Math 53 DIS 202/204 **Jiazhen Tan (tanjz@berkeley.edu)**
Multivariable Calculus *August 31, 2020*

Filling up holes in the grading policy.

- Lowest HW and lowest two quiz grades dropped.
- 20% penalty for unexcused late HWs besides 4 late days. Regrade requests on Gradescope, due next Tue 4pm.
- You can discuss but should write down solutions yourself. Show your work and partial solutions.
- For HW2, Monday is Labor Day, so it is due Wed Sep 9th. Regrades due Fri Sep 18th 4pm.

Full grading policy in `http://pi.math.cornell.edu/~tanjz/53/#grading`.

Today's format: Breakout rooms

- I will make everyone co-host and put everyone into either room 1 or room 2.
- See if you can go to the opposite room. Help each other out if you figured out!
- Next, I will split people into room 1-6, where room n is for discussion on problem #n. But you don't have to stay there, even if you did not finish the problem. If you want to work on a different problem, just move yourself to a different room.
- I will be wandering, and you can see where I am from the breakout room list (Unassigned means I'm in the main room). You can come to me if your group want hints, if you want extra explorations, or if you want to ask about quiz and homework.

A semester-long reflection: What can discussion sections do?

- Discussion sections: catch up with material? Go through common errors? See fun and insightful extra math? Anything else we should include? You don't have to answer this now, but let me know if you think of anything!

Problems

1. The book page 690 says the equation of the cycloid is

$$x = R(\theta - \sin(\theta)), y = R(1 - \cos(\theta)) \text{ where } R \text{ is a constant.}$$

Can you find a way to write this curve in Cartesian equation (an equation with just x and y, no θ involved)?

2. Can you parametrize the curve

$$y^2 = x^3 + x$$

by $x = f(t), y = g(t)$ where $f(t), g(t)$ are both polynomials? Why?

Feel free to graph it and try.

3. If the cycloid
$$x = R(\theta - \cos(\theta)), y = R(1 - \sin(\theta)), 0 \leq \theta \leq 2\pi$$
where R is a constant is rotated around the x-axis, what is the exact area of the resulting surface?

4. **10.2, Exercise 64** If the curve
$$x = 2\cos\theta - \cos(2\theta), y = 2\sin\theta - \sin(2\theta)$$
is rotated around the x-axis, what is the exact area of the resulting surface? Graph it first.

5. For functions in cartesian coordinates, one has the so-called "vertical line test", meaning that a function cannot intersect the line $x = a$ more than once, for any a.

   Look at section 10.3. For functions in polar coordinates, do we have a similar "radial-line test" (for example, when $0 \leq \theta \leq \pi$, or when $0 \leq \theta < \pi$)?

   Look at Figure 16, 17, 18 on page 705. Do they violate your radial line test?

   If someone doesn't have the textbook, someone else who has the e-book can screen-share.

6. Can you write the cycloid
$$x = a(\theta - \cos(\theta)), y = a(1 - \sin(\theta)),$$
where a is a constant, in polar coordinates? (for definition, see textbook section 10.3)

   For the parametric equation above, the θ value for a point $P = (x, y)$ denotes how far the circle that traces the cycloid has travelled, not the angle between the x-axis and the line $\overline{OP}$. So the equation above needs an overhaul.

Exercises with section numbers comes from ***Multivariable Calculus***, **Eighth Edition,** James Stewart.