Quick Review for the Math Portion of the OGT

- **Ascending order** (like A, B, C,… or 1, 2, 3,…) & **Descending order** (like Z, Y, X,… or 10, 9, 8,…)
- **Prime numbers** include 2, 3, 5, 7, 11, 13, 17, 19, 23, 29,… (The number "1" is NOT prime.)
- **Perfect square numbers** include 1, 4, 9, 16, 25, 36, 49, 64, 81, …
- The **absolute value** of a number is always positive. Examples: $|-3| = 3$ and $|5| = 5$
- A **solution** is an answer to a mathematical equation. Solutions can be written in set notation:
  - **Empty Set, or Null Set**: This set contains NO elements – not even zero! It is symbolized by $\{\ \}$ or $\varnothing$.
  - **Natural Numbers, or Counting Numbers**: $\{1, 2, 3, \ldots\}$
  - **Whole Numbers**: $\{0, 1, 2, 3, \ldots\}$
  - **Integers**: $\{\ldots -3, -2, -1, 0, 1, 2, 3, \ldots\}$ Even Integer…2*n* Odd Integer… 2*n*-1
  - **Rational Numbers**: Any number that CAN be written as a simplified fraction. (ex: ½, 3/5, 8)
  - **Irrational Numbers**: the set consisting of all Real Numbers that are NOT Rational. (Ex: $\pi, \sqrt{2}, \sqrt{5}$)
  - **Real Numbers**: This set consists of all of the Rational Numbers plus all of the Irrational Numbers.

- **Commutative Property** – switch the order; Example: *a + b = b + a* or *ab = bc*
- **Associative Property** – regroup; Example: *(a + b) + c = a + (b + c)* or *(ab)c = a(bc)*
- **Distributive Property** – Example: *3(a + b) = 3a + 3b*

- Memorize these conversion factors:

To convert, start with what you want to convert and set up the units such that they can "build one".

1,000 millimeters = 1 meter	3 feet = 1 yard
100 centimeters = 1 meter	1 pound = 16 ounces
10 decimeters = 1 meter	2,000 pounds = 1 ton
1 kilometer = 1,000 meters	8 fluid ounces = 1 cup
5,280 feet = 1 mile	2 cups = 1 pint
1 foot = 12 inches	2 pints = 1 quart
3 feet = 1 yard	4 quarts = 1 gallon

- **Scientific Notation:** Positive Exponents: $3.25 \times 10^4 = 32{,}500$; Negative Exponents: $3.25 \times 10^{-2} = 0.0325$

- Positive and Negative Exponents:
  - $x^2 \cdot x^3 = (x \cdot x)(x \cdot x \cdot x) = x^5$
  - $(x^2)^3 = (x^2)(x^2)(x^2) = (x \cdot x)(x \cdot x)(x \cdot x) = x^6$
  - $\dfrac{x^3}{x^5} = \dfrac{x \cdot x \cdot x}{x \cdot x \cdot x \cdot x \cdot x} = \dfrac{1}{x^2}$
  - $x^{-3} = \dfrac{1}{x^3}$
  - $6x^{-3} = \dfrac{6}{x^3}$

- Simplify: $-3^2 = -1 \cdot 3 \cdot 3 = -9$ versus… $(-3)^2 = (-3)(-3) = 9$

- There are **3 terms** in $7x^2 + 4x - 5$, but the **degree** is **2**.
- Monomial = 1 term; Binomial = sum of 2 terms; Trinomial = sum of 3 terms; Polynomial = sum of many terms

- Double = 2 times; Twice = 2 times; Triple = 3 times; **Quadruple** = 4 times

- Gratuity = a tip (such as is given to a waiter) Example: A 15% tip on a $35.00 meal is _?_. (A: $5.25)

- **Functions:**

- A **horizontal** line is a function, but a **vertical** line is not a function.
- ↔
- Independent variable, x … dependent variable, y
- A **relation** is anything you can draw. A relation that passes the **Vertical Line Test** is a function.
- The equation of any **horizontal** line is **y = (some number)**. For example, y = -3 is a horizontal line because the **y**-coordinate of every point on the line is –3! The slope of a horizontal line is **m = 0**.
- The equation of any **vertical** line is **x = (some number)**. For example, x = 8 is a vertical line because the **x**-coordinate of every point on the line is 8! The slope of a vertical line is **m = no slope or undefined**.
- Memorize the slope formula: $m = \frac{\text{up or down}}{\text{right or left}}$ or $\boxed{m = \frac{y_2 - y_1}{x_2 - x_1}}$ (Note: **rate** = slope)
- Find the equation of a line given (-5, 7) and (-9, 3). Answer: y = x + 12
- Be able to graph a line given the equation of the line in **y = mx + b** form where m = slope, b = y-intercept.
- **Parallel** $(\|)$ lines have the same slope!
- The slopes of **perpendicular** $(\perp)$ lines are opposite reciprocals. (If $m_1 = \frac{1}{2}$ and $m_2 = {}^-2$, then perpendicular.)
- **Collinear** points all lie on the same line.
- When given a linear set of data, a **line of best fit** can be drawn as close as possible to all data points.
- y = 3x + 4 is a **linear** function. $y = 3x^2 + 4$ is NOT a linear function, or a **nonlinear** function.
- $y = 3x^2 + 4$ is the equation of a **parabola** that opens up. (It opens up b/c the **coefficient** of x^2 is positive.)
- The **zeros or roots** of a function are where that function intersects the x-axis.
- Use the **Quadratic Formula** (on formula sheet) to find the zeros or roots of a parabola.

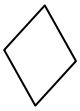
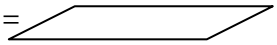
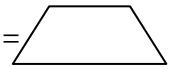
- An equation may have 1 solution (like $3x - 5 = 7; x = 4$), no solution (like $5x + 3 = 5x - 2; \varnothing$), or many solutions (like $2x + 6 = 2(x + 3); \mathbb{R}$).
- Solve the proportion $\frac{3}{x} = \frac{5}{9}$ by using the shortcut…. $x = 3 \cdot 9 \div 5$ so $\therefore x = 5.4$.
- Be able to solve percent problems using $\boxed{\frac{P}{100} = \frac{is}{of}}$. Ex: 9 is 36% of what number? (Answer: 25)
- Be able to solve an inequality like $2x - 9 < 13$. Solve it like an equation, BUT if you multiply or divide both sides by a negative number, the inequality symbol changes directions! (When graphed, solid line if $\leq or \geq$, dashed if < or >.)
- The **prime factorization** of 54 is $54 = 2 \cdot 3 \cdot 3 \cdot 3$. The **factors** of 54 are 1,2,3,6,9,18,27,54.
- **Factor** $8x^3y^4z^2 + 12x^2y^5z + 16x^3y^3$. $\therefore 4x^2y^3\left(2xyz^2 + 3y^2z + 4x\right)$
- Use **FOIL** to multiply a binomial times a binomial. For example, $(x+4)(x+{}^-7)$

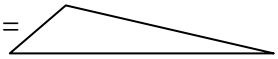
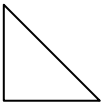
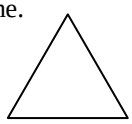
  $\boxed{x \cdot x} + \boxed{x \cdot {}^-7} + \boxed{4 \cdot x} + \boxed{4 \cdot {}^-7}$

  $x^2 + {}^-7x + 4x + {}^-28$

  $x^2 + {}^-3x + {}^-28$
- Equations can be written in function notation. For example, $y = 4x + 7$ can be written in function notation as $f(x) = 4x + 7$, read "f of x equals 4 times x plus 7".
- Find the **midpoint** of a segment by taking the average of the x-coordinates and the average of the y-coordinates, writing the answer as a point.
- Use the **Distance Formula** (from the OGT formula sheet) to find the distance between two points.
- Use the **Pythagorean Theorem** $\boxed{a^2 + b^2 = c^2}$ to find the length of a missing side of a right triangle. (Note: A **theorem** is a statement that can be proved to be true.)
- Use the formula sheet to find the length of a missing side of a right triangle if one of the angles is $30°$, $45°$, or $60°$.

- Use **sin, cos, or tan** to find the length of a missing side of a right triangle (in feet, miles, etc.)
- Use **$\sin^{-1}$, $\cos^{-1}$, or $\tan^{-1}$** to find the measure of a missing angle of a right triangle (in degrees).

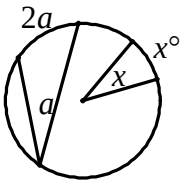
- An object can be **rotated** (turned… "rotate an object about a point"), **reflected** (flipped), or **translated** (slid) without changing the shape of the object. Note: **glide reflection** = translation + reflection. (All of these are types of **transformations**.) A **dilation** does change the size, but not the shape, of an object.
- Quadrilaterals: **rhombus** =  **parallelogram** =  **trapezoid** = 
- All squares are rectangles! But not all rectangles are squares.
- A square is a rhombus, rectangle, and a parallelogram!

- **Equidistant** means equal distance.
- **Congruent** ($\cong$) means same size and shape. **Similar** ($\sim$) means same shape.
- Triangles are similar if two pairs of angles are congruent, or have equal measures.
- If a scale model is made of a building, the angles in the original building and the scale model are the same.
- The **scale factor** of two similar figures is found by reducing the ratio of two corresponding sides.
- Triangles: **obtuse scalene** =  **isosceles right** =  **acute equilateral** = 

- 2 **complementary** angles = 90^o; 2 **supplementary** angles = 180^o; 1 **straight** angle = 180^o

- There are 360^o in a circle. There are 180^o in a semicircle.

- In a circle, the **radius** goes halfway across but the **diameter** goes all the way across the circle, passing through the center. A **chord** has 2 endpoints touching the circle. A **tangent** is outside the circle; it intersects the circle in one point. A **secant** is a line that intersects a circle in 2 points. A **central angle**'s vertex in on the center of the circle. An **inscribed angle**'s vertex is on the circle. A **semicircle** is half of a circle.



- There are 360^o in a quadrilateral. There are 180^o in a triangle. Divide any polygon into triangles that share the same vertex to see how many degrees are in the polygon. (ex: Divide a pentagon into 3 triangles… 3 triangles times 180^o equals 540^o in a pentagon.)

- A **regular** polygon has equal sides and equal angles. Find shaded area: 

- Polygons include: triangle(3 sides), quadrilateral(4), pentagon(5), hexagon(6), heptagon(7), octagon(8), nonagon(9), decagon(10), undecagon(11), dodecagon(12). **Convex** polygons do NOT "cave" inwards.

- **Prisms** are 3-dimensional objects that have 2 congruent bases. **Pyramids** have only one base and a "point". **Lateral area** is the area of the faces, or sides, that are not the bases.

- Use the formula sheet to help you find area and volume of figures! Remember to label correctly…
  area = units squared while volume = units cubed.

- **Probability** = $\frac{\text{\# of ???}}{\text{total}}$ BUT **Odds** is… (# of ways CAN do something)**:**(# of ways CAN NOT do something)

- **Probability without replacement**…Example: Find the probability of drawing an Ace out of a deck of cards followed by drawing a 2nd Ace if the first card is not replaced. (4/52)*(3/51) = (1/221) $\approx$ 0.005 $\approx$ 0.5%
- Simplify "four **factorial**". Answer: $4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$

- Use the **Permutation** formula if the order does matter (like batting order for a baseball team), but use the **Combination** formula if order does NOT matter (like if choosing a small group of people to form a committee). Example: 2 out of 15 girls and 5 out of 36 boys are chosen to be on a food stand committee. In how many different ways can the committee be formed? (A: 39,584,160 different ways.)

- An **outlier** in a set of data greatly effects the **mean** (average) and the **range** (biggest minus smallest), but it does not typically effect the **median** (middle number when data is in order) or the **mode** (most often). "**Measures of central tendency**" refers to mean, median, & mode. Create a sample set of data to see how the mean, median, and/or mode may be affected by some change.

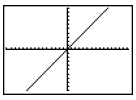
- A sample of data can be **biased** if the sample is too small (like asking only 10 people out of 1,000 which type of pet they prefer) or if the sample concentrates on an unfair representation of the whole data (like taking a poll that supposedly represents everyone in Ohio but the poll only telephones democrats to ask who their favorite candidate is).

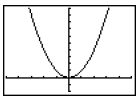
- For money, memorize: **I = PRT** or **Interest = Principal**(or $) *** rate**(written as a decimal) *** time**(in years)
- 36 months = 3 years; 24 months = 2 years; 18 months = 1.5 years
- Annually = once a year; Semiannually = twice a year; Quarterly = 4 times a year; Monthly = 12 times a year

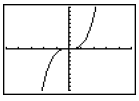
- Graphs: **Box-and-whisker plot** (break data into quartiles; find medians!), **Histogram** (no space between bars), **Stem-and-Leaf Plot** (rewrite data if asked to find mean, etc.), **Circle Graphs** (1 slice = $360^\circ \div$ # of slices)

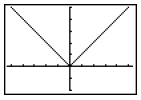
- **Direct variation** – line through the origin $\left(y = kx\right)$ versus **Inverse Variation** – hyperbola $\left(y = \frac{k}{x}\right)$

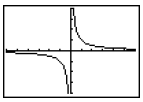
- Parent Functions:

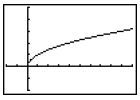
  - Line, $y = x$, 
    - If data looks like it lies in a straight line, it is said to be **linear**. Use a linear model to make predictions.

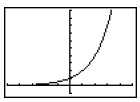
  - Parabola, $y = x^2$, 
    - If data looks like it forms a parabola, a **quadratic** function – one that is degree 2 – can be used to model that data.

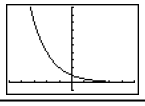
  - Cubic, $y = x^3$, 

  - Absolute Value, $y = |x|$, 
    - The absolute value of any number is always positive!

  - Hyperbola, $y = \frac{1}{x}$, 
    - In Quadrant I, as x increases, y decreases.

  - Square Root, $y = \sqrt{x}$, 
    - The square root of a negative number is an imaginary number. For examples, $\sqrt{-1} = i$ and $\sqrt{-25} = 5i$

  - Exponential Growth, $y = ab^x$ where b is greater than one, (Bacteria grows exponentially.) 

  - Exponential Decay, $y = ab^x$ where b is between zero and one, (Hot coffee cools exponentially.) 

    If data looks like it is exponential, it never ever intersects the x-axis (even though this is hard to tell by looking at some graphs).