

Calculators are not allowed

Answer the following questions:

1. (7 points) Use the differentials to find an approximate value of $\frac{\sqrt[3]{1.02} + (1.02)^2}{\sqrt{102}}$

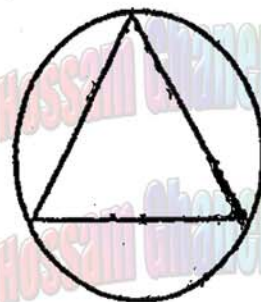
2. (7 points) Find equations for the normal lines to the graph of

$$x^2y + \sin y = 2\pi$$

at the points whose y -coordinate is 2π .

3. (7 points) An equilateral triangle is inscribed inside a circle of radius r (see the figure).

If the radius of the circle increases at a rate of $\frac{dr}{dt} = 2$ cm/sec, find the rate of change of the area of the triangle when $r = \sqrt{3}$ cm.



4. (2+5 points) State Rolle's theorem. Let $f(x) = \sin \frac{x}{4} + \cos \frac{x}{4}$, find all real numbers $c \in (0, 2\pi)$ that satisfy the conclusion of Rolle's theorem for f .

5. Let

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

(a) (3 points) Find the intervals on which f is increasing or decreasing, and find the local extrema of f (if any).

(b) (3 points) Find the intervals on which the graph of f is concave upward or concave downward, and find the points of inflection (if any).

(c) (3 points) Find the vertical and horizontal asymptotes for the graph of f (if any).

(d) (3 points) Sketch the graph of f .