## HOMEWORK 3 - MATH 151 DUE DATE: Monday, October 9 INSTRUCTOR: George Voutsadakis

Read each problem **very carefully** before starting to solve it. Four out of the ten problems will be chosen at random and graded. Each problem graded is worth 3 points. It is necessary to show **all** your work. Correct answers without explanations are worth 0 points.

## GOOD LUCK!!

1. Differentiate the following functions

(a) 
$$f(x) = x^3 - 4x + 6$$
 (b)  $f(x) = \frac{x^2 + 4x + 7}{\sqrt[3]{x}}$  (c)  $f(x) = \sqrt[3]{x^2} + 2\sqrt{x^3}$ 

- 2. Find the equations of the tangent line and the normal line to the curve  $f(x) = -6\cos x$  at  $(\frac{\pi}{3}, -3)$ .
- 3. Find the first and the second derivatives of the following functions

(a) 
$$f(x) = 2\cos x - 3\sin x$$
 (b)  $g(x) = \sqrt{x} + 5\sin x$ 

- 4. Find an equation for the normal line to the parabola  $y = x^2 5x + 4$  that is parallel to the line x 3y = 5.
- 5. If a tank holds 5000 gallons of water, which drains from the bottom of the tank in 40 minutes, then Torricelli's Law gives the volume V of water remaining in the tank after t minutes as  $V = 5000(1 \frac{1}{40}t)^2, 0 \le t \le 40$ . Find the rate at which the water is draining from the tank after a minutes. At which time is the water draining out the fastest? How about the slowest?
- 6. Differentiate the following functions:

(a) 
$$f(x) = x^3 \sin x$$
 (b)  $f(x) = (\frac{1}{x^2} - \frac{3}{x^4})(x + 5x^3)$  (c)  $f(x) = \frac{x^2}{3x^2 - 2x + 1}$   
(d)  $f(x) = \frac{\sqrt{x} + 1}{\sqrt{x} - 1}$  (e)  $f(x) = \frac{1 + \cos x}{x + \sin x}$ 

7. If f is a differentiable function find an expression for the derivatives of g and h in terms of the derivative of f:

(a) 
$$g(x) = x^2 f(x)$$
 (b) $h(x) = \frac{1 + x f(x)}{\sqrt{x}}$ 

8. Find the derivative of the following functions:

(a) 
$$f(x) = \frac{1}{(x^4 + 1)^7}$$
 (b)  $f(x) = 7^3 + \cos^3 x$  (c)  $f(x) = (x^2 + 1)\sqrt[3]{x^2 + 2}$  (d)  $f(x) = \cos(x \sin x)$ 

9. Find the derivative of the following functions:

(a) 
$$f(x) = \sqrt{\frac{x-1}{x+1}}$$
 (b)  $f(x) = \sin\sqrt{1+x^2}$  (c)  $f(x) = (1+\cos^2 x)^9$  (d)  $f(x) = \cos(\cos(\cos x))$ 

10. Find all points on the graph of  $f(x) = 2\sin x + \sin^2 x$  at which the tangent line is horizontal.