Q1) Prove that

$$\sqrt{\frac{1-\cos x}{1+\cos x}} = \operatorname{cosec} x - \cot x$$

Sol 1) $RHS = \frac{1}{\sin x} - \frac{\cos x}{\sin x} = \frac{1-\cos x}{\sin x}$.

$$LHS = \frac{\sqrt{1-\cos x}}{\sqrt{1+\cos x}} = \frac{\sqrt{1-\cos x}}{\sqrt{1+\cos x}} \times \frac{\sqrt{1-\cos x}}{\sqrt{1-\cos x}}$$

$$= \frac{1-\cos x}{\sin x} = RHS$$

Q2) Find the value of $\cos 40^\circ - \cos 20^\circ + \cos 80^\circ$

Sol 2) $\cos 40^\circ - \cos 20^\circ + \cos 80^\circ$

$$= 2\cos\left(\frac{40^\circ+80^\circ}{2}\right)\cos\left(\frac{40^\circ-80^\circ}{2}\right) - \cos(20^\circ)$$

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

$$= 0$$

Q3) Prove that

$$\tan\theta + 2\tan 2\theta + 4\tan 4\theta + 8\cot 8\theta = \cot\theta$$

Sol 3) $\tan 8\theta = \frac{2\tan 4\theta}{1-\tan^2 4\theta}$

$$\Rightarrow 8\cot 8\theta + 4\tan 4\theta = \frac{8(1-\tan^2 4\theta) + 4\tan(4\theta)}{2\tan 4\theta}$$

$$= \frac{8}{2\tan 4\theta} = \frac{4}{\tan 4\theta}$$

$$\Rightarrow \tan\theta + 2\tan 2\theta + \frac{4}{\tan 4\theta}$$

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$\because \tan 4\theta = \frac{2\tan 2\theta}{1-\tan^2 2\theta}$

$\Rightarrow \frac{2\tan 2\theta + 4}{\tan 4\theta} = 2\tan 2\theta + \frac{4(1-\tan^2 2\theta)}{2\tan 2\theta}$

$= \frac{2}{\tan 2\theta}$

Now, $\tan\theta + \frac{2}{\tan 2\theta}$

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

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

$= \frac{1}{\tan\theta} = \cot\theta = RHS$

Q4) Show that $\cos A \cos 2A \cos 4A = \frac{\sin 8A}{8\sin A}$

Ans4) $\sin 8A = 2\sin 4A \cos 4A$

$= 4\sin 2A \cos 2A \cos 4A$

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

$\therefore RHS = \frac{\sin 8A}{8\sin A} = \cos A \cos 2A \cos 4A = LHS$