EAPCET 2022 - 5th July Morning Shift

**Options:**

A. II, III and IV

B. Only III

C. I and III

D. II and III

**Answer: D**

## Solution:

For option I,

$$\begin{aligned}\sin(-292^\circ) &= -\sin 292^\circ \\ &= -\sin(360^\circ - 68^\circ) = -\sin 68^\circ \\ &= -(-) = +\text{ ve value}\end{aligned}$$

So, clearly $\sin(-292^\circ)$ give +ve value.

For option II,

$$\begin{aligned}\tan(-193^\circ) &= -\tan 193^\circ \\ &= -\tan(180^\circ + 13^\circ) \\ &= -\tan 13^\circ \text{ (-ve value)}\end{aligned}$$

For option III,

$$\begin{aligned}\cos(-207^\circ) &= \cos 207^\circ \\ &= \cos(180 + 27^\circ) \\ &= -\cos 27^\circ(-\text{ ve value })\end{aligned}$$

For option IV,

$$\begin{aligned}\cot(-222^\circ) &= \cot(180^\circ + 42^\circ) \\ &= +\cot 42^\circ(+\text{ ve value })\end{aligned}$$

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# Question60

$$\sin^2 \frac{2\pi}{3} + \cos^2 \frac{5\pi}{6} - \tan^2 \frac{3\pi}{4} =$$

### AP EAPCET 2022 - 5th July Morning Shift

**Options:**

A. 0

B. 1/2

C. 1

D. 1/3

**Answer: B**

### Solution:

Here,

$$\sin^2\left(\frac{2\pi}{3}\right)+\cos^2\left(\frac{5\pi}{6}\right)-\tan^2\left(\frac{3\pi}{4}\right)$$
$$=\sin^2\left(\pi-\frac{\pi}{3}\right)+\cos^2\left(\pi-\frac{\pi}{6}\right)-\tan^2\left(\pi-\frac{\pi}{4}\right)$$
$$=\sin^2\left(\frac{\pi}{3}\right)+\left(-\cos\left(\frac{\pi}{6}\right)\right)^2-\left(-\tan\frac{\pi}{4}\right)^2$$

$$\begin{bmatrix}\therefore \sin(\pi-x)=\sin x\\ \cos(\pi-x)=-\cos x\\ \tan(\pi-x)=-\tan x\end{bmatrix}$$

$$=\left(\frac{\sqrt{3}}{2}\right)^2+\left(\frac{-\sqrt{3}}{2}\right)^2-(-1)^2$$
$$=\frac{3}{4}+\frac{3}{4}-1=\frac{6}{4}-1=\frac{1}{2}$$

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# Question61

### A true statement among the following identities is

### AP EAPCET 2022 - 4th July Evening Shift

**Options:**

A. $\sin 5\theta=16\cos^4\theta\sin\theta-12\cos^2\theta\sin\theta+\sin\theta$

B. $\sin 5\theta=16\cos^4\theta-12\cos^2\theta+1$

C. $\sin 5\theta=16\cos^4\theta\sin\theta+12\cos^2\theta\sin\theta-\sin\theta$

D. $\sin 5\theta=16\cos^4\theta\sin\theta+12\cos^2\theta\sin\theta+\sin\theta$

**Answer: A**

### Solution:

$$\sin 5\theta=\sin(3\theta+2\theta)$$
$$=\sin 3\theta\cos 2\theta+\cos 3\theta\cdot\sin 2\theta$$
$$=\left(3\sin\theta-4\sin^3\theta\right)\cdot\left(1-2\sin^2\theta\right)$$
$$+\left(4\cos^3\theta-3\cos\theta\right)\cdot(2\sin\theta\cos\theta)$$
$$=3\sin\theta-6\sin^3\theta-4\sin^3\theta+8\sin^5\theta+8\sin\theta\cos^4\theta$$
$$-6\sin\theta\cos^2\theta$$
$$=3\sin\theta-10\sin^3\theta+8\sin^5\theta+8\sin\theta\cos^4\theta$$
$$-6\sin\theta\cos^2\theta$$

$= 3\sin\theta - 10\sin^3\theta + 8\sin^5\theta + 8\sin\theta(1-\sin^2\theta)^2$
$- 6\sin\theta\left(1-\sin^2\theta\right)$
$= 3\sin\theta - 10\sin^3\theta + 8\sin^5\theta + 8\sin\theta\left(1+\sin^4\theta - 2\sin^2\theta\right)$
$- 6\sin\theta + 6\sin^3\theta$
$= -3\sin\theta - 4\sin^3\theta + 8\sin^5\theta + 8\sin\theta$
$+ 8\sin^5\theta - 16\sin^3\theta$
$= 5\sin\theta - 20\sin^3\theta + 16\sin^5\theta$
$= 5\sin\theta - 20\sin\theta\left(1-\cos^2\theta\right) + 16\left(1-\cos^2\theta\right)^2\sin\theta$
$= 5\sin\theta - 20\sin\theta + 20\sin\theta\cos^2\theta + 16\sin\theta$
$\left(1+\cos^4\theta - 2\cos^2\theta\right)$
$= -15\sin\theta + 20\sin\theta\cos^2\theta + 16\sin\theta + 16\cos^4\theta\sin\theta$
$- 32\cos^2\theta\sin\theta$
$= 16\cos^4\theta\sin\theta - 12\cos^2\theta\sin\theta + \sin\theta$

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# Question62

**If** $A+B+C=\pi, \cos B=\cos A\cos C$**, then** $\tan A\tan C=$

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**Options:**

A. 0

B. 1

C. 2

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

**Answer: C**

## Solution:

Given $A+B+C=\pi$

$$\begin{aligned}
&\therefore \cos B = \cos A \cdot \cos C \\
\Rightarrow\quad & \cos\{\pi-(A+C)\} = \cos A \cdot \cos C \\
\Rightarrow\quad & -\cos(A+C) = \cos A \cdot \cos C \\
\Rightarrow\quad & -\cos A \cdot \cos C + \sin A \cdot \sin C = \cos A \cdot \cos C \\
\Rightarrow\quad & \sin A \cdot \sin C = 2\cos A\cos C \\
\Rightarrow\quad & \frac{\sin A}{\cos A} \cdot \frac{\sin C}{\cos C} = 2 \\
\Rightarrow\quad & \tan A \cdot \tan C = 2
\end{aligned}$$

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

# Question63

**The value of $\tan\left(\frac{7\pi}{8}\right)$ is**

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**Options:**

A. $\sqrt{2}-1$

B. $1-\sqrt{2}$

C. $1+\sqrt{2}$

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

**Answer: B**

## Solution:

Observe that $$\begin{aligned}\tan\left(\frac{7\pi}{8}\right) &= \tan\left(\pi-\frac{\pi}{8}\right)\\ &= -\tan\left(\frac{\pi}{8}\right)\end{aligned}$$

Now, using $\tan(2\theta)=\frac{2\tan\theta}{1-\tan^2\theta}$

Let $\theta=\frac{\pi}{8}$

So, $\tan\left(2\cdot\frac{\pi}{8}\right)=\frac{2\tan\frac{\pi}{8}}{1-\tan^2\frac{\pi}{8}}$

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

On putting $\tan\frac{\pi}{8}=x$,

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

$$\Rightarrow$$

$$\Rightarrow \quad \begin{aligned} 1-x^2-2x=0 &\Rightarrow x^2+2x-1=0\\ x=-1-\sqrt{2}, &\sqrt{2}-1\end{aligned}$$

But, $\tan\frac{\pi}{8}>0$ so, only take $\tan\frac{\pi}{8}=\sqrt{2}-1$

Thus, $\tan\left(\frac{7\pi}{8}\right)=-\tan\left(\frac{\pi}{8}\right)=-(\sqrt{2}-1)=1-\sqrt{2}$

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# Question64

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

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**Options:**

A. $\sin 2x$

B. $\sin^2 x$

C. $\tan^2 x$

D. $\sec^2 x$

**Answer: D**

## Solution:

Given,

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

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# Question65

**If the identity $\cos^4 \theta=a \cos 4\theta+b \cos 2\theta+c$ holds for some $a, b, c \in Q$ then $(a, b, c)=$**

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**Options:**

A. $\left(\frac{1}{8}, \frac{3}{8}, \frac{1}{2}\right)$

B. $\left(\frac{1}{8}, \frac{1}{2}, \frac{3}{8}\right)$

C. $\left(\frac{1}{2}, \frac{1}{8}, \frac{3}{8}\right)$

D. $\left(\frac{1}{2}, \frac{3}{8}, \frac{1}{8}\right)$

**Answer: B**

## Solution:

$\cos^4\theta = a\cos 4\theta + b\cos 2\theta + c$
$\Rightarrow \cos^4\theta = a\left[2\cos^2 2\theta - 1\right] + b\left[2\cos^2\theta - 1\right] + c$
$\Rightarrow \cos^4\theta = a \cdot 2\cos^2 2\theta - a + 2b\cos^2\theta - b + c$
$\Rightarrow \cos^4\theta = 2a(\cos 2\theta)^2 + 2b\cos^2\theta - a - b + c$
$\Rightarrow \cos^4\theta = 2a\left(2\cos^2\theta - 1\right)^2 + 2b\cos^2\theta - a - b + c$
$\Rightarrow \cos^4\theta = 2a\left(4\cos^4\theta + 1 - 4\cos^2\theta\right)$
$+ 2b\cos^2\theta - a - b + c$
$\Rightarrow \cos^4\theta = 8a\cos^4\theta + 2a - 8a\cos^2\theta$
$+ 2b\cos^2\theta - a - b + c$
$\Rightarrow \cos^4\theta = 8a\cos^4\theta + \cos^2\theta(-8a + 2b) + a - b + c$

On comparing the corresponding coefficients, we get

$8a = 1, -8a + 2b = 0$ and $a - b + c = 0$

$\Rightarrow \quad a = \frac{1}{8}$

$\therefore \quad -8\left(\frac{1}{8}\right) + 2b = 0$ gives $b = \frac{1}{2}$

and $\quad \frac{1}{8} - \frac{1}{2} + c = 0$ gives $c = \frac{3}{8}$.

---

# Question66

## The value of $\frac{\sin\theta + \sin 3\theta}{\cos\theta + \cos 3\theta}$ is

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**Options:**

A. $\cos 2\theta$

B. $\cot 2\theta$

C. $\tan 2\theta$

D. $\operatorname{cosec}\theta + \sin\theta$

**Answer: C**

## Solution:

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

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# Question67

**If $(1+\tan 1^\circ)(1+\tan 2^\circ)\ldots(1+\tan 45^\circ)=2^n$, then $n=$**

### AP EAPCET 2022 - 4th July Morning Shift

**Options:**

A. 0

B. 32

C. 23

D. 2

**Answer: C**

## Solution:

$(1+\tan 1^\circ)(1+\tan 2^\circ)(1+\tan 3^\circ)\ldots(1+\tan 45^\circ)$

Considering the following two terms

$(1+\tan x)(1+\tan(45^\circ-x))$

$$\begin{aligned}
&=1+\tan x+\tan(45^\circ-x)+\tan x\cdot\tan(45^\circ-x)\\
&=1+[\tan x+\tan(45^\circ-x)]+\tan x\cdot\tan(45^\circ-x)\\
&=1+\tan(x+(45^\circ-x))\cdot[1-\tan x\cdot\tan(45^\circ-x)]\\
&\quad+\tan x\cdot\tan(45^\circ-x)\\
&=1+[1-\tan x\cdot\tan(45^\circ-x)]+\tan x\cdot\tan(45^\circ-x)\\
&=1+1=2
\end{aligned}$$

There are 22 such terms in the given multiplication

$= (2)^{22} \cdot (1 + \tan 45°)$
$= 2^{22} \cdot 2^1 = 2^{23} = 2^n$
$\therefore \quad n = 23$

---

# Question68

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

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**Options:**

A. $\cos\theta - \sin\theta$

B. $\sin\theta - \cos\theta$

C. $\cos\theta + \sin\theta$

D. $(1 - \tan\theta)\sin\theta$

**Answer: C**

## Solution:

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

---

# Question69

**If** $\operatorname{cosech} x = \frac{4}{5}$**, then** $\sinh x =$

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**Options:**

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

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

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

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

**Answer: B**

## Solution:

$\operatorname{cosech} x=\frac{4}{5}$

We know that, $\sinh x=\frac{1}{\operatorname{cosech} x}$

$\therefore \sinh x=\frac{5}{4}$

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# Question70

### Let $\theta$ be an angle in the standard position such that the point $(-5,12)$ lies on its terminal side, then

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**Options:**

A. $|\sin \theta|=-\sin \theta$

B. $|\cos \theta|=\cos \theta$

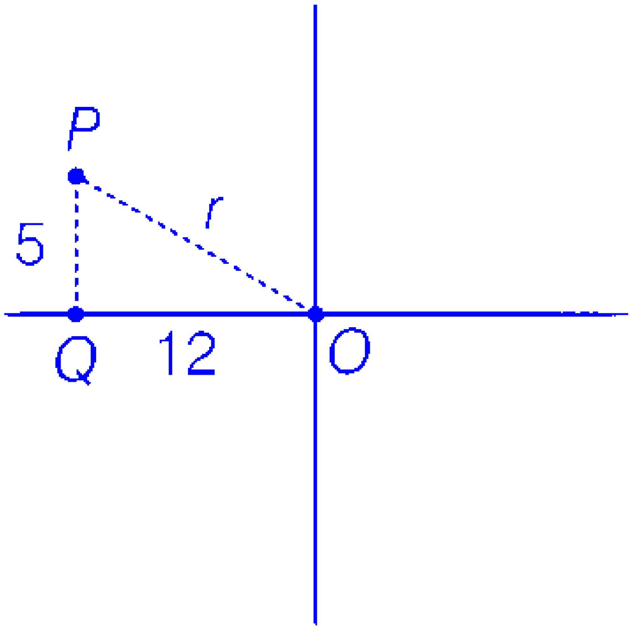
C. $|\tan \theta|=-\tan \theta$

D. $|\operatorname{cosec} \theta|=-\operatorname{cosec} \theta$

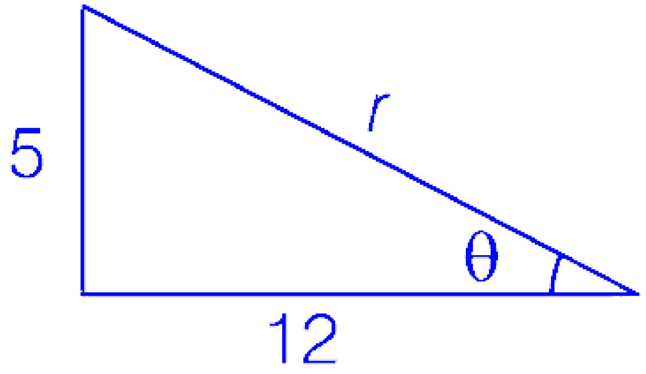
**Answer: C**

## Solution:

$\tan \theta=\frac{-5}{12}$




Then, $|\tan\theta| = 5/12$




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

$\therefore |\tan\theta| = -\tan\theta$

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# Question71

**If $\cos\frac{\pi}{4}\cos\frac{\pi}{8}\cos\frac{\pi}{16}\cos\frac{\pi}{32} = 2^m \operatorname{cosec}\frac{\pi}{n}$, then $m+n$ is equal to**

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**Options:**

A. 27

B. 25

C. 28

D. 29

**Answer: C**

## Solution:

$$\cos\frac{\pi}{4}\cos\frac{\pi}{8}\cos\frac{\pi}{16}\cos\frac{\pi}{32}$$
$$=\cos\frac{\pi}{2^2}\cdot\cos\frac{\pi}{2^3}\cdot\cos\frac{\pi}{2^4}\cdot\cos\frac{\pi}{2^5}$$
$$=\frac{1}{2\sin\left(\frac{\pi}{2^5}\right)}$$
$$\left[2\sin\left(\frac{\pi}{2^5}\right)\cdot\cos\left(\frac{\pi}{2^5}\right)\cdot\cos\frac{\pi}{2^2}\cdot\cos\frac{\pi}{2^3}\cdot\cos\frac{\pi}{2^4}\right]$$
$$=\frac{1}{2}\operatorname{cosec}\left(\frac{\pi}{2^5}\right)\left[\sin\frac{\pi}{2^4}\cdot\cos\frac{\pi}{2^4}\cdot\cos\frac{\pi}{2^2}\cdot\cos\frac{\pi}{2^3}\right]$$
$$=\frac{1}{4}\operatorname{cosec}\left(\frac{\pi}{2^5}\right)\left[\sin\frac{\pi}{2^3}\cdot\cos\frac{\pi}{2^3}\cdot\cos\frac{\pi}{2^2}\right]$$
$$=\frac{1}{8}\operatorname{cosec}\left(\frac{\pi}{2^5}\right)\left[\sin\frac{\pi}{2^2}\cdot\cos\frac{\pi}{2^2}\right]$$
$$=\frac{1}{16}\operatorname{cosec}\frac{\pi}{2^5}\sin\frac{\pi}{2}$$
$$=2^{-4}\operatorname{cosec}\frac{\pi}{2^5}\quad\left[\because\sin\frac{\pi}{2}=1\right]$$
$\therefore m=-4$ and $n=2^5$, then
$m+n=-4+32=28$

---

# Question72

**If $A+B+C=\frac{3\pi}{2}$, then $\cos 2A+\cos 2B+\cos 2C$ is equal to**

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**Options:**

A. $1-4\sin A\sin B\sin C$

B. $1+4\sin A\sin B\sin C$

C. $1-2\sin A\sin B\sin C$

D. $1+2\sin A\sin B\sin C$

**Answer: A**

## Solution:

$$A+B+C=\frac{3\pi}{2}$$
$$A+B=\frac{3\pi}{2}-C$$
$$\cos(A+B)=\cos\left(\frac{3\pi}{2}-C\right)=-\sin C$$

Now, $\cos 2A+\cos 2B+\cos 2C$

$$\begin{aligned}
&=2\cos(A+B)\cos(A-B)+\cos 2C\\
&=2(-\sin C)\cos(A-B)+\cos 2C\\
&=-2\sin C\cos(A-B)+1-2\sin^2 C\\
&=1-2\sin C(\cos(A-B)+\sin C)\\
&=1-2\sin C\left[\cos(A-B)+\sin\left(\frac{3\pi}{2}-(A+B)\right)\right]\\
&=1-2\sin C[\cos(A-B)+(-\cos(A+B)]\\
&=1-2\sin C[\cos(A-B)-\cos(A+B)]\\
&=1-2\sin C[2\sin A\sin B]\\
&=1-4\sin A\sin B\sin C
\end{aligned}$$

---

# Question73

$\sinh(x+y)\cosh(x-y)$ **is equal to**

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**Options:**

A. $\frac{1}{2}(\sinh 2x+\sinh 2y)$

B. $(\sinh 2x+\sinh 2y)$

C. $\frac{1}{2}(\sinh 2x-\sinh 2y)$

D. $(\sinh 2x-\sinh 2y)$

**Answer: A**

## Solution:

$\sinh(x+y)\cosh(x-y)=\frac{1}{2}[2\sin \mathrm{h}(x+y)\cosh(x-y)]$ .... (i)

$\because \sin \mathrm{h} A+\sin \mathrm{h} B=2\sin \mathrm{h}\left(\frac{A+B}{2}\right)\cosh\left(\frac{A-B}{2}\right)$

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

$\Rightarrow A+B=2x+2y$
and $A-B=2x-2y$

Adding, we obtain $2A=4x$

$A=2x$

Subtracting, we obtain $2B = 4y$

$$B = 2y$$

$$\therefore 2\sinh(x+y)\cosh(x-y) = \sinh 2x + \sin \mathrm{h}2y$$

$$\Rightarrow \sinh(x+y)\cosh(x-y) = \frac{1}{2}[\sin \mathrm{h}2x + \sin \mathrm{h}2y]$$

---

# Question74

**What is the value of $\cos\left(22\frac{1}{2}\right)^{\circ}$ ?**

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**Options:**

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

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

C. $\sqrt{2}-1$

D. $\sqrt{2}+1$

**Answer: B**

## Solution:

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

$$= \sqrt{\frac{1+\frac{1}{\sqrt{2}}}{2}} = \sqrt{\frac{\sqrt{2}+1}{2\sqrt{2}}}$$

---

# Question75

**If $\cos\theta = -\sqrt{\frac{3}{2}}$ and $\sin\alpha = \frac{-3}{5}$, where '$\theta$' does not lie in the third quadrant, then the value of $\frac{2\tan\alpha+\sqrt{3}\tan\theta}{\cot^2\theta+\cos\alpha}$ is equal to**

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**Options:**

A. $\frac{7}{22}$

B. $\frac{5}{22}$

C. $\frac{9}{22}$

D. $\frac{22}{5}$

**Answer: A**

## Solution:

$$\cos\theta = -\sqrt{\frac{3}{2}}$$
$$\sin\alpha = -\frac{3}{5}$$
$$\text{As,} \quad -1 \leq \cos\theta \leq 1$$

In the question given, $\cos\theta = -\sqrt{\frac{3}{2}}$. So, this is a wrong question.

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# Question76

**If $\tan\beta = \frac{\tan\alpha + \tan\gamma}{1 + \tan\alpha\tan\gamma}$, then $\frac{\sin 2\alpha + \sin 2\gamma}{1 + \sin 2\alpha \sin 2\gamma}$ is equal to**

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**Options:**

A. $\sin 2\beta$

B. $\cos 2\beta$

C. $\tan 2\beta$

D. $\sec 2\beta$

**Answer: A**

## Solution:

$$\tan\beta = \frac{\tan\alpha + \tan\gamma}{1 + \tan\alpha\tan\gamma}$$
$$\tan\beta = \frac{\sin\alpha\cos\gamma + \sin\gamma\cos\alpha}{\cos\alpha\cos\gamma + \sin\alpha\sin\gamma}$$
$$\tan\beta = \frac{\sin(\alpha+\gamma)}{\cos(\alpha-\gamma)}$$
$$\frac{\sin 2\alpha + \sin 2\gamma}{1 + \sin 2\alpha \sin 2\gamma}$$
$$= \frac{2\sin(\alpha+\gamma)\cos(\alpha-\gamma)}{1 + (2\sin\alpha\cos\gamma)(2\sin\gamma\cos\alpha)}$$
$$= \frac{2\sin(\alpha+\gamma)\cos(\alpha-\gamma)}{1 + [\sin(\alpha+\gamma)+\sin(\alpha-\gamma)][\sin(\alpha+\gamma)-\sin(\alpha-\gamma)]}$$
$$= \frac{2\sin(\alpha+\gamma)\cos(\alpha-\gamma)}{1 + \sin^2(\alpha+\gamma) - \sin^2(\alpha-\gamma)}$$
$$= \frac{2\sin(\alpha+\gamma)\cos(\alpha-\gamma)}{\sin^2(\alpha+\gamma) + \cos^2(\alpha-\gamma)} = \frac{2\tan\beta}{1+\tan^2\beta} = \sin 2\beta$$

---

# Question77

**The sides of a triangle inscribed in a given circle subtend angles $\alpha, \beta, \gamma$ at the center. The minimum value of the AM of $\cos\left(\alpha + \frac{\pi}{2}\right), \cos\left(\beta + \frac{\pi}{2}\right)$ and $\cos\left(\gamma + \frac{\pi}{2}\right)$ is equal to**

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**Options:**

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

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

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

D. $\sqrt{2}$

**Answer: B**

## Solution:

$$\cos\left(\alpha + \frac{\pi}{2}\right) = -\sin\alpha$$
$$\cos\left(\beta + \frac{\pi}{2}\right) = -\sin\beta$$
$$\cos\left(\gamma + \frac{\pi}{2}\right) = -\sin\gamma$$
$$\because \quad AM \geq GM$$
$$\frac{-(\sin\alpha + \sin\beta + \sin\gamma)}{3} \geq (-\sin\alpha\sin\beta\sin\gamma)^{1/3}$$

Equating holds, when $\alpha = \beta = \gamma$

$$\alpha + \beta + \gamma = 360\gamma$$
$$\alpha = \beta = \gamma = 120\gamma$$

$$\Rightarrow AM = \frac{1}{3}\left[\left(-\frac{\sqrt{3}}{2}\right) + \left(-\frac{\sqrt{3}}{2}\right) + \left(-\frac{\sqrt{3}}{2}\right)\right]$$
$$= -\frac{\sqrt{3}}{2}$$

---

# Question78

**In a $\triangle ABC$, if $3 \sin A + 4 \cos B = 6$ and $4 \sin B + 3 \cos A = 1$, then $\sin(A + B)$ is equal to**

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**Options:**

A. 1

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

C. 0

D. $\cos C$

**Answer: B**

## Solution:

$3 \sin A + 4 \cos B = 6$ ...... (i)

and $4 \sin B + 3 \cos A = 1$ .... (ii)

Squaring Eqs. (i) and (ii), we get

$9\sin^2 A + 16\cos^2 B + 24 \sin A \cos B = 36$ ..... (iii)

$16\sin^2 B + 9\cos^2 A + 24 \sin B \cos A = 1$ .... (iv)

Adding Eqs. (iii) and (iv), we get

$$9\left(\sin^2 A + \cos^2 A\right) + 16\left(\sin^2 B + \cos^2 B\right)$$
$$+ 24(\sin A \cos B + \cos A \sin B) = 37$$
$$\Rightarrow \quad 25 + 24 \sin(A + B) = 37$$
$$\sin(A + B) = 1/2$$

---

# Question79

$\tan \alpha+2 \tan 2 \alpha+4 \tan 4 \alpha+8 \cot 8 \alpha$ **is equal to**

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**Options:**

A. $\tan 16 \alpha$

B. 0

C. $\cot \alpha$

D. $\tan \alpha$

**Answer: C**

## Solution:

Let $\tan A+2 \cot 2 A$

$=\frac{\sin A}{\cos A}+\frac{2 \cos 2 A}{\sin 2 A}$

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

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

$=\frac{1-\sin ^2 A}{\sin A \cos A}=\frac{\cos ^2 A}{\sin A \cos A}=\cot A$

$\therefore \tan \alpha+2 \tan 2 \alpha+4 \tan 4 \alpha+8 \cot 8 \alpha=\tan \alpha+2 \tan 2 \alpha+4(\tan 4 \alpha+2 \cot 2(4 \alpha))$

$=\tan \alpha+2 \tan 2 \alpha+4 \cot 4 \alpha$

$=\tan \alpha+2(\tan 2 \alpha+2 \cot 2(2 \alpha))$

$=\tan \alpha+2 \cot 2 \alpha=\cot \alpha$

---

# Question80

**If** $f(x)=\frac{\cot x}{1+\cot x}$ **and** $\alpha+\beta=\frac{5 \pi}{4}$**, then the value of** $f(\alpha) f(\beta)$ **is equal to**

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**Options:**

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

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

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

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

**Answer: D**

## Solution:

$$\text{If } f(x)=\frac{\cot x}{1+\cot x} \text{ and } \alpha+\beta=\frac{5\pi}{4}$$
$$\Rightarrow \cot(\alpha+\beta)=\cot\frac{5\pi}{4}=1 \Rightarrow \frac{\cot\alpha\cot\beta-1}{\cot\beta+\cot\alpha}=1$$
$$\Rightarrow \cot\alpha\cot\beta=\cot\beta+\cot\alpha+1 \quad ....(\text{i})$$
$$\text{Now, } f(\alpha)f(\beta)=\frac{\cot\alpha}{1+\cot\alpha}\times\frac{\cot\beta}{1+\cot\beta}$$
$$=\frac{\cot\alpha\cot\beta}{1+\cot\alpha+\cot\beta+\cot\alpha\cot\beta}=\frac{\cot\alpha\cot\beta}{2\cot\alpha\cot\beta}=\frac{1}{2}$$

---

# Question81

**In $\triangle ABC \cdot \frac{a+b+c}{BC+AB}+\frac{a+b+c}{AC+AB}=3$, then $\tan\frac{C}{8}$ is equal to**

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**Options:**

A. $\sqrt{6}+\sqrt{3}+\sqrt{2}-2$

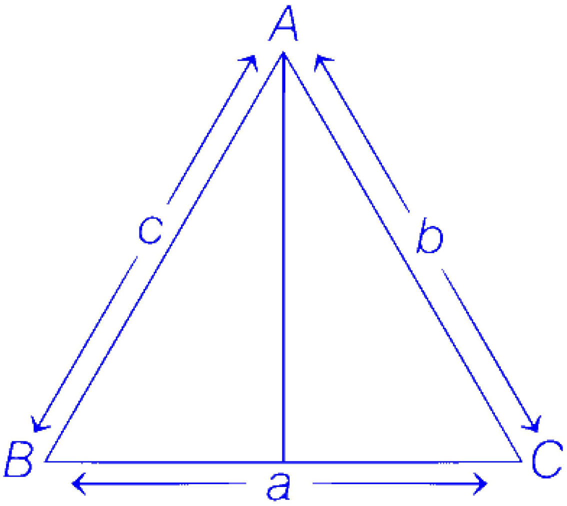
B. $\sqrt{6}-\sqrt{3}-\sqrt{2}+2$

C. $\sqrt{6}-\sqrt{3}+\sqrt{2}-2$

D. $\sqrt{6}+\sqrt{3}-\sqrt{2}+2$

**Answer: C**

## Solution:




In $\triangle ABC$,

$AB = c, BC = a, AC = b$

$$\because \frac{a+b+c}{BC+AB} + \frac{a+b+c}{AC+AB} = 3$$

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

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

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

$$\Rightarrow \quad \frac{a^2+b^2-c^2}{\phantom{x}} = ab$$

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

$$\Rightarrow \quad C = 60\Upsilon$$

Now, $\tan \frac{C}{8} = \tan \frac{60\Upsilon}{8}$

$= \tan \left(7\frac{1}{2}\right)^{\Upsilon} = (\sqrt{3} - \sqrt{2})(\sqrt{2} - 1)$

$= \sqrt{6} - \sqrt{3} + \sqrt{2} - 2$

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# Question82

**Mean of the values** $\sin^2 10Y, \sin^2 20Y, \sin^2 30Y, \ldots\ldots\ldots\ldots, \sin^2 90Y$ **is**

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**Options:**

A. $\frac{5}{9}$

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

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

D. $\frac{1}{9}$

**Answer: A**

## Solution:

To find the mean of the values given, $\sin^2 10Y, \sin^2 20Y, \sin^2 30Y, \ldots, \sin^2 90Y$, we first need to recognize a pattern or symmetry that can simplify our calculations.

Firstly, we note that the sine function has a property where $\sin^2$ of complementary angles add to 1. This is given by the identity:

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

When dealing with complementary angles, we can write this as:

$\sin^2(90^\circ - \theta) = \cos^2\theta$

So, if we pair each element with its complement to $90^\circ$, we get:

$\sin^2 10Y = \cos^2 80Y$

$\sin^2 20Y = \cos^2 70Y$

$\sin^2 30Y = \cos^2 60Y$

$\sin^2 40Y = \cos^2 50Y$

$\sin^2 50Y = \cos^2 40Y$

$\sin^2 60Y = \cos^2 30Y$

$\sin^2 70Y = \cos^2 20Y$

$\sin^2 80Y = \cos^2 10Y$

$\sin^2 90Y = 1$

Essentially, the sum of each pair $\sin^2\theta + \cos^2\theta = 1$. Therefore, pairing these up (excluding $\sin^2 90Y$ as it stands alone giving 1), we see that the total number of pairs is 4 (since we started from 10 up to 80, which is 8 elements). Each pair sums to 1, so we have:

$\sin^2 10Y + \sin^2 80Y = 1$

$\sin^2 20Y + \sin^2 70Y = 1$

$\sin^2 30Y + \sin^2 60Y = 1$

$\sin^2 40Y + \sin^2 50Y = 1$

And $\sin^2 90Y = 1$

Thus, the total sum of the 9 terms is:

$4 \times 1 + 1 = 5$

Since there are 9 total terms, the mean is:

$\frac{\text{Total sum}}{\text{Number of terms}} = \frac{5}{9}$

Therefore, the correct answer is Option A: $\frac{5}{9}$

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# Question83

**When the coordinate axes are rotated through an angle $135\Upsilon$, the coordinates of a point $P$ in the new system are known to be $(4, -3)$. Then find the coordinates of $P$ in the original system.**

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**Options:**

A. $\left(\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$

B. $\left(\frac{-1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$

C. $\left(\frac{1}{\sqrt{2}}, \frac{-7}{\sqrt{2}}\right)$

D. $\left(\frac{-1}{\sqrt{2}}, \frac{-7}{\sqrt{2}}\right)$

**Answer: B**

## Solution:

Let coordinate of $P$ original system be $(x, y)$.

Then, new coordinate after rotating axes through $135\Upsilon$ is $(4, -3)$

$$\therefore \quad 4 = x\cos 135x + y\sin 135\Upsilon$$
$$\text{and } -3 = -x\sin 135\gamma + y\cos 135\Upsilon$$
$$\Rightarrow \quad 4 = \frac{-x}{\sqrt{2}} + \frac{y}{\sqrt{2}}$$
$$\text{and} \quad -3 = \frac{-x}{\sqrt{2}} - \frac{y}{\sqrt{2}}$$

On adding, $\quad 1 = \frac{-2x}{\sqrt{2}} \Rightarrow x = -\frac{1}{\sqrt{2}}$

On subtracting, $7 = \frac{2y}{\sqrt{2}} \Rightarrow y = \frac{7}{\sqrt{2}}$

Coordinate of $P$ in original system $\left(\frac{-1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$.

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# Question84

**The maximum value of $f(x) = \sin(x)$ in the interval $\left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$ is**

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**Options:**

A. 0

B. $-1$

C. 1

D. $\sqrt{2}$

**Answer: C**

## Solution:

Given, $f(x)=\sin x, x \in\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

Range of $\sin x=[-1,1]$

For $x \in\left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \sin x$ is increasing function

It is maximum at $x=\frac{\pi}{2}$

Max $f(x)=\left(\frac{\pi}{2}\right)=\sin \frac{\pi}{2}=1$

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# Question85

$\tan 2\alpha \cdot \tan(30Y-\alpha)+\tan 2\alpha \cdot \tan(60Y-\alpha)+\tan(60\Upsilon-\alpha) \cdot \tan(30\gamma-\alpha)$ **is equal to**

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**Options:**

A. $\tan 3\alpha$

B. $\tan^2 2\alpha-\tan^2 60\gamma$

C. 1

D. 0

**Answer: C**

## Solution:

$\because \tan(A+B+C)$
$= \dfrac{\tan A+\tan B+\tan C-\tan A\tan B\tan C}{1-\tan A\tan B-\tan B\tan C-\tan C\tan A}$

If $A+B+C=90\Upsilon$, then

$1-\tan A\tan B-\tan B\tan C-\tan C\tan A=0$

or $\tan A\tan B+\tan B\tan C+\tan C\tan A=1$

Here, $A=2\alpha, B=30\Upsilon-\alpha, C=60\Upsilon-\alpha$, then

$A+B+C=2\alpha+30Y-\alpha+60Y-\alpha=90^{\circ}$
$\therefore \tan 2\alpha\tan(30Y-\alpha)+\tan 2\alpha\cdot\tan(60Y-\alpha)$
$+\tan(30Y-\alpha)\tan(60Y-\alpha)=1$

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# Question86

**If $\sin\alpha-\cos\alpha=m$ and $\sin 2\alpha=n-m^2$, where $-\sqrt{2}\leq m\leq\sqrt{2}$, then n is equal to**

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**Options:**

A. 0

B. 1

C. 2

D. $-2$

**Answer: B**

## Solution:

$\sin\alpha-\cos\alpha=m$ and $\sin 2\alpha=n-m^2$

$\therefore (\sin\alpha-\cos\alpha)^2=m^2$

$\sin^2\alpha+\cos^2\alpha-2\sin\alpha\cos\alpha=m^2$

or $1-\sin 2\alpha=m^2$

or $\sin 2\alpha=1-m^2$

But $\sin 2\alpha=n-m^2$ (given)

$\Rightarrow n=1$

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# Question87

**If $\sinh u = \tan \theta$, then $\cosh u$ is equal to**

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**Options:**

A. $-\sec \theta$

B. $\sec \theta$

C. $\sin \theta$

D. $\cot \theta$

**Answer: B**

## Solution:

$\because \tan \theta = \sinh u$

$\Rightarrow \quad \tan \theta = \sqrt{\cosh^2 u - 1} \quad [\cosh^2 x - \sinh^2 x = 1]$

$\Rightarrow \cosh u = \sqrt{1 + \tan^2 \theta} \Rightarrow \cosh u = \sec \theta$

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