

THE O.P. GUPTA

ADVANCED MATH CLASSES

Class XII - Mathematics (041)

Topics - Applications Of Derivatives

Alpha Test Series-5

(For Academic session 2025-26)

Max. Marks - 30

Time - 60 Minutes

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Followings are of 2 Marks each (Q01-05).

Q01. A man 2 m high, walks at a uniform speed of 6 m/min away from a lamp post, 5 m high. At what rate the length of his shadow changes?

Q02. Find the interval in which $f(x) = \cos 3x$, $x \in \left[0, \frac{\pi}{2}\right]$ is increasing or decreasing.

Q03. Find the values of 'a' and 'b' for which the function $f(x) = \sin x - ax + b$ strictly increases on $\mathbb{R}$.

Q04. A particle moves in a straight line such that the distance covered by it in t seconds measured from a fixed point on the line is given by $s = \left(\frac{t^3}{3} - 16t\right)$ cm. Find its acceleration when velocity is zero.

Q05. For the function $f(x) = 12x^{\frac{4}{3}} - 6x^{\frac{1}{3}}$, $x \in [-1, 1]$, find the absolute maximum and absolute minimum values (if possible). [2 × 5 = 10]

Followings are of 3 Marks each (Q06-07).

Q06. For $f(x) = \frac{\log x}{x}$, find the point of local maximum. Also write the local maximum value of $f(x)$.

Q07. Show that the maximum value of $f(x) = x + \frac{1}{x}$ is less than its minimum value. [3 × 2 = 6]

Following is of 4 Marks (Q08).

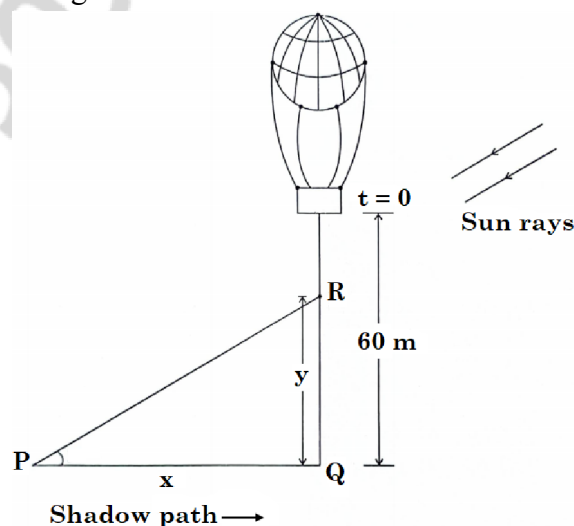
Q08. **CASE STUDY QUESTION :** A sandbag is dropped from a balloon at a height of 60 metres. When the angle of elevation of the sun is 30° , the position of the sandbag is given by the equation $y = 60 - 4.9t^2$, where y is the height of the sandbag above the ground and t is the time in seconds.

(i) Find the relation between x and y , where x is the distance of the shadow at P from the point Q and y is the height of the sandbag above the ground.

(ii) After how much time will the sandbag be 35 m above the ground?

(iii) Find the rate at which the shadow of the sandbag is travelling along the ground when the sandbag is at a height of 35 metres.

(iv) How fast is the height of the sandbag decreasing when 2 seconds have elapsed? [1 × 4 = 4]



Followings are of 5 Marks each (Q09-10).

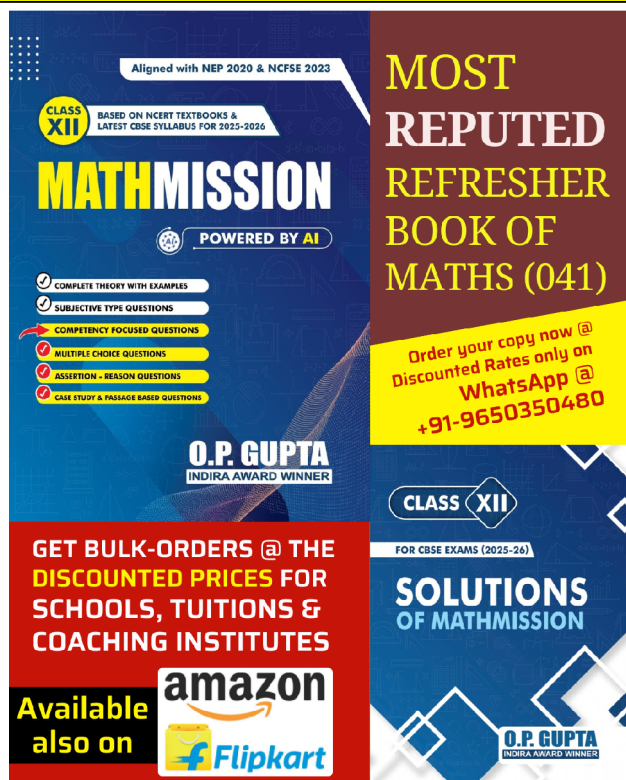
Q09. Find the intervals in which the function $f(x) = -3\log(1+x) + 4\log(2+x) - \frac{4}{2+x}$ is strictly increasing or strictly decreasing.

OR

Using first derivative test, determine the points of local maxima and minima (if any), of the function $f(x) = (x-1)^3(x+1)^2$; also find the local maximum and local minimum values.

- Q10. A student is given card board of area 27 square centimeters. He wishes to form an open box with square base to have maximum capacity and no wastage of the board. What are the dimensions of the box so formed? Also find the maximum volume of the box. [$5 \times 2 = 10$]

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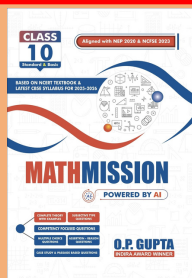
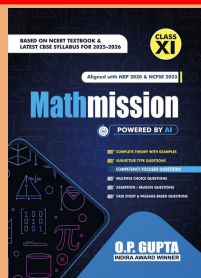
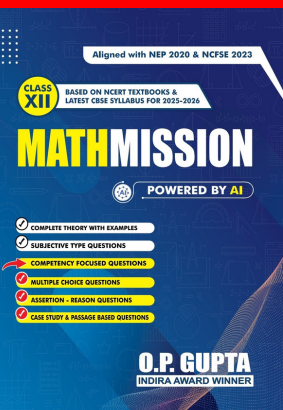
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