

Answer all of the following questions. Calculators are not allowed
All items are weighted equally at 5 points each.

1. (a) Find $\frac{dy}{dx}$ if $y = \sqrt{x+1} \sin^3\left(\frac{x}{1+x}\right)$

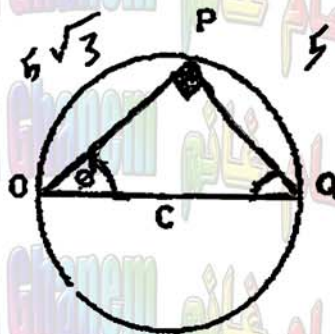
(b) If $y = \sqrt{1+\sqrt{u}}$ and $u = 2 + \sec^2 x$, then find $\frac{dy}{dx}$ at $x = \frac{\pi}{4}$

2. (a) Find the absolute extrema of the function $f(x) = (x^2 - 9)^{\frac{2}{3}}$, $-1 \leq x \leq 6$.

(b) Use the Mean value theorem to show that $|\sin^2 a - \sin^2 b| \leq |a - b|$, for all real numbers a and b

3. (a) Use differentials to approximate $1 + (7.9)^{\frac{2}{3}}$

(b) A point P moves on a circle of radius 5 m. at a constant rate $\frac{d\theta}{dt} = 3$ rad/sec.
Find the rate at which the area of the triangle OPQ (see figure) changes when
 $\theta = \frac{\pi}{6}$



C is the center of the circle

4. (a) If

$$f(x) = \begin{cases} 1 + \sin 3(x-1) & , x < 1 \\ ax^2 + b & , x \geq 1 \end{cases}$$

then find the constants a and b so that $f'(1)$ exists.

(b) Find the value of the constant c such that the line joining the points $(0,1)$ and $(2,2)$ is normal to the graph of $y = \frac{c}{1+x}$

Good Luck