

Some of this assignment should be completed using Maple. Please hand in all of the Maple stuff 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) This curve is to be revolved about the x -axis, so we are only interested in the portion of it for which $y \geq 0$. Determine the value of t such that $y(t) = 0$. Then show that $x(t) = 2\lambda$ for this choice of t .
 - 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 α be a regular curve let t_0 be a parameter such that α achieves its closest distance to the origin at t_0 . Suppose $\alpha(t_0) \neq 0$. Show that $\alpha(t_0)$ is orthogonal to $\alpha'(t_0)$. Hint: minimizing distance is equivalent to minimizing distance squared!

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