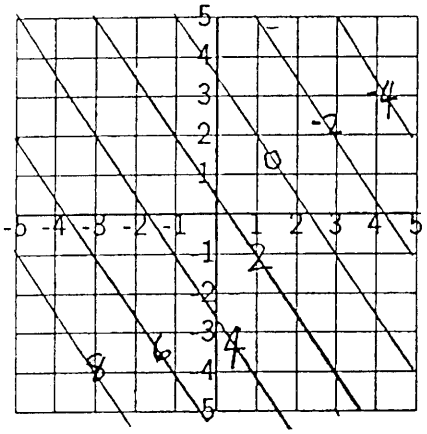
There will be two parts. Part I will consist of 8 multiple choice questions, each worth 5 points. Part II will consist of 6 problems, each worth 10 points. Work must be shown and partial credit is possible. There will also be a 5 point Maple problem for extra credit. Sample part II problems appear below and sample part I problems appear after.

0.1 Find an equation for the plane passing through the points $(0,1,2)$, $(1,1,1)$ and $(2,-5,0)$.

0.2 An airplane is heading due north. Its speed through the air is 200 miles/hour but the wind is blowing to the exact northeast at 40 miles/hour. Find a) the plane's speed over the ground, b) the angle, in degrees, by which the plane's direction deviates from due north.

0.3 Draw and label contours of the function $f(x,y) = \frac{1}{x^2} - y$ corresponding to function values 0, 1 and 2. Be sure to draw enough of each contour to make its overall shape clear.

0.4 Consider the following contour diagram a function $f(x,y)$. Explain why f could be a linear function and find a possible formula for $f(x,y)$.



0.5 The total heat energy U (in joules) produced in a certain electrical device is a function of an applied voltage V (in volts) and an adjustable resistance R (in ohms): $U = f(V,R)$. Suppose you have the following data about the function f and its partial derivatives.

$f(200,300) = 12.0, f_V(200,300) = 0.6, f_R(200,300) = -0.4$

a) What are the units of f_R?

b) Explain in a sentence the practical meaning of $f_R(200,300) = -0.4$.

c) Suppose you had a formula for f, namely $U = aV^2R + b/R^2 + c$, where a, b and c are constants. Find a formula for $f_R(V,R)$.

0.6 Find a *unit* vector normal to the plane containing the three points $(0,0,0)$, $(1,1,0)$ and $(1,-1,1)$.

1. Find the distance in space from (2, -1, 4) to (3, 1, 5).

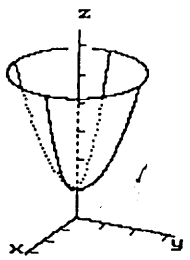
   a) $\sqrt{6}$ b) 6 c) 4 d) 2 e) 16

2. Find the point (x, y, z) in the plane $z = 3$ that is closest to the point (-1, 5, 7).

   a) (0, 0, 7) b) (0, 0, 3) c) (1, -5, 3) d) (-1, 5, 3)

   e) (3, 3, 7)

3. Which equation has approximately the graph shown?



   a) $z = x^2 + y^2$ b) $z^2 = x^2 + y^2$

   c) $z + 1 = x^2 + y^2$ d) $z - 1 = x^2 + y^2$

   e) $z - 1 = x^2 - y^2$

4. Find the displacement vector from (2, 1, 0) to (0, 0, 1).

   a) $2\vec{i} + \vec{j} + \vec{k}$ b) $2\vec{i} + \vec{j} - \vec{k}$ c) $\vec{i} + (1/2)\vec{j} + (1/2)\vec{k}$

   d) $-2\vec{i} - \vec{j} + \vec{k}$ e) $-2\vec{i} - \vec{j} - \vec{k}$

5. Find a unit vector parallel to $2\vec{i} - 6\vec{j} - 3\vec{k}$ but with opposite direction.

   a) $(1/2)(-2\vec{i} + 6\vec{j} + 3\vec{k})$ b) $(1/7)(-2\vec{i} + 6\vec{j} + 3\vec{k})$

   c) $(1/7)(2\vec{i} - 6\vec{j} - 3\vec{k})$ d) $-(1/\sqrt{7})(2\vec{i} - 6\vec{j} - 3\vec{k})$

   e) $(1/\sqrt{7})(2\vec{i} - 6\vec{j} - 3\vec{k})$

6. Find the angle between $2\vec{i} - 3\vec{j} + \vec{k}$ and $\vec{i} - 2\vec{j}$.

   a) 0 b) $\cos^{-1}(4/\sqrt{70})$ c) $\pi/2$ d) $\cos^{-1}(-4/\sqrt{70}$

   e) $\cos^{-1}(8/\sqrt{70})$

7. Find the area of the parallelogram having $\vec{a} = \vec{i} - 4\vec{j} + \vec{k}$ and $\vec{b} = 2\vec{i} + 3\vec{j} - 2\vec{k}$ as adjacent edges.

   a) $\sqrt{152}$ b) $\sqrt{146}$ c) 162 d) $2\sqrt{3}$ e) $9\sqrt{2}$

8. Let $f(x, y) = x^2 e^{xy}$. Find $f_y(-3, 0)$.

a) 9 b) 0 c) -33 d) 18 e) -27

EXTRA CREDIT. 5 points

Let $f(x,y) = -x\sin(4xy)$. Write Maple commands to do the following.

1. Define the function f in Maple.

2. Plot the graph of $z = f(x,y)$ in three dimensions for x between -3 and 3, y between -2 and 2.

3. Plot a two dimensional contour diagram for the same ranges as in 2.