Due Date: Tuesday, October 4 at 5PM EDT

Carefully read and provide solutions to the problems below, showing all work required to justify any conclusions you make. You are encouraged to collaborate with your classmates, but all solutions turned in should be your own work. If you do collaborate, please record the names of those other students on your submitted work. Finally, your work should be submitted as a PDF on Canvas before the listed due date.

Textbook problems: Section 14.5 #2, 6, 24, 38; Section 14.6 #14, 24, 34; Section 14.7 #2, 10, 36, 46

Optional textbook problems: the odd numbered problems from Sections 14.5 - 14.7

Problem 1. (Lecture 14.5, Exercise 2) An airplane is on approach to Hartsfield–Jackson Airport on an unknown trajectory, but its altitude h (in feet) is a function of its coordinates x and y on the 2-dimensional radar display in the control tower (both listed in miles). The plane is following a trajectory described by some vector valued function $\langle x(t), y(t)\rangle$ where t is time in minutes and the control tower staff are able to determine that right now, the plane's altitude and ground coordinates have the following rates of change:

$$\frac{\partial h}{\partial x} = -5 \text{ feet/mile}, \quad \frac{\partial h}{\partial y} = 2 \text{ feet/mile}, \quad \frac{dx}{dt} = 3 \text{ miles/minute} \quad \text{and} \quad \frac{dy}{dt} = 7 \text{ miles/minute}.$$

Find the current rate of change in the plane's altitude per minute.

Problem 2. A hiker visiting a state park is descending a mountain as night falls, decreasing visibility. Their altitude is given by the function

$$h(x, y) = \frac{5(x + y)}{x^2 + y^2 + 1}$$

based on their geographical coordinates (x, y), in miles to the east and north of the park entrance in the southwest.

(a) If the hiker is currently 4 miles north and 5 miles east of the park entrance, in which direction should they head to descend the mountain most quickly?

(b) How steep is the descent in this direction?

(c) Is this in the direction of the park entrance?