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Instructor: _____

Math 20550, Practice 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 10 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) Find symmetric equations of the line L passing through the point $(2, -5, 1)$ and perpendicular to the plane $x + 3y - z = 9$.

(a) $\dfrac{x-2}{1} = \dfrac{y+5}{3} = \dfrac{z-1}{-1}$

(b) $2(x-1) = (-5)(y-3) = z+1$

(c) $(x-2) + 3(y-3) - (z-1) = 9$

(d) $\dfrac{x-1}{2} = \dfrac{y-3}{-5} = \dfrac{z+1}{1} = 9$

(e) $\dfrac{x-1}{2} = \dfrac{y-3}{-5} = \dfrac{z+1}{1}$

2.(6 pts) The two curves below intersect at the point $(1, 4, -1) = \mathbf{r}_1(0) = \mathbf{r}_2(1)$. Find the cosine of the angle of intersection

$$\mathbf{r}_1(t) = e^{3t}\mathbf{i} + 4\sin\left(t + \frac{\pi}{2}\right)\mathbf{j} + (t^2 - 1)\mathbf{k}$$
$$\mathbf{r}_2(t) = t\mathbf{i} + 4\mathbf{j} + (t^2 - 2)\mathbf{k}$$

(a) 0 (b) 3 (c) $\dfrac{1}{\sqrt{5}}$ (d) $\dfrac{1}{5}$ (e) $\dfrac{e}{\sqrt{e^2+4}}$

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3.(6 pts) Find the projection of the vector $\langle 1, -1, 5\rangle$ onto the vector $\langle 2, 1, 4\rangle$

(a) $\frac{1}{5}\langle 2, 1, 5\rangle$ (b) $\langle 6, 3, 12\rangle$ (c) $\langle 1, -1, 5\rangle$ (d) $\langle 3, -3, 15\rangle$ (e) $\langle 2, 1, 4\rangle$

4.(6 pts) Find $\int \mathbf{r}(x)dx$ where

$$\mathbf{r}(x) = (\sec^2 x)\mathbf{i} + e^x\mathbf{k}$$

Recall: $\int \sec^2 x\, dx = \tan x + C$.

(a) $(\tan x + C_1)\mathbf{i} + C_2\mathbf{j} + (e^x + C_3)\mathbf{k}$

(b) $\tan x + e^x + C$

(c) $(\tan x)\mathbf{i} + e^x\mathbf{k}$

(d) $(\tan x + C_1)\mathbf{i} + (e^x + C_2)\mathbf{k}$

(e) $(\tan x + C)\mathbf{i} + C\mathbf{j} + (e^x + C)\mathbf{k}$

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5.(6 pts) Find the volume of the parallelepiped spanned by the three vectors $\langle 1, 2, -1\rangle$, $\langle 0, 1, 2\rangle$ and $\langle 3, 2, 1\rangle$.

(a) $9\sqrt{2}$ (b) $2\sqrt{3}$ (c) 0 (d) 12 (e) $3\sqrt{2}$

6.(6 pts) Find the area of the triangle formed by the three points $(1, 0, 1)$, $(2, 0, 2)$ and $(3, 3, 3)$.

(a) 2.2 (b) 0 (c) $\frac{3}{2}\sqrt{2}$ (d) 4 (e) $\frac{\sqrt{3}}{2}$

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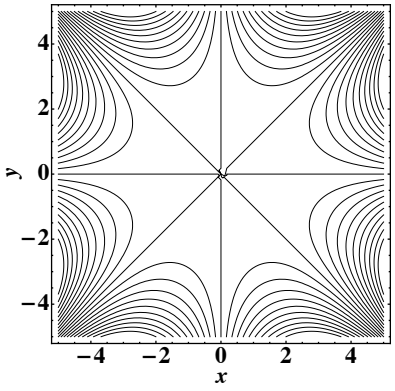
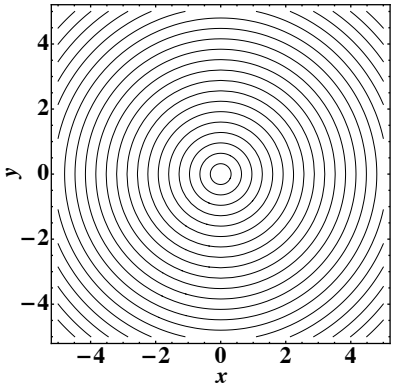
7.(6 pts) Which of the following is a contour map for $f(x,y) = \dfrac{xy}{x^2+1}$?

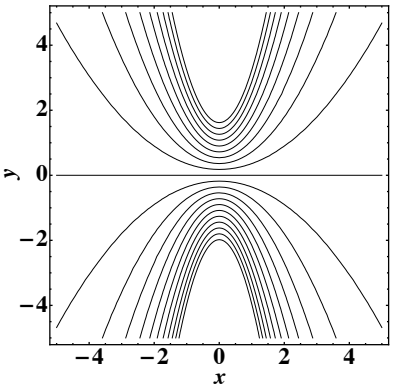
(a)



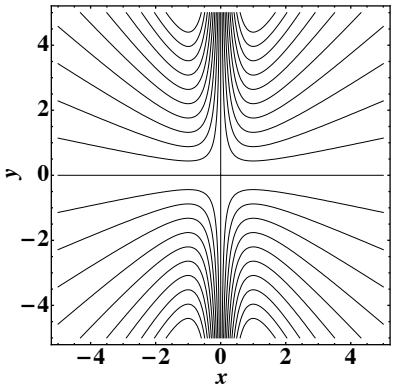
(b)



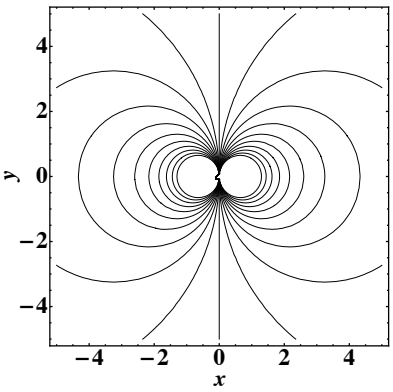
(c)



(d)



(e)



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8.(6 pts) An particle is travelling and has position at time t given by $\mathbf{r}(t) = \left\langle \frac{2}{3}t^3, \frac{\sqrt{12}}{2}t^2, 3t \right\rangle$. How far does it travel from time $t = 0$ to time $t = 3$.

(a) 56 (b) 27 (c) 14 (d) 96 (e) 48

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9.(6 pts) Find the radius of the sphere given by the equation

$$x^2 - 8x + y^2 + 2y + z^2 - 10z + 30 = 0.$$

(a) 6 (b) $\sqrt{10}$ (c) 12 (d) $2\sqrt{3}$ (e) $\sqrt{42}$

10.(6 pts) Below are five expressions involving two vectors $\mathbf{a}$ and $\mathbf{b}$. All of them are always equal to either 0 (the scalar) or $\mathbf{0}$ (the vector) except one. Which one can be nonzero?

(a) $(\mathbf{a} \times \mathbf{b}) \times (\mathbf{b} \times \mathbf{a})$ (b) $(\mathbf{a} \times \mathbf{b}) - (\mathbf{b} \times \mathbf{a})$ (c) $(\mathbf{a} + \mathbf{b}) \cdot (\mathbf{a} \times \mathbf{b})$

(d) $\mathbf{b} \cdot (\mathbf{a} \times \mathbf{a})$ (e) $\mathbf{a} \cdot (\mathbf{b} \times \mathbf{a})$

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Partial Credit

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

11.(12 pts.) Consider the curve

$$\mathbf{r}(t) = \sin(2t)\mathbf{i} + t\mathbf{j} - \cos(2t)\mathbf{k}.$$

Give equations for the normal plane and the osculating plane at $t = 0$.

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12.(12 pts.) Are the lines $\langle 3, -2, -1\rangle + t\langle 2, 1, 1\rangle$ and $\langle 7, 5, 6\rangle + t\langle 1, 3, 3\rangle$ parallel, intersecting, or skew? If intersecting, find a point of intersection.

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13.(12 pts.) Suppose the curve C has parametric equations:

$$x(t) = t^3 - t, \quad y(t) = 1 - 2\sqrt{t}, \quad z(t) = t^2 + t$$

Find the parametric equation for the tangent line to the above curve C at the point $P = (0, -1, 2)$.