## EXAM 2

Math 212, 2015-2016 Spring, Clark Bray.

You have 50 minutes.

No notes, no books, no calculators.

## YOU MUST SHOW ALL WORK AND EXPLAIN ALL REASONING TO RECEIVE CREDIT. CLARITY WILL BE CONSIDERED IN GRADING.

All answers must be simplified. All of the policies and guidelines on the class webpages are in effect on this exam.

Good luck!

Name \_\_\_\_\_\_\_

"I have adhered to the Duke Community Standard in completing this examination."

1. \_\_\_\_\_\_\_

Signature: \_\_\_\_\_\_

3. \_\_\_\_\_\_

4. \_\_\_\_\_\_

Total Score \_\_\_\_\_\_ (/100 points)

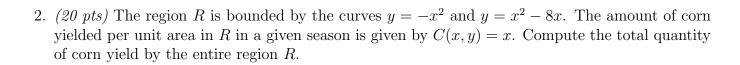
1. (20 pts) The barometric pressure P (measured in kPa) is dependent on position (x, y) (measured in miles east and north (respectively) of a fixed reference point) in a particular region as described by the equation below.

$$P = 101 + \frac{\sin(3x - 7y)}{6}$$

At a given moment, a car is located at (0,0) and moving at 60 miles per hour in the direction indicated by the vector (4,3).

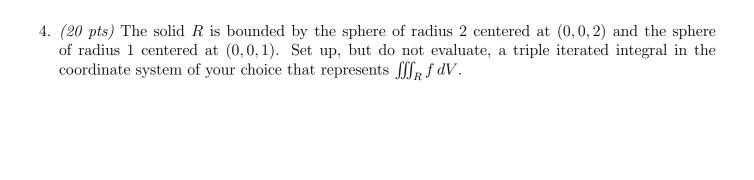
(a) Use the multivariable chain rule to compute  $\frac{dP}{dt}$  as experienced by the car.

(b) Use the directional derivative to compute  $\frac{dP}{dt}$  as experienced by the car.



3. (20 pts) The solid T is the region under the surface 8x + 4y + 2z = 24 and above the triangle in the xy-plane with vertices at (0,1,0), (1,2,0), and (2,1,0). The density is  $\delta(x,y,z) = ke^{-z}$ , and the mass is known to be M.

Set up, but do not evaluate, a triple iterated integral representing the y coordinate of the centroid of T.



5. (20 pts) A vector in the st-plane is rotated counterclockwise around the origin by the angle  $\pi/4$  by the function

$$R(s,t) = \begin{pmatrix} (s-t)/\sqrt{2} \\ (s+t)/\sqrt{2} \end{pmatrix}$$

Use this function and the method of change of variables to compute the value of the integral  $\iint_P x \, dx \, dy$ , where P is the rectangle in the xy-plane with vertices at (0,0),  $(3\sqrt{2},3\sqrt{2})$ ,  $(-\sqrt{2},\sqrt{2})$ ,  $(2\sqrt{2},4\sqrt{2})$ .

(You may NOT use a geometric argument to compute the Jacobian determinant.)