**Quiz 5. March 2, 2011.   Name**

1. Not much is known about the original dome of the Hagia Sophia other than that it was 10 feet lower than the current one. It is safe to assume that the inner and outer surfaces of the first dome were determined by concentric hemispheres. Since the first dome was lower, let's assume that it was flatter, and that the inner and outer radii of the concentric hemispheres were 70 feet and 72.5 feet respectively. Suppose that the first dome (as the current one) was supported by 40 ribs that descended to the base of the dome between each of 40 windows. The figure below provides a sketch

100°   70 feet

P P
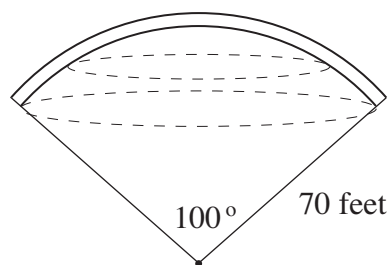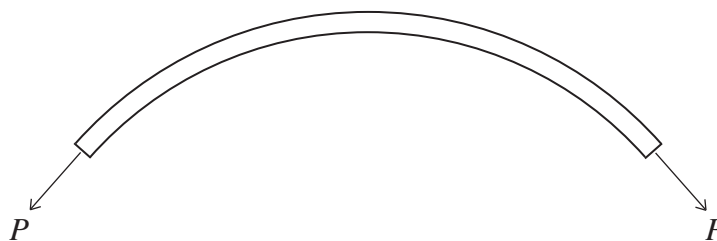
(a)   (b)

of the shell above the gallery of windows. Using the information in the sketch, the estimate of 23,500 cubic feet for the volume of the original dome, and the weight of the masonry of the shell as 110 pounds per cubic foot, estimate the force P that each of the 40 ribs exerted on the base of the original dome.

2. Let P and Q be the points of intersection of the focal axis of an ellipse with the ellipse and let A be any point on the focal axis between P and Q. Let a and b be the semimajor and semiminor axes of the ellipse respectively. Use the $\frac{PA \cdot AQ}{AB^2}$ equals a constant property of the ellipse to show that the
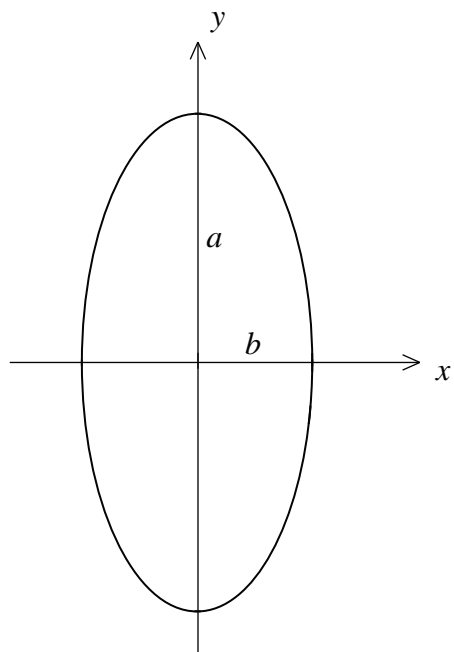
equation of the ellipse above is $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$.

3. Solve the following problem from Islamic mathematics: Find a number such that if 7 is added to it and the sum multiplied by the root of 3 times the number, then the result is 10 times the number.