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Homework H03 MATH 3110/5110 (Barsamian) Due at the start of class Fri Feb 7, 2020

Problem:	1	2	3	4	5	Total	Rescaled		
Your Score:									
<b>Possible:</b>	20	20	20	20	20	100	10		

There is a large collection of *Suggested Exercises* for the fourth week. (The whole list of suggested exercises for the course can be found on the web page. These exercises are not to be turned in and are not graded, but you should write down solutions for as many of them as possible and keep your solutions in a notebook for study.)

2.1 # 1, 3, 5, 6, 8, 10, 11, 12, 13, 16, 18, 19, 24 (Some of this content was discussed in the third week.) 2.2 # 4, 5, 6, 7, 9, 10, 11, 18, 19, 20 2.3 # 1, 2, 3, 4, 5, 9

2.5 + 1, 2, 5, 1, 5, 7

[1] Equations for Cartesian Lines and Poincaré lines

- a) Find the equation for the line through (2,1) and (4,3) in the Cartesian plane.
- b) Find the equation for the line through (2,1) and (4,3) in the Poincaré plane.

Recall that there are two common questions about geometries. I call them the BIG QUESTIONS.

- BIG QUESTION #1: Do parallel lines exist?
- •BIG QUESTION #2: Given a line L and a point P not on L, how many lines exists that contain P and are parallel to L?

[2] Examples about BIG QUESTION #2 in the Cartesian Plane, the Poincaré plane, and the Riemann sphere.

- a) Find all lines through (0,1) that are parallel to the vertical line  $L_5$  in the Cartesian plane
- b) Find all lines through (0,1) that are parallel to the type I line  ${}_5L$  in the Poincaré plane
- c) Find all lines through the north pole N = (0,0,1) that are parallel to the equator in the Riemann sphere.

[3] Distance in the Poincaré plane. Find the distance between (2,1) and (4,3) in the Poincaré plane. (Refer to [1](b) for the line equation.)

[4] Using rulers (coordinate systems) in the Cartesian Plane, the Taxicab plane, and the Poincaré plane.

- a) In the Euclidean Plane, (i) find the coordinate of (2,3) with respect to the line x = 2, and (ii) find the coordinate of (2,3) with respect to the line y = -4x + 11.
- b) In the taxicab plane, find the coordinate of (2,3) with respect to the line y = -4x + 11.
- c) In the Poincaré plane, (i) find the coordinate of (2,3) with respect to the line x = 2, and (ii) find the coordinate of (2,3) with respect to the line  $(x 1)^2 + y^2 = 10$ .
- d) In the Euclidean Plane, find a point P on the line  $L_{2,-3}$  whose coordinate is -2.
- e) In the Taxicab Plane, find a point *P* on the line  $L_{2,-3}$  whose coordinate is -2.
- f) In the Poincaré Plane, find a point *P* on the line  ${}_{-3}L_{\sqrt{7}}$  whose coordinate is 2.

[5] Book Exercise 2.3#5 Prove that a line in a metric geometry has infinitely many points.