9. COMPOUND ANGLES

Class: VIII. MATHEMATICS

FOUNDATION+. SOLUTIONS

TEACHING TASK (2025/26)

JEE MAINS LEVEL

01 $A+B+C=\pi$

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

$\Rightarrow \tan(A+B)=\tan(\pi-C)$

$\Rightarrow \dfrac{\tan A+\tan B}{1-\tan A\cdot\tan B}=-\tan C$

$\Rightarrow \tan A+\tan B+\tan C=\tan A\cdot\tan B\cdot\tan C$

$\Rightarrow \sum \tan A=\prod \tan A$

Ans. A

02 $$\frac{\tan 225^\circ-\cot 81^\circ\cdot\cot 69^\circ}{\cot 261^\circ+\tan 21^\circ}$$

$$=\frac{1-\cot 81^\circ\cdot\cot 69^\circ}{\cot 81^\circ+\cot 69^\circ}$$

$$=-\left(\frac{\cot 81^\circ\cdot\cot 69^\circ-1}{\cot 81^\circ+\cot 69^\circ}\right)$$

$=-\cot(81^\circ+69^\circ)=-\cot 150^\circ=-\cot(180^\circ-30^\circ)$

$=\cot 30^\circ=\sqrt{3}$

$\tan 225^\circ=\tan(180^\circ+45^\circ)$

$=\tan 45^\circ$

$=1$

$\cot 261^\circ=\cot(180^\circ+81^\circ)$

$=\cot 81^\circ$

Ans. C

03 $$\frac{(1+\tan 13^\circ)(1+\tan 32^\circ)}{(1+\tan 12^\circ)(1+\tan 33^\circ)}=$$

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

NOTE

$A+B=45^\circ$

$\Rightarrow (1+\tan A)(1+\tan B)=2$

Ans. A

04 Given $A+B=300^\circ$

Let $A=B=150^\circ$

$\cot 150^\circ = \cot(180^\circ-30^\circ) = -\cot 30^\circ = -\sqrt{3}$

$\therefore (1+\sqrt{3}\cot A)(1+\sqrt{3}\cot A)$

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

$= (1-3)(1-3) = (-2)(-2) = 4$ Ans. A

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05 Given $A+B+C=360^\circ$

Let $A=B=C=120^\circ$

Now, $\frac{A}{4}=\frac{B}{4}=\frac{C}{4}=30^\circ$

$\cot\frac{A}{4}+\cot\frac{B}{4}+\cot\frac{C}{4} = K\cdot\cot\frac{A}{4}\cdot\cot\frac{B}{4}\cdot\cot\frac{C}{4}$

$\Rightarrow \sqrt{3}+\sqrt{3}+\sqrt{3} = K\cdot\sqrt{3}\cdot\sqrt{3}\cdot\sqrt{3}$

$\Rightarrow 3\sqrt{3} = K\cdot 3\sqrt{3} \Rightarrow K=1$ Ans. D

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06 $\frac{\tan 160^\circ - \tan 110^\circ}{1+\tan 160^\circ\cdot\tan 110^\circ} = \tan(160^\circ-110^\circ) = \tan 50^\circ = \cot 40^\circ$

$= \frac{1}{\tan 40^\circ} = \frac{1}{\tan 2\times 20^\circ} = \frac{1}{\left(\frac{2\tan 20^\circ}{1-\tan^2 20^\circ}\right)} = \frac{1-p^2}{2p}$ Ans. B

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07 $A+B=225^\circ \Rightarrow \cot(A+B)=\cot 225^\circ$

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

$\Rightarrow \cot A\cdot\cot B - 1 = \cot A+\cot B \rightarrow (1)$

Now, $\frac{\cot A}{1+\cot A}\cdot\frac{\cot B}{1+\cot B} = \frac{\cot A\cot B}{1+\cot A+\cot B+\cot A\cdot\cot B}$.

$$= \frac{\cot A \cdot \cot B}{\cot A \cdot \cot B + \cot A \cdot \cot B} \quad (\text{from } ①) \quad (3)$$

$$= \frac{\cot A \cdot \cot B}{2 \cot A \cdot \cot B} = \frac{1}{2}$$

Ans. B

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08 $A + B + C = 180^\circ$

$\Rightarrow A + B = 180^\circ - C$

$\Rightarrow \sin(A+B) = \sin(180^\circ - C)$

$\Rightarrow \sin A \cos B + \cos A \sin B = \sin C$

$= \left(\frac{3}{5}\right) \cdot \frac{12}{13} + \left(\frac{-4}{5}\right) \cdot \frac{5}{13} = \sin C$

$\Rightarrow \sin C = \frac{16}{65}$

Since A is obtuse

$\Rightarrow \cos A = -\frac{4}{5}$

Ans. C

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09 In $\triangle ABC$, Let $A = B = C = 60^\circ$

$$\sum \frac{\sin(60^\circ + 60^\circ)\sin(60^\circ - 60^\circ)}{\sin^2 60^\circ \cdot \sin^2 60^\circ} = 0$$

Ans. B

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10. Let $A = 30^\circ$, $B = 60^\circ$

$\frac{\cos A}{\cos B} = n \Rightarrow \frac{\left(\frac{\sqrt{3}}{2}\right)}{\left(\frac{1}{2}\right)} = n \Rightarrow \boxed{n = \sqrt{3}}$

$\frac{\sin A}{\sin B} = m \Rightarrow \frac{\left(\frac{1}{2}\right)}{\left(\frac{\sqrt{3}}{2}\right)} = m \Rightarrow \boxed{m = \frac{1}{\sqrt{3}}}$

Given $(m^2 - n^2)\sin^2 B$

$= \left(\frac{1}{3} - 3\right) \cdot \frac{3}{4} = -\frac{8}{3} \times \frac{3}{4} = -2$

Option A: $1 - n^2 = 1 - 3 = -2$

Ans. A

11 $\angle R = \frac{\pi}{2} \Rightarrow P + Q = 90^\circ$

$\Rightarrow \frac{P}{2} + \frac{Q}{2} = 45^\circ$

$\Rightarrow \tan\left(\frac{P}{2} + \frac{Q}{2}\right) = \tan 45^\circ$

$\Rightarrow \frac{\tan\frac{P}{2} + \tan\frac{Q}{2}}{1 - \tan\frac{P}{2}\cdot\tan\frac{Q}{2}} = 1$

$\frac{\left(\frac{-b}{a}\right)}{1 + \frac{c}{a}} = 1$ (4)

$\Rightarrow a + b = c$

Ans: A

JEE ADVANCED LEVEL

01. $\sin^2 52\frac{1}{2}^\circ - \sin^2 22\frac{1}{2}^\circ$

$= \sin\left(52\frac{1}{2}^\circ + 22\frac{1}{2}^\circ\right).\sin\left(52\frac{1}{2}^\circ - 22\frac{1}{2}^\circ\right)$

$= \sin 75^\circ . \sin 30^\circ$

$= \frac{\sqrt{3}+1}{2\sqrt{2}} \cdot \frac{1}{2} = \frac{\sqrt{3}+1}{4\sqrt{2}}$ (or) $\frac{1}{2\sqrt{2}(\sqrt{3}+1)}$

Ans.. A, D

02 $\sin(\theta + \alpha) = \cos(\theta + \alpha)$

$\Rightarrow \tan(\theta + \alpha) = 1$

$\Rightarrow \frac{\tan\theta + \tan\alpha}{1 - \tan\theta\cdot\tan\alpha} = 1$

$\Rightarrow \tan\alpha = \frac{1 - \tan\theta}{1 + \tan\theta}$

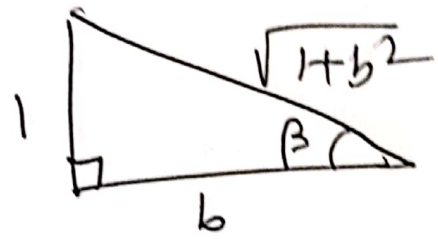
Ans: B

03 Statement I:

$\sin\alpha = \frac{a}{\sqrt{1+a^2}}$

$\therefore \tan\alpha = a$

$$\cos\beta = \frac{b}{\sqrt{1+b^2}}$$



$$\tan\beta = \frac{1}{b}$$

$$\tan(\alpha+\beta) = \frac{a+\frac{1}{b}}{1-\frac{a}{b}} = \frac{ab+1}{b-a} \quad \text{(False)}$$

Statement II:

$$\tan 2B = \tan\left[(A+B)-(A-B)\right] = \frac{m-n}{1+mn} \quad \text{(False)}$$

Ans. B

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04. Statement I:

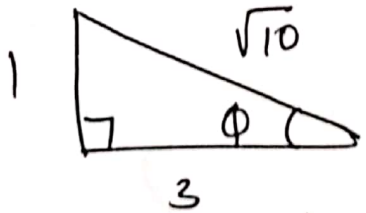
$$\sin(\alpha+\beta) = \sin\alpha\cdot\cos\beta + \cos\alpha\cdot\sin\beta$$

$$= \frac{12}{13}\cdot\left(\frac{-3}{5}\right) + \left(\frac{5}{13}\right)\left(\frac{-4}{5}\right)$$

$$= \frac{-56}{65} \quad \text{(False)}$$

Statement II:

$$\sin\phi = \frac{1}{\sqrt{10}}$$



$$\therefore \tan\phi = \frac{1}{3}$$

$$\tan 2\phi = \frac{2\left(\frac{1}{3}\right)}{1-\left(\frac{1}{3}\right)^2} = \frac{3}{4}$$

Now, $\tan(\theta+2\phi) = \dfrac{\tan\theta + \tan 2\phi}{1 - \tan\theta\cdot\tan 2\phi}$

$$= \frac{\frac{1}{7}+\frac{3}{4}}{1-\frac{1}{7}\cdot\frac{3}{4}} = \frac{25}{21} = 1 = \tan 45^\circ$$

hence, $\theta + 2\phi = 45^\circ$ (True) Ans. D

05 **Assertion:** $\cot A + \cot B + \cot C = \sqrt{3}$

Let $A = B = C = 30^\circ$ so that $A+B+C = 90^\circ$

$\cot 30^\circ + \cot 30^\circ + \cot 30^\circ$

$= \sqrt{3} + \sqrt{3} + \sqrt{3} = 3\sqrt{3}$ (False)

Reason: mathematically (True) Ans. D

06 **Assertion:** Given $\tan A + \tan B + \tan C = \tan A \cdot \tan B \cdot \tan C$

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

$$\Rightarrow \tan(A+B) = -\tan C = \tan(-C)$$

$$\Rightarrow A + B = n\pi - C$$

$$\Rightarrow A + B + C = n\pi \quad \forall n \in \mathbb{Z} \text{ (True)}$$

Reason: Conceptual (True) Ans. A

07 $\cos^2\left(\frac{\pi}{4}+x\right) - \sin^2\left(\frac{\pi}{4}-x\right)$

$= \cos\left(\frac{\pi}{4}+x+\frac{\pi}{4}-x\right) \cdot \cos\left(\frac{\pi}{4}+x-\frac{\pi}{4}+x\right)$

$= \cos\left(\frac{\pi}{2}\right) \cdot \cos 2x = 0$ Ans. D

~~$\Rightarrow \cos^2\left(\frac{\pi}{6}\right)$~~

08 $\cos^2\left(\frac{\pi}{6}+\theta\right) - \cos^2\left(\frac{\pi}{6}-\theta\right)$ (7)

$= \sin\left(\frac{\pi}{6}+\theta+\frac{\pi}{6}-\theta\right).\sin\left(\frac{\pi}{6}-\theta-\frac{\pi}{6}-\theta\right)$

$= \sin\frac{\pi}{3}.\sin(-2\theta) = -\frac{\sqrt{3}}{2}\sin 2\theta$ Ans. B

09 $\cos(A+B).\cos(A-B) + \sin(A+B).\sin(A-B)$

$= \cos^2A - \sin^2B + \sin^2A - \sin^2B$

$= 1 - 2\sin^2B$

$= 1 - 2(1-\cos^2B)$ Ans. C

$= 2\cos^2B - 1$

10 $\tan 2A = \tan[(A+B)+(A-B)]$

$= \frac{p+q}{1-pq}$ Ans. C

11 $\cot 2B = \cot[(A+B)-(A-B)]$

$= \frac{pq+1}{p-q}$ Ans. C

12 $\tan 2A.\cot 2B + \tan 2B.\cot 2A$

$= \frac{p+q}{1-pq}.\frac{pq+1}{p-q} + \frac{p-q}{pq+1}.\frac{1-pq}{p+q}$

Let $p=1, q=0$

$= \frac{1}{1}.\frac{1}{1} + \frac{1}{1}.\frac{1}{1} = 2$ Ans. D

13 $\tan(A+B) = \dfrac{\frac{n}{n+1} + \frac{1}{2n+1}}{1 - \frac{n}{n+1}\cdot\frac{1}{2n+1}}$

put $n=1$

$= \dfrac{\frac{1}{2}+\frac{1}{3}}{1-\frac{1}{2}\cdot\frac{1}{3}} = 1$ hence $A+B = 45^\circ$

Ans: 45°

14 $A+B+C = 180^\circ$

$\Rightarrow A+B = 180^\circ - C$

$\Rightarrow \sin(A+B) = \sin(180^\circ - C)$

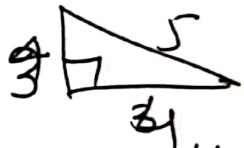
$\Rightarrow \sin A\cos B + \cos A \sin B = \sin C$

$\Rightarrow \frac{3}{5}\cdot\frac{5}{13} + \frac{4}{5}\cdot\frac{12}{13} = \sin C$

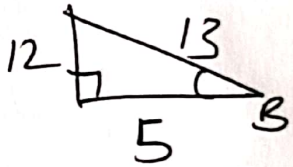
$\Rightarrow 15 + 48 = 65\sin C$

$\therefore 65\sin C = 63$

$\sin A = \frac{3}{5}$



$\cos A = \frac{4}{5}$



$\cos B = \frac{5}{13}$

Ans: 63

15 a) $A+B+C = 180^\circ$

let $A = B = C = 60^\circ$

$\sum \dfrac{\cot A + \cot B}{\tan A + \tan B}$

$= \sum \dfrac{\left(\frac{1}{\sqrt{3}} + \frac{1}{\sqrt{3}}\right)}{\sqrt{3}+\sqrt{3}}$

$= \sum \frac{1}{3} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1$ ( )

(9)

b) In $\triangle ABC$,

let $A=B=C=60^\circ$

$$\sum \frac{\cos(B-C)}{\sin B \cdot \sin C} = \sum \frac{1}{\left(\frac{\sqrt{3}}{2}\right)\cdot\left(\frac{\sqrt{3}}{2}\right)} = \sum \frac{4}{3}$$

$$= \frac{4}{3}+\frac{4}{3}+\frac{4}{3} = 4 \quad (q)$$

c) In $\triangle ABC$

let $A=B=C=60^\circ$

$$\sum \frac{\sin(A-B)}{\cos A \cdot \cos B} = \sum \frac{\sin(60^\circ-60^\circ)}{\cos 60^\circ \cdot \cos 60^\circ} = 0 \quad (r)$$

d) $A+B+C=90^\circ$

let $A=B=C=30^\circ$

$$\frac{\cot A+\cot B+\cot C}{\cot A \cdot \cot B \cdot \cot C} = \frac{\cot 30^\circ+\cot 30^\circ+\cot 30^\circ}{\cot 30^\circ \cdot \cot 30^\circ \cdot \cot 30^\circ}$$

$$= \frac{3\times\sqrt{3}}{(\sqrt{3})^3} = \frac{3\sqrt{3}}{3\sqrt{3}} = 1 \quad (t)$$

Ans. (t), q, r, (t)

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16 a)

$$\frac{\sin\theta}{\sin\left(\frac{\pi}{8}+\frac{\theta}{2}+\frac{\pi}{8}-\frac{\theta}{2}\right)\cdot\sin\left(\frac{\pi}{8}+\frac{\theta}{2}-\frac{\pi}{8}+\frac{\theta}{2}\right)}$$

$$= \frac{\sin\theta}{\sin\frac{\pi}{4}\cdot\sin\theta} = \sqrt{2} \quad (t)$$

b) $\tan\left(\frac{\pi}{4}+\frac{\theta}{2}\right)+\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)=a$

let $\theta=0^\circ$

$\Rightarrow a=2$

Now, $\tan^{-1}\left(\frac{\pi}{4}+\theta\right)+\tan^{-1}\left(\frac{\pi}{4}-\theta\right) \rightarrow (\#)$ (10)

let $\theta = 0^\circ$

$(\#) \Rightarrow 2$ Now, $a^2 - 2 = (2)^2 - 2 = 2 = 2(r)$

c) $\cot A + 2\tan(A-B)$

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

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

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

$= 0 \ (q)$

d) $A+B+C = 90^\circ$

We have

$\tan A \tan B + \tan B \cdot \tan C + \tan C \cdot \tan A = 1 \ (s)$

Ans: t, r, q, s

LEARNER'S TASK (CUQ's

01. $\sin 40^\circ \cdot \cos 50^\circ + \cos 40^\circ \cdot \sin 50^\circ = \sin(40^\circ + 50^\circ) = \sin 90^\circ = 1$

Ans. A

02 $\cos 70^\circ \cdot \cos 20^\circ - \sin 70^\circ \cdot \sin 20^\circ$

$= \cos(70^\circ + 20^\circ) = \cos 90^\circ = 0$

Ans. B

03 $\frac{\tan 20^\circ + \tan 25^\circ}{1 - \tan 20^\circ \cdot \tan 25^\circ} = \tan(20^\circ + 25^\circ) = \tan 45^\circ = 1$

Ans. A

04 $\tan(A+B) = \frac{\frac{1}{2}+\frac{1}{3}}{1-\frac{1}{2}\frac{1}{3}} = \frac{5}{5} = 1 = \tan\frac{\pi}{4}$ Ans: C

05 $\cos(A+B) - \cos(A-B) = -2\sin A \sin B$ Ans. B

06 $\tan 90^\circ$ = Not defined Ans. D

07 $\cos^2 A - \sin^2 B$ (or) $\cos^2 B - \sin^2 A$ Ans. A

08 $\cos^2 45^\circ - \sin^2 15^\circ$

$= \cos(45^\circ+15^\circ).\cos(45^\circ-15^\circ)$

$= \cos 60^\circ . \cos 30^\circ$

$= \frac{1}{2} \times \frac{\sqrt{3}}{2} = \frac{\sqrt{3}}{4}$ Ans: C

09 $\cos(120^\circ+A) + \cos(120^\circ-A)$

$= 2\cos 120^\circ . \cos A = 2\left(-\frac{1}{2}\right).\cos A = -\cos A$ Ans B

10 $\sin^2 C - \sin^2 B$ Ans. B

JEE MAINS LEVEL

01 $\sin 75^\circ . \cos 75^\circ = \frac{1}{2}(2\sin 75^\circ \cos 75^\circ) = \frac{1}{2}\sin 2\times 75^\circ$

$= \frac{1}{2}\sin 150^\circ = \frac{1}{2}\sin(180^\circ - 30^\circ) = \frac{1}{2}.\sin 30^\circ = \frac{1}{2}.\frac{1}{2} = \frac{1}{4}$

Ans. C

02 $\sin^2 75^\circ + \cot^2 75^\circ = (2+\sqrt{3})^2 + (2-\sqrt{3})^2$

$= 2\left[(2)^2 + (\sqrt{3})^2\right] = 14$ Ans. A

03 $\frac{\tan A + \tan B}{1 - \tan A \cdot \tan B} = \frac{\frac{4}{3} + \frac{5}{12}}{1 - \frac{4}{3} \cdot \frac{5}{12}} = \frac{63}{16}$ (12) Ans. D

04 $A + B = 45^\circ$

$\Rightarrow \tan(A+B) = \tan 45^\circ$

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

$\Rightarrow \tan A + \tan B = 1 - \tan A \cdot \tan B$

$\Rightarrow \tan A + \tan B + \tan A \cdot \tan B = 1$

$= (1 + \tan A)(1 + \tan B) = 2$ Ans. B

05 $20^\circ = 55^\circ - 35^\circ$

$\Rightarrow \tan 20^\circ = \frac{\tan 55^\circ - \tan 35^\circ}{1 + \tan 55^\circ \cdot \tan 35^\circ}$

$\Rightarrow \tan 20^\circ = \frac{\tan 55^\circ - \tan 35^\circ}{1 + 1}$

$\Rightarrow 2\tan 20^\circ = \tan 55^\circ - \tan 35^\circ$

$\Rightarrow 2\tan 20^\circ + \tan 35^\circ = \tan 55^\circ$

$\therefore x = 55^\circ$

Since $\tan 35^\circ = \cot 55^\circ$

Ans. C

06 $\cos^2 48^\circ - \sin^2 12^\circ$

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

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

$= \frac{1}{2} \times \frac{1+\sqrt{5}}{4} = \frac{1+\sqrt{5}}{8}$ Ans. A

07. $x = \frac{\sin A}{\cos A} - \frac{\sin B}{\cos B}$

$= \frac{\sin A\cos B - \cos A \sin B}{\cos A \cdot \cos B}$

$= \frac{\sin(A-B)}{\cos A \cdot \cos B}$

$y = \frac{\cos B}{\sin B} - \frac{\cos A}{\sin A}$

$= \frac{\sin A\cos B - \cos A \sin B}{\sin B \cdot \sin A}$

$= \frac{\sin(A-B)}{\sin A \cdot \sin B}$

Now, $\frac{1}{x} + \frac{1}{y} = \frac{\cos A\cos B + \sin A \sin B}{\sin(A-B)}$

$= \frac{\cos(A-B)}{\sin(A-B)} = \cot(A-B)$ Ans. A

08 $\tan(A-B) = \frac{1}{24}$

$\Rightarrow \frac{\tan A - \tan B}{1 + \tan A \cdot \tan B} = \frac{1}{24}$

$\Rightarrow \frac{\frac{4}{3} - \tan B}{1 + \frac{4}{3}\cdot \tan B} = \frac{1}{24}$

$\Rightarrow \tan B = \frac{3}{4}$

$\tan(A+B) = \frac{\frac{4}{3} + \frac{3}{4}}{1 - \frac{4}{3}\cdot\frac{3}{4}}$

$=$ Not defined

$A + B = \frac{\pi}{2}$

Ans. D

09 $\tan(A+B+C) = \frac{(1+2+3) - (1\cdot 2\cdot 3)}{1 - (1\cdot 2 + 2\cdot 3 + 3\cdot 1)} = 0$

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

Ans. B

10 $A+B+C = 90^\circ \iff \tan A \cdot \tan B + \tan B \cdot \tan C + \tan C \cdot \tan A = 1$

Now, $A+B+C = 180^\circ$

$\Rightarrow \frac{A}{2} + \frac{B}{2} + \frac{C}{2} = 90^\circ$

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

$\Rightarrow \frac{5}{6}\cdot\frac{20}{37}+\frac{20}{37}\cdot\tan\frac{C}{2}+\tan\frac{C}{2}\cdot\frac{5}{6}=1$

$\Rightarrow \tan\frac{C}{2}=\frac{122}{305}$ Ans. A

JEE ADVANCED LEVEL

01 $A+B=\frac{\pi}{4} \Rightarrow (1+\tan A)(1+\tan B)=2$

$(1+\cot A)(1+\cot B)=2\cot A\cdot\cot B$

Ans. A, C

02 $\frac{\cos 9^\circ+\sin 9^\circ}{\cos 9^\circ-\sin 9^\circ}=\frac{1+\tan 9^\circ}{1-\tan 9^\circ}=\frac{\tan 45^\circ+\tan 9^\circ}{1-\tan 45^\circ\cdot\tan 9^\circ}$

$=\tan 54^\circ=\cot 36^\circ$ Ans. A, C

03 Statement I: $\tan A=x\tan B \Rightarrow x=\frac{\tan A}{\tan B}$

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

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

Statement II: Conceptual (True) Ans. A

04 Statement I:

$$m\cos(\theta + \alpha) = n\cos(\theta - \alpha)$$

$$\Rightarrow \frac{m}{n} = \frac{\cos(\theta-\alpha)}{\cos(\theta+\alpha)}$$

$$\Rightarrow \frac{m+n}{m-n} = \frac{\cos(\theta-\alpha)+\cos(\theta+\alpha)}{\cos(\theta-\alpha)-\cos(\theta+\alpha)}$$

$$= \frac{2\cos\theta\cdot\cos\alpha}{2\sin\theta\cdot\sin\alpha} = \cot\theta\cdot\cot\alpha \text{ (False)}$$

Statement II:

Given $\frac{\sin(\alpha+\beta)}{\sin(\alpha-\beta)} = \frac{a+b}{a-b}$

$$\Rightarrow \frac{\sin(\alpha+\beta)+\sin(\alpha-\beta)}{\sin(\alpha+\beta)-\sin(\alpha-\beta)} = \frac{(a+b)+(a-b)}{(a+b)-(a-b)}$$

$$\Rightarrow \frac{2\sin\alpha\cos\beta}{2\cos\alpha\cdot\sin\beta} = \frac{2a}{2b}$$

$$\Rightarrow \tan\alpha\cdot\cot\beta = \frac{a}{b} \text{ (True)}$$

Ans. D

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05 Assertion: LHS $= \tan 75^\circ - \cot 15^\circ$

$= \tan(90^\circ - 15^\circ) - \cot 15^\circ$

$= \cot 15^\circ - \cot 15^\circ = 0$ (True)

Ans. A

Reason: Conceptual (True)

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06 Assertion: Mathematically (True)

Reason: Conceptual (True)

Ans. A

07 $A+B=45^\circ$

$\Rightarrow \cot(A+B)=\cot 45^\circ$

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

$\Rightarrow \cot A\cdot\cot B-\cot A-\cot B=1$

$\Rightarrow (\cot A-1)(\cot B-1)=2$

Ans: C

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08 $A=22\frac{1}{2}^\circ$

$\Rightarrow 2A=45^\circ$

$\Rightarrow \tan 2A=\tan 45^\circ$

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

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

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

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

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

$=\sqrt{2}-1$

Ans: C

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09 $A=67\frac{1}{2}^\circ$

$2A=135^\circ$

$\Rightarrow \tan 2A=\tan 135^\circ$

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

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

$\Rightarrow x^2-2x-1=0$

$\Rightarrow x=\frac{2+\sqrt{4+4}}{2}$

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

Ans. B

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10 A) Consider $(\sin 15^\circ+\cos 15^\circ)^2=1+2\sin 15^\circ\cos 15^\circ$

$=1+\sin 30^\circ$

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

$=\frac{3}{2}$

$\therefore \sin 15^\circ+\cos 15^\circ=\sqrt{\frac{3}{2}}=\frac{\sqrt{6}}{2}$

B) $\tan 15^\circ - \cot 75^\circ$

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

$= (2-\sqrt{3}) - (2-\sqrt{3}) = 0$ (True)

Ans: C

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11. $x = \tan 15^\circ + \tan 75^\circ$

$= (2-\sqrt{3}) + (2+\sqrt{3}) = 4$

$\therefore x^2 = 16$

Ans: D

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12 $80^\circ - 10^\circ = 70^\circ$

Since $\tan 80^\circ - \tan 10^\circ =$

$\Rightarrow \tan(80^\circ - 10^\circ) = \tan 70^\circ$

$\Rightarrow \frac{\tan 80^\circ - \tan 10^\circ}{1 + \tan 80^\circ \cdot \tan 10^\circ} = \tan 70^\circ$

$\rightarrow \frac{\tan 80^\circ - \tan 10^\circ}{\tan 70^\circ} = 2$

Ans. 2

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13 In $\triangle ABC$, Let $A = B = C = 60^\circ$

$\therefore \tan\frac{A}{2} \cdot \tan\frac{B}{2} + \tan\frac{B}{2} \cdot \tan\frac{C}{2} + \tan\frac{C}{2} \cdot \tan\frac{A}{2}$

$= 3 \tan\frac{A}{2} \cdot \tan\frac{B}{2}$

$= 3 \tan 30^\circ \cdot \tan 30^\circ$

$= 3 \cdot \frac{1}{\sqrt{3}} \cdot \frac{1}{\sqrt{3}} = 1$

Ans. 1

14 a) $\cos\theta + \cos(120^\circ - \theta) + \cos(120^\circ + \theta)$

Let $\theta = 0^\circ$

$= 1 + \cos 120^\circ + \cos 120^\circ$

$= 1 - \frac{1}{2} - \frac{1}{2} = 0$ (t)

b) $\cos\theta + \cos(240^\circ + \theta) + \cos(240^\circ - \theta)$

Let $\theta = 0^\circ$

$= 1 + \cos 240^\circ + \cos 240^\circ$

$= 1 - \frac{1}{2} - \frac{1}{2} = 0$ (t)

c) $\cos\theta - \cos(60^\circ + \theta) - \cos(60^\circ - \theta)$

Let $\theta = 0^\circ$

$= 1 - \cos 60^\circ - \cos 60^\circ$

$= 1 - \frac{1}{2} - \frac{1}{2} = 0$ (t)

d) $\sin\theta + \sin(120^\circ + \theta) + \sin(\theta - 60^\circ)$

Let $\theta = 0^\circ$

$= 0 + \sin 120^\circ - \sin 60^\circ$

$= 0 + \frac{\sqrt{3}}{2} - \frac{\sqrt{3}}{2} = 0$ (t)

~~$\sin\theta = \sin(\theta + 3)$~~

Ans. t, t, t, t

15 a) $20^\circ + 40^\circ = 60^\circ$

$\Rightarrow \tan(20^\circ + 40^\circ) = \tan 60^\circ$

$\Rightarrow \frac{\tan 20^\circ + \tan 40^\circ}{1 - \tan 20^\circ \cdot \tan 40^\circ} = \sqrt{3}$

$\Rightarrow \tan 20^\circ + \tan 40^\circ + \sqrt{3}\tan 20^\circ \cdot \tan 40^\circ = \sqrt{3}$ (s) (19)

b) $75^\circ - 30^\circ = 45^\circ$

$\tan(75^\circ - 30^\circ) = \tan 45^\circ$

$\Rightarrow \tan 75^\circ - \tan 30 - \tan 75^\circ \cdot \tan 30^\circ = 1$ (p)

c) $\dfrac{\cos 13^\circ - \sin 13^\circ}{\cos 13^\circ + \sin 13^\circ} + \dfrac{1}{\cot 45^\circ}$

$= \dfrac{1 - \tan 13^\circ}{1 + \tan 13^\circ} + \tan 45^\circ$

$= \dfrac{\tan 45^\circ - \tan 13^\circ}{1 + \tan 45^\circ \cdot \tan 13^\circ} + \tan(180^\circ - 32^\circ)$

$= \tan(45^\circ - 13^\circ) - \tan 32^\circ$

$= \tan 32^\circ - \tan 32^\circ = 0$ (r)

d) $\dfrac{\tan\alpha + \tan\beta}{\tan(\alpha+\beta)} + \dfrac{\tan\alpha - \tan\beta}{\tan(\alpha-\beta)}$

$= \dfrac{\tan\alpha + \tan\beta}{\left(\dfrac{\tan\alpha + \tan\beta}{1 - \tan\alpha \cdot \tan\beta}\right)} + \dfrac{\tan\alpha - \tan\beta}{\left(\dfrac{\tan\alpha - \tan\beta}{1 + \tan\alpha \tan\beta}\right)}$

$= 1 - \tan\alpha \cdot \tan\beta + 1 + \tan\alpha \cdot \tan\beta$

$= 2$ (t)

Ans: s, p, r, t

ADDITIONAL PRACTICE QUESTIONS

(20)

01 $\operatorname{cosec} 15^\circ - \sec 15^\circ$

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

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

$= \sqrt{2}(\sqrt{3}+1-\sqrt{3}+1) = 2\sqrt{2}$ Ans. A

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02 $4x + 5x = 9x$

$\Rightarrow \tan(4x+5x) = \tan 9x$

$\Rightarrow \frac{\tan 4x + \tan 5x}{1 - \tan 4x \cdot \tan 5x} = \tan 9x$

$= \tan 4x + \tan 5x - \tan 9x = -\tan 4x \cdot \tan 5x \cdot \tan 9x$

$\therefore k = -1$ Ans. B

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03 $\tan\left(\frac{\pi}{4}+\theta\right) * \tan\left(\frac{3\pi}{4}+\theta\right)$

at $\theta = 0^\circ$

$= \tan\frac{\pi}{4} * \tan\frac{3\pi}{4} = 1 * -1 = -1$ Ans. B

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04 $\cos\alpha + \cos\beta = 0 \Rightarrow \cos^2\alpha + \cos^2\beta + 2\cos\alpha\cos\beta = 0 \rightarrow (1)$

$\sin\alpha + \sin\beta = 0 \Rightarrow \sin^2\alpha + \sin^2\beta + 2\sin\alpha\sin\beta = 0 \rightarrow (2)$

$(1) + (2) \Rightarrow 1 + 1 + 2\cos(\alpha-\beta) = 0$

$\Rightarrow \cos(\alpha-\beta) = -1$ Ans. C

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05 $\dfrac{\cos A\cdot\cos B+\sin A\sin B}{\cos A\cos B-\sin A\sin B}+\dfrac{\cos C\cos D-\sin C\sin D}{\cos C\cos D+\sin C\sin D}=0$ (24)

$=\dfrac{1+\tan A\cdot\tan B}{1-\tan A\cdot\tan B}+\dfrac{1-\tan C\cdot\tan D}{1+\tan C\cdot\tan D}=0$

$=1+\tan C\tan D+\tan A\tan B+\tan A\cdot\tan B\tan C\cdot\tan D$

$+1-\tan C\cdot\tan D-\tan A\cdot\tan B+\tan A\cdot\tan B\tan C\cdot\tan D=0$

$=\tan A\cdot\tan B\cdot\tan C\cdot\tan B=1$ Ans: B

$\Rightarrow$ THE END $\Leftarrow$