

Calculators and mobile phones are not allowed.  
Answer the following questions.

1. Use differentials to find an approximate value of  $\sqrt[3]{64.1}$ .  
(3 Points)

2. Find an equation for the tangent line to the graph of  
 $y + y^2 \tan x + \sin(xy) = 1$  at  $x = 0$   
(4 Points)

3. Show that  $\cos x - \sin x + \frac{2}{\pi} = 0$  has a solution in the interval  $[0, \pi]$   
(Hint: Use the mean value theorem for  $f(x) = \sin x + \cos x$ )  
(4 Points)

4. Find the point on the graph of  
 $y = x^2 + 5$   
which is closest to the point  $(3, 5)$ .  
(4 Points)

5. Gas is pumped into a spherical ball at a rate of  $10 \text{ cm}^3/\text{sec}$ . Find the rate at which  
the radius of the ball is changing when the diameter of the ball is  $20 \text{ cm}$  long.  
(4 Points)

6. Let  
 $f(x) = x^3 - 6x^2 + 9x + 1$ , for  $x \in [0, 4]$ .  
(a) Find the intervals on which  $f$  is increasing or decreasing, and find the local extrema of  $f$ , if any.  
(b) Find the intervals on which the graph of  $f$  is concave up or concave down, and find the points of inflection, if any.  
(c) Sketch the graph of  $f$  on  $[0, 4]$ .  
(6 Points)