More problems for section 4.13 of *Essentials of Precalculus with Calculus Previews* by Zill and Dewar, 6e.

In all of these problems, \(a\), \(b\), and \(c\) are the three sides of a triangle. The angle opposite side \(a\) is \(\alpha\), the angle opposite side \(b\) is \(\beta\), and the angle opposite side \(c\) is \(\gamma\):

![Triangle Diagram]

Hint: identify each group of problems as either SAS, SSA, AAS, or SSS.

1. Find \(c\), given \(a\), \(b\), and \(\gamma\).
   - a. \(a = 15\), \(b = 12\), \(\gamma = 70^\circ\)
   - b. \(a = 10\), \(b = 5\), \(\gamma = 13^\circ\)
   - c. \(a = 3\), \(b = 4\), \(\gamma = 105^\circ\)
   - d. \(a = 3\), \(b = 4\), \(\gamma = 25^\circ\)
   - e. \(a = 14\), \(b = 2\), \(\gamma = 35^\circ\)
   - f. \(a = 13\), \(b = 13\), \(\gamma = 175^\circ\)

2. Find \(\gamma\), given \(a\), \(b\), and \(c\).
   - a. \(a = 12\), \(b = 3\), \(c = 10\)
   - b. \(a = 3\), \(b = 4\), \(c = 6\)
   - c. \(a = 3\), \(b = 4\), \(c = 8\)
   - d. \(a = 9\), \(b = 5\), \(c = 7\)
   - e. \(a = 15\), \(b = 9\), \(c = 8\)
   - f. \(a = 13\), \(b = 13\), \(c = 13\)

3. Points A and B are on opposite sides of Lake Jake. From a third point C, the angle between the lines of sight to A and to B is 46°. If AC is 350 meters long and BC is 286 meters long, find AB.

4. The sides of a parallelogram are 4 cm and 6 cm. On angle is 58° while the other is 122°. Find the lengths of the diagonals of the parallelogram.

5. Two ships leave a harbor at the same time, each traveling in a straight line. If their courses have an angle of 130° between them and if they each travel 402 miles, how far apart are they?

6. Two ships leave a harbor at the same time, each traveling in a straight line. One ship travels 36 km/hr, while the other ship travels 45 km/hr. If the angle between their courses is 54°, find the distance between them after 3 hours.

7. Three boards measuring 13 ft, 16 ft, and 20 ft are nailed together to form a triangle. Find the angle between the 16 ft and the 20 ft long board.

8. A balloonist is directly above a straight and level road 1.5 miles long between two towns. She finds that her angle of depression to the nearer town is 35°, while her angle of depression to the farther town is 31°. What is the altitude of the balloon?

9. The town of Bryan lies 7 miles directly south of the town of West Jefferson. A balloonist is floating directly south of Bryan. If the angle of depression from the balloon to Bryan is 60°, and if the angle of depression from the balloon to West Jefferson is 17°, find the distance from the balloon to West Jefferson.

10. Find the altitude of the balloon in Problem 9.

11. Surveyors use a tool called a **theodolite** to measure angles of elevation and depression. A surveyor standing 50 meters from the base of a building finds that the angle of elevation from her theodolite to the top of the building is 37°, and the angle of elevation from her theodolite to the top of an antenna on top of the building is 39°. If the theodolite is 2 meters above the ground, find the length of the antenna.
12. A building stands on the side of a hill that slopes downward at an angle of $12^\circ$. The sun is uphill from the building with a $50^\circ$ angle of elevation. If the building casts a shadow 35 m long down the slope of the hill, find the building’s height.

Answers

1a. $c = 15.680$  
1b. $c = 5.250$  
1c. $c = 5.586$  
1d. $c = 1.802$  
1e. $c = 12.414$  
1f. $c = 25.975$  
2a. $\gamma = 42.598^\circ$  
2b. $\gamma = 117.279^\circ$  
2c. no such triangle exists.  
2d. $\gamma = 50.703^\circ$  
2e. $\gamma = 26.324^\circ$  
2f. $\gamma = 60^\circ$  
3. 255.392 m  
4. 5.154 cm and 8.799 cm  
5. 728.671 miles  
6. 112.912 km  
7. 40.453°  
8. 4.851 miles  
9. 8.889 miles  
10. 2.599 miles  
11. 2.811 m  
12. 33.523 m