Quantitative Aptitude

Arithmetic

ASVAB mathematics is a difficult area for many, but with patience and logic it can be easy and even (gasp) enjoyable!

"Bistromathics itself is simply a revolutionary new way of understanding the behavior of numbers. Just as Einstein observed that space was not an absolute but depended on the observer's movement in space, and that time was not an absolute, but depended on the observer's movement in time, so it is now realized that numbers are not absolute, but depend on the observer's movement in restaurants."

- Douglas Adams

"Like the crest of a peacock so is mathematics at the head of all knowledge."
- Indian saying

What are the most important steps in solving a math problem?

1. Identify the question.
2. Put the question into a mathematical equation.
3. List the information you need.
4. List the steps to solve the problems.

In the Mathematical Knowledge section, problems are more or less laid out for you: the question is clear. In the Arithmetic Reasoning section, you are presented with word problems, so you will need to pay more attention to identify the question being asked.

Especially with math problems, practice makes perfect. Here we will present you with most of the mathematics topics that will be addressed on the test. In order to be fully prepared, however, you must PRACTICE PRACTICE PRACTICE!!!

Mathematics Topics to Know

Here is a list of mathematics topics and terms you are likely to encounter on the ASVAB. Items are in alphabetical order.

Quantitative Aptitude

Algebra

Algebra is math that represents numbers with symbols, enabling equations to be more easily solved.

For example, if you want to buy four new tires for your car, with each one costing $75, you could calculate the price by simple addition: $75 + $75 + $75 + $75 = $300. But you could also represent the price as 4P, where "P" represents the price of a single tire. This would be easier to write down, for one thing. It is also more flexible: say you decide to buy tires that cost $100 each instead. You can still use 4P as the equation for the total, which now would be 4 x ($100 each) = $400.

The above example is extremely simple. In reality, most algebraic expressions have at least two variables (hotspot link?). In the above example, you would have:

TOTAL = 4 x (Price per tire)

Which might be represented as:

T = 4P

Often, equations are expressed using y and x. You must seek an answer for y, depending on changes in x. There are some priority rules for operations in algebra:

1. Perform all operations in parentheses first. You must follow the parentheses OUTWARDS: do operations in the innermost parentheses first.
2. Raising a number to a power or taking the root of a number comes first.
3. Multiplication and division come next.
4. Addition and subtraction take lowest priority.

Look at these examples for more:

a) 5x + 4y = 7

Solve for y:

4y = 7 - 5x --> y = (7 - 5x)/4

b) x^2 = y^(1/2)

Solve for y:

[y^(1/2)]^2 = (x^2)^2 --> y = x^4

Circles

Some terms to know:

Radius: The distance from the center of a circle to any point on its perimeter.

Diameter: Twice the radius. The distance straight from one point on the perimeter, passing through the center, meeting the perimeter on the other side.

Circumference: The perimeter of a circle. Calculated as 2 x pi x radius.

Area: The two-dimensional area enclosed by a circle. Calculated as pi x (radius)^2.

Exponents

Exponents just represent the number of times to multiply something by. For example:

(3)^4 says "three raised to the fourth power" or "three to the fourth." The lower number is called the "base" and the power to raise it to is called the "exponent". Here, 3 is the base and 4 is the exponent. To calculate, you just multiply the base by itself exponent times. Here you get:

3 x 3 x 3 x 3 = 81

What about fractions? For example:

(16)^(1/2)

This is a bit strange: how do you multiply something by itself only half a time? In the example above, we are looking for the square root, or the number that when squared would make 16. The answer turns out to be +4 OR -4! Remember that even though you may find multiple answers, often times a problem will only make sense with one answer. For example, if you were told that the height of an object goes as:

h = t^2

And given a height of 16, asked to find the time, you would get answers of time = +4 or -4. But there is no such thing as negative time! So eliminate -4 and your answer is +4.

Factorial

A factorial is represented with an exclamation point - "!" It means multiply all integers from 1 to that number. For example:

3! = 1 x 2 x 3 = 6
6! = 1 x 2 x 3 x 4 x 5 x 6 = 720
10! = 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 x 9 x 10 = 3,628,800

Three important notes:

- 0! = 1 -- 0! (zero factorial) does NOT equal zero.
- Negative numbers are not used in factorials. There is no such thing as (-5)!, for example. Though you may see -(5!).

- Fractions are not used in factorials. For example, (2/3)! is not a valid mathematical operation. However, (2!)/(3!) is.

Fractions

Fractions are one number divided by another. The number on top is called the numerator, the number on the bottom is called the denominator. For example:

5/8.

Five (5) is the numerator, eight (8) is the denominator.

Here it is read "five divided by eight", which works out to 0.625.

Mixed Numbers: A mixed number combines a whole number with a fraction. For example:

-5 2/7

Is really -5 + (-2/7). To convert to a fraction, multiply the whole number by the denominator in the fraction. Then add it to the numerator. Finally, divide the sum by the numerator. Ignore the sign of the fraction - just put it there when you're all done. Here you would get:

- 5 * 7 = 35 --> The whole number times the denominator
- 35 + 2 = 37 --> Add the above product to the numerator
- -37/7 --> Divide the above sum by the denominator, and put the sign back.

Improper Fractions: An improper fraction is a fraction in which the numerator is greater than the denominator. In the example above we converted -5 2/7 to an improper fraction, since 37 is bigger than 7. So how do you convert an improper fraction to a mixed number? First, divide the numerator by the denominator to find the largest whole number that will go into it. Next, take the remainder from the division out and divide it by the denominator. Finally, put the whole number and the fraction together. Again, leave the sign out of things until the end. For example:

- -37/7 --> 7 goes into 37 five (5) times
- The remainder is 37 - (7x 5) = 37 - 35 = 2, so the fractional part is 2/7
- Combine 5 and 2/7 and the negative sign to get -5 2/7

Lowest Terms: A fraction is in lowest terms when it cannot be divided any further. There are no integers that will wholly divide BOTH the numerator and denominator. For example:

- 2/4 is NOT in lowest terms. Both 2 and 4 can again be divided by 2 to get ½.
- -50/51 IS in lowest terms. There is no integer that can go wholly into both 50 and 51.
- 27/84 is NOT in lowest terms. Both 27 and 84 are divisible by 3. You can reduce terms to get 9/28.

Quantitative Aptitude

Inequalities

Some quickie definitions:

- "=": "Equals" sign. 0 = 0, -2 = -2, 100 = 100, etc.
- ">": "Greather than" sign. 0 > -2, 100 > -20, 0.01 > 0.001, etc.
- "<": "Less than" sign. -2 < 0, -20 < 100, 0.98 < 0.99, etc.
- ">=": "Greater than OR Equal to" sign. 0 >= 0, 0 >= -2, 100 >= -20, 0.5 >= 0.5, etc.
- "<=": "Less than OR Equal to" sign. 0 <= 0, -2 <= 0, -20 <= 100, 0.5 <= 0.5, etc.

Inequalities are not as hard as they look. They are best solved pretending that the inequality is not there until the very end of the equation; just pretend that the inequality is an "=" sign. For example:

3x + 28 <= 5x

Just treat this as you would any other algebraic equation. Subtract 5x from both sides, and then subtract 28 from both sides to get:

-2x <= -28

Now divide both sides by -2 to get:

x >= 14

Notice that when you multiply or divide by a negative number, the inequality direction changes! When multiplying or dividing by a positive number, the inequality direction stays the same.

Interest

Interest calculations are most commonly used with money problems. For the ASVAB, you will only need to know this simple formula:

Interest = Principle x Interest Rate x Time --- or I = P x R x T

For example, if you deposit $10,000 at a bank earning 5% yearly interest, how much money will you have after 18 months?

1. First, define your terms. P = $10,000, R = 0.05 (remember to move the decimal two spaces to the left to convert a percentage to a decimal) and T = 1.5 (express the months in years - 12 months = 1 year).
2. Second, calculate the interest. Here, I = ($10,000) x (0.05) x (1.5) = $750.
3. Finally, add the interest back to the principal to get the total. You have $10,000 + $750 = $10,750 in your bank account.

Quantitative Aptitude

Numbers

Real Numbers: Real numbers encompass rational (expressible as a fraction) and irrational (not expressible by fractions) numbers, both positive and negative.

Imaginary Numbers: Imaginary numbers can be expressed as some real number times the square root of negative one (sqrt(-1)). They are only found in high-level math and science. You will not have to worry about them on the ASVAB.

Rational Numbers: Rational numbers are numbers that can be expressed as fractions. For example, 0.60 is a rational number since it can also be expressed as 3/5.

Irrational Numbers: Irrational numbers CANNOT be expressed by a fraction. This means that they will have a non-repeating decimal component. For example, pi is irrational, since 3.14.... cannot be expressed as a fraction.

Whole Numbers: Whole numbers are numbers that have no decimal component and are greater than or equal to zero. They can be expressed as: W = {0, 1, 2, 3, 4, 5, ...}

Natural Numbers: Natural numbers are just a subset of Whole numbers. However, Natural numbers do not include zero. Natural numbers can be expressed as N = {1, 2, 3, 4, 5, 6,...}

Integers: Integers are essentially positive and negative whole numbers. In other words, they are all numbers with no decimal component, both greater than, less than, and including zero. They can be expressed as I = {... -4, -3, -2, -1, 0, 1, 2, 3, 4, ...}

Prime Numbers: Prime numbers are those that can only divided by 1 and themselves - no other whole numbers fully divide them. 1 is usually considered a "special case" and thus not a prime number. The prime numbers up to 100 are: P = {2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97}.

Composite Numbers: Composite numbers are the "opposite" of primes. They are all numbers that can be divided wholly by 1, themselves, and at least one other whole number. The following are all examples of composite numbers: 10, 18, 27, 44, 121.

Quantitative Aptitude

Patterns & Sequences

Patterns and sequences are used widely throughout math. They follow some prescribed formula. Often you will be given a sequence of numbers and then asked to figure out the mathematical pattern governs it. For example:

1, 2, 3, 4, 5...

It is easy to see that the pattern here is +1: each number just = the previous number +1.

Another example:

-20, -19, -17, -14, -10, -5, 1, 8, 16, 25...

Here the pattern is to add one more than has been added to the previous number, starting with +4. So if we begin -20 and add 1, we get -19. Now add one more than you added to -20: add 2, so you get -17. Now add 3 to get -14. Now add 4 to get -10. Now add 5... and so on.

Reciprocal

A reciprocal is just one divided by the number in question. For example, the reciprocal of 5 is 1/5. The reciprocal of -13 is - 1/13. The reciprocal of ? is 1/(1/2) = 2.

Rounding

Rounding numbers is the skill of approximation. Often times we only need to know about how much a number is, not exactly. For example, if you go to a basketball game and try to get an exact count of people there, you would go nuts! It would be much easier to say something like "there were about 20,000 people at the basketball game."

Rules for Rounding: To round a number, first you must know to what number place you want to round to. Then you look at the number immediately to the right (this may or may not cross over the decimal point) to determine which way to round the number. First of all, here are the most common "places" of numbers:

0.001: 1 is in the "thousandth" place
0.01: 1 is in the "hundredth" place
0.1: 1 is in the "tenth" place
1: 1 is in the "ones" place
10: 1 is in the "tens" place
100: 1 is in the "hundreds" place
1,000: 1 is in the "thousands" place
10,000: 1 is in the "ten-thousands" place
100,000: 1 is in the "one-hundred-thousand" place
1,000,000: 1 is in the "millions" place

Quantitative Aptitude

Rounding Up: If the number to the right of your target is 5 or greater, round "up."

Rounding Down: If the number to the right of your target is less than 5 (4, 3, 2, 1, or 0), round "down." Actually, you leave the target the same.

In both cases, change all numbers to the right of the target to zeros.

Let's make some sense of this with examples!

a) Round 123 to the nearest tens place.

- 2 is in the tens place.
- Look at the place to the right of the tens, the ones place. We have 3.
- 3 is less than 5. So we do not change the 2.
- Drop the 3 and change it to 0. We are left with 120.

b) Round 378,572 to the nearest thousand (thousands place).

- 8 is in the thousands place.
- Look to the right of the thousands place, the hundreds place. That number is 5.
- 5 means we round up, so add one to 8 to get 9.
- Drop everything to the right of the 9. We are left with 379,000.

c) Round -2.34167 to the nearest thousandths place.

- 1 is in the thousandths place.
- To the right (in the "ten-thousandths" place) of 1 is 6.
- 6 is greater than or equal to 5 - so round up!
- We add one to 1 to get 2.
- Change everything to the right to 0.
- The answer would be -2.342.

General Study Tips: Military.com has put together a no-muss, no-fuss list of study tips that should help you no matter what you're studying for.