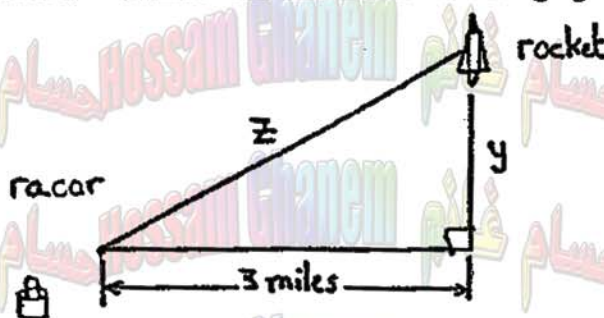


Calculators and Mobile Phones are not allowed.

1. Find the equation of the tangent line to the curve  $\frac{x^2}{9} + \frac{y^2}{4} = 1$  at the point  $(0, -2)$ . (5 points)

2. A metallic sheet having a square shape is being heated. If the length of each side increases from 15 cm to 15.02 cm, use differentials to find the approximate increase in the area of the square. (5 points)

3. A rocket is launched vertically and is tracked by a radar station located on the ground 3 miles from the launching site. What is the vertical speed  $\frac{dy}{dt}$  of the rocket at the instant when its distance from the radar station is  $z = 5$  miles and this distance is changing at the rate  $\frac{dz}{dt} = 5000$  miles/hr. (5 points)



4. State Rolle's theorem, and use it to show that  $x^3 + x - 17 = 0$  can not have two distinct real roots. (5 points)

5. Find

a)  $\int \frac{3x^3 + 2x^2 - 1}{\sqrt{x}} dx$ , (2.5 points)

b)  $\int \frac{dx}{\cos^2(3x - 7)}$  (2.5 points)

6. Let

$$f(x) = \frac{x}{x^2 + 4x + 4}$$

a) Show that  $f'(x) = \frac{2-x}{(x+2)^3}$  (3 points)

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

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

d) Given that  $f''(x) = \frac{2(x-4)}{(x+2)^4}$ , find the intervals on which the graph of  $f$  is concave upward or concave downward, and find the points of inflection (if any). (3 points)

e) Sketch the graph of  $f$ . (3 points)