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Problems

Q① Find the value of $\sqrt{3}\operatorname{cosec}20^\circ - \sec 20^\circ$

A①
$$= \frac{\sqrt{3}}{\sin 20^\circ} - \frac{1}{\cos 20^\circ}$$
$$= \frac{\sqrt{3}\cos 20^\circ - \sin 20^\circ}{\sin 20^\circ \cos 20^\circ}$$
$$= 4\left(\frac{\sin 60^\circ \cos 20^\circ - \cos 60^\circ \sin 20^\circ}{\sin 40^\circ}\right)$$
$$= 4\left(\frac{\sin(60^\circ - 20^\circ)}{\sin 40^\circ}\right) = 4$$

Q② Show that $\tan 3x \tan 2x \tan x = \tan 3x - \tan 2x - \tan x$

A② Let $3x = 2x + x$

$\tan 3x = \tan(2x + x)$ $\left(\because \tan(x+y) = \frac{\tan x + \tan y}{1 - \tan x \tan y}\right)$

$\Rightarrow \tan 3x = \frac{\tan 2x + \tan x}{1 - \tan 2x \tan x}$

$\Rightarrow \tan 3x - \tan 3x \tan 2x \tan x = \tan 2x + \tan x$

$\Rightarrow \tan 3x \tan 2x \tan x = \tan 3x - \tan 2x - \tan x$

Q③ Prove that:
$$\cos^2 x + \cos^2\left(x + \frac{\pi}{3}\right) + \cos^2\left(x - \frac{\pi}{3}\right) = \frac{3}{2}$$

A③ LHS $= \cos^2 x + \left(\cos x \cos\frac{\pi}{3} - \sin x \sin\frac{\pi}{3}\right)^2 + \left(\cos x \cos\frac{\pi}{3} + \sin x \sin\frac{\pi}{3}\right)^2$

$= \cos^2 x + \left(\frac{1}{2}\cos x - \frac{\sqrt{3}}{2}\sin x\right)^2 + \left(\frac{1}{2}\cos x + \frac{\sqrt{3}}{2}\sin x\right)^2$

$= \cos^2 x + \frac{1}{2}\cos^2 x + \frac{3}{2}\sin^2 x = \frac{3}{2}\cos^2 x + \frac{3}{2}\sin^2 x = \frac{3}{2} =$ RHS

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Q4) Find the value of $\cos 570^\circ \sin 510^\circ + \sin(-330^\circ)\cos(-390^\circ)$

Ans 4) $= \cos(570^\circ)\sin(510^\circ) - \sin(330^\circ)\cos(390^\circ)$ $\quad (\because \sin(-x) = -\sin x)$

$= \cos(210^\circ)\sin(150^\circ) - \sin(330^\circ)\cos(30^\circ)$

$(\because \sin(2\pi + x) = \sin x \ \& \ \cos(2\pi + x) = \cos x)$

$= -\cos(30^\circ)\cos(60^\circ) + \sin(30^\circ)\cos(30^\circ)$

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

$= 0$

Q5) Show that $2\sin^2\beta + 4\cos(\alpha+\beta)\sin\alpha\sin\beta + \cos[2(\alpha+\beta)]$
$= \cos(2\alpha)$

Ans 5) $LHS = 2\sin^2\beta + 4\cos(\alpha+\beta)\sin\alpha\sin\beta + \cos 2(\alpha+\beta)$

$= 2\sin^2\beta + 4(\cos\alpha\cos\beta - \sin\alpha\sin\beta)\sin\alpha\sin\beta$
$+ (\cos 2\alpha\cos 2\beta - \sin 2\alpha\sin 2\beta)$

$= 2\sin^2\beta + 4\sin\alpha\cos\alpha\sin\beta\cos\beta - 4\sin^2\alpha\sin^2\beta + \cos 2\alpha\cos 2\beta$
$- \sin 2\alpha\sin 2\beta$

$= 2\sin^2\beta + \cancel{\sin 2\alpha\sin 2\beta} - 4\sin^2\alpha\sin^2\beta + \cos 2\alpha\cos 2\beta$
$- \cancel{\sin 2\alpha\sin 2\beta}$

$= \cancel{2\sin^2\beta}(1-\cos 2\beta) - (2\sin^2\alpha)(2\sin^2\beta) + \cos 2\alpha\cos 2\beta$

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

$= (1-\cos 2\beta)(\cancel{1-1} + \cos 2\alpha) + \cos 2\alpha\cos 2\beta$

$= \cos 2\alpha$

$= RHS$