



Prince Sultan University
Department of General Sciences
MATH 111 Final Exam
Semester 2, Term 162
Saturday, May 13th, 2017, Time Allowed **3 hours**

Student Name: _____

Student ID #: _____

Section #: _____

Teacher's Name: _____

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 13 problems, some with several parts.

Problems	Max points	Student's Points
1	15	
2-4	14	
5-7	17	
8-10	17	
11	19	
12-13	18	
Total	100	_____ % = _____/40

1. (2+2+3+3+5 pts) Find the derivative y' of each problem below.

(a) $y = e^{\sin 2x} + \sin(e^{2x})$

(b) $y = (z^2 + e^z)\sqrt{z}$

(c) $y = \tan^4[\ln(5x+6)]$

(d) $f(\theta) = \theta^6 \cos 2\theta \sin 3\theta$

(e) $x^2 + xy + y^2 = 3\tan^{-1}(y) + \cosh(y)$

2. (6 pts) For what value of the constants a and b is the function f continuous on $(-\infty, \infty)$

$$f(x) = \begin{cases} \frac{25x+25}{\tan(x+1)} & \text{if } x < -1 \\ b \cdot x^2 - 9 & \text{if } -1 \leq x \leq 0 \\ a \cdot x^{\sqrt{x}} & \text{if } x > 0 \end{cases}$$

3. (4 pts) Find an equation of the normal line to the curve $y^2(y^2 - 4) = x^2(x^2 - 5)$ at the point $(0, -2)$

4. (4 pts) Find the 10th derivative of $y = \cos 2x$

5. (5 pts) Find the derivative of $y = (\sin x)^{\ln x}$
6. (6 pts) A ladder 5m long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a rate of 0.2m/s, how fast is the top of the ladder sliding down the wall when the bottom of the ladder is 3m away from the wall?
7. (6 pts) A water tank has the shape of a circular cone with base radius 2m and height 8m. If water is being pumped into the tank at a rate of $3\text{m}^3/\text{min}$, find the rate at which the water level is rising when the water is 2m deep.

8. (5 pts) Find the derivative of $y = (\operatorname{sech} x)(1 + \ln \operatorname{sech} x)$, **simplify as much as possible.**

9. (6 pts) Find the absolute max. and min. of $f(x) = 3x^4 - 4x^3 - 12x^2 + 1$ on the interval $[-2, 3]$

10. (6 pts) Sketch the graph of a function that satisfies the following conditions:

$f'(5) = 0$, $f'(x) < 0$ over the interval $(-\infty, 5)$, $f'(x) > 0$ when over the interval $(5, \infty)$

$f''(2) = 0$, $f''(8) = 0$, $f''(x) < 0$ over the interval $(-\infty, 2) \cup (8, \infty)$, $f''(x) > 0$ over the interval $(2, 8)$

$\lim_{x \rightarrow \infty} f(x) = 3$ $\lim_{x \rightarrow -\infty} f(x) = 3$

11. (3+3+3+5+5 pts) Use **L'Hospital's Rule** to evaluate the following limits:

a) $\lim_{x \rightarrow 4} \frac{x^2 - 2x - 8}{x - 4}$

b) $\lim_{x \rightarrow 1} \frac{\ln x}{\sin \pi x}$

c) $\lim_{x \rightarrow 0} \frac{x 3^x}{3^x - 1}$

d) $\lim_{x \rightarrow -\infty} x \ln \left(1 - \frac{1}{x} \right)$

e) $\lim_{x \rightarrow 0^+} (4x + 1)^{\cot x}$

12. (6 pts) Find the critical numbers of $f(x) = (x-4)\sqrt[3]{x}$.

13. (12 pts) Sketch a complete graph of $y = 6x^{1/3} + 3x^{4/3}$.

Find the domain and the x and y intercepts, if any.

Find the horizontal and vertical asymptotes, if any.

Find the coordinates of the local max and/or min, if any.

Find the intervals of increase, decrease, concave up and concave down. Find the inflection point(s).