Due March 11:

1. **Final Draft of Assignment 4/5/4.5:** Everything you ever wanted to know about straightness on cones and cylinders. Be sure to address differing cone angles.
   - **a.** What curves are straight on a cylinder or cone?
   - **b.** Can geodesics intersect themselves on cylinders or cones? If so, how many times can they intersect? (Optional: At what angle do they intersect?)
   - **c.** Is there always a geodesic joining two points on cylinders or cones? Can there be more than one geodesic joining two points? How many are there?
   - **d.** Are right angles always equal on cylinders or cones?

2. **First Draft of Assignment 7:** Side-Angle-Side (SAS) congruence theorem – if you have two sides and their included angle, is there only one triangle you can build with those parts?
   - **a.** Find <u>at least one</u> counter example for SAS on <u>each</u> of the following surfaces: sphere, cylinder, cone (you choose the cone angle.)
   - **b.** Find a class of "small" triangles for which SAS is true for spheres, cylinders, and cones. You should give your definition for "small" triangle, and justify why SAS works for these triangles.

Terminology: A *triangle* is a geometric figure formed of three points (*vertices*) joined by three straight line (*geodesic*) segments (*sides*). (Can a triangle have self-intersections, i.e. "fish" triangles on the sphere?) A triangle divides the surface into two regions (the *interior* and *exterior*). The (*interior*) *angles* of the triangle are the angles between the sides in the interior of the triangle. Two figures are *congruent* if one of them can be made to coincide with the other through a combination of translations, rotations, and reflections. (It turns out reflections are sufficient – see Chapter 11.)

Isosceles Triangle Theorem (ITT) (p75)

a. (**ITT**) Given a triangle with two of its sides congruent, then are the two angles opposite those sides also congruent? Look at this on all five of the surfaces we are studying. (Draw a picture.)
b. **Corollary**: The bisector of the top angle of an isosceles triangle is also the perpendicular bisector of the base of that triangle.

<u>Constructions on the plane (using only compass and straightedge):</u>

1. Given any angle, construct a copy of that angle.
2. Given any angle, bisect that angle.
3. Given a line segment, bisect it.
4. Given a line l and a point P on the line, construct a line perpendicular to l that goes through P.
5. Given a line l and a point Q not on the line, construct a line parallel to l that goes through Q.

2) Bonus Problem (due whenever): Circumference of a Circle

Find a simple formula for the circumference of a circle on a sphere of radius R in terms of the circle's intrinsic radius r. Make the formula as intrinsic as possible.