

Trigonometric Ratios & Identities

JEE Main 2021 (July) Chapter-wise Questions

Questions with Answer Keys

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Q1 (25 July 2021 Shift 2)

The value of $\cot \frac{\pi}{24}$ is:

- (1) $\sqrt{2} + \sqrt{3} + 2 - \sqrt{6}$
- (2) $\sqrt{2} + \sqrt{3} + 2 + \sqrt{6}$
- (3) $\sqrt{2} - \sqrt{3} - 2 + \sqrt{6}$
- (4) $3\sqrt{2} - \sqrt{3} - \sqrt{6}$

Q2 (27 July 2021 Shift 1)

If $\sin \theta + \cos \theta = \frac{1}{2}$, then

- $16(\sin(2\theta) + \cos(4\theta) + \sin(6\theta))$ is equal to:
- (1) 23
 - (2) -27
 - (3) -23
 - (4) 27



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Questions with Answer Keys

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Answer Key

Q1 (2) Q2 (3)

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Hints and Solutions

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

$$\theta = \frac{\pi}{24}$$

$$\Rightarrow \cot\left(\frac{\pi}{24}\right) = \frac{1+\left(\frac{\sqrt{3}+1}{2\sqrt{2}}\right)}{\left(\frac{\sqrt{3}-1}{2\sqrt{2}}\right)}$$

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

$$= \frac{2\sqrt{6}+2\sqrt{2}+3+\sqrt{3}+\sqrt{3}+1}{2}$$

$$= \sqrt{6} + \sqrt{2} + \sqrt{3} + 2$$

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Q2

$$\sin \theta + \cos \theta = \frac{1}{2}$$

$$\sin^2 \theta + \cos^2 \theta + 2 \sin \theta \cos \theta = \frac{1}{4}$$

$$\sin 2\theta = -\frac{3}{4}$$

Now:

$$\cos 4\theta = 1 - 2 \sin^2 2\theta$$

$$= 1 - 2 \left(-\frac{3}{4}\right)^2$$

$$= 1 - 2 \times \frac{9}{16} = -\frac{1}{8}$$

$$\sin 6\theta = 3 \sin 2\theta - 4 \sin^3 2\theta$$

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

$$= \left[3 - 4 \left(\frac{9}{16}\right)\right] \cdot \left(-\frac{3}{4}\right)$$

$$\Rightarrow \left[\frac{3}{4}\right] \times \left(-\frac{3}{4}\right) = -\frac{9}{16}$$

$$16[\sin 2\theta + \cos 4\theta + \sin 6\theta]$$

$$16 \left(-\frac{3}{4} - \frac{1}{8} - \frac{9}{16}\right) = -23$$

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