

JQE Study Guide
Algebra

- Be able to perform basic operations (add, subtract, multiply, divide) of expressions with fractions and/or absolute values.
- Be able to convert a description of a set of real numbers to an inequality or interval notation and vice versa.
 - Inequality notation is of the form $-1 \leq x < 2$
 - Interval notation is of the form $[-1, 2)$
- Be able to perform basic operations (add, subtract, multiply) with polynomials.
 - A polynomial is of the form $a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$, where $a_0, a_1, a_2, \dots, a_n$ are real numbers with $a_n \neq 0$.
- Be able to factor polynomials.
- Be able to simplify rational expressions.
 - A rational expression is a fraction of polynomials: $\frac{p}{q}$ where p and q are polynomials.
- Given a region with sides represented by algebraic expressions, be able to write the area of the region in the form of a polynomial.
- Be able to solve problems concerning a line.
 - Understand the concept of the slope of a line and be able to determine the slope by use of points on the line, the equation of the line, or by knowing that the line is parallel or perpendicular to another line.
 - The slope m of a non-vertical line through the points (x_1, y_1) and (x_2, y_2) is $m = \frac{y_2 - y_1}{x_2 - x_1}$.
 - The slopes of parallel lines are equal and the slopes of perpendicular lines are negative reciprocals of each other.
 - Be able to determine the intercepts of the line.
 - The intercepts of a line are the points where the line crosses the x -axis ($y = 0$) and the y -axis ($x = 0$).
 - Be able to find the equation of a line given certain information about the line.
 - The slope-intercept form of an equation of a line is $y = mx + b$, where m is the slope and b is the y -intercept of the line.
 - The point-slope form of an equation of a line is $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$, where (x_1, y_1) and (x_2, y_2) are two points on the line.
- Be able to determine the domain of a function.
 - The domain of a function is the set of all real numbers for which the expression is defined.
- Be able to determine or evaluate functional values.

- Given the graph of an equation/function, be able to determine such data as the slope (of a line), the intercepts, and the maximum/minimum values.
 - The function value $f(c)$ is a relative minimum of the function $f(x)$ if there exists an interval (a,b) that contains c such that $a < x < b$ implies $f(c) \leq f(x)$.
 - The function value $f(c)$ is a relative maximum of the function $f(x)$ if there exists an interval (a,b) that contains c such that $a < x < b$ implies $f(c) \geq f(x)$.

- Given a function, be able to determine the zeros and the maximum/minimum values.
 - The value c is a zero of the function $f(x)$ if $f(c) = 0$.

- Be able to graph basic functions: linear, quadratic, cubic, absolute value, radical, and piecewise-defined.
 - Shown below are examples of each type of function:

Linear: $f(x) = 3x + 5$

Quadratic: $f(x) = 3x^2 - 3x + 5$

Cubic: $f(x) = 3x^3 + 5$

Absolute value: $f(x) = |x - 3|$

Radical: $f(x) = \sqrt{x + 2}$

Piecewise-defined: $f(x) = \begin{cases} x, & x \leq 1 \\ x^2, & x > 1 \end{cases}$

- Understand the concepts of shifts and reflections and be able to determine the transformation of a given point on the original graph.
 - A shift moves the graph of a function to the right, left, up, or down.
 - A reflection represents a mirror image across an axis.
- Be able to determine the transformations (horizontal/vertical shifts and reflections) of the graph of one function as related to the graph of a basic function, as defined above.
- Be able to determine the solutions of basic linear/quadratic equations over the set of real numbers or set of complex numbers.
- Be able to solve a real-life problem by first converting the verbal description of the problem to an algebraic equation and then by solving the algebraic problem.
- Be able to determine the number of relative extrema (relative maximum or minimum) of a function given the number of zeros of the function.
- Be able to solve for an indicated variable of a formula written in several variables.