

## Transformation Formulae Ex 8.1 Q5(i)

$$\cos 10^{\circ} \cos 30^{\circ} \cos 50^{\circ} \cos 70^{\circ} = \frac{3}{16}$$

$$LHS = \cos 10^{\circ} \cos 30^{\circ} \cos 50^{\circ} \cos 70^{\circ}$$

$$= \cos 30^{\circ} \cos 10^{\circ} \cos 50^{\circ} \cos 70^{\circ}$$

$$= \frac{\sqrt{3}}{2} (\cos 10^{\circ} \cos 50^{\circ} \cos 70^{\circ})$$

$$= \frac{\sqrt{3}}{4} (2 \cos 10^{\circ} \cos 50^{\circ}) \cos 70^{\circ}$$

$$= \frac{\sqrt{3}}{4} (2 \cos 10^{\circ} \cos 50^{\circ}) \cos 70^{\circ}$$

$$= \frac{\sqrt{3}}{4} \cos 70^{\circ} (\cos (50^{\circ} + 10^{\circ}) + \cos (10^{\circ} - 50^{\circ}))$$

$$= \frac{\sqrt{3}}{4} \cos 70^{\circ} (\cos (50^{\circ} + \cos (-40^{\circ}))$$

Now,
$$\cos (-\theta) = \cos \theta$$

$$= \frac{\sqrt{3}}{4} \cos 70^{\circ} (\frac{1}{2} + \cos 40^{\circ})$$

$$= \frac{\sqrt{3}}{8} \cos 70^{\circ} + \frac{\sqrt{3}}{4} \cos 70^{\circ} \cos 40^{\circ}$$

$$= \frac{\sqrt{3}}{8} \cos 70^{\circ} + \frac{\sqrt{3}}{4} \cos 70^{\circ} \cos 40^{\circ}$$

$$= \frac{\sqrt{3}}{8} (\cos 70^{\circ} + \cos (10^{\circ} + 40^{\circ}) + \cos (70^{\circ} - 40^{\circ}))$$

$$= \frac{\sqrt{3}}{8} [\cos 70^{\circ} + \cos (10^{\circ} - 70^{\circ}) + \frac{\sqrt{3}}{2}]$$

$$= \frac{\sqrt{3}}{8} [\cos 70^{\circ} + \cos (180^{\circ} - 70^{\circ}) + \frac{\sqrt{3}}{2}]$$

$$= \frac{\sqrt{3}}{8} [\cos 70^{\circ} - \cos 70^{\circ} + \cos (180^{\circ} - 70^{\circ}) + \frac{\sqrt{3}}{2}]$$

$$= \frac{\sqrt{3}}{8} [\cos 70^{\circ} - \cos 70^{\circ} + \frac{\sqrt{3}}{2}]$$

$$= \frac{\sqrt{3}}{8} [\cos 70^{\circ} - \cos 70^{\circ} + \frac{\sqrt{3}}{2}]$$

$$= \frac{\sqrt{3}}{8} \cos 70^{\circ} - \cos 70^{\circ} + \frac{\sqrt{3}}{2}]$$

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

Transformation Formulae Ex 8.1 Q5(ii)

Cos 40° cos 80° cos 160° = 
$$-\frac{1}{8}$$

LHS = cos 40° cos 80° cos 160°
= cos 80° cos 40° cos 160°

Multiplying and dividing by 2
=  $\frac{1}{2} \left( \cos 80^{\circ} \times \left( 2 \cos 40^{\circ} \cos 160^{\circ} \right) \right)$ 
2 cos  $A \cos B = \cos \left( A + B \right) + \cos \left( A - B \right)$ 
=  $\frac{1}{2} \left( \cos 80^{\circ} \left( \cos \left( 40^{\circ} + 160^{\circ} \right) + \cos \left( 40^{\circ} - 160^{\circ} \right) \right) \right)$ 
=  $\frac{1}{2} \left( \cos 80^{\circ} \left( \cos 200 + \cos \left( -120 \right) \right) \right)$ 
=  $\frac{1}{2} \cos 80^{\circ} \left( \cos 20^{\circ} + \cos 60^{\circ} \right) + \cos \left( 180^{\circ} - 60^{\circ} \right) \right)$ 
=  $\frac{1}{2} \cos 80^{\circ} \left( \cos 20^{\circ} + \cos 60^{\circ} \right)$ 
=  $\frac{1}{2} \cos 80^{\circ} \cos 20^{\circ} + \frac{1}{2} \cos 80^{\circ} + \cos 60^{\circ}$ 
=  $-\frac{1}{2} \left( 2 \cos 80^{\circ} \cos 20^{\circ} + \frac{1}{2} \cos 80^{\circ} \cos 60^{\circ}$ 
=  $-\frac{1}{4} \left[ 2 \cos 80^{\circ} \cos 20^{\circ} + \cos 80^{\circ} \right]$ 
=  $-\frac{1}{4} \left[ \cos \left( 80^{\circ} + 20^{\circ} \right) + \cos \left( 80^{\circ} - 20^{\circ} \right) + \cos 80^{\circ} \right]$ 
=  $-\frac{1}{4} \left[ \cos \left( 180^{\circ} - 80^{\circ} \right) + \cos 60^{\circ} + \cos 80^{\circ} \right]$ 
=  $-\frac{1}{4} \left[ - \cos 80^{\circ} + \cos 60^{\circ} + \cos 80^{\circ} \right]$ 
=  $-\frac{1}{4} \left[ - \cos 80^{\circ} + \cos 60^{\circ} + \cos 80^{\circ} \right]$ 
=  $-\frac{1}{4} \left[ - \cos 80^{\circ} + \cos 60^{\circ} + \cos 80^{\circ} \right]$ 
=  $-\frac{1}{4} \left[ - \cos 80^{\circ} + \cos 60^{\circ} + \cos 80^{\circ} \right]$ 
=  $-\frac{1}{4} \cos 60^{\circ}$ 
=  $-\frac{1}{4} \times \frac{1}{2}$ 
=  $-\frac{1}{8} \text{ RHS}$ 

## Transformation Formulae Ex 8.1 Q5(iii)

$$\begin{aligned} &\sin 20^{\circ} \sin 40^{\circ} \sin 80^{\circ} \\ &= \frac{1}{2} \left[ 2 \sin 20^{\circ} \sin 40^{\circ} \right) \sin 80^{\circ} \\ &= \frac{1}{2} \left[ \cos \left( 40^{\circ} - 20^{\circ} \right) - \cos \left( 40^{\circ} + 20^{\circ} \right) \right] \sin 80^{\circ} \\ &= \frac{1}{2} \left[ \cos 20^{\circ} - \cos 60^{\circ} \right] \sin 80^{\circ} \\ &= \frac{1}{2} \left[ \cos 20^{\circ} - \frac{1}{2} \right] \sin 80^{\circ} \\ &= \frac{1}{2} \left[ \cos 20^{\circ} \sin 80^{\circ} \right] - \frac{1}{4} \sin 80^{\circ} \\ &= \frac{1}{4} \left[ 2 \cos 20^{\circ} \sin 80^{\circ} - \sin 80^{\circ} \right] \\ &= \frac{1}{4} \left[ \sin \left( 80^{\circ} + 20^{\circ} \right) + \sin \left( 80^{\circ} - 20^{\circ} \right) - \sin 80^{\circ} \right] \\ &= \frac{1}{4} \left[ \sin 100^{\circ} + \sin 60^{\circ} - \sin 80^{\circ} \right] \\ &= \frac{1}{4} \left[ \sin \left( 180^{\circ} - 80^{\circ} \right) + \frac{\sqrt{3}}{2} - \sin 80^{\circ} \right] \\ &= \frac{1}{4} \left[ \sin 80^{\circ} + \frac{\sqrt{3}}{2} - \sin 80^{\circ} \right] \\ &= \frac{\sqrt{3}}{8} = \text{RHS} \end{aligned}$$

Transformation Formulae Ex 8.1 Q5(iv)

$$cos20^{+}cos 40^{+}cos 80^{+} 
= \frac{1}{2}(2cos 20^{+}cos 40^{+}) cos 80^{+} 
= \frac{1}{2}(2cos (40^{+}+20^{+}) + cos (40^{+}-20^{+})] cos 80^{+} 
= \frac{1}{2}(2cos 60^{+}+cos 20^{+}) cos 80^{+} 
= \frac{1}{2}(2cos 80^{+}+cos 20^{+}) cos 80^{+} 
= \frac{1}{2}(2cos 80^{+}+2cos 20^{+}) cos 80^{+} 
= \frac{1}{2}(2cos 80^{+}+2cos 20^{+}) cos 80^{+} 
= \frac{1}{4}(2cos 80^{+}+2cos 20^{+}) cos 60^{+} 
= \frac{1}{4}(2cos 80^{+}+cos (180^{+}+80^{+}) + cos 60^{+}] 
= \frac{1}{4}(2cos 80^{+}+cos (180^{+}+80^{+}) + cos 60^{+}] 
= \frac{1}{4}(2cos 80^{+}+cos (180^{+}+80^{+}) + cos 60^{+}] 
= \frac{1}{4}(2cos 80^{+}+cos 60^{+}+cos 60^{+}) 
= (2cos 80^{+}+cos 80^{+}+cos 80^{+}) \sqrt{3} 
= (2cos 20^{+}+cos 40^{+}+cos 80^{+}) \sqrt{3} 
= (2cos 20^{+}+cos 40^{+}+cos (40^{+}+20^{+}+cos 80^{+}) 
= (2cos 4cos 8) - cos 60^{+}+cos 60^{+} 
= (2cos 4cos 8) - cos 60^{+}+cos 60^{+} 
= (2cos 20^{+}+cos 20^{+}+cos 80^{+}) - cos 80^{+} 
= (2cos 20^{+}+cos 20^{+}+cos 80^{+}) - cos 80^{+} 
= (2cos 80^{+}+cos 100^{+}+cos 60^{+}) + cos (80^{+}-20^{+})) - cos 80^{+} 
= (2cos 80^{+}+cos 100^{+}+cos 60^{+}) + cos 60^{+} 
= (2cos 80^{+}+cos 100^$$

Transformation Formulae Ex 8.1 Q5(vi)

tan 20° tan 30° tan 40° tan 80°  $\frac{1}{\sqrt{3}}$  (tan 20° tan 40° tan 80°)  $\left[ v \tan 30^{\circ} = \frac{1}{\sqrt{3}} \right]$ (sin 20° sin 40° sin 80°) (cos 20° cos 40° cos 80°) √3 (2 sin 20° sin 40°) sin 80° - √3 (2 cos 20° cos 40°) cos 80° Applying  $2\sin A\sin B = \cos(A - B) - \cos(A + B)$  $2\cos A\cos B = \cos \left(A+B\right) + \cos \left(A-B\right)$  $=\frac{\left(\cos{(40^{\circ}-20^{\circ})}-\cos{(20^{\circ}+40^{\circ})}\right)\sin{80^{\circ}}}{\cos{(20^{\circ}+40^{\circ})}+\cos{(40^{\circ}-20^{\circ})}\cos{80^{\circ}}\sqrt{3}}$  $= \frac{(\cos 20^{\circ} - \cos 60^{\circ}) \sin 80^{\circ}}{\sqrt{3} (\cos 60^{\circ} + \cos 20^{\circ}) \cos 80^{\circ}}$  $=\frac{\left(\cos 20^{\circ}-\frac{1}{2}\right)\sin 80^{\circ}}{\sqrt{3}\left(\frac{1}{2}+\cos 20^{\circ}\right)\cos 80^{\circ}}$  $= \frac{2 \sin 20^{\circ} \sin 80^{\circ} - \sin 80^{\circ}}{\sqrt{3} (\cos 80^{\circ} + 2 \cos 20^{\circ} \cos 80^{\circ})}$ Now,  $2\sin A\cos B=\sin \left( A+B\right) +\sin \left( A-B\right)$  $\Rightarrow$ sin(80° + 20°) + sin(80° - 20°) - sin 80°  $= \frac{\sqrt{3} (\cos 80^{\circ} + \cos (20^{\circ} + 80^{\circ}) + \cos (80^{\circ} - 20^{\circ}))}{(\cos 80^{\circ} + \cos (20^{\circ} + 80^{\circ}) + \cos (80^{\circ} - 20^{\circ}))}$  $= \frac{\sin 100^{\circ} + \sin 60^{\circ} - \sin 80^{\circ}}{\sqrt{3} \left(\cos 80^{\circ} + \cos 100^{\circ} + \cos 60^{\circ}\right)}$ sin 100° + sin 60° - sin (80° - 100°)  $= \frac{1}{\sqrt{3} (\cos 80^{\circ} + \cos (1800^{\circ} - 80^{\circ}) + \sin 60^{\circ})}$  $= \frac{\sin 100^{\circ} + \frac{\sqrt{3}}{2} - \sin 100^{\circ}}{\sqrt{3}(\cos 80^{\circ} - \cos 80^{\circ} + \cos 60^{\circ})}$  $=\frac{\frac{\sqrt{3}}{2}}{\sqrt{3}\left(\frac{1}{2}\right)}=1=$ Transformation Formulae Ex 8.1 Q5(vii)  $\sin 10^{\circ} \sin 50^{\circ} \sin 60^{\circ} \sin 70^{\circ} = \frac{\sqrt{3}}{16}$ LHS sin 10° sin 50° sin 70° √3/2  $v \sin 60^\circ = \frac{\sqrt{3}}{2}$  $= \sin(90^\circ - 80^\circ) \sin(90^\circ - 40^\circ) \sin(90^\circ - 20^\circ) \frac{\sqrt{3}}{2}$ = cos 80° cos 40° cos 20° √3  $=\frac{\sqrt{3}}{2\times2}(2\cos 40^{\circ}\cos 20^{\circ})\cos 80^{\circ}$  $[\because 2\cos A\cos B = \cos(A+B) + \cos(A-B)]$  $= \frac{\sqrt{3}}{2 \times 2} \left[ \cos (40^\circ + 20^\circ) + \cos (40^\circ - 20^\circ) \right] \cos 80^\circ$  $=\frac{\sqrt{3}}{2\times2}[\cos 60^{\circ} + \cos 20^{\circ}]\cos 80^{\circ}$  $=\frac{\sqrt{3}}{2\times2}\left[\frac{1}{2}+\cos 20^{\circ}\right]\cos 80^{\circ}$  $= \frac{\sqrt{3}}{4} \left[ \frac{1}{2} \cos 80^{\circ} + \cos 20^{\circ} \cos 80^{\circ} \right]$  $=\frac{\sqrt{3}}{9}[\cos 80^{\circ} + 2\cos 20^{\circ}\cos 80^{\circ}]$  $= \frac{\sqrt{3}}{8} \left[ \cos 80^{\circ} + \cos (80^{\circ} + 20^{\circ}) + \cos (80^{\circ} - 20^{\circ}) \right]$ 

 $=\frac{\sqrt{3}}{8}[\cos 80^{\circ} + \cos 100^{\circ} + \cos 60^{\circ}]$ 

 $=\frac{\sqrt{3}}{8}[\cos 60^{\circ}]=\frac{\sqrt{3}}{16}=RHS$ 

 $=\frac{\sqrt{3}}{8}[\cos 80^{\circ} + \cos(180^{\circ} - 80^{\circ}) + \cos 60^{\circ}]$ 

## Transformation Formulae Ex 8.1 Q5(viii)

= 
$$\sin 20^\circ \sin 40^\circ \sin 80^\circ \times \frac{\sqrt{3}}{2}$$

$$\left[ \because \sin 60^\circ = \frac{\sqrt{3}}{2} \right]$$

$$= \frac{\sqrt{3}}{2} \times \frac{1}{2} (2 \sin 20^{\circ} \sin 40^{\circ}) \sin 80^{\circ}$$

$$= \frac{\sqrt{3}}{4} \left[ \cos \left( 40^{\circ} - 20^{\circ} \right) - \cos \left( 40^{\circ} + 20^{\circ} \right) \right] \sin 80^{\circ}$$

= 
$$\frac{\sqrt{3}}{4}$$
[ $\cos 20^{\circ} - \cos 60^{\circ}$ ] $\sin 80^{\circ}$ 

$$= \frac{\sqrt{3}}{4} \left[ \cos 20^{\circ} \sin 80^{\circ} - \frac{1}{2} \sin 80^{\circ} \right]$$

$$= \frac{\sqrt{3}}{8} [2\cos 20^{\circ} \sin 80^{\circ} - \sin 80^{\circ}]$$

$$= \frac{\sqrt{3}}{8} \left[ \sin(80^{\circ} + 20^{\circ}) + \sin(80^{\circ} - 20^{\circ}) - \sin 80^{\circ} \right]$$

$$= \frac{\sqrt{3}}{8} [\sin 100^\circ + \sin 60^\circ - \sin 80^\circ]$$

$$= \frac{\sqrt{3}}{8} [\sin 80^{\circ} + \sin 60^{\circ} - \sin 80^{\circ}]$$

$$= \frac{\sqrt{3}}{8} \times \sin 60^\circ = \frac{\sqrt{3}}{8} \times \frac{\sqrt{3}}{2}$$

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