Name____________________ ID__________ Section_____

1-8	/40	11	/20
9	/13	12	/15
10	/12	13	/ 5

MATH 253 Exam 1 Spring 2003

Sections 501-503 P. Yasskin

Multiple Choice: (5 points each) Work Out: (points indicated)

1. Find the distance between the points $P = (2,6,-3)$ and $Q = (6,3,9)$.

a. $\sqrt{151}$
b. 13
c. 19
d. 151
e. 169

2. A triangle has vertices $A = (1,2,3)$, $B = (1,0,1)$ and $C = (2,2,2)$. Find the angle at A.

a. $0°$
b. $30°$
c. $45°$
d. $60°$
e. $120°$

3. A triangle has vertices $A = (1,2,3)$, $B = (1,0,1)$ and $C = (2,2,2)$. Find the area.

a. $\sqrt{6}$
b. $\sqrt{2}$
c. $\sqrt{3}$
d. $2\sqrt{2}$
e. $2\sqrt{3}$

4. Find x so that $\langle 2,1,3\rangle \cdot \langle 4,2,x\rangle = 1$.

- **a.** -3
- **b.** -2
- **c.** 0
- **d.** 2
- **e.** 3

5. $\vec{a}$ is 4 units long and points along the positive x-axis.
$\vec{b}$ is 3 units long and points along the positive z-axis. Then $\vec{a} \times \vec{b}$ is

- **a.** 7 units long and points along the negative x-axis.
- **b.** 5 units long and points along the positive y-axis.
- **c.** 5 units long and points along the negative y-axis.
- **d.** 12 units long and points along the positive y-axis.
- **e.** 12 units long and points along the negative y-axis.

6. A certain plane may be parametrized as $\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 3 \\ 2 \\ 1 \end{pmatrix} + s\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix} + t\begin{pmatrix} 0 \\ 2 \\ 2 \end{pmatrix}$.

Find its non-parametric equation.

- **a.** $x + y + z = 6$
- **b.** $x - y - z = 0$
- **c.** $x - y + z = 2$
- **d.** $-x - y + z = -4$
- **e.** $x + y - z = -2$

7. You swing a ball on a string, so that it moves in the circle $\vec{r}(t) = (3\cos t, 0, 3\sin t)$ where t measures time. What is the tangential acceleration?

a. 0
b. 3
c. 6
d. 9
e. 12

8. If $f(x,y,z) = x^4 y^3 z^2$ then $\left.\dfrac{\partial^4 f}{\partial^2 x\,\partial y\,\partial z}\right|_{(x,y,z)=(1,2,3)} =$

a. 1
b. 6
c. 72
d. 96
e. 864

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9. $\left(13 \text{ points}\right)$ Find the arc length of the curve $\vec{r}(t) = \left\langle \frac{3}{2}t^2, 2t^2, \frac{5}{3}t^3 \right\rangle$ for $0 \le t \le \sqrt{3}$.
HINT: Factor the quantity inside the square root.

10. (12 points) The equation $xz^2 + yz^3 = 5$ implicitly defines z as a function of x and y. Compute $\frac{\partial z}{\partial y}$ at the point $(x,y,z) = (3,2,1)$.

11. (20 points) Consider the hyperbolic paraboloid $z = f(x,y) = y^2 - x^2$.
Find the tangent plane at $(x,y) = (1,2)$. Then identify the z-intercept of the tangent plane.

12. (15 points) The equation $2xz^4 + yz^3 = 7$ implicitly defines $z = f(x,y)$ near $(x,y,z) = (2,3,1)$. Using implicit differentiation, it can be shown (DON'T DO IT.) that

$$\frac{\partial f}{\partial x}(2,3) = -.08 \quad \text{and} \quad \frac{\partial f}{\partial y}(2,3) = -.04$$

Using the linear approximation, estimate $f(2.1, 3.2)$.

13. (5 points Extra Credit) Drop a perpendicular from the point $Q = (4,6)$ to the line $(x,y) = (1,2) + t(2,1)$. Find the foot of the perpendicular, i.e. the point where the perpendicular line intersects the original line.