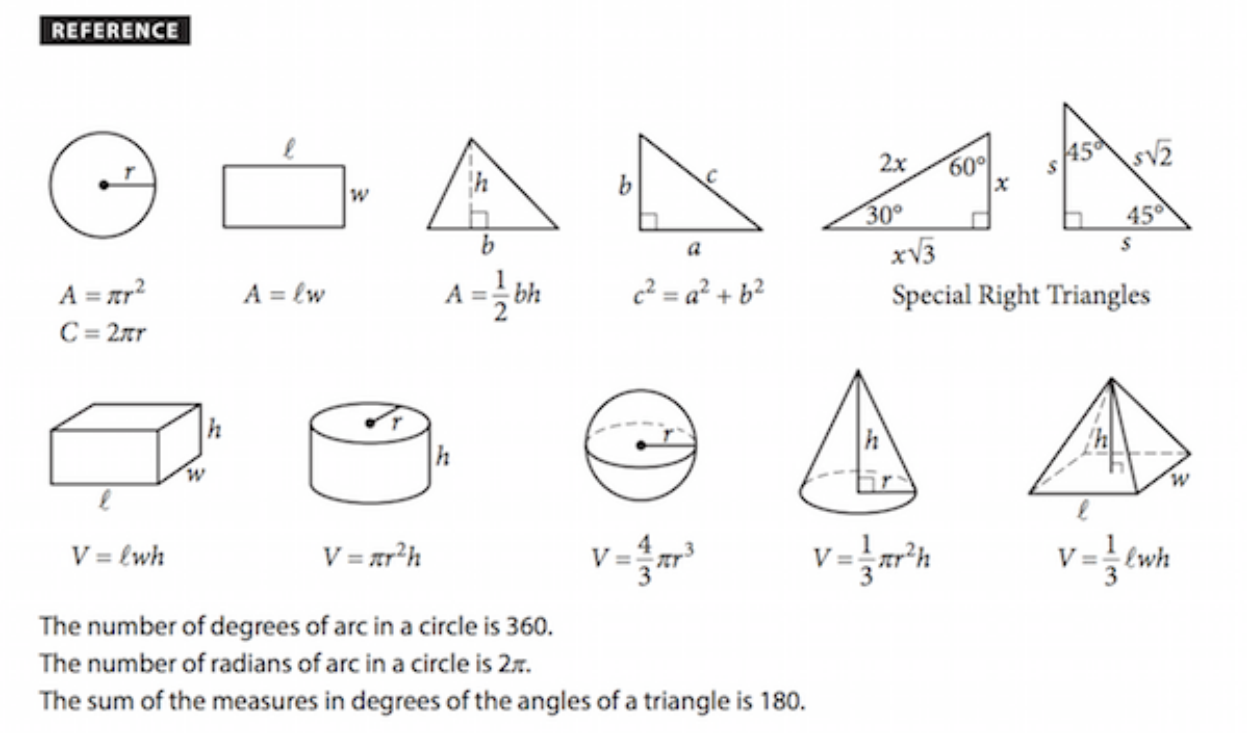
Formulas Given on the SAT, Explained



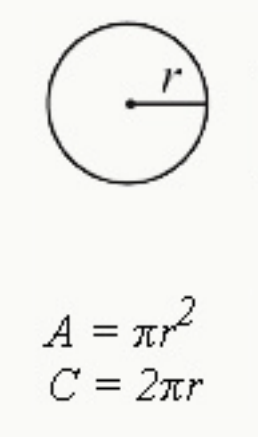
This is exactly what you'll see at the beginning of both math sections (the calculator and no calculator section). It can be easy to look right past it, so familiarize yourself with the formulas now to avoid wasting time on test day.

You are given 12 formulas on the test itself and three geometry laws. It can be helpful and save you time and effort to memorize the given formulas, but **it is ultimately unnecessary,** as they are given on every SAT math section.

You are only given geometry formulas, so prioritize memorizing your algebra and trigonometry formulas before test day (we'll cover these in the next section). You should focus most of your study effort on algebra anyways, because geometry has been de-emphasized on the new SAT and now makes up just 10% (or less) of the questions on each test.

Nonetheless, you do need to know what the given geometry formulas mean. The explanations of those formulas are as follows:

Area of a Circle



A=πr2

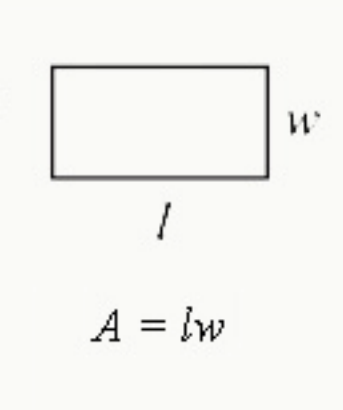
- π is a constant that can, for the purposes of the SAT, be written as 3.14 (or 3.14159)
- *r* is the radius of the circle (any line drawn from the center point straight to the edge of the circle)

Circumference of a Circle

C=2πr (or C=πd)

- *d* is the diameter of the circle. It is a line that bisects the circle through the midpoint and touches two ends of the circle on opposite sides. It is twice the radius.

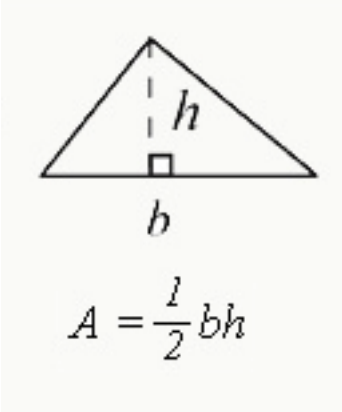
Area of a Rectangle



$A=lw$

- l is the length of the rectangle
- w is the width of the rectangle

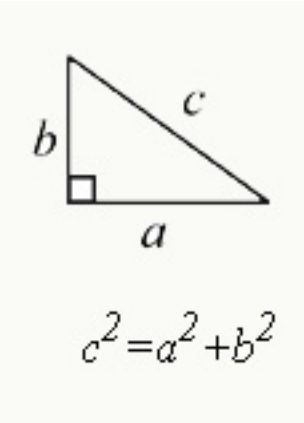
Area of a Triangle



A=12bh

- b is the length of the base of triangle (the edge of one side)
- h is the height of the triangle
    - In a right triangle, the height is the same as a side of the 90-degree angle. For non-right triangles, the height will drop down through the interior of the triangle, as shown above.

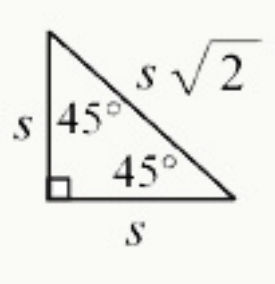
The Pythagorean Theorem



a2+b2=c2

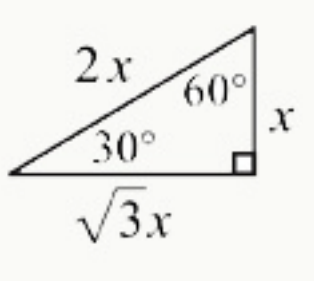
- In a right triangle, the two smaller sides (*a* and *b*) are each squared. Their sum is the equal to the square of the hypotenuse (c, longest side of the triangle).

Properties of Special Right Triangle: Isosceles Triangle



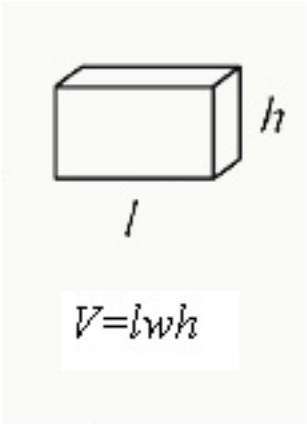
- An isosceles triangle has two sides that are equal in length and two equal angles opposite those sides.
- An isosceles right triangle always has a 90-degree angle and two 45 degree angles.
- The side lengths are determined by the formula: x, x, x2, with the hypotenuse (side opposite 90 degrees) having a length of one of the smaller sides *2.
    - E.g., An isosceles right triangle may have side lengths of 12, 12, and 122.

Properties of Special Right Triangle: 30, 60, 90 Degree Triangle



- A 30, 60, 90 triangle describes the degree measures of the triangle's three angles.
- The side lengths are determined by the formula: x, x3, and 2x
    - The side opposite 30 degrees is the smallest, with a measurement of x.
    - The side opposite 60 degrees is the middle length, with a measurement of x3.
    - The side opposite 90 degree is the hypotenuse (longest side), with a length of 2x.
    - For example, a 30-60-90 triangle may have side lengths of 5, 53, and 10.

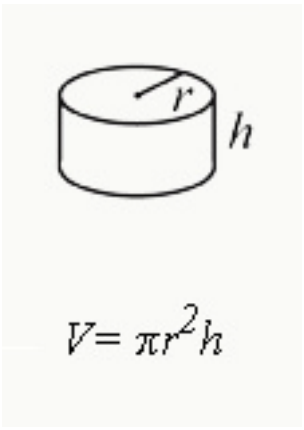
Volume of a Rectangular Solid



$$V=lwh$$

- l is the length of one of the sides.
- h is the height of the figure.
- w is the width of one of the sides.

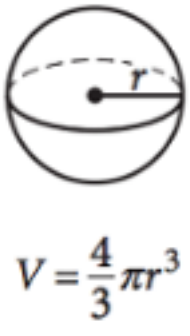
Volume of a Cylinder



V=πr2h

- r is the radius of the circular side of the cylinder.
- h is the height of the cylinder.

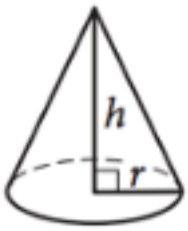
Volume of a Sphere



V=(43)πr3

- r is the radius of the sphere.

Volume of a Cone

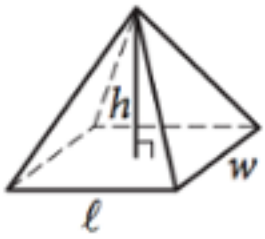


$$V = \frac{1}{3}\pi r^2 h$$

V=(13)πr2h

- r is the radius of the circular side of the cone.
- h is the height of the pointed part of the cone (as measured from the center of the circular part of the cone).

Volume of a Pyramid



$$V = \frac{1}{3}\ell wh$$

V=(13)lwh

- l is the length of one of the edges of the rectangular part of the pyramid.
- h is the height of the figure at its peak (as measured from the center of the rectangular part of the pyramid).
- w is the width of one of the edges of the rectangular part of the pyramid.

Law: the number of degrees in a circle is 360

Law: the number of radians in a circle is 2π

Law: the number of degrees in a triangle is 180

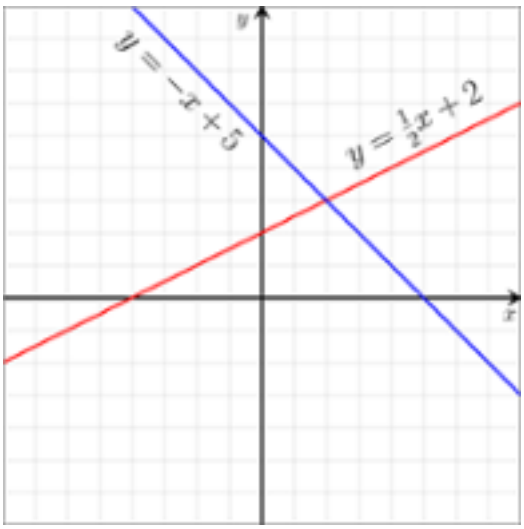
 *Gear up that brain because here come the formulas you have to memorize.*

Formulas Not Given on the Test

For most of the formulas on this list, you'll simply need to buckle down and memorize them (sorry). Some of them, however, can be useful to know but are ultimately unnecessary to memorize, as their results can be calculated via other means. (It's still useful to know these, though, so treat them seriously).

We've broken the list into **"Need to Know"** and **"Good to Know,"** depending on if you are a formula-loving test taker or a fewer-formulas-the-better kind of test taker.

Slopes and Graphs



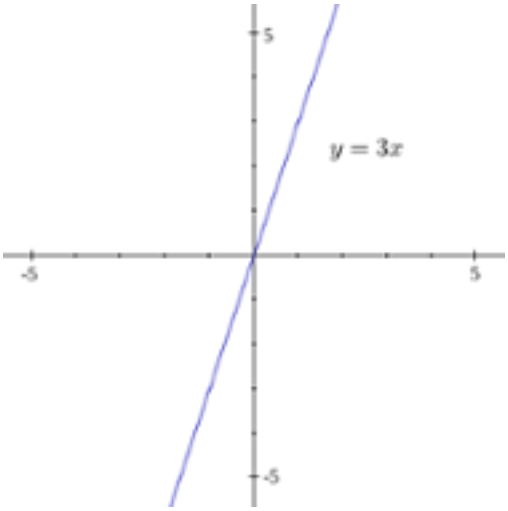
Need to Know

- **Slope formula**
  - Given two points, A(x1,y1),B(x2,y2), find the slope of the line that connects them:

    (y2−y1)(x2−x1)

  - The slope of a line is the rise(verticalchange)run(horizontalchange).

- **How to write the equation of a line**
  - The equation of a line is written as: y=mx+b
    - **If you get an equation that is NOT in this form (ex. mx−y=b), then re-write it into this format!** It is very common for the SAT to give you an equation in a different form and then ask you about whether the slope and intercept are positive or negative. If you don't re-write the equation into y=mx+b, and incorrectly interpret what the slope or intercept is, you will get this question wrong.
  - *m* is the slope of the line.
  - *b* is the y-intercept (the point where the line hits the y-axis).
  - If the line passes through the origin (0,0), the line is written as y=mx.



Good to Know

- **Midpoint formula**
  - Given two points, A(x1,y1), B(x2,y2), find the midpoint of the line that connects them:

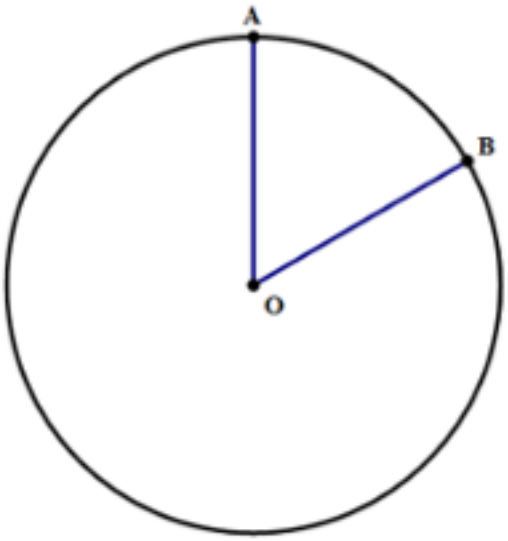
((x1+x2)2,(y1+y2)2)

- **Distance formula**
  - Given two points, A(x1,y1),B(x2,y2), find the distance between them:

[(x2−x1)2+(y2−y1)2]

You don't need this formula, as you can simply graph your points and then create a right triangle from them. The distance will be the hypotenuse, which you can find via the Pythagorean Theorem.

Circles



Good to Know

- **Length of an arc**
  - Given a radius and a degree measure of an arc from the center, find the length of the arc
  - Use the formula for the circumference multiplied by the angle of the arc divided by the total angle measure of the circle (360)
    - Larc=(2πr)(degreemeasurecenterofarc360)
    - E.g., A 60 degree arc is 16 of the total circumference because 60360=16

- **Area of an arc sector**

  - Given a radius and a degree measure of an arc from the center, find the area of the arc sector

    - Use the formula for the area multiplied by the angle of the arc divided by the total angle measure of the circle
      - Aarcsector=(πr2)(degreemeasurecenterofarc360)

- **An alternative to memorizing the "formula"** is just to stop and think about arc circumferences and arc areas logically.
  - You know the formulas for the area and circumference of a circle (because they are in your given equation box on the test).
  - You know how many degrees are in a circle (because it is in your given equation box on the text).
  - Now put the two together:

    - If the arc spans 90 degrees of the circle, it must be 14th the total area/circumference of the circle because 36090=4. If the arc is at a 45 degree angle, then it is 18th the circle, because 36045=8.
    - The concept is exactly the same as the formula, but it may help you to think of it this way instead of as a “formula” to memorize.

Algebra

Need to Know

- **Quadratic equation**
    - Given a polynomial in the form of ax2+bx+c, solve for x.

x=−b±√2a

- Simply plug the numbers in and solve for x!

    - Some of the polynomials you'll come across on the SAT are easy to factor (e.g. x2+3x+2, 4x2−1, x2−5x+6, etc), but some of them will be more difficult to factor and be near-impossible to get with simple trial-and-error mental math. In these cases, the quadratic equation is your friend.

    - Make sure you don't forget to do two different equations for each polynomial: one that's x=−b+√2a and one that's x=−b−√2a.

Note: If you know how to complete the square, then you don't need to memorize the quadratic equation. However, if you're not completely comfortable with completing the square, then it's relatively easy to memorize the quadratic formula and have it ready. I recommend memorizing it to the tune of either "Pop Goes the Weasel" or "Row, Row, Row Your Boat".

Averages

Need to Know

- The average is the same thing as the mean
- Find the average/mean of a set of numbers/terms

Mean=sumofthetermsnumberofdifferentterms

- Find the average speed

Speed=totaldistancetotaltime

Probabilities

Need to Know

- Probability is a representation of the odds of something happening.

Probability of an outcome=number of desired outcomestotal number of possible outcomes

Good to Know

- A probability of 1 is guaranteed to happen. A probability of 0 will never happen.

Percentages

Need to Know

- Find x percent of a given number n.

n(x100)

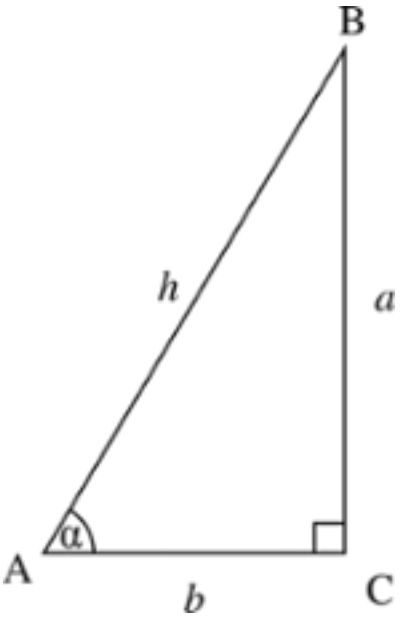
- Find out what percent a number n is of another number m.

(n100)m

- Find out what number n is x percent of.

(n100)x

Trigonometry



Trigonometry is a new addition to the new 2016 SAT math section. Though it makes up less than 5% of math questions, you won't be able to answer the trigonometry questions without knowing the following formulas.

Need to Know

- Find the sine of an angle given the measures of the sides of the triangle.

sin(x)= Measure of the opposite side to the angle / Measure of the hypotenuse

In the figure above, the sine of the labeled angle would be ah.

- Find the cosine of an angle given the measures of the sides of the triangle.

cos(x)= Measure of the adjacent side to the angle / Measure of the hypotenuse

In the figure above, the cosine of the labeled angle would be bh.

- Find the tangent of an angle given the measures of the sides of the triangle.

tan(x)= Measure of the opposite side to the angle / Measure of the adjacent side to the angle

In the figure above, the tangent of the labeled angle would be ab.

- A helpful memory trick is an acronym: SOHCAHTOA.

Sine equals **O**pposite over **H**ypotenuse

Cosine equals **A**djacent over **H**ypotenuse

Tangent equals **O**pposite over **A**djacent

SAT Math: Beyond the Formulas

Though these are all the *formulas* you'll need (the ones you're given as well as the ones you need to memorize), this list doesn't cover every aspect of SAT Math. You'll also need to understand how to factor equations, how to manipulate and solve for absolute values, and how to manipulate and use exponents, and much more. These topics are all covered here.

Another important thing to remember is that while memorizing the formulas in this article that aren't given to you on the test is important, knowing this list of formulas doesn't mean you're all set for SAT Math. **You also need to practice applying these formulas to answer questions, so that you know when it makes sense to use them.**

For instance, if you're asked to calculate how likely it is that a white marble would be drawn from a jar that contains three white marbles and four black marbles, it's easy enough to realize you need to take this probability formula:

$$\text{Probability of an outcome}=\frac{\text{number of desired outcomes}}{\text{total number of possible outcomes}}$$

and use it to find the answer:

$$\text{Probability of a white marble}=\frac{\text{number of white marbles}}{\text{total number of marbles}}$$

$$\text{Probability of a white marble}=\frac{3}{7}$$

On the SAT math section, however, you will also run into more complex probability questions like this one:

Dreams Recalled During One Week

	None	1 to 4	5 or more	Total
Group X	15	28	57	100
Group Y	21	11	68	100
Total	36	39	125	200

The data in the table above were produced by a sleep researcher studying the number of dreams people recall when asked to record their dreams for one week. Group X consisted of 100 people who observed early bedtimes, and Group Y consisted of 100 people who observed later bedtimes. If a person is chosen at random from those who recalled at least 1 dream, what is the probability that the person belonged to Group Y?

A) 68100

B) 79100

C) 79164

D) 164200

There's a lot of information to synthesize in that question: a table of data, a two-sentence long explanation of the table, and then, finally, what you need to solve for.

If you haven't practiced these kinds of problems, you won't necessarily realize that you'll need that probability formula you memorized, and it might take you a few minutes of fumbling through the table and racking your brain to figure out how to get the answer—**minutes that you now can't use on other problems in the section or to check your work.**

If you have practiced these kinds of questions, however, you'll be able to quickly and effectively deploy that memorized probability formula and solve the problem:

This is a probability question, so I'll probably (ha) need to use this formula:

Probability of an outcome=number of desired outcomestotal number of possible outcomes

OK, so the number of desired outcomes is anyone in Group Y who remembered at least one dream. That's these bolded cells:

	None	1 to 4	5 or more	Total
Group X	15	28	57	100
Group Y	21	**11**	**68**	100
Total	36	39	125	200

And then the total number of possible outcomes is all people who recalled at least one dream. To get that, I have to subtract the number of people who didn't recall at least one

dream (36) from the total number of people (200). Now I'll plug it all back into the equation:

Probability of an outcome=11+68200−36

Probability of an outcome=79164

The correct answer is **C)** 79164