MTH 306 J&K

Lab 6 **Friday, March 7, 2025**

Names of collaborating students: _____

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Drawing curves in the phase plane

Recently we've began to study **systems** of differential equations. An example is when we have two functions x(t) and y(t) and the rate of change of each of them depends on both of them.

To acquaint you with the situation, in today's lab you'll use an app to explore the relationship between the picture in the xy-plane - the "phase plane", which is like the phase line but in 2D - and the graphs of the two dependent variables x and y versus time. Work in pairs or triples so that you can discuss things with your partner(s) as you go.

First follow the Lab 6 instructions on the website, which help you download the app.

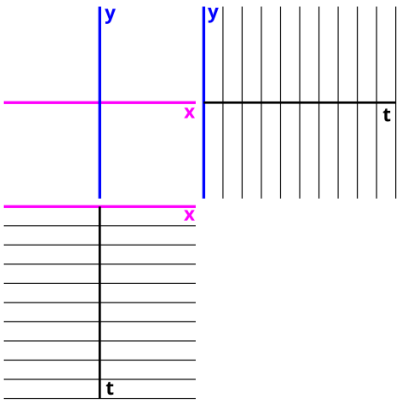
When you run the app ("python ppd.py" in your terminal or Anaconda prompt), you can draw a curve in the phase plane (upper left panel) and the app will draw corresponding plots of x(t) and y(t).

Perform the following exercises, and write brief responses on the sheet.

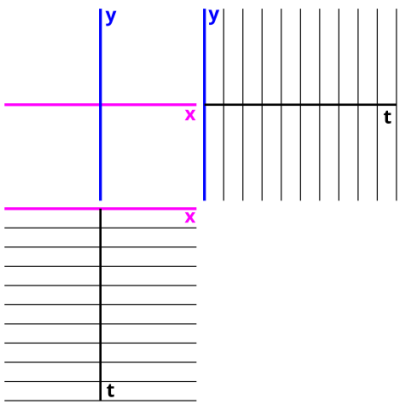
(1) Run the code, and in the phase plane panel, draw a circle counter-clockwise, as smoothly as you can, starting at a point on the x-axis. Look at the graphs of x(t) and y(t) that you have generated. Do they make sense? Do they remind you of any familar functions?

(2) How would the graphs of x(t) and y(t) differ if your starting point were on the y-axis? Predict what you think to your partner before trying it. Then check your prediction by doing it.

your prediction

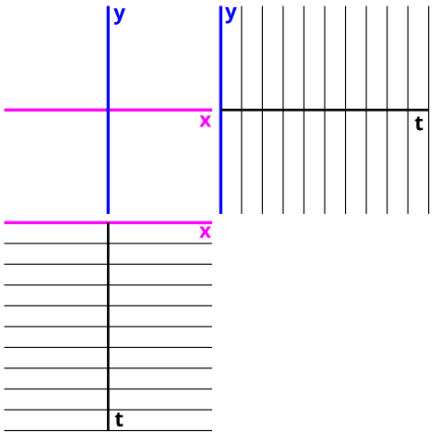


actual with app

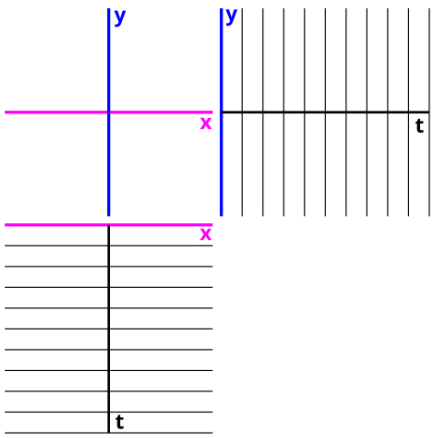


(3) How would the graphs differ if you drew the same circle, but slower? Again, predict first, then try it.

your prediction

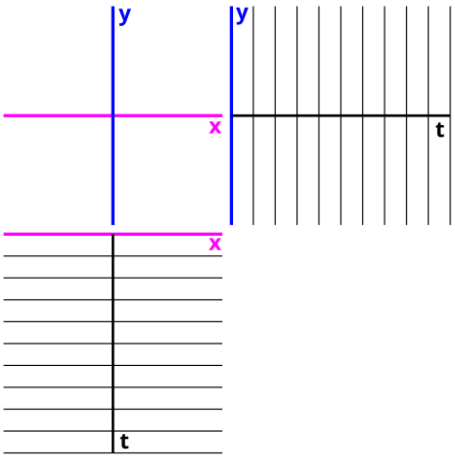


actual with app

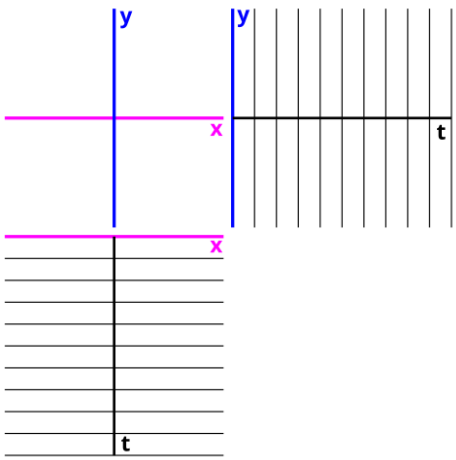


(4) How would the graphs differ if you drew the same circle, but you slow down dramatically for a short time while you're drawing the circle? Once again, predict first, then try it.

your prediction

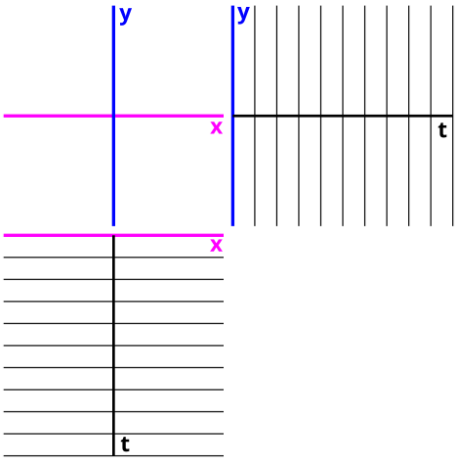


actual with app

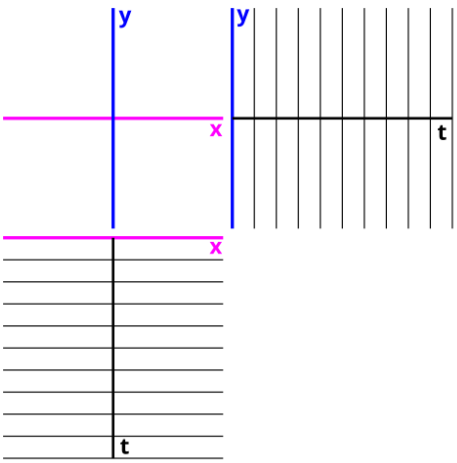


(5) How about if you draw the same circle but counterclockwise. Predict, then check.

your prediction

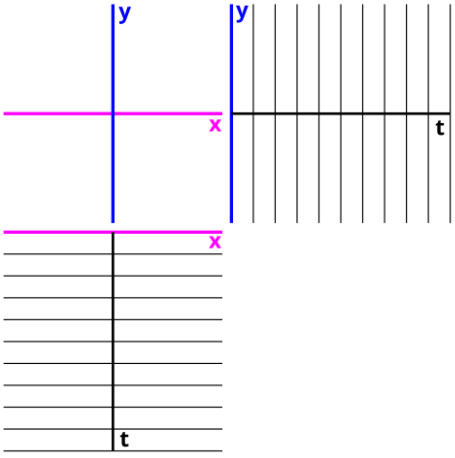


actual with app

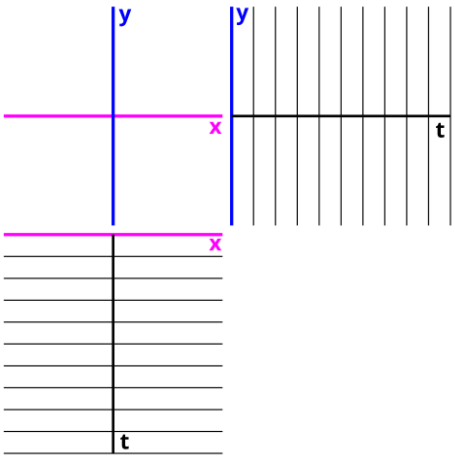


(6) Draw some spirals and observe the corresponding graphs of x(t) and y(t).

your prediction



actual with app



(7) Finally see if you can go from graphs of x(t) and y(t) to the corresponding phase plane curve. Try at least one of the following 3 examples.

The TA will show you the answer after you've drawn your curve(s).