

MATH TEST KEY POINTS

TEST 4

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. Slope of a Straight Line (c19)

The slope of a non-vertical line that contains points $A(x_1, y_1)$ and $B(x_2, y_2)$ is given by the formula:

Remember ✱:

$$\text{Slope}(m) = \frac{\text{Change in } y}{\text{Change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$$

- Slope-Intercept Form: $y = mx + b$. A line in this form has slope m and includes y -intercept b (the point $(0, b)$).

2. Operations with Exponents (c33)

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

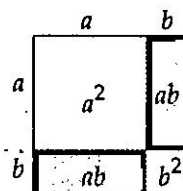
$(a^m)(a^n) = a^{m+n}$	$(a^m)^n = a^{m \cdot n}$
$(ab)^n = a^n b^n$	$\left(\frac{a}{b}\right)^0 = \frac{a^0}{b^0} = 1$
$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	$\left(\frac{a}{b}\right)^{-n} = \frac{a^{-n}}{b^{-n}} = \frac{b^n}{a^n}$
$\frac{a^m}{a^n} = a^{m-n}$	$a^{\frac{m}{n}} = \sqrt[n]{a^m}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

3. Factorization of Squares (nc4)

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

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

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



4. Factored Form of a Polynomial (c9)

$$a^3 - a^2b - ab^2 + b^3$$

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

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

5. Properties of Square Roots (nc8)

A number b is called the square root of a positive real number, a , if the equation $b^2 = a$ holds true.

A square root is also denoted by an exponent of value $\frac{1}{2}$, that is, $a^{\frac{1}{2}} = \sqrt{a}$.

Remember ✱:

- Product Property of Square Roots:** For any numbers a and b , where $a \geq 0$ and $b \geq 0$,

$$\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$$
- Quotient Property of Square Roots:** For any numbers a and b , where $a \geq 0$ and $b > 0$,

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

6. 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 $(px + r)(qx + s)$.

7. Defining a Function (c2, c23)

- 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.

8. Roots of a Quadratic Function

Let r and β be the two roots of a quadratic function $f(x) = ax^2 + bx + c$, ($a \neq 0$). Then, $f(x)$ can be represented as follows:

$$\begin{aligned} f(x) &= a(x - r)(x - \beta) \\ &= a\{x^2 - (r + \beta)x + r\beta\} \\ &= ax^2 - a(r + \beta)x + ar\beta \end{aligned}$$

Therefore, it follows that $r + \beta = -\frac{b}{a}$, $r\beta = \frac{c}{a}$.

Note that the roots of the quadratic function

$f(x)$ have the following form: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

If $b^2 - 4ac \geq 0$, then the function has real number solutions.

9. Shift of a Function (c16)

When the function $y = f(x)$ is given, the following function shifts the original function to the right a units and upward b units.

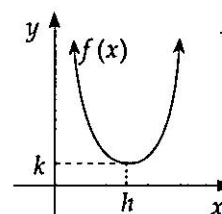
$$y - b = f(x - a) \rightarrow y = f(x - a) + b \quad \star$$

The following function shifts the original function to the left a units and downward b units.

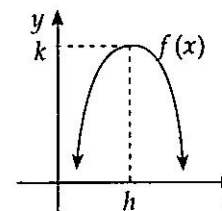
$$y + b = f(x + a) \rightarrow y = f(x + a) - b \quad \star$$

10. Interpreting a Quadratic Function (nc20)

The graph of a quadratic function $y = a(x - h)^2 + k$ has its minimum value k at the vertex (h, k) if $a > 0$ (the parabola opens upward).



$y = a(x - h)^2 + k$ has its maximum value k at the vertex (h, k) if $a < 0$ (the parabola opens downward).



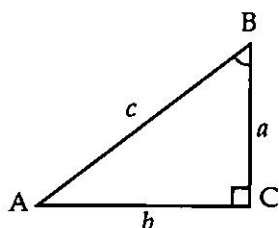
11. Absolute Value of a Function (nc20)

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

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

12. Pythagorean Theorem (nc19)

If a , b , and c are the sides of the right triangle and a and b are adjacent to the right angle, then the following equation holds:



$$c^2 = a^2 + b^2$$

14. Circles (nc13)

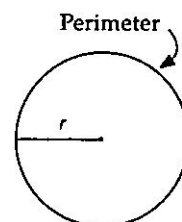
Let r be the radius of the circle.

$$\pi \approx 3.14$$

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

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

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



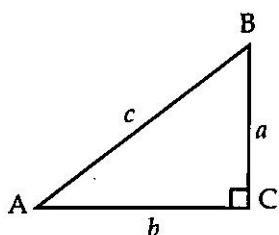
Remember ✱:

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

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

13. Trigonometric Ratios

Trigonometric ratios are the ratios between the lengths of the sides of a right triangle.



Trigonometric Ratio	Definition
Sin A	$\frac{\text{leg opposite } \angle A}{\text{hypotenuse}} = \frac{a}{c}$
Cos A	$\frac{\text{leg adjacent } \angle A}{\text{hypotenuse}} = \frac{b}{c}$
Tan A	$\frac{\text{leg opposite } \angle A}{\text{leg adjacent } \angle A} = \frac{a}{b}$

Based on the ratios given above, we can also conclude that the following holds true:

$$\tan(A) = \frac{\sin(A)}{\cos(A)}$$

15. Concentration (c31)

The concentration of a substance can be defined as the amount of one substance divided by the total amount of a mixture. This is expressed in the following formula:

Remember ✱:

$$\text{Concentration of } A = \frac{\text{Amount of Substance } A}{\text{Amount of Mixture}}$$

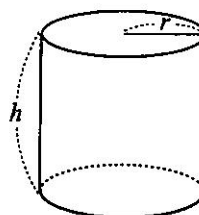
A mixture is always greater than or equal to the quantity of Substance A.

16. Cylinders (nc13)

Let r be the radius of the circular base of the cylinder and h be the cylinder's height. Note that the top circle and bottom circle are the same size.

$$\text{Volume of Cylinder } (V) = (\text{Area of bottom circle}) \times \text{height.}$$

$$\text{That is, } V = \pi r^2 h$$



17. Work Problems (c15)

Work problems deal with the rate of work.

$$\text{rate of work} = \frac{\text{amount of work completed}}{\text{time worked}}$$

Assume workers A, B, and C can finish the same job in x , y , and z hours, respectively, when working alone. Workers A, B, C can complete $\frac{1}{x}$, $\frac{1}{y}$, $\frac{1}{z}$ of the job per hour, respectively. If they work together, their rate of work is $\frac{1}{x} + \frac{1}{y} + \frac{1}{z}$. The number of hours they need to complete the job together is given by the following formula:

Remember *:

$$\frac{1}{\frac{1}{x} + \frac{1}{y} + \frac{1}{z}} = \frac{1}{\frac{yz + xz + xy}{xyz}} = \frac{xyz}{xy + yz + xz}$$

18. Rates (nc6, c29)

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 *:

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

19. Percentages (c37)

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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