

MATH TEST KEY POINTS

TEST 2

P The Key Points section reviews many of the concepts you will encounter on the SAT Math Practice Tests. Each Key Point corresponds to one or more test questions. Key Points with a **nc** next to them correspond to "no calculator" questions, while Key Points with a **c** next to them correspond to "calculator" questions. The numbers next to the **nc** and **c** labels tell you which question each Key Point relates to.

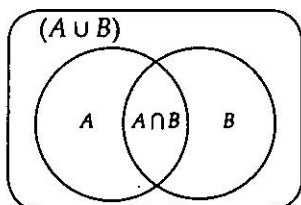
1. Systems of Equations (c23)

A system of equations is a set of two or more equations with the same variables. Some systems will have either no solutions or infinite solutions.

- **Solution:** When there are the same number of equations as there are variables. ☆
- **No solution:** When two equations contradict each other.
- **Infinite solutions:** When two equations are equivalent to each other.

2. Union of Two Sets (nc5)

The union of two sets A and B is the set of elements which are in A , in B , or in both A and B . In symbols, $A \cup B = \{x : x \in A \text{ or } x \in B\}$.



Remember ✱

$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

* n denotes the number of elements

To find the union of two sets, add the number of elements in A and B , then subtract the duplicates in $A \cap B$.

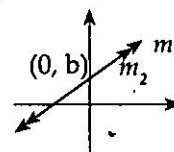
3. Parallel and Perpendicular Lines(c23)

- Two lines are parallel if their slopes, m , are identical. $\longleftrightarrow$
- Two lines are perpendicular if their slopes, m_1 and m_2 are negative reciprocals.

TIP :

$$m_1 \cdot m_2 = -1$$

$$\text{so, } m_1 = -\frac{1}{m_2}$$



- Two lines are identical if their slopes, m_1 and m_2 and the y -intercepts, b_1 and b_2 are identical.

4. Complex Numbers (c8, c30)

The symbol $\sqrt{\quad}$ is called a **radical** and is used to indicate a square root. A number or expression under a radical is referred to as a **radicand**.

Radical $\rightarrow \sqrt{\quad} \leftarrow$ Radicand

- For any real number a , $\sqrt{a^2} = |a|$ ☆
- Using similar logic, the square root of any negative number can be defined as follows: For any real number a ,

$$\sqrt{a^2} = |a| i \text{ where } i^2 = -1.$$

A **complex number** is any number of the form $a + bi$, where a and b are real numbers, $b \neq 0$ and i is the imaginary unit.

5. Operations with Exponents (c3,c9,c19)

The operations of exponents are summarized below. Assume all bases and denominators are nonzero.

$(a^m)(a^n) = a^{m+n}$	$(a^m)^n = a^{m \cdot n}$
$(ab)^n = a^n b^n$	$\left(\frac{a}{b}\right)^0 = \frac{a^0}{b^0} = 1$
$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	$\left(\frac{a}{b}\right)^{-n} = \frac{a^{-n}}{b^{-n}} = \frac{b^n}{a^n}$
$\frac{a^m}{a^n} = a^{m-n}$	$a^{\frac{m}{n}} = \sqrt[n]{a^m} = \left(\sqrt[n]{a}\right)^m$

6. Exponential Function (c36, c38)

An exponential function is a function of the form $f(x) = b^x$ in which the input variable x occurs as an exponent. A function of the form $f(x) = a \cdot b^x$ is also considered an exponential function.

To solve, simply take the **log** or the **natural log** of the exponential function to bring the exponents down.

Note)

$$\ln e^x = x \cdot \ln e = x$$

$$\log 2^x = x \cdot \log 2$$

7. Factoring Quadratics (c14)

A quadratic trinomial of the form $ax^2 + bx + c$ for which $a \neq 1$ can be factored in the following way:

If $ax^2 + bx + c = pqx^2 + (ps + qr)x + rs$, where $a = pq$, $b = ps + qr$ and $c = rs$, then, the factored form is $(px + r)(qx + s)$.

Quadratics can be solved by factoring or using the quadratic equation:

Remember ✱:

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

8. Factorization of Cubes

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

$$(a - b)^3 = a^3 - 3a^2b + 3ab^2 + b^3 \quad \text{*one minus sign}$$

$$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3 \quad \text{*signs are all plus}$$

9. Defining a Function (nc6)

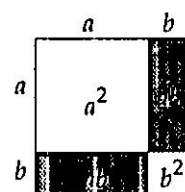
- A **function** is a set of ordered pairs with a consistent relation between the two values of each pair. Often times, a function is denoted as $y = f(x)$.
- The **domain** of a function is the set of all the first coordinates of the ordered pairs. The domain of $y = f(x)$ is the set of x-coordinates on the graph of the function.
- The **range** of a function is the set of all the second coordinates of the ordered pairs. The range of $y = f(x)$ is the set of y-coordinates on the graph of the function. ★

10. Factorization of Squares

$$a^2 - b^2 = (a + b)(a - b)$$

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$



11. Rates (c20)

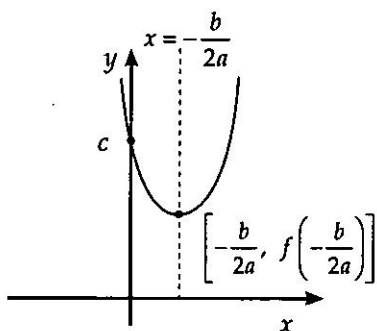
Rates are a measure of the change in some quantity per unit time. A commonly seen rate is average speed. It is calculated using the formula:

Remember ✱:

$$\text{Average Speed} = \frac{\text{total distance}}{\text{total time}}$$

12. Graphing a Quadratic Function (nc16)

The graph of a quadratic function is a parabola. It is either the standard form or the vertex form of the equation:



- **Standard Form:** $y = ax^2 + bx + c$

The vertex is $\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$

The axis of symmetry is $x = -\frac{b}{2a}$

The y-intercept is $(0, c)$

The x-intercepts are $\left(\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}, 0\right)$

- **Vertex Form:** $y = a(x - h)^2 + k$

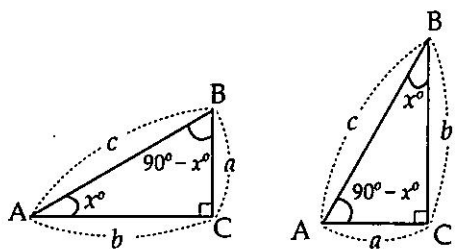
The vertex is (h, k)

If the x-intercepts are $(p, 0)$ and $(q, 0)$, then

$$h = \frac{p + q}{2}$$

13. Trigonometric Relations (c15)

The sine and cosine of complementary angles in a right triangle are equal.



$$\sin x^\circ = \cos(90^\circ - x^\circ) = \frac{a}{c}$$

$$\cos x^\circ = \sin(90^\circ - x^\circ) = \frac{b}{c}$$

Given an angle in radians, we have the following results:

$$\begin{aligned}\sin \theta &= \sin(\pi - \theta), \\ \cos \theta &= -\cos(\pi - \theta)\end{aligned}$$

14. Absolute Value of a Function (c18)

The graph of $y = |f(x)|$ consists of two parts:

$$y = \begin{cases} f(x) & \text{if } f(x) \geq 0 \\ -f(x) & \text{if } f(x) < 0 \end{cases}$$

If $a \leq f(x) \leq b$, it follows that

$$|a| \leq |y| \leq |b| \text{ if } |a| \leq |b|$$

$$|b| \leq |y| \leq |a| \text{ if } |b| \leq |a|$$

15. Circles (c20, c28, c34)

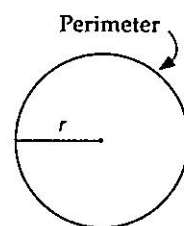
Let r be the radius of the circle.

$$\pi \approx 3.14$$

$$\text{Diameter} = 2r$$

$$\text{Area of circle } S = \pi r^2$$

$$\text{Circumference of circle } C = 2\pi r$$



Remember:

$$\text{Equation of circle: } (x - h)^2 + (y - k)^2 = r^2$$

* where (h, k) is the coordinate of the center and r is the radius.

16. Measure of Center and Spread (c11)

- **Mean:** The mean of a set of a data (commonly called the "average") is the sum of the numbers in the set divided by the number of members of the set. If n numbers are given, each number denoted by a_i (where $i = 1, 2, \dots, n$), the arithmetic mean is given as following.

$$\text{Mean} = \frac{1}{n} \sum_{i=1}^n a_i = \frac{1}{n} (a_1 + a_2 + \dots + a_n)$$

- **Median:** The median of a data set is the *middle value* when the set is arranged in order of increasing value. If there are an even number of values in the set, the median is the average of the two middle values.
- **Mode:** The mode is the *most occurring number* in the set.
- **Range:** The range is the *difference between the greatest and least values* of the set.

17. Arcs, Sectors, and Central Angles (nc12)

If r is the radius of sector A (shown below), s is the arc length of the sector, and θ is the measurement of the central angle in radians, then the area of a sector A is given as follows:

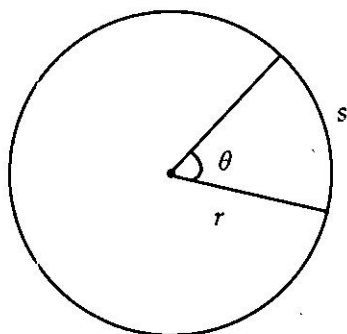
$$A = \frac{1}{2}rs$$

If r and θ are given, and if θ is in degrees, then the area of a sector A is given as follows:

$$A = \frac{1}{2}r^2\theta$$

$$A = \frac{1}{2}r^2\theta \cdot \left(\frac{\pi}{180}\right)$$

$$A = \frac{\theta}{360}\pi r^2$$



18. Percentages (c33)

Percentages are a way of representing parts of a whole in terms of hundredths. For example, 85% is equivalent to $\frac{85}{100}$, and 0.85. A **percentage change** is calculated as follows:

Remember ✱:

$$\text{Percent Change} = \frac{\text{amount of change}}{\text{original amount}} \times 100\%$$

Percent Error is a special case of the percentage form of relative change calculated from the absolute change between the experimental (measured) and theoretical (accepted) values, and dividing by the theoretical (accepted) value, so:

$$\text{Percent Error} = \frac{\text{Experimental Value} - \text{Theoretical Value}}{\text{Theoretical Value}}$$

or

$$\text{Percent Error} = \frac{|\text{Approximate Value} - \text{Exact Value}|}{|\text{Exact Value}|}$$

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