PreCalc 11

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ **1.** In the arithmetic sequence: –18, –10, –2, 6, ...; which term has the value 222?
A. t_{37} **C.** t_{19}
B. t_{21} **D.** t_{31}

____ **2.** Determine the common difference, *d*, of this arithmetic sequence: –32.1, –27.8, –23.5, –19.2, ...
A. $d = -4.3$ **C.** $d = 4.3$
B. $d = -32.1$ **D.** The sequence has no common difference.

____ **3.** The sum of the first 22 terms of an arithmetic series is 2288. The sum of the first 23 terms is 2484. The common difference is 8. Determine the first 4 terms of the series.
A. $-49 - 41 - 33 - 25$ **C.** $20 + 28 + 36 + 44$
B. $4 + 12 + 20 + 28$ **D.** $-25 - 17 - 9 - 1$

____ **4.** Which sequence could be geometric?
A. 3, –1.2, 0.48, –0.192 **C.** –2, –2.1, –2.2, –2.3, ...
B. –9, –6, –3, 0, ... **D.** –10, –50, –250, –1250, ...

____ **5.** 4096 is a term in which geometric sequence?
A. 2, 4, 8, 16, ... **C.** 2, 12, 72, 432, ...
B. 4, 24, 144, 864, ... **D.** 3, 6, 12, 24, ...

____ **6.** Determine the 8th term of this geometric sequence: 7, 21, 63, 189, ...
A. 45 927 **C.** 21 870
B. 19 683 **D.** 15 309

____ **7.** Determine the 6th term of this geometric sequence: –9, 27, –81, 243, ...
A. -1458 **C.** 2187
B. 2430 **D.** -972

____ **8.** To reproduce, a single bacterium splits into two. Assume it takes a single bacterium 20 min to split. When will there be 128 bacteria?
A. 140 min **C.** 168 min
B. 176 min **D.** 480 min

____ **9.** Jane deposited $1500 in a long-term savings account on her 23rd birthday. She did not make any more deposits or withdrawals. The account earned 7% per year. How much money did she have in the account when she turned 40?
A. $4428.25 **C.** $3867.80
B. $5424.79 **D.** $27 285.00

____ **10.** Write the first 4 terms of the geometric sequence with $t_1 = 405$ and $r = -\frac{1}{3}$.
A. 405, –135, 45, –15 **C.** 405, 135, –45, 15
B. $405, -\frac{1}{135}, \frac{1}{45}, -\frac{1}{15}$ **D.** 405, –1215, 3645, –10935

____ **11.** The sum of the first 12 terms of which geometric series is 5460?

A. $-3 + 6 - 12 + \ldots + 6144$ **C.** $-2 - 8 + 16 - \ldots + 4096$
B. $-5 + 10 - 20 + \ldots + 10\,240$ **D.** $-4 + 8 - 16 + \ldots + 8192$

____ **12.** The sum of the first *n* terms of a geometric series is: $S_n = 5^n - 1$

For this series:

I. The common ratio is 5.
II. The first 3 terms are 4, 20, and 100.
III. The difference between the common ratio and the 1st term is 1.
IV. The difference between S_6 and S_5 is the same as the difference between S_4 and S_3.

A. Statements I, II, III, and IV are correct.
B. Statements I, II, and III are correct.
C. Statements I, III, and IV are correct.
D. All of the statements are correct.

____ **13.** Determine the sum of the first 9 terms of this geometric series: $-3 + 4.5 - 6.75 + \ldots$
Write the sum to the nearest hundredth if necessary.

A. 47 **C.** -47.33
B. -76 **D.** -29

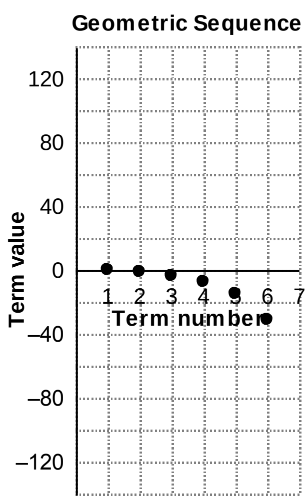
____ **14.** Determine the common ratio of a geometric series that has these partial sums: $S_4 = -3.5$, $S_5 = -3.75$, $S_6 = -3.875$

A. $r = 1$ **C.** $r = -0.5$
B. $r = -2$ **D.** $r = 0.5$

____ **15.** The sum of the first 5 terms of a geometric series is 682. The common ratio is $\frac{1}{4}$. Determine the 3rd term.

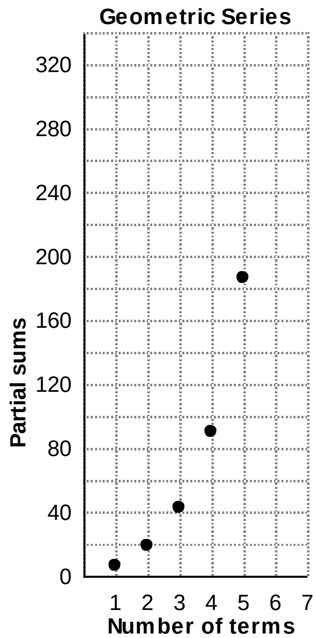
A. 8 **C.** 128
B. 32 **D.** 512

____ **16.** Which geometric sequence could this graph represent?



A. $-1, -\frac{1}{2}, -\frac{1}{4}, -\frac{1}{8}, \ldots$ **C.** –1, –2, –4, –8, ...
B. –1, –3, –9, –27, ... **D.** –1, 2, –4, 8, ...

____ **17.** Which geometric series could this graph represent?



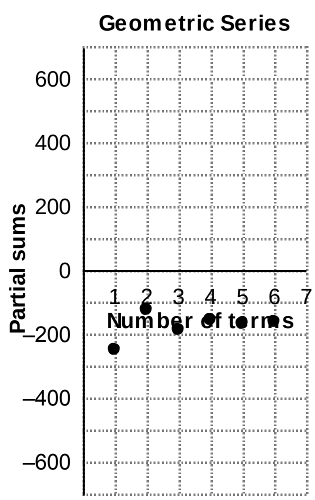
A. $6 + \frac{1}{12} + \frac{1}{24} + \frac{1}{48} + ...$

B. $6 + 12 + 24 + 48 + ...$

C. $6 - 12 + 24 - 48 + \ldots$

D. $6 + 18 + 54 + 162 + ...$

____ **18.** Which value of *r* could be the common ratio of the geometric series represented by this graph?



A. $r = 2$

B. $r = \frac{1}{2}$

C. $r = -2$

D. $r = -\frac{1}{2}$

____ **19.** Determine whether this infinite geometric series has a finite sum: $5 + \frac{20}{3} + \frac{80}{9} + \frac{320}{27} + \ldots$

If it does, determine the sum.

A. This series does not have a finite sum.

C. $S_\infty = 20.\overline{5}$

B. $S_\infty = -15$ **D.** $S_\infty = 5$

____ **20.** A geometric series has $t_1 = -3$ and $S_\infty = -6$. Determine the common ratio.
A. $r = 0.\overline{3}$ **C.** $r = 0.5$
B. $r = -2$ **D.** $r = 0.25$

____ **21.** Evaluate: $-3\left|-13+(1)\right| - (-5-(5))\left|21-(-21)\right|$
A. 384 **B.** –68 **C.** 429 **D.** –384

____ **22.** Write this entire radical as a mixed radical: $\sqrt[3]{-320}$
A. $-4\sqrt[3]{5}$ **B.** $-8\sqrt[3]{10}$ **C.** $-4\sqrt[3]{25}$ **D.** $-8\sqrt[3]{5}$

____ **23.** For which values of the variable, *x*, is this radical defined?
$\sqrt{-22x^4}$
A. $x \geq 0$ **C.** $x \leq 0$
B. $x \in \mathbb{R}$ **D.** the radical is never defined

____ **24.** Which radical expression simplifies to $2\sqrt{2}$?
A. $\sqrt{4}$ **B.** $\sqrt{8}$ **C.** $\sqrt{16}$ **D.** $\sqrt{9}$

____ **25.** Which radical expression simplifies to $9\sqrt{2}$?
A. $\sqrt{32} - 7\sqrt{2} + \sqrt{8}$ **C.** $\sqrt{32} + 7\sqrt{8} - \sqrt{2}$
B. $\sqrt{32} - \sqrt{8} + 7\sqrt{2}$ **D.** $\sqrt{2} + 7\sqrt{8} - \sqrt{32}$

____ **26.** Which radical expression simplifies to $6\sqrt{2} + 20\sqrt{5}$?
A. $\sqrt{3125} + \sqrt{8} + \sqrt{125} + \sqrt{32}$
B. $\sqrt{3125} - \sqrt{8} + \sqrt{125} - \sqrt{32}$
C. $\sqrt{3125} + \sqrt{8} + \sqrt{125} - \sqrt{32}$
D. $\sqrt{3125} + \sqrt{8} - \sqrt{125} + \sqrt{32}$

____ **27.** Which radical expression simplifies to $11r^2\sqrt{3s}$, $r \in \mathbb{R}$, $s \geq 0$?
A. $9\sqrt{3r^4s} + 4r\sqrt{3r^2s} - 2r^2\sqrt{3s}$
B. $9\sqrt{3r^4s} + 4r\sqrt{3r^3s} + 2r^2\sqrt{3s}$
C. $9\sqrt[3]{3r^4s} + 4r\sqrt[3]{3r^2s} - 2r^2\sqrt[3]{3s}$
D. $9\sqrt{3r^3s} + 4r\sqrt{3r^2s} - 2r^3\sqrt{3s}$

____ **28.** Simplify this radical, if possible: $\sqrt{38}$
A. $3\sqrt{19}$ **C.** $19\sqrt{2}$
B. $9\sqrt{2}$ **D.** cannot be simplified

____ **29.** Simplify by adding or subtracting like terms: $\sqrt[3]{729w^4} - 3w\sqrt[3]{w} - \sqrt[3]{27w^7} + 3w^2$, $w \in \mathbb{R}$
A. $6w\sqrt[3]{w} - 3w^2\sqrt[3]{w} + 3w^2$ **C.** $6w\sqrt[3]{w}$
B. $6w\sqrt[3]{w} + 6w^2$ **D.** $3w\sqrt[3]{w} + 3w^2$

____ **30.** Expand and simplify this expression: $\left(\sqrt{5}-3\right)\left(5\sqrt{5}+4\right) - \left(4\sqrt{5}-5\right)^2$
A. $-18 + 31\sqrt{5}$ **C.** $-92 + 31\sqrt{5}$

B. $-18+29\sqrt{5}$ **D.** $-92+29\sqrt{5}$

____ **31.** Solve this equation: $3=\sqrt[4]{-9x}$
A. $x=-3$ **B.** $x=9$ **C.** $x=3$ **D.** $x=-9$

____ **32.** Factor this polynomial: $8x^2-18x-35$
A. $(2x+7)(4x+5)$ **C.** $(2x+7)(4x-5)$
B. $(2x-7)(4x+5)$ **D.** $(2x-7)(4x-5)$

____ **33.** Which statement is true for the equation $x=\sqrt{6x+7}$?
A. 7 and –1 are roots.
B. 7 is a root of the original equation and –1 is an extraneous root.
C. 1 is a root of the original equation and –7 is an extraneous root.
D. 7 and 1 are both extraneous roots.

____ **34.** Solve by factoring: $x^2+4x-21=0$
A. $x=-7$ or $x=3$ **C.** $x=7$ or $x=-3$
B. $x=-7$ or $x=-3$ **D.** $x=7$ or $x=3$

____ **35.** For which quadratic equation is $2+\sqrt{5}$ a solution?
A. $x^2-4x=1$ **C.** $x^2-2x=5$
B. $x^2-2x=3$ **D.** $x^2-4x=3$

____ **36.** Determine the value of that makes $x^2-13x+\square$ a perfect square.
A. 169 **B.** 84.5 **C.** 6.5 **D.** 42.25

____ **37.** Solve $x^2+8x+13=0$ by completing the square.
A. $x=-4\pm\sqrt{3}$ **C.** $x=64\pm\sqrt{3}$
B. $x=4\pm\sqrt{19}$ **D.** $x=-8\pm\sqrt{19}$

____ **38.** The roots of any quadratic equation are: $x=\dfrac{-b+\sqrt{b^2-4ac}}{2a}$ and $x=\dfrac{-b-\sqrt{b^2-4ac}}{2a}$
Which expression represents the product of these roots?
A. $-\dfrac{2c}{a}$ **B.** $4ac$ **C.** $\dfrac{c}{a}$ **D.** $\dfrac{2b^2}{a}$

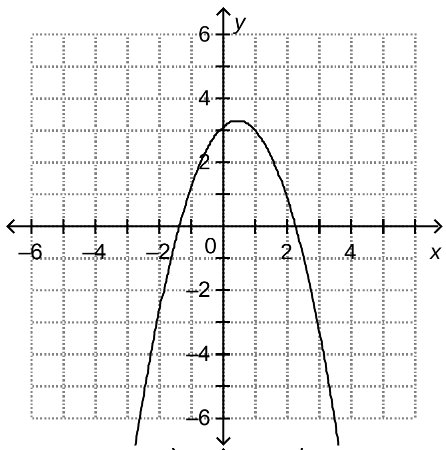
____ **39.** Without solving, determine the number of real roots of this equation: $x^2-x+2=0$
A. 2 **B.** 0 **C.** 1

____ **40.** For a quadratic function, which characteristic of its graph is equivalent to the zero of the function?
A. minimum point **C.** *x*-intercept
B. maximum point **D.** *y*-intercept

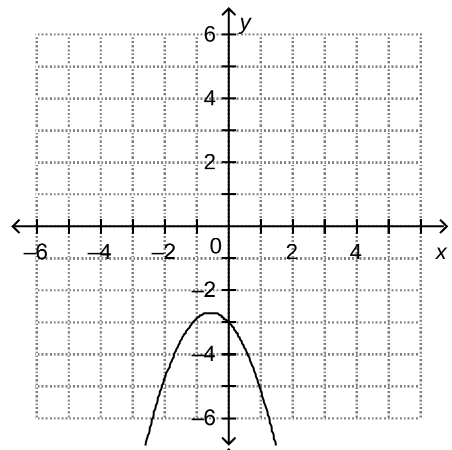
____ **41.** Which statement below is NOT true for the graph of a quadratic function?
A. The vertex of a parabola is its highest or lowest point.
B. When the coefficient of x^2 is positive, the vertex of the parabola is a minimum point.
C. The axis of symmetry intersects the parabola at the vertex.
D. The parabola is symmetrical about the *y*-axis.

____ **42.** Which graph represents the quadratic function $y=-x^2+x-3$?

A.



C.



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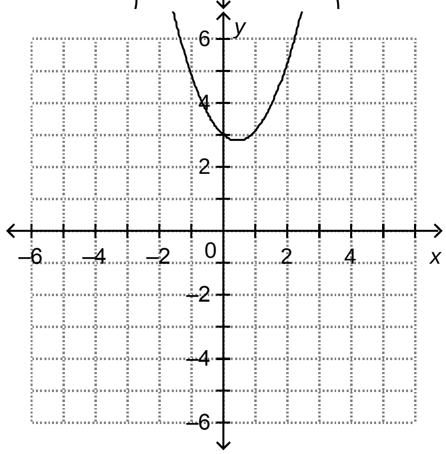
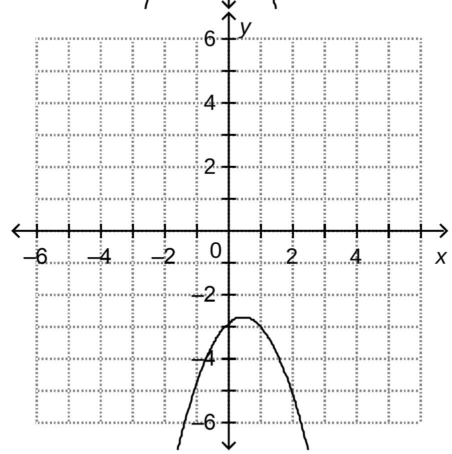


D.



____ **43.** Identify the quadratic function that this table of values represents, then determine the value of y when $x = 7$.

x	y
–1	–9
0	–3
3	–33

A. $y = 4x^2 - 2x + 3$; 185
C. $y = -4x^2 + 2x - 3$; –185
B. $y = 4x^2 - 2x - 3$; 185
D. $y = -4x^2 + 2x + 2$; –182

____ **44.** Which of the following describes the translation that would be applied to the graph of $y = x^2$ to get the graph of $y = (x-4)^2$?

A. Translate 4 units right
C. Translate 4 units up
B. Translate 4 units left
D. Translate 4 units down

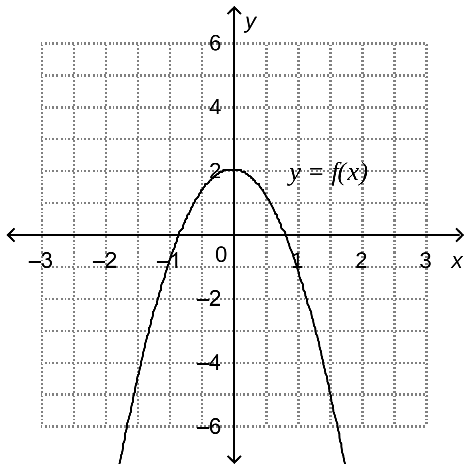
____ **45.** Which statement is NOT true for the graph of $y = x^2 + q$?

A. When q is positive, the graph lies above the x-axis.
B. As q increases, the graph moves up.
C. When q is negative, the vertex is above the x-axis.
D. The graph has the same size and shape as the graph of $y = x^2$.

____ **46.** Which statement is NOT true for the graph of $y = ax^2$?

A. When *a* is greater than 1, the graph is the image of the graph of $y = x^2$ after a vertical stretch.
B. When $0 < a < 1$, the graph is the image of the graph of $y = x^2$ after a vertical compression and a reflection in the *x*-axis.
C. The vertex of the graph is always at the origin.
D. When *a* is less than -1, the graph is the image of the graph of $y = x^2$ after a vertical stretch and a reflection in the *x*-axis.

____ **47.** Determine an equation of this graph of a quadratic function.



A. $y = -\frac{1}{3}x^2 + 2$

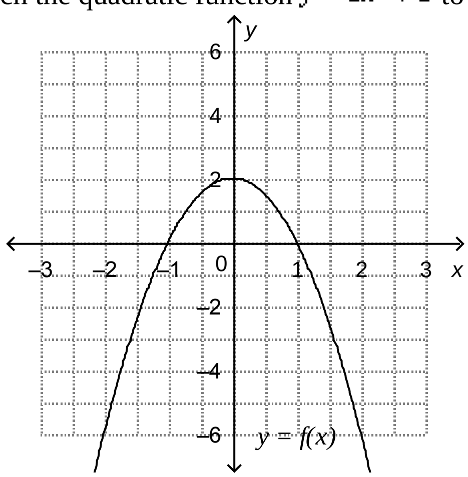
B. $y = -3x^2 + 2$

C. $y = 3x^2$

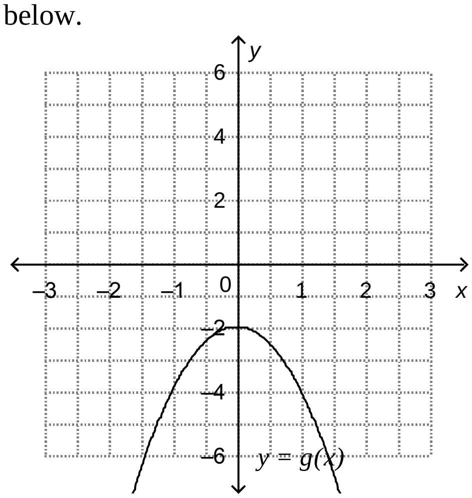
D. $y = \frac{1}{3}x^2 - 2$

____ **48.** Match the quadratic function $y = 2x^2 + 2$ to a graph below.

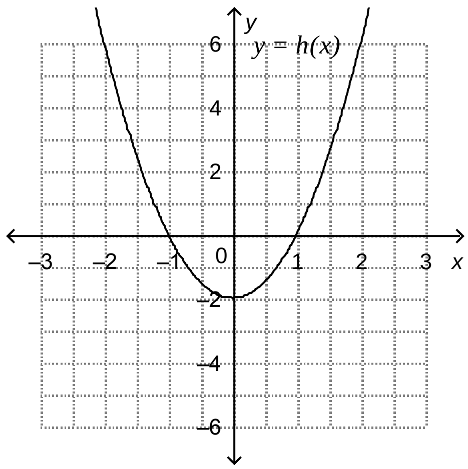
A.



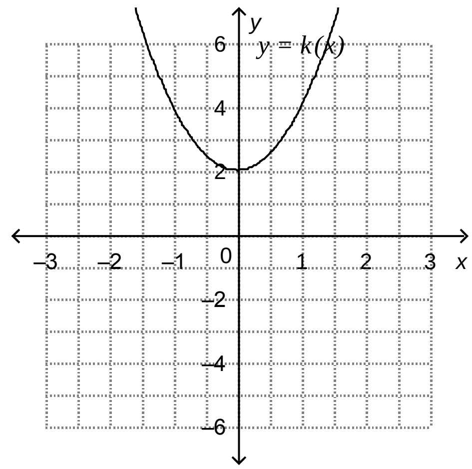
C.



B.



D.



____ **49.** Determine an equation of a quadratic function with the given characteristics of its graph: coordinates of the vertex: V(0, 2); passes through A(–2, –18)

A. $y = -2x^2 + 2$
B. $y = -18x^2 - 2$
C. $y = -5x^2 - 2$
D. $y = -5x^2 + 2$

____ **50.** Which equation represents the same quadratic function as $y = (x+3)^2 - 1$?

A. $x^2 - 2x + 8$
B. $x^2 + 6x + 8$
C. $x^2 + 8x + 6$
D. $x^2 - 6x + 8$

____ **51.** Which equation represents the same quadratic function as $y = -2(x-3)^2 + 5$?

A. $-2x^2 - 12x - 13$
B. $2x^2 - 12x + 23$
C. $-2x^2 + 12x - 18$
D. $-2x^2 + 12x - 13$

____ **52.** Two numbers have a difference of 12 and their product is a minimum. Determine the numbers.

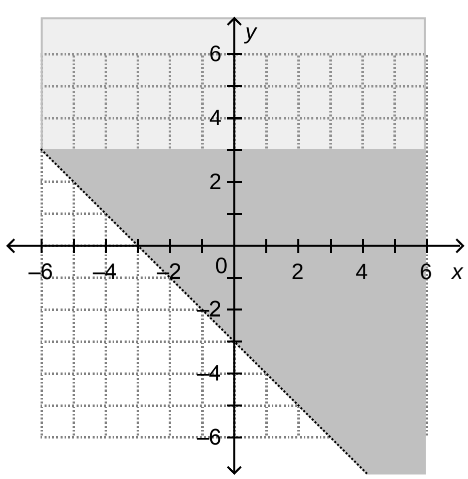
A. –6 and 6 **B.** –3 and 9 **C.** 6 and 18 **D.** 0 and 12

____ **53.** Which coordinates are a solution of the inequality $4x - 2y < -2$?

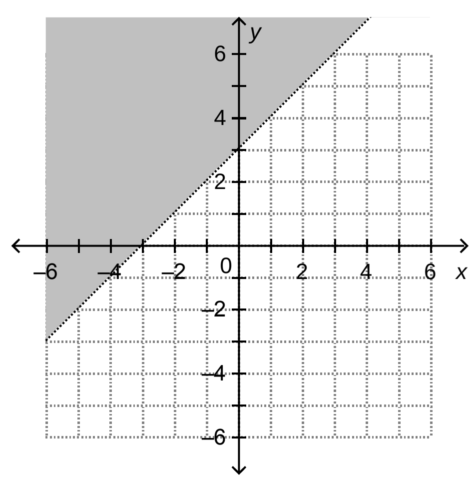
A. (2, 8) **B.** (0, 1) **C.** (3, 7) **D.** (5, 8)

____ **54.** Match the inequality $-3x + 3y > -9$ to its graph.

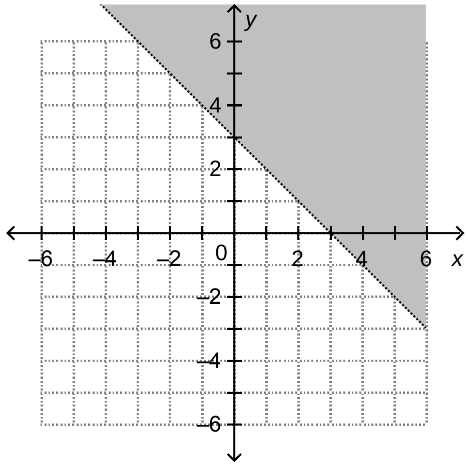
A.



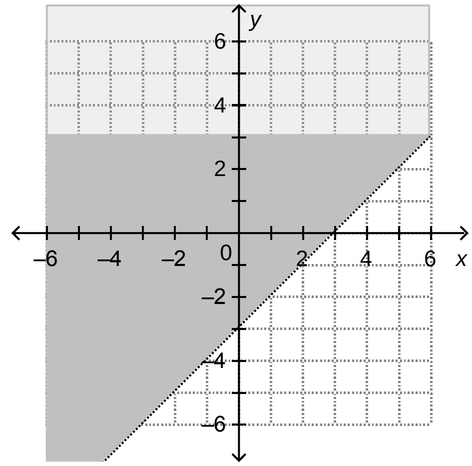
C.



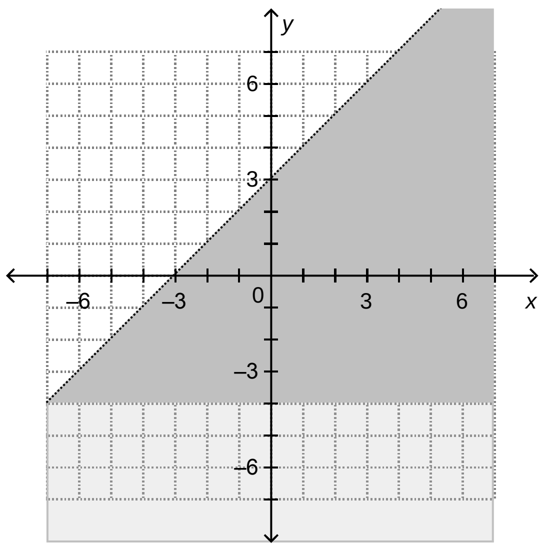
B.



D.



____ **55.** Write an inequality to describe this graph.

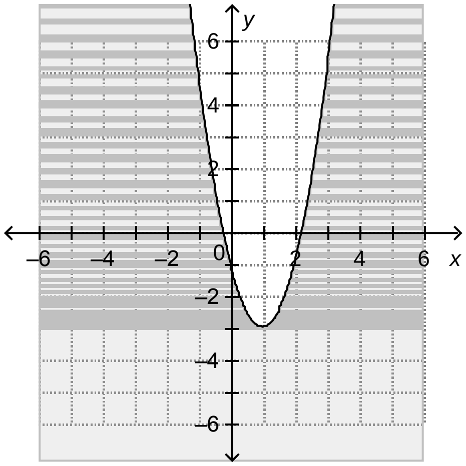


A. $-3x + 3y < -9$
B. $3x - 3y > -9$
C. $3x - 3y < -9$
D. $-3x + 3y > -9$

____ **56.** Which ordered pair is a solution of the quadratic inequality $y > 5x^2 - 3$?

A. (3, 36) **B.** (1, 1) **C.** (–1, 2) **D.** (2, 19)

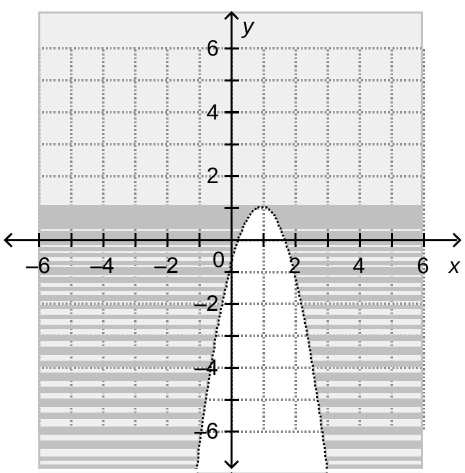
____ **57.** Which statement describes an error in the graph of $y < 2x^2 - 4x - 1$?



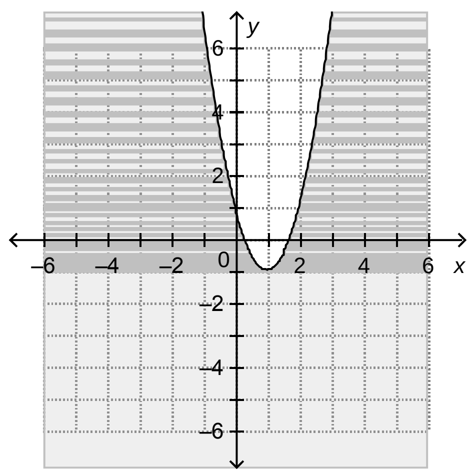
A. The incorrect region is shaded.
B. The parabola opens in the wrong direction.
C. The vertex is incorrect.
D. The parabola should be a broken line.

____ **58.** Which graph represents the inequality $y > 2(x-1)^2 - 1$?

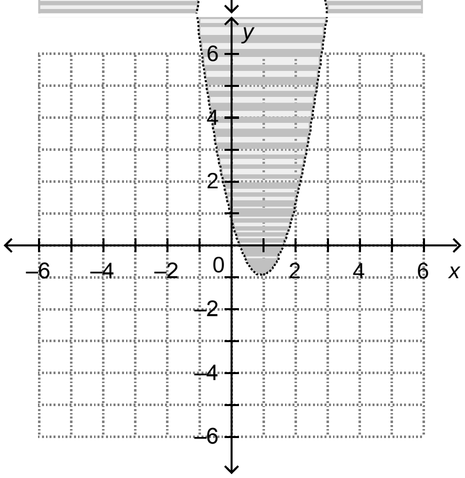
A.



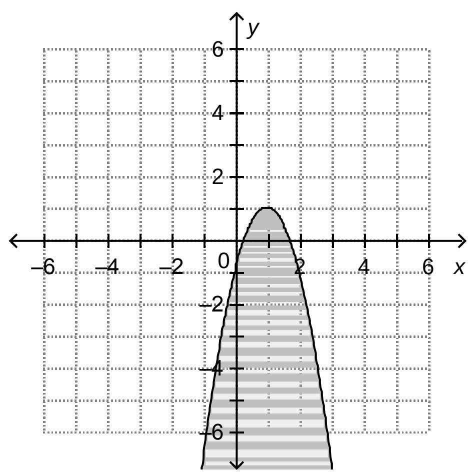
C.



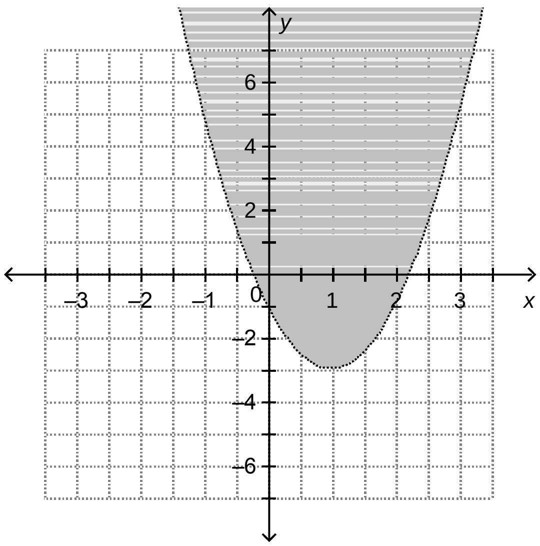
B.



D.



____ **59.** Write an inequality to describe this graph.



A. $y < 2(x-1)^2 - 3$

B. $y \geq 2(x+1)^2 + 3$

C. $y \leq 2(x+1)^2 + 3$

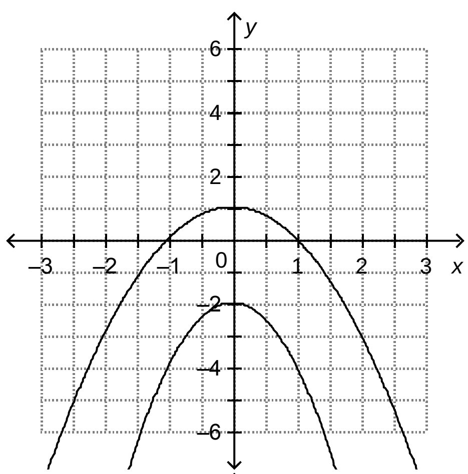
D. $y > 2(x-1)^2 - 3$

____ **60.** Use a graphing calculator. Which graph represents this system of equations?

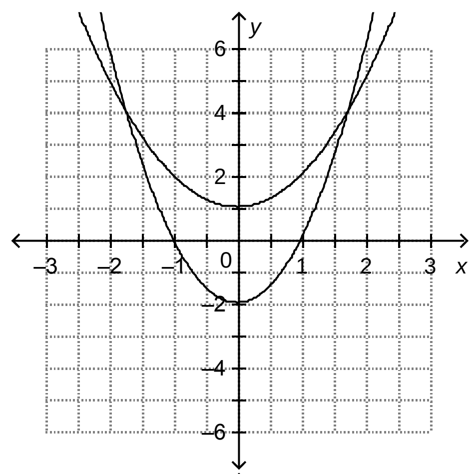
$y = -x^2 + 1$

$y = -2x^2 - 2$

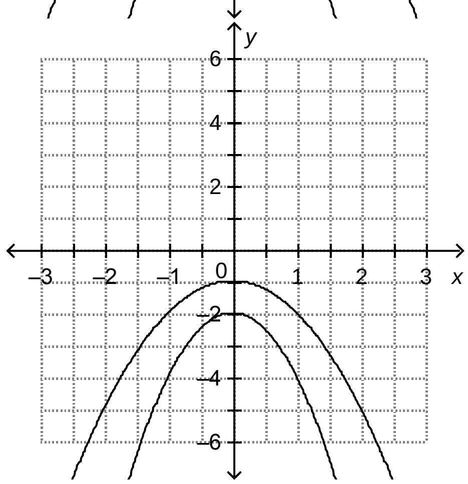
A.



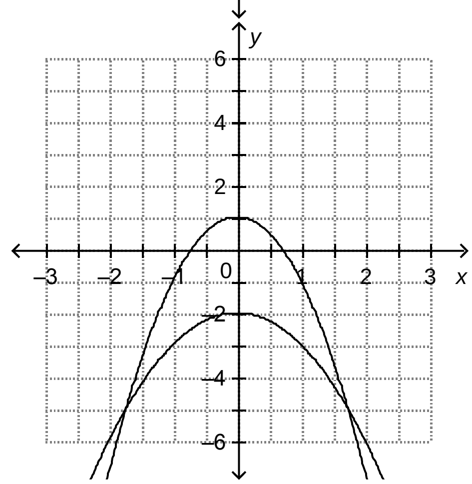
C.



B.



D.



____ **61.** Point P(9, 4) is on the terminal arm of an angle θ in standard position. To the nearest tenth, determine the distance from the origin to P.

A. 6.5 **B.** 9.8 **C.** 13.0 **D.** 5.1

____ **62.** Point P(x, y) is on the terminal arm of a 35° angle in standard position. The distance r between P and the origin is 7. To the nearest tenth, determine the coordinates of P.

A. (5.7, 4.0) **B.** (4.0, 5.7) **C.** (2.4, 6.6) **D.** (8.0, 11.5)

____ **63.** A helicopter is ascending vertically. On the ground, a searchlight is 175 m from the point where the helicopter lifted off. It shines on the helicopter and the angle the beam makes with the ground is 50°. To the nearest metre, how high is the helicopter at this point?

A. 147 m **B.** 134 m **C.** 209 m **D.** 272 m

____ **64.** In ΔDEF, DE = 8 cm and ∠D = 60°. When EF = 7 cm, how many triangles are possible?

A. 0 **B.** 2 **C.** 3 **D.** 1

____ **65.** In ΔXYZ, XY = 6 cm and ∠X = 33°. For which value of YZ is no triangle possible?

A. 6 cm **B.** 3 cm **C.** 4 cm **D.** 12 cm

____ **66.** In ΔLMN, LM = 9.7 m and ∠L = 56°. For which value of MN can an isosceles triangle be drawn?

A. 8 m **B.** 9.7 m **C.** 8.3 m **D.** 11.7 m

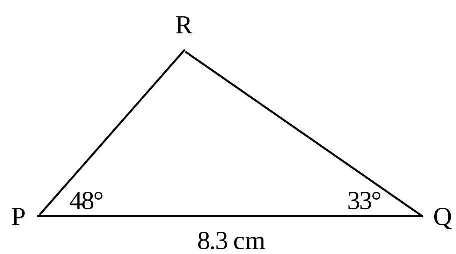
____ **67.** In ΔDEF, DE = 11 cm and EF = 9 cm. For which measure of ∠D is it possible to draw two scalene triangles?

A. 54° **B.** 65° **C.** 58° **D.** 90°

____ **68.** In ΔPQR, PQ = 6.2 cm and ∠P = 46°. For what value of QR is ΔPQR a right triangle with ∠R = 90°? Where necessary, give the answer to the nearest tenth.

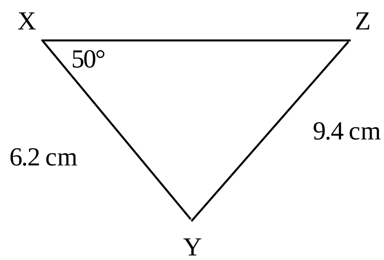
A. 4.5 cm **B.** 5.9 cm **C.** 8.6 cm **D.** 6.2 cm

____ **69.** For ΔPQR, determine the length of QR to the nearest tenth of a centimetre.



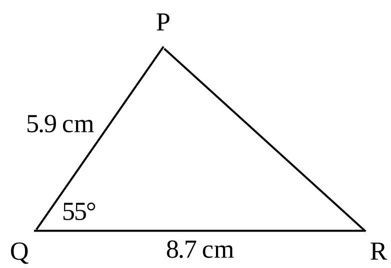
A. 6.2 cm **B.** 3.4 cm **C.** 15.2 cm **D.** 4.6 cm

____ **70.** For ΔXYZ, determine the measure of ∠Z to the nearest degree and the measure of XZ to the nearest tenth of a centimetre.



A. $\angle Z = 28°$; XZ = 7.3 cm
B. $\angle Z = 30°$; XZ = 12.1 cm
C. $\angle Z = 53°$; XZ = 8.0 cm
D. $\angle Z = 59°$; XZ = 4.8 cm

____ **71.** In ΔPQR, determine the measure of ∠R to the nearest degree.



A. 42° **B.** 86° **C.** 83° **D.** 7°

____ **72.** Which of the following are the non-permissible values for this rational expression?

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

A. $n = 0$, $n = 3$, and $n = 1$
B. $n = 0$, $n = -3$, and $n = -1$
C. $n = 0$ and $n = 1$
D. $n = 0$ and $n = -1$

____ **73.** Simplify this rational expression and state the non-permissible values of the variable.

$$\frac{m^2 - 16}{m^2 + 6m + 8}$$

A. $\frac{m+4}{m+2}$; $m = -4$ and $m = -2$
B. $\frac{m-4}{m+2}$; $m = 4$ and $m = 2$
C. $\frac{m-4}{m+2}$; $m = -4$ and $m = -2$
D. $\frac{m+4}{m+2}$; $m = -4$ and $m = 2$

____ **74.** Simplify this expression:

$$\frac{5a^3bc}{8ab^3} \div \frac{-ab^2}{6a^5b} \cdot \frac{2a^2b^3}{3b}$$

A. $\frac{-5bc}{72}$, $a \neq 0, b \neq 0$
B. $\frac{-5a^8c}{2b}$, $a \neq 0, b \neq 0, c \neq 0$
C. $\frac{-5bc}{72}$, $a \neq 0, b \neq 0, c = 0$
D. $\frac{-5a^8c}{2b}$, $a \neq 0, b \neq 0$

____ **75.** Simplify.

$\frac{5}{a} + \frac{9}{7}$

A. $\frac{9a+35}{7a}$, $a \neq 0$

B. $\frac{14}{a+7}$, $a \neq -7$

C. $\frac{9a+35}{a+7}$, $a \neq -7$

D. $\frac{14}{7a}$, $a \neq 0$

____ **76.** Simplify.

$\frac{1}{r} - \frac{5r^2-1}{2r} - 5r$

A. $\frac{-5r^2-5r+2}{-r}$, $r \neq 0$

B. $\frac{-5r^2-5r+2}{2r}$, $r \neq 0$

C. $\frac{-15r^2+3}{2r}$, $r \neq 0$

D. $\frac{-15r^2+3}{2r^2}$, $r \neq 0$

____ **77.** Simplify.

$\frac{3-2y}{2y^3} - \frac{3-y}{6y^2}$

A. $\frac{-3y}{6y^3}$, $y \neq 0$

B. $\frac{y^2-9y+9}{6y^3}$, $y \neq 0$

C. $\frac{y^2-3y+3}{2y^3}$, $y \neq 0$

D. $\frac{-y}{6y^3}$, $y \neq 0$

____ **78.** Simplify.

$pq - \frac{p-q}{p} + \frac{p+q}{q}$

A. $\frac{pq}{p+q}$, $p \neq 0, q \neq 0$

B. $1, p \neq 0, q \neq 0$

C. $\frac{p^2q^2+p^2+q^2}{pq}$, $p \neq 0, q \neq 0$

D. $\frac{p^2q^2+p^2+q^2+2pq}{pq}$, $p \neq 0, q \neq 0$

____ **79.** Which expression is equivalent to $\frac{mn^2+1}{mn} - \frac{2n-1}{2}$?

A. $\frac{mn^2-2n}{mn-2}$, $mn \neq 2$

B. $\frac{mn+2}{2mn}$, $m \neq 0, n \neq 0$

C. $\frac{mn^2-2n}{2mn}$, $m \neq 0, n \neq 0$

D. $\frac{2-mn}{2mn}$, $m \neq 0, n \neq 0$

____ **80.** Simplify.

$\frac{7d}{d+6} - \frac{2d}{d+6}$

A. $\frac{5}{d+6}$, $d \neq -6$

B. $\frac{5d}{d+6}$, $d \neq -6$

C. $\frac{5d}{d+6}$, $d \neq 0$

D. none of the above

____ **81.** Simplify.

$\dfrac{r+6}{r-2}+\dfrac{4}{2-r}$

A. $\dfrac{r+10}{(r-2)^2}$, $r \neq 2$

B. $\dfrac{r+2}{r-2}$, $r \neq 2$

C. $\dfrac{r+2}{(r-2)^2}$, $r \neq 2$

D. $\dfrac{r+10}{r-2}$, $r \neq 2$

____ **82.** Which statement about the absolute value function $y = |x-6|$ is NOT true?

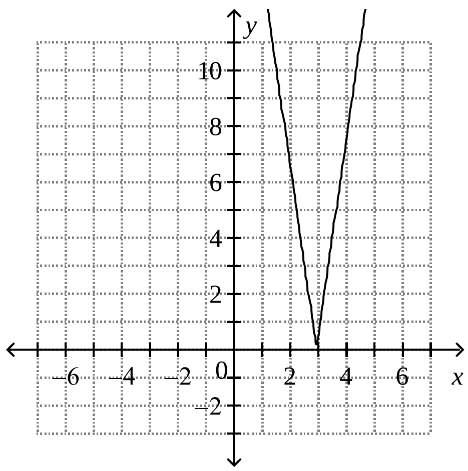
A. Its graph is the same as the graph of $y = -(x-6)$ when $x \leq 6$.

B. Its graph is the same as the graph of $y = x-6$ when $x \leq 6$.

C. Its graph is the same as the graph of $y = -x+6$ when $x \leq 6$.

D. Its graph is the same as the graph of $y = x-6$ when $x \geq 6$.

____ **83.** Which absolute value function is represented by this graph?



A. $y = |7x-21|$

B. $y = |7x^2-21|$

C. $y = |-7x-21|$

D. $y = |7x^2-21x|$

____ **84.** The graph of which absolute value function would have *x*-intercepts $\sqrt{2}$ and $-\sqrt{2}$ and *y*-intercept 4?

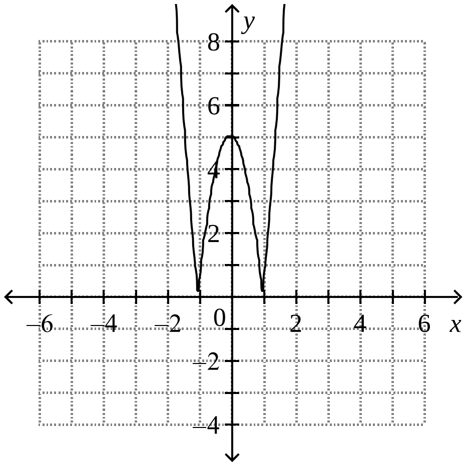
A. $y = |2x-4|$

B. $y = |x^2-4|$

C. $y = |2x^2-4|$

D. $y = |-4x^2+2|$

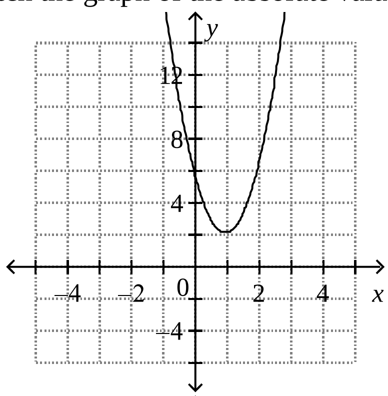
____ **85.** Which absolute value function is represented by this graph?



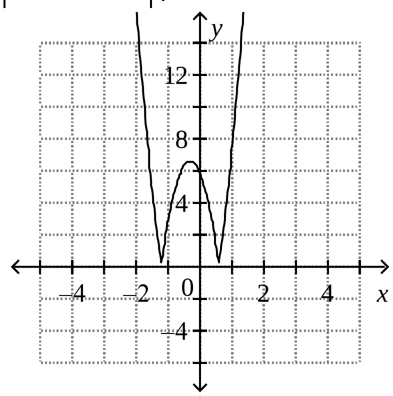
A. $f(x) = |-5x + 5|$
B. $f(x) = |x^2 + 5|$
C. $f(x) = |-5x^2 + 5|$
D. $f(x) = |5x^2 + 5|$

____ **86.** Sketch the graph of the absolute value function $y = |4x^2 - 8x + 6|$.

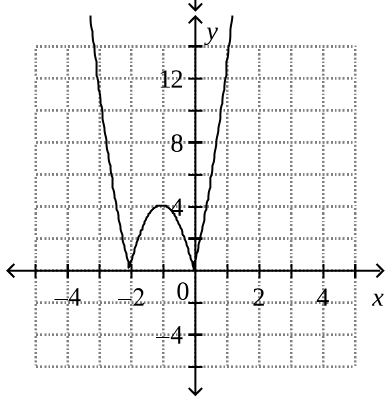
A.



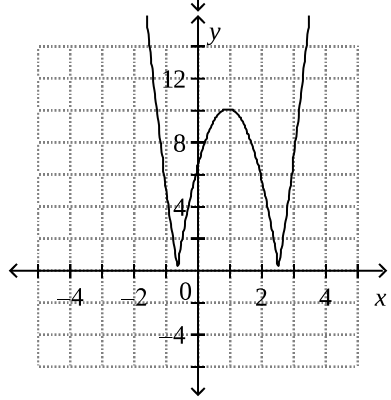
C.



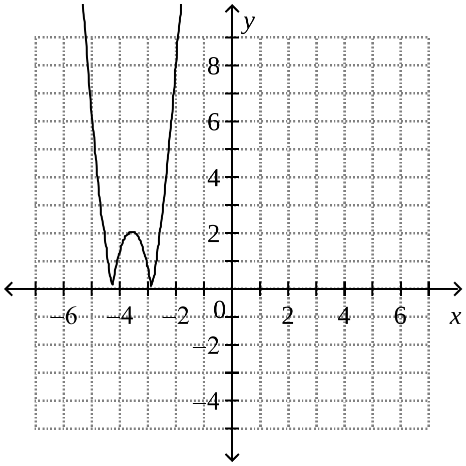
B.



D.



____ **87.** Which absolute value function is represented by this graph?



A. $y = \left|(-2x-2)^2 - 7\right|$
B. $y = \left|(-2x-7)^2 - 2x\right|$
C. $y = \left|(-2x-7)^2 - 2\right|$
D. $y = \left|(-2x-7)^2 + 4\right|$

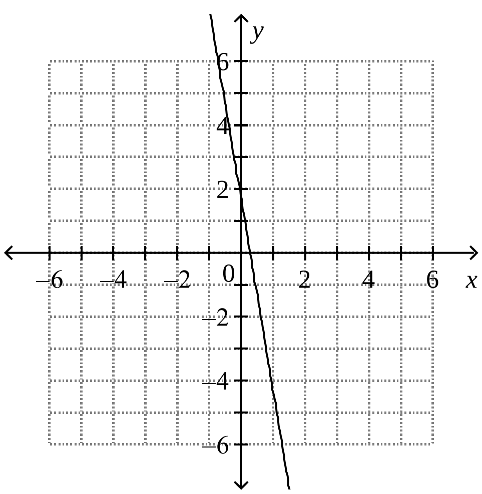
____ **88.** The function $y = f(x)$ is linear. The line $y = 14$ intersects the graph of $y = \left|f(x)\right|$ at (6, 14) and (–8, 14). The line $y = 6$ intersects the graph of $y = \left|f(x)\right|$ at (2, 6) and (–4, 6). What is an equation for the function $y = f(x)$?

A. $y = 2x + 2$
B. $y = 2x - 2$
C. $y = 3x - 2$
D. $y = 3x + 2$

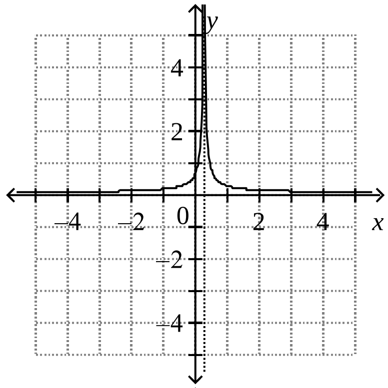
____ **89.** For the function $y = 8x + 1$, write the equation of its reciprocal function.

A. $y = \dfrac{1}{8x+1}$
B. $y = -8x - 1$
C. $y = \dfrac{1}{-8x-1}$
D. $y = \dfrac{1}{9x}$

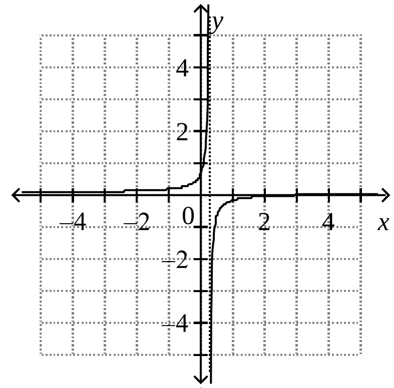
____ **90.** This is the graph of a linear function. Which graph below represents the reciprocal function and its asymptotes?



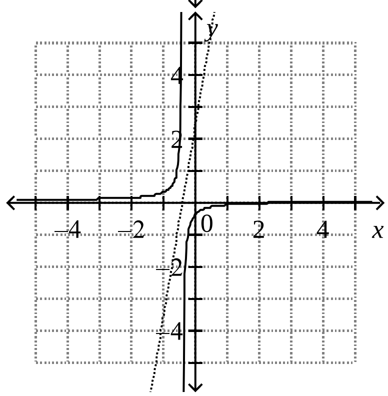
A.



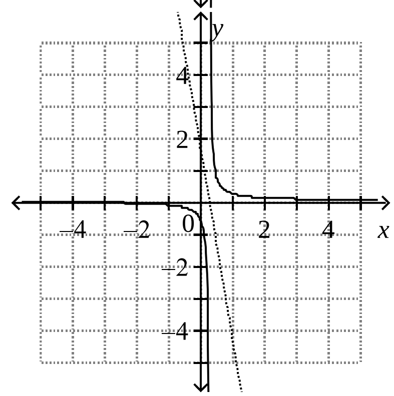
C.



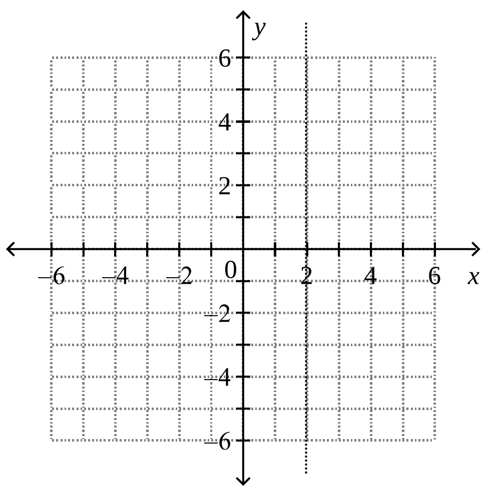
B.



D.



____ **91.** The graph of the reciprocal of a linear function has this vertical asymptote. What is the linear function?



A. $y = -2x - 4$

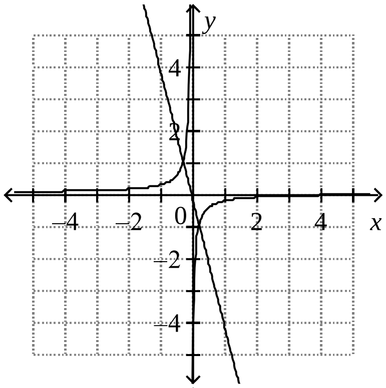
B. $y = -2x - 3$

C. $y = -2x + 4$

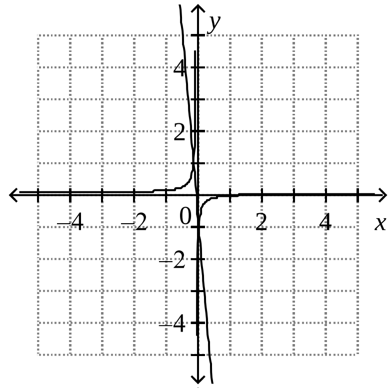
D. $y = 2x - 3$

____ **92.** Which graph represents the function $y = -4x$ and its reciprocal function $y = \dfrac{1}{-4x}$?

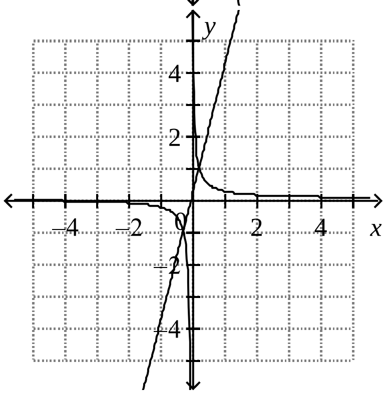
A.



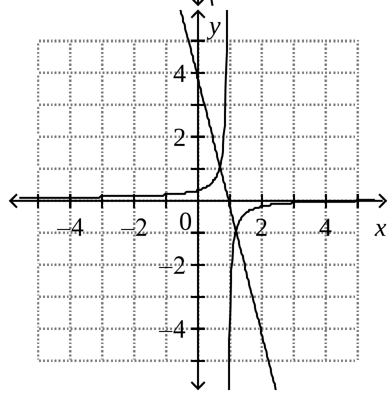
C.



B.

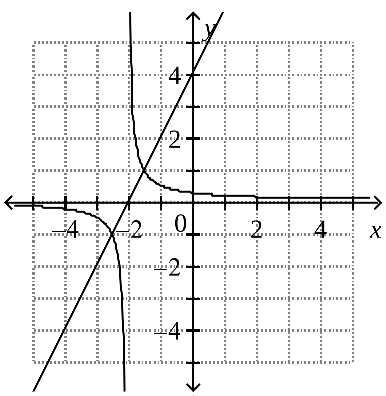


D.

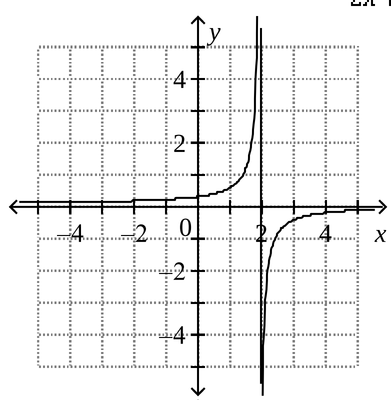


____ **93.** Which graph represents the function $y = -2x + 4$ and its reciprocal function $y = \dfrac{1}{-2x + 4}$?

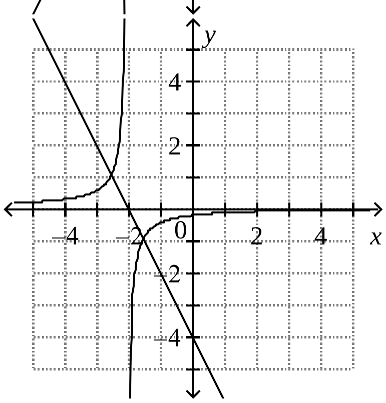
A.



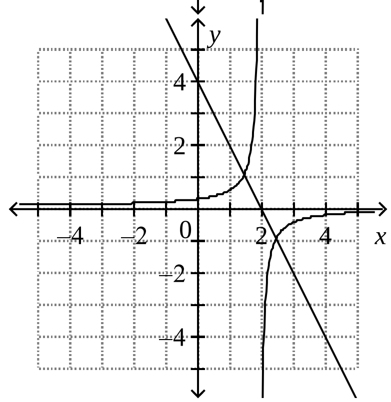
C.



B.



D.



____ **94.** The equation of the vertical asymptote of the graph of the reciprocal of a linear function is $x = -2$. Which is a possible equation of the reciprocal function?

A. $y = \dfrac{1}{2x-4}$

B. $y = 4x + 6$

C. $y = \dfrac{1}{-2x+4}$

D. $y = \dfrac{1}{2x+4}$

____ **95.** The equation of the vertical asymptote of the graph of the reciprocal of a linear function is $x = \frac{1}{2}$. Which is a possible equation of the reciprocal function?

A. $y = \dfrac{1}{16x+8}$

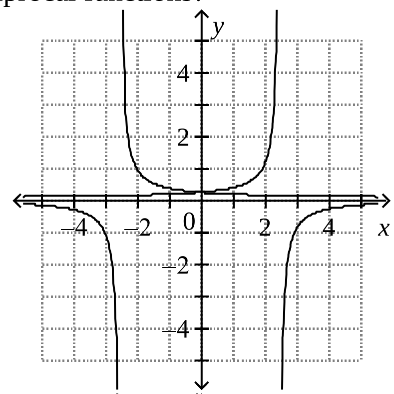
B. $y = \dfrac{1}{-16x-8}$

C. $y = \dfrac{1}{-16x+8}$

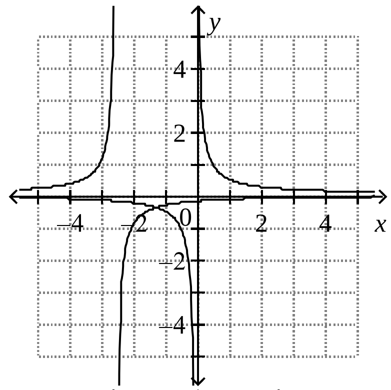
D. $y = -32x - 8$

____ **96.** The graphs of two distinct linear functions $y = f(x)$ and $y = g(x)$ are parallel. Their reciprocal functions, $y = \dfrac{1}{f(x)}$ and $y = \dfrac{1}{g(x)}$, are graphed on the same grid. Which graph below is a possible graph of the two reciprocal functions?

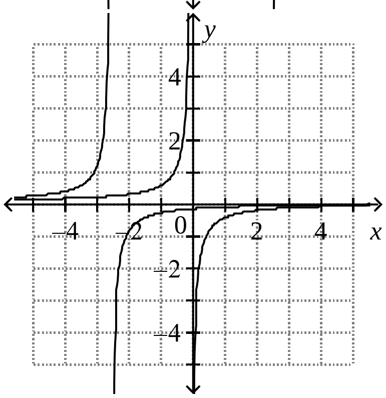
A.



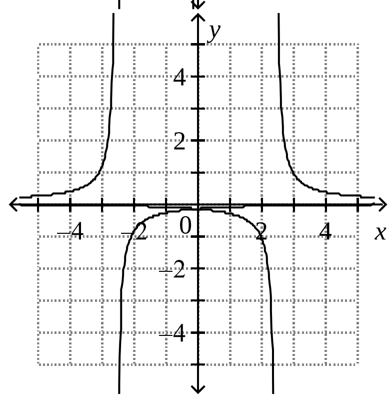
C.



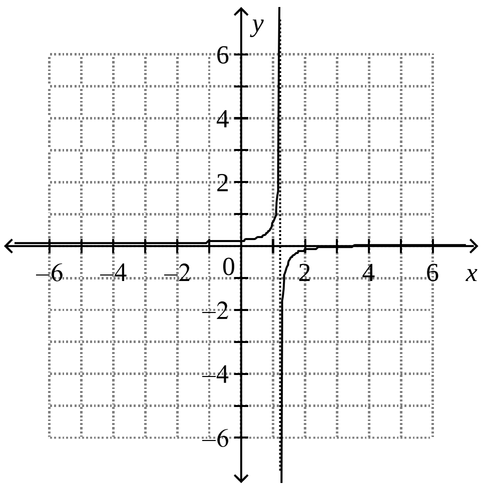
B.



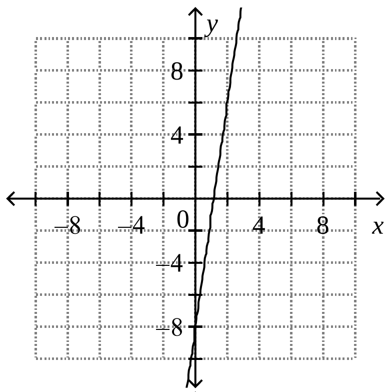
D.



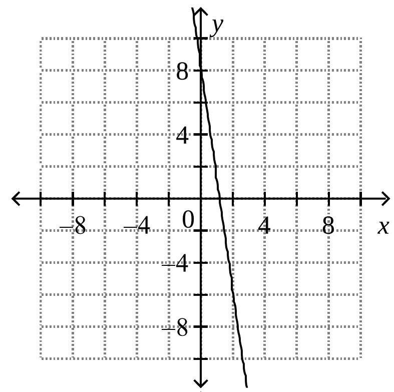
____ **97.** This is the graph of the reciprocal of a linear function. Which graph below represents the linear function?



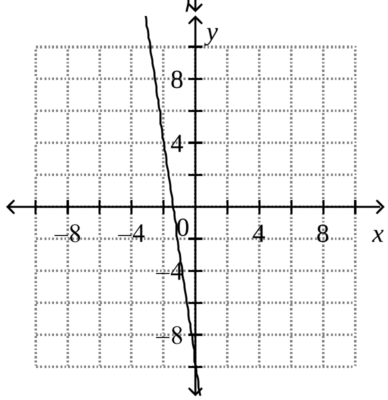
A.



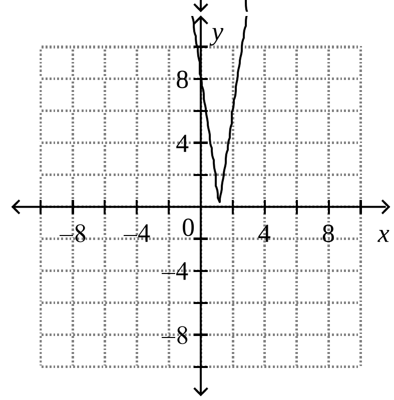
C.



B.



D.



____ **98.** Without graphing, determine the equations of the vertical asymptotes of the graph of $y = \dfrac{1}{-x^2 + 11}$.

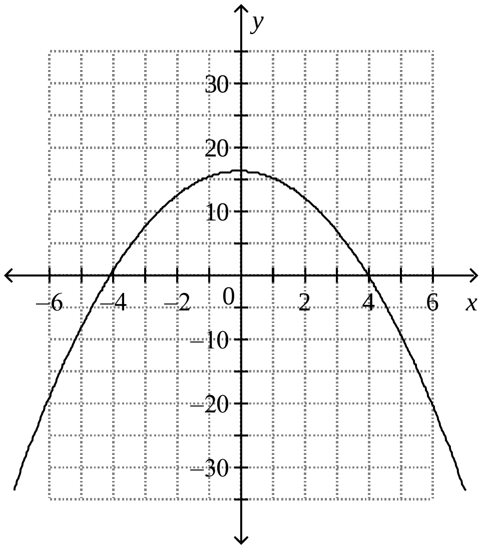
A. $x = 11$ and $x = -11$

B. $x = 0$

C. $x = \sqrt{11}$ and $x = -\sqrt{11}$

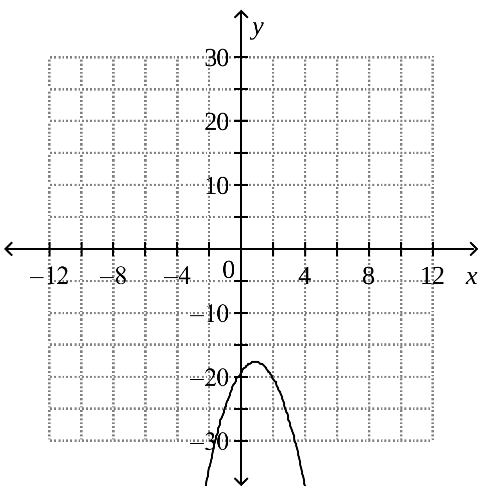
D. no vertical asymptotes

____ **99.** This is a graph of $y = -x^2 + 16$. Identify the vertical asymptotes of the graph of the reciprocal function.



A. $y = 4$ and $y = -4$
B. $x = 16$ and $y = -16$
C. $x = 4$ and $x = -4$
D. no vertical asymptotes

____ **100.** This is a graph of $y = -2(x-1)^2 - 18$. Identify the vertical asymptotes of the graph of the reciprocal function.

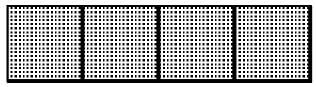


A. $y = 4$ and $y = -4$
B. $x = 1$ and $x = 18$
C. $x = 4$ and $x = -2$
D. no vertical asymptotes

Problem

1. Tempel 1 is a periodic comet that orbits the Sun every 5.5 years and was last seen in the year 2005. If Tempel 1 maintains its current orbit around the Sun, will it appear in the year 2093?

2. A convention centre uses square tables arranged in a single row as shown below. Each square table seats 4 people, but adding another square table adds only 2 more seats. The number of seats for a given number of tables can be represented by an arithmetic sequence.



a) Determine the first 5 terms of the arithmetic sequence.
b) How many seats are there if 10 tables are arranged in a single row?

3. In this arithmetic sequence, k is a natural number: $k, \frac{3k}{5}, \frac{k}{5}, -\frac{k}{5}, \ldots$

a) Determine t_6.

b) Write an expression for t_n.

c) Suppose $t_{20} = -33$; determine the value of k.

4. Use the given data about each arithmetic series to determine the indicated value.
a) $-4 - 2 - 0 + 2 + \ldots$; determine S_{16}
b) $t_1 = 23$ and $d = -9$; determine S_{17}
c) $t_1 = 16$ and $t_{94} = 806.5$; determine S_{94}

5. Use the given data about each arithmetic series to determine the indicated value.
a) $S_{12} = 228$ and $t_{12} = 41$; determine t_1
b) $S_n = -4584.5$, $t_1 = 17.5$, and $t_n = -190.5$; determine n

6. a) A geometric sequence has these terms:
$t_4 = 8$, $t_5 = 2$, $t_6 = \frac{1}{2}$
State the common ratio, then write the first 3 terms of the sequence.
b) Identify the sequence as convergent or divergent. Explain.

7. The first term in a geometric sequence is 0.0005. Each term is double the previous term.
What is term 25?

8. The sum of the first 6 terms of a geometric series is –315. The common ratio is 2. Determine t_1.

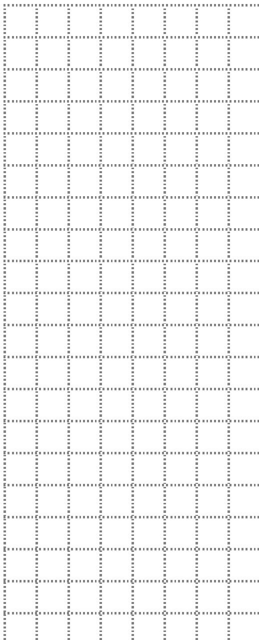
9. A robotic frog is programmed to make a sequence of jumps, each jump $\frac{1}{4}$ the length of the preceding one. A frog is programmed to jump to a position 12 m away in 12 jumps. Determine the horizontal distance of each of the first 3 jumps. Give your answers to the nearest hundredth of a metre.

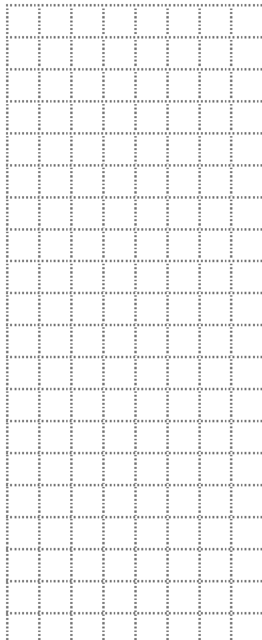
10. Suppose the lengths of a frog's jumps form a geometric series. After 12 jumps, the frog has travelled a horizontal distance of approximately 6265.56 cm. The common ratio is $\frac{7}{5}$.
Determine the length of the frog's first jump.

11. a) Without graphing, describe the graph of this geometric sequence:
3, 9, 27, 81, 243, 729, ...

b) Without graphing, describe the graph of the partial sums of this geometric series:
$3 + 9 + 27 + 81 + 243 + 729 + \ldots$

c) Verify your descriptions by graphing. Sketch and label each graph on a grid below.

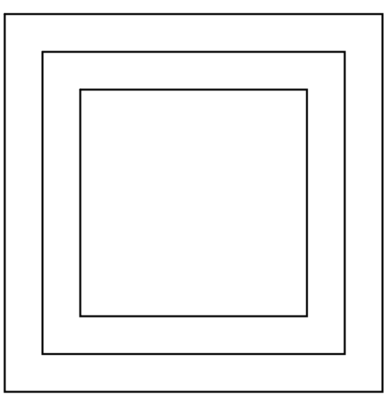




12. An infinite geometric series with $r = -\frac{1}{9}$ is represented by this equation: $t_n = -5\left(-\frac{1}{9}\right)^{n-1}$

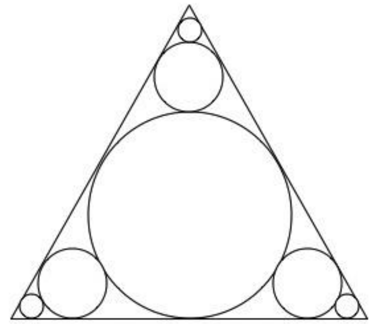
a) Determine the first 4 terms of the series.
b) Determine whether the series diverges or converges.
c) If the series has a finite sum, determine the sum.

13. Yvette created the design shown below. The perimeter of the largest square is 13 in. The perimeter of each subsequent square is 75% of the perimeter of the previous square. Suppose Yvette could continue her design indefinitely. Determine the sum of the perimeters of all the squares. Explain your work.



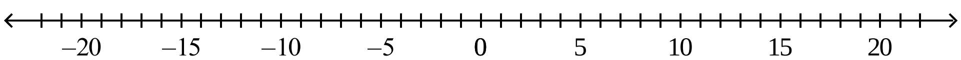
14.

A circle with radius 1.0 cm is inscribed inside an equilateral triangle, as shown. Smaller circles are then inscribed in the remaining space as shown. The radius of each smaller circle is $\frac{1}{3}$ the radius of the previous circle. Suppose the process continues indefinitely. Determine the sum of the areas of the circles.



15. Mark each number on the number line below and indicate its distance from 0.

A = 12 B = 9 C = $4\frac{1}{2}$ D = –18.5

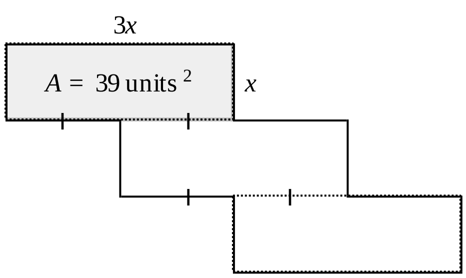


16. When 8 is added to an integer, *x*, the absolute value of the sum is 5. Determine a value for *x*. How many different values of *x* are possible? Show how you solved the problem.

17. A right triangle has legs of lengths $\frac{3}{2}x$ and x^2.

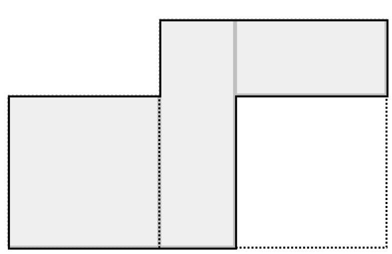
a) What are the restrictions on the variable *x*?
b) Write an expression for the length of the hypotenuse. Show your work.

18. Three congruent rectangles are joined as shown. The length of each rectangle is 3 times its width. The area of each rectangle is 39 square units. In simplest form, write a radical expression for the perimeter of the shape formed. Show your work.



19. A squuare with area 44 square units is cut from a larger square, then placed beside it as shown.

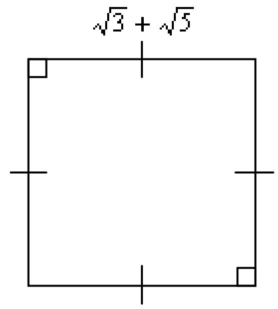
The side length of the larger square is $\frac{3}{2}$ times as long as the side length of the smaller square. In simplest form, write a radical expression for the perimeter of the shaded region. Show your work.



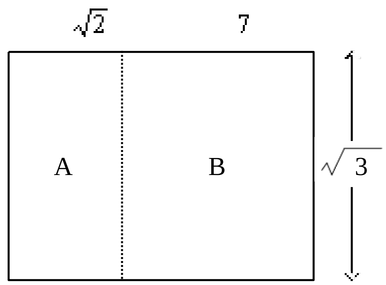
20. Expand and simplify this expression: $\left(-5\sqrt{2}+3\sqrt{3}\right)\left(-6\sqrt{2}-2\sqrt{3}\right)$

Show your work.

21. The side length of a square is $(\sqrt{3}+\sqrt{5})$ units.
Write, then simplify, a radical expression for the area of the square.
Show your work.



22. Rectangles A and B are placed side by side to form a large rectangle as shown.
Write, then simplify, a radical expression for the area of the large rectangle.
Show your work.



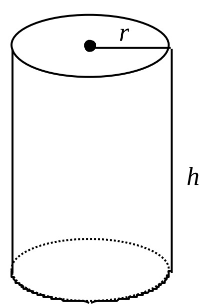
23. a) Identify the values of the variables for which this expression is defined.
b) Write the expression in simplest form. Show your work.

$$\frac{-5\sqrt{s}+3\sqrt{t}}{4\sqrt{s}-5\sqrt{t}}$$

24. Does this equation have a real root? Justify your answer.

$$\sqrt{2x+4} = \sqrt{-4+6x}$$

25. The formula $V = \pi r^2 h$ relates the volume, V, of the cylinder to its radius, r, and its height, h.
This cylinder has volume 260.4 cm^3, and height 18.6 cm.
What is the radius of the cylinder to the nearest tenth of a centimetre?



26. The volume of water in Lake Ontario is about 1710 km^3.
a) To the nearest kilometre, determine the edge length of a cube with the same volume.

b) To the nearest kilometre, determine the radius of a sphere with the same volume.

27. Consider the polynomial $5x^2 + kx - 9$. Determine a value for *k* so that $5x - 3$ is a factor of the polynomial. Explain your strategy.

28. The perimeter, *P*, of a rectangular concrete slab is 46 m and its area, *A*, is 90 m^2.
Use the formula $P = 2l + 2w$. Determine the dimensions of the slab. Show your work.

29. Solve this equation, then verify the solution: $\sqrt{x+14} = x - 16$
Explain your steps.

30. A student wrote the solution below to solve this equation: $(4x+1)^2 = (2x-3)^2$

$$(4x+1)^2 = (2x-3)^2$$
$$4x + 1 = 2x - 3$$
$$4x + 1 - 2x + 3 = 0$$
$$2x + 4 = 0$$
$$2(x+2) = 0$$
$$x = -2$$

Identify the error, then write the correct solution.

31. Solve $x^2 - 13x - 7 = 0$ by completing the square. Show your work.

32. A student wrote the solution below to solve this quadratic equation: $2x^2 - 12x - 13 = 0$

$$2x^2 - 12x - 13 = 0$$
$$2x^2 - 12x = 13$$
$$2(x^2 - 6x) = 13$$
$$2(x^2 - 6x + 9) = 13 + 9$$
$$2(x-3)^2 = 22$$
$$(x-3)^2 = 11$$
$$x - 3 = \pm\sqrt{11}$$
$$x = 3 \pm \sqrt{11}$$

The roots are: $x = 3 + \sqrt{11}$ and $x = 3 - \sqrt{11}$

Identify the error, then write the correct solution.

33. Solve this equation $x^2 - 4x + 3 = 0$ using each strategy below. Which strategy do you prefer? Explain why.
a) factoring
b) completing the square
c) using the quadratic formula

34. Consider this quadratic equation: $-x^2 + \frac{2}{3}x - \frac{1}{2} = 0$
a) Rewrite the equation so that it does not contain fractions.
b) Solve the equation. Explain your answer.

35. Determine the values of *k* for which the equation $9x^2 - kx + 1 = 0$ has exactly one real root, then write a possible equation.

36. Determine the values of k for which the equation $2x^2 - 3x + k = 0$ has no real roots, then write a possible equation.

37. Create two different quadratic equations whose discriminant is 64. Explain your strategy.

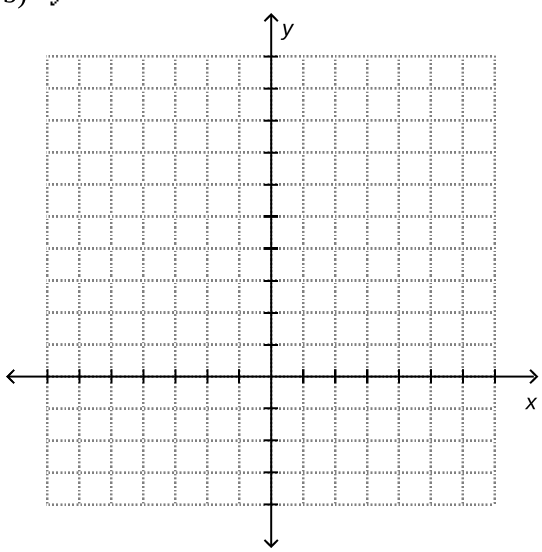
38. Use a graphing calculator to graph the quadratic function $y = -2x^2 - 1.5x + 3.25$.

Determine:
a) the intercepts
b) the coordinates of the vertex
c) the equation of the axis of symmetry
d) the domain of the function
e) the range of the function
Write the answers to the nearest hundredth, if necessary.

39. A toy rocket is launched from a platform. The height of the rocket, h metres, t seconds after launch is modelled by the equation $h = -4.9t^2 + 28t + 3$.
a) Use a graphing calculator to graph the quadratic function.
b) Determine the t-intercepts of the graph, to the nearest hundredth. What do they represent?
c) To the nearest metre, what is the greatest height that the rocket reached? Explain how you know.
d) What is the domain? What does it represent?

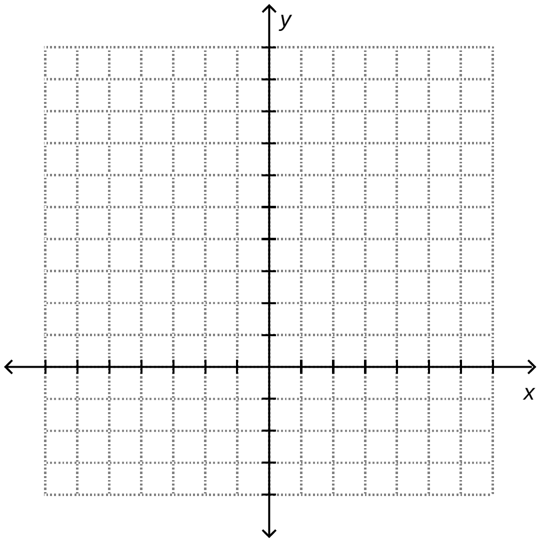
40. Use graphing technology to solve this equation: $x^2 + 16x + 63 = 0$
Explain your strategy.

41. Graph each quadratic function on the same grid without using a table of values or a graphing calculator. Explain your strategy each time.
a) $y = x^2 + 1$
b) $y = x^2 - 2$



42. Graph each quadratic function on the same grid without using a table of values or a graphing calculator. Explain your strategy each time.
a) $y = (x + 3)^2$

b) $y = (x - 4)^2$

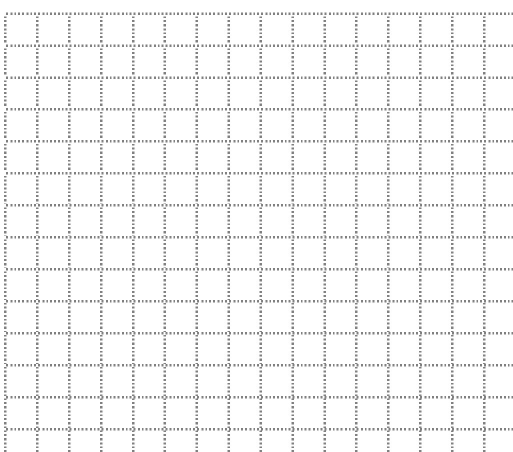


43. Determine an equation of a quadratic function with the given characteristics of its graph.
coordinates of the vertex: V(5, 4); *y*-intercept 79

44. For the quadratic function $y = -2(x - 4)^2 - 8$

a) Identify:
   i) the direction of opening
   ii) the vertex
   iii) the equation of the axis of symmetry
   iv) the intercepts
   v) the domain and range of the function

b) Sketch a graph. Explain your strategy.



45. What are the coordinates of the vertex of the parabola with equation $y = x^2 + 12x + 11$? Show your work.

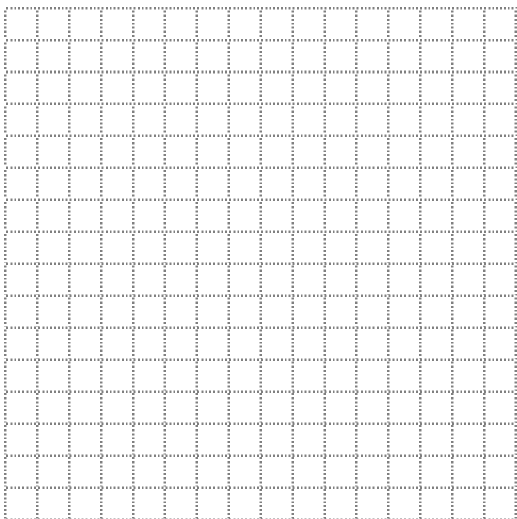
46. Write $y = x^2 - 7x - 13$ in standard form, then identify the coordinates of the vertex. Show your work.

47. a) Do the equations $y = 2x^2 - 12x + 23$ and $y = 2(x - 3)^2 + 5$ represent the same quadratic function? Show your work.

b) What are the advantages of rewriting $y = 2x^2 - 12x + 23$ in standard form? Identify the characteristics of the graph of the function.

48. Write $y = -\frac{1}{3}x^2 + 6x - 33$ in standard form. Explain your steps.

49. Sketch a graph of this quadratic function: $y = 2x^2 - x - 15$
Explain your steps.

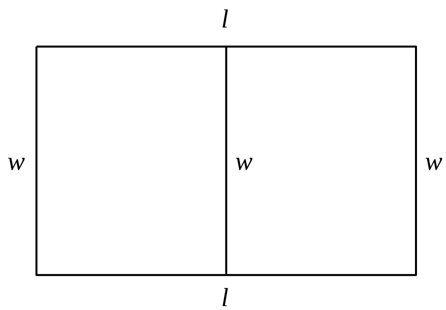


50. A bridge spans a horizontal distance of 70 m and has a parabolic arch. At the centre of the bridge, the arch is 25 m high. Determine an equation that represents this parabolic arch. Explain your strategy.

51. Identify the minimum value or the maximum value of this quadratic function: $y = 5(x - 6)^2 + 6$ Explain how you know.

52. A toy rocket is launched from a platform. Its height, *h* metres, after *t* seconds is modelled by the equation $h = -4.9t^2 + 20t + 2$. Use a graphing calculator to determine the maximum height of the rocket and the amount of time the rocket was in the air.

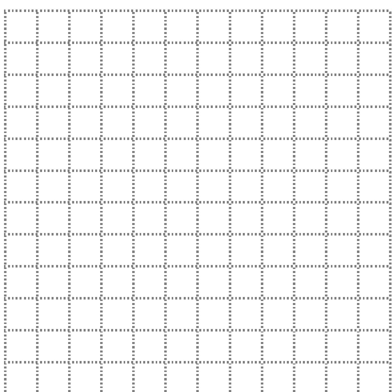
53. Maribel is building rectangular pens for her dogs, as shown below. She will fence the entire rectangular area with 78 m of fencing. What dimensions enclose the total maximum area? Show your work.



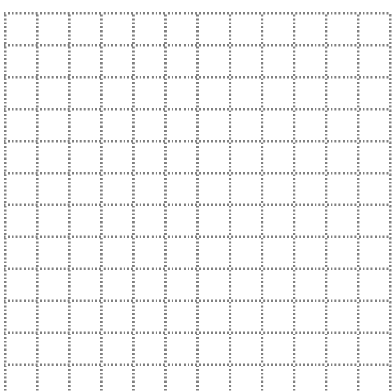
54. A baseball is hit upward from a platform that is 2 m high at an initial speed of 20 m/s. The approximate height of the baseball, *h* metres, after *t* seconds is given by the equation $h - 2 = -5t^2 + 20t$. Determine the time period for which the baseball is higher than 18 m.
Explain your strategy.

55. Graph each inequality for the given restrictions on the variables. Explain your strategy and describe the solution.

a) $y < -3x + 4$; for $x > 0$ and $y < 0$



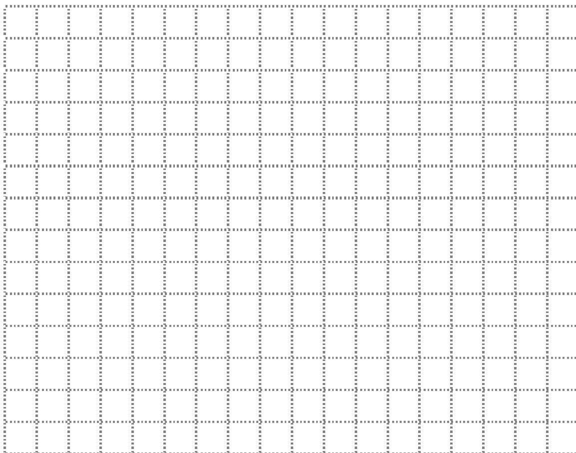
b) $3x + 2y + 6 \leq 0$; for $x \leq 0$ and $y \leq 0$



56. An electronics store makes a profit of $24 on the sale of a cordless phone and a profit of $30 on the sale of a cordless phone with answering machine. The manager’s profit target is at least $180 a day from the sales of these phones.

a) Write an inequality that describes the profit.

b) Graph the inequality. What is the solution of the inequality?



c) This table shows the numbers of phones sold on 3 consecutive days.

Day	**Cordless Phone**	**Cordless Phone with Answering Machine**
1	2	5
2	3	3
3	5	2

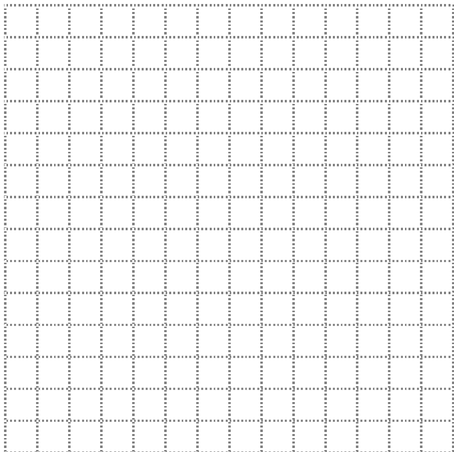
Use the graph to determine if the manager’s profit target was met each day.
Explain your strategy.

57. For B(–4, *b*) to be a solution of $y \geq 2x^2 - 10$, what must be true about *b*?
Show and explain your work.

58. For A(*a*, 3) to be a solution of $y < -3x^2 + 9$, what must be true about *a*?
Show and explain your work.

59. Two numbers are related in this way: 8 minus 4 times the square of one number is greater than the sum of 2 and 2 times the other number.

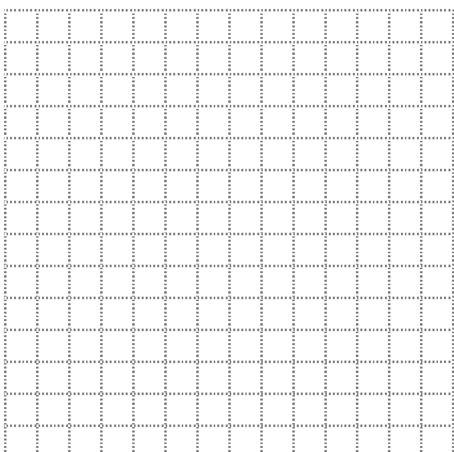
a) Graph an inequality that represents this relationship.



b) Use the graph to list 3 pairs of integer values for the 2 numbers.
Show and explain your strategy.

60. The length of a rectangle is 10 less than twice the square of a number. The width is 5 times another number. The length of the rectangle is greater than its width.

a) Sketch a graph to represent this situation.



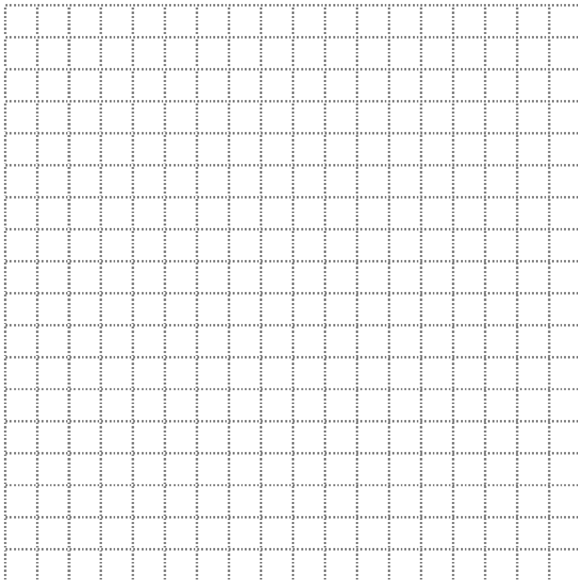
b) Use the graph to list 3 possible sets of dimensions for the rectangle.
Show your work.

61. Use a graphing calculator. Graph this system of equations.

$y = (50 + x)(100 - x)$

$y = 7000 - 40x$

a) Sketch the graphs on the same grid.



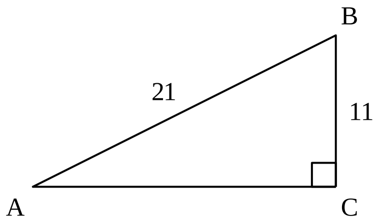
b) Write the coordinates of the points of intersection.

62. Two numbers are related in this way:
The sum of 5 times the first number and 6 times the second number is 0.
When twice the second number is subtracted from the square of the first number, the result is equal to 20 minus the first number.
a) Create a system of equations to represent this relationship.
b) Solve the system to determine the numbers. Explain the strategy you used.

63. A stuntman jumped from an elevation of 500 m and was in free fall before he opened his parachute. His elevation, *h* metres, *t* seconds after jumping is modelled by these equations:
$h = -4.9t^2 + 2t + 500$, before the parachute was opened
$h = -5t + 188$, after the parachute was opened
a) How many seconds after the stuntman jumped did he open the parachute?
b) What was his elevation when he opened the parachute?
Explain your strategy. Give your answers to the nearest tenth of a unit.

64. A football is kicked upward at an initial speed of 10 m/s. The approximate height of the ball, *h* metres, after *t* seconds is modelled by the equation $h = -4.9t^2 + 10t + 1$. A soccer ball is kicked upward with an initial speed of 12 m/s. The approximate height of the ball, *h* metres, after *t* seconds is modelled by the equation $h = -4.9t^2 + 12t$.
a) The soccer ball is kicked 1 s after the football is kicked. Determine when both balls reached the same height.
b) What is this height?
Explain your strategy. Give your answers to the nearest tenth of a unit.

65. Determine the measures of $\angle$A and $\angle$B to the nearest tenth of a degree. Explain your strategy.

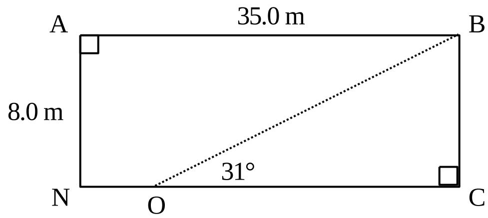


66. A rectangular lawn has the dimensions shown. A gardener wants to use an electric lawnmower to mow the lawn. The electrical outlet is located at O.

a) Determine the length of cord needed to reach corner B, to the nearest tenth of a metre.

b) Determine the distance between the electrical outlet and corner N, to the nearest tenth of a metre.

Explain your work.



67. Point P(–1, –5) is a terminal point of an angle θ in standard position.

a) Determine the ratios $\cos\theta$, $\sin\theta$, and $\tan\theta$.

b) Determine the measure of θ to the nearest degree.

Show your work.

68. Point P(9, –4) is a terminal point of an angle θ in standard position. Determine θ to the nearest degree, then sketch the angle. Show your work.

69. A coast guard patrol boat is due west of the Carmanah lighthouse. An overturned fishing boat is due north of the lighthouse. The patrol boat travels 9.1 km directly to the fishing boat. The angle between due east and the patrol boat's path is 54°. To the nearest tenth of a kilometre, determine the distance between the fishing boat and the lighthouse. Explain your work.

70. In $\triangle ABC$, AB = 35 cm, BC = 19 cm, and $\angle A = 30°$.

a) Explain why it is possible to draw two different triangles with these measures.

b) Sketch a diagram to show both triangles.

71. In ΔABC, AB = 8.3 cm and BC = 5.3 cm.

a) Describe the possible triangles.

b) To the nearest degree, determine possible measures of acute ∠A.

Show your work.

72. In ΔABC, AB = 6 cm and $\angle A = 75°$. Complete the chart below for your own values of BC.

Length of BC (cm)	**Value of $\frac{BC}{AB}$**	**How does $\frac{BC}{AB}$**	**Description of possible triangles**

		compare with sin A?	
			No triangles are possible.
			1 isosceles triangle
			1 scalene triangle
			2 scalene triangles

73. Two firefighters want to rescue a cat stuck in a tree. The cat is at an angle of elevation of 38° with respect to one firefighter and 80° with respect to the other firefighter. The firefighters are 30 m apart, and on opposite sides of the tree. To the nearest tenth of a metre, how high off the ground is the cat? Explain your strategy.

74. Two divers are 50 m apart. Each diver sees a treasure chest on the sea floor. The treasure chest is vertically below the line between the divers. From the divers, the angles of depression to the treasure chest are 35° and 51°. To the nearest metre, how far is the treasure chest from each diver? Consider possible cases and show your work.

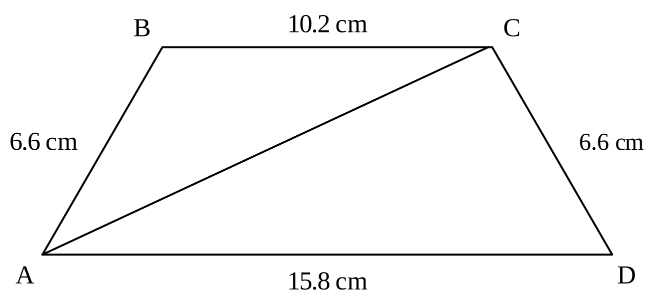
75. Two fishing boats are 18 m apart. The fishermen in each boat see a school of fish vertically below the line through the boats. From the boats, the angles of depression to the fish are 35° and 51°. To the nearest metre, how far below sea level is the school of fish? Consider possible cases and show your work.

76. In ΔDEF, DE = 7.5 cm, ∠D = 70°, and EF = 9 cm.

a) Determine how many triangles can be drawn.
b) Solve the triangle(s). Give angle measures to the nearest degree and side lengths to the nearest tenth of a centimetre.

Show your work.

77. In trapezoid ABCD, calculate the length of diagonal AC to the nearest tenth. Show your work.



78. Explain why $\frac{2x}{3x}$ is not an equivalent form of the expression $\frac{2x(x-2)}{3x(x-2)}$.

79. Here is a student's solution for simplifying a rational expression. Identify the error, then write a correct solution.

$$\frac{r^2 - 2r - 15}{r^3 - 9r} = \frac{(r+3)(r-5)}{r(r+3)(r-3)}$$
$$= \frac{(r-5)}{r(r-3)},\ r \neq 0,\ r \neq 3$$

80. Write this rational expression in simplest form. State the non-permissible values of the variable. Show your work.

$$\frac{n^4 - 5n^2 + 4}{3n^4 - 3n^3 - 6n^2}$$

81. This rational expression is the quotient of two different rational expressions. What might the rational expressions have been? Describe your strategy.

$$\frac{2}{x-4}$$

82. Write a polynomial M such that the product of the two rational expressions below simplifies to 1. Describe your strategy.

$$\frac{3q^2 + 7q + 2}{M} \cdot \frac{q^2 - 8q + 15}{3q^2 - 8q - 3}$$

83. The optical power of a thin lens is approximately the sum of the reciprocals of two distances: the distance from an object to a lens, D_1, and the distance from a lens to the image it produces, D_2. Write a simplified rational expression to represent the optical power of a thin lens. Show your work.

84. Simplify and show your work.

$$\frac{3x^2 - 6x - 72}{5x^2 - 35x + 30} \div \frac{x^2 + 9x + 20}{x^2 + x - 2} - \frac{x}{x^2 - 25}$$

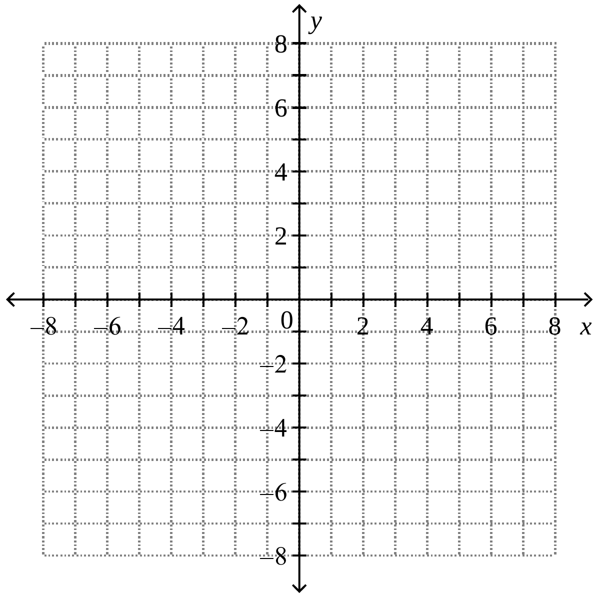
85. Write a rational equation with 3 as a solution and –3 as an extraneous root. Describe your strategy.

86. Ginelle is a master carpenter, and Tonya is her apprentice. It takes Tonya 18 h longer to install a subfloor for a new home than it takes Ginelle. Working together, they can install a subfloor in 12 h. How long would it take each person to install a subfloor working alone? Explain your solution.

87. A cyclist rode from town A to town B and back, a distance of about 3 km each way. On the trip out, there was a 8-km/h tailwind. On the return trip, there was a 6-km/h headwind. The total riding time was 5 h. To the nearest tenth of a kilometre per hour, what is the cyclist's average speed when there is no wind? Explain your solution.

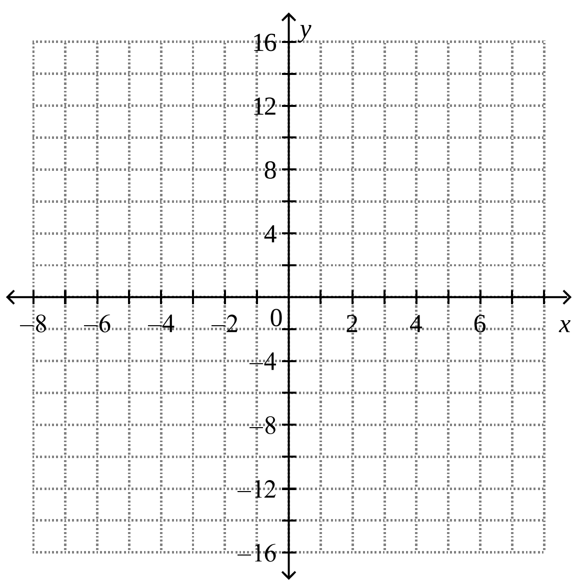
88. Complete this table of values, then sketch the graphs of $y = f(x)$ and $y = |f(x)|$ on the same grid.

x	–2	–1	0	1	2	3
$f(x) = 2x - 2$	–6	–4			2	4
$y = \|2x - 2\|$			2	0		



89. Complete this table of values, then sketch the graphs of $y = f(x)$ and $y = |f(x)|$ on the same grid. Identify the intercepts, domain, and range of the absolute value function.

x	–2	–1	0	1	2
$f(x) = 5x^2 - 5$			–5	0	
$y = \|5x^2 - 5\|$					



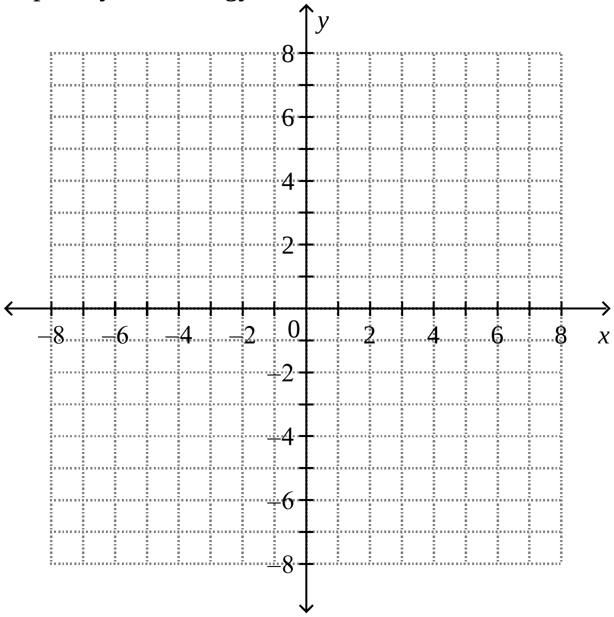
90. The function $y = f(x)$ is linear. Two points on the graph of $y = |f(x)|$ are S(–6, 3) and T(3, 6).

a) Graph the functions $y = f(x)$ and $y = |f(x)|$.

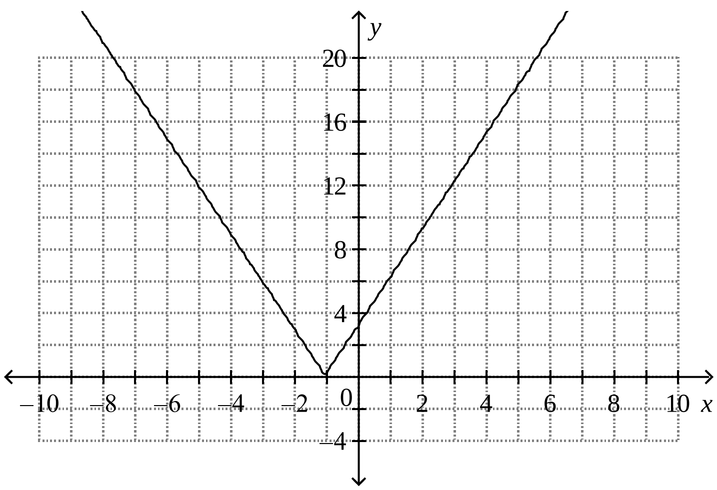
b) Determine the equations of the two functions and their intercepts.

c) Calculate the value of $y = |f(x)|$ when $x = 1$.

Explain your strategy.



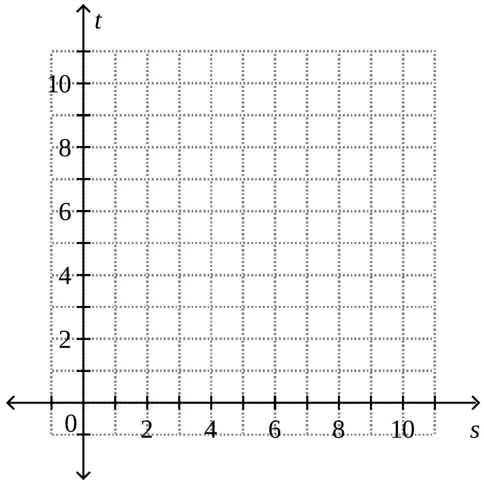
91. Solve the equation $|3x + 3| = 12$. Use a graph to justify your answer.
Graph of $y = |3x + 3|$:



92. Solve the equation $6 - |2x^2 - 8x - 1| = -3$. Show your work.

93. The graphs of the linear functions $y = -2x - 2$ and $y = 0.5x + 3$ are perpendicular. That is, their slopes are negative reciprocals. Do the graphs of their reciprocal functions intersect? How do you know?

94. a) Write a reciprocal function that describes the time, *t* hours, it takes an athlete to run 1 km, as a function of her speed, *s* kilometres per hour.
b) What are the domain and range of the reciprocal function in part a?
c) Sketch a graph of the reciprocal function in part a.



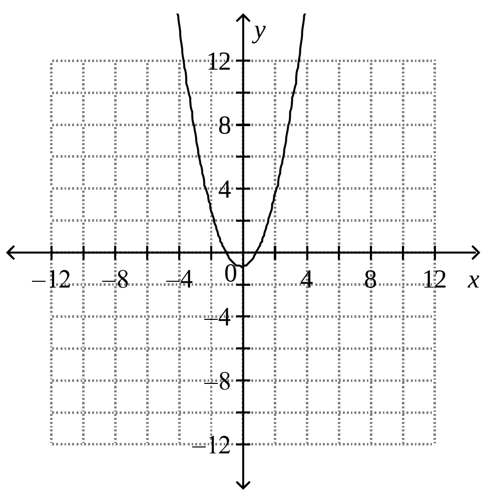
95. Predict the number of vertical asymptotes of the graph of each reciprocal function. Explain your answer. Write the equation of each vertical asymptote you identify.

a) $y = \dfrac{1}{x^2 - 2}$

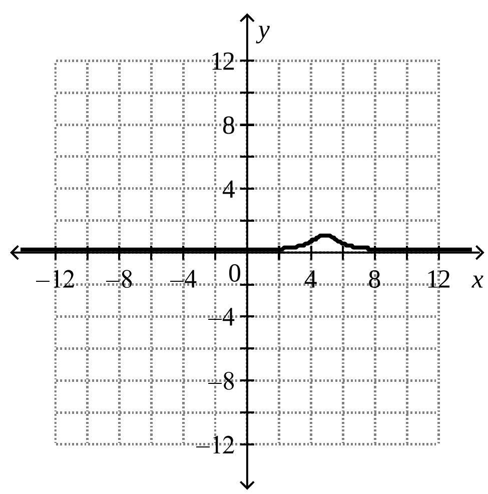
b) $y = \dfrac{1}{-2x^2 + 8}$

96. Match each graph of a quadratic function on the left to the corresponding graph of its reciprocal function on the right. Justify your answers.

a)

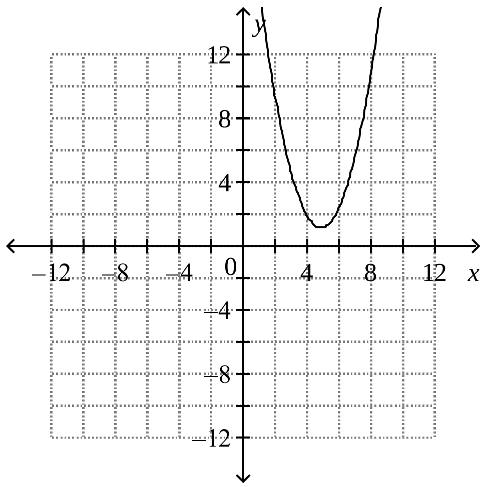


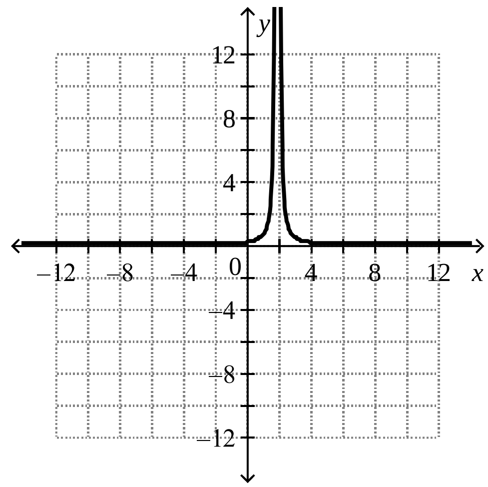
i)



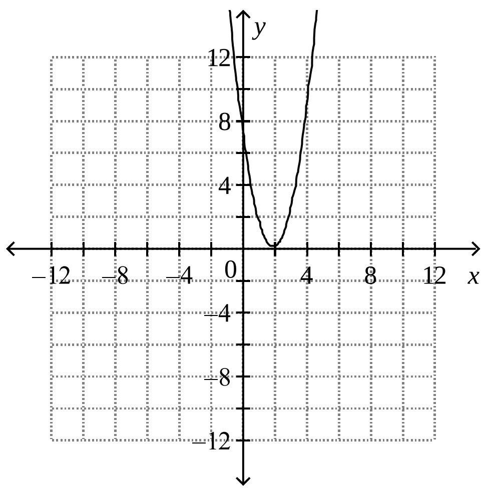
b)

ii)

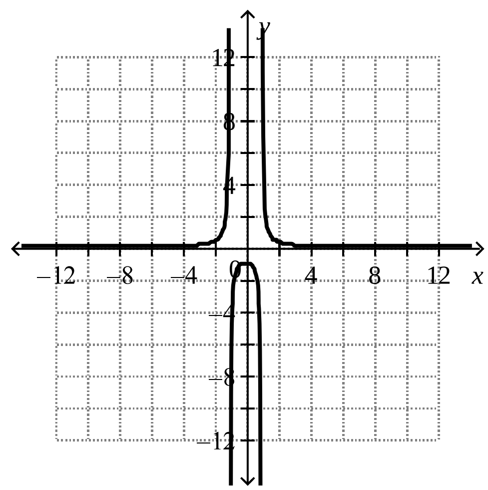




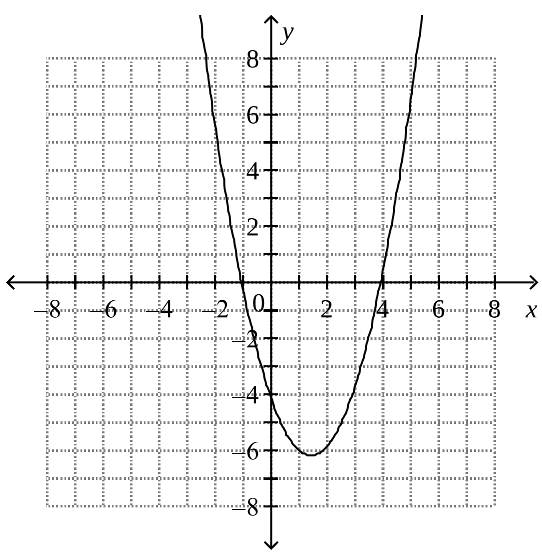
c)



iii)



97. This is the graph of a quadratic function $y = f(x)$. Sketch a graph of the reciprocal function $y = \frac{1}{f(x)}$ and identify the vertical asymptotes, if they exist. Describe your strategy.

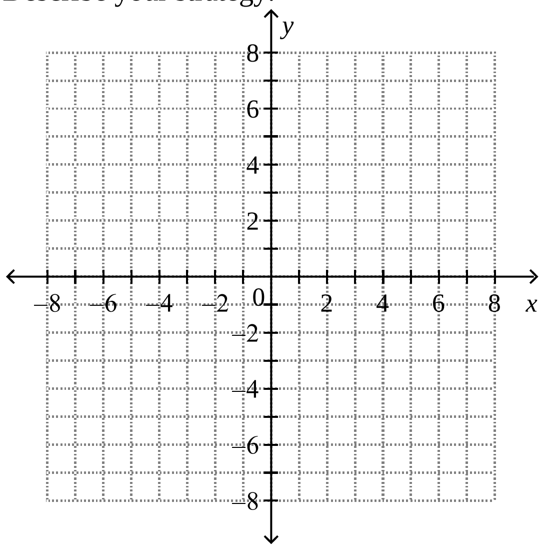


98. The graph of the reciprocal of a quadratic function has one vertical asymptote, $x = 1$. Points $(2, 1)$ and $(0, 1)$ are common to the graphs of the quadratic function and its reciprocal.

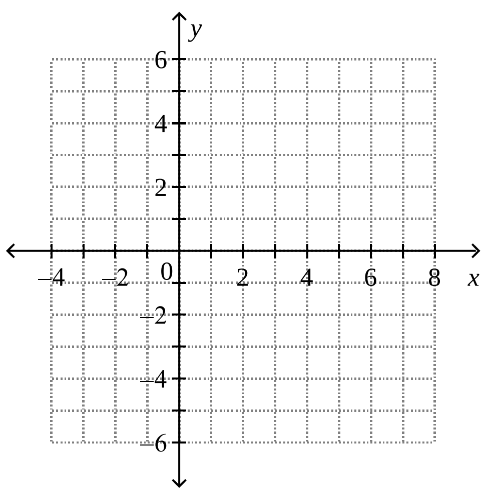
a) Sketch the graphs of the quadratic function and its reciprocal on the same grid.

b) Determine the equations of both the quadratic function and its reciprocal.

Describe your strategy.



99. Graph the functions $y = (x - 3)^2 + 1$ and $y = \dfrac{1}{(x - 3)^2 + 1}$ on the same grid. Describe your strategy.



100. Determine the values of *k* for which each reciprocal function has the given number of vertical asymptotes. Explain your work.

a) $y = \dfrac{1}{-x^2 + kx - 6}$; no vertical asymptotes

b) $y = \dfrac{1}{x^2 + kx + 1}$; one vertical asymptote

c) $y = \dfrac{1}{x^2 + kx + 8}$; two vertical asymptotes

PreCalc 11
Answer Section

MULTIPLE CHOICE

1. ANS: D PTS: 1 DIF: Moderate REF: 1.1 Arithmetic Sequences
LOC: 11.RF9 TOP: Procedural Knowledge

2. ANS: C PTS: 1 DIF: Easy REF: 1.1 Arithmetic Sequences
LOC: 11.RF9 TOP: Relations and Functions KEY: Procedural Knowledge

3. ANS: C PTS: 1 DIF: Moderate REF: 1.2 Arithmetic Series
LOC: 11.RF9 TOP: Relations and Functions KEY: Procedural Knowledge

4. ANS: D PTS: 1 DIF: Easy REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions KEY: Conceptual Understanding

5. ANS: A PTS: 1 DIF: Difficult REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

6. ANS: D PTS: 1 DIF: Easy REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

7. ANS: C PTS: 1 DIF: Easy REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

8. ANS: A PTS: 1 DIF: Difficult REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions
KEY: Problem-Solving Skills | Procedural Knowledge

9. ANS: A PTS: 1 DIF: Difficult REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions
KEY: Problem-Solving Skills | Procedural Knowledge

10. ANS: A PTS: 1 DIF: Moderate REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

11. ANS: D PTS: 1 DIF: Moderate REF: 1.4 Geometric Series
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

12. ANS: B PTS: 1 DIF: Difficult REF: 1.4 Geometric Series
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

13. ANS: C PTS: 1 DIF: Moderate REF: 1.4 Geometric Series
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

14. ANS: D PTS: 1 DIF: Moderate REF: 1.4 Geometric Series
LOC: 11.RF10 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

15. ANS: B PTS: 1 DIF: Moderate REF: 1.4 Geometric Series
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

16. ANS: C PTS: 1 DIF: Easy
REF: 1.5 Graphing Geometric Sequences and Series LOC: 11.RF9 | 11.RF10
TOP: Relations and Functions KEY: Conceptual Understanding

17. ANS: B PTS: 1 DIF: Easy
REF: 1.5 Graphing Geometric Sequences and Series LOC: 11.RF9 | 11.RF10
TOP: Relations and Functions KEY: Procedural Knowledge

18. ANS: D PTS: 1 DIF: Moderate
REF: 1.5 Graphing Geometric Sequences and Series LOC: 11.RF9 | 11.RF10
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

19. ANS: A PTS: 1 DIF: Easy REF: 1.6 Infinite Geometric Series
LOC: 11.RF10 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

20. ANS: C PTS: 1 DIF: Moderate REF: 1.6 Infinite Geometric Series
LOC: 11.RF10 TOP: Relations and Functions KEY: Procedural Knowledge

21. ANS: A PTS: 0 DIF: Moderate
REF: 2.1 Absolute Value of a Real Number LOC: 11.AN1
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

22. ANS: A PTS: 0 DIF: Moderate
REF: 2.2 Simplifying Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Procedural Knowledge

23. ANS: D PTS: 0 DIF: Moderate
REF: 2.2 Simplifying Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

24. ANS: B PTS: 0 DIF: Easy
REF: 2.3 Adding and Subtracting Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Procedural Knowledge

25. ANS: B PTS: 0 DIF: Easy
REF: 2.3 Adding and Subtracting Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Procedural Knowledge

26. ANS: D PTS: 0 DIF: Moderate
REF: 2.3 Adding and Subtracting Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Procedural Knowledge

27. ANS: A PTS: 0 DIF: Moderate
REF: 2.3 Adding and Subtracting Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

28. ANS: D PTS: 0 DIF: Easy
REF: 2.3 Adding and Subtracting Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Procedural Knowledge | Conceptual Understanding

29. ANS: A PTS: 0 DIF: Moderate
REF: 2.3 Adding and Subtracting Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

30. ANS: D PTS: 0 DIF: Moderate
REF: 2.4 Multiplying and Dividing Radical Expressions LOC: 11.AN2
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

31. ANS: D PTS: 0 DIF: Difficult REF: 2.5 Solving Radical Equations
LOC: 11.AN3 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

32. ANS: B PTS: 0 DIF: Easy
REF: 3.1 Factoring Polynomial Expressions LOC: 11.RF1
TOP: Relations and Functions KEY: Procedural Knowledge

33. ANS: B PTS: 0 DIF: Moderate
REF: 3.2 Solving Quadratic Equations by Factoring LOC: 11.AN3
TOP: Algebra and Number KEY: Conceptual Understanding

34. ANS: A PTS: 0 DIF: Easy
REF: 3.2 Solving Quadratic Equations by Factoring LOC: 11.RF5
TOP: Relations and Functions KEY: Procedural Knowledge

35. ANS: A PTS: 0 DIF: Moderate
REF: 3.3 Using Square Roots to Solve Quadratic Equations LOC: 11.RF5

TOP: Relations and Functions KEY: Procedural Knowledge

36. ANS: D PTS: 0 DIF: Easy
REF: 3.3 Using Square Roots to Solve Quadratic Equations LOC: 11.RF5
TOP: Relations and Functions KEY: Procedural Knowledge

37. ANS: A PTS: 0 DIF: Moderate
REF: 3.3 Using Square Roots to Solve Quadratic Equations LOC: 11.RF5
TOP: Relations and Functions KEY: Procedural Knowledge

38. ANS: C PTS: 0 DIF: Moderate REF: 3.5 Interpreting the Discriminant
LOC: 11.RF5 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

39. ANS: B PTS: 0 DIF: Easy REF: 3.5 Interpreting the Discriminant
LOC: 11.RF5 TOP: Relations and Functions KEY: Conceptual Understanding

40. ANS: C PTS: 0 DIF: Easy
REF: 4.1 Properties of a Quadratic Function LOC: 11.RF4
TOP: Relations and Functions KEY: Conceptual Understanding

41. ANS: D PTS: 0 DIF: Easy
REF: 4.1 Properties of a Quadratic Function LOC: 11.RF4
TOP: Relations and Functions KEY: Conceptual Understanding

42. ANS: D PTS: 0 DIF: Moderate
REF: 4.1 Properties of a Quadratic Function LOC: 11.RF4
TOP: Relations and Functions KEY: Procedural Knowledge

43. ANS: C PTS: 0 DIF: Moderate
REF: 4.1 Properties of a Quadratic Function LOC: 11.RF4
TOP: Relations and Functions KEY: Procedural Knowledge

44. ANS: A PTS: 0 DIF: Easy
REF: 4.3 Transforming the Graph of y = x^2 LOC: 11.RF3
TOP: Relations and Functions KEY: Conceptual Understanding

45. ANS: C PTS: 0 DIF: Easy
REF: 4.3 Transforming the Graph of y = x^2 LOC: 11.RF3
TOP: Relations and Functions KEY: Conceptual Understanding

46. ANS: B PTS: 0 DIF: Easy
REF: 4.3 Transforming the Graph of y = x^2 LOC: 11.RF3
TOP: Relations and Functions KEY: Conceptual Understanding

47. ANS: B PTS: 0 DIF: Moderate
REF: 4.4 Analyzing Quadratic Functions of the Form y = a(x - p)^2 + q
LOC: 11.RF3 TOP: Relations and Functions KEY: Procedural Knowledge

48. ANS: D PTS: 0 DIF: Easy
REF: 4.4 Analyzing Quadratic Functions of the Form y = a(x - p)^2 + q
LOC: 11.RF3 TOP: Relations and Functions KEY: Conceptual Understanding

49. ANS: D PTS: 0 DIF: Moderate
REF: 4.4 Analyzing Quadratic Functions of the Form y = a(x - p)^2 + q
LOC: 11.RF3 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

50. ANS: B PTS: 0 DIF: Easy
REF: 4.5 Equivalent Forms of the Equation of a Quadratic Function
LOC: 11.RF4 TOP: Relations and Functions KEY: Procedural Knowledge

51. ANS: D PTS: 0 DIF: Easy
REF: 4.5 Equivalent Forms of the Equation of a Quadratic Function
LOC: 11.RF4 TOP: Relations and Functions KEY: Procedural Knowledge

52. ANS: A PTS: 0 DIF: Moderate
REF: 4.7 Modelling and Solving Problems with Quadratic Functions
LOC: 11.RF4 TOP: Relations and Functions KEY: Procedural Knowledge

53. ANS: A PTS: 0 DIF: Easy
REF: 5.2 Graphing Linear Inequalities in Two Variables LOC: 11.RF7
TOP: Relations and Functions KEY: Procedural Knowledge

54. ANS: D PTS: 0 DIF: Easy
REF: 5.2 Graphing Linear Inequalities in Two Variables LOC: 11.RF7
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

55. ANS: B PTS: 0 DIF: Moderate
REF: 5.2 Graphing Linear Inequalities in Two Variables LOC: 11.RF7
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

56. ANS: D PTS: 0 DIF: Easy
REF: 5.3 Graphing Quadratic Inequalities in Two Variables LOC: 11.RF7
TOP: Relations and Functions KEY: Procedural Knowledge

57. ANS: D PTS: 0 DIF: Easy
REF: 5.3 Graphing Quadratic Inequalities in Two Variables LOC: 11.RF7
TOP: Relations and Functions KEY: Conceptual Understanding

58. ANS: B PTS: 0 DIF: Easy
REF: 5.3 Graphing Quadratic Inequalities in Two Variables LOC: 11.RF7
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

59. ANS: D PTS: 0 DIF: Moderate
REF: 5.3 Graphing Quadratic Inequalities in Two Variables LOC: 11.RF7
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

60. ANS: A PTS: 0 DIF: Easy
REF: 5.4 Solving Systems of Equations Graphically LOC: 11.RF6
TOP: Relations and Functions KEY: Procedural Knowledge

61. ANS: B PTS: 0 DIF: Easy
REF: 6.1 Angles in Standard Position in Quadrant 1 LOC: 11.T1
TOP: Trigonometry KEY: Conceptual Understanding | Procedural Knowledge

62. ANS: A PTS: 0 DIF: Moderate
REF: 6.1 Angles in Standard Position in Quadrant 1 LOC: 11.T2
TOP: Trigonometry KEY: Conceptual Understanding | Procedural Knowledge

63. ANS: C PTS: 0 DIF: Moderate
REF: 6.1 Angles in Standard Position in Quadrant 1 LOC: 11.T2
TOP: Trigonometry KEY: Procedural Knowledge | Problem-Solving Skills

64. ANS: B PTS: 0 DIF: Easy REF: 6.3 Constructing Triangles
LOC: 11.T3 TOP: Trigonometry KEY: Procedural Knowledge

65. ANS: B PTS: 0 DIF: Easy REF: 6.3 Constructing Triangles
LOC: 11.T3 TOP: Trigonometry KEY: Procedural Knowledge

66. ANS: B PTS: 0 DIF: Easy REF: 6.3 Constructing Triangles
LOC: 11.T3 TOP: Trigonometry KEY: Procedural Knowledge

67. ANS: A PTS: 0 DIF: Moderate REF: 6.3 Constructing Triangles
LOC: 11.T3 TOP: Trigonometry KEY: Procedural Knowledge

68. ANS: A PTS: 0 DIF: Moderate REF: 6.3 Constructing Triangles
LOC: 11.T3 TOP: Trigonometry KEY: Procedural Knowledge

69. ANS: A PTS: 0 DIF: Moderate REF: 6.4 The Sine Law
LOC: 11.T3 TOP: Trigonometry
KEY: Conceptual Understanding | Procedural Knowledge

70. ANS: B PTS: 0 DIF: Moderate REF: 6.4 The Sine Law
LOC: 11.T3 TOP: Trigonometry
KEY: Conceptual Understanding | Procedural Knowledge

71. ANS: A PTS: 1 DIF: Moderate REF: 6.5 The Cosine Law
LOC: 11.T3 TOP: Trigonometry
KEY: Conceptual Understanding | Procedural Knowledge

72. ANS: A PTS: 0 DIF: Moderate
REF: 7.1 Equivalent Rational Expressions LOC: 11.AN4
TOP: Algebra and Number KEY: Conceptual Understanding | Procedural Knowledge

73. ANS: C PTS: 0 DIF: Moderate
REF: 7.1 Equivalent Rational Expressions LOC: 11.AN4
TOP: Algebra and Number KEY: Conceptual Understanding | Procedural Knowledge

74. ANS: D PTS: 1 DIF: Moderate
REF: 7.2 Multiplying and Dividing Rational Expressions LOC: 11.AN5
TOP: Algebra and Number KEY: Conceptual Understanding | Procedural Knowledge

75. ANS: A PTS: 0 DIF: Easy
REF: 7.3 Adding and Subtracting Rational Expressions with Monomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Conceptual Understanding | Procedural Knowledge

76. ANS: C PTS: 0 DIF: Moderate
REF: 7.3 Adding and Subtracting Rational Expressions with Monomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Conceptual Understanding | Procedural Knowledge

77. ANS: B PTS: 0 DIF: Moderate
REF: 7.3 Adding and Subtracting Rational Expressions with Monomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Conceptual Understanding | Procedural Knowledge

78. ANS: C PTS: 0 DIF: Moderate
REF: 7.3 Adding and Subtracting Rational Expressions with Monomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Conceptual Understanding | Procedural Knowledge

79. ANS: B PTS: 0 DIF: Moderate
REF: 7.4 Adding and Subtracting Rational Expressions with Binomial and Trinomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Conceptual Understanding | Procedural Knowledge

80. ANS: B PTS: 0 DIF: Easy
REF: 7.4 Adding and Subtracting Rational Expressions with Binomial and Trinomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Conceptual Understanding | Procedural Knowledge

81. ANS: B PTS: 0 DIF: Easy
REF: 7.4 Adding and Subtracting Rational Expressions with Binomial and Trinomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Conceptual Understanding | Procedural Knowledge

82. ANS: B PTS: 0 DIF: Easy REF: 8.1 Absolute Value Functions
LOC: 11.RF2 TOP: Relations and Functions KEY: Conceptual Understanding

83. ANS: A PTS: 0 DIF: Moderate REF: 8.1 Absolute Value Functions
LOC: 11.RF2 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

84. ANS: C PTS: 0 DIF: Moderate REF: 8.1 Absolute Value Functions

LOC: 11.RF2 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

85. ANS: C PTS: 0 DIF: Moderate REF: 8.1 Absolute Value Functions
LOC: 11.RF2 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

86. ANS: A PTS: 0 DIF: Moderate REF: 8.1 Absolute Value Functions
LOC: 11.RF2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication

87. ANS: C PTS: 0 DIF: Moderate REF: 8.1 Absolute Value Functions
LOC: 11.RF2 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

88. ANS: A PTS: 0 DIF: Difficult
REF: 8.2 Solving Absolute Value Equations LOC: 11.RF2
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

89. ANS: A PTS: 0 DIF: Easy
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding

90. ANS: C PTS: 0 DIF: Moderate
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

91. ANS: C PTS: 0 DIF: Moderate
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

92. ANS: A PTS: 0 DIF: Moderate
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

93. ANS: D PTS: 0 DIF: Moderate
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

94. ANS: D PTS: 0 DIF: Moderate
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

95. ANS: C PTS: 0 DIF: Moderate
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

96. ANS: B PTS: 0 DIF: Difficult
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

97. ANS: C PTS: 0 DIF: Moderate
REF: 8.3 Graphing Reciprocals of Linear Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

98. ANS: C PTS: 0 DIF: Moderate
REF: 8.4 Using Technology to Graph Reciprocals of Quadratic Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

99. ANS: C PTS: 0 DIF: Easy
REF: 8.5 Graphing Reciprocals of Quadratic Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

100. ANS: D PTS: 0 DIF: Easy

REF: 8.5 Graphing Reciprocals of Quadratic Functions LOC: 11.RF11
TOP: Relations and Functions KEY: Conceptual Understanding | Procedural Knowledge

PROBLEM

1. ANS:
The years in which the comet appears form an arithmetic sequence. The arithmetic sequence for Tempel 1 has $t_1 = 2005$ and $d = 5.5$. To determine whether Tempel 1 should appear in 2093, determine whether 2093 is a term of its sequence.

$t_n = t_1 + d(n-1)$ Substitute: $t_n = 2093$, $t_1 = 2005$, $d = 5.5$

$2093 = 2005 + 5.5(n-1)$ Solve for n.

$88 = 5.5n - 5.5$

$5.5n = 93.5$

$n = 17$

Since the year 2093 is the 17th term in the sequence, Tempel 1 should appear in 2093.

PTS: 1 DIF: Moderate REF: 1.1 Arithmetic Sequences
LOC: 11.RF9 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

2. ANS:
a) $t_1 = 4$, $d = 2$

$t_1 = 4$

t_2 is $t_1 + d = 4 + 2$, or 6

t_3 is $t_2 + d = 6 + 2$, or 8

t_4 is $t_3 + d = 8 + 2$, or 10

t_5 is $t_4 + d = 10 + 2$, or 12

The first 5 terms are: 4, 6, 8, 10, 12

b) The arithmetic sequence has $t_1 = 4$, $d = 2$, and $n = 10$.

$t_n = t_1 + d(n-1)$ Substitute: $t_1 = 4$, $d = 2$, $n = 10$

$t_{10} = 4 + 2(10-1)$ Solve for t_{10}.

$t_{10} = 22$

There are 22 seats when 10 tables are arranged in a single row.

PTS: 1 DIF: Moderate REF: 1.1 Arithmetic Sequences
LOC: 11.RF9 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

3. ANS:
a) The common difference, *d*, is: $\frac{3k}{5} - k = \frac{3k}{5} - \frac{5k}{5} = -\frac{2k}{5}$

$t_6 = t_4 + 2d$ Substitute: $t_4 = -\frac{k}{5}$, $d = -\frac{2k}{5}$

$t_6 = -\frac{k}{5} + 2\left(-\frac{2k}{5}\right)$

$t_6 = -\frac{k}{5} - \frac{4k}{5}$

$t_6 = -\frac{5k}{5}$

b) Use: $t_n = t_1 + d(n-1)$ Substitute: $t_1 = k$, $d = -\frac{2k}{5}$

$t_n = k + \left(-\frac{2k}{5}\right)(n-1)$

$t_n = k - \frac{2kn}{5} + \frac{2k}{5}$

$t_n = \frac{7k}{5} - \frac{2kn}{5}$

c) Use: $t_n = \frac{7k}{5} - \frac{2kn}{5}$ Substitute: $t_n = -33$, $n = 20$

$-33 = \frac{7k}{5} - \frac{2k(20)}{5}$

$-33 = \frac{7k}{5} - \frac{40k}{5}$

$k = 5$

PTS: 1 DIF: Difficult REF: 1.1 Arithmetic Sequences
LOC: 11.RF9 TOP: Relations and Functions KEY: Problem-Solving Skills

4. ANS:

a) Use: $S_n = \frac{n\left[2t_1 + d(n-1)\right]}{2}$ Substitute: $n = 16$, $t_1 = -4$, $d = 2$

$S_{16} = \frac{16\left[2(-4) + 2(16-1)\right]}{2}$

$S_{16} = 176$

b) Use: $S_n = \frac{n\left[2t_1 + d(n-1)\right]}{2}$ Substitute: $n = 17$, $t_1 = 23$, $d = -9$

$S_{17} = \frac{17\left[2(23) + (-9)(17-1)\right]}{2}$

$S_{17} = -833$

c) Use: $S_n = \dfrac{n(t_1 + t_n)}{2}$ Substitute: $n = 94, t_1 = 16, t_n = 806.5$

$$S_{94} = \frac{94(16 + 806.5)}{2}$$

$$S_{94} = 38657.5$$

PTS: 1 DIF: Moderate REF: 1.2 Arithmetic Series
LOC: 11.RF9 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

5. ANS:

a) Use: $S_n = \dfrac{n(t_1 + t_n)}{2}$ Substitute: $S_n = 228,\ n = 12,\ t_n = 41$

$$228 = \frac{12(t_1 + 41)}{2}$$

$$228 = 6t_1 + 246$$

$$-18 = 6t_1$$

$$t_1 = -3$$

b) Use: $S_n = \dfrac{n(t_1 + t_n)}{2}$ Substitute: $S_n = -4584.5,\ t_1 = 17.5,\ t_n = -190.5$

$$-4584.5 = \frac{n(17.5 - 190.5)}{2}$$

$$-9169 = -173n$$

$$n = 53$$

PTS: 1 DIF: Moderate REF: 1.2 Arithmetic Series
LOC: 11.RF9 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge

6. ANS:

a) r is $\dfrac{2}{8} = \dfrac{1}{4}$

Use: $t_n = t_1 r^{n-1}$ Substitute: $t_n = 8$, $r = \frac{1}{4}$, $n = 4$

$$8 = t_1\left(\frac{1}{4}\right)^{4-1}$$

$$t_1 = 512$$

$$t_2 = 512\left(\frac{1}{4}\right) = 128$$

$$t_3 = 512\left(\frac{1}{4}\right)^2 = 32$$

The first 3 terms are:
$t_1 = 512,\ t_2 = 128,\ t_3 = 32$

b) The sequence is convergent because the terms approach a constant value of 0.

PTS: 1 DIF: Moderate REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions
KEY: Communication | Conceptual Understanding | Problem-Solving Skills

7. ANS:
The geometric sequence has first term 0.0005 and common ratio 2.
Use: $t_n = t_1 r^{n-1}$ Substitute: $t_1 = 0.0005$, $r = 2$, $n = 25$

$$t_{25} = 0.0005(2)^{25-1}$$

$$t_{25} = 8388.608$$

Term 25 is 8388.608.

PTS: 1 DIF: Moderate REF: 1.3 Geometric Sequences
LOC: 11.RF10 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

8. ANS:
Use: $S_n = \frac{t_1(1-r^n)}{1-r}$, $r \neq 1$ Substitute: $n = 6$, $S_n = -315$, $r = 2$

$$-315 = \frac{t_1\left(1-2^6\right)}{1-2}$$

$$-315 = \frac{t_1(1-64)}{-1}$$

$$315 = -63t_1$$

$$t_1 = -5$$

So, the first term is –5.

PTS: 1 DIF: Moderate REF: 1.4 Geometric Series
LOC: 11.RF10 TOP: Relations and Functions
KEY: Problem-Solving Skills | Procedural Knowledge

9. ANS:
To determine t_1, use:

$$S_n = \frac{t_1(1-r^n)}{1-r},\ r \neq 1 \quad \text{Substitute: } S_{12} = 12,\ n = 12,\ r = \frac{1}{4}$$

$$12 = \frac{t_1\left(1-\frac{1}{4}^{12}\right)}{1-\frac{1}{4}}$$

$$12 = \frac{t_1\left(1-\frac{1}{16\,777\,216}\right)}{\frac{3}{4}}$$

$$9 = \frac{16\,777\,215}{16\,777\,216}t_1$$

$$t_1 = 9.0000\ldots$$

The 1st jump is approximately 9.00 m.

To determine t_2, use:

$$t_n = t_1 r^{n-1} \quad \text{Substitute: } t_1 = 9.0000\ldots,\ r = \frac{1}{4},\ n = 2$$

$$t_2 = 9.0000\ldots\left(\frac{1}{4}\right)^{2-1}$$

$$t_2 = 2.2500\ldots$$

The 2nd jump is approximately 2.25 m.

To determine t_3, use:

$$t_n = t_1 r^{n-1} \quad \text{Substitute: } t_1 = 9.0000\ldots,\ r = \frac{1}{4},\ n = 3$$

$$t_3 = 9.0000\ldots\left(\frac{1}{4}\right)^{3-1}$$

$$t_3 = 0.5625\ldots$$

The 3rd jump is approximately 0.56 m.

PTS: 1 DIF: Difficult REF: 1.4 Geometric Series
LOC: 11.RF10 TOP: Relations and Functions
KEY: Communication | Conceptual Understanding | Problem-Solving Skills

10. ANS:

Use: $S_n = \dfrac{t_1(1-r^n)}{(1-r)}$, $r \neq 1$ Substitute: $S_n = 6265.56$, $n = 12$, $r = \dfrac{7}{5}$

$$6265.56 = \frac{t_1\left(1-\frac{7}{5}^{12}\right)}{\left(1-\frac{7}{5}\right)}$$

$$t_1 = 44.9999\ldots$$

The length of the frog's first jump was approximately 45 cm.

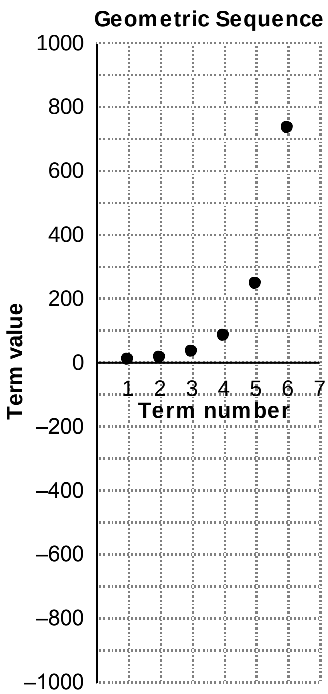
PTS: 1 DIF: Difficult REF: 1.4 Geometric Series
LOC: 11.RF10 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

11. ANS:

a) The common ratio is 3, which is greater than 1, so the term values increase.

b) The common ratio is 3, which is greater than 1, so the partial sums increase.

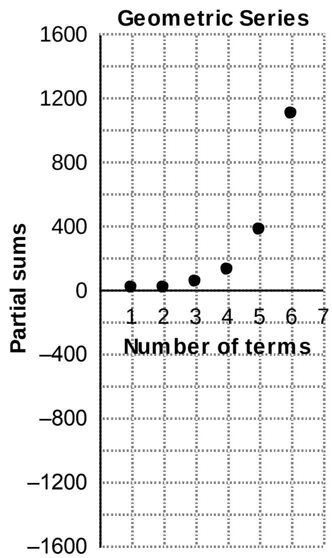
c)



To graph the geometric series, determine the partial sums.

S_1	S_2	S_3	S_4	S_5	S_6

3	$S_2 = S_1 + t_2$ $S_2 = 3 + (9)$ $S_2 = 12$	$S_3 = S_2 + t_3$ $S_3 = 12 + (27)$ $S_3 = 39$	$S_4 = S_3 + t_4$ $S_4 = 39 + (81)$ $S_4 = 120$	$S_5 = S_4 + t_5$ $S_5 = 120 + (243)$ $S_5 = 363$	$S_6 = S_5 + t_6$ $S_6 = 363 + (729)$ $S_6 = 1092$



PTS: 1 DIF: Moderate REF: 1.5 Graphing Geometric Sequences and Series
LOC: 11.RF9 | 11.RF10 TOP: Relations and Functions
KEY: Communication | Conceptual Understanding | Procedural Knowledge

12. ANS:

a) $t_n = -5\left(-\frac{1}{9}\right)^{n-1}$ Substitute: $n = 1$

$t_1 = -5\left(-\frac{1}{9}\right)^{1-1}$

$t_1 = -5\left(-\frac{1}{9}\right)^{0}$

$t_1 = -5(1)$

$t_1 = -5$

t_2 is: $-5\left(-\frac{1}{9}\right) = \frac{5}{9}$

t_3 is: $\frac{5}{9}\left(-\frac{1}{9}\right) = -\frac{5}{81}$

t_4 is: $-\frac{5}{81}\left(-\frac{1}{9}\right) = \frac{5}{729}$

b) $r = -\frac{1}{9}$, so the series converges.

c) The series has a finite sum because the common ratio is between -1 and 1.

Use: $S_\infty = \frac{t_1}{1-r}$ Substitute: $t_1 = -5, r = -\frac{1}{9}$

$$S_\infty = \frac{-5}{1-\left(-\frac{1}{9}\right)}$$

$$S_\infty = -4.5$$

The sum is -4.5.

PTS: 1 DIF: Moderate REF: 1.6 Infinite Geometric Series
LOC: 11.RF10 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

13. ANS:
The perimeter of the first square is 13 in., so $t_1 = 13$.

The perimeter of each subsequent square is 75% of the perimeter of the previous square, so $r = \frac{75}{100}$, or $\frac{3}{4}$.

Use: $S_\infty = \frac{t_1}{1-r}$ Substitute: $t_1 = 13,\ r = \frac{3}{4}$

$$S_\infty = \frac{13}{1-\frac{3}{4}}$$

$$S_\infty = 52$$

The sum of the perimeters of all the squares is 52 in.

PTS: 1 DIF: Difficult REF: 1.6 Infinite Geometric Series
LOC: 11.RF10 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

14. ANS:

Area of first circle

Use: $A = \pi r^2$ Substitute: $r = 1$

$$A = \pi(1)^2$$

$$A = \pi$$

Area of second circles

Use: $A = 3 \times \pi r^2$ Substitute: $r = \frac{1}{3}$

$$A = 3(\pi\left(\frac{1}{3}\right)^2)$$

$$A = 3\left(\frac{\pi}{9}\right)$$

Area of third circles

Area of fourth circles

Use: $A = 3 \times \pi r^2$ Substitute: $r = \left(\frac{1}{3}\right)^2 = \frac{1}{9}$ Use: $A = 3 \times \pi r^2$ Substitute: $r = \left(\frac{1}{3}\right)^3 = \frac{1}{27}$

$A = 3(\pi\left(\frac{1}{9}\right)^2)$ $A = 3(\pi\left(\frac{1}{27}\right)^2)$

$A = 3\left(\frac{\pi}{81}\right)$ $A = 3\left(\frac{\pi}{729}\right)$

The values of the areas of the circles form an infinite geometric series.

Total area = $\pi + 3\left(\frac{\pi}{9}\right) + 3\left(\frac{\pi}{81}\right) + 3\left(\frac{\pi}{729}\right) + \ \ldots$

$= \pi + \frac{\pi}{3}\left(1 + \frac{1}{9} + \frac{1}{81} + \ \ldots\right)$

This is an infinite geometric series with $t_1 = 1$ and $r = \frac{1}{9}$.

Substitute for t_1 and r in $S_\infty = \frac{t_1}{1-r}$.

$S_\infty = \frac{1}{1-\frac{1}{9}}$

$S_\infty = \frac{1}{\frac{8}{9}}$

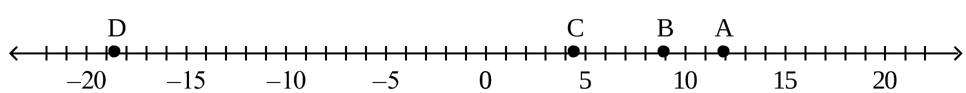
$S_\infty = \frac{9}{8}$

Add: $\pi + \frac{\pi}{3}\left(\frac{9}{8}\right) = \frac{11\pi}{8}$

So, the sum of the areas of the circles is $\frac{11\pi}{8}$ cm^2.

PTS: 1 DIF: Difficult REF: 1.6 Infinite Geometric Series
LOC: 11.RF10 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

15. ANS:



Point A: |12| = 12, so Point A is 12 units from 0.
Point B: |9| = 9, so Point B is 9 units from 0.
Point C: $|4\frac{1}{2}| = 4\frac{1}{2}$, so Point C is $4\frac{1}{2}$ units from 0.
Point D: |–18.5| = 18.5, so Point D is 18.5 units from 0.

PTS: 0 DIF: Easy REF: 2.1 Absolute Value of a Real Number
LOC: 11.AN1 TOP: Relations and Functions KEY: Conceptual Understanding

16. ANS:

Write, then solve an equation: $|x + 8| = 5$

Since $|5| = 5$ and $|-5| = 5$

then, $x + 8 = 5$ or $x + 8 = -5$

$x = -3$ $x = -13$

So, two values of *x* are possible: –3 or –13

PTS: 0 DIF: Difficult REF: 2.1 Absolute Value of a Real Number
LOC: 11.AN1 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

17. ANS:

a) The length of a leg of a triangle must be greater than 0, so $x > 0$.

b) The Pythagorean Theorem states that in a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides. So, $a^2 + b^2 = c^2$, where the lengths of the legs are represented by *a* and *b*, and the length of the hypotenuse by *c*.

$a^2 + b^2 = c^2$ Substitute: $a = \frac{3}{2}x$ and $b = x^2$

$$\left(\frac{3}{2}x\right)^2 + (x^2)^2 = c^2$$

$$\frac{9}{4}x^2 + x^4 = c^2$$

$$c = \sqrt{\frac{9}{4}x^2 + x^4}$$

$$c = x\sqrt{\frac{9}{4} + x^2}$$

An expression for the length of the hypotenuse is: $x\sqrt{\frac{9}{4} + x^2}$

PTS: 0 DIF: Moderate REF: 2.2 Simplifying Radical Expressions
LOC: 11.AN2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication

18. ANS:

Use the formula for the area, *A*, of a rectangle: $A = lw$

Substitute: $l = 3x$ and $w = x$

$A = lw$

$39 = (3x)x$

$39 = 3x^2$

$x = \sqrt{13}$

Perimeter of shape formed $= 2(l) + 6(w) + 4\left(\frac{1}{2}l\right)$

$= 2(3x) + 6(x) + 2(3x)$

$= 6x + 6x + 6x$

$= 18x$ Substitute: $x = \sqrt{13}$

$= 18\sqrt{13}$

An expression for the perimeter of the shape formed is: $18\sqrt{13}$

PTS: 0 DIF: Moderate REF: 2.3 Adding and Subtracting Radical Expressions
LOC: 11.AN2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

19. ANS:
The side length of a square is the square root of its area.
So, the side length of the smaller square is: $\sqrt{44}$, or $2\sqrt{11}$ units
The side length of the larger square is: $\frac{3}{2}(2\sqrt{11})$, or $3\sqrt{11}$ units
The difference in their lengths is: $3\sqrt{11} - 2\sqrt{11}$, or $\sqrt{11}$ units
Perimeter of shaded region is the sum of 5 times the side length of the smaller square + the side length of the larger square + 3 times the difference in their side lengths
$= 5\left(2\sqrt{11}\right) + 3\sqrt{11} + 3(\sqrt{11})$
$= 16\sqrt{11}$
So, a radical expression for the perimeter of the shaded region is : $16\sqrt{11}$

PTS: 0 DIF: Moderate REF: 2.3 Adding and Subtracting Radical Expressions
LOC: 11.AN2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

20. ANS:
$\left(-5\sqrt{2} + 3\sqrt{3}\right)\left(-6\sqrt{2} - 2\sqrt{3}\right)$
$= -5\sqrt{2}\left(-6\sqrt{2} - 2\sqrt{3}\right) + 3\sqrt{3}\left(-6\sqrt{2} - 2\sqrt{3}\right)$
$= 60 + 10\sqrt{6} - 18\sqrt{6} - 18$
$= 42 - 8\sqrt{6}$

PTS: 0 DIF: Easy REF: 2.4 Multiplying and Dividing Radical Expressions
LOC: 11.AN2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication

21. ANS:
Use the formula for the area, *A*, of a square: $A = s^2$
$s = \sqrt{3} + \sqrt{5}$
$A = \left(\sqrt{3} + \sqrt{5}\right)^2$
$A = \left(\sqrt{3}\right)^2 + 2\left(\sqrt{3}\right)\left(\sqrt{5}\right) + \left(\sqrt{5}\right)^2$
$A = 3 + 2\sqrt{15} + 5$
$A = 8 + 2\sqrt{15}$

PTS: 0 DIF: Moderate REF: 2.4 Multiplying and Dividing Radical Expressions
LOC: 11.AN2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication

22. ANS:
Use the formula for the area, *A*, of a rectangle: $A = lw$
Substitute: $l = \sqrt{3}$ and $w = \sqrt{2} + 7$

$A = lw$

$A = \sqrt{3}\left(\sqrt{2} + 7\right)$

$A = \sqrt{6} + 7\sqrt{3}$

PTS: 0 DIF: Easy REF: 2.4 Multiplying and Dividing Radical Expressions
LOC: 11.AN2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication

23. ANS:

a) $s \geq 0$ and $t \geq 0$

b)
$$\frac{-5\sqrt{s} + 3\sqrt{t}}{4\sqrt{s} - 5\sqrt{t}} = \frac{\left(-5\sqrt{s} + 3\sqrt{t}\right)}{\left(4\sqrt{s} - 5\sqrt{t}\right)} \cdot \frac{\left(4\sqrt{s} + 5\sqrt{t}\right)}{\left(4\sqrt{s} + 5\sqrt{t}\right)}$$
$$= \frac{-20s - 25\sqrt{st} + 12\sqrt{st} + 15t}{(4\sqrt{s})^2 - (5\sqrt{t})^2}$$
$$= \frac{-20s - 13\sqrt{st} + 15t}{16s - 25t}$$

PTS: 0 DIF: Moderate REF: 2.4 Multiplying and Dividing Radical Expressions
LOC: 11.AN2 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

24. ANS:

Since $2x + 4 \geq 0$, then $x \geq -2$

Since $-4 + 6x \geq 0$, then $x \geq \frac{2}{3}$

So, for both radicals to be defined, $x \geq \frac{2}{3}$

$$\sqrt{2x+4} = \sqrt{-4+6x}$$
$$\left(\sqrt{2x+4}\right)^2 = \left(\sqrt{-4+6x}\right)^2$$
$$2x + 4 = -4 + 6x$$
$$-4x = -8$$
$$x = 2$$

Since *x* = 2 lies in the set of possible values for *x*, $x = 2$ is a root of the equation.

PTS: 0 DIF: Moderate REF: 2.5 Solving Radical Equations
LOC: 11.AN3 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

25. ANS:

Use the formula $V = \pi r^2 h$ to write an equation for the radius, *r*.

$V = \pi r^2 h$

$r^2 = \frac{V}{\pi h}$

$r = \sqrt{\frac{V}{\pi h}}$

Substitute: $V = 260.4$ and $h = 18.6$

$r = \sqrt{\dfrac{V}{\pi h}}$

$r = \sqrt{\dfrac{260.4}{\pi(18.6)}}$

$r \doteq 2.1$

The radius of the cylinder is approximately 2.1 cm.

PTS: 0 DIF: Moderate REF: 2.5 Solving Radical Equations
LOC: 11.AN3 TOP: Relations and Functions
KEY: Procedural Knowledge | Problem-Solving Skills

26. ANS:

a) Use the formula for the volume, *V*, of a cube: $V = s^3$, where *s* represents the edge length of the cube.

$V = s^3$

$s = \sqrt[3]{V}$ Substitute: $V = 1710$

$s = \sqrt[3]{1710}$

$s \doteq 12.0$

A cube with the same volume as Lake Ontario would have an edge length of about 12.0 km.

b) Use the formula for the volume, *V*, of a sphere: $V = \dfrac{4}{3}\pi r^3$, where *r* represents the radius of the sphere.

$V = \dfrac{4}{3}\pi r^3$

$r^3 = \dfrac{3V}{4\pi}$

$r = \sqrt[3]{\dfrac{3V}{4\pi}}$ Substitute: $V = 1710$

$r = \sqrt[3]{\dfrac{3(1710)}{4\pi}}$

$r \doteq 7.4$

A sphere with the same volume as Lake Ontario would have a radius of about 7.4 km.

PTS: 0 DIF: Difficult REF: 2.5 Solving Radical Equations
LOC: 11.AN3 TOP: Relations and Functions
KEY: Procedural Knowledge | Problem-Solving Skills

27. ANS:

Write $5x^2 + kx - 9 = (5x - 3)(x + h)$

Equate the constant terms.

If $5x - 3$ is a factor, then $-9 = -3h$, so $h = 3$

Substitute this value for *h* in $(5x - 3)(x + h)$, then expand.

$(5x - 3)(x + 3) = 5x^2 + 12x - 9$

The value of *k* is 12.

PTS: 0 DIF: Difficult REF: 3.1 Factoring Polynomial Expressions
LOC: 11.RF1 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

28. ANS:

$P = 2l + 2w$ Substitute: $P = 46$
$46 = 2l + 2w$ Divide each term by 2.
$23 = l + w$
$l = 23 - w$
The length of the slab, in metres, is $23 - w$.

The area of the slab is 90 m^2. Use the formula $A = lw$.
$A = lw$ Substitute: $A = 90$, $l = 23 - w$
$90 = (23 - w)w$
$90 = 23w - w^2$
$w^2 - 23w + 90 = 0$
$(w - 5)(w - 18) = 0$
Either $w = 5$ or $w = 18$

Determine the value of l when $w = 5$.
$P = 2l + 2w$ Substitute: $P = 46$, $w = 5$
$46 = 2l + 2(5)$
$46 = 2l + 10$
$36 = 2l$
$l = 18$
The width of the slab is 5 m and its length is 18 m.

Or

Determine the value of l when $w = 18$.
$P = 2l + 2w$ Substitute: $P = 46$, $w = 18$
$46 = 2l + 2(18)$
$46 = 2l + 36$
$10 = 2l$
$l = 5$
The width of the slab is 18 m and its length is 5 m.
So, there is one slab of dimensions 18 m by 5 m.

PTS: 0 DIF: Difficult REF: 3.2 Solving Quadratic Equations by Factoring
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

29. ANS:
$\sqrt{x + 14} = x - 16$ Square each side of the equation.
$(\sqrt{x + 14})^2 = (x - 16)^2$
$x + 14 = x^2 - 32x + 256$ Combine like terms.
$0 = x^2 - 33x + 242$ Factor.
$0 = (x - 11)(x - 22)$ Solve using the zero product property.
Either $x - 11 = 0$ or $x - 22 = 0$
$x = 11$ $x = 22$

Check for extraneous roots.
In $\sqrt{x + 14} = x - 16$, substitute: $x = 11$ and $x = 22$

$$\begin{aligned} \text{L.S.} &= \sqrt{x+14} \\ &= \sqrt{11+14} \\ &= \sqrt{25} \\ &= 5 \\ \text{R.S.} &= x-16 \\ &= 11-16 \\ &= -5 \end{aligned} \qquad \begin{aligned} \text{L.S.} &= \sqrt{x+14} \\ &= \sqrt{22+14} \\ &= \sqrt{36} \\ &= 6 \\ \text{R.S.} &= x-16 \\ &= 22-16 \\ &= 6 \end{aligned}$$

For $x = 11$, the left side does not equal the right side, so $x = 11$ is not a root of the radical equation.
For $x = 22$, the left side is equal to the right side, so this solution is verified.
The root is: $x = 22$

PTS: 0 DIF: Difficult REF: 3.2 Solving Quadratic Equations by Factoring
LOC: 11.AN3 TOP: Algebra and Number
KEY: Communication | Problem-Solving Skills

30. ANS:
The student should not have taken the square root of each side to solve the equation.
The correct solution is:

$$\begin{aligned} (4x+1)^2 &= (2x-3)^2 \\ (4x+1)^2 - (2x-3)^2 &= 0 \\ [(4x+1)+(2x-3)][(4x+1)-(2x-3)] &= 0 \\ [4x+1+2x-3][4x+1-2x+3] &= 0 \\ (6x-2)(2x+4) &= 0 \\ 2(3x-1)2(x+2) &= 0 \\ 4(3x-1)(x+2) &= 0 \\ \text{Either } 3x-1 &= 0 \quad \text{or} \quad x+2 = 0 \\ x &= \frac{1}{3} \qquad\qquad x = -2 \end{aligned}$$

PTS: 0 DIF: Moderate REF: 3.2 Solving Quadratic Equations by Factoring
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

31. ANS:

$$\begin{aligned} x^2 - 13x - 7 &= 0 \\ x^2 - 13x &= 7 \\ x^2 - 13x + \frac{169}{4} &= 7 + \frac{169}{4} \\ (x - \frac{13}{2})^2 &= \frac{197}{4} \\ x - \frac{13}{2} &= \pm\sqrt{\frac{197}{4}} \\ x &= \frac{13}{2} \pm \sqrt{\frac{197}{4}} \\ x &= \frac{13 \pm \sqrt{197}}{2} \end{aligned}$$

The roots are: $x = \frac{13+\sqrt{197}}{2}$ and $x = \frac{13-\sqrt{197}}{2}$

PTS: 0 DIF: Moderate REF: 3.3 Using Square Roots to Solve Quadratic Equations
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

32. ANS:
The student should have added 18 ($2 \times 9 = 18$) instead of 9 to the right side of the equation.

$$2x^2 - 12x - 13 = 0$$
$$2x^2 - 12x = 13$$
$$2(x^2 - 6x) = 13$$
$$2(x^2 - 6x + 9) = 13 + 18$$
$$2(x - 3)^2 = 31$$
$$(x - 3)^2 = \frac{31}{2}$$
$$x - 3 = \pm\sqrt{\frac{31}{2}}$$
$$x = 3 \pm \sqrt{\frac{31}{2}}$$

The roots are: $x = 3 + \sqrt{\frac{31}{2}}$ and $x = 3 - \sqrt{\frac{31}{2}}$

PTS: 0 DIF: Difficult REF: 3.3 Using Square Roots to Solve Quadratic Equations
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

33. ANS:

a) Find two numbers whose product is 3 and whose sum is –4. The numbers are –1 and –3.
$$x^2 - 4x + 3 = 0$$
$$(x - 1)(x - 3) = 0$$
$$x = 1 \text{ or } x = 3$$

b)
$$x^2 - 4x + 3 = 0$$
$$x^2 - 4x = -3$$
$$x^2 - 4x + 4 = -3 + 4$$
$$(x - 2)^2 = 1$$
$$x - 2 = \pm\sqrt{1}$$
$$x = 2 \pm 1$$
$$x = 3 \text{ or } x = 1$$

c) Substitute: $a = 1$, $b = -4$, $c = 3$ in: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
$$x = \frac{4 \pm \sqrt{(-4)^2 - 4(1)(3)}}{2(1)}$$
$$x = \frac{4 \pm \sqrt{4}}{2}$$
$$x = \frac{4 \pm 2}{2}$$
$$x = 2 \pm 1$$
$$x = 3 \text{ or } x = 1$$

Sample response: I prefer factoring because it takes less time and less space.

PTS: 0 DIF: Moderate REF: 3.4 Developing and Applying the Quadratic Formula
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

34. ANS:

a) Multiply each side by the common denominator, 6, to remove the fractions.

$-x^2 + \frac{2}{3}x - \frac{1}{2} = 0$

$-6x^2 + 4x - 3 = 0$

b) Substitute: $a = -6$, $b = 4$, $c = -3$ in: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-4 \pm \sqrt{(4)^2 - 4(-6)(-3)}}{2(-6)}$

$x = \frac{-4 \pm \sqrt{-56}}{-12}$

Since $\sqrt{-56}$ is not a real number, the equation has no real roots.

PTS: 0 DIF: Moderate REF: 3.4 Developing and Applying the Quadratic Formula
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

35. ANS:

For an equation to have exactly one real root, $b^2 - 4ac = 0$

Substitute: $a = 9$, $b = -k$, $c = 1$

$(-k)^2 - 4(9)(1) = 0$

$k^2 - 36 = 0$

$k^2 = 36$

$k = \pm 6$

For $9x^2 - kx + 1 = 0$ to have exactly one real root, *k* must be equal to ± 6.

Sample response: A possible value of *k* is 6. So, an equation with exactly one real root is: $9x^2 - 6x + 1 = 0$

PTS: 0 DIF: Moderate REF: 3.5 Interpreting the Discriminant
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

36. ANS:

For an equation to have no real roots, $b^2 - 4ac < 0$

Substitute: $a = 2$, $b = -3$, $c = k$

$(-3)^2 - 4(2)(k) < 0$

$9 - 8k < 0$

$-8k < -9$

$k > \frac{9}{8}$

For $2x^2 - 3x + k = 0$ to have no real roots, *k* must be greater than $\frac{9}{8}$.

Sample response: A possible value of *k* is 3. So, an equation with no real roots is: $2x^2 - 3x + 3 = 0$

PTS: 0 DIF: Moderate REF: 3.5 Interpreting the Discriminant
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

37. ANS:
Use guess and test to determine two values of *a*, *b*, and *c* so that: $b^2 - 4ac = 64$
Substitute: $b = 2$
$(2)^2 - 4ac = 64$
$4 - 4ac = 64$
$-4ac = 60$
This is satisfied by $a = -5$ and $c = 3$.
So, one equation is: $-5x^2 + 2x + 3 = 0$

Substitute: $b = 4$
$(4)^2 - 4ac = 64$
$16 - 4ac = 64$
$-4ac = 48$
This is satisfied by $a = -2$ and $c = 6$.
So, another equation is: $-2x^2 + 4x + 6 = 0$

PTS: 0 DIF: Difficult REF: 3.5 Interpreting the Discriminant
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

38. ANS:
a) *x*-intercepts: –1.70, 0.95
y-intercept: 3.25
b) vertex: (–0.38, 3.53)
c) axis of symmetry: $x = -0.38$
d) domain: $x \in \mathbb{R}$
e) range: $y \leq 3.53, y \in \mathbb{R}$

PTS: 0 DIF: Moderate REF: 4.1 Properties of a Quadratic Function
LOC: 11.RF4 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

39. ANS:

b) The *t*-intercepts are –0.11 and 5.82. The *t*-intercepts represent the times at which the height of the rocket is 0 m. Time cannot be negative, so the height of the rocket is 0 m at about 5.82 s.
c) The maximum value of the function represents the greatest height of the rocket. The greatest height that the rocket reached was approximately 43 m.
d) The domain is: $0 \leq t \leq 5.82$. The domain represents the time the toy rocket was in the air: about 5.82 s.

PTS: 0 DIF: Difficult REF: 4.1 Properties of a Quadratic Function
LOC: 11.RF4 TOP: Relations and Functions
KEY: Conceptual Understanding | Problem-Solving Skills | Procedural Knowledge

40. ANS:

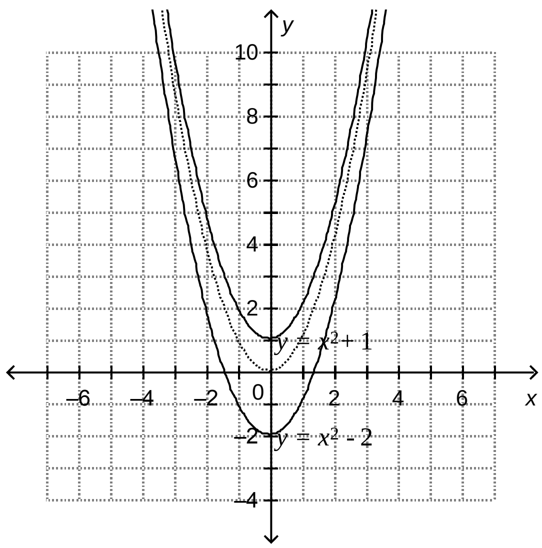
For $x^2 + 16x + 63 = 0$, graph $y = x^2 + 16x + 63$. On a graphing calculator, press: [2ND] [TRACE] [2]. Move the cursor to the left of the 1st *x*-intercept, then press [ENTER]; move the cursor to the right of the intercept and press [ENTER] [ENTER]. The screen displays $x = -7$. Repeat the process for the 2nd *x*-intercept to get $x = -9$. The roots are $x = -7$ and $x = -9$.

PTS: 0 DIF: Moderate REF: 4.2 Solving a Quadratic Equation Graphically
LOC: 11.RF5 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

41. ANS:
I first sketched the graph of $y = x^2$ as a broken curve.

a) I translated the graph of $y = x^2$ 1 unit up to get the graph of $y = x^2 + 1$.

b) I translated the graph of $y = x^2$ 2 units down to get the graph of $y = x^2 - 2$.

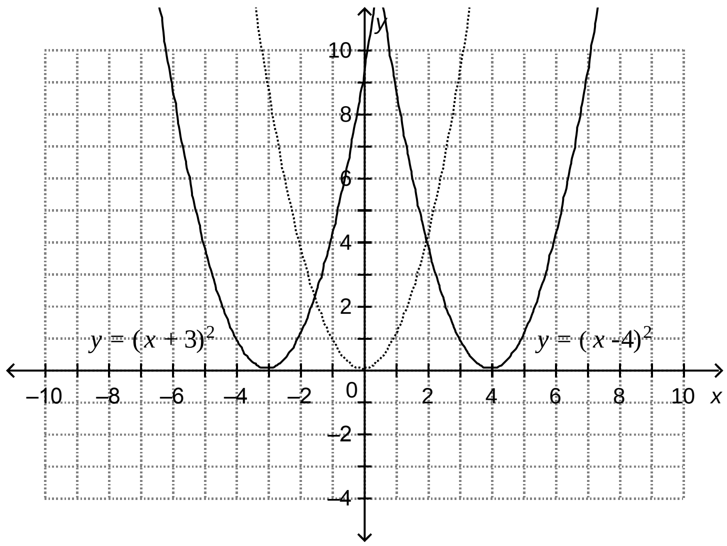


PTS: 0 DIF: Moderate REF: 4.3 Transforming the Graph of y = x^2
LOC: 11.RF3 TOP: Relations and Functions
KEY: Communication | Conceptual Understanding | Procedural Knowledge

42. ANS:
I first sketched the graph of $y = x^2$ as a broken curve.

a) I translated the graph of $y = x^2$ 3 units left to get the graph of $y = (x + 3)^2$.

b) I translated the graph of $y = x^2$ 4 units right to get the graph of $y = (x - 4)^2$.



PTS: 0 DIF: Moderate REF: 4.3 Transforming the Graph of y = x^2
LOC: 11.RF3 TOP: Relations and Functions
KEY: Communication | Conceptual Understanding | Procedural Knowledge

43. ANS:

An equation has the form $y = a(x - p)^2 + q$.
The vertex is at V(5, 4), so $p = 5$ and $q = 4$.
The equation becomes $y = a(x - 5)^2 + 4$.

Substitute the coordinates of the *y*-intercept: (0, 79)
$x = 0$, $y = 79$
$79 = a(0 - 5)^2 + 4$
$75 = 25a$
$a = 3$
So, the equation of the function is: $y = 3(x - 5)^2 + 4$

PTS: 0 DIF: Moderate
REF: 4.4 Analyzing Quadratic Functions of the Form y = a(x - p)^2 + q
LOC: 11.RF3 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

44. ANS:

Compare $y = -2(x - 4)^2 - 8$ with $y = a(x - p)^2 + q$.

a) i) *a* is negative, so the graph opens down.
ii) *p* = 4 and *q* = –8, so the coordinates of the vertex are: (4, –8)
iii) In general, the equation of the axis of symmetry is $x = p$; so for this graph it is $x = 4$.
iv) For the *y*-intercept, substitute $x = 0$ in $y = -2(x - 4)^2 - 8$.
$y = -2(0 - 4)^2 - 8$ Solve for y.
$y = -32 - 8$
$y = -40$
The *y*-intercept is –40.

For the *x*-intercept, substitute $y = 0$ in $y = -2(x - 4)^2 - 8$.

$0 = -2(x-4)^2 - 8$ Solve for x.

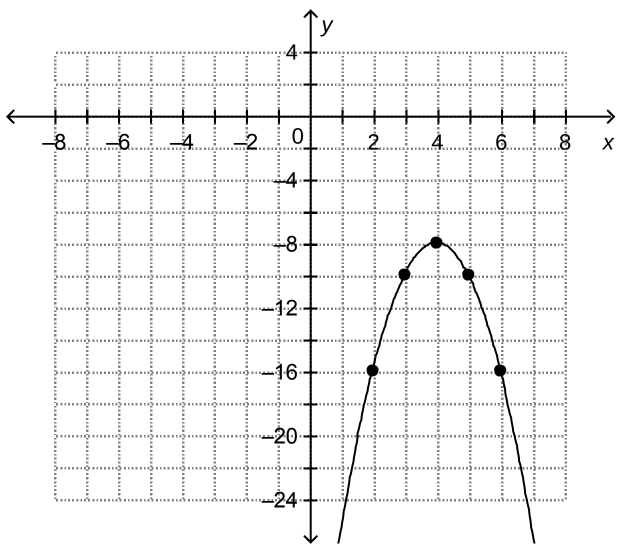
$8 = -2(x-4)^2$

$(x-4)^2 = -4$

This equation has no solution because a square number cannot be negative.
So, there are no *x*-intercepts.

v) The domain is: $x \in \mathbb{R}$
The graph opens down, so the vertex is a minimum point with *y*-coordinate –8. The range is: $y \leq -8,\ y \in \mathbb{R}$

b) The graph of $y = -2(x-4)^2 - 8$ is congruent to the graph of $y = -2x^2$.
On a grid, mark a point at the vertex (4, –8). Use the step pattern. Multiply each vertical step by –2 because the graph is a vertical expansion of factor 2 of the graph of $y = -x^2$.



PTS: 0 DIF: Moderate
REF: 4.4 Analyzing Quadratic Functions of the Form y = a(x - p)^2 + q
LOC: 11.RF3 TOP: Relations and Functions
KEY: Communication | Conceptual Understanding | Procedural Knowledge

45. ANS:

Write $y = x^2 + 12x + 11$ in standard form: $y = a(x-p)^2 + q$

$y = (x^2 + 12x) + 11$ Add and subtract: $\left(\frac{12}{2}\right)^2 = 36$

$= (x^2 + 12x + 36 - 36) + 11$

$= (x^2 + 12x + 36) - 36 + 11$

$= (x+6)^2 - 25$

Compare this with $y = a(x-p)^2 + q$.
The vertex of the parabola has coordinates $(-6, -25)$.

PTS: 0 DIF: Moderate
REF: 4.5 Equivalent Forms of the Equation of a Quadratic Function
LOC: 11.RF4 TOP: Relations and Functions

KEY: Communication | Procedural Knowledge

46. ANS:

$y = (x^2 - 7x) - 13$ Add and subtract: $\left(\frac{-7}{2}\right)^2 = \frac{49}{4}$

$= \left(x^2 - 7x + \frac{49}{4} - \frac{49}{4}\right) - 13$

$= \left(x^2 - 7x + \frac{49}{4}\right) - \frac{49}{4} - 13$

$= \left(x - \frac{7}{2}\right)^2 - \frac{49}{4} - 13$

$= \left(x - \frac{7}{2}\right)^2 - \frac{101}{4}$

Compare this with $y = a(x - p)^2 + q$.

The vertex of the parabola has coordinates $\left(\frac{7}{2}, -\frac{101}{4}\right)$.

PTS: 0 DIF: Moderate
REF: 4.5 Equivalent Forms of the Equation of a Quadratic Function
LOC: 11.RF4 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

47. ANS:

a) Expand: $y = 2(x - 3)^2 + 5$
$y = 2(x^2 - 6x + 9) + 5$
$y = 2x^2 - 12x + 18 + 5$
$y = 2x^2 - 12x + 23$

This matches the other equation. So, the equations represent the same quadratic function.

b) From the standard form, it is easier to identify the coordinates of the vertex, the equation of the axis of symmetry, the direction of opening, and the *y*-intercept. These characteristics can be used to sketch a graph of the function.

i) The coordinates of the vertex are (3, 5).
ii) The equation of the axis of symmetry is $x = 3$.
iii) The graph of the function opens up.
iv) The *y*-intercept can be determined by substituting $x = 0$ into the equation:
$y = 2(x - 3)^2 + 5$
$y = 2(0 - 3)^2 + 5$
$y = 2(-3)^2 + 5$
$y = 18 + 5$
$y = 23$

PTS: 0 DIF: Moderate
REF: 4.5 Equivalent Forms of the Equation of a Quadratic Function
LOC: 11.RF4 TOP: Relations and Functions
KEY: Communication | Conceptual Understanding | Procedural Knowledge

48. ANS:

$y = -\frac{1}{3}x^2 + 6x - 33$

$y = -\frac{1}{3}(x^2 - 18x) - 33$

$y = -\frac{1}{3}(x^2 - 18x + 81 - 81) - 33$

$y = -\frac{1}{3}(x^2 - 18x + 81) + 27 - 33$

$y = -\frac{1}{3}(x - 9)^2 - 6$

Step 1: Remove $-\frac{1}{3}$ as a common factor from the first 2 terms.

Step 2: Add and subtract the square of one half of 18, the coefficient of *x*.

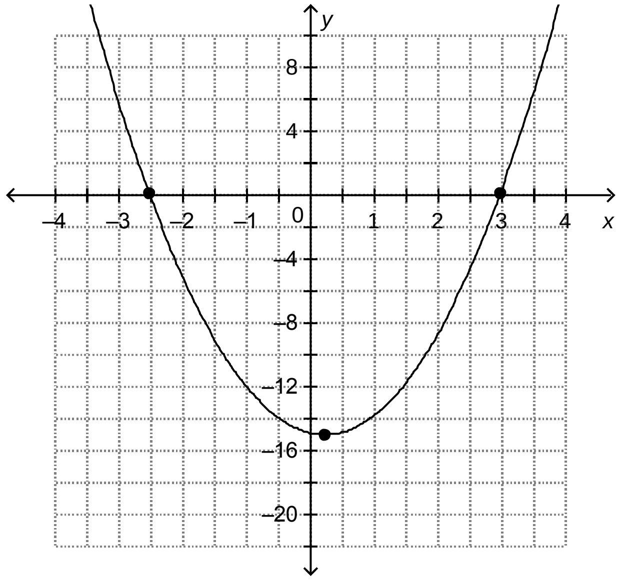
Step 3: Take –81 outside of the brackets by multiplying it by $-\frac{1}{3}$.

Step 4: Write the terms in the brackets as a perfect square. Simplify the terms outside of the brackets.

PTS: 0 DIF: Difficult
REF: 4.5 Equivalent Forms of the Equation of a Quadratic Function
LOC: 11.RF4 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

49. ANS:
Check whether the equation factors.
The value of the discriminant is: $(-1)^2 - 4(2)(-15) = 121$
Since 121 is a perfect square, the equation factors.
Use decomposition to factor.
$y = 2x^2 - x - 15$
$y = (2x + 5)(x - 3)$
The *x*-intercepts are: $-\frac{5}{2}$ and 3, or –2.5 and 3
The *x*-coordinate of the vertex is: $\frac{-2.5 + 3}{2} = 0.25$
Determine the *y*-coordinate of the vertex.
Substitute $x = 0.25$ in $y = 2x^2 - x - 15$.
$y = 2x^2 - x - 15$
$y = 2(0.25)^2 - (0.25) - 15$
$y = -15.125$
The coordinates of the vertex are: $(0.25, -15.125)$

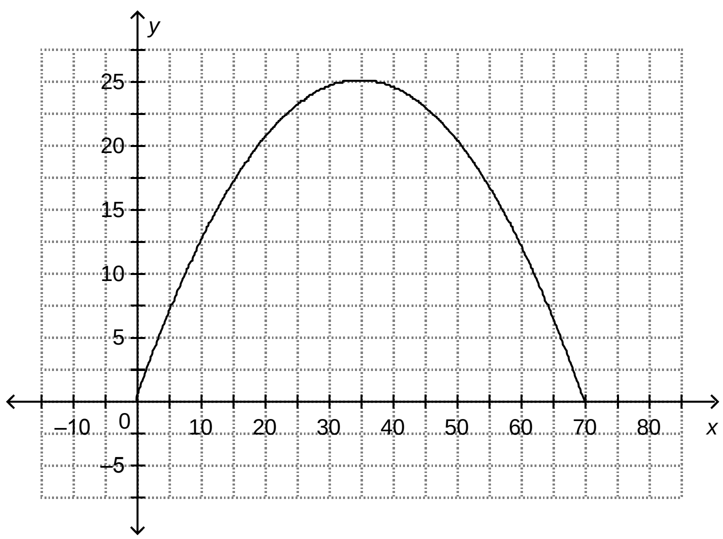
On a grid, mark points at the vertex and the intercepts. Draw a smooth curve through the points.



PTS: 0 DIF: Moderate
REF: 4.6 Analyzing Quadratic Functions of the Form y = ax^2 + bx + c
LOC: 11.RF4 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

50. ANS:
Sketch the parabola on coordinate axes, with one end of the arch at the origin. Since the arch is 70 m wide, the other end of the arch has coordinates (70, 0).

The centre of the arch is at the vertex of the parabola. The height of the arch is the *y*-coordinate of the vertex; that is, $y = 25$. The *x*-coordinate of the vertex is halfway between 0 and 70; that is, $x = 35$.



The *x*-intercepts are 0 and 70, so use the factored form of the equation of a quadratic function:
$y = a(x - x_1)(x - x_2)$
Substitute: $x_1 = 0$ and $x_2 = 70$
The equation becomes: $y = a(x - 0)(x - 70)$, or $y = ax(x - 70)$

Use the coordinates of the vertex to determine the value of *a*.
Substitute $x = 35$ and $y = 25$ in $y = ax(x - 70)$.
$25 = a(35)(35 - 70)$
$25 = -1225a$
$a = -\frac{1}{49}$
Substitute $a = -\frac{1}{49}$ in $y = ax(x - 70)$.

An equation of the quadratic function is: $y = -\frac{1}{49}x(x - 70)$

PTS: 0 DIF: Difficult
REF: 4.6 Analyzing Quadratic Functions of the Form y = ax^2 + bx + c
LOC: 11.RF4 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

51. ANS:
Compare the equation to $y = a(x - p)^2 + q$.
a is positive, so the function has a minimum value.
The coordinates of the vertex are: (6, 6)
So, the minimum value is 6.

PTS: 0 DIF: Easy
REF: 4.7 Modelling and Solving Problems with Quadratic Functions
LOC: 11.RF4 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

52. ANS:
Graph the equation. Use the CALC feature to determine the coordinates of the vertex.
The *h*-coordinate of the vertex is the maximum height of the rocket: approximately 22.4 m.
The amount of time the rocket was in the air is the positive *t*-intercept: approximately 4.2 s.

PTS: 0 DIF: Moderate
REF: 4.7 Modelling and Solving Problems with Quadratic Functions
LOC: 11.RF4 TOP: Relations and Functions
KEY: Problem-Solving Skills | Procedural Knowledge

53. ANS:
Let the width of each rectangle be *w* metres. Let the length of the rectangle made up of the 2 smaller rectangles be *l* metres.
The area, *A* square metres, is given by the equation $A = lw$.
The perimeter of the rectangular pens is 78 m.
So, $78 = 2l + 3w$
$78 - 2l = 3w$
$w = \frac{1}{3}(78 - 2l)$

So, $A = \frac{1}{3}l(78 - 2l)$
$A = -\frac{2}{3}l(l - 39)$
The coefficient of l^2 is negative, so the graph has a maximum value.

From the equation, the l-intercepts are: 0, 39
The l-coordinate of the vertex is 19.5. So, $l = 19.5$

Then, $A = -\frac{2}{3}(19.5)(19.5 - 39)$

$A = 253.5$

The maximum area is 253.5 m^2.

$w = \frac{1}{3}\left(78 - 2(19.5)\right)$

$w = 13$

The dimensions that enclose the maximum area are 19.5 m by 13 m.

PTS: 0 DIF: Difficult
REF: 4.7 Modelling and Solving Problems with Quadratic Functions
LOC: 11.RF4 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

54. ANS:

Rearrange the equation to isolate h: $h - 2 = -5t^2 + 20t$

$$h = -5t^2 + 20t + 2$$

An inequality that represents the situation is: $-5t^2 + 20t + 2 > 18$
A related quadratic equation is: $-5t^2 + 20t + 2 = 18$, or $-5t^2 + 20t - 16 = 0$
Solve the equation.

$$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \text{Substitute: } a = -5,\ b = 20,\ c = -16$$

$$t = \frac{-20 \pm \sqrt{20^2 - 4(-5)(-16)}}{2(-5)}$$

$$t = \frac{-20 \pm \sqrt{80}}{-10}$$

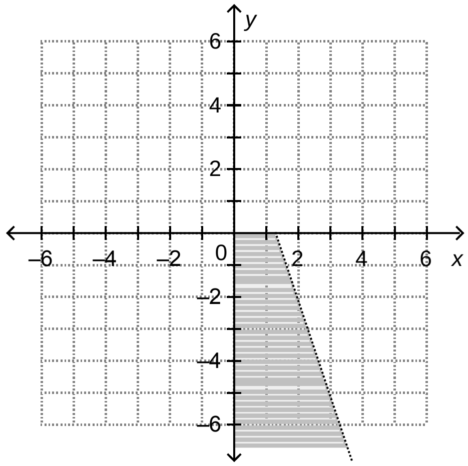
$t \doteq 1.1$ or $t \doteq 2.9$

Substitute into the inequality.
When $t < 1.1$, such as $t = 0$, L.S. = 2 and R.S. = 18; so $t = 0$ does not satisfy the inequality.
When $t > 2.9$, such as $t = 3$, L.S. = 17 and R.S. = 18; so $t = 3$ does not satisfy the inequality.
When $1.1 < t < 2.9$, such as $t = 2$, L.S. = 22 and R.S. = 18; so $t = 2$ does satisfy the inequality.
The solution is: $1.1 < t < 2.9$
So, the baseball is higher than 18 m between 1.1 s and 2.9 s after it is hit.

PTS: 0 DIF: Difficult REF: 5.1 Solving Quadratic Inequalities in One Variable
LOC: 11.RF8 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

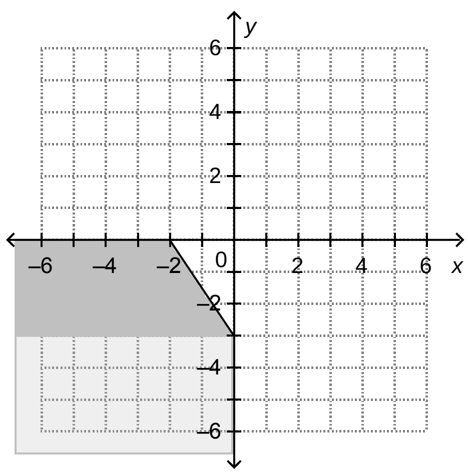
55. ANS:

a) Since $x > 0$ and $y < 0$, the graph is in Quadrant 4.
The graph of the related function has slope –3 and y-intercept 4.
Draw a broken line to represent the related function in Quadrant 4.
Shade the region below the line.
The axes bounding the graph are broken lines.



b) Since $x \le 0$ and $y \le 0$, the graph is in Quadrant 3.
Graph the related function.
When $y = 0$, $x = -2$.
When $x = 0$, $y = -3$.
Draw a solid line to represent the related function in Quadrant 3.

Use (0, 0) as a test point.
L.S. = 6; R.S. = 0
Since 6 > 0, the origin is not in the shaded region.
Shade the region below the line.
The axes bounding the graph are solid lines.

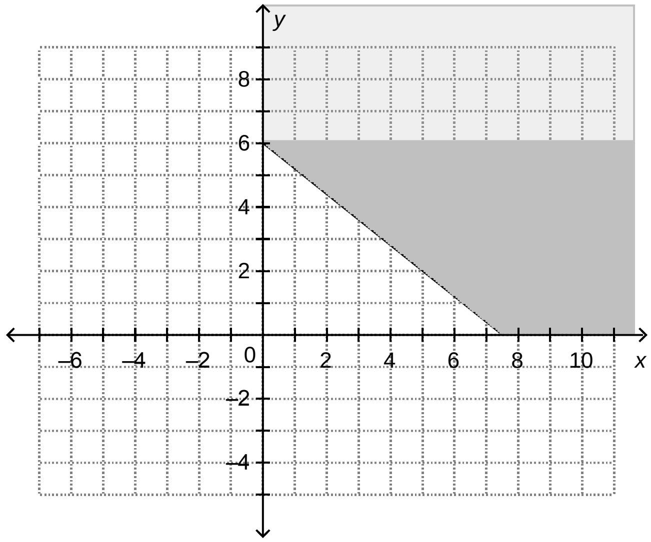


PTS: 0 DIF: Difficult REF: 5.2 Graphing Linear Inequalities in Two Variables
LOC: 11.RF7 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

56. ANS:

a) Let *x* represent the number of cordless phones sold and *y* represent the number of cordless phones with answering machines sold.
An inequality is: $24x + 30y \ge 180$

b) The solution of the inequality is the points, with whole-number coordinates, in the region above the line and the points, with whole-number coordinates, on the line.



c) Day 1: the point (2, 5) is in the shaded region, so the manager's profit target was met.
Day 2: the point (3, 3) is not in the shaded region, nor is it on the line, so the manager's profit target was not met.
Day 3: the point (5, 2) is on the line, so the manager's profit target was met.

PTS: 0 DIF: Difficult REF: 5.2 Graphing Linear Inequalities in Two Variables
LOC: 11.RF7 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

57. ANS:
In $y \geq 2x^2 - 10$, substitute: $x = -4$, $y = b$
$b \geq 2(-4)^2 - 10$ Solve for b.
$b \geq 32 - 10$
$b \geq 22$

PTS: 0 DIF: Moderate REF: 5.3 Graphing Quadratic Inequalities in Two Variables
LOC: 11.RF7 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

58. ANS:
In $y < -3x^2 + 9$, substitute: $x = a$, $y = 3$
$3 < -3a^2 + 9$ Solve for *a*.
$-3a^2 > -6$ Divide both sides by –3.
$a^2 < 2$ Square both sides.
$a < \sqrt{2}$, or $a > -\sqrt{2}$
That is, $-\sqrt{2} < a < \sqrt{2}$

PTS: 0 DIF: Moderate REF: 5.3 Graphing Quadratic Inequalities in Two Variables
LOC: 11.RF7 TOP: Relations and Functions
KEY: Communication | Procedural Knowledge

59. ANS:
a) Let the numbers be represented by *x* and *y*.
An inequality is: $8 - 4x^2 > 2y + 2$

Write the inequality in general form.

$8 - 4x^2 > 2y + 2$

$2y < 8 - 4x^2 - 2$

$2y < -4x^2 + 6$

$y < -2x^2 + 3$

Use transformations to graph the corresponding function: $y = -2x^2 + 3$

The graph is the image of $y = x^2$ after a vertical stretch of factor 2, a reflection in the *x*-axis, and a translation of 3 units up.

The coordinates of the vertex are: (0, –3).

Draw a broken curve.

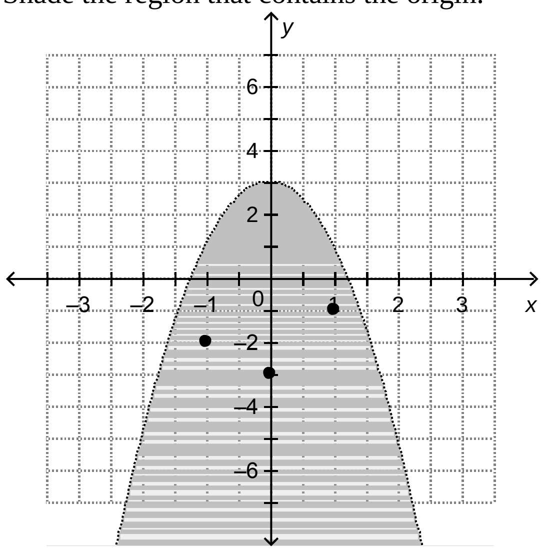
To determine the region to be shaded, use the origin as a test point.

Substitute $x = 0$ and $y = 0$ in $y = -2x^2 + 3$.

L.S. = 0 and R.S. = 3

Since (0, 0) satisfies the inequality, the origin is a solution.

Shade the region that contains the origin.



b) Choose 3 lattice points that are in the shaded region.

Sample response: (0, –3), (1, –1), (–1, –2)

Three pairs of integers are: 0 and –3; 1 and –1; and –1 and –2

PTS: 0 DIF: Difficult REF: 5.3 Graphing Quadratic Inequalities in Two Variables
LOC: 11.RF7 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

60. ANS:

a) Let the length of the rectangle be represented by ($2x^2 - 10$) units and the width by 5*y* units.

The length is greater than the width so an inequality is: $5y < 2x^2 - 10$, or $y < 0.4x^2 - 2$

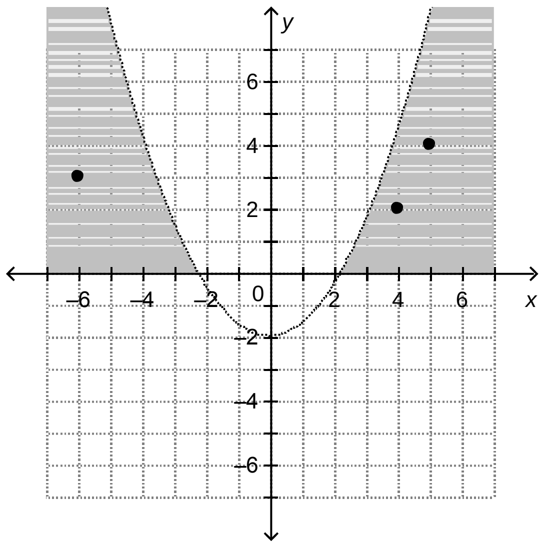
The graph of the related function is congruent to $y = 0.4x^2$ and its vertex is (0, –2).

The curve is broken.

Since *y* cannot be negative, only the region above the *x*-axis is shaded.

Also, $2x^2 - 10 > 0$, so $x > \sqrt{5}$ or $x < -\sqrt{5}$.

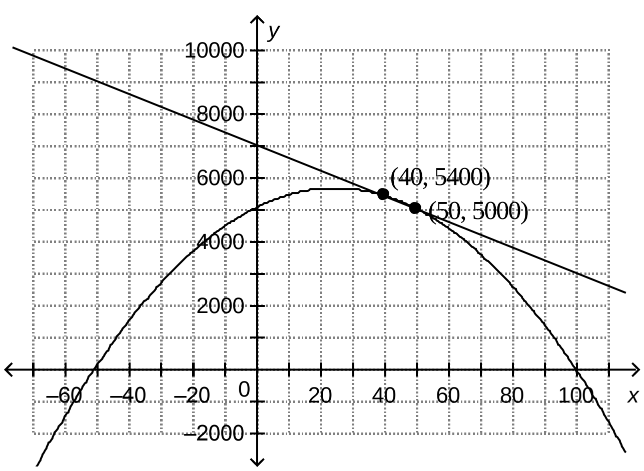
Shade the region that satisfies these inequalities: $y < 0.4x^2 - 2$, $y > 0$, $|x| > \sqrt{5}$



b) Sample response:
Three sets of coordinates are: (4, 2), (5, 4), (–6, 3)
So, 3 possible sets of dimensions are:
length: $2(4)^2 - 10 = 22$; width: $5(2) = 10$
length: $2(5)^2 - 10 = 40$; width: $5(4) = 20$
length: $2(-6)^2 - 10 = 62$; width: $5(3) = 15$
Possible dimensions are: 22 units by 10 units; 40 units by 20 units; 62 units by 15 units

PTS: 0 DIF: Difficult REF: 5.3 Graphing Quadratic Inequalities in Two Variables
LOC: 11.RF7 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

61. ANS:



PTS: 0 DIF: Moderate REF: 5.4 Solving Systems of Equations Graphically
LOC: 11.RF6 TOP: Relations and Functions
KEY: Problem-Solving Skills | Procedural Knowledge

62. ANS:

a) Let x represent the first number and let y represent the second number.
The statement that the sum of 5 times the first number and 6 times the second number is 0 can be modelled with the equation: $5x + 6y = 0$
The statement that when twice the second number is subtracted from the square of the first number, the result is equal to 20 minus the first number can be modelled with the equation: $x^2 - 2y = 20 - x$

Solve each equation for y to get a system:

$$y = -\frac{5}{6}x \qquad ①$$

$$y = \frac{1}{2}x^2 + \frac{1}{2}x - 10 \qquad ②$$

b) Solve the system. Since the left sides of the equations are equal, the right sides must also be equal.

$$-\frac{5}{6}x = \frac{1}{2}x^2 + \frac{1}{2}x - 10$$

$$-\frac{1}{2}x^2 - \frac{1}{2}x - \frac{5}{6}x + 10 = 0$$

$$-\frac{1}{2}x^2 - \frac{3}{6}x - \frac{5}{6}x + 10 = 0$$

$$x^2 + \frac{8}{3}x - 20 = 0$$

Use the quadratic formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad \text{Substitute: } a = 1,\ b = \frac{8}{3},\ c = -20$$

$$x = \frac{-\frac{8}{3} \pm \sqrt{\left(\frac{8}{3}\right)^2 - 4(1)(-20)}}{2(1)}$$

$$x = \frac{-\frac{8}{3} \pm \sqrt{\frac{784}{9}}}{2}$$

So, $x = -6$ or $x = \frac{10}{3}$

Substitute each value of x in equation ①.

When $x = -6$:

$$y = -\frac{5}{6}(-6)$$

$$y = 5$$

When $x = \frac{10}{3}$:

$$y = \left(-\frac{5}{6}\right)\left(\frac{10}{3}\right)$$

$$y = -\frac{25}{9}$$

The solutions are: –6 and 5; $\frac{10}{3}$ and $-\frac{25}{9}$

Verify the solutions using the statement of the problem.
For $x = -6$ and $y = 5$:

The sum of 5 times –6 and 6 times 5 is 0.
When 2 times 5 is subtracted from $(-6)^2$, the result is equal to 20 minus -6.
These numbers satisfy the problem statement.

For $x = \frac{10}{3}$ and $y = -\frac{25}{9}$:
The sum of 5 times $\frac{10}{3}$ and 6 times $-\frac{25}{9}$ is 0.
When 2 times $-\frac{25}{9}$ is subtracted from $\left(\frac{10}{3}\right)^2$, the result is equal to 20 minus $\frac{10}{3}$.
These numbers satisfy the problem statement.

So, the numbers are: –6 and 5; or $\frac{10}{3}$ and $-\frac{25}{9}$

PTS: 0 DIF: Difficult REF: 5.5 Solving Systems of Equations Algebraically
LOC: 11.RF6 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

63. ANS:

a) Solve the system formed by the 2 equations:
$h = -4.9t^2 + 2t + 500$ ①
$h = -5t + 188$ ②
From equation ①, substitute $h = -4.9t^2 + 2t + 500$ in equation ②.
$-4.9t^2 + 2t + 500 = -5t + 188$
$-4.9t^2 + 7t + 312 = 0$
$4.9t^2 - 7t - 312 = 0$

Use the quadratic formula.
$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ Substitute: $a = 4.9$, $b = -7$, $c = -312$

$t = \frac{7 \pm \sqrt{(-7)^2 - 4(4.9)(-312)}}{2(4.9)}$

$t = \frac{7 \pm \sqrt{6164.2}}{9.8}$
Since time cannot be negative, ignore the negative root.
$t = \frac{7 + \sqrt{6164.2}}{9.8}$

$t = 8.7257...$
The stuntman opened his parachute approximately 8.7 s after he jumped.

b) Substitute $t = 8.7257...$ in equation ②.
$h = -5(8.7257...) + 188$
$h = 144.3712...$
The stuntman opened his parachute at an elevation of approximately 144.4 m.

PTS: 0 DIF: Difficult REF: 5.5 Solving Systems of Equations Algebraically
LOC: 11.RF6 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

64. ANS:

a) Write an equation that represents the height of the soccer ball *t* seconds after the football is kicked.

$h = -4.9(t-1)^2 + 12(t-1)$

Solve the system formed by the 2 equations:

$h = -4.9t^2 + 10t + 1$ ①

$h = -4.9(t-1)^2 + 12(t-1)$ ②

From equation ①, substitute $h = -4.9t^2 + 10t + 1$ in equation ②.

$-4.9t^2 + 10t + 1 = -4.9(t-1)^2 + 12(t-1)$

$-4.9t^2 + 10t + 1 = -4.9(t^2 - 2t + 1) + 12(t-1)$

$-4.9t^2 + 10t + 1 = -4.9t^2 + 9.8t - 4.9 + 12t - 12$

$17.9 = 11.8t$

$t = 1.5169...$

The football and the soccer ball reached the same height after approximately 1.5 s.

b) Substitute $t = 1.5169...$ in equation ①.

$h = -4.9(1.5169...)^2 + 10(1.5169...) + 1$

$= 4.8939...$

After 1.5 s, both balls are at a height of approximately 4.9 m.

PTS: 0 DIF: Difficult REF: 5.5 Solving Systems of Equations Algebraically
LOC: 11.RF6 TOP: Relations and Functions
KEY: Communication | Problem-Solving Skills

65. ANS:

First determine the measure of ∠B.

In right ΔABC,

$\cos B = \frac{\text{adjacent}}{\text{hypotenuse}}$

$\cos B = \frac{BC}{AB}$

$\cos B = \frac{11}{21}$

$\angle B = \cos^{-1}\left(\frac{11}{21}\right)$

$\angle B = 58.4118...°$

In a right triangle, when one acute angle is θ, the other acute angle is $90° - \theta$.

$\angle A = 90° - \angle B$

$\angle A = 90° - 58.4118...°$

$\angle A = 31.5881...°$

So, ∠B is approximately 58.4° and ∠A is approximately 31.6°.

PTS: 0 DIF: Moderate REF: 6.1 Angles in Standard Position in Quadrant 1

LOC: 11.T2 TOP: Trigonometry
KEY: Conceptual Understanding | Communication

66. ANS:

a) In right ΔBCO, BO is the hypotenuse, BC is opposite ∠O, and CO is adjacent to ∠O.

To determine the length of BO, use the sine ratio.

$$\sin O = \frac{\text{opposite}}{\text{hypotenuse}}$$
$$\sin O = \frac{BC}{BO}$$
$$\sin 31° = \frac{8.0}{BO}$$

Solve the equation for BO.

$$\sin 31° = \frac{8.0}{BO}$$
$$BO \sin 31° = 8.0$$
$$\frac{BO \sin 31°}{\sin 31°} = \frac{8.0}{\sin 31°}$$
$$BO = \frac{8.0}{\sin 31°}$$
$$BO = 15.5328\ldots$$

The length of cord needed to reach corner B is approximately 15.5 m.

b) In right ΔBCO, to determine the length of CO, use the cosine ratio.

$$\cos O = \frac{\text{adjacent}}{\text{hypotenuse}}$$
$$\cos O = \frac{CO}{BO}$$
$$\cos 31° = \frac{CO}{15.5328\ldots}$$

Solve the equation for CO.

$$\cos 31° = \frac{CO}{15.5328\ldots}$$
$$(15.5328\ldots) \cos 31° = CO$$
$$CO = 13.3142\ldots$$

To determine the distance between the electrical outlet and corner N, subtract CO from CN.

$$NO = CN - CO$$
$$NO = 35.0 - 13.3142\ldots$$
$$NO = 21.6857\ldots$$

The distance between the electrical outlet and corner N is approximately 21.7 m.

PTS: 0 DIF: Difficult REF: 6.1 Angles in Standard Position in Quadrant 1
LOC: 11.T2 TOP: Trigonometry
KEY: Communication | Problem-Solving Skills

67. ANS:

a) Determine the distance *r* from the origin to P.

$x = -1$, $y = -5$

$r = \sqrt{x^2 + y^2}$
$r = \sqrt{(-1)^2 + (-5)^2}$
$r = \sqrt{26}$

$\cos\theta = \frac{x}{r}$

$\cos\theta = \frac{-1}{\sqrt{26}}$

$\sin\theta = \frac{y}{r}$

$\sin\theta = \frac{-5}{\sqrt{26}}$

$\tan\theta = \frac{y}{x}$

$\tan\theta = \frac{-5}{-1}$, or 5

b) The reference angle is: $\tan^{-1}(5) = 78.69\ldots°$
Since θ is in Quadrant 3, the angle θ is approximately: $180° + 78.69° = 258.69°$

PTS: 0 DIF: Moderate REF: 6.2 Angles in Standard Position in All Quadrants
LOC: 11.T2 TOP: Trigonometry
KEY: Procedural Knowledge | Communication

68. ANS:
Determine the distance *r* from the origin to P.
$x = 9$, $y = -4$
$r = \sqrt{x^2 + y^2}$
$r = \sqrt{(9)^2 + (-4)^2}$
$r = \sqrt{97}$

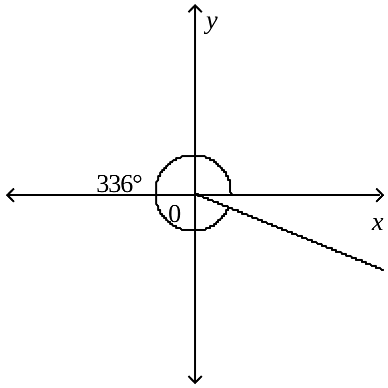
Use: $\cos\theta = \frac{x}{r}$

$\cos\theta = \frac{9}{\sqrt{97}}$

The reference angle, to the nearest degree, is:

$$\cos^{-1}\left(\frac{9}{\sqrt{97}}\right) = 24°$$

Since *x* is positive and *y* is negative, the terminal arm is in Quadrant 4, and θ is approximately $336°$.



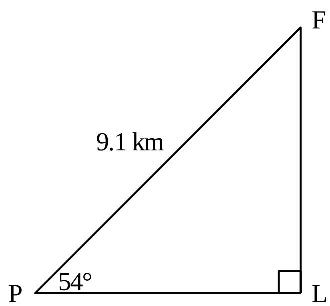
PTS: 0 DIF: Moderate REF: 6.2 Angles in Standard Position in All Quadrants
LOC: 11.T2 TOP: Trigonometry
KEY: Procedural Knowledge | Communication

69. ANS:
Draw a labelled diagram to represent the problem.
In right ΔFLP, FP is the hypotenuse and FL is the side opposite ∠P.
So, use the sine ratio to determine the length of FL.

$$\sin P = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\sin P = \frac{FL}{FP}$$

$$\sin 54° = \frac{FL}{9.1}$$



Solve the equation for FL.

$$\sin 54° = \frac{FL}{9.1}$$

$$9.1 \sin 54° = FL$$

$$FL = 7.3620\ldots$$

The distance between the fishing boat and the lighthouse is approximately 7.4 km.

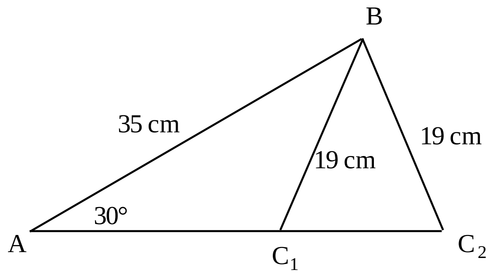
PTS: 0 DIF: Moderate REF: 6.2 Angles in Standard Position in All Quadrants
LOC: 11.T2 TOP: Trigonometry
KEY: Communication | Problem-Solving Skills

70. ANS:
a) $\frac{BC}{AB} = \frac{19}{35}$, or 0.5428...

$\sin 30° = 0.4999$

Since $\sin 30° < \frac{BC}{AB}$, there are two possible triangles with the given measures.

b)



PTS: 0 DIF: Moderate REF: 6.3 Constructing Triangles
LOC: 11.T3 TOP: Trigonometry
KEY: Communication | Problem-Solving Skills

71. ANS:

a) Since $\frac{BC}{AB} < 1$, the following situations are possible:

i) No triangle is possible.
ii) Two scalene triangles are possible.

b) i) $\angle A$ is acute, so $\angle A < 90°$

For no triangle, $\frac{BC}{AB} < \sin A$

$\sin A > \frac{BC}{AB}$

$\sin A > \frac{5.3}{8.3}$

$\sin^{-1}\left(\frac{5.3}{8.3}\right) \doteq 40°$

For an acute angle θ, as θ increases, $\sin\theta$ also increases.

So, for no triangle, $40° < \angle A < 90°$

ii) For two scalene triangles, $\sin A < \frac{BC}{AB} < 1$

$\frac{BC}{AB} = \frac{5.3}{8.3}$, so $\sin A < \frac{5.3}{8.3}$

Since $\sin^{-1}\left(\frac{5.3}{8.3}\right) \doteq 40°$, $\angle A < 40°$; so, for two scalene triangles, $\angle A < 40°$.

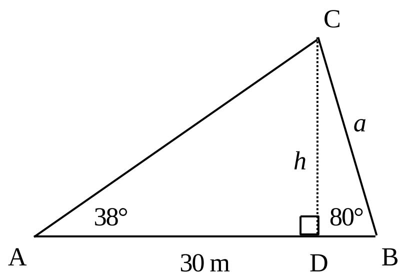
PTS: 0 DIF: Difficult REF: 6.3 Constructing Triangles
LOC: 11.T3 TOP: Trigonometry
KEY: Conceptual Understanding | Communication | Problem-Solving Skills

72. ANS:
Possible solution:
$\sin A = \sin 75°$
$= 0.9659\ldots$

Length of BC (cm)	Value of $\frac{BC}{AB}$	How does $\frac{BC}{AB}$ compare with sin A?	Description of possible triangles
5	0.8333...	$\frac{BC}{AB} < \sin A$	No triangles are possible.
6	1	$\frac{BC}{AB} = 1 > \sin A$	1 isosceles triangle
7	1.1666...	$\frac{BC}{AB} > 1 > \sin A$	1 scalene triangle
5.9	0.9833...	$\sin A < \frac{BC}{AB} < 1$	2 scalene triangles

PTS: 0 DIF: Moderate REF: 6.3 Constructing Triangles
LOC: 11.T3 TOP: Trigonometry
KEY: Conceptual Understanding | Problem-Solving Skills

73. ANS:
Sketch a diagram for the situation.
C represents the position of the cat and *h* represents its height above the ground. AB represents the distance between firefighters A and B.



Use the angle sum in a triangle.

$\angle C = 180° - (\angle A + \angle B)$
$\angle C = 180° - (38° + 80°)$
$\angle C = 62°$

Use the Sine Law to determine *a*, the length of BC.

$$\frac{a}{\sin A} = \frac{c}{\sin C}$$
$$\frac{a}{\sin 38°} = \frac{30}{\sin 62°}$$
$$a = \frac{30 \sin 38°}{\sin 62°}$$
$$a = 20.9183\ldots$$

Use the sine ratio in right $\triangle BCD$.

$$\sin B = \frac{h}{a}$$
$$h = a \sin B$$
$$h = (20.9183\ldots) \sin 80°$$
$$h \doteq 20.6$$

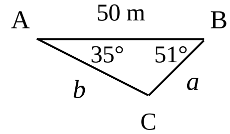
The cat is approximately 20.6 m above the ground.

PTS: 0 DIF: Difficult REF: 6.4 The Sine Law
LOC: 11.T3 TOP: Trigonometry
KEY: Communication | Problem-Solving Skills

74. ANS:

The treasure chest could be between the two divers or on one side of both divers.

Case 1: The treasure chest C is between the two divers, A and B.

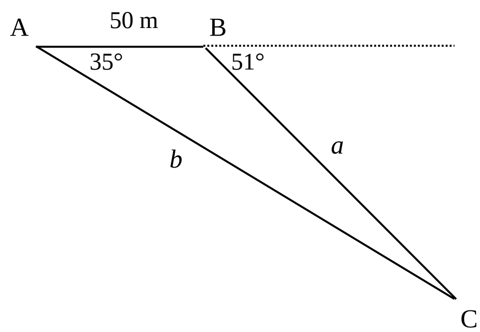


$$\angle C = 180° - (\angle A + \angle B)$$
$$\angle C = 180° - (35° + 51°)$$
$$\angle C = 94°$$

$$\frac{a}{\sin A} = \frac{c}{\sin C}$$
$$\frac{a}{\sin 35°} = \frac{50}{\sin 94°}$$
$$a = \frac{50 \sin 35°}{\sin 94°}$$
$$a \doteq 29$$
$$\frac{b}{\sin B} = \frac{c}{\sin C}$$
$$\frac{b}{\sin 51°} = \frac{50}{\sin 94°}$$
$$b = \frac{50 \sin 51°}{\sin 94°}$$
$$b \doteq 39$$

The treasure chest is approximately 29 m and 39 m from the divers.

Case 2: The treasure chest C is on one side of both divers A and B.



$$\frac{a}{\sin A} = \frac{c}{\sin C}$$
$$\frac{a}{\sin 35°} = \frac{50}{\sin 16°}$$
$$a = \frac{50 \sin 35°}{\sin 16°}$$
$$a \doteq 104$$

In $\triangle ABC$,

$$\angle B = 180° - 51° = 129°$$
$$\angle C = 180° - (35° + 129°) = 16°$$
$$\frac{b}{\sin B} = \frac{c}{\sin C}$$
$$\frac{b}{\sin 129°} = \frac{50}{\sin 16°}$$
$$b = \frac{50 \sin 129°}{\sin 16°}$$
$$b \doteq 141$$

The treasure chest is approximately 104 m and 141 m from the divers.

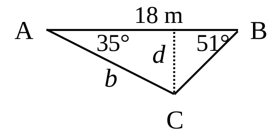
PTS: 0 DIF: Difficult REF: 6.4 The Sine Law
LOC: 11.T3 TOP: Trigonometry

KEY: Communication | Problem-Solving Skills

75. ANS:

Let C represent the location of the school of fish and *d* represent its distance below sea level.
The school of fish could be between the two boats or on one side of both boats.

Case 1: The school of fish is between boats A and B.



$\angle C = 180° - (\angle A + \angle B)$

$\angle C = 180° - (35° + 51°)$

$\angle C = 94°$

$\frac{b}{\sin B} = \frac{c}{\sin C}$

$\frac{b}{\sin 51°} = \frac{18}{\sin 94°}$

$b = \frac{18 \sin 51°}{\sin 94°}$

$b \doteq 14$

$\sin A = \frac{d}{b}$

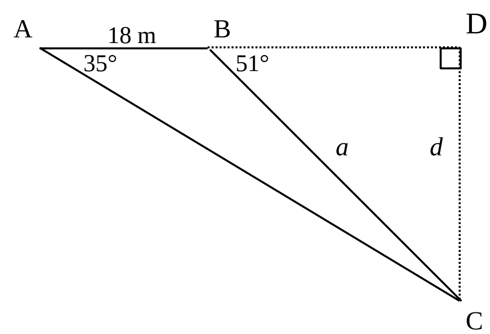
$d = b \sin A$

$d \doteq 14 \sin 35°$

$d \doteq 8$

The school of fish is approximately 8 m below sea level.

Case 2: The school of fish is on one side of both boats A and B.



In $\triangle ABC$,

$\angle B = 180° - 51°$

$= 129°$

$\angle C = 180° - (35° + 129°)$

$= 16°$

$\frac{a}{\sin A} = \frac{c}{\sin C}$

$\frac{a}{\sin 35°} = \frac{18}{\sin 16°}$

$a = \frac{18 \sin 35°}{\sin 16°}$

$a \doteq 37$

In right $\triangle BDC$,

$\sin B = \frac{d}{a}$

$d = a \sin B$

$d \doteq 37 \sin 51°$

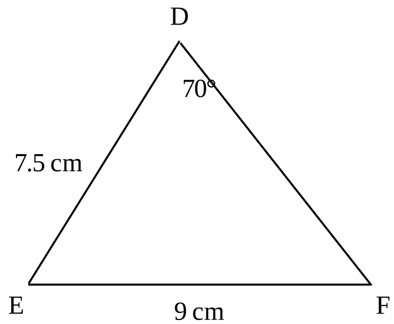
$d \doteq 29$

The school of fish is approximately 29 m below sea level.

PTS: 0 DIF: Difficult REF: 6.4 The Sine Law
LOC: 11.T3 TOP: Trigonometry
KEY: Communication | Problem-Solving Skills

76. ANS:

a) Sketch the triangle.



Use the ratio $\frac{EF}{DE}$ to determine the number of possible triangles.

$$\frac{EF}{DE} = \frac{9}{7.5}$$
$$= 1.2$$

Since $\frac{EF}{DE} > 1$, one triangle is possible.

b) Solve for ∠F:

$$\frac{\sin F}{DE} = \frac{\sin D}{EF}$$
$$\frac{\sin F}{7.5} = \frac{\sin 70°}{9}$$
$$\sin F = \frac{7.5 \sin 70°}{9}$$
$$\angle F = \sin^{-1}\left(\frac{7.5 \sin 70°}{9}\right)$$
$$\angle F \doteq 52°$$

Solve for ∠E:

$$\angle E \doteq 180° - (70° + 52°)$$
$$\angle E \doteq 58°$$

Solve for DF:

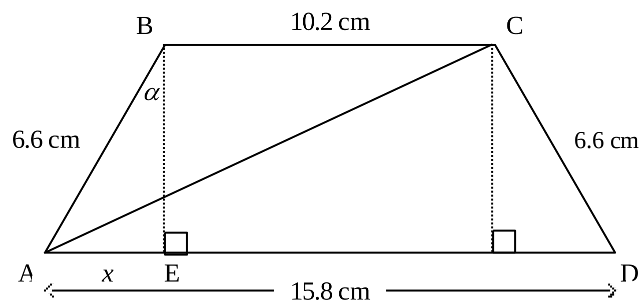
$$\frac{DF}{\sin E} = \frac{EF}{\sin D}$$
$$\frac{DF}{\sin 58°} \doteq \frac{9}{\sin 70°}$$
$$DF \doteq \frac{9 \sin 58°}{\sin 70°}$$
$$DF \doteq 8.1$$

So, in ΔDEF, the approximate measures are: ∠E = 58°, ∠F = 52°, and DF = 8.1 cm.

PTS: 0 DIF: Difficult REF: 6.4 The Sine Law
LOC: 11.T3 TOP: Trigonometry
KEY: Procedural Knowledge | Communication

77. ANS:
Draw lines perpendicular to AD through B and through C.

$2x + BC = AD$
$2x + 10.2 = 15.8$
$2x = 15.8 - 10.2$
$x = 2.8$



In ΔABE:

$\sin\alpha = \dfrac{x}{AB}$

$\sin\alpha = \dfrac{2.8}{6.6}$

$\alpha = \sin^{-1}\left(\dfrac{2.8}{6.6}\right)$

$\alpha \doteq 25°$

In ΔABC:
$\angle B = 90° + \alpha$
$\angle B \doteq 90° + 25°$
$\angle B \doteq 115°$

Use the Cosine Law to determine AC.

$AC^2 = AB^2 + BC^2 - 2(AB)(BC)\cos B$

$AC = \sqrt{AB^2 + BC^2 - 2(AB)(BC)\cos B}$

$AC \doteq \sqrt{6.6^2 + 10.2^2 - 2(6.6)(10.2)\cos 115°}$

$\doteq 14.3$

The length of diagonal AC is approximately 14.3 cm.

PTS: 1 DIF: Difficult REF: 6.5 The Cosine Law
LOC: 11.T3 TOP: Trigonometry
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

78. ANS:
The expressions are not equivalent because the non-permissible values of the two expressions are not the same.

For example, when $x = 2$, $\dfrac{2x}{3x} = \dfrac{2}{3}$, whereas $\dfrac{2x(x-2)}{3x(x-2)}$ is undefined.

PTS: 0 DIF: Moderate REF: 7.1 Equivalent Rational Expressions
LOC: 11.AN4 TOP: Algebra and Number
KEY: Conceptual Understanding | Communication

79. ANS:
The error in the solution is that $r = -3$ must be included as a non-permissible value. Division by $r + 3$ is not possible when $r = -3$. The correct solution is:

$$\frac{r^2 - 2r - 15}{r^3 - 9r} = \frac{(r+3)(r-5)}{r(r+3)(r-3)}$$

$$= \frac{(r-5)}{r(r-3)},\ r \neq 0,\ r \neq 3,\ r \neq -3$$

PTS: 0 DIF: Moderate REF: 7.1 Equivalent Rational Expressions
LOC: 11.AN4 TOP: Algebra and Number
KEY: Conceptual Understanding | Communication

80. ANS:

$$\frac{n^4 - 5n^2 + 4}{3n^4 - 3n^3 - 6n^2} = \frac{(n^2 - 1)(n^2 - 4)}{3n^2(n^2 - n - 2)}$$
$$= \frac{(n+1)(n-1)(n+2)(n-2)}{3n^2(n+1)(n-2)}$$
$$= \frac{(n-1)(n+2)}{3n^2}, n \neq -1, n \neq 2, n \neq 0$$

PTS: 0 DIF: Difficult REF: 7.1 Equivalent Rational Expressions
LOC: 11.AN4 TOP: Algebra and Number
KEY: Procedural Knowledge | Communication

81. ANS:
First, write two rational expressions such that when the numerators and denominators are divided by their common factors, the final expression is $\frac{2}{x-4}$.

For example:
$$\frac{2}{x-4} = \frac{2(x)}{(x-4)(x+3)} \cdot \frac{x+3}{x}$$
Expand the first expression, then invert the second expression, and change the operation to division.
$$\frac{2}{x-4} = \frac{2x}{x^2 - x - 12} \cdot \frac{x+3}{x}$$
$$= \frac{2x}{x^2 - x - 12} \div \frac{x}{x+3}, x \neq 0, x \neq -3, x \neq 4$$

PTS: 1 DIF: Difficult REF: 7.2 Multiplying and Dividing Rational Expressions
LOC: 11.AN5 TOP: Algebra and Number
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

82. ANS:
Set the product equal to 1.
$$\frac{3q^2 + 7q + 2}{M} \cdot \frac{q^2 - 8q + 15}{3q^2 - 8q - 3} = 1$$
Factor the polynomials.
$$\frac{(3q+1)(q+2)}{M} \cdot \frac{(q-5)(q-3)}{(3q+1)(q-3)} = 1, q \neq \frac{-1}{3}, 3$$
Simply.
$$\frac{(q+2)(q-5)}{M} = 1$$
$$(q+2)(q-5) = M, q \neq -2, 5$$
Expand.
$$M = q^2 - 3q - 10$$

PTS: 1 DIF: Difficult REF: 7.2 Multiplying and Dividing Rational Expressions
LOC: 11.AN5 TOP: Algebra and Number
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

83. ANS:
Add: $\frac{1}{D_1} + \frac{1}{D_2}$

A common denominator is D_1D_2.

$$\frac{1}{D_1}+\frac{1}{D_2}=\frac{1}{D_1}\cdot\frac{D_2}{D_2}+\frac{1}{D_2}\cdot\frac{D_1}{D_1}$$
$$=\frac{D_2}{D_1D_2}+\frac{D_1}{D_1D_2}$$
$$=\frac{D_1+D_2}{D_1D_2},\ D_1\neq 0,\ D_2\neq 0$$

A rational expression for the optical power of a thin lens is: $\frac{D_1+D_2}{D_1D_2},\ D_1\neq 0,\ D_2\neq 0$

PTS: 0 DIF: Moderate
REF: 7.3 Adding and Subtracting Rational Expressions with Monomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Procedural Knowledge | Communication

84. ANS:

$$\frac{3x^2-6x-72}{5x^2-35x+30}\div\frac{x^2+9x+20}{x^2+x-2}-\frac{x}{x^2-25}$$
$$=\frac{3(x^2-2x-24)}{5(x^2-7x+6)}\cdot\frac{x^2+x-2}{x^2+9x+20}-\frac{x}{x^2-25}$$
$$=\frac{3(x+4)(x-6)}{5(x-1)(x-6)}\cdot\frac{(x-1)(x+2)}{(x+4)(x+5)}-\frac{x}{(x+5)(x-5)}$$
$$=\frac{3(x+2)}{5(x+5)}-\frac{x}{(x+5)(x-5)}$$
$$=\frac{3(x+2)}{5(x+5)}\cdot\frac{x-5}{x-5}-\frac{x}{(x+5)(x-5)}\cdot\frac{5}{5}$$
$$=\frac{3(x+2)(x-5)-5x}{5(x+5)(x-5)}$$
$$=\frac{3x^2-14x-30}{5(x+5)(x-5)},\ x\neq -4,\ x\neq 6,\ x\neq 1,\ x\neq -5,\ x\neq -2,\ x\neq 5$$

PTS: 0 DIF: Difficult
REF: 7.4 Adding and Subtracting Rational Expressions with Binomial and Trinomial Denominators
LOC: 11.AN5 TOP: Algebra and Number
KEY: Procedural Knowledge | Communication

85. ANS:

For example:
For –3 to be an extraneous root, it must be a solution that is also a non-permissible value.
Start by writing a rational equation with $y+3$ as the common denominator.

$$\frac{\quad}{y+3}=\frac{\quad}{y+3}$$

Then, write another equation with 3 and –3 as its roots:
$y^2=9$
Use the terms from the above equation as the numerators:

$$\frac{y^2}{y+3} = \frac{9}{y+3}$$

This equation then has the required properties:

$$\frac{y^2}{y+3} = \frac{9}{y+3}$$

$$(y+3)\frac{y^2}{y+3} = (y+3)\frac{9}{y+3}$$

$$y^2 = 9$$

$$y = \pm\sqrt{9}$$

$$y = 3 \text{ or } y = -3$$

Since $y = -3$ is a non-permissible value, –3 is an extraneous root.

PTS: 0 DIF: Difficult REF: 7.5 Solving Rational Equations
LOC: 11.AN6 TOP: Algebra and Number
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

86. ANS:

Let x hours represent the time it takes Ginelle to install a subfloor on her own.
Then, the time it takes Tonya is $(x + 18)$ hours.

In 1 h, Ginelle can install $\frac{1}{x}$ of the subfloor and Tonya can install $\frac{1}{x+18}$ of the subfloor.

Working together, it takes 12 h to completely install the subfloor. So, an equation is:

$$12\left(\frac{1}{x} + \frac{1}{x+18}\right) = 1$$

$$\frac{12}{x} + \frac{12}{x+18} = 1, x > 0$$

Solve the equation. A common denominator is: $x(x + 18)$

$$\frac{12}{x} + \frac{12}{x+18} = 1$$

$$x(x+18)\left(\frac{12}{x}\right) + x(x+18)\left(\frac{12}{x+18}\right) = x(x+18)$$

$$12(x+18) + 12(x) = x(x+18)$$

$$12x + 216 + 12x = x^2 + 18x$$

$$x^2 - 6x - 216 = 0$$

$$x = 18 \text{ or } x = -12$$

Since time cannot be negative, $x = 18$.
So, $x + 18 = 36$
It would take Ginelle 18 h to install a subfloor and it would take Tonya 36 h to install a subfloor.

PTS: 0 DIF: Difficult REF: 7.6 Applications of Rational Equations
LOC: 11.AN6 TOP: Algebra and Number
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

87. ANS:

Let x km/h represent the average speed of the cyclist when there is no wind.
An equation representing the total riding time is:

$$\frac{3}{x+8} + \frac{3}{x-6} = 5, x > 6$$

Solve the equation. A common denominator is: $(x + 8)(x - 6)$

Multiply all terms in the equation by the common denominator and simplify.

$$\frac{3}{x+8}+\frac{3}{x-6}=5$$

$$(x+8)(x-6)\left(\frac{3}{x+8}\right)+(x+8)(x-6)\left(\frac{3}{x-6}\right)=5(x+8)(x-6)$$

$$3(x-6)+3(x+8)=5(x-6)(x+8)$$

$$5x^2+4x-246=0$$

Solve the equation $5x^2+4x-246=0$ using the quadratic formula.

$$x=\frac{-4\pm\sqrt{(4)^2-4(5)(-246)}}{2(5)}$$

$$x=\frac{-4\pm\sqrt{4936}}{10}$$

$x \doteq 6.6$ or $x \doteq -7.4$

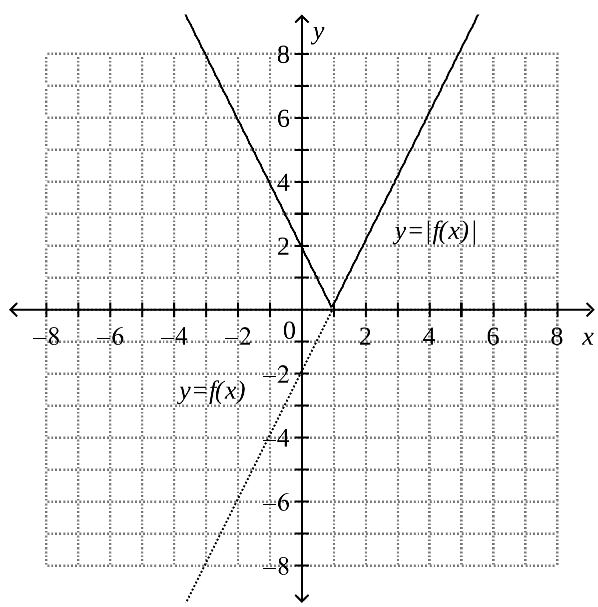
Since speed cannot be negative, $x \doteq 6.6$.

The cyclist's average speed when there is no wind is approximately 6.6 km/h.

PTS: 0 DIF: Difficult REF: 7.6 Applications of Rational Equations
LOC: 11.AN6 TOP: Algebra and Number
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

88. ANS:

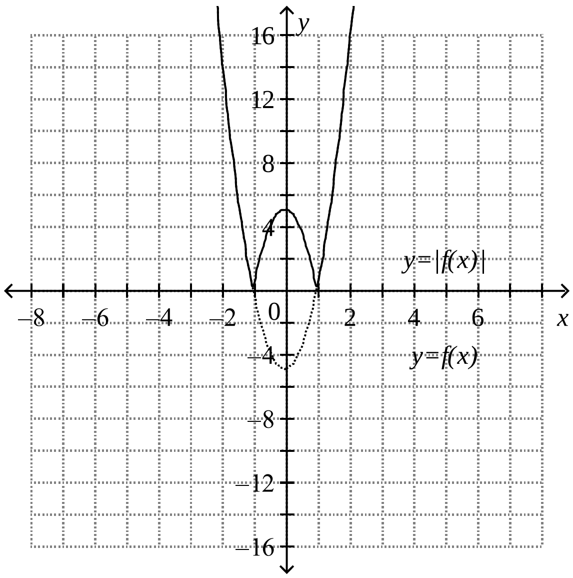
x	–2	–1	0	1	2	3
$f(x)=2x-2$	–6	–4	–2	0	2	4
$y=\lvert 2x-2\rvert$	6	4	2	0	2	4



PTS: 0 DIF: Moderate REF: 8.1 Absolute Value Functions
LOC: 11.RF2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication

89. ANS:

x	–2	–1	0	1	2
$f(x) = 5x^2 - 5$	15	0	–5	0	15
$y = \|5x^2 - 5\|$	15	0	5	0	15



$y = |5x^2 - 5|$

x-intercepts: ± 1

y-intercept: 5

Domain: $x \in \mathbb{R}$

Range: $y \geq 0$

PTS: 0 DIF: Moderate REF: 8.1 Absolute Value Functions
LOC: 11.RF2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication

90. ANS:

a) Two points on the graph of the linear function $y = f(x)$ are: S(–6, 3) and S1(3, –6). Join the points.
Reflect, in the x-axis, the part of the graph that is below the x-axis to sketch the graph of $y = |f(x)|$.

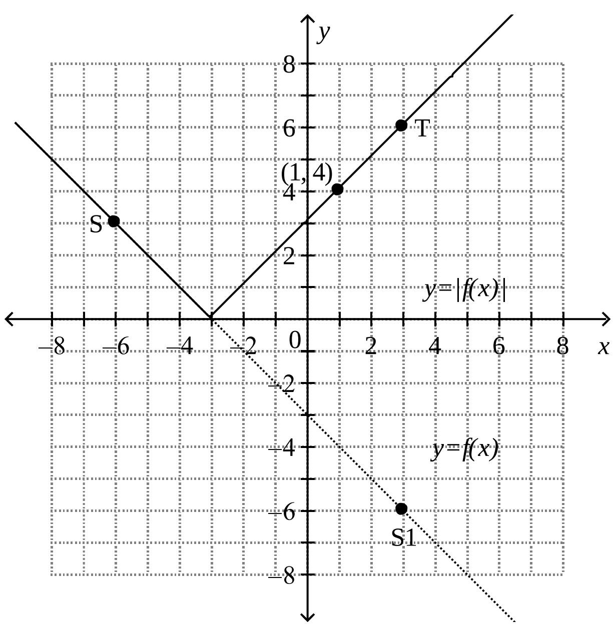
b) An equation of the linear function has the form $y = mx + n$.
Use points S and S1 to determine the slope m.

$$m = \frac{-6 - 3}{3 + 6}$$
$$= -1$$

Use the point (–6, 3) to determine n.

$$3 = -(-6) + n$$
$$n = -3$$

So, an equation is: $y = -x - 3$
x-intercept: –3; y-intercept: –3
An equation of the absolute value function is: $y = |-x - 3|$
x-intercept: –3; y-intercept: 3



c) When $x = 1$,

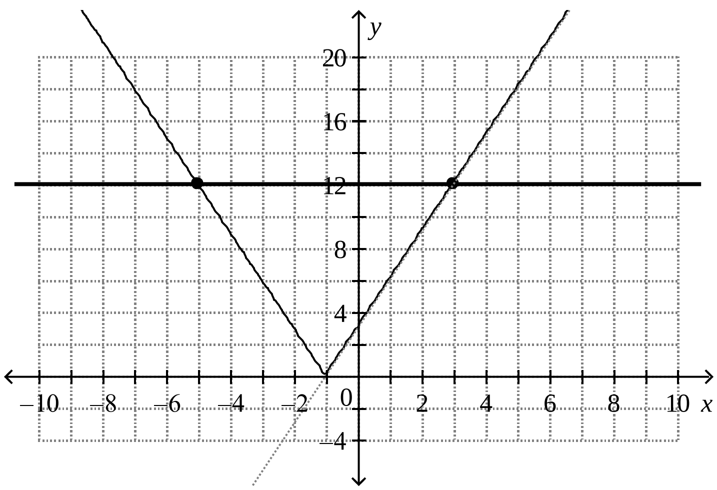
$y = |f(1)|$
$y = |-(1) - 3|$
$y = 4$

PTS: 0 DIF: Difficult REF: 8.1 Absolute Value Functions
LOC: 11.RF2 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

91. ANS:
The absolute value function $|3x + 3| = 12$ creates two linear equations:

$3x + 3 = 12$ and $-3x - 3 = 12$
$x = 3$ and $x = -5$

So, the equation has two solutions: $x = 3$ and $x = -5$
Graph the line $y = 12$ on the same grid as $y = |3x + 3|$:



The line $y = 12$ intersects the graph of $y = |3x + 3|$ at two points: (3, 12) and (–5, 12)

These points satisfy the equation $|3x + 3| = 12$, so $x = 3$ and $x = -5$ are solutions.

PTS: 0 DIF: Moderate REF: 8.2 Solving Absolute Value Equations
LOC: 11.RF2 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

92. ANS:
Simplify the equation:

$6 - |2x^2 - 8x - 1| = -3$
$|2x^2 - 8x - 1| = 9$

The absolute value function $|2x^2 - 8x - 1| = 9$ creates two quadratic equations:

$2x^2 - 8x - 1 = 9$
$2x^2 - 8x - 10 = 0$
$2(x - 5)(x + 1) = 0$
$x = 5$ or $x = -1$

and

$-(2x^2 - 8x - 1) = 9$
$-2x^2 + 8x - 8 = 0$
$2(x^2 - 4x + 4) = 0$
$2(x - 2)(x - 2) = 0$
$x = 2$

So, the solutions are $x = -1$, $x = 2$, and $x = 5$.

PTS: 0 DIF: Moderate REF: 8.2 Solving Absolute Value Equations
LOC: 11.RF2 TOP: Relations and Functions

KEY: Conceptual Understanding | Procedural Knowledge | Communication

93. ANS:

If there is a value of *x* for which the *y*-values of the reciprocal functions are the same, then the graphs of the reciprocal functions intersect.

$$\frac{1}{f(x)} = \frac{1}{g(x)}$$
$$\frac{1}{-2x-2} = \frac{1}{0.5x+3}$$
$$-2x-2 = 0.5x+3$$
$$-2.5x = 5$$
$$x = -2$$

Substitute $x = -2$ in $y = \frac{1}{-2x-2}$:

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

So, the graphs of the reciprocal functions intersect at (–2, $\frac{1}{2}$).

PTS: 0 DIF: Difficult REF: 8.3 Graphing Reciprocals of Linear Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

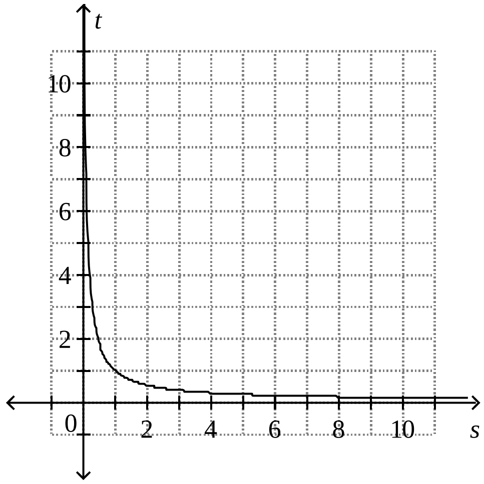
94. ANS:

a) Use the formula for speed:

$$s = \frac{d}{t} \qquad \text{Substitute: } d = 1$$
$$s = \frac{1}{t}$$
$$t = \frac{1}{s}$$

b) Both time and speed are positive.
The reciprocal function has vertical asymptote $s = 0$ and horizontal asymptote $t = 0$.
So, the domain is $s \in \mathbb{R}$, $s > 0$ and the range is $t \in \mathbb{R}$, $t > 0$.

c) A sketch of the reciprocal function is:



PTS: 0 DIF: Moderate REF: 8.3 Graphing Reciprocals of Linear Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Procedural Knowledge | Communication | Problem-Solving Skills

95. ANS:

a) Compare $y = \dfrac{1}{x^2 - 2}$ with $y = \dfrac{1}{ax^2 + q}$.

Since the value of *a* is positive and the value of *q* is negative, the related quadratic function $y = x^2 - 2$ has 2 *x*-intercepts.
So, the graph of the reciprocal function has 2 vertical asymptotes.

$y = \dfrac{1}{x^2 - 2}$ is undefined when $x^2 - 2 = 0$.

$$x^2 = 2$$
$$x = \sqrt{2} \text{ or } x = -\sqrt{2}$$

So, the lines $x = \sqrt{2}$ and $x = -\sqrt{2}$ are vertical asymptotes.

b) Compare $y = \dfrac{1}{-2x^2 + 8}$ $y = \dfrac{1}{x^2 - 2??}$ with $y = \dfrac{1}{ax^2 + q}$.

Since the value of *a* is negative and the value of *q* is positive, the related quadratic function $y = -2x^2 + 8$ has 2 *x*-intercepts.
So, the graph of the reciprocal function has 2 vertical asymptotes.

$y = \dfrac{1}{-2x^2 + 8}$ is undefined when $-2x^2 + 8 = 0$.

$$8 = 2x^2$$
$$x = 2 \text{ and } x = -2$$

So, the lines $x = 2$ and $x = -2$ are vertical asymptotes.

PTS: 0 DIF: Difficult
REF: 8.4 Using Technology to Graph Reciprocals of Quadratic Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

96. ANS:

a) The graph that corresponds to graph a is graph iii. The graph of the quadratic function has two *x*-intercepts, so the graph of its reciprocal function has two vertical asymptotes.

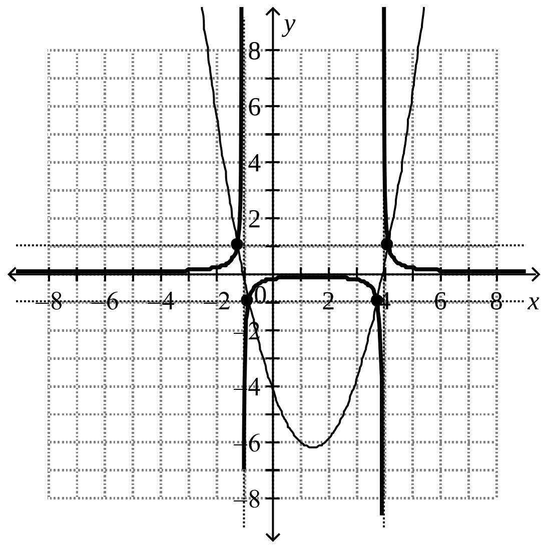
b) The graph that corresponds to graph b is graph i. The graph of the quadratic function has no *x*-intercepts, so the graph of its reciprocal function has no vertical asymptotes.

c) The graph that corresponds to graph c is graph ii. The graph of the quadratic function has one *x*-intercept, so the graph of its reciprocal function has one vertical asymptote.

PTS: 0 DIF: Moderate REF: 8.5 Graphing Reciprocals of Quadratic Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

97. ANS:

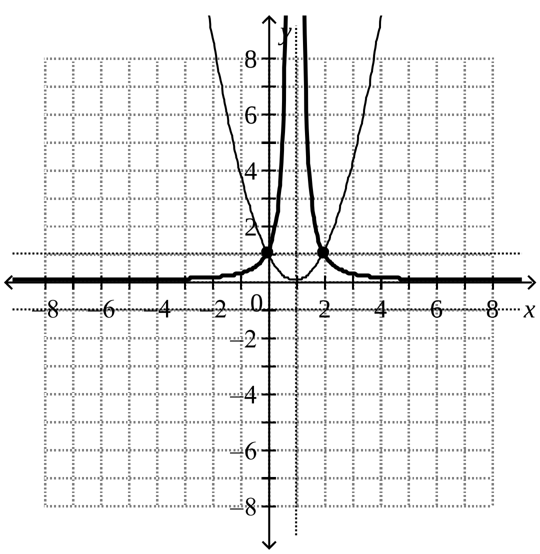
The graph of $y = f(x)$ opens up and has *x*-intercepts –1 and 4.
So, the graph of the reciprocal function has vertical asymptotes $x = -1$ and $x = 4$.
Plot points where the lines $y = 1$ and $y = -1$ intersect the graph of $y = f(x)$. These points are common to both graphs. Using these points and the asymptotes, draw smooth curves that approach the asymptotes but never touch them.The graph of the reciprocal function has Shape 3.



PTS: 0 DIF: Moderate REF: 8.5 Graphing Reciprocals of Quadratic Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

98. ANS:

a) When the graph of a reciprocal function has one vertical asymptote, the graph of the corresponding quadratic function has one *x*-intercept. Since the vertical asymptote is $x = 1$, the graph of the quadratic function has vertex $(1, 0)$ and passes through the points $(2, 1)$ and $(0, 1)$. Since the points common to both graphs are above the *x*-axis, the graph of the quadratic function opens up.

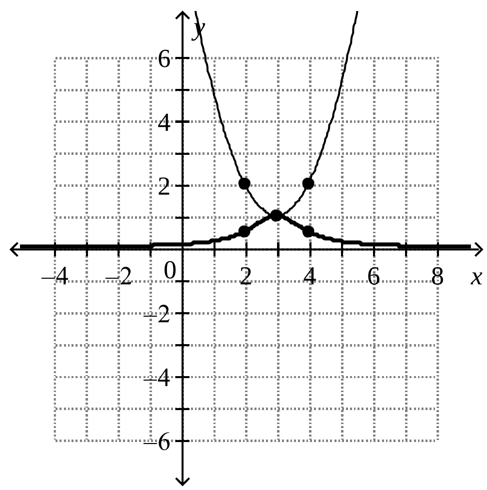


b) The equation of the quadratic function has the form $y = a(x - h)^2 + k$, where (h, k) is the vertex of the parabola, and a represents its size and direction. Substitute $h = 1$ and $k = 0$.
$y = a(x - (1))^2 + 0$
$y = a(x - 1)^2$
Use one of the points $(2, 1)$ and $(0, 1)$ to solve for a: $a = 1$
The equation of the quadratic function is: $y = (x - 1)^2$
The equation of the reciprocal function is: $y = \dfrac{1}{(x - 1)^2}$

PTS: 0 DIF: Difficult REF: 8.5 Graphing Reciprocals of Quadratic Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

99. ANS:

The graph of $y = (x - 3)^2 + 1$ opens up, has vertex $(3, 1)$, and does not intersect the x-axis.
So, the graph of its reciprocal function has no vertical asymptotes and has vertex $(3, 1)$.
The points $(4, 2)$ and $(2, 2)$ are on the graph of the quadratic function, so the points $(4, \frac{1}{2})$ and $(2, \frac{1}{2})$ are on the graph of the reciprocal function.
Draw smooth curves through the appropriate points to obtain the graphs.



PTS: 0 DIF: Difficult REF: 8.5 Graphing Reciprocals of Quadratic Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication

100. ANS:

a) The reciprocal function $y = \dfrac{1}{-x^2 + kx - 6}$ has no vertical asymptotes when the related function $y = -x^2 + kx - 6$ has no x-intercepts. That is, the equation has no real roots. This occurs when $b^2 - 4ac < 0$.

$$b^2 - 4ac < 0$$
$$k^2 - 4(-1)(-6) < 0$$
$$k^2 - 24 < 0$$
$$k^2 < 24$$
$$-2\sqrt{6} < k < 2\sqrt{6}$$

b) The reciprocal function $y = \dfrac{1}{x^2 + kx + 1}$ has one vertical asymptote when the related function $y = x^2 + kx + 1$ has one x-intercept. That is, the equation has equal roots. This occurs when $b^2 - 4ac = 0$.

$$b^2 - 4ac = 0$$
$$k^2 - 4(1)(1) = 0$$
$$k^2 - 4 = 0$$
$$k^2 = 4$$
$k = 2$ or $k = -2$

c) The reciprocal function $y = \dfrac{1}{x^2 + kx + 8}$ has two vertical asymptotes when the related function $y = x^2 + kx + 8$ has two *x*-intercepts. That is, the equation has two real roots. This occurs when $b^2 - 4ac > 0$.

$$b^2 - 4ac > 0$$
$$k^2 - 4(1)(8) > 0$$
$$k^2 - 32 > 0$$
$$k^2 > 32$$
$k < -4\sqrt{2}$ or $k > 4\sqrt{2}$

PTS: 0 DIF: Difficult REF: 8.5 Graphing Reciprocals of Quadratic Functions
LOC: 11.RF11 TOP: Relations and Functions
KEY: Conceptual Understanding | Procedural Knowledge | Communication