

SM2 8.5B: Inverse Trig Ratios Story Problems

Application Problems:

- 1) A little girl is watching planes take off of the runway from a building's rooftop 40 meters away from the airport. If the height of the building is 400 meters and the girl snaps a photo of a plane at a 24° angle of elevation, what is the altitude, or vertical height, of the plane when the photo is taken?

$$\begin{aligned}x &= 40 \tan(24^\circ) + 400 \\ &\approx 17.81 + 400 \\ &\approx 417.81 \text{ m}\end{aligned}$$

- 2) Burj Khalifa in Dubai is the tallest building in the world, standing at 828 meters. An adjacent building, 100 meters away, stands at 550 meters tall. What is the angle of depression from Burj Khalifa to the adjacent building?

$$\theta = \tan^{-1}\left(\frac{278}{100}\right) \approx 70.23^\circ$$

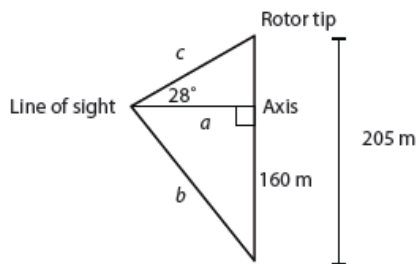
- 3) A 14-foot ladder is being used to get the top of a 12-foot-tall wall. At what angle of elevation must the ladder be positioned in order to reach the top of the wall?

$$\theta = \sin^{-1}\left(\frac{12}{14}\right) \approx 59.00^\circ$$

- 4) A sonar operator on an anchored cruiser detects a pod of dolphins feeding at a depth of about 255 meters directly below. If the cruiser travels 450 meters west and the dolphins remain at the same depth to feed, what is the angle of depression, x , from the cruiser to the pod? What is the distance, y , between the cruiser and the pod?

$$\begin{aligned}x &= \tan^{-1}\left(\frac{255}{450}\right) = 29.54^\circ \\ y &= \sqrt{450^2 + 255^2} = 517.23 \text{ m}\end{aligned}$$

- 5) You are on a steep hillside directly across from the axis of a wind turbine. The information post on the hill indicates that the wind turbines are 160 meters to their axis (or center of rotation) and that the rotor tips reach a height of 205 meters when they are in line, or at 180° , with the wind turbine pole. The information post also says that for an observer, who is 6 feet tall, the angle of elevation to the rotor tip is 28° and the observer's eyes are level with the axis of the wind turbine. Use this information to answer the following questions.



- a. If an observer is 6 feet tall, what is the distance from the observer's eye level to the wind turbine's axis?

$$a = \frac{45}{\tan(28^\circ)} = 84.63 \text{ m}$$

- b. What is the distance, from the observer's eye level to the base of the wind turbine?

$$b = \sqrt{160^2 + 84.63^2} = 181.00 \text{ m}$$

- c. What is the distance, from the observer's eye level to the tip of a rotor when it reaches its highest point?

$$c = \frac{45}{\sin(28^\circ)} = 95.85 \text{ m}$$

- 6) A mother gazes out a second-floor window at her son playing at the playground. If the mother's eye level is 12.6 meters off of level ground and the playground is 20 meters from the base of the building, what is the angle of depression from the mother's line of sight to the playground?

$$\theta = \tan^{-1}\left(\frac{12.6}{20}\right) = 32.21^\circ$$

- 7) Tourists marvel at Niagara Falls from two sightseeing boats, A and B. The boats are 100 feet and 150 feet away from the base of the falls, respectively. Given that Niagara Falls is 167 feet high, what is the angle of elevation from both boats to the top of the falls?

$$\theta_A = \tan^{-1}\left(\frac{167}{100}\right) = 59.09^\circ$$

$$\theta_B = \tan^{-1}\left(\frac{167}{150}\right) = 48.07^\circ$$

- 8) A slide at a water park with a constant slope sends riders traveling a distance of 45 feet to the pool at the bottom of the slide. If the depth of the pool is 12 feet and the angle of depression from the top of the slide is 45° , what is the vertical distance from the top of the slide to the bottom of the pool?

$$\sin 45^\circ = \frac{x}{45}$$

$$x = 45 \sin 45^\circ = 31.82 \text{ ft}$$

Add the 12 ft to get the total height 43.82 ft.