Math 2D – Suggested Homework 2

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Note: AP refers to the additional problem(s) on the next page. I know that there are lots of problems, but hopefully most of the ones in chapter 12 are straightforward!

Reading: Sections 10.2 – 10.3, 12.1 – 12.3. In 10.2, only focus on arclength this time, in 10.3, ignore the sections on Symmetry and Graphing Polar Curves with Graphing Devices, in 12.2 ignore the section on Applications (unless you're physics-inclined), in 12.3 ignore the section on Direction Angles and Direction Cosines; I won't ask about Work, but it's useful in physics.

- **Section 10.2:** 41, AP1, AP2
- **Section 10.3:** 3(b), 5(b)(i), 10, 30, 35, 55, 57, 64
- **Section 12.1:** 7, 8, 17, 29, 31, 35
- **Section 12.2:** 5, 19, 23, 26
- **Section 12.3:** 1, 2, 6, 9, 23(a), 39, 42, 45

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Additional Problems:

(AP1) I thought of that on my flight back to Asia, I think it's very neat!

Consider the circle of radius r centered at (0,0).

(a) Based on Lecture 1, what are the parametric equations of that circle?

(b) Find the slope of the tangent line L_1 at time t, that is at a point $(x(t), y(t))$

(c) On the other hand, find the slope of the line L_2 going through (0,0) and $(x(t), y(t))$ (this requires no calculus)

(d) Multiply the slopes you found in (b) and (c). What does that tell you about the lines L_1 and L_2.

(e) Illustrate this with a picture. Does that remind you of something you learned in high school geometry? Maybe it doesn't, but here you proved it, how neat!

(AP2) Show that the length of a curve given in polar coordinates by $r = r(\theta)$ from a to b is given by the formula

$$\int_a^b \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2}\, d\theta$$

Hint: Start with the formula for arclength in section 10.3 but with θ instead of t and use $x = r\cos(\theta)$ and $y = r\sin(\theta)$. Remember that r is also a function of θ.

Note: If you're really stuck, look at the section about Arclengths in section 10.4.