

W5 – Problems in 2 and 3-Dimensions

MCR3U

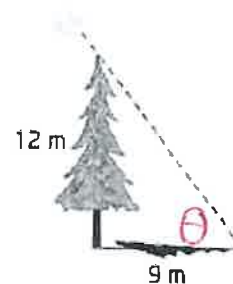
Jensen

- 1) The shadow of a tree that is 12 meters tall measures 9 meters in length. Determine the angle of elevation of the sun.

$$\tan \theta = \frac{12}{9}$$

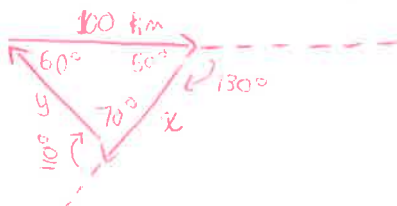
$$\theta = \tan^{-1}\left(\frac{12}{9}\right)$$

$$\theta \approx 53.1^\circ$$



- 2) Yolanda flies her ultra-light airplane due east for 100 km. She turns right through an angle of 130° , and flies a second leg. Then, she turns right 110° and returns to her starting point.

- a) Represent the flight path using an appropriate diagram, labeling all information.



- b) Determine the total length of the flight, to the nearest km.

$$\frac{x}{\sin 60^\circ} = \frac{100}{\sin 70^\circ}$$

$$x = \frac{100 \sin 60^\circ}{\sin 70^\circ}$$

$$x \approx 92.2 \text{ km}$$

$$\frac{y}{\sin 50^\circ} = \frac{100}{\sin 70^\circ}$$

$$y = \frac{100 \sin 50^\circ}{\sin 70^\circ}$$

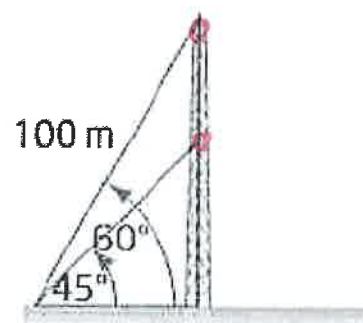
$$y \approx 81.5 \text{ km}$$

$$\text{Length of flight} \approx 92.2 + 81.5 + 100$$

$$\approx 273.7 \text{ km}$$

$$\approx 274 \text{ km}$$

- 3) A radio antenna is stabilized by two guy wires. One guy wire is 100 m in length and is attached to the top of the antenna. The wire makes an angle of 60° with the ground. One end of the second guy wire is attached to the ground at the same point as the first guy wire. The other end is attached to the antenna such that the wire makes an angle of 45° with the ground. Determine an exact expression for the distance between the points where the two guy wires are attached to the antenna.

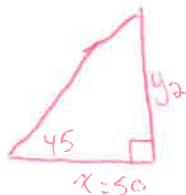


$$\sin 60^\circ = \frac{y_1}{100}$$

$$\frac{\sqrt{3}}{2} = \frac{y_1}{100}$$

$$\frac{100\sqrt{3}}{2} = y_1$$

$$y_1 = 50\sqrt{3}$$



$$\cos 60^\circ = \frac{x}{100}$$

$$\frac{1}{2} = \frac{x}{100}$$

$$\frac{100}{2} = x$$

$$x = 50$$

$$\tan 45^\circ = \frac{y_2}{50}$$

$$1 = \frac{y_2}{50}$$

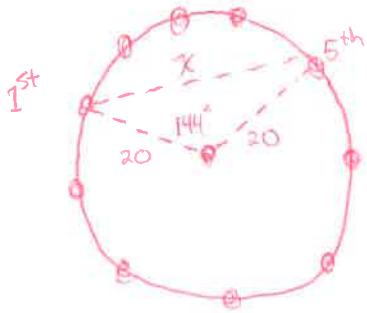
$$y_2 = 50$$

$$\text{Distance between where wires are attached is } = y_1 - y_2$$

$$= 50\sqrt{3} - 50$$

$$= 50(\sqrt{3} - 1) \text{ m}$$

4) A Ferris wheel has a radius of 20 m, with 10 cars spaced around the circumference at equal distances. If the cars are numbered in order, how far is it directly from the first car to the fifth car?



$$x^2 = 20^2 + 20^2 - 2(20)(20) \cos(144)$$

$$x \approx 38 \text{ m}$$

5) Determine the value of x to the nearest cm.

$$\tan 35 = \frac{y}{15}$$

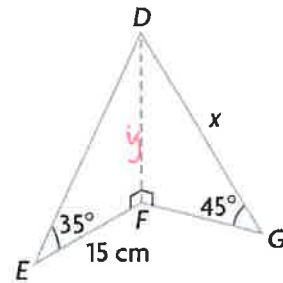
$$\sin 46 = \frac{10.5}{x}$$

$$15 \tan 35 = y$$

$$x = \frac{10.5}{\sin 46}$$

$$y \approx 10.5 \text{ cm}$$

$$x \approx 15 \text{ cm}$$



6) Determine the measure of θ to the nearest degree.

$$x^2 = 18^2 + 14^2 - 2(18)(14) \cos(95)$$

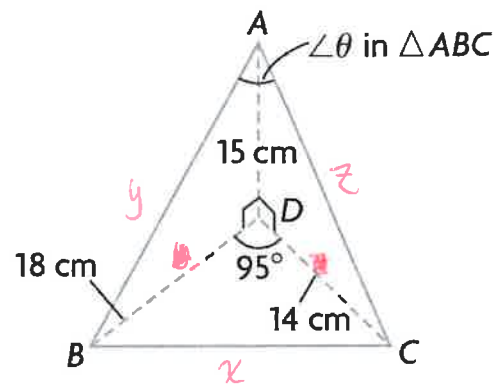
$$x \approx 23.75$$

$$18^2 + 15^2 = y^2$$

$$y \approx 23.43$$

$$14^2 + 15^2 = z^2$$

$$z \approx 20.52$$



$$\cos A = \frac{23.75^2 - 23.43^2 - 20.52^2}{-2(23.43)(20.52)}$$

$$\cos A = \frac{-405.9729}{-961.5672}$$

$$A \approx 65^\circ$$

7) Bert wants to calculate the height of a tree on the opposite bank of a river. To do this, he lays out a baseline 80 m long and measure the angles as shown. The angle of elevation from A to the top of the tree is 28° . Calculate the height of the tree to the nearest meter.

$$\frac{80}{\sin 65} = \frac{b}{\sin 30}$$

$$b = \frac{80 \sin 30}{\sin 65}$$

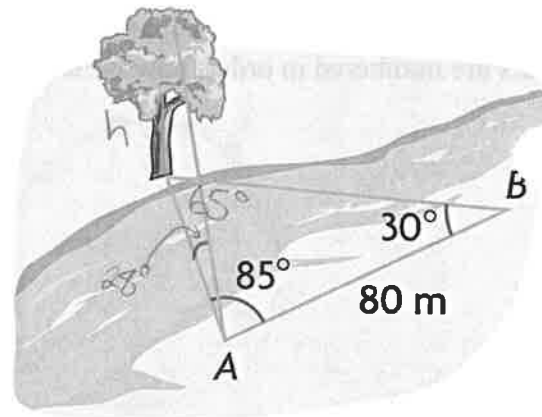
$$b \approx 44.1$$

$$\tan 28^\circ = \frac{h}{44.1}$$

$$h \approx 44.1 \tan 28^\circ$$

$$h \approx 23.4 \text{ m}$$

$$h \approx 23 \text{ m}$$



8) The bases on a baseball diamond are 27.4 m apart. The pitcher pitches, and the batter hits a fly ball straight up 15 m. What is the maximum angle of elevation of the ball, to the nearest degree, as seen by the pitcher if he is standing at the center of the diamond?



$$y^2 = 27.4^2 + 27.4^2$$

$$y \approx 38.75$$

$$x \approx \frac{38.75}{2}$$

$$x \approx 19.4$$

$$\tan \theta = \frac{15}{19.4}$$

$$\theta = \tan^{-1} \left(\frac{15}{19.4} \right)$$

$$\theta \approx 38^\circ$$

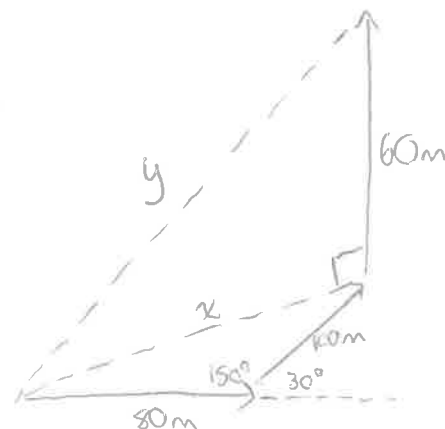
9) Ranjeet parks his car in a lot on the corner of Park Lane and Main Street. He walks 80 m east to First Avenue, turns 30° to the left, and follows First Avenue for 100 m to the Metro Building, where he takes the elevator to his office on the 15th floor. Each floor in the building is 4 m in height. From his office window, Ranjeet can see his car in the lot. How far is Ranjeet from his car, in a direct line to the nearest meter?

$$x^2 = 80^2 + 100^2 - 2(80)(100)(\cos 150^\circ)$$

$$x \approx 174 \text{ m}$$

$$y^2 = 174^2 + 60^2$$

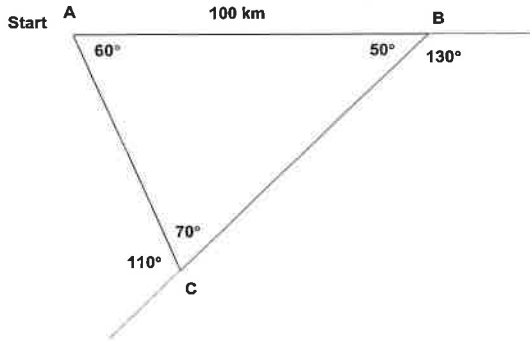
$$y \approx 184 \text{ m}$$



Answers

53°

2) a)



b) 274 km

3) $50(\sqrt{3} - 1)$ m.

4) approximately 38 m.

5) 15 cm

6) 93°

7) 23 m

8) 38°

9) 184 m