Name: ____________________________

Instructor: ________________________

Math 20550, Exam 2
January 1, 01

- The Honor Code is in effect for this examination. All work is to be your own.
- No calculators.
- The exam lasts for 1 hour and 15 minutes.
- Be sure that your name is on every page in case pages become detached
- Be sure that you have all 9 pages of the test.
- Each multiple choice question is 6 points, each partial credit problem is 12 points. You will receive 4 extra points.

PLEASE MARK YOUR ANSWERS WITH AN X, not a circle!

1.	(a)	(b)	(c)	(d)	(e)
2.	(a)	(b)	(c)	(d)	(e)
3.	(a)	(b)	(c)	(d)	(e)
4.	(a)	(b)	(c)	(d)	(e)
5.	(a)	(b)	(c)	(d)	(e)
6.	(a)	(b)	(c)	(d)	(e)
7.	(a)	(b)	(c)	(d)	(e)
8.	(a)	(b)	(c)	(d)	(e)
9.	(a)	(b)	(c)	(d)	(e)
10.	(a)	(b)	(c)	(d)	(e)

Please do NOT write in this box.

Multiple Choice	________
11.	________
12.	________
13.	________
Extra Points.	4
Total	________

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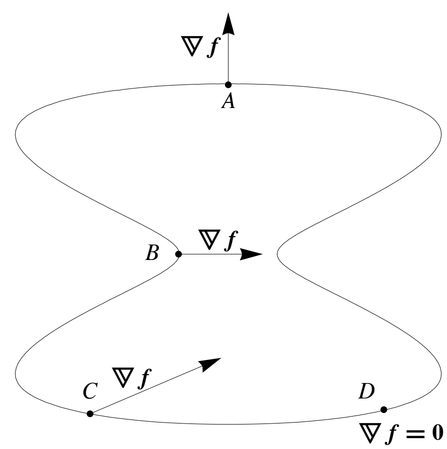
Multiple Choice

1.(6 pts) The graph below shows the level curve $g(x, y) = k$, along with four points A, B, C, and D on the curve. At A, B, and C the gradient of another function $f(x, y)$ has been evaluated at that point and plotted. At D the gradient of f is $\mathbf{0}$. Which of the following statements about the points A, B, C, and D **must always be true**?



(a) Subject of $g(x, y) = k$, $f(x, y)$ has a possible absolute maximum or minimum at B.

(b) $f(x, y)$ has an absolute maximum at D.

(c) Subject of $g(x, y) = k$, $f(x, y)$ has an absolute minimum at A.

(d) Subject of $g(x, y) = k$, $f(x, y)$ has a possible absolute maximum or minimum at C.

(e) Subject of $g(x, y) = k$, $f(x, y)$ has an absolute maximum at A.

2.(6 pts) Compute the volume of the solid bounded by the planes $x = 0, x = 3, y = 0, y = 2, z = 7$, and $z = 6 - 2x$. (Hint: this is the combinations of two very nice solids.)

(a) 6 (b) 18 (c) 42 (d) 12 (e) 24

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3.(6 pts) Compute $\dfrac{\partial z}{\partial x}$ if $z^x - y^2 z = 1 - xy$.

(a) $\dfrac{z^x \ln z + y}{y^2 - xz^{x-1}}$ (b) $\dfrac{y^2 - xz^{x-1}}{z^x \ln z + y}$ (c) 0

(d) $\dfrac{(2y+1)z}{y^2 - xz^{x-1}}$ (e) $\dfrac{z^x}{x}$

4.(6 pts) You are hiking on a hill with shape $z = 2500 - .75x^2 - y^2$ and are currently standing at the point $P(12, 20, 1992)$. Your hiking buddy decides that you should continue in the direction $\langle 2, -1\rangle$. Are you headed up the hill or down, and at what rate?

(a) up, 4 (b) down, $\dfrac{76}{\sqrt{5}}$ (c) down, $\dfrac{4}{\sqrt{5}}$ (d) up, $\dfrac{4}{\sqrt{5}}$ (e) down, 4

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5.(6 pts) Joe the baker is making a pretzel. He stretches a cylinder of dough out that he will later tie into a pretzel knot. The volume of the dough is constant at 12π cm^3, the current length of the dough cylinder is 3 cm and Joe is stretching the length at a rate of 5 cm/s. At what rate is the radius of the dough cylinder changing?

(a) $-\dfrac{5}{3}$ cm/s (b) -16π cm/s (c) $-\dfrac{\pi}{3}$ cm/s

(d) 16π cm/s (e) $-\dfrac{5}{6}$ cm/s

6.(6 pts) Consider the surfaces given by $3x + 2y + z^2 = 11$ and $x^2 + y^2 + z^2 = 9$. What is the vector equation for the tangent line of the curve of intersection at the point $(1, 2, 2)$?

(a) $\mathbf{r}(t) = \langle 3, 2, 1\rangle + t\langle -4, 2, 2\rangle$ (b) $\mathbf{r}(t) = \langle 1, 2, 2\rangle + t\langle -8, -4, 8\rangle$

(c) $\mathbf{r}(t) = \langle 1, 2, 2\rangle + t\langle -4, 2, 2\rangle$ (d) $\mathbf{r}(t) = \langle 1, 2, 2\rangle + t\langle 4, -6, 4\rangle$

(e) $\mathbf{r}(t) = \langle 1, 2, 2\rangle + t\langle 3, 2, 1\rangle$

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7.(6 pts) Suppose $f(x, y)$ is a continuous function with critical points $(-1, 1)$, $(0, 1)$, and $(1, 1)$ and second partial derivatives $f_{xx}(x, y) = 12x^2 - 4$, $f_{xy}(x, y) = f_{yx}(x, y) = 0$, and $f_{yy}(x, y) = 2$. What can we say about the critical points?

(a) $(-1, 1)$ is a local maximum, $(1, 1)$ is local minimum, and $(0, 1)$ is a saddle point.

(b) $(0, 1)$ and $(1, 1)$ are saddle points and $(-1, 1)$ is a local minimum.

(c) $(-1, 1)$ and $(1, 1)$ are local maximums and $(0, 1)$ is a local minimum.

(d) all points are local minimums.

(e) $(-1, 1)$ and $(1, 1)$ are local minimums and $(0, 1)$ is a saddle point.

8.(6 pts) Compute the iterated integral $\int_0^1 \int_{x^2}^{x} 2xy + 3y^2 \, dydx$.

(a) $\dfrac{4}{21}$

(b) 0

(c) $\dfrac{13}{14}$

(d) -1

(e) 1

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9.(6 pts) What are the absolute minimum and maximum values for the function $f(x, y, z) = yz + xy$ subject to the contstraints $xy = 1$ and $y^2 + z^2 = 1$.

(a) maximum $\frac{3}{2}$, minimum $\frac{1}{2}$

(b) maximum 1, minimum $\frac{1}{2}$

(c) maximum $\frac{3}{2}$, minimum 0

(d) maximum 1, minimum 0

(e) maximum $\frac{1}{2}$, minimum 0

10.(6 pts) The electric potential over a region in space is given by $V(x, y, z) = 2xy + y^2 - x^2yz$. At a point $P(1, 2, 1)$ in what direction does V **decrease** most rapidly?

(a) $\frac{1}{\sqrt{29}}\langle 0, -5, 2\rangle$

(b) $\frac{1}{\sqrt{29}}\langle 0, 5, 2\rangle$

(c) $\langle 1, 0, 0\rangle$

(d) $\frac{1}{\sqrt{29}}\langle 0, 5, -2\rangle$

(e) $\langle 1, 2, 1\rangle$

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Partial Credit

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

11.(12 pts.)
Use the method of Lagrange multipliers to find the the point on the plane $2x - y + 3z + 14 = 0$ closest to the origin. Be sure to show all your work.

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12.(12 pts.) Sarah the architect is designing a modern building. The floor is given by $z = 0$, the roof is given by $z = 9 - x^2 - 2y$, and walls are given by $x = 0$, $y = 0$, and $y = 2 - x$. What is the volume of her building? Be sure to show the integral with limits used to compute the volume and all your work.

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13.(12 pts.) Find the global maximum and the global minimum of the function $f(x, y) = (4 - y^2)e^{2x^2}$ over the region $4x^2 + y^2 \leq 4$. Be sure to show all your work.

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