Consider two satellites in orbit above Earth’s equator at an altitude of $a$ miles. The satellites are $\theta$ degrees apart, where $0 < \theta < 180^\circ$ and $\theta$ is measured from the center of the Earth between direct lines to the two satellites. Assume the radius of Earth is $r$ miles.

If $a$ is not large enough, then the satellites cannot communicate to each other due to physical interference from Earth.

But if $a$ is large enough, then the satellites can communicate along a direct line.

Let $h$ be the distance from the center of Earth to the midpoint of the direct line segment between the satellites.

(i) Solve for $h$ in terms of $r$, $a$, and $\theta$.

(ii) Using the result in (i), solve for the values of $a$ that make $h \geq r + 10$. Then give the specific altitude needed for $h \geq r + 10$ using $r = 3963.2$ miles and $\theta = 30^\circ$.

(iii) Using the result in (i), solve for the values of $\theta$ that make $h \geq r + 10$. Note: The function $\cos^{-1}(x)$ is a decreasing function of $x$. That is, if $-1 \leq a < b \leq 1$, then $\cos^{-1}(a) > \cos^{-1}(b)$.

(iv) Give the specific angle needed for $h \geq r + 10$ using $r = 3963.2$ mi. and $a = 200$ mi.