

**MATH 515 HOMEWORK-3 DUE AT THE BEGINNING OF CLASS ON MONDAY,
SEPT. 29**

One goal for this course is for you to develop your skill in effectively communicating mathematics. With this in mind, you should clearly write up your solutions. Solutions with little or no justification will receive little or no credit.

- (1) Read (at least) pages 69-91 in *Discovering Geometry*.
- (2) A student said that the formula for the arc length of a circle of radius r is $r\theta$, where θ is the central angle defining the arc. Explain this formula.
- (3) Use calculus to find the area of a triangle with base b and height h . It will probably be easier to first do this for a right triangle.
- (4) In class we found the volume of a sphere using spherical coordinates. Find a calculus book and review this method. There is a nice description in the multi-variable calculus book by McCallum, Hughes-Hallet and Gleason, et al.
- (5) Do either a or b .
 - (a) Using spherical coordinates, derive the formula for the surface area of a sphere. Write a paragraph comparing our work on the sphere to the discussion on page 90.
 - (b) Paul suggested that one could find the volume of a sphere using a slicing method, rather than using spherical coordinates. Do this. Write a paragraph comparing this method to the one discussed in class.
- (6) From chapter 2, do problems 20, 22, 23, 29, 32, 34, and 36.
- (7) *This problem may be edited after class on Monday:* Length, area, and volume have analogous meanings, but in different dimensions. In class we discussed one way to generalize this concept to arbitrary dimension. A triangle is a special polygon in the plane, and analogous figures exist in higher and lower dimensions.
 - (a) What figures could be classified as "higher-dimensional triangles" and "lower-dimensional triangles?"
 - (b) Which properties of the triangle are retained in the higher-dimensional and lower-dimensional examples?
 - (c) Write a definition for a "triangle" that would make sense in arbitrary dimension. Explain why it works.