Math 241 Summer 2019 Professor MG
Recitation Worksheet 2 Name: _____

(1) Use implicit differentiation to find dy/dx: $2xy + y^2 = x + y$

(2) Find the equation of the line tangent and the line normal to $y^2 - xy = 3x^3y^4 + x^2 + 4$ at the point $(0, 2)$

(3) One car leaves a given point and travels north at 30 mph. Another car leaves the same point at the same time and travels west at 40 mph. At what rate is the distance between the two cars changing at the instant when the cars have traveled 2 hours?

(4) $s = 6t - t^2$, $0 \le t \le 6$ gives the position of a body moving on a coordinate line, with s in meters and t in seconds.

   (a) Find the body's displacement and average velocity for the given time interval.
   (b) Find the body's speed and acceleration at the endpoints of the interval.
   (c) When, if ever, during the interval does the body change direction?
   (d) Find the total distance travelled by the body during the interval.

(5) A rock thrown vertically upward from the surface of the moon at a velocity of 24 m/sec (about 86 km/h) reaches a height of $s = 24t - 0.8t^2$ meters in t seconds.

   (a) Find the rock's velocity and acceleration at time t
   (b) How long does it take the rock to reach its highest point?
   (c) How high does the rock go?

(6) Find the absolute maximum and minimum values of the function $f(x) = \dfrac{x}{(2x+1)^2}$ on $0 \le x \le 2$

(7) Find the absolute extrema of $f(x) = 3x^4 - 4x^3$ on the interval $[-1, 2]$

(8) Use linear approximation to approximate $\sqrt[3]{9}$. Is this an over or underestimate?

(9) Find the differential dy for the following:

   (a) $y = x\sqrt{1 - x^2}$
   (b) $y = \cos\left(x^2\right)$

(10) Find all values of c that satisfy the conclusion of the mean value theorem for the function $f(x) = x^2 - 5x + 4$ on the interval $[1, 4]$

(11) Show that $x^5 + 10x + 3 = 0$ has exactly one solution.

(12) Show that $f(x) = x^4 + 3x + 1$ has exactly one zero in the interval $[-2, -1]$

(13) Let

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

Then

$$f'(x) = -\frac{2x}{(1+x^2)^2} \text{ and } f''(x) = \frac{6x^2-2}{(1+x^2)^3}$$

(a) Find the intervals on which the graph is increasing and decreasing. Find the local maximums and minimums.

(b) Find the intervals on which the graph is concave up and which it is concave down. Find any inflection points.

(14) Find the relative extrema of $f(x) = x^4 - 4x^3$ and the open intervals in which the graph is concave up and down.