

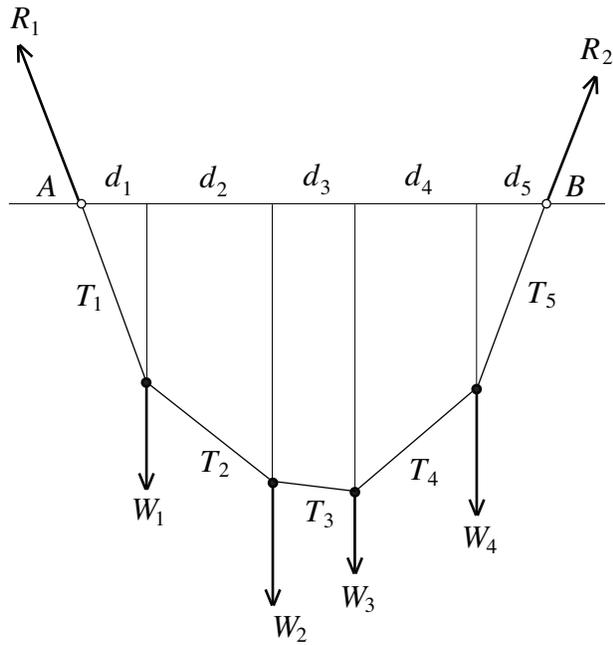
Final Math 10270, May 1, 2014. Name (5 pts)

(I know its worth much more)

1. (15 pts) Explain the connection between the circle, the square, consonant musical tones, and the design of buildings in terms of Alberti's architectural philosophy.

2. (15 pts) Describe the most important architectural contributions that Michelangelo made to St. Peter's Basilica.

3. (20 pts) A string is held at its two ends at the points A and B by the respective forces R_1 and R_2 . The segment AB is horizontal. The string holds up the 4 weights W_1, W_2, W_3 , and W_4 . A typical situation is shown in the diagram on the next page. The symbols d_1, d_2, d_3, d_4 , and d_5 represent the indicated distances.



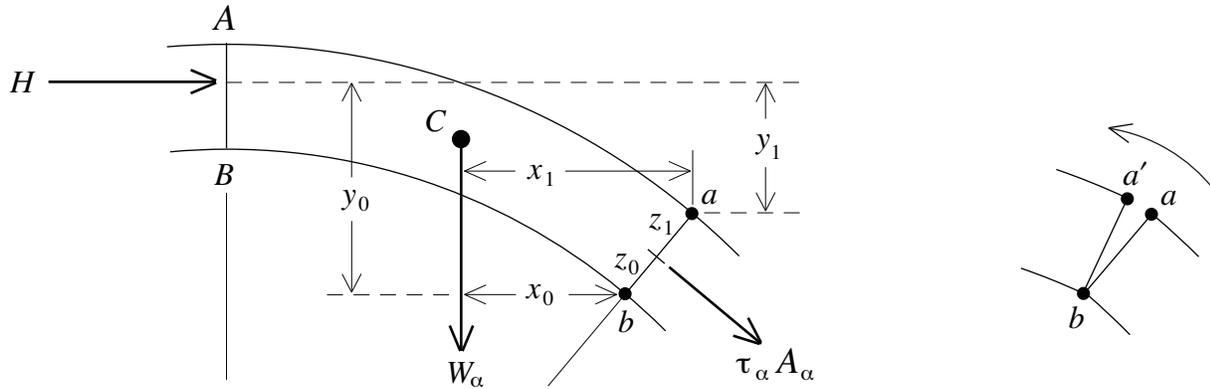
$T_1 =$	$T_2 =$	$T_3 =$
$T_4 =$	$T_5 =$	

1) Consider the case where the respective magnitudes of the vertical components of R_1 and R_2 are 25 and 35 pounds and the respective magnitudes of their horizontal components are both 30 pounds. The four weights are $W_1 = 15, W_2 = 20, W_3 = 15$ and $W_4 = 10$ pounds. Let a vector of length 1 inch represent a force of 10 pounds and draw the force polygon for this situation into the space provided above. Use your diagram to provide close estimates (in pounds) of the tensions:

2) Suppose that $d_1 = 1, d_2 = 3, d_3 = 1.5,$ and $d_4 = 1$ (all in feet). Let 1 foot correspond to 1 inch and draw the funicular polygon that corresponds to this situation below. What is d_5 equal to? What is the full length of the string? (both in feet).

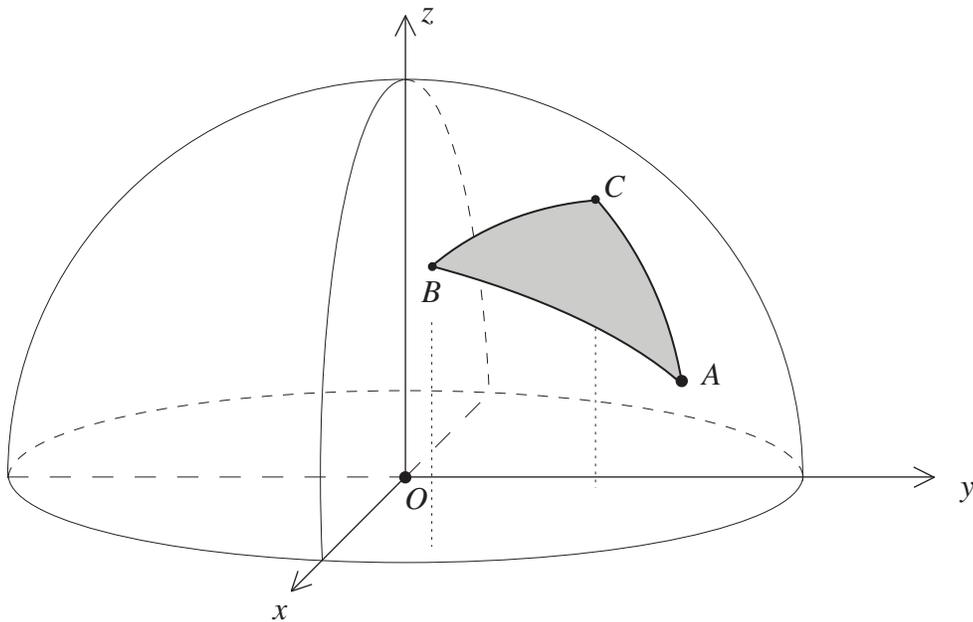
$d_5 =$
length =

4. (15 pts) The figure below on the left shows the diagram that Coulomb used to study hinging failure of arches. The forces H (horizontal force), W_α (weight), and $\tau_\alpha A_\alpha$ (maximum tensile force)



all act on the arch segment $ABba$. The point C is the center of mass of the segment. Express the torque (rotational effect) of each of the forces around the point b and say whether it is clockwise or counterclockwise. What inequality relating these torques guarantees that hinging failure of the type shown on the right will not occur. Place your inequality in the box below.

5. (15 pts) What was the geometric insight that made the construction of the curving shells of Utzon's Sydney Opera Project feasible? The figure below depicts a hemisphere and the geometry of a typical vault. Refer to the figure and explain how the sides of the spherical triangle ΔABC are determined.



6. (15 pts) Explain the meaning and the relevance of the image below.

