1. Use addition or subtraction formulas to find the exact solution. \( \sin \frac{19\pi}{12} \)

Find all solutions to the equation. EC for finding solutions on the interval \([0, 2\pi)\)

2. \( \sin \left( 2x - \frac{\pi}{6} \right) = -\frac{\sqrt{3}}{2} \)

3. Find the exact value of the expression whenever it is defined. \( \csc \left( \tan^{-1} \frac{8}{24} \right) \)

Find the exact value of the expression whenever it is defined.

4. \( \tan \left[ \arccos \left( -\frac{1}{\sqrt{10}} \right) + \sin^{-1} \left( \frac{5}{12} \right) \right] \)

5. \( \cos \left[ \frac{1}{2} \arctan \left( -\frac{3}{2} \right) \right] \)

6. \( \sec \left[ 2 \tan^{-1} \left( -\frac{2}{5} \right) \right] \)

Find all the solutions to the equations. For extra credit give the solutions on the interval \([0, 2\pi)\). Give the exact solution when appropriate.

7. \( \cos (3t) \cos (-5t) = \sin (-3t) \sin (-5t) \)

8. \( 1 - \sin \theta = \sqrt{3} \cos \theta \)

9. \( 2 \sin^2 6\theta - 3 \sin 6\theta = -1 \)

10. Find all the solutions to the equations. For extra credit give the solutions on the interval \([0^\circ, 360^\circ)\).

\( 5 \sin^3 3\theta + 3 \sin 3\theta = 2 \)

11. Solve the triangle given that \( \gamma = 32^\circ, c = 574, b = 264 \). Now find the area.

12. Solve the triangle given that \( a = 5, c = 6, \) and \( \alpha = 42^\circ \). Now find the area.

13. Solve the triangle given that \( a = 195, b = 248, \) and \( \alpha = 113^\circ \). Now find the area.

14. Solve the triangle given that \( a = 10, b = 15, \) and \( c = 12 \). Now find the area.

15. Solve the triangle given that \( b = 20, a = 10, \) and \( \beta = 115^\circ \). Now find the area.

16. Solve the triangle given that \( c = 40, b = 70, \) and \( \alpha = 73^\circ \). Now find the area.
17. Solve the triangle given that \( c = 14, a = 87, \) and \( \beta = 74^\circ \). Now find the area.

18. Alan is golfing and sets up for a long drive. He slices it and hits a tree 80 feet away. The ball ricochets off the tree at a 110\(^\circ\) angle and comes to a stop 20\(^\circ\) away. Form a triangle with the 80 feet between the two angle measures. Find the distance his ball traveled by finding the length of the side across from the 110\(^\circ\). Round to one decimal place.

19. An airplane has to fly between three airports. The trip from the first to the second is 120 miles. After landing at the second airport, the plane must turn towards the third airport forming a 40\(^\circ\) inside the triangle. At the third airport, the plane turns towards home forming an 80\(^\circ\) inside the triangle. How far does the airplane have to travel to get home? Round to one decimal place.

20. Find the rectangular coordinates of the points given in polar form. \((4, \frac{2\pi}{3})\)

21. The rectangular coordinates of a point are given. Find two pairs of polar coordinates \((r, \theta)\) for each point, one with \( r > 0 \) and the other with \( r < 0 \). Express \( \theta \) in radians. \((2\sqrt{2}, -2\sqrt{2})\)

22. Write the complex number in polar form. Express your argument in degrees.

   a) \(-9\sqrt{3} + 9i\)

   b) \(1 - \sqrt{3}i\)

23. Use the information found in problem 22 to multiply the two complex numbers. Return your final answer to \( a + bi \) form. Show work in polar form.

24. For the given \( z \) and \( w \) find \( \frac{z}{w} \). Show your final answer to \( a + bi \) form. Show work in polar form.

   a) \( z = 2\left(\cos 205^\circ + i \sin 205^\circ\right), w = 3\left(\cos 85^\circ + i \sin 85^\circ\right) \)

   b) \( z = \sqrt{3}\left(\cos 10^\circ + i \sin 10^\circ\right), w = \frac{1}{2}\left(\cos 72^\circ + i \sin 72^\circ\right) \)

25. The vector \( v \) has initial point \( P \) and terminal point \( Q \). Write \( v \) in the form \( ai + bj \). \( P = (-3, 2); Q = (6, 5) \)

   Find the dot product \( v \cdot w \) and the angle between \( v \) and \( w \) where \( 0 \leq \theta < 2\pi \).

26. \( v = 3i - j, \ w = i + j \)

27. \( v = -2i - j, \ w = 2i + j \)

28. \( v = -5i + 12j, \ w = 6i + 2j \)

29. \( v = -2i + 2j, \ w = -3i + 2j \)

30. \( v = -3i + 2j, \ w = -2i + j \)

31. \( v = -4i - j, \ w = i - 2j \)

Decompose \( v \) into two vectors, one parallel to \( w \) and the other orthogonal to \( w \).
32. Find the fifth roots of \(-8 - 8i\).

33. Write the expression in the standard \(a + bi\) form.

\[
\left[ 3 \left( \cos \frac{7\pi}{10} + i \sin \frac{7\pi}{10} \right) \right]^6
\]

SOLUTIONS: Must show work to receive credit.

1. \(-\sqrt{2} - \sqrt{6} \over 4\)

2. \(\frac{3\pi}{4} + \pi n, \frac{11\pi}{12} + \pi n = \frac{3\pi}{4}, \frac{7\pi}{4}, \frac{11\pi}{12}, \frac{23\pi}{12}\)

3. \(-\sqrt{10}\)

4. \(\frac{216 - 25\sqrt{119}}{53}\)

5. \(-\sqrt{338 + 52\sqrt{13}} \over 26\)

6. \(77 \over 21\)

7. \(\frac{\pi}{16} + \frac{3\pi}{16} + \frac{5\pi}{16} + \frac{7\pi}{16} + \frac{9\pi}{16} + \frac{11\pi}{16} + \frac{13\pi}{16} + \frac{15\pi}{16}\)

8. \(\frac{2\pi}{6} + 2\pi n, \frac{11\pi}{6} + 2\pi n = \frac{7\pi}{6}, \frac{11\pi}{6}, \frac{\pi}{2}\)

9. \(\frac{\pi}{36} + \frac{\pi n}{3} + \frac{5\pi}{36} + \frac{\pi n}{3} + \frac{\pi}{12} + \frac{\pi n}{3} = \frac{\pi}{36}, \frac{5\pi}{36}, \frac{13\pi}{36}, \frac{17\pi}{36}, \frac{25\pi}{36}, \frac{29\pi}{36}, \frac{37\pi}{36}, \frac{41\pi}{36}, \frac{49\pi}{36}, \frac{53\pi}{36}, \frac{61\pi}{36}, \frac{65\pi}{36}, \frac{\pi}{12}, \frac{5\pi}{12}, \frac{3\pi}{12}, \frac{13\pi}{12}, \frac{17\pi}{12}, \frac{7\pi}{12}\)

10. \(7.9' + 120' n, 52.1' + 120' n, 90' + 120' n = 7.9', 52.1', 90', 127.9', 172.1', 210'\)

11. \(\alpha = 133.9', \beta = 14.1', a = 780.5\) Area = 54,594.7

12. \(\beta_1 = 84.6', \beta_2 = 11.4', b_1 = 7.4, b_2 = 1.5, \gamma_1 = 53.4', \gamma_2 = 126.6'\)

Area 1 = 14.9 and Area 2 = 3

13. No such triangle and no such area.

14. \(\alpha = 41.6', \beta = 85.5', \gamma = 52.9'\) Area = 59.8

15. \(\alpha = 26.9', \gamma = 38.1', c = 13.6\) Area = 61.7

16. \(\beta = 73.8', \gamma = 33.2', a = 69.7\) Area = 1,338.8

17. \(\alpha = 96.9', \gamma = 9.4', b = 84.2\) Area = 585.4
18. 98.1 feet  
19. 78.3 miles  
20. $-2 + 2i\sqrt{3}$  
21. $r = 4, \quad \theta = \frac{7\pi}{4}$ or $r = -4, \quad \theta = \frac{3\pi}{4}$  
22. a) $18(\cos150^\circ + i\sin150^\circ)$  
   b) $2(\cos300^\circ + i\sin300^\circ)$  
23. $36(\cos90^\circ + i\sin90^\circ) = 36i$  
24. $2\sqrt{3}(\cos62^\circ - i\sin62^\circ) = 1.6263 - 3.0586i$  
25. $9i + 3j$  
26. $\mathbf{v} \cdot \mathbf{w} = 2, \quad \theta = 1.107$  
27. $\mathbf{v} \cdot \mathbf{w} = -5, \quad \theta = \pi$  
28. $\mathbf{v} \cdot \mathbf{w} = -6, \quad \theta = 1.644$  
29. $\mathbf{v} \cdot \mathbf{w} = 10, \quad \theta = 0.1974$  
30. $v_1 = -\frac{16}{5}i + \frac{8}{5}j, \quad v_2 = \frac{1}{5}i + \frac{2}{5}j$  
31. $v_1 = -\frac{2}{5}i + \frac{4}{5}j, \quad v_2 = -\frac{18}{5}i - \frac{9}{5}j$  
32. $w_0 = 2^{\frac{7}{10}} \cos \frac{\pi}{4} = 1.15 + 1.15i$  
33. $729 \cos \frac{\pi}{5} = 589.77 + 428.5i$  
34. $w_1 = 2^{\frac{7}{10}} \cos \frac{13\pi}{20} = -0.74 + 1.45i$  
35. $w_2 = 2^{\frac{7}{10}} \cos \frac{21\pi}{20} = -1.6 - 0.25i$  
36. $w_3 = 2^{\frac{7}{10}} \cos \frac{29\pi}{20} = -0.25 - 1.6i$  
37. $w_4 = 2^{\frac{7}{10}} \cos \frac{37\pi}{20} = 1.45 - 0.74i$  