Notes -

$$\tan(x+y) = \frac{\tan x + \tan y}{1 - \tan x \tan y}$$

$$\tan(x-y) = \frac{\tan x - \tan y}{1 + \tan x \tan y}$$

$$\tan(2x) = \frac{2\tan x}{1-\tan^2 x} \quad , 2x \neq \text{odd multiple of } \frac{\pi}{2}$$

$$\tan(3x) = \frac{3\tan x - \tan^3 x}{1 - 3\tan^2 x}$$

$3x \neq$ odd multiple of $\frac{\pi}{2}$

$$\cot(x+y) = \frac{\cot x \cot y - 1}{\cot x + \cot y}$$

$$\cot(x-y) = \frac{1 + \cot x \cot y}{\cot y - \cot x}$$

$$\cot(2x) = \frac{\cot^2 x - 1}{2\cot x}$$

$$\cot(3x) = \frac{\cot^3 x - 3\cot x}{3\cot^2 x - 1}$$

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Q) Show that :-

$$\frac{\cos 7x + \cos 3x}{\sin 7x - \sin 3x} = \cot 2x$$

A) $LHS = \dfrac{2\cos\left(\frac{7x+3x}{2}\right)\cos\left(\frac{7x-3x}{2}\right)}{2\cos\left(\frac{7x+3x}{2}\right)\sin\left(\frac{7x-3x}{2}\right)} = \cot(2x) = RHS$

Q) Compute $\sin(18°)$.

A) $\sin x = \cos\left(\frac{\pi}{2} - x\right)$

$\sin(36°) = \cos(54°)$ , $\theta = 18°$

$\sin(2\theta) = 2\sin\theta\cos\theta$

$\cos(3\theta) = 4\cos^3\theta - 3\cos\theta$

$2\sin\theta\cos\theta - (4\cos^3\theta - 3\cos\theta) = 0$

$\Rightarrow \cos\theta(2\sin\theta - 4\cos^2\theta + 3) = 0$

$\Rightarrow 4\cos^2\theta - 2\sin\theta - 3 = 0$

$\Rightarrow 4 - 4\sin^2\theta - 2\sin\theta - 3 = 0$

$\Rightarrow 4\sin^2\theta + 2\sin\theta - 1 = 0$

$\Rightarrow \sin\theta = \dfrac{-2 \pm \sqrt{20}}{8} = \dfrac{-1 + \sqrt{5}}{4}$

$\therefore \boxed{\sin 18° = \dfrac{\sqrt{5}-1}{4}}$