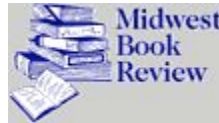


## 101 Things Everyone Should Know About Math

“A wonderful book for making complex math topics enjoyable!”

Ages 11-15, 8.5” x 5.5”, 208 pages; \$9.95



Math is a critical part of our everyday lives. The second title in the award-winning “101 Things Everyone Should Know” series helps you understand how you use math dozens of times—every day. With entertaining, real-life connections in sports, travel, food, hobbies and more, math concepts are simplified and explained. You’ll even learn some fun trivia and math history! Using an engaging question-and-answer format, *101 Things Everyone Should Know About Math* is perfect for kids, parents, educators, and anyone interested in the difference between an Olympic event score of 9.0 and a Richter scale score of 9.0.

### Sample Questions!

#### 1. Following Orders

Solve the following:  $7 \times 3 + 2 \div 4 - 2^2 \times (6 - 1)^2$

#### 2. There and Back Again

Zach lives a mile from school. It takes him 15 minutes to ride his bike to school, but only 5 minutes to ride home (There’s a lesson on motivation here, but that’s beside the point). What is Zach’s *average* speed?

- A. 4 miles per hour
- B. 6 miles per hour
- C. 8 miles per hour
- D. 12 miles per hour



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**3. Team Player**

Daniel plays soccer on a team in the local BES (“Busy Every Saturday”) soccer league. There are 10 players on his team. At any one time, eight players are on the field. The coach always chooses his players randomly. What percent of the time does Daniel not play?

**4. Hard Pill to Swallow**

Each morning Xander must take a pill containing 100 mg of medicine. Let’s assume that the medicine is immediately introduced into his system. Among other things, our bodies work to wash foreign stuff out, including medicine. Because of this process, in 24 hours, Xander’s body will wash out 40% of the existing amount of medicine in his body. Xander takes his medicine at 8:00 a.m. each morning. If he takes it for the first time on Monday, how much medicine is in his body just before he takes his dose on Wednesday?

- a) 4 mg    b) 96 mg    c) 128 mg

**5. Sprockets**

Bob has a new mountain bike with three sprockets in the front and six sprockets in the back. Each sprocket, front and back, is a different size. Bob can use each possible combination of sprockets to make a “gear.” Each gear gives him an advantage in speed or in riding up and down hills. How many different “gears” does the bike have?

**6. Steve, Steve, Steve, Mary and Steve**

Five friends, Steve, Steve, Steve, Mary and Steve go to a baseball game. One of them catches a foul ball. What are the odds that it was a Steve?

- a) 5 to 1 in favor                      c) 4 to 1 in favor  
b) 1 to 5 in favor                        d) 1 to 4 in favor

**7. Batting Average**

Joe Slugger is on the Mudville Nine baseball team. With 200 times at bat, Joe has a batting average of .250. Batting average is equal to the number of hits divided by the total number of times at bat. Of his next 100 times at bat, how many hits does Joe need to bring his batting average up to .300?

**8. Triple Doubles**

In Monopoly, you roll two dice and move the number of spaces equal to the sum of the dice. If you roll doubles, you get to roll again. However, if you roll 3 doubles in a row, you go directly to jail, do not pass Go and do not collect \$200. What are the chances of this happening?

- a) 1 in 6                                      c) 1 in 216  
b) 1 in 36                                    d) 1 in a million

**9. Chuck the Woodchuck**

Giles notices an advertisement in the newspaper for an in-store discount of 50% off Woodchuck Chuckin’ Wood. This is good news for Giles, who knows precisely how much wood his woodchuck Chuck chucks, since his woodchuck can chuck wood. At the store, Giles notes that Chuck’s favorite flavor of Chuckin’ Wood (maple, of course) has a coupon for an additional 50% off the lowest marked price. The cashier says that 50% + 50% = 100%, so the bag is free. Is the cashier correct?

**10. Buying Tires**

Farmer Kabibble needs to get new tires for his truck. At the tire store, he finds that there are two different-sized tires that would work. The Super Deluxe Dirt Grabbers are 60 cm in diameter, and the Premium Road Grippers are 50 cm in diameter. The price of the Premium Road Grippers is 10% less than the price of the Super Deluxe Dirt Grabbers. Which tires are the better deal?

**11. Father of Algebra**

Who is considered the father of algebra?

- a) Muhammad ibn Musa al-Khwarizmi
- b) Euclid of Alexandria
- c) Gottfried Wilhelm Leibniz
- d) Leonhard Euler

**12. Proof Positive**

True or false: the following proves that  $1=2$ :

Suppose  $a = b$

Multiply both sides by  $b$

$$ab = b^2$$

Subtract  $a^2$  from both sides

$$ab - a^2 = b^2 - a^2$$

Factor both sides

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

Cancel  $(b - a)$  from both sides

$$a = b + a$$

Substitute  $a$  for  $b$ , since  $a = b$

$$a = a + a \text{ or } a = 2a$$

Divide both sides by  $a$

$$1 = 2$$

**13. Super Sprinter**

World-class sprinter Allyson Fleetfeet can run the 100-meter dash in about 10 seconds. If Allyson could maintain that pace for an entire marathon (26 miles and 385 yards), about how long would it her take to finish?

- a) around 10 minutes
- b) around 1 hour
- c) around 3 hours
- d) around 6 hours

**14. Tennis, Anyone?**

The serve of a professional tennis player can travel between 120 mph and 150 mph. Sally is just learning to play, so her serve travels at only about 80 mph (120 feet per second). A serve that can't be returned is called an ace. Typically, an ace will travel about 80 feet to land right in the corner of the court. If Sally hits the tennis ball on her serve when it is seven feet off the ground, what would be the best trajectory for her to try to achieve?

- a) A positive slope (ascending)
- b) A slope of zero (moving horizontally)
- c) A negative slope (descending)

**15. Flip a Coin**

When your friend is bored, he has a habit of flipping a coin into the air, catching it and calling out whether it landed on heads or tails. Today, he is bored. You have heard him call out "Heads, tails, tails, heads, heads, heads." He then says to you, "I just flipped three heads in a row. What is the chance that my next flip will be heads?" Is it...

- a) 25%
- b) 50%
- c) 75%
- d) 100%

## Answers:

### 1. The answer is: -78.5

NEED A CLUE? The key to this problem is to understand what calculations to do first. That is called the “order of operations”. In arithmetic and algebra, certain rules are used for the order in which the operations in expressions are to be evaluated. These precedence rules (which are just conventions, not mathematical facts) are also used in many programming languages and by most modern calculators.

The order of operations is: 1. parentheses 2. exponents (to the power of) and roots (square root, cube root, etc) 3. multiplication and division (from left to right) 4. addition and subtraction (from left to right) and it works as follows:

1. Do all the calculations inside of parentheses first. If there are parentheses inside parentheses, do the inner most set first. So,  $(1 + (3 \times 2))$  would be solved as  $(1 + (3 \times 2)) = (1 + 6) = 7$ .

2. Resolve all the expressions with exponents, that includes “to the power of” and roots (e.g. square root, cube root, etc.) as well. If there are expressions that are nested (one inside the other) do the innermost first. So,  $\sqrt[4]{3} = \sqrt[4]{64} = 8$

3. Perform all the multiplication and divisions. In math multiplication and division are basically two ways of looking at the same thing. So, when performing this step, just move through the equation from left to right and perform the divisions and multiplications in the order in which you find them.

The right way:  $2 \times 10 \div 4 \times 3 = 20 \div 4 \times 3 = 5 \times 3 = 15$

The wrong way:  $2 \times 10 \div 4 \times 3 = 20 \div 4 \times 3 = 20 \div 12 = 5/3$

4. Perform all the subtractions and additions. In math subtraction and addition are also two ways at looking at the same thing. So, when performing this step, just move through the equation from left to right and perform the additions and subtractions in the order in which you find them.

The right way:  $2 - 10 + 4 - 3 = -8 + 4 - 3 = -4 - 3 = -7$

The wrong way:  $2 - 10 + 4 - 3 = 2 - 14 - 3 = -12 - 3 = -15$

In this case,

$7 \times 3 + 2 \div 4 - 22 \times (6 - 1)^2 = 7 \times 3 + 2 \div 4 - 22 \times 5^2 =$

$7 \times 3 + 2 \div 4 - 4 \times 25 = 21 + 1/2 - 100 = -78.5$

### 2. The answer is: B, 6 miles per hour

Distance is given in miles, and we want to know Zach’s rate in miles per hour, or miles/hour.

If it takes Zach 15 minutes to go one mile to school and 5 minutes to come home, it takes Zach a total of 20 minutes to go 2 miles.

That means Zach’s average rate is:  $r = 2 \text{ miles}/20 \text{ minutes} = 2 \text{ miles}/(1/3) \text{ hour} = 6 \text{ miles per hour}$ .

**3. The answer is: 20%.**

An easy way to calculate this is to note that, all things being equal, two of the 10 players will be sitting out at any given time, so everyone will sit  $2/10$  (or 20%) of the time. Another way to solve this problem is to figure out how many different combinations of players can be fielded—and then determine how many include Daniel. Choosing at random, there are 10 players that the coach can pick for the first person to sit out, and nine choices remaining for the second person to sit out. That would be 90 choices for players to sit out. However, it doesn't matter whether a player is picked first or second to sit out. To take that into account, we need to divide by the number of ways two players can be chosen (2). Therefore, we get  $90/2 = 45$  possible ways for two players to sit on the bench.

Next, we need to figure out how many of those ways include Daniel. There are nine combinations of Daniel and one other player sitting out. So out of 45 possible choices, 9 include Daniel.  $9/45$  reduces to  $1/5$ , or 20%.

**4. The answer is: B, 96 mg**

On Monday, just after taking the dosage, Xander has 100 mg of medicine in his system. On Tuesday, just before taking the second dose, he has 60% of 100 mg (60 mg) of medicine in his system. Just after taking the Tuesday dose, he has 160 mg in his system. On Wednesday, just before taking his daily dose he has 60% of 160 mg, which is 96 mg.

**5. The answer is: 18**

This question is asking how many different ways you can combine the three sprockets in front with the six sprockets in back. You find this by multiplying the number of front sprockets with the number of rear sprockets:  $3 \times 6 = 18$ .

**6. The answer is C, 4 to 1**

There are five friends, and four are named Steve, so the probability of a Steve catching the ball is  $4/5$  or 80%. However, the question asked for the odds. The fraction  $4/5$  tells us that out of five catches, a Steve is expected to catch the ball four times and, therefore, not catch the ball one time. In other words, the odds of a ball being caught by a Steve is four for every one ball not caught by a Steve. That's odds of 4 to 1 in favor of a Steve.

**7. The answer is: 40**

To have a batting average of .300 after 300 times at bat, one needs to have  $300 \times .300 = 90$  hits. Joe has a batting average of .250 after 200 times at bat. That means that Joe has had  $200 \times 0.25 = 50$  hits. Therefore, to ensure a batting average of .300, Joe needs  $90 - 50 = 40$  hits out of the next 100 times at bat.

**8. The answer is: C, 1 in 216**

NEED A CLUE? First, determine the chances of rolling doubles on the first roll.

There are six outcomes possible for each die, making a total of 36 possible outcomes. There are six ways to roll doubles (1-1, 2-2, 3-3, 4-4, 5-5, and 6-6). Six in 36 is the same as  $1/6$ . The same holds true on the second and third rolls. Since the rolls don't influence each other (the dice have no recollection of what was rolled each time), we need to multiply the results of each separate roll together. When we do, we get:  $1/6 \times 1/6 \times 1/6 = 1/216$ , or 1 in 216.

**9. The answer is: No**

Giles, being exceptionally honest, corrects the cashier and explains that he should not get the Chuckin' Wood for free. He should get 75% off.

Here's why:

- The first discount is 50%, so the price becomes 50% of the original price.
- The second discount is against the discounted price or 50% of 50%, or 25% of the original price.
- So, the total discount of the original price is  $50\% + 25\% = 75\%$ .

**10. The answer is: The Super Deluxe Dirt Grabbers (the more expensive ones).**

For a given number of miles, tires with a smaller diameter will suffer more wear than tires with a larger diameter. This is because the wear of a tire is related to how many times the tire goes around on the ground. Tires with smaller diameters need to go around more times to cover the same distance as larger diameter tires. This is because the circumference (C) of a circle is directly proportional to its diameter (d). The formula is  $C = \pi d$  (remember that  $\pi$  is approximately 3.14). The less expensive tires have a circumference that is  $5/6$  that of the more expensive tires. The price of the less expensive tires is  $9/10$  the price of the other tires. The bottom line is that if you purchase the Premium Road Grippers you save 10% on the price but get 16% fewer miles before the tires wear out. So, the more expensive tires are actually the better deal.

**11. The answer is: A**

NEED A CLUE? The source of the word "algebra" is an Arabic word: *al-jabr*

The word "algebra" comes from the title of Muhammad ibn Musa al-Khwarizmi book, *Hisab al-jabr w'almuqabala*, written around the year 830 BCE. The title translates to "Calculation by Restoration and Reduction." Besides other important advances, al-Khwarizmi was among the first to use zero as a number. This probably seems simple, since you already know about zero, but imagine if you didn't! He's also immortalized in another way: the word "algorithm" is derived from his name.

Euclid is the "father of geometry." He was a Greek mathematician who lived in Alexandria, Egypt between about 325 and 265 BCE. His most popular work, *Elements*, is still widely-used today. Gottfried Wilhelm Leibniz (1646-1716) was a German polymath (someone who excels in multiple fields). Leibniz is famous not just for his work in mathematics, but also for his contributions to philosophy, biology, medicine, geology, politics, psychology, theology and law. One of Leibniz's claims to fame is his invention of calculus.

Sure, Isaac Newton usually gets the credit, but Leibniz invented calculus independently, and it is Leibniz's notation that is still used. He even developed the binary system, the foundation of virtually all modern computer architectures.

Leonhard Euler (pronounced "Oiler") (1707-1783) was a Swiss mathematician and physicist. He created much of the terminology and notation for mathematics, including the notations for square root and pi. According to the Guinness Book of World Records, he holds the record for mathematical authorship. His collected works fill 60 to 80 volumes. Euler is so famous that his picture is on money in Switzerland.

## 12. The answer is: False

When we cancel factors, we are actually dividing by that factor. If  $a = b$ , then  $b - a = 0$ . We can't divide by zero so the proof is false. So just what is a proof? A proof is a logical way of proving something is true. It starts with a hypothesis. It proceeds, step by step, based on what we know to be true (called "theorems") and what we assume to be true (called "axioms"). If every step of the argument is true, then the conclusion must also be true. Another way to use a proof is instead of proving something to be true, we can assume it's false and see if we can arrive at a contradiction.

## 13. The answer is: B, around 1 hour

- First, convert Allyson's speed to kilometers per second:  $100\text{m}/10\text{sec}$   
 $\times 1\text{km}/1000\text{m} = 0.01\text{ km/s}$ .
  - To estimate the length of the marathon in kilometers, we toss out the 385 yards and get the equation  $26\text{mi} \times 1\text{km}/.6\text{mi} = 26 \times 1/0.6\text{ km}$ .
  - Now the problem becomes "What is  $1/0.6$ ?" Well,  $1/0.5$  is 2 and  $1/0.67$  is 1.5 so  $1/0.6$  must be somewhere in between.
  - Using what we know, we find that  $26/0.5 = 52$  and  $26/0.67 = 39$ . We know the answer is in the middle there somewhere, so let's pick 45 km (because it is easy to work with).
  - To get the time it will take to run the marathon, we need to divide the distance by the rate in the units (km/s). The formula is  $45\text{km}/(0.01\text{km/s})$ , or  $45\text{km}/(0.01\text{km/s}) = 4500$  seconds.
  - We can convert 4,500 seconds to hours by dividing by 3,600 (60 minutes  $\times$  60 seconds = 3,600 seconds in an hour).
  - The answer is  $4,500/3,600 = 5/4 = 1.25$  hours
- As it turns out, it's impossible to sprint for that long. World-class marathoners take between 2 and 2.25 hours to finish a race.

## 14. The answer is: A, a positive slope (ascending)

If the tennis ball gets hit horizontally and has to go about 80 feet traveling at 120 feet per second, then it takes  $80\text{ft}/120\text{ft/s}$ , or  $2/3$  (0.67) seconds to go that distance horizontally.

Here's how to figure out how long it will take for an object to fall.

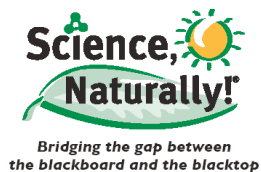
A good approximation for how long it takes for something to fall is this equation:  $t = 1/4 \sqrt{h}$ , where  $t$  is in seconds and  $h$  is in feet. So if the tennis ball were dropped from seven feet, it would take  $1/4 \sqrt{7}$  seconds. In this case, it's easiest to use a calculator to find the square root of 7, which is about 2.65. Multiply by  $1/4$ , and you'll find that the fall takes about 0.66 seconds.

So gravity will pull the ball to the ground just before it goes the required distance. In order to get the ball to hit the ground at the appropriate distance, it must be hit at a slight incline. That means it must have a positive, or ascending, slope.

## 15. The answer is: B, 50%

Coins do not have memory. The probability of flipping a coin heads-side up (or tails-side up for that matter) never changes, regardless of the number of previous flips. There is always a 50-50 chance of the coin landing on heads.

On the other hand, suppose you have a bag filled with 100 marbles where 99 are black and 1 is white. The likelihood of drawing a white marble would change with every draw, assuming that any marble drawn is not put back in the bag.



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