Name : _____ **Class Number:** _____

Math 1D: Lesson 3 Suggested Problems

Theoretic Problems: Discussed in-class

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1. Construct the cartesian coordinate system in $\mathbb{R}^2$ from first principles. In particular:
   A. Explain how to create a cartesian coordinate system by establishing the origin $(x, y) = (0, 0)$, the $x-$axis with equation $y = 0$, and the $y-$axis with equation $x = 0$.
   B. Consider the point $(-3, 4)$. What does it mean to travel a distance of -3 along the $x-$axis and a distance of $+4$ along the $y-$axis?
   C. Explain why we can interpret the ordered pair (x, y), encoded in cartesian coordinates, as traveling signed (or oriented) distances.
   D. Jeff claimed that in order to create a cartesian coordinate system, it is enough to specify the location of three points: $(0, 0), (1, 0), (0, 1)$. Explain why these three points establish the $x-$ and $y-$axis and create an orientation in which we can travel signed distances with respect to x and y.

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2. Construct the polar coordinate system in $\mathbb{R}^2$ from first principles. In particular:
   A. Explain how to create a polar coordinate system by establishing the pole $(r, \theta) = (0, 0)$, the positive polar axis $\theta = 0$ with $r \geq 0$, and choosing an orientation for the positive direction $\theta \geq 0$.
   B. Explain why points in polar coordinates do NOT have a unique representation.
   C. Explain the convention we use to choose a "unique" polar representation for each point in $\mathbb{R}^2$
   D. Derive each of the formulas to convert from cartesian coordinates to polar coordinates.
   E. Derive each of the formulas to convert from polar coordinates to cartesian coordinates.

Problems Solved in Jeff's Handwritten Notes

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3. Example 10.2.1 p. 720 - 721
4. Example 10.2.2 p. 721 - 722

Suggested Problems: Answers in Book

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3. Example 10.2.3 p. 723
4. Example 10.2.4 p. 724
5. Example 10.2.5 p. 725
6. Example 10.2.9 p. 726 - 727

Optional Challenge Problems

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3. Exercise 10.2.110 p. 732