

Math 95--General Word Problems--page 1

This worksheet is going to cover a few of the major types of word problems used in algebra. I hope you find it helpful!

Part A: One Unknown Occasionally, you'll have a word problem where you solve for one unknown. Typically, this type of problem is solved using "direct translation" where you read words and write mathematical symbols. Be sure to label the unknown with a variable, translate the problem into an equation, solve the equation, and answer the question. To help you with direct translation, I've included a list of some of the major words used. The ones with a * in front are the words that reverse the order.

Add	Subtract	Multiply	Divide	Equals
sum	difference	product	quotient	equals
increased by	decreased by	times	divide	is equal to
*more than	*less than	double	divided by	is
*added to	*subtracted from	twice	*goes into	is the same as

A couple of examples will illustrate. I'll set up the problem, let you solve, and then I'll give the solution.

- a. \$144 more than four times the price of a stereo system is \$5176. Find the price of the stereo system.

price of stereo system = x

$$4x + 144 = 5176 \text{ ("more than" reversed the order so write 144 AFTER the plus symbol)}$$

The price of the stereo system is \$1258.

- b. 858 feet less than three times the height of a mountain is 15840 feet. Find the height of a mountain.

height of a mountain = x

$$3x - 858 = 15840 \text{ ("less than" reversed the order so write 858 AFTER the subtract symbol)}$$

The height of the mountain is 5566 feet.

- c. 6 times the height of a tree, decreased by 24 feet, is 96 feet. Find the height of the tree.

height of tree = x

$$6x - 24 = 96 \text{ (no reversal of order!)}$$

The height of the tree is 20 feet.

Homework.

- Eleven days more than twice the number of sick days is 101. Find the number of sick days.
- Fourteen minutes less than 3 times the time to bake brownies is 82 minutes. Find the time it takes to bake brownies.
- Four times the length of a sidewalk, decreased by 40 feet, is 36 feet. Find the length of the sidewalk.

Answer Key

- | | | |
|--|--|---|
| 1. sick days = x
$2x + 11 = 101$
$x = 45$ sick days
There are 45 sick days. | 2. minutes = x
$3x - 14 = 82$
$x = 32$ minutes
It takes 32 minutes. | 3. length of sidewalk = x
$4x - 40 = 36$
$x = 19$ feet
The sidewalk is 19 feet long. |
|--|--|---|

More on One Unknown: With one unknown word problems, you occasionally also have the following type. Observe.

- d. If you add 3 to a number, the result is the same as 15 less than twice the original number.

the number = x

$$x + 3 = 2x - 15 \text{ ("add to" reversed order and "less than" reversed order)}$$

The number is 18.

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- e. If you subtract 5 from a number and double that result, you get the same outcome as if you add 20 to the original number.

$$\text{the number} = x$$

$$2(x - 5) = x + 20 \text{ ("subtract from" and "add to" reversed the order)}$$

The number is 30.

Homework.

4. If you take 7 from a number, the result is the same as 24 less than twice the original number.
5. If you add 8 to a number and triple that result, you get the same outcome as 8 less than 5 times the original number.

Answer Key.

4. the number = x

$$x - 7 = 2x - 24$$

$$x = 17$$

The number is 17.

5. the number = x

$$3(x + 8) = 5x - 8$$

$$x = 16$$

The number is 16.

Part B: Two Unknowns Many times in algebra, you are finding more than one unknown. When you are required to find two or more unknowns, you need two or more labels for what you don't know. Generally, the unknown you know nothing about is labeled x . The other unknown is labeled with an expression built around x . When you are labeling this second unknown with an expression, you'll make use of direct translation (remember the words which reverse order!). This process should become a little clearer with examples. After you have labeled your unknowns (one with x ; one with an expression built around x), you should look for a sentence that gives you an equation. Set up and solve the equation. The answer you get is the answer for the unknown you labeled with x . To find the second unknown, substitute the answer into the expression you built that contains x . Then answer the question asked. A few examples will illustrate.

- f. Together, a TV and a stereo system cost \$3284. The stereo system costs \$36 less than three times the TV system. Find the cost of each.

$$\text{cost of TV system} = x$$

$$\text{cost of stereo system} = 3x - 36$$

$$\text{stereo} + \text{TV} = 3284$$

$$(3x - 36) + (x) = 3284 \text{ and solve}$$

$$x = 830$$

or

$$\text{TV} + \text{stereo} = 3284$$

$$(x) + (3x - 36) = 3284 \text{ and solve}$$

$$x = 830 \text{ (same answer!)}$$

$$\text{TV} = x = \$830$$

$$\text{stereo} = 3x - 36 = 3(830) - 36 = \$2454$$

The cost of the TV system is \$830; the cost of the stereo system is \$2454.

- g. Jim, Larry, and Jodi counted their CDs. Jim had twice as many as Larry did; Jodi had 28 more than Jim did. Together, they had 948 CDs. How many did each one have?

$$\text{Larry's CDs} = x$$

$$\text{Jim's CDs} = 2x$$

$$\text{Jodi's CDs} = \text{Jim} + 28 = 2x + 28$$

$$\text{Jodi} + \text{Jim} + \text{Larry} = 948$$

$$(2x + 28) + (2x) + (x) = 948 \text{ and solve}$$

$$x = 184$$

$$\text{Larry} = x = 184 \text{ CDs}$$

$$\text{Jim} = 2x = 2(184) = 368 \text{ CDs}$$

$$\text{Jodi} = 2x + 28 = 2(184) + 28 = 396 \text{ CDs}$$

Larry had 184 CDs; Jim had 368 CDs; Jodi had 396 CDs.

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Homework.

- Mark and Mike had a total of 800 marbles. If Mike had 75 marbles less than 4 times as many as Mark, find the number each one had.
- Together, a TV and stereo cost \$4077. The stereo costs \$225 more than twice the cost of the TV. Find the cost of each.
- Penny was looking at her clothes closet. The number of dresses she owned were 18 more than twice the number of suits. Together, the number of dresses and the number of suits totaled 57. Find the number of each that she owned.
- Mindy and Joley had a total of 700 plants. If Mindy had 65 plants less than 4 times as many as Joley, find the number each one had.
- Roberto hit three times as many balls as Mike did; Leon hit 23 more balls than Roberto did. Together, they hit 156 balls. How many did each one hit?

Answer Key

- | | |
|----------------------------|--|
| Mark's marbles = x | Mark + Mike = 800 |
| Mike's marbles = $4x - 75$ | $(x) + (4x - 75) = 800$ |
| | $x = 175$ |
| | Mark's marbles = $x = 175$ marbles |
| | Mike's marbles = $4x - 75 = 4(175) - 75 = 625$ marbles |
- | | |
|-----------------------------|--|
| cost of TV = x | stereo + TV = 4077 |
| cost of stereo = $2x + 225$ | $(2x + 225) + (x) = 4077$ |
| | $x = 1284$ |
| | cost of TV = $x = \$1284$ |
| | cost of stereo = $2x + 225 = 2(1284) + 225 = \2793 |
- | | |
|-------------------------------|---|
| number of suits = x | suits + dresses = 57 |
| number of dresses = $2x + 18$ | $(x) + (2x + 18) = 57$ |
| | $x = 13$ |
| | number of suits = $x = 13$ suits |
| | number of dresses = $2x + 18 = 2(13) + 18 = 44$ dresses |
- | | |
|----------------------------|---|
| Joley's plants = x | Joley + Mindy = 700 |
| Mindy's plants = $4x - 65$ | $(x) + (4x - 65) = 700$ |
| | $x = 153$ |
| | Joley's plants = $x = 153$ plants |
| | Mindy's plants = $4x - 65 = 4(153) - 65 = 547$ plants |
- | | |
|-------------------------|--|
| Mike's hits = x | Mike + Roberto + Leon = 156 |
| Roberto's hits = $3x$ | $(x) + (3x) + (3x + 23) = 156$ |
| Leon's hits = $3x + 23$ | $x = 19$ |
| | Mike = $x = 19$ hits for Mike |
| | Roberto = $3x = 3(19) = 57$ hits for Roberto |
| | Leon = $3x + 23 = 3(19) + 23 = 80$ hits for Leon |

Part C: Formulas Some word problems utilize both direct translation and a formula, many times from geometry. If the word problem involves a shape, I recommend making a sketch of the shape. Use direct translation to label the unknowns. Then choose the appropriate formula for the problem, fill in the formula with the labels and numbers from the problem, solve, and answer the question asked. Look at the examples.

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- h. A rectangular floor has a width which is 12 feet less than the length. The perimeter of the floor is 148 feet. Find the length and width.

$$\text{length} = x$$

$$\text{width} = x - 12$$

$$2l + 2w = P$$

$$2(x) + 2(x - 12) = 148$$

$$2x + 2x - 24 = 148$$

$$4x - 24 = 148$$

$$4x = 172$$

$$x = 43$$

$$\text{length} = x = 43 \text{ ft}$$

$$\text{width} = x - 12 = 43 - 12 = 31 \text{ feet.}$$

The length is 43 feet; the width is 31 feet.

- i. In a triangle, the 2nd angle is twice the 1st angle. The 3rd angle is 15° less than the 2nd angle. Find all three angles.

You can set up the labels using the words given. Notice you aren't given an equation. That's because you're supposed to remember that all angles in a triangle add up to 180° .

$$1^{\text{st}} \text{ angle} = x$$

$$2^{\text{nd}} \text{ angle} = 2x$$

$$3^{\text{rd}} \text{ angle} = 2x - 15$$

$$1^{\text{st}} + 2^{\text{nd}} + 3^{\text{rd}} = 180^\circ$$

$$(x) + (2x) + (2x - 15) = 180$$

$$5x - 15 = 180$$

$$5x = 195$$

$$x = 39$$

$$1^{\text{st}} \text{ angle} = x = 39^\circ$$

$$2^{\text{nd}} \text{ angle} = 2x = 2(39) = 78^\circ$$

$$3^{\text{rd}} \text{ angle} = 2x - 15 = 2(39) - 15 = 63^\circ$$

The first angle is 39° ; the second angle is 78° ; the third angle is 63° .

Homework.

11. A rectangular flower garden has a length that is 5 feet more than its width. The perimeter of the garden is 34 feet. Find the length and width.
12. A rectangle has a width that is 3 inches less than its length. The perimeter of the rectangle is 134 inches. Find the length and width.
13. A rectangular lot has a length that is 4 feet longer than its width. The perimeter of the lot is 80 feet. What are the length and width?
14. A backyard is rectangular shaped. If the width is 7 yards shorter than the length and the perimeter of the backyard is 42 yards, what are the length and width?
15. A rectangular playground has a width which is 28 feet less than its length. The perimeter of the playground is 436 feet. Find the length and width.
16. A rectangular window has a length which is 22 inches more than its width. The perimeter of the window is 198 inches. Find the length and width.
- *17. A rectangular floor has a length that is 1 foot more than twice its width. The perimeter of the floor is 44 feet. Find the length and width.
- *18. A rectangle has a length that is 5 feet more than three times its width. If the perimeter is 82 feet, find the length and width.

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19. In a triangle, the 2nd angle is 30° more than the 1st angle. The 3rd angle is 45° more than the 1st angle. Find all three angles.
20. In a triangle, the 3rd angle is 3 times the 2nd angle. The 1st angle is 12° more than twice the 2nd angle. Find all three angles.
21. In a triangle, the 2nd angle is 8° more than twice the 1st angle. The 3rd angle is 28° less than 7 times the 1st angle. Find all three angles.
- *22. In a triangle, the 2nd angle is twice the 1st angle. The 3rd angle is 55° more than the 2nd angle. Find all three angles.

Answer Key

11. width = x
length = $x + 5$
 $2l + 2w = P$
 $2(x + 5) + 2(x) = 34$
 $x = 6$
width = $x = 6$ ft
length = $x + 5 = 6 + 5 = 11$ ft
12. length = x
width = $x - 3$
 $2l + 2w = P$
 $2(x) + 2(x - 3) = 134$
 $x = 35$
length = $x = 35$ inches
width = $x - 3 = 35 - 3 = 32$ inches
13. width = x
length = $x + 4$
 $2l + 2w = P$
 $2(x + 4) + 2(x) = 80$
 $x = 18$
width = $x = 18$ feet
length = $x + 4 = 18 + 4 = 22$ feet
14. length = x
width = $x - 7$
 $2l + 2w = P$
 $2(x) + 2(x - 7) = 42$
 $x = 14$
length = $x = 14$ yards
width = $x - 7 = 14 - 7 = 7$ yards
15. length = x
width = $x - 28$
 $2l + 2w = P$
 $2(x) + 2(x - 28) = 436$
 $x = 123$
length = $x = 123$ ft
width = $x - 28 = 123 - 28 = 95$ ft
16. width = x
length = $x + 22$
 $2l + 2w = P$
 $2(x + 22) + 2(x) = 198$
 $x = 38.5$
width = $x = 38.5$ in
length = $x + 22 = 38.5 + 22 = 60.5$ in
17. width = x
length = $2x + 1$
 $2l + 2w = P$
 $2(2x + 1) + 2(x) = 44$
 $x = 7$
width = $x = 7$ feet
length = $2x + 1 = 2(7) + 1 = 15$ feet

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18. width = x
length = $3x + 5$
- $2l + 2w = P$
 $2(3x + 5) + 2(x) = 82$
 $x = 9$
width = $x = 9$ feet
length = $3x + 5 = 3(9) + 5 = 32$ feet
19. 1st angle = x
2nd angle = $x + 30$
3rd angle = $x + 45$
- $1^{\text{st}} + 2^{\text{nd}} + 3^{\text{rd}} = 180$
 $(x) + (x + 30) + (x + 45) = 180$
 $x = 35$
1st angle = $x = 35^{\circ}$
2nd angle = $x + 30 = 35 + 30 = 65^{\circ}$
3rd angle = $x + 45 = 35 + 45 = 80^{\circ}$
20. 2nd angle = x
3rd angle = $3x$
1st angle = $2x + 12$
- $1^{\text{st}} + 2^{\text{nd}} + 3^{\text{rd}} = 180^{\circ}$
 $(2x + 12) + (x) + (3x) = 180$
 $x = 28$
2nd angle = $x = 28^{\circ}$
 $3x = 3^{\text{rd}} \text{ angle} = 84^{\circ}$
 $2x + 12 = 1^{\text{st}} \text{ angle} = 68^{\circ}$
21. 1st angle = x
2nd angle = $2x + 8$
3rd angle = $7x - 28$
- $1^{\text{st}} + 2^{\text{nd}} + 3^{\text{rd}} = 180$
 $(x) + (2x + 8) + (7x - 28) = 180$
 $x = 25$
1st angle = $x = 20^{\circ}$
2nd angle = $2x + 8 = 2(20) + 8 = 48^{\circ}$
3rd angle = $7x - 28 = 7(20) - 28 = 112^{\circ}$
22. 1st angle = x
2nd angle = $2x$
3rd angle = $2x + 55$
- $1^{\text{st}} + 2^{\text{nd}} + 3^{\text{rd}} = 180$
 $(x) + (2x) + (2x + 55) = 180$
 $x = 25$
1st angle = $x = 25^{\circ}$
2nd angle = $2x = 2(25) = 50^{\circ}$
3rd angle = $2x + 55 = 2(25) + 55 = 105^{\circ}$

Part D: Consecutive Number Problems Sometimes you're asked to use the concept of consecutive numbers. Consecutive numbers build up by 1; consecutive even numbers build up by 2; consecutive odd numbers build up by 2. This concept is used to label your unknowns. See the examples.

Labels for

Consecutive Numbers

first number = x
second number = $x + 1$
third number = $x + 2$

Consecutive Even Numbers

first even number = x
second even number = $x + 2$
third even number = $x + 4$

Consecutive Odd Numbers

first odd number = x
second odd number = $x + 2$
third odd number = $x + 4$

- j. The sum of the consecutive page numbers in a book is 219. Find the page numbers.

first page number = x
second page number = $x + 1$

first page + second page = 219
 $(x) + (x + 1) = 219$
 $x = 109$

first page number = $x = 109$
second page number = $x + 1 = 109 + 1 = 110$

The first page number is 109; the second page number is 110.

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- k. The sum of three consecutive odd numbers is 99. Find all three odd numbers.

$$\begin{aligned}\text{first odd} &= x \\ \text{second odd} &= x + 2 \\ \text{third odd} &= x + 4\end{aligned}$$

$$\begin{aligned}\text{first odd} + \text{second odd} + \text{third odd} &= 99 \\ (x) + (x + 2) + (x + 4) &= 99 \\ x &= 31\end{aligned}$$

$$\begin{aligned}\text{first odd} &= x = 31 \\ \text{second odd} &= x + 2 = 31 + 2 = 33 \\ \text{third odd} &= x + 4 = 31 + 4 = 35\end{aligned}$$

The three consecutive odd numbers are 31, 33, and 35.

- l. There are three consecutive even numbers. If you add the first one and third one, the result is 92. Find all three even numbers.

$$\begin{aligned}\text{first even} &= x \\ \text{second even} &= x + 2 \\ \text{third even} &= x + 4\end{aligned}$$

$$\begin{aligned}\text{first even} + \text{third even} &= 92 \\ (x) + (x + 4) &= 92 \\ x &= 44\end{aligned}$$

$$\begin{aligned}\text{first even} &= x = 44 \\ \text{second even} &= x + 2 = 44 + 2 = 46 \\ \text{third even} &= x + 4 = 44 + 4 = 48\end{aligned}$$

The three consecutive even numbers are 44, 46, and 48.

Homework.

23. The sum of three consecutive pages in a book is 426. Find all three page numbers.
24. The sum of two consecutive odd numbers is 480. Find the numbers.
25. There are three consecutive even numbers. If you add the second and the third one, the result is 262. Find all three even numbers.

Answer Key

$$\begin{aligned}23. \text{ first page} &= x \\ \text{second page} &= x + 1 \\ \text{third page} &= x + 2\end{aligned}$$

$$\begin{aligned}\text{first page} + \text{second page} + \text{third page} &= 426 \\ (x) + (x + 1) + (x + 2) &= 426 \\ x &= 141 \\ \text{first page} &= x = 141 \\ \text{second page} &= x + 1 = 141 + 1 = 142 \\ \text{third page} &= x + 2 = 141 + 2 = 143\end{aligned}$$

$$\begin{aligned}24. \text{ first odd} &= x \\ \text{second odd} &= x + 2\end{aligned}$$

$$\begin{aligned}\text{first odd} + \text{second odd} &= 480 \\ (x) + (x + 2) &= 480 \\ x &= 239 \\ \text{first odd} &= x = 239 \\ \text{second odd} &= x + 2 = 239 + 2 = 241\end{aligned}$$

$$\begin{aligned}25. \text{ first even} &= x \\ \text{second even} &= x + 2 \\ \text{third even} &= x + 4\end{aligned}$$

$$\begin{aligned}\text{second even} + \text{third even} &= 262 \\ (x + 2) + (x + 4) &= 262 \\ x &= 128 \\ \text{first even} &= x = 128 \\ \text{second even} &= x + 2 = 128 + 2 = 130 \\ \text{third even} &= x + 4 = 128 + 4 = 132\end{aligned}$$