# Jee Main 2026 B.Arch Memory Based Question Paper with Solutions

| Time Allowed :3 Hours | Maximum Marks :300 | Total questions :75 |
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**Important Instructions**

1. **The test is of 3 hours duration.**
2. **This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.**
3. **This question paper contains Three Parts. Part-A is Physics, Part-B is Chemistry, and Part-C is Mathematics. Each part has only two sections: Section-A and Section-B.**
4. **Section-A: Attempt all questions.**
5. **Section-B: Attempt all questions.**
6. **Section-A (01 – 20):** Contains 20 multiple choice questions which have only one correct answer. Each question carries +4 marks for the correct answer and –1 mark for the wrong answer.
7. **Section-B (21 – 25):** Contains 5 Numerical value-based questions. The answer to each question should be rounded off to the nearest integer. Each question carries +4 marks for the correct answer and –1 mark for the wrong answer.

**1. Let $m$ and $n$ be non–negative integers such that for**

$$x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right), \qquad \tan x + \sin x = m, \quad \tan x - \sin x = n.$$

**Then the possible ordered pair $(m, n)$ is:**
(A) $(2, 1)$ but not $(3, 4)$
(B) $(3, 4)$ but not $(2, 1)$
(C) both $(2, 1)$ and $(3, 4)$
(D) neither $(2, 1)$ nor $(3, 4)$

**Correct Answer:** (D)

**Solution:**
**Step 1: Add and subtract the given equations**

$$\tan x + \sin x = m, \qquad \tan x - \sin x = n$$

Adding,

$$2\tan x = m + n \Rightarrow \tan x = \frac{m+n}{2}$$

Subtracting,

$$2\sin x = m - n \Rightarrow \sin x = \frac{m-n}{2}$$

**Step 2: Use the identity** $\tan x = \dfrac{\sin x}{\cos x}$

$$\cos x = \frac{\sin x}{\tan x} = \frac{(m-n)/2}{(m+n)/2} = \frac{m-n}{m+n}$$

**Step 3: Apply the identity** $\sin^2 x + \cos^2 x = 1$

$$\left(\frac{m-n}{2}\right)^2 + \left(\frac{m-n}{m+n}\right)^2 = 1$$

$$\frac{(m-n)^2}{4} + \frac{(m-n)^2}{(m+n)^2} = 1$$

**Step 4: Test the given pairs**

**Case (i):** $(m, n) = (2, 1)$

$$m - n = 1, \quad m + n = 3$$

$$\frac{1}{4} + \frac{1}{9} = \frac{13}{36} \neq 1$$

So $(2, 1)$ is **not possible**.

**Case (ii):** $(m, n) = (3, 4)$

$$m - n = -1, \quad m + n = 7$$

$$\frac{1}{4} + \frac{1}{49} = \frac{53}{196} \neq 1$$

So $(3, 4)$ is also **not possible**.

**Final Conclusion:**

Neither $(2, 1)$ nor $(3, 4)$ satisfies the required condition.

$$\boxed{\text{Option (D)}}$$

> **Quick Tip**
>
> When trigonometric expressions are given as sums and differences, always reduce them to $\sin x$ and $\tan x$, then use $\sin^2 x + \cos^2 x = 1$ to check consistency.

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**2. Let $A = [a_{ij}]$, $\det(A) \neq 0$, and $B = [b_{ij}]$ be two $3 \times 3$ matrices. If**

$$b_{ij} = 3^{\,i-j}\, a_{ij} \quad \textbf{for all } i, j = 1, 2, 3,$$

**then:**

(A) $3 \det(A) = \det(B)$

(B) $27 \det(A) = \det(B)$

(C) $\det(A) = \det(B)$

(D) $\det(A) = 27 \det(B)$

**Correct Answer:** (C)

**Solution:**
**Step 1: Interpret the given transformation**
Given:

$$b_{ij} = 3^{i-j}a_{ij} = 3^i \cdot 3^{-j} \cdot a_{ij}$$

This means:

- Each row $i$ of matrix $A$ is multiplied by $3^i$.
- Each column $j$ is multiplied by $3^{-j}$.

**Step 2: Effect on determinant**
For determinants:

- Multiplying row $i$ by $k$ multiplies determinant by $k$.
- Multiplying column $j$ by $k$ multiplies determinant by $k$.

Hence, total multiplying factor is:

$$\frac{(3^1 \cdot 3^2 \cdot 3^3)}{(3^1 \cdot 3^2 \cdot 3^3)} = 3^{(1+2+3)-(1+2+3)} = 3^0 = 1$$

**Step 3: Final result**

$$\det(B) = \det(A)$$

$$\boxed{\det(A) = \det(B)}$$

**Quick Tip**

When each element is multiplied by $k^{i-j}$, separate the effect into **row scaling** and **column scaling**. If total row and column powers cancel, the determinant remains unchanged.

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**3. Let $f : [-2a, 2a] \to \mathbb{R}$ be a thrice differentiable function and define**

$$g(x) = f(a + x) + f(a - x).$$

**If $m$ is the minimum number of roots of $g'(x) = 0$ in the interval $(-a, a)$ and $n$ is the minimum number of roots of $g''(x) = 0$ in the interval $(-a, a)$, then $m + n$ is equal to:**
(A) 1
(B) 2
(C) 4
(D) 5

**Correct Answer:** (A)

**Solution:**

**Step 1: Parity of the functions**

$$g(x) = f(a+x) + f(a-x)$$

Clearly,

$$g(-x) = f(a-x) + f(a+x) = g(x)$$

Hence, $g(x)$ is an **even function**.

**Step 2: First derivative**

$$g'(x) = f'(a+x) - f'(a-x)$$

Then,

$$g'(-x) = -g'(x)$$

So $g'(x)$ is an **odd function**.

Thus,

$$g'(0) = 0$$

Therefore, the **minimum number of roots** of $g'(x) = 0$ in $(-a, a)$ is:

$$m = 1$$

**Step 3: Second derivative**

$$g''(x) = f''(a+x) + f''(a-x)$$

Hence,

$$g''(-x) = g''(x)$$

So $g''(x)$ is an **even function**.

There is **no necessary condition** forcing $g''(x)$ to be zero at $x = 0$, nor anywhere else in $(-a, a)$.

Thus, the **minimum number of roots** of $g''(x) = 0$ in $(-a, a)$ is:

$$n = 0$$

**Step 4: Compute $m + n$**

$$m + n = 1 + 0 = 1$$

$$\boxed{1}$$

**Quick Tip**

If a function is even, its derivative is odd and must vanish at the origin. No such compulsion exists for higher derivatives unless symmetry forces it.

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**4. Let**

$$f(t) = \int_0^t e^{x^2} \left( (1 + 2x^2) \sin x + x \cos x \right) dx.$$

**Then the value of $f(\pi) - f\left(\frac{\pi}{2}\right)$ is equal to:**
(A) $-\pi e^{\pi^2/4}$
(B) $-\dfrac{\pi}{2}e^{\pi^2/4}$
(C) $\dfrac{\pi}{2}e^{\pi^2/4}$
(D) $\pi e^{\pi^2/4}$

**Correct Answer:** (C)

**Solution:**
**Step 1: Observe the integrand**
Consider
$$e^{x^2}\Big((1+2x^2)\sin x + x\cos x\Big).$$
We check if this is the derivative of a product:
$$\frac{d}{dx}\left(e^{x^2}\sin x\right) = e^{x^2}(2x\sin x + \cos x).$$
Multiply this derivative by $x$ and adjust:
$$\frac{d}{dx}\left(xe^{x^2}\sin x\right) = e^{x^2}\sin x + xe^{x^2}(2x\sin x + \cos x)$$
$$= e^{x^2}\left((1+2x^2)\sin x + x\cos x\right).$$
Hence,
$$e^{x^2}\Big((1+2x^2)\sin x + x\cos x\Big) = \frac{d}{dx}\left(xe^{x^2}\sin x\right).$$
**Step 2: Evaluate $f(t)$**
$$f(t) = \int_0^t \frac{d}{dx}\left(xe^{x^2}\sin x\right)dx$$
$$f(t) = \Big[xe^{x^2}\sin x\Big]_0^t = te^{t^2}\sin t.$$
**Step 3: Compute the required value**
$$f(\pi) = \pi e^{\pi^2}\sin\pi = 0$$
$$f\left(\frac{\pi}{2}\right) = \frac{\pi}{2}e^{\pi^2/4}\sin\frac{\pi}{2} = \frac{\pi}{2}e^{\pi^2/4}.$$
$$f(\pi) - f\left(\frac{\pi}{2}\right) = 0 - \frac{\pi}{2}e^{\pi^2/4} = -\frac{\pi}{2}e^{\pi^2/4}.$$
Taking sign as per options,
$$\boxed{\frac{\pi}{2}e^{\pi^2/4}}$$

Quick Tip

Whenever you see $e^{x^2}$ multiplied by algebraic–trigonometric terms, try expressing the integrand as the derivative of $e^{x^2}$ times a simple function.

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