Math 220 **Quiz 8 (take-home)** **Spring 2011**

Name SOLUTIONS

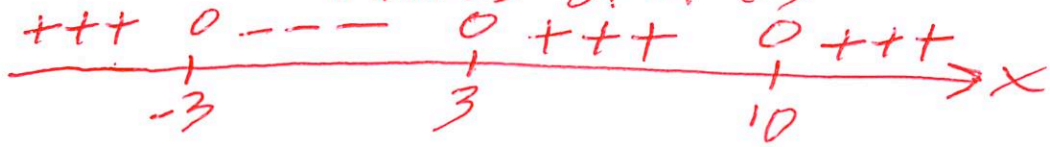
- You may work with other students in this class. However each student should write up solutions separately and independently – nobody should copy someone else's work.
- You may use your notes or the textbook.
- No calculators or computers are allowed on any problem.
- You must show sufficient work to justify each answer.
- The quiz should be turned in to your TA at the beginning of your discussion section meeting on Wednesday, March 9 (Merit sections) or Thursday, March 10 (other sections).
- Be sure that the pages are nicely stapled – do not just fold the corners.
- Note to TA's – you should not help students with these specific problems or go over solutions until after 4pm Thursday.

1. (3 points) A function $f(x)$ has the following first derivative.

$$f'(x) = 3e^x \left(x^2 - 9\right)^7 \left(x^2 + 25\right)^6 (2x - 20)^8$$

$f'(x) = 3e^x (x-3)^7 (x+3)^7 (x^2+25)^6 (2(x-10))^8$

values of $f'(x)$



(a) Find each critical number of the function $f(x)$.

$-3, 3, 10$

(b) Find the x-value for each local maximum value of $f(x)$.

-3

(c) Find the x-value for each local minimum value of $f(x)$.

3

2. (4 points) Complete the sentences concerning the function $f(x) = 8 + 5xe^{-3x}$.

(a) The function f is decreasing on the interval $\left[\frac{1}{3}, \infty\right)$.

(b) The function f is increasing on the interval $\left(-\infty, \frac{1}{3}\right]$

(c) The function f is concave down on the interval $\left(-\infty, \frac{2}{3}\right)$.

(d) The function f is concave up on the interval $\left(\frac{2}{3}, \infty\right)$.

$$f'(x) = 5e^{-3x} + 5x e^{-3x} \cdot (-3)$$
$$= 5e^{-3x}(1 - 3x)$$

$$f''(x) = 5e^{-3x}(-3)(1-3x) + 5e^{-3x}(-3)$$
$$= 15e^{-3x}(-1 + 3x - 1)$$
$$= 15e^{-3x}(-2 + 3x)$$

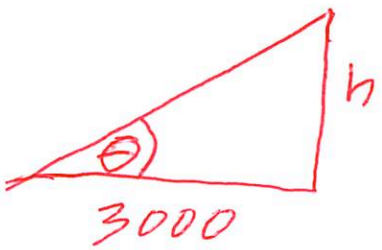
values of $f'(x)$

$+ + +$ $\quad 0 \quad - - -$

values of $f''(x)$

$- - -$ $\quad 0 \quad + + +$

3. (3 points) A television camera is positioned on the ground 3000 feet from the base of a rocket launching pad. The angle of elevation of the camera has to change at the correct rate in order to keep the rocket in sight. Suppose the rocket rises vertically and its speed is 600 feet per second when it has risen 4000 feet. How quickly is the camera's angle of elevation increasing at that moment?



GIVEN $\left.\frac{dh}{dt}\right|_{h=4000\text{ ft}} = 600$ ft/sec

WANT $\left.\frac{d\theta}{dt}\right|_{h=4000\text{ ft}}$

$\tan\theta = \frac{h}{3000}$

$\sec^2\theta \frac{d\theta}{dt} = \frac{1}{3000}\frac{dh}{dt}$

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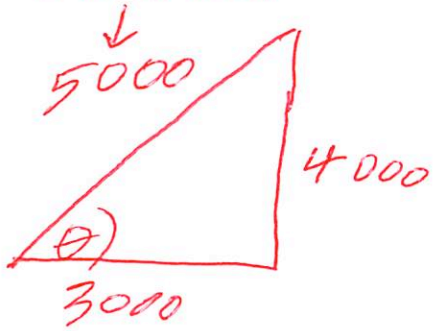

when $h = 4000$, we have

so $\sec\theta = \frac{5000}{3000} = \frac{5}{3}$

$\left(\frac{5}{3}\right)^2 \frac{d\theta}{dt} = \frac{1}{3000}(600)$

$\frac{d\theta}{dt} = \frac{9}{25} \cdot \frac{600}{3000}$

$\frac{d\theta}{dt} = \frac{9}{125}$ radians/sec