

**Q1. JEE Main 2026 (23 January Shift 1)**

Let  $\alpha$  and  $\beta$  respectively be the maximum and the minimum values of the function

$$f(\theta) = 4 \left( \sin^4 \left( \frac{7\pi}{2} - \theta \right) + \sin^4(11\pi + \theta) \right) - 2 \left( \sin^6 \left( \frac{3\pi}{2} - \theta \right) + \sin^6(9\pi - \theta) \right), \theta \in \mathbf{R}. \text{ Then } \alpha + 2\beta \text{ is equal to :}$$

- (1) 4 (2) 6 (3) 5 (4) 3

**Q2. JEE Main 2026 (22 January Shift 2)**

Let  $\cos(\alpha + \beta) = -\frac{1}{10}$  and  $\sin(\alpha - \beta) = \frac{3}{8}$ , where  $0 < \alpha < \frac{\pi}{3}$  and  $0 < \beta < \frac{\pi}{4}$ . If  $\tan 2\alpha = \frac{3(1-r\sqrt{5})}{\sqrt{11}(s+\sqrt{5})}$ ,  $r, s \in \mathbf{N}$ , then  $r + s$  is equal to \_\_\_\_\_.

**Q3. JEE Main 2026 (22 January Shift 1)**

If  $\frac{\cos^2 48^\circ - \sin^2 12^\circ}{\sin^2 24^\circ - \sin^2 6^\circ} = \frac{\alpha + \beta\sqrt{5}}{2}$ , where  $\alpha, \beta \in \mathbf{N}$ , then  $\alpha + \beta$  is equal to \_\_\_\_\_

**Q4. JEE Main 2026 (23 January Shift 2)**

The least value of  $(\cos^2 \theta - 6 \sin \theta \cos \theta + 3 \sin^2 \theta + 2)$  is

- (1) -1 (2) 1 (3)  $4 - \sqrt{10}$  (4)  $4 + \sqrt{10}$

**Q5. JEE Main 2026 (23 January Shift 2)**

Let  $\frac{\pi}{2} < \theta < \pi$  and  $\cot \theta = -\frac{1}{2\sqrt{2}}$ . Then the value of

$$\sin \left( \frac{15\theta}{2} \right) (\cos 8\theta + \sin 8\theta) + \cos \left( \frac{15\theta}{2} \right) (\cos 8\theta - \sin 8\theta)$$

is equal to

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

**Q6. JEE Main 2026 (21 January Shift 1)**

The value of  $\operatorname{cosec} 10^\circ - \sqrt{3} \sec 10^\circ$  is equal to :

- (1) 8 (2) 6 (3) 2 (4) 4

**Q7. JEE Main 2026 (28 January Shift 1)**

If  $\frac{\tan(A-B)}{\tan A} + \frac{\sin^2 C}{\sin^2 A} = 1$ ,  $A, B, C \in (0, \frac{\pi}{2})$ , then

- (1)  $\tan A, \tan C, \tan B$  are in A.P.  
(2)  $\tan A, \tan B, \tan C$  are in G.P.  
(3)  $\tan A, \tan C, \tan B$  are in G.P.  
(4)  $\tan A, \tan B, \tan C$  are in A.P.

**Q8. JEE Main 2026 (24 January Shift 1)**

If  $\cot x = \frac{5}{12}$  for some  $x \in (\pi, \frac{3\pi}{2})$ , then  $\sin 7x \left( \cos \frac{13x}{2} + \sin \frac{13x}{2} \right) + \cos 7x \left( \cos \frac{13x}{2} - \sin \frac{13x}{2} \right)$  is equal to

(1)  $\frac{4}{\sqrt{26}}$

(2)  $\frac{6}{\sqrt{26}}$

(3)  $\frac{5}{\sqrt{13}}$

(4)  $\frac{1}{\sqrt{13}}$

**Q9. JEE Main 2026 (24 January Shift 1)**

The value of  $\frac{\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ}{\cos 20^\circ \cos 40^\circ \cos 60^\circ \cos 80^\circ}$  is equal to

(1) 16

(2) 32

(3) 64

(4) 12

## ANSWERS AND SOLUTIONS

1. (3)      2. 20      3. 4      4. (3)      5. (4)      6. (4)      7. (3)      8. (4)

9. (3)

$$1. \quad (3) \quad f(\theta) = 4 \left\{ \sin^4 \left( \frac{7\pi}{2} - \theta \right) + \sin^4(11\pi + \theta) \right\} - 2 \left\{ \sin^2 \left( \frac{3\pi}{2} - \theta \right) + \sin^2(9\pi - \theta) \right\}$$

$$f(\theta) = 4(\cos^4(\theta) + \sin^4(\theta)) - 2(\cos^6\theta + \sin^6\theta)$$

$$f(\theta) = 4(1 - 2\sin^2\theta \cos^2\theta) - 2(1 - 3\sin^2\theta \cos^2\theta)$$

$$f(\theta) = 2 - 2\sin^2\theta \cos^2\theta$$

$$f(\theta) = 2 - \frac{\sin^2(2\theta)}{2}$$

$$\alpha = f(\theta)_{\max} = 2$$

$$\beta = f(\theta)_{\min} = \frac{3}{2}$$

$$\Rightarrow \alpha + 2\beta = 5$$

$$2. \quad (20) \quad \tan 2\alpha = \tan[(\alpha + \beta) + (\alpha - \beta)]$$

$$\tan 2\alpha = \frac{\tan(\alpha + \beta) + \tan(\alpha - \beta)}{1 - \tan(\alpha + \beta) \cdot \tan(\alpha - \beta)}$$

$$\tan 2\alpha = \frac{\left( -\sqrt{99} + \frac{3}{\sqrt{55}} \right)}{1 - \left( -\sqrt{99} \right) \left( \frac{3}{\sqrt{55}} \right)}$$

$$\tan 2\alpha = \frac{-3\sqrt{11} + \frac{3}{\sqrt{5} \times \sqrt{11}}}{1 + \frac{9\sqrt{11}}{\sqrt{5} \times \sqrt{11}}}$$

$$\tan 2\alpha = \frac{3(1 - 11\sqrt{5})}{\sqrt{11}(9 + \sqrt{5})}$$

$$\tan 2\alpha = \frac{3(1 - 11\sqrt{5})}{\sqrt{11}(9 + \sqrt{5})}$$

$$r = 11, s = 9$$

$$r + s = 20$$

$$3. \quad (4) \quad \text{Using } \cos^2 A - \sin^2 B = \cos(A + B) \cos(A - B):$$

$$\cos^2 48^\circ - \sin^2 12^\circ = \cos 60^\circ \cos 36^\circ = \frac{1}{2} \cos 36^\circ.$$

$$\text{Using } \sin^2 A - \sin^2 B = \sin(A + B) \sin(A - B):$$

$$\sin^2 24^\circ - \sin^2 6^\circ = \sin 30^\circ \sin 18^\circ = \frac{1}{2} \sin 18^\circ.$$

$$\text{Ratio} = \frac{\cos 36^\circ}{\sin 18^\circ} = \frac{(1 + \sqrt{5})/4}{(\sqrt{5} - 1)/4} = \frac{(1 + \sqrt{5})^2}{4} = \frac{6 + 2\sqrt{5}}{4} = \frac{3 + \sqrt{5}}{2}.$$

$$\alpha = 3, \beta = 1. \alpha + \beta = 4.$$

$$4. \quad (3) \quad \cos^2 \theta + 3 \sin^2 \theta - 3 \sin 2\theta + 2.$$

Using double angle formulas:

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

$$= 4 - \cos 2\theta - 3 \sin 2\theta.$$

Minimum of  $-\cos 2\theta - 3\sin 2\theta = -\sqrt{1+9} = -\sqrt{10}$ .

Least value  $= 4 - \sqrt{10}$ .

5. (4) Expanding and regrouping:

$$\begin{aligned} & \sin \frac{15\theta}{2} (\cos 8\theta + \sin 8\theta) + \cos \frac{15\theta}{2} (\cos 8\theta - \sin 8\theta) \\ &= \left( \cos \frac{15\theta}{2} \cos 8\theta + \sin \frac{15\theta}{2} \sin 8\theta \right) + \left( \sin \frac{15\theta}{2} \cos 8\theta - \cos \frac{15\theta}{2} \sin 8\theta \right) \\ &= \cos \left( 8\theta - \frac{15\theta}{2} \right) + \sin \left( \frac{15\theta}{2} - 8\theta \right) = \cos \frac{\theta}{2} - \sin \frac{\theta}{2}. \end{aligned}$$

From  $\cot \theta = -\frac{1}{2\sqrt{2}}$ :  $\sin \theta = \frac{2\sqrt{2}}{3}$ ,  $\cos \theta = -\frac{1}{3}$ .

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

Since  $\frac{\pi}{4} < \frac{\theta}{2} < \frac{\pi}{2}$ ,  $\sin \frac{\theta}{2} > \cos \frac{\theta}{2}$ , so the value is  $\frac{1-\sqrt{2}}{\sqrt{3}}$ .

6. (4)  $\operatorname{cosec} 10^\circ - \sqrt{3} \sec 10^\circ = \frac{\cos 10^\circ - \sqrt{3} \sin 10^\circ}{\sin 10^\circ \cos 10^\circ}$ .

$$\text{Numerator: } \cos 10^\circ - \sqrt{3} \sin 10^\circ = 2 \left( \frac{1}{2} \cos 10^\circ - \frac{\sqrt{3}}{2} \sin 10^\circ \right) = 2 \cos 70^\circ = 2 \sin 20^\circ.$$

$$\text{Denominator: } \sin 10^\circ \cos 10^\circ = \frac{1}{2} \sin 20^\circ.$$

$$\text{Result} = \frac{2 \sin 20^\circ}{\frac{1}{2} \sin 20^\circ} = 4.$$

7. (3) Starting with  $\frac{\tan(A-B)}{\tan A} + \frac{\sin^2 C}{\sin^2 A} = 1$ , rearrange to  $\frac{\tan(A-B)}{\tan A} = 1 - \frac{\sin^2 C}{\sin^2 A}$ .

$$\Rightarrow \tan(A-B) \tan A = \sin^2 A - \sin^2 C.$$

Applying the identity  $\sin^2 \theta = \frac{\tan^2 \theta}{1+\tan^2 \theta}$  and simplifying leads to a relationship between the tangent values.

The constraint reduces to  $(\tan C)^2 = \tan A \cdot \tan B$ , which means  $\tan A$ ,  $\tan C$ , and  $\tan B$  form a geometric progression with common ratio  $r = \frac{\tan C}{\tan A}$ .

8. (4)  $\cot x = \frac{5}{12} \Rightarrow \cos x = \frac{-5}{13} = 2 \cos^2 \frac{x}{2} - 1$

$$\cos \left( \frac{x}{2} \right) = -\frac{2}{\sqrt{13}} \text{ or } \frac{2}{\sqrt{13}} \text{ (rejected)}$$

$$\left\{ \because \frac{x}{2} \in \left( \frac{\pi}{2}, \frac{3\pi}{4} \right) \right\}$$

$$\left( \sin 7x \frac{\sin 13x}{2} + \cos 7x \frac{\cos 13x}{2} \right) + \left( \sin 7x \frac{\cos 13x}{2} - \cos 7x \frac{\sin 13x}{2} \right)$$

$$\cos \left( 7x - \frac{13x}{2} \right) + \sin \left( 7x - \frac{13x}{2} \right)$$

$$\cos \frac{x}{2} + \sin \left( \frac{x}{2} \right)$$

$$\frac{3}{\sqrt{13}} - \frac{2}{\sqrt{13}} = \frac{1}{\sqrt{13}}$$

9. (3) Numerator:

$$\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ = \frac{\sqrt{3} \cos 20^\circ - \sin 20^\circ}{\sin 20^\circ \cos 20^\circ}$$

$$\sqrt{3} \cos 20^\circ - \sin 20^\circ = 2 \left( \frac{\sqrt{3}}{2} \cos 20^\circ - \frac{1}{2} \sin 20^\circ \right)$$

$$= 2 \cos(20^\circ + 30^\circ) = 2 \cos 50^\circ$$

$$\text{So numerator} = \frac{2 \cos 50^\circ}{\sin 20^\circ \cos 20^\circ} = \frac{4 \cos 50^\circ}{\sin 40^\circ} = 4$$

Denominator:

$$\cos 20^\circ \cos 40^\circ \cos 60^\circ \cos 80^\circ \text{ where } \cos 60^\circ = \frac{1}{2}$$

Using product formula:

$$\sin 20^\circ \cos 20^\circ \cos 40^\circ \cos 80^\circ = \frac{1}{8} \sin 20^\circ$$

$$\text{Therefore } \cos 20^\circ \cos 40^\circ \cos 80^\circ \cdot \frac{1}{2} = \frac{1}{16}$$

$$\text{So, } \frac{4 \cdot \sin 20^\circ \cos 20^\circ}{\frac{1}{16}} = 64$$