[06-01-25-T11]

3. $\beta = 27°30'$, $\gamma = 54°30'$, $a = 9.27$
4. $\beta = 105°$, $\gamma = 23°40'$, $a = 24.2$

B

5. $\alpha = 25°50'$, $a = 65.00$, $b = 105.0$, β obtuse
6. $\alpha = 33°20'$, $a = 30.0$, $b = 44.5$, β acute
7. $\beta = 31°40'$, $a = 12.0$, $b = 8.00$, α acute
8. $\alpha = 38°$, $a = 1.95$, $b = 2.43$, β obtuse
9. $a = 50$, $c = 40$, $\gamma = 30°$
10. $a = 23$, $b = 20$, $\beta = 37°$
11. $a = 14$, $b = 23$, $\alpha = 41°$
12. $\beta = 32°20'$, $a = 140$, $b = 60$

C

13. Mollweide's equation,

$$(a - b)\cos\frac{\gamma}{2} = c\sin\frac{\alpha - \beta}{2}$$

is often used to check the final solution of a triangle since all six parts of a triangle are involved in the equation. If, after substitution the left side does not equal the right side, then an error has been made in solving a triangle. Use this equation to check Problem 1.

14. Use Mollweide's equation from Problem 13 to check Problem 3.
15. Use the law of sines and suitable identities to show that for any triangle

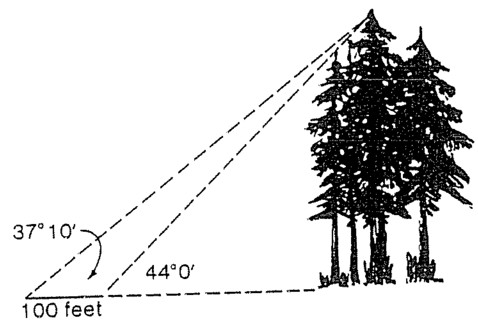
$$\frac{a - b}{a + b} = \frac{\tan\dfrac{\alpha - \beta}{2}}{\tan\dfrac{\alpha + \beta}{2}}$$

16. Verify the formula in Problem 15 with values from Problem 1.

APPLICATIONS

17. *Coast guard.* Two lookout posts, A and B (10.0 miles apart), are established along a coast to watch for illegal ships coming within the 3-mile limit. If post A reports a ship S at angle $BAS = 37°30'$, and post B reports the same ship at angle $ABS = 20°0'$, how far is the ship from post A? How far is the ship from the shore (assuming the shore is along the line joining the two observation posts)?
18. *Fire lookout.* A fire at F is spotted from two fire lookout stations A and B, which are 10.0 miles apart. If station B reports the fire at angle $ABF = 53°0'$, and station A reports the fire at angle $BAF = 28°30'$, how far is the fire from station A? From station B? (Give the answer to three significant digits.)

19. *Natural science.* The tallest trees in the world grow in Redwood National Park in California; they are taller than a football field is long. Find the height of one of these trees, given the information in the figure.



20. *Surveying.* To measure the height of Mt. Whitney in California, surveyors used the scheme shown in the figure in Problem 19. They set up a horizontal base line 2,000 feet long at the foot of the mountain and found the angle nearest the mountain to be 43°5′; the angle farthest from the mountain was found to be 38°0′. If the baseline was 5,000 feet above sea level, how high is Mt. Whitney above sea level?

21. *Astronomy.* The orbits of the Earth and Venus are approximately circular, with the sun at the center. A sighting of Venus is made from Earth, and the angle SEV is found to be 18°40′. If the radius of the orbit of the Earth is 1.495×10^8 kilometers, and the radius of the orbit of Venus is 1.085×10^8 kilometers, what are the possible distances from the Earth to Venus?

22. *Astronomy.* In Problem 21, find the maximum angle SEV. [*Hint:* The angle is maximum when a straight line joining the Earth and Venus is tangent to Venus's orbit.]

7. $a = 10.5 \quad b = 20.7, \quad c = 12.2$

8. $a = 42.3, \quad b = 76.8, \quad c = 131$

C

9. Show, using the law of cosines, that if $\gamma = 90°$, then $c^2 = a^2 + b^2$ (the Pythagorean theorem).

10. Show, using the law of cosines, that if $c^2 = a^2 + b^2$, then $\cos \gamma = 90°$.

11. Check Problem 1 using Mollweide's equation:

$$(a - b) \cos \frac{\gamma}{2} = c \sin \frac{\alpha - \beta}{2}$$

12. Check Problem 3 using Mollweide's equation from Problem 11.

APPLICATIONS

13. *Geometry.* Two adjacent sides of a parallelogram meet at an angle of 35°10′ and have lengths of 3 and 8 feet. What is the length of the shortest diagonal of the parallelogram (to three significant digits)?

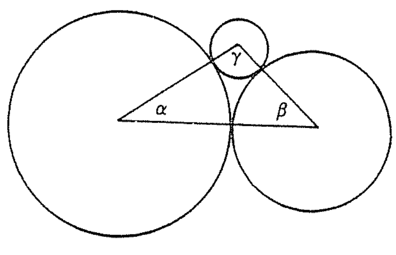
14. *Geometry.* What is the length of the longest diagonal of the parallelogram in Problem 13 (to three significant digits)?

15. *Navigation.* Los Angeles and Las Vegas are approximately 200 miles apart. A pilot 80 miles from Los Angeles finds that she is 6°20′ off course relative to her start in Los Angeles. How far is she from Las Vegas at this time? (Compute the answer to three significant digits.)

16. *Search and rescue.* At noon two search planes set out from San Francisco to find a downed plane in the ocean. Plane A travels due west at 400 miles/hour and plane B northwest at 500 miles/hour. At 2 PM plane A spots the survivors of the downed plane and radios plane B to come and assist in the rescue. How far is plane B from plane A at this time (to three significant digits)?

17. *Geometry.* Find the perimeter of a pentagon inscribed in a circle of radius 12.6 meters.

18. *Engineering.* Three circles of radius 2.03, 5.00, and 8.20 centimeters are tangent to one another (see the figure). Find to the nearest 10′ the three angles formed by the lines joining their centers.



Exercise 6-7 Chapter Review

5. 135°, 225° (6-6) **6.** 0, π, $\pi/4$, $5\pi/4$ (6-6) **7.** $2k\pi + 0.7878$, $(2k + 1)\pi - 0.7878$, k any integer (6-6)
8. $k\pi - 1.526$, k any integer (6-6) **15.** (A) $3\sqrt{10}/10$; (B) $-\frac{24}{25}$; (C) $\frac{24}{7}$ (6-4) **16.** 2 cos 2x sin x (6
17. cos 7x + cos 3x (6-5) **18.** $\pi/3$, $2\pi/3$, $4\pi/3$, $5\pi/3$ (6-6) **19.** 0°, 120° (6-6)
20. $k\pi$, $2k\pi \pm \pi/6$, k any integer (6-6) **21.** 1.178, 2.749 (6-6) **22.** $-\frac{24}{25}$ (6-4) **23.** $\frac{24}{25}$ (6-3)
24. 0, $\pi/3$, $2\pi/3$ (6-6) **25.** $\pi/12$, $5\pi/12$, 0, $\pi/3$ (6-6) **26.** 0, $\pi/2$ (6-6)

Practice Test: Chapter 6

4. cos x (6-3) **5.** (A) $3/\sqrt{10}$ or $3\sqrt{10}/10$; (B) $\frac{7}{25}$ (6-4) **6.** $\frac{1}{2}$ sin 10x + $\frac{1}{2}$ sin 4x (6-5)
7. $k\pi$, $2k\pi + \pi/6$, $(2k + 1)\pi - \pi/6$, k any integer (6-6) **8.** 120°, 240° (6-6) **9.** 0, $2\pi/3$ (6-6)
10. 0.6259, 2.516 (6-6)

Chapter 7

Exercise 7-1

1. $\alpha = 72°10'$, $a = 3.28$, $b = 1.06$ **3.** $\alpha = 46°40'$, $b = 116$, $c = 169$ **5.** $\beta = 67°0'$, $b = 127$, $c = 138$
7. $\beta = 36°48'$, $a = 31.84$, $c = 39.76$ **9.** $\alpha = 35°20'$, $\beta = 54°40'$, $c = 10.4$ **11.** $\alpha = 37°30'$, $\beta = 52°30'$, $a = 7.67$
13. $\alpha = 48°40'$, $\beta = 41°20'$, $b = 2.12$ **15.** 218 feet **17.** 127.5 feet **19.** 2,292 feet **21.** 2,225 miles
23. 44° **25.** 0.5 mile **27.** 86.2 square centimeters **29.** 0.77 meter

Exercise 7-2

1. $\alpha = 67°20'$, $a = 55.1$, $c = 58.8$ **3.** $\alpha = 98°$, $b = 4.32$, $c = 7.62$ **5.** $\beta = 135°15'$, $\gamma = 18°55'$, $c = 48.36$
7. $\alpha = 52°$, $\gamma = 96°20'$, $c = 15.1$ **9.** $\alpha = 141°$, $\alpha' = 39°$, $\beta = 9°$, $\beta' = 111°$, $b = 13$, $b' = 75$ **11.** No triangle
13. $26.997 \approx 26.999$ **17.** 4.06 miles, 2.47 miles **19.** 353 feet **21.** 4.42×10^7 kilometers, 2.36×10^8 kilon

Exercise 7-3

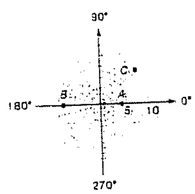
1. $a = 6.00$, $\beta = 65°0'$, $\gamma = 64°20'$ **3.** $c = 14.0$, $\alpha = 20°40'$, $\beta = 39°0'$ **5.** $\alpha = 23°30'$, $\beta = 92°30'$, $\gamma = 64°0'$
7. $\alpha = 22°20'$, $\beta = 131°30'$, $\gamma = 26°10'$ **9.** $c^2 = a^2 + b^2 - 2ab\cos 90° = c^2 = a^2 + b^2$, since $\cos 90° = 0$
11. $-0.87 = -0.87$ **13.** 5.81 feet **15.** 121 miles **17.** 74.1 meters

Exercise 7-4

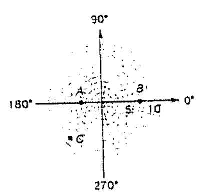
1. $H = 28$ pounds, $V = 10$ pounds **3.** $H = 6.8$ knots, $V = 19$ knots **5.** 1,700 miles north; 1,000 miles east
7. $M_3 = 69$ pounds, $\beta = 16°$ **9.** $M_3 = 22$ miles/hour, $\beta = 6°$ **11.** Magnitude = 13 miles/hour, direction =
13. 349 pounds **15.** Left cable: 518 pounds; right cable: 390 pounds
17. For *AB*, a compression of 9,050 pounds; for *BC* a tension of 7,540 pounds **19.** 350.8°, 247 miles/hour
21. 51.0°; 3.83 knots

Exercise 7-5

1.



3.



5.