1 Exponents

1. Match each expression from the left-hand column to an expression from the right-hand column

a) Product of powers	i) $(ab)^c$
b) Division of powers	ii) $\left(\frac{a}{b}\right)^c$
c) Power of a product	iii) $a^b a^c$
d) Power of a power	iv) $\left(a^b\right)^c$
e) Power of a quotient	v) $\frac{a^b}{a^c}$

---

2. Simplify each of the following expressions fully, using only positive exponents.

(a) $\dfrac{\left(x^3yz^4\right)^2}{\left(xy^2z\right)^{-1}}$

(b) $\left(\dfrac{a^{10}b^3}{c^5b^2}\right)^{-3} \cdot \left(\dfrac{a^4b^7}{a^6b^{10}c^7}\right)^{-2}$

(c) $\dfrac{\left(9x^2y^4\right)^{1/2}\left(x^{-2}y^3\right)^{-2}}{3x^2y^{-1}}$

(d) $\dfrac{x^{n-3}}{x^{n-2}} \div \dfrac{\left(x^3\right)^{n+1}}{x^{n-2}}$

---

3. Write an equivalent expression to the one below in the form of a power, that is, using a single base and an exponent.

$$\left(\frac{\sqrt{2} \times \sqrt[3]{4}}{\sqrt[4]{8}}\right)^6$$

4. If $x < 0$, which of the following expressions is equivalent to $(-x)^{-1/2}$?

(a) $\frac{1}{\sqrt{-x}}$ (b) $\frac{-1}{\sqrt{-x}}$ (c) $\frac{-1}{\sqrt{x}}$ (d) $\sqrt{x}$

---

5. Which expression is equivalent to $\sqrt[4]{x^6}$? (Note that $x > 0$.)

(a) $\sqrt{x^{24}}$ (b) $\sqrt{x^3}$ (c) $\sqrt[6]{x^4}$ (d) x^2

---

6. Which expression is equivalent to $\sqrt{4x^{-4}}$? (Note that $x > 0$.)

(a) $\pm\frac{2}{x^2}$ (b) $\pm\frac{1}{2x^2}$ (c) $\pm 2x^2$ (d) $\pm\frac{x^2}{2}$

---

7. Given $x \neq 0$ and $y \neq 0$, which of the following is equivalent to $(-x)^{-2} - (y)^{-3}$?

(a) $\frac{1}{x^2} + \frac{1}{y^3}$ (b) $-\frac{1}{x^2} - \frac{1}{y^3}$ (c) $\frac{1}{x^2} - \frac{1}{y^3}$ (d) $-\frac{1}{x^2} + \frac{1}{y^3}$

8. Simplify the following expressions. Make sure to show all of your work.

(a) $(-2x)(-3x)^2$

(b) $\left(\dfrac{2x^{-2}y^3}{-4x^2y^2}\right)^{-2}$

(c) $\left(\dfrac{3a^{-3}b^2c^{-1}}{12a^0b^{-1}c}\right)^{-2}$

(d) $\dfrac{25\left(x^2y^3\right)^2}{2\left(x^2\right)^3y^2}\cdot\dfrac{6x^4y}{5xy^4}$

(e) $\dfrac{16^a\times 2^{a+2}}{8^a}$

(f) $\dfrac{20a^{-2}b^4c^{-6}}{-4a^{-3}\left(bc^2\right)^4}$

(g) $(-2x)^{-2}\left(-3x^2\right)^3\left(\dfrac{2}{x}\right)^{-2}$

(h) $(2x)^{-3}(4y)^2$

9. Simplify the following expressions. Make sure to show all of your work.

(a) $-\left(\frac{1}{4}\right)^{-2}$

(b) $\left(\frac{2}{3}\right)^{-1} + 8^0 - 16^{1/2}$

(c) $\left(4x^3y^2\right)(2xy)^3$

(d) $\dfrac{\left(-2x^2y^3\right)^5}{-4\left(x^{-2}\right)^{-3}}$

(e) $\left(-2x^2y^{-4}\right)^{-2}$

(f) $\left(\dfrac{3x^2y^{-3}}{2x^{-3}y}\right)^{-2}$

10. Simplify the following:

(a) $16^{5/4}$ (b) $27^{-1/3}$ (c) $\left(\frac{3}{4}\right)^{-2}$

---

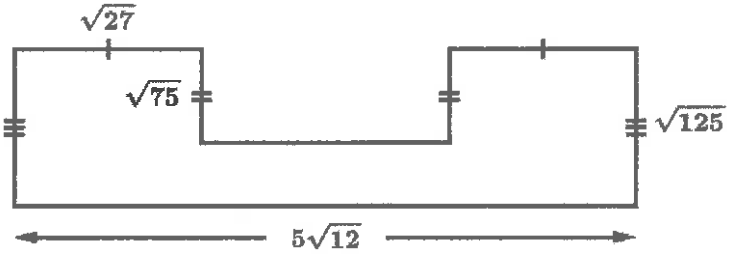
11. Simplify the following, making sure to only have positive exponents in your final answer.

(a) $\left(2x^2y^{-3}\right)^5$ (c) $\dfrac{\left(x^{y+1}\right)\left(x^{y-1}\right)}{\left(x^y\right)^2}$

(b) $\left(\dfrac{-3xy^2}{5x^{-2}y^4}\right)^{-2}$ (d) $\dfrac{\left(2a^3b^2\right)^2}{2a^5b^3} + b\sqrt{16a^2} + 10ab$

2 Radicals

1. Express the perimeter of the figure below in the simplest radical form. Note that the figure is *not* drawn to scale.



(a) $40\sqrt{15}$

(b) $30\sqrt{3}+10\sqrt{5}$

(c) $20\sqrt{3}+10\sqrt{5}$

(d) $30\sqrt{15}$

---

2. When simplified, $\left(\sqrt{11}-x\sqrt{x}\right)^2$ equals:

(a) $11-2x\sqrt{11x}+x^3$

(b) $11-x^3$

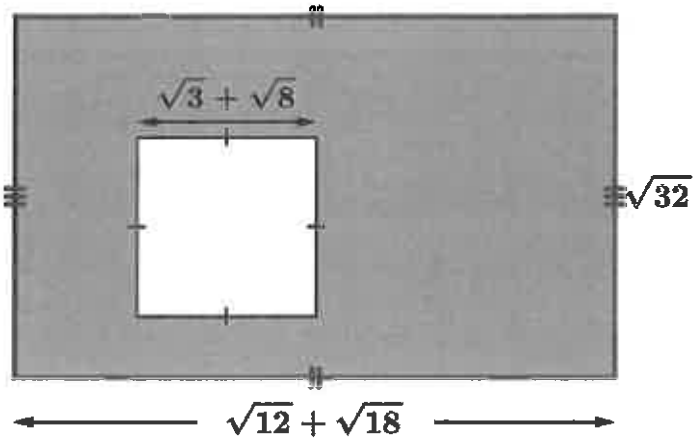
(c) $11+2x\sqrt{11x}+x^3$

(d) $11+x^3$

---

3. Simplify and rationalize the expression $\dfrac{5\sqrt{2}-4}{2\sqrt{2}-1}$

4. Find the simplified radical expression for the shaded area in the figure below. Note that the figure is *not* drawn to scale.



---

5. Simplify the following as much as possible.

(a) $2\sqrt{3}\cdot\left(\sqrt{2}-5\right)$

(b) $\sqrt{27x^3y^{10}z^8}$

(c) $3\sqrt{8}+7\sqrt{2}-6\sqrt{12}+\sqrt{72}$

(d) $\dfrac{3\sqrt{5}}{2\sqrt{10}}$

(e) $\dfrac{\left(2\sqrt{x^2y}\right)^2\left(-3x^3\right)}{\left(\sqrt{x^2y^4}\right)(-2x)^2}$

(f) $\left(2\sqrt{3}-3\sqrt{5}\right)\left(\sqrt{2}-\sqrt{5}\right)$

(g) $3\sqrt{20}\cdot\left(5\sqrt{5}-3\sqrt{2}\right)$

---

6. The distance that Billy travelled on a trip was $\left(2-\sqrt{5}\right)\ km$. It took him $\left(3\sqrt{2}-\sqrt{5}\right)\ hrs$ to get there. Write an expression that represents how fast Billy was travelling. Be sure to simplify as much as possible and use proper units!

3 Factoring

1. Find the sum of the factors of $3x^2 + 2x - 8$.

   (a) $3x - 4$

   (b) $x + 2$

   (c) $4x - 2$

   (d) $4x + 2$

---

2. When $8x^4 - 20x^3 - 48x^2$ is factored completely, which of the following is not one of its factors?

   (a) $2x + 3$

   (b) $x - 4$

   (c) $x + 4$

   (d) $4x^2$

---

3. The volume of a standard rectangular-prism aquarium is $2x^3 - 8x^2 - 90x\ cm^3$. If the dimension of the aquarium are the factors of this expression, find its dimensions.

4. Factor the following:

(a) $81x^4 - 16y^8$

(b) $3p^4 + 10qp^2 - 8q^2$

(c) $x^2\left(x^2+1\right) - 6x\left(x^2+1\right) + 9\left(x^2+1\right)$

(d) $\dfrac{4(m+n)^2}{9} - \dfrac{25(m-n)^2}{81}$

4 Rational Expressions

1. For which set of real numbers is the expression $\dfrac{x}{x^3 - 81x}$ undefined? Choose the best response.

   (a) $\{0\}$

   (b) $\{0, 9\}$

   (c) $\{0, 3, -3\}$

   (d) $\{0, 9, -9\}$

---

2. Write each rational expression in lowest terms, noting any restriction(s).

   (a) $\dfrac{(x+1)(x-3)}{2x(x+1)}$

   (b) $\dfrac{m-n}{m^2-n^2}$

   (c) $\dfrac{x^2+8x+15}{x^2+5x+6}$

   (d) $\dfrac{m^4-25m^2}{m^3-10m^2+25m}$

3. Write each of the following as a single rational expression in lowest terms, remembering to keep track of restrictions if need be. Show all of your steps.

(a) $\dfrac{4x^3 - 36x}{5x^4 + 14x^3 - 3x^2} \div \dfrac{x^2 - x - 6}{1 - 5x}$

(b) $\dfrac{a^2}{a^2 - b^2} + \dfrac{b - a}{a - b}$

(c) $\dfrac{x^2}{x^2 + 2xy} - \dfrac{xy}{xy - 2y^2} + \dfrac{5xy}{x^2 - 4y^2}$

(d) $\dfrac{1 + \frac{1}{x}}{\frac{1}{x^2} + \frac{1}{x^3}}$

4. Ignoring restrictions, the expression $\dfrac{\dfrac{x^2}{2}-2}{\dfrac{x}{2}+1}$ simplifies to:

(a) $x+2$

(b) $x-2$

(c) $\dfrac{x^2-2}{x+1}$

(d) $\dfrac{x-2}{x+2}$

---

5. Simplify the following and **state restrictions**:

(a) $\dfrac{x^2-3x-10}{2x^2-9x-5} \div \dfrac{x^2-4x-12}{36-6x}$

(b) $\dfrac{2x+1}{x^2-x-6} - \dfrac{x+5}{x^2+6x+8}$

6. Simplify the following:

(a) $\dfrac{y^2 - 25}{xy + 3y + 5x + 15}$

(b) $\dfrac{5}{2a^2} + \dfrac{3a - 1}{6a^3}$

(c) $\dfrac{x}{4 - x^2} + \dfrac{3}{x + 2}$

5 Long Division

1. The volume of a right prism with a rectangular base is $\left(2x^3 + x^2 - 22x + 24\right)\ m^3$.
   The area of its base face is $\left(2x^2 + 5x - 12\right)\ m^2$.
   What are the three dimensinos of this prism?
   Express each dimension as a binomial with integer coefficients and constants. Show all of your work.

2. The volume of a rectangular prism, in cm^3, is given by the algebraic expression:

$$V = 6x^3 - 13x^2 - 10x + 24$$

   The height of the prism is $(x - 2)\ cm$.
   Find the algebraic expressions for the dimensions of the base of the prism. (*Integer coefficients and constants only.*) Show all of your work.

3. Given the following equation:

$$(b+3)\,x = b^3 + 5b^2 + 5b - 3$$

What simplified algebraic expression (in terms of b) corresponds to the value of x in this equation if $b \neq -3$?

4. The area of a rectangle is $\left(6x^3 - 17x^2 + 5\right)$. The width of the rectangle is $(2x+1)$. Find the length. Make sure to show all of your work.

6 Polynomials and Solving Quadratic Equations

1. The width of a rectangle is x cm. Its length is 6 cm more than its width. If the area of the rectangle were increased by 9 cm^2, it would be equal to the area of a square whose sides measure 15 cm.

   Which equation can be used to calculate the width x of the rectangle?

   (a) $x(6x) - 9 = 225$

   (b) $x(x + 6) - 9 = 225$

   (c) $x(x + 6) + 9 = 225$

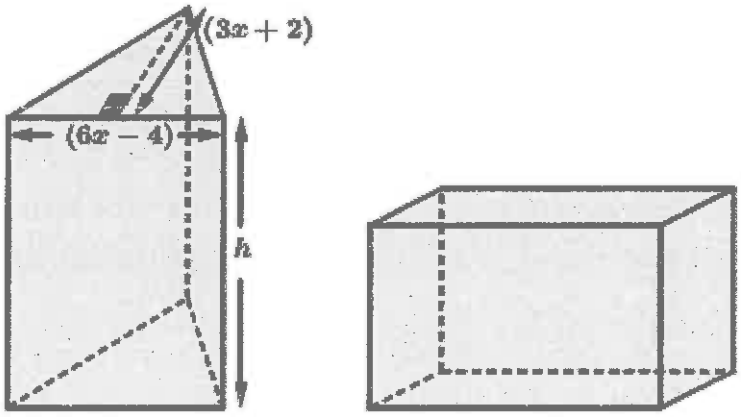
   (d) $x(6x) + 9 = 225$

---

2. The side of a square is equal to the width of a rectangle.
   The area of the square is $\left(x^2 - 16x + 64\right)$ m^2.
   The area of the rectangle is $\left(x^2 - 3x - 40\right)$ m^2.

   What binomial expression (with integer coefficients and constants) represents the length of the rectangle? Show all of your work.

3. The triangular and rectangular prisms pictured below have the same volume (*figures are not drawn to scale*).



If the volume of the rectangular prism is given by the algebraic expression

$$18x^4 - 8x^2$$

Find the algebraic expression for the height h of the triangular prism.

(a) x^2

(b) $3x + 2$

(c) $2x^2$

(d) $3x - 2$

---

4. To win a contest, a person must find an integer from the following clue:

The square of a number reduced by its quadruple is equal to 12.

Let x represent the number. The clue then translates into the quadratic equation

$$x^2 - 4x = 12$$

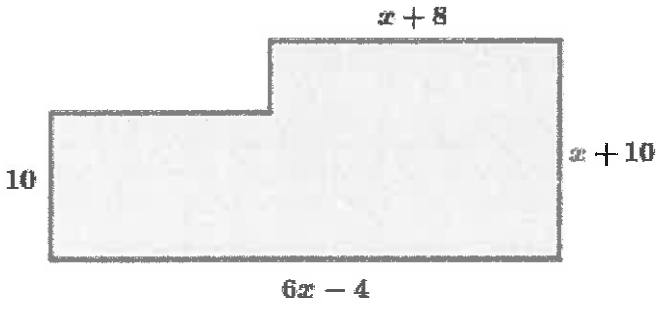
Solve the equation to find the two integers that satisfy the equation. Show all of your work.

5. A rectangle of area $63\ m^2$ has a length $2\ m$ more than its width.

   Find the length and width of the rectangle. Solve algebraically. Non-supported solutions will not be accepted.

---

6. A surveyor has just measured the boundaries of a piece of land.
   She gives her colleague the plan below and tells her that the area of this lot is $248\ m^2$.



   What is the perimeter of this piece of land?

7. Solve using the method of completing the square. Show all of your steps.

$$3\left(x^2 - 2\right) = 7x$$

---

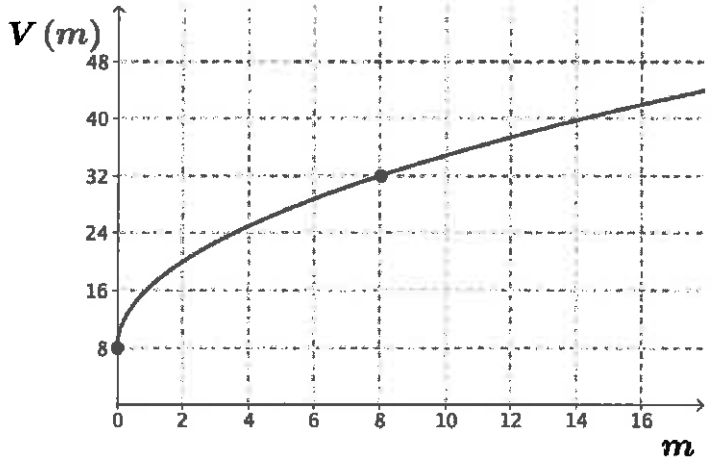
8. Find the solution set for $x \in \mathbb{R}$ to each of the following:

   (a) $(x+5)(x+6) = 30$

   (b) $6x = 4x^2 + 5$

7 Functions

1. The speed of a vehicle, $V(m)$, in kilometres per hour, can be determined by the length of its skid marks, m.



What is the value of $V(8)$?

(a) 0

(c) 8

(b) 24

(d) 32

---

2. **Optional:** Given $f(x) = 2x$ and $g(x) = x + 1$, which of the following equals $g[f(-3)]$?

(a) -7

(c) -5

(b) -4

(d) 7

3. Given $M(x) = 2x - 3$ and $N(x) = 3x^2 + 2x - 4$, find:

   (a) the simplified algebraic expression for $3\left(M(x)\right)^2 - 2N(x)$.

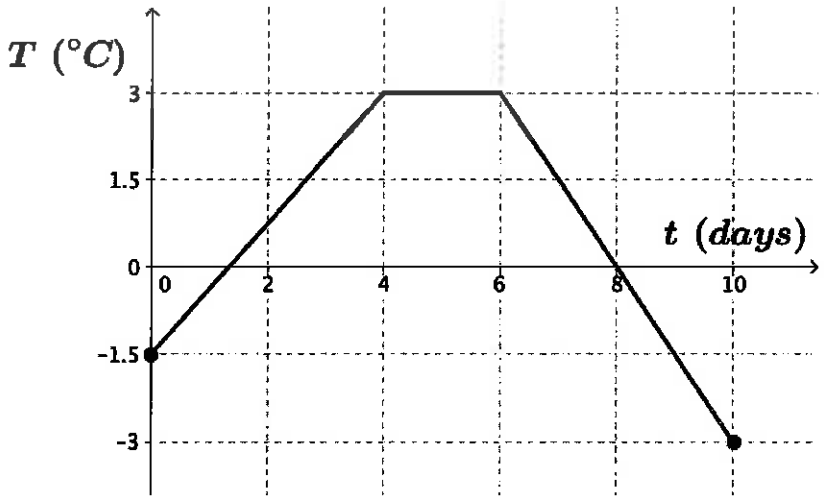
   (b) $N(-1)$

   (c) the values of x when $N(x) = -3$

   (d) the zeros of the function $M(x) + N(x)$

---

4. The graph below shows the variation in the outdoor temperature T $(^\circ C)$ to the elapsed time t for a 10-day period.



   (a) On which interval is the function: (i) decreasing? (ii) constant?

   (b) What is the rate of change of the interval associated with the last 4 days of the 10-day period?

   (c) What are the (approximate) zeros of the function?

   (d) On which intervals is the sign of the function negative?

   (e) On which interval is the function strictly positive?

   (f) What is the function's: (i) absolute minimum? (ii) absolute maximum?

   (g) In the context of the situation, what is the: (i) Domain? (ii) Range?

   (h) On what days during the 10-day period was the outdoor temperature equal to $-1.5\ ^\circ C$?

8 Linear Functions

1. The function $f(x) = 15 - 10x$ is represented by a straight line in the Cartesian plane.

   What is the y-intercept of this line?

   (a) 15

   (b) -10

   (c) 10

   (d) -15

---

2. In a Cartesian plane, a line with slope $-\frac{2}{3}$ passes through the point $(3, 0)$.

   What is the equation of this line?

   (a) $2x + 3y + 3 = 0$

   (b) $3x + 2y - 3 = 0$

   (c) $3x + 2y - 9 = 0$

   (d) $2x + 3y - 6 = 0$

---

3. A horizontal line passes through the point $(-3, 4)$. Its equation is:

   (a) $x = -3$

   (b) $y = -3$

   (c) $y = 4$

   (d) $x = 4$

4. In a Cartesian plane, a line passes through points $A = (0, -3)$ and $B = (4, 0)$.

   What is the equation of this line?

   (a) $3x - 4y - 12 = 0$

   (b) $y = \frac{4}{3}x - 3$

   (c) $y = \frac{3}{4}x + 4$

   (d) $4x - 3y + 12 = 0$

---

5. In a Cartesian plane, a line passes through points $C = (2, 4)$ and $D = (-3, 1)$.

   What is the y-intercept of this line? Show all of your work.

---

6. Kim's parents spend their summer holidays at the family's cottage near a beautiful lake. This year, they decided to rent a rowboat for their entire stay.
   They paid \$185 for 45 days, and they could have rented it for as many days as they liked.
   Some of the prices are given in the table below.

Rowboat Rentals	
Time(days)	Cost($)
30	140
45	185
60	230

   (a) Determine the equation of the function that models this situation in the form $C(d) = ad + b$, which relates the cost C of renting the rowboat to the number of days d that it is rented. Show all of your work.

   (b) If Kim's neighbours rented the boat and paid a rental fee of \$206, for how many days did they rent the boat? Solve algebraically, showing all of your work.

9 Quadratic Functions

1. The functions f and g are defined as follows:

$$\begin{aligned} f(x) &= x^2 + 3x - 2 \\ g(x) &= 4x \end{aligned}$$

What are the zeros of the function $f - g$?

(a) -2 and -1

(b) -1 and 2

(c) -2 and 1

(d) 1 and 2

2.

The table of values on the right represents a second-degree polynomial (i.e. quadratic) function.

What are the coordinates of the vertex of the parabola?

x	$f(x)$
6	60
7	25
8	0
9	-15
10	-20
11	-15
12	0
13	25

(a) $(6, 60)$

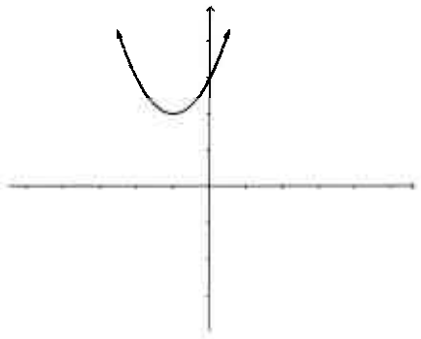
(b) $(10, -20)$

(c) $(12, 0)$

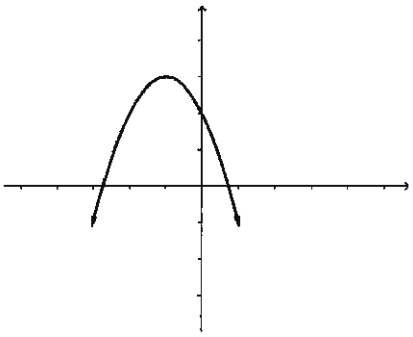
(d) $(13, 25)$

3. Which of the following graphs could represent the function defined by the equation $y = -x^2 - 4x + 3$?

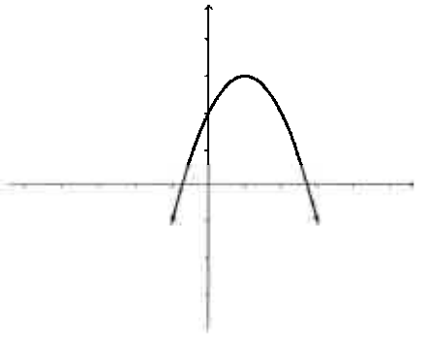
(a)



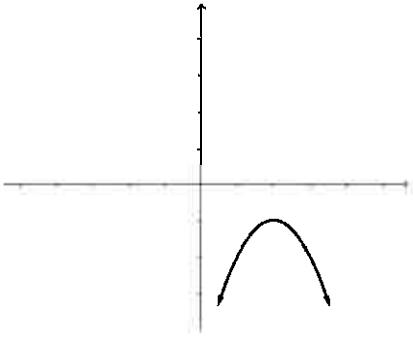
(c)



(b)



(d)



4. Given the quadratic function defined by $h(x) = -\frac{6}{7}x^2 + bx + 8$ where $b^2 \neq 4ac$, which graph corresponds to this function?

(a) A parabola that opens downward and whose vertex is above the x-axis.

(b) A parabola that opens downward and whose vertex is below the y-axis.

(c) A parabola that opens upward and whose vertex is above the x-axis.

(d) A parabola that opens upward and whose vertex is below the x-axis.

5. The rule $g(x) = ax^2 + bx + c$ corresponds to a second-degree polynomial (i.e. quadratic) function. For which of the following cases would $g(x)$ have no zeros?

(a) $b^2 - 4ac > 0$

(b) $b^2 - 4ac < 0$

(c) $b^2 - 4ac = 0$

(d) Cannot be determined

---

6. Write each of the following rules in standard form:

(a) $f(x) = x^2 + 6x + 8$

(b) $g(x) = -3x^2 + 12x - 10$

(c) $h(x) = 2x^2 + 5x - 3$

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

---

7. The height h in metres of a ball thrown vertically into the air is given by $h(t) = -5t^2 + 30t + 15$, where t is the time in seconds since the ball was thrown.

What is the maximum height that the ball will reach? Show all of your work.

8. For the quadratic function defined by the rule $f(x) = x^2 - x - 6$, give:

   (a) the direction of opening (concavity) _____

   (b) the coordinates of the vertex _____

   (c) the equation of the axis of symmetry _____

   (d) the Domain _____

   (e) the Range _____

   (f) the y-intercept _____

   (g) the x-intercept(s) _____

   (h) the increasing interval(s) _____

   (i) the decreasing interval(s) _____

   (j) the positive interval(s) _____

   (k) the negative interval(s) _____

9. If $h(x) = -4(x+7)^2 + 15$, find the value(s) of x when $h(x) = 10$. Solve algebraically and express your answer in radical form.

10. Determine the zeros of the quadratic functions given below:

    (a) $A(x) = -(x+1)^2 + 4$

    (b) $B(x) = -5x^2 + 4x + 1$

    (c) $C(x) = 2\left(x^2 - 8x + 17\right)$

11. Find the rule for each of the following parabolas:

(a) A parabola has its vertex located at $(5, 3)$ and passes through the point $(1, -1)$. Determine the equation of the parabola in general form.

(b) A parabola reaches its minimum at $(1, 1)$ and has a y-intercept equal to 5.

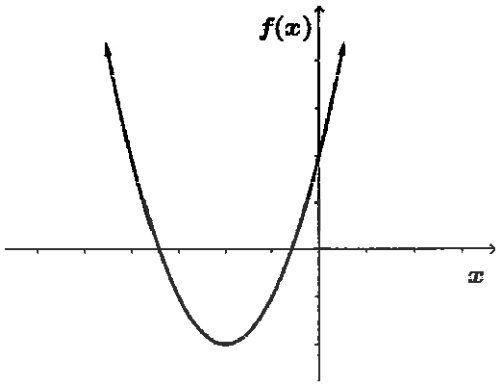
(c) A parabola passes through $(7, -16)$ and has zeros of 3 and -1.

---

12. A riverbed (under water) is in the shape of a parabola.
The maximum depth of the river is 6 metres and its width is 60 metres.

At what distance from the two shores must buoys be positioned to indicate a depth of 4 metres? Show all of your work, and round your answer to the nearest metre.

13. The equation of the graph to the right is given by $f(x) = x^2 + x - 8$.

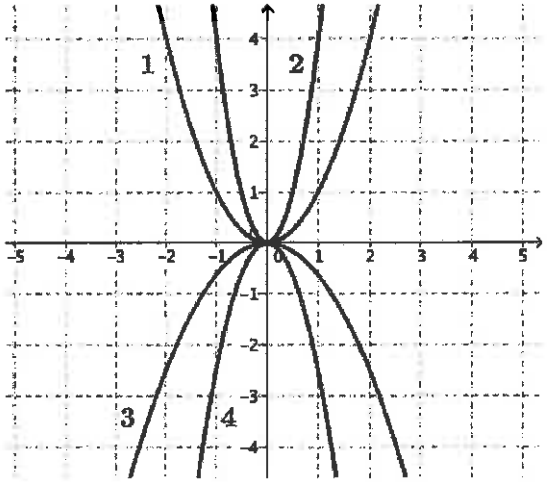


In order to determine the zeros of this function, one must set $f(x) = 0$ and solve the resulting equation for x.

Find the <u>exact</u> zeros of the function. Solve algebraically, showing all of your work.

---

14. Match the parabola to one of the rules:



$f(x) = -\frac{5}{8}x^2$ _____

$g(x) = x^2$ _____

$h(x) = -2.5x^2$ _____

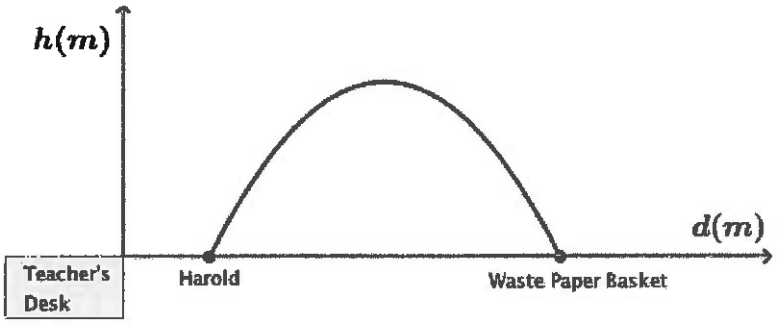
$i(x) = 4x^2$ _____

15. Harold throws a piece of paper into the waste paper basket that is located in the corner of the room.

The path of the paper is described in the diagram below and is given by the equation

$$h = -\frac{1}{2}d^2 + 3d - \frac{5}{2}$$

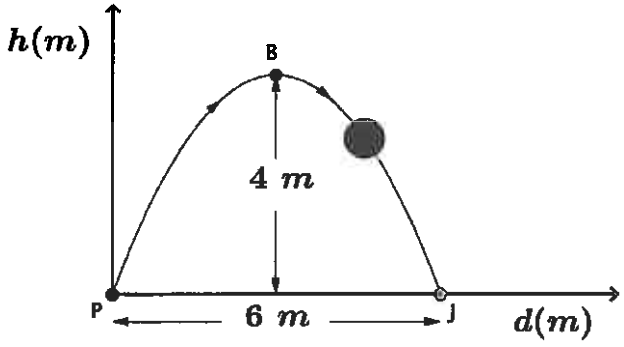
where d is the horizontal distance (in metres) that the paper is from the teacher's desk, and h is the height of the paper (in metres) above the ground.



How far is Harold from the waste paper basket? Show all of your work.

---

16. Patrick (P) and Julie (J) are playing ball in the pool.
The drawing below represents the parabolic path of the ball when Patrick threw it.

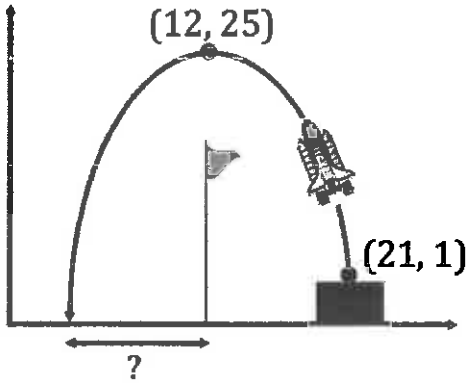


Using the point P as the origin, find the equation describing the path of the ball and use it to determine the horizontal distances from both Patrick and Julie at which the ball's height will be 2 metres. Express your distances to one decimal place, and make sure to show all of your work.

17. A rocket is launched from a platform, flies over a flagpole and lands on the ground on the other side (see diagram).

All measures are in kilometers, and the trajectory is a parabola.

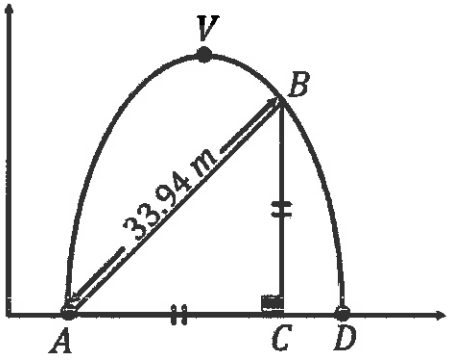
To the nearest tenth, at what horizontal distance from the base of the flagpole, where the point of launch is $(21, 1)$, does the rocket land? Solve algebraically, showing all of your work. Note that the figure is not drawn to scale.



18.

In the following diagram, isosceles triangle $\triangle ACB$ is drawn inside a parabola.
The zeros of the parabola are $A = (5, 0)$ and $D = (35, 0)$.
The length of AB is $33.94\ cm$.

Find the coordinates of the vertex of the parabola. Note that the figure is not drawn to scale.



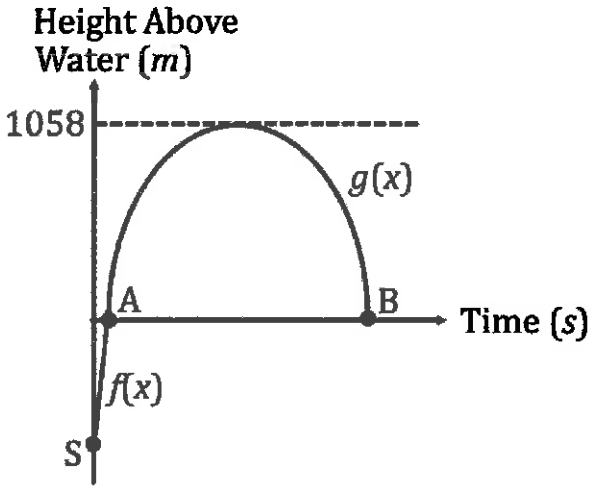
19. **Optional:** A docking station for a projectile camera is located underwater at point S, and the receiver is located on the beach at point B. The camera is launched from point A as shown in the diagram.

Underwater, the camera follows a straight line from point S to point A, whose equation is $f(x) = 368x - 184$.

Starting at point A, the trajectory of the camera in the air is a parabola given by some unknown function $g(x)$.

The entire flight of the camera lasts 12 seconds, and the maximum height reached by the camera is $1058\ m$ above the water.

Find the rule for the function $g(x)$ in general form.

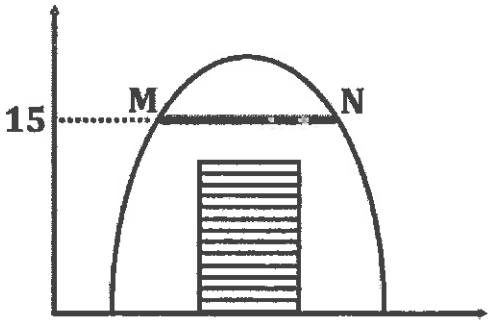


---

20. The roof of a warehouse is in the form of a parabola whose equation is $f(x) = -0.5x^2 + 15x - 95.5$.

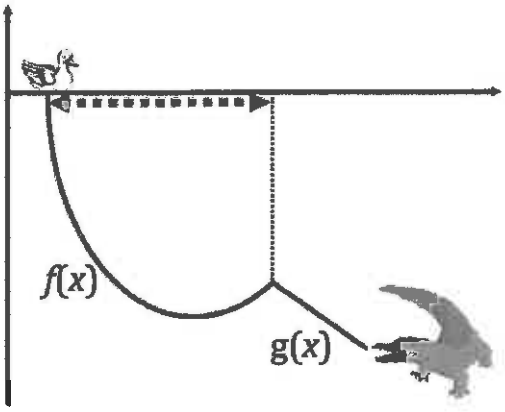
A horizontal support beam must be installed between points M and N at a height of $15\ m$.

What is the length of the beam? An algebraic solution is required, and make sure to show all of your work.



21. **Optional:** A duck, peacefully floating on a lake decides to dive in order to get some food. The trajectory of the duck is given by the function $f(x) = \frac{1}{3}(x-7)^2 - 5$. Unfortunately, as the duck begins its ascent toward the surface, a crocodile follows in a straight line and eats the duck. The trajectory of the crocodile is given by $g(x) = -2x + 18$.

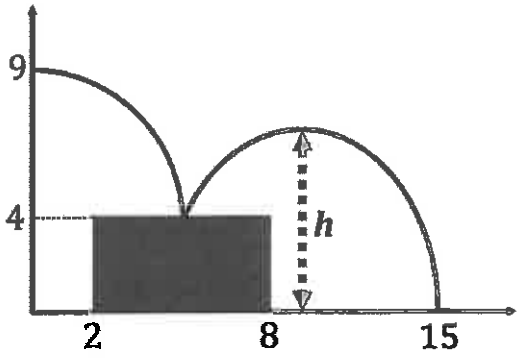
What horizontal distance (along the surface of the water) did the duck travel before it met its tragic end?



---

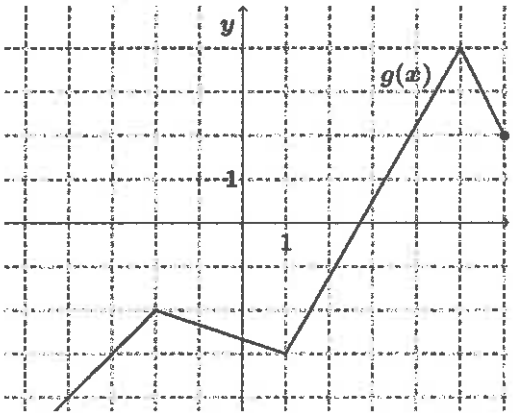
22. A ball is thrown from a height of 9 metres. It bounces on the center of a rectangular platform, and lands 15 meters horizontally away from the starting position, as shown below. The first parabolic pathway that the ball follows has a its vertex at $(0, 9)$, the starting position. We also know that the parameter a is the same for both parabolas.

If the table is 4 metres high, and the edges of the platform are located 2 metres and 8 metres away from the throwing point, what maximum height, h, did the ball reach after its bounce on the table?



10 Overall Review

1. Consider the graph of function g in the Cartesian plane below.



Which of the following statements is **true**?

(a) $dom\ g =]-\infty, 6]$

(b) Function g is positive over the interval $[1, 5]$.

(c) The maximum of function g is 6.

(d) Function g is increasing over the interval $[-3, 4]$.

---

2. Given the following algebraic fraction:

$$\frac{2x^3 + 10x^2 + 12x}{2x^2 - 18}$$

Which of the following is the simplified form of the denominator?

(a) $2x$

(b) $(x + 2)$

(c) $(x - 2)$

(d) $(x - 3)$

3. Simplify the following algebraic expression, ignoring any restrictions:

$$\frac{a^2-1}{a^2+a-2} \div \frac{2a+2}{6a^2+12a}$$

---

4. Factor the following polynomials:

   (a) $ax + x^2 + ay + xy$

   (b) $4x^2 + 28x - 120$

   (c) $15xy + 20y^2 - 18x - 24y$

5. Factor and simplify the following:

(a) $\dfrac{4a^2 - 3a - 4ab + 3b}{12a - 9}$

(b) $x^8 - 9$

(c) $x^2 + 4x - 12$

(d) $x^2 + 4x + 5$

---

6. Graph the following:

(a) $y = x + 2$

(b) $y = -x - 2$

(c) $3y - 6x = 12$

(d) $y = x$

(e) $y = 2x + 3$

7. The volume of a right prism with a rectangular base is $2x^3 + x^2 - 13x + 6$.

   The height of the prism is $(2x - 1)$.

   Find the dimensions of its base (integer coefficients and constants) by using **long division** and then **factoring**.

---

8. Simplify:

   (a) $\sqrt{5}\left(\sqrt{2} - \sqrt{6}\right)$

   (b) $\left(1 + \sqrt{6}\right)\left(9 + \sqrt{3}\right)$

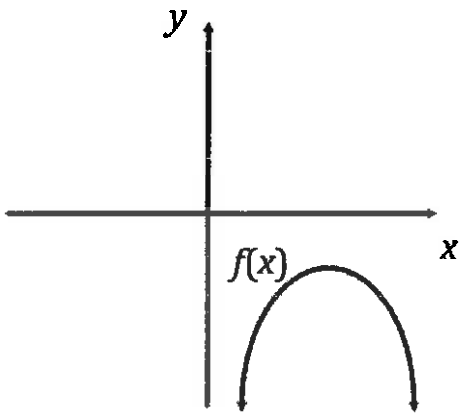
   (c) $\dfrac{6 - \sqrt{2}}{6 + \sqrt{2}}$

   (d) $\sqrt{9ab} \cdot \sqrt{5ab}$

   (e) $\sqrt{7k^3} \cdot \sqrt{10k}$

   (f) $\dfrac{a - 4}{6a} + \dfrac{1}{3a^2} + \dfrac{7 - 3a}{9a^3}$

9. The graph of a function f is given below.



The rule defining this function f is of the form $f(x) = a(x-h)^2 + k$.

Which one of the following is **true**?

(a) $a < 0, h < 0$ and $k < 0$

(b) $a < 0, h > 0$ and $k < 0$

(c) $a > 0, h > 0$ and $k < 0$

(d) $a > 0, h > 0$ and $k > 0$

---

10. The function $f(x) = x^2$ undergoes the three transformations below:

- a reflection about the x-axis
- a translation of 1 unit to the right
- a translation of 2 units down

The equation of the image obtained is of the form: $g(x) = a(x-h)^2 + k$.

Which equation below *could* represent the image $g(x)$ of the function f?

(a) $g(x) = -(x+1)^2 - 2$

(b) $g(x) = (x-1)^2 + 2$

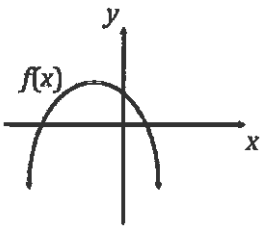
(c) $g(x) = -(x+1)^2 + 2$

(d) $g(x) = -(x-1)^2 - 2$

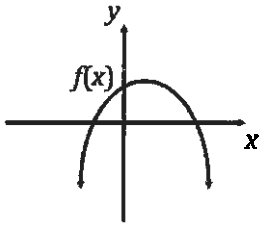
11. The rule for a quadratic function is $f(x) = a(x-h)^2 + k$.

If parameter a is negative, h is negative and k is positive, whic of the graphs below could correspond to such a afunction?

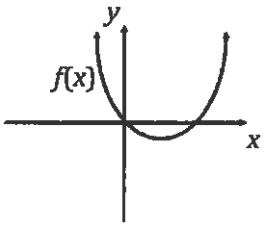
(a)



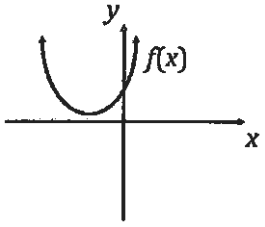
(c)



(b)



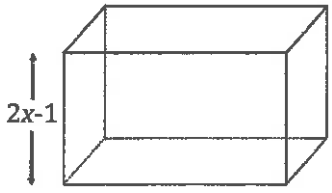
(d)



---

12. The polynomial $4x^3 + 16x^2 + 11x - 10$ represents the volume of a right prism with a rectangular base.

The height of this prism is represented by the binomial $2x - 1$.



What binomials (integer coefficients and constants) represent the length and the width of the base of this prism? Show all of your work.

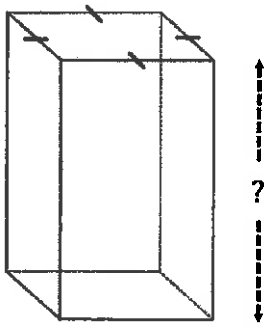
13. Simplify the following algebraic expression. Note that the denominators are not equal to zero, and hence you do not need to worry about restrictions.

$$\frac{2x^2+5x+3}{4x^2-9} \times \frac{4x^2-6x}{(x+1)(x+1)}$$

14.

The figure on the right represents a right rectangular prism with a square base.

The are of the square base is $\left(x^2+6x+9\right)\ m^2$ and the area of each of the lateral faces is $\left(2x^2+x-15\right)\ m^2$.



What is the simplified algebraic expression that corresponds to the measure of the height of the prism? Show all of your work.

15. The volume of a right prism with a rectangular base is $2x^3 + x^2 - 13x + 6$. The height of the prism is $2x - 1$.

Which of the following are possible dimensions of its base?

(a) $(x - 3)$ and $(x + 2)$

(b) $(x - 3)$ and $(x - 2)$

(c) $(x + 3)$ and $(x - 2)$

(d) $(x + 3)$ and $(x + 2)$

---

16. Which of the following expressions is equivalent to $\dfrac{\left(a^3b^{-1}\right)^{-2}}{\left(a^{-3}b^4\right)^3}$?

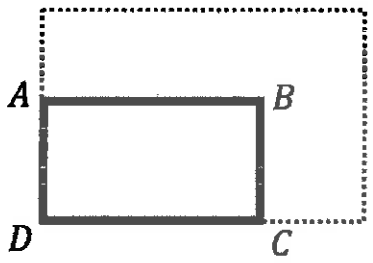
(a) $\dfrac{a}{b^4}$

(b) $\dfrac{a^5}{b^{14}}$

(c) $\dfrac{a^5}{b^{10}}$

(d) $\dfrac{a^3}{b^{10}}$

17. In the figure below, the area of rectangle $ABCD$ in square units is expressed by the trinomial $2x^2 - 11x + 12$, the measure of its sides being binomials with integer coefficients and constants.
Sides DA and DC are each extended 4 units to form a new rectangle.



In square units, what algebraic expression represents the area of the new rectangle?

(a) $2x^2 + 1$

(b) $2x^2 + x$

(c) $2x^2 - 11x + 28$

(d) $2x^2 + 23x + 56$

---

18. Mary wrote the following three polynomials:

$$A: \quad \left(5x^3 - 7x^2 - 48x + 12\right)$$
$$B: \quad \left(-2x^3 + 12x^2 - 76x - 96\right)$$
$$C: \quad (3x + 2)$$

She can find a fourth polynomial by using this relation: $D = \dfrac{A + B}{C}$.

Which of the following represents the simplified expression of polynomial D, ignoring any possible restrictions?

(a) $(x + 6)(x - 7)$

(b) $(x - 6)(x + 7)$

(c) $(x + 6)(x + 7)$

(d) $(x - 6)(x - 7)$

19. Simplify the following algebraic expression fully. State all applicable restrictions.

(a) $\dfrac{2x^2+5x+3}{4x^2-9} \cdot \dfrac{4x^2-6x}{x^2+2x+1}$

(b) $\dfrac{a}{4a^2-12a+9} - \dfrac{a+2}{4a^2-9}$

20. Solve each of the following equations using an appropriate method. Make sure you show all of your work.

(a) $2x^2 - 18x = 0$

(b) $x^2 - 5x - 7 = 0$

(c) $-2(x+5)^2 + 18 = 0$

(d) $4x^2 - 12x + 9 = 0$

(e) $-3x^2 + x + 5 = 10$

---

21. Solve the following inequality. State your answer using interval notation.

(a) $4x^2 - 14x + 3 \leq 13$

(b) $(3x-1)(2x-3) \geq -2$

22. A square of side length x cm is equivalent to (has the same area as) a rectangle, which has an algebraic expression repesenting its area, namely $\left(2x^2 - 7x - 60\right)$ cm^2.

    If the sides of the rectangle are binomials with integer coefficients and constants, what is the *numerical* perimeter of the rectangle?

---

23. The profit, $P(x)$ of a company, in millions of dollars, depends on the number of x units sold during a given month.

    This profit is defined by the function $P(x) = -0.5x^2 + 40x - 750$.

    Determine the interval of the number of sold units in which the profit of the company was strictly positive.

24. If the denominator is rationalized, which of the following simplified expressions is equivalent to $\dfrac{3-\sqrt{3}}{3+\sqrt{3}}$?

(a) $\dfrac{12+\sqrt{3}}{6}$

(b) $12-6\sqrt{3}$

(c) $2-\sqrt{3}$

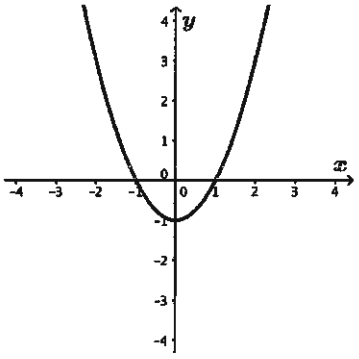
(d) $2+\sqrt{3}$

---

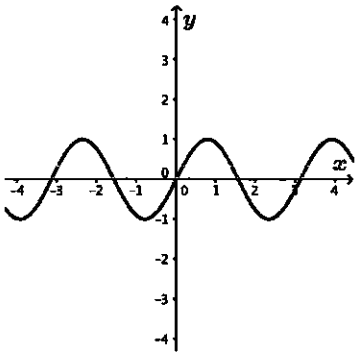
25. Which of the graphs below corresponds to a function which:

- Has a maximum of 1
- Is negative over the interval $x \in [-3,-1] \cup [1,3]$

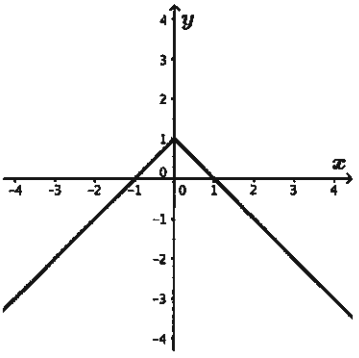
(a)



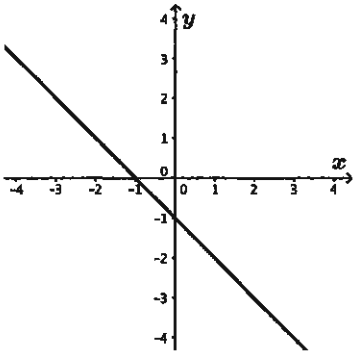
(c)



(b)



(d)



26. Which of the following expressions is equivalent to:

$$(ab)^{-2} \div \left(2a^2\right)^3 \cdot \left(\frac{a}{2b}\right)^{-4}$$

(a) $\dfrac{2b^2}{a^{12}}$

(b) $\dfrac{1}{128a^4b^6}$

(c) $\dfrac{4a^{12}}{3b^2}$

(d) $\dfrac{128b^6}{a^4}$

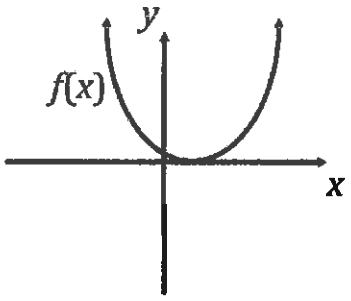
---

27. Which of the following could be the graph of the function:

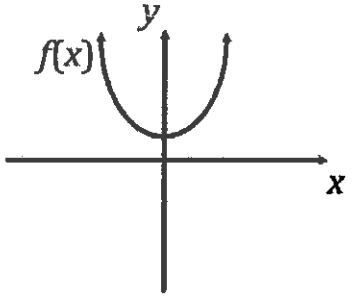
$$y = ax^2 + bx + c$$

given that $\Delta = b^2 - 4ac = 0$ and $a < 0$?

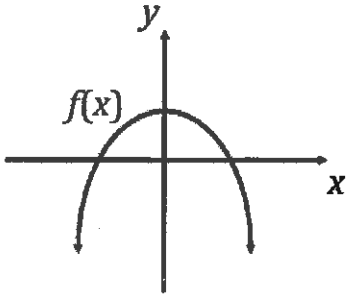
(a)



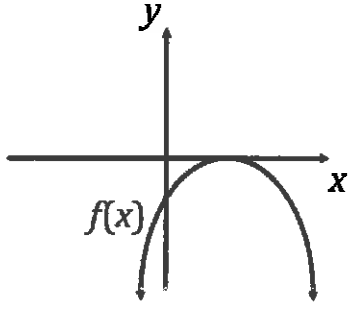
(c)



(b)



(d)



28. Functions f and g are defined by the following rules:

$$\begin{aligned} f(x) &= -4(x+2)^2+3 \\ g(x) &= 4(x-2)^2+3 \end{aligned}$$

Which of the following statements is **true**?

(a) The graphs of f and g both have the same axis of symmetry.

(b) The maximum of f is equal to the minimum of g.

(c) Functions f and g have the same initial value (y-intercept).

(d) Functions f and g have two zeros (x-intercepts).

---

29. Given that a parabola has $(-2,0)$ and $(8,0)$ as zeros, and it goes through the point $(-1,3)$, determine the equation of the parabola. You may express your answer in any form.

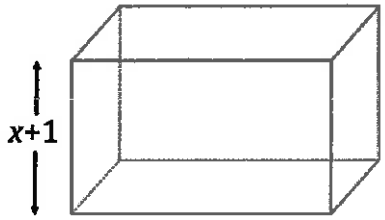
---

30. Simplify the following expression as much as possible:

$$\frac{2x+1}{x^2+x-2}+\frac{3x}{x^2+5x+6}$$

Do *NOT* state restrictions.

31. You are given the following right rectangular prism as shown below. The height is $(x+1)$ and the volume is $V = 2x^3 + 5x^2 + x - 2$.



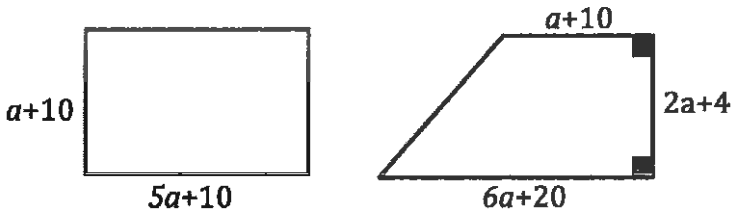
Determine the fully simplified expression, in terms of x, which represents the total surface area of the prism. Show all of your work.

---

32. A farmer wants to fence in two lots, one rectangular and the other in the shape of a right trapezoid. The two lots are equivalent (have the same area).

Recall the formula for the area of a trapezoid: $A = \dfrac{(B+b) \times h}{2}$

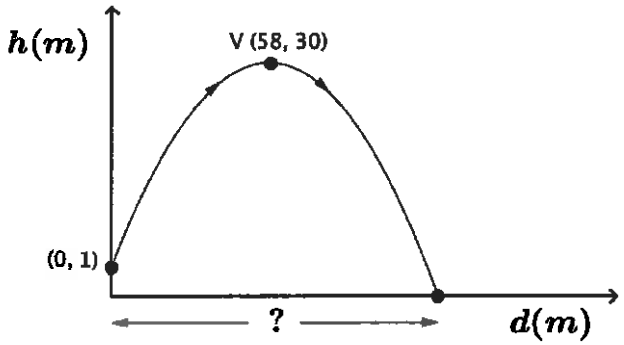
The dimensions of the lots are represented in the diagram below.



The farmer needs to find out what the *numerical* perimeter of each is. Determine a and hence the perimeters of each lot.

33. Harrison hits a baseball into the air from a height of 1 metre, as shown in the figure below. The ball follows a parabolic trajectory and reaches its maximum height of $30\ m$ after covering a horizontal distance of $58\ m$.

Assuming the ball is not caught, determine the hoizontal distance the ball travels before hitting the ground for the first time?
Round to two decimal places.



---

34. A financial consultant recommends two different stocks for you to consider buying.

The first stock called A follows a quadratic model, started at a value of \$58, and after 10 weeks it reaches a minimum value of \$8.

A second stock called B follows a linear model. After 2 weeks, it is worth \$20, and after 8 weeks it is worth \$32.

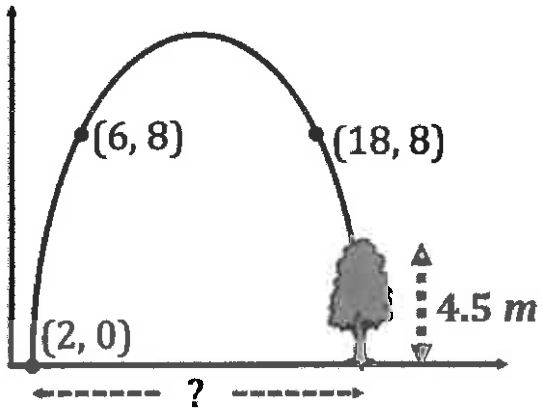
Considering the first year only (use 52 weeks), how many weeks was stock A worth more than stock B?
Round your final answer to two decimal places.

35. Find all numerical values of m so that the quadratic equation $x^2+(m-1)\,x+1=0$ has only one solution.

---

36. The diagram below represents the trajectory of a golf ball, where x represents the horizontal distance from a fence located at the origin, and y represents the height of the ball. All units are given in metres.

    The ball is hit 2 m from the fence. Unfortunately, the ball hits the top of a tree that is 4.5 m tall. Determine the horizontal distance from where the ball was hit to the base of the tree.



37. Which of the following expressions is equivalent to $-3\sqrt{8x^4y^9}$, assuming $x \neq 0$ and $y \neq 0$.

(a) $-12x^2y^3$

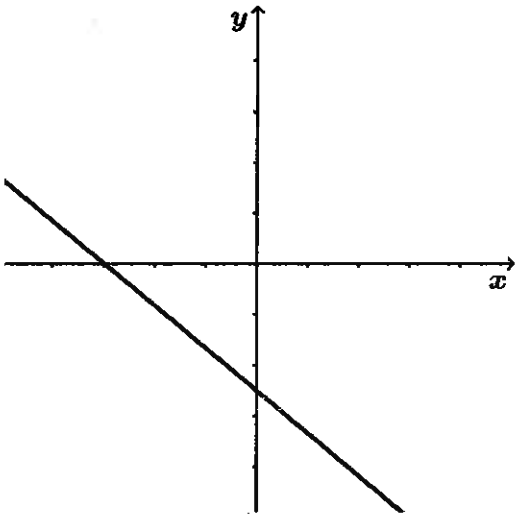
(b) $-12x^2y^3\sqrt{2}$

(c) $-6x^2y^4\sqrt{2y}$

(d) $-6x^2y^3\sqrt{2}$

---

38. A function, $f(x) = ax + b$, is represented in Cartesian plane below.



Which of the following statements is **false**?

(a) The parameter **b**, and the parameter **a** are both negative.

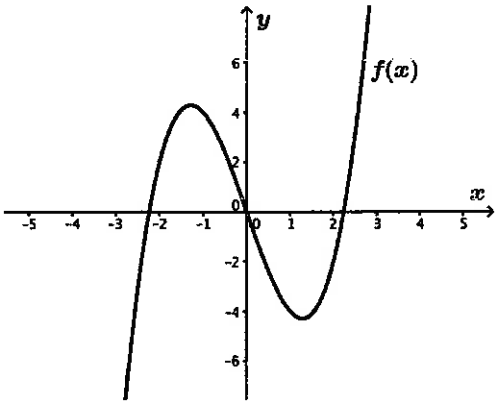
(b) The zero is negative, and the y-intercept is negative.

(c) The parameter **a** is negative, and the value at zero is negative.

(d) The function is increasing over the interval $x \in]-\infty, -3]$.

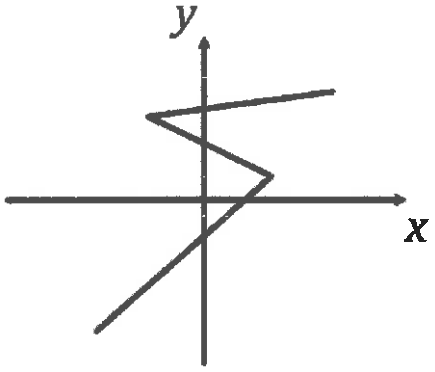
39. Which of the following relations is *NOT* a function?

(a)



(b) $f(x)$: $\left\{ \begin{array}{cc} (1,6) & (2,7) \\ (4,4) & (5,10) \\ (6,10) & \end{array} \right\}$

(c)



(d)

x	$f(x)$
-4	16
-3	9
0	0
3	9
4	16

---

40. Which one of the following is a restriction for the expression below?

$$\frac{x^2+5x+6}{2x^2-3x-5} \div \frac{x^2}{3x+15}$$

(a) $x \neq 5$

(b) $x \neq 15$

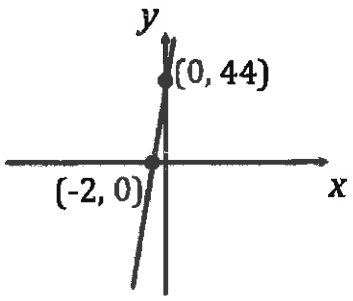
(c) $x \neq -15$

(d) $x \neq 0$

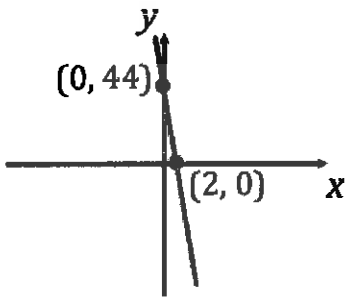
41. Functions f and g are defined as follows: $f(x) = -3x - 12$ and $g(x) = 7x - 32$.

Which one of the following graphs represents the function: $g - f$?

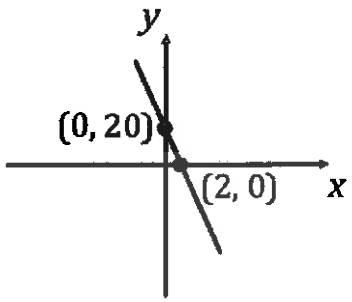
(a)



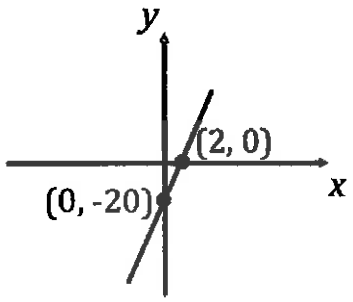
(c)



(b)



(d)



---

42. Consider the 3 polynomials below:

$$\begin{aligned} Q &= 5x^3 + 2x^2 - 14 \\ R &= 3x^3 - 3x^2 + 9x + 4 \\ S &= 2x + 3 \end{aligned}$$

The polynomial P is calculated by: $P = \dfrac{Q - R}{S}$

Which of the following is the simplified form of P, given $x \neq -\frac{3}{2}$?

(a) $(x + 3)(x - 2)$

(c) $(x - 3)(x - 2)$

(b) $(x - 3)(x + 2)$

(d) $(x + 3)(x + 2)$

43. Simplify the following expressions completely. Answers must be in radical form.

(a) $2\sqrt{32} + 4\sqrt{50} - \sqrt{8}$

(b) $\dfrac{2\sqrt{3}}{4\sqrt{3}+2}$

---

44. The area of a square corresponds to $\left(49a^2 - 70ab + 25b^2\right)\ cm^2$. Determine the simplified algebraic expression that corresponds to the following.

(a) The length of each side of the square.

(b) The perimeter of the square.

---

45. Factor completely.

(a) $x^3 + 4x^2 + 2x + 8$

(b) $\dfrac{x^4}{16} - y^8$

46. A right rectangular prism has a volume of $\left(6x^3 + 13x^2 - 10x - 24\right)\ m^3$ and a height of $(3x - 4)\ m$. Determine the simplified algebraic expression representing the **perimeter** of its base, if the dimensions of the base are binomials with integer coefficients and constants.

---

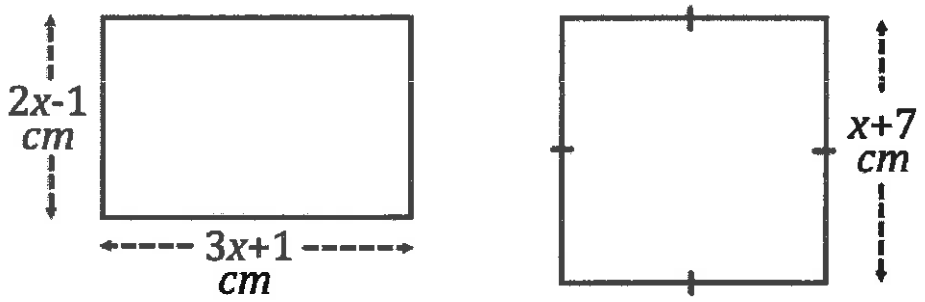
47. The profit for a particular firm followed a parabolic function for the first 12 months of its existence. The table below shows the mathematical model of its profits (in thousands of dollars) as a function of time in months.

Month	Profit
2	2.8
5	8.2
8	10
11	8.2

For how many months during the twelve month period was the firm making a profit of \$5,000 or more?

An algebraic solution is required.

48. The following square and rectangle are equivalent (have the same area). Determine the *numerical* value representing the perimeter of the rectangle. An algebraic solution is required.



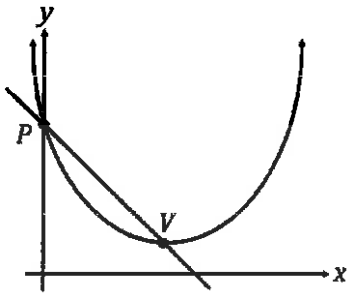
---

49. In order to earn a little extra money, Mr. Moussouni has a company that sells t-shirts. If he sells 42 t-shirts in one month, he makes a profit of \$240. If he sells 50 t-shirts in one month, he makes a profit of \$320.

    This month, he would like to make a profit of \$450. How many t-shirts does he need to sell if we assume that the prices remain fixed? An algebraic solution is required.

50. The equation of the parabola shown below is $f(x) = 3x^2 - 36x + 110$.

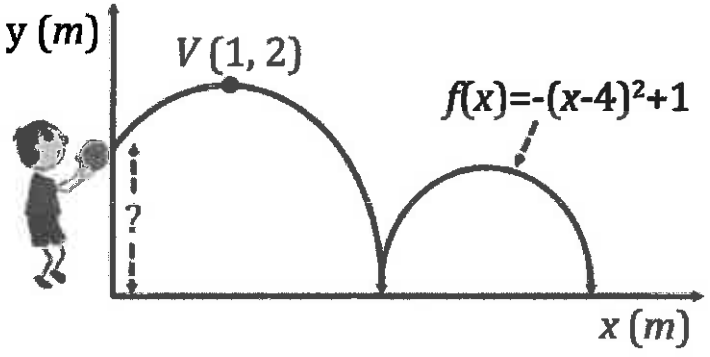
Point V is the vertex of the parabola. The parabolas intersects the y-axis at point P.



What is the equation of the line passing through points P and V?
An algebraic solution is required.

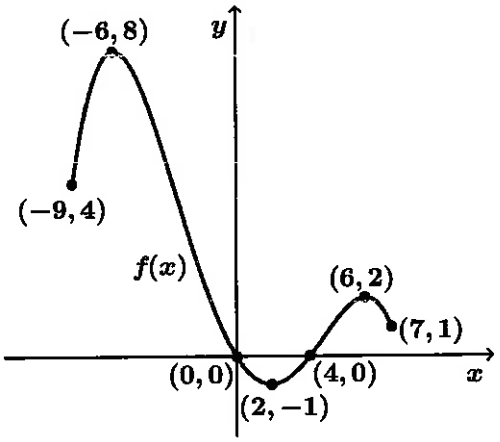
---

51. Mark would like to shoot a basketball. The diagram below illustrates the path it takes. In the diagram, point V is the vertex of the parabola representing the trajectory of the basketball immediately after it was thrown.
The function rule $f(x) = -(x-4)^2 + 1$ is associated with the parabola representing the trajectory of the basketball after its first bounce off the ground.



How far above the ground was the basketball at the moment Mark shot it?
An algebraic solution is required.

52. Function f is drawn in the Cartesian plan below.



Which of the following statements is **true**?

(a) $f(2) = 6$

(b) The function is negative over the interval $x \in [0, 4]$

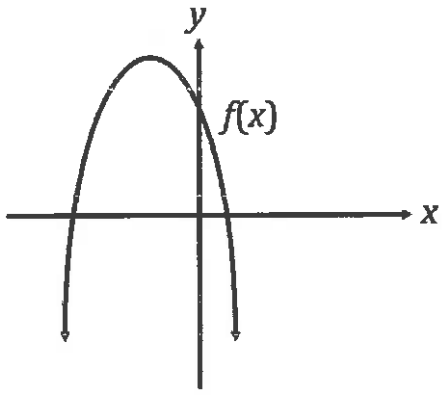
(c) Range of f is $y \in [-6, 2]$

(d) This function is increasing over the interval $x \in [-9, 8]$

---

53. Show that $(x + 1)$ is a factor of the polynomial $\left(2x^3 - 9x^2 + x + 12\right)$. Use your result to factor the polynomial completely.

54. The rule of function $f(x)$ represented on the right is of the form $f(x) = a(x-h)^2 + k$.



The values of parameters a and k were changed to obtain function g.

The following changes were made:

- The value of a was doubled.
- The value of k was decreased by 2 units.

Which of the following statements is/are true?

i) The range of function g is the same as the range of function f.

ii) The domain of function g is the same as the domain of function f.

iii) The interval over which function g is increasing is the same as the interval over which function f is increasing.

(a) Statement ii) only.

(b) Statements i) and iii) only.

(c) Statements ii) and iii) only.

(d) Statements i), ii) and iii).

---

55. Given the function $g(x) = 4(x-1)^2 + 8$, determine the following:

(a) Domain:

(b) Range:

(c) Intercept(s), if any:

(d) Variation:

56. Simplify the following expression completely. Your answer must be in radical form.

$$2\sqrt{32} + \sqrt{3} - 4\sqrt{50} + 2\sqrt{147} - \sqrt{8}$$

---

57. Factor completely:

(a) $x^3 + 4x^2 + 2x + 8$

(b) $(x-3)^2 - y^2$

---

58. Given that a parabola has a vertex of $(-4, 10)$ and passes through the point $(6, -50)$, find the equation of the parabola in **general form**.

59. Perform the following operations. Simplify your answers completely and state all restrictions:

(a) $\dfrac{x+1}{2x-4} - \dfrac{x}{x^2-x-2}$

(b) $\dfrac{ax-6-2x+3a}{x^2-5x+6} \div \dfrac{x^2-9}{5x-10}$

---

60. Given $f(x) = x^2 + 2x - 5$ and $g(x) = 3x + 4$, determine the following:

(a) $f(-2)$

(b) x when $g(x) = 10$.

61. Elizabeth hits a baseball and, unfortunately, she pops it up. The height, h, of the ball is given by $h(t) = -5t^2 + 20t + 1.2$, where h is in metres and t is in seconds elapsed since the ball was hit.

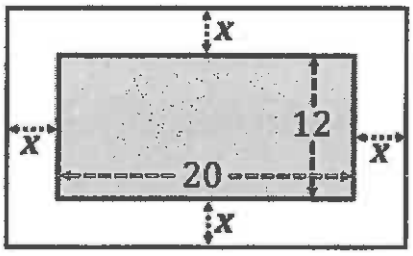
(a) What is the maximum height of the ball?

(b) How lond does the fielder have to into position to catch the ball before it hits the ground?

---

62. Chelsea's parents have decided to put a paved walkway of uniform width around their swimming pool. The pool is rectangular and measures 12 feet by 20 feet. The area of the walkway (excluding the pool of course) will be 144 square feet.

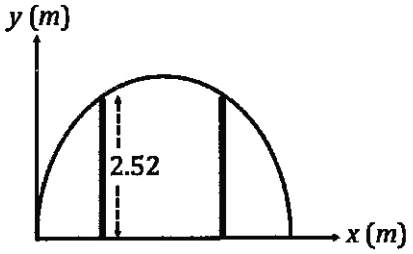
Find the uniform width, x, of the walkway.



63. The entrance to a medieval castle is parabolic in shape. The width of the arch on the ground is $8\ m$. The maximum height is $3\ m$.

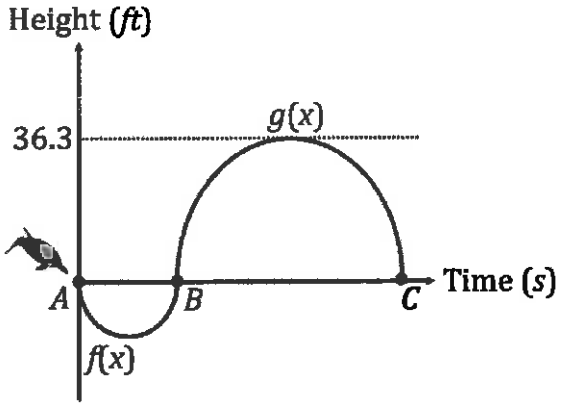
In order to make the arch safe, it is suggested that two vertical supports that are $2.52\ m$ in length be inserted as shown.

How far apart will these supports be placed?



---

64. Starting at the origin (point A), Brad, a super-dolphin, swims underwater in a parabolic path defined by function $f(x)$. He then jumps out of the water at point B and follows another parabolic path defined by function $g(x)$ and re-enters the water at point C.

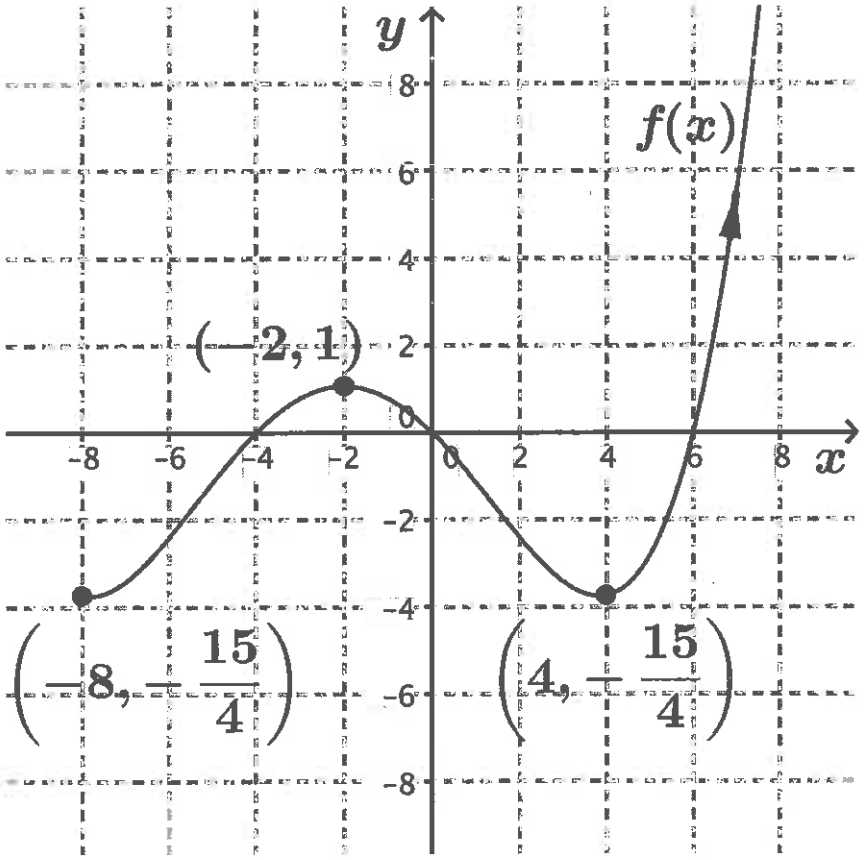


Brad's maximum height in the air is $36.3\ ft$.

The rule of function f is $f(x) = (x-4)^2 - 16$, and it takes 30 seconds to go from point A to point C.

How long was Brad at least 12 feet in the air?

65. Consider the function below and complete a study of its sign and variation.



(a) Positive Sign: $f(x) \geq 0$

(b) Negative Sign: $f(x) \leq 0$

(c) Increasing Variation:

(d) Decreasing Variation:

11 Solutions

11.1 Exponents

1. $\{(a, iii), (b, v), (c, i), (d, iv), (e, ii)\}$
2. (a) $x^7y^4z^9$ (b) b^3c^{29}/a^{26} (c) x^3/y^3 (d) $1/x^{2n+6}$
3. $2^{5/2}$ 4. (a) 5. (b) 6. (a) 7. (c)
8. (a) $-18x^3$ (c) $16a^6c^4/b^6$ (e) 2^{2a+2} (g) $-27x^6/16$
   (b) $4x^8/y^2$ (d) $15xy$ (f) $-5a/c^14$ (h) $2y^2/x^3$
9. (a) -16 (c) $32x^6y^5$ (e) $y^8/4x^4$
   (b) $-\frac{3}{2}$ (d) $8x^4y^{15}$ (f) $4y^8/9x^{10}$
10. (a) 32 (b) 1/3 (c) 16/9
11. (a) $32x^{10}/y^{15}$ (b) $25y^4/9x^6$ (c) 1 (d) $16ab$

11.2 Radicals

1. (b) 2. (a) 3. $\dfrac{16-3\sqrt{2}}{7}$ 4. $4\sqrt{6}+13$
5. (a) $2\sqrt{6}-10\sqrt{3}$ (e) $-3x^2/y$
   (b) $3xy^5z^4\sqrt{3x}$
   (c) $7\sqrt{2}-12\sqrt{3}$ (f) $15+2\sqrt{6}-3\sqrt{10}-2\sqrt{15}$
   (d) $3\sqrt{2}/4$ (g) $150-18\sqrt{10}$
6. $Speed = \left(2-\sqrt{5}\right)/\left(3\sqrt{2}-\sqrt{5}\right)\ kph = \left(6\sqrt{2}+2\sqrt{5}-3\sqrt{10}-5\right)/13\ kph$

11.3 Factoring

1. (c)

2. (c)

3. $\{2x, x-9, x+5\}$

4. (a) $\left(9x^2+4y^4\right)\left(3x+2y^2\right)\left(3x-2y^2\right)$

   (b) $\left(3p^2-2q\right)\left(p^2+4q\right)$

   (c) $\left(x^2+1\right)(x-3)^2$

   (d) $\left(\frac{m}{9}+\frac{11n}{9}\right)\left(\frac{11m}{9}+\frac{n}{9}\right)$

11.4 Rational Expressions

1. (d)

2. (a) $\dfrac{x-3}{2x}, \quad x \neq 0, -1$

   (b) $\dfrac{1}{m+n}, \quad m \neq \pm n$

   (c) $\dfrac{x+5}{x+2}, \quad x \neq -3, -2$

   (d) $\dfrac{m(m+5)}{m-5}, \quad m \neq 0, 5$

3. (a) $\dfrac{-4}{x(x+2)}, \quad x \neq -3, -2, 0, \frac{1}{5}, 3$

   (b) $\dfrac{b^2}{(a-b)(a+b)}, \quad a \neq \pm b$

   (c) $\dfrac{xy}{(x-2y)(x+2y)}, \quad x \neq 0, y \neq 0, x \neq \pm 2y$

   (d) $x^2, \quad x \neq 0, -1$

4. (b)

5. (a) $\dfrac{-6}{2x+1}, \quad x \neq -2, -\frac{1}{2}, 5, 6$

   (b) $\dfrac{x^2+7x+19}{(x-3)(x+2)(x+4)}, \quad x \neq -4, -2, 3$

6. (a) $\dfrac{y-5}{x+3}, \quad y \neq -5, x \neq -3$

   (b) $\dfrac{18a-1}{6a^3}, \quad a \neq 0$

   (c) $\dfrac{2(x-3)}{(x-2)(x+2)}, \quad x \neq \pm 2$

11.5 Long Division

1. $\{(x-2)\ m, (2x-3)\ m, (x+4)\ m\}$
2. $\{(3x+4)\ cm, (2x-3)\ cm\}$
3. $x = b^2 + 2b - 1$
4. $length = 3x^2 - 10x + 5$

11.6 Polynomials and Solving Quadratic Equations

1. (c)
2. $length = (x+5)\ m$
3. (c)
4. $x \in \{-2, 6\}$
5. $width = 7\ m$ and $length = 9\ m$
6. $x = 4\ m$ and $perimeter = 68\ m$
7. $x \in \{-2/3, 3\}$
8. (a) $x \in \{-11, 0\}$ (b) $x \in \{\emptyset\}$

11.7 Functions

1. (d)
2. (c)
3. (a) $6x^2 - 40x + 35$
   (b) -3
   (c) $x \in \left\{-1, \frac{1}{3}\right\}$
   (d) $x \in \left\{-\frac{7}{3}, 1\right\}$
4. (a) (i) $x \in [4, 10]$ (ii) $x \in [4, 6]$
   (b) $-3/2$
   (c) $x \in \{1, 8\}$
   (d) Negative: $x \in [0, 1] \cup [8, 10]$
   (e) Positive: $x \in [1, 8]$
   (f) (i) $Abs\ Min = -3$ (ii) $Abs\ Max = 3$
   (g) (i) $Domain:\ x \in [0, 10]$ (ii) $Range:\ y \in [-3, 3]$
   (h) $t \in \{0, 9\}$

11.8 Linear Functions

1. (a) 2. (d) 3. (c) 4. (a) 5. $\frac{14}{5}$
6. (a) $C(d) = 3d + 50$ (b) $52\ days$

11.9 Quadratic Functions

1. (b) 2. (b) 3. (c) 4. (a) 5. (b)

6. (a) $f(x) = (x+3)^2 - 1$

   (b) $g(x) = -3(x-2)^2 + 2$

   (c) $h(x) = 2\left(x + \frac{5}{4}\right)^2 - \frac{49}{8}$

   (d) $i(x) = x^2 - 4$ (it is in both standard and general form already)

7. $Max\ \ Height = 60\ m$

8. (a) Concave up $\rightarrow$ upward

   (b) $V = \left(\frac{1}{2}, -\frac{25}{4}\right)$

   (c) $x = -\frac{1}{2}$

   (d) $Dom\ f: \quad x \in \mathbb{R}$

   (e) $Ran\ f: \quad y \in \left[-\frac{25}{4}, +\infty\right[$

   (f) $y - int = f(0) = -6$

   (g) $x \in \{-2, 3\}$

   (h) $Inc: \quad x \in \left[\frac{1}{2}, +\infty\right[$

   (i) $Dec: \quad x \in \left]-\infty, \frac{1}{2}\right]$

   (j) $Pos: \quad x \in]-\infty, -2] \cup [3, +\infty[$

   (k) $Neg: \quad x \in [-2, 3]$

9. $x \in \left\{-7 \pm \frac{\sqrt{5}}{2}\right\}$

10. (a) $x \in \{-3, 1\}$ (b) $x \in \left\{-\frac{1}{5}, 1\right\}$ (c) $x \in \{\emptyset\}$

11. (a) $f(x) = y = -\frac{1}{4}x^2 + \frac{5}{2}x - \frac{13}{4}$

    (b) $f(x) = y = 4(x-1)^2 + 1$

    (c) $f(x) = y = -\frac{1}{2}(x-3)(x+1)$

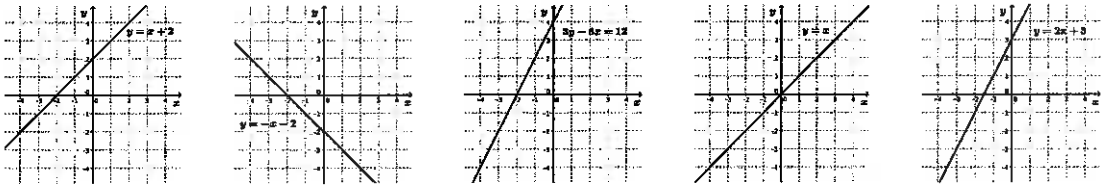
12. $13\ m$

13. $x \in \{\frac{-1 \pm \sqrt{33}}{2}\}$

14. $\{(f(x),3),(g(x),1),(h(x),4),(i(x),2)\}$
15. $4\ m$
16. $y=-\frac{4}{9}(x-3)^2+4;\quad 0.9\ , m$ and $5.1\ m$
17. $9.19\ km$
18. $(20, 37.5)$
19. $g(x)=y=-\frac{529}{18}x^2+\frac{6877}{18}x-\frac{13225}{72}$
20. $4\ m$
21. $distance=3+\sqrt{15}\approx 6.87$
22. $Max\ \ Height=h=\frac{36}{5}\ m$

11.10 Overall Review

1. (a)
2. (d)
3. $3a$
4. (a) $(x+y)(x+a)$ (b) $4(x+10)(x-3)$ (c) $(3x+4y)(5y-6)$
5. (a) $a-b/3$ (c) $(x+6)(x-2)$
   (b) $\left(x^4+3\right)\left(x^4-3\right)$ (d) $unfactorable$
6. (a) (b) (c) (d) (e)



7. $(x+3)$ and $(x-2)$

8. (a) $\sqrt{10}-\sqrt{30}$ (c) $\left(19-6\sqrt{2}\right)/17$ (e) $k^2\sqrt{70}$

(b) $9+9\sqrt{6}+\sqrt{3}+3\sqrt{2}$ (d) $3ab\sqrt{5}$ (f) $\left(3a^3-12a^2+14\right)/18a^3$

9. (b) 10. (d) 11. (a)

12. $(2x+5)$ and $(x+2)$ 13. $2x/(x+1)$ 14. $(2x-5)\ m$

15. (c) 16. (d)

17. (b) 18. (b)

19. (a) $\dfrac{2x}{x+1},\quad x\neq -1,\pm\dfrac{3}{2}$ (b) $\dfrac{2(a+3)}{(2a-3)^2(2a+3)},\quad a\neq\pm\dfrac{3}{2}$

20. (a) $x\in\{0,9\}$ (c) $x\in\{-8,-2\}$ (e) $x\in\{\emptyset\}$

(b) $x\in\left\{\frac{5\pm\sqrt{53}}{2}\right\}$ (d) $x\in\left\{\frac{3}{2}\right\}$

21. (a) $x\in\left[\frac{7-\sqrt{89}}{4},\frac{7+\sqrt{89}}{4}\right]$ (b) $x\in\left]-\infty,\frac{5}{6}\right]\cup[1,+\infty[$

22. $44\ cm$ 23. $x\in\,]30,50[$

24. (c) 25. (b) 26. (a) 27. (d) 28. (b)

29. $y=-\frac{1}{3}(x+2)(x-8)$

30. $\dfrac{5x^2+4x+3}{(x+3)(x+2)(x-1)}$

31. $Surface\ Area=10x^2+14x-2$

32. $Rectangle\ Perimeter=160$ and $Trapezoid\ Perimeter\approx 188.62$

33. $116.99\ m$ 34. $36.51\ weeks$ 35. $m\in\{-1,3\}$ 36. $18\ m$

37. (c) 38. (d) 39. (c) 40. (d) 41. (d) 42. (a)

43. (a) $26\sqrt{2}$ (b) $\left(6-\sqrt{3}\right)/11$

44. (a) $(7a-5b)\ cm$ (b) $(28a-20b)\ cm$

45. (a) $\left(x^2+2\right)(x+4)$

(b) $\left(\frac{x^2}{4}+y^4\right)\left(\frac{x}{2}+y^2\right)\left(\frac{x}{2}-y^2\right)$

46. $(6x+10)\ m$ 47. $9\ months$ 48. $50\ cm$ 49. $63\ t\text{-}shirts$

50. $y = -\dfrac{19}{3}x + 110$

51. $2.5\ m$ 52. (b) 53. $(x+1)(2x-3)(x-4)$

54. (c)

55. (a) $Domain: \quad x \in \mathbb{R}$
    (b) $Range: \quad y \in [8, +\infty[$
    (c) $y-int: \quad (0,12)$ and $x-int: \quad \emptyset$
    (d) $Inc: \quad x \in [1, +\infty[$ and $Dec: \quad x \in]-\infty, 1]$

56. $-14\sqrt{2} + 17\sqrt{3}$

57. (a) $(x+4)\left(x^2+2\right)$ (b) $(x-3+y)(x-3-y)$

58. $y = -\dfrac{3}{5}(x+4)^2 + 10$

59. (a) $\dfrac{x^2+1}{2(x-2)(x+1)}, \quad x \neq -1, 2$ (b) $\dfrac{5(a-2)}{(x-3)^2}, \quad x \neq \pm 3, 2, 3$

60. (a) $f(-2) = -5$ (b) $x = 2$

61. (a) $21.2\ m$ (b) $4.06\ s$

62. $x = 2\ ft$

63. $3.2\ m$

64. $5.7\ s$

65. (a) $Positive: \quad x \in [-4, 0] \cup [6, +\infty[$
    (b) $Negative: \quad x \in [8, -4] \cup [0, 6]$
    (c) $Increasing: \quad x \in [-8, -2] \cup [4, +\infty[$
    (d) $Decreasing: \quad x \in [-2, 4]$