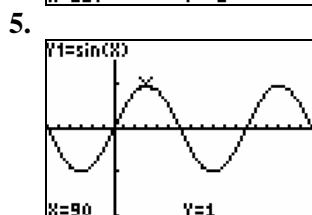
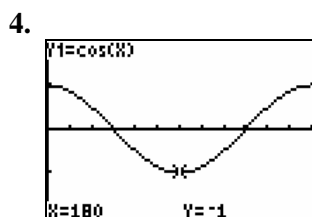
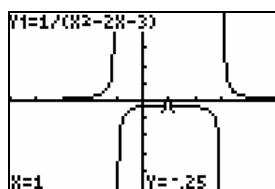


Prerequisite Skills

1. a) 0.4816 b) 0.9511
 c) -0.7660 d) -0.2679
 2. a) 46.3156 b) 1.5950
 c) -1.4843 d) 1.0861
 3. a) $\frac{1}{\sqrt{2}}$ b) $-\frac{1}{\sqrt{3}}$ c) -1
 d) $\frac{2}{\sqrt{3}}$ e) $\frac{2}{\sqrt{3}}$ f) 1



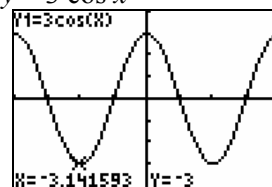
6. a) amplitude 2, period 360° , phase shift 180° to the right, 3 units upward
 b) maximum 5, minimum 1
 c) none
 d) 1
 7. a) amplitude 0.5, period 120° , phase shift 360° to the left, 1 unit downward
 b) maximum -0.5, minimum -1.5
 c) -1
 8. a) 57.7° b) 47.9°
 c) 54.3° d) 69.9°
 9. a) 0.77 b) 1.17
 c) 1.30 d) 0.54
 10. a) $x = 3, x = -1$ b) $y = 0$
 c)



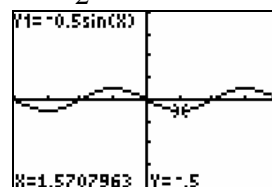
11. a) 0.8°C/h b) 0.6°C/h

5.1 Graphs of Sine, Cosine, and Tangent Functions

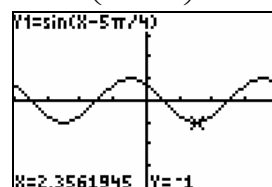
1. a) $y = 3 \cos x$



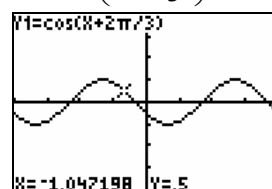
- b) $y = -\frac{1}{2} \sin x$



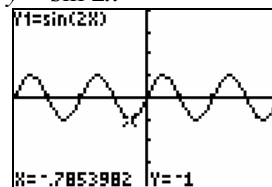
- c) $y = \sin\left(x - \frac{5\pi}{4}\right)$



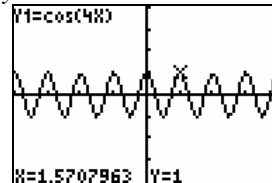
- d) $y = \cos\left(x + \frac{2\pi}{3}\right)$



- e) $y = \sin 2x$

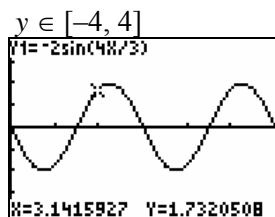


- f) $y = \cos 4x$



2. a) $y = -2 \sin \frac{4}{3}x$

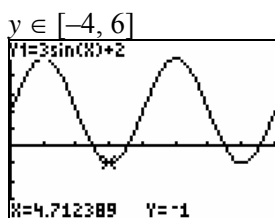
b) Window: $x \in [0, 3\pi]$, $Xscl = \frac{\pi}{2}$,



3. a) 3

b) 2 units upward

c) Window: $x \in [0, 4\pi]$, $Xscl = \frac{\pi}{2}$,

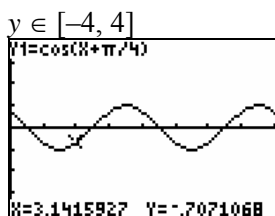


4. a) 2π

b) $\frac{\pi}{4}$ rad to the left

c) $y = \cos\left(x + \frac{\pi}{4}\right)$

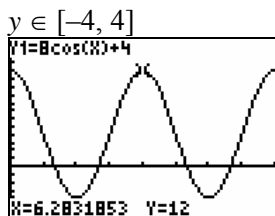
d) Window: $x \in [0, 4\pi]$, $Xscl = \frac{\pi}{2}$,



5. a) 8

b) 4 units upward

c) Window: $x \in [0, 4\pi]$, $Xscl = \frac{\pi}{2}$,



6. a) $[0, 0.79) \cup (3.93, 6.28]$

b) (0.79, 3.93) c) 0.79, 3.93

7. a) Even. The graph of $y = -2 \cos(-x) + 3$ is equivalent to the graph of $y = -2 \cos(x) + 3$.

b) Neither.

d)

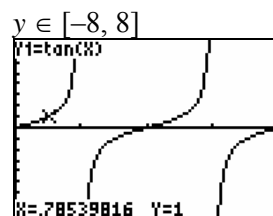
c) Odd. The graph of $y = \frac{1}{4} \sin(-x)$ is equivalent to the graph of $y = -\frac{1}{4} \sin x$.

8. a) $\frac{\pi}{3}$

b) Yes, $\frac{\pi}{3} \pm 2\pi k$ and $\pi \pm 2\pi k$, where $k \in \mathbb{Z}$.

5.2 Graphs of Reciprocal Trigonometric Functions

1. a) Window: $x \in [0, 2\pi]$, $Xscl = \frac{\pi}{2}$,



b) $x \approx 1.41, x \approx 4.55$

2. $x \approx 2.50, x \approx 3.79$

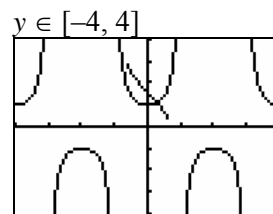
3. $x \approx 3.48, x \approx 5.94$

4. a) $y = \sec\left(x - \frac{\pi}{2}\right)$ b) $y = \sec\left(x + \frac{3\pi}{2}\right)$

5. a) The cotangent function is the reciprocal of the tangent function and \tan^{-1} is the opposite operation of tangent.

b) $\cot \frac{1}{\sqrt{3}} \approx 1.5352, \tan^{-1}\left(\frac{1}{\sqrt{3}}\right) = \frac{\pi}{6}$

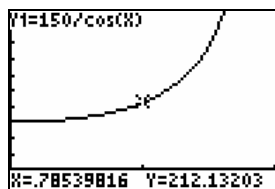
6. a) Window: $x \in [2\pi, 2\pi]$, $Xscl = \frac{\pi}{2}$,



b) $x \approx 0.446$

7. a) $d = 150 \sec x$ b) $\frac{300}{\sqrt{3}} \text{ m}$

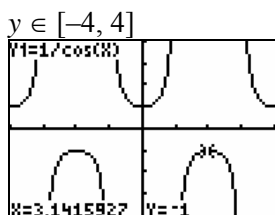
c) 173.2 m



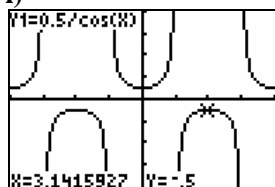
8. a) Answers may vary. Sample answer:

$$\sec^2 x = \csc^2 \left(x - \frac{\pi}{2} \right)$$

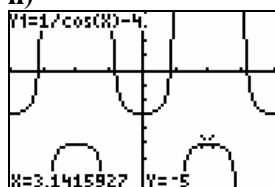
9. a) Window: $x \in [2\pi, 2\pi]$, Xscl = $\frac{\pi}{2}$,



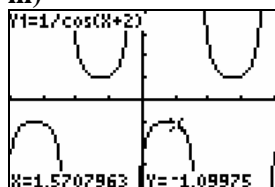
b) i)



ii)



iii)



iv)



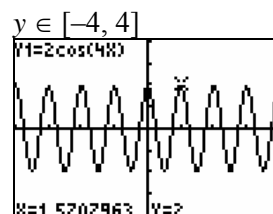
5.3 Sinusoidal Functions of the Form

$$f(x) = a \sin[k(x - d)] + c \text{ and}$$

$$f(x) = a \cos[k(x - d)] + c$$

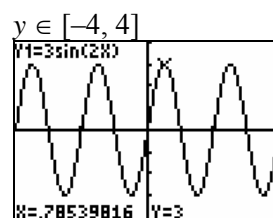
1. a) amplitude 2, period $\frac{\pi}{2}$

Window: $x \in [2\pi, 2\pi]$, Xscl = $\frac{\pi}{2}$,



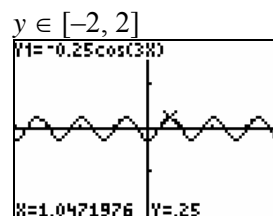
b) amplitude 3, period π

Window: $x \in [2\pi, 2\pi]$, Xscl = $\frac{\pi}{2}$,



c) amplitude $\frac{1}{4}$, period $\frac{2\pi}{3}$

Window: $x \in [2\pi, 2\pi]$, Xscl = $\frac{\pi}{2}$,



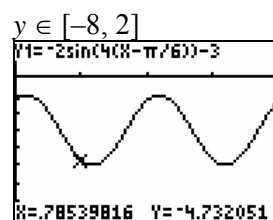
2. a) 2

b) $\frac{\pi}{2}$

c) $\frac{\pi}{6}$ rad to the right

d) 3 units downward

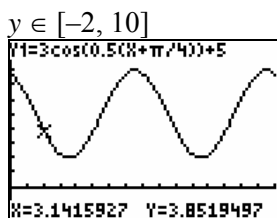
e) Window: $x \in [0, \pi]$, Xscl = $\frac{\pi}{4}$,



3. a) 3 b)
- 4π

c) $\frac{\pi}{4}$ rad to the left

d) 5 units upward

e) Window: $x \in [0, 8\pi]$, $Xscl = \frac{\pi}{2}$,

4. a) amplitude 1, period
- $\frac{2\pi}{3}$
- , phase shift

 $\frac{2\pi}{3}$ rad to the right, no vertical translationb) amplitude $\frac{1}{2}$, period π , phase shift $\frac{5\pi}{6}$ rad to the left, vertical translation 1 unit downwardc) amplitude 2, period 8π , phase shift $\frac{3\pi}{4}$ rad to the right, vertical translation 3.5 units upwardd) amplitude 4, period $\frac{2}{3}$, phase shift

2 rad to the right, vertical translation 2 units upward

5. a) amplitude 3, period
- 2π
- , phase shift

 $\frac{\pi}{3}$ rad to the right, vertical translation 2 units upwardb) amplitude $\frac{1}{4}$, period π , phase shift $\frac{5\pi}{4}$ rad to the left, no vertical translationc) amplitude 1, period $\frac{\pi}{2}$, phase shift $\frac{\pi}{6}$ rad to the right, vertical translation 3 units downward

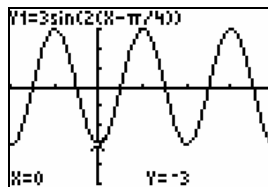
d) amplitude 1, period 1, phase shift 3 rad to the left, vertical translation 1 unit upward

6. a) amplitude 3, period
- π
- , phase shift

 $\frac{\pi}{4}$ rad to the right, no vertical translation

b) $y = 3 \sin \left[2 \left(x - \frac{\pi}{4} \right) \right]$

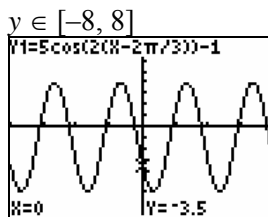
c)



d) Answers may vary. Sample answer:

$$y = 3 \cos \left[2 \left(x - \frac{\pi}{2} \right) \right]$$

7. a) $y = 5 \cos \left[2 \left(x - \frac{2\pi}{3} \right) \right] - 1$

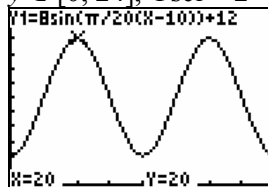
b) Window: $x \in [-2\pi, 2\pi]$, $Xscl = \frac{\pi}{2}$,

8. a) amplitude 8 m, period 40 s

b) 12 m upward

c) 10 m to the right

d) $y = 8 \sin \left[\frac{\pi}{20}(t - 10) \right] + 12$

e) Window: $x \in [0, 80]$, $Xscl = 10$, $y \in [0, 24]$, $Yscl = 2$ 

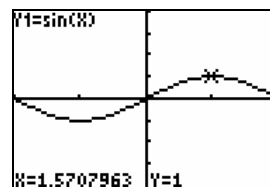
9. $y = a \sec[k(x-d)] + c$; a : multiply y -value by a ; k : changes the period to $\frac{2\pi}{k}$; d : phase shifts work the same as for sinusoidal functions; c : vertical translations work the same as for sinusoidal functions.

5.4 Solve Trigonometric Equations

1. a) 2.21, 4.07 b) no solutions
 c) 3.48, 5.94 d) 0.35, 3.49
 e) 1.16, 5.12
3. a) $\frac{3\pi}{4}, \frac{7\pi}{4}$ b) $\frac{\pi}{6}, \frac{5\pi}{6}$
 c) $\frac{5\pi}{6}, \frac{11\pi}{6}$ d) $\frac{\pi}{4}, \frac{7\pi}{4}$
 e) $\frac{5\pi}{6}, \frac{7\pi}{6}$
5. a) 0.52, 2.62, 3.66, 5.76
 b) 0.83, 2.31, 3.97, 5.45
 c) 0.80, 2.35, 3.94, 5.49
 d) 0.64, 2.50, 3.79, 5.64
 e) 0.69, 2.45, 3.83, 5.59
7. $\frac{\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$
8. 1.33, 1.71, 4.47, 4.85
9. $\frac{\pi}{3}$ or 1.05, 1.23, 5.05, $\frac{5\pi}{3}$ or 5.24
10. a) $\frac{\pi}{12}, \frac{5\pi}{12}$ b) $\frac{5\pi}{12}$
11. $\frac{\pi}{2}, \frac{3\pi}{2}$
12. exact solutions: $\frac{\pi}{8}, \frac{5\pi}{8}, \frac{9\pi}{8}, \frac{13\pi}{8}$
 approximate solutions: 0.39, 1.96, 3.53, 5.11
13. 0.73, 2.41
14. $\frac{\pi}{6}, \frac{5\pi}{6}, 3.48, 5.94$
15. 0.58, 2.29, 3.72, 5.43
17. a) $\left[0, \frac{\pi}{2}\right]$ b) 0.21, 1.37
18. $-\pi, -\frac{3\pi}{4}, -\frac{\pi}{4}, 0, \frac{\pi}{4}, \frac{3\pi}{4}, \pi, \frac{5\pi}{4}$

5.5 Making Connections and Instantaneous Rate of Change

1. a)



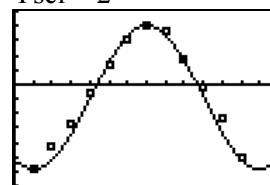
b) $-\frac{\pi}{2}, \frac{\pi}{2}$

c) maximum 0, minimum $-\pi$ or π

2. a) i) 0.542 ii) 0.529
 iii) 0.526 iv) 0.526
 b) 0.526 m/s c) no

3. a) $T = 9.85 \sin\left[\frac{\pi}{6}(m-4)\right] - 1.85$

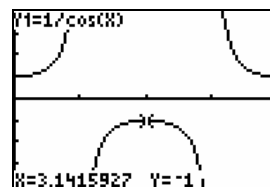
b) Window: $x \in [0, 14], y \in [-14, 10]$,
 $Y_{\text{scl}} = 2$



c) $T \approx 9.75 \sin[0.49(m-3.80)] - 1.97$
 d) phase shift

4. -4.4°C/day

5. a)

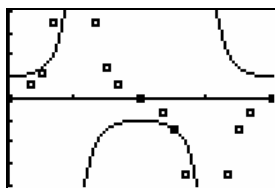


b) 0, π , 2π

c)

Angle x	$f(x) = \sec x$	Instantaneous Rate of Change
0	1	0
Error! Bookmark not defined. $\frac{\pi}{6}$	1.15	0.67
$\frac{\pi}{4}$	1.41	1.41
$\frac{\pi}{3}$	2	3.46
$\frac{\pi}{2}$	undefined	undefined
$\frac{2\pi}{3}$	-2	3.46
$\frac{3\pi}{4}$	-1.41	1.41
$\frac{5\pi}{6}$	-1.15	0.67
π	-1	0
$\frac{7\pi}{6}$	-1.15	-0.67
$\frac{5\pi}{4}$	-1.41	-1.41
$\frac{4\pi}{3}$	-2	-3.46
$\frac{3\pi}{2}$	undefined	undefined
$\frac{5\pi}{3}$	2	-3.46
$\frac{7\pi}{4}$	1.41	-1.41
$\frac{11\pi}{6}$	1.15	-0.67
2π	1	0

d)



e) Answers may vary.

Chapter 5 Review

1. a) 4 b) -5

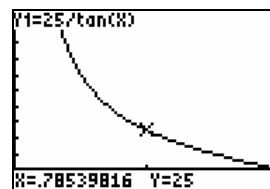
2. $y = \tan\left[2\left(x - \frac{\pi}{4}\right)\right]$

3. a) $\frac{23\pi}{12}$ b) $\frac{24}{23}$

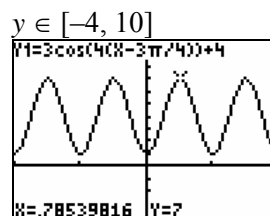
4. 1.74, 4.54

5. a) $d = 25 \cot x$

b)

c) as $x \rightarrow 0$, distance $\rightarrow \infty$; as $x \rightarrow \frac{\pi}{2}$, distance $\rightarrow 0$ 6. a) amplitude 4, period π , 2.5 rad to the left, no vertical translationb) amplitude 0.25, period $\frac{2\pi}{3}$, $\frac{3\pi}{4}$ rad to the left, vertical translation 5 units downwardc) amplitude 1, period 4π , $\frac{2\pi}{3}$ rad to the right, vertical translation 3.5 units upward

7. a) $y = 3 \cos\left[4\left(x - \frac{3\pi}{4}\right)\right] + 4$

b) Window: $x \in [-\pi, \pi]$, Xscl = $\frac{\pi}{2}$,8. a) i) 0.93, 2.21 ii) 0.64, 3.79
 iii) 1.82, 4.46 iv) 4.07, 5.36

9. a) 1.13, 2.01, 4.27, 5.16

b) 0.98, 2.16, 4.12, 5.30

c) 0.68, 2.47, 3.82, 5.61

d) 0.41, 2.73, 3.55, 5.87

10. $0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}, 2\pi$ 11. $0.41, \frac{\pi}{6}, \frac{5\pi}{6}, 2.73$

12. a) 1.6 s, 4.7 s, 7.9 s

b) maximum 3.1 s, minima 0 s and 6.3 s

Chapter 5 Test

1. C

2. B

3. D

4. D

5. B

6. a) The secant function is the reciprocal of the cosine function and \cos^{-1} is the opposite operation of cosine.

b) $\sec \frac{1}{\sqrt{2}} \approx 1.3154, \cos^{-1}x\left(\frac{1}{\sqrt{2}}\right) = \frac{\pi}{4}$

7. $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}$

8. a) 3 b) π

c) $\frac{5\pi}{6}$ rad to the right

d) 4.75 units down

e) Window: $x \in [-\pi, \pi]$, $Xscl = \frac{\pi}{2}$,

