

PART 1 - MATHEMATICS

Topic : Continuity and differentiability

SECTION-A : (Maximum Marks : 8)

This section contains **TWO** questions.

Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).

For each question, choose the option(s) corresponding to (all) the correct answer(s).

Answer to each question will be evaluated according to the following marking scheme :

Full Marks : +4 ONLY if (all) the correct option(s) is(are) chosen;

Partial Marks : +3 If all the four options are correct but ONLY three options are chosen;

Partial Marks : +2 If three or more options are correct but ONLY two options are chosen, both of which are correct;

Partial Marks : +1 If two or more options are correct but ONLY one option is chosen and it is a correct option;

Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

Negative Marks : -1 In all other cases.

For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then choosing ONLY (A), (B) and (D) will get +4 marks; choosing ONLY (A) and (B) will get +2 marks; choosing ONLY (A) and (D) will get +2 marks; choosing ONLY (B) and (D) will get +2 marks; choosing ONLY (A) will get +1 mark; choosing ONLY (B) will get +1 mark; choosing ONLY (D) will get +1 mark; choosing no option (i.e. the question is unanswered) will get 0 marks; and choosing any other combination of options will get -1 marks.

1. Let R denote the set of all real numbers. Let $f: R \rightarrow R$ be an arbitrary function and let $g: R \rightarrow R$ be the function defined by $g(x) = xf(x)$, for all $x \in R$.

Then which of the following statements is (are) TRUE ?

[JEE Advanced 2026 Paper 1]

- (A) The function g is always continuous at $x = 0$
 (B) If f is continuous at $x = 0$, then g is differentiable at $x = 0$
 (C) If g is differentiable at $x = 0$, then f is continuous at $x = 0$
 (D) If g is differentiable at $x = 0$, then $\lim_{x \rightarrow 0} f(x)$ exists

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Space for Rough Work

2. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ and $g: \mathbb{R} \rightarrow \mathbb{R}$ be functions defined by

$$f(x) = \begin{cases} x|x| \sin\left(\frac{1}{x}\right), & x \neq 0, \\ 0, & x = 0, \end{cases} \text{ and } g(x) = \begin{cases} 1-2x, & 0 \leq x \leq \frac{1}{2}, \\ 0, & \text{otherwise.} \end{cases}$$

Let $a, b, c, d \in \mathbb{R}$. Define the function $h: \mathbb{R} \rightarrow \mathbb{R}$ by

$$h(x) = a f(x) + b \left(g(x) + g\left(\frac{1}{2} - x\right) \right) + c(x - g(x)) + d g(x), \quad x \in \mathbb{R}.$$

Match each entry in **List-I** to the correct entry in **List-II**.

[JEE Advanced 2024 Paper 1]

List-I		List-II	
P.	If $a = 0, b = 1, c = 0$, and $d = 0$, then	1.	h is one-one.
Q.	If $a = 1, b = 0, c = 0$, and $d = 0$, then	2.	h is onto.
R.	If $a = 0, b = 0, c = 1$, and $d = 0$, then	3.	h is differentiable on $\mathbb{R}$.
S.	If $a = 0, b = 0, c = 0$, and $d = 1$, then	4.	the range of h is $[0, 1]$.
		5.	the range of h is $\{0, 1\}$.

(A) $(P) \rightarrow (4) (Q) \rightarrow (3) (R) \rightarrow (1) (S) \rightarrow (2)$

(B) $(P) \rightarrow (5) (Q) \rightarrow (2) (R) \rightarrow (4) (S) \rightarrow (3)$

(C) $(P) \rightarrow (5) (Q) \rightarrow (3) (R) \rightarrow (2) (S) \rightarrow (4)$

(D) $(P) \rightarrow (4) (Q) \rightarrow (2) (R) \rightarrow (1) (S) \rightarrow (3)$

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SECTION-B : (Maximum Marks : 12)

This section contains **THREE** questions.

The answer to each question is a **NUMERICAL VALUE**.

For each question, enter the correct numerical value of the answer (in decimal notation, truncated / rounded-off to the **SECOND DECIMAL PLACE**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) in the place designated to enter the answer.

Answer to each question will be evaluated according to the following marking scheme :

Full Marks : +4 If **ONLY** the correct answer is entered;

Zero Marks : 0 In all other cases.

3. Consider the function $f: \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) \rightarrow (-\infty, \infty)$ defined by

$$f(x) = (|x| + |x-1|)\sin x + [x\sin x],$$

where $[x\sin x]$ is the greatest integer less than or equal to $x\sin x$.

Let α be the total number of points in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ at which f is NOT continuous,

and let β be the total number of points in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ at which f is NOT differentiable.

Then the value of $\alpha + \beta$ is _____.

[JEE Advanced 2026 Paper 1]

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4. For a real number α , let $[\alpha]$ denote the greatest integer less than or equal to α . For a finite set S , let $|S|$ denote the number of elements in the set S .

Consider the functions $f: (-3, 3) \rightarrow (-\infty, \infty)$ and $g: (-3, 3) \rightarrow (-\infty, \infty)$ defined by

$$f(x) = [x^3]\log_e(1 + \sin^2(\pi(x - [x])))$$

and

$$g(x) = x^3\sin^2(\pi\log_e(1 + x - [x])).$$

Let

$$A = \{x \in (-3, 3) : f \text{ is discontinuous at } x\}$$

and

$$B = \{x \in (-3, 3) : g \text{ is discontinuous at } x\}.$$

Then the value of $|A| + 2|B| - |A \cap B|$ is _____.

[JEE Advanced 2026 Paper 2]

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5. Let $\mathbb{R}$ denote the set of all real numbers. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ and $g: \mathbb{R} \rightarrow (0, 4)$ be functions defined by

$$f(x) = \log_e(x^2 + 2x + 4), \text{ and } g(x) = \frac{4}{1 + e^{-2x}}.$$

Define the composite function $f \circ g^{-1}$ by $(f \circ g^{-1})(x) = f(g^{-1}(x))$, where g^{-1} is the inverse of the function g .

Then the value of the derivative of the composite function $f \circ g^{-1}$ at $x = 2$ is _____.

[JEE Advanced 2025 Paper 2]

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JEE ADVANCED CONTINUITY AND
DIFFERENTIABILITY — PYQS

Test Pattern : JEE (Advanced)

ANSWER KEY

SECTION-A																							
Ques.	1	2																					
Ans.	B, D	C																					

SECTION-B													
Ques.	3	4	5										
Ans.	5	56	0.2 to 0.3										