Name: ______________________________

Instructor: __________________________

Math 20550, Exam 1
September 23, 2014

- 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)
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9.	(a)	(b)	(c)	(d)	(e)
10.	(a)	(b)	(c)	(d)	(e)

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

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Multiple Choice

1.(6 pts) Let $\mathbf{a} = \langle 1, 2, 0 \rangle$, $\mathbf{b} = \langle 3, 1, -1 \rangle$, and let $\mathbf{c} = \text{proj}_{\mathbf{a}}\mathbf{b}$ be the vector projection of $\mathbf{b}$ onto $\mathbf{a}$. Which one of the following vectors is orthogonal to $\mathbf{b} - \mathbf{c}$?

(a) $\langle 0, 1, 1 \rangle$ (b) $\langle 2, 1, -1 \rangle$ (c) $\langle 1, 2, 0 \rangle$

(d) $\langle 2, 1, 0 \rangle$ (e) $\langle 1, 0, 1 \rangle$

2.(6 pts) Find the radius of the sphere given by the equation

$$x^2 + y^2 + z^2 - 6x + 4z + 7 = 10.$$

(a) 3 (b) 9 (c) -4 (d) 2 (e) 4

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3.(6 pts) A particle moves with the position function $\mathbf{r}(t) = \langle t^2, -t, 2\rangle$. Find the normal component of acceleration.

(a) $a_N = \dfrac{2}{\sqrt{1+4t^2}}$ (b) $a_N = 4t$ (c) $a_N = 2$

(d) $a_N = \dfrac{4t}{\sqrt{1+4t^2}}$ (e) $a_N = \sqrt{1+4t^2}$

4.(6 pts) Find the volume of the parallelepiped determined by the vectors $\mathbf{a} = \langle 1, 2, 2\rangle$, $\mathbf{b} = \langle 3, 2, 2\rangle$, and $\mathbf{c} = \langle 7, 3, 1\rangle$.

(a) -4 (b) 8 (c) 3 (d) -8 (e) 4

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5.(6 pts) Where does the line with parametric equations

$$x = -1 + 3t \qquad y = 2 - 2t \qquad z = 3 + t$$

intersect the plane $3x + y - 4z = -4$?

(a) they do not intersect (b) $(-3, -3, -2)$ (c) $(8, -4, 6)$

(d) $(-10, 8, 0)$ (e) $(0, 0, 1)$

6.(6 pts) Compute f_{xy} for $f(x, y) = x^3y + 3y^2 + \sin(2xy - x)$

(a) $3x^2 + 2\cos(2xy - x) - 2x\sin(2xy - x)$

(b) $3x^2 + 6y + 2\cos(2xy - x) - 2x(2y - 1)\sin(2xy - x)$

(c) $3x^2 + 2\cos(2xy - x) - 2x(2y - 1)\sin(2xy - x)$

(d) $3x^2 + 2\cos(2xy - x) - (2y - 1)\sin(2xy - x)$

(e) $3x^2 - 2x(2y - 1)\sin(2xy - x)$

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7.(6 pts) Find the position $\mathbf{r}(1)$ of a particle at time $y = 1$ if it has acceleration $\mathbf{a}(t) = e^t\mathbf{i} - 6t\mathbf{k}$, the initial position of the particle is $\mathbf{r}(0) = \langle 1, 0, -1\rangle$ and the initial velocity is $\mathbf{v}(0) = \langle 1, 1, 0\rangle$.

(a) $\mathbf{r}(1) = \langle 1, 0, 1\rangle$ (b) $\mathbf{r}(1) = \langle e, 0, 0\rangle$ (c) $\mathbf{r}(1) = \langle e, 1, -1\rangle$

(d) $\mathbf{r}(1) = \langle e, 1, -2\rangle$ (e) $\mathbf{r}(1) = \langle 0, 1, 2\rangle$

8.(6 pts) Which of these is an equation of the tangent line to the curve

$$\mathbf{r}(t) = \langle t^2 + 2t + 3,\ 4t\cos(t),\ 2e^{3t}\rangle$$

at the point where $t = 0$?

(a) $\langle x, y, z\rangle = \langle 3, 4, 2e\rangle + t\langle 2, 0, 6e\rangle$ (b) $\langle x, y, z\rangle = \langle 3, 0, 2\rangle + t\langle 1, 2, 3\rangle$

(c) $\langle x, y, z\rangle = \langle 3, 0, 2\rangle + t\langle 1, -2, 3\rangle$ (d) $\langle x, y, z\rangle = \langle 3, 4, 2\rangle + t\langle 1, 2, 3\rangle$

(e) $\langle x, y, z\rangle = \langle 3, 0, 2e\rangle + t\langle 2, 4, 6\rangle$

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9.(6 pts) Which of the following expressions gives the length of the curve defined by $\mathbf{r}(t) = t^2\mathbf{i} - \mathbf{j} + \ln t\,\mathbf{k}$ between the points $(1, -1, 0)$ and $(e^2, -1, 1)$?

(a) $\int_1^{e^2} \sqrt{4t^2 + 1/t^2}\, \mathrm{d}t$

(b) $\int_1^{e} \sqrt{t^2 + 1 + \ln^2 t}\, \mathrm{d}t$

(c) $\int_0^{1} \sqrt{2t + \ln t}\, \mathrm{d}t$

(d) $\int_1^{e} \sqrt{2t + \ln t}\, \mathrm{d}t$

(e) $\int_1^{e} \sqrt{4t^2 + 1/t^2}\, \mathrm{d}t$

10.(6 pts) Which one of the following functions has level curves drawn below?

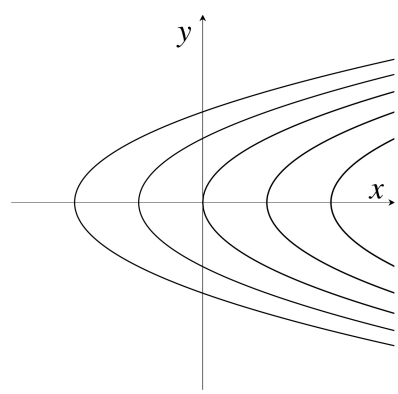
(a) $f(x, y) = y^2 + x$

(b) $f(x, y) = y + x^2$

(c) $f(x, y) = y - x^2$

(d) $f(x, y) = y^2 - x$

(e) $f(x, y) = y^2 - x^2$



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Partial Credit

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

11.(12 pts.) Find an equation for the line of intersection of the planes $3x - y + z = 0$ and $2x - 3y + z = 0$.

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12.(12 pts.) The position function of a moving object is $\mathbf{r}(t) = t^2\mathbf{i} - \mathbf{j} + \ln t\,\mathbf{k}$.

(a) Find the unit tangent vector $\mathbf{T}$, the principal normal vector $\mathbf{N}$, and the bi-normal vector $\mathbf{B}$ at $t = 1$.

(b) Find an equation of the normal plane at $t = 1$.

(c) Find an equation of the osculating plane at $t = 1$.

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13.(12 pts.) Find the distance from the point $(-4, 1, 4)$ to the plane containing the points $P(0, 0, 3)$, $Q(1, 1, 3)$, and $R(1, 0, -1)$.

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