Simon Fraser University
Department of Mathematics
Burnaby and Surrey Campus

MATH 251-3, Fall 2005
Midterm 1
October 5th, 2005, 8:30 – 9:20

Last Name (please print): ______________________________

First Name (please print): ______________________________

Student Number: ______________________________

Instructor: D. Marinescu P. Menz

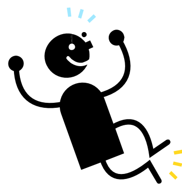
Instructions:

1. DO NOT OPEN THIS BOOKLET UNTIL TOLD TO DO SO.
2. Fill in the above box.
3. This exam contains 7 pages with a total of 6 questions. Once the exam begins please check to make sure your exam is complete.
4. SHOW ALL YOUR WORK!
5. If you run out of space in a problem, use the space on the back of the previous page and clearly indicate where the solution continues.
6. **Only** scientific, non-programmable calculators with no differentiation and integration capabilities are allowed.
7. No book, paper, or device, other than the usual writing instruments, this booklet and an acceptable calculator, shall be within reach of a student during the examination.
8. During the examination, speaking to, communicating with, or deliberately exposing written papers to the view of other examinees is forbidden.
9. Try your Best!

Do not write in this table!	
Question	**Marks**
1	**/3**
2	**/4**
3	**/3**
4	**/4**
5	**/3**
6	**/3**
Total	**/20**

1. Match the equations with their graphs by placing the letter next to the equation in the square box next to the graph. **[1/2 mark each=3 marks]**

a) $\theta = \dfrac{\pi}{4}$



d) $\phi = \dfrac{\pi}{4}$

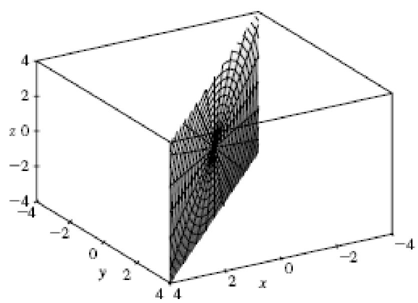
b) $z = e^{y}$

e) $y^2 + 0.25z^2 = 1$

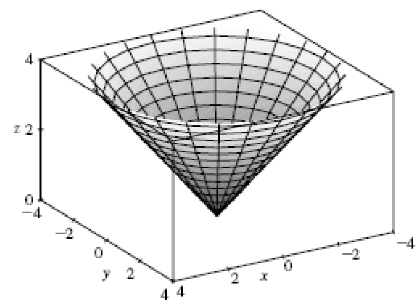
c) $8x + 2y + 3z = 0$

f) $x^2 + y^2 + 0.25z^2 = 1$

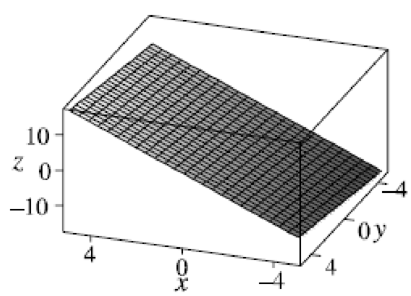
g) $\square$



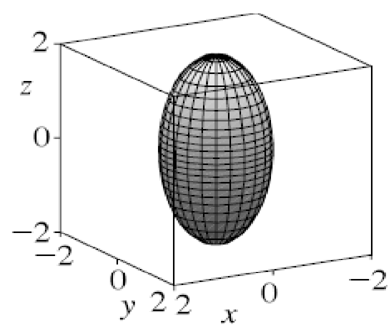
j) $\square$



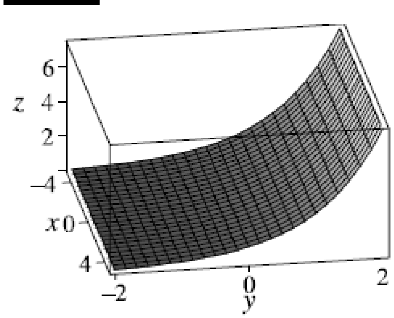
h) $\square$



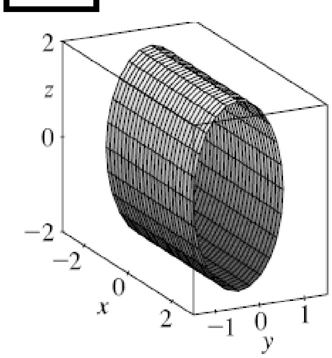
k) $\square$



i) $\square$



l) $\square$



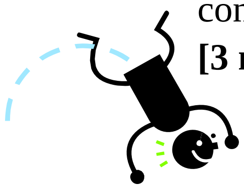
2. Let $\vec{r}, \vec{s}, \vec{t}$ be distinct non-zero vectors in space. Which of the following statements must be true, which might be true, and which cannot be true? For each statement explain briefly why it must be true or might be true, or give an example showing that it is false. **[1 mark each=4 marks]**

a) If $\vec{r} \parallel \vec{s}$ and $\vec{s} \parallel \vec{t}$, then $\vec{r} \parallel \vec{t}$.

b) If $\vec{r} \perp \vec{s}$ and $\vec{s} \perp \vec{t}$, then $\vec{r} \perp \vec{t}$.

c) If $\vec{r} \times (\vec{s} \times \vec{t}) = \vec{0}$ and $\vec{s} \times \vec{t} \neq \vec{0}$, then $\vec{r} \perp (\vec{s} + \vec{t})$.

d) If $\vec{r} \cdot (\vec{s} \times \vec{t}) = 0$ and $\vec{s} \times \vec{t} \neq \vec{0}$, then $\vec{r} \perp (\vec{s} + \vec{t})$.

3. Find an equation of the plane that passes through the point $P(1,3,-2)$ and contains the line of intersection of the planes $x+y-z=1$ and $x-y+z=1$.

[3 marks]

4. Do the following. **[4 marks]**

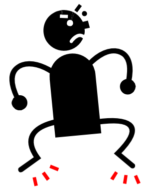
a) Change $(7,0,0)$ from spherical to cylindrical coordinates.

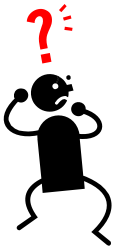
b) Write the equation $3x^2+3y^2-4z^2=12$ in cylindrical coordinates.

c) Sketch the space curve described by the position function $\vec{r}(t)=\langle \cos 2t, \sin 2t \rangle$, $0 \le t \le \dfrac{\pi}{2}$ and indicate initial point, end point, and direction.

d) Find the velocity of the particle with position function $\vec{r}(t)=\left\langle 4e^{3t}, 5\ln(t+1) \right\rangle$.

5. A particle moves with position function $\vec{r}(t) = 2\cos t\,\vec{i} + 2\sin t\,\vec{j} + 2t\,\vec{k}$. Find the unit tangent vector, normal vector and tangential component of the acceleration vector. **[3 marks]**





6. Suppose a plane curve is described by $y = f(x)$. Let x be the parameter and write $\vec{r}(x) = x\vec{i} + f(x)\vec{j}$. Use this to show that $\kappa = \dfrac{|f''(x)|}{\left[1+\left(f'(x)\right)^2\right]^{3/2}}$ from your space curvature formula. **[3 marks]**