# Things to Know for the Algebra I Regents

**Types of Numbers:**

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| Real Number: any number you can think of (integers, rational, irrational)<br>Imaginary Number: square root of a negative number<br>Integers: whole numbers (positive, negative, zero) | Rational: whole numbers; perfect squares; can be written as a fraction; repeating decimals; terminating decimals<br>Irrational: cannot be written as a fraction; non-perfect squares; non-repeating decimals; non-terminating decimals |

**Properties of Real Numbers:** (only work with addition and multiplication)

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| Commutative: change order of terms<br>Ex: $a + b + c = a + c + b$<br>$a(bc) = (bc)a$<br>Associative: group ( ) differently<br>Ex: $a + (b + c) = (a + b) + c$<br>$a(bc) = (ab)c$<br>Distributive: number outside the ( ) multiplies to every term inside the ( )<br>Ex: $2(x + 5) = 2x + 2(5) = 2x + 10$ | Identity: value you start with is the value you end with<br>Ex: $7 + 0 = 7$<br>$7(1) = 7$<br>Inverse: uses the opposite<br>Ex: $3 + (-3) = 0$<br>$3(\frac{1}{3}) = 1 \rightarrow$ reciprocal<br>Zero: anything multiplied by zero is zero<br>Ex: $6(0) = 0$ |

**Monomials & Polynomials:** Mono = 1 term; Poly = binomial (2 terms), trinomial (3 terms)

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| Expression: has no equal sign<br><br>Coefficient: number in front of a variable | Term: piece of an expression separated by +<br><br>Constant: numerical term with no variable |
| Standard Form: like terms combined; highest to lowest exponent<br><br>Multiplying Variables: add exponents<br><br>Dividing Variables: subtract exponents | Multiplying Polynomials: double distribute<br>Ex: $(2x - 6)(x - 3)$<br>$= 2x(x - 3) - 6(x - 3)$<br>$= 2x^2 - 6x - 6x + 18$<br>$= 2x^2 - 12x + 18$ |
| Negative Exponents: bring to the denominator & make them positive | Zero Exponent: will always result in an answer of 1 |
| "From goes first":<br>Ex: Subtract $2x^2 + 3x - 1$ from $x^2 - 5x - 7$<br>$= (x^2 - 5x - 7) - (2x^2 + 3x - 1) = x^2 - 5x - 7 - 2x^2 - 3x + 1 = -x^2 - 8x - 6$ | |

**Radicals:** radicand = # under radical sign

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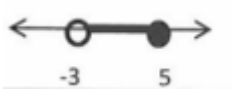
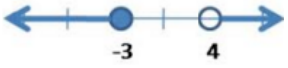
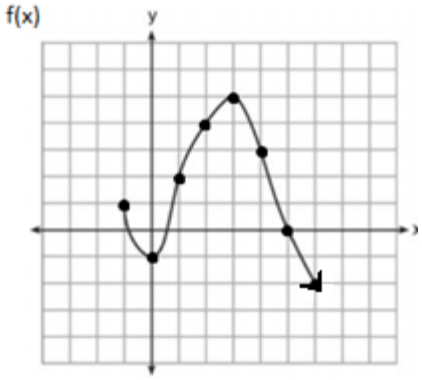
| Perfect Squares: variables with even exponents<br><br>1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169,.. | Simplifying: find the largest perfect square that divides in evenly; perfect squares come out of the radical |
| Adding/Subtracting: simplify radicand first; +/−coefficients of like radicands | Multiplying/Dividing: ×/÷coefficients; ×/÷radicands; simplify |

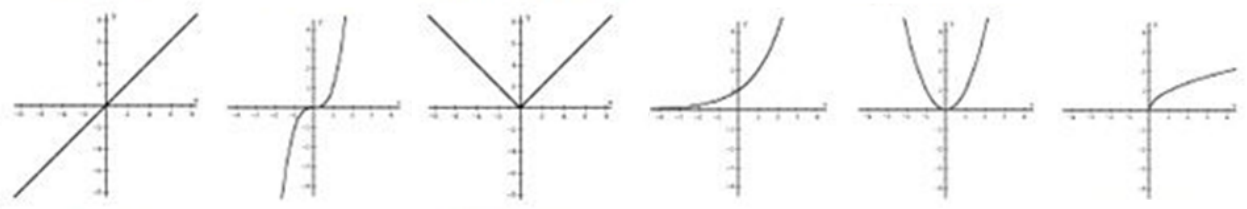
**Inequalities:** variable must be on left side of inequality symbol; ÷ by negative → flip inequality sign

| Graphing on a Number Line: | Graphing on Coordinate Grid: |
|---|---|
| <"less than", shade left, open circle<br>>"greater than", shade right, open circle<br>≤"less than or = to", shade left, closed circle<br>≥"greater than or = to", shade right, closed circle | <"less than", shade down, dotted line<br>>"greater than", shade up, dotted line<br>≤"less than or = to", shade down, solid line<br>≥"greater than or = to", shade up, solid line |
| Compound "and" Inequality: shade in between 2 values<br>Ex:  <br>Interval Notation: (-3, 5]<br>Set Builder: {x E R \| -3 < x ≤ 5} | Compound "or" Inequality: shade one way OR the other; use union symbol for int. not.<br>Ex:  <br>Interval Notation: (-∞, -3] ∪ (4, ∞)<br>Set Builder: {x E R \| x ≤ -3 or x > 4} |

**Functions:**

| Function: x-values can't repeat; graph will pass vertical line test<br>1-1 Function: x-values AND y-values can't repeat | Interval Notation:<br>( ) means unequal/open circles<br>[ ] means equal/closed circles ∞ always gets ( ) |
|---|---|
| Domain: List of x-values (input values)<br>Ex: Interval Notation: [-1, ∞)<br>Set Builder: {x E R \| x ≥ -1}<br>"x is an element of all real #'s such that..."<br><br>Range: List of y-values (output values)<br>Ex: Interval Notation: (-∞, 5]<br>Set Builder: {y E R \| y ≤ 5}<br>"y is an element of all real #'s such that..." |  |

Parent Functions:



Linear Cubic Absolute Value Exponential Quadratic Square Root

**Transformations**: moving of a parent graph

| Translations: shift or slide | Reflection: flip | Dilation: grow or shrink |
|---|---|---|
| $y = \|x\| + a$ shift up<br>$y = \|x\| - a$ shift down<br>$y = \|x + a\|$ shift left<br>$y = \|x - a\|$ shift right | $y = -\|x\|$ reflect over x-axis | $y = a\|x\|$<br>$a > 1 \rightarrow$ vertical stretch (narrows)<br>$0 < a < 1 \rightarrow$ vertical shrink (widens) |

**Linear Functions:** m = slope b = y-intercept

| Slope-intercept Form: | Point-slope Form: | Slope/ARC Formula: |
|---|---|---|
| $y = mx + b$ | $y - y_1 = m(x - x_1)$ | $m = \frac{y_2 - y_1}{x_2 - x_1}$ "y's go up high" |

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| Vertical Lines: pass through x-axis $\rightarrow$ x = #; undefined slope | Horizontal Lines: pass through y-axis $\rightarrow$ y = #; zero slope |
| Parallel Lines: have equal slopes; never intersect; symbol: // | Perpendicular Lines: have negative reciprocal slopes; intersect and form a right angle; symbol: $\perp$ |
| Writing eqt given slope and 1 point:<br>Plug in m, x, and y. Solve for b.<br>Rewrite equation with new b value. | Writing eqt given 2 points:<br>Find m using slope formula. Plug in m, x, and y.<br>Solve for b. Rewrite equation with new b value. |

**Linear Systems:** Solution = POI (Point of Intersection)

| Three Types of Graphs: | Algebraically: |
|---|---|
| 1) Consistent = lines intersect at one point; have different slopes<br>2) Inconsistent = lines do not intersect; have same slope<br>3) Dependent = lines are identical and intersect at infinite points; have same slope & y-int | 1) Substitution Method<br>- one eqt has a variable alone; plug this expression into other equation<br>2) Addition/Elimination Method<br>- like terms stacked on top of each other; need opposite sign coefficients |

**Word Problems**: the value they tell you the least about is "x"

| Perimeter: sum of all side lengths<br><br>Distance = rate(time) | Area:<br>Rectangle: A = length(width)<br>Square: $A = (side)^2$ |
|---|---|
| Consecutive Integers:<br>Let 1st CI = x<br>Let 2nd CI = x + 1<br>Let 3rd CI = x + 2 | Consecutive Even/Odd Integers:<br>Let 1st CEI/COI = x<br>Let 2nd CEI/COI = x + 2<br>Let 3rd CEI/COI = x + 4 |

**Exponential Functions:** Growth uses addition; decay uses subtraction

Compound Interest Formula: $A = P(1 \pm \frac{r}{n})^{nt}$

A = amount accumulated P = initial/principle amount
r = rate (no percents) n = number of times compounded per year
t = time (annually = 1; semi = 2; quarterly = 4; monthly = 12)

**Quadratics:** solutions = roots = x-intercepts = zeroes; shape = parabola

Standard form: $y = ax^2 + bx + c$

Vertex form: $y = (x - h)^2 + k$ where (h, k) is the vertex

Graphing: make sure to include table of values, labels, 1B = 1U

1) Axis of Symmetry (AOS): $x = \frac{-b}{2a}$
2) Vertex/Turning Point (TP): plug in x and solve for y
3) End Behavior: leading coefficient positive → faces upward; vertex is a minimum
   leading coefficient negative → faces downward, vertex is a maximum
4) Y-intercept: where x = 0
5) Roots/x-intercepts: where y = 0

Three Ways to Solve for Solutions:

1) Factoring: T-Chart and solve for x

   GCF: Largest coefficient that divides into all terms evenly; smallest exponent on variable

   $5x + 10 = 0$
   $5(x + 2) = 0$
   $x = -2$ Solution Set: {-2}

   DOTS: Both terms must be perfect squares; subtraction in the middle

   $x^2 = 16$
   $x^2 - 16 = 0$
   $(x + 4)(x - 4) = 0$
   $x = -4$ and $x = 4$ Solution Set: {±4}

   Trinomial: If last sign is pos, signs in blanks are same; if last sign is neg, signs in blanks are dif.

   $x^2 + 5x + 6 = 0$
   $x^2 + \underline{3x} + \underline{2x} + 6 = 0$
   $x(x + 3) + 2(x + 3) = 0$
   $(x + 3)(x + 2) = 0$
   $x = -3$ and $x = -2$ Solution Set: {-3, -2}

2) Quadratic Formula: standard form = zero; express in simplest radical form

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

3) Completing the Square: half of "b" value, then square it

   $x^2 - 14x + 1 = 0$
   $x^2 - 14x + \underline{(-7)^2} = -1 + \underline{(-7)^2}$
   $x^2 - 14x + 49 = -1 + 49$
   $(x - 7)^2 = 48$
   $x - 7 = \pm\sqrt{48}$
   $x = 7 \pm 4\sqrt{3}$ → roots are real, irrational, unequal

Real-Life Word Problems: time = x value; height = y value

Time object reaches max height: AOS
Maximum height: y-value of vertex
Time to hit ground: root (use quadratic formula)

**Quadratic/Linear Systems:** solution = POI (Point of Intersection) - one, two, or no solutions

Algebraically:
1) Both equations must be in standard form (y = )
2) Set expressions equal to each other and set = zero
3) Solve for x (use factoring, quadratic formula, or completing the square)
4) Substitute x value(s) into original equation to find y value(s)
5) State your answers as coordinate points (x, y)

**Sequences**: A list of numbers that follows a specific pattern.

| Arithmetic: | Geometric: |
|---|---|
| Uses addition and a common difference (d).<br>To find d, subtract 2nd term and 1st term.<br>Represented by a linear function. | Uses multiplication and a common ratio (r).<br>If the numbers are getting bigger, r is a whole #.<br>If the numbers are getting smaller, r is a fraction.<br>To find r, divide 2nd term by 1st term.<br>Represented by an exponential function. |
| Explicit Formulas:<br>Arithmetic: $a_n = a_1 + (n - 1)(d)$<br>Geometric: $a_n = a_1(r)^{n-1}$ | Recursive Formulas: use previous term; must state 1st term<br>Ex: 2, 4, 6, 8...<br>$a_n = a_{n-1} + 2$ when $a_1 = 2$ |

**Statistics**:biased favors one thing over another

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|---|---|
| Quantitative = things that can be counted<br><br>Qualitiative = characteristics that can't be counted | Univariate = 1 set of data<br><br>Bivariate = 2 sets of data |
| Statistical Summary Values: Calc: STAT → EDIT → type in list → STAT → CALC → 1VAR-STAT L1<br>1) Mean: average; add up numbers & divide by # of values<br>2) Median: middle number after numbers are in numerical order<br>3) Mode: number that appears the most (bimodal = more than 1 mode)<br>4) Range: maximum – minimum<br>5) IQR (Interquartile Range): Q3 – Q1 | |
| Finding an Outlier:<br><br>To the Left: Q1 – (1.5(IQR))<br><br>To the Right: Q3 + (1.5(IQR)) | Types of Data Distributions:<br>1) Symmetrical = typical measure is mean; mean/median close in value<br>2) Skewed = typical measure is median; mean/median are not close in value |

**Linear Regression**: Calc: STAT → EDIT → type in lists → STAT → CALC → #4 L1, L2

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| Correlation Coefficient (r):<br>shows how strong relationship is between 2 sets of data<br><br>r = ±1 → strong relationship<br>r = 0 → no relationship<br>To turn "r" on: 2ND → 0 → DIAGNOSTICS ON | Interpolate: predict what occurs with a value that is within range of given values<br><br>Extrapolate: predict what occurs with a value that is outside range of given values |
| Scatter Plot: relates bivariate data; shows correlation (which does not indicate causation) | Residual Plot: shows distance values are from line of best fit<br>Residual = actual value – predicted value |