Name: ______________________________

Instructor: __________________________

Math 20550, Exam 1
February 17, 2015

- 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) If the scalar projection of $\mathbf{b}$ onto $\mathbf{a}$ is $\text{Comp}_{\mathbf{a}}\,\mathbf{b} = 1$, what is $\text{Comp}_{2\mathbf{a}}\,3\mathbf{b}$?

(a) 2 (b) 5 (c) $\frac{3}{2}$ (d) 6 (e) 3

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

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

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

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

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

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

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3.(6 pts) Find the distance from the point $(1, 2, 3)$ to the plane $x + 2y - 2z = -7$.

(a) $\sqrt{3}$ (b) 1 (c) 6 (d) 2 (e) $\sqrt{6}$

4.(6 pts) Suppose the position function $\mathbf{r}(t) = \langle t^3/3, t^2/2, t\rangle$. Find the normal component of the acceleration vector at $t = 1$.

(a) $a_N = \sqrt{2}$ (b) $a_N = \sqrt{3}$ (c) $a_N = \sqrt{5}$

(d) $a_N = 1$ (e) $a_N = 0$

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5.(6 pts) Find the area of the triangle with vertices $(4,2,2)$, $(3,3,1)$ and $(5,5,1)$.

(a) 0 (b) 4 (c) $\sqrt{3}$ (d) $\sqrt{6}$ (e) 2

6.(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) $\frac{1}{5}$ (b) $\frac{1}{\sqrt{5}}$ (c) 0 (d) $\frac{e}{\sqrt{e^2+4}}$ (e) 3

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7.(6 pts) Find the vector equation of the line passing through the point $(1, 1, 1)$ and $(1, 2, 3)$

(a) $\langle x, y, z\rangle = \langle 1, 1, 1\rangle + t\langle 0, 1, 2\rangle$

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

(c) $\langle x, y, z\rangle = \langle 1, 1, 1\rangle + t\langle 0, 0, 1\rangle$

(d) None of the above

(e) $\langle x, y, z\rangle = \langle 1, 1, 1\rangle + t\langle 1, 2, 3\rangle$

8.(6 pts) Consider a helix curve

$$\mathbf{r}(t) = \langle \cos t - 1, \sin t, t\rangle.$$

Find the equation of the osculating plane of the curve at the point $(0, 0, 0)$

(a) $x = 0$

(b) $-y + z = 0$

(c) None of the above

(d) $y + z = 0$

(e) $x + y + z = 0$

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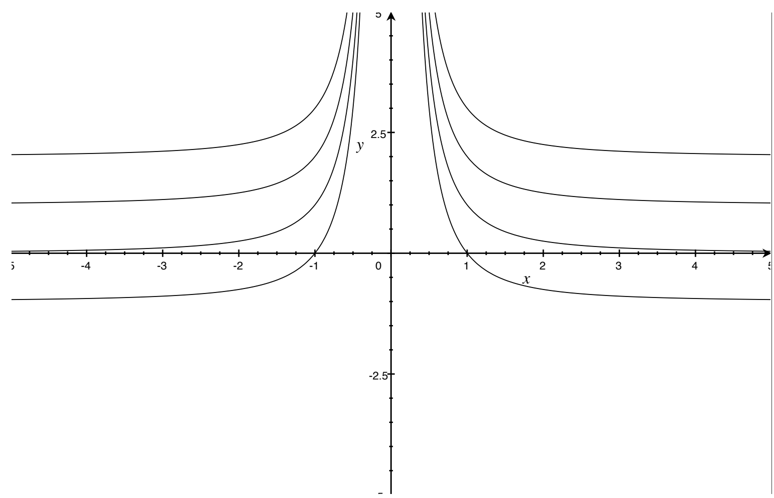
9.(6 pts) Given a space curve
$$\mathbf{r}(t) = \langle 2\cos t, e^t, t\rangle.$$
Which of the following points is in the tangent line of the curve at the point $(2, 1, 0)$?

(a) $(1, 1, 1)$ (b) $(2, 1, 1)$ (c) $(1, 2, 0)$

(d) $(2, 2, 1)$ (e) $(0, 1, 2)$

10.(6 pts) Which of the following functions has this contour map



(a) $f(x, y) = xy$ (b) $f(x, y) = y - \dfrac{xy - 1}{x}$

(c) $f(x, y) = y - \dfrac{1}{x^2}$ (d) $f(x, y) = \dfrac{1}{x}$

(e) $f(x, y) = \dfrac{1}{x^2}$

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11.(6 pts) Given three points $P(2, 0, 2)$, $Q(1, 1, 0)$ and $R(1, 2, 3)$.
(a) Find an equation of the plane through P, Q and R.
(b) Find an equation of the line through the point $(1, 1, 1)$ perpendicular to the plane in part (a).

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12.(6 pts) (a)Find an equation for the line of intersection of the planes $x - 3y + 2z = 0$ and $2x - 3y + z = 0$.

(b) Does the line from part (a) intersect the line with equations $x = 1 + t$, $y = 3 - t$, $z = 1 + t$? If so, where do they intersect?

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13.(6 pts) A particle has the acceleration

$$\mathbf{a}(t) = 2\mathbf{j} + 6t\mathbf{k}.$$

At the time $t = 0$, the particle's position is at the origin and its velocity is $\mathbf{v}(0) = \mathbf{i} + \mathbf{k}$. Find the position function $\mathbf{r}(t)$ of the particle.