Chapter 6

Arithmetic Reasoning

In This Chapter

- Working on word problems
- Reviewing essential basic math
- Thinking like a calculator
- Avoiding common mistakes and traps

Remember the first time your teacher asked you, "If Martha has two bananas and Johnny gives her three bananas, how many bananas does Martha have?" Like many people, you may have wondered why Johnny was giving Martha bananas in the first place — unless Martha was his pet gorilla — but in fact, your teacher was introducing you to the concept of word problems.

Word problems help you apply mathematical principles to the real world (at least the real world according to the people who think up word problems). And the Arithmetic Reasoning subtest tests your ability to do real-life, basic, mathematical calculations derived from simple word problems. If you slept through high-school math, don't worry. We're pretty good at explaining this stuff, if we do say so ourselves.

The Arithmetic Reasoning subtest asks you to read a word problem, determine what the question is asking, and select the correct answer. (Then you have to repeat the process 29 more times.) Most of the problems look like this:

Jane walks five miles to work each morning and five miles home each evening. How many miles does Jane walk in a day?

(A) 6 miles

(B) 8 miles

(C) 7 miles

(D) 10 miles

You have 36 minutes to answer 30 questions, so you have to work quickly to finish, but you're not being tested on speed. The test administrator will supply you with scratch paper so that you can work out some of the problems on paper if needed. Remember, it never hurts to illustrate the problem by drawing graphics — like Martha's two bananas and Johnny's three bananas.

Arithmetic Reasoning is an important part of the overall ASVAB score — otherwise known as the Armed Forces Qualification Test (AFQT) score. (See Chapter 1 for more information.) Also, certain military jobs require that you score well on this subtest. Turn to Appendix A to find out which jobs require what scores on this subtest.

In order to do well on the Arithmetic Reasoning subtest, you have to remember that there are two parts to it: Arithmetic and Reasoning. You usually have to use both of these skills for each problem. The arithmetic part comes in when you have to perform mathematical operations such as addition, subtraction, multiplication, and division. The reasoning comes in when you figure out what numbers to use in your calculations. In other words, Arithmetic Reasoning tests how you apply your ability to perform calculations to everyday, real-life types of problems.

SERGEANT SAYS

You're not allowed to use calculators during the ASVAB test, so now is a good time to get into the practice of using scratch paper instead of a calculator.

Wrestling with Word Problems

Test takers often waste a lot of time reading and rereading word problems as if the answer might reveal itself to them by some miracle, which isn't going to happen.

What's the problem? Figuring out what the question is asking

As you read the question, ask yourself what it wants you to do. Maybe the question wants you to find the volume of a cardboard box. Maybe you don't know how to do this. Fine. Don't freak out. Just don't forget to figure out what the question asks. If you waste time panicking and trying to read the problem in such a way that you don't have to find the volume of the cardboard box, you're not doing yourself any favors. Take the philosophical approach and accept what you cannot change.

Suppose you're asked the following question:

EXAMPLE

How many cubic inches of sand does a cardboard box measuring 12-inches long by 14-inches wide by 10-inches tall contain?

(A) 52 cubic inches

(B) 88 cubic inches

(C) 120 cubic inches

(D) 1,680 cubic inches

What does this question want you to determine? It wants you to figure out how much sand can fit in a box. Would figuring out the perimeter of the box help you with this question? Nope. Would figuring out the area of one side of the box help you? Nope (you're not painting the box, you're filling it). The question wants you to determine the volume of the container. After you know what the question is looking for, you may or may not know how to correctly solve the problem, but at least you know what the problem wants you to find.

Looking for answers in all the right places

One of the best ways to solve a word problem is to write down a formula that will produce the answer to the question and then find the correct facts to plug into the formula. For instance, a question may ask:

EXAMPLE

Joan just turned 37. She wants to travel to Key West to become a beach bum for a year and then return to her accounting job. To finance this lifelong dream, she needs to save a total of $15,000. How much does Joan need to save each year if she wants to become a beach bum by her 40th birthday?

Write down, in mathematical terms, what the question is asking you to determine. Because the question is asking how much money Joan needs to save per year to reach $15,000, you can say: *y* (years Joan has to save) times *m* (money she needs to save each year) equals $15,000. Or to put it more mathematically:

$ym = \$15{,}000$

You don't know the value of *m* (yet) — that's the unknown you're being asked to find. But you can find out the value of *y* — the number of years Joan has to save. If she's 37 and wants to be a beach bum by the time she's 40, she has 3 years to save. So now the formula looks like this:

$3m = 15{,}000$

To isolate the unknown on one side of the equation, you simply divide each side by 3, so that $3m \div 3 = 15{,}000 \div 3$. (If you don't remember how to isolate unknowns, flip on over to Chapter 7.) Thus, your answer is

$m = 5{,}000$

Joan needs to save $5,000 each year for 3 years to reach her goal of $15,000 by the time she's 40.

Welcome Back to Basic (Math) Training

Numbers come in several varieties. *Whole* numbers are numbers like 1, 2, 17, and 54. *Fractions, percents,* and *decimals* are numbers used to represent what part of the whole you have. The following sections present some specific strategies you need to remember when you're crunching the numbers to figure out those menacing word problems.

Operating like a mathematical surgeon

When you toss numbers together (mathematically speaking), you perform an *operation.* When you add or multiply, you perform a *basic operation.* But because math, like the universe, functions according to yin-yang-like principles, each of these basic operations also has an opposite operation, called an *inverse operation.* Thus, the inverse of addition is subtraction, and the inverse of multiplication is division. And, of course, the inverse of subtraction is — you got it — addition. The inverse of division (as we're sure that we don't have to tell you) is multiplication.

REMEMBER

Don't confuse *opposite* with *inverse.* When you're doing mathematical operations, such as adding and multiplying, the inverse operation *is* the opposite operation (the inverse of addition is subtraction; the inverse of multiplication is division). But (you knew that was coming) when you're talking numbers, opposite and inverse *don't* mean the same thing. The opposite of a positive number is a negative number, so the *opposite* of x is $-x$. But the inverse of a number is that number turned on its head! The *inverse* of x is $\frac{1}{x}$. The inverse of $\frac{1}{5}$ is $\frac{5}{1}$ (or just 5).

The result of each operation goes by a different name. When you add two numbers together, you arrive at a *sum;* when you subtract, all that remains is a *remainder;* when you multiply, you come up with a *product;* and when you divide, you don't conquer, but instead you're left with a *quotient.*

Falling for fractions

If a *whole number* is a pie, a *fraction* is a slice of pie. A fraction also illustrates its relationship to the whole pie. For example, consider the fraction $\frac{3}{5}$. If you accuse your cousin of eating $\frac{3}{5}$ of the pie at Thanksgiving dinner, you're saying that the pie is divided into five equal-sized slices — fifths — and your cousin ate three of those five slices. Can anyone say *pig?*

The number above the fraction bar — the three slices your cousin ate — is called the *numerator.* The number written below the fraction bar — the total number of slices the pie is divided into — is called the *denominator.*

Adding and subtracting fractions

To add and subtract fractions, the fractions must have the same denominator, which is called a *common denominator.* If the fractions don't have a common denominator, you have to find one. Sound fun? Read on.

Finding a common denominator can be easy, or it can be hard. Suppose you want to add $\frac{3}{5}$ and $\frac{3}{10}$. This is an easy one. You can divide one denominator, 10, by the other denominator, 5. The quotient that results is 2. Take the fraction with the smaller denominator ($\frac{3}{5}$) and multiply the denominator by 2, the quotient that resulted when you divided the larger denominator by the smaller. This operation results in a new denominator of 10. Then multiply the numerator by 2 (resulting in a new numerator of 6). Thus, you can also express $\frac{3}{5}$ as $\frac{6}{10}$. (If you cut the pie into 10 slices instead of 5, and your cousin ate 6 slices instead of 3, he would have eaten exactly the same amount of pie.)

You can use this process whenever you can evenly divide one denominator by another.

After you have found a common denominator, you add the two fractions by simply adding the numerators together: $\frac{6}{10} + \frac{3}{10} = \frac{9}{10}$. Think of it this way: If your cousin eats $\frac{6}{10}$ of the pie (which is just another way of saying $\frac{3}{5}$), and your grandpa eats $\frac{3}{10}$ of the pie, together they've eaten $\frac{9}{10}$ of the pie.

But suppose your cousin eats $\frac{3}{5}$ of one pie and your aunt eats $\frac{1}{6}$ of another pie (one that was cut into 6 slices instead of 5), and you want to know how much pie has been eaten. In this case, you need to add $\frac{3}{5}$ and $\frac{1}{6}$.

Adding these fractions is a bit more difficult because you can't divide either denominator by the other. So you have to find a common denominator that both 5 and 6 divide into evenly. The easiest way to find this number is to multiply 5×6 to produce 30. Now you know that you need to convert the fractions so that they both have a common denominator of 30. To get the job done, express each fraction this way: $\frac{3}{5} = \frac{?}{30}$. Because you have to multiply the denominator by 6 to reach 30 ($5 \times 6 = 30$), you also have to multiply the numerator by 6. This time you get 18 ($3 \times 6 = 18$). Your missing numerator is 18, and the fraction $\frac{3}{5}$ can be expressed as $\frac{18}{30}$.

When you're trying to find the common denominator for a fraction, you must always multiply the numerator and the denominator by the same number. Otherwise, you will change the value of the fraction.

With the problem illustrated above, you multiply the numerator and the denominator by 6, discovering that $\frac{3}{5}$ is the same thing as $\frac{18}{30}$. But if you had multiplied only the denominator by 6, you would have a new number. $\frac{3}{5}$ and $\frac{3}{30}$ do not have the same value.

Now express the second fraction the same way: $\frac{1}{6} = \frac{?}{30}$. You multiply the denominator by 5 to reach 30 ($6 \times 5 = 30$), so you have to multiply the numerator by the same number. Perform this little operation ($1 \times 5 = 5$), and you find out that your new numerator is 5. The fraction $\frac{1}{6}$ can be expressed as $\frac{5}{30}$.

After all that work, you can finally add the fractions: $\frac{18}{30} + \frac{5}{30} = \frac{23}{30}$.

If you have more than two fractions with different denominators, you have to find a common denominator that all the denominators divide into. Suppose you need to add $\frac{1}{2} + \frac{2}{3} + \frac{3}{5}$. A simple way to find a common denominator is to take the largest denominator (in this case 5) and multiply it by whole numbers, starting with 1, 2, 3, 4, and so on until you find a denominator that the other denominators also divide into evenly. If you multiply 5 by 2, you get 10, but 3 doesn't divide evenly into 10. So keep going: $5 \times 3 = 15$, $5 \times 4 = 20$, and so on until you find a number that 2, 3, and 5 can divide into evenly. In this case, 30 is the first number you can find that 2, 3, and 5 can divide into evenly, so 30 is your common denominator.

You can always multiply all the denominators together to find a common denominator, but this process may result in a really big, hard-to-handle denominator.

Multiplying and simplifying fractions

Multiplying fractions is easy. You just multiply the numerators and then multiply the denominators.

Thus, $\frac{1}{2} \times \frac{3}{4} \times \frac{3}{5}$ can be multiplied as $1 \times 3 \times 3 = 9$ (the numerators) and then $2 \times 4 \times 5 = 40$ (the denominators) to result in $\frac{9}{40}$.

Occasionally, when you multiply fractions, you end up with an extremely large fraction that can be *simplified.* To express a fraction in its *lowest terms* means to put it in such a way that you can't divide the numerator and the denominator by the same number (other than 1).

If you have the fraction $\frac{6}{10}$, you can see that both the numerator (6) and the denominator (10) can be divided by the same number (2). A number that you can divide into both the numerator and the denominator is called a *common factor.* In this example, the common factor is 2. If you perform the operations ($6 \div 2 = 3$ and $10 \div 2 = 5$), you see that $\frac{6}{10}$ can be expressed in the simpler terms of $\frac{3}{5}$. You can't reduce (simplify) $\frac{3}{5}$ any further; the only other number that both the numerator and denominator can be divided by is 1, and the result would be the same, $\frac{3}{5}$.

Converting improper fractions to mixed numbers . . . and back again

If you have a fraction with a numerator larger than its denominator, you have an *improper fraction.* For example, $\frac{7}{3}$ is an improper fraction. To put an improper fraction into simpler (proper) terms, you can change $\frac{7}{3}$ into a mixed number (a number that includes a whole number and a fraction). Simply divide the numerator by the denominator. 7 divided by 3 becomes a quotient of 2 with $\frac{1}{3}$ left over. There's something left over because 3 doesn't divide evenly into 7. The number that is left over becomes a numerator over the original denominator. Thus, $\frac{7}{3}$ is the same as $2\frac{1}{3}$.

If you want to multiply or divide a mixed number, you need to convert it into a fraction — an improper fraction. To make the change, you convert the whole number into a fraction and add it to the fraction you already have. So, if you have $7\frac{2}{3}$, you convert 7 to a fraction, which gives you $\frac{21}{3}$, and add that fraction to the fraction that already exists — $\frac{2}{3}$ — to arrive at $\frac{23}{3}$.

How do you know that 7 is the same thing as $\frac{21}{3}$? Well, to convert the whole number into a fraction, multiply the whole number by the denominator of the existing fraction to arrive at a new numerator: $7 \times 3 = 21$. You then place this new numerator over the existing denominator to achieve $\frac{21}{3}$. But you're not done yet. You add that fraction to the remaining fraction to get the final answer: $\frac{21}{3} + \frac{2}{3} = \frac{23}{3}$. (Check out the "Adding and subtracting fractions" section earlier in this chapter for the complete scoop on the adding-fractions thing.) Or, if you want to get technical, you can look at the whole process this way, too:

$$7\frac{2}{3} = \frac{(7 \times 3) + 2}{3} = \frac{23}{3}$$

Dividing fractions

Dividing fractions is simple if you remember this rule: Dividing a fraction by a number (pick a nonzero number) is the same as multiplying it by the *inverse* of that number (remember, the inverse of a number is obtained by reversing the number). That means that if you want to divide a fraction by 5, you simply multiply the fraction by the inverse of 5, which is $\frac{1}{5}$.

This process is more easily illustrated if you remember that 5 is the same thing as $\frac{5}{1}$. In other words, 5 divided by 1 equals 5 ($5 \div 1 = 5$). And the inverse of $\frac{5}{1}$ is $\frac{1}{5}$. To come up with the inverse of a number, simply stand the number on its head.

SERGEANT SAYS

You can't use this operation on zero. Zero has no inverse. No one knows why — it just is.

So, to divide a fraction, use the inverse of the number that follows the division symbol (÷) and substitute a multiplication symbol (×) for the division symbol. Therefore, $\frac{1}{3} \div 2$ is expressed as $\frac{1}{3} \times \frac{1}{2}$, and you already know how to multiply fractions. (If not, check out the "Multiplying and simplifying fractions" section earlier in the chapter.) $1 \times 1 = 1$ and $3 \times 2 = 6$, so the product of $\frac{1}{3} \times \frac{1}{2}$ is $\frac{1}{6}$. Thus, $\frac{1}{3} \div 2 = \frac{1}{6}$.

Converting fractions to decimals and decimals to percents

A fraction can also be expressed as a decimal and as a percent. To change a fraction into a decimal, divide the numerator (number of slices your cousin ate) by the denominator (number of slices in the whole pie). Given that handy explanation, $\frac{3}{5}$ converted into decimal form is 0.60. To make a decimal into a percent, move the decimal point two spaces to the right and add a percent sign — 0.60 becomes 60.0%. (See the following sections for more thorough discussions of decimals and percents.)

Dealing with decimals

Decimals are just another way of expressing a fraction. The expression 0.1 simply means $\frac{1}{10}$. A decimal expressed as 0.01 is the same as the fraction $\frac{1}{100}$. You can also express these decimals as percents: 0.1 = 10% and 0.01 = 1%.

Adding and subtracting decimals

To add and subtract decimals, put the numbers in a column and line up the decimal points. Then add or subtract as if the decimals were whole numbers, keeping the decimal point in the same position in your answer. Here are two examples:

$$\begin{array}{r} 1.4583 \\ +\ 0.55 \\ \hline 2.0083 \end{array} \qquad \begin{array}{r} 1.4583 \\ -\ 0.55 \\ \hline 0.9083 \end{array}$$

SERGEANT SAYS

You can add zeroes to the end of a decimal if performing the calculations this way is easier for you. So 0.1 can be 0.100 without changing its value. In the above problems, 0.55 can be 0.5500 to help you do the operation.

Multiplying decimals

Multiplying a decimal is like multiplying a regular, everyday whole number, except that you have to place the decimal point in the right position. To multiply decimals, start off by adding the number of decimal places (from the right of the decimal point) in the numbers being multiplied. If one of the numbers you're multiplying is 0.1, for example, you have one decimal place. If the other number you're multiplying is 3, you have no decimal places, so the total number of decimal places in your answer is one. In this example, you have to be sure that you have one decimal place in your answer, counting from right to left and putting a decimal point in where you stop. Thus, if you multiply 3 × 0.1, the product is 0.3.

Or, put another way:

$$3 \times 1/10 = 3/1 \times 1/10 = 3/10 = 0.3$$

If you're multiplying a number that has only zeroes to the right of the decimal point, then those decimals don't count. For instance, in the above problem, 3 could also be expressed as 3.0, but you wouldn't count the "0" as a decimal place. All of the zeroes to the right of the decimal don't count unless a number other than zero is also to the right of the decimal. 3.000007 has six decimal spaces; 3.0070 has three decimal spaces; and 3.000 has none, at least not for the purpose of multiplying.

If your answer doesn't include enough numbers for the decimal spaces you need, then add as many zeroes as necessary to the left of the answer. Suppose your answer is 50, and you have to move the decimal point over three spaces. There aren't three spaces in 50. So you add a zero to the left, to make 050, and put the decimal point in its proper position: .050 is your answer.

Here's another example: 0.04 × 0.25. Add the decimal places in the two numbers. (There are four.) Multiply the decimals as if they were whole numbers: 4 × 25 = 100. Then put the decimal point in the correct place in the answer. For 100, count from right to left four places, and put the decimal point there: 0.0100. Here's the method behind the madness:

$$4/100 \times 25/100 = 100/1000 = 1/10 = 0.01 \text{ (or } 0.0100)$$

Dividing decimals

Decimals are divided according to slightly different rules depending on whether or not both numbers in the problem are decimals.

Dividing decimals by whole numbers

If you're dividing a decimal by a whole number, perform the operation as if the two numbers were both whole numbers. Move the decimal point over to the right until the decimal is a whole number, counting the number of decimal places. Remember how many places you moved the decimal — you need that info later.

Here's an example: 1.25 ÷ 4 = ?. First, change the 1.25 to 125 by moving the decimal two decimal places to the right. Then, perform the division operation on the whole number: 125 ÷ 4 = 31.25. No, you're not done yet.

Now move the decimal point two places to the left (to make up for moving it two places to the right when you made 1.25 into a whole number), and your answer is 0.3125.

Dividing decimals by decimals

To divide a decimal by another decimal, make the *divisor* (the decimal going into the other number) a whole number. Move the decimal point all the way to the right, counting (and remembering) the number of places you move it. Then move the decimal in the *dividend* (the number being divided) the same number of decimal places.

So, if you want to divide 0.15 by 0.25, (0.15 ÷ 0.25) move the decimal point two places to the right in the divisor: 0.25 then becomes 25. Next move the decimal in the dividend the same number of spaces: 0.15 becomes 15. Then, divide 15 by 25. The result is 0.60. You don't need to move any more decimals around — 0.60 is your final answer.

If the dividend is a longer decimal than the divisor, you follow these same steps, but you have to add an extra step at the end. So, if your problem is 0.125 ÷ 0.50, move the decimal point in the divisor (0.50) two places to the right so that you have the whole number 50. Then move the decimal point in the dividend two places, to come up with 12.5. Now the problem looks like this: 12.5 ÷ 50. Now divide following the instructions in the earlier "Dividing decimals by whole numbers" section.

When the divisor is a longer decimal than the dividend, such as 0.5 ÷ 0.125, move the decimal place in the divisor all the way to the right, in this case making 0.125 into 125, counting spaces. Then move the decimal the same number of spaces in the dividend, adding zeroes as needed: 0.5 then becomes 500. 500 ÷ 125 = 4, which is the correct answer (0.50 ÷ 0.125 = 4).

Playing with percents

A *percent* is a fraction based on one hundredths. Five percent (5%) is the same as $\frac{5}{100}$ or 0.05. [illegible] "15% off" or "an increase of 15%" on the Arithmetic Reasoning subtest. You need to be able to convert percents to fractions or decimals to answer these questions correctly.

To add, subtract, multiply, or divide using percents, change the percent to a fraction or a decimal. Remember, a percent is just hundredths, so 3% is $\frac{3}{100}$ or 0.03, 22% is $\frac{22}{100}$ or .22, and 110% is $\frac{110}{100}$ or 1.10. Just drop the percent sign and move the decimal point two places to the left, adding zeros as needed. The decimal point always starts to the right of a whole number, so 60 is the same thing as 60.0. Moving the decimal point two spaces to the left leaves you with 0.60. After you do the conversion, follow the rules we outline in the earlier sections for performing specific operations on fractions or decimals.

Some fractions convert to *repeating decimals* — a decimal in which one digit is repeated infinitely. $\frac{2}{3}$ is the same as 0.66666 (with the sixes never stopping). Repeating decimals are often rounded to the nearest hundredth; therefore, $\frac{2}{3}$ rounds to 0.67. Remember, the first space to the right of the decimal is the *tenth* place, the second space is the *hundredth* place, and the third is the *thousandth* (and so on).

Running through ratios

A *ratio* shows a relationship between two things. It expresses a comparison by proportion. If Margaret invested in her tattoo parlor at a 2:1 ratio to her business partner Julie, then Margaret put in two dollars for every one dollar that Julie put in.

Remembering rate

The term *rate* has various meanings. Essentially, a rate is a fixed quantity (a 5% interest rate, for example). It can mean the speed at which one works. (John reads at the rate of one page per minute.) It can also mean an amount of money paid based on another amount. (Life insurance may be purchased at a rate of $1 per $100 of coverage.)

Hitting the scale

Scale, particularly when used on the ASVAB, relates to scale drawings. For example, a map drawn to scale may have a one-inch drawing of a road that represents one mile of physical road in the real world. The Arithmetic Reasoning portion of the ASVAB often asks you to calculate a problem based on scale, which can be represented as a ratio or a fraction.

For example, on a map with a scale of one inch to one mile, the ratio of the scale is represented as 1:1. But questions are never this easy on the ASVAB. You're more likely to see something like, "If a map has a scale of one inch to every four miles. . . ." That scale could be expressed as the ratio 1:4.

SERGEANT SAYS

Almost every military job makes use of scales, which is why scale-related questions are so common on the ASVAB. No, we're not talking about the scale you climb onto to see if you need to skip lunch. Whether you're reading maps at Mountain Warfare School or organizing trash pickup around the base, you'll need to use and interpret scales frequently.

Uncovering an unusual series of events

The Arithmetic Reasoning subtest often includes questions that test your ability to logically complete a series of numbers. Generally, these problems are the only questions that aren't word problems, but they test your ability to do arithmetic and to reason because you must be able to determine how the numbers are related to each other. And to do this, you must also be able to quickly perform mathematical operations.

Suppose you have a series of numbers that look like this:

1, 4, 7, 10, ?

You can easily see that each number is reached by adding three. $1 + 3 = 4$; $4 + 3 = 7$; and so on. So the next number in the sequence would be $10 + 3$ *or* 13.

But, of course, the questions on the ASVAB aren't quite this simple. More likely, you'll see something like this:

2, 4, 16, 256, ?

In this case, each number is being multiplied by itself, so $2 \times 2 = 4$; $4 \times 4 = 16$; and so on. 256×256 is 65,536, so that's the correct answer.

You may also see sequences like this:

1, 2, 3, 6, ?

In this sequence, the numbers are being added together. $1 + 2 = 3$ and $1 + 2 + 3 = 6$. So the next number would be $1 + 2 + 3 + 6$ *or* 12.

Finding the pattern

To answer sequence questions correctly, you need to figure out the pattern as quickly as possible. Some people, blessed with superior sequencing genes, can figure out patterns instinctively. The rest of us have to rely on more difficult, manual effort.

SERGEANT SAYS

Finding a pattern in a series of numbers requires you to think about how numbers work. For instance, in the second example in the preceding section, seeing the number 256 should alert you that multiplication is the operation because 256 is so much larger than the other numbers. On the other hand, because the values in the third example don't increase by much, you can guess that the pattern requires addition rather than multiplication.

Dealing with more than one operation in a series

Don't forget that more than one operation can occur in a series. For example, a series may be "add one, subtract one, add two, subtract two." That would look something like this:

2, 3, 2, 4, ?

Because the numbers in the series both increase and decrease as the series continues, you should suspect that something tricky is going on.

Remember that scratch paper? Use it! Jot down notes while you're trying to find the pattern in a series. Writing your work down helps you keep track of what operations you've tried.

Testing 1, 2, 3: Test-Taking Strategies

Guessing in boot camp is a definite no-no, but guessing in many areas of the ASVAB is perfectly fine. On the Arithmetic Reasoning subtest, you aren't penalized for wrong answers, so it makes sense to guess if you don't know the answer. After all, you have a 1 in 4, or 25%, or 0.25, chance to guess the correct answer. That's better than the 0% chance you have of getting a question right if you skip it. Plus, by following the tips in the following sections, you can do a better job of guessing correctly and increase your odds of winning the lottery, er, we mean scoring well on the ASVAB.

Don't spend much more than a minute on any one problem. If you do, you may not have time to finish this subtest. But, before you commit to an answer to a math question, double-check your calculations. One easy way to double-check your work is to plug the answer into the question.

Logical deductions: Eliminating unlikely answers

Check out the sand-in-the-box problem you first encounter in the "What's the problem?" section, earlier in this chapter.

How many cubic inches of sand does a cardboard box measuring 12 inches long by 14 inches wide by 10 inches tall contain?

(A) 52 cubic inches

(B) 88 cubic inches

(C) 120 cubic inches

(D) 1,680 cubic inches

You've already shrewdly determined that the question is asking you to find the volume of the cardboard box. But you don't remember that Volume = length × width × height. In fact, you think that the only time anyone told you about volume was when they said that your stereo was too loud, which is no help to you now.

Still all is not lost. If you use logic, you may be able to eliminate some incorrect or unlikely answers from the choices, which improves your chances of guessing correctly.

Applying other formulas to identify wrong answers

You know that adding the length of each side of the box gives you the perimeter, which isn't the right answer. So, if 12 + 12 + 14 + 14 = the perimeter, or 52 inches, then you know that Answer A is *not* correct.

So you continue thinking about the problem. You know that if you multiply the height of the box by its length, you get the area, not the volume. So solving for area by multiplying length times width and coming up with 120 doesn't solve the problem. Therefore Answer C is also wrong.

At this point, it may occur to you that if you multiply the height of the box by its length and by its width, you get its volume.

Or it may not occur to you. But you do know that the volume measurement is going to be greater than the area measurement. So you can choose an answer that is larger than the area of the cardboard box. Thus, if Answer C, 120, is too small, then Answer B, 88, is also too small — and also wrong. So the correct answer is D, 1680.

Everything doesn't usually work out quite so neatly on the ASVAB, but in general, you can eliminate a few choices through logical reasoning. Then you can choose among the remaining answers. Doing this means you have a greater chance of guessing the right answer.

Avoiding testing traps

Don't forget to solve the entire problem. Sometimes those crafty test-makers set little traps for you to fall into. For instance, suppose you have this question:

John, a roofing contractor, needs to purchase asphalt shingles for a client's roof. How many 4-x-4-inch shingles are needed to cover a roof that measures 12 x 16 feet?

(A) 192

(B) 12

(C) 27,648

(D) 1,728

This question asks you to perform several operations. You must determine the area of the roof, figure out the area each shingle will cover, and then come up with the total number of shingles required to cover the area of the roof.

Many people fail to complete the entire series of calculations because they're sweating the pressure from the clock. They think, "Aha! I know how to answer this one!" They figure out that the area of the roof is 192 square feet (12 × 16) and choose Answer A as the correct answer. But Choice A isn't the correct answer because coming up with 192 square feet is only a small portion of the problem.

Others folks go further with their calculations and determine that the area of each shingle is 16 inches (4 × 4) and divide 192 (the area of the roof) by 16 to reach 12 shingles. They choose Answer B, and they're wrong. They're wrong because the roof is measured in feet and the shingles are measured in inches. The measurements must be converted so that the area of the shingles and the area of the roof are both expressed in the same measuring unit.

The easiest way to do this is to multiply both the length and the height of the roof by 12 (because 12 inches are in a foot) and then multiply the height and the length of the roof together to determine the total area of the roof in inches.

Thus, the area of the roof in inches is 27,648. Some people, pleased that they remembered to convert feet into inches, choose Answer C. That's an incorrect answer because the question asks how many shingles are needed to cover the roof. To determine the number of shingles needed, divide 27,648 by 16 (the area in inches of each shingle) to come up with 1,728 shingles (or enough to cause John to go back to the shop for a heavy-duty pickup truck). *Correct answer:* D.

Use your common sense! If an answer doesn't seem reasonable — like a roof requiring only 12 shingles — you've probably made a mistake in your calculations. Go back and try again. Remember, this subtest is testing your ability to make calculations based on real-life problems, and no real-life roof was ever covered with only 12 shingles.

Sample Test Questions

Now that you know what you're up against, give these sample questions a try. They're similar to the ones you'll see on the ASVAB Arithmetic Reasoning subtest.

1. If apples are on sale at 15 for $3, what is the cost of each apple?

   (A) 50 cents

   (B) 25 cents

   (C) 20 cents

   (D) 30 cents

   Correct answer: C. Divide $3 by 15.

2. A noncommissioned officer challenged her platoon of 11 enlisted women to beat her record of performing a 26-mile training run in 4 hours. If all of the enlisted women match her record, how many miles will they have run?

   (A) 71.5 miles

   (B) 6.5 miles

   (C) 286 miles

   (D) 312 miles

   Correct answer: C. Multiply 26 × 11. The other information in the question is irrelevant — it's there to throw you off.

3. Margaret gets her hair cut and colored at an expensive salon in town. She is expected to leave a 15% tip for services. If a haircut is $45 and a color treatment is $150, how much of a tip should Margaret leave?

   (A) $22.50

   (B) $29.25

   (C) $20.00

   (D) $195.00

   Correct answer: B. Add 45 and 150 and multiply the answer by .15 (15%).

4. A bag of sand holds 1 cubic foot of sand. How many bags of sand are needed to fill a square sandbox measuring 5-feet long and 1-foot high?

   (A) 25 bags

   (B) 5 bags

   (C) 10 bags

   (D) 15 bags

   Correct answer: A. The volume of the sandbox (l × w × h) is 25 cubic feet, and each bag hold one cubic foot of sand.

5. The day Samantha arrived at boot camp, the temperature reached a high of 90 degrees in the shade and a low of –20 at night in the barracks. What was the average temperature for the day?

   (A) 55 degrees

   (B) 45 degrees

   (C) 70 degrees

   (D) 62 degrees

   Correct answer: A. Divide the temperature range of 110 degrees by 2 to reach the average temperature.

6. Farmer Beth has received an offer to sell her 320-acre farm for $3,000 per acre. She agrees to give the buyer $96,000 worth of land. What fraction of Farmer Beth's land is the buyer getting?

   (A) $\frac{1}{4}$

   (B) $\frac{1}{10}$

   (C) $\frac{1}{5}$

   (D) $\frac{2}{3}$

   Correct answer: B. $96,000 divided by $3,000 (price per acre) equals 32 acres. 32 acres divided by 320 acres (total of the farm) equals 10% or $\frac{1}{10}$ of the land.

7. A map is drawn so that 1 inch equals 3 miles. On the map, the distance from Kansas City to Denver is 192½ inches. How far is the roundtrip from Kansas City to Denver in miles?

   (A) 192½ miles

   (B) 577.5 miles

   (C) 385 miles

   (D) 1,155 miles

   Correct answer: D. Multiply 192.5×3 to get the distance in miles and then double the answer to account for both legs of the trip.

8. Margaret and Julie can sell their tattoo parlor for $150,000. They plan to divide the proceeds according to the ratio of the money they each invested in the business. Margaret put in the most money, at a 3:2 ratio to Julie. How much money should Julie get from the sale?

   (A) $50,000

   (B) $30,000

   (C) $60,000

   (D) $90,000

   Correct answer: C. According to the ratio, Margaret should get $\frac{3}{5}$ of the money and Julie should get $\frac{2}{5}$ of the money. The fractions are calculated by adding both sides of the ratio together ($3 + 2 = 5$) to determine the denominator. Each side of the ratio then becomes a numerator, so that Margaret's investment can be shown to be $\frac{3}{5}$ of the total investment, and Julie's is $\frac{2}{5}$ of the total investment. (You can check these fractions by adding $\frac{3}{5}$ and $\frac{2}{5}$ to get $\frac{5}{5}$ or 1, which is all of the money.) Divide $150,000 by 5, then multiply the answer by 2 to determine Julie's share of the money.

9. What is the fifth number in the series 4, 8, 16, 32?

   (A) 48

   (B) 64

   (C) 96

   (D) 8

   Correct answer: B. The pattern is to double each number: 4 + 4 =8; 8 + 8 =16; 16 + 16 = 32; so 32 + 32 = 64

10. In the military, $\frac{1}{4}$ of an enlisted person's time is spent sleeping and eating, $\frac{1}{12}$ is spent standing at attention, $\frac{1}{6}$ is spent staying fit, and $\frac{2}{5}$ is spent working. The rest of the time is spent at the enlisted person's own discretion. How many hours per day does this discretionary time amount to?

    (A) 6.0 hours

    (B) 1.6 hours

    (C) 2.4 hours

    (D) 3.2 hours

    Correct answer: C. Calculate this answer by first assigning a common denominator of 60 to all the fractions and adjusting the numerators accordingly: $\frac{15}{60}$, $\frac{5}{60}$, $\frac{10}{60}$, and $\frac{24}{60}$. Add the fractions to find out how much time is allotted to all of these tasks. The total is $\frac{54}{60}$, which leaves $\frac{6}{60}$ or $\frac{1}{10}$ of the day to the enlisted person's discretion. $\frac{1}{10}$ of 24 hours is 2.4 hours.

ARITHMETIC REASONING REVIEW

The Arithmetic Reasoning section in the ASVAB includes basic math processes like addition, subtraction, multiplication, and division, and applying these computational operations to solve simple math problems you come across in everyday life. The ability to perform basic math operations and to use computational skills to solve simple math problems is needed for activities at work, school, or home; in shopping and banking; or engaging in social, community, or recreational activities.

A concise review of basic arithmetic follows. It is provided to refresh your memory about basic math operations and give you practice for the math word problems that are on the ASVAB.

Review of Basic Arithmetic

Whole Numbers

1.	One
10.	Ten
100.	One hundred
1,000.	One thousand
10,000.	Ten thousand
100,000.	One hundred thousand
1,000,000.	One million
10,000,000.	Ten million
100,000,000.	One hundred million
1,000,000,000.	One billion

Always start counting from the decimal point. Note that the value of a digit increases when the digit is moved to the left. Each time it is moved farther to the left of the decimal point, the value of a digit is multiplied by ten. To make it easier to read great numbers (numbers containing four or more digits), commas are placed every three spaces as you go left from the decimal point.

If the decimal point is not shown with the whole number, it is understood to be just to the right of the last digit on the right.

24 means 24.   12,528 means 12,528.

Decimals

0.1	One tenth
0.01	One hundredth
0.001	One thousandth
0.0001	One ten-thousandth
0.00001	One hundred-thousandth
0.000001	One millionth

Always start counting from the decimal point. Note that the value of a digit decreases when the digit in a decimal is moved to the right. The value of the digit is divided by ten each time it is moved one place farther to the right of the decimal point.

Decimals are also known as decimal fractions, since the denominator is a tenth, hundredth, thousandth, etc.

0.1 is $\frac{1}{10}$ $\quad 0.01$ is $\frac{1}{100}$ $\quad 0.001$ is $\frac{1}{1000}$

Fractions

A fraction is a number that indicates one or more equal parts. A fraction has a *numerator*, a *division line*, and a *denominator*.

$\frac{1}{4}$ or $1/4$

The bottom number (*denominator*) shows the number of equal parts into which the whole has been divided.

The top number (*numerator*) shows how many of these equal parts are in the fraction.

A *proper fraction* has a numerator that is less than the denominator. It is also called a *common fraction* or *fraction*.

$1/3$ or $\frac{1}{3}$ $\quad 3/4$ or $\frac{3}{4}$ $\quad 7/9$ or $\frac{7}{9}$

An *improper fraction* has a numerator that is equal to or greater than the denominator.

$3/3$ or $\frac{3}{3}$ $\quad 9/8$ or $\frac{9}{8}$ $\quad 16/15$ or $\frac{16}{15}$

A *mixed number* consists of the sum of whole number and a fraction.

$1\ 1/4$ or $1\frac{1}{4}$ $\quad$ $12\ 1/2$ or $12\ \frac{1}{2}$

Percent

Percent means hundredth. It may be expressed with the % symbol, as a fraction with a denominator of 100, or as a decimal.

Here is a quick chart to rename percents as fractions and decimals.

Percent	Fraction	Decimal
1%	$\frac{1}{100}$	0.01
50%	$\frac{50}{100}$ or $\frac{1}{2}$	0.50 or 0.5
$12\frac{1}{2}\%$	$\frac{12.5}{100}$ or $\frac{125}{1000}$	0.125

Addition

Addition is indicated by the plus (+) sign, the word *plus*, or the word *and.*

Addends are the numbers that are added. The *total* or *sum* is the number obtained by adding all the addends.

Adding Whole Numbers, Decimals, and Dollars and Cents

The numbers to be added are arranged in vertical columns. As additions consist of combining similar units, units must be placed directly under units, tens under tens, hundreds under hundreds, etc. If decimals are to be added, place tenths under tenths, hundredths under hundredths, etc.

		9					$4.32
4	167	82			6.40	$3.85	16.68
21	285	134	23,857	28.7	12.25	6.21	103.14
+153	+310	+2675	+71,204	+34.7	+107.125	+ 4.16	+421.08
178	762	2900	95,061	63.4	125.775	$14.22	$545.22

Note that in vertical additions of dollars and cents, the $ is placed to the left of the top addend and to the left of the total.

Subtraction

Subtraction is indicated by the subtraction sign (–), the word *minus*, the words *take away*, or the words *find the difference between*. There are three parts to a subtraction problem:

> *Minuend:* Placed on the top of the vertical subtraction. It is the number from which another number is taken away.
>
> *Subtrahend:* Placed below the minuend in vertical subtraction. It is the number that is taken away.
>
> *Difference* or *remainder:* Result of the subtraction or what is left. This result is put at the bottom in vertical subtraction.

581	minuend
–350	subtrahend
231	difference or remainder

Subtracting Whole Numbers, Decimals, and Dollars and Cents

As with addition, the numbers in the subtraction are arranged in vertical columns. Units must be placed directly under units, tens under tens, hundreds under hundreds, etc. If there are decimals, place the decimal point directly under the decimal point, tenths under tenths, hundredths under hundredths, etc.

576	385	87.647	$743.65
–342	–57	–8.350	–418.45
234	328	79.297	$325.20

Note that in vertical subtraction of dollars and cents, the $ is placed to the left of the minuend and to the left of the answer.

Multiplication

Multiplication is indicated by the multiplication sign (×), the word *multiply*, or the word *times*. There are three main parts to multiplication problems:

1. *Multiplicand:* Number being multiplied.
2. *Multiplier:* Number by which you multiply.
3. *Product:* Answer obtained by multiplying the multiplicand by the multiplier.

12	multiplicand	483	multiplicand
×9	multiplier	×24	multiplier
108	product	1932	partial product (4×483)
		966	partial product (2×483)
		11592	product

Note that when the multiplier consists of more than one digit, the answer obtained by multiplying the multiplicand by each digit of the multiplier is called a *partial product*.

Multiplying Whole Numbers

In the multiplication process, first multiply units, then tens, then hundreds, etc. The answers to each of these separate multiplications are partial products. The final answer or product is obtained by adding all the partial products.

```
  365
 ×124
 1460  (ones)
  730  (tens)
 365   (hundreds)
45,260
```

Note that the right digit of each partial product is placed in a vertical line with the digit used as a multiplier. The addition of the partial products is made easier by placing the right digit of each succeeding partial product one place farther to the left.

Multiplying Decimals and Dollars and Cents

The multiplication process is the same as that for the whole numbers. However, it requires the additional step of fixing the decimal point in the answer. This is accomplished by counting the total number of digits to the right of the decimal points in both the multiplicand and the multiplier and then fixing the decimal point in the answer by counting off the same total number of places from right to left in the product.

25.6	One digit to the right of the decimal point in the multiplicand plus
× .43	two digits to the right of the decimal point in the multiplier equals
768	three.
1024	Count off three places from right to left in the product to fix the
11.008	decimal point.

$ 325.75	Two digits to the right of the decimal point in the multiplicand plus
× 18	zero digits to the right of the decimal point in the multiplier equals
260600	two.
32575	Count off two from right to left in the product to fix the
$5,863.50	decimal point.

Division

Division is indicated by the division sign (÷), the fraction sign (— or /), the words *divided by*, the short-division symbol)______, or the long-division symbol $\overline{)\quad\quad}$. Division problems have four parts:

1. *Dividend:* Number being divided.
2. *Divisor:* Number by which you divide.
3. *Quotient:* Answer to division.
4. *Remainder:* Number that is left if division is not exact.

Dividing Whole Numbers

If the divisor is a single-digit number, use either short division or long division. If the divisor has more than one digit, use long division.

Short division

Divisor	$3\underline{)867}$	Dividend
	289	Quotient

1. 8 divided by 3 is 2 with a remainder of 2, change 6 to 26.
2. Record the 2 in the quotient under 8.
3. 26 divided by 3 is 8 with a remainder of 2, change 7 to 27.
4. Record the 8 in the quotient under 6.
5. 27 divided by 3 is 9 exactly.

To check if the division is correct, multiply the quotient by the divisor. If no error was made, the product should be the same as the dividend.

Check:
$$\begin{array}{r} 289 \\ \underline{\times 3} \\ 867 \end{array}$$

Long division:

$$\begin{array}{r} 35 \\ 26\overline{)910} \\ \underline{-78} \\ 130 \\ \underline{-130} \\ 0 \end{array}$$

1. Estimate 91 divided by 26 as 3.
2. Record the 3 in the quotient over 1 and multiply 26 by 3.
3. Record the product 78 under 91.

   (If the product is greater than 91, it means that 3 is too great and that a lesser number should be used.)
4. Subtract the 78 from the 91 and record the 13.

   (If the difference is greater than 26, it means that 3 is too small and that a greater number should be estimated.)
5. Bring down the next digit (0 in this case) and join it to the difference.
6. Estimate 130 divided by 26 as 5.
7. Record the 5 in the quotient over the 0 and multiply 26 by 5.
8. Record the product under 130.
9. Subtract 130 from 130.
10. The difference is 0, so there is no remainder.

Check:

$$\begin{array}{r} 35 \\ \underline{\times 26} \\ 210 \\ \underline{70} \\ 910 \end{array}$$

Dividing Decimals

To divide a decimal by a whole number, proceed as if the dividend were a whole number. Then fix the decimal point in the quotient directly in line with the decimal point in the dividend.

$$\begin{array}{r} 8\overline{)385.04} \\ 48.13 \end{array} \qquad \begin{array}{r} 48.13 \\ 8\overline{)385.04} \\ \underline{-32} \\ 65 \\ \underline{-64} \\ 10 \\ \underline{-8} \\ 24 \\ \underline{-24} \\ 0 \end{array}$$

Check:

$$\begin{array}{r} 48.13 \\ \times \quad 8 \\ \hline 385.04 \end{array}$$

To divide by a decimal, first rename the divisor as a whole number by moving the decimal point to the right of the last digit on the right. Then move the decimal point in the dividend to the right the same number of places. If necessary, add zeros. Finally, complete the division as you ordinarily would with a whole number as a divisor.

$.6\overline{)2.4}$	is changed to	$6\overline{)24}$
$.6\overline{)24.}$	is changed to	$6\overline{)240}$
$2.4\overline{)3.12}$	is changed to	$24\overline{)31.2}$
$2.46\overline{)3.198}$	is changed to	$246\overline{)319.8}$
$.005\overline{)30.}$	is changed to	$5\overline{)30000}$

Note that in all the above changes, the quotient is unchanged as both the divisor and the dividend are multiplied by the same amount.

Decimal division is also used when the division involves dollars and cents or just cents alone.

$$\frac{\$9.60}{3} = \$3.20 \quad \frac{\$.75}{15} = \$.05$$

Note that when dollars or cents are divided by a number, the answer is in dollars or cents.

$$\frac{\$150}{\$5} = 30 \quad \frac{\$5.50}{\$.25} = 22$$

Note that when dollars are divided by dollars or when dollars and cents are divided by dollars and cents, the answer is a number.

Sample Questions

The following sample questions illustrate some of the question types in the Arithmetic Reasoning subtest that deal with the application of the four basic arithmetic operations just covered. Answers and explanations are located on pages 164–167.

Addition

1. 75 + 49 =

   The sum is

   1-A 114

   ✓1-B 124

   1-C 125

   1-D 225

2. The sum of $51.75, $172.50, $39, $8.54, and $0.09 is

   2-A $116.64

   2-B $171.78

   2-C $261.89

   ✓2-D $271.88

Subtraction

3. Subtract: 57,697

   −9,748

   The difference is

   3-A 40,945

   ✓3-B 47,949

   3-C 48,949

   3-D 67,445

4. Subtract $987.59 from $1,581.06. The difference is

   ✓4-A $593.47

   4-B $603.47

   4-C $693.47

   4-D $694.47

5. Add $72.07 and $31.54, and then subtract $25.75. The correct answer is

   ✓5-A $77.86

   5-B $82.14

   5-C $88.96

   5-D $129.36

Multiplication

6. Multiply 36
   $\underline{\times 8}$

   The product is
   6-A 246
   6-B 262
   ✓6-C 288
   6-D 368

7. Multiply 312.77 by .04 and round the result to the nearest hundredth.
   ✓7-A 12.51
   7-B 12.511
   7-C 12.518
   7-D 12.52

Division

8. Divide $5\overline{)455}$

   The quotient is
   8-A 81
   8-B 84
   ✓8-C 91
   8-D 94

9. $7.95 \div 0.15 =$
   9-A 0.53
   9-B 5.3
   ✓9-C 53
   9-D 530

Additional Sample Arithmetic Problems Encountered in Everyday Life

10. Which of the following amounts of money has the greatest value?
    10-A 3 quarters
    ✓10-B 8 dimes
    10-C 15 nickels
    10-D 79 pennies

11. Two weeks, five days plus three weeks, four days equals
    - 11-A 5 weeks, 1 day.
    - 11-B 5 weeks, 2 days.
    - 11-C 6 weeks, 1 day.
    - ✓11-D 6 weeks, 2 days.

12. Subtract: 2 feet, 4 inches
    −1 foot, 6 inches
    - 12-A 8 inches
    - ✓12-B 10 inches
    - 12-C 1 foot
    - 12-D 1 foot, 2 inches

13. Of the 36 students registered in a class, $\frac{2}{3}$ of them are females. How many males are registered in the class?
    - ✓13-A 12
    - 13-B 18
    - 13-C 24
    - 13-D 30

14. If a 200-mile trip takes 4 hours to complete, the average speed is
    - 14-A 30 miles per hour.
    - 14-B 40 miles per hour.
    - ✓14-C 50 miles per hour.
    - 14-D 60 miles per hour.

15. How many pounds are in 24 ounces?
    - 15-A $\frac{1}{2}$
    - 15-B 1
    - ✓15-C $1\frac{1}{2}$
    - 15-D 2

16. The sales tax of 8% on a purchase of $12 is
    - 16-A $0.86
    - ✓16-B $0.96
    - 16-C $1.06
    - 16-D $1.60

17. A dozen oranges cost $1.35. The cost per orange is most nearly

17-A 11¢
17-B 12¢
17-C 13¢
17-D 14¢

18. A $75 fund is available for a holiday party. If 75% of the available money is spent for food and beverages, how much is left for other expenses?

18-A $18.75
18-B $28.75
18-C $46.25
18-D $56.25

19. A certain employee is paid at the rate of $6.74 per hour with time-and-a-half for overtime. The regular work week is 40 hours. During the past week, the employee put in 44 working hours. What were the employee's gross wages for that week?

19-A $269.60
19-B $296.56
19-C $310.04
19-D $444.84

20. It takes 4 men 14 days to do a certain job. How long should it take 7 men working at the same rate to do the same job?

20-A 5 days
20-B 6 days
20-C 7 days
20-D 8 days

21. If one quart of floor wax covers 400 square feet, how many gallons of wax are needed to wax the floor of a 6,400-square-foot office?

21-A 4 gallons
21-B 8 gallons
21-C 12 gallons
21-D 16 gallons

22. A pole 15 feet high casts a shadow 5 feet long. A 6-foot man standing nearby would cast a shadow

22-A $1\frac{1}{2}$ feet long.
22-B 2 feet long.
22-C $2\frac{1}{2}$ feet long.
22-D 3 feet long.

23. If 1 foot of chain costs 17¢, then 4 yards of this chain would cost
    - 23-A $0.68
    - 23-B $1.53
    - ✓23-C $2.04
    - 23-D $2.75

24. Tires regularly priced at $44 each are on sale for $37. How much would a truck owner save by buying four tires at the sale price?
    - 24-A $7
    - ✓24-B $28
    - 24-C $49
    - 24-D $81

25. How many 32-passenger buses are needed to transport 180 persons?
    - 25-A 4
    - 25-B 5
    - ✓25-C 6
    - 25-D 7

26. If a service station greased 270 vehicles in a 31-day period, the daily average of vehicles greased is most nearly
    - 26-A 6
    - 26-B 7
    - 26-C 8
    - ✓26-D 9

27. To check on a shipment of 500 articles, a sampling of 50 articles was carefully inspected. Of the sample, 4 articles were defective. On this basis, what is the probable percentage of defective articles in the original shipment?
    - 27-A .04%
    - 27-B 4%
    - ✓27-C 8%
    - 27-D 10%

28. If the total area of a four-room apartment is 3,600 square feet, the average area of each room is
    - ✓28-A $\frac{1}{4}$ of the total area.
    - 28-B $\frac{1}{3}$ of the total area.
    - 28-C $\frac{1}{2}$ of the total area.
    - 28-D $\frac{3}{4}$ of the total area.

Geometry

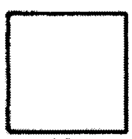
Area, Perimeter, and Volume

Area

Area is the space enclosed by a plane (flat) figure. A *rectangle* is a plane figure with four right angles. Opposite sides of a rectangle are of equal length and are parallel to each other. To find the area of a rectangle, multiply the length of the base of the rectangle by the length of its height. Area is always expressed in square units.

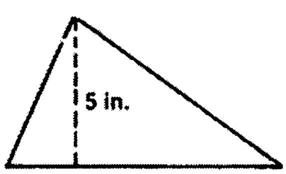
$$A = bh$$
$$A = 9 \text{ ft.} \times 3 \text{ ft.}$$
$$A = 27 \text{ sq. ft.}$$

A *square* is a rectangle in which all four sides are the same length. The area of a square is found by squaring the length of one side, which is exactly the same as multiplying the square's base by its height.



$$A = s^2$$
$$A = 4 \text{ in.} \times 4 \text{ in.}$$
$$A = 16 \text{ sq. in.}$$

A *triangle* is a three-sided plane figure. The area of a triangle is found by multiplying the base by the altitude (height) and dividing by two.



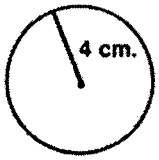
$$A = \frac{1}{2}bh$$

$$A = \frac{1}{2}(9 \text{ in.})(5 \text{ in.}) = \frac{45}{2}$$

$$A = 22\frac{1}{2} \text{ sq. in.}$$

A *circle* is a perfectly round plane figure. The distance from the center of a circle to its rim is its radius. The distance from one edge to the other through the center is its diameter. The diameter is twice the length of the radius.

Pi (π) is a mathematical value equal to approximately 3.14 or $\frac{22}{7}$. Pi is frequently used in calculations involving circles. The area of a circle is found by squaring the radius and multiplying it by π.

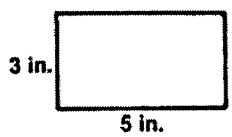


$$A = \pi r^2$$
$$A = \pi(4 \text{ cm.})^2$$
$$A = 16\pi \text{ sq. cm.}$$

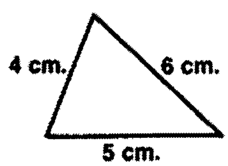
You may leave the area in terms of pi unless you are told what value to assign π.

Perimeter

The perimeter of a plane figure is the distance around the outside. To find the perimeter of a polygon (a plane figure bounded by straight lines), just add the lengths of the sides.

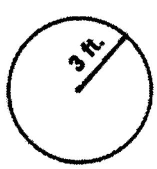


$$P = 3 \text{ in.} + 5 \text{ in.} + 3 \text{ in.} + 5 \text{ in.}$$
$$= 16 \text{ in.}$$



$$P = 4 \text{ cm.} + 6 \text{ cm.} + 5 \text{ cm.}$$
$$= 15 \text{ cm.}$$

The perimeter of a circle is called the *circumference*. The formula for the circumference of a circle is πd or $2\pi r$, which are both, of course, the same thing.



$$C = 2 \cdot 3 \cdot \pi = 6\pi$$

Volume

The volume of a solid figure is the measure of the space within. To figure the volume of a solid figure, multiply the area of the base by the height or depth.