

Word Problems

To solve word problems you need to answer at least three questions:

- 1.) What numbers are needed to answer the question?
- 2.) What mathematical operation(s) are needed to arrive at an answer?
- 3.) Does your answer make sense?

1.) What numbers are needed to answer the question?

We ask this question because in real-life you are often given more information than is necessary.

Let's look at a couple of problems and practice selecting important information and ignoring irrelevant things.

Example 1: On Oct. 1, Jim, a 7-year employee of ARTCO, will get a raise. He used to make \$15.65 per hour but will now earn \$0.18 more per hour. How much will he earn per hour after the raise?

The fact that the raise will occur on Oct. 1 and Jim's term of employment (7 yrs) has nothing to do with determining his new hourly pay rate. The numbers you really need are \$15.65 and \$0.18.

Example 2: A 15" long, 3/4"-diameter pipe that weighs 1.1 lbs. is to be welded to a 24" by 30" piece of 1/4" thick mild steel that weighs 3.5 lbs. What will be the total weight when the two pieces are welded together?

Since we are interested only in the total weight of the pipe and the plate, we really don't care about the length and diameter of the pipe or the dimensions of the plate.

2.) What mathematical operation(s) are needed to arrive at an answer?

In other words, you need to decide if you will add, subtract, multiply, or divide.

Let's practice determining the correct mathematical operation(s) by identifying words that indicate addition, subtraction, multiplication, and division and identifying typical situations where a given operation used.

ADDITION

There are certain words that traditionally indicate addition is required:

Example 1: Determine the **total** weight of these three boxes: 10 lbs, 12.5 lbs, and 4.3 lbs.

Example 2: If you are told, "I want you to **increase** the length of time that casserole stays in the oven by 10 minutes more than what the recipe says (45 minutes)." How long will you keep the casserole in the oven?

Example 3: This truck has a 10,000 lb load limit. Right now I've got 7500 lbs of cargo on board. If I **add** 2000 lbs, will I exceed my truck's load limit?

Example 4: What is the **combined** length of these three fence lines? 105 ft, 290 ft, and 756 ft.

Other addition "signals" include *sum, plus, in all, altogether, additional, extra.*

SUBTRACTION

There are certain words that traditionally indicate subtraction is required:

Example 1: In the morning, 32 copies of the Automotive Cooling System Repair textbook were on hand at the bookstore. If 20 copies were sold during the day, how many textbooks were left?

Example 2: My checkbook has a balance of \$350. If I then write a check for \$78.50, how much money remains in my checkbook account?

Example 3: Karen's mutual fund went from \$29.50 per share down to \$28.70 per share last week. How much did the price fall (drop) last week?

Example 4: Last month Ray's production line made 14,566 water valves. This month his line made 13,880. What was the decrease in the amount of water valves made?

Other subtraction words are, *less than, more than, difference, reduce, lost, nearer, farther, change.*

MULTIPLICATION

There are certain words that traditionally indicate multiplication is required:

Example 3: When at the NorthTowne Mall, Jill saw a jacket she wanted for \$65. At another store, the asking price was twice as much. How much was the jacket at the other store?

Example 4: At a meeting, Daryl stated that by the end of next year, international sales will be four times higher than today. If international sales are \$1,200,000 this year, what will they be next year?

Other key words are: *Multiplied, total, of, as much.*

Multiplication is often used as a shortcut to repetitious addition problems. Usually you have a situation where you have 1 (one) of something and want the total of many.

Example 1: What is the total weight of twenty-five, 10.5 lb packages?

You could add 10.5 twenty-five times: $10.5 + 10.5 + 10.5 + \dots + 10.5 = 262.5 \text{ lbs}$

Multiplication is better of course: $25 \times 10.5 = 262.5 \text{ lbs}$

Example 2: A holiday party of 45 guests is to be served by Speedy Catering Service. If each guest is to receive a 6 oz portion of ribeye steak, how many ounces of ribeye should Speedy Catering order for the party? (*This problem is very similar to the one above.*)

Sometimes you will multiply because it is required by a formula:

Example 1: Overtime Pay = Regular Pay Rate \times 1.5 (*assuming overtime is "time-and-a-half"*)

Example 2: Area of a Rectangle = Length \times Width

Example 3: Simple Interest Earned = Principal \times Rate \times Time

Example 4: Volume of a Box = Length \times Width \times Height

DIVISION

There are certain words that traditionally indicate division is required:

Some key division words are, *Divide evenly, split, cut, equal sized pieces, break up.*

You will divide when you have a situation where you are given a whole quantity and are asked to determine how many portions, pieces, parts, of a given size can be obtained from it.

Example 1: It takes John about 0.3 hr to interview a candidate for a new job. In an 8 hr work day, ***how many*** people could John interview?

The whole quantity is 8 hrs. We are to see how many 0.3 hr time blocks (each representing one person) are in that 8 hr day.

Setup: $8 \div 0.3 = 26.666\dots = 26$ complete interviews

Example 2: If you have a 55 gallon supply of motor oil, ***how many*** cars could you service if each car uses 5 quarts (1.25 gallons) of oil?

The whole quantity is 55 gallons. We will determine how many 1.25 gallon changes can be done with that supply.

Setup: $55 \div 1.25 = 44$ oil changes

When you have a whole quantity and are required to break it up into a certain number of equally-sized pieces, the division will tell you how large each piece will be.

Example 1: If 3.25 lbs of gold are ***divided evenly*** among 4 pirates, how much gold will each pirate get?

The 3.25 lbs of gold is the whole quantity. If you divide that amount by 4, you will know how much gold each pirate gets.

Setup: $3.25 \div 4 = 0.8125$ lbs of gold for each pirate.

Example 2: If a 7 acre parcel of land is ***split-up*** into 20 equal sized lots, how large will be each lot?

The 7 acre parcel of land is the whole quantity. Divide this amount by 20, in order to determine the size of a single lot.

Setup: $7 \div 20 = 0.35$ acres per lot

Sometimes you will multiply because it is required by a formula:

Example 1: Fuel Efficiency (miles per gallon) = Miles Driven \div Gallons of Gas Used

Example 2: Speed (miles per hour) = Distance traveled in Miles \div Time in Hours

Example 3: Weekly Pay = Yearly Pay \div 52

3.) Does your answer make sense?

Just because a number shows up on your calculator display doesn't mean it's correct! Is it logical? Try to have at least some expectations about what the final answer should look like before you start. When you are finished, ask yourself, "Does my answer make sense for this particular situation?"

Check to see if your answer is of a reasonable size.

Example 1: Let's say you deposited \$100 in a savings account that pays 2.5% interest. You then compute the amount of interest that you will earn if the money sits for 5 years and come up with an answer of \$1250.

Does it make sense that you could deposit \$100 and end up with \$1250 of interest five years later by putting it in a basic savings account? Not a chance... you better recalculate your answer. The problem here is that the decimal is in the wrong place. The correct answer is \$12.50. These mistakes are easy to catch if you check to see if your answer is reasonable.

Determine if your answer should get larger or smaller.

Example 1: You need to convert all the English measurements on a blueprint to metric. One dimension is 12 inches but it needs to be in centimeters (1 in = 2.54 cm). You come up with an answer of 4.72 cm.

You know a centimeter is a smaller unit of measure than an inch so you will need more centimeters than inches to make up the same distance. That means your answer must be larger than 12. The problem here is that you divided by 2.54 instead of multiplying. It is easy to press the divide button on your calculator when you meant to multiply or vice versa. If you know whether your answer should get larger or smaller you can catch these mistakes.

Determine if there are limits on your answer.

Example 1: You are asked calculate the average daily sales for the past five days. Mon = \$205.89, Tues = \$334.64, Wed = \$340.10, Thurs = \$390.86, Fri = \$508.11. You came up with \$1779.60.

An average is a measure of the center of a group of numbers. You can't have an average that is smaller than the smallest number or larger than the largest number. Our average must be somewhere between \$334.64 and \$508.11. The problem here is that you calculated the total sales for the week rather than the average. To find the average you need to take the total divided by the number of days you are averaging. ($\$1779.60 \div 5 \text{ days} = \355.92 per day) If you recognize that there are logical limits on this problem you catch this type of mistake.