



Pre-Calculus

Equations & Answers

FUNCTIONS & THEIR GRAPHS

Definitions

- A function is a relation in which each element of the domain is paired with only one element of the range.
- In most cases, x is the independent variable and y or $f(x)$ is the dependent variable.

Linear Functions

A function whose graph is a non-vertical line or part of a non-vertical line. There are 3 forms of linear equations: slope-intercept, point-slope, and standard form.

- Slope-intercept form:** $y = mx + b$, where m is the slope and b is the y -intercept of the line.

EX: If a line has a slope of 3 and y -intercept of 5, the equation is $y = 3x + 5$.

- Point-slope form:** $y - y_1 = m(x - x_1)$, where m is the slope and (x_1, y_1) is a point on the line.

EX: If a line has a slope of -2 and contains the point $(0, -4)$, the equation is $y - (-4) = -2(x - 0)$ or $y + 4 = -2(x - 0)$.

- Standard form:** $Ax + By = C$, where A , B , and C are integers and A is positive. The slope is $-\frac{A}{B}$ and the y -intercept is $-\frac{C}{B}$. This form of a line is most often used to find intercepts by plugging 0 in for x and y separately and solving.

EX: Given the line $3x + 2y = 4$, the slope is $-\frac{3}{2}$ and the y -intercept is 2. The intercepts can also be found by substitution:

x -intercept (plug in 0 for y):

$$3x + 2y = 4 \quad 3x + 2(0) = 4 \quad 3x = 4 \quad x = \frac{4}{3}$$

y -intercept (plug in 0 for x):

$$3x + 2y = 4 \quad 3(0) + 2y = 4 \quad 2y = 4 \quad y = 2$$

Polynomial Functions

A function is a polynomial function if it can be written in the form

$$f(x) = ax^n + bx^{n-1} + cx^{n-2} + \dots + dx + e.$$

- The greatest power of a polynomial with one variable is called its **degree**.
 - When the degree of the function is odd, there is at least one real zero; when the degree is even, there may be no real zeros.
 - Both types can have imaginary roots of the form $a + bi$.
- EX: $f(x) = 2x^3 + 3x^2 - x + 4$ has a degree of 3, one real zero at $x = -2.1608$, and two non-real roots.

Quadratic Functions

Written in the form $f(x) = ax^2 + bx + c$, where $a \neq 0$

- The **axis of symmetry** is the vertical line with equation $x = -\frac{b}{2a}$.
- The y -intercept is c .
- Quadratic functions can be written in **vertex form**, $f(x) = a(x - h)^2 + k$, where (h, k) is the vertex of a parabola that opens up when $a > 0$ and opens down when $a < 0$.
- Quadratic functions can have none, one, or two real-number solutions.
- The graph is a parabola if the parabola opens left or right—it is not a function.
- The vertex is the **critical point** where the graph changes from increasing to decreasing or decreasing to increasing.

Methods for Finding Roots

Equation	Method	Justification	Solution
$x^2 - 9 = 0$	Square Roots	There is no x -term.	$x^2 - 9 = 0$ $x^2 = 9$ $x = 3$ or -3
$x^2 + 2x - 8 = 0$	Factoring	It has only a few factors to check.	$x^2 + 2x - 8 = 0$ $(x + 4)(x - 2) = 0$ $x = -4$ or 2
$2x^2 + 5x - 9 = 0$	Quadratic Formula	The equation cannot be factored.	$x = \frac{-5 \pm \sqrt{5^2 - 4(2)(-9)}}{2(2)}$ $x = \frac{-5 \pm \sqrt{25 + 72}}{4}$ $x = \frac{-5 \pm \sqrt{97}}{4}$
$x^2 - 8x + 3 = 0$	Completing the Square or Quadratic Formula	The coefficient of the x^2 -term is 1 but the equation cannot be factored.	$x^2 - 8x + 3 = 0$ $x^2 - 8x = -3$ $x^2 - 8x + 16 = -3 + 16$ $(x - 4)^2 = 13$ $x - 4 = \pm\sqrt{13}$ $x = 4 \pm\sqrt{13}$

The **discriminant** is the expression under the radical in the Quadratic Formula and can be used to determine the number of real solutions.

- A function can be identified using the **vertical line test**. If a vertical line passes through the graph of the function in more than one point, the graph is not a function.
- A function can be represented by an equation in terms of x and y or with function notation: $y = 7x - 11$ or $f(x) = 7x - 11$.

Discriminant: $b^2 - 4ac > 0$

EX: $2x^2 - 7x + 3 = 0$

The discriminant is $(-7)^2 - 4(2)(3) = 25$, which is positive.

There are two real number solutions.



Discriminant: $b^2 - 4ac = 0$

EX: $x^2 - 8x + 16 = 0$

The discriminant is $(-8)^2 - 4(1)(16) = 0$.

There is one real number solution.



Discriminant: $b^2 - 4ac < 0$

EX: $2x^2 - 7x + 8 = 0$

The discriminant is $(-7)^2 - 4(2)(8) = -15$, which is negative.

There are no real number solutions.



Rational Functions

A rational function is an equation of the form $f(x) = \frac{p(x)}{q(x)}$, where $p(x)$ and $q(x)$ are polynomial functions and $q(x) \neq 0$.

- Rational functions may have breaks in continuity that appear in the graph as vertical asymptotes or point discontinuities that appear as holes.
- Vertical asymptotes occur where a rational function is undefined.
- Point discontinuities occur where there is a common factor in the numerator and denominator.

To multiply: First multiply the numerators, then the denominators.

$$\frac{8x^2 - 8}{3x + 10} \cdot \frac{4x + 6}{2x - 2} = \frac{(8x^2 - 8)(4x + 6)}{(3x + 10)(2x - 2)}$$

To divide: Multiply by the multiplicative inverse (reciprocal) of the divisor.

$$\begin{aligned} \frac{x^2 + 3x + 10}{x^2 + 3x + 2} \cdot \frac{x - 2}{3x + 3} &= \frac{x^2 + 3x + 10}{x^2 + 3x + 2} \cdot \frac{x - 2}{3(x + 1)} \\ &= \frac{(x + 5)(x + 2)(x - 2)}{(x + 2)(x + 1) \cdot 3(x + 1)} \\ &= \frac{x + 5}{3(x + 1)} \end{aligned}$$

Order is important for division.

To add and subtract: There must be a common denominator. To find it for rational expressions with polynomials in the denominator, factor first to determine common factors.

$$\frac{5}{x^2 - x - 20} + \frac{7}{2x - 10} = \frac{5}{(x + 4)(x - 5)} + \frac{7}{2(x - 5)}$$

Using one of each factor, the LCM is $2(x + 4)(x - 5)$. Multiply each fraction's numerator and denominator by the factors missing from the LCM.

$$\begin{aligned} &= \frac{5}{(x + 4)(x - 5)} \cdot \frac{2}{2} + \frac{7}{2(x - 5)} \cdot \frac{(x + 4)}{(x + 4)} \\ &= \frac{10}{2(x + 4)(x - 5)} + \frac{7(x + 4)}{2(x - 5)(x + 4)} \\ &= \frac{10 + 7x + 28}{2(x + 4)(x - 5)} \end{aligned}$$

$$\text{Subtracting: } \frac{x - 4}{x^2 + 3x + 10} - \frac{x + 2}{x^2 + 3x + 20} = \frac{x - 4}{(x + 3)(x + 2)} - \frac{x + 2}{(x + 3)(x + 5)}$$

Using one of each factor, the LCM is $(x + 3)(x + 5)(x + 4)$. Multiply each fraction's numerator and denominator by the factors missing from the LCM.

Hint: The common denominator is the LCM (least common multiple) of the denominators.

Warning: The subtraction sign must be distributed to each part of the numerator of the second fraction.

$$\begin{aligned} &= \frac{x - 4}{(x + 3)(x + 2)} - \frac{x + 2}{(x + 3)(x + 5)} \\ &= \frac{(x - 4)(x + 5) - (x + 2)(x + 3)}{(x + 3)(x + 2)(x + 5)} \\ &= \frac{x^2 - 8x + 20 - x^2 - 5x - 6}{(x + 3)(x + 2)(x + 5)} \end{aligned}$$

Precalculus Study And Solutions Guide

Dianna L. Zook



Precalculus Study And Solutions Guide:

The Pre-calculus Problem Solver Max Fogiel, Research and Education Association, 1984 Student Study and Solutions Guide Ron Larson, 2002-08-01 Contains solutions to all odd numbered exercises for Precalculus and Calculus I material
Student Solutions are also available for the odd exercises in the precalculus material at the beginning of the text

Precalculus Ron Larson, Robert P. Hostetler, 2001 As the best seller in its field Precalculus 5 e offers both instructors and students a more solid comprehensive and flexible program than ever before Designed for the one or two term precalculus course the text opens with moderate algebra review and introduces trigonometry first with a unit circle approach and then with the right triangle For a complete listing of features see Larson Hostetler College Algebra 5 e **Study and Solutions Guide** Dianna L. Zook, 1997 Study and Solutions Guide for Precalculus, Second Edition, Larson/Hostetler

Dianna L. Zook, 1989 Study and Solutions Guide Ron Larson, 2003-02 **Study and Solutions Guide for Larson/Hostetler S Precalculus, 5th** Ron Larson, Professor Ron Larson, 2000-08 *Student Solutions Guide for Calculus, an Applied Approach, 5th Ed. [by] Larson/Edwards* Ron Larson, Bruce H. Edwards, 1999 **Precalculus** Roland E. Larson, 1993 **Student Solutions Guide to Accompany Brief Calculus with Applications** Dianna L. Zook, Larson, 1995

Larson Precalculus Concise Plus Study and Solutions Guide First Edition plus Eduspace Houghton Mifflin College Division, 2007-07 **100 Top Picks for Homeschool Curriculum** Cathy Duffy, 2005 A critical volume for the homeschooling community that helps parents make informed choices regarding learning styles and curriculum *Secondary Textbook Review*, 1993 **Mathematics and Computer Education**, 1986 Study Guide with Student Solutions Manual for Larson's Precalculus, 10th Ron Larson, 2017-01-13 This guide offers step by step solutions for all odd numbered text exercises Chapter and Cumulative Tests and Practice Tests with solutions giving you a way to check your answers

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