



Prince Sultan University

Math 111

Major Exam 2

First Semester, Term 141

Sunday, December 07, 2014

Time Allowed: 90 minutes

Student Name: _____

Student ID #: _____

Serial Class #: _____

Section #: 224, 225, 226, 227

Instructor's Name: Dr. Aiman Mukheimer, Dr. Jamiiru Luttamaguzi

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. Talking during the examination is NOT allowed.
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 12 problems, some with several parts. Make sure your paper has all these problems.

Problems	Max points	Student's Points
1	21	
2,3,4,5	18	
6,7	13	
8,9	17	
10,11	15	
12	16	
Total	100	

Q1 (21 points) Use derivatives rules to differentiate each function below, **Do not simplify**.

1. $y = 2^x + 3^x \cdot \ln(x^2 + 5)$

2. $y = \cos^2(e^{2x} - e^{\tan x})$

3. $y = \frac{x \sec x^3}{2x + 3}$

4. $y = \sin^{-1}(\cosh(2x))$

5. $f(x) = \left(\frac{\sqrt{x}}{x^3 - 1} \right)^4$

6. $g(x) = \sqrt{xe^x + \tan^{-1}(x^5)}$

7. $y = \sinh(\sec^{-1} 3\pi x)$

Q2 (6 points) If $f(x) = x^2h(x)$, $g(x) = \frac{h(x)}{x^2}$, $h(2) = 3$ and $h'(2) = -4$, find the value of

(a) $f'(2)$

(b) $g'(2)$

Q3 (4 points) where does the normal line to the parabola $y = x - x^2$ at the point $(1, 0)$ intersect the parabola a second time?

Q4 (4 points) The radius of a sphere is increasing at a rate 4 mm/s. How fast is the volume increasing when the diameter is 80 mm?

Q5 (4 points) Find y' if $y = \ln(x^2 + y^2)$.

Q6 (9 points) Find the equation of the normal line to the graphs below at the indicated points

(a) $y = x\sqrt{2-x}$ and $P(1,1)$.

(b) $y = \sin x - \cos x$ at $P(\pi,1)$.

(c) $\sqrt{x} + \sqrt{y} = 5$ at the point $(4,9)$.

Q7 (4 points) If $g(x) = x \ln x$, find $g'''(x)$ and $g^{(n)}(x)$.

Q8 (9 points) Evaluate the limit, if it exists.

i.
$$\lim_{x \rightarrow 0} \frac{\sin^2(3x) \cos(2x)}{x^2}$$

ii.
$$\lim_{x \rightarrow 0} \frac{\cos x - \sin x}{2 \cos x}$$

iii.
$$\lim_{x \rightarrow 1} \frac{2 \sin(x-1)}{x^2 + x - 2}$$

Q9 (8 points) Prove the following identities:

(a) $(\cosh x + \sinh x)^5 = \cosh 5x + \sinh 5x$

(b) $2 \sinh x \cosh x = \sinh(2x)$

Q10 (5 points) Two cars start moving from the same point. One travels east at 60 km/h and the other travels north at 70 km/h. At what rate is the distance between the cars increasing after 30 minutes?

Q11 (10 points) Find the second derivative for

(a) $y = \ln(x + \sqrt{1 + x^2})$

(b) $x^2 + y^2 = 5$

Q11 (16 points) Find the derivatives below. **Do not simplify** y' .

i. $y = x^{\sin x}$

ii. $y = \sqrt{1-x^2} \cos^{-1}(\ln x)$

iii. $x^2 + y^2 = 5xy$

iv. Use logarithmic differentiation **only** to find the derivative of $y = \frac{(\tan x)^{2/3} \sqrt{x^5 + 2}}{(3x - 2)^4}$