Math 10270 : Midterm
March 7, 2018

Name:

_____

Sign the pledge. "On my honor, I have neither given nor received unauthorized aid on this Exam":

_____

1. (10 points.) (a) Briefly show how to construct an oval starting from two equilateral triangles with an edge in common. (You don't have to describe how to construct the triangles.)

(b) Find values of s, the side length of the equilateral triangles, and r, the length of the side extension, which will result in an oval with a long axis of 500 feet and a short axis of 300 feet.

2. A ladder rests against a frictionless wall and makes an angle of 60°
with the ground as shown. Assume that the ladder itself is weightless
but that it supports a 100 lb. load fixed at the top.

Find the frictional force needed at the floor to stop the ladder from
sliding.

3. (10 points.) The diagram shows a regular pentagon with vertices labeled. Let P be the symmetry given by reflection in the vertical axis and Q be rotation about the center by $72°$ counterclockwise.

(a) Write P and Q in matrix form using the numbered vertices.

(b) Calculate QP and QPQ as matrices and describe their effects geometrically, that is, say which single symmetry they correspond to.

4. (10 points.) A truss as shown consists of 5 frames of the same length, is supported by a vertical force at its apex, and carries a 100 lb. load at its lowest point.

(a) Find the magnitude of the force applied by each of frames.
Hint: Assume that the forces are arranged symmetrically. First consider the forces at the lowest point. The calculation at the apex is basically the same, why? Finally look at one of the intermediate pins to work out the force in the cross-beam.

(b) Label which frames are in compression and which are in tension.

5. (10 points.) Write a paragraph or two describing the architecture of the Hagia Sophia. Include some discussion of the main dome, how it is supported and buttressed.