Q1. A ladder 13m long is leaning against a vertical wall. The bottom of the ladder is dragged away from the wall along the ground at the rate of 2cm/sec. How fast is the height on the wall decreasing when the foot of the ladder is 5m away from the wall? **5 Marks**

Q2. Find the local maxima and local minima, if any, of the following function. Also find the local maximum and the local minimum values, as the case may be: **5 Marks**
$f(x) = \sin x + \frac{1}{2}\cos 2x, \ 0 \le x \le \frac{\pi}{2}$

Q3. Of all the closed right circular cylindrical cans of volume $128\pi \text{ cm}^3$, find the dimensions of the can which has minimum surface area. **5 Marks**

Q4. Prove that the height of the cylinder of maximum volume that can be inscribed in a sphere of radius R is $\frac{2R}{\sqrt{3}}$ Also finds the maximum volume. **5 Marks**

Q5. Amongst all open (from the top) right circular cylindrical boxes of volume $125\pi\text{cm}^3$, find the dimensions of the box which has the least surface area. **5 Marks**

Q6. The sum of the perimeters of circle and a square is K, where K is some constant. Prove that the sum of their areas is least when the side of the square is twice the radius of the circle. **5 Marks**

Q7. Show that the altitude of the right circular cone of maximum volume that can be inscribed in a sphere of radius r is $\frac{4r}{3}$. Also find the maximum volume of cone. **5 Marks**

Q8. Show that of all the rectangles inscribed in a given fixed circle, the square has the maximum area. **5 Marks**

Q9. Find the intervals in which the function f(x) = x^3 - 12x^2 + 36x +17 is (a) increasing, (b) decreasing. **5 Marks**

Q10. Find the absolute maximum and absolute minimum values of the function f given by **5 Marks**
$f(x) = \sin^2 x - \cos x \ , \ x \in [0, \pi]$.

Q11. Show that the altitude of the right circular cone of maximum volume that can be inscribed in a sphere of radius r is $\frac{4r}{3}$. Also show that the maximum volume of the cone is $\frac{8}{27}$ of the volume of the sphere. **5 Marks**

Q12. Find the intervals on which the function f(x) = (x − 1)^3 (x − 2)^2 is: **5 Marks**
1. Strictly increasing.
2. Strictly decreasing.

Q13. Show that the height of the cylinder of maximum volume that can be inscribed in a cone of height h is $\frac{1}{3}h$. **5 Marks**

Q14. Determine the intervals in which the function $f(x) = x^4 - 8x^3 + 22x^2 - 24x + 21$ is strictly increasing or strictly decreasing. **5 Marks**

Q15. Prove that $y = \frac{4\sin\theta}{2+\cos\theta} - \theta$ is an increasing function of θ on $\left[0, \frac{\pi}{2}\right]$. **5 Marks**