1. (15 pts) Explain what a pendentive, a pilaster, and a pier is, and draw diagrams that illustrate these architectural elements.

2. (10 pts) A force of magnitude 20 units is represented by the vector $F$ in the diagram below. Use the information given in the diagram to compute the magnitude of the component of $F$ in the direction $\theta$.

3. (15 pts) Which three architectural features of the Parthenon demonstrate the remarkable attention to detail as well as the precision with which the Greek architects constructed it.
4. The figures below are models of a Gothic arch. In either case, the arch is under a total load of \( L \) that is assumed to act at the top of the arch.

\[
\begin{align*}
H & \leftarrow \alpha \quad \alpha \rightarrow H \\
H & \leftarrow \alpha \quad \alpha \rightarrow H
\end{align*}
\]

i). (15 pts) Refer to the diagram on the left and derive the formula \( H = \frac{L}{2 \tan \alpha} \) for the horizontal component of the thrust down along one of the slanting elements.

ii). (15 pts) Show that the horizontal thrust \( H \) is given by \( H = wd\sqrt{1 + \frac{d^2}{h^2}} \). Discuss how \( H \) varies relative to \( h \) with \( w \) and \( d \) held fixed.
5. Consider the plan of the Dome of the Rock shown below. An $x$-$y$ coordinate system is placed into each figure in such a way that the horizontal and vertical segments lie on the $x$-and $y$-axes respectively and their point of intersection is the origin. Suppose that the surrounding circle has radius $R$.

i. (10 pts) Find the equation of the line through the points $P_1$ and $P_2$. (Your answer should involve the variables $x$ and $y$ and the constant $R$.)

ii. (10 pts) Find the equations of the horizontal line through $P_1$ and the vertical line through $P_2$. (Your answers should involve the variables $x$ and $y$ and the constant $R$.)

iii. (10 pts) Use the information of (i) and (ii) to determine the radius of the smaller circle in the figure on the right in terms of $R$. 