

**RD Sharma**  
**Solutions**  
**Class 11 Maths**  
**Chapter 8**  
**Ex 8.2**

**Transformation Formulae Ex 8.2 Q1**

(i)  $\sin 12\theta + \sin 4\theta$

$$= 2 \sin \left( \frac{12\theta + 4\theta}{2} \right) \cos \left( \frac{12\theta - 4\theta}{2} \right)$$

$$= 2 \sin 8\theta \cos 4\theta$$

$$\left[ \because \sin C + \sin D = 2 \sin \frac{C+D}{2} \cos \frac{C-D}{2} \right]$$

(ii)  $\sin 5\theta - \sin \theta$

$$= 2 \cos \left( \frac{5\theta + \theta}{2} \right) \sin \left( \frac{5\theta - \theta}{2} \right)$$

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

$$\left[ \because \sin C - \sin D = 2 \sin \frac{C+D}{2} \sin \frac{C-D}{2} \right]$$

(iii)  $\cos 12\theta + \cos 8\theta$

$$= 2 \cos 10\theta \cos 2\theta$$

$$\left[ \because \cos C + \cos D = 2 \cos \frac{C+D}{2} \cos \frac{C-D}{2} \right]$$

(iv)  $\cos 12\theta - \cos 4\theta$

$$= -2 \sin \left( \frac{12\theta + 4\theta}{2} \right) \sin \left( \frac{12\theta - 4\theta}{2} \right)$$

$$= -2 \sin 8\theta \sin 4\theta$$

$$\left[ \because \cos D - \cos C = -2 \sin \frac{C+D}{2} \sin \frac{C-D}{2} \right]$$

(v)  $\sin 2\theta + \cos 4\theta$

$$= \sin 2\theta + \sin(90 - 4\theta)$$

$$= 2 \sin \frac{(2\theta + 90 - 4\theta)}{2} \cos \frac{(2\theta - 90 + 4\theta)}{2}$$

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

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**Transformation Formulae Ex 8.2 Q2**

$$\sin 38^\circ + \sin 22^\circ = \sin 82^\circ$$

$$\text{LHS} = \sin 38^\circ + \sin 22^\circ$$

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

$$\Rightarrow \sin 38^\circ + \sin 22^\circ = 2 \sin \frac{60^\circ}{2} \cos \frac{16^\circ}{2}$$

$$= 2 \sin 30^\circ \cos 8^\circ$$

$$= 2 \times \frac{1}{2} \cos 8^\circ$$

$$= \cos (90-82)^\circ$$

$$= \sin 82^\circ = \text{RHS}$$

$$[\because \cos \theta = \sin (90 - \theta)]$$

**Transformation Formulae Ex 8.2 Q2(i)**

$$\cos 100^\circ + \cos 20^\circ = \cos 40^\circ$$

$$\text{LHS} = \cos 100^\circ + \cos 20^\circ$$

$$[\because \cos C + \cos D = 2 \cos \frac{C+D}{2} \cos \frac{C-D}{2}]$$

$$\Rightarrow 2 \cos \frac{(100^\circ + 20^\circ)}{2} \cos \frac{(100^\circ - 20^\circ)}{2}$$

$$= 2 \cos 60^\circ \cos 40^\circ$$

$$= 2 \times \frac{1}{2} \cos 40^\circ$$

$$= \cos 40^\circ = \text{RHS}$$

$$[\because \cos 60^\circ = \frac{1}{2}]$$

**Transformation Formulae Ex 8.2 Q2(ii)**

$$\sin 50^\circ + \sin 10^\circ = \cos 20^\circ$$

$$\text{LHS} = \sin 50^\circ + \sin 10^\circ$$

$$[\because \sin C + \sin D = 2 \sin \frac{C+D}{2} \cos \frac{C-D}{2}]$$

$$\sin 50^\circ + \sin 10^\circ = 2 \sin \frac{60^\circ}{2} \cos 20^\circ$$

$$= 2 \sin 30^\circ \cos 20^\circ$$

$$= 2 \times \frac{1}{2} \cos 20^\circ$$

$$= \cos 20^\circ = \text{RHS}$$

$$[\because \sin 30^\circ = \frac{1}{2}]$$

**Transformation Formulae Ex 8.2 Q2(iii)**

$$\sin 30^\circ + \sin 37^\circ = \cos 7^\circ$$

$$\text{LHS} = \sin 23^\circ + \sin 37^\circ$$

$$= 2 \sin \left( \frac{23^\circ + 37^\circ}{2} \right) \cos \left( \frac{23^\circ - 37^\circ}{2} \right)$$

$$= 2 \sin (30^\circ) \cos (-7^\circ)$$

$$= 2 \times \frac{1}{2} \cos 7^\circ$$

$$= \cos 7^\circ = \text{RHS}$$

$$[\because \sin C + \sin D = 2 \sin \frac{C+D}{2} \cos \frac{C-D}{2}]$$

$$[\because \cos(-\theta) = \cos \theta, \sin 30^\circ = \frac{1}{2}]$$

**Transformation Formulae Ex 8.2 Q2(iv)**

$$\text{LHS} = \sin 105^\circ + \cos 105^\circ$$

$$= \sin 105^\circ + \cos(90^\circ + 15^\circ)$$

$$= \sin 105^\circ - \sin 15^\circ$$

$$= 2 \sin \left( \frac{105^\circ - 15^\circ}{2} \right) \cos \left( \frac{105^\circ + 15^\circ}{2} \right)$$

$$= 2 \sin 45^\circ \cos 60^\circ$$

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

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

$$= \cos 45^\circ$$

**Transformation Formulae Ex 8.2 Q2(v)**

$$\sin 40^\circ + \sin 20^\circ = \cos 10^\circ$$

$$\text{LHS} = \sin 40^\circ + \sin 20^\circ$$

$$= 2 \sin \left( \frac{40^\circ + 20^\circ}{2} \right) \cos \left( \frac{40^\circ - 20^\circ}{2} \right)$$

$$= 2 \sin 30^\circ \cos 10^\circ$$

$$= 2 \times \frac{1}{2} \cos 10^\circ$$

$$[\because \sin C + \sin D = 2 \sin \frac{C+D}{2} \cos \frac{C-D}{2}]$$

$$\begin{aligned}
 &= \cos 10^\circ \\
 &= \text{RHS} \qquad \left[ \because \sin 30^\circ = \frac{1}{2} \right]
 \end{aligned}$$

### Transformation Formulae Ex 8.2 Q3(i)

$$\cos 55^\circ + \cos 65^\circ + \cos 175^\circ = 0$$

$$\cos 175^\circ = -\cos 5^\circ$$

substitute above value in the equation we get

$$\cos 55^\circ + \cos 65^\circ = \cos 5^\circ$$

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

$$\cos 55^\circ + \cos 65^\circ = 2 \cos \left( \frac{65+55}{2} \right) \cos \left( \frac{65-55}{2} \right) = 2 \cos 60^\circ \cos 5^\circ = 2 \times \frac{1}{2} \times \cos 5^\circ = \cos 5^\circ$$

Hence Proved

### Transformation Formulae Ex 8.2 Q3(ii)

$$\sin 50^\circ - \sin 70^\circ + \sin 10^\circ = 0$$

$$(\sin 50^\circ - \sin 70^\circ) + \sin 10^\circ$$

$$\Rightarrow \left( 2 \sin \left( \frac{50^\circ - 70^\circ}{2} \right) \cos \left( \frac{50^\circ + 70^\circ}{2} \right) \right) + \sin 10^\circ \qquad \left[ \because \sin C - \sin D = 2 \sin \left( \frac{C-D}{2} \right) \cos \left( \frac{C+D}{2} \right) \right]$$

$$= 2 \sin(-10^\circ) \cos 60^\circ + \sin 10^\circ$$

$$= -2 \sin 10^\circ \times \frac{1}{2} + \sin 10^\circ \qquad \left[ \because \cos 60^\circ = \frac{1}{2} \right]$$

$$= 0$$

$$= \text{RHS}$$

### Transformation Formulae Ex 8.2 Q3(iii)

$$\cos 80^\circ + \cos 40^\circ - \cos 20^\circ = 0$$

$$(\cos 80^\circ + \cos 40^\circ) - \cos 20^\circ$$

$$= 2 \cos \left( \frac{80^\circ + 40^\circ}{2} \right) \cos \left( \frac{80^\circ - 40^\circ}{2} \right) - \cos 20^\circ \qquad \left[ \because \cos C + \cos D = 2 \cos \left( \frac{C+D}{2} \right) \cos \left( \frac{C-D}{2} \right) \right]$$

$$= 2 \cos 60^\circ \cos 20^\circ - \cos 20^\circ$$

$$= 2 \times \frac{1}{2} \cos 20^\circ - \cos 20^\circ$$

$$= \cos 20^\circ - \cos 20^\circ$$

$$= 0$$

$$= \text{RHS}$$

### Transformation Formulae Ex 8.2 Q3(iv)

$$\cos 20^\circ + \cos 100^\circ + \cos 140^\circ = 0$$

$$\Rightarrow (\cos 20^\circ + \cos 100^\circ) + \cos 140^\circ$$

$$= 2 \cos \left( \frac{20^\circ + 100^\circ}{2} \right) \cos \left( \frac{20^\circ - 100^\circ}{2} \right) + \cos 140^\circ \qquad \left[ \because \cos C + \cos D = 2 \cos \left( \frac{C+D}{2} \right) \cos \left( \frac{C-D}{2} \right) \right]$$

$$= 2 \cos 60^\circ \cos(-40^\circ) + \cos 140^\circ$$

$$= 2 \times \frac{1}{2} \cos 40^\circ + \cos 140^\circ \qquad \left[ \because \cos 60^\circ = \frac{1}{2} \right]$$

$$= \cos 40^\circ + \cos(180^\circ - 40^\circ)$$

$$= \cos 40^\circ - \cos 40^\circ$$

$$= 0$$

$$= \text{RHS}$$

### Transformation Formulae Ex 8.2 Q3(v)

$$\sin \frac{5\pi}{18} - \cos \frac{4\pi}{9} = \sqrt{3} \sin \frac{\pi}{9}$$

$$\text{LHS} = \sin \frac{5\pi}{18} - \cos \frac{4\pi}{9}$$

$$= \sin 50^\circ - \cos 80^\circ$$

$$= \sin 50^\circ - \sin 10^\circ$$

$$= 2 \sin \left( \frac{50^\circ - 10^\circ}{2} \right) \cos \left( \frac{50^\circ + 10^\circ}{2} \right)$$

$$= 2 \sin 20^\circ \cos 30^\circ$$

$$= 2 \sin 20^\circ \times \frac{\sqrt{3}}{2}$$

$$= \sqrt{3} \sin \frac{\pi}{9}$$

### Transformation Formulae Ex 8.2 Q3(vi)

$$\cos \frac{\pi}{12} - \sin \frac{\pi}{12} = \frac{1}{\sqrt{2}}$$

Multiplying and dividing by  $\sqrt{2}$  on LHS

$$= \sqrt{2} \left( \frac{1}{\sqrt{2}} \cos \frac{\pi}{12} - \frac{1}{\sqrt{2}} \sin \frac{\pi}{12} \right)$$


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$$\begin{aligned}
 &= \sqrt{2} \left( \sin \frac{\pi}{4} \cos \frac{\pi}{12} - \cos \frac{\pi}{4} \sin \frac{\pi}{12} \right) \\
 &= \sqrt{2} \left( \sin \left( \frac{\pi}{4} - \frac{\pi}{12} \right) \right) \\
 &= \sqrt{2} \left( \sin \frac{\pi}{6} \right) \\
 &= \sqrt{2} \times \frac{1}{2} \\
 &= \frac{1}{\sqrt{2}} \\
 &= \text{RHS}
 \end{aligned}$$

$$\left[ \because \frac{1}{\sqrt{2}} = \cos \frac{\pi}{4} = \sin \frac{\pi}{4} \right]$$

$$\left[ \because \sin(A - B) = \sin A \cos B - \cos A \sin B \right]$$

### Transformation Formulae Ex 8.2 Q3(vii)

$$\sin 80^\circ - \cos 70^\circ = \cos 50^\circ$$

$$\text{LHS} = \sin 80^\circ = \cos 50^\circ + \cos 70^\circ$$

Now,

$$\cos C + \cos D = 2 \cos \frac{C+D}{2} \cos \frac{C-D}{2}$$

$$\text{RHS} = \cos 50^\circ + \cos 70^\circ$$

$$= 2 \cos \left( \frac{50^\circ + 70^\circ}{2} \right) \cos \left( \frac{50^\circ - 70^\circ}{2} \right)$$

$$= 2 \cos 60^\circ \cos(-10^\circ)$$

$$= 2 \times \frac{1}{2} \cos 10^\circ$$

$$[\cos(-\theta) = \cos \theta]$$

$$= \cos 10^\circ$$

$$= \sin 80^\circ$$

$$= \text{LHS}$$

$$[\because \cos \theta = \sin(90 - \theta)]$$

### Transformation Formulae Ex 8.2 Q3(viii)

$$\sin 51^\circ + \cos 81^\circ = \cos 21^\circ$$

$$\sin 51^\circ = \cos 21^\circ - \cos 81^\circ$$

$$\text{RHS} = \cos 21^\circ - \cos 81^\circ$$

$$= -2 \sin(51^\circ) \sin(-30^\circ)$$

$$\left[ \because \cos C - \cos D = -2 \sin \frac{C+D}{2} \sin \frac{C-D}{2} \right]$$

$$= +2 \sin 51^\circ \sin 30^\circ$$

$$= 2 \sin 51^\circ \times \frac{1}{2}$$

$$= \sin 51^\circ$$

$$= \text{LHS}$$

### Transformation Formulae Ex 8.2 Q4

We have,

$$\text{LHS} = \cos \left( \frac{3\pi}{4} + x \right) - \cos \left( \frac{3\pi}{4} - x \right)$$

$$= - \left[ \cos \left( \frac{3\pi}{4} - x \right) - \cos \left( \frac{3\pi}{4} + x \right) \right]$$

$$= - \left[ 2 \sin \frac{3\pi}{4} \sin x \right]$$

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

$$= -2 \sin \frac{3\pi}{4} \sin x$$

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

$$= -2 \cos \frac{\pi}{4} \sin x$$

$$= -2 \times \frac{1}{\sqrt{2}} \times \sin x$$

$$= - \frac{\sqrt{2} \times \sqrt{2}}{\sqrt{2}} \sin x$$

$$= -\sqrt{2} \sin x$$

$$= \text{RHS}$$

$$\therefore \cos \left( \frac{3\pi}{4} + x \right) - \cos \left( \frac{3\pi}{4} - x \right) = -\sqrt{2} \sin x \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q4(i)

We have,

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

$$= 2 \cos \frac{\pi}{4} \cos x$$

$$[\because \cos(A + B) + \cos(A - B) = 2 \cos A \cos B]$$

$$= 2 \times \frac{1}{\sqrt{2}} \times \cos x$$

$$= \frac{\sqrt{2} \times \sqrt{2}}{\sqrt{2}} \cos x$$

$$\begin{aligned}
 &= \sqrt{2} \cos x \\
 &= \text{RHS}
 \end{aligned}$$

$$\therefore \cos\left(\frac{\pi}{4} + x\right) + \cos\left(\frac{\pi}{4} - x\right) = \sqrt{2} \cos x.$$

### Transformation Formulae Ex 8.2 Q5(i)

We have,

$$\begin{aligned}
 \text{LHS} &= \sin 65^\circ + \cos 65^\circ \\
 &= \sin(45^\circ + 20^\circ) + \cos(90^\circ - 25^\circ) \\
 &= \sin(45^\circ + 20^\circ) + \sin 25^\circ \\
 &= \sin(45^\circ + 20^\circ) + \sin(45^\circ - 20^\circ) \\
 &= 2 \sin 45^\circ \cos 20^\circ \\
 &= 2 \times \frac{1}{\sqrt{2}} \cos 20^\circ \\
 &= \frac{\sqrt{2} \times \sqrt{2}}{\sqrt{2}} \times \cos 20^\circ \\
 &= \sqrt{2} \cos 20^\circ \\
 &= \text{RHS}
 \end{aligned}$$

$$\therefore \sin 65^\circ + \cos 65^\circ = \sqrt{2} \cos 20^\circ \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q5(ii)

We have,

$$\begin{aligned}
 \text{LHS} &= \sin 47^\circ + \cos 77^\circ \\
 &= \sin(90^\circ - 43^\circ) + \cos 77^\circ \\
 &= \cos 43^\circ + \cos 77^\circ \\
 &= \cos(60^\circ - 17^\circ) + \cos(60^\circ + 17^\circ) \\
 &= 2 \cos 60^\circ \cos 17^\circ \\
 &= 2 \times \frac{1}{2} \times \cos 17^\circ \\
 &= \cos 17^\circ \\
 &= \text{RHS}
 \end{aligned}$$

$$\therefore \sin 47^\circ + \cos 77^\circ = \cos 17^\circ \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 6(i)

We have,

$$\begin{aligned}
 \text{LHS} &= \cos 3A + \cos 5A + \cos 7A + \cos 15A \\
 &= [\cos 5A + \cos 3A] + [\cos 15A + \cos 7A] \\
 &= \left[ 2 \cos \frac{(5A + 3A)}{2} \cos \frac{(5A - 3A)}{2} \right] + \left[ 2 \cos \frac{(15A + 7A)}{2} \cos \frac{(15A - 7A)}{2} \right] \\
 &= 2 \cos 4A \cos A + 2 \cos 11A \cos 4A \\
 &= 2 \cos 4A [\cos A + \cos 11A] \\
 &= 2 \cos 4A [\cos 11A + \cos A] \\
 &= 2 \cos 4A \left[ 2 \cos \frac{(11A + A)}{2} \cos \frac{(11A - A)}{2} \right] \\
 &= 4 \cos A [\cos 6A \cos 5A] \\
 &= 4 \cos 4A \cos 5A \cos 6A \\
 &= \text{RHS}
 \end{aligned}$$

$$\therefore \cos 3A + \cos 5A + \cos 7A + \cos 15A = 4 \cos 4A \cos 5A \cos 6A \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 6(ii)

We have,

$$\begin{aligned}
 \text{LHS} &= \cos A + \cos 3A + \cos 5A + \cos 7A \\
 &= (\cos 3A + \cos A) + (\cos 7A + \cos 5A) \\
 &= \left[ 2 \cos \left( \frac{3A + A}{2} \right) \cos \left( \frac{3A - A}{2} \right) \right] + \left[ 2 \cos \left( \frac{7A + 5A}{2} \right) \cos \left( \frac{7A - 5A}{2} \right) \right] \\
 &= 2 \cos 2A \cos A + 2 \cos 6A \cos A \\
 &= 2 \cos A [\cos 2A + \cos 6A] \\
 &= 2 \cos A [\cos 6A + \cos 2A] \\
 &= 2 \cos A \left[ 2 \cos \left( \frac{6A + 2A}{2} \right) \cos \left( \frac{6A - 2A}{2} \right) \right] \\
 &= 4 \cos A [\cos 4A \cos 2A] \\
 &= \text{RHS}
 \end{aligned}$$

$$\therefore \cos A + \cos 3A + \cos 5A + \cos 7A = 4 \cos A \cos 2A \cos 4A. \quad \text{Hence proved.}$$

**Transformation Formulae Ex 8.2 Q 6(iii)**

We have,

$$\begin{aligned}
\text{LHS} &= \sin A + \sin 2A + \sin 4A + \sin 5A \\
&= (\sin 2A + \sin A) + (\sin 5A + \sin 4A) \\
&= \left[ 2 \sin \left( \frac{2A+A}{2} \right) \cos \left( \frac{2A-A}{2} \right) \right] + \left[ 2 \sin \left( \frac{5A+4A}{2} \right) \cos \left( \frac{5A-4A}{2} \right) \right] \\
&= 2 \sin \frac{3A}{2} \cos \frac{A}{2} + 2 \sin \frac{9A}{2} \cos \frac{A}{2} \\
&= 2 \cos \frac{A}{2} \left[ \sin \frac{3A}{2} + \sin \frac{9A}{2} \right] \\
&= 2 \cos \frac{A}{2} \left[ \sin \frac{9A}{2} + \sin \frac{3A}{2} \right] \\
&= 2 \cos \frac{A}{2} \left[ 2 \sin \left\{ \frac{1}{2} \left( \frac{9A}{2} + \frac{3A}{2} \right) \right\} \cos \left\{ \frac{1}{2} \left( \frac{9A}{2} - \frac{3A}{2} \right) \right\} \right] \\
&= 4 \cos \frac{A}{2} \left[ \sin \frac{12A}{4} \cos \frac{6A}{4} \right] \\
&= 4 \cos \frac{A}{2} \sin 3A \cos \frac{3A}{2} \\
&= 4 \cos \frac{A}{2} \cos \frac{3A}{2} \sin 3A \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \sin A + \sin 2A + \sin 4A + \sin 5A = 4 \cos \frac{A}{2} \cos \frac{3A}{2} \sin 3A. \quad \text{Hence proved.}$$

**Transformation Formulae Ex 8.2 Q 6(iv)**

We have,

$$\begin{aligned}
\text{LHS} &= \sin 3A + \sin 2A - \sin A \\
&= \sin 3A - \sin A + \sin 2A \\
&= 2 \sin \left( \frac{3A-A}{2} \right) \cos \left( \frac{3A+A}{2} \right) + \sin 2A \\
&= 2 \sin A \cos 2A + \sin 2A \\
&= 2 \sin A \cos 2A + 2 \sin A \cos A \\
&= 2 \sin A [\cos 2A + \cos A] \\
&= 2 \sin A \left[ 2 \cos \left( \frac{2A+A}{2} \right) \cos \left( \frac{2A-A}{2} \right) \right] \\
&= 4 \sin A \cos \frac{3A}{2} \cos \frac{A}{2} \\
&= 4 \sin A \cos \frac{A}{2} \cos \frac{3A}{2} \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \sin 3A + \sin 2A - \sin A = 4 \sin A \cos \frac{A}{2} \cos \frac{3A}{2}. \quad \text{Hence proved.}$$

**Transformation Formulae Ex 8.2 Q 6(v)**

We have,

$$\begin{aligned}
\text{LHS} &= \cos 20^\circ \cos 100^\circ + \cos 100^\circ \cos 140^\circ - \cos 140^\circ \cos 200^\circ \\
&= \frac{1}{2} [2 \cos 100^\circ \cos 20^\circ + 2 \cos 140^\circ \cos 100^\circ - 2 \cos 200^\circ \cos 140^\circ] \\
&= \frac{1}{2} \left[ \cos (100^\circ + 20^\circ) + \cos (100^\circ - 20^\circ) + \cos (140^\circ + 100^\circ) + \cos (140^\circ - 100^\circ) \right. \\
&\quad \left. - \{ \cos (200^\circ + 140^\circ) + \cos (200^\circ - 140^\circ) \} \right] \\
&= \frac{1}{2} [\cos 120^\circ + \cos 80^\circ + \cos 240^\circ + \cos 40^\circ - \cos 340^\circ - \cos 60^\circ] \\
&= \frac{1}{2} [\cos (90^\circ + 30^\circ) + \cos 80^\circ + \cos 40^\circ - \cos (180^\circ + 60^\circ) - \cos (360^\circ - 20^\circ) - \frac{1}{2}] \\
&= \frac{1}{2} \left[ -\sin 30^\circ + 2 \cos \left( \frac{80^\circ + 40^\circ}{2} \right) \cos \left( \frac{80^\circ - 40^\circ}{2} \right) - \cos 60^\circ - \cos 20^\circ - \frac{1}{2} \right] \\
&= \frac{1}{2} \left[ -\frac{1}{2} + 2 \cos 60^\circ \cos 20^\circ - \frac{1}{2} - \cos 20^\circ - \frac{1}{2} \right] \\
&= \frac{1}{2} \left[ -\frac{3}{2} + 2 \times \frac{1}{2} \times \cos 20^\circ - \cos 20^\circ \right] \\
&= \frac{1}{2} \left[ -\frac{3}{2} + \cos 20^\circ - \cos 20^\circ \right] \\
&= \frac{1}{2} \left[ -\frac{3}{2} + 0 \right] \\
&= -\frac{3}{4} \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \cos 20^\circ \cos 100^\circ + \cos 100^\circ \cos 140^\circ - \cos 140^\circ \cos 200^\circ = -\frac{3}{4}. \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 6(vi)

We have,

$$\begin{aligned} \text{LHS} &= \sin \frac{\theta}{2} \sin \frac{7\theta}{2} + \sin \frac{3\theta}{2} \sin \frac{11\theta}{2} \\ &= \frac{1}{2} \left[ 2 \sin \frac{7\theta}{2} \sin \frac{\theta}{2} + 2 \sin \frac{11\theta}{2} \sin \frac{3\theta}{2} \right] \\ &= \frac{1}{2} \left[ \cos \left( \frac{7\theta}{2} - \frac{\theta}{2} \right) - \cos \left( \frac{7\theta}{2} + \frac{\theta}{2} \right) + \cos \left( \frac{11\theta}{2} - \frac{3\theta}{2} \right) - \cos \left( \frac{11\theta}{2} + \frac{3\theta}{2} \right) \right] \\ &= \frac{1}{2} \left[ \cos \frac{6\theta}{2} - \cos \frac{8\theta}{2} + \cos \frac{8\theta}{2} - \cos \frac{14\theta}{2} \right] \\ &= \frac{1}{2} [\cos 3\theta - \cos 4\theta + \cos 4\theta - \cos 7\theta] \\ &= \frac{1}{2} [\cos 3\theta - \cos 7\theta] \\ &= \frac{-1}{2} [\cos 7\theta - \cos 3\theta] \\ &= \frac{-1}{2} \left[ -2 \sin \left( \frac{7\theta + 3\theta}{2} \right) \sin \left( \frac{7\theta - 3\theta}{2} \right) \right] \\ &= \sin \frac{10\theta}{2} \sin \frac{4\theta}{2} \\ &= \sin 5\theta \sin 2\theta \\ &= \sin 2\theta \sin 5\theta \\ &= \text{RHS} \end{aligned}$$

$$\therefore \sin \frac{\theta}{2} \sin \frac{7\theta}{2} + \sin \frac{3\theta}{2} \sin \frac{11\theta}{2} = \sin 2\theta \sin 5\theta. \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 7(i)

We have,

$$\begin{aligned} \text{LHS} &= \frac{\sin A + \sin 3A}{\cos A - \cos 3A} \\ &= \frac{2 \sin \left( \frac{A+3A}{2} \right) \cos \left( \frac{A-3A}{2} \right)}{-2 \sin \left( \frac{A+3A}{2} \right) \sin \left( \frac{A-3A}{2} \right)} \\ &= \frac{-\sin 2A \times \cos(-A)}{\sin 2A \sin(-A)} \\ &= \frac{-\cos(-A)}{\sin(-A)} \\ &= \frac{-\cos A}{-\sin A} && [\because \cos(-\theta) = \cos \theta \text{ and } \sin(-\theta) = -\sin \theta] \\ &= \frac{\cos A}{\sin A} \\ &= \cot A \\ &= \text{RHS} \end{aligned}$$

$$\therefore \frac{\sin A + \sin 3A}{\cos A - \cos 3A} = \cot A. \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 7(ii)

We have,

$$\begin{aligned} \text{LHS} &= \frac{\sin 9A - \sin 7A}{\cos 7A - \cos 9A} \\ &= \frac{2 \sin \left( \frac{9A-7A}{2} \right) \cos \left( \frac{9A+7A}{2} \right)}{-2 \sin \left( \frac{7A+9A}{2} \right) \sin \left( \frac{7A-9A}{2} \right)} \\ &= \frac{-\sin A \cos 8A}{\sin 8A \sin(-A)} \\ &= \frac{-\sin A \cos 8A}{-\sin A \times \sin 8A} && [\because \sin(-\theta) = -\sin \theta] \\ &= \frac{\cos 8A}{\sin 8A} \\ &= \cot 8A \\ &= \text{RHS} \end{aligned}$$

$$\therefore \frac{\sin 9A - \sin 7A}{\cos 7A - \cos 9A} = \cot 8A. \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 7(iii)



We have,

$$\begin{aligned} \text{LHS} &= \frac{\sin A - \sin B}{\cos A + \cos B} \\ &= \frac{2 \cos \left( \frac{A+B}{2} \right) \sin \left( \frac{A-B}{2} \right)}{2 \cos \left( \frac{A+B}{2} \right) \cos \left( \frac{A-B}{2} \right)} \\ &= \frac{\sin \left( \frac{A-B}{2} \right)}{\cos \left( \frac{A-B}{2} \right)} \\ &= \tan \left( \frac{A-B}{2} \right) \\ &= \text{RHS} \end{aligned}$$

$$\therefore \frac{\sin A - \sin B}{\cos A + \cos B} = \tan \left( \frac{A-B}{2} \right). \quad \text{Hence proved.}$$

#### Transformation Formulae Ex 8.2 Q7(iv)

We have,

$$\begin{aligned} \text{LHS} &= \frac{\sin A + \sin B}{\sin A - \sin B} \\ &= \frac{2 \sin \left( \frac{A+B}{2} \right) \cos \left( \frac{A-B}{2} \right)}{2 \sin \left( \frac{A-B}{2} \right) \cos \left( \frac{A+B}{2} \right)} \\ &= \frac{\sin \left( \frac{A+B}{2} \right) \cos \left( \frac{A-B}{2} \right)}{\cos \left( \frac{A+B}{2} \right) \sin \left( \frac{A-B}{2} \right)} \\ &= \tan \left( \frac{A+B}{2} \right) \cot \left( \frac{A-B}{2} \right) \\ &= \text{RHS} \end{aligned}$$

$$\therefore \frac{\sin A + \sin B}{\sin A - \sin B} = \tan \left( \frac{A+B}{2} \right) \cot \left( \frac{A-B}{2} \right). \quad \text{Hence proved.}$$

#### Transformation Formulae Ex 8.2 Q 7(v)

We have,

$$\begin{aligned} \text{LHS} &= \frac{\cos A + \cos B}{\cos B - \cos A} \\ &= \frac{2 \cos \left( \frac{A+B}{2} \right) \cos \left( \frac{A-B}{2} \right)}{-2 \sin \left( \frac{B+A}{2} \right) \sin \left( \frac{B-A}{2} \right)} \\ &= \frac{-\cos \left( \frac{A+B}{2} \right) \cos \left( \frac{A-B}{2} \right)}{\sin \left( \frac{A+B}{2} \right) \sin \left( \frac{B-A}{2} \right)} \\ &= \frac{-\cos \left( \frac{A+B}{2} \right) \cos \left( \frac{A-B}{2} \right)}{-\sin \left( \frac{A+B}{2} \right) \sin \left( \frac{A-B}{2} \right)} \\ &= \cot \left( \frac{A+B}{2} \right) \cot \left( \frac{A-B}{2} \right) \\ &= \text{RHS} \end{aligned}$$

$$[\because \sin(-\theta) = -\sin\theta]$$

$$\therefore \frac{\cos A + \cos B}{\cos B - \cos A} = \cot \left( \frac{A+B}{2} \right) \cot \left( \frac{A-B}{2} \right). \quad \text{Hence proved.}$$

#### Transformation Formulae Ex 8.2 Q 8(i)

We have,

$$\begin{aligned} \text{LHS} &= \frac{\sin A + \sin 3A + \sin 5A}{\cos A + \cos 3A + \cos 5A} \\ &= \frac{(\sin 5A + \sin A) + \sin 3A}{(\cos 5A + \cos A) + \cos 3A} \\ &= \frac{2 \sin \left( \frac{5A+A}{2} \right) \cos \left( \frac{5A-A}{2} \right) + \sin 3A}{2 \cos \left( \frac{5A+A}{2} \right) \cos \left( \frac{5A-A}{2} \right) + \cos 3A} \\ &= \frac{2 \sin 3A \cos 2A + \sin 3A}{2 \cos 3A \cos 2A + \sin 3A} \end{aligned}$$


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$$\begin{aligned}
&= \frac{2 \cos 3A \cos 2A + \cos 3A}{\sin 3A (2 \cos 2A + 1)} \\
&= \frac{\cos 3A (2 \cos 2A + 1)}{\cos 3A (2 \cos 2A + 1)} \\
&= \frac{\sin 3A}{\cos 3A} \\
&= \tan 3A \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \frac{\sin A + \sin 3A + \sin 5A}{\cos A + \cos 3A + \cos 5A} = \tan 3A \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 8(ii)

We have,

$$\begin{aligned}
\text{LHS} &= \frac{\cos 3A + 2 \cos 5A + \cos 7A}{\cos A + 2 \cos 3A + \cos 5A} \\
&= \frac{(\cos 7A + \cos 3A) + 2 \cos 5A}{(\cos 5A + \cos A) + 2 \cos 3A} \\
&= \frac{2 \cos \left( \frac{7A + 3A}{2} \right) \cos \left( \frac{7A - 3A}{2} \right) + 2 \cos 5A}{2 \cos \left( \frac{5A + A}{2} \right) \cos \left( \frac{5A - A}{2} \right) + \cos 3A} \\
&= \frac{2 \cos 5A \cos 2A + 2 \cos 5A}{2 \cos 3A \cos 2A + 2 \cos 3A} \\
&= \frac{2 \cos 5A (\cos 2A + 1)}{2 \cos 3A (\cos 2A + 1)} \\
&= \frac{\cos 5A}{\cos 3A} \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \frac{\cos 3A + 2 \cos 5A + \cos 7A}{\cos A + 2 \cos 3A + \cos 5A} = \frac{\cos 5A}{\cos 3A} \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 8(iii)

We have,

$$\begin{aligned}
\text{LHS} &= \frac{\cos 4A + \cos 3A + \cos 2A}{\sin 4A + \sin 3A + \sin 2A} \\
&= \frac{(\cos 4A + \cos 2A) + \cos 3A}{(\sin 4A + \sin 2A) + \sin 3A} \\
&= \frac{2 \cos \left( \frac{4A + 2A}{2} \right) \cos \left( \frac{4A - 2A}{2} \right) + \cos 3A}{2 \sin \left( \frac{4A + 2A}{2} \right) \cos \left( \frac{4A - 2A}{2} \right) + \sin 3A} \\
&= \frac{2 \cos 3A \cos A + \cos 3A}{2 \sin 3A \cos A + \sin 3A} \\
&= \frac{\cos 3A (2 \cos A + 1)}{\sin 3A (2 \cos A + 1)} \\
&= \frac{\cos 3A}{\sin A} \\
&= \cot 3A \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \frac{\cos 4A + \cos 3A + \cos 2A}{\sin 4A + \sin 3A + \sin 2A} = \cot 3A \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 8(iv)

We have,

$$\begin{aligned}
\text{LHS} &= \frac{\sin 3A + \sin 5A + \sin 7A + \sin 9A}{\cos 3A + \cos 5A + \cos 7A + \cos 9A} \\
&= \frac{(\sin 9A + \sin 3A) + (\sin 7A + \sin 5A)}{(\cos 9A + \cos 3A) + (\cos 7A + \cos 5A)} \\
&= \frac{2 \sin \left( \frac{9A + 3A}{2} \right) \cos \left( \frac{9A - 3A}{2} \right) + 2 \sin \left( \frac{7A + 5A}{2} \right) \cos \left( \frac{7A - 5A}{2} \right)}{2 \cos \left( \frac{9A + 3A}{2} \right) \cos \left( \frac{9A - 3A}{2} \right) + 2 \cos \left( \frac{7A + 5A}{2} \right) \cos \left( \frac{7A - 5A}{2} \right)} \\
&= \frac{2 \sin 6A \cos 3A + 2 \sin 6A \cos A}{2 \cos 6A \cos 3A + 2 \cos 6A \cos A} \\
&= \frac{2 \sin 6A (\cos 3A + \cos A)}{2 \cos 6A (\cos 3A + \cos A)} \\
&= \frac{\sin 6A}{\cos 6A} \\
&= \tan 6A \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \frac{\sin 3A + \sin 5A + \sin 7A + \sin 9A}{\cos 3A + \cos 5A + \cos 7A + \cos 9A} = \tan 6A$$

Hence proved.

### Transformation Formulae Ex 8.2 Q 8(v)

We have,

$$\begin{aligned} \text{LHS} &= \frac{\sin 5A - \sin 7A + \sin 8A - \sin 4A}{\cos 4A + \cos 7A - \cos 5A - \cos 8A} \\ &= \frac{-(\sin 7A - \sin 5A) + (\sin 8A - \sin 4A)}{-(\cos 7A - \cos 5A) - (\cos 8A - \cos 4A)} \\ &= \frac{-\left[2 \sin \left(\frac{7A-5A}{2}\right) \cos \left(\frac{7A+5A}{2}\right)\right] + \left[2 \sin \left(\frac{8A-4A}{2}\right) \cos \left(\frac{8A+4A}{2}\right)\right]}{-2 \sin \left(\frac{7A+5A}{2}\right) \sin \left(\frac{7A-5A}{2}\right) - \left[-2 \sin \left(\frac{8A+4A}{2}\right) \sin \left(\frac{8A-4A}{2}\right)\right]} \\ &= \frac{-2 \sin A \cos 6A + 2 \sin 2A \cos 6A}{-2 \sin 6A \sin A + 2 \sin 6A \sin 2A} \\ &= \frac{2 \cos 6A [-\sin A + \sin 2A]}{2 \sin 6A [-\sin A + \sin 2A]} \\ &= \frac{\cos 6A}{\sin 6A} \\ &= \cot 6A \\ &= \text{RHS} \end{aligned}$$

$$\therefore \frac{\sin 5A - \sin 7A + \sin 8A - \sin 4A}{\cos 4A + \cos 7A - \cos 5A - \cos 8A} = \cot 6A$$

Hence proved.

### Transformation Formulae Ex 8.2 Q 8(vi)

We have,

$$\begin{aligned} \text{LHS} &= \frac{\sin 5A \cos 2A - \sin 6A \cos A}{\sin A \sin 2A - \cos 2A \cos 3A} \\ &= \frac{2(\sin 5A \cos 2A - \sin 6A \cos A)}{2(\sin A \sin 2A - \cos 2A \cos 3A)} \\ &= \frac{2 \sin 5A \cos 2A - 2 \sin 6A \cos A}{2 \sin A \sin 2A - 2 \cos 2A \cos 3A} \\ &= \frac{\sin(5A+2A) + \sin(5A-2A) - [\sin(6A+A) + \sin(6A-A)]}{\cos(2A-A) - \cos(2A+A) - [\cos(3A+2A) + \cos(3A-2A)]} \\ &= \frac{\sin 7A + \sin 3A - \sin 7A - \sin 5A}{\cos A - \cos 3A - \cos 5A - \cos A} \\ &= \frac{\sin 3A - \sin 5A}{-\cos 3A - \cos 5A} \\ &= \frac{-(\sin 5A - \sin 3A)}{-(\cos 5A + \cos 3A)} \\ &= \frac{\sin 5A - \sin 3A}{\cos 5A + \cos 3A} \\ &= \frac{2 \sin \left(\frac{5A-3A}{2}\right) \cos \left(\frac{5A+3A}{2}\right)}{2 \cos \left(\frac{5A+3A}{2}\right) \cos \left(\frac{5A-3A}{2}\right)} \\ &= \frac{\sin A \cos 4A}{\cos 4A \cos A} \\ &= \frac{\sin A}{\cos A} \\ &= \tan A \\ &= \text{RHS} \end{aligned}$$

$$\therefore \frac{\sin 5A \cos 2A - \sin 6A \cos A}{\sin A \sin 2A - \cos 2A \cos 3A} = \tan A$$

Hence proved.

### Transformation Formulae Ex 8.2 Q 8(vii)

We have,

$$\begin{aligned} \text{LHS} &= \frac{\sin 11A \sin A + \sin 7A \sin 3A}{\cos 11A \sin A + \cos 7A \sin 3A} \\ &= \frac{2(\sin 11A \sin A + \sin 7A \sin 3A)}{2(\cos 11A \sin A + \cos 7A \sin 3A)} \\ &= \frac{2 \sin 11A \sin A + 2 \sin 7A \sin 3A}{2 \cos 11A \sin A + 2 \cos 7A \sin 3A} \\ &= \frac{\cos(11A-A) - \cos(11A+A) + \cos(7A-3A) - \cos(7A+3A)}{\sin(11A+A) - \sin(11A-A) + \sin(7A+3A) - \sin(7A-3A)} \\ &= \frac{\cos 10A - \cos 12A + \cos 4A - \cos 10A}{\sin 12A - \sin 10A + \sin 10A - \sin 4A} \\ &= \frac{-(\cos 12A - \cos 4A)}{\sin 12A - \sin 4A} \\ &= \frac{-(\cos 12A - \cos 4A)}{[ \dots ]} \end{aligned}$$

$$\begin{aligned}
&= \frac{-\left[-2 \sin\left(\frac{12A-4A}{2}\right) \sin\left(\frac{12A+4A}{2}\right)\right]}{2 \sin\left(\frac{12A-4A}{2}\right) \cos\left(\frac{12A+4A}{2}\right)} \\
&= \frac{2 \sin 8A \sin 4A}{2 \sin 4A \cos 8A} \\
&= \frac{\sin 8A}{\cos 8A} \\
&= \tan 8A \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \frac{\sin 11A \sin A + \sin 7A \sin 3A}{\cos 11A \sin A + \cos 7A \sin 3A} = \tan 8A$$

Hence proved.

### Transformation Formulae Ex 8.2 Q 8(viii)

$$\begin{aligned}
\text{LHS} &= \frac{\sin 3A \cos 4A - \sin A \cos 2A}{\sin 4A \sin A + \cos 6A \cos A} \\
&= \frac{2(\sin 3A \cos 4A - \sin A \cos 2A)}{2(\sin 4A \sin A + \cos 6A \cos A)} \\
&= \frac{2 \sin 3A \cos 4A - 2 \sin A \cos 2A}{2 \sin 4A \sin A + 2 \cos 6A \cos A} \\
&= \frac{\sin(4A+3A) - \sin(4A-3A) - [\sin(2A+A) - \sin(2A-A)]}{\cos(4A-A) - \cos(4A+A) + \cos(6A+A) + \cos(6A-A)} \\
&= \frac{\sin(7A) - \sin(A) - \sin(3A) + \sin(A)}{\cos(3A) - \cos(5A) + \cos(7A) + \cos(5A)} \\
&= \frac{\sin(7A) - \sin(3A)}{\cos(3A) + \cos(7A)} \\
&= \frac{2 \sin\left(\frac{7A-3A}{2}\right) \cos\left(\frac{7A+3A}{2}\right)}{2 \cos\left(\frac{7A+3A}{2}\right) \cos\left(\frac{7A-3A}{2}\right)} \\
&= \frac{\sin 2A}{\cos 2A} \\
&= \tan 2A \\
&= \text{RHS}
\end{aligned}$$

### Transformation Formulae Ex 8.2 Q 8(ix)

We have,

$$\begin{aligned}
\text{LHS} &= \frac{\sin A \sin 2A + \sin 3A \sin 6A}{\sin A \cos 2A + \sin 3A \cos 6A} \\
&= \frac{2[\sin A \sin 2A + \sin 3A \sin 6A]}{2[\sin A \cos 2A + \sin 3A \cos 6A]} \\
&= \frac{2 \sin 2A \sin A + 2 \sin 6A \sin 3A}{2 \cos 2A \sin A + 2 \cos 6A \sin 3A} \\
&= \frac{\cos(2A-A) - \cos(2A+A) + \cos(6A-3A) - \cos(6A+3A)}{\sin(2A+A) - \sin(2A-A) + \sin(6A+3A) - \sin(6A-3A)} \\
&= \frac{\cos A - \cos 3A + \cos 3A - \cos 9A}{\sin 3A - \sin A + \sin 9A - \sin 3A} \\
&= \frac{\cos A - \cos 9A}{\sin 9A - \sin A} \\
&= \frac{-[\cos 9A - \cos A]}{\sin 9A - \sin A} \\
&= \frac{-\left(-2 \sin\left(\frac{9A+A}{2}\right) \times \sin\left(\frac{9A-A}{2}\right)\right)}{2 \sin\left(\frac{9A-A}{2}\right) \times \cos\left(\frac{9A+A}{2}\right)} \\
&= \frac{\sin 5A \sin 4A}{\sin 4A \cos 5A} \\
&= \tan 5A \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \frac{\sin A \sin 2A + \sin 3A \sin 6A}{\sin A \cos 2A + \sin 3A \cos 6A} = \tan 5A$$

Hence proved.

### Transformation Formulae Ex 8.2 Q 8(x)

We have,

$$\begin{aligned}
\text{LHS} &= \frac{\sin A + 2 \sin 3A + \sin 5A}{\sin 3A + 2 \sin 5A + \sin 7A} \\
&= \frac{\sin 5A + \sin A + 2 \sin 3A}{\sin 7A + \sin 5A + 2 \sin 3A}
\end{aligned}$$


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$$\begin{aligned}
&= \frac{2 \sin \left( \frac{5A+A}{2} \right) \cos \left( \frac{5A-A}{2} \right) + 2 \sin 3A}{2 \sin \left( \frac{7A+3A}{2} \right) \cos \left( \frac{7A-3A}{2} \right) + 2 \sin 5A} \\
&= \frac{2 \sin 3A \cos 2A + 2 \sin 3A}{2 \sin 5A \cos 2A + 2 \sin 5A} \\
&= \frac{2 \sin 3A (\cos 2A + 1)}{2 \sin 5A (\cos 2A + 1)} \\
&= \frac{\sin 3A}{\sin 5A} \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \frac{\sin A + 2 \sin 3A + \sin 5A}{\sin 3A + 2 \sin 5A + \sin 7A} = \frac{\sin 3A}{\sin 5A} \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 8(xi)

We have,

$$\begin{aligned}
\text{LHS} &= \frac{\sin(\theta + \phi) - 2 \sin \theta + \sin(\theta - \phi)}{\cos(\theta + \phi) - 2 \cos \theta + \cos(\theta - \phi)} \\
&= \frac{\sin(\theta + \phi) + \sin(\theta - \phi) - 2 \sin \theta}{\cos(\theta + \phi) + \cos(\theta - \phi) - 2 \cos \theta} \\
&= \frac{2 \sin \left[ \frac{(\theta + \phi) + (\theta - \phi)}{2} \right] \cos \left[ \frac{(\theta + \phi) - (\theta - \phi)}{2} \right] - 2 \sin \theta}{2 \cos \left[ \frac{(\theta + \phi) + (\theta - \phi)}{2} \right] \cos \left[ \frac{(\theta + \phi) - (\theta - \phi)}{2} \right] - 2 \cos \theta} \\
&= \frac{2 \sin(\theta) \cos(\phi) - 2 \sin \theta}{2 \cos(\theta) \cos(\phi) - 2 \cos \theta} \\
&= \frac{2 \sin \theta (\cos \phi - 1)}{2 \cos \theta (\cos \phi - 1)} \\
&= \frac{\sin \theta}{\cos \theta} = \tan \theta \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \frac{\sin(\theta + \phi) - 2 \sin \theta + \sin(\theta - \phi)}{\cos(\theta + \phi) - 2 \cos \theta + \cos(\theta - \phi)} = \tan \theta \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q9(i)

We have,

$$\begin{aligned}
\text{LHS} &= \sin \alpha + \sin \beta + \sin \gamma - \sin(\alpha + \beta + \gamma) \\
&= (\sin \alpha + \sin \beta) + (\sin \gamma - \sin(\alpha + \beta + \gamma)) \\
&= 2 \sin \left( \frac{\alpha + \beta}{2} \right) \cos \left( \frac{\alpha - \beta}{2} \right) + 2 \sin \left( \frac{\gamma - (\alpha + \beta + \gamma)}{2} \right) \cos \left( \frac{\gamma + \alpha + \beta + \gamma}{2} \right) \\
&= 2 \sin \left( \frac{\alpha + \beta}{2} \right) \cos \left( \frac{\alpha - \beta}{2} \right) + 2 \sin \left( \frac{-\alpha - \beta}{2} \right) \cos \left( \frac{\alpha + \beta + 2\gamma}{2} \right) \\
&= 2 \sin \left( \frac{\alpha + \beta}{2} \right) \cos \left( \frac{\alpha - \beta}{2} \right) - 2 \sin \left( \frac{\alpha + \beta}{2} \right) \cos \left( \frac{\alpha + \beta + 2\gamma}{2} \right) \\
&= 2 \sin \left( \frac{\alpha + \beta}{2} \right) \left[ \cos \left( \frac{\alpha - \beta}{2} \right) - \cos \left( \frac{\alpha + \beta + 2\gamma}{2} \right) \right] \\
&= 2 \sin \left( \frac{\alpha + \beta}{2} \right) \left[ -2 \sin \left[ \frac{\frac{\alpha - \beta}{2} + \frac{\alpha + \beta + 2\gamma}{2}}{2} \right] \sin \left[ \frac{\frac{\alpha - \beta}{2} - \frac{\alpha + \beta + 2\gamma}{2}}{2} \right] \right] \\
&= 2 \sin \left( \frac{\alpha + \beta}{2} \right) \left[ -2 \sin \left[ \frac{2\alpha + 2\gamma}{2 \times 2} \right] \sin \left[ \frac{-2\beta - 2\gamma}{2 \times 2} \right] \right] \\
&= -4 \sin \left( \frac{\alpha + \beta}{2} \right) \left[ \sin \left( \frac{\alpha + \gamma}{2} \right) \sin \left( \frac{-(\beta + \gamma)}{2} \right) \right] \\
&= 4 \sin \left( \frac{\alpha + \beta}{2} \right) \sin \left( \frac{\alpha + \gamma}{2} \right) \sin \left( \frac{\beta + \gamma}{2} \right) \\
&= 4 \sin \left( \frac{\alpha + \beta}{2} \right) \sin \left( \frac{\beta + \gamma}{2} \right) \sin \left( \frac{\alpha + \gamma}{2} \right) \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \sin \alpha + \sin \beta + \sin \gamma - \sin(\alpha + \beta + \gamma) = 4 \sin \left( \frac{\alpha + \beta}{2} \right) \sin \left( \frac{\beta + \gamma}{2} \right) \sin \left( \frac{\alpha + \gamma}{2} \right) \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q9(ii)

We have,

$$\text{LHS} = \cos(A + B + C) + \cos(A - B + C) + \cos(A + B - C) + \cos(A - B - C)$$

$$\begin{aligned}
&= \cos(A+B+C) + \cos(A-B+C) + \cos(A+B-C) + \cos(-A+B+C) \\
&= [\cos(A+B+C) + \cos(A-B+C)] + [\cos(A+B-C) + \cos(-A+B+C)] \\
&= 2\cos\left\{\frac{A+B+C+A-B+C}{2}\right\}\cos\left\{\frac{A+B+C-A+B-C}{2}\right\} + 2\left\{\cos\left\{\frac{A+B-C-A+B+C}{2}\right\}\right. \\
&\quad \left.\cos\left\{\frac{A+B-C+A-B-C}{2}\right\}\right\} \\
&= 2\cos\left\{\frac{2A+2C}{2}\right\}\cos\left\{\frac{2B}{2}\right\} + 2\cos\left\{\frac{2B}{2}\right\}\cos\left\{\frac{2A-2C}{2}\right\} \\
&= 2\cos(A+C)\cos(B) + 2\cos(B)\cos(A-C) \\
&= 2\cos(B)[\cos(A+C) + \cos(A-C)] \\
&= 2\cos(B)\left[2\cos\left(\frac{A+C+A-C}{2}\right)\cos\left(\frac{A+C-A+C}{2}\right)\right] \\
&= 2\cos(B)[2\cos A \cos C] \\
&= 4\cos A \cos B \cos C.
\end{aligned}$$

### Transformation Formulae Ex 8.2 Q10

We have,

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

and,  $\sin A + \sin B = \frac{1}{4}$

Now,

$$\frac{\sin A + \sin B}{\cos A + \cos B} = \frac{\frac{1}{4}}{\frac{1}{2}}$$

[On dividing]

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

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

$$\Rightarrow \tan\left(\frac{A+B}{2}\right) = \frac{1}{2} \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 11.

We have,

$$\cos eCA + \sec A = \cos eCB + \sec B$$

$$\Rightarrow \sec A - \sec B = \cos eCB - \cos eCA$$

$$\Rightarrow \frac{1}{\cos A} - \frac{1}{\cos B} = \frac{1}{\sin B} - \frac{1}{\sin A}$$

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

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

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

$$\Rightarrow \tan A \tan B = \frac{-\sin\left(\frac{A-B}{2}\right)\cos\left(\frac{A+B}{2}\right)}{-\sin\left(\frac{A-B}{2}\right)\sin\left(\frac{A+B}{2}\right)} \quad [\because \sin(-\theta) = -\sin\theta]$$

$$\Rightarrow \tan A \tan B = \cot\left(\frac{A+B}{2}\right) \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 12.

We have,

$$\sin 2A = \lambda \sin 2B$$

$$\Rightarrow \lambda = \frac{\sin 2A}{\sin 2B}$$

Now,

$$\frac{\lambda + 1}{\lambda - 1} = \frac{\frac{\sin 2A}{\sin 2B} + 1}{\frac{\sin 2A}{\sin 2B} - 1} = \frac{\sin 2A + \sin 2B}{\sin 2A - \sin 2B}$$

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

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

$$\Rightarrow \frac{\tan(A+B)}{\tan(A-B)} = \frac{\lambda + 1}{\lambda - 1} \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q13(i)

We have,

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

$$\therefore \frac{\cos(A+B+C) + \cos(-A+B+C) + \cos(A-B+C) + \cos(A+B-C)}{\sin(A+B+C) + \sin(-A+B+C) + \sin(A-B+C) - \sin(A+B-C)} = \cot C. \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q13(ii)

We have,

$$\begin{aligned}
\text{LHS} &= \sin(B-C) \cos(A-D) + \sin(C-A) \cos(B-D) + \sin(A-B) \cos(C-D) \\
&= \frac{1}{2} [2 \sin(B-C) \cos(A-D) + 2 \sin(C-A) \cos(B-D) + 2 \sin(A-B) \cos(C-D)] \\
&= \frac{1}{2} \left[ \begin{aligned} &\sin(B-C+A-D) + \sin(B-C-A+D) + \sin(C-A+B-D) + \sin(C-A-B+D) \\ &\quad + \sin(A-B+C-D) + \sin(A-B-C+D) \end{aligned} \right] \\
&= \frac{1}{2} \left[ \begin{aligned} &\sin(A+B-C-D) + \sin(B+D-C-A) + \sin(B+C-A-D) + \sin(C+D-A-B) \\ &\quad + \sin(A+C-B-D) + \sin(A+D-B-C) \end{aligned} \right] \\
&= \frac{1}{2} \left[ \begin{aligned} &\sin(A+B-C-D) - \sin(A+C-B-D) - \sin(A+D-B-C) - \sin(A+B-C-D) \\ &\quad + \sin(A+C-B-D) + \sin(A+D-B-C) \end{aligned} \right] \\
&= \frac{1}{2} [0] \\
&= 0 \\
&= \text{RHS}
\end{aligned}$$

$$\therefore \sin(B-C) \cos(A-D) + \sin(C-A) \cos(B-D) + \sin(A-B) \cos(C-D) = 0 \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 14.

We have,

$$\frac{\cos(A-B)}{\cos(A+B)} + \frac{\cos(C+D)}{\cos(C-D)} = 0$$

$$\Rightarrow \frac{\cos(A-B)}{\cos(A+B)} = -\frac{\cos(C+D)}{\cos(C-D)} \quad \text{---(i)}$$

Now,

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

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

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

$$\Rightarrow \frac{\cos(A+B) + \cos(A-B)}{\cos(A+B)} = \frac{-[\cos(C+D) - \cos(C-D)]}{\cos(C-D)} \quad \text{---(ii)}$$

Again,

$$\frac{\cos(A-B)}{\cos(A+B)} = \frac{-\cos(C+D)}{\cos(C-D)} \quad \text{[By equation (i)]}$$

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

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

$$\Rightarrow \frac{-[\cos(A+B) - \cos(A-B)]}{\cos(A+B)} = \frac{-[\cos(C+D) + \cos(C-D)]}{\cos(C-D)}$$

$$\Rightarrow \frac{\cos(A+B) - \cos(A-B)}{\cos(A+B)} = \frac{\cos(C+D) + \cos(C-D)}{\cos(C-D)} \quad \text{---(iii)}$$

Dividing equation (ii) by equation (iii), we get

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

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

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

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

$$\Rightarrow -1 = \tan A \tan B \tan C \tan D$$

$\therefore \tan A \tan B \tan C \tan D = -1$  Hence proved.

### Transformation Formulae Ex 8.2 Q 15.

We have,

$$\cos(\alpha + \beta) \sin(\gamma + \delta) = \cos(\alpha - \beta) \sin(\gamma - \delta)$$

$$\Rightarrow \frac{\cos(\alpha + \beta)}{\cos(\alpha - \beta)} = \frac{\sin(\gamma - \delta)}{\sin(\gamma + \delta)} \quad \text{---(i)}$$

Now,

$$\frac{\cos(\alpha + \beta)}{\cos(\alpha - \beta)} = \frac{\sin(\gamma - \delta)}{\sin(\gamma + \delta)}$$

$$\Rightarrow \frac{\cos(\alpha + \beta)}{\cos(\alpha - \beta)} + 1 = \frac{\sin(\gamma - \delta)}{\sin(\gamma + \delta)} + 1$$

$$\Rightarrow \frac{\cos(\alpha + \beta) + \cos(\alpha - \beta)}{\cos(\alpha - \beta)} = \frac{\sin(\gamma - \delta) + \sin(\gamma + \delta)}{\sin(\gamma + \delta)} \quad \text{---(ii)}$$

Again,

$$\frac{\cos(\alpha + \beta)}{\cos(\alpha - \beta)} = \frac{\sin(\gamma - \delta)}{\sin(\gamma + \delta)} \quad \text{[By equation (i)]}$$

$$\Rightarrow \frac{\cos(\alpha + \beta)}{\cos(\alpha - \beta)} - 1 = \frac{\sin(\gamma - \delta)}{\sin(\gamma + \delta)} - 1$$

$$\Rightarrow \frac{\cos(\alpha + \beta) - \cos(\alpha - \beta)}{\cos(\alpha - \beta)} = \frac{\sin(\gamma - \delta) - \sin(\gamma + \delta)}{\sin(\gamma + \delta)} \quad \text{---(iii)}$$

Dividing equation (ii) by equation (iii), we get

$$\frac{\cos(\alpha + \beta) + \cos(\alpha - \beta)}{\cos(\alpha + \beta) - \cos(\alpha - \beta)} = \frac{\sin(\gamma - \delta) + \sin(\gamma + \delta)}{\sin(\gamma - \delta) - \sin(\gamma + \delta)}$$

$$\Rightarrow \frac{\cos(\alpha + \beta) + \cos(\alpha - \beta)}{\cos(\alpha + \beta) - \cos(\alpha - \beta)} = \frac{[\sin(\gamma + \delta) + \sin(\gamma - \delta)]}{[\sin(\gamma + \delta) - \sin(\gamma - \delta)]}$$

$$\Rightarrow \frac{2 \cos \left\{ \frac{\alpha + \beta + \alpha - \beta}{2} \right\} \cos \left\{ \frac{\alpha + \beta - \alpha + \beta}{2} \right\}}{-2 \sin \left\{ \frac{\alpha + \beta + \alpha - \beta}{2} \right\} \sin \left\{ \frac{\alpha + \beta - \alpha + \beta}{2} \right\}} = \frac{[2 \sin \left\{ \frac{\gamma + \delta + \gamma - \delta}{2} \right\} \cos \left\{ \frac{\gamma + \delta - \gamma + \delta}{2} \right\}]}{[2 \sin \left\{ \frac{\gamma + \delta - \gamma + \delta}{2} \right\} \cos \left\{ \frac{\gamma + \delta + \gamma - \delta}{2} \right\}]}$$

$$\Rightarrow \frac{\cos \alpha \cos \beta}{\sin \alpha \sin \beta} = \frac{\sin \gamma \cos \delta}{\sin \delta \cos \gamma}$$

$$\Rightarrow \cot \alpha \cot \beta = \frac{\sin \gamma \cos \delta}{\cos \gamma \sin \delta}$$

$$\Rightarrow \cot \alpha \cot \beta = \frac{\cot \delta}{\cot \gamma}$$

$$\Rightarrow \cot \alpha \cot \beta \cot \gamma = \cot \delta$$

$\therefore \cot \alpha \cot \beta \cot \gamma = \cot \delta$  Hence proved.

### Transformation Formulae Ex 8.2 Q 16.

We have,

$$y \sin \phi = x \sin(2\theta + \phi)$$

$$\Rightarrow \frac{\sin \phi}{\sin(2\theta + \phi)} = \frac{x}{y} \quad \text{---(i)}$$

Now,



$$\frac{\sin \phi}{\sin(2\theta + \phi)} = \frac{x}{y}$$

$$\Rightarrow \frac{\sin \phi}{\sin(2\theta + \phi)} + 1 = \frac{x}{y} + 1$$

$$\Rightarrow \frac{\sin \phi + \sin(2\theta + \phi)}{\sin(2\theta + \phi)} = \frac{x + y}{y} \quad \text{--- (i)}$$

Again,

$$\frac{\sin \phi}{\sin(2\theta + \phi)} = \frac{x}{y} \quad \text{[By equation (i)]}$$

$$\Rightarrow \frac{\sin \phi}{\sin(2\theta + \phi)} - 1 = \frac{x}{y} - 1$$

$$\Rightarrow \frac{\sin \phi - \sin(2\theta + \phi)}{\sin(2\theta + \phi)} = \frac{x - y}{y} \quad \text{--- (iii)}$$

Dividing equation (ii) by equation (iii), we get

$$\frac{\sin \phi + \sin(2\theta + \phi)}{\sin \phi - \sin(2\theta + \phi)} = \frac{x + y}{x - y}$$

$$\Rightarrow \frac{2 \sin \left( \frac{\phi + 2\theta + \phi}{2} \right) \cos \left( \frac{\phi - 2\theta - \phi}{2} \right)}{2 \sin \left( \frac{\phi - 2\theta - \phi}{2} \right) \cos \left( \frac{\phi + 2\theta + \phi}{2} \right)} = \frac{x + y}{x - y}$$

$$\Rightarrow \frac{\sin(\theta + \phi) \cos(\theta - \phi)}{\sin(-\theta) \cos(\theta + \phi)} = \frac{x + y}{x - y}$$

$$\Rightarrow \frac{\sin(\theta + \phi) \cos(\theta)}{\cos(\theta + \phi) [-\sin(\theta)]} = \frac{x + y}{x - y}$$

$$\Rightarrow \frac{-\cot(\theta)}{\cot(\theta + \phi)} = \frac{x + y}{x - y}$$

$$\Rightarrow -(x - y) \cot \theta = (x + y) \cot(\theta + \phi)$$

$$\Rightarrow (y - x) \cot \theta = (x + y) \cot(\theta + \phi)$$

$$\Rightarrow (x + y) \cot(\theta + \phi) = (y - x) \cot \theta \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 17.

We have,

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

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

Now,

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

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

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

Again,

$$\frac{\cos(A + B)}{\cos(A - B)} = \frac{\sin(C + D)}{\sin(C - D)} \quad \text{[By equation (i)]}$$

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

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

Dividing equation (ii) by equation (iii), we get

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

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

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

$$\Rightarrow \frac{1}{-\tan A \tan B} = \frac{\sin C \cos D}{\cos C \sin D}$$

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

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

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

$$\Rightarrow \tan A \tan B \tan C + \tan D = 0 \quad \text{Hence proved.}$$

### Transformation Formulae Ex 8.2 Q 18.

$$\text{Given } x \cos \theta = y \cos \left( \theta + \frac{2\pi}{3} \right) = z \cos \left( \theta + \frac{4\pi}{3} \right) = k \text{ (say)}$$

$$x = \frac{k}{\cos \theta}$$

$$y = \frac{k}{\cos \left( \theta + \frac{2\pi}{3} \right)}$$

$$z = \frac{k}{\cos \left( \theta + \frac{4\pi}{3} \right)}$$

$$\begin{aligned}
xy + yz + zx &= k^2 \left[ \frac{1}{\cos\theta \cos\left(\theta + \frac{2\pi}{3}\right)} + \frac{1}{\cos\left(\theta + \frac{2\pi}{3}\right) \cos\left(\theta + \frac{4\pi}{3}\right)} + \frac{1}{\cos\left(\theta + \frac{4\pi}{3}\right) \cos\theta} \right] \\
&= k^2 \left[ \frac{\cos\left(\theta + \frac{4\pi}{3}\right) + \cos\theta + \cos\left(\theta + \frac{2\pi}{3}\right)}{\cos\theta \cos\left(\theta + \frac{2\pi}{3}\right) \cos\left(\theta + \frac{4\pi}{3}\right)} \right] \\
&= k^2 \left[ \frac{\cos\theta \cos\frac{4\pi}{3} - \sin\theta \sin\frac{4\pi}{3} + \cos\theta + \cos\theta \cos\frac{2\pi}{3} - \sin\theta \sin\frac{2\pi}{3}}{\cos\theta \cos\left(\theta + \frac{2\pi}{3}\right) \cos\left(\theta + \frac{4\pi}{3}\right)} \right] \\
&= k^2 \left[ \frac{\cos\theta \left(\frac{-1}{2}\right) - \sin\theta \left(\frac{-\sqrt{3}}{2}\right) + \cos\theta + \cos\theta \left(\frac{-1}{2}\right) - \sin\theta \left(\frac{\sqrt{3}}{2}\right)}{\cos\theta \cos\left(\theta + \frac{2\pi}{3}\right) \cos\left(\theta + \frac{4\pi}{3}\right)} \right] \\
&= k^2 \left[ \frac{-\cos\theta + \sin\theta \left(\frac{\sqrt{3}}{2}\right) + \cos\theta + -\sin\theta \left(\frac{\sqrt{3}}{2}\right)}{\cos\theta \cos\left(\theta + \frac{2\pi}{3}\right) \cos\left(\theta + \frac{4\pi}{3}\right)} \right] \\
&= 0
\end{aligned}$$

Hence Proved