

Math 10270 : Midterm
March 2, 2016

Name:

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

1. (10 points.) (i) A Roman semicircular arch has a span of 145 ft. Find the height of the arch at the highest point above its base.

(ii) A Gothic arch has a span of 145 ft. Find the height of the arch at the highest point above its base.

2. (10 points.) Describe how to use a straightedge and compass to bisect an angle.

Number each step in your construction and label any figures clearly.

3. (10 points.) (i) List the 8 permutations describing the symmetries of a square. Say which rotation or reflection each permutation corresponds to.

(ii) Sketch a quadrilateral whose symmetry group has order 2 and is described by the permutations

$$I = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 1 & 2 & 3 & 4 \end{pmatrix}, \quad P = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 3 & 4 & 1 & 2 \end{pmatrix}$$

4. (10 points.) Describe in a sentence or two what we mean by a barrel (or longitudinal) vault, a groin vault and a ribbed vault.

What advantages does a ribbed vault have over the other two?

5. (10 points.) A truss in the shape of an isosceles triangle has two supports at its base and must carry a load of 200 lb. attached to its tip.

(i) Find a formula for the force H exerted by the horizontal bar in terms of the angle α .

(ii) Does the tension of the horizontal bar increase or decrease as we increase α ? What is the minimal value of α necessary so that the magnitude of the force in the horizontal bar is no more than 20 lb.