MAT251 Multivariable Calculus III MIDTERM Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Prof. PORTER PRACTICE

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What is Multivariable Calculus? Give a good reason why your major might want you to know this material?

Mention any literature you might have encountered that uses the topics in this course.

1. If two ships start at arbitrary coordinates A(0,0,0) in space. One heads towards location B(1,2,3) in space and the other heads toward location C (3,-2,1) in space. Use vectors to find how many degrees are there between the two coordinates? \*\*\* Find θ between **AB** and **AC**

Answer\_\_\_\_\_\_\_\_\_\_\_\_

Find the equation of a plane containing the three points given above.

Answer\_\_\_\_\_\_\_\_\_\_\_\_

1. If a sailing boat at location A (1,2,0) on a map leaves heading towards location B(6, 2,1) on the map at the same time a submarine leaves location C(3,-2,1) on the map and follows the equation

**r(t)** = <3-2t,-2+2t,2t+1> on the map. Will the paths cross?

Answer\_\_\_\_\_\_\_\_\_\_\_\_

1. The equation below is a model for an egg centered at the origin and measured in cm. Draw on y-z plane and label the pictures of the slices of the egg for slices at x = 0, 2, and 4 cm. Discuss any irregularities.

 z

y

Identify the shape of the surface:

a)  Answer\_\_\_\_\_\_\_\_\_\_\_\_

b)  Answer\_\_\_\_\_\_\_\_\_\_\_\_

c)  Answer\_\_\_\_\_\_\_\_\_\_\_\_

1. A car drives up a parking garages spiral driveway to get to the top floor. The center line is modeled by the parametric curve below **r**(t). By using this model, find the distance (to 2 decimal places) the car travels if we assume that the car starts at **r**(0) and goes up to the top floor which occurs at the position **r**(10π)?

**r**(t) = 450’cost**i**+450’sint**j**+500t/π’**k**

Answer\_\_\_\_\_\_\_\_\_\_\_

What is the speed that the car is traveling up the driveway at t=10π?

Answer\_\_\_\_\_\_\_\_\_\_\_

What direction is the car heading at t=10π?

Answer\_\_\_\_\_\_\_\_\_\_\_

1. Find the limit as (x,y) goes to (0,0) along the paths x = 0 and y = x for the functions:

a) f(x,y) = 

Answer\_\_\_\_\_\_\_\_\_\_\_

b) Is f(x,y) continuous at (0,0)?

Answer\_\_\_\_\_\_\_\_\_\_\_

c) Can you add another function ( or piece) to make this function continuous.?

Answer\_\_\_\_\_\_\_\_\_\_

1. Given g(x,y) = cosy e 7x  and x(u,v) = 2u + 5v and y(u,v) = 3u - 2v

Find ,,, and in terms of u and v.

Answer\_\_\_\_\_\_\_\_\_\_\_

Answer\_\_\_\_\_\_\_\_\_\_\_

Answer\_\_\_\_\_\_\_\_\_\_\_

Answer\_\_\_\_\_\_\_\_\_\_\_

Answer\_\_\_\_\_\_\_\_\_\_\_

1. The electrical potential E is given by the product of the magnetic field M and the square of the circuit C . After an experiment, magnetic field is measured at 8.1e (plus or minus .05e) and the circuit C is measured at 24c (plus or minus .5c).

Give the equation for E.

Answer\_\_\_\_\_\_\_\_\_\_\_

Give total differential for E ?

Answer\_\_\_\_\_\_\_\_\_\_\_

Use the total differential to approximate the maximum error for E in the experiment above?

Answer\_\_\_\_\_\_\_\_\_\_\_

1. Use the chain rule and Implicit Differentiation to determine the partial derivative of y with respect to x  when z2 = x3 - 2x2y +10 y3

Answer\_\_\_\_\_\_\_\_\_\_\_

Find the equation of the tangent plane to the surface z2 = x3 - 2x2y +10 y3 at the point (1,1,3)

Answer\_\_\_\_\_\_\_\_\_\_\_

1. Find the directional derivative of the function f(x,y) = yx2 +9 cos(xy) at the point (1,2) in the direction of the point (2,1) ?

Answer\_\_\_\_\_\_\_\_\_\_\_

What is the largest directional derivative at the point (1,2) in any direction ?

Answer\_\_\_\_\_\_\_\_\_\_\_

1. For the equation z = 32 - x4 + 16xy - y4, find all the critical values.

Answer\_\_\_\_\_\_\_\_\_\_\_

Determine if the critical values are a max., min., or saddle point.

Answer\_\_\_\_\_\_\_\_\_\_\_

Find the absolute max and min on the region R = {(x,y): 0<x<1, 1<y<2}

Answer\_\_\_\_\_\_\_\_\_\_\_

1. The product of three numbers x,y,z is125. Use substitution to minimize the sum ( x+ y + z) of the numbers. (hint: x y z = 125 so z=?)

Answer\_\_\_\_\_\_\_\_\_\_\_

Use Lagrange multipliers to solve the above problem.

1. Evaluate the integral over the region R = {(x,y): 0<x<2, 1<y<5}



Answer\_\_\_\_\_\_\_\_\_\_\_

Evaluate: 

Answer\_\_\_\_\_\_\_\_\_\_\_

Draw the region on the x-y plane.

Give an explanation of the integral in words. What is the function being integrated? What is the geometric interpretation of the answer?