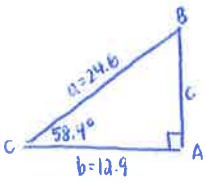


For #1 – 2, solve (find all missing side lengths and all missing angles) $\triangle ABC$ with right angle A, given the following information:

1. $a = 24.6, b = 12.9$



$$\cos C = \frac{12.9}{24.6}$$

$$m\angle C = \cos^{-1}\left(\frac{12.9}{24.6}\right)$$

$$m\angle C = 58.4^\circ$$

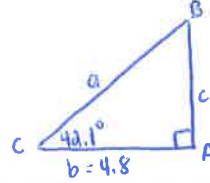
$$m\angle B = 31.6^\circ$$

$$\frac{\sin 58.4}{1} = \frac{c}{24.6}$$

$$c = 24.6 \sin 58.4$$

$$c = 21$$

2. $C = 42.1^\circ, b = 4.8$



$$m\angle B = 47.9^\circ$$

$$\frac{\tan 42.1}{1} = \frac{c}{4.8}$$

$$c = 4.8 \tan 42.1$$

$$c = 4.3$$

$$\frac{\cos 42.1}{1} = \frac{4.8}{a}$$

$$4.8 = a \cdot \cos 42.1$$

$$a = \frac{4.8}{\cos 42.1}$$

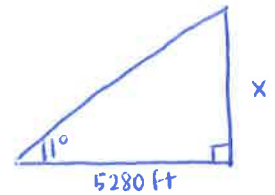
$$a = 6.5$$

Draw a picture and write an equation for each of the following problems. Round your answers to the nearest tenth.

3. The angle of elevation to the top of the Empire State Building in New York is 11° from a point on the ground 1 mile from the base of the building. Find the height of the Empire State Building in feet. (5,280 ft = 1 mile)

$$\frac{\tan 11}{1} = \frac{x}{5280}$$

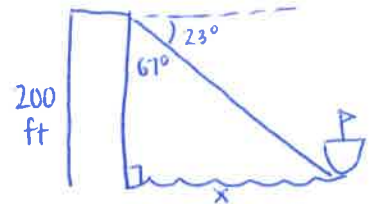
$$x = 5280 \tan 11 \Rightarrow x \approx 1026.3 \text{ ft}$$



4. From the top of a 200 foot lighthouse, the angle of depression to a ship on the ocean is 23° . How far is the ship from the base of the lighthouse?

$$\frac{\tan 67}{1} = \frac{x}{200}$$

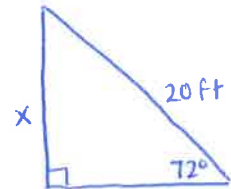
$$x = 200 \cdot \tan 67 \Rightarrow x \approx 471.2 \text{ ft}$$



5. A 20-foot ladder leans against a building so that the angle between the ground and the ladder is 72° . How high does the ladder reach on the building?

$$\frac{\sin 72}{1} = \frac{x}{20}$$

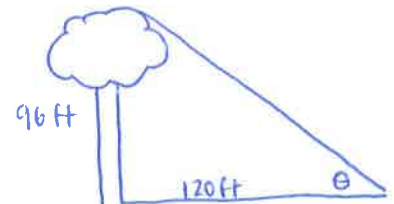
$$x = 20 \sin 72 \Rightarrow x \approx 19.0 \text{ ft}$$



6. A 96-foot tree casts a shadow that is 120 feet long. What is the angle of elevation to the top of the tree?

$$\tan \theta = \frac{96}{120}$$

$$\theta = \tan^{-1}\left(\frac{96}{120}\right) \Rightarrow \theta = 38.7^\circ$$

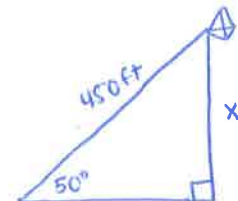


7. A man is laying on the beach, flying a kite. He holds the end of the kite string at ground level and estimates the angle of elevation of the kite to be 50° . If the string is 450 feet long, how high is the kite above the ground?

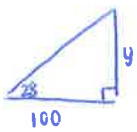
$$\frac{\sin 50}{1} = \frac{x}{450}$$

$$x = 450 \sin 50^\circ$$

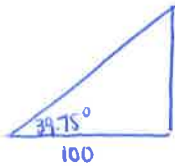
$$x \approx 344.7 \text{ ft}$$



8. A flagpole is mounted on the roof of a public library. From a point 100 feet in front of the library, the angles of elevation to the base of the flagpole and to the top of the flagpole are 28° and $39^\circ 45'$, $\rightarrow 39.75^\circ$ respectively. Find the height of the flagpole.

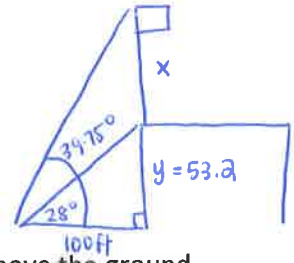


$$\begin{aligned} \tan 28^\circ &= \frac{y}{100} \\ y &= 100 \tan 28^\circ \\ y &= 53.2 \end{aligned}$$



$$\begin{aligned} \tan 39.75^\circ &= \frac{x + 53.2}{100} \\ x + 53.2 &= 100 \tan 39.75^\circ \\ x + 53.2 &= 83.2 \end{aligned}$$

$$\boxed{x = 30 \text{ ft tall}}$$

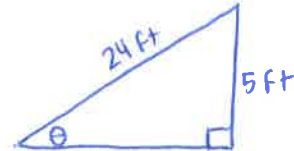


9. A builder wishes to construct a ramp 24 feet long that rises to a height of 5 feet above the ground. Find the angle of elevation of the ramp.

$$\sin \theta = \frac{5}{24}$$

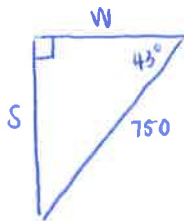
$$\theta = \sin^{-1}\left(\frac{5}{24}\right)$$

$$\boxed{\theta = 12.0^\circ}$$



10. A plane leaves the airport flying at 375 mph and follows a course with a bearing of $S47^\circ W$. After two hours, how far south and how far west is the plane from the airport?

$$375 \text{ mph} \times 2 \text{ hrs} = 750 \text{ mi}$$



$$\cos 43^\circ = \frac{W}{750}$$

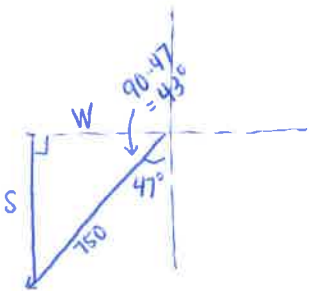
$$W = 750 \cos 43^\circ$$

$$\boxed{W = 548.5 \text{ mi}}$$

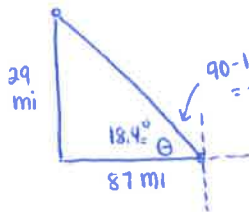
$$\sin 43^\circ = \frac{S}{750}$$

$$S = 750 \sin 43^\circ$$

$$\boxed{S = 511.5 \text{ mi}}$$



11. A boat is 87 miles east and 29 miles south of the harbor. If the boat is heading directly for the harbor, what bearing should the captain follow?



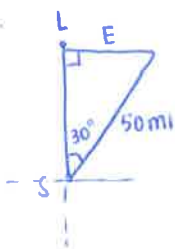
$$\tan \theta = \frac{29}{87}$$

$$\theta = \tan^{-1}\left(\frac{29}{87}\right)$$

$$\theta = 18.4^\circ$$

$$\boxed{N 71.6^\circ W}$$

12. A ship is due south of a lighthouse. After the ship sails 50 miles with a bearing of $N30^\circ E$, it is at a point due east of the lighthouse. At that point, how far is the ship from the lighthouse?

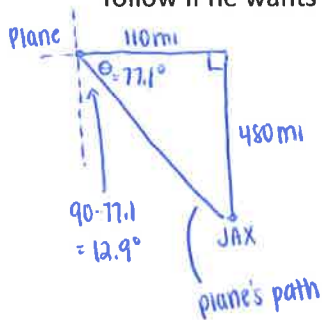


$$\sin 30^\circ = \frac{E}{50}$$

$$E = 50 \sin 30^\circ$$

$$\boxed{E = 25 \text{ mi}}$$

13. A pilot is 480 miles north and 110 miles west of the Jacksonville airport. What bearing should he follow if he wants to fly directly to the Jacksonville airport?



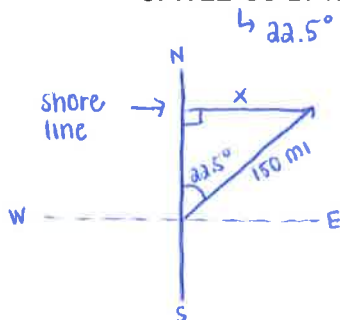
$$\tan \theta = \frac{480}{110}$$

$$\boxed{S 12.9^\circ E}$$

$$\theta = \tan^{-1} \left(\frac{480}{110} \right)$$

$$\theta = 77.1^\circ$$

14. A ship sets sail from a shore which runs due north and south. The ship sails 150 miles with a bearing of $N 22^\circ 30' E$. How far is the ship from the shore line?

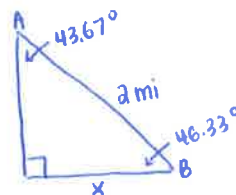
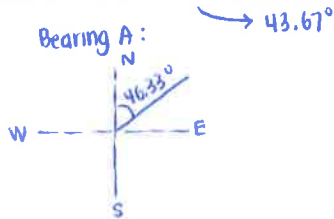
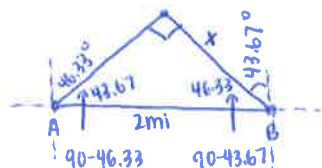


$$\frac{\sin 22.5}{1} = \frac{x}{150}$$

$$x = 150 \sin 22.5$$

$$\boxed{x \approx 57.4 \text{ miles}}$$

15. Radio direction finders are set up at points A and B, which are 2 miles apart on an east-west line. From A it is found that the bearing of the signal from a radio transmitter is $N 46^\circ 20' E$, while from B, the bearing of the same signal is $N 43^\circ 40' W$. Find the distance of the transmitter from B.



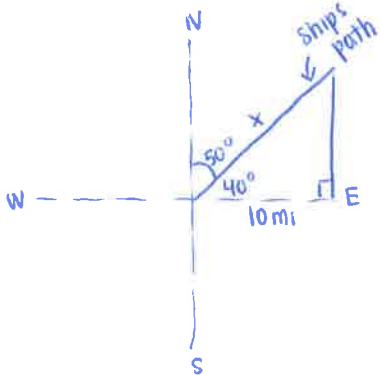
$$\frac{\sin 43.67}{1} = \frac{x}{2}$$

$$x = 2 \sin 43.67$$

$$x = 1.38$$

$$\boxed{\text{About 1.4 miles from the transmitter}}$$

16. A ship travels on a $N 50^\circ E$ course. The ship travels until it is due north of a port which is 10 nautical miles due east of the port from which the ship originated. How far did the ship travel? Round to the nearest tenth.

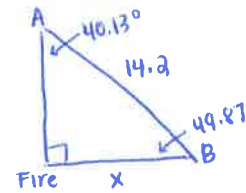
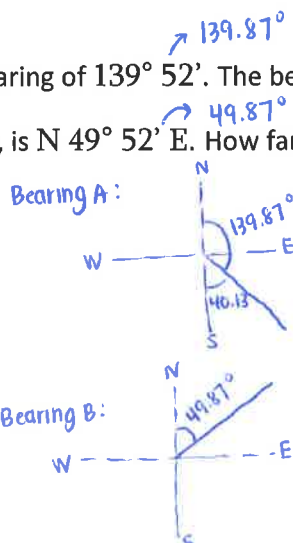
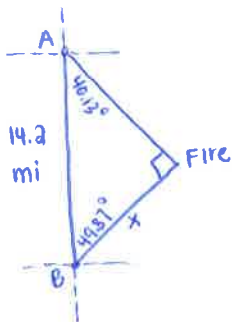


$$\frac{\cos 40}{1} = \frac{10}{x}$$

$$10 = x \cos 40$$

$$\boxed{x = 13.1 \text{ miles}}$$

17. A fire is sighted from lookout A at a bearing of $139^\circ 52'$. The bearing of the fire from lookout B, which is 14.2 miles due south of lookout A, is $N 49^\circ 52' E$. How far is the fire from lookout B? Round to the nearest tenth of a mile.

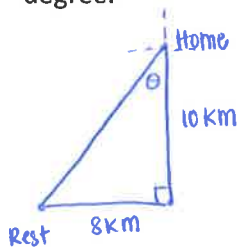


$$\frac{\cos 49.87}{1} = \frac{x}{14.2}$$

$$x = 14.2 \cos 49.87$$

$$x = 9.2 \text{ mi away}$$

18. A cyclist travels from her house 10 km south, then turns and travels 8 km west and stops at a rest stop. Please find the cyclist's bearing from her home to the rest stop. Round to the nearest tenth of a degree.



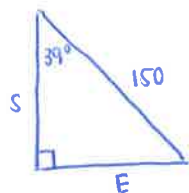
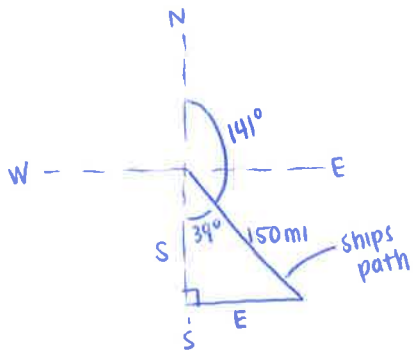
$$\tan \theta = \frac{8}{10}$$

$$\theta = \tan^{-1}\left(\frac{8}{10}\right)$$

$$\theta = 38.7^\circ$$

$$S 38.7^\circ W$$

19. A commercial fishing boat left port at 10:00am and proceeded on a bearing of 141° at a speed of 30 knots until it reached its destination fishing spot. At 3:00pm, how far south and how far east is the fishing spot from the port? Round to the nearest nautical mile. 10am to 3pm: 5 hrs \times 30 knots = 150 mi



$$\frac{\cos 39}{1} = \frac{S}{150}$$

$$S = 150 \cos 39$$

$$S = 116.6 \text{ mi}$$

$$\frac{\sin 39}{1} = \frac{E}{150}$$

$$E = 150 \sin 39$$

$$E = 94.4 \text{ mi}$$

Answers:

1. $B = 31.6^\circ$, $C = 58.4^\circ$, $c = 20.9$ 2. $B = 47.9^\circ$, $c = 4.3$, $a = 6.5$ 3. 1026.3 feet
 4. 471.2 ft 5. 19.0 ft 6. 38.7° 7. 344.7 ft 8. 30 ft 9. 12.0°
 10. 548.5 mi West, 511.5 mi South 11. $N 71.6^\circ W$ 12. 25 miles 13. $S 12.9^\circ E$ 14. 57.4 mi
 15. 1.4 mi 16. 13.1 mi 17. 9.2 mi 18. $S 38.7^\circ W$ 19. 116.6 mi South, 94.4 mi East