2022A9 LIDAR

ANSWERS

Level 1: From our given information, we have 3 of the 10 calculated heights already: 39 meters, 80 meters, and 124 meters. Let's start calculating the other heights from the 39 meters base height.

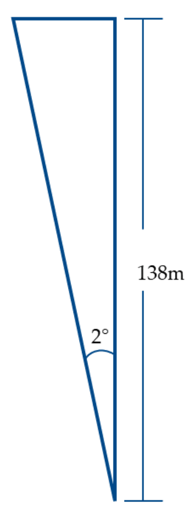
$$39m + 10m = 49m$$
$$49m + 10m = 59m$$
$$59m + 10m = 69m$$
$$69m + 10m = 79m$$

Our next additional 10 meters would put us over 80 meters, so according to our rules, we now add from the 80 meters height.

$$80m + 10m = 90m$$
$$90m + 10m = 100m$$
$$100m + 10m = 110m$$
$$110m + 10m = 120m$$

Including our maximum tip height of 124 meters, that's all 11 of our heights calculated! As a summary, here are all 11 heights: 39 meters, 49 meters, 59 meters, 69 meters, 79 meters, 80 meters, 90 meters, 100 meters, 110 meters, 120 meters, 124 meters. As a side note, measuring at both 79 meters and 80 meters is a little redundant. For this question, that is the correct answer, but in practice, we would adjust the heights.

Level 2: Let's simplify our problem first. By splitting a cone in half long-way (or hot-dog style), we can create a triangle. Now, we can use a little trigonometry to help us solve this problem. First, let's find what we know. Because the LiDAR is one meter off the ground and it projects a laser 139 meters in the air, the height of the measurement from the LiDAR is 138 meters. We also know that the angle of the laser's cone at the LiDAR is 4°. Therefore, the triangle has an interior angle of 2°. Here is our triangle so far:



This is just enough for us to solve for the base of the triangle! According to our trigonometry rules, we can use the $tangent()$ function to calculate this value.

$$\frac{length\ of\ opposite\ side}{length\ of\ adjacent\ side} = \tan(angle)$$

$$\frac{length\ of\ opposite\ side}{138m} = \tan(2°)$$

Now, we can solve the equation from here!

$$length\ of\ opposite\ side = 138 * \tan(2°)$$

$$length\ of\ opposite\ side = 138m * 0.035$$

$$length\ of\ opposite\ side = 4.82m$$

Because the angle of the laser's cone at the LiDAR is so small, the length of the opposite side is also small. We found the length of the base of the triangle; this is equivalent to the radius of the base of the cone!

The LiDAR unit can measure wind speed at the same height as the turbine behind it, despite being over 76 meters shorter!