1. Draw some of the curves given by $x^2 + y^2 = C$. On top of that, draw curves that meet these at right angles.

2. Find the orthogonal trajectories of the following family of equations. (Carefully justify everything you do, explaining in words if needed.)

   (a) $x^2 + y^2 = C$

   Does you think your drawing in Question 1 correspond to your answer?

   (b) $y^4 = Cx$
(c) In your own words, explain the steps involved in finding orthogonal trajectories of a set of curves. What is the form of your final answer?

(d) In the previous problems, what method of solving differential equations did you use?

3. (Newton’s Law of cooling)

(a) What is Newton’s Law of Cooling?

(b) Restate Newton’s Law of Cooling using the language of proportionality.

(c) How would you solve this differential equation?

4. Suppose that we want to find an Euler polygon approximation to $y(t)$ where $y(t)$ is the solution to the initial value problem

$$\frac{dy}{dt} = f(t, y) = 3t + y, \quad y(0) = 1,$$

with a step size $h = 0.5$. In this case, the Euler polygon starts at $(t_0, y_0) = (0, 1)$, and we can find the other points of the Euler polygon by the formulae

$$t_{i+1} = t_i + h,$$
$$y_{i+1} = y_i + hf(t_i, y_i).$$

The above iterative equations then determine $(t_1, y_1), (t_2, y_2)$, and so forth where each $y_j$ estimates $y(t_j)$. Carry out this procedure to estimate $y(0)$.

Section 2.1 will be on the test, so read it and bring questions to office hours/Mathlab.

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3For extra practice, try solving each of the orthogonal trajectory problems in number 8 of Homework 2.