PRACTICE PAPER 01 (2026-27)
CHAPTER 05 : CONTINUITY AND DIFFERENTIABILITY

SUBJECT: MATHEMATICS	**MAX. MARKS:** 40
CLASS: XII	**DURATION:** 1½ hrs

General Instructions:

(i) All questions are compulsory.

(ii) This question paper contains 20 questions divided into five Sections A, B, C, D and E.

(iii) Section A comprises 10 MCQs of 1 mark each (Q9 and Q10 are Assertion–Reason questions). Section B comprises 4 questions of 2 marks each. Section C comprises 3 questions of 3 marks each. Section D comprises 1 question of 5 marks with an internal choice. Section E comprises 2 case study based questions of 4 marks each, with internal choice in the last sub-part.

(iv) There is no overall choice. Internal choices have been provided where indicated.

(v) Use of calculators is not permitted.

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. The function f given below is continuous at x = 2. The value of k is

$$f(x) = \begin{cases} kx^2, & \text{if } x \le 2 \\ 3, & \text{if } x > 2 \end{cases}$$

(a) 3/4 (b) 4/3 (c) 3 (d) 4

2. The derivative of sin(log x) with respect to x is

(a) cos(log x) (b) −cos(log x)/x (c) cos(log x)/x (d) sin(log x)/x

3. At x = 3, the function f(x) = |x − 3| is

(a) differentiable, not continuous (b) continuous, not differentiable (c) continuous and differentiable (d) neither continuous nor differentiable

4. If $y = 5\cos x - 3\sin x$, then $d^2y/dx^2 + y$ is equal to

(a) y (b) −y (c) 2y (d) 0

5. The function $f(x) = (x^2 - 9)/(x - 3)$ for $x \neq 3$ is continuous at x = 3 if f(3) equals

(a) 3 (b) 6 (c) 9 (d) 0

6. The derivative of $5^x + x^5$ with respect to x is

(a) $5^x + 5x^4$ (b) $x \cdot 5^{x-1} + 5x^4$ (c) $5^x \log 5 + 5x^4$ (d) $5^x \log 5 + x^5 \log 5$

7. If $x = t^2$ and $y = t^3$, then dy/dx at t = 2 is

(a) 3 (b) 3/2 (c) 6 (d) 2

8. The value of c in Rolle's theorem for $f(x) = x^2 - 4x + 3$ on the interval [1, 3] is

(a) 1 (b) 3/2 (c) 3 (d) 2

For Q9 and Q10, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

9. Assertion (A): A function that is continuous at a point is also differentiable at that point.

Reason (R): The function f(x) = |x| is continuous but not differentiable at x = 0.

10. Assertion (A): d/dx (log|x|) = 1/x for all $x \neq 0$.

Reason (R): For x < 0, log|x| = log(−x) and d/dx [log(−x)] = 1/x.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. Differentiate $\log(\sin e^x)$ with respect to x.

12. Find dy/dx if $y = x^{\cos x}$, $x > 0$.

13. Find dy/dx if $x^2y + xy^2 = 12$.

14. Find the value of k for which the function below is continuous at $x = \pi$.

$$f(x) = \begin{cases} kx + 1, & \text{if } x \le \pi \\ \cos x, & \text{if } x > \pi \end{cases}$$

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Show that the function given below is continuous but not differentiable at $x = 1$.

$$f(x) = \begin{cases} x^2, & \text{if } x \le 1 \\ 3x - 2, & \text{if } x > 1 \end{cases}$$

16. If $y = 2e^{3x} + 5e^{-x}$, prove that $d^2y/dx^2 - 2\,dy/dx - 3y = 0$.

17. If $x = a(\theta - \sin\theta)$ and $y = a(1 - \cos\theta)$, find dy/dx and its value at $\theta = 2\pi/3$.

SECTION – D

Question 18 carries 5 marks.

18. Find dy/dx if $y = (\tan x)^x + x^{\tan x}$, $0 < x < \pi/2$.

OR

If $y = (\sin^{-1} x)^2$, prove that $(1 - x^2)\,d^2y/dx^2 - x\,dy/dx = 2$.

SECTION – E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

19. A cab company in a city charges a fare of ₹f(x) for a trip of x km, according to the rule

$$f(x) = \begin{cases} 20x + 10, & \text{if } 0 \le x \le 3 \\ 15x + k, & \text{if } x > 3 \end{cases}$$

where k is a constant.

Based on the above information, answer the following questions:

(i) Find the left hand limit of f(x) at $x = 3$. (1)

(ii) Find the value of k for which f is continuous at $x = 3$. (1)

(iii) For this value of k, find the rate of change of the fare just before and just after 3 km. Is f differentiable at $x = 3$? (2)

OR

(iii) For this value of k, find the fare for a 10 km trip and the rate of change of the fare with respect to distance at $x = 10$. (2)

20. After a patient takes a medicine, its concentration in the blood after t hours is $C(t) = 20t\, e^{-t/2}$ mg/L, $t \geq 0$.

Based on the above information, answer the following questions:

(i) Find dC/dt. (1)

(ii) At what time is $dC/dt = 0$? (1)

(iii) Find d^2C/dt^2 and show that the concentration is maximum at the time found in (ii). (2)

OR

(iii) Show that $4\, d^2C/dt^2 + 4\, dC/dt + C = 0$. (2)

— End of Question Paper —