

# Combine Like Terms

## Unit #12

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# Professor Weissman's Algebra Classroom

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I'm going to make Algebra so simple, anyone can do it; so interesting, everyone can enjoy it!



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## What Does The Proverb "Oil And Water Don't Mix" mean?

Have you ever heard someone talking about a relationship of two people using the phrase "oil and water don't mix?"

What is trying to be conveyed is that this couple is not a good match. Certain of their qualities or personalities are incompatible.

## Where Do We Learn That Oil And Water Don't Mix?

One of the most basic rules students learn in science class is that oil and water don't mix. No-where was this lesson more painfully learned than in Prince William Sound, Alaska, where the Exxon Valdez spilled several million gallons of crude oil into the water, damaging the pristine environment and killing thou-



sands of seabirds and wildlife.

Many things in real life just don't mix or are kept apart for various reasons.

When shopping in the supermarket you don't put apples and oranges in the same plastic bag.

The literal meaning of the proverb is clear. You can

not 'combine' oil and water. They will always be visible as distinct and different. from each other.

## What is the Algebra Equivalent Of The Proverb?

In Algebra, we say that "Unlike terms don't combine; You can only combine LIKE TERMS."

## What Are 'terms?'

A term is an expression made up of numbers and/or letters connected by only multiplication and/or division. A term starts with either a + or a - sign. A + or - sign separates an expression into terms.

### What Are Like Terms?

Terms with the same variable factors are called like terms.  $2n$  and  $3n$  are like terms, but  $4x$  and  $3y$  are not like terms. So too,  $2x^2$  and  $3x$  are unlike terms. The both have  $x$  but the exponents are unlike.

### What Are some Examples of Terms?

Examples of terms:  
 $a$  is a term  
 $3a$  is a term  
 $3a^2$  is a term  
 $3a^2 - 4$  are two terms  
 $3a^2 - 4a$  are two terms  
 $3a^2 - 4a + 7$  are three terms.

### What Are The Three Terms of $3a^2 - 4a + 7$ ?

We'll separate the expression just before each  $+$  or  $-$  sign with a line. Prefix a  $+$  sign at the beginning of the expression.

$$+3a^2 \quad | \quad -4a \quad | \quad +7$$

The First Term is:  $+3a^2$

The Second Term is:  $-4a$

The Third Term is:  $+7$

### How are Terms Different From Factors?

Terms are combined, factors are multiplied.  $7+x+y$  is an expression with three terms.  $7xy$  is a term with three factors. Both terms and factors can be rearranged.

$$7 + x + y = y + 7 + x$$

$$7xy = 7yx$$



1862 July 8, Morrill Anti-Bigamy Law, signed by Abraham Lincoln.

First basic federal legislation by the Congress of the United States that was designed "to punish and prevent the practice of polygamy in the Territories of the United States".

### What Is A Nomial?

A nomial is a name that we give to an expression with terms.

A trinomial has three terms. A binomial has 2 terms. A monomial has only one term.

The word polynomial is a general name used for expressions that have many terms. What is many? For some, 2 could mean a lot. So a



binomial might also be called a polynomial.

We also use the prefixes mono, bi and poly with how many wives a man has. Monogamy means 1 wife, bigamy 2 wives and polygamy means many wives. As with terms, Polygamy might also mean 2 wives.

### What Does Descending Powers Mean?

An exponent is a power. When an expression has many terms with different exponents, it is usually preferable to rearrange the terms so that the term with the highest exponent is first. We then continue with the next highest exponents in the same way. If there is a constant term it goes last.

Example: Rewrite in descending powers:

$$7a - 4a^3 + 9 + 6a^2 - 4a^3 + 6a^2 + 7a + 9$$

The perimeter,  $P$ , of a rectangle is the distance around the rectangle. If we call the length  $L$  and the width  $W$ , then adding the 4 sides we get  $P = L + W + L + W$ . When we combine like terms we get  $P = 2L + 2W$

If the Length=2 feet and the Width=4 feet, then

$$P=2(3 \text{ ft})+2(9 \text{ ft}),$$

$$P=6 \text{ ft} + 18 \text{ ft (combine like terms)}$$

$$P= 24 \text{ ft.}$$

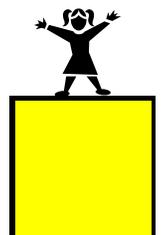


The perimeter,  $P$ , of a square is the distance around the square. If we call the length of each side,  $S$ , then adding the 4 sides we get  $P = S + S + S + S$ . When we combine like terms we get  $P = 4S$

If each side  $S=5$  feet, then

$$P = 4(5 \text{ ft})$$

$$P= 20 \text{ ft}$$



## What Are Missing Terms? How Are Like Terms Combined?

Recall the use of the digit 0 as a placeholder in numbers. For example the digit 0 in the number 1,023 means 0 hundreds.

When an expression only has one variable, say  $x$ , and the terms are put in descending order it is sometimes obvious that a term is missing.

For example  $3x + x^3 + 7$  when put in order looks like this:  $x^3 + 3x + 7$

The expression is missing an  $x^2$  term. We can show this missing term but we must use a coefficient of 0.

So, with the missing term the expression looks like this:  $x^3 + 0x^2 + 3x + 7$

Professor Weissman suggests that you combine like terms in a column. Let's see why.

Combine:  $5x + 7x + x$

Step #1 Put all the like terms in an  $x$  column.

Step #2 Combine the coefficients.

Step #3 Attach an  $x$  to the sum of the coefficients.

It's easy to make a mistake with exponents. By using an  $x$  column you can remember better that the sum and the terms combined are all like terms.

It's especially easy to make a mistake when combining like terms with exponents. It's very tempting to add the exponents.

Consider this example.

Combine:  $6a^2 - a^2 - 7a^2$

Step #1 Put these three like terms in an  $a^2$  column.

Step #2 Combine the coefficients

Step #3 The sum, like the three terms combined will also have an  $a^2$  and NOT  $a^6$ .

In sum, all entries in a column 'look alike.'

**Combining 3 like terms. Sum is also a like term**

$$\begin{array}{r} +5x \\ +7x \\ +1x \\ \hline +13x \end{array}$$

**Sum is  $+6a^2$**

$$\begin{array}{r} +6a^2 \\ -1a^2 \\ -7a^2 \\ \hline -2a^2 \end{array}$$

**NOT  $-2a^6$**

## How Is A Complicated Expression Simplified?



When you need to simplify a complicated expression think of your college experience. When you first start college and learn that you need to accumulate 64 or 128 credits it sounds like a huge challenge.

In reality, you only take about 16 credits each

term.

Your focus should be only on one term at a time.

As you finish each term your credits are combined in a new transcript.

Simplifying a complex expression should be

done the same way. Remember "SSC"

Step #1 Separate the expression into terms.

Step #2 Simplify each term.

Step #3 Combine the results.

Example #1 Simplify:

$$5x - (7xy - 2y) - 2(3x + 5yx + y)$$

$$5x \mid - (7xy - 2y) \mid - 2(3x + 5yx + y) \quad \text{Step #1 Separate (terms)}$$

$$+5x \mid - 7xy + 2y \mid - 6x - 10yx - 2y \quad \text{Step #2 Simplify (each term)}$$

$$+5x \quad -7xy \quad +2y$$

$$-6x \quad -10xy \quad -2y$$

Answer:  $-1x - 10xy$

Step #3 Combine (in columns)

Note:  $-10yx$  rewritten  $-10xy$

Note:  $+2y - 2y = 0$

## FTC Releases Consumer Fraud Survey October 29, 2007

### 30.2 Million Americans - 13.5 Percent of U.S. Adults - Fell Victim to Fraud

The Federal Trade Commission today released a statistical survey of fraud in the United States that shows that 30.2 million adults – 13.5 percent of the adult population – were victims of fraud during the year studied. More people – an estimated 4.8 million U.S. consumers – were victims of fraudulent weight-loss products than any of the other frauds covered by the survey.

Fraudulent foreign lottery offers and buyers club memberships tied for second place in the survey. Lottery scams occur when consumers are told they have won a foreign lottery that they had not entered. Victims supplied either personal information such as their bank account numbers or paid money to receive their “winnings.” In the case of buyers clubs, victims are billed for a “membership” they had not agreed to buy. An estimated 3.2 million people were victims of these frauds during the period studied.

Twenty percent of African Americans and 18 percent of Hispanics are estimated to have been victims, while the rate for non-Hispanic whites was 12 percent. In addition, the survey found that younger consumers, those who did not complete college, and those with high levels of debt were more likely to be victims of fraud. Consumers between 65 and 74 years of age were 32 percent less likely to report having experienced fraud than those between 35 and 44.

### Numbers In The News

“30.2 million adults – were victims of fraud.”

The 30.2 is an ‘abbreviation’ for what number?

30 million would be 30,000,000. The number 30.2 million can be expanded by replacing the decimal with a comma and adding 5 zeros.

30.2 million = 30,200,000.

The top 10 frauds listed in the report include:

- Fraudulent Weight-Loss Products (4.8 million victims)
- Foreign Lottery Scams (3.2 million victims)
- Unauthorized Billing - Buyers Clubs (3.2 million victims)
- Prize Promotions (2.7 million victims)
- Work-at-Home Programs (2.4 million victims)
- Credit Card Insurance (2.1 million victims)
- Unauthorized Billing - Internet Services (1.8 million victims)
- Advance-Fee Loans (1.7 million victims)
- Credit Repair Scams (1.2 million victims)
- Business Opportunities (0.8 million victims)

**Report fraud: If you think you've been a victim of fraud, report it. It's one way to get even with a scam artist who cheated you. Complain online at [ftc.gov](http://ftc.gov) or by phone at 1-877-FTC HELP**

The FTC offers these tips for consumers:

- Know who you're dealing with: Do business only with companies that plainly provide their name, street address, and phone number.
- Protect your personal information: Share credit card and other personal information only with companies you know and trust; never share it in email, regardless who is asking for it.
- Take your time: Resist the urge to act now. Most any offer that's good today will be good tomorrow, too.
- Read the small print: Get all promises in writing and read all paperwork before paying any money or signing any contracts.
- Free means free: Throw out any offer that says you have to pay to get a gift or for something that's called “free.” If something is free or a gift, you shouldn't have to pay for it.

“18 percent of Hispanics [were] victims.”

18 percent can be written as the fraction  $18/100$ . This fraction is read “18 hundredths” and 0.18 would be its decimal equivalent.

“13.5 percent of the adult population – were victims of fraud “

13 percent would be 0.13

13.5 percent is written 0.135



How about some more brain exercise? Take a look at these examples...

#1  $5b^3 + 3b^3 = 8b^3$   
 #2  $2x + 7x + x = 10x$   
 #3  $6ab + 7ab = 13ab$   
 #4  $9xy^2 + 5xy^2 = 14xy^2$

...and like the great guy I am, I'll even provide all the answers.

Hey Professor... where were you when I was taking the SAT?

Or when my father caught me sneaking home 3 o'clock in the morning?

I don't understand something Professor. Why is the answer to the second problem  $10x$ ? I get  $9x$ !

22222

That's a common mistake. When a term has no number...put in a 1.

#1  $5b^3 + 3b^3 = 8b^3$   
 #2  $2x + 7x + x = 10x$   
 #3  $6ab + 7ab = 13ab$   
 #4  $9xy^2 + 5xy^2 = 14xy^2$

So the example will read  $2x + 7x + 1x = 10x$

What about the first example? Shouldn't the answer be  $8b^6$ ?

Again...that's what we do when we multiply. Remember, we're combining now!

#1  $5b^3 + 3b^3 = 8b^3$   
 #2  $2x + 7x + x = 10x$   
 #3  $6ab + 7ab = 13ab$   
 #4  $9xy^2 + 5xy^2 = 14xy^2$

Now...back to my fruit again. I've got 3 apples and 2 bananas. What do I get when I combine them?

$3a + 2b =$

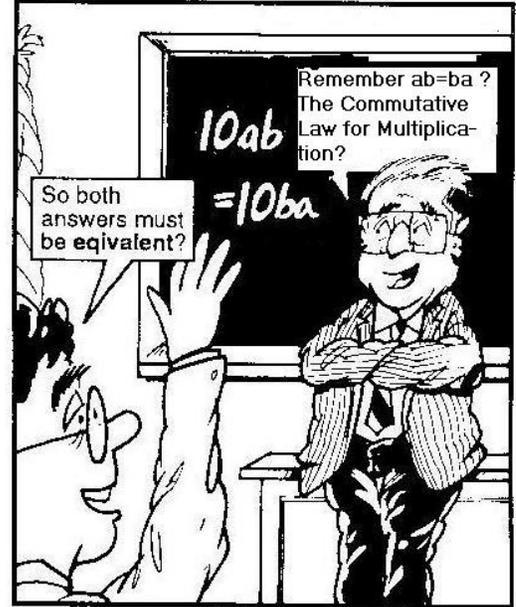
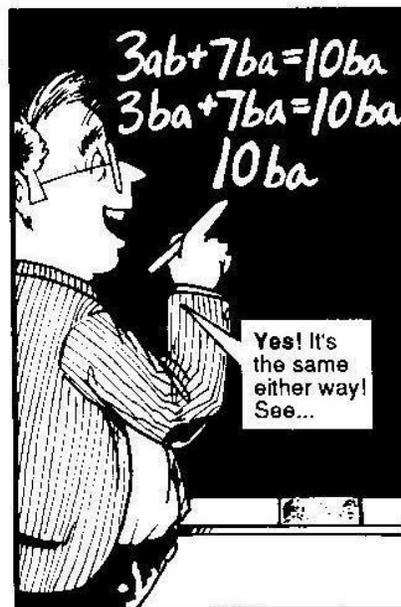
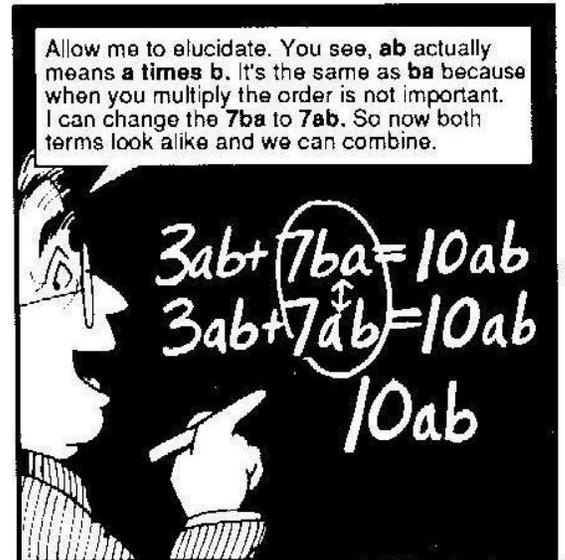
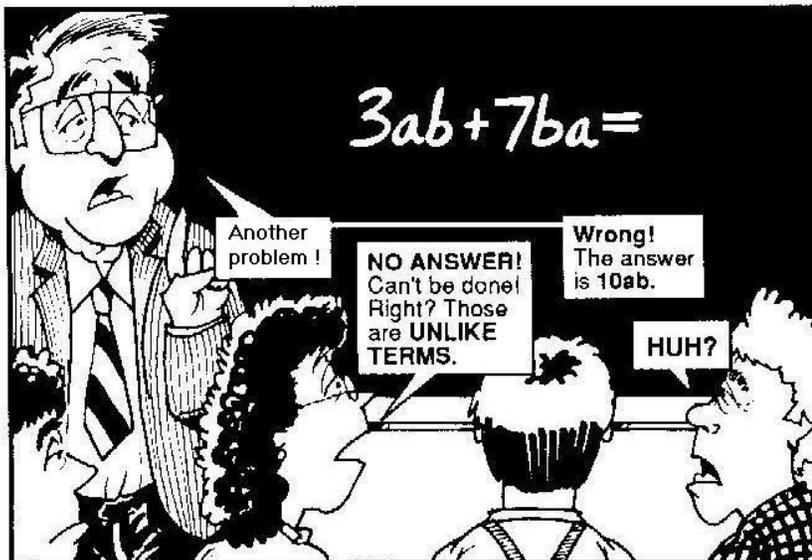
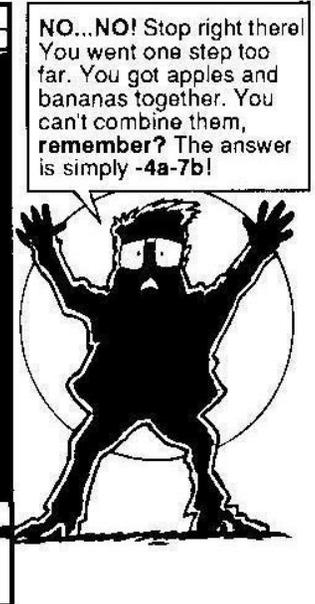
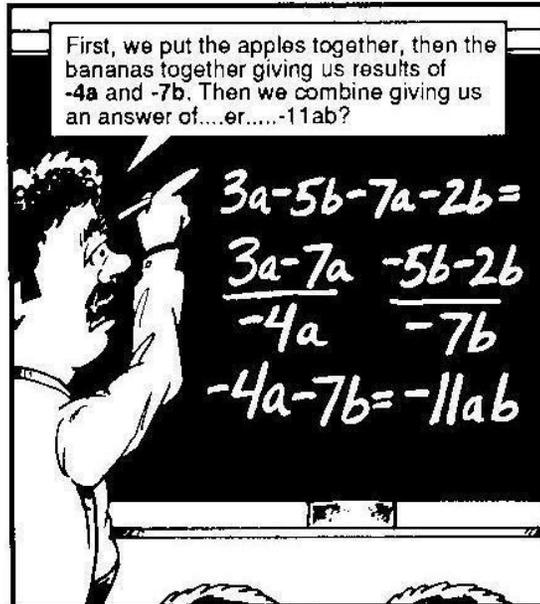
5ab?

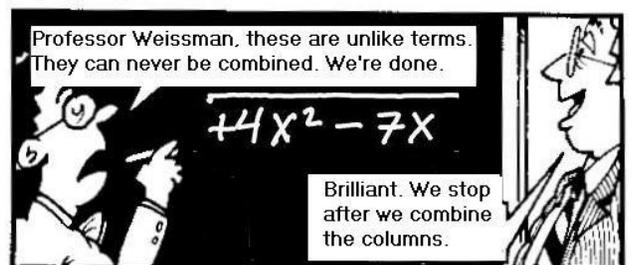
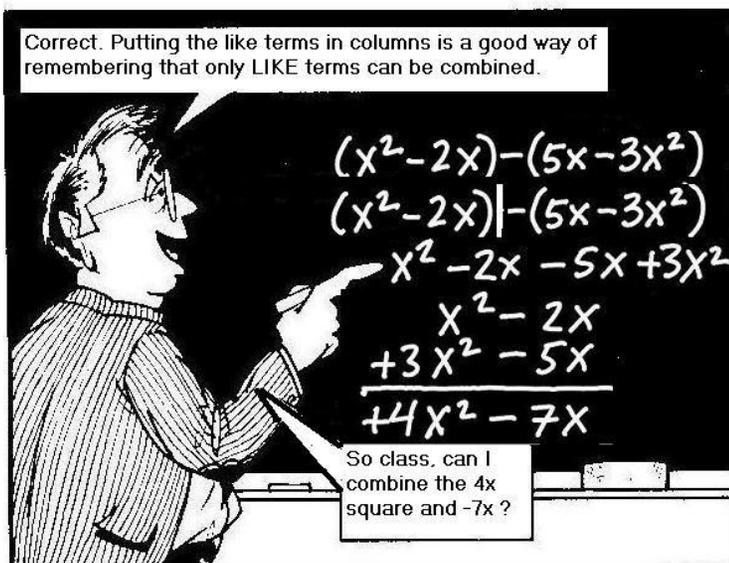
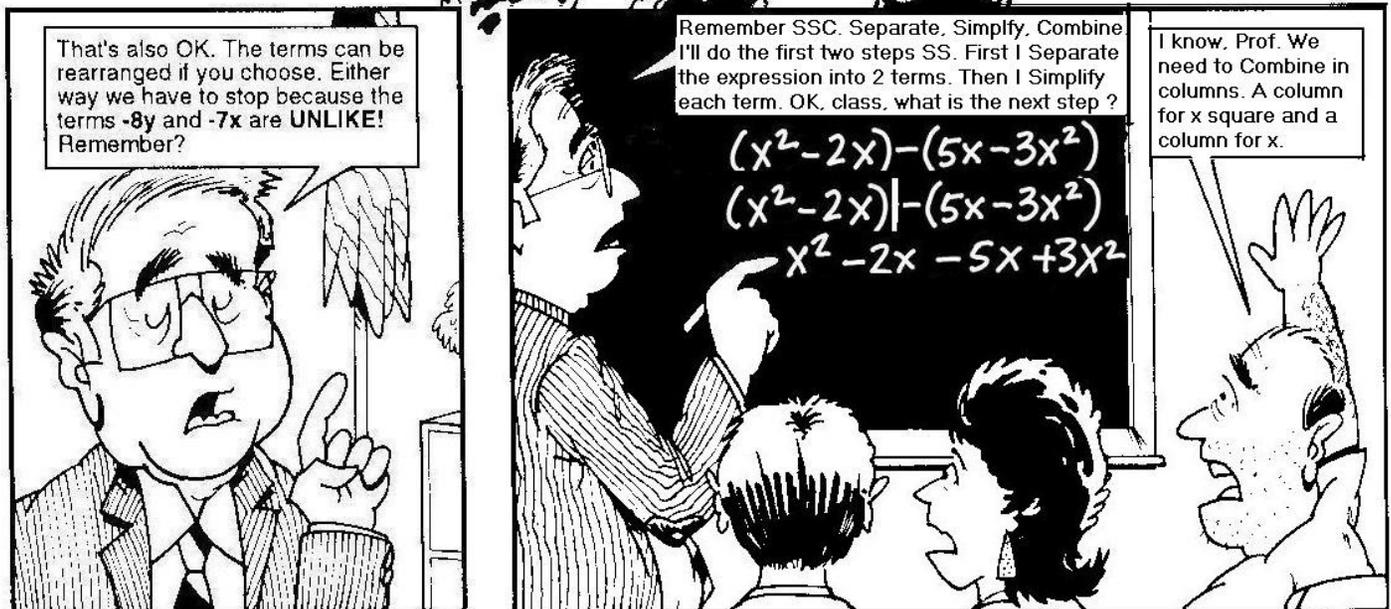
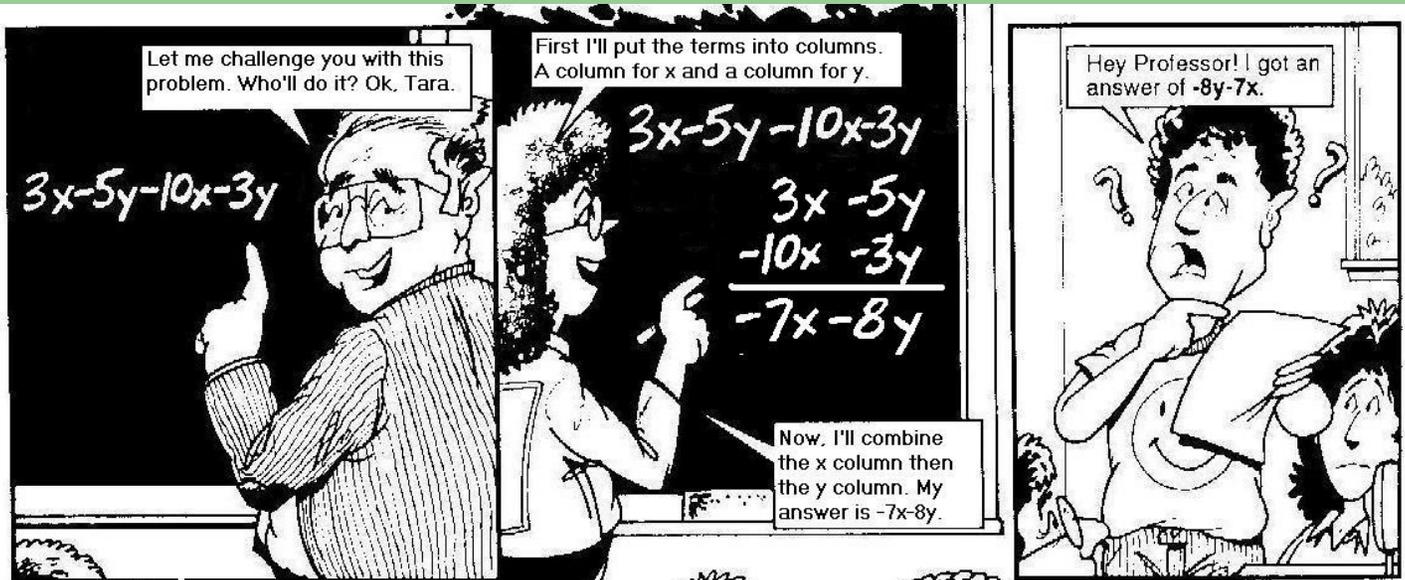
I know how we can combine those apples and bananas Professor!

I won't even ask what you're doing with a blender. The two terms,  $3a$  and  $2b$  are **UNLIKE!** Unlike terms can't be combined. You don't have 5 apples and you don't have 5 bananas and you certainly don't have 5 applebananas! Ain't no such kind of fruit!

SO WHAT'S THE ANSWER?

There is no answer! You can't add apples and bananas... that is unless you want to make fruit salad.





## Exercise Set 12

### 1. Combine Like Terms

- $5d + 3d$
- $5m + 7m + m$
- $-5m - 7m - m$
- $7n - 10n$
- $3m + 2n + 7m + n$
- $3m - 2n - 7m - n$
- $5x + 2y$
- $3c^2 + 7c^2$
- $4mn + 7mn$
- $20ab - ab$
- $5cd + 6dc$
- $3a - 5b - 7b - 8a + 5ab$
- $7xy^2 - 10xy^2$
- $4ab^2 + 6a^2b$
- $-7am + 7am$
- $5x - 7y + 2y - 9x + 5y$
- $5 - 3x - 9 - 2x$
- $10m - 3 - 2 - 10m + 5$

### 2. Simplify

- $-(-5a)$
- $-(2b - 1)$
- $-(-3e - 7e)$
- $2x - (-5x)$
- $b - (-b)$
- $2a - 7 - (5 + 6a)$
- $3m - 7 + (2m + 1)$
- $(2a - 4b)$
- $(2a - 4b) + (6a - 7b)$
- $(2a - 4b) - (6a - 7b)$

- Subtract  $-3x$  from  $7x$
- Subtract  $2a + 5b$  from  $7a - 2b$
- Find the sum of  $-3x$  and  $-2x$
- Find the difference of  $-3x$  and  $-2x$
- What terms when combined with  $7h - 8g$  will equal zero?
- $2.3x + 5x + 0.16x$
- $40x - 3.4x$
- $23y - 1.71y$
- $3p - 7p$
- $7p - 3p$
- $(\frac{1}{2})a + 2.5a$
- $(\frac{2}{3})x + (\frac{4}{5})x$
- What is twice  $-7x^3$

### 3. Fill in the blanks.

- Only \_\_\_\_\_ terms can be combined.
- To combine like terms, combine the \_\_\_\_\_ and keep the \_\_\_\_\_.
- Unlike terms can not be \_\_\_\_.
- Two other ways to write  $+7xy$  are \_\_\_\_ and \_\_\_\_.
- The numerical coefficient of  $-xy$  is \_\_\_\_.
- In  $-xy$ ,  $x$  and  $y$  are \_\_\_\_.

### 4. True or False? Why?

- $2a + 3b = 5ab$
- $5b^3 + 7b^3 = 12b^6$
- There is no numerical coefficient in the term:  $xy$

d)  $12mn$  and  $-5nm$  are like terms.

e)  $2x$  and  $x^2$  are equivalent.

5. Find the perimeter of a square with side

- 8 mm
- 3 1/2 inches.
- 7.3 cm.

6. Find the side of a square whose perimeter is:

- 100 feet
- 2 2/3 yards

7.  $2b - b^4 + 3 - 6b^2$

a) How many terms are there?

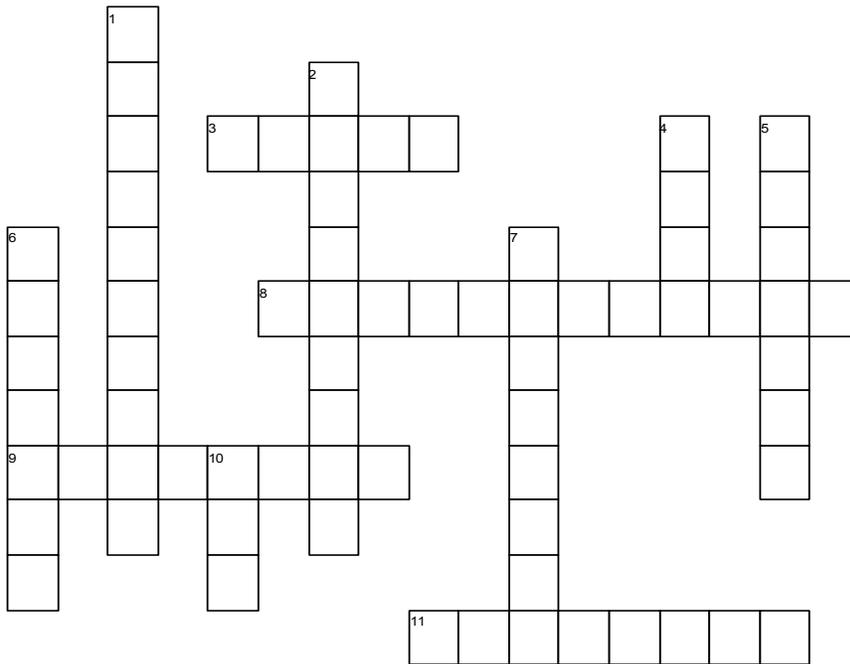
b) What is the coefficient of the 1st term?

c) How many factors are there in the 4th term?

d) Arrange the terms in descending powers.

e) Arrange the terms in descending powers and account for missing terms.

## Crossword #12



www.CrosswordWeaver.com

### ACROSS

3 what we separate an expression into

8 combine these

9 one term

11 many wives

### DOWN

1 start with highest exponent

2 three terms

4 you can only combine these terms

5 parts of a term

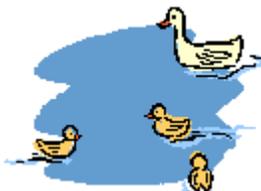
6 put like terms in these

7 two terms

10 water and oil don't

## Jokes Set #12

The math professor's six-year-old son knocks at the door of his father's study. "Daddy", he says. "I need help with a math problem I couldn't do at school."



"Sure", the father says and smiles. "Just tell me what's bothering you."

"Well, it's a really hard

problem: *There are four ducks swimming in a pond, when two more ducks come and join them. How many ducks are now swimming in the pond?*"

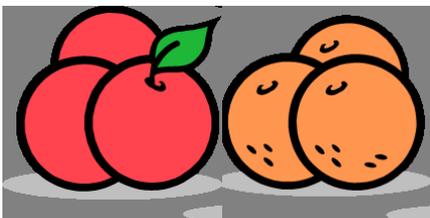
The Professor stares at his son with disbelief: "You could-

n't do that?! All you need to know is that  $4 + 2 = 6$ "

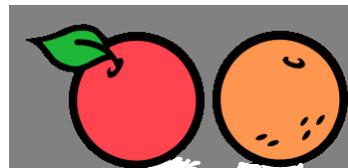
"Do you think, I'm stupid?! Of course, I know that  $4 + 2 = 6$ . But what does this have to do with ducks!?"

## Brain Teasers Set #12

**Apples and Oranges:** beled "Apples", In the garage behind your house, you have three big boxes. One of the boxes is labeled "Apples", another one "Oranges" and the last one

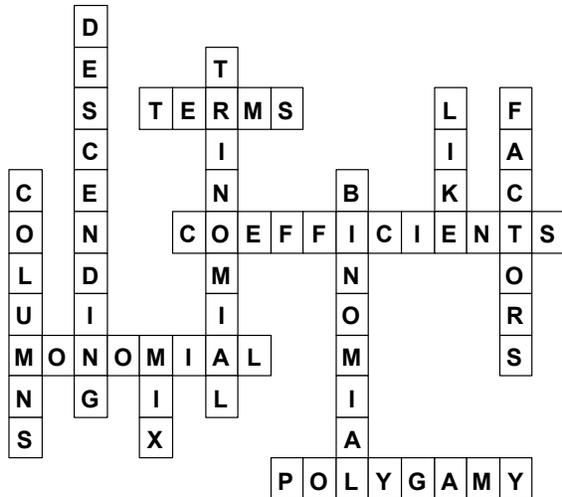


"Apples and Oranges". The only thing you know is that none of boxes is labeled correct. How can



you correctly re-label all the boxes, if you are only allowed to take out ONE fruit from ONE of the boxes?

## Crossword #12 Solution



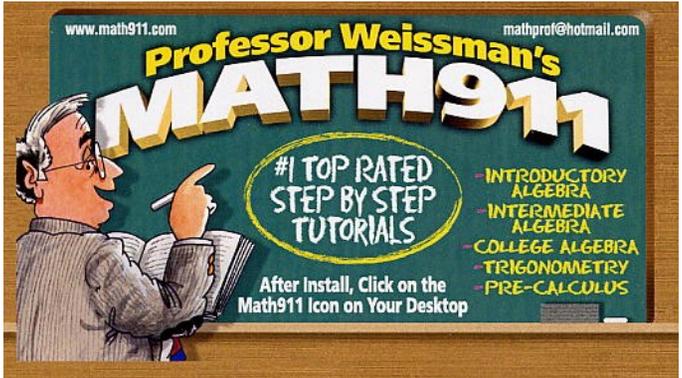
## Answers to Exercise Set 12

- |                  |                  |              |                                  |                          |
|------------------|------------------|--------------|----------------------------------|--------------------------|
| 1. a) $+8d$      | n) $4ab^2+6a^2b$ | i) $+8a-11b$ | w) $-14x^3$                      | c) 29.2 cm               |
| b) $+13m$        | o) 0             | j) $-4a+3b$  | 3. a) like                       |                          |
| c) $-13m$        | p) $-4x$         | k) $+10x$    | b) coefficients, literal factors | 6.                       |
| d) $-3n$         | q) $-5x-4$       | l) $+5a-7b$  | c) combined                      | a) 25 ft.                |
| e) $+10m+3n$     | r) 0             | m) $-5x$     | d) $7xy, 7yx$                    | b) $2/3$ yd              |
| f) $-4m-3n$      | 2. a) $+5a$      | n) $-1x$     | e) $-1$                          | 7..                      |
| g) $5x+2y$       | b) $-2b+1$       | o) $-7h+8g$  | f) literal factors               | a) 4                     |
| h) $+10c^2$      | c) $+10e$        | p) $7.46x$   | 4. a) False                      | b) 2                     |
| i) $+11mn$       | d) $+7x$         | q) $36.6x$   | b) False                         | c) 3                     |
| j) $+19ab$       | e) $+2b$         | r) $21.29y$  | c) False                         | d) $-b^4-6b^2+2b+3$      |
| k) $+11cd$       | f) $4a-12$       | s) $-4p$     | d) True                          | e) $-b^4+0b^3-6b^2+2b+3$ |
| l) $-5a-12b+5ab$ | g) $+5m-6$       | t) $+4p$     | e) False                         |                          |
| m) $-3xy^2$      | h) $+2a-4b$      | u) $+3a$     | 5.                               |                          |
|                  |                  | v) $22x/15$  | a) 32 mm                         |                          |
|                  |                  |              | b) 14 inches                     |                          |

## Brain Teaser #12 Answer

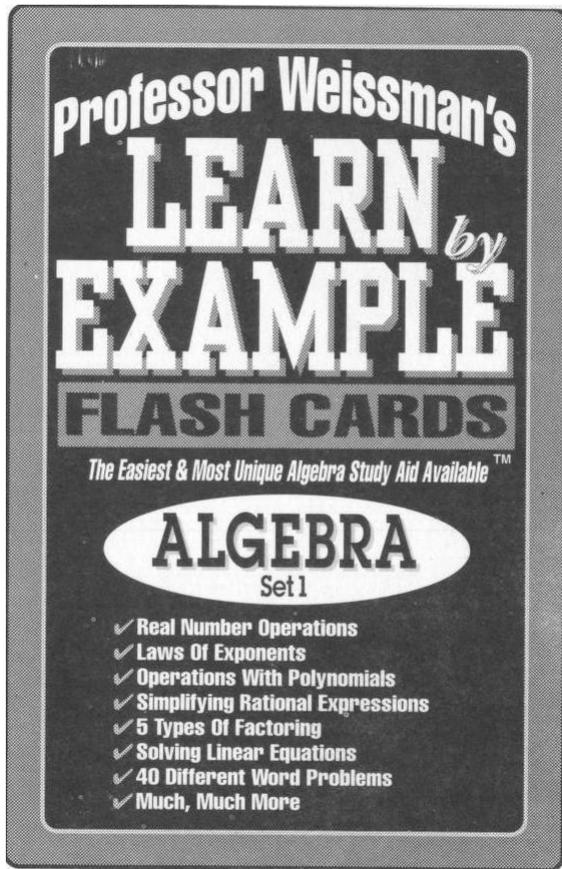
Answer: You take a fruit from the box labeled "apples and oranges". If you pull out an apple, then you should put the "apple" label on that box. If you pull out an orange, then put the "orange" label on that box. Then since you knew all three boxes had incorrect labels, you would switch the remaining two labels as well. If you pulled out an apple, You now know that box should be labeled "Apples." You know the box labeled "Oranges" isn't correct, so the only other thing it can be is "Apples/Oranges. Leaving the last label Apples," which should be changed to "Oranges." Follow the 3 steps [1],[2], and [3] in the table below.

Apples/Oranges [will be renamed Apples]	Oranges [Will be renamed Apple/Oranges]	Apples [Will be renamed Oranges]
[1] You pick an apple. Rename this box apples.	[2] This can't be oranges since all boxes are labeled wrong. It can't be apples since first box is apples. Label this box Apple/ Oranges.	[3] This can only be oranges. Label this oranges.



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### MO-1 WORD PROBLEMS

Two cars leave the same place at the same time and travel in opposite directions at 30mph and 40 mph. In how many hours are they 210 miles apart?

Rate	Time	Distance
30		
40		
		210

Motion      1 missing amount-time      Opposite directions      Total distance given

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### MO-1 Two cars leave the same place at the same time and travel in opposite directions at 30mph and 40 mph. In how many hours are they 210 miles apart?

**STEP #1**  
Let X = hours each travels. They both travel the same x hours

Rate	Time	Distance
30	x	30x
40	x	40x
		210

**STEP #2**  
Complete the CHART by multiplying across.

30x      40x  
←-----→  
210 miles

**STEP #3**  
Write the equation  
The total distance traveled was 210 miles.  $30x + 40x = 210$

**STEP #4**  
Solve the equation.  
 $70x = 210$   
 $x = 210/70 = 3$  hours

**STEP #5**  
Check  
Are they 210 miles apart after 3 hours? Yes!

rate	time	distance
30	3	90
40	3	120
		210