

## Math 141 Homework 3. Due 2/9

**Reading:** GP sections 1.3 and 1.4 (we'll continue with 1.4 next week)

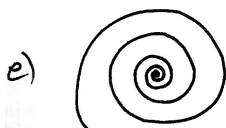
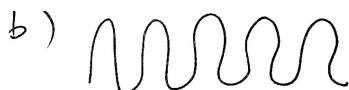
### Problems to hand in:

1. Do the following problems from GP section 1.3:

1, 5, 6, 9.

Note: Problem 9 shows that every manifold is locally a graph (a fact that came up as a question in class earlier).

2. Which of these curves could be the images of an immersion from  $\mathbb{R}$  to  $\mathbb{R}^2$ ? Give a short sentence of justification for each one, but you do not need to give a proof.



3. Do the following problems from GP section 1.4:

1, 7.

4. (related to GP 1.4 problem 5)

(a) What are the critical values of the map  $f : \mathbb{R}^3 \rightarrow \mathbb{R}$  defined by  $f(x, y, z) = x^2 + y^2 - z^2$ ? Show your work.

(b) Use wolframalpha.com or another program to graph the sets  $\{(x, y, z) : x^2 + y^2 - z^2 = a\}$  when  $a$  is positive, negative or zero. You do not need to hand in a copy of the graphs. However, do describe what you observe.

(c) (Challenge, not to hand in) Can you generalize this example? See if you can define other functions with one critical point, and investigate their level sets.