



Prince Sultan University

MATH 111

Major Exam II

First Semester Term 171

Sunday, December 10th, 2017

Time Allowed: **100 minutes**

Student Name: _____

Student ID #: _____

Teacher's Name: _____ Section #: _____

Serial #: _____

Important Instructions:

1. You may use a scientific calculator that does not have programming or graphing capabilities.
2. You may NOT borrow a calculator from anyone.
3. You may NOT use notes or any textbook.
4. There should be NO talking during the examination.
5. Your exam will be taken immediately if your mobile phone is seen or heard
6. Looking around or making an attempt to cheat will result in your exam being cancelled
7. This examination has a total of 6 pages with 10 problems, some with several parts. Make sure your paper has all these problems.

Questions #	points	Total Points
Q.1	20	
Q.2 , Q.3	16	
Q.4 , Q.5 , Q.6	16	
Q.7 , Q.8	13	
Q.9 , Q.10	15	
Total	80	

20

Q.1 (20 points) Find $\frac{dy}{dx}$ for the following functions:

(Note: Show your work without simplifying)

a) $y = \cot^{-1}(x \ln x)$

b) $y = \sinh\left(\tanh\left(\sqrt{1+e^{2t}}\right)\right)$

c) $y = \sqrt[4]{\frac{x^2 \sqrt{1+x^2}}{e^{4x} (1-x^2)^2}}$

d) $y = (x^2 + 7)^{\cos x}$

e) $3x^2y^2 = 4x^2 - 4xy$

Q.2 (8 points) Find the absolute maximum and the absolute minimum of:

a) $f(x) = x^2 e^{-3x}$ on $[1, 3]$

b) $y = (x^2 + 2x - 3)^3$ on $[-4, 0]$

Q.3 (8 points) Find the critical numbers of each function.

a) $f(x) = \sin^2 x - \sin x$ on $[0, 2\pi]$

b) $y = \sqrt{x} (x - 1)^2$

Q.4 (5 points) Verify the identity using definitions: $2\sinh^2(x) + 1 = \cosh(2x)$

Q.5 (5 points) Verify that $f(x) = \frac{x}{x+2}$ satisfies the hypotheses of the Mean Value Theorem on $[0, 2]$.

Find all numbers c that satisfy the conclusion of the Mean Value Theorem on $[0, 2]$.

Q.6 (6 points) Check whether $f(x) = \frac{x^2 - 2x - 15}{6 - x}$ satisfies the hypotheses of Rolle's Theorem on $[-3, 5]$.

If so, find the value(s) of c that satisfy the conclusion of Rolle's Theorem.

Q.7 (3+3 points) Evaluate the limits:

(Note: **Show your work in details**)

a) $\lim_{x \rightarrow \infty} \frac{\sinh(2x)}{2e^{2x}}$

b) $\lim_{x \rightarrow 4} \frac{\sin(x-4)}{\tan(2x-8)}$

Q.8 (7 points) Car B is 20km west of car A . At 1:00 p.m. car A is travelling South at 45 km/hour and car B is travelling West at 50 km/hour. At what rate is the distance between the cars changing at 3:00 p.m.?

Q.9 (5 points) A balloon deflates (loses air) at the rate of $250 \text{ cm}^3/\text{second}$. At what rate is the **radius** changing when the **diameter** is 10 cm?

Q.10 (4+6 points)

a) Suppose that $f(1) = 0$ and $f'(1) = 2$. Find an equation of the tangent line to the

curve $g(x) = \frac{1+xf(x)}{1+x}$ at $x = 1$

b) Find an equation of the normal line to the curve whose equation is $xy + 4xy^2 = \frac{3}{y}$ at $(4, \frac{1}{2})$.