A mass on a spring is moving with simple harmonic motion. After a time t, the height h of the mass above its rest position is given by the following formula.

$$h = a\cos(wt - c)$$

Find the height of the mass when $a = 7.9$ m, $w = \frac{3\pi}{7}$ rad/s, $t = 5$ s, and $c = \frac{3\pi}{7}$ rad.

Do not round any intermediate computations. Round your answer to the nearest hundredth.

$$h = 7.9\cos\left(\frac{3\pi}{7}(5) - \frac{3\pi}{7}\right)$$

$$h = 4.93$$

An object moves in simple harmonic motion with amplitude $8\ \mathrm{m}$ and period 4 minutes. At time $t=0$ minutes, its displacement d from rest is $0\ \mathrm{m}$, and initially it moves in a positive direction.

$$h = a\sin(bx)$$
$$a\cos(bx)$$

$$\text{perod} = 4 = \frac{2\pi}{b}$$

$$b = \frac{\pi}{2}$$

$$d = 8\sin\left(\frac{\pi}{2}t\right)$$

$$\frac{4b}{4} = \frac{2\pi}{4}$$

$$b = \pi/2$$

A buoy floating in the ocean is bobbing in simple harmonic motion with amplitude 3 ft and period 8 seconds. Its displacement d from sea level at time $t=0$ seconds is -3 ft, and initially it moves upward. (Note that upward is the positive direction.)

$$d = -3\cos\left(\frac{\pi}{4}t\right)$$

$$8 = \frac{2\pi}{b} \rightarrow \frac{8b}{8} = \frac{2\pi}{8}$$

$$b = \frac{2\pi}{8} = \frac{\pi}{4}$$

$$b = \frac{\pi}{4}$$

min $(0, 0.5)$ max $(1, 5.5)$

$f(t) = a(\cos(bt + c)) + d$

$$\boxed{f(t) = -2.5\cos(\pi t) + 3}$$

2.5 5.5

3

2.5 0.5

$5.5 - .5 =$

$5/2 = 2.5$

$2 = \frac{2\pi}{b}$

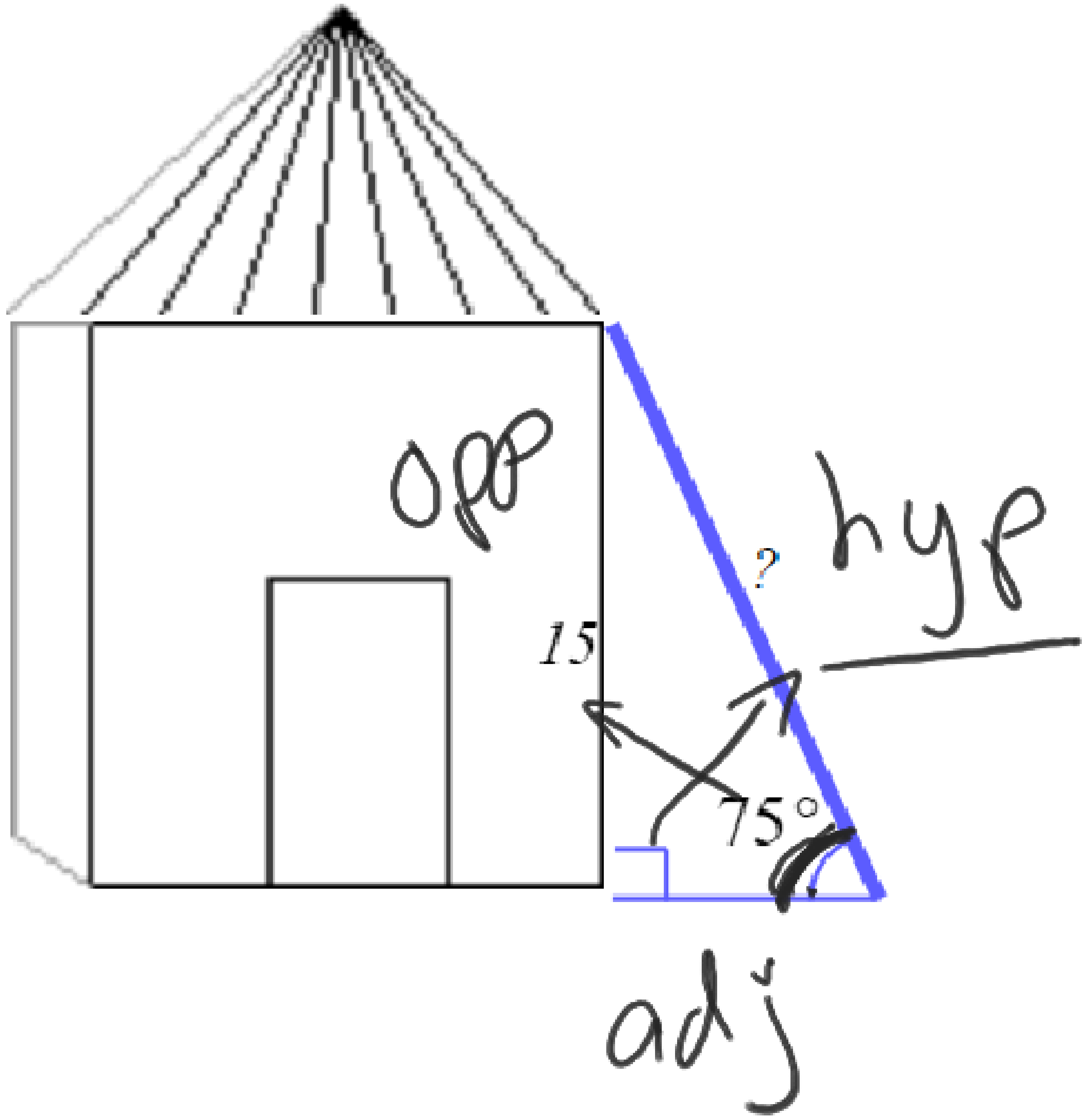
$b = \pi$

Suppose a weight that is attached at the end of a spring oscillates up and down in simple harmonic motion.

The following equation describes the weight's displacement d (in centimeters) from the resting position at time t (in seconds). Note that upward is the positive direction.

$$d = 12\cos\left(\frac{5\pi}{8}t\right)$$

$\frac{8}{5\pi}$	x	y	$12y$
0	0	1	12
$\frac{4}{5}$	$\frac{\pi}{2}$	0	0
$\frac{8}{5}$	π	-1	-12
$12/5$	$\frac{3\pi}{2}$	0	0
$16/5$	2π	1	12



SOH CAH TOA

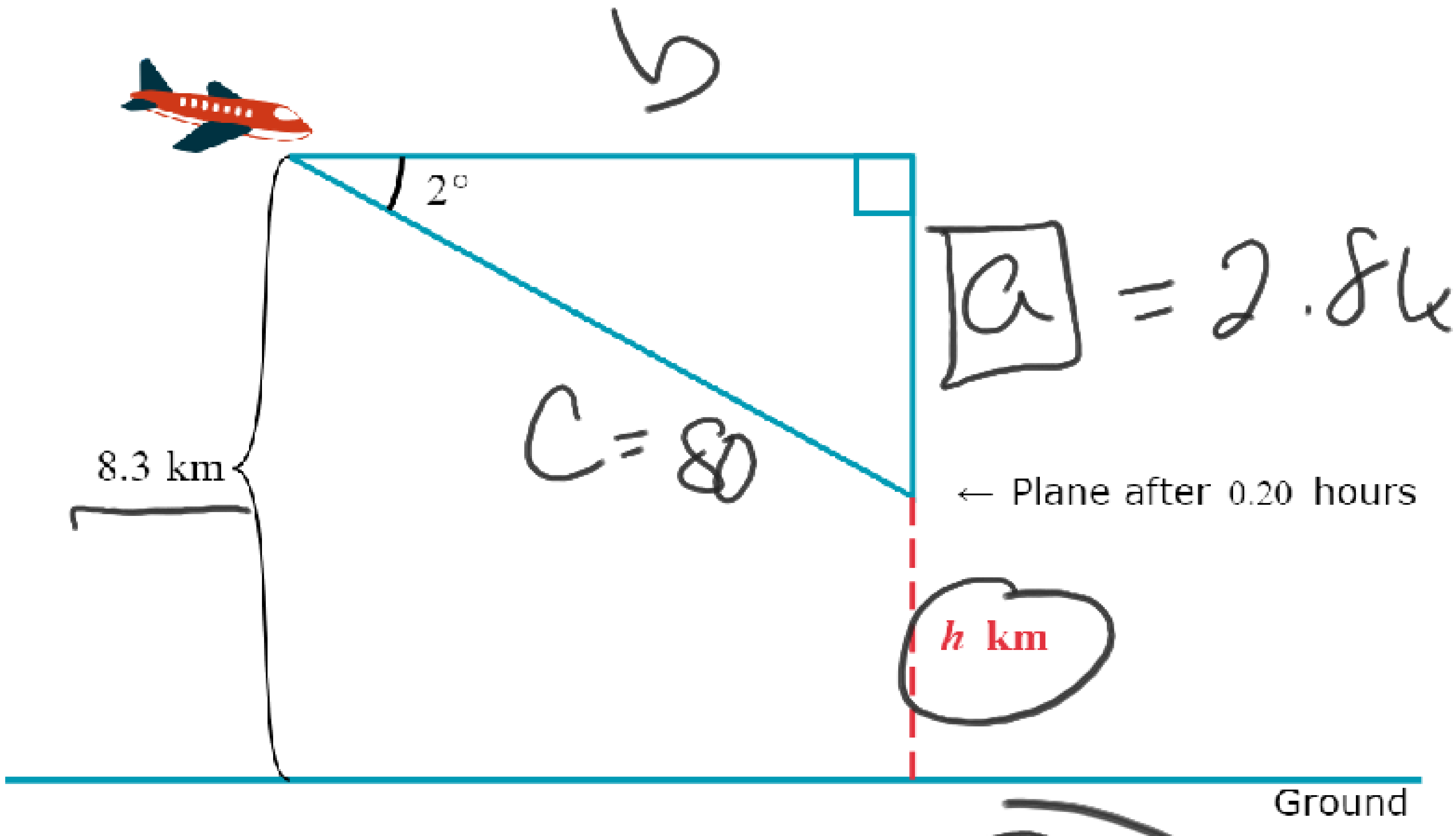
ft

$$\sin 75^\circ = \frac{15}{X}$$

$$X = \frac{15}{\sin 75}$$

$$X = 15.53$$

A plane is descending at an angle of 2° from the horizontal. The plane's current altitude is 8.3 km. See the figure below. (The figure is not drawn to scale.) Find the plane's new altitude, h, after 0.20 hours if it travels at a constant speed of 400 km/hr along the direction of its flight. Carry your intermediate computations to at least four decimal places, and round your answer to the nearest tenth of a kilometer.



0.2 h $\quad 400 \text{ km/hr}$

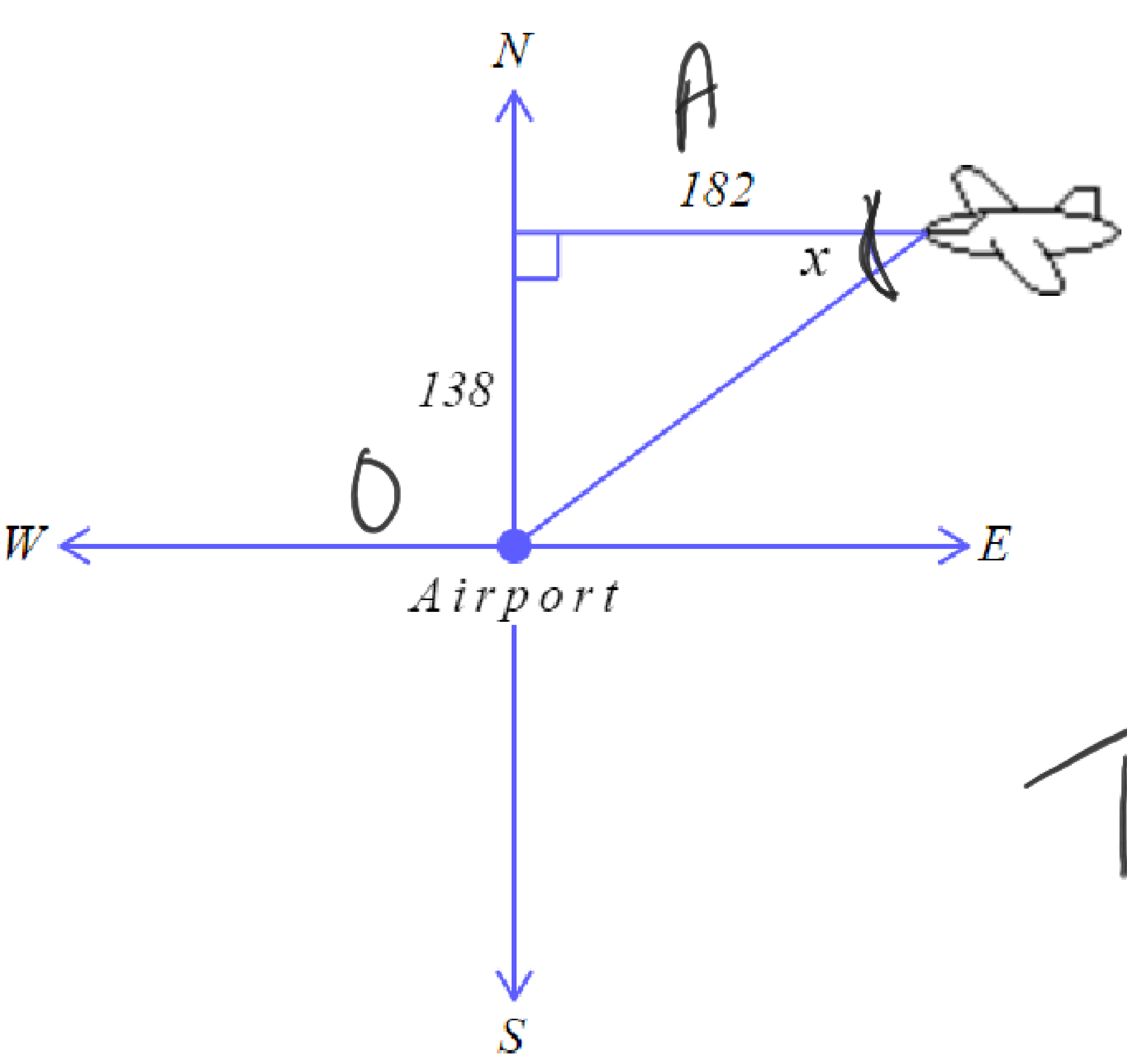
$\boxed{a} = 2.8 \text{ km}$

80 km

$\sin(2^\circ) = \frac{a}{80}$

$a = 80 \sin(2)$

$8.3 - 2.8 = 5.5$



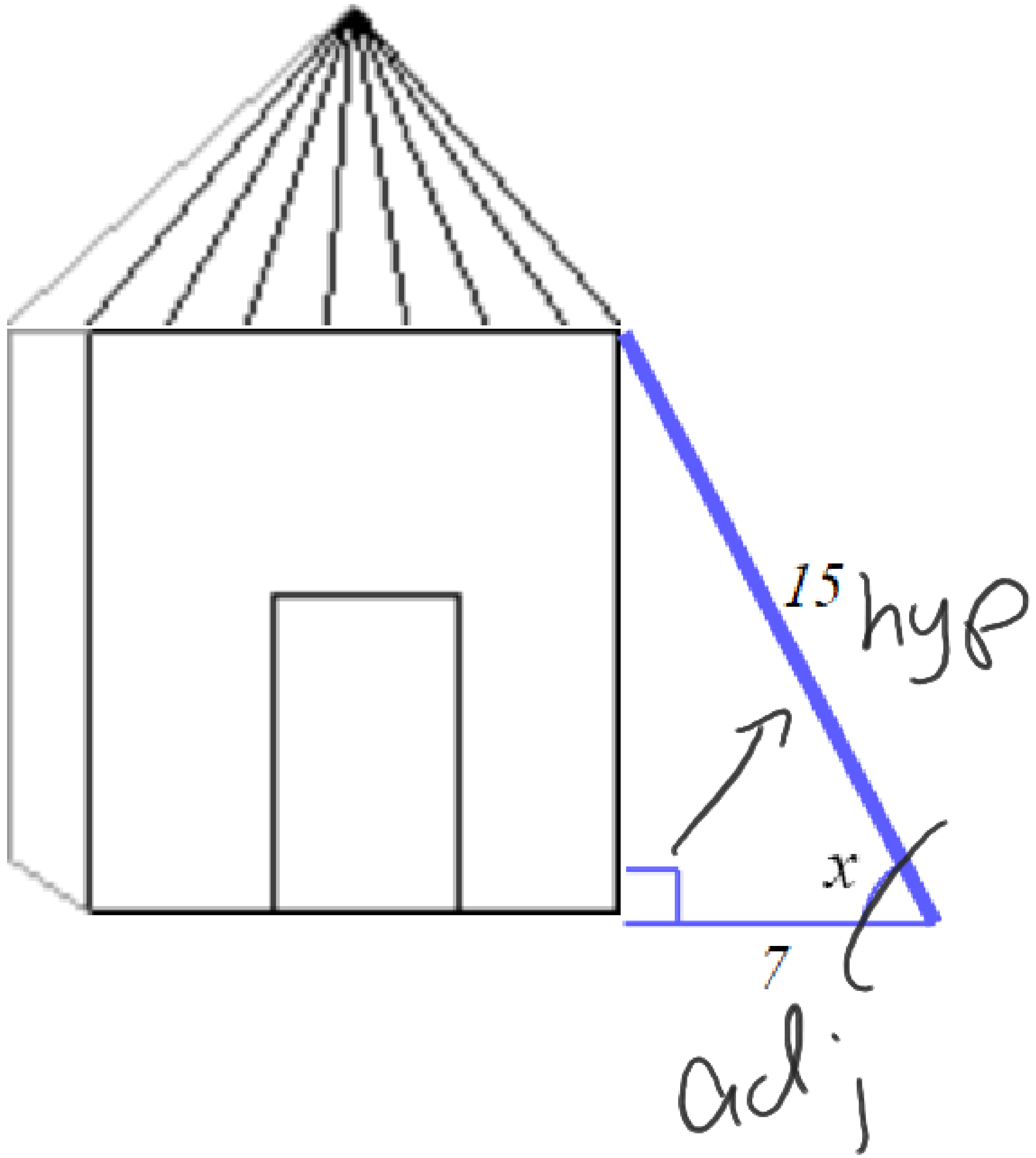
arctan

$\tan^{-1}$

$x = \square^{\circ}$ 37.2°

$$\operatorname{Tan}(x) = \frac{138}{182}$$

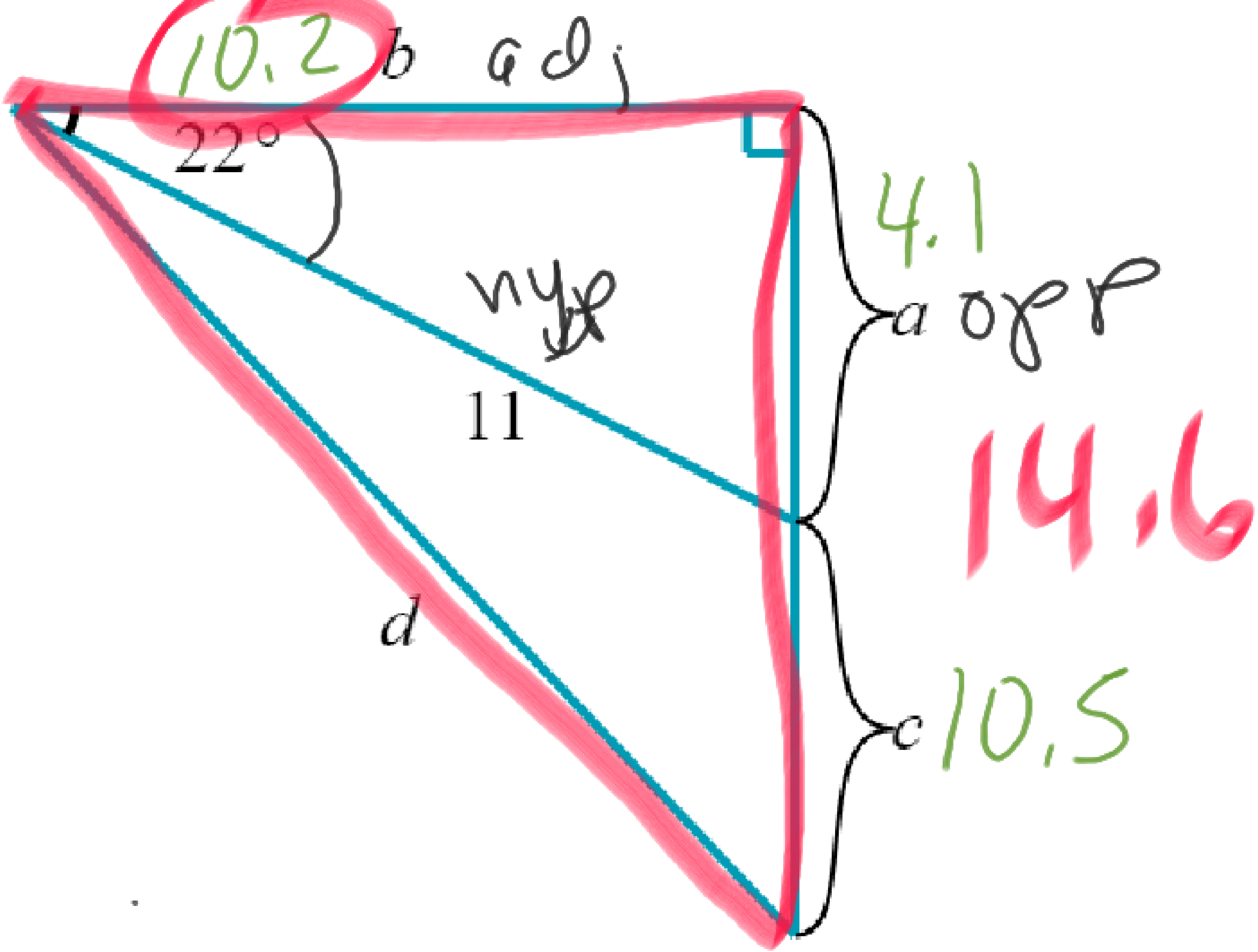
$$x = \operatorname{Tan}^{-1}\left(\frac{138}{182}\right)$$



$$\cos(x) = \frac{7}{15}$$

$$\cos^{-1}\left(\frac{7}{15}\right)$$

$$x = 62.2^\circ$$



$$\sin 22 = \frac{a}{11}$$

$$a = 11(\sin 22) = 4.1$$

$$\cos 22 = \frac{b}{11}$$

$$b = 11\cos 22 = 10.2$$

$$10.2^2 + 14.6^2 = d^2$$

$$d = 17.8$$

$$ac = 43$$

$$(4.1)c = 43$$

$$c = \frac{43}{4.1} = 10.5$$

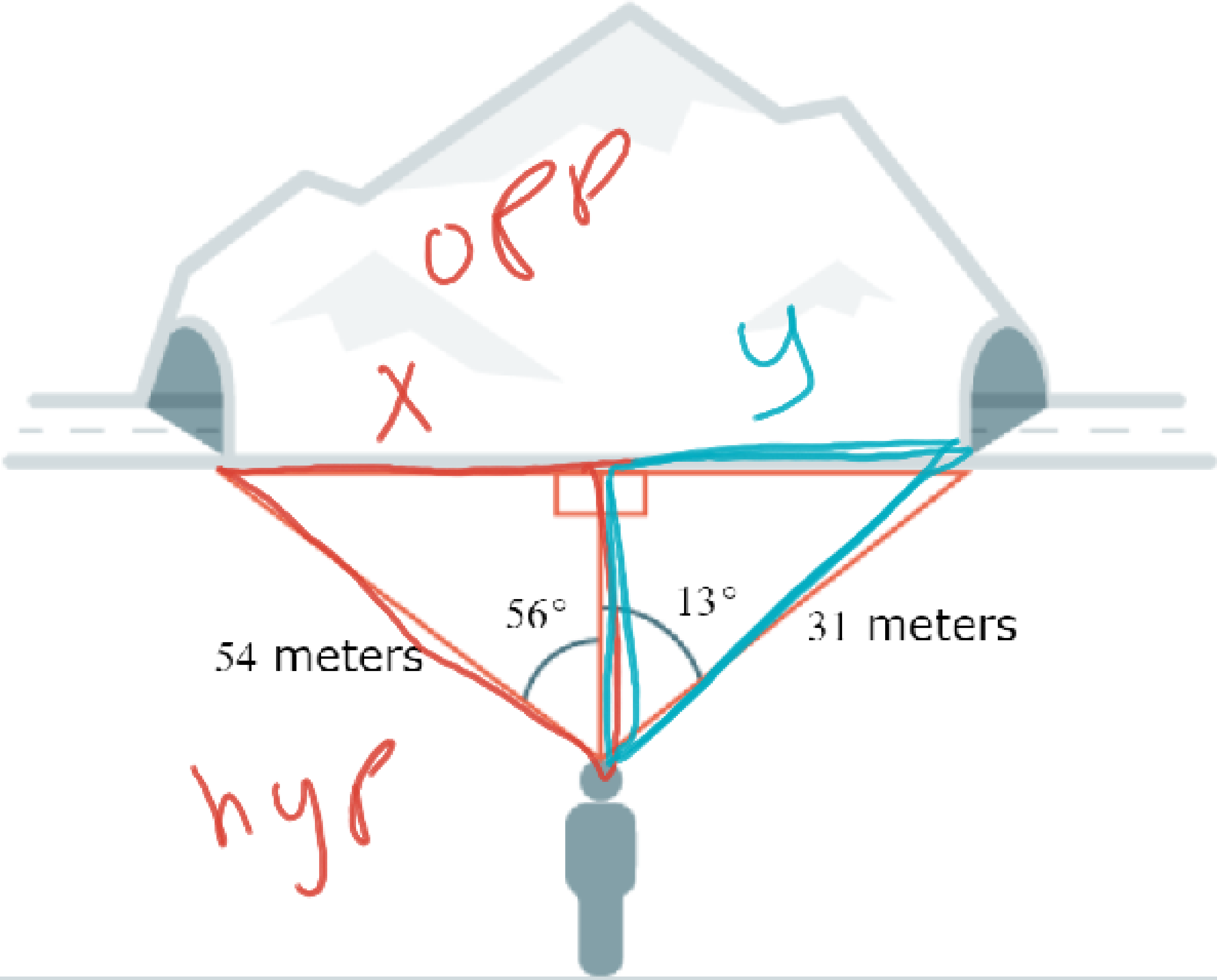
A surveyor wants to know the length of a tunnel built through a mountain. According to her equipment, she is located 54 meters from one entrance of the tunnel, at an angle of $56°$ to the perpendicular. Also according to her equipment, she is 31 meters from the other entrance of the tunnel, at an angle of $13°$ to the perpendicular. Based on these measurements, find the length of the entire tunnel.

Do not round any intermediate computations. Round your answer to the nearest tenth.

Note that the figure below is not drawn to scale.

$$\sin 56 = \frac{x}{54}$$

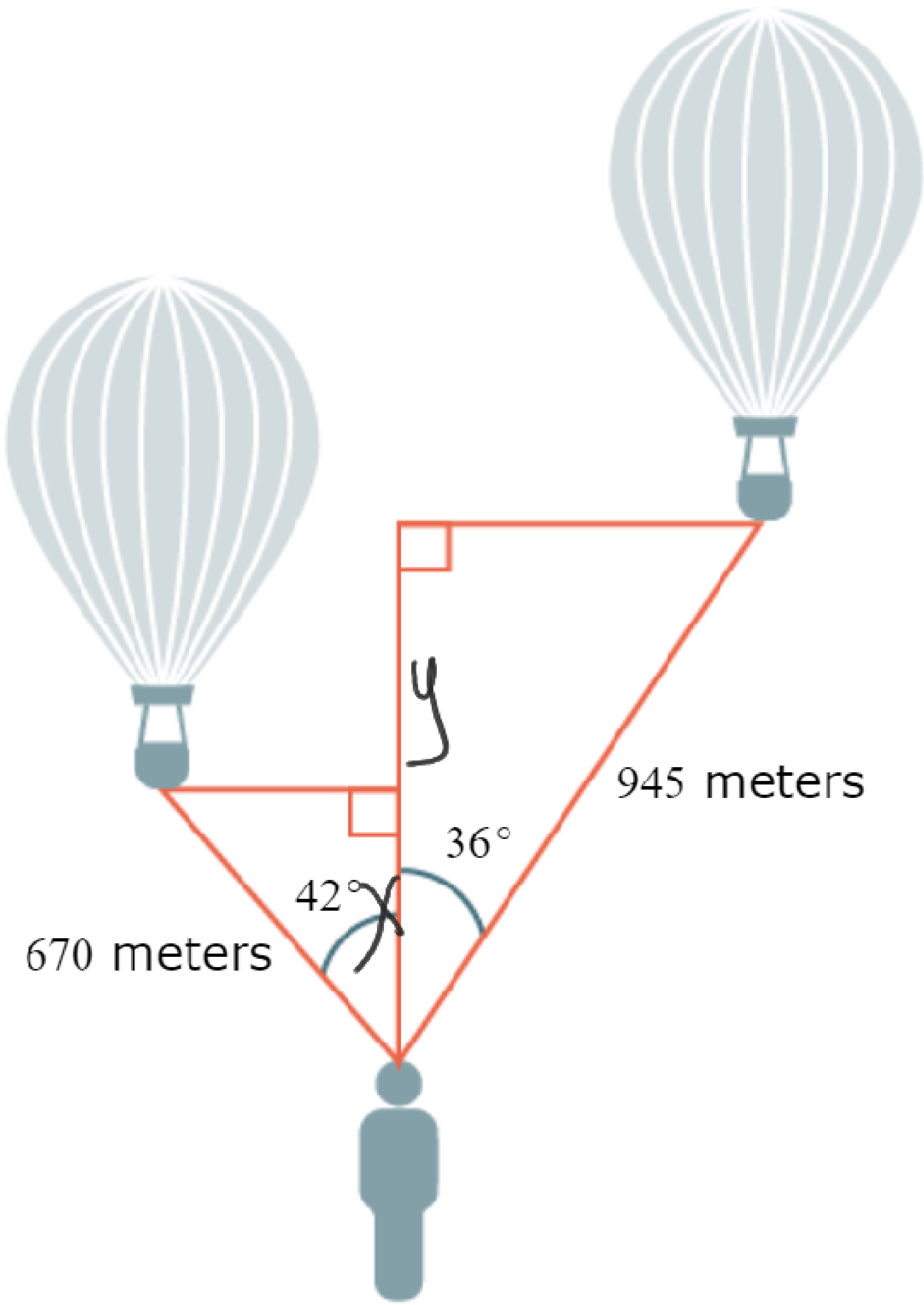
$$x = 54 \sin 56$$



meters 51.7

$$\sin 13 = \frac{y}{31}$$

$$y = 31 \sin 13$$



$$\cos 42 = \frac{x}{670}$$

$$x = 670 \cos 42$$

$$\cos 36 = \frac{y}{945}$$

$$y = 945 \cos 36$$

$$y - x$$