

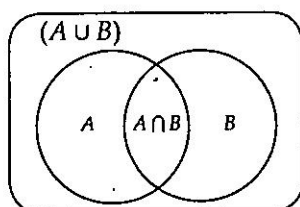
MATH TEST KEY POINTS

TEST 6

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. Union of Two Sets (nc9)

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 $A \cap B$.

2. Operations with Exponents (nc17, c20)

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

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

3. Defining a Function (nc14)

- A **function** is a set of ordered pairs (x, y) 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.

4. The Quadratic Formula

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

Remember *

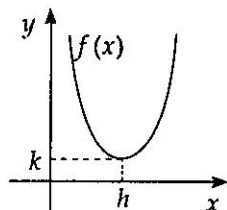
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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

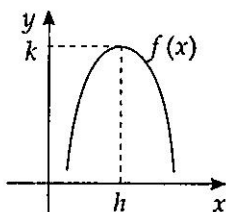
- If $D > 0$, there exist two real number roots.
- If $D = 0$, there exists one real number root.
- If $D < 0$, there does not exist a real number root.

5. Interpreting a Quadratic Function (nc12)

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).



6. Measure of Center and Spread (c34)

- **Mean:** The mean of a set of data (also called the "average") is the sum of the numbers in the set divided by the number of members of the set.
- **Median:** The median of a data set is the *middle value* when the set is arranged in order of increasing value. If there are even numbers 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.

7. Translation of a Function (c27)

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

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

The following function reflects over the x -axis. $\star$

$$y = -f(x)$$

The following function reflects over the y -axis. $\star$

$$y = f(-x)$$

8. Circles (nc7)

Let r be the radius of the circle.

$$\pi \approx 3.14$$

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

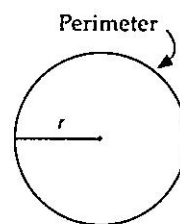
$$\text{Area of circle } A = \pi r^2$$

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

Remember $\odot$:

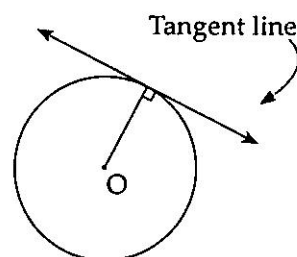
$$\text{Equation of circle: } (x - h)^2 + (y - k)^2 = r^2$$

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



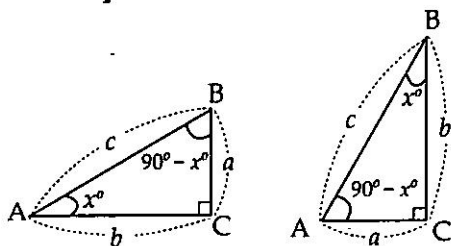
9. A Tangent to a Circle (c36)

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.



10. Trigonometric Relations (c29)

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



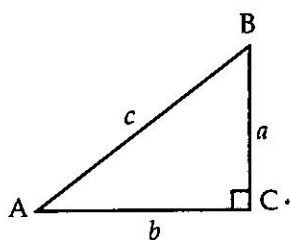
$$\sin x^\circ = \cos(90^\circ - x^\circ) = \frac{a}{c} \quad \cos x^\circ = \sin(90^\circ - x^\circ) = \frac{b}{c}$$

Given an angle in radian, we have the following results.

$$\sin \theta = \sin(\pi - \theta), \quad \cos \theta = -\cos(\pi - \theta)$$

11. Trigonometric Ratios (c29)

Trigonometric ratios are the ratios between the lengths of the sides in 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:

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

12. Arcs, Sectors, and Central Angles (c30)

If r is the radius of sector A , 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:

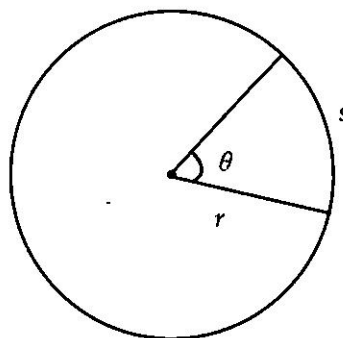
$$A = \frac{1}{2}rs$$

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

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

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

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



13. Complex Number (nc13)

Memorize the following values for the imaginary unit i :

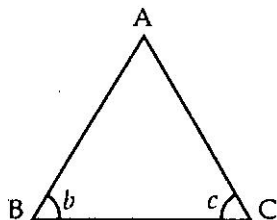
- $i = \sqrt{-1}$
- $i^2 = -1$
- $i^4 = 1$

Remember *

$$\begin{aligned} \frac{1}{a+bi} &= \frac{1 \cdot (a-bi)}{(a+bi)(a-bi)} \\ &= \frac{a-bi}{a^2 - (bi)^2} \\ &= \frac{a-bi}{a^2 + b^2} \end{aligned}$$

14. Isosceles Triangles (c28)

If two angles b, c of a triangle are the same, then the length of two sides, $\overline{AB}$ and $\overline{AC}$, of the triangle are the same.



$$\overline{AB} = \overline{AC} \Leftrightarrow b = c$$

15. Exponential Function (nc10, 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 (ln)** of the exponential function to bring the exponents down.

Note)

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

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

Understanding these logarithmic relationships will save time and effort:

- when $y = a(b^x) \rightarrow b^x = \frac{y}{a} \rightarrow$

$$x = \log_b \left(\frac{y}{a} \right) \rightarrow \frac{\log \left(\frac{y}{a} \right)}{\log(b)}$$

- $\log(10^x) = x$

- $\log_b(x) = \frac{\log(x)}{\log(b)}$

- $\log(a(b)) = \log(a) + \log(b)$

- $\log \left(\frac{a}{b} \right) = \log(a) - \log(b)$

- $\log(a^b) = b(\log(a))$

16. Percentages (c35)

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:

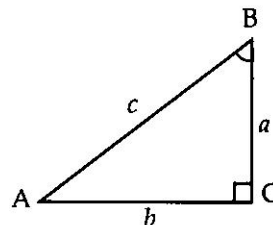
$$\text{Percent Error} = \frac{\text{Experimental Value} - \text{Theoretical Value}}{\text{Theoretical Value}}$$

or

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

The **percentage difference** is the difference between two values divided by the average of the two values, expressed as a percentage.

17. Pythagorean theorem (c33, c36)



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:

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

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