

10.7.1 EXERCISES

For a link to all of the additional resources available for this section, click [OSttS Chapter 10 materials](#).

In Exercises 1 - 18, find all of the exact solutions of the equation and then list those solutions which are in the interval $[0, 2\pi)$.

For help with these exercises, click the resource below:

- [Solving basic equations](#)

- | | | |
|---|--|--|
| 1. $\sin(5x) = 0$ | 2. $\cos(3x) = \frac{1}{2}$ | 3. $\sin(-2x) = \frac{\sqrt{3}}{2}$ |
| 4. $\tan(6x) = 1$ | 5. $\csc(4x) = -1$ | 6. $\sec(3x) = \sqrt{2}$ |
| 7. $\cot(2x) = -\frac{\sqrt{3}}{3}$ | 8. $\cos(9x) = 9$ | 9. $\sin\left(\frac{x}{3}\right) = \frac{\sqrt{2}}{2}$ |
| 10. $\cos\left(x + \frac{5\pi}{6}\right) = 0$ | 11. $\sin\left(2x - \frac{\pi}{3}\right) = -\frac{1}{2}$ | 12. $2\cos\left(x + \frac{7\pi}{4}\right) = \sqrt{3}$ |
| 13. $\csc(x) = 0$ | 14. $\tan(2x - \pi) = 1$ | 15. $\tan^2(x) = 3$ |
| 16. $\sec^2(x) = \frac{4}{3}$ | 17. $\cos^2(x) = \frac{1}{2}$ | 18. $\sin^2(x) = \frac{3}{4}$ |

In Exercises 19 - 42, solve the equation, giving the exact solutions which lie in $[0, 2\pi)$

For help with these exercises, click one or more of the resources below:

- [Solving equations which become quadratic in form after using identities](#)
- [Solving equations using the Double Angle Identities](#)
- [Solving equations using other techniques](#)

- | | |
|-----------------------------------|--------------------------------|
| 19. $\sin(x) = \cos(x)$ | 20. $\sin(2x) = \sin(x)$ |
| 21. $\sin(2x) = \cos(x)$ | 22. $\cos(2x) = \sin(x)$ |
| 23. $\cos(2x) = \cos(x)$ | 24. $\cos(2x) = 2 - 5\cos(x)$ |
| 25. $3\cos(2x) + \cos(x) + 2 = 0$ | 26. $\cos(2x) = 5\sin(x) - 2$ |
| 27. $3\cos(2x) = \sin(x) + 2$ | 28. $2\sec^2(x) = 3 - \tan(x)$ |

29. $\tan^2(x) = 1 - \sec(x)$

30. $\cot^2(x) = 3 \csc(x) - 3$

31. $\sec(x) = 2 \csc(x)$

32. $\cos(x) \csc(x) \cot(x) = 6 - \cot^2(x)$

33. $\sin(2x) = \tan(x)$

34. $\cot^4(x) = 4 \csc^2(x) - 7$

35. $\cos(2x) + \csc^2(x) = 0$

36. $\tan^3(x) = 3 \tan(x)$

37. $\tan^2(x) = \frac{3}{2} \sec(x)$

38. $\cos^3(x) = -\cos(x)$

39. $\tan(2x) - 2 \cos(x) = 0$

40. $\csc^3(x) + \csc^2(x) = 4 \csc(x) + 4$

41. $2 \tan(x) = 1 - \tan^2(x)$

42. $\tan(x) = \sec(x)$

In Exercises 43 - 58, solve the equation, giving the exact solutions which lie in $[0, 2\pi)$

For help with these exercises, click the resource below:

- [Solving equations using other techniques](#)

43. $\sin(6x) \cos(x) = -\cos(6x) \sin(x)$

44. $\sin(3x) \cos(x) = \cos(3x) \sin(x)$

45. $\cos(2x) \cos(x) + \sin(2x) \sin(x) = 1$

46. $\cos(5x) \cos(3x) - \sin(5x) \sin(3x) = \frac{\sqrt{3}}{2}$

47. $\sin(x) + \cos(x) = 1$

48. $\sin(x) + \sqrt{3} \cos(x) = 1$

49. $\sqrt{2} \cos(x) - \sqrt{2} \sin(x) = 1$

50. $\sqrt{3} \sin(2x) + \cos(2x) = 1$

51. $\cos(2x) - \sqrt{3} \sin(2x) = \sqrt{2}$

52. $3\sqrt{3} \sin(3x) - 3 \cos(3x) = 3\sqrt{3}$

53. $\cos(3x) = \cos(5x)$

54. $\cos(4x) = \cos(2x)$

55. $\sin(5x) = \sin(3x)$

56. $\cos(5x) = -\cos(2x)$

57. $\sin(6x) + \sin(x) = 0$

58. $\tan(x) = \cos(x)$

In Exercises 59 - 68, solve the equation.

59. $\arccos(2x) = \pi$

60. $\pi - 2 \arcsin(x) = 2\pi$

61. $4 \arctan(3x - 1) - \pi = 0$

62. $6 \operatorname{arccot}(2x) - 5\pi = 0$

63. $4 \operatorname{arcsec} \left(\frac{x}{2} \right) = \pi$

64. $12 \operatorname{arccsc} \left(\frac{x}{3} \right) = 2\pi$

65. $9 \arcsin^2(x) - \pi^2 = 0$

66. $9 \arccos^2(x) - \pi^2 = 0$

67. $8 \operatorname{arccot}^2(x) + 3\pi^2 = 10\pi \operatorname{arccot}(x)$

68. $6 \arctan(x)^2 = \pi \arctan(x) + \pi^2$

In Exercises 69 - 80, solve the inequality. Express the exact answer in interval notation, restricting your attention to $0 \leq x \leq 2\pi$.

69. $\sin(x) \leq 0$

70. $\tan(x) \geq \sqrt{3}$

71. $\sec^2(x) \leq 4$

72. $\cos^2(x) > \frac{1}{2}$

73. $\cos(2x) \leq 0$

74. $\sin\left(x + \frac{\pi}{3}\right) > \frac{1}{2}$

75. $\cot^2(x) \geq \frac{1}{3}$

76. $2 \cos(x) \geq 1$

77. $\sin(5x) \geq 5$

78. $\cos(3x) \leq 1$

79. $\sec(x) \leq \sqrt{2}$

80. $\cot(x) \leq 4$

In Exercises 81 - 86, solve the inequality. Express the exact answer in interval notation, restricting your attention to $-\pi \leq x \leq \pi$.

81. $\cos(x) > \frac{\sqrt{3}}{2}$

82. $\sin(x) > \frac{1}{3}$

83. $\sec(x) \leq 2$

84. $\sin^2(x) < \frac{3}{4}$

85. $\cot(x) \geq -1$

86. $\cos(x) \geq \sin(x)$

In Exercises 87 - 92, solve the inequality. Express the exact answer in interval notation, restricting your attention to $-2\pi \leq x \leq 2\pi$.

87. $\csc(x) > 1$

88. $\cos(x) \leq \frac{5}{3}$

89. $\cot(x) \geq 5$

90. $\tan^2(x) \geq 1$

91. $\sin(2x) \geq \sin(x)$

92. $\cos(2x) \leq \sin(x)$

In Exercises 93 - 98, solve the given inequality.

93. $\arcsin(2x) > 0$

94. $3 \arccos(x) \leq \pi$

95. $6 \operatorname{arccot}(7x) \geq \pi$

96. $\pi > 2 \arctan(x)$

97. $2 \arcsin(x)^2 > \pi \arcsin(x)$

98. $12 \arccos(x)^2 + 2\pi^2 > 11\pi \arccos(x)$

In Exercises 99 - 107, express the domain of the function using the extended interval notation. (See page 792 in Section 10.3.1 for details.)

99. $f(x) = \frac{1}{\cos(x) - 1}$

100. $f(x) = \frac{\cos(x)}{\sin(x) + 1}$

101. $f(x) = \sqrt{\tan^2(x) - 1}$

102. $f(x) = \sqrt{2 - \sec(x)}$

103. $f(x) = \csc(2x)$

104. $f(x) = \frac{\sin(x)}{2 + \cos(x)}$

105. $f(x) = 3 \csc(x) + 4 \sec(x)$

106. $f(x) = \ln(|\cos(x)|)$

107. $f(x) = \arcsin(\tan(x))$

108. With the help of your classmates, determine the number of solutions to $\sin(x) = \frac{1}{2}$ in $[0, 2\pi)$. Then find the number of solutions to $\sin(2x) = \frac{1}{2}$, $\sin(3x) = \frac{1}{2}$ and $\sin(4x) = \frac{1}{2}$ in $[0, 2\pi)$. A pattern should emerge. Explain how this pattern would help you solve equations like $\sin(11x) = \frac{1}{2}$. Now consider $\sin\left(\frac{x}{2}\right) = \frac{1}{2}$, $\sin\left(\frac{3x}{2}\right) = \frac{1}{2}$ and $\sin\left(\frac{5x}{2}\right) = \frac{1}{2}$. What do you find? Replace $\frac{1}{2}$ with -1 and repeat the whole exploration.

Checkpoint Quiz 10.7

1. Solve the following equations. List the solutions which lie in the interval $[0, 2\pi)$.

(a) $2 \sin(2x) - 1 = 0$

(c) $\sin(2x) = \cos(x)$

(e) $\tan^2(x) = \sec(x) + 1$

(b) $3 \sin(2x) - 1 = 0$

(d) $4 \cos(2x) = 2 \cos(x) - 1$

2. Solve the following inequalities on $[0, 2\pi)$.

(a) $2 \sin(x) + 1 \leq 0$

(b) $\tan(2x) \geq \sqrt{3}$

(c) $4 \cos(x) - 1 \leq 0$

For worked out solutions to this quiz, click the links below:

- [Quiz Solution Part 1](#)

- [Quiz Solution Part 4](#)

- [Quiz Solution Part 7](#)

- [Quiz Solution Part 2](#)

- [Quiz Solution Part 5](#)

- [Quiz Solution Part 3](#)

- [Quiz Solution Part 6](#)

10.7.2 ANSWERS

1. $x = \frac{\pi k}{5}; x = 0, \frac{\pi}{5}, \frac{2\pi}{5}, \frac{3\pi}{5}, \frac{4\pi}{5}, \pi, \frac{6\pi}{5}, \frac{7\pi}{5}, \frac{8\pi}{5}, \frac{9\pi}{5}$
2. $x = \frac{\pi}{9} + \frac{2\pi k}{3}$ or $x = \frac{5\pi}{9} + \frac{2\pi k}{3}; x = \frac{\pi}{9}, \frac{5\pi}{9}, \frac{7\pi}{9}, \frac{11\pi}{9}, \frac{13\pi}{9}, \frac{17\pi}{9}$
3. $x = \frac{2\pi}{3} + \pi k$ or $x = \frac{5\pi}{6} + \pi k; x = \frac{2\pi}{3}, \frac{5\pi}{6}, \frac{5\pi}{3}, \frac{11\pi}{6}$
4. $x = \frac{\pi}{24} + \frac{\pi k}{6}; x = \frac{\pi}{24}, \frac{5\pi}{24}, \frac{3\pi}{8}, \frac{13\pi}{24}, \frac{17\pi}{24}, \frac{7\pi}{8}, \frac{25\pi}{24}, \frac{29\pi}{24}, \frac{11\pi}{8}, \frac{37\pi}{24}, \frac{41\pi}{24}, \frac{15\pi}{8}$
5. $x = \frac{3\pi}{8} + \frac{\pi k}{2}; x = \frac{3\pi}{8}, \frac{7\pi}{8}, \frac{11\pi}{8}, \frac{15\pi}{8}$
6. $x = \frac{\pi}{12} + \frac{2\pi k}{3}$ or $x = \frac{7\pi}{12} + \frac{2\pi k}{3}; x = \frac{\pi}{12}, \frac{7\pi}{12}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{17\pi}{12}, \frac{23\pi}{12}$
7. $x = \frac{\pi}{3} + \frac{\pi k}{2}; x = \frac{\pi}{3}, \frac{5\pi}{6}, \frac{4\pi}{3}, \frac{11\pi}{6}$
8. No solution
9. $x = \frac{3\pi}{4} + 6\pi k$ or $x = \frac{9\pi}{4} + 6\pi k; x = \frac{3\pi}{4}$
10. $x = -\frac{\pi}{3} + \pi k; x = \frac{2\pi}{3}, \frac{5\pi}{3}$
11. $x = \frac{3\pi}{4} + \pi k$ or $x = \frac{13\pi}{12} + \pi k; x = \frac{\pi}{12}, \frac{3\pi}{4}, \frac{13\pi}{12}, \frac{7\pi}{4}$
12. $x = -\frac{19\pi}{12} + 2\pi k$ or $x = \frac{\pi}{12} + 2\pi k; x = \frac{\pi}{12}, \frac{5\pi}{12}$
13. No solution
14. $x = \frac{5\pi}{8} + \frac{\pi k}{2}; x = \frac{\pi}{8}, \frac{5\pi}{8}, \frac{9\pi}{8}, \frac{13\pi}{8}$
15. $x = \frac{\pi}{3} + \pi k$ or $x = \frac{2\pi}{3} + \pi k; x = \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$
16. $x = \frac{\pi}{6} + \pi k$ or $x = \frac{5\pi}{6} + \pi k; x = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$
17. $x = \frac{\pi}{4} + \frac{\pi k}{2}; x = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$
18. $x = \frac{\pi}{3} + \pi k$ or $x = \frac{2\pi}{3} + \pi k; x = \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$

19. $x = \frac{\pi}{4}, \frac{5\pi}{4}$
20. $x = 0, \frac{\pi}{3}, \pi, \frac{5\pi}{3}$
21. $x = \frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$
22. $x = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{2}$
23. $x = 0, \frac{2\pi}{3}, \frac{4\pi}{3}$
24. $x = \frac{\pi}{3}, \frac{5\pi}{3}$
25. $x = \frac{2\pi}{3}, \frac{4\pi}{3}, \arccos\left(\frac{1}{3}\right), 2\pi - \arccos\left(\frac{1}{3}\right)$
26. $x = \frac{\pi}{6}, \frac{5\pi}{6}$
27. $x = \frac{7\pi}{6}, \frac{11\pi}{6}, \arcsin\left(\frac{1}{3}\right), \pi - \arcsin\left(\frac{1}{3}\right)$
28. $x = \frac{3\pi}{4}, \frac{7\pi}{4}, \arctan\left(\frac{1}{2}\right), \pi + \arctan\left(\frac{1}{2}\right)$
29. $x = 0, \frac{2\pi}{3}, \frac{4\pi}{3}$
30. $x = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{\pi}{2}$
31. $x = \arctan(2), \pi + \arctan(2)$
32. $x = \frac{\pi}{6}, \frac{7\pi}{6}, \frac{5\pi}{6}, \frac{11\pi}{6}$
33. $x = 0, \pi, \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$
34. $x = \frac{\pi}{6}, \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{5\pi}{4}, \frac{7\pi}{4}, \frac{11\pi}{6}$
35. $x = \frac{\pi}{2}, \frac{3\pi}{2}$
36. $x = 0, \frac{\pi}{3}, \frac{2\pi}{3}, \pi, \frac{4\pi}{3}, \frac{5\pi}{3}$
37. $x = \frac{\pi}{3}, \frac{5\pi}{3}$
38. $x = \frac{\pi}{2}, \frac{3\pi}{2}$
39. $x = \frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$
40. $x = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{3\pi}{2}, \frac{11\pi}{6}$
41. $x = \frac{\pi}{8}, \frac{5\pi}{8}, \frac{9\pi}{8}, \frac{13\pi}{8}$
42. No solution
43. $x = 0, \frac{\pi}{7}, \frac{2\pi}{7}, \frac{3\pi}{7}, \frac{4\pi}{7}, \frac{5\pi}{7}, \frac{6\pi}{7}, \pi, \frac{8\pi}{7}, \frac{9\pi}{7}, \frac{10\pi}{7}, \frac{11\pi}{7}, \frac{12\pi}{7}, \frac{13\pi}{7}$
44. $x = 0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}$
45. $x = 0$
46. $x = \frac{\pi}{48}, \frac{11\pi}{48}, \frac{13\pi}{48}, \frac{23\pi}{48}, \frac{25\pi}{48}, \frac{35\pi}{48}, \frac{37\pi}{48}, \frac{47\pi}{48}, \frac{49\pi}{48}, \frac{59\pi}{48}, \frac{61\pi}{48}, \frac{71\pi}{48}, \frac{73\pi}{48}, \frac{83\pi}{48}, \frac{85\pi}{48}, \frac{95\pi}{48}$
47. $x = 0, \frac{\pi}{2}$
48. $x = \frac{\pi}{2}, \frac{11\pi}{6}$
49. $x = \frac{\pi}{12}, \frac{17\pi}{12}$
50. $x = 0, \pi, \frac{\pi}{3}, \frac{4\pi}{3}$
51. $x = \frac{17\pi}{24}, \frac{41\pi}{24}, \frac{23\pi}{24}, \frac{47\pi}{24}$
52. $x = \frac{\pi}{6}, \frac{5\pi}{18}, \frac{5\pi}{6}, \frac{17\pi}{18}, \frac{3\pi}{2}, \frac{29\pi}{18}$

$$53. x = 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \pi, \frac{5\pi}{4}, \frac{3\pi}{2}, \frac{7\pi}{4}$$

$$54. x = 0, \frac{\pi}{3}, \frac{2\pi}{3}, \pi, \frac{4\pi}{3}, \frac{5\pi}{3}$$

$$55. x = 0, \frac{\pi}{8}, \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}, \pi, \frac{9\pi}{8}, \frac{11\pi}{8}, \frac{13\pi}{8}, \frac{15\pi}{8}$$

$$56. x = \frac{\pi}{7}, \frac{\pi}{3}, \frac{3\pi}{7}, \frac{5\pi}{7}, \pi, \frac{9\pi}{7}, \frac{11\pi}{7}, \frac{5\pi}{3}, \frac{13\pi}{7}$$

$$57. x = \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, \frac{\pi}{5}, \frac{3\pi}{5}, \pi, \frac{7\pi}{5}, \frac{9\pi}{5}$$

$$58. x = \arcsin\left(\frac{-1 + \sqrt{5}}{2}\right) \approx 0.6662, \pi - \arcsin\left(\frac{-1 + \sqrt{5}}{2}\right) \approx 2.4754$$

$$59. x = -\frac{1}{2}$$

$$60. x = -1$$

$$61. x = \frac{2}{3}$$

$$62. x = -\frac{\sqrt{3}}{2}$$

$$63. x = 2\sqrt{2}$$

$$64. x = 6$$

$$65. x = \pm \frac{\sqrt{3}}{2}$$

$$66. x = \frac{1}{2}$$

$$67. x = -1, 0$$

$$68. x = -\sqrt{3}$$

$$69. [\pi, 2\pi]$$

$$70. \left[\frac{\pi}{3}, \frac{\pi}{2}\right) \cup \left[\frac{4\pi}{3}, \frac{3\pi}{2}\right)$$

$$71. \left[0, \frac{\pi}{3}\right] \cup \left[\frac{2\pi}{3}, \frac{4\pi}{3}\right] \cup \left[\frac{5\pi}{3}, 2\pi\right]$$

$$72. \left[0, \frac{\pi}{4}\right) \cup \left(\frac{3\pi}{4}, \frac{5\pi}{4}\right) \cup \left(\frac{7\pi}{4}, 2\pi\right]$$

$$73. \left[\frac{\pi}{4}, \frac{3\pi}{4}\right] \cup \left[\frac{5\pi}{4}, \frac{7\pi}{4}\right]$$

$$74. \left[0, \frac{\pi}{2}\right) \cup \left(\frac{11\pi}{6}, 2\pi\right]$$

$$75. \left(0, \frac{\pi}{3}\right] \cup \left[\frac{2\pi}{3}, \pi\right) \cup \left(\pi, \frac{4\pi}{3}\right] \cup \left[\frac{5\pi}{3}, 2\pi\right)$$

$$76. \left[0, \frac{\pi}{3}\right] \cup \left[\frac{5\pi}{3}, 2\pi\right]$$

$$77. \text{No solution}$$

$$78. [0, 2\pi]$$

$$79. \left[0, \frac{\pi}{4}\right] \cup \left(\frac{\pi}{2}, \frac{3\pi}{2}\right) \cup \left[\frac{7\pi}{4}, 2\pi\right]$$

$$80. [\operatorname{arccot}(4), \pi) \cup [\pi + \operatorname{arccot}(4), 2\pi)$$

$$81. \left(-\frac{\pi}{6}, \frac{\pi}{6}\right)$$

$$82. \left(\arcsin\left(\frac{1}{3}\right), \pi - \arcsin\left(\frac{1}{3}\right)\right)$$

$$83. \left[-\pi, -\frac{\pi}{2}\right) \cup \left[-\frac{\pi}{3}, \frac{\pi}{3}\right] \cup \left(\frac{\pi}{2}, \pi\right]$$

$$84. \left(-\frac{2\pi}{3}, -\frac{\pi}{3}\right) \cup \left(\frac{\pi}{3}, \frac{2\pi}{3}\right)$$

85. $\left(-\pi, -\frac{\pi}{4}\right] \cup \left(0, \frac{3\pi}{4}\right]$

86. $\left[-\frac{3\pi}{4}, \frac{\pi}{4}\right]$

87. $\left(-2\pi, -\frac{3\pi}{2}\right) \cup \left(-\frac{3\pi}{2}, -\pi\right) \cup \left(0, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \pi\right)$

88. $[-2\pi, 2\pi]$

89. $(-2\pi, \operatorname{arccot}(5) - 2\pi] \cup (-\pi, \operatorname{arccot}(5) - \pi] \cup (0, \operatorname{arccot}(5)] \cup (\pi, \pi + \operatorname{arccot}(5))$

90. $\left[-\frac{7\pi}{4}, -\frac{3\pi}{2}\right) \cup \left(-\frac{3\pi}{2}, -\frac{5\pi}{4}\right] \cup \left[-\frac{3\pi}{4}, -\frac{\pi}{2}\right) \cup \left(-\frac{\pi}{2}, -\frac{\pi}{4}\right] \cup \left[\frac{\pi}{4}, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \frac{3\pi}{4}\right] \cup \left[\frac{5\pi}{4}, \frac{3\pi}{2}\right) \cup \left(\frac{3\pi}{2}, \frac{7\pi}{4}\right]$

91. $\left[-2\pi, -\frac{5\pi}{3}\right] \cup \left[-\pi, -\frac{\pi}{3}\right] \cup \left[0, \frac{\pi}{3}\right] \cup \left[\pi, \frac{5\pi}{3}\right]$

92. $\left[-\frac{11\pi}{6}, -\frac{7\pi}{6}\right] \cup \left[\frac{\pi}{6}, \frac{5\pi}{6}\right] \cup \left\{-\frac{\pi}{2}, \frac{3\pi}{2}\right\}$

93. $(0, \frac{1}{2}]$

94. $[\frac{1}{2}, 1]$

95. $\left(-\infty, \frac{\sqrt{3}}{7}\right]$

96. $(-\infty, \infty)$

97. $[-1, 0)$

98. $\left[-1, -\frac{1}{2}\right) \cup \left(\frac{\sqrt{2}}{2}, 1\right]$

99. $\bigcup_{k=-\infty}^{\infty} (2k\pi, (2k+2)\pi)$

100. $\bigcup_{k=-\infty}^{\infty} \left(\frac{(4k-1)\pi}{2}, \frac{(4k+3)\pi}{2}\right)$

101. $\bigcup_{k=-\infty}^{\infty} \left\{\left[\frac{(4k+1)\pi}{4}, \frac{(2k+1)\pi}{2}\right) \cup \left(\frac{(2k+1)\pi}{2}, \frac{(4k+3)\pi}{4}\right]\right\}$

102. $\bigcup_{k=-\infty}^{\infty} \left\{\left[\frac{(6k-1)\pi}{3}, \frac{(6k+1)\pi}{3}\right] \cup \left(\frac{(4k+1)\pi}{2}, \frac{(4k+3)\pi}{2}\right)\right\}$

103. $\bigcup_{k=-\infty}^{\infty} \left(\frac{k\pi}{2}, \frac{(k+1)\pi}{2}\right)$

104. $(-\infty, \infty)$

105. $\bigcup_{k=-\infty}^{\infty} \left(\frac{k\pi}{2}, \frac{(k+1)\pi}{2}\right)$

106. $\bigcup_{k=-\infty}^{\infty} \left(\frac{(2k-1)\pi}{2}, \frac{(2k+1)\pi}{2}\right)$

107. $\bigcup_{k=-\infty}^{\infty} \left[\frac{(4k-1)\pi}{4}, \frac{(4k+1)\pi}{4}\right]$