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. Oprea 1.2.2

2. Consider the curve $\alpha(t) = (e^{-bt}\cos(\omega t), e^{-bt}\sin(\omega t)$.

a) Compute the arclength function $s(t) = \int_0^t |\alpha'(u)|\, du$.

b) Show that $\lim_{t\to\infty} s(t)$ is finite.

c) Find a function $h(r)$ such that $\beta(r) = \alpha(h(r))$ is parameterized by arclength.

3. Oprea 1.2.8

4. An ox is standing at the origin and is attached to a heavy rock at position $(1, 0)$ by a rope of length 1. The ox then walks in a straight line traveling along the positive y-axis, dragging the rock behind him. Later in the course we will derive that the rock traverses a path that can be parameterized in terms of its x-coordinate by

$$\alpha(x) = (x, \operatorname{arcsech}(x) - \sqrt{1 - x^2})$$

for $0 < x \leq 1$. For now we will just verify that this is the correct solution.

a) Perform a computation using Maple to show that the tangent line to this curve at $\alpha(x)$ intersects the y-axis at a point that is distance 1 from $\alpha(x)$. To do this computation efficiently you will want to use Maple's `assume` facility. If you enter `simplify(sqrt(x^2))` in Maple, you will get an answer `csgn(a) a` since the answer really depends on whether $x > 0$ or not. But if you enter `simplify(sqrt(x^2)) assuming x>0` then Maple will return `x`.

b) Extra Credit. Make an animation in Maple that demonstrates that this curve satisfies the dragging property described. You will want to reparameterize the curve.