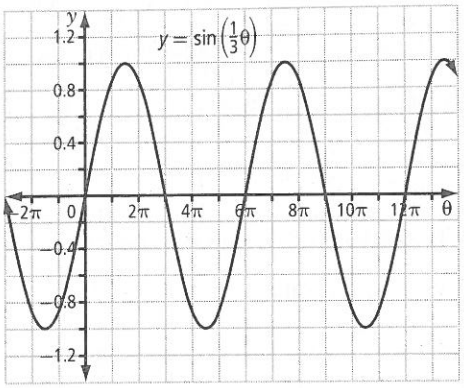
Chapter 4 Review, pages 145–147

1. a) $\frac{3\pi}{2}$ b) 300°
   c) $\frac{5\pi}{3}$ d) $\frac{-720°}{\pi}$
   e) $\frac{11\pi}{4}$ f) 585°
2. Examples:
   a) $\frac{23\pi}{6}, -\frac{\pi}{6}$,
   general form: $\frac{11\pi}{6} \pm 2\pi n, n \in \mathrm{N}$
   b) 345°, −735°,
   general form: $-375° \pm (360°)n, n \in \mathrm{N}$
3. a) 6.3 b) 28.6°
4. $-\frac{\sqrt{5}}{3}$
5. a) $\frac{\pi}{3}$ b) $\frac{7\pi}{4}$
6. 56°, 304°, 416°, 664°
7. a) $-\sqrt{3}$ b) $-\frac{2}{\sqrt{3}}$
8. $\theta_1 \approx 128.7° + 360°n, n \in \mathrm{I}$;
   $\theta_2 \approx 231.3° + 360°n, n \in \mathrm{I}$
9. $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{2}$

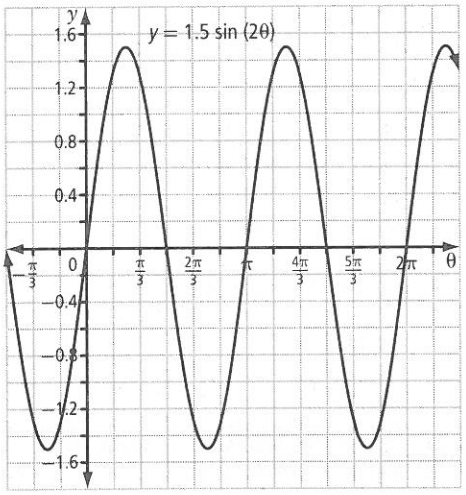
Chapter 5

5.1 Graphing Sine and Cosine Functions, pages 149–157

1. a) 2 b) $\frac{1}{4}$
   c) 5 d) 3
2. a) 360°, 2π b) 180°, π
   c) 1440°, 8π d) 240°, $\frac{4\pi}{3}$
3. a) 2π; $\frac{1}{2}$ b) $\frac{2\pi}{3}$; 1
   c) $\frac{\pi}{2}$; 2 d) 6π; 1.5
4. a) For $y = \sin\theta$:
   amplitude: 1; maximum value: 1; minimum value: −1; period: 2π; θ-intercepts: $\pi n, n \in \mathrm{I}$; y-intercept: 0
   For $y = \sin\left(\frac{1}{3}\theta\right)$:
   amplitude: 1; maximum value: 1; minimum value: −1; period: 6π; θ-intercepts: $3\pi n$, $n \in \mathrm{I}$; y-intercept: 0

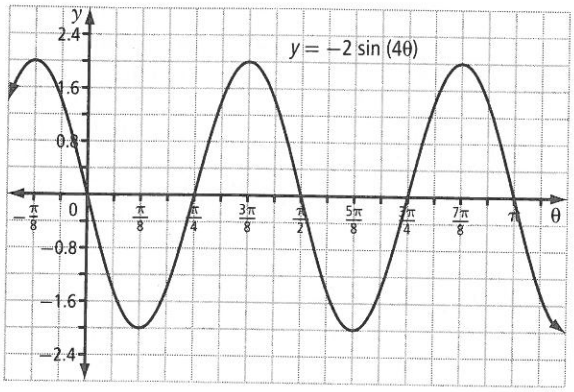


   b) For $y = \sin\theta$:
   amplitude: 1; maximum value: 1; minimum value: −1; period: 2π; θ-intercepts: $\pi n, n \in \mathrm{I}$; y-intercept: 0
   For $y = 1.5\sin(2\theta)$:
   amplitude: 1.5; maximum value: 1.5; minimum value: −1.5; period: π; θ-intercepts: $\frac{\pi}{2}n, n \in \mathrm{I}$; y-intercept: 0

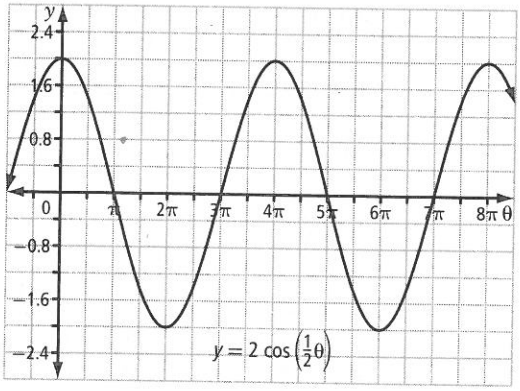


c) For $y = \sin \theta$:
amplitude: 1; maximum value: 1; minimum value: -1; period: 2π; θ-intercepts: πn, $n \in I$; y-intercept: 0

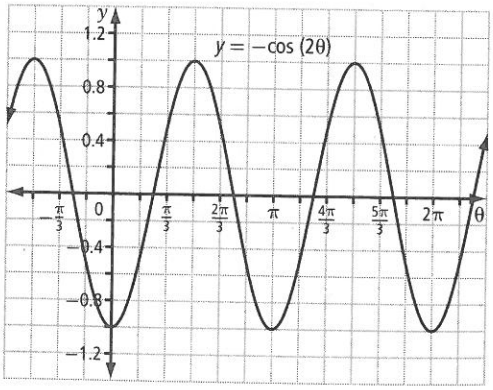
For $y = y = -2 \sin (4\theta)$:
amplitude: 2; reflected in x-axis; maximum value: 2; minimum value: -2; period: $\frac{\pi}{2}$; θ-intercepts: $\frac{\pi}{4}n$, $n \in I$; y-intercept: 0



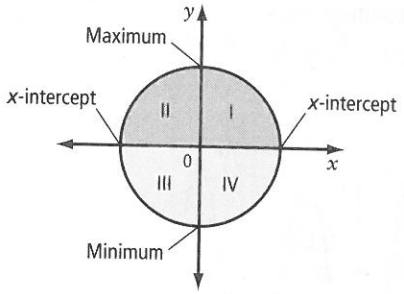
5. a) amplitude: 2; maximum value: 2; minimum value: -2; period: 4π; θ-intercepts: $\pi + 2\pi n$, $n \in I$; y-intercept: 2



b) amplitude: 1; reflected in the x-axis; maximum value: 1; minimum value: -1; period: π; θ-intercepts: $\frac{\pi}{4} + \frac{\pi}{2}n$, $n \in I$; y-intercept: -1



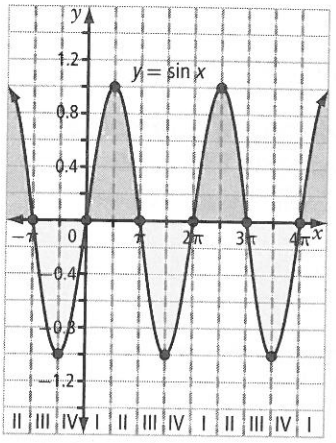
6. $y = \sin x$:



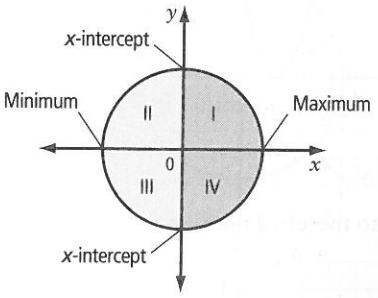
maximum values: $\frac{\pi}{2}, \frac{5\pi}{2}$

minimum values: $-\frac{\pi}{2}, \frac{3\pi}{2}, \frac{7\pi}{2}$

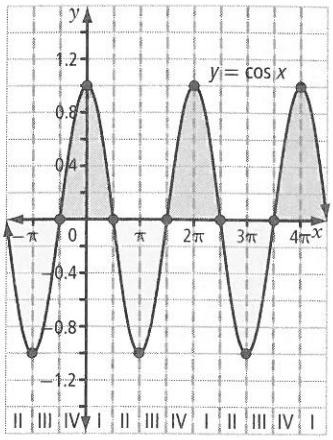
x-intercepts: $-\pi, 0, \pi, 2\pi, 3\pi, 4\pi$



$y = \cos x$:

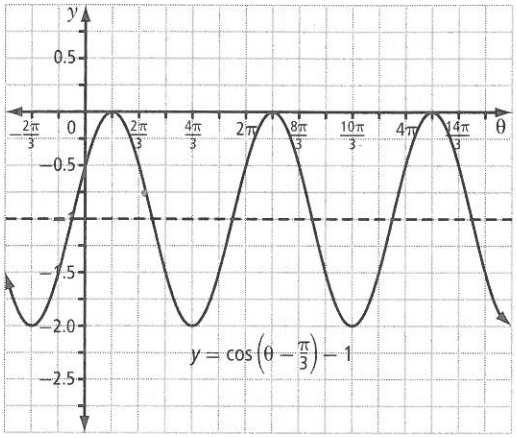


maximum values: $0, 2\pi, 4\pi$
minimum values: $-\pi, \pi, 3\pi$
x-intercepts: $-\frac{\pi}{2}, \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2}$

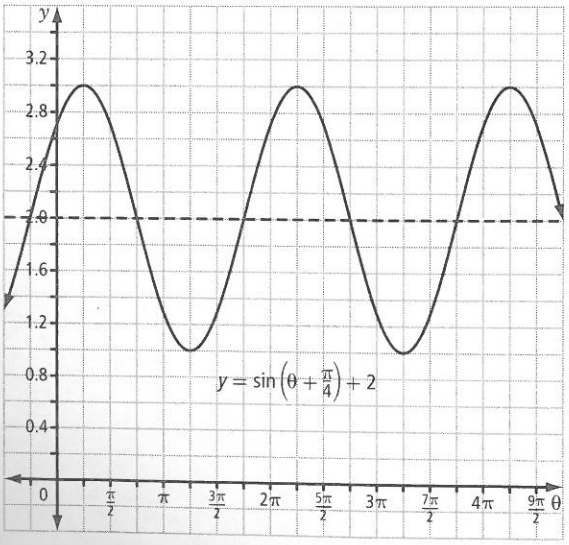


5.2 Transformations of Sinusoidal Functions, pages 158–166

1. a) $\frac{\pi}{3}$ units to the right; 1 unit down



b) $\frac{\pi}{4}$ units to the left; 2 units up



2. a) amplitude: 5; period: 720°; phase shift: 90° to the right; vertical displacement: 15 units up; domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid 10 \le y \le 20, y \in \mathrm{R}\}$

b) amplitude: 0.1; period: 180°; phase shift: 45° to the left; vertical displacement: 1 unit down; domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid -1.1 \le y \le -0.9, y \in \mathrm{R}\}$

c) amplitude: 1; period: π; phase shift: $\frac{\pi}{12}$ units to the right; vertical displacement: 0.5 units up; domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid -0.5 \le y \le 1.5, y \in \mathrm{R}\}$

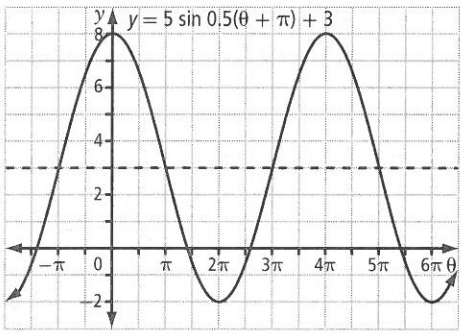
d) amplitude: 1.5; period: 4π; phase shift: $\frac{\pi}{2}$ units to the left; vertical displacement: 1 unit down; domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid -2.5 \le y \le 0.5, y \in \mathrm{R}\}$

3. a) $y = 2 \sin 2\left(x + \frac{\pi}{3}\right) - 1$

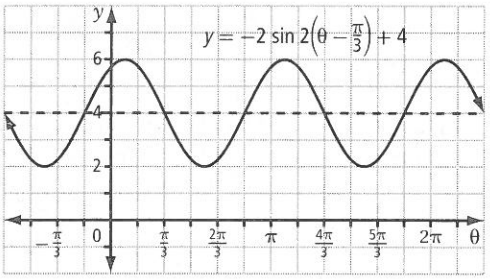
b) $y = \frac{1}{4} \sin \frac{1}{3}(x + \pi) + 2$

c) $y = 4 \sin \frac{2}{3}(x - 60°)$

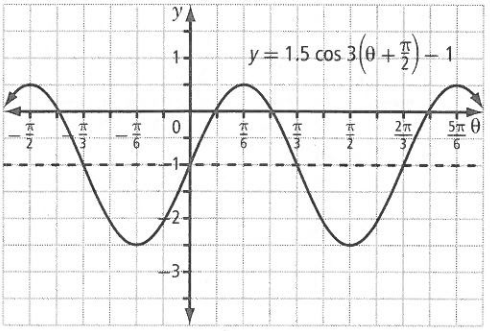
4. a)



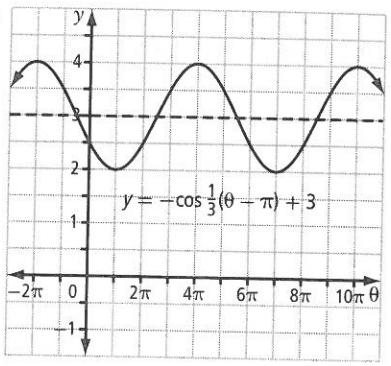
b)



c)



d)



5. Example: $y = -4 \sin(0.5\theta) + 1$;
$y = 4 \sin(0.5\theta - 2\pi) + 1$

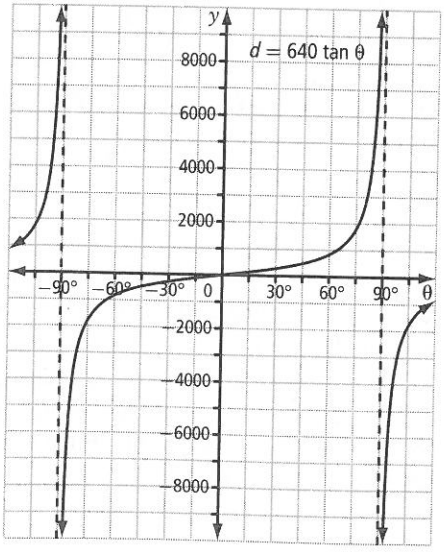
6. Example: $y = 2.2 \cos\left(2\left(\theta - \frac{\pi}{6}\right)\right) - 1.8$;
$y = 2.2 \cos\left(2\left(\theta + \frac{7\pi}{6}\right)\right) - 1.8$

7. Example: $y = 3 \sin\left(3\left(\theta - \frac{\pi}{6}\right)\right) + 2$;
$y = -3 \cos(3\theta) + 2$

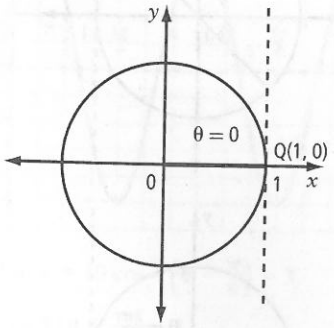
8. Examples:
   a) $a = 3, b = 2, c = \frac{\pi}{2}, d = 2$
   b) $a = -3, b = 2, c = 0, d = 2$
   c) $a = 3, b = 2, c = -\frac{\pi}{4}, d = 2$

5.3 The Tangent Function, pages 167–174

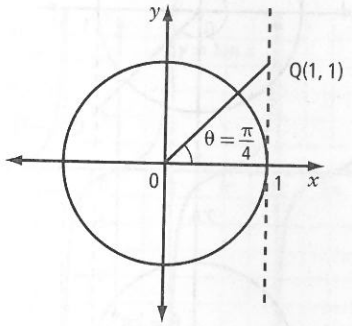
1. **a)** 0 **b)** undefined **c)** 1 **d)** −1
2. **a)** 0 **b)** 0 **c)** 0
3. **a)** 1 **b)** 1 **c)** 1
4. **a)** $n\pi, n \in I$ **b)** $\frac{\pi}{4} + n\pi, n \in 1$
5. **a)** 0.70 **b)** 0.70 **c)** −0.70
6. **a)** $d = 640 \tan\theta$
   b) Example:
   domain: $\{\theta \mid -90° < \theta < 90°, \theta \in R\}$;
   range: $\{d \mid -8000 \le d \le 8000, d \in R\}$



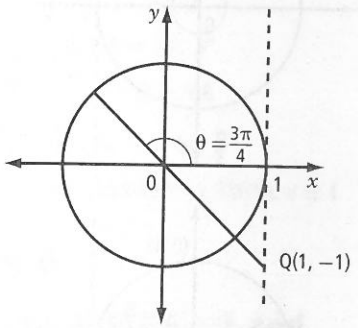
7. **a)** $s = 10 \tan\theta, -75° \le \theta \le 75°$
   b) Example: the sun passes directly overhead with no tilt; it is a sunny day
   c) 10 cm **d)** 17.3 cm
8. **a)** **A**



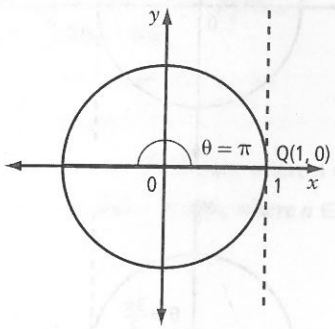
B



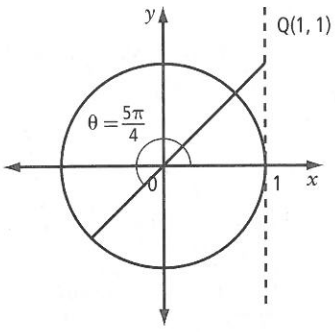
C



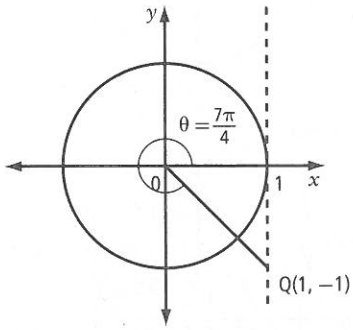
D



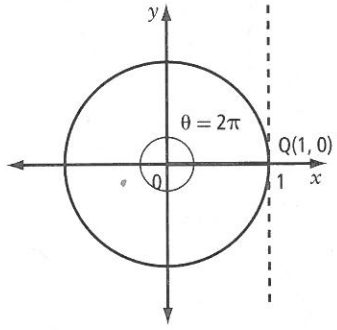
E



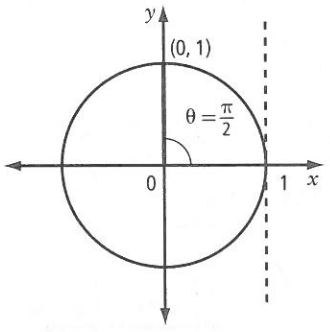
F



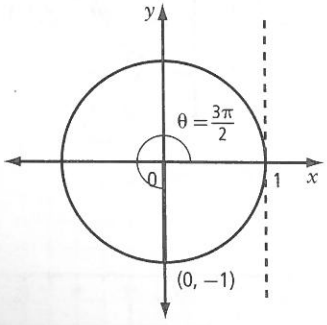
G



b) i)

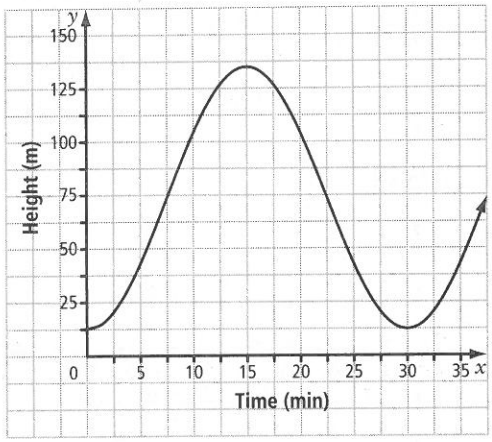


ii)



5.4 Equations and Graphs of Trigonometric Functions, pages 175–182

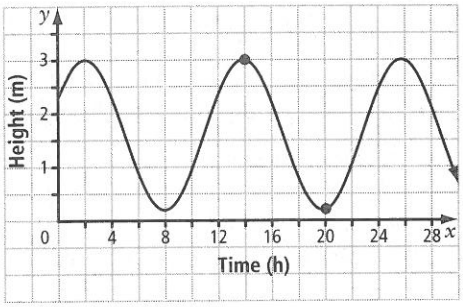
1. a) $x = \frac{\pi}{12}, \frac{5\pi}{12}, \frac{7\pi}{12}, \frac{11\pi}{12}$ b) $x = \frac{\pi}{4} + \frac{\pi}{2}n, n \in \mathrm{I}$
2. Examples:
   a) $t \approx 0.0008, 0.0075, 0.0175, 0.0242$
   b) $t \approx 0.0104, 0.0146, 0.0269$
   c) $t = \frac{n}{120}, n \in \mathrm{I}$
3. a) $\frac{1}{440}$ s b) $y = \sin(880\pi x)$
   c) $y = \sin(523.26\pi x)$ or $y \approx \sin(1643.87x)$
4. a) $y = 168 \sin(120\pi x)$
   b) $y = 308 \sin(100\pi x)$
5. a)



Example: I assume that the ride does not stop to let on passengers, and that the wheel is vertical (perpendicular to the ground).

b) $y = -61 \cos\left(\frac{\pi}{15}x\right) + 74$;
domain: $\{x \mid 0 \le x \le 30, x \in \mathrm{R}\}$ unless the passenger goes around more than once

6. a)



Example: assume that the amplitude of the tide is equal each occurrence, and that the tide comes in every 12 h exactly.

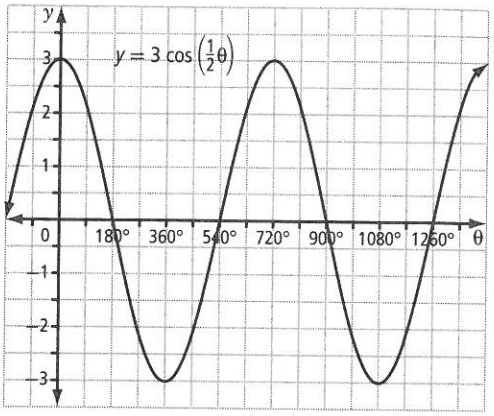
b) $y = 1.4 \sin\left(\frac{\pi}{6}(x + 1)\right) + 1.6$; The domain should be restricted to some reasonable amount of time such that the assumptions made in part a) are roughly correct.

7. $y = -18.6 \cos\left(\frac{\pi}{6}(x - 1)\right) + 0.3$

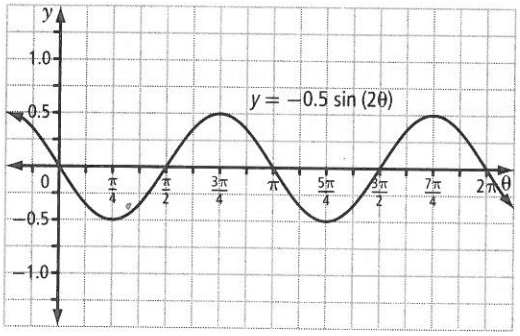
8. Examples: precipitation, ocean tides, temperatures, hours of daylight

Chapter 5 Review, pages 183–186

1. amplitude: 3; period: 720°



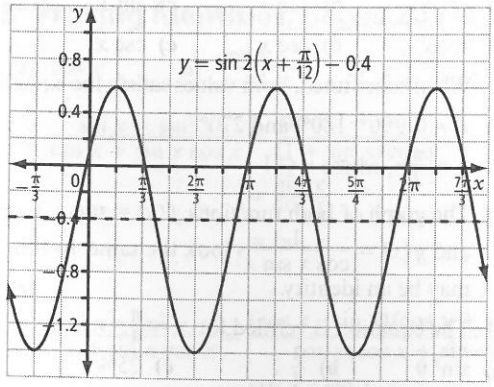
2. amplitude: 0.5; period: π



3. a) amplitude: 2; period: 120° or $\frac{2\pi}{3}$
   b) amplitude: $\frac{1}{3}$; period: 360° or 2π
   c) amplitude: $\frac{3}{4}$; period: 180° or π
   d) amplitude: 4; period: 540° or 3π

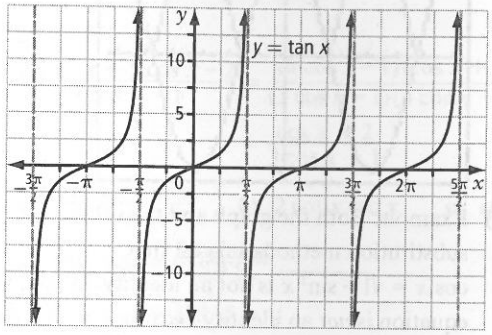
4. a) amplitude: 5; period: 8π; phase shift: $\frac{\pi}{3}$ units to the left; vertical displacement: 1 unit down
   b) amplitude: $\frac{1}{2}$; period: π; phase shift: π units to the right; vertical displacement: 3 units down
   c) amplitude: 3; period: 90°; phase shift: 50° to the left; vertical displacement: 6 units up

5.



6. Examples: $y = 10 \cos 4\left(\theta - \frac{\pi}{4}\right) - 3$,
   $y = 10 \cos 4\left(\theta + \frac{\pi}{4}\right) - 3$

7.



8. a) $\tan\theta = 0.58$; $\theta \approx 30.1°$
   b) $\tan\theta = -0.8$; $\theta \approx 141.3°$

9. $y = -7.7 \cos\frac{\pi}{6}(x - 1) + 9.6$

10. a) $0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}, 2\pi$ b) $\frac{\pi}{2}$
    c) $15° + 180°n$ and $135° + 180°n$, $n \in I$

Chapter 6

6.1 Reciprocal, Quotient, and Pythagorean Identities, pages 188–196

1. a) $x \neq \frac{\pi}{2} + \pi n$, where $n \in I$
   b) $x \neq \frac{\pi}{2} n$, where $n \in I$
   c) $x \neq \pi n$ and $x \neq \frac{3\pi}{2} + 2\pi n$, where $n \in I$
   d) $x \neq \frac{\pi}{2} + \pi n$ and $x \neq 2\pi n$, where $n \in I$