

MATH TEST KEY POINTS

TEST 3

 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.

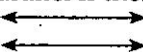
1. Equation of a Line (nc3, nc11)

There are several ways to write the equation of a linear function.

Remember ✱:

- **Point-Slope Form:** $y - y_1 = m(x - x_1)$. A line in this form has slope m and includes the point (x_1, y_1)
- **Slope-Intercept Form:** $y = mx + b$. A line in this form has slope m and includes y -intercept b (the point $(0, b)$).
- **Standard Form:** $Ax + By = c$.
- **Intercept Form:** $\frac{x}{a} + \frac{y}{b} = 1$. A line in this form has x -intercept a and y -intercept b .

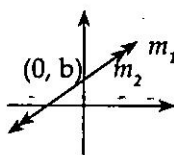
2. Parallel and Perpendicular Lines(c27)

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

$$m_1 \cdot m_2 = -1$$

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

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



3. Quadratic Formula (c13)

For the binomial function $f(x) = ax^2 + bx + c$, the roots of $f(x) = 0$ are as follows:

Remember ✱:

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

Let $D = b^2 - 4ac$, then the following holds:

- If $D > 0$, there exist two real number roots.
- If $D = 0$, there exists one real number root.
- If $D < 0$, there does not exist a real number root.

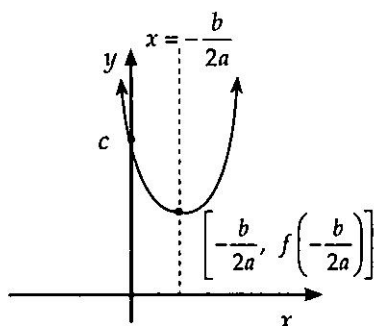
4. Operations with Exponents (nc4, nc7, c10)

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

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

5. Graphing a Quadratic Function (nc13, c5)

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

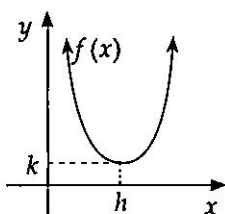
The vertex is (h, k) .

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

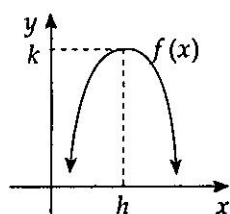
$$h = \frac{p + q}{2}$$

6. Min/Max of Quadratic Function (c34)

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).



7. Exponential Functions (c6, c23)

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)

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

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

8. Absolute Value of a Function (c22)

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

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

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

$$-b \leq f(x) \leq -a, \text{ or } a \leq f(x) \leq b, \text{ if } a > 0$$

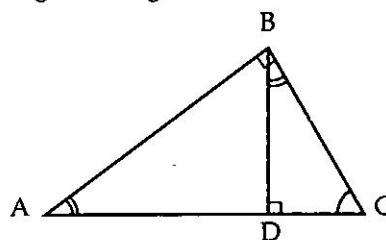
$$-b \leq f(x) \leq b \text{ if } a = 0$$

9. Factors of a Polynomial Function

Let $f(x)$ be a polynomial function. If the function has a factor $x - a$, then $f(a) = 0$.

10. Triangle Theorem (c27)

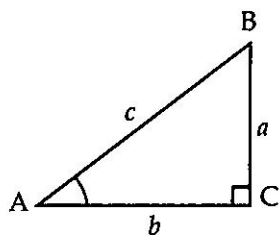
The altitude of right triangle drawn from the right angle creates three similar triangles. This is due to the fact that each of the two resultant smaller triangles shares a common acute angle with the largest triangle.



$$\triangle ABC \sim \triangle ADB \sim \triangle BDC$$

11. Trigonometric Ratios (c27)

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



Trigonometric Ratio	Definition
$\sin A$	$\frac{\text{leg opposite } \angle A}{\text{hypotenuse}} = \frac{a}{c}$
$\cos A$	$\frac{\text{leg adjacent } \angle A}{\text{hypotenuse}} = \frac{b}{c}$
$\tan A$	$\frac{\text{leg opposite } \angle A}{\text{leg adjacent } \angle A} = \frac{a}{b}$

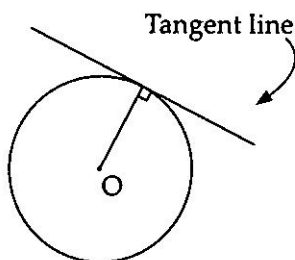
Based on the ratios given above, we can also conclude that the following holds true:

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

$$\sin(A) = \sin\left(\frac{\pi}{2} - B\right) = \cos(B)$$

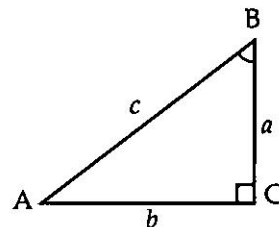
12. A Tangent to a Circle (c27)

A tangent to a circle is a straight line which touches the circle at only one point. A tangent to a circle forms a right angle with the circle's radius at the point of contact with the tangent.



13. Pythagorean Theorem (c29)

If a , b , 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. Measure of Center

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.

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

15. Work Problems (nc8, nc19)

Work problems deal with the rate of work.

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

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

Remember ✱:

$$\frac{1}{\frac{1}{x} + \frac{1}{y}} = \frac{1}{\frac{x+y}{xy}} = \frac{xy}{x+y}$$

16. Percentages (c18)

Percentages are a way of representing parts of a whole in terms of hundredths. For example, 85% is equivalent to $\frac{85}{100}$ and to 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

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

17. Concentration (nc9,c24)

Remember ✱:

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

Mixture is always in greater than or equal to quantity of Substance A.

18. Circles (nc10,c27)

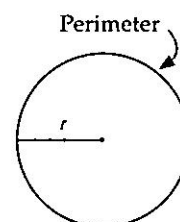
Let r be the radius of the circle.

$$\pi \approx 3.14$$

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

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

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



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.

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