Name _______________________________________

Signature: ____________________________________

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Academic Honesty Statement: By signing my name above, I acknowledge that I understand each of the following behaviors:

- using a calculator on a cell phone (or any other communication technology);
- referring to a piece of paper or object with helpful information on it (cheat sheet, crib sheet, bill of a baseball cap, etc...);
- looking at a test or answer sheet that is not my own;
- allowing another student to look at my test or answer sheet;
- communicating with other students (verbally or nonverbally);
- taking the test for another student;
- taking my bubble sheet of answers with me when I've finished;
- talking while waiting to hand in my test materials to the proctors

to be a form of academic dishonesty (cheating). I am also pledging not to engage in any of these behaviors. I understand that if I do engage in these behaviors, the consequences will be failure of the exam and a formal charge of academic dishonesty to the Ombuds Office.

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Please shut off all cell phones, ear phones, computers, beepers, etc...

Please put everything away except a #2 pencil and a calculator that is NOT your cell phone.
You may write on the test. There are thirty multiple choice questions and each question is weighted equally.

1. On the bubble sheet, where it says “Name,” please print your last name, leave a space, and then print your first name in the rectangles. Then fill in the bubbles underneath.

2. On the bubble sheet, where it says “Identification Number,” please write your entire Student ID number in the rectangles and fill in the bubbles underneath. Please double check to make sure you bubbled in your ID # correctly.

4. On the bubble sheet, where it says “Special Codes,” please write the numbers: 121601 in the rectangles and fill in the bubbles underneath. Please double check to make sure you bubbled in the special code correctly.

5. Lastly, on the bubble sheet, in the margin above your name, please neatly print “Final Exam Fall 2015”, and sign your name.

Please make sure you bubble in your answers carefully on the bubble sheet and circle your answers on your test booklet.
1.) Evaluate the integral: \( \int x^2 \left( 1 + 5x^3 + \frac{7}{x^3} + \frac{4}{x^4} \right) dx \)

(A) \( \frac{1}{3} x^3 \left( x + \frac{5}{4} x^4 - \frac{7}{3x^3} - \frac{2}{x^2} \right) + C \)
(B) \( \frac{1}{3} x^3 + \frac{5}{6} x^6 - \frac{7}{x} + 4 \ln|x| + C \)
(C) \( 2x + 25x^4 - \frac{14}{x^3} - \frac{4}{x^2} + C \)
(D) \( x^2 + 5x^5 + \frac{7}{x^2} + 4 \ln|x| + C \)

2.) Find \( f(2) \) if \( f'(x) = 3x^4 + e^{6x} \) with \( f(0) = 3 \).

(A) 27,145
(B) 27,142
(C) 27,148
(D) 162,803

3.) Evaluate the integral: \( \int (x^3 + 3x^2) \sqrt{x^4 + 4x^3} \, dx \)

(A) \( \frac{2}{3} \left( \frac{1}{4} x^4 + x^3 \right) \left( \frac{1}{5} x^5 + x^4 \right)^{3/2} + C \)
(B) \( 2(x^4 + 4x^3)^{3/2} + C \)
(C) \( \frac{1}{6} (x^4 + 4x^3)^{3/2} + C \)
(D) \( \frac{2}{3} (x^4 + 4x^3)^{3/2} + C \)

4.) Evaluate the integral: \( \int e^{4x} \cos(e^{4x}) \, dx \)

(A) \( \frac{1}{4} \sin(e^{4x}) + C \)
(B) \( -\frac{1}{4} \sin(e^{4x}) + C \)
(C) \( \sin(e^{4x}) + C \)
(D) \( \frac{1}{4} e^{4x} \sin(e^{4x}) + C \)
5.) Evaluate the integral. \( \int x^2 e^{6x} \, dx \)

(A) \( \frac{1}{18} e^{3x} + C \)

(B) \( 6x^2 e^{6x} - 72xe^{6x} - 864e^{6x} + C \)

(C) \( \frac{1}{6} x^2 e^{6x} - \frac{1}{18} xe^{6x} - \frac{1}{108} e^{6x} + C \)

(D) \( \frac{1}{6} x^2 e^{6x} - \frac{1}{18} xe^{6x} + \frac{1}{108} e^{6x} + C \)

6.) Evaluate the integral. \( \int 4x \sin(5x) \, dx \)

(A) \( -\frac{4}{5} x \cos(5x) + \frac{4}{25} \sin(5x) + C \)

(B) \( \frac{4}{5} x \cos(5x) + \frac{4}{25} \sin(5x) + C \)

(C) \( -\frac{4}{5} x \cos(5x) - \frac{4}{25} \sin(5x) + C \)

(D) \( -\frac{2}{5} x^2 \cos(5x) + C \)

7.) A graph of the relative growth rate of a population is given in the following figure: By what percentage does the population change over the 30 year period?

(A) Increases by 64%

(B) Decreases by 36%

(C) Increases by 45%

(D) Decreases by 45%
8.) Given the supply curve \( p = 64 + q^2 \) and the demand curve \( p = 192 - q^2 \), find the producer surplus when the market is in equilibrium.

(A) $1365  
(B) $1024  
(C) $683  
(D) $341

9.) You take out a car loan for $15,000. Assuming a 5% annual interest rate and a monthly payment of $340, how long will the loan run?

(A) Between 3 and 4 years  
(B) Between 4 and 5 years  
(C) Between 5 and 6 years  
(D) Between 6 and 7 years

10.) A person will need $100,000 in 18 years. Assuming a 6% annual interest rate, how much should you deposit monthly?

(A) $757  
(B) $157  
(C) $463  
(D) $258

11.) Exam scores are normally distributed with a mean of 84 and a standard deviation of 3. What is the probability that a randomly selected person will score between a 70 and 80?

(A) 0.6827  
(B) 0.1000  
(C) 0.0912  
(D) 0.1731

12.) The mean time at a stop light is exponentially distributed with a mean of 30 seconds. Find the probability that a person will wait more than 30 seconds.

(A) 0.50  
(B) 0.6321  
(C) 0.0333  
(D) 0.3679
13.) Assume $X$ is a uniformly distributed random variable on $3 \leq x \leq 15$. Find $P(3 \leq X \leq 5)$.

(A) 0.0833  
(B) 0.1667  
(C) 0.6667  
(D) 0.50  

14.) $X$ is an exponentially distributed random variable with a mean of 7. Find the median.

(A) 14.29  
(B) 7  
(C) 4.85  
(D) 1.95  

15.) Given the following PDF, find the median.

(A) 5; 10; 4.56; 9.02; 10.11; 6.47  
(B) 5.55; 8.28; 7.07; 9.48; 2.34; 8.49  
(C) 2.93; 10.09; 12.09; 11.15; 6.16; 3.34  
(D) 9.047; 7.03; 5.66; 10.75; 9.78; 6.99
16.) Given the PDF \( f(x) = \begin{cases} \frac{1}{18}x - \frac{1}{9} & 2 \leq x \leq 8 \\ 0 & x < 2 \\ 0 & x > 8 \end{cases} \), find the mean.

(A) 6  
(B) 4  
(C) 5.93  
(D) 4.93

17.) A piece of electronic surveying equipment is designed to operate in specific temperatures and humidity levels. The higher the performance index, the better the performance. If the performance index of the function \( P = f(h, t) \) is given in the table below, estimate \( f(10,20) \).

<table>
<thead>
<tr>
<th>Temperature, ( t ) ( ^\circ \text{C} )</th>
<th>Humidity, ( h )</th>
<th>0</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.38</td>
<td>0.46</td>
<td>0.43</td>
<td>0.28</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.65</td>
<td>0.79</td>
<td>0.73</td>
<td>0.47</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>0.81</td>
<td>0.99</td>
<td>0.91</td>
<td>0.59</td>
<td>0.02</td>
<td></td>
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<tr>
<td>30</td>
<td>0.71</td>
<td>0.87</td>
<td>0.81</td>
<td>0.52</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

(A) 0.81  
(B) 0.88  
(C) 0.91  
(D) 0.18

18.) Given \( f(x, y) = 3x^2y + 6y^2 - 5xe^{y^2} + y\cos(3x) \), find \( f_x(x, y) \).

(A) \( 6xy + 12y - 10ye^{y^2} - 3y\sin(3x) \)

(B) \( 3x^2 + 12y - 10xye^{y^2} + \cos(3x) \)

(C) \( 6x - 10ye^{y^2} - 3\sin(3x) \)

(D) \( 6xy - 5e^{y^2} - 3y\sin(3x) \)
19.) Given \( f(x, y) = \sin(8xe^{7xy}) \). Find \( f_y(x, y) \).

(A) \(-56x^2e^{7xy} \cos(8xe^{7xy})\)

(B) \(\cos(56x^2e^{7xy})\)

(C) \((56x^2e^{7xy} + 8e^{7xy}) \cos(8xe^{7xy})\)

(D) \(56x^2e^{7xy} \cos (8xe^{7xy})\)

20.) Find \( f_{xy} \) if \( f(x, y) = 8y \sin(xy) \).

(A) \(-8y^3 \sin(xy) + 16xy \cos(xy)\)

(B) \(8y \cos(xy)\)

(C) \(-8xy^2 \sin(xy) + 16y \cos(xy)\)

(D) \(8y^2 \cos(xy)\)

21.) The function \( f(x, y) = x^2 + y^3 - 3x + 5y^2 - 9 \) has a local minimum at what y value?

(A) \(y = 0\)

(B) \(y = -\frac{10}{3}\)

(C) \(y = 0, y = -\frac{10}{3}\)

(D) \(y = \frac{3}{2}\)

22.) Find the x coordinate of the critical value(s) of \( f(x, y) = xy - 2x^3 + y^2 \)

(A) \(x = 0\)

(B) \(x = 0, x = -\frac{1}{12}\)

(C) \(x = -\frac{1}{12}, x = 0, x = \frac{1}{12}\)

(D) \(x = -8, 0, 8\)
23.) Suppose \( f(x, y) = x^2 + Ax + y^2 + By + C \) has a local minimum value of 21 at the point (2,3). Find the value of \( A \).

(A) \(-6\)
(B) \(-4\)
(C) 2
(D) Not enough information to find \( A \).

24.) A company sells two products, \( x \) and \( y \). The profit the company makes is given by the function \( P(x, y) = 30xy - 4x - 3y + 2 \), where \( P \) is measured in hundreds of thousands of dollars. Find the maximum profit.

(A) $160,000
(B) $170,000
(C) $320,000
(D) There is no maximum profit.

25.) Given the following information:
   \[
   f_x(3,2) = 0, \quad f_y(3,2) = 0, \quad f_{xx}(3,2) = 9, \quad f_{yy}(3,2) = -4, \quad f_{xy}(3,2) = -7
   \]
   \[
   f_x(4,5) = 0, \quad f_y(4,5) = 0, \quad f_{xx}(4,5) = -2, \quad f_{yy}(4,5) = -8, \quad f_{xy}(4,5) = 3
   \]
Which of the following is true?

(A) There is a local minimum at (3,2) and a local maximum at (4,5).
(B) There is a saddle point at (3,2) and a local maximum at (4,5).
(C) There is a local minimum at (3,2) and a saddle point at (4,5).
(D) There is a saddle point at (3,2) and a local minimum at (4,5).
26.) Suppose the quantity of items produced, \( q \), depends on the number of two items, \( x \) and \( y \), needed to produce the item and can be modeled by the function: 
\[
q = 6x^{3/4} y^{1/4}
\]
If the cost is $18 per unit \( x \), and $20 per unit \( y \), with a total budget of $1728, find the optimal quantity produced.

(A) 314  
(B) 487  
(C) 300  
(D) 320

27.) Find the global minimum of the function.
\[
f(x, y) = x^2 - 12x + y^2 - 16y
\]
with constraint \( 2x + 2y = 12 \).

(A) \(-68\)  
(B) \(-61\)  
(C) \(-36\)  
(D) \(-74\)

28.) Find the particular solution of the differential equation: 
\[
x^5 \frac{dy}{dx} = y \text{ with } y(1) = 3e^{-1/4}.
\]

(A) \( y = e^{-1/4x^{4}} - 1/4 \)  
(B) \( y = -3e^{-1/4x^{4}} \)  
(C) \( y = e^{-1/4x^{4}} + 1/4 \)  
(D) \( y = 3e^{-1/4x^{4}} \)
29.) Find the particular solution to the differential equation: \( xy' = 4x^2e^{2x} \) with \( y(0) = 18 \).

(A) \( y = 2xe^{2x} - e^{2x} + 19 \)

(B) \( y = 4xe^{2x} - 2e^{2x} + 20 \)

(C) \( y = 2xe^{2x} - e^{2x} + 18 \)

(D) \( y = 2xe^{2x} - 2e^{2x} + 19 \)

30.) A flower pot weighing 3 pounds falls from a balcony 150 feet above the ground. Using that acceleration due to gravity is \(-32\, ft/s^2\), how long does it take the flower pot to hit the ground?

(A) 2.6 seconds

(B) 2.8 seconds

(C) 3.1 seconds

(D) 3.5 seconds

**Second Derivative Test for Functions of Two Variables:**

\[ D = D(a, b) = f_{xx}(a, b)f_{yy}(a, b) - [f_{xy}(a, b)]^2 \]

a) If \( D > 0 \) and \( f_{xx}(a, b) > 0 \), then \( f(a, b) \) is a local minimum.

b) If \( D > 0 \) and \( f_{xx}(a, b) < 0 \), then \( f(a, b) \) is a local maximum.

c) If \( D < 0 \), then \( f(a, b) \) is not a local maximum or minimum.

d) If \( D = 0 \), then the test is inconclusive.
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