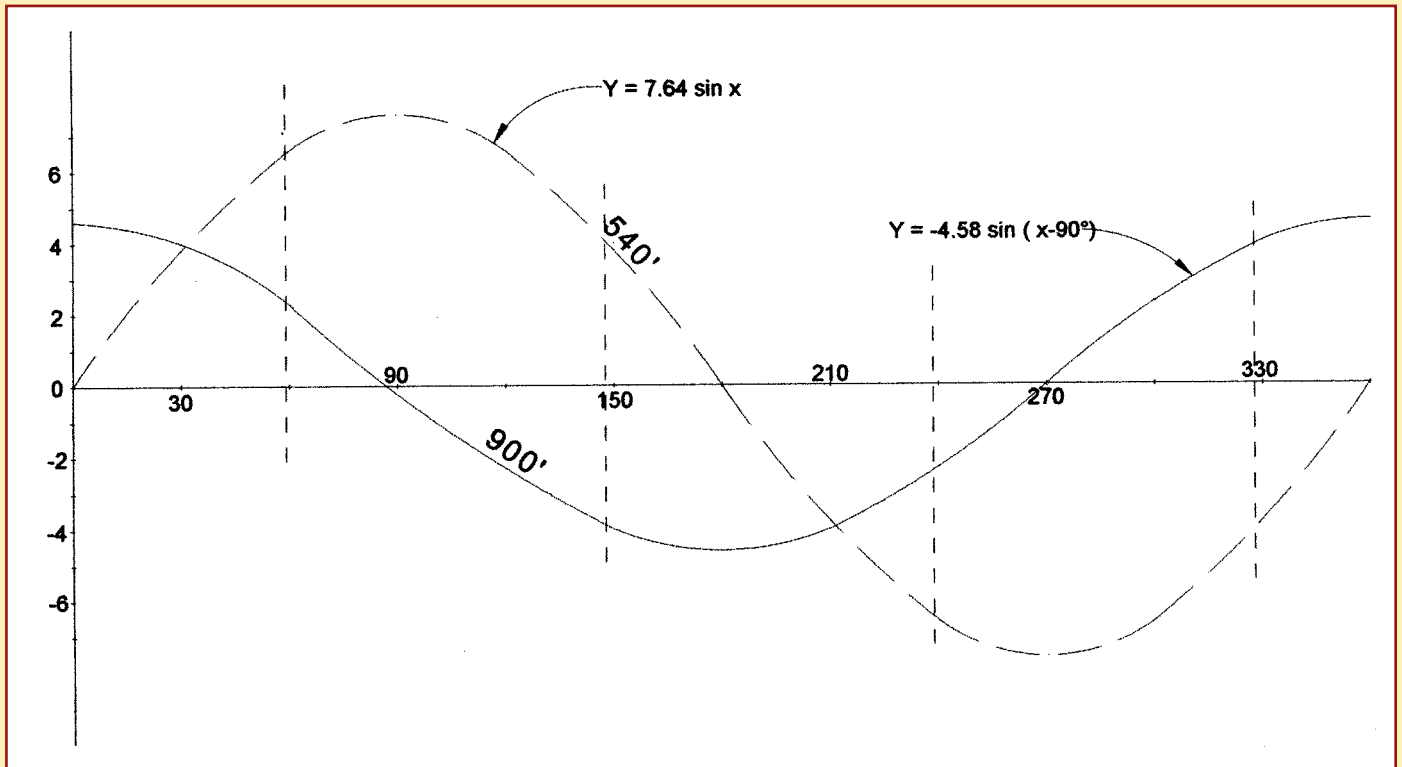




## Solution to Problem 25



PLOT HOW EACH DIRECTION IS AFFECTED INDIVIDUALLY, AS ABOVE. (I USED 30° INCREMENTS.) THE CURVES AND EQUATIONS GIVE SECONDS OF ARC. IF THE TWO EQUATIONS ARE ADDED TOGETHER AND SET EQUAL TO ZERO, A MINIMUM VALUE WILL BE FOUND:

$$7.64 \sin x - 4.58 \sin(x - 90^\circ) = 0 = 7.64 \sin x + 4.58 \cos x$$

$$7.64 \sin x / -4.58 \cos x = 1, -1.668 \tan x = 1, \tan x = -0.5995$$

$$x = 149^\circ 04' \text{ and } 329^\circ 04', \text{ OR } 149^\circ \text{ AND } 349^\circ \text{ TO THE NEAREST DEGREE}$$

IF THE FIRST DERIVATIVE OF THE SUM IS SET EQUAL TO ZERO, A MAXIMUM VALUE WILL BE FOUND:

$$7.64 \cos x - 4.58 \sin x = 0, 4.58 \sin x / 7.64 \cos x = 1$$

$$0.5995 \tan x = 1, \tan x = 1.668, x = 59^\circ 03' \text{ and } 239^\circ 03'$$

(Note that the minimums lie on a tangent to a circle passing through the set-up point and the two sights and the maximums lie on a radial to that circle. Another quick solution is to measure where the two curves cancel each other for the minimums.)