Department of Mathematics
University of Notre Dame
Math 10260 – Bus. Calc. II
Spring 2009

Name:_____

Instructor:_____

Exam II

March 5, 2009

This exam is in 2 parts on 11 pages and contains 15 problems worth a total of 100 points. You have 1 hour and 15 minutes to work on it. You may use a calculator, but no books, notes, or other aid is allowed. Be sure to write your name on this title page and put your initials at the top of every page in case pages become detached. Good luck!

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Multiple Choice

1. (5 pts.) The equation of a plane passing through $(1, -2, 3)$ having slope 2 in the x-direction and slope 5 in the y-direction is

(a) $3z = x - 2y$

(b) $z - 3 = (x - 2) - 2(y - 5)$

(c) $z = 2x + 5y + 11$

(d) $x - 2y + 3z = 11$

(e) $x = 2y + 3z + 7$

2. (5 pts.) The distance between the points $(1, 1, 2)$ and $(2, 1, 1)$ is

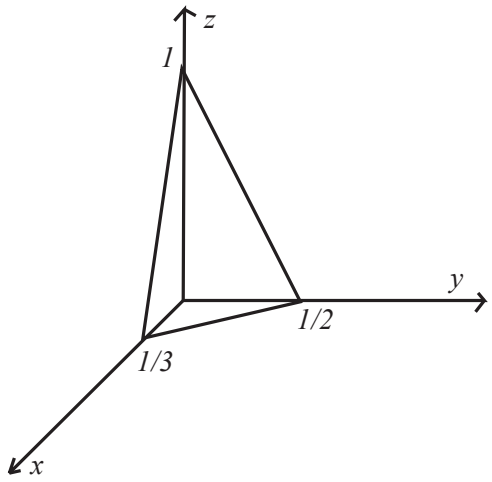
(a) $\sqrt{2}$ (b) $\sqrt{6}$ (c) 2 (d) -1 (e) 1

3. (5 pts.) Which of the following points is a critical point of the function

$$f(x, y) = xy - e^x.$$

(a) $(1, 0)$ (b) $(-1, 0)$ (c) $(0, -1)$ (d) $(1, 1)$ (e) $(0, 1)$

4. (5 pts.) The equation of the plane depicted below



is given by:

(a) $z = x + y$

(b) $z = -3x - 2y + 1$

(c) $z = -\frac{x}{3} - \frac{y}{2} + 5$

(d) $z = 3x + 2y - 1$

(e) $z = \frac{x}{3} + \frac{y}{2}$

5. (5 pts.) Consider the function $f(x, y) = \ln(x^2 + y^2)$. Then $\frac{\partial^2 f}{\partial x^2} =$

(a) $-\frac{1}{(x^2+y^2)^2}$ (b) $\frac{2}{(x^2+y^2)}$

(c) $\frac{2x}{x^2+y^2}$ (d) $\frac{2(y^2-x^2)}{(x^2+y^2)^2}$

(e) $\frac{2}{(x^2+y^2)^2}$

6. (5 pts.) The number of camper vans (in thousands) sold per week by a certain company is a function of the form $f(x, y)$, where x is the average price of a van (in thousands of dollars) and y is the average price (in cents) of gasoline throughout the U.S. Suppose that

$$f(25, 170) = 900, \quad \frac{\partial f}{\partial x}(25, 170) = -180 \quad \text{and} \quad \frac{\partial f}{\partial y}(25, 170) = -12.$$

Find the number of vans sold if the average price of a van goes up by \$200 while the price of gasoline goes down by 10 cents a gallon.

(a) 816 (b) 1020 (c) 984 (d) 780 (e) 864

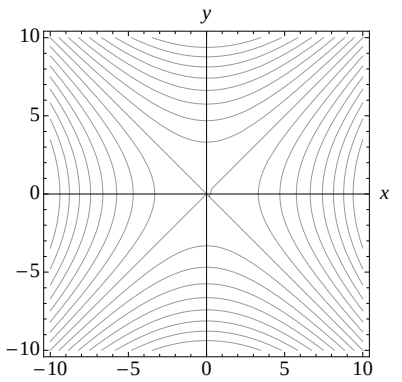
7. (5 pts.) The constant function $y = 1$ is a stable equilibrium solution to the differential equation

(a) $y' = y(y-2)$ (b) $y' = y - 1$

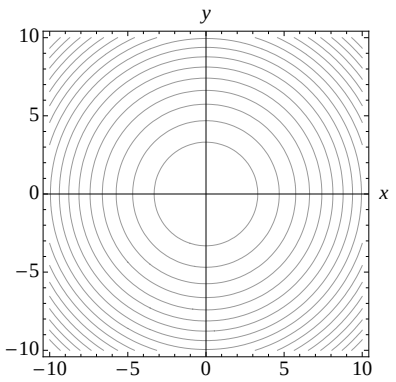
(c) $y' = y^2 - y$ (d) $y' = y(1-y)$

(e) $y' = \frac{1}{y}$

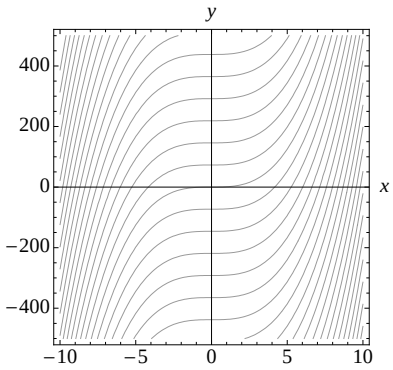
8. (5 pts.) Which of the following pictures shows level curves of the function $f(x, y) = x^3 - y$



(1)



(2)



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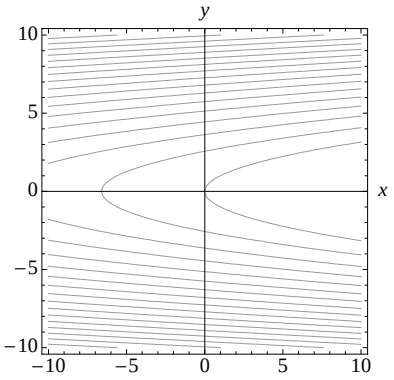

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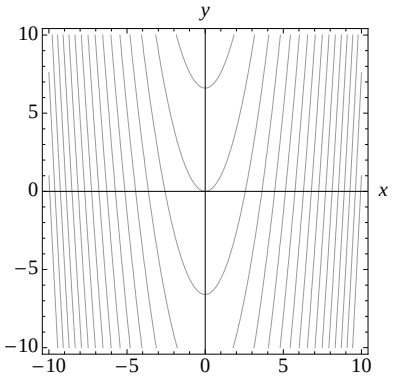


(5)

(a) Picture 1 (b) Picture 4 (c) Picture 2 (d) Picture 3 (e) Picture 5

9. (5 pts.) The minimum of the function $f(x, y) = 4x + y$, $x > 0$, subject to the constraint $xy = 1$ is

(a) 3 (b) 5 (c) 4 (d) $\sqrt{5}$ (e) 3.5

10. (5 pts.) The level sets of the function

$$f(x, y) = \frac{1}{\sqrt{x^2 + y^2 - 1}}$$

are

(a) neither circles, nor lines

(b) lines with slope 1

(c) circles with the center at $(1, 1)$

(d) lines with slope -1

(e) circles with the center at the origin

Partial Credit

You must show your work on the partial credit problems to receive credit!

11. (10 pts.) (a) Find the critical points of the function

$$p(x, y) = 3(4y - 3x - 2)^2 - (3y - 2x - 1)^2 - 15.$$

(b) Use the second derivative test to decide whether the critical point $(5, 1)$ of the function

$$f(x, y) = (x - 5)(y^2 - 3y + 2)$$

is a local minimum, a local maximum or a saddle point?

12. (10 pts.) (a) Find the x-slope and y-slope of the plane containing the points $(1, 2, 3)$, $(1, 3, 4)$ and $(2, 3, 5)$.

(b) Find the equation of the tangent plane to the graph of the function $f(x, y) = e^{x^2-y^4}$ at $(1, -1)$.

13. (10 pts.) (a) Write the error function $E(a, b)$ for the data below.

$$(1, 6), \quad (2, 5), \quad (3, 3), \quad (6, 1).$$

(b) (b) Let y be the quantity (in thousands of units) of an item sold when its price (in hundreds of dollars) is x. Given the data table

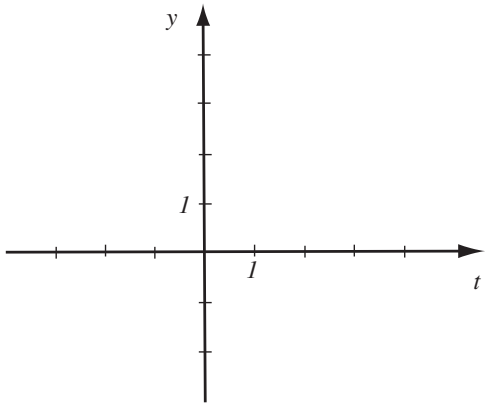
Price of item: x	1	2	3
Quantity sold: y	5	4	4

find the least squares line fitting these data best, and use it to predict the quantity sold if the price $x = 0.8$.

14. (10 pts.) A rectangular shape bus stop shelter of height z, with two sides of width x, a back of width y, a top and open front is to be constructed.
(a) Write down a formula for the total cost $c(x, y, z)$ of the materials if the cost of the material used for the top is \$ 10 per square foot and the rest is \$ 5 per square foot.

(b) Find the minimum of the function $f(x, y) = 2x + 3y$ subject to the constraint $x^2e^y = 1$.

15. (10 pts.) Consider the differential equation $y' = (2 - y)(y + 1)$.
(a) Find and sketch all equilibrium solutions. Sketch solutions corresponding to each of the three initial conditions $y(0) = 4, y(0) = 0$ and $y(0) = -2$.



(b) Use Euler's method with step size $\frac{1}{2}$ to find the approximate value of $y(1)$, where y is a solution to the equation with initial condition $y(0) = -\frac{1}{2}$.

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