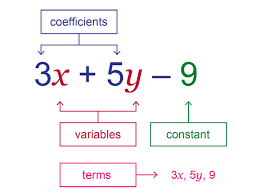
Week 2 – Algebraic Expressions (read across from far left to far right across the graphic)

Let me start out by saying, anytime you work with you mind for long periods of time, it should come as no surprise that you need to take a break at regular intervals (periods of time). If you have been hard at it for an hour or more, you should take a break for ten to fifteen minutes. You need to absorb the material and relax so that your retention or ability to hang onto the information increases. I recommend that you do the reading and short practices, and then you go take a break. Then come back and attempt the homework section. I am serious about this. I know during class we go for around two to three hours before a break, but we are up against time limits. Our time in class is mapped out to the minute practically, but you have the freedom to break up your day now, so plan it to include breaks.

It is time to understand the parts of an expression so you know what is being talked about in this topic and how to write about them using the appropriate academic vocabulary. Some of these things you may already know (review) and some may be totally new (acquiring new information). As you can see below each part of an expression has a name. ***Coefficients*** are numeric values that are with a variable. ***Variables*** are letters that represent a numeric values that change. Numbers that stand alone are called ***constants*** and ***terms*** include coefficients with their variables (as written in the expression) and constant or numeric values. There is one more part you should be aware of and that is the ***operations*** which are +, -, x, ÷. Remember an expression does NOT include the equal sign (=), only and equation does.

When we talk about expressions remember, at this time, there are ***algebraic expressions*** which include variables (letters), and numeric expressions, which include number values and NO variables (letters). Each will contain operations, so you know what to do with the terms in the expression. Constants can also be classified as a quantity, which is something you can measure. A variable quantity is a quantity that changes or varies. Classify each of the following as either a numeric (NE) or algebraic expression (AE)

\_\_\_\_\_ a. 120m \_\_\_\_\_ b. 40(30) \_\_\_\_\_ c. 75ab \_\_\_\_\_ d. 51 ÷ 17

\_\_\_\_\_ e. 12(35 – 16) \_\_\_\_\_ f. 5(d + 1) \_\_\_\_\_ g. x + 6y + 20 \_\_\_\_\_ h. 3x – 4y + 2z

\_\_\_\_\_ i. 14 x 15 \_\_\_\_\_ j. 7d ÷ 3 \_\_\_\_\_ k. 45 + 8 – 36 \_\_\_\_\_ l. 25 – 6d

Which of the following are variable quantities (V), and which are just quantities (Q) that remain constant?

\_\_\_\_\_ if you pay for your cell service by the minute, what is your bill?

\_\_\_\_\_ the rental of a hall for an office party, what is the cost of the hall?

\_\_\_\_\_ you take out a loan on a car, what is the payment?

\_\_\_\_\_ the caterer charges $21 a plate for food, what is the total cost for food?

\_\_\_\_\_ you are charged $0.10 an hour to park your car, what is the cost for parking?

\_\_\_\_\_ the rent on an apartment is $620 per month, what is the rent per month?

Being able to identify whether a value is a constant of variable (changing) sets you up to write expressions if you are given a word problem to solve. This becomes important as a skill in a little while, as we move closer to the goal of solving algebraic equations. Can you think of any other examples of constant quantities and algebraic quantities?

Constant examples Algebraic examples

Homework Topic 1-2

Classify the following expressions.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1. D + 7

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. 11 x 12 – 5

3. Which of the following expressions are algebraic expressions? Mark all that apply.

\_\_\_\_\_ a. 11a – 40y \_\_\_\_\_ b. 8(15a) \_\_\_\_\_ c. 140 ÷ 35 \_\_\_\_\_ d. 70a – 55

\_\_\_\_\_ e. 17 + 27 x 16

4. \_\_\_\_\_ Justin is at the amusement park for 7 hours. The number of rides he goes on depends on how long the line is for each ride. Is the number of rides he gets to go on a variable quantity?

5. Of the 26 households in a neighborhood, 16 have at least one dog. There are 19 dogs in the neighborhood. The owners walk their dogs at least three times a day. The number of times an owner walks his dog changes from day to day. Which of the quantities listed below are not variable quantities? Select all that apply.

\_\_\_\_\_ the number of households in the neighborhood

\_\_\_\_\_ the number of households in the neighborhood with at least one dog

\_\_\_\_\_ the number of times an owner walks his dog in one day

\_\_\_\_\_ the number of dogs in the neighborhood

5. Describe the expression (4a ÷ 2) – 9y using appropriate academic language. (Hint: values within the parenthesis is considered one term)

\_\_\_\_\_ quotient of two terms

\_\_\_\_\_ sum of two terms

\_\_\_\_\_ difference of two terms

\_\_\_\_\_ product of two terms

6. Is the statement true or false? Explain your answer.

\_\_\_\_\_\_\_\_\_\_\_ The expression (14a + 7y) + 5a + 9(33y + 11) is the sum of three terms.

7. Which parts shown here can you correctly describe as the product of two terms within the expression

8(2a + 3) – (35y ÷ 7) + 15(6z)? Select all that apply.

\_\_\_\_\_ (2a + 3) – (35y ÷ 7) \_\_\_\_\_ 15 (16z) \_\_\_\_\_ (35y ÷ 7) \_\_\_\_\_ 8(2a + 3)

8. a. Which of the expressions listed below are algebraic expressions? Select all that apply.

\_\_\_\_\_ 70a + 3y + 118 \_\_\_\_\_ (19 – 7) + 4(36 ÷ 18) \_\_\_\_\_ 32 + 25(6b)

\_\_\_\_\_ a + bc \_\_\_\_\_ 45ab \_\_\_\_\_ 250(230)

b. What makes the algebraic expression different from those that are not algebraic?

9. How can you use parentheses to change the expression 12 x 6y ÷ 2 so that it is a quotient of two terms?

\_\_\_\_\_ place the parentheses around y ÷ 2

\_\_\_\_\_ place the parentheses around 6y ÷ 2

\_\_\_\_\_ place the parentheses around 6y

\_\_\_\_\_ place the parentheses around 12 x 6y

Topic 1-3 Writing Algebraic Expressions

You can write algebraic expressions to represent real-world situations that have an unknown value. (Hint: in word problems unknown values are always represented by a variable in the resulting expression)

Use the following operations and algebraic expressions to complete the table.

Subtraction Addition n + 20 n – 20 20 ÷ n

Table

|  |  |  |
| --- | --- | --- |
| Word Phrase | Operation | Algebraic Expression |
| A number + 20 |  |  |
| 20 times a number | Multiplication | 20n |
| The difference of a number and 20 |  |  |
| 20 divided by a number | Division |  |

Notice that every time the text mentions “a number” the expression displays the variable ‘n’. When writing algebraic expressions you can choose any letter to represent an unknown quantity, except ‘i’, because ‘i’ stands for an imaginary number and has specific meaning in algebra. You will learn about it when you take Algebra II or advanced algebra.

What expression would you write to represent the situation in the following text:

A state park has 3 lakes. In the spring, each lake was stocked with the same number of fish. What algebraic expression represents the number of fish in the lakes?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

There is a phrase that can help you to make sense of a problem, and it won’t matter if it is a strictly numeric problem or an algebraic problem with an unknown value. This phrase is “Know, Need, Plan”, think of it in the same way as the “Allstate Insurance Ad”, where the spokesperson walks into the restaurant and everyone starts repeating “safe driving, save 40%”. So, every time you face a word problem – “Know, Need, Plan”

|  |
| --- |
| KNOW   * The cost of a T-shirt is $15 * The cost for one letter is $2 |
| NEED  An algebraic expression to represent the total cost of a T-shirt with ‘n’ (unknown number) of letters. |
| PLAN   * Define what the variable represents * Write an algebraic expression using what I know. |

Suppose a store that personalizes T-shirts charges $15 for a shirt, plus $2 for each letter. What algebraic expression can be used to represent the total cost of a shirt with n letters?

The expression for the above example, in combinations with what is known gives us –

15 (cost of T-shirt) + 2n (cost per letter times an unknown number of letters) or **15 + 2n**

Now you try!

A national park charges $25 per bus and $12 per person for an organized tour group. What algebraic expression can be used to represent the total cost for a one-day tour with one bus and n people?

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

Remember a number seated next to a letter 2n or parentheses 2(9) means to multiply.

The algebraic expression is:

On to the homework practice!!

Topic 1-3 Homework

Let ‘n’ be a number. Translate the expression n ÷ 3 into an English phrase.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Write an algebraic expression for “43 more than ‘t’”

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The length of a rectangle is six times the width. If the width is represented by ‘y’ , then write an algebraic expression that describes the length.

|  |
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| KNOW |
| NEED |
| PLAN |

The algebraic expression is:



Lindsey has 50 coins in her change purse that are either dimes or quarters. If ‘y’ represents the number of quarters she has, write an algebraic expression in terms of ‘y’ that describes the number of dimes.

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

(Hint – I know this looks like you have two unknowns, but think of this only in terms of the # of quarters.)

My algebraic expression is

5.

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

My algebraic expression is:

Penny pays $14 a month for her book club membership. With the membership, each book costs $5. Write an algebraic expression for her total bill for one month if she buys ‘b’ books that month.

6.

The price of gasoline changes from week to week. At one station last week, the price was six cents less than the price this week. Next week, the price at that station is expected to be three cents greater than the price this week. Let ‘g’ represent the price of gas in cents this week.

a. What operation should you use to write an algebraic expression for the price of gas next week?

\_\_\_\_\_ subtraction \_\_\_\_\_ division

\_\_\_\_\_ multiplication \_\_\_\_\_ addition

b. Use this operation to write an algebraic expression for the price of gas next week. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. a. What does the variable ‘b’ represent?

A flower shop charges $29 dollars for a bouquet. It costs and additional $9 to include the vase. Last month, the shop sold ‘b’ bouquets and ‘v’ of the bouquets included the vase.

\_\_\_\_\_ the price of each vase \_\_\_\_\_ the number of customers

\_\_\_\_\_ the price of each bouquet

\_\_\_\_\_ the number of bouquets sold

\_\_\_\_\_ the number of bouquets sold last month that included the vase.

b. What does the variable ‘v’ represent?

\_\_\_\_\_ the price of each bouquet \_\_\_\_\_ The number of bouquets sold last month

\_\_\_\_\_ the number of bouquets sold last that included the vase \_\_\_\_\_ the price of each vase

\_\_\_\_\_ the number of customers

Repeated posting to eliminate turning back.

A flower shop charges $29 dollars for a bouquet. It costs and additional $9 to include the vase. Last month, the shop sold ‘b’ bouquets and ‘v’ of the bouquets included the vase.

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

c. Write an algebraic expression for the shop’s total sales of bouquets and vases last month.

8. Select the two different word phrases for the algebraic expression h + 6.

\_\_\_\_\_ h times 6 \_\_\_\_\_ the sum of h and 6 \_\_\_\_\_ 6 more than h \_\_\_\_\_ the product of h and 6

9. Write an algebraic expression for “84 more than the product of 167 and b”.

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

10. A salesperson sold 3 cars for a total value of $43,800. Her co-worker sold 7 cars for a total the value of ‘d’ dollars

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

1. Write an algebraic expression that represents the combined value of the cars sold by the salesperson and her co-worker.
2. Suppose the salesperson and each of n co-workers sold 3 cars a piece at a price of ‘k’ dollars per car. What algebraic expression would represent the combined value of these sales?

11. A group of friends is planning a boating trip. It costs $2,500 to rent the boat. Lunch costs $13 per adult and $8 per child. Write an algebraic expression for the total cost for a group of ‘b’ adults and ‘c’ children.

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

Topic 1-4 – Evaluating Algebraic Expressions

Evaluating algebraic expressions involves using a given value for a variable, like n=3, and then replacing every ‘n’ in an expression with its given value. So, if you have 2n-5 that expression becomes 2(3) – 5 or three multiplied by two less five, giving you an answer of one or 2(3) is 6, so 6 – 5 = 1. I love to refer to this method of evaluating algebraic expressions as “plug and play”, because you “plug” the numbers in for the letters (variables) that represent them and then using the orders of operation, you solve the, now, numeric expression. That is it, that is all there is to this aspect of algebra! Now, you try.

There are two expressions - 13 – m 35 + 2m

Then there are two values for m - m = 5 and m = 7 evaluate each expression for each value.

Next is evaluating an expression with two different variables. The instructions for doing this are still the same, only, you must make sure you are substituting the correct value for the variable you are replacing. This time there are three expressions and two variables.

Variables - n = 5 y = 8

Expressions - 3n + 2y 12ny + 20 4(n + y) – 10

Last, it is time to apply what you have learned about wording and creating algebraic expressions and using given information in a word problem to get values for the variables in your expression so you can evaluate them!

You can choose between two part-time jobs. You can earn $20 per lawn mowing lawns or you can earn $7 per hour washing cars. Which part-time job sill help you earn more money?

1. Write an algebraic expression for each situation.
2. How can you use the algebraic expressions to compare potential earnings for each job?
3. Suppose you could mow 2 lawns per week. In which job would you earn more money making that assumption?

One of the ways you can compare the two jobs is to create charts to explore the possibilities. So, if you earn $20 per lawn you mow, you could say that is 20m or (20 multiplied by the variable m, which stands for the number of lawns mowed). The same with working at the car wash, but in this case you earn $7 per hour worked. So, your expression is 7n or seven multiplied by the number of hours a week you work.

Fill in the values after you calculate them.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| m = ? | 1 | 2 | 3 | 5 | 10 | 15 |
| 20m = ? |  |  |  |  |  |  |

Fill in the values after you calculate them.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| n = ? | 1 | 2 | 3 | 5 | 10 | 15 |
| 7n = ? |  |  |  |  |  |  |

Now, you can see and compare the values. Which is the job that will earn you the most amount of money?

Topic 1-4 Homework

1. Evaluate 18 ÷ y for y = 2
2. Evaluate 4b + c for b = 8 and c = 6
3. You are part of a group of 8 students working on an art project. You bring 67 paper clips and your friend brings 13 to share evenly with the group. To find how many paper clips each student can use, evaluate the expression (b + c) ÷ 8 for b = 67 and c = 13.
4. Bruce is taking a taxi to the airport. The taxi charges an initial fee of $4 and $2 per mile.
   1. Write an algebraic expression for the cost of a taxi ride of ‘m’ miles.
   2. How much would a 9-mile taxi ride cost Bruce?
5. Evaluate 10p ÷ q + 4(r – 7) for p = 9, q = 5, and r = 14. Then choose different values for ONE of the variables and explain the differences you see in the outcome of the expression.
6. Ben’s teacher asks Ben to evaluate the expression m – n ÷ 4 for m = 44 and n = 36. Ben incorrectly states that when m = 44 and n = 36, then m – n ÷ 4 = 25.
   1. Find the correct value of the expression when m = 44 and n = 36.
   2. What error did Ben likely make?

\_\_\_\_\_ substituted n’s value for m, and m’s value for n.

\_\_\_\_\_ He used the incorrect order of operations.

\_\_\_\_\_ He added when she should have subtracted.

\_\_\_\_\_ He multiplied when he should have divided.

1. A class is going on a trip to a museum. It costs $790 to rent a bus. Each ticket to the museum costs $11.
   1. Write an algebraic expression that represents the cost of the trip for ‘n’ people.
   2. Evaluate this expression for n = 37 people.
2. What should you do first in order to evaluate 9 + 7t for t = 6?

\_\_\_\_\_ multiply 7 and t \_\_\_\_\_ replace t with 6 \_\_\_\_\_ divide 7 by t \_\_\_\_\_ find 9 + 7

Now, complete the evaluation of the expression.

1. A. Evaluate expressions ny ÷ 2 and 12n – y for n = 10 and y = 20.

B. Which expression gives the greater value when evaluated for n = 10 and y = 20?

\_\_\_\_\_ ny ÷ 2 \_\_\_\_\_ 12n – y \_\_\_\_\_ Their values are equal.

1. You and a friend charge $24 to rake a yard. You get half the money. You also earn $9 an hour babysitting. Suppose you and your friend rake ‘y’ yards and you babysit for ‘n’ hours.
   1. Write an algebraic expression for how much money you would earn.
   2. How much money would you earn by raking 5 yards and babysitting for 5 hours?

WEEK 3 – Algebraic Expressions (Continued)

Topic 1 – 5 Expressions with Exponents

Way back at the beginning of school we talked about bases and exponents and how exponents were the key to determining place values in a number system with a certain base, for instance:

Binary base 2 number system only two digits 0 and 1

Octal base 8 number system only 8 digits 0 through 7

Decimal base 10 number system only 10 digits 0 through 9

Hexadecimal base 16 number system only 16 digits 0 through 9 and A through F

I did a demonstration on binary to help you to understand place value and how it is derived, then I also did decimal.

20 = 1 Ones 100 = 1 Ones

21 = 2 Twos 101 = 10 Tens

22 = 4 Fours 102 = 100 Hundreds

23 = 8 Eights 103 = 1000 Thousands

24 = 16 Sixteens 104 = 10,000 Ten Thousands

25 = 32 Thirty Seconds 105 = 100,000 Hundred Thousands

26 = 64 Sixty Fours 106 = 1,000,000 Millions

And so on. In each case the BASE is how many digits are available in the number system. In binary it is only two digits, in decimal it is ten digits. This is why decimal is referred to as a BASE 10 number system. With exponents, the only number that is multiplied, is the BASE number. The exponent DOES NOT get multiplied. So in the above example, when we look at 23 and 103 (so that there is no confusion), the base numbers are what is multiplied and the exponent tells how many times to multiply. Like this

23 = 2 x 2 x 2 = 8 and 103 = 10 x 10 x 10 = 1000 Notice each number is multiplied 3 times.

24 = 2 x 2 x 2 x2 = 16 and 104 = 10 x 10 x 10 x 10 = 10,000 Notice each number is multiplied 4 times.

The exponent in both examples was never multiplied. This is the key to calculating exponents correctly.

Note – If you look back to the decimal number place values, you might see or notice an additional bonus. The exponent also equals the number of zeros that appear in the answer to the calculation. Aren’t working in the tens wonderful?!

Some other things you need to know. When discussing a ‘power’, the reference is to an exponent. For instance:

5 to the power of three, or five to the third power, is the same as 53. If a problem uses the word ‘squared’ or a person talks about a number being squared, that is a reference to the second power or an exponent of 2. If ‘cubed’ is mentioned, now we are discussing a base to the third power or an exponent of three.

Squared is a ‘n’ number to the second power or n2

Cubed is a ‘n’ number to the third power of n3

Don’t forget that exponents are the second item to be handled in the order of operations, directly after parentheses are solved. P – parentheses E – Exponents MD – multiplication/division AS – addition/subtraction

Time to Practice!!!

Fill in the blanks with an appropriate value to make the statement true.

1. 4 x 4 x 4 = 4 \_\_\_\_\_ = \_\_\_\_\_\_\_
2. \_\_\_\_\_ x \_\_\_\_\_ x \_\_\_\_\_ x \_\_\_\_\_ x \_\_\_\_\_ = 25 = \_\_\_\_\_
3. 21 – 32 = 21 - \_\_\_\_\_ = \_\_\_\_\_\_\_

What is the value of each expression for a = 5, b = 12, and c = 9?

1. 2a + 8 B. 2c C. 5b
2. 12a E. b2 – 63 F. c2

Suppose you want to find the area of one wall in a room. The wall is both n feet tall and n feet wide. (Draw a square and label the left side x and the bottom x) The area of the wall would be n feet x n feet or n2.

Now let’s take it a little further. Suppose you want to paint a room that has 4 walls. Each wall is a square wall with a side length of 10 feet. On gallon of paint will cover about 400 square feet. Will one gallon of paint be enough to give the room 2 coats of paint?

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

Now use what you know to solve the problem, remember area is the length x width.

Topic 1-5 Homework – Exponents

1. A. Rewrite the expression 3 x 3 x 3 using an exponent: \_\_\_\_\_\_\_\_\_
2. Find the value of the expression: \_\_\_\_\_\_\_\_
3. 9 x 9 x 9 x 9
   1. Identify the base: \_\_\_\_\_\_\_\_
   2. Identify what the exponent will be: \_\_\_\_\_\_\_\_
   3. Write the above expression using the exponent: \_\_\_\_\_\_\_\_
   4. Find the value of the expression: \_\_\_\_\_\_\_\_
4. What is the value of b3a if b = 2 and a = 6
5. The area of a square is s2 (side squared or to the second power). Find the area of a square with a side length of 3 units.
6. The pilot of a hot-air balloon drops an object overboard at a height of 3,000 feet. The expression 16t2 represents the distance in feet that the object falls in ‘t’ seconds, until the object hits the ground. Find the distance the object falls in 6 seconds.

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

1. Is the statement 8 x 8 x 8 x 8 x 8 x z x z = (8z)2 true or false? Explain your reasoning. Also, support your reasoning with an example.
2. The expression n x 23 give the population (in thousands) of an animal after 3 years, where n is the starting population (in thousands). Find the population after 3 years if the starting population is 5,000. (Hint – you can shorten 5000 to 5 in the expression, but remember to multiply the answer by 1,000).
3. There is an expression s2 – t2
   1. If s = 20 and t = 5, what is the value of the expression?
   2. Describe an easy way to mentally subtract the lesser square from the greater.
4. Evaluate the expression x2 + 3(x + y) for x = 4 and y = 6.
5. Which of the following is the correct meaning of 27x(yz)5 ?
   1. 27x(yz)5 = 27x ∙ yz ∙ 5
   2. 27x(yz)5 = 27x ∙ yz ∙ yz ∙ yz ∙ yz ∙ yz
   3. 27x(yz)5 = 27xy ∙ z ∙ z ∙ z ∙ z ∙ z
   4. 27x(yz)5 = 27xyz ∙ 27xyz ∙ 27xyz ∙ 27xyz ∙ 27xyz
6. Suppose you want to tile a floor. The floor is a square with a side length of 12 feet. You want the tiles to be squares with a side length of 2 feet.

|  |
| --- |
| KNOW |
| NEED |
| PLAN |

* 1. How many tiles do you need to cover the entire floor? (Hint: remember your tiles are 2 feet square, not one foot square.)
  2. Find three other tile sizes that will cover the floor exactly with a whole number of tiles. (In other words, you aren’t cutting any tiles to make them all fit.)

Topic 1-6 Problem Solving Notes

Yeah, I know, it is your least favorite part of math, word problems. I want to see if I can change your mind about them though, if you are a puzzle solver, or you like solving riddles, or you enjoy concrete (real or actual) problems involving items you are familiar with, or you are good at visualization and actually imagining the aspects being described, then word problems may not be that bad. Truly.

Now, you know that you have the “Know, Need, Plan” chart to extract the information from the word problem and the chart organizes it so you can plan an expression. Now, we are going to explore the use of a model involving a small rectangle broken into two parts called a “Bar Model” for addition and subtraction expressions. One thing you need to understand right away is that the length of the entire bar represents the ‘whole’ or original value. I’ll talk more about that as we get into the examples. So, pay attention.

Alright, here we go! Part 1 Addition and Subtraction Bar Model

Addition Model

This model is easy to understand. You have two or more terms and the bar is divided accordingly. Each term gets its own ‘cell’ within the bar. By the way, in this case, “cell” is a spreadsheet term. A spreadsheet has columns and rows, and where a column and row intersect is called a “cell”. See the example below.

Column A Column B Column C

|  |  |  |
| --- | --- | --- |
| Cell A1 | Cell B1 | Cell C1 |
| Cell A2 | Cell B2 | Cell C2 |
| Cell A3 | Cell B3 | Cell C2 |

Row 1

Row 2

Row 3

In the above model, each cell has its address in it. The address is a combination of the column letter and the row number. If you get into any math related field, a spreadsheet is a very powerful program you will probably use. Anyway, this is where the name “cell” comes from. It is a handy reference in this case.

So, let’s look at an expression and the corresponding bar model. So, for an addition bar model, the text wants you to write an algebraic expression for the word phrase **a number plus 32**.

In this instance the whole bar is equivalent to n + 32, which is the algebraic expression. A small side or cell of the bar

| - - - - - - - - - - n + 32 - - - - - - - - - - - | contains the variable n, your unknown number and the other side of the bar or

|  |  |
| --- | --- |
| n | 32 |

cell contains the constant 32, the “whole thing” being n + 32. In the “Know, Need, Plan” chart, all of this would probably go in the plan part of the chart.

Now, you are probably wondering what the Bar Model will look like for a subtraction problem, right? Well, this is where the model gets interesting. Remember, the model is really built for addition because addition deals with a total or whole, and it is very easy to see how one term combined with or added to another makes the whole. Well, the same “rule” regarding the whole still applies to the subtraction model.

For the subtraction model the book wants you to write an algebraic expression for the word phrase **16 subtracted from a number**. Now, you know that the algebraic expression is going to be n – 16, but how does this work in the model, using the bar?

| - - - - - - - - - - - n - - - - - - - - - - - - - | Consider that the unknown amount is n, the variable, because if you added the

|  |  |
| --- | --- |
| n - 16 | 16 |

answer to the expression (n – 16) and 16, you would have the value of n, the original number. So, the whole bar is equal to n! Hopefully, that makes sense so far. Now let’s get into the two cells. The first cell contains your algebraic expression. The second cell contains the constant 16. I know, you’re wondering, why are you writing 16 twice? Well, remember the combination of the two cells has to equal some “whole amount” or original number, which at this moment is unknown. Notice that in the subtraction expression you came up with, there is a minus sign in front of the 16. That makes the 16 a negative number, so, the minus sign is serving a dual (double) purpose. It is telling you to subtract an amount, and it is signifying a negative number. Now, if you combine the minus or negative 16 with its opposite, the positive 16 or constant in the second cell, what are you left with? That’s right, zero or n – 0, which equals n! Identity Property strikes again, and names the variable above the bar in the model, at the bottom of the previous page. Once again, this model would be used in the plan part of the Know, Need, Plan chart. If you need to, go through this explanation a couple of times, change the number in the problem, and use that number in place of 16 in the explanation and see if you can follow it through. Then attempt the examples below.

A library had x number of biographies and bought 13 new biographies. What algebraic expression can be used to represent the total number of biographies the library has now?

Draw a bar to model of the parts being added. Substitute the values into the bar diagram. Then find the sum of the parts.

|  |  |
| --- | --- |
| Biographies the library had | Number of new biographies |

Remember to use the variable for the unknown amount. Don’t forget to write the expression above the bar.

| - - - - - - - - - - - - - - - - - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - - - - - - - - - - - - - - - - - - - |

|  |  |
| --- | --- |
|  |  |

Emilio delivered x number of papers to people in this neighborhood. He recently lost 9 clients due to using the internet for news. Write an algebraic expression that will reveal how many clients Emilio has now.

| - - - - - - - - - - - - - - - - - - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - - - - - - - - - - - - - - - - - - - |

|  |  |
| --- | --- |
|  |  |

Part 2 Multiplication and Division Models

Just as with addition and subtraction expressions, you can model multiplication or division expressions with a bar diagram. (It looks more like a line diagram to me, but, whatever.)

Multiplication Model

Suppose each page of a photo album is designed to hold 4 photographs and an album can have p number of pages.

| - - - - - - - photographs in all - - - - - - - - - - - - |

|  |
| --- |
| 4 |

p pages

Photographs on each page. The algebraic expression is 4 ∙ p or 4p. Four represents the constant mentioned in the story, the number of photographs that fit on each page, and p represents the unknown number of pages. Once again, putting in the correct order the terms needed for the algebraic expression. Notice that the diagram represents a total, just like the addition/subtraction bar models. This diagram would go in the planning area of the Know, Need, Plan chart.

Division Model

Suppose a company that manufactures the photo albums is packaging them for shipment. Each shipping box holds 12 albums. Just as with the addition and subtraction bar model, the diagram represents the total. Which we do not know, and if we knew how many albums there were, we could calculate how many boxes were needed. So, the real unknown number is the number of albums to be packaged, which needs to be represented by a variable – x.

So, in this example the total is the number of albums to be packed. So, the length of the diagram represents that number, just as in the multiplication diagram. So, that is listed at the top of the diagram, just as before.

| - - - - -\_\_\_\_\_\_\_\_\_X\_\_\_\_\_\_\_\_\_\_\_\_ - - - - - - |

|  |
| --- |
| 12 |

Number of boxes needed

Albums in each box

You’ll notice that your problem is set up for you, look, you have x over 12 or x ÷ 12 which will give you the number of boxes needed to pack the albums. Additionally, if you know the number of boxes needed, that number could be multiplied by 12 to get the total number of albums, which is represented by x, because we don’t know what that value is.

Now it is your turn. See if you can work out the diagram for the following real-world situation involving division.

A factory robot is used to pack 16 bottles of orange juice into each box. If the factory manufactures b bottles of orange juice per day, what algebraic expression can be used to represent how many boxes the robot packs per day?

| - - - - - - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - - - - - - |

|  |
| --- |
|  |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the expression is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Well, after all of this, it is time to do the homework. Thankfully, you only have four problems to do. Yea!!

Topic 1-6 Problem Solving Homework

1. Suppose a bookstore sells b copies of a book. The price of the book is $8.
   1. Which of the bar diagrams below models the total cost of b books?
      1. \_\_\_\_\_ | - - - - - Total Cost - - - - - |

|  |
| --- |
| 8 ÷ b |

b books

Price of each book

* + 1. \_\_\_\_\_ | - - - - - Total Cost - - - - - |

|  |
| --- |
| 8 |

b books

Price of each book

More on next page.

* + 1. \_\_\_\_\_ | - - - - - Total Cost - - - - - |

|  |
| --- |
| b |

8 books

Price of each book

* + 1. \_\_\_\_\_ | - - - - - Total Cost - - - - - |

|  |
| --- |
| 8 |

12b books

Price of each book

1. Isabella and Juan each have 18 books. Isabella gives Juan b books.
   1. Which of the following diagrams models how many books Isabella has now?
      1. | - - - - - - 18 - - - - - -|

|  |  |
| --- | --- |
| b | 18 ÷ b |

* + 1. | - - - - - - - b - - - - - - -|

|  |  |
| --- | --- |
| 18 | b - 18 |

* + 1. |- - - - - - - 18 - - - - - - -|

|  |  |
| --- | --- |
| b | 18 - b |

* + 1. | - - - - - - - b - - - - - - - |

|  |  |
| --- | --- |
| 18 | 18 + b |

* 1. Which diagram models the number of books Juan has now?
     1. | - - - - - - - b ∙ 18 - - - - - - - |

|  |  |
| --- | --- |
| b | 18 |

* + 1. | - - - - - - - - - 18 - - - - - - - - -|

|  |  |
| --- | --- |
| b | 18 - b |

* + 1. | - - - - - - - b + 18 - - - - - - -|

|  |  |
| --- | --- |
| b | 18 |

* + 1. | - - - - - - - - - b - - - - - - - - - |

|  |  |
| --- | --- |
| 18 | b + 18 |

1. Some friends are going to an amusement park together. The park charges $33 for each ticket. The total cost for the group is c. Choose the diagram that represents the total cost for the group. Circle your letter choice.

| - - - - - - - - - - - - 33c - - - - - - - - - - - - - - - - - |

|  |
| --- |
| c |

33 people

Price per ticket.

More choices on the next page.

| - - - - - - - - - - - - - - - 18 - - - - - - - - - - - - - - - |

|  |
| --- |
| $33 |

c ÷ 33

Price per ticket.

| - - - - - - - - - - - - - c + 33 - - - - - - - - - - - - - - - |

|  |
| --- |
| $33 |

c people

Price per ticket.

| - - - - - - - - - - - - - - - 33c - - - - - - - - - - - - - - - |

|  |
| --- |
| $33 |

c people

Price per ticket.

1. A farmer is planting vegetables. Suppose one plot of land can have r rows of plants. Each row can have 13 plants. The bar diagram represents the total number of plants the farmer can grow in this plot.

| - - - - - - - - - - - \_\_\_\_\_\_\_\_\_\_\_ - - - - - - - - - - - - |

|  |
| --- |
| 13 |

r rows

Plants in each row.

Which letter below has the algebraic expression that is the missing label?

1. 13 ÷ r
2. 13r
3. 13 – r
4. 13 + r

Topic 3 – 1 Expressions to Equations

You made it! We now get to start on equations, which means the equal sign comes back! So, let’s get started.

An **equation** is a mathematical sentence that **includes an equal sign** to compare two expressions. In the past you have been given numeric equations to evaluate or solve. They are considered the basics of math, and your ability to understand them prepared you for this moment. So, those basic number sentences like:

2 +2 = 7 + 10 = 25 + 47 = 5 – 2 = 16 – 4 = 67 – 32 =

4 x 7 = 9 x 12 = 36 x 21 = 16 ÷ 4 = 35 ÷ 7 = 156 ÷ 12 =

You learned all the operations (+, -, x, and ÷). You learned the values of all the symbols we call numbers. Then you learned how to combine or separate numbers, in all kinds of different combinations. You even have solved for missing numbers in a number sentence, like:

24 + \_\_\_\_\_ = 136 45 - \_\_\_\_\_ = 22 16 x \_\_\_\_\_ = 32 108 ÷ \_\_\_\_\_ = 12

These types of problems set you up to solve for a variable. The blank in the above number sentences are going to become letters and you will be asked to find what those letters equal. So, you have covered a lot over the years!

Now, the first skill that we need to be sure you have, is that you can tell the difference between and expression and an equation. Remember the only difference is whether or not an equal sign is present.

Which of the following are expressions and which are equations? Arrange them under the appropriate headings below.

56 + 8 27 = 3(9) 1000 ÷ 100p 11 ∙ 2 = 22 3 = 2z

27 – 17 = 5x 13a – 1 4(20) = 5(16) 750 ÷ 50 x = 100 32z

**Expressions** **Equations**

There are six or one and four of the other. Is that the split that you got. If not, go back and check. Compare what you wrote to the actual number sentences.

Now, since we have an equal sign, we of course have to discuss equality or equivalence. Our current number sentences are comparing one thing to another in terms of equivalence. To use some real world examples, it is like:

A five dollar bill being equivalent to five one dollar bills.

Twelve eggs being equivalent to a one dozen carton of eggs.

16 oz of strawberries being equivalent to one pound of strawberries, and so on.

Then there are those things which are not equivalent, such as:

1 egg and a dozen eggs

1 dollar and a five dollar bill

1 strawberry and 1 pound of strawberries

So, it is time to see if you can spot equivalent equations and equations that are not equivalent. You are going to be given a series of expressions and you need to match up equivalent expressions into a pair that becomes a pair of equivalent equations.

Example: 3 x 4 and 2 x 6 can be rewritten as 3 x 4 = 2 x 6 Now it’s your turn.

3 ∙ 10 5(3w) 25w – 15w 2(15) 20 – 10 10w 15w

Equivalent Equations – Write your answers here.

An equation that is true or **true equation** will have equivalent expressions on either side of the equal sign.

An equation that is false or **false equation** will have unequal expressions on either side of the equal sign.

A **solution of an equation** is a value substituted for a variable that makes the equation true.

An **open sentence** is an equation that includes one or more variables.

Circle the equations in which the variable equals 10. (Hint – substitute 10 for the variable and see if the equation is true)

10t = 30 3t = 30 m + 6 = 10 m – 6 = 4 m + 10 = 11 20 ÷ c = 2

10 ÷ c = 10 100 ÷ c = 20 12 – y = 2 12 + y = 14

Only four of them should work.

Time for some practice. If you have been hard at it for an hour or more, you should take a break for ten to fifteen minutes. You need to absorb the material and relax so that your retention or ability to hang onto the information increases. Just a little reminder.

Topic 3 – 1 Homework

1. Identify g – h = 8 as an expression or an equation. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Is 81 – 9 = 72 a true or false open sentence? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Use distributive property to rewrite the expression 3(x + 8) without parentheses. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Which number is a solution to x + 29 = 1 + 5x? Circle your choice
   1. 8 b. 9 c. 3 d. 7 e. 6
5. Think about the last time you went to your favorite store.
   1. Describe the items you bought, the cost of each, and how much you spent in all.
   2. Write an expression to represent your purchases.
   3. Write an equation using the previous expression and how much you spent in all.
   4. What is the difference between the expression and the equation you wrote?
6. Name the properties of operations used in each step to show that the expressions 6 + 5(x + 9) and 5x + 51 are equivalent.

6 + 5(x + 9) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

= 6 + (5x + 45) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

= 6 + (45 + 5x) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

= (6 + 45) + 5x \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

= 51 + 5x Definition of Addition

= 5x + 51 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Your teacher solved the equation 4x + 1 = 22 + x. Unfortunately, due to messy handwriting (yeah right – NOT!), you are not sure if the solution is 2, 7, or 8.
   1. Describe how you can find the solution without solving the equation again.
   2. Use this to find the solution.
2. Is 15x + 10 = 13 true, false, or an open sentence? Circle one. Show your work or state your reasoning.
3. Write three different equations that have 1 as a solution.
   1. Use x as the variable. Use substitution (plug and play) to show that your equations are true when x is 1.

* 1. What is the simplest possible equation that has 1 as a solution?