

**First Examination**  
*Friday, September 12, 2014*

**Instructions:** This exam should be done on your own paper. Your name should be on each sheet and on the back of the last sheet; the answers should appear written carefully and in order. If in doubt, show intermediate steps: Full credit may not be given, even for correct answers, unless work is arranged clearly and explained. This exam is closed book. You may leave after handing in your exam paper, but be sure to check your answers carefully. You may keep this exam sheet. Each entire problem is worth 20 points.

1. Draw the  $c = -1$ ,  $c = 1/9$ , and  $c = 1$  contours of the function

$$f(x, y) = -x^2 + \frac{y^2}{9},$$

labeling the contours and any intersection points with the axes. What geometric figures do these contours represent?

2. Write down an equation of the form  $z = f(x, y)$  for the plane passing through the points  $(0, 0, 2)$ ,  $(1, 0, 4)$ , and  $(0, 1, 1)$ .
3. Write down a vector perpendicular to the plane corresponding to the equation

$$x - y + 2z = -3.$$

4. Does

$$f(x, y) = \frac{x^2 - y^2}{x^2 + y^2}$$

have a limit at  $(x, y) = (0, 0)$ ? Why or why not?

5. An airplane is pointed due east and traveling through the air with a speed of 700 kilometers per hour. The air at the altitude the plane is traveling is moving from the southwest to the northeast (making an angle of 45 degrees with respect to due east) at a speed of 100 kilometers per hour.
- (a) Draw a diagram of the plane's air velocity, the wind velocity, and the plane's ground velocity.
- (b) Write down the components of the plane's air velocity  $\vec{a}$ , the wind velocity  $\vec{w}$ , and the plane's ground velocity  $\vec{g}$ .
- (c) Write down the net speed at which the plane is traveling.
- (d) Write down the angle of the plane's path. (Assume the positive  $x$ -axis is east, the positive  $y$ -axis is north, and angles are measured counterclockwise from the positive  $x$ -axis.)