

All parts of this homework to be completed in Maple should be done in a single worksheet. You can submit either the worksheet by email or a printout of it with your homework.

1. Modification of Exercise 1.1.6. Let  $(x(t), y(t))$  be the curve given in problem 1.1.6.
  - a) Using Maple, find all solutions of the equation  $x(t) = 2\lambda$ . You may find the command `solve` to be handy.
  - b) Plot a graph of  $x(t)$  and  $y(t)$  versus  $t$  on the same graph, assuming  $\lambda = 3$ . The parameter  $t$  should range from  $1/3$  to  $3$ .
  - c) Determine for what value of  $t$  is  $y(t) = 10$  when  $\lambda = 3$ . Find a solution with  $t > 1$ . The `fsolve` command will be handy.
  - d) Using Maple, make a plot of the curve for  $\lambda = 3$ ,  $x \geq 2\lambda$ ,  $0 \leq y \leq 10$ . Look at the help page for parametric plots: `?plot,parametric`.
  - e) Using Maple, compute the velocity and acceleration vectors for this curve.
  - f) What angle does the curve make with the  $x$ -axis where it intersects at  $(2\lambda, 0)$ ?
  
2. Let  $\alpha$  be a regular curve let  $t_0$  be a parameter such that  $\alpha$  achieves its closest distance to the origin at  $t_0$ . Suppose  $\alpha(t_0) \neq 0$ . Show that  $\alpha(t_0)$  is orthogonal to  $\alpha'(t_0)$ .
  
3.
  - a) Oprea 1.1.13
  - b) Henceforth, assume  $a = 1$ . Use Maple to compute the arclength of the curve over one period. *Hint:* `int(f,t=0..3)` computes  $\int_0^3 f dt$ .
  - c) What happens if you try to compute the general arclength function?
  - d) Let `al` be your expression (in  $t$ ) for the arclength. Then `int(al,t)` returns the indefinite integral of `al`. However (from the `int` help page):
 

“Note that the indefinite integral in Maple is defined up to a piecewise constant. Hence, the results returned by `int` may be discontinuous at some points. In many cases, you can ensure continuity by replacing an indefinite integration problem by the corresponding definite integral.”

Make a plot that shows that the indefinite integral that Maple finds for your problem has discontinuities.
  - e) It is sometimes useful in cases like this to use the “inert” form of `int`. The expression `Int(f,t=0..T)` is a placeholder for the expression  $\int_0^T f dt$ . Execute the following Maple commands to get a feeling for how `Int` works.
    - `Int(cos(s),s=0..x)`
    - `subs(x=3.14,Int(cos(s),s=0..x))`

- `evalf(subs(x=3.14,Int(cos(s),s=0..x)))`
- `plot(Int(cos(s),s=0..x),x=0..2*Pi)`

Now use these ideas to generate a plot of the arc length  $s(t)$  of the cycloid over 3 periods.

4. Oprea 1.1.17
5. Oprea 1.2.7