Word Problems

Math students often feel that word problems are their biggest headache. I think that may be because there is no one recipe that will always get you to the right answer. In many cases you'll need to evaluate a situation that's new to you and come up with a creative solution. That's not so difficult -- you are probably coming up with creative stuff all the time if you are taking, say, English comp. The difference is that in math you need your creativity to lead you to the one right answer.

General Approach

When you first read a word problem you may feel intimidated. Don't let it bother you: You are not supposed to understand much of it on the first reading. You may need to read a problem several times before you can sort out all the important information in it.

1. The first time through, just read without expecting anything.
2. **Read the problem again and give a one-letter name to the thing you are being asked to find, as well as to other important variables.**
3. **Read it again and look for what it is telling you and what it is asking you. Take notes about those things.**
4. Read through once paying particular attention to units and what they represent -- for example, if you see something in square feet, you can figure that means area.

After that, setting up a word problem is a translation from a word sentence to a number sentence. That's where most of the work is.

Example 1 *You're driving across several states to get to a friend who needs your help. After you've driven 100 miles, you are ⅔ of the way there. How long is the whole trip?*

Wondering where to start? **Name things**. You're asked how long the trip is. You can't answer that yet but you do need to talk about it, so give it a letter name, say *L*. (If you name a variable *L*, always make it upper case, to avoid confusion with 1.)

The problem tells you that ⅔ of the trip is 100 miles. Thus "⅔ of the trip is 100 miles" translates to $L\ 00.\ {}_3^2 = 1$

Now you have an equation so you're almost there. To solve the equation, multiply both sides by 3/2. . You get

$L\ 00\ {}_2^3\cdot\ {}_3^2 = 1$

$L = 00\ {}_2^3\cdot\ 1$

$L = 150$

So the whole trip is 150 miles.

Check: L 00. $\frac{2}{3} = \frac{2}{3}(150) = 1$

Check.

Example 2 *Sam paid $102 for a new suit for his new job. This was $34 less than twice what he spent on a pair of shoes. How much did the shoes cost?*

Give a letter name to the thing you are looking for:

> *p*: the price of the shoes

What will you need to figure that out? Make notes about the information given.

> Price of suit: $102
> Price of suit is $34 less than 2*p*

Now translate from words into an equation. It may help to start with a word equation and work your way toward something algebraic that you can solve.

> Price of suit, $102, is 34 less than 2p

$$102 = 2p - 34$$

That “less than” business can be tricky, because “less than” in a problem can mean subtraction, as it does here, or it can indicate an inequality, as in $a < b$.

Now you’ve got an equation, so you’re past the hard part. Solve it:

$$102 = 2p - 34$$
$$2p = 136$$
$$p = 68$$

So it looks like the shoes cost $68.

It’s always a good idea to check your answer. Is $34 less than twice the price of the shoes indeed equal to $102? Twice the price of the shoes is $136. $34 less than that is $102. Check.

In many cases there is more than one approach; in only a few cases have I shown more than one way. If you know another way that makes sense to you and that works, go for it.

Kinds of Word Problems

Some kinds of word problems come up repeatedly. Approaches for some of these are shown below.

Work Problems

Photocopier A can copy 1000 pages in 40 minutes. Photocopier B can copy 1000 pages in 60 minutes. Janice has a document that is 1000 pages long. She is in a hurry and wants to use both photocopiers together. If Janice distributes the pages of her document to the two photocopiers so that both finish at the same time, and if all the copying goes smoothly, how long will it take the two machines together to complete the job?

What do you need to find? How much time the two machines need together. Let *t* be the time the two machines need together.

You are told how much time the job takes for each copier alone. **Translate that into what fraction of the job each copier can do within a minute.** Photocopier A can do the job in 40 minutes. That means photocopier A can do 1/40 of the job in 1 minute. Similarly, photocopier B can do 1/60 of the job in 1 minute.

What fraction of the whole job does photocopier A do? It does the fraction it can do it one minute times the number of minutes the job takes. If the whole job takes *t* minutes, then copier A does $\frac{t}{40}$. Similarly, the fraction that photocopier B does is $\frac{t}{60}$. The two photocopiers do the whole job, so the sum of the fractions is 1:

$$\frac{t}{40} + \frac{t}{60} = 1$$

Clear the fractions. That means multiply both sides of the equation by the least common multiple of the denominators (120 in this case) so that all the denominators go away:

$$\frac{t}{40} \cdot 120 + \frac{t}{60} \cdot 120 = 1 \cdot 120$$

$3t + 2t = 120$

$5t = 120$

$t = 24$ minutes

Looks like the answer is 24 minutes.

To check, substitute $t = 24$ into the original equation: . Check. $\frac{t}{40} + \frac{t}{60} = \frac{24}{40} + \frac{24}{60} = \frac{3}{5} + \frac{2}{5} = \frac{5}{5} = 1$

Alternative way to check: Figure out how many pages each machine can copy in the time you found, and then make sure the sum of those two page counts is 1000:

Copier A: $(1000\ pages/40\ min) \times 24\ min = 600\ pages$

Copier B: $(1000\ pages/60\ min) \times 24\ min = 400\ pages$

$600\ pages + 400\ pages = 1000\ pages$. Check.

Distance Problems

For these problems, you will use the equation $d = rt$, distance equals rate times time.

Two cars leave City A and drive to City B to deliver food donations to poor people. The first car leaves City A 2 hours before the second car leaves. The second car travels 20 miles per hour faster than the first, and both arrive at City B at the same time, 8 hours after the first car leaves city A. Find the speed of each car.

Apply the distance equation, $d = rt$, to both cars. To do that, you need to name variables.

Let *d* be the distance between city A and city B.
Let *r* be the first car's speed. Then, since the second car travels 20 mph faster than the first, $r + 20$ is the second car's speed.

The time for the first car to travel between the cities is 8 hours. Then, because the second car starts 2 hours later but arrives at the same time, $8 - 2 = 6$ hours is the time for the second car to travel between the cities.

A table may help:

	Rate	Time	Distance
First car	r	8	$8r$
Second car	$r + 20$	6	$6(r + 20)$

The distance is the same for both cars, and two things that equal the same thing equal each other, so you can set the distances equal to each other and solve for r :

$8r = 6(r + 20)$

$2r = 120$
$r = 60$
$r + 20 = 80$

So the first car A goes 60 miles per hour and the second car goes 80 miles per hour.

Check: Make sure it works. For the first car, use the equation $d = rt$ and solve for *d* to find the distance traveled.

$$d = 60 \text{ } miles \text{ } per \text{ } hour \times 8 \text{ } hours = 480 \text{ } miles$$

Car B should travel the same distance in 6 hours going $80 \text{ } miles \text{ } per \text{ } hour$.

$$d = 80 \text{ } miles \text{ } per \text{ } hour \times 6 \text{ } hours = 480 \text{ } miles$$

Same distance. Check.

Systems of Equations

To solve a problem with two unknowns you need two equations. If both unknowns show up in both equations, that's called a *system of equations* and you have to solve the two equations together. The two most common methods of doing that are elimination and substitution.

Elimination

The elimination method applies properties of equality to a system of equations to eliminate one unknown from one equation so that you are left with an equation with just one unknown, something you can get your arms around.

Example 1: *The sum of two numbers is 2. The difference between the same numbers is 4. Find the numbers.*

Name the unknowns:

a : one number
b : the other number

Then express the problem in terms of the unknowns you just named.

$a + b = 2$

$a - b = 4$

The addition property of equality says that if equal quantities are added to both sides of an equation, the sums are equal. The second equation says $a - b = 4$, so $a - b$ and 4 are equal quantities. Therefore if you add $a - b$ from the second equation to $a + b$ from the first equation, that sum will equal the sum of 2 (what $a + b$ equals) and 4 from the first equation. In other words, you can add two equations together.

$a + b = 2$ One of the original equations

$+ (a - b = 4)$ Add one side of the second original equation to each side of the first original equation.

$2a = 6$ Unknown b has dropped out. You have enough information to solve for a .

$a = 3$ Solve for a .

Once you've solve for a , you can go back to either of the original equations to find b .

$a - b = 4$ One of the original equations

$3 - b = 4$ Substitute 3 for a .

$b =- 1$ Solve for b.

Then use the other original equation as a check.

$a + b = 2$ Original equation

$3 - 1 =?2$ Substitute the values you've found for a and b.

$2 = 2$ Check.

Example 2: Getting one unknown to drop out is not always as easy as adding the two equations together, as it was in example 1. Consider the system of equations in "Integer Problems," below: (Note: In "Integer Problems" this set of equations is shown in a slightly different format.)

$W/3 - J = -17$
$-W + 2J = 28$

If you simply add the two equations together, you will get another equation that contains both variables. That doesn't help. But notice that the coefficients of W in the two equations are

opposite in sign and that the absolute value of the W coefficient in the second equation, 1, is three times the absolute value of the W coefficient in the first equation, . So if you multiply the $\frac{1}{3}$ first equation by 3, then the W coefficients will be equal in absolute value and opposite in sign and if you then add the two equations together, the W terms will drop out. Then you can solve for J.

$W/3 - J = -17$ Original equation

$W - 3J = -51$ Multiply both sides by 3.

$+(-W + 2J) = +28$ Add the other original equation.

$-J = -23$
$J = 23$ Result

$W - 3J = -51$ $W = 3J - 51$ $W = 3(23) - 51$ Go back to an original equation and solve for W.
$W = 18$

$W = 18$ $J = 23$

Check: Go back to the original problem, plug in the numbers you found, and see if everything works.

$W/3 - J = -17$
$-W + 2J = 28$

$3\ 3 - 7\ \frac{18}{3} - 2 = 6 - 2 = 1$
$-18 + 2 \cdot 23 = -18 + 46 = 28$

Check.

The elimination method can be used for two, three, four, or more unknowns.

Substitution

For the substitution method, you solve for one variable in terms of the other and use that solution to create an equation in one variable.

An organization is hosting a seminar on how to improve your health through good nutrition and eating habits. Because they are doing this as a service to the community, they want to charge just enough to cover their expenses, which amount to $1499 for the use of a conference room and presentation equipment. The organization is expecting to fill all 250 seats in the room. Tickets for members cost $3.50 and tickets for non-members cost $7.50. If all 250 tickets are sold and the total paid for the 250 tickets is $1499, how many of each kind of ticket are sold?

The number of tickets sold to members -- call that *m* -- and the number of tickets sold to nonmembers -- call that *n*.

m : number of tickets sold to members
n : number of tickets sold to nonmembers
Name variables. What are you looking for?

$m + n = 250$ 250 tickets were sold. One equation.

$3.5m$ paid for members' tickets $7.5n$ paid for nonmembers' tickets

Members' tickets go for $3.50, so 3.5 m is the money taken in for members' tickets. Nonmembers' tickets go for $7.50, so 7.5 n is the money taken in for nonmembers' tickets.

$3.5m + 7.5n = 1499$ The total amount taken in, $1499, is the sum of the amounts taken in for the two kinds of tickets.

You'll need to solve the two equations to find the numbers of the two kinds of tickets sold. A second equation.

Notice that it's easy to solve the first equation for one of the variables in terms of the other:

$m + n = 250$ $m = 250 - n$

$3.5\,(250 - n) + 7.5n = 1499$ Substitute $250 - n$ for m in the other equation, and that will give you an equation in one variable.

$n = 156$ Solve for n .

$m = 250 - n$

$m = 250 - 156 = 94$
Use the other equation to find m .

So if 94 members and 156 nonmembers buy tickets, that will pay the full expenses of $1499. Substitute the values you've found for *m* and *n* back into the equation $3.5m + 7.5n = 1499$:

$3.5m + 7.5n = 1499$
$3.5 \cdot 94 + 7.5 \cdot 156 = 1499$. Check.

Percent

A percent is a specific kind of fraction, one with a denominator of 100 shown not in fraction form but with a percent sign. For example, $\frac{50}{100} = 50\%$.

How can you change formats? To convert a number to a percent, multiply it by 100 and stick a percent sign on the resulting number. (Why this works: Because percent means "divided by 100," sticking the percent sign on amounts to dividing by 100. So multiplying by 100 and then dividing by 100 gives you no net change in the number's value, just a change in format.) If there's a decimal point in a number, then move the decimal point 2 places to the right to multiply by 100.

Similarly, to change from percent format, take off the percent sign and divide by 100. To divide by 100, slide the decimal point two places to the left.

Example To convert 0.80 to percent format,

1. Multiply by 100: $0.80 \times 100 = 80$
2. Add a pecent sign: 80%

To convert 80% to decimal format,

1. Remove the percent sign: $80\% \rightarrow 80$
2. Divide by 100: $80 \rightarrow 0.80$

Kinds of Percent Problems

What is *a*% of *b*?

Consider what happens with a fraction. *What is, for example, 1/4 of 8?* To find the answer, multiply the two numbers together: $\frac{1}{4} \cdot 8 = 2$. And what is 25% of 8? It's the same problem, this time in percent format. To find the answer, **multiply the two numbers together:** $25\% \cdot 8$. To do that multiplication, change the percent term to decimal format. Then $25\% \cdot 8 = 0.25 \cdot 8 = 2$.

For problems that ask "what is *a*% of *b*?" replace "what" with *x*; replace % with division by 100, and replace *of* with *times*. Then "what is *a*% of *b*" translates to $x = \frac{a}{100} \cdot b$

What percent of *a* is *b*?

Roger got 6 points on an 8-point quiz. Express his score as a percent.

What fraction of possible points did Roger get? . How can you express that as a percent? $\frac{6}{8} = \frac{3}{4}$ Convert it to decimal format and then follow the steps above to convert to percent: $.75$ 5%. $\frac{3}{4}$ $= 0 = 7$

For problems that ask "What percent of *a* is *b*?" express $b \div a$ **as a fraction and then convert it to a percent.**

a% of what is b?

Roger scored 85% on a test. Roger had 17 questions correct and all questions were weighted equally. How many questions were on the test?

In other words, 85% of what is 17?

Convert 85% to a decimal number: $85\% = 0.85$.

Next, name the variable. Let n represent the number of questions on the test. Then "85% of what is 17" translates to

$$0.85n = 17$$

Solve for *n*:

$$n = 20$$

The test has 20 questions.
Check: $.85$ $\frac{17}{20} = 0$

For problems that ask "a% of what is *b*?" replace "*a* percent" with , replace *of* with $\frac{a}{100}$

"times," replace *what* with x and replace *is* with "equals." Then "a% of what is *b*?" translates to $\frac{a}{100} \cdot x = b$.

Some percent problems

Jenny sees a dress she wants to buy but it costs $100 and that's over her budget. The dress goes on sale for 25% off. What is the sale price?

Name the thing you are looking for. Let *p* be the dress's sale price.

This problem is of the first type discussed above: What is *a*% of *b*? In this case you're asked for 25% of 100. Change the percent to a fraction and multiply: $25\% = 0.25$ and $.25 \times \$100 = \$25$.

Note that this result, $25, is an interim answer, something you need to find on the way to the answer. When you solve word problems that have lots of steps, it is too easy to get an interim answer and think you're done. **Reread the problem when you think you're done** just to make sure you really are done.

The question is what Jenny has to pay for the dress. She has to pay the original price minus the discount: $p = \$100 - \$25 = \$75$. Final answer: **Jenny needs to pay $75 for the dress.**

Alternatively, from the start you can set the problem up so that it gives you the final answer and then you don't have to clean up at the end. Going back to the start of the problem:

$100\% - 25\% = 75\%$ The sale price is 75% of the original price.

$75\% = 0.75$ Convert from percent to decimal. This is the fraction of the original price that Jenny has to pay.

$0.75 \cdot \$100 = 75$ Fraction that has to be paid times original price equals amount that has to be paid.

Same answer. Check.

Another problem:

Pierre runs a small grocery store. His suppliers have raised the prices they charge grocers, so Pierre must raise the prices he charges customers. Pierre used to charge $1.00 per pound for organic potatoes, but now he must charge $1.25 per pound. What is the percent increase?

This is a problem of the type "What percent of *a* is *b*?"

Call the percent increase *p*.

The fractional increase is the new price minus the original price all divided by the original price. The percent increase, *p,* is the fractional increase expressed in percent form.

$p = \frac{1.25-1}{1} = 0.25 = 25\%$

The percent increase is 25%.

Generally, $percent\ increase = \frac{difference}{original} \times 100\%$ **.**

In an apartment building, 87.5% of the apartments are occupied. That amounts to 42 apartments. What is the total number of apartments in the building?

This is a problem of the kind "*a*% of what is *b*?"

a% of what is *b* => $\frac{a}{100} \cdot x = b$

$a = 87.5$ and $b = 42$

Then $\frac{87.5}{100} \cdot x = 42$

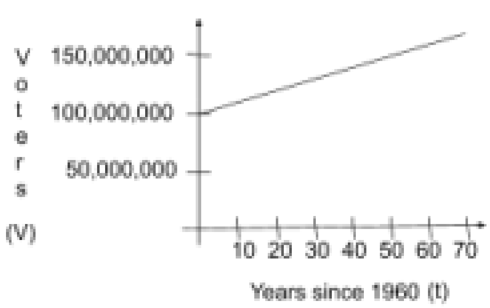
Solve for x : $x = \frac{42 \cdot 100}{87.5} = 48$

There are 48 apartments in the building.

Trend Problems

In a certain country, the number of people who vote in national elections has increased linearly since 1960. In 1960, 100,000,000 people voted. In 2010, 150,000,000 people voted. Write an equation to represent the number of people voting in any year. Let t represent the number of years after 1960 and let $V(t)$ *represent the number of voters.*

The equation you need is the equation of a straight line. You know that because you are told the increase in voters in linear. The equation of a straight line is of the form $y = mx + b$.



But instead of *x* and *y* in this problem you have been told to use variable names *t* and *V.* So

$V(t) = mt + b$

and you need to find m, the slope, and b, the $V-$intercept.

"*Let t represent the number of years after 1960*" means *t* is taken as 0 in 1960. Then $t = 1$ in 1961, $t = 2$ in 1962, etc. Problems that talk about dates often use this mechanism to make the numbers easier.

$(0, 100M)$, $(50, 150M)$ When $t = 0$ $V = 100M$ and when $t = 50$ $V = 150M$. Write these two pieces of information as ordered pairs. You can use them to find the line's equation.

$m = \frac{150M - 100M}{50 - 0} = \frac{50M}{50} = 1M$ Find the slope: $m = \frac{y_2 - y_1}{x_2 - x_1}$

$V = mt + b$
$V = 1Mt + b$

To complete the equation you still need the *V*-intercept.To find it, use the slope you have found as well as the data from one of the points.Try to choose the easier point. In this case that looks like the point $(0, 100M)$.

$100M = 1M \cdot 0 + b$ $b = 100M$

$V = 1Mt + 100M$ Substitute in the value of *b* to complete the equation. $V = 1Mt + 100M$.

To check the equation, substitute both points back into it. $V = 1Mt + 100M$

$(0, 100M)$ $100M \overset{?}{=} 1M(0) + 100M$
$100M = 100M$

$(50, 150M)$ $150M = 1M(50) + 100M$
$150M = 150M$

Investment Problems

Simple Interest

The formula for simple interest is $I = prt$ **.** What the letters mean:

I interest earned

p principal, the amount invested

r yearly rate of interest, expressed as a decimal

t time of investment, in years

Simple interest is not real-world, but it can get you started thinking about how interest works. With simple interest, the interest you get on an investment is proportional to the amount you invest, the rate of interest, and the time invested.

Emma puts $100 into the bank at an interest rate of 5% simple interest. The interest rate remains 5% for the next 10 years. At the end of the 10 years, Emma takes out all the money in the account. How much money does she take out?

Emma's earned interest is $I = prt$. Look at what you've got and what you need:
I , amount of interest, is unknown.
P, principal, is $100
r, rate of interest, is 5%=0.05
t , time of investment, is 10 years

$I = \$100 \times 0.05 \times 10 = \$50$

After 10 years, Emma gets $50 interest. That gets added to her principal, so the money Emma takes out of the bank is $\$100 + \$50 = \$150$.

Compound Interest

At any time, Emma from the simple interest problem above could take her money out of her bank and deposit it in a different bank. She would take out not only the money she deposited originally but also also the interest she earned up to that point. Then the new bank would pay her interest not only on her original $100 but also on the interest she earned at the first bank.

Emma's first bank wants to offer her the same deal she could get by changing banks. That is, the first bank will give Emma interest on her interest. Exactly what does that amount to?

Perhaps the bank will start giving interest on interest (that's called *compounding*) after 1 year. So for an interest rate of 5%, after 1 year Emma will have $\$100 \times .05 \times 1 = \$5$ in interest, for a total of $\$100 + \$5 = \$105$. This is 1.05 times the amount she started with: the original \$100 (1 time what she started with) plus \$5 (0.05 times what she started with) in interest. If interest is compounded annually, then every year Emma's balance will become 1.05 what it was a year earlier.

Let's look at what happens to the amount in the bank over the course of a few years:

$\$100$ Start of first year

$\$100 \cdot 1.05$ End of first year

$\$100 \cdot 1.05 \cdot 1.05$ End of second year

$\$100 \cdot 1.05 \cdot 1.05 \cdot 1.05 = \$100 \cdot 1.05^3$ End of third year

$\$\ 100 \cdot 1.05^n$ End of *n*th year

The formula for interest compounded annually is:

$A = P(1 + r)^t$ where

A the amount in the account at any time

p principal, the amount invested

r rate of interest, expressed as a decimal

t time of investment, in years

So if Emma invests that same \$100 at 5% interest compounded annually, at the end of 10 years she will have:

$A = P(1 + r)^t = \$100(1 + .05)^{10} = \$162.89$. That's \$12.89 more than she would have had with simple interest.

What if a bank offered compounding every month? The formula for that is:

$A = P\left(1 + \frac{r}{12}\right)^{12t}$, where variables are defined as above.

Interest gets compounded 12 times in a year, but the amount added in each compounding is less -- now it's in proportion to r/12 (because each compounding comes just 1/12 of a year after the one before it), not r. For Emma's problem, that is:

$$A = \$100\left(1 + \frac{0.05}{12}\right)^{12\cdot 10} = \$164.70$$

That gives Emma just $1.81 more than she would get with annual compounding.

This can be taken farther. For any number, *n*, of compoundings per year, $A = P\left(1 + \frac{r}{n}\right)^{nt}$

Interest compounded daily looks like this: $A = P\left(1 + \frac{r}{365}\right)^{365t}$.

For Emma's investment of $100 invested at 5%, interest compounded daily looks like: $A = \$100\left(1 + \frac{0.05}{365}\right)^{365\cdot 10} = \$164.8665$, which rounds off to $164.87.

Interest can even be compounded continuously. The formula for that is:

$$A = Pe^{rt}$$

Where e is a constant that comes up a lot in exponential problems and is equal to about 2.72.

For Emma's investment, that's

$A = \$100e^{.05\cdot 10} = \$164.8721$, which also rounds off to $164.87.

Numbers representing money are usually rounded to the nearest cent. But in the last two calculations I have included two more decimal places just to show the difference between the results of the different scenarios -- to the nearest cent, the two numbers are the same.

Mixture Problems

A mother of small children reads that the best fruit juice for children has a concentration of 50%. Mom buys fruit juice with a concentration of 100% and tries to dilute it to 50%, but she slips and dilutes the juice to 40%. She has 1 L of juice at 40% concentration. How much pure juice should she add to get fruit juice at 50% concentration?

What do you need to find? The amount of pure juice that needs to be added to the overly diluted juice. So let *p* be the amount of pure juice that Mom needs to add to 1 L of the 40% juice to get 50% juice.

To come up with equations, think of the problem in terms of the amount of pure juice in the final mixture. That amount is 40% of the overly diluted juice plus the amount of pure juice that Mom adds; it's also 50% of the perfectly diluted juice that Mom wants to end up with.

Find expressions for those two different ways of calculating the amount of juice in the final mixture and set them equal to each other. Forty percent of the 1 liter of overly diluted juice plus the pure juice added is $0.4L + p$. And fifty percent of the perfectly diluted juice -- that is, the 1 L plus the amount added -- is $0.5\,(1L + p)$. These are both equal to the same thing, the amount of juice in the final mixture, so $0.4L + p = 0.5\,(1L + p)$.

In other words:

$0.4L$ Amount of pure juice diluted to 40%. That is 0.4 of a 1-liter bottle. p Amount of

pure juice to be added

$0.4L + p$ Amount of pure juice contained in the final mixture.

$1L + p$ Total amount of juice in the final mixture

$0.5\,(1L + p)$ 50% of the final mixture

$0.4L + p = 0.5\,(1L + p)$ The amount of pure juice in the final mixture equals half the final mixture.

Solve that for *p* and you get $p = 0.2L$.

That means Mom needs to add **0.2 L** of juice to the 40% mixture to get 50% juice.

Is that right? The 1L of 40% juice plus the 0.2L of pure juice means a total volume of 1.2 L of 50% juice. Fifty percent of that, the amount of pure juice, is 0.6L of pure juice. And the amount of pure juice is 40% of 1 L -- that's 0.4 L of pure juice -- plus the 0.2 L of pure juice that gets added for a total of 0.6 L of pure juice. That's 0.6 L of pure juice either way. Check.

Integer Problems

An *integer* is a whole number or the negative of a whole number, or zero. In other words, the set of integers includes real numbers that are not fractions or radicals. People's ages are usually counted in integers. While money is usually counted in decimals, coins and dollar bills are counted in integers. Here is a typical integer problem:

Will and Jared are brothers. One-third of Will's current age is 17 years less than Jared's age. Five years ago, twice Jared's age was 23 more than Will's age. Set up a system of equations to find the brothers' ages now.

W : Will's current age J : Jared's current age

Name variables

$7\ \frac{W}{3} = J - 1$ From the problem: *One-third of Will's current age is 17 years less than Jared's age.*

$W - 5$, $J - 5$ The brothers' respective ages 5 years ago

$2\,(J - 5) = (W - 5) + 23$ From the problem: *Five years ago, twice Jared's age was 23 more than Will's age*

The equations you need are 7 and . Clean up the format: $\frac{W}{3} = J - 1$ $2\,(J - 5) = (W - 5) + 23$

$7 - 7\,J - 1\ \frac{W}{3} = J - 1 \rightarrow \frac{W}{3} - J = 1 \rightarrow W - 3 = 5$
$2\,(J - 5) = (W - 5) + 23 \rightarrow 2J - 10 = W + 18 \rightarrow - W + 2J = 28$

So the system is:
$W - 3J = - 51$
$- W + 2J = 28$

You're asked just to set these equations up, not to solve them. But you can't really check your work unless you do solve them. For a way to solve this system, see example 2 in "Elimination" in "systems of equations" above.

The solution is that Jared is 23 and Will is 18. To check it, go back to the original problem and make sure the numbers work. Will is 18. One-third of his age is 6. Jared is 23. Seventeen less than that is 6. So these numbers work for the problem's statement "One-third of Will's current age is 17 year's less than Jared's age. Five years ago, Jared was 18 and Will was 13. Two times 18 is 36. That is 23 more than Will's age, 13,

Conclusion

Word problems are as varied as life, so of course I am not able to cover all possible kinds. But I have tried to show you a sampling of the most common types. If you have questions about any of these, please come to the math lab and ask any of us working there, or email me at jhacker@nvcc.edu.