1. A particle moves along the curve \( y = x^2 + 2x \) at what points on the curve are the \( x \) & \( y \) co-ordinates of the particle changing at the same rate?

2. A balloon in the form of a circular cone surmounted by a hemisphere having a diameter equal to the height of the cone is being inflated. How fast is its volume changing with respect to the total length \( h \), when \( h = 9 \) cm.

3. The radius of a cylinder is increasing at the rate 2 cm/sec & its attitude decreasing at the rate of 3 cm/sec. Find the rate of change of volume where radius is 3 cm & altitude is 5 cm.

4. A particle moves along the curve \( y = \frac{2}{3}x^3 + 1 \). Find the points on the move at which the \( y \)-co-ordinate is changing twice as fast as its \( x \)-co-ordinate.

5. Use differentiation to find the approximate values of (i) \((0.009)^{\frac{1}{3}}\) (ii) \((0.007)^{\frac{1}{3}}\) (iii) \((255)^{\frac{1}{4}}\)

6. Find approximate value of \( f(5.00) \) if \( f(x) = x^3 - 7x^2 + 15 \)

7. Find the percentage curves in finagling the surface area of a cubical box if an error 1% is made in mercury the length of edges of the cube.

8. Verify Rolle’s Theorem for the functions \( f(x) = (x - 9)^m (x - b)^n \) on the retrieval \((a, b)\) where \( m, n \) are \(+ve\) integers.

9. Verify Rolle’s theorem for (i) \( f(x) = e^x / \sin x - \cos x \) on the interval \((a, b)\)

10. Verify mean value theorem for (i) \( f(x) = \sin x + \sin 2x \) on \((0, \pi)\) (ii) \( f(x) = x^3 - 2x^2 - x + 3 \) on \((0, 1)\) (iii) \( f(x) = 10e^x \) on \([1, 2]\)

11. Prove : tangents to the curve \( y = x^2 - 5x + 6 \) at points \((2, \cdot)\) and \((3, 0)\) are at right angles.

12. Find the equation of the normal to the curve \( x = a \cos^3 \theta, y = a \sin^3 \theta \) at \( \theta = \frac{2\pi}{3} \)

13. Find the equation of the tangent & normal to the curves: (i) \( a = a \) (or \( \sin \theta \)) \( y = a (1 + \cos \theta) \) at \( \theta = \frac{\pi}{2} \) (ii) \( y = x^3 - 3x \) at \( x = 2 \) (iii) \( y^2 + 3y + y^3 = 5 \) at \((1, 1)\)

14. Find the mean of normal to the curve \( x = a \cos \theta, y = a \sin \theta \) at \( \theta = \pi/4 \)

15. Find the interval in which \( f(x) \) is (i) increase (ii) decrease (a) \( f(x) = 2x^3 + px^2 + 12x + 20 \) (ii) \( f(x) = x^4 = x^3/3 \) (iii) \( f(x) x^3 + \frac{1}{x} \)

16. Separate \((0, \frac{\pi}{2})\) in sub-intervals in which \( f(x) = \sin 3x \) in increasing or decreasing is also \( f(x) = \sin 4x + \cos 4x \).

17. Show that semi-vertical angle of cone of max vol. \( K \) of given slant is \( \tan^{-1} \sqrt{2} \)