One Two academy | Applications of Differential Calculus

Maximum Mark: 25 **Mathematics** **Time: 50 minutes**

Choose the correct answer: **3 x 1 = 3**

1. The number given by MVT for the function $\frac{1}{x}, x \in [1,9]$ is

(a) 2 (b) 2.5 (c) 3 (d) 3.5

2. The point on the curve 6y = $x^3 + 2$ at which y-coordinate changes 8 times as fast as x-coordinate is

(a) (4,11) (b) (4,-11) (c) (-4,11) (d) (-4,-11)

3. The least value of a when f(x) = $x^2 + ax + 1$ is increasing on (1,2) is

(a) -2 (b) 2 (c) 1 (d) -1

Answer the following: **3 x 2 = 6**

4. A man 2m high walks at a uniform speed of 5km/hr away from a lamp post 6m high. Find the rate at which the length of his shadow increases?

5. Evaluate: $\lim_{x\to 0}\left(\frac{1}{sinx} - \frac{1}{x}\right)$

6. Explain why Lagrange's MVT is not applicable to the following function

f(x) = |3x + 1|, $x \in [-1,3]$.

Answer any two of the following: **2 x 3 = 6**

7. Find the absolute extrema: f(x) = $6\,x^{\frac{4}{3}} - 3x^{\frac{1}{3}}$; [-1,1].

8. Write the Maclaurin series expansion for $\tan^{-1} x; -1 \le x \le x$.

9. Salt is poured from a conveyer belt at a rate of 30 cubic metre per minute forming a conical pile with a circular base whose height and diameter of base are always equal. How fast is the height of the pile increasing when the pile is 10 metre high?.

Answer the following: **2 x 5 = 10**

10. Find the intervals of concavity and the points of the inflection for the function:

$$f(x) = \frac{1}{2}(e^x - e^{-x})$$

11. A manufacturer wants to design an open box having square base and a surface area of 108 cm^2. Determine the dimension of the box for the maximum volume.

OR

If the curve $ax^2 + by^2 = 1$ and $cx^2 + dy^2 = 1$ intersect each other orthogonally then show that $\frac{1}{a} - \frac{1}{b} = \frac{1}{c} - \frac{1}{d}$.

All the Best

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Answer Key attached in the next page !!!

This page is to prevent seeing answer key

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Answer Key

<table>
<tr><th>Q.no</th><th>Solution</th><th>Marks</th></tr>
<tr><td>1.</td><td>(c) 3</td><td>1</td></tr>
<tr><td>2.</td><td>(a) (4,11)</td><td>1</td></tr>
<tr><td>3.</td><td>(a) -2</td><td>1</td></tr>
<tr><td>4.</td><td>2.5 km/hr</td><td>2</td></tr>
<tr><td>5.</td><td>0.</td><td>2</td></tr>
<tr><td>6.</td><td>f(x) is continuous in [-1,3] but f(x) is not differentiable at x = $-\frac{1}{3}$</td><td>2</td></tr>
<tr><td>7.</td><td>Absolute maximum = 9
Absolute minimum = $-\frac{9}{8}$</td><td>3</td></tr>
<tr><td>8.</td><td>$\tan^{-1} x = x - \frac{x^3}{3} + \frac{x^5}{5} - \cdots$</td><td>3</td></tr>
<tr><td>9.</td><td>$\frac{6}{5\pi}\frac{m}{min}$</td><td>3</td></tr>
<tr><td>10.</td><td><table><tr><th>Interval</th><th>Sign if f”(x)</th><th>Concavity</th></tr><tr><td>$(-\infty, 0)$</td><td>-ve</td><td>Concave down</td></tr><tr><td>$(0, \infty)$</td><td>+ve</td><td>Concave up</td></tr></table>Point of inflection (0,0)</td><td>5</td></tr>
<tr><td>11.</td><td>L = 6cm, B = 6 cm, H = 3 cm.
OR
Correct proof</td><td>5</td></tr>
<tr><td></td><td></td><td></td></tr>
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