Chapter P Prerequisites

■ Quiz Sections P.1 to P.4

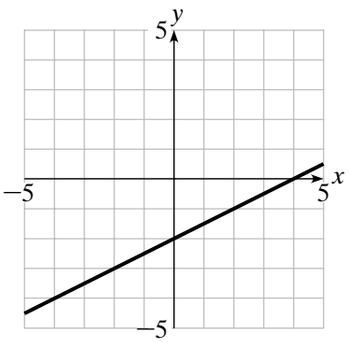
1. $[-2, 3)$

2. $x = 4$

3. $\sqrt{130} \approx 11.4$

4. A

5.



6. $\left[\frac{2}{3}, \infty\right)$

7. E

8. $y = \frac{1}{5}x - 5$

9. $\left(-\frac{3}{2}, 4\right), \left(\frac{3}{2}, 1\right), (2, 3)$

10. $\left[-\frac{25}{2}, \frac{23}{2}\right]$

■ Quiz Sections P.5 to P.7

1. C

2. $x = -5, x = \frac{3}{2}$

3. $(-3, 2)$

4. D

5. $(-\infty, -9) \cup (7, \infty)$

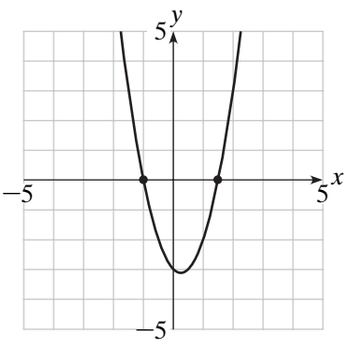
6. $x = -7 - 2\sqrt{10}$ and $x = -7 + 2\sqrt{10}$

7. $\frac{17}{2} - \frac{7}{2}i$

8. $(-1, 3)$

9. $x \geq 0$ or $x = -1$

10.



■ Chapter Test Form A

1. Distributive property of multiplication over addition.

2.

x	y
-2	-9
3	1
-1	-7
4	3

3. 3 years

4. $\frac{16}{25} + \frac{37}{25}i$

5. D

6. $y - 4 = 2(x - 3)$

7. $y = \frac{7}{2}x - 7$

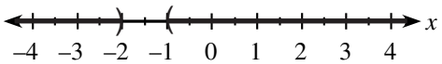
8. $(x - 2)^2 + (y + 6)^2 = 81$

9. $x = \frac{1}{4}$ or $x = \frac{11}{4}$

10. $x = -0.5, x \approx -0.37$, or $x \approx 1.37$

11. D

12. $(-\infty, -2) \cup (-1, \infty)$



13. $\frac{2 \pm i\sqrt{26}}{6}$

14. $[-2, 3]$

15. $x = 4 + \sqrt{11}$ or $x = 4 - \sqrt{11}$

16. 9 seconds through 11 seconds

■ Chapter Test Form B

1. Commutative property of addition

2.

x	y
-2	8
3	-7
2	-4
-1	5

3. 4 years

4. $\frac{7}{10} - \frac{8}{5}i$

5. C

6. $y - 3 = -4(x - 1)$

7. $y = \frac{5}{3}x - 5$

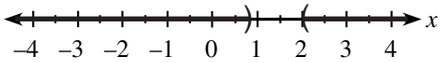
8. $(x + 3)^2 + (y - 4)^2 = 49$

9. $x = -2$ or $x = \frac{4}{5}$

10. $x \approx -1.62, x \approx 0.33$, or $x \approx 0.62$

11. D

12. $\left(-\infty, \frac{2}{3}\right] \cup [2, \infty)$;



13. $\frac{-3 \pm i\sqrt{19}}{4}$

14. $[-4, 1]$

15. $x = \frac{9}{2} - \frac{1}{2}\sqrt{65}$, $x = \frac{9}{2} + \frac{1}{2}\sqrt{65}$

16. 6 seconds through 16 seconds

Chapter 1
Functions and Graphs

Quiz Sections 1.1 to 1.3

1. $[5, \infty]$

2. $[8, \infty]$

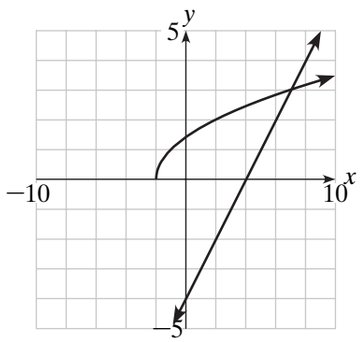
3. $(-3, -5)$

4. Answers will vary. One answer is $y = \frac{1}{x}$; discontinuous at $x = 0$.

5. 180,000 sq. ft.

6. $x = 2.8$, $x = -2.9$

7. Solution: $x = 7$
Extraneous solution: $x = 2$



8. **(a)** $0, -\sqrt{2}, \sqrt{2}$
(b) increasing on $(-1, 0)$ and $(1, \infty)$

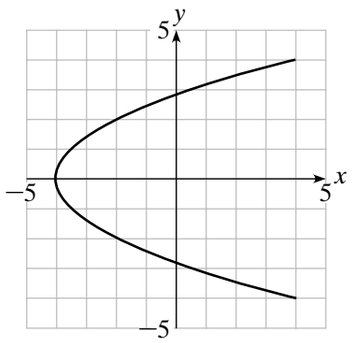
9. C

10. E

Quiz Sections 1.4 to 1.7

1. B

2.



3. Horizontal shrink of factor $\frac{1}{2}$.

4. $g(x) = -2x^3 - 3x^2 - 5x + 6$

5. $y = -4x^2 + 5$

6. $f^{-1}(x) = \frac{x + 5}{3x - 6}$

7. $y = -x + 2$ and $y = x - 2$
Domain: $x \leq 2$

8. 22%

9. $0.12x + 0.20(20) = 0.15(x + 20)$; $33\frac{1}{3}$ gallons

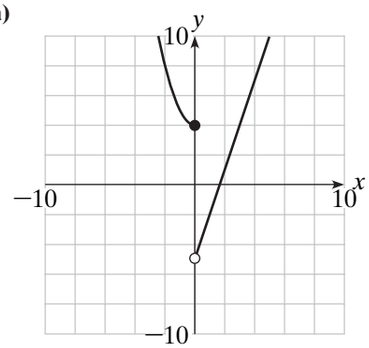
10. **(a)** $A = 1.23x$
(b) 37.40

Chapter Test Form A

1. C

2. Vertical: $x = 5$, $x = -2$; Horizontal: $y = 0$

3. **(a)**

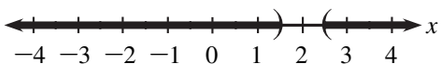


(b) Not continuous; a jump occurs at $x = 0$.

4. $x = 2$, $x = -5$

5. 57 mph

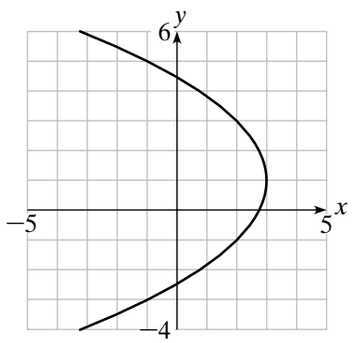
6. $\left(-\infty, \frac{3}{2}\right) \cup \left(\frac{5}{2}, \infty\right)$



7. $f(g(x)) = \dfrac{12}{x^2} - 5$; domain: $\{x | x \neq 0\}$

8. $V = 13{,}500\,\pi\ - 5t$

9.



10. Shift the graph of $y = x^2$ one unit to the left, then stretch vertically by a factor of 4.

11. $y = x^2$, $y = \cos(x)$, $y = |x|$

12. $x = t$, $y = -16t^2 + 60t + 3$
Max. ht. = 59.25 ft
Time = 1.88 sec

13. Min at $x \approx 2.59$
Max at $x \approx -0.26$

14. **(a)** f passes the horizontal and vertical line tests and hence is one-to-one.
(b) $f^{-1}(x) = 2 - x^2$, domain of $f^{-1}(x)$: $[0, \infty)$

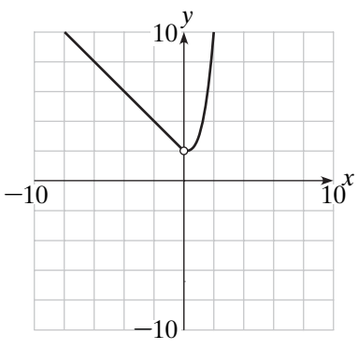
15. Upper: $y = 3$; Lower: $y = 1$

■ Chapter Test Form B

1. B

2. Vertical: $x = -\dfrac{1}{2}$, $x = 6$; Horizontal: $y = 0$

3. **(a)**

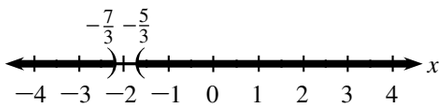


(b) Discontinuous, hole at $x = 0$

4. $x = 3$, $x = -4$

5. 34 mph

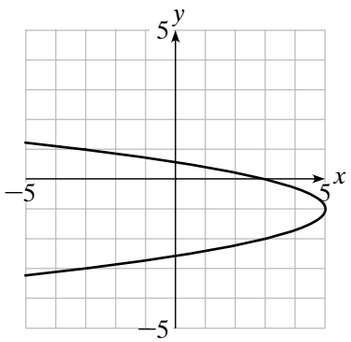
6. $\left(-\infty, -\dfrac{7}{3}\right) \cup \left(-\dfrac{5}{3}, \infty\right)$



7. $f \circ g = -\dfrac{5x^2}{4}$; Domain: $(-\infty, \infty)$

8. $V(t) = 6{,}250\pi - 4t$

9.



10. Shift the graph of $y = x^2$ one unit to the right, then stretch vertically by a factor of 5.

11. $y = x$, $y = x^3$, $y = \dfrac{1}{x}$, $y = \sin(x)$, $y = \tan(x)$

12. $x = t$, $y = -16t^2 + 65t + 4$
Max. ht. = 70.02 ft
Time = 2.03 sec

13. Min at $x = 2$
Max at $x = -0.33$

14. **(a)** f passes the horizontal and vertical line tests and hence is one-to-one.
(b) $f^{-1}(x) = x^2 + 5$, Domain of $f^{-1}(x)$: $[0, \infty)$

15. Upper: $y = 1$
Lower: $y = -2$

Chapter 2
Polynomial, Power, and Rational Functions

■ Quiz Sections 2.1 to 2.4

1. $y = 4x^2 - 24x + 34$

2. B

3. $f(x) \to \underline{\infty}$ as $x \to -\infty$;
$f(x) \to \underline{-\infty}$ as $x \to \infty$

4. 28

5. D

6. $5x - 1$

7. $3x^2 - 8x + 21 - \dfrac{45}{x + 2}$

8. $V = -3{,}000t + 45{,}000$

9. Maximum height: 81 ft
Time: 2.25 sec

10. **(a)** $R(x) = -25x^2 + 1{,}900x + 60{,}000$
(b) \$1,550 rent per month
(c) \$96,100

■ Quiz Sections 2.5 to 2.8

1. D

2. $-\frac{5}{2}, -1, 4$

3. $-1, 2, i, -i$

4. $(x-1)\left(x+\frac{1}{2}-\frac{3\sqrt{3}}{2}i\right)\left(x+\frac{1}{2}+\frac{3\sqrt{3}}{2}i\right)$

5. D

6. $(-\infty, -5]$

7. Root: $\frac{-15}{4}$

Extraneous root: 2

8. $f(x) = x^2 - 6x + 13$

9. $(-\infty, -1) \cup \left[-\frac{2}{3}, 0\right)$

10. y-intercept: $\frac{5}{2}$; vertical asymptote: $x = -2$; slant asymptote: $y = x - 5$

■ Chapter Test Form A

1. Quotient: $x^2 + x + 7$;
Remainder: 19

2. 2 **3.** \$1,600

4. D

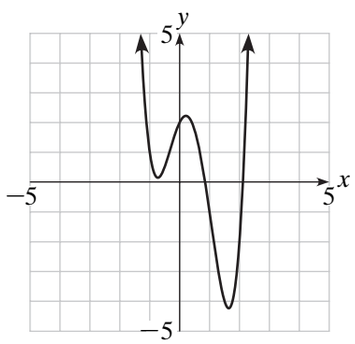
5. Zeros: $3, -1 \pm \sqrt{6}\,i$;
$f(x) = (x-3)(x+1-\sqrt{6}\,i)(x+1+\sqrt{6}\,i)$

6. 128

7. $y = x^2 - 6x + 5$

8. 10 in. $\times$ 14 in.

9. Possible answer: (see graph)

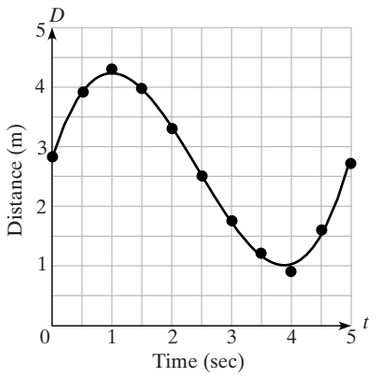


10. $-\infty; -\infty$

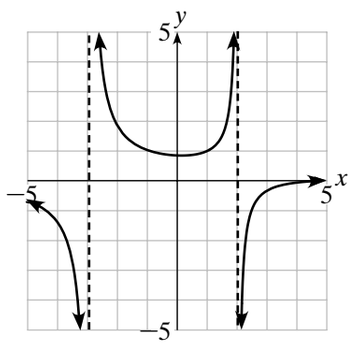
11. Horizontal: $y = 3$
Vertical: $x = 3$ and $x = 4$

12. $(-\infty, 2) \cup (2, 6]$

13. $D = 0.266t^3 - 1.955t^2 + 3.118t + 2.811$



14. Asymptotes:
$x = -3$, $x = 2$,
$y = 0$;
Intercepts:
$(5, 0)$, $\left(0, \frac{5}{6}\right)$



15. Translate 2 units left, stretch vertically by a factor of 4, and translate 3 units down. The order may be changed provided the vertical stretch precedes the vertical translation.

16. $(-2, 0) \cup [5, \infty)$

■ Chapter Test Form B

1. Quotient: $x^2 + 5x + 2$;
Remainder: 11

2. 18 **3.** \$1,130

4. C

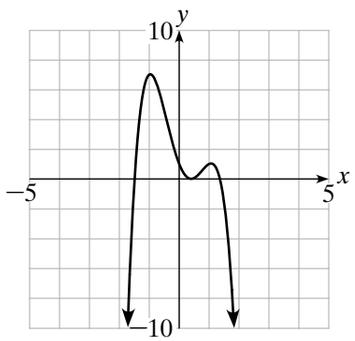
5. Zeros: $-2, -1 \pm \sqrt{10}\,i$.
$f(x) = (x-2)(x+1-\sqrt{10}\,i)(x+1+\sqrt{10}\,i)$

6. -106

7. $y = x^2 - 6x + 2$

8. 24 ft. $\times$ 32 ft.

9. Possible answer: (see graph)



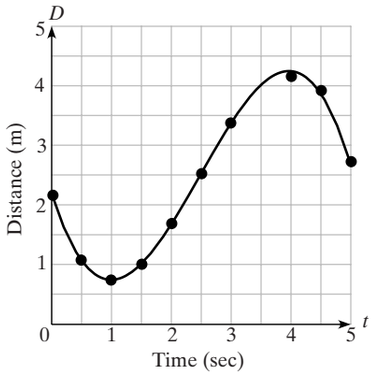
10. $\infty; -\infty$

11. Horizontal: $y = \frac{5}{2}$

Vertical: $x = 4$ and $x = \frac{3}{2}$

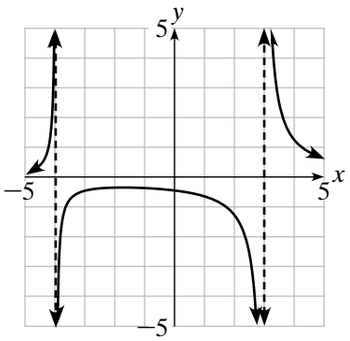
12. $[4, \infty)$

13. $D = -0.266t^3 + 1.990t^2 - 3.193t + 2.206$



14. Asymptotes: $x = -4$, $x = 3$, $y = 0$;

Intercepts: $(-6, 0)$, $\left(0, -\frac{1}{2}\right)$



15. Translate 4 units right, stretch vertically by a factor of 2, and translate 5 units up. The order may be changed provided the vertical stretch precedes the vertical translation.

16. $(-\infty, -3) \cup (0, 4]$

Chapter 3 Exponential, Logistic, and Logarithmic Functions

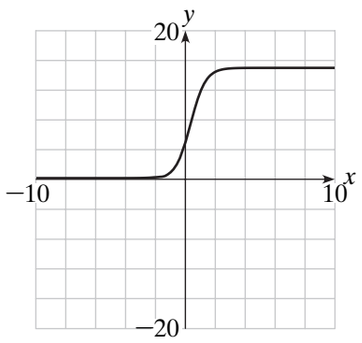
■ Quiz Sections 3.1 to 3.4

1. $g(x) \to$ ∞ as $x \to -\infty$; $g(x) \to$ 0 as $x \to \infty$

2. E

3. 13.81 years

4.



5. $\log_3 9 = x$

6. $f^{-1}(x) = \ln x - 2$

7. Vertical stretch by a factor of 5 to obtain $y = 5 \ln x$, horizontal shift 1 unit right to obtain $y = 5 \ln (x - 1)$, vertical shift 3 units up to obtain $y = 5 \ln (x - 1) + 3$.

8. C

9. $x = \sqrt[3]{5}$

10. 1.64

■ Quiz Sections 3.5 to 3.6

1. A

2. $x = 2$; Extraneous $x = -4$

3. B

4. $x = -1.45, 0$

5. 42.58 minutes

6. $8346.05

7. 6.18%

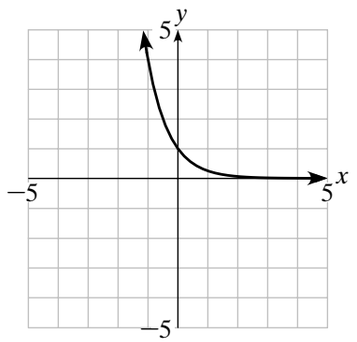
8. $28,649.40

9. 3.32 years

10. $874.02

■ Chapter Test Form A

1.



2. **(a)** 3 **(b)** 9

3. About 53 days

4. Equation: $y = -0.50 + 5.69 \ln x$; y-value: 14.91

5. $f(g(x)) = f(e^{4x}) = \frac{1}{4}\ln(e^{4x}) = \frac{1}{4}(4x) = x$

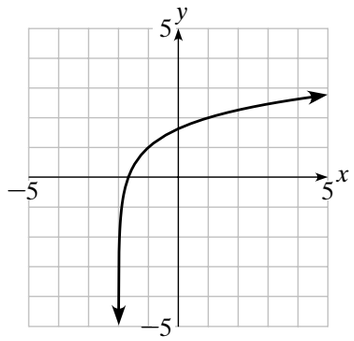
$g(f(x)) = g\left(\frac{1}{4}\ln x\right) = e^{4(1/4\ln x)} = e^{\ln x} = x$

6. **(a)** $y = 0$, $y = 5$

(b) Domain $(-\infty, \infty)$ Range $(0, 5)$

(c) $\lim_{x\to\infty} f(x) = 5$ $\lim_{x\to-\infty} f(x) = 0$

7. Translate 2 units left and 1 unit up (in either order).



8. $x = e^{-4/3} \approx 0.26$

9. Solution: $x = 7$; Extraneous: $x = 0$; $x = 0$ is extraneous because $\log(0 - 5)$ and $\log(0 - 2)$ are undefined.

10. $x = \frac{5}{3}$

11. About 36.81 min

12. A

13. $23,369.26

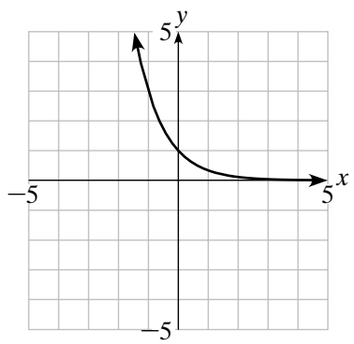
14. $3,853.73

15. $115,510.22

16. D

■ Chapter Test Form B

1.



2. **(a)** 4 **(b)** 5

3. About 40 days

4. Equation: $y = -1.42 + 5.10 \ln x$; y-value: 13.32

5. $f(g(x)) = f(e^{5x}) = \frac{1}{5}\ln(e^{5x}) = \frac{1}{5}(5x) = x$

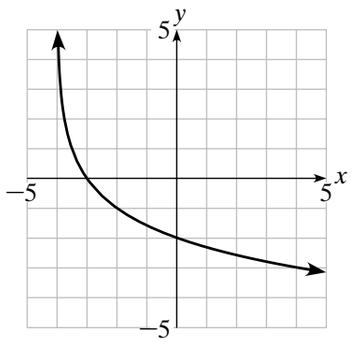
$g(f(x)) = g\left(\frac{1}{5}\ln x\right) = e^{5(1/5\ln x)} = e^{\ln x} = x$

6. **(a)** $y = 0$, $y = 6$

(b) Domain: $(-\infty, \infty)$

(c) $\lim_{x\to\infty} f(x) = 6$, $\lim_{x\to-\infty} f(x) = 0$

7. Translate 4 units left and reflect across the x-axis (in either order).



8. $x = 10^{-3/4} \approx 0.18$

9. Solution: $x = 5$; Extraneous: $x = -6$; $x = -6$ is extraneous because $\log(-6 - 4)$ and $\log(-6 + 5)$ are undefined.

10. $x = 2$

11. About 65.03 minutes

12. D

13. $32,925.80

14. $4,492.38

15. $366,148.70

16. C

Chapter 4 Trigonometric Functions

■ Quiz Sections 4.1 to 4.4

1. $\sin\theta = \frac{5\sqrt{34}}{34}$, $\cos\theta = -\frac{3\sqrt{34}}{34}$, $\tan\theta = -\frac{5}{3}$,

$\csc\theta = \frac{\sqrt{34}}{5}$, $\sec\theta = -\frac{\sqrt{34}}{3}$, $\cot\theta = -\frac{3}{5}$

2. A

3. $\frac{-2\sqrt{21}}{21}$

4. 1.73 yards

5. 0.6248

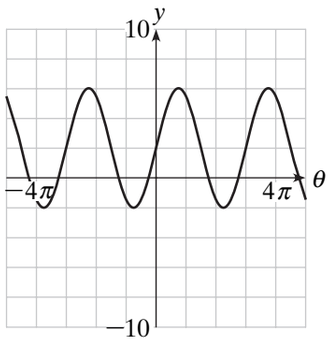
6. $\frac{\pi}{3}$

7. B

8. 2

9. 57.98°

10.

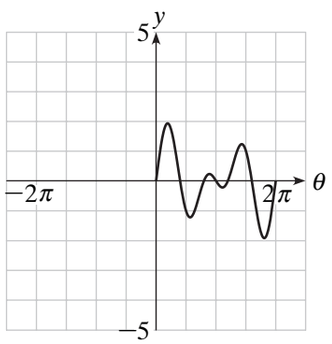


■ Quiz Sections 4.5 to 4.8

1. $\frac{\pi}{2}$

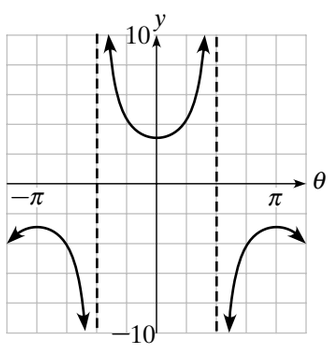
2. B

3.



4. Domain: $(-\infty, \infty)$
Range: $[0, 1]$
Period: π

5.



6. 3.61

7. A

8. 109.19 feet

9. 423.02 feet

10. 14,600 units

■ Chapter Test Form A

1. $\sin\theta = \frac{15}{17}, \cos\theta = \frac{8}{17}, \tan\theta = \frac{15}{8}, \csc\theta = \frac{17}{15}, \sec\theta = \frac{17}{8}, \cot\theta = \frac{8}{15}$

2. $\sec 2 \approx -2.40$

3. 16 inches

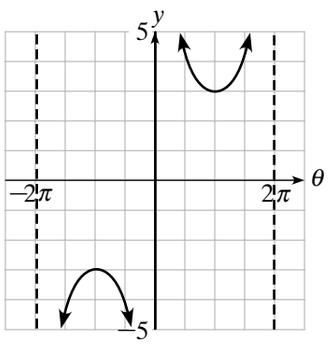
4. $\alpha = 52°; a \approx 5.76; c \approx 7.31$

5. B

6. Amplitude: 6; Period: $\frac{2\pi}{3}$; Phase shift: $\frac{\pi}{12}$; Vertical translation: 2

7. **(a)** No
(b) Yes, 3^{-x}
(c) Yes, $-4x$
(d) No
(e) Yes, $0.35e^{-0.07x}$

8. The graph of $y = 3\csc\frac{1}{2}x$ can be obtained from the graph of $y = \csc x$ by a vertical stretch of factor 3 and a horizontal stretch of factor 2. Period: 4π; Domain: all reals except $x = 2\pi n$, n any integer; Range: $(-\infty, -3] \cup [3, \infty)$; Zeros: none; Asymptotes: $x = n2\pi$, n any integer



9. $x \approx 3.50$ or $x \approx 6.64$

10. $a \approx 4.47; b = 5.00; h \approx 0.22$

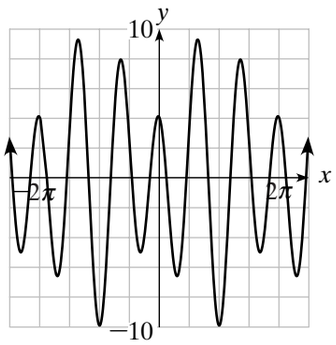
11. B

12. 327.4 meters

13. $\cos(\sin^{-1}u) = \sqrt{1-u^2}$; The $\pm$ sign is unnecessary because the range of $\sin^{-1}u$ is $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ and $\cos x \geq 0$ for $x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$.

14. **(a)** \$80 million
(b) \$92.5 million
(c) 8 years

15. Period: 2π



■ Chapter Test Form B

1. $\sin\theta = \frac{12}{13}$; $\cos\theta = \frac{5}{13}$; $\tan\theta = \frac{12}{5}$; $\csc\theta = \frac{13}{12}$; $\sec\theta = \frac{13}{5}$; $\cot\theta = \frac{5}{12}$

2. $\csc 3 \approx 7.09$

3. 16.8 inches

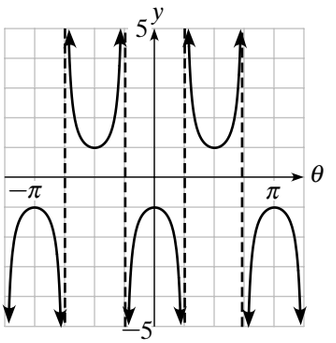
4. $\beta = 47°$; $b \approx 3.75$; $c \approx 5.13$

5. C

6. Amplitude: 2; Period: $\frac{\pi}{2}$; Phase shift: $\frac{\pi}{20}$; Vertical translation: -3

7. **(a)** Yes, 4^{-x}
(b) No
(c) Yes, $-5x$
(d) No
(e) Yes, $45e^{-0.1x}$

8. The graph of $y = -\sec 2x$ can be obtained from the graph of $y = \sec x$ by a horizontal shrink of factor $\frac{1}{2}$ and a reflection across the x-axis. Period: π; Domain: $x \neq \frac{\pi}{4} + \frac{n\pi}{2}$, n any integer; Range: $(-\infty, -1] \cup [1, \infty)$; Zeros: none; Asymptotes: $x = \frac{\pi}{4} + \frac{n\pi}{2}$, n any integer



9. $x \approx 5.98$ or $x \approx 9.12$

10. $a \approx 7.21$; $b = 3.00$; $h \approx 0.33$

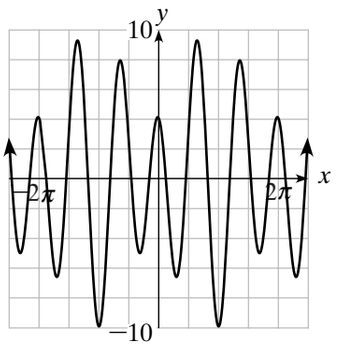
11. E

12. 273.6 meters

13. $\csc(\cos^{-1} u) = \frac{1}{\sqrt{1-u^2}}$; The $\pm$ sign is unnecessary because the range of $\cos^{-1} u$ is $[0, \pi]$ and $\csc x \geq 0$ for $x \in [0, \pi]$.

14. **(a)** \$68 million
(b) \$125.8 million
(c) 6 years

15. Period: 2π



Chapter 5
Analytic Geometry

■ Quiz Sections 5.1 to 5.3

1. $\cot\theta$

2. $1 + \csc x$

3. B

4.
$$\frac{\sin\theta}{1+\cos\theta} + \frac{1+\cos\theta}{\sin\theta} = \frac{\sin^2\theta + (1+\cos\theta)^2}{\sin\theta(1+\cos\theta)}$$
$$= \frac{\sin^2\theta + 1 + 2\cos\theta + \cos^2\theta}{\sin\theta(1+\cos\theta)}$$
$$= \frac{(\sin^2\theta + \cos^2\theta) + 1 + 2\cos\theta}{\sin\theta(1+\cos\theta)}$$
$$= \frac{2 + 2\cos\theta}{\sin\theta(1+\cos\theta)}$$
$$= \frac{2(1+\cos\theta)}{\sin\theta(1+\cos\theta)}$$
$$= \frac{2}{\sin\theta} = 2\csc\theta$$

5. $\cos\theta + \cos 2\theta + \cos(2\theta + \theta)$
$= \cos\theta + \cos 2\theta + \cos 2\theta\cos\theta - \sin 2\theta\sin\theta$
$= \cos\theta + \cos 2\theta + \cos 2\theta\cos\theta - 2\sin^2\theta\cos\theta$
$= \cos\theta + \cos 2\theta + \cos 2\theta\cos\theta - 2\cos\theta(1 - \cos^2\theta)$
$= \cos 2\theta + \cos 2\theta\cos\theta - \cos\theta + 2\cos^3\theta$
$= \cos 2\theta + \cos 2\theta\cos\theta + \cos\theta(2\cos^2\theta - 1)$
$= \cos 2\theta + \cos 2\theta\cos\theta + \cos\theta\cos 2\theta$
$= \cos 2\theta + 2\cos 2\theta\cos\theta$
$= \cos 2\theta(1 + 2\cos\theta)$

6. D

7. $x = \frac{\pi}{2} + n\pi,\ x = \frac{\pi}{4} + \frac{n\pi}{2}$, where n is any integer.

8. $x = \frac{\pi}{6},\ x = \frac{5\pi}{6}$

9. $\left[\frac{\pi}{6}, \frac{5\pi}{6}\right] \cup \left[\frac{7\pi}{6}, \frac{11\pi}{6}\right]$

10. This is not an identity. For example, if $x = 0$
$2\cos(0) = 2 \neq \sin(2\cdot 0) = 0$.

■ Quiz Sections 5.4 to 5.6

1. $\gamma = 113°$, $a = 9.50$, and $c = 13.07$

2. C

3. 6,040 meters

4. 36.98 sq units

5. 142.19 sq units

6. 26.0 meters

7. C

8. $\frac{\sqrt{2 - \sqrt{2}}}{2}$

9. 63.29 ft

10. $\frac{\sin^3 A - \cos^3 \mathrm{A}}{\sin^2 A - \cos^2 \mathrm{A}}$
$= \frac{(\sin A - \cos A)(\sin^2 A + \sin A\cos A + \cos^2 A)}{(\sin A + \cos A)(\sin A - \cos A)}$
$= \frac{(1 + \sin A\cos A)}{(\sin A + \cos A)}$
$= \frac{1 + \frac{1}{2}\sin 2A}{\sin A + \cos A}$
$= \frac{2 + \sin 2A}{2(\sin A + \cos A)}$

■ Chapter Test Form A

1. $\sec^2 x - \frac{\sec^2 x}{\csc^2 x} = \frac{1}{\cos^2 x} - \frac{\frac{1}{\cos^2 x}}{\frac{1}{\sin^2 x}} = \frac{1 - \sin^2 x}{\cos^2 x}$

$= \frac{\cos^2 x}{\cos^2 x} = 1.$

2. $(\tan x + 1)^2 = \tan^2 x + 2\tan x + 1$
$= (\tan^2 x + 1) + 2\tan x$
$= \sec^2 x + 2\tan x$
$= \frac{1}{\cos^2 x} + 2\frac{\sin x}{\cos x} = \frac{1 + 2\sin x\cos x}{\cos^2 x}$

3. $x = -\frac{\pi}{2} + 2\pi n$, or $x = \frac{\pi}{4} + n\pi$ where n is any integer

4. No; any value of x (except $\frac{\pi}{2} + n\pi$, n an integer) is a counter example.

5. $\frac{\sqrt{6} - \sqrt{2}}{4}$

6. $\cos 3x = \cos x\cos 2x - \sin x\sin 2x$
$= \cos x(\cos^2 x - \sin^2 x) - \sin x(2\sin x\cos x)$
$= \cos^3 x - 3\sin^2 x\cos x$

7. $\pm\sqrt{\frac{1 - \cos 6C}{2}}$

8. $\beta = 59.16°$

9. 0

10. $\theta \approx 25.41°$ or $\theta \approx 64.59°$

11. 52,440 square feet

12. 12.2 meters

13. About 646.7 ft

14. 87.5 meters

15. $A(\theta) = 64\cos\frac{\theta}{2}\sin\frac{\theta}{2} = 32\sin\theta$
$\theta \approx 51.38°$ or $\theta \approx 128.62°$

■ Chapter Test Form B

1. $\tan^2 x - \frac{\csc^2 x}{\cot^2 x} = \frac{\sin^2 x}{\cos^2 x} - \frac{\frac{1}{\sin^2 x}}{\frac{\cos^2 x}{\sin^2 x}} = \frac{\sin^2 x - 1}{\cos^2 x}$

$= \frac{-\cos^2 x}{\cos^2 x} = -1.$

2. $(1 + \cot x)^2 = 1 + 2\cot x + \cot^2 x$
$= (1 + \cot^2 x) + 2\cot x$
$= \csc^2 x + 2\cot x$
$= \frac{1}{\sin^2 x} + 2\frac{\cos x}{\sin x} = \frac{1 + 2\sin x\cos x}{\sin^2 x}$

3. $x = n\pi$, or $x = \frac{\pi}{2} + 2n\pi$ where n is any integer

4. No; any value of x (except $x = n\pi$, n an integer) is a counter example.

5. $\frac{-(\sqrt{6} + \sqrt{2})}{4}$

6. $\sin 3x = \sin x\cos 2x + \cos x\sin 2x$
$= \sin x(2\cos^2 x - 1) + \cos x(2\sin x\cos x)$
$= 4\sin x\cos^2 x - \sin x$

7. $\pm\sqrt{\frac{1 + \cos 8C}{2}}$

8. 53.67°

9. 1

10. $\theta \approx 19.90°$ or $\theta \approx 70.10°$

11. 24,495 square feet

12. 12.9 meters

13. Approximately 616.9 feet

14. 216.4 meters

15. $A(\theta) = 100 \cos \frac{\theta}{2} \sin \frac{\theta}{2} = 50 \sin \theta$

$\theta \approx 47.73°$ or $\theta \approx 132.27°$

Chapters P–5 Midterm Exam

■ Midterm Exam A

1. $\left(-\frac{18}{5}, -\frac{8}{5}\right]$

2. Sample answer:

$AB = \sqrt{[1 - (-8)]^2 + (-3 - 1)^2}$
$= \sqrt{9^2 + (-4)^2} = \sqrt{81 + 16} = \sqrt{97};$

$BC = \sqrt{[-8 - (-4)]^2 + (1 - 10)^2}$
$= \sqrt{(-4)^2 + (-9)^2} = \sqrt{16 + 81} = \sqrt{97};$

$CD = \sqrt{(-4 - 5)^2 + (10 - 6)^2}$
$= \sqrt{(-9)^2 + 4^2} = \sqrt{81 + 16} = \sqrt{97};$

$AD = \sqrt{(1 - 5)^2 + (-3 - 6)^2}$
$= \sqrt{(-4)^2 + (-9)^2} = \sqrt{16 + 81} = \sqrt{97};$

$m_{\overline{AB}} = \frac{1 - (-3)}{-8 - 1} = -\frac{4}{9}$ and

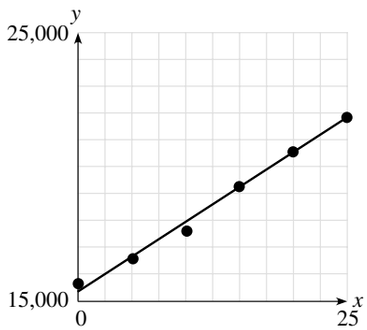
$m_{\overline{BC}} = \frac{10 - 1}{-4 - (-8)} = \frac{9}{4},$

so $\overline{AB} \perp \overline{BC}$ since $m_{\overline{AB}} \cdot m_{\overline{BC}} = -1$. Since all four sides have the same length and since one pair of adjacent sides are perpendicular, the points are the vertices of a square. (Note: Other proofs are possible; check students' work.)

3. $\sqrt[35]{x^3}$

4. $y = -\frac{2}{5}x + \frac{31}{5}$ or $y = -0.4x + 6.2$

5. $y = 256.51x + 15{,}326.48$;
2008: About \$23,791



6. Approximately $(-\infty, 29.43]$

7. Solution: $x = 8$; Extraneous root: $x = 1$. The root $x = 1$ is extraneous because the domain of the logarithm function is the positive real numbers.

8. $x \approx -1.30$ or $x \approx 4.37$

9. $g \circ f(x) = x - 2$; Domain: $[3, \infty)$

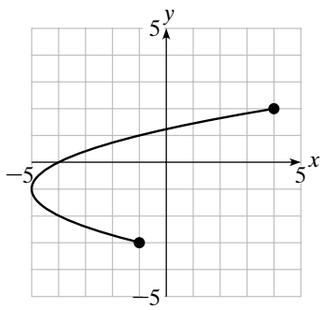
10. $A(x) = 240x - 2x^2$; $x \approx 30.85$ or $x \approx 89.15$

11. $(-\infty, 4) \cup (12, \infty)$

12. Center: $(-10, 8)$; $r = 2\sqrt{21}$

13. $y = 3x^2 - 12x + 7$

14.



15. $y = 3(x - 5)^2 - 6$

16. B

17. x-intercepts: $(4, 0), (-4, 0)$

y-intercept: $\left(0, \frac{32}{9}\right)$

Vertical asymptotes: $x = 3$, $x = -3$

Horizontal asymptote: $y = 2$

18. Sample answer: According to the lower bound test for real zeros, -2 is a lower bound for the zeroes of $f(x)$ if and only if 2 is an upper bound for the zeros of $f(-x) = x^4 + 3x^3 - 4x^2 - 8x - 2$. Applying the upper bound test for real zeros, we obtain the synthetic division

2	1	3	−4	−8	−2
		2	10	12	8
	1	5	6	4	6

Since the last row contains no negative numbers, 2 is an upper bound for the zeros of $f(-x)$ and -2 is a lower bound for the zeros of $f(x)$.

19. $x = 2 \pm \sqrt{17}i$

20. $x^3 + x^2 - 32x + 70$

21. $e^{(x/2)} - 3$

22. C

23. Translate 2 units left, stretch vertically by a factor of 4, and translate 3 units down. The order may be changed as long as the vertical stretch precedes the downward translation.

24. \$13,374.18

25. After 6 years

26. **(a)** 16

(b) After 159.78 years

(c) 1216

27. $\sin \theta = 15/17$ $\quad \cos \theta = 8/17$
$\tan \theta = 15/8$ $\quad \sec \theta = 17/8$
$\csc \theta = 17/15$ $\quad \cot \theta = 8/15$

28. $\alpha = 52°$ $a \approx 5.76$ $c \approx 7.31$

29. B

30. 64.6 feet

31. B

32. **(a)** \$108 million
(b) \$117.5 million
(c) 6 years

■ Midterm Exam B

1. $[-4, 2)$

2. Sample answer:

$$AB = \sqrt{[4-(-1)]^2 + (2-0)^2} = \sqrt{5^2+2^2} = \sqrt{25+4} + \sqrt{29};$$

$$BC = \sqrt{[-1-(-3)]^2 + (0-5)^2} = \sqrt{2^2+(-5)^2} = \sqrt{4+25} = \sqrt{29};$$

$$CD = \sqrt{[2-(-3)]^2 + (7-5)^2} = \sqrt{5^2+2^2} = \sqrt{25+4} = \sqrt{29};$$

$$AD = \sqrt{(4-2)^2 + (2-7)^2} = \sqrt{2^2+(-5)^2} = \sqrt{4+25} = \sqrt{29};$$

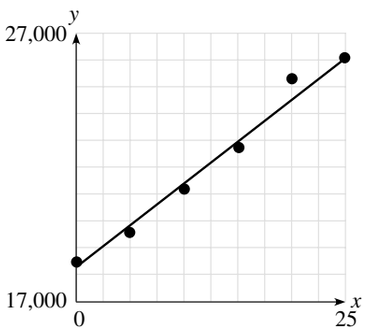
$m_{\overline{AB}} = \dfrac{0-2}{-1-4} = \dfrac{2}{5}$ and $m_{\overline{BC}} = \dfrac{5-0}{-3-(-1)} = -\dfrac{5}{2}$,

so $\overline{AB} \perp \overline{BC}$ since $m_{\overline{AB}} \cdot m_{\overline{BC}} = -1$. Since all four sides have the same length and since one pair of adjacent sides are perpendicular, the points are the vertices of a square. (Note: Other proofs are possible; check students' work.)

3. $\sqrt[15]{x}$

4. $y = \dfrac{3}{8}x + \dfrac{41}{8}$ or $y = 0.375x + 5.125$

5. $y = 316.89x + 18{,}295.19$;
2012: About \$30,020



6. Approximately $(-\infty, 15.25]$

7. Solution: $x = 5$; Extraneous root: $x = -6$. The root $x = -6$ is extraneous because the domain of the logarithm function is the positive real numbers.

8. $x \approx -0.71$ or $x \approx 3.31$

9. $f \circ g(x) = x + 4$; Domain: $[-5, \infty)$

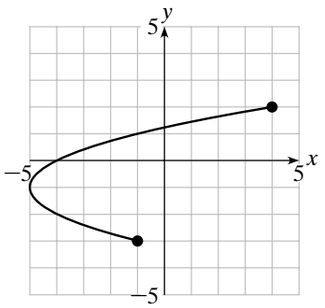
10. $A(x) = 160x - 2x^2$; $x \approx 25.86$ or $x \approx 54.14$

11. $(-\infty, 2] \cup [8, \infty)$

12. Center: $(12, -6)$; $r = 4\sqrt{5}$

13. $y = 2x^2 + 12x + 22$

14.



15. $y = 0.3(x+5)^2 + 6$

16. C

17. x-intercepts: $(5, 0)$, $(-5, 0)$

y-intercept: $\left(0, \dfrac{75}{4}\right)$

Vertical asymptotes: $x = 2$, $x = -2$

Horizontal asymptote: $y = 3$

18. Sample answer: According to the lower bound test for real zeros, -3 is a lower bound for the zeroes of $f(x)$ if and only if 3 is an upper bound for the zeros of $f(-x) = x^4 + 2x^3 - 8x^2 - 3x - 10$. Applying the upper bound test for real zeros, we obtain the synthetic division

3	1	2	−8	−3	−10
		3	15	21	54
	1	5	7	18	44

Since the last row contains no negative numbers, 3 is an upper bound for the zeros of $f(-x)$ and -3 is a lower bound for the zeros of $f(x)$.

19. $x = 3 \pm 7i$

20. $x^3 - 21x^2 + 148x - 340$

21. $y = e^{(x-4)} - 1$

22. D

23. Translate 4 units right, reflect across the x-axis, and translate 5 units up. The order may be changed as long as the reflection precedes the upward translation.

24. \$10,932.03

25. After 2 years and 7 months

26. **(a)** 23
(b) After 88.31 years
(c) 1518

27. $\sin\theta = 12/13$ $\cos\theta = 5/13$
$\tan\theta = 12/5$ $\sec\theta = 13/5$
$\csc\theta = 13/12$ $\cot\theta = 5/12$

28. $\beta = 47°$ $b \approx 3.75$ $c \approx 5.13$

29. B

30. 175.6 feet

31. A

32. **(a)** \$47 million

(b) \$84.4 million

(c) 12 years

Chapter 6
Applications of Trigonometry

■ Quiz Sections 6.1 to 6.3

1. $\frac{3}{5}\mathbf{i} - \frac{4}{5}\mathbf{j}$

2. D

3. (315.47, 450.53)

4. 176.63°

5. $\langle 5\cos(242°), 5\sin(242°)\rangle = \langle -2.35, -4.41\rangle$

6. $x = y^2 - 10y + 27$

7. $x(t) = 5 + 3t$

$y(t) = -4 - 10t$

8. $\langle 3, -3\rangle$

9. C

10. 4.55 seconds

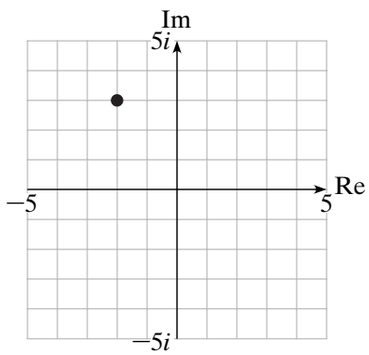
■ Quiz Sections 6.4 to 6.6

1. $\left(4\sqrt{2}, \frac{3\pi}{4}\right), \left(-4\sqrt{2}, \frac{7\pi}{4}\right)$

2. D

3. $x^2 - 3y + y^2 = 0$

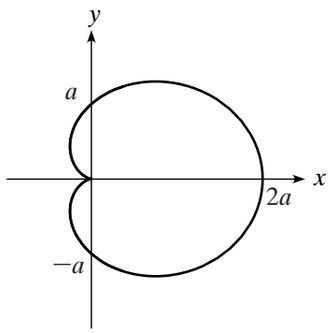
4. $\sqrt{13}$;



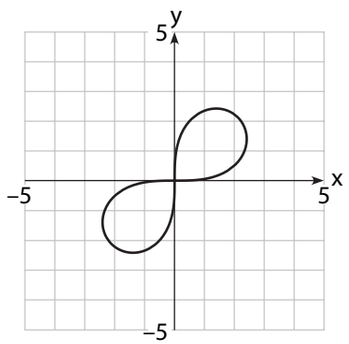
5. $-\sqrt{3} + 3i$

6. $r = 4\cos 2\theta$

7.



8.



9. B

10. $\cos 2\pi/5 + i\sin 2\pi/5, \cos 4\pi/5 + i\sin 4\pi/5, \cos 6\pi/5 + i\sin 6\pi/5, \cos 8\pi/5 + i\sin 8\pi/5, \cos 0 + i\sin 0 = 1 + 0i$

■ Chapter Test Form A

1. $-5\mathbf{i} + \mathbf{j}$

2. $\langle -10, 19\rangle$

3. Ground speed ≈ 437.90 mph; Bearing ≈ 261.78° or 8.22° south of due west.

4. $\langle 7/25, -24/25\rangle = \langle 0.28, -0.96\rangle$

5. $\langle 2, -2\rangle$

6. $12(\cos 3\pi/4 + i\sin 3\pi/4)$

7. $\langle 3, 3\rangle$

8. Approximately (6.55, −4.59)

9. $\frac{7}{4} + i\frac{7\sqrt{3}}{4}$

10. parabola; $y = 1 - x^2$

11. **(a)** $x(t) = (90\cos 70°)\,t$;
$y(t) = -16t^2 + (90\sin 70°)t$

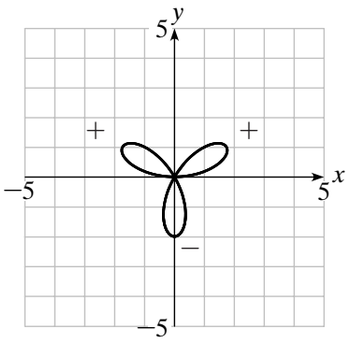
(b) $0 \le t \le 5.29$

(c) ≈ 163 ft

12. A

13. About 7.63 miles

14. $0 \le \theta \le \pi$;



15. $5(\cos\theta + i\sin\theta)$, where $\theta = 5\pi/12, 3\pi/4, 13\pi/12, 17\pi/12, 7\pi/4$

16. $15{,}625i$

■ Chapter Test Form B

1. $-7\mathbf{i} + 2\mathbf{j}$

2. $\langle -13, 14\rangle$

3. Ground speed $\approx$ 418.36 mph; Bearing $\approx$ 143.67° or 36.33° east of due south.

4. $\langle -4/5, 3/5\rangle = \langle -0.8, 0.6\rangle$

5. $\langle 5, -5\rangle$

6. $6(\cos 2\pi/3 + i\sin 2\pi/3)$

7. $\langle 4, 4\rangle$

8. Approximately $(-6.66, 2.16)$

9. $-\frac{9}{8}\sqrt{2} + \frac{9}{8}\sqrt{2}i$

10. hyperbola; $y = 1 + \frac{2}{x}$

11. **(a)** $x(t) = (95\cos 65°)\,t$;
$y(t) = -16t^2 + (95\sin 65°)t$

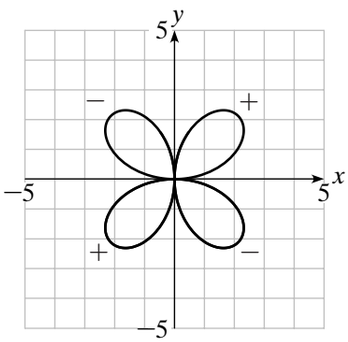
(b) $0 \le t \le 5.38$

(c) $\approx$ 216 ft

12. A

13. About 608 miles

14. $0 \le \theta \le 2\pi$;



15. $6(\cos\theta + i\sin\theta)$, where $\theta = \pi/2, 9\pi/10, 13\pi/10, 17\pi/10$

16. $7776i$

Chapter 7
Systems and Matrices

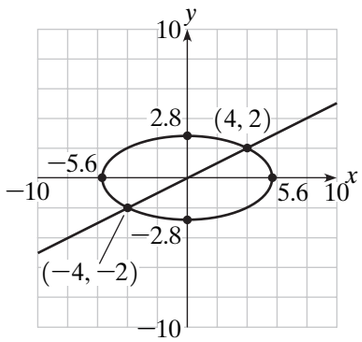
■ Quiz Sections 7.1 to 7.2

1. E

2. $(4, -3)$

3. $(2, 3), (-2, 3)$

4. $(4, 2), (-4, -2)$



5. -20

6. $\begin{bmatrix} 8{,}000 \\ 19{,}100 \\ 13{,}300 \\ 3{,}450 \end{bmatrix}$ represents the revenue by color.

7. C

8. 88; yes

9. $\begin{bmatrix} 3/34 & 4/17 \\ -1/17 & 3/17 \end{bmatrix}$

10. Yes; $AB = BA = I_3$

■ Quiz Sections 7.3 to 7.5

1. $\begin{bmatrix} 1 & 2 & -3 \\ 2 & -3 & 4 \\ 3 & -1 & 0 \end{bmatrix}\begin{bmatrix} y \\ x \\ z \end{bmatrix} = \begin{bmatrix} 19 \\ -17 \\ 4 \end{bmatrix}$

2. $(x, y, z) = (3, 5, -2)$

3. $(5, -2, 3)$

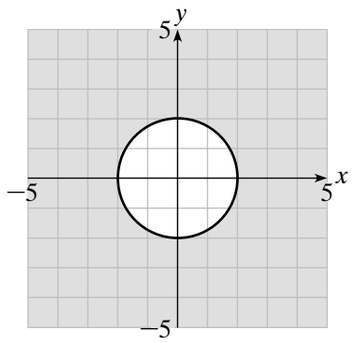
4. $(1 + 2a, 2 - 3a, a)$

5. $\frac{3}{x^2 + 1} + \frac{1}{(x^2 + 1)^2}$

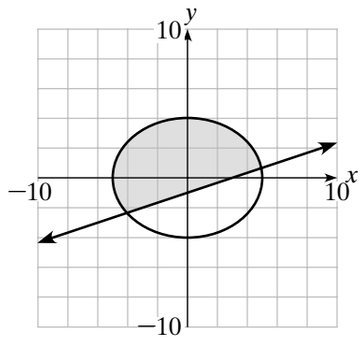
6. C

7. $y \le 4 - x^2$

8.



9.



10. C

■ Chapter Test Form A

1. $(-1, -4), (2, -1)$

2. $(1, 3)$

3. $(-2.20, -7.81), (-0.41, -0.64), (1.11, 5.44)$

4. B

5. $(2, -3, 1)$

6. $(3z + 2, 2z - 1, z)$, where z is any real number

7. D

8. $\begin{bmatrix} 299 & 460 \\ 345 & 207 \end{bmatrix}$ is 1.15 times the original matrix.

9.
$$\begin{aligned} 2x + y &= 3 \\ -x + 3y + 4z &= 0 \\ -2y + z &= 5 \end{aligned}$$

10. $(-13, 28, 23)$

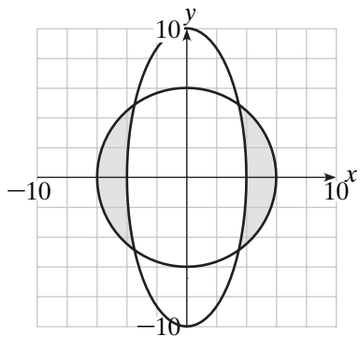
11. **(a)**
$$\begin{aligned} x + y + z &= 40{,}000 \\ 6x + 8y + 10z &= 324{,}000 \\ 8y - 5z &= 0 \end{aligned}$$

(b) $\begin{bmatrix} 1 & 1 & 1 \\ 6 & 8 & 10 \\ 0 & 8 & -5 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 40{,}000 \\ 324{,}000 \\ 0 \end{bmatrix}$

12. $\begin{bmatrix} 1 & 0 & 0 \\ 22 & 1 & -5 \\ -4 & 0 & 1 \end{bmatrix}$

13. $\dfrac{3}{x + 3} + \dfrac{2}{x - 2}$

14.



$-6 \le x \le -3.4$ and $3.4 \le x \le 6$

15. $C = 21$ at $(3, 6)$

■ Chapter Test Form B

1. $(-1, -5), (2, -2)$

2. $(2, -1)$

3. $(-0.84, -2.68), (0.86, 0.72), (2.31, 3.62)$

4. C

5. $(2z + 4, 3z - 2, z)$, where z is any real number

6. No solution

7. C

8. $\begin{bmatrix} 432 & 360 \\ 240 & 192 \end{bmatrix}$ is 1.2 times the original matrix.

9.
$$\begin{aligned} 4y + 3z &= -1 \\ 5x + y - 2z &= 0 \\ 3x + z &= 2 \end{aligned}$$

10. $(1, 2, 2)$

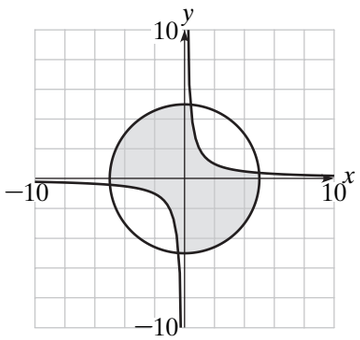
11. **(a)**
$$\begin{aligned} x + y + z &= 50{,}000 \\ 5x + 7y + 10z &= 376{,}400 \\ 7x - 5z &= 0 \end{aligned}$$

(b) $\begin{bmatrix} 1 & 1 & 1 \\ 5 & 7 & 10 \\ 7 & 0 & -5 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 50{,}000 \\ 376{,}400 \\ 0 \end{bmatrix}$

12. $\begin{bmatrix} 1 & 0 & 0 \\ 33 & 1 & -6 \\ -5 & 0 & 1 \end{bmatrix}$

13. $\dfrac{3/2}{x - 3} + \dfrac{1/2}{x + 1} = \dfrac{3}{2(x - 3)} + \dfrac{1}{2(x + 1)}$

14.



$-4.98 \le x \le -0.4$ and $0.4 \le x \le 4.98$

15. $C = -24$ at $(0, 8)$

Chapter 8 Analytic Geometry in Two and Three Dimensions

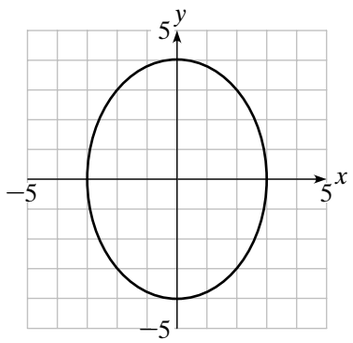
■ Quiz Sections 8.1 to 8.3

1. $(4, -2)$

2. $x = 1/12y^2 = 0.0833y$

3. $(x + 4)^2 = 4(y + 4)$

4.



5. A

6. $\dfrac{(x+1)^2}{16} - \dfrac{(y-2)^2}{9} = 1.$

7. For an ellipse, the $0 \le e < 1$ and

$e = c/a = \dfrac{\sqrt{a^2 - b^2}}{a}$, so if $e = 0$, $a^2 = b^2$, and

hence the graph of the quadratic is a circle. For all other values of e between 0 and 1, the graph of the quadratic is an ellipse.

8. $(2 \pm \sqrt{39}, -3)$

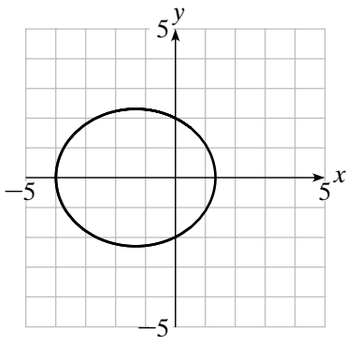
9. B

10. $\dfrac{(x-1)^2}{9} - \dfrac{(y+4)^2}{27} = 1.$

■ Quiz Sections 8.4 to 8.6

1. Parabola

2.



3. Hyperbola; $r = \dfrac{28}{3 + 4\sin\theta}$

4. $x = -6$

5. $96 > 0$; hyperbola

6. C

7. $(x', y') = (3/2 + 2\sqrt{3}, -3\sqrt{3}/2 + 2)$
$\approx (4.96, -0.60)$

8. C

9. $\sqrt{57}$

10. $x = -1 + 7t$, $y = 2 - 2t$, $z = 4 - 7t$

■ Chapter Test Form A

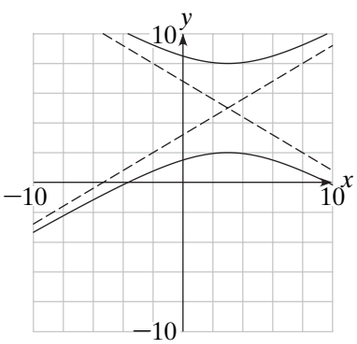
1. C

2. $x = \dfrac{1}{4}(y + 4)^2 - 4$

3. Center: $(3, 5)$; Foci: $(3, 5 \pm \sqrt{34})$;
Endpoints: $(3, 2)$, $(3, 8)$;

Asymptotes: $y = 5 \pm \dfrac{3}{5}(x - 3)$.

4.



5. $(3, 5)$

6. $x = \dfrac{1}{4}(y - 4)^2 + 2$

7. $r = \dfrac{15}{4 - \sin\theta}$

8. 40 meters

9. Hyperbola: $e = \dfrac{8}{5}$; Directrix: $x = 3$

10. The antenna should be $\dfrac{4}{3}$ feet from the vertex or 16 inches.

11. Hyperbola

12. $y = \dfrac{4 - x \pm \sqrt{25x^2 - 32x - 56}}{6}$

13. $\dfrac{(x-5)^2}{4} + (y+2)^2 = 1$; ellipse

14. $\sqrt{21}$

15. $x = 2 + 3t$; $y = -1 - 5t$; $z = 3 + 3t$

16. $(x-1)^2 + (y-5)^2 + (z+4)^2 = 144$

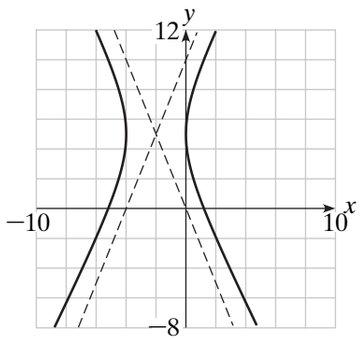
■ Chapter Test Form B

1. D

2. $y = \dfrac{1}{2}(x+2)^2 - 2$

3. Center: $(-2, 5)$;
Foci: $(-2 \pm 2\sqrt{5}, 5)$;
Endpoints of transverse axis: $(-4, 5)$, and $(0, 5)$;
Asymptotes: $y = \pm 2(x+2) + 5$

4.



5. $(-1, -10)$

6. $y = -\dfrac{1}{16}(x-2)^2 + 1$

7. $r = \dfrac{15}{4 + \cos\theta}$

8. 52 meters

9. Ellipse: $e = \dfrac{4}{7}$; Directrix: $y = -5$.

10. The antenna should be $\dfrac{3}{4}$ feet or 9 inches from the vertex.

11. Ellipse

12. $y = \dfrac{4 + x \pm \sqrt{(-23x^2 + 20x + 88)}}{6}$

13. $\dfrac{(x-2)^2}{4} + \dfrac{(y+2)^2}{4} = 1$. This is a circle.

14. $\sqrt{14}$

15. $x = 4 + 5t$, $y = -2 - 3t$; $z = 3 + 3t$

16. $(x+3)^2 + (y-5)^2 + (z-2)^2 = 64$

Chapter 9
Discrete Mathematics

■ Quiz Sections 9.1 to 9.3

1. 17,576,000

2. 32,801,517

3. A

4. 0.98

5. $\dfrac{5}{16}$

6. 62%

7. **(a)** $\dfrac{1}{16}$

(b) $\dfrac{11}{16}$

8. $3125x^5 - 25{,}000x^4y + 80{,}000x^3y^2 - 128{,}000x^2y^3 + 102{,}400xy^4 - 32{,}768y^5$

9. $508{,}035{,}072x^5y^{15}$

10. D

■ Quiz Sections 9.4 to 9.6

1. Explicit: $a_n = -43 + 15n$
Recursive: $a_1 = -28$ and $a_n = a_{n-1} + 15$ for $n \geq 2$

2. Explicit: $a_n = \dfrac{1}{8}(2^{n-1})$
Recursive: $a_1 = \dfrac{1}{8}$ and $a_n = 4 \cdot a_{n-1}$ for $n \geq 2$

3. B

4. -60

5. **(a)** Converge to $\dfrac{5}{2}$
(b) Diverge
(c) Converge to 0

6. 5

7. $P_1 = 1(1!) = 2! - 1$
$P_k = 1(1!) + 2(2!) + \ldots + k(k!) = (k+1)! - 1$
P_{k+1}
$= 1(1!) + 2(2!) + \ldots + k(k!) + (k+1)(k+1)!$
$= (k+1)! - 1 + (k+1)(k+1)!$

8. \$6,977.00

9. E

10. $P_1 = 3 = 1(2 \cdot 1 + 1)$

Assume P_k: $3 + 7 + 11 + \ldots + (4k - 1) = k(2k + 1)$

Prove $P_{k+1} = (k + 1)(2(k + 1) + 1)$

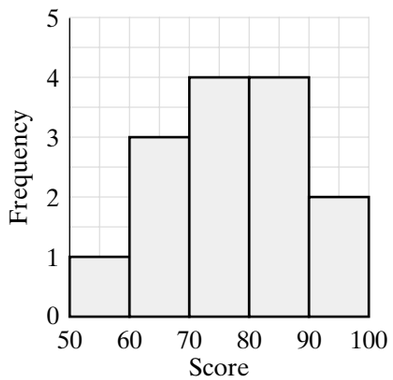
$$\begin{aligned} P_{k+1} &= 3 + 7 + 11 + \ldots + (4k - 1) + (4(k + 1) - 1) \\ &= k(2k + 1) + (4(k + 1) - 1) \\ &= 2k^2 + k + 4k + 4 - 1 \\ &= 2k^2 + 5k + 3 \\ &= (k + 1)(2k + 3) \\ &= (k + 1)(2(k + 1) + 1) \end{aligned}$$

■ Quiz Sections 9.7 to 9.8

1. Mean = 3.25; Median = 3; Mode = 3, 5

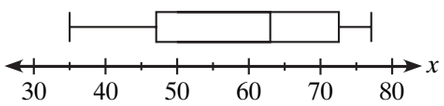
2. Standard deviation = 10.23
Variance = 104.6

3.

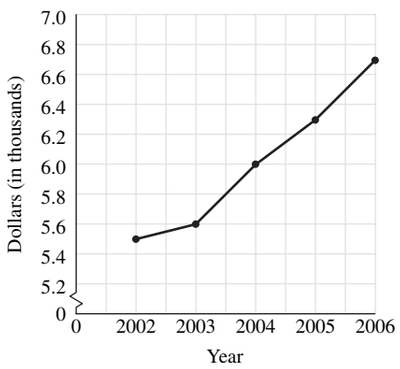


4. {35, 47, 63, 72.5, 77}
Range = 42

5.



6.



7. D

8. A

9. 86

10. 82

■ Chapter Test Form A

1. (a) 3

(b) $a_n = 3a_{n-1}$

2. C

3. $\sum_{n=1}^{8} 6\left(\frac{1}{3}\right)^{n-1} = \frac{6560}{729} = 8\frac{728}{729} \approx 8.999$

4. (a) $\frac{5}{3}$

(b) Does not converge

5. $32x^5 + 80x^4y + 80x^3y^2 + 40x^2y^3 + 10xy^4 + y^5$

6. $n^3 - n^2 + 5n$

7. 1,256,640

8. 50,400

9. A

10. $\frac{7}{12}$

11. $\binom{6}{r-1} + \binom{6}{r}$

$$= \frac{6!}{(r-1)![6-(r-1)]!} + \frac{6!}{r!(6-r)!}$$

$$\frac{6!}{(r-1)!(7-r)!} \cdot \frac{r}{r} + \frac{6!}{r!(6-r)!} \cdot \frac{7-r}{7-r}$$

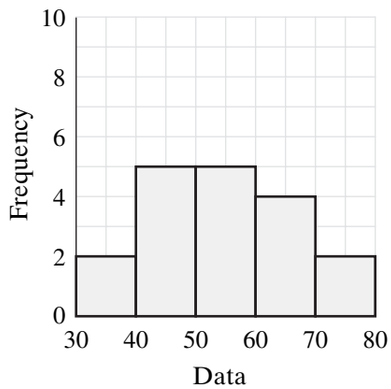
$$= \frac{6![r + (7-r)]}{r!(7-r)!} = \frac{7!}{r!(7-r)!} = \binom{7}{r}$$

12.

Stem	Leaf
3	9 7
4	3 8 9 4 1
5	1 7 6 2 6
6	5 1 8 3
7	2 5

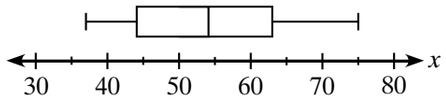
13.

Interval	Frequency
30–39	2
40–49	5
50–59	5
60–69	4
70–79	2



14. Mean: 54.28; Median: 54; Variance: 122.53

15.



16. P_1: $1(2 \cdot 1 + 1) = 3$

Assume P_k:
$3 + 7 + 11 + \ldots + (4k - 1) = k(2k + 1)$
Prove $P_{k+1} = (k + 1)(2(k + 1) + 1)$

$$\begin{aligned} P_{k+1} &= 3 + 7 + 11 + \ldots + (4k - 1) + (4(k + 1) - 1) \\ &= k(2k + 1) + (4(k + 1) - 1) \\ &= 2k^2 + k + 4k + 4 - 1 \\ &= 2k^2 + 5k + 3 \\ &= (k + 1)(2k + 3) \\ &= (k + 1)(2(k + 1) + 1) \end{aligned}$$

■ Chapter Test Form B

1. (a) -4

(b) $a_n = a_{n-1} - 4$

2. D

3. $\sum_{n=1}^{27} (-12 + 7n) = 2322$

4. (a) Converges to $\frac{5}{2}$

(b) Does not converge

5. $81x^4 + 108x^3y + 54x^2y^2 + 12xy^3 + y^4$

6. $\frac{4}{3}n^3 + 3n^2 - \frac{22}{3}n$

7. 3,575,880

8. 1,680

9. E

10. $\frac{5}{18}$

11. $\binom{k}{7} + \binom{k}{8} = \frac{k!}{7!(k-7)!} + \frac{k!}{8!(k-8)!}$

$= \frac{k!}{7!(k-7)!} \cdot \frac{8}{8} + \frac{k!}{8!(k-8)!} \cdot \frac{k-7}{k-7}$

$\frac{k![8 + (k - 7)]}{8!(k-7)!} = \frac{(k+1)!}{8![(k+1) - 8]!}$

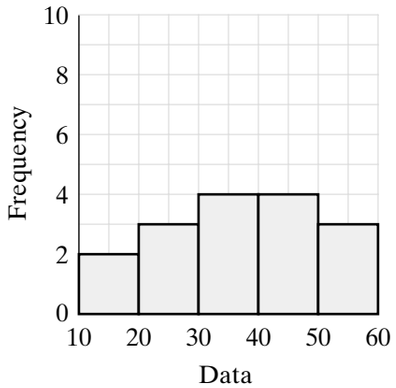
$= \binom{k+1}{8}$

12.

Stem	Leaf
1	8 9
2	7 9 7
3	3 7 7 8
4	2 5 2 5
5	2 8 6

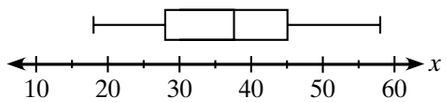
13.

Interval	Frequency
10–19	2
20–29	3
30–39	4
40–49	4
50–59	3



14. Mean: 37.81; Median: 37.5; Variance: 135.03

15.



16. P_1: $(3 \cdot 1 - 2) = 1$

Assume P_k: $1 + 7 + 13 \ldots + (6k - 5)$
$= k(3k - 2)$

Prove $P_{k+1} = (k + 1)(3(k + 1) - 2)$

$$\begin{aligned} P_{k+1} &= 1 + 7 + 13 + \ldots + (6k - 5) + (6(k + 1) - 5) \\ &= k(3k - 2) + (6(k + 1) - 5) \\ &= 3k^2 - 2k + 6k + 6 - 5 \\ &= 3k^2 + 4k + 1 \\ &= (k + 1)(3k + 1) \\ &= (k + 1)(3(k + 1) - 2) \end{aligned}$$

Chapter 10
An Introduction to Calculus: Limits, Derivatives and Integrals

■ Quiz Sections 10.1 to 10.4

1. $5(\sqrt{5.3} - \sqrt{4.7}) \approx 0.67$

2. (a) $m = -1$

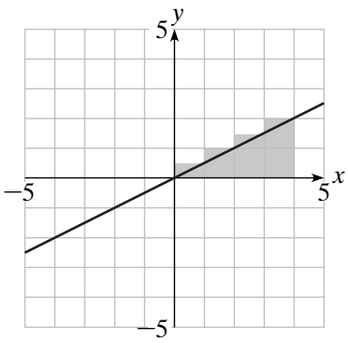
(b) $y = -x + 6$

3. C

4. $8x$

5. [1, 1.5]. [1.5, 2]. [2, 2.5], [2.5, 3], [3, 3.5], [3.5, 4], [4, 4.5], [4.5, 5]

6.



7. 42

■ Chapter Test Form A

1. C

2. 30

3. $\frac{9086}{5} = 1817.2$

4. 7

5. **(a)** $-\frac{1}{3}$

(b) $y = -\frac{1}{3}x - \frac{2}{3}$

6. **(a)** 64 ft/sec

(b) 128 ft/sec

7. **(a)** -32

(b) $-\frac{1}{2}$

(c) ∞

(d) -5

(e) 0

(f) Does not exist

8. **(a)** $\frac{x^3 + 64}{x + 4}$ is not defined at $x = -4$.

(b) 48

9. **(a)** 5

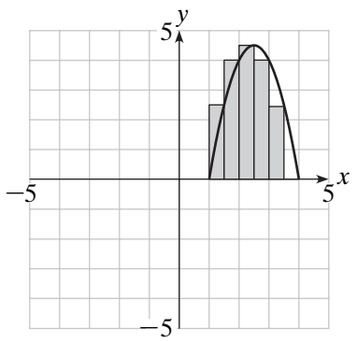
(b) 4

(c) Does not exist because $\lim_{x \to 2^-} f(x) \neq \lim_{x \to 2^+} f(x)$.

10. $\{c \mid c < 1 \text{ or } c > 1\}$

11. B

12. 8.75



13. $\int_1^2 x^3\,dx$

14. This area consists of two right triangles, each with legs 2 units long. So the area is $2 \cdot \left[\frac{1}{2}(2)(2)\right] = 4$.

15. 12.39

■ Chapter Test Form B

1. B

2. -24

3. $-3{,}549.2$

4. -4

5. **(a)** $\frac{3}{16}$

(b) $y = \frac{3}{16}x - \frac{9}{8}$

6. **(a)** 32 ft/s

(b) 64 ft/s

7. **(a)** 256

(b) $-\frac{5}{4}$

(c) $-\infty$

(d) 5

(e) 0

(f) Does not exist

8. **(a)** $\frac{x^3 - 27}{x - 3}$ is not defined at $x = 3$.

(b) 27

9. **(a)** 4

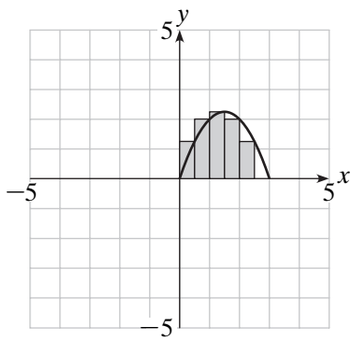
(b) 3

(c) Does not exist because $\lim_{x \to 4^-} f(x) \neq \lim_{x \to 4^+} f(x)$.

10. $\{c \mid c < 0 \text{ or } c > 0\}$

11. A

12. 4.375



13. $\int_1^3 x^2\,dx$

14. This area consists of two right triangles, each with legs 2 units long. So the area is $2 \cdot \left[\frac{1}{2}(2)(2)\right] = 4$.

15. 11.59

Chapters 6–10 Final Exam

■ Final Exam A

1. $(-1.38, -0.46)$ and $(1.38, 0.46)$

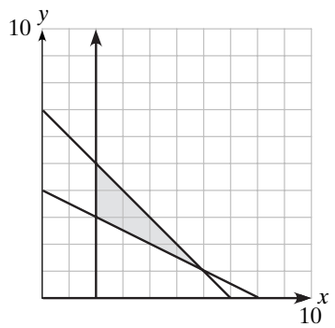
2. $x = 0, y = 4, z = 2$

3. C

4. $(2, 0, -1)$

5. $(5, -8, 7)$

6. $C = 19$ at $(6, 1)$



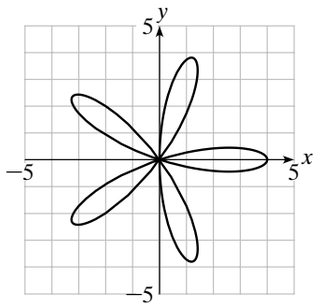
7. $(4, 0)$

8. $\frac{(x+4)^2}{49} + \frac{(y+3)^2}{16} = 1$

9. D

10. $(x-2)^2 + (y+1)^2 + (z-6)^2 = 25$

11. $0 \le \theta \le \pi$



12. B

13. $\langle 253.98, 598.33 \rangle$

14. About 463 ft

15. No, $\langle 2, -1 \rangle \cdot \langle -2, -5 \rangle \neq 0$

16. 3.37°

17. $x = 2 - 5t, y = -1 - 2t, z = 5 - 5t$

18. $y = \frac{2}{x+3}$; this is a hyperbola.

19. $2\left(\cos\frac{17\pi}{15} + i\sin\frac{17\pi}{15}\right), 2\left(\cos\frac{19\pi}{30} + i\sin\frac{19\pi}{30}\right),$
$2\left(\cos\frac{49\pi}{30} + i\sin\frac{49\pi}{30}\right), 2\left(\cos\frac{2\pi}{15} + i\sin\frac{2\pi}{15}\right)$

20. $81x^4 - 216x^3y^2 + 216x^2y^4 - 96xy^6 + 16y^8$

21. 6

22. \$20,065.73

23. P_1: $1^2 = 1\frac{(2(1)-1)(2(1)+1)}{3}$

Assume P_n: $1^2 + 3^2 + 5^2 + \ldots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$

Prove
$$P_{n+1} = \frac{(n+1)(2(n+1)-1)(2(n+1)+1)}{3} = \frac{(n+1)(2n+1)(2n+3)}{3}$$

$$\begin{aligned} P_{n+1} &= 1^2 + 3^2 + 5^2 + \ldots + (2n-1)^2 + (2(n+1)-1)^2 \\ &= \frac{n(2n-1)(2n+1)}{3} + (2(n+1)-1)^2 \\ &= \frac{n(2n-1)(2n+1)}{3} + \frac{3(2(n+1)-1)^2}{3} \\ &= \frac{n(2n-1)(2n+1)}{3} + \frac{3(2n+1)^2}{3} \\ &= \frac{(2n+1)}{3}(n(2n-1) + 3(2n+1)) \\ &= \frac{(2n+1)}{3}(2n^2 + 5n + 3) \\ &= \frac{(n+1)(2n+1)(2n+3)}{3} \end{aligned}$$

24. $\frac{9}{100}$

25. $\frac{1}{67{,}600}$

26. $\frac{2}{x} + \frac{1}{x^2}$

27. D

28. $\frac{1}{2}\left(e - \frac{1}{e}\right) \approx 1.18$

29. $y = -x + 2$

30. 128 ft

■ Final Exam B

1. $(-1.44, 2.08)$ and $(1.44, 2.08)$

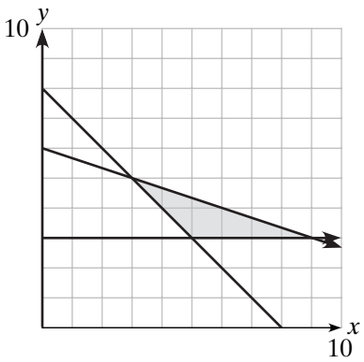
2. $x = 3, y = -1, z = 1$

3. A

4. $(1, 1, -1)$

5. $(-5, 9, -3)$

6. $C = -21$ at $(9, 3)$



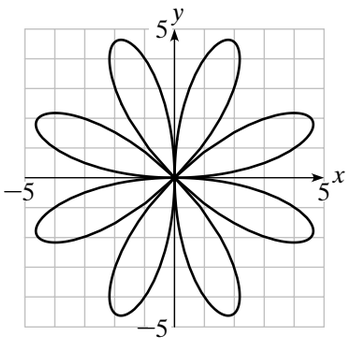
7. $(0, \pm 3)$

8. $\frac{(x-4)^2}{16} + \frac{(y-3)^2}{49} = 1$

9. B

10. $(x-1)^2 + (y+2)^2 + (z-6)^2 = 9$

11. $0 \le \theta \le 2\pi$



12. C

13. $\langle 579.56, 155.29 \rangle$

14. About 17.86 ft

15. No, $\langle 2, -1 \rangle \cdot \langle -3, -7 \rangle \neq 0$

16. 49.76°

17. $x = -1 + 4t, y = 2 - 3t, z = 5 - 5t$

18. $x = \frac{3}{y+1}$; this is a hyperbola.

19. $3\left(\cos\frac{3\pi}{5} + i\sin\frac{3\pi}{5}\right), 3\left(\cos\frac{19\pi}{15} + i\sin\frac{19\pi}{15}\right),$
$3\left(\cos\frac{29\pi}{15} + i\sin\frac{29\pi}{15}\right)$

20. $x^{10} - 15x^8y + 90x^6y^2 - 270x^4y^3 + 405x^2y^4 - 243y^5$

21. 4

22. \$18,424.28

23. $P_1: 1^3 = \frac{1^2(1+1)^2}{4}$

Assume $P_n: 1^3 + 2^3 + 3^3 + \ldots + n^3 = \frac{n^2(n+1)^2}{4}$

Prove $P_{n+1} =$
$$\frac{(n+1)^2((n+1)+1)^2}{4} = \frac{(n+1)^2(n+2)^2}{4}$$

$$P_{n+1} = 1^3 + 2^3 + 3^3 + \ldots + n^3 + (n+1)^3$$
$$= \frac{n^2(n+1)^2}{4} + (n+1)^3$$
$$= \frac{n^2(n+1)^2}{4} + \frac{4(n+1)(n+1)^2}{4}$$
$$= \frac{(n+1)^2}{4}(n^2 + 4n + 4)$$
$$= \frac{(n+1)^2(n+2)^2}{4}$$

24. $\frac{11}{144}$

25. $\frac{1}{17{,}576{,}000}$

26. $\frac{2}{x^2} - \frac{3}{x}$

27. D

28. $\frac{\sin\frac{\pi}{2} - \sin 0}{\frac{\pi}{2}} = \frac{2}{\pi} \approx 0.64$

29. $y = \frac{1}{2}x - 2$

30. About 145.45 ft