

IMPORTANT BOARD QUESTIONS FOR APPLICATION OF DERIVATIVES

1. Find the approximate value of $f(2.01)$ where $f(x) = x^2 + x + 1$
2. Prove that the function $f(x) = x^3 - 6x^2 + 12x + 5$ is increasing for all $x \in \mathbb{R}$.
3. Find the point on the curve $y = x^2$, where the slope of the tangent is $\frac{1}{2}$.
4. If $x = \sin \theta$, $y = \cos \theta$, find $\frac{dy}{dx}$ at $\theta = \frac{\pi}{4}$
5. Find the slope of the tangent to the curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = 2$ at $(1,1)$
6. Find the point in the curve $y = \frac{x}{1+x^2}$, where the tangent to the curve has the greatest slope.
7. The side of an equilateral triangle is increasing at the rate of 2cm/s. At what rate is its area increasing when the side of the triangle is 20 cm?
8. Find the local maxima and local minima, of the function $f(x) = \sin x - \cos x$, $0 < x < 2\pi$.
9. Also find the local minimum and local maximum values.
10. Find the coordinates of a point of the parabola $y = x^2 + 7x + 2$ which is closest to the straight line $y = 3x - 3$.
11. Find the minimum value of $(ax + by)$, where $xy = c^2$.
12. Find the minimum area of an isosceles triangle inscribed in the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ with its vertex at one end of the major axis.
13. Find a point on the curve $y = (x - 2)^2$ at which the tangent is parallel to the chord joining the points $(2,0)$ and $(4,4)$. Also find the equation of the tangent.
14. Find two such positive numbers whose sum is 16 and the sum of whose cubes is minimum.
15. If the function $f(x) = 2x^3 - 9mx^2 + 12m^2x + 1$, where $m > 0$ attains its maximum and minimum at p and q respectively such that $p^2 = q$, then find the value of m .
16. Find the absolute maximum and absolute minimum values of the function f given by $f(x) = \sin^2 x - \cos x$, $x \in [0, \pi]$.
17. Find the equation of the straight line is tangent at one point and normal at another point of the curve $x = 3t^2$, $y = 2t^3$.
18. Find the maximum and minimum values of $f(x) = \sec x + \log \cos^2 x$, $0 < x < 2\pi$.

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19. Show that the equation of normal at any point on the curve $x = 3 \cos \theta - \cos^3 \theta, y = 3 \sin \theta - \sin^3 \theta$ is $4(y \cos^3 x - x \sin^3 \theta = 3 \sin 4\theta)$.
20. An open box is to be constructed by removing equal squares from each corner of a 3m X 8m rectangular sheet of aluminum and filling up the sides. Find the volume of the largest such box.
21. If the radius of a sphere is measured as 9 cm with an error of 0.03 cm, then find the approximate error in calculating its surface area.
22. Show that the right circular cone of least curved surface and given volume has an altitude equal to $\sqrt{2}$ times the radius of the base.
23. A window has the shape of a rectangle surmounted by an equilateral triangle. If the perimeter of the window is 12 m, find the dimensions of the rectangle that will produce the largest area of the window.
24. Find the intervals in which the function $f(x) = (x - 1)(x - 2)^2$ is (a) increasing, (b) decreasing.
25. Find the area of smaller region bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and the straight line $\frac{x}{a} + \frac{y}{b} = 1$.
26. Find all the points of local maxima and local minima for the function f, given by $f(x) = (x - 1)^3 (x + 2)^2$.
27. A point is given on the circumference of a circle of radius r. A chord QR is parallel to the tangent line at P. Find the maximum area of ΔPQR .
28. If the length of a trapezium other than the base is 10 cm each, find the area of the trapezium, when it is maximum.
29. Find the intervals in which the following function $f(x) = \sin x + \cos x, 0 \leq x \leq 2\pi$. (a) strictly increasing & (b) strictly decreasing.
30. Show that the volume of the greatest cylinder that can be inscribed in a cone of height 'h' and semi-vertical angle α is $\frac{4}{27} \pi h^3 \tan^2 \alpha$.

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