SAT & ACT Tip Sheet

Tips for the SAT Reading and Writing/Language Sections

1. **It's an open book test:** The SAT Critical Reading exam is an open book test. You can always put your finger on the correct answers. It's never what you think the text is saying, it's what the text is saying.

2. **Reading:** While the reading portion has charts, tables, and graphs, they are often very manageable. Slow down a little in order to score easy points. The literature section is often the harder and longer passage of them all. If you recognize the passage will be difficult, it might be better to skip it and return after you have read the other passages.

3. **Dual Passages**: If the first passage is more difficult than the second, start with the second passage. If you understand more of it, you should be able to deduce more about the first passage from context clues. Always try to keep the relationship between the passages in mind because the comparison questions will all stem from how each author might respond to the other.

4. **Writing/Language:** Read the first paragraph in its entirety, looking for grammar mistakes and trying to understand what the author is conveying; you will be asked both content and grammar questions. After you complete the paragraph go back and answer the questions. After you answer each question, plug it back into the text and read it to make sure it's the best answer choice.

5. **Prepare while doing your homework:** Each night when you do your homework, spend 25 minutes reading the homework you're least interested in as if it were SAT text. It boils down to understanding what you're reading and that takes focus. It also helps to remember that the SAT is not as easy as the exams in school and that you have to gear up for the test.

Tips for the ACT Reading and English Sections

1. **Test the three Reading approaches:** You are likely to find one that works for you.
   - Start with the line reference questions before going into the text to find the answers
   - Read the entire passage then answer the questions
   - Preview the questions, read the text, and then answer the questions

2. **Practice your timing:** The reading portion of the ACT is a speed exam. You have 8 minutes and 45 seconds to read each passage and answer 10 questions. It might be a good idea to determine what genre you excel at, along with what genres are problematic; this can help you decide what order to tackle the different passages. If you continue to struggle with time, you may have to answer questions by looking for their line reference or key words. Especially for the science passages, you should be able to quickly spot terms or lines that allow you to answer questions without fully reading the passage.

3. **English:** Read the first paragraph in its entirety, looking for grammar mistakes and to fully understand what the author is trying to convey, because you will be asked both content and grammar questions. After you complete the paragraph go back and answer the questions. After you answer each question, plug it back into the text and read it to make sure it's the best answer choice.

4. **Prepare while doing your homework:** Each night when you do your homework, spend 25 minutes reading the homework you're least interested in as if it were ACT text. It boils down to understanding what you're reading and that takes focus. It also helps to remember that the ACT is not as easy as the exams in school and that you have to gear up for the test.

Helpful Tips for the SAT Math Section

1. **Know what you're solving for:** Be sure to underline the question and glance at the answer choices. Always keep in mind what the question is asking.
2. **You've done this before:** While some are in a different format, these are still the same concepts as you learned in class.
3. **The answers are all on the page:** As a last resort on the multiple choice questions, you can plug-in answer choices until one satisfies the conditions of the problem.
4. **No Calculator:** From this point forward, start to do your homework without a calculator when possible. Any practice without a calculator will be beneficial come test day.
5. **Most students benefit from answering the questions out-of-numerical order:** students should generally answer all of the grid-in exercises before completing the final third of the multiple choice questions. This maximizes the likelihood that a student running out of time will not answer the very hardest questions on the test while still providing a 25% chance for a student to get those questions correct. This also allows students to spend as much time as they have remaining on the very hardest problems instead of being uncertain as to when they need to move on to the grid-in problems.

Helpful Tips for the ACT Math Section

1. **It's a speed test:** There are more problems and less time to do them then on the SAT. Work quickly, but do not rush. Going too fast can lead to careless errors. There is no partial credit! Make sure you use all of the time you are allotted.
2. **Don't be intimidated:** Problems that contain a large amount of text are generally simpler than they appear, and are designed to look intimidating. Read and interpret each sentence before proceeding to the next one, and then piece the puzzle together when you get to the end.
3. **Tips #3 on the SAT also apply here:** Use the answer choices to your advantage—all of the answers are already on the page.
4. **Questions 1 through 30 are generally easier, and questions 31 through 60 are generally harder:** All questions are worth the same amount. Because of the time constraints, be aware of where you are in the exam and strategize accordingly.

Helpful Tips for the ACT Science Section

1. **It's an open book:** The ACT Science exam, like the reading exam, is an open book test. You can always put your finger on the correct answer.
2. **Figures, Tables, Charts:** The science test on the ACT is not testing how well you remember biology, chemistry, natural science, or physics. It is testing how well you can read graphs, read tables, predict trends, and extract information efficiently.
3. **Go to the questions first:** You should go directly to the questions on each passage. Skim the passage when there is a term in a question that you need to define, a variable that you don't know what it stands for, or the question specifies "according to the information provided."
4. **The test will let you know where to look:** If a problem begins In Experiment 1, that should tell you where to look! Keywords and specific units of measure can also give you hints when it is still unclear.
5. **Identify the one passage worth reading (Conflicting Viewpoints):** There is one passage that be majority text and have very few figures and tables, if any. That is the only passage you need to read for information. Identify and complete questions in this order: questions about the information only, questions about single viewpoints, and then comparison questions. This may take longer than other passages so budget your time accordingly!
6. **There's no substitute for (timed) practice:** Given three hours to complete the exam, any student could score in the 30s. The trick is to learn how the exam asks questions and recognize its patterns so you can do it in the time allotted. Time your practice and analyze why you spent a long time on passages when you went over the allotted time.

60+ Facts, Formulas, and Concepts that Lead to Student Success

Arithmetic Concepts

1. **Integers** are all **whole** numbers—positive, negative, and zero. Decimals, fractions, and imaginaries are not integers.

2. **Real Numbers** can be thought of as points on an infinitely long line called (you guessed it) the number line. The real numbers include:
   - All the **rational numbers** which are numbers that can be expressed as the ratio of any two integers $\frac{a}{b}$ and include:
     - All the **integers**, which are all whole numbers, both positive and negative.
     - All the **wholes**, which are non-negative integers including 0.
     - All the **natural numbers**. Do not worry about naturals. These are positive integers used for counting, ordering, and naming only. This will not come up on the test. They DO NOT include 0. **Irrational numbers**, are numbers that CANNOT be expressed as the ratio of any two integers $\frac{a}{b}$ and include numbers such as π and $\sqrt{2}$

3. **Prime Numbers** are numbers that have exactly two factors. The number 1 only has one factor, so it is not prime. The smallest primes are 2, 3, 5, 7, 11, 13, 17, and 19. The only even prime is 2.

4. **Perfect Squares** are the product of some integer and itself. For example, 25 is a perfect square, since it can be written as 5×5. Perfect squares include: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169...

5. **Perfect Cubes** are numbers that are the result of the number multiplied by itself twice: For example, 27 is a perfect cube because it can be written as $3 \times 3 \times 3$. Perfect cubes include: 1, 8, 27, 64, 125, 216...

6. **Consecutive Numbers** are numbers that come one after the next in a sequence, like 3, 4, 5... etc. Can be written as x, $x+1$, $x+2$ … etc.
   - **Consecutive Odd** (3, 5, 7…) and **Consecutive Even** (4, 6, 8 …) can both be written as x, $x+2$, $x+4$ … etc.

7. **Evens and Odds**: Remember: Even + Even = Even, Even + Odd = Odd, Odd + Odd = Even. Even $\cdot$ Even = Even, Even $\cdot$ Odd = Even, Odd $\cdot$ Odd = Odd. If you forget the rules, test an example.

8. **Remainders:**
   - The remainder is the whole number left over after division. For example, $\frac{26}{10}$ is equal to 2 with a remainder of 6. Note that if you express the result as a mixed, unreduced fraction, (in this example, $2\frac{6}{10}$,) the numerator is always equal to the remainder.
   - Remainders are additive: if $\frac{a}{7}$ has remainder 3 and $\frac{b}{7}$ has remainder 2, then $\frac{a+b}{7}$ has remainder 5.
   - Remainders cannot be larger than the divisor. If $\frac{a}{4}$ has remainder 3 and $\frac{b}{4}$ has remainder 2, then $\frac{a+b}{4}$ has remainder 1, because there are 5 leftover, but 4 of the leftover form another "group".

9. **Rules of Fractions**.
   - The number on top is the *numerator* and on bottom is the *denominator*
   - Fractions can be <u>reduced</u> by dividing both the top and the bottom by the same number. For example, $\frac{6}{8} = \frac{3}{4}$. You can also multiply the top and bottom by the same number.
   - To multiply fractions, just multiply the numerators and denominators straight across. For example, $\frac{2}{3} \cdot \frac{5}{7} = \frac{2 \cdot 5}{3 \cdot 7} = \frac{10}{21}$.

- To divide fractions, flip the divisor and multiply. For example, $\frac{2}{3} \div \frac{5}{7} = \frac{2}{3} \cdot \frac{7}{5} = \frac{2 \cdot 7}{3 \cdot 5} = \frac{14}{15}$.
- To add or subtract fractions, you need a common denominator. $\frac{1}{2} + \frac{1}{3} = \frac{3}{6} + \frac{2}{6} = \frac{5}{6}$.
- Fractions that are less than one behave just the opposite of integers when exponents or roots are applied. The square of is $\frac{1}{16}$, less than $\frac{1}{4}$. The square root of $\frac{1}{4}$ is $\frac{1}{2}$, more than $\frac{1}{4}$.

10. **Ratios** look like fractions, but aren't. When written as a fraction, $\frac{2}{7}$ means "two out of seven." However, $\frac{2}{7}$ as a ratio means two parts to seven parts. Therefore, when you have a ratio of this to that is 2 to 7, it means there is a total of 9- or some multiple of 9.

11. **Proportions** are just two ratios set equal to one another. Be sure that you have the same units above and same units below the ratios before working the problem.

12. **Percentages**. Percent means "out of 100." You can write 13% as .13 or $\frac{13}{100}$. You can write k percent as $\frac{k}{100}$ or $.01k$. The word "of" ALWAYS means multiplication.

    - To calculate a **Percentage Change**, we can use the idea of a growth factor. The general rule is:

      $(\text{Original Value})(\text{Growth Factor}) = \text{New Value}$

      Note that the "growth factor" is determined by the percent change. For a percent increase, growth factor is greater than 1, and for a percent decrease, growth factor is less than 1. For example, to calculate what number must be increased by 30% to equal 260, we fill in these values: $(\text{Original Value})(1.30) = 260$ To calculate what 500 decreased by 30% is, we fill in these values: $(500)(0.70) = \text{New Value}$.

    - **Alternative Approach to Percent Change**:

      $$\text{Percent Change} = \frac{\text{New Value} - \text{Original Value}}{\text{Original Value}}$$

13. **Ratios, Fractions, Percentages: Identify the Whole**. The key to solving most story problems involving ratios, fractions, and percents is to identify the whole. Very frequently, the "whole" comes immediately after the word "of." For example, "one-half of the students are boys" indicates that the whole group in this problem are the students.

14. **Mean, Median, Mode & Range:**
    - **Mean**: Add the numbers up and divide by the amount. The mean is the same as the average.
    - **Median**: List lowest to highest, pick the one in the middle. If there are two, add those and divide by 2.

      If you are dealing with a histogram or frequency table, start by finding the total number of items in the set. Next, divide that number by 2.

      If the quotient is a non-integer value the middle term is equal to the quotient rounded to the nearest whole number. For example, if there are 13 items in a set $\frac{13}{2} = 6.5$, which means that the median term must be the 7^{th} term in the set.

      If the quotient is an integer, there are two terms in the middle, the quotient and the next consecutive integer term are the middle terms. For example, if there are 24 items in a set $\frac{24}{2} = 12$, which means that the 12^{th} and 13^{th} terms are the middle terms.
    - **Mode**: The one that occurs most often.
    - **Range**: The difference between the highest and the lowest values in a set.

15. **Probability**. The **probability** of an event happening at random if each possible event is equally likely is:

    $$\text{Probability} = \frac{\text{Number of Possible Successes}}{\text{Number of Possibilities}}$$

16. **Counting Possibilities**. If event 1 can happen a ways and event 2 can happen b ways, the two events can happen ab ways. Remember that they are sometimes dependent- if you are filling four actors for four roles, event a (filling the first role) can happen four ways and event b (filling the second) can happen three ways, since one of the actors is now ineligible.

17. **Sequences**. Look for sequences that repeat and group terms. When faced with arithmetic sequences (where the difference between consecutive terms is always the same), label that difference x and rewrite all of the other values in terms of x. For example, if the first term is 11, the second term must be $11 + x$, the third term must be $11 + 2x$ … etc.

18. **Arithmetic Sequence** can be defined as a sequence of numbers where the difference between consecutive terms is constant. For example, the sequence 6, 10, 14, 18, 22 … is an arithmetic sequence with a common difference of 4.

19. **Finding a specific term in an Arithmetic Sequence:** the formula you will need to remember is $a_1 + (n-1)d =$ the term you are looking for, where a_1 equals the first term, n equals the term you are looking for, and d equals the common difference.

20. **Summing an Arithmetic Sequence:** $(a_{first} + a_{last})\left(\frac{n}{2}\right)$ where a_{first} equals the relative first term in the sequence, a_{last} equals the relative last term in the sequence, and n equals the total number of terms in the sequence.

21. **Geometric Sequence** can be defined as a sequence of numbers where each term after the first is found by multiplying the previous one by a non-zero constant called the common ratio. For example, the sequence 4, 12, 36, 108, … is a geometric progression with common ratio 3. Similarly 20, 10, 5, 2.5, … is a geometric sequence with common ratio $\frac{1}{2}$.

Algebra I Concepts

22. **PEMDAS**. Parentheses, Exponents, Multiplication, Division, Addition, Subtraction, always left to right. Absolute value bars function like parentheses. Wrong answer choices very frequently involve PEMDAS mistakes, so always be aware.

23. **Inequalities:** Flip the inequality signs when multiplying or dividing the entire inequality by -1. Combine inequalities by testing all four pairs of endpoints.

24. **Nonlinear Inequalities:** Solve the inequality as an equation and plot the answers on a number line. Test one point from each segment to determine which portions of the number line are parts of your solution set.

25. **Systems of Equations**. Two ways to solve multiple equations and multiple variables: substitute, or stack and add/subtract. Substitute when you have an equation with an isolated variable and stack when you have coefficients that match in each equation.

    - **Infinite Solutions** occur when the two lines, represented graphically are identical. This means the lines have the same slope and same y-intercept.

    - **No Solutions** occur when the two lines, represented graphically, are parallel (see tip #45). This means the lines have the same slope but different y-intercept.

26. **Rules of Exponents**. You must ALWAYS have the same base before working with exponents.

    - $x^a \cdot x^b = x^{a+b}$
    - $\frac{x^a}{x^b} = x^{a-b}$
    - $(x^a)^b = x^{ab}$
    - $x^{-n} = \frac{1}{x^n}$
    - $x^{\frac{1}{2}} = \sqrt{x}$
    - $x^{\frac{m}{n}} = \sqrt[n]{x^m}$
    - $(xy)^n = x^n y^n$

27. **Square Root Simplification & Rules of Roots:**

    - $\sqrt{32} = \sqrt{16 \cdot 2} = 4\sqrt{2}$
    - $\sqrt{a}\sqrt{b} = \sqrt{ab}$
    - $\sqrt{a} + \sqrt{b} \neq \sqrt{a+b}$
    - $\frac{n}{\sqrt{2}} = \frac{n\sqrt{2}}{2}$

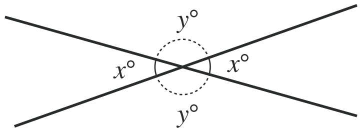
28. **Made-Up Functions**. When dealing with made-up functions, identify the guide given in the problem and simply plug-in. For example, if told that $x \triangledown y = xy + y^2$, then $3 \triangledown 5 = 5(3) + 5^2 = 15 + 25 = 40$.

Plane Geometry Concepts

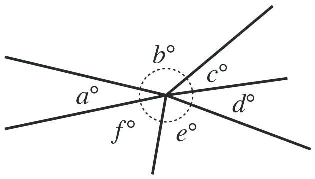
29. **Complementary Angles** are angles that sum to 90 degrees.

30. **Supplementary Angles** are angles that sum to 180 degrees.

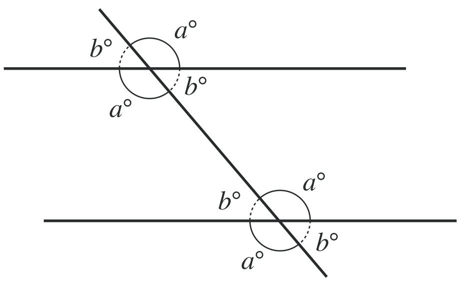
31. **Vertical Angles** occur when two lines intersect each other creating two pairs of congruent angles. For example, $x = x$, $y = y$, and $x + y = 180$.



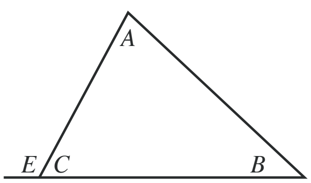
32. **Degrees Around a Single Point** will always sum to 360 degrees. For example, $a + b + c + d + e + f = 360$



33. **Parallel lines**. When parallel lines are crossed by anther line, you get two types of angles. All angles labeled a° are the same and all labeled b° are the same, and $a + b = 180$. When you see parallel lines on the test, ALWAYS extend them.

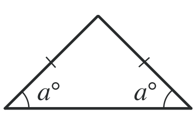


34. **Angles of a Triangle** will always sum to 180 degrees. The exterior angle of a triangle will always be equal to the sum of the two opposite interior angles.

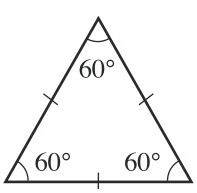


- $A + B + C = 180$
- $E + C = 180$
- $E = A + B$

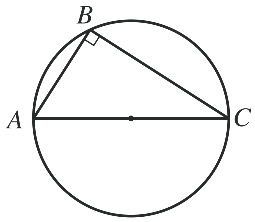
35. **Isosceles Triangles** are triangles that have two sides of equal length and the two angles opposite the equal sides are equal as well.



36. **Equilateral Triangle** is a triangle in which all three sides are equal and all angles are equal to 60 degrees.



37. **Any angle inscribed in a semi-circle is a right angle.**



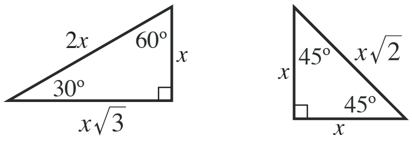
38. **Area, Circumference/Perimeter, Volume Formulas** are given to you on the SAT, but not on the ACT. Here are the ones that will (generally) be tested without being provided to you in the problem:

- **Area of a Circle**: $A = \pi r^2$
- **Area of a Sector** of a Circle with central angle measuring x°: $A = \frac{x}{360}\pi r^2$
- **Area of a Rectangle**: $A = lw$
- **Area of a Triangle**: $A = \frac{1}{2}bh$
- **Area of a Parallelogram**: $A = bh$
- **Area of a Trapezoid**: $A = \frac{1}{2}(b_1 + b_2)h$
- **Surface Area of a Box**: $A = 2lw + 2hl + 2hw$
- **Surface Area of a Cube**: $A = 6s^2$
- **Circumference of a Circle**: $C = 2\pi r$
- **Arc Length** of a sector of a circle with central angle measuring x°: arc length $= \frac{x}{360}2\pi r$
- **Perimeter of a Rectangle**: $P = 2(l + w)$
- **Volume of a Box**: $V = lwh$
- **Volume of a Cube**: $V = s^3$
- **Volume of a Right Circular Cylinder:** $V = \pi r^2 h$
- **Volume of a Sphere**: $V = \frac{4}{3}\pi r^3$
- **Volume of a Cone**: $V = \frac{1}{3}\pi r^2 h$
- **Volume of a Pyramid**: $V = \frac{1}{3}lwh$

39. **Pythagorean Theorem** states that the square of the hypotenuse is equal to the sum of the squares of the other two sides. It can be written as $a^2 + b^2 = c^2$ where c is the hypotenuse.

- **Pythagorean Triples and Multiples**: 3-4-5, 6-8-10, 9-12-15, 12-16-20. 5-12-13, 10-24-26, 7-24-25.

40. **Special Right Triangles**. Students should be familiar with the side lengths of 45-45-90 and 30-60-90 right triangles as displayed below. A tip off to when these concepts are being tested are if students see $\sqrt{2}$ or $\sqrt{3}$ in your answer choices.



41. **Triangle Side Lengths**. The lengths of any two sides of a triangle must sum to greater than the length of the third side.

Coordinate Geometry Concepts

42. **Midpoint Formula.** If you want to find the midpoint (x_m, y_m) where the endpoints are (x_1, y_1) and (x_2, y_2), then $x_m = \frac{x_1 + x_2}{2}$, and $y_m = \frac{y_1 + y_2}{2}$.

43. **Distance Formula**. To calculate the distance between (x_1, y_1) and (x_2, y_2), use the distance formula: $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$. Note that you can often also draw a right triangle and use the Pythagorean Theorem.

44. **Vectors** represent physical quantities that have both magnitude and direction. Let $\vec{u} = \langle u_1, u_2 \rangle$ and $\vec{v} = \langle v_1, v_2 \rangle$. The sum of $\vec{u}$ and $\vec{v}$ is the vector $\vec{u} + \vec{v} = \langle u_1 + v_1, u_2 + v_2 \rangle$ and the difference of $\vec{u}$ and $\vec{v}$ is the vector $\vec{u} - \vec{v} = \langle u_1 - v_1, u_2 - v_2 \rangle$.

45. **Norm (or Magnitude).** The norm or magnitude of a vector is the distance from zero. The norm can be calculated using $|\langle u, v \rangle| = \sqrt{(u^2 + v^2)}$, for example, the norm of $\langle -3, -4 \rangle = \sqrt{(-3)^2 + (-4)^2} = \sqrt{9 + 16} = \sqrt{25} = 5$.

46. **Slope and Slope-Intercept Form.**
    - When you are given a linear function or graph, often the test will refer to slope-intercept form. Slope-intercept form is when the equation of a line is expressed as $y = mx + b$, where m is the slope and b is the y-intercept (the value at which the line crosses the y-axis). You can then plug in coordinate pairs (x, y).
    - You can calculate the slope by the formula $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta y}{\Delta x} = \frac{\text{Rise}}{\text{Run}}$
    - Finally, it is important to know that two **parallel lines** have the same slope and never intersect, while two **perpendicular lines** have slopes that are the negative reciprocals of one another.

47. **Functions.** When we see function notation such as $f(x) = 2x + 7$, we are simply giving the function a name (f) so that we can refer to it, and indicating that the output of the function is dependent on the variable x.

    When we're told that $f(x) = y$, that simply means that (x, y) lies on the graph of $f(x)$. When we're asked for $f(3)$, plug in (3) for x to the initial equation and simplify. DON'T forget to substitute the parentheses.

48. **General Form of a Parabola + Shifts**. The general form of a parabola is $y = a(x - h)^2 + k$, where (h, k) is the vertex of the parabola. If $a > 0$, the vertex is the lowest point on the parabola it opens upward. If $a < 0$, the vertex is the highest point on the parabola and it opens downward.
    - When k is positive you must shift the graph up that many units. If k is negative (subtraction), shift down.
    - When h is positive the parabola must shift right that many units. If h is negative (addition inside the parentheses), the parabola shifts left.
    - When a is greater than one the parabola becomes skinnier. If a is a number between zero and one, it becomes wider.
    - Finally, remember that if a is negative, the graph is flipped upside down.
    - These shifts also apply generally to absolute value functions, for example, $f(x) = a|x - h| + k$.

49. **General Form of a Circle**: The general form of a circle is $(x - h)^2 + (y - k)^2 = r^2$, where (h, k) is the center of the circle, and r is the radius of the circle.
    - If presented a circle in the form $ax^2 + bx + cy^2 + dy = e$ you will have to factor by completing the square twice. Once with the x terms and again with the y terms.

50. **General Form of an Ellipse:** The general form of an ellipse is $\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1$, where (h, k) is the center of the ellipse and a and b are the **semi-major and semi-minor axes**, you can think of these values as the radii of the x and y-axes respectively.
    - To find the **foci** of the ellipse use the formula $c^2 = a^2 - b^2$ to solve for c. The foci are located c units away from the center in either direction.

Algebra II Concepts

51. **Absolute Value:** When $|x|$ is set equal to something else, remove the absolute value sign and set the other side equal to its current value OR the current value's additive inverse.

- Example 1: $|x| = 4 \Rightarrow x = -4, 4$
- Example 2: $|-x| = 8 \Rightarrow x = -8, 8$

This applies basically the same way if something besides x is inside the absolute value. You'll just have to do a step or two afterwards.

- Example 3: $|4x - 2| = 6 \Rightarrow 4x - 2 = 6$ OR $4x - 2 = -6 \Rightarrow x = -1, 2$.

However, if you have stuff OUTSIDE the absolute value sign on the same side, you need to isolate the absolute value before proceeding.

- Example. 4: $2|x+2| + 1 = 9 \Rightarrow 2|x+2| = 8 \Rightarrow |x+2| = 4 \Rightarrow x + 2 = 4$ OR $x + 2 = -4 \Rightarrow x = -6, 2$.

52. **Absolute Value Inequalities:** You can identify a conjunction by a less than $(<)$ sign: conjunctions are AND statements.

- Example 5: $2|x+3| \le 10 \Rightarrow |x+3| \le 5 \Rightarrow -5 \le x + 3 \le 5 \Rightarrow -8 \le x \le 2$

You can identify a disjunction by a greater sign $(>)$: disjunctions are OR statements.

- Example 6: $2|x+3| \ge 10 \Rightarrow |x+3| \ge 5 \Rightarrow x + 3 \ge 5$ OR $x + 3 \le -5 \Rightarrow x \ge 2$ OR $x \le -8$

53. **Direct and Inverse Proportions**. Remember, if x is directly proportional to y, then $y = kx$ where k is a constant. If y is INVERSELY proportionate to x, then $y = \frac{k}{x}$ where k is a constant. Sometimes you'll run into y is directly or inversely proportional to x^2. Then $y = kx^2$ or $y = \frac{k}{x^2}$.

54. **Factoring, FOIL and the Quadratic Identities:**
- $(x+y)^2 = x^2 + 2xy + y^2$ • $(x-y)^2 = x^2 - 2xy + y^2$ • $(x+y)(x-y) = x^2 - y^2$

55. **Quadratics and Factoring when $a \neq 1$.** To factor a quadratic in the form $ax^2 + bx + c = 0$, find two numbers whose product is ac and sum is b, and use that to fill in the gaps. For example:

- $2x^2 - 17x + 30 \Rightarrow$ What're two numbers that multiply to 60 and add to -17? (Answer: -5 and -12) $\Rightarrow$ $2x^2 - 12x - 5x + 30 \Rightarrow 2x(x-6) - 5(x-6) \Rightarrow$ so the factors are $(2x-5)(x-6)$.

56. **Quadratics and the Discriminant.** The discriminant of a quadratic in the form $ax^2 + bx + c = 0$ is defined as $b^2 - 4ac$.

- If the discriminant is **positive**, the quadratic has **two distinct roots**.
- If the discriminant is **negative**, the quadratic has **two imaginary roots**.
- If the discriminant is **zero**, the quadratic has **one double real root**.

57. **Quadratic Formula, Sum/Product of Roots.** The roots of a quadratic of the form $ax^2 + bx + c = 0$ are $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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- The **sum of roots** of this quadratic is $-\frac{b}{a}$.
- The **product of roots** of this quadratic is $\frac{c}{a}$.

58. **Imaginary Numbers**: When you see i, it means $\sqrt{-1}$. Don't be intimidated! Treat it like any other variable, but always remember:

- $i^2 = \sqrt{-1} \cdot \sqrt{-1} = -1$ • $i^3 = i^2 \cdot i = -1 \cdot i = -i$ • $i^4 = i^2 \cdot i^2 = -1 \cdot -1 = 1$ • … and so on.

59. **Logarithms**: Remember the facts about logs and you will be good to go:

- $\log_a b = c$ means $a^c = b$.
- $\log$ without a base is automatically base 10, i.e. $\log 100 = 2$
- Natural log $(\ln)$ has a base of *e*.
- $\log_a b + log_a c = \log_a bc$ $\log_a b - \log_a c = \log_a \frac{b}{c}$ $\log_a b^n = n \log_a b$

60. **Matrices**:

- When **adding matrices**, add each respective term (ie, adding the second row and third column of matrix A with the second and third column of matrix B will give the second row and third column of AB. For example:
- $\begin{bmatrix} 1 & 3 & 2 \\ 3 & 0 & 4 \end{bmatrix} + \begin{bmatrix} 0 & 1 & 1 \\ 6 & 9 & 2 \end{bmatrix} = \begin{bmatrix} 1+0 & 3+1 & 2+1 \\ 3+6 & 0+9 & 4+2 \end{bmatrix} = \begin{bmatrix} 1 & 4 & 3 \\ 9 & 9 & 6 \end{bmatrix}$
- When **multiplying matrices**, multiply the elements of each row of the first matrix by the elements of each column in the second matrix, and then add the products (ie, multiplying each term in the second row of matrix A with its respective term in the third column of matrix B and then adding these values will give the second row and third column of matrix AB).
- **Scalar Multiplication:** $2\begin{bmatrix} 1 & 3 & 2 \\ 3 & 0 & 4 \end{bmatrix} = \begin{bmatrix} 2\times 1 & 2\times 3 & 2\times 2 \\ 2\times 3 & 2\times 0 & 2\times 4 \end{bmatrix} = \begin{bmatrix} 2 & 6 & 4 \\ 6 & 0 & 8 \end{bmatrix}$
- **Matrix $\times$ Matrix ('Dot Product'):** $\begin{bmatrix} 1 & 2 & 5 \\ 3 & 0 & 4 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 5 & 6 \\ 8 & 2 \end{bmatrix} = \begin{bmatrix} (1\cdot 0)+(2\cdot 5)+(5\cdot 8) & (1\cdot 1)+(2\cdot 6)+(5\cdot 2) \\ (3\cdot 0)+(0\cdot 5)+(4\cdot 8) & (3\cdot 1)+(0\cdot 6)+(4\cdot 2) \end{bmatrix} = \begin{bmatrix} 50 & 23 \\ 32 & 11 \end{bmatrix}$
- **Determinant of a 2×2 Matrix:** $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$

61. **Trigonometry**:

- You should remember SOH CAH TOA: Sine = $\frac{\text{Opp}}{\text{Hyp}}$, Cosine = $\frac{\text{Adj}}{\text{Hyp}}$, Tangent = $\frac{\text{Opp}}{\text{Adj}}$.
- You should also know that Sine = $\frac{1}{\text{cosecant}}$, Cosine = $\frac{1}{\text{secant}}$, Tangent = $\frac{1}{\text{cotangent}}$.
- You should be familiar with the mnemonic "**A**ll **S**tudents **T**ake **C**alculus" that tells you where each of the three major trigonometric functions is positive - **A**ll in the 1st quadrant,**S**ine in the 2nd, **T**angent in the 3rd, and **C**osine in the 4th
- Finally, you should be relatively familiar with the unit circle below. If you draw a right triangle such that one side is along the x-axis and the hypotenuse forms the angle whose trig value you are looking to calculate, the x value of the point on the circle (in the figure below, A) will be the value of Cosine and the y-value will be the value of sine.