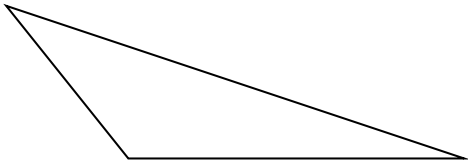
Math 329 Geometry Spring 11 Midterm 2

- You may use a compass and straight edge, but no notes.

(1) Given a line segment AB construct a parallelogram with a 30° angle and a side with the same length as AB.

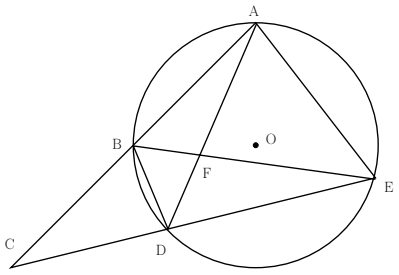
A _____ B

(2) Construct a square with the same area as the triangle below.



(3) Let ABC be a triangle where $\overline{AB} \neq \overline{BC}$. Let BD be a median of the triangle. Show that BD is not perpendicular to AC.

(4) In the circle below, the arc segments $BD : DE : EA : AB$ are in the ratio $2 : 3 : 4 : 3$. Find angle $\angle DFE$.



(5) Show that the composition of a rotation by $\pi/4$ about $(0, 0)$ followed by a four unit translation in the direction of the positive x-axis gives rise to another rotation. Describe the rotation explicitly.

(6) What is the area of a triangle on the unit sphere in terms of its angles? Can you tile the sphere with triangles with angles $2\pi/3, 2\pi/3$ and $\pi/2$?

(7) Use vectors to show that the median from the right angle to the hypotenuse of a right angled triangle is half the length of the hypotenuse.

(8) What are the hyperbolic lines in the upper half space model for hyperbolic space? Sketch the hyperbolic quadrilateral with vertices $A = i, B = 2i, C = 1 + i$ and $D = 1 + 2i$. Explain why the sides AB and CD are the same length, and why AC and BD are different lengths.

(9) Two surfaces are constructed by identifying sides of polygons, as illustrated below. Find the Euler characteristic of the surfaces. Identify the surfaces.