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ABSTRACT

This document offers instructional materials for a 60-hour course on math operations involving decimals, fractions, proportions, statistics, probability, measurement, geometry, and linear algebra as applied in the workplace. The course was part of a workplace literacy project developed by Mercer County Community College (New Jersey) and its partners. The following topics are covered: basic decimal concepts and problem-solving techniques, basic fraction concepts and problem-solving techniques, basics of percents and solving percent problems, ratio and proportion, statistics, graph basics, data analysis, probability basics, measurement systems and geometry basics, and linear algebra. The document begins with a description of the project and a course outline that includes objectives, topical outline, textbook references, and list of supplies. The rest of th' document consists of information sheets and exercises for learners. The document ends with two forms of a pretest and one answer key. (CML)

ED351580

II

BASIC MATHEMATICS FOR MANUFACTURING

CE062482

Prepared Under a United States Department of Education
National Workplace Literacy Program Grant to
MERCER COUNTY COMMUNITY COLLEGE
Center for Training and Development
1200 Old Trenton Road
Trenton, NJ 08690

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Director, Workplace Skills Project

Acknowledgements

This manual was developed and taught for a manufacturing plant by Kathy Safford, a Ph.D. candidate in mathematics. She supplemented all materials with real life situations to make math come alive for the factory workers. With much appreciation, we thank Kathy for the time and effort she put into her 7:00 am classes.

OVERVIEW OF WORKPLACE LITERACY PROJECT
Skills for Tomorrow, NOW

The Workplace Literacy Project resulted from a Department of Education grant, plus in-kind contributions from a partnership with General Motors Inland Fisher Guide Plant, Princeton Plasma Physics Laboratory, and St. Francis Medical Center. The project is an attempt to find solutions to the growing "skills gap" in industry today. More than 25 million Americans cannot read the front page of a newspaper. In addition, workers whose average ages are rising, must produce in a technological environment that may not have existed when they began working. This lack of knowledge makes it difficult to compete in a technologically changing workplace. Moreover, an increasing number of immigrants have entered the workforce with limited English communication skills. In response to this growing need, the Federal government provided a grant to Mercer County Community College and its partners to develop ways to enrich and expand employees' basic workplace knowledge. The aim of the project was also to improve the self-esteem of the participants.

Support for the project was solicited from all levels of company management and the unions. In addition, an advisory council, comprising key management and employees from each company determined the design, goals, and time-frame of the project. Each company provided a liaison person from their site, and MCCC hired a director to manage the program. Employee release time for classes was site-specific.

Participation in the program was voluntary. Information about classes was disseminated through company letters, flyers, union notices, notices included with paychecks, and open forums with supervisors and employees.

The ABLE test was used for normative pre and post testing. Other types of evaluations varied from course to course. MCCC counselors met with each student to discuss present and future educational objectives.

Courses were offered in reading, business writing, math, science, and English as a Second Language. In addition, there were workshops in problem solving, stress management, and other work survival skills. The curricula for the courses were customized for each worksite to be as job focused as possible.

It is our hope that this program will serve as a model for other organizations to empower their employees with the skills needed to succeed in the changing technological workplace, today and in the future.

BASIC MATH II

COURSE OUTLINE

BASIC MATH II

Reviews basic operations involving fractions, decimals, and proportions. It also covers the basics of statistics, probability, measurement, geometry, and linear algebra. The examples and word problems used emphasize applications in the work environment. When possible, material used in the workplace was used in the lesson.

OBJECTIVES

Upon completion of this course, students will be able to:

- Perform basic operations involving fractions, decimals, and proportions.
- Solve word problems involving fractions, decimals, and proportions
- Demonstrate an understanding of the basic concepts of statistics, probability, measurement, geometry, and linear algebra.

TOPICAL OUTLINE

- Basic Decimal Concepts and Problem Solving Techniques
- Basic Fraction Concepts and Problem Solving Techniques
- Basics of Percents and Solving Percent Problems
- Ratio and Proportion
- Statistics
- Graph Basics
- Data Analysis
- Probability Basics
- Measurement Systems and Geometry Basics
- Linear Algebra

OTHER

- 60 hours

SUPPLIES

graph paper, calculators, metric rulers

TEXTBOOK

Shea, James T., Working With Numbers, Refresher, Steck-Vaughn, Texas, 1990.

BASIC MATH II

Module: Decimals

Lesson: Basic Decimal Concepts

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Identify place value from the millions to the thousandths place.
2. Demonstrate an understanding of the terms standard and expanded notation.
3. Order and compare numbers.
4. Solve word problems involving decimals.

BASIC DECIMAL CONCEPTS

A) PLACE VALUE

OUR DECIMAL SYSTEM USES THE TEN NUMERALS 0 THRU 9 TO REPRESENT ANY DECIMAL NUMBER WE REQUIRE. THE VALUE OF THAT NUMERAL WITHIN A SPECIFIC NUMBER IS DETERMINED BY ITS' PLACE WITHIN THE NUMBER

WHOLE NUMBERS ARE NAMED IN GROUPS OF THREE:

HUNDREDS	TENS	UNITS
7	9	6

IN THE ABOVE NUMBER, 7 REPRESENTS 7 HUNDREDS, 9 REPRESENTS 9 TENS, AND 6 REPRESENTS 6 UNITS.

FOR LARGE NUMBERS, DIGITS ARE SPEARATED INTO GROUPS OF THREE WHICH ARE CALLED PERIODS AND ARE SEPARATED BY COMMAS.

PERIODS TRILLIONS, BILLIONS, MILLIONS, THOUSANDS, ONES

	HUNDREDS	TENS	UNITS,	HUNDREDS	TENS	UNITS,	HUNDREDS	TENS	UNITS,	HUNDREDS	TENS	UNITS,	HUNDREDS	TENS	UNITS
THE NUMBER			6,	5	4	3,	2	4	5,	7	8	1,	5	6	7

WOULD BE READ:

SIX TRILLION, FIVE HUNDRED FORTY-THREE BILLION,
TWO HUNDRED FORTY-FIVE MILLION, SEVEN HUNDRED EIGHTY-ONE THOUSAND, FIVE HUNDRED SIXTY-SEVEN

WHEN A NUMBER IS WRITTEN USING NUMERALS, WE SAY IT IS WRITTEN IN **STANDARD** NOTATION. WHEN WE WRITE OUT ALL THE WORDS, WE SAY THAT IT IS WRITTEN IN **EXPANDED** NOTATION.

EXAMPLES:

A) THE NUMBER 81,902 IS WRITTEN IN STANDARD NOTATION IF I WANT TO WRITE IT IN EXPANDED NOTATION, I WRITE EIGHTY-ONE THOUSAND, NINE HUNDRED TWO.

B) THE NUMBER TWO MILLION, THREE HUNDRED THIRTY THOUSAND IS WRITTEN IN EXPANDED NOTATION. WRITTEN IN STANDARD NOTATION IT WOULD BE 2,330,000

****

WRITE THE FOLLOWING IN EXPANDED NOTATION:

1) 518

2) 31,491

3) 14,324,713

WRITE THE FOLLOWING IN STANDARD NOTATION:

1) THREE HUNDRED EIGHTY-THREE

2) TWENTY-ONE THOUSAND, FOUR HUNDRED THIRTY-SEVEN

3) ONE HUNDRED MILLION, THREE HUNDRED TWENTY-NINE THOUSAND, SIX HUNDRED THIRTY-FOUR

B) DECIMAL NUMBERS

ONE WAY TO REPRESENT A PORTION OF A UNIT IS WITH A DECIMAL. THE PLACE VALUE OF EACH NUMBER IS AS FOLLOWS:

.	TENTHS	HUNDREDTHS	THOUSANDTHS	TEN THOUSANDTHS	HUNDRED THOUSANDTHS	MILLIONTHS

THE WORD "AND" INDICATES THE POSITION OF THE DECIMAL POINT AND MARKS THE SHIFT FROM WHOLE NUMBER TO PART. THE NUMBER 0.641 HAS A 6 IN THE TENTH POSITION, A 4 IN THE HUNDREDTH POSITION AND A 1 IN THE THOUSANDTH POSITION WE READ IT AS IF IT WERE A WHOLE NUMBER AND IT TAKES THE NAME OF THE PLACE WHERE THE LAST NON-ZERO NUMERAL FALLS. THEREFORE, 0.641 WOULD BE READ "SIX HUNDRED FORTY-ONE THOUSANDTHS".

****

WRITE THE FOLLOWING IN STANDARD FORMAT:

1) SIX AND THREE TENTHS

2) TWENTY-TWO HUNDREDTHS

3) THIRTY AND FOUR THOUSANDTHS

4) TWO MILLION, FORTY THOUSAND, SIXTY THREE AND SEVENTY-NINE THOUSANDTHS

WRITE THE FOLLOWING IN EXPANDED NOTATION:

1) 142.97

2) 0.1457

3) 1,000,002.05

4) 0.0072

5) THE NEWSPAPER REPORTS THAT A FEDERAL GRANT HAS BEEN OBTAINED FOR TWO HUNDRED FIFTY MILLION, FIVE HUNDRED SIXTY-FIVE THOUSAND, TWO HUNDRED TWENTY-FIVE DOLLARS. WHAT WOULD THAT LOOK LIKE EXPRESSED IN NUMERALS?

6) THE UTILITY COMPANY HAS ACCIDENTALLY SENT YOU A REBATE FOR $3,565,789.55! WHAT DOES THAT LOOK LIKE WRITTEN OUT ON THE CHECK?

C) ORDER AND COMPARISON OF NUMBERS

WHENEVER WE NEED TO COMPARE TWO OR MORE NUMBERS TO FIND THE LARGEST, SMALLEST, OR TO PUT THEM ALL IN ASCENDING OR DESCENDING ORDER, WE ALIGN THEM ALL ON PLACE VALUE. THEN PROCEED LEFT TO RIGHT COMPARING THE VALUES IN EACH PLACE IN ORDER TO MAKE A DECISION.

EXAMPLE:

TO DECIDE WHICH OF THE NUMBERS 435.324, 435.332 OR 435.145 IS THE LARGEST, WE WOULD LINE THEM UP LIKE THIS:

435.324
435.332
435.145

THEN WE WOULD PROCEED TO COMPARE EACH PLACE UNTIL WE HIT THE TENTHS COLUMN WHERE THE LAST NUMBER DROPS OUT OF THE RUNNING FOR LARGEST. WE WOULD HAVE TO GO AS FOR AS THE HUNDREDTHS COLUMN, HOWEVER, BEFORE DECIDING THAT THE MIDDLE NUMBER WAS THE LARGEST.

****

1) DURING THE MONTH OF SEPTEMBER, ELECTRICITY USAGE AT INLAND FISHER GUIDE WAS $88,885 (WEEK 1), $101,347 (WEEK2), $98.945 (WEEK 3) AND $93,690 (WEEK 4). RANK THE WEEKS IN DESCENDING ORDER BASED ON ELECTRICITY USAGE.

2) FEDERAL SPECIFICATIONS FOR A CERTAIN PART ALLOW IT TO BE

NO SMALLER THAN 38.75 INCHES AND NO GREATER THAN 38.80 INCHES. A SAMPLE OF THREE PARTS MEASURE 38.735, 38.752 AND 38.793. WHICH, IF ANY, OF THESE PARTS ARE ACCEPTABLE?

BASIC MATH II

Module: Computational skills

Lesson: The Addition and Subtraction Sentence

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Demonstrate an understanding of the addition and subtraction sentence.
2. Solve word problems involving addition and subtraction.

NEW OPPORTUNITIES IN THE WORKPLACE

A) The Addition/Subtraction Sentence

There are four basic operations which we perform when we do Mathematics. They come in pairs, actually, the first two being addition and subtraction while the second pair are multiplication and division.

Addition is indicated , mathematically, by the "+" sign. The basic addition sentence looks like this:

Part + Part = Whole

Example:

11 men + 9 women = 20 NOW students

****

1) Department 2 produced 12,465 parts last week.
Department 3 produced 13,138 parts last week.
Department 1 produced 22,984 parts last week.
How many parts were produced by the three departments last week?

2) Profits for the first three quarters of 1991 were $2 million, $3,498,742, and $500,430. If the profit for the last quarter was $1,500,000, what was the 1991 profit?

3) The state has announced a plan to reduce its workforce by attrition. Last year (1991) the quarterly retirements were: 325, 281, 403, and 368 Assuming that they were not replaced, how many less people are working for the state at the start of 1992 than at the start of 1991?

4) Mary and Harold both work at Inland Fisher Guide She took home $365.12 last week. Harold netted $126.55 more than Mary during the same pay period What was their combined pay for that week?

B) Subtraction

Subtraction uses the same sentence as addition, but in subtraction one of the parts is unknown while we know the whole amount.

Part + Part = Whole

Example: 11 men + ? women = 20 NOW students

****

1) The monthly output goal of Department 6 is 267,900 pieces. By the fifteenth they have produced 150,775 pieces. How many must they complete to make their goal?

2) Departments 1, 2, and 3 completed 567,293 pieces last week. If Department 1 produced 230,000 of those and Department 3 produced 178,942 of them, what was the amount produced by Department 2?

3) Mary cashed and deposited four checks in her checking account. She knows that three of them were for \$432.55, \$28.99, and \$68.33. She can't remember the amount of the fourth check but her total deposit was \$831.87. How much was that fourth check worth?

4) Kathy put twenty dollars in her wallet and headed for the supermarket. She put skim milk ($1.96), bananas (3 lbs. @ 3 for a dollar), Super Fruity Yummies cereal ($4.39), and cheese ($1.99) into her cart. She then discovered that turkeys were on sale and she would like to get one for $8.92. Can she do it?

BASIC MATH II

Module: Computational Skills

Lesson: Multiplication and Division

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Demonstrate an understanding of multiplication as repeated addition.
2. Demonstrate an understanding of division as repeated subtraction.
3. Identify parts of a multiplication problem by name and meaning.
4. Identify 4 ways to write a multiplication problem.
5. Identify three ways to write a division problem.
6. Solve word problems involving multiplication and division.

NEW OPPORTUNITIES IN THE WORKPLACE

A) Multiplication

The operation of multiplication is actually a shortcut way to handle repeated addition.

$$5 + 5 + 5 + 5 = 5 \times 4 = 20$$

We call the numbers being multiplied "factors" and the answer we get the "product".

Example:

Mary bought three candy bars, each of which cost thirty-five cents. What did she spend in all?

Addition solution: \$.35 + \$.35 + \$.35 = \$1.05

Multiplication solution: \$.35 x 3 = \$1.05

The factors are \$.35 and 3, the product is \$1,05

We show multiplication several ways in Mathematics. 3 x 5, 3(5), 3 * 5 are all ways of saying three times five. Occasionally you will see it written 3 5.

****

1) Josh bought three bags of sugar, each of which weighed five pounds. How many pounds of sugar did he buy?

2) Natalie worked a forty hour week last week If her hourly rate is twelve dollars and fifty-five cents, how much did she gross last week?

3) This week Natalie worked sixteen hours overtime. If her overtime rate is $18.78, what did she gross this week?

4) Department 6 had a goal of 200,000 parts per month last year They managed to meet that goal for the first half of the year How many parts did Department 6 produce during the first half of the year? How many parts did they produce during the second half of the year?

5) Kathy put forty dollars in her wallet and went to the supermarket. She bought six pounds of bananas (@3 pounds for a dollar), an eighteen pound turkey (@sixty-nine cents a pound), two boxes of Super Fruity Yummy cereal (@$4.39 a box) and a toothbrush ($1.19) Can she afford to leave the store?

B) Division

Just as subtraction was a variation of addition, division is the opposite of multiplication. One way of looking at division is repeated subtraction. When you ask the question "How many sixes are in thirty?" you could look at it this way:

30	
− 6	1
24	
− 6	2
18	
− 6	3
12	
− 6	4
6	5

There are five sixes in thirty

Example:

Tom had forty-eight tulip bulbs to plant. If he plants them eight-to-a-row, how many rows will he get?

$48 \div 8 = 6$

We indicate division in several different ways. The statement above could have been written as $8\overline{)48}$, 48/8 or $\frac{48}{8}$. The last way ties division to fractions, a topic later on in the course.

****

1) Marissa bought twenty-four yards of ribbon for bows. If each bow uses two yards of ribbon, how many bows will

she get from the roll?

Suppose each bow required three yards of ribbon?

Suppose the ribbon came in a roll of twenty-eight yards How many bows of each kind might she get?

2) Department 1 produces 17,550 parts per shift If the parts are batched in bins of 125, how many bins are needed to hold the output from one shift? How many are needed for one day?

****

Another occurrence of division is the situation where you need to partition some amount among individuals or containers. Here you know the number of groupings but you do not know how much each will receive.

Example:

A mother has twenty cookies and four children How many

cookies does each child receive?

20 / 4 = 5

Each child gets five cookies.

****

1) Department 6 produced 12,466 finished pieces during the first shift yesterday. If the line ran continuously for eight hours, how many parts were produced each hour?

2) The union is planning to march in a Labor Day parade. If two hundred thirty people signed up to go, how many buses are needed to hold them? The buses seat forty-two

3) In problem two, the union has two choices of bus companies. One company charges $200 per bus and the buses hold forty-two. The other company charges $250 but their buses seat fifty. With which company should the union contract?

BASIC MATH II

Module: Fractions

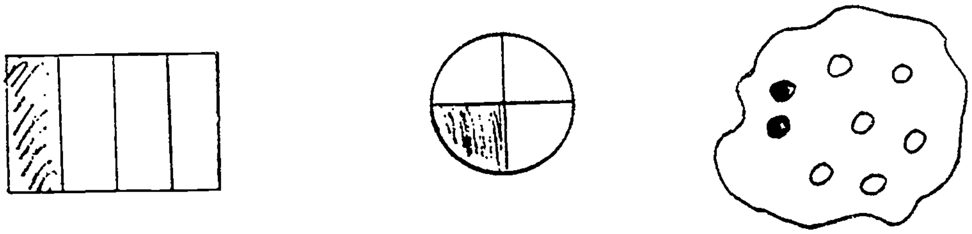
Lesson: Basic Fraction Concepts

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Identify the parts of a fraction by name and meaning.
2. Physically represent a fraction using a drawing.
3. Name a fraction when given a drawing and/or a word problem.
4. Convert a fraction to its decimal equivalent.
5. Define repeating decimals and write them using repeat bar notation.
6. Rename fractions.
7. Compare fractions.
8. Convert an improper fraction to a mixed number.
9. Convert a mixed number to an improper fraction.
10. Compare mixed numbers.

A) A fraction expresses a relationship between a part of a unit and the whole unit. The total number of pieces which the whole is broken into go on the bottom of the fraction line and is called the denominator. The count of pieces we are interested in go on the top and is called the numerator.



$$\frac{1}{4}$$

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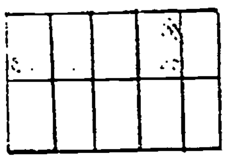
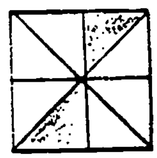
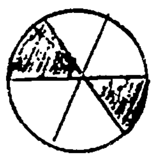
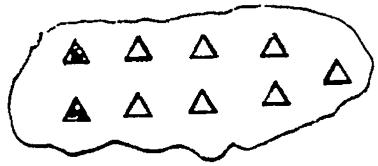
1) What fractional part of the following is represented by the shaded portions:

a) 

b) 

c) 

d) 

2) Draw a representation of the following fractions:

a) 5/8

b) 11/14

c) There are twenty students in the NOW class. Nine of them are men. What fraction of the class is female?

B) Fraction to Decimal Equivalents

Every fractional part of a whole can be expressed as a decimal You can find the decimal equivalent by dividing the denominator into the numerator:

Example: $1/4 = 4\overline{)\,1.00}$ with quotient $.25$

****

Find the decimal version of the following fractions:

a) 3/10

b) 5/8

c) 1/2

d) 3/4

e) 1/3

What happened!

While all fractions can be expressed as decimals, some of the decimals never end. We call these repeating decimals and either round them to the hundredth position (good enough for most calculations) or write the repeating part like this:

$$1/3 = .\bar{3}$$

The bar over the three shows that it would go on forever if we let it.

****

Write the following fractions as decimals:

a) 2/7

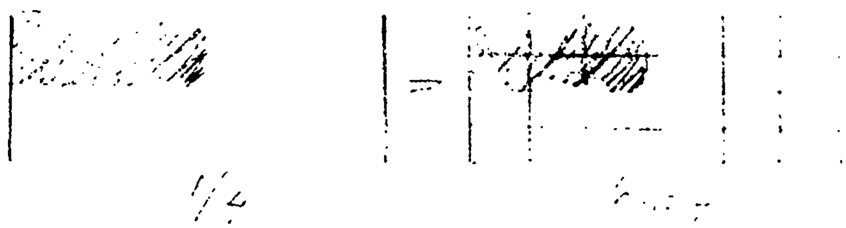
b) 2/3

c) Sixty quality operators have completed the NOW program. Fifty-eight of them showed significant improvement on their skills tests. What fraction of the students have improved? What decimal approximates that fraction?

C) Renaming Fractions

Sometimes it is desirable to consider a fractional part of a whole in terms of a different denominator

Examples:



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Rewrite the following fractional parts in terms of the indicated denominator:

a)

Sixths

b)

Twentieths

c)

Your Choice

d) 2/3 = ?/9 = ?/24

e) Eleven out of twenty students failed the pretest Based on that fraction, suppose there were sixty students in the class How many would you expect to fail the pretest?

D) Comparison of Fractions

If we want to compare two fractions to see if one is greater than the other, there are several ways to do it. One way is to change them to decimals and compare the resulting decimals on a place value basis

Example:

Is 2/3 greater than 5/8?

$$3\overline{)2.0000000}\quad = .6666666$$ or about 0.67

$$8\overline{)5.000}\quad = .625$$

0.625 < 0.67, so 5/8 < 2/3

Another way to compare two fractions is to find a denominator that each can be renamed into and compare the two resulting fractions.

Example:

Is 5/8 greater than 5/6?

Both 8 and 6 divide evenly into 24, so we could rename them in terms of 24ths.

5/8 = 15/24   5/6 = 20/24

Once they are rewritten in terms of the same denominator, it is easy to see that 5/6 is greater than 5/8

****

1) Compare the following fractions any way that you like:

a) 1/4 ? 1/3

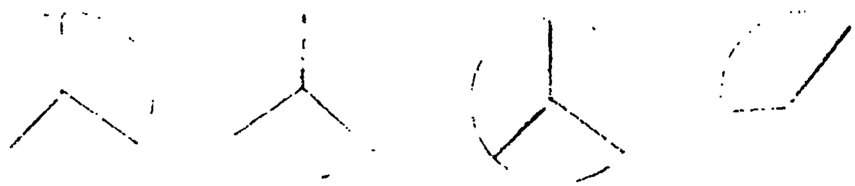
b) 9/10 ? 11/12

c) 3/8 ? 2/5

d) 4/7 ? 4/6

E) It is quite possible to have several whole units and a fractional portion. When that happens, we call it a mixed number. We read a mixed number by saying the whole number portion, the word and, and then the fractional piece. Sometimes we want to consider the total quantity, wholes and part as a fraction. When that happens, the top (numerator) will be equal to or greater than the bottom (denominator) and it is traditionally called an improper fraction.

Example:

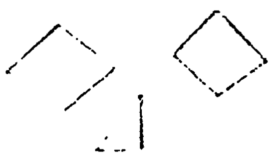


The above quantity could be looked upon as 3-1/3 (three and one third), 2-4/3, 1-7/3, or 10/3. The last three are improper fractions and the second and fourth are useful when we perform operations with fractions. But all of them describe the same quantity.

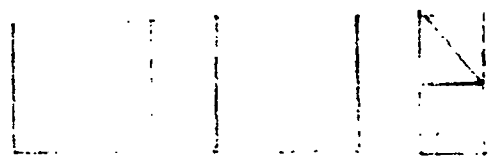
****

1) Write the following quantities at least three different ways:

a)



b)



c)

F) Comparing Mixed Numbers

Mixed numbers are compared in the same way as fractions If the fractional part is improper, however, you have to extract the wholes and add them to the ones you have before you can make a true comparison

Example:

a) Which is larger, 2-3/8 or 2-1/3?

Both 8 and 3 divide evenly into 24, so rename the fractions as 24ths.

2-3/8 is the same as 2-9/24

2-1/3 is the same as 2-8/24

So 2-3/8 is greater than 2-1/3

b) Which is larger, 4-3/8 or 3-12/8?

The denominators are the same, so there is no need to look for a common denominator. However, one of the fractions contains at least one whole Before comparing the two, it is necessary to change 3-12/8 to 3 and 1-4/8 or 4-4/8.

4-3/8 < 3-12/8 because 4-3/8 < 4-4/8

****

Compare the following:

1) 3-1/4 ? 3-1/3

2) 7-11/12 ? 5-22/12

3) Department 3 had the following daily outputs: 2 bins, 3 bins, 4 bins, 3-1/2 bins, and 2-1/2 bins. Department 2 produced the following that week: 3 bins, 2-1/2 bins, 3-1/4 bins, 3-3/4 bins and 4 bins. Which department produced more goods during the week described?

BASIC MATH II

Module: Fractions

Lesson: Adding, Subtracting, and Multiplying Fractions

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Add fractions and mixed numbers.
2. Subtract fractions and mixed numbers.
3. Multiply fractions.
4. Draw a representation of given fractions.
5. Divide fractions.
6. Solve word problems involving all three computational operations.

NEW OPPORTUNITIES IN THE WORKPLACE

A) Addition of Fractions and Mixed Numbers

In order to add two numbers with fractional parts you must rename the fractions so that they have the same denominator. This can be a number which is a multiple of the two numbers or it can be one hundred (convert to a decimal).

Examples:

1-1/2 + 3-1/4 = 1-2/4 + 3-1/4 = 4-3/4

or

1-1/2 + 3-1/4 = 1.5 + 3.25 = 4.75

****

1) The first shift produced 14-1/4 bins of parts. The second shift produced 7-1/2 bins. How many bins of parts were produced that day?

2) The parking lot is being resurfaced. Each day a small section is roped off and redone. In the course of the week, 1/5, 1/6, 3/10, and 3/12 of the lot were done (It rained one day). How much of the lot was resurfaced that week? How much is left to go?

3) Last week, Tiffany clocked the following hours: 8 hrs. 15 min., 9 hrs., 8 hrs. 10 min., 9 hrs. 15 min., 10 hrs 20 min. Using fractions, figure out how many hours Tiffany worked last week.

Sometimes the addition results in an "improper" fraction When that happens, you need to rewrite the fraction as a mixed number and add the wholes to the wholes you already have

Example:

3-3/4 + 5-1/2 = 8-5/4 = 8 + 1-1/4 = 9-1/4

****

1) Last week the following tonnage of steel was delivered to the plant:

Monday	214-5/8
Tuesday	168
Wednesday	78-7/8
Thursday	193-1/4
Friday	212-1/2

How much steel was delivered last week?

2) Sharon needs some shelving for her wall She needs three pieces that measure 2-1/2 feet and two pieces that measure 4-1/6 feet. How many feet of shelving does she need altogether?

When she gets to the hardware store, she discovers that the pine shelving is sold in four foot sections so she needs to figure out how many sections she will need. What do you think?

Then the salesman points out that the shelving is also available in eight foot sections If the four foot pieces are $8 00 and the eight foot sections are $14 00, what is the best choice for Sharon?

B) Subtraction of Fractions and Mixed Numbers

Since subtraction is the "partner" of addition, many of the tactics above work the same. If we want to subtract one fraction from another, we must arrange for them to have a common denominator if they do not already have one. Like subtraction in whole number computation, we sometimes have to rename a larger place in terms of the smaller place.

Example:

792		78¹2
-145	becomes	-145
		647

In fractions,

8-1/3		7-4/3
- 6-2/3	becomes	- 6-2/3
		1-2/3

****

1) 7/8 - 3/8

2) 5/6 - 1/2

3) 4-3/4 - 2-1/4

4) 8-2/3 - 5-1/4

5) 8-1/3 - 6-2/3

6) 7-1/4 - 4-5/6

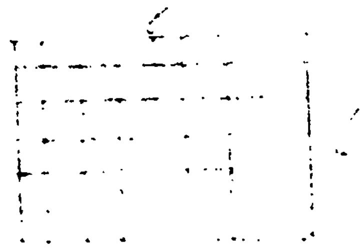
7) Each shift is supposed to produce five bins of parts. The first shift produced 4-1/4 bins by 2 o'clock. What must they produce in their final hour of work?

8) Sharon bought two of the eight foot pieces of shelving Based on her shelf measurements, how can she cut them to get what she needs? Can she, in fact, do it?

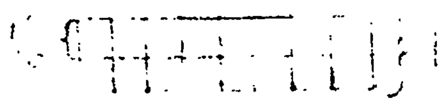
9) Juanita has set up a budget for herself She is going to bank 1/10 of her income, pay 1/4 for rent and pay 1/6 for her car She figures that groceries will eat up (tee hee!) another 1/6 of her income An insurance agent is trying to get her to buy life insurance that would cost 1/12 of her pay If she does that, what part of her pay is left?

C) Multiplication of Fractions

Perhaps the best way to picture multiplication of fractions is to use the area model for multiplication. For instance, the problem 8 times 6 could be pictured this way,



The problem 8 times 1/2 could then be thought of as,



Many people are used to thinking of multiplication as a process that gives a larger answer than any of the original factors. But with fraction multiplication (and decimal multiplication) the product is smaller than the original multiplicand factor.

****

1) Can you draw a representation of 24 times 1/4?

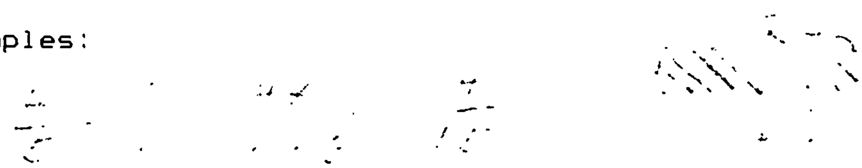
How about 12 times 1/2?

Does your picture look like anything you see in everyday life?

2) Can you picture 2-1/2 times 1/2?

To multiply fractions we use a rule or "algorithm" which requires that all the numbers be strictly fractions, no mixed numbers. Once that is true, you multiply all the numerators to get the product numerator and you multiply all the denominators to get the product denominator. Usually we take the final answer and make it a mixed number, if necessary, and reduce the fraction to its lowest terms.

Examples:

a) 

b) 

****

Solve the following:

1) 1/2 * 1/3

2) 3/4 * 2/5

3) 4-1/2 * 1/2

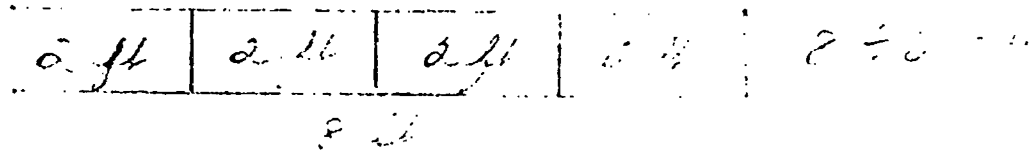
4) On a normal day, Department 2 produces 4,800 pieces. Today the line malfunctioned and it was down for half of the day. What should management expect production to be today?

5) Maria makes $650 in a forty hour week. She was out sick last week for two days and she will not get paid (Boo!). What will her pay be as result?

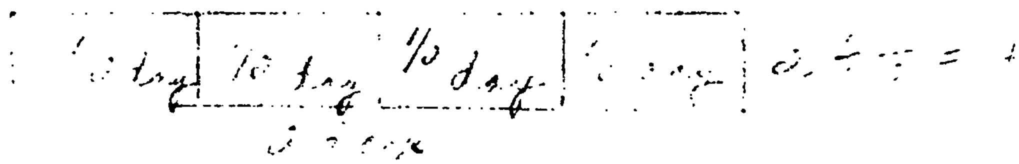
6) Management has agreed to cut overtime by one third. If Department 9 logged 1236 hours of overtime last quarter, what can they expect to log this quarter?

D) Division of Fractions

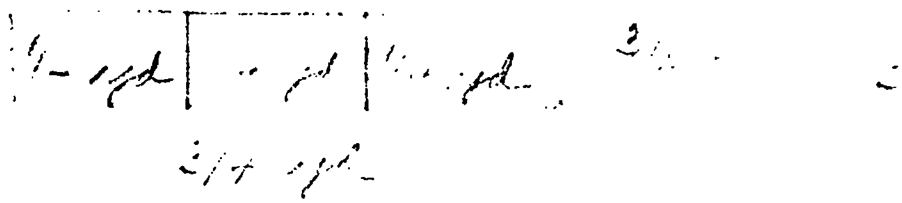
One way of thinking about division was the repeated subtraction of a quantity from a known whole quantity.



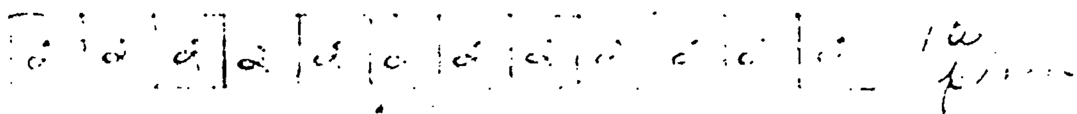
It is possible that the size of the piece being removed (the divisor) is a fraction.



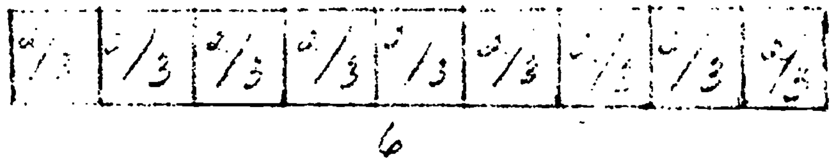
It is also possible that the known whole (the dividend) is a fraction.



In whole number operations, it is very common to explain that when we divide a quantity into two pieces we "take a half." The numbers two and one-half are called multiplicative reciprocals and we are going to apply the above relationship to divide fractions.



$24 \div 2$ yields the same answer as $24 \times 1/2$. That is, they are both equal to 12.



6 ÷ 2/3 is the same as 6 × 3/2 is equal to 9

The ability to rewrite the division problem as a multiplication problem eliminates the need to create a new set of "rules" for fraction division computation.

****

Solve the following:

1) 36 ÷ 4

2) 10 ÷ 1/2

3) 1/2 ÷ 10

4) 3/4 ÷ 1/4

5) Steel rods arrive at the plant in 12 foot lengths. Each door handle uses up 1/2 foot of the rod. How many handles can be manufactured from each rod that is delivered?

6) Janice has a craft business. She knows that she can make a door decoration in a half-hour. This week she can free up six hours to make crafts. How many decorations can she make this week?

7) Next week she expects to have twelve and a half hours to work on the decorations. How many can she make next week?

8) Pallets can sustain 3/4 ton of weight. If twenty tons of parts are manufactured by Department 1, how many pallets will they need to store the parts?

BASIC MATH II

Module: Percents

Lesson: Basics of Percents

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Define the term percent.
2. Convert percents into fractions.
3. Convert percents into decimals.
4. Convert decimals into percents.
5. Convert fractions into percents.

A) WHAT DOES PERCENT REPRESENT?

PER CENT - PER HUNDRED

EXAMPLE: 25 PERCENT MEANS 25 PER HUNDRED -- 25/100

****

REWRITE THE FOLLOWING PERCENTS IN TERMS OF "PER HUNDRED"

1) 40%

2) 33-1/3%

3) 1/2%

B) CHANGING A PERCENT TO A FRACTION

25/100 = 1/4 IN LOWEST TERMS

25 PERCENT = 1/4

8-1/3 % = 8-1/3 / 100 = 25/3 * 1/100 = 1/12

****

1) WRITE 30% AS A FRACTION

2) WRITE 66-2/3% AS A FRACTION

3) WRITE 1/4% AS A FRACTION

4) WRITE 300% AS A FRACTION

C) CHANGING A PERCENT TO A DECIMAL

EXAMPLE A: 25 PERCENT = 25/100 = 25 HUNDREDTHS = .25

****

1) WRITE 65% AS A DECIMAL

2) WRITE 4% AS A DECIMAL

****

EXAMPLE B: 3-1/4% = 13/4 * 1/100 = 13/400 = $400\overline{)13.0000}$ (quotient: .0325)

****

1) WRITE 12-1/2% AS A DECIMAL

2) WRITE 1/3% AS A DECIMAL

D) CHANGING A DECIMAL TO A PERCENT

EXAMPLE A: .28 = 28/100 = 28%

****

1) WRITE .125 OF A UNIT AS A PERCENT

2) WRITE .005 OF A UNIT AS A PERCENT

3) WRITE 4 TIME A UNIT AS A PERCENT

****

EXAMPLE B: .3333333 = $.33\bar{3}$ = $33.\bar{3}\%$ = 33-1/3%

1) WRITE $.66\bar{6}$ AS A PERCENT

2) WRITE $.08\bar{3}$ AS A PERCENT

E) CHANGING A FRACTION TO A PERCENT

EXAMPLE A: $1/4 = x/100$
$100 = 4x$
$X = 25$ $\quad 25/100 = 25\%$

****

1) WRITE THE FRACTIONAL PIECE 7/8 AS A PERCENT

2) WRITE THE FRACTIONAL PIECE 1/50 AS A PERCENT

****

EXAMPLE B: $1/7 = x/100$
$7x = 100$
$x = 100/7 = 14\text{-}2/7\%$

****

1) WRITE THE FRACTIONAL PORTION 2/9 AS A PERCENT

2) WRITE THE FRACTIONAL PORTION 1/3 AS A PERCENT

NEW OPPORTUNITIES IN THE WORKPLACE

FRACTION	DECIMAL	PERCENT
1/75		
	3.4	
		18%
		7%
3/4		
	0.005	

BASIC MATH II

Module: Percents

Lesson: Solving Percent Problems

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Identify the parts of a percent sentence and equation.
2. Solve percent problems.
3. Solve percent word problems.

A) The Percent Sentence and The Percent Equation

Fifteen is twenty percent of seventy-five.

The Amount	is	the Percent	of	The Base
A	=	P	×	B
15	=	20%	×	75

****

1) Identify A, P, and B in the following sentences:

Thirty percent of fifty is fifteen

$1.40 is 7% of $20.00

Twenty-five percent of thirty thousand dollars is seven thousand five hundred dollars

What number is nine percent of five thousand?

Six dollars is what percent of one thousand dollars?

Fourteen is seven percent of what number?

B) The Percent Proportion

$$\frac{A}{B} = \frac{P}{100}$$

Eight is twenty percent of 40

$$\frac{8}{40} = \frac{20}{100}$$

Two is 1/10% of two thousand

$$\frac{2}{2000} = \frac{1/10}{100}$$

What number is seven percent of 375

$$\frac{x}{375} = \frac{7}{100}$$

****

1) Seven is what percent of 350?

2) What number is 400% of $3500?

3) Thirty-three and one/third% of $90 is what number?

4) What is the sales tax in New Jersey on a purchase of $375? What is the total price of the item?

5) In a certain manufacturing plant, the contract says that for every nine line workers, there must also be a steward. What percentage of the shop are stewards?

If the same plant has 380 people working on the floor, how many of them are stewards?

6) A manufacturer has announced a first quarter profit of $3,200,000. This represents three percent of their sales What were sales for that quarter?

7) Unemployment figures for New Jersey last month were released. 6.9% of the employable population was out of work. This percent represents 269,000 people. Based on that information, what is the number of employable people in New Jersey?

8) Assume that a manufacturer employs 600,000 people. If a new plant opens and 4,500 people are transferred there, what percent of the company employees are transferred? If the cost of transferring each one is five thousand dollars, how much will be spent on the move alone?

BASIC MATH II

Module: Percents

Lesson: Percent Applications

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Solve word problems involving tax withholdings from paychecks.
2. Solve word problems involving sales taxes.
3. Solve word problems involving percent increase and decrease.
4. Solve word problems involving simple interest.

A) Tax Applications

Weekly Income Range	Witholding Tax
$200 - 499	11%
$500 - 749	13%
$750 - 999	16%
$1000 - 1500	20%

1) Based on the above table, what tax will be withheld from the check of a worker whose gross pay is $425 a week?

2) A worker receives $12.50 an hour, with time and a half after 40 hours. In a week when he works 48 hours, how much will be withheld for income tax?

3) If a salaried employee of this company makes $975 per week, how much will be withheld from his salary during the course of the year?

4) How much does an assembler earn if $132 80 is withheld from his check for income tax?

B) Sales Applications

Discount Amount = Discount Percent × Original Cost

Sale Price = Original Cost - Discount Amount

1) A store advertises "40% OFF EVERYTHING!" The coat you have wanted all season was $175. What will it cost now?

2) At the same store, on the same day, you purchase a sweater marked $45. The salesgirl says, "That will be $30." Was the discounted computed properly?

3) A local department store has a bedspread which you want. It costs $120. The white sales are on and everything in that department is discounted 25%. Not only that, but you have a friend who works there and can get it for an additional discount of 15%. What is the final cost to you?

C) Percent Increase

Step 1

  New Amount
- Old Amount

  Change

Step 2

$$\frac{\text{Change}}{\text{Old Amt.}} = \frac{\text{Percent}}{100}$$

****

1) The population of the United States in 1960 was 200,000,000 By 1990 that figure had risen to 250,000,000. What was the percent increase?

2) The brand of cereal you like was $2.99 last payday. This pay, you discover that it is $3 39. What percent increase does that represent?

3) A new contract is negotiated. All workers will receive a 5.5% increase If you are making $14 45 an hour now, what will you make under the new contract?

4) In 1970, a new Buick costing $4000 was purchased by a man earning $20,000 a year. That same man earns $60,000 today. What percent increase does that represent? What should he expect to pay for a car to maintain the same percent increase for the cost of the Buick?

A) Percent Decrease

Step 1:

$$\begin{array}{r} \text{Old Amount} \\ -\ \text{New Amount} \\ \hline \text{Change} \end{array}$$

Step 2:

$$\frac{\text{Change}}{\text{Old Amount}} = \frac{\text{Percent}}{100}$$

****

1) What is the percent decrease from \$800 to \$600?

2) Last year, the company contributed \$5,000 for the plant picnic. This year, because of budget cuts, the contribution will be \$4800. What is the percent decrease which this reflects?

3) A state has decreased its education subsidy by 8%. Last year, Hooperville received \$475,000 in subsidies What can it expect to receive this year?

4) State workers are being furloughed two days to balance the budget. If the expected number of work days per year is 260, what percent does the furlough represent? On an annual salary of \$29,000, how much pay will the worker be giving up?

5) A stereo originally priced at \$499 is on sale this week for \$375 What is the discount rate (percent of decrease) for this markdown?

B) Simple Interest

A = P * B (Percent Formula)

I = Rate * Principal * Time

$60 = 6% * $1000 * 1 year

****

1) In the following, identify the Principal, Rate and Time:

a) $400 was borrowed for six months at 9 9% per year

b) $2500 was deposited in a C D which paid 6 8% per year. The deposit period was 36 months.

c) A local bank is offering a $100 bonus for deposits of $5000 in two year Certificates of Deposit which are paying 6.5%

2) The Rate period must agree with the time period

Example: 5.5% per year for two years

1.5% per month for three months

If the rate that is given doesn't agree, change the time period to agree with the rate period

Example: 5.5% per year for twenty-four months =
5.5% per year for two years

1.5% per month for one year =
1.5% per month for twelve months

3) To find the simple interest, find the interest for one rate period and then multiply your answer by the number of time periods

Example: Find the interest on a $500 loan borrowed at 10% per year for two years

$$\frac{I}{\$500} = \frac{10}{100}$$

The interest for one rate period is $50
The loan is for two years, so the total interest is 2 times $50 = $100

****

1) What is the interest on a charge account balance of $350 if the monthly rate is 1.75% and the balance remains for six months?

2) If GM has to raise capital for new equipment it can issue bonds on the stock market. If the money needed (borrowed with the bonds) is $3,500,000 and the bond rate is 9%, what will the interest be on the bonds if they are issued for a five year period?

Suppose the bonds don't sell at that rate and the company is forced to offer a 9.5% rate? What will the interest be in five years?

How much money will GM have to have to repay the bonds at the end of the five years in the first problem? How about the second problem?

You are going to buy a car in New Jersey The sticker price, with all the classy options is $15,999. You are going to finance it with a loan from the Credit Union. The current rate is 8 2% The required down payment is 10% You take the loan for five years What will your monthly payments be?

BASIC MATH II

Module: Ratio and Proportion

Lesson: Basics of Ratios and Proportions

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Demonstrate an understanding of the meaning of ratio.
2. Simplify ratios to lowest terms.
3. Calculate ratios.
4. Calculate the missing value when given proportions.
5. Solve word problems involving ratios and proportions.
6. Solve rate problems.

NEW OPPORTUNITIES IN THE WORKPLACE

A) Ratio

A common usage of mathematics in everyday life is a mathematical relationship called a ratio. We use ratios to compare the measures of quantities which are similar in some way For example, one evaluation of a sports team's performance is the comparison of the games it has won to the games it has lost. This win-loss ratio is written as a fraction. For a team which has won ten games and lost three, the win-loss ratio is written 10/3 or sometimes 10:3.

In many ways, ratios perform like fractions. They can be reduced to lower terms or rewritten as a fraction with a larger denominator. This last exercise is used to guess the team performance over a greater number of games (most unreliable, as gambling sports buffs will tell you).

There are important ways in which ratios do not behave like fractions They are never rewritten as mixed numbers They can, conceivably have a zero in the denominator.

Examples:

1) The ratio of students to teachers in the NOW class is 20 to 4, written 20/4. Reduced to lower terms, there are five students for every teacher, 5/1.

2) A union contract guarantees a ten minute break for every two hours worked The ratio would be 10/120 It is necessary for the comparison to be in the same unit of measure or it could be misleading.

****

Ratio Problems

1) State law requires one adult for every ten children in a licensed day care facility What is the ratio of students to adults?

2) For every grand prize ticket printed in a contest there are 2,500,000 tickets printed for smaller prizes How could the ratio of grand prize tickets to other tickets be written?

3) In a certain factory, there is one steward for every nine line workers What is the ratio of stewards to line workers?

B) Rates

Sometimes we compare two things that are not similar but are related in some way. For instance, when we travel by car we frequently like to know how many miles we have travelled for each hour driven or how many miles we have gone on one tank of gas. This special kind of ratio is called a rate and all the rules for ratios hold for rates too. Additionally, whenever we can reduce the rate so that the denominator is a one, we call the rate a unit rate.

Examples:

1) A 300 mile trip takes 7 hours to complete. The rate comparing distance to time would be written

300 miles / 7 hours.

2) A box of corn cereal is priced at $2.39 and contains 18 ounces of cereal. The rate of price to weight would be written

$2.39 / 18 ounces.

If I were interested in the price of one ounce, the "unit price", I could find it by dividing the numerator and denominator by the number in the denominator. $2.39 -- 18 is about .13 so the unit rate for this cereal is 13 / 1 ounce.

****

Rate Problems

1) Department 4 produces 3,242 finished parts each eight-hour shift Express that as a rate Write it as a unit rate of parts per hour How about parts per minute?

2) The students in the NOW class consume three hundred cups of coffee in a work week What is that rate per student? What is that rate per day? What is that rate per student, per day?

3) During a twenty-four day class, the Math teacher reviews eight years of grade school Math Express that as a rate Express it as a unit rate Does that unit rate give a true picture of how the work is distributed?

C) Proportion

When two rates or two ratios are equal we say that they are "in proportion". Many things in life are proportional. A typist who types forty words per minute will probably type 1200 words in thirty minutes. A car driving 55 miles per hour on an interstate will probably have travelled 220 miles in four hours.

On the other hand, many things in life are not proportional The train fare for a trip of a thousand miles is not priced at the same rate as the fare for a three hour trip. The driver who travelled on the interstate cannot expect to drive at the same rate when he leaves the highway and travels through a small Southern town.

When two rates or ratios are in proportion we can write them as an equation with one rate equal to the other:

40 parts/10 min = 120 parts/30 min

If we don't know one of the numbers we can find it by using our knowledge of fractions:

40 parts/10 min = ? parts/60 min.

60 divided by 10 gives 6, 6 times 40 yields an answer of 240 parts/60 min

****

1) Weed killer must be diluted one-half teaspoon per quart. If I want to add weed killer to four quarts of water, how much weed killer must I use?

2) A recipe calls for two eggs to serve eight people If I want to serve twelve people, how many eggs will I need?

3) Bob is making a scale drawing of a room He is using one-half inch to represent a foot of space How big will his drawing be if the room he is drawing is twenty feet by fifteen feet?

4) A long-distance trucker averages 47 miles/1 hour How far can he expect to travel in six hours If he takes two half-hour breaks at rest stops, how far can he expect to travel in the twelve hours between 8:00 A M and 8:00 P.M ?

BASIC MATH
WORKSHEET
RATIOS AND PROPORTIONS

1. What is the ratio in lowest terms of 20 minutes to 2 hours?

2. What is the ratio in lowest terms of 3 hours to 90 minutes?

3. A work group has 15 men and 10 women.

   a. What is the ratio of men to women?

   b. What is the ratio of women to men?

4. The company spends 16 cents on size B bolts and 64 cents on size M bolts.

   a. What is the ratio of money spent on size B bolts to money spent on size M bolts.

   b. What is the ratio of money spent on size M bolts to money spent on size B bolts.

FOR PROBLEMS 5 - 7: ARE THE FOLLOWING RATIOS EQUAL?

5. $\frac{3}{4}$ $\frac{54}{72}$

6. $\frac{\frac{1}{3}}{8}$ $\frac{2}{48}$

7. $\frac{0.3}{8}$ $\frac{2}{50}$

8. Jeff takes 16 minutes to install 3 parts and Michelle can install 9 of the same parts in 48 minutes. Do Jeff and Michelle work at the same rate?

9. Fifty 1/2" screws sell for $0.20 and eighty 5/8" screws sell for $0.30. Do the two types of screws sell at the same rate?

10. An older method for making car bodies resulted in 12 pieces of scrap for every 150 pieces made. The new method results in 5 pieces of scrap for every 195 pieces made. Do the two methods have the same scrap rate?

BASIC MATH
RATIOS AND RATES
ANSWER KEY

RATIOS AND PROPORTIONS:

1.	1/6	2.	2/1
3.	a. 3/2 b. 2/3	4.	a. 1/4 b. 4/1
5.	yes	6.	yes
7.	no	8.	yes
9.	no	10.	no

BASIC MATH
SOLVING PROPORTIONS

FOR PROBLEMS 1 - 5: SOLVE FOR THE MISSING NUMBER

1. $\frac{2}{?} = \frac{1}{4}$

2. $\frac{20}{15} = \frac{100}{?}$

3. $\frac{\frac{1}{2}}{2} = \frac{3}{?}$

4. $\frac{0.2}{2} = \frac{1.2}{?}$

5. $\frac{?}{1.5} = \frac{2.5}{7.5}$

6. If a copy machine can produce 90 copies in 1 minute, how long will it take the machine to produce 360 copies?

7. If 5 pounds of packing material are used for 300 packages, how many packages can you pack with 17.5 pounds of packing material?

8. A worker inspected 200 door handles and found 18 defective. At this rate, how many defective handles would you expect there to be in a shipment of 12,000 handles?

9. If 15 parts cost $1.20, how much will 20 parts cost?

10. A work team managed to complete 4 units in 12 minutes. If they continue at that rate, how many units can they complete in 90 minutes?

11. The instructions for a cleaning product say that for every 5 ounces of cleaner you use 4 quarts of water. At that rate, how many ounces of cleaner should you add to 10 quarts of water?

12. If the company reimburses employees at the rate of $0.25 per mile, how many miles was driven if the company paid an employee $14?

BASIC MATH
SOLVING PROPORTIONS
ANSWER KEY

SOLVING PROPORTIONS:

1. 8
2. 75
3. 12
4. 12
5. 0.5
6. 4 minutes
7. 1050 packages
8. 1080 handles
9. $1.60
10. 30 units
11. 12.5 ounces
12. 56 miles

Module: Stastics

Lesson: Statistic Basics

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Explain what is involved in the study of statistics
2. Demonstrate an understanding of sampling
3. Construct a survey

A) Statistics

The branch of Mathematics called Statistics concerns itself with collecting and analyzing data. The data is used to quantify facts about a population or measure the opinions of the population about specific topics. The term population to a statistician can mean people or events, depending on what s/he is counting

Examples:

Statistical Fact - Four adults in the NOW class are studying for the GED test

Statistical Fact - It rained 2.4 inches in April. Last year it rained 1.3 inches in the same month.

Statistical Measure of Opinion - Five students in the NOW class feel that the cafeteria should serve liquor.(!!)

Statistical methods frequently are used to help people identify, study, and solve problems. In the plant, for instance, detailed records are kept concerning acceptable and scrapped parts. This information helps the Quality Control staff find problems and suggest solutions.

B) Sampling

It is frequently not possible to measure or count every person or event that might take place. In that case, a group is selected from the whole (universal) population and that group is measured. This subset of the population is called a sample. If an accurate picture of the whole population is to be gathered from the sample, every attempt must be made to have some of every possible kind of outcome measured. This is called random sampling.

Examples:

Random Samples

Phoning homes by entering whatever digits enter your mind, including the area code digits

Mailing a survey to every adult whose name begins with L or R.

Looking at the records of every soldier who fought in World War II.

Limited (Biased) Samples

Phoning households whose numbers begin with 609-588

Measuring the height of first-graders.

Asking a question outside a church on Sunday morning at 8:30.

Sample size is also important. If the data is to truly represent the entire population, an attempt must be made to ask or measure as large a sample as is possible. You would not want to decide on a medical treatment if it had only been evaluated on two people. On the other hand, statistics summarizing the incidence of illness in one million people may tells you something meaningful

c) Survey

When facts or opinion are desired concerning a population, a survey is frequently used. The nature of the questions will influence the following:

Who is asked

Where the survey is conducted

How the information is gathered

When you contact the people

What is asked and how it is worded

Any good statistical report should tell you all the above information in addition to the intended population and the size of the sample.

****

Design a survey question and describe how you will go about conducting the survey.

BASIC MATH II

Module: Statistics

Lesson: Graphs

Lesson Objectives:

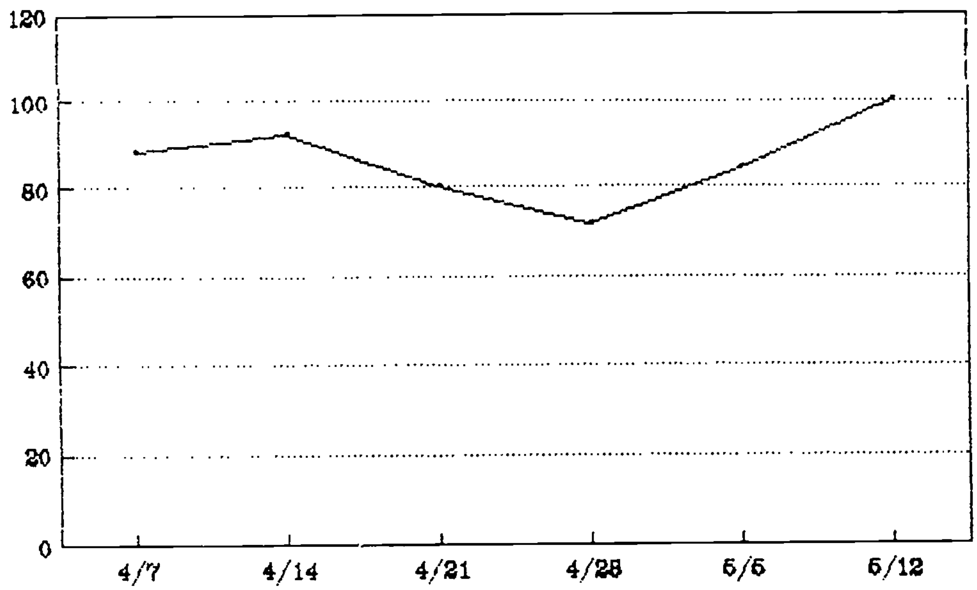
Upon completion of this lesson students will be able to:

1. Demonstrate understanding of a line graph.
2. Draw a line graph when given data.
3. Demonstrate understanding of a pie chart.
4. Draw a pie chart when given data.
5. Demonstrate understanding of a histogram.
6. Draw a histogram when given data.

A) Line Graphs

One way to display the data you have gathered is a line graph. Many people are familiar with line graphs from grammar school days. Teachers frequently used line graphs to show progress in Spelling.

The line graph for a student who had test scores of 88, 92, 80, 72, 84, and 100 would look like this:



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Draw a line graph which shows the following information:

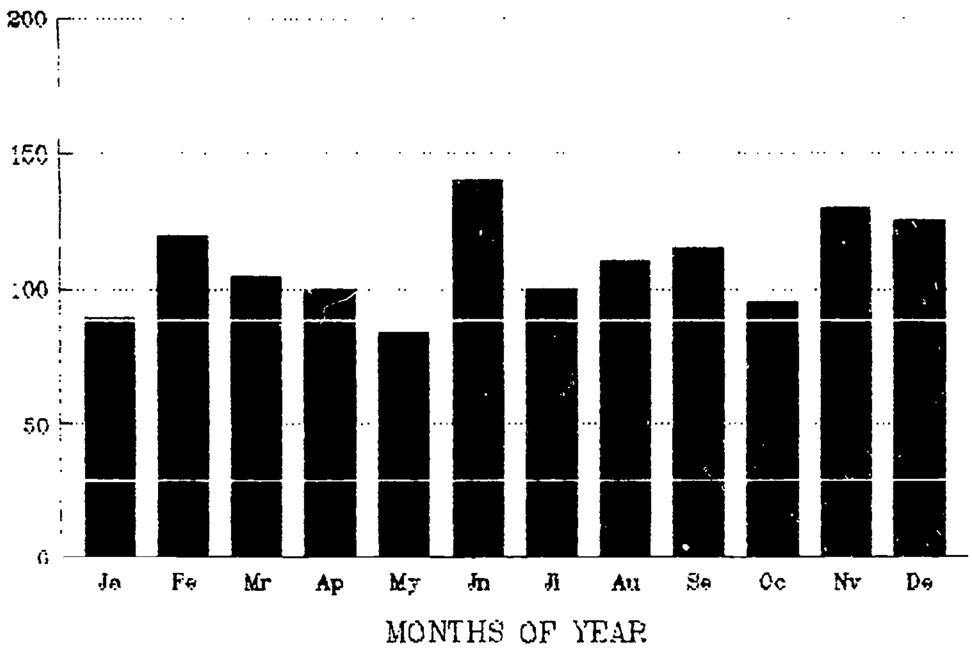
Average Precipitation In Inches	1989	1990
January	2.5	3.1
February	5.6	2.1
March	3.2	1.9
April	2.9	4.0
May	3.5	2.8
June	2.4	5.0
July	3.3	6.0
August	2.7	4.5
September	2.0	3.0
October	3.0	2.8
November	2.0	2.5
December	4.0	1.6

B) Histograms (Bar Chart)

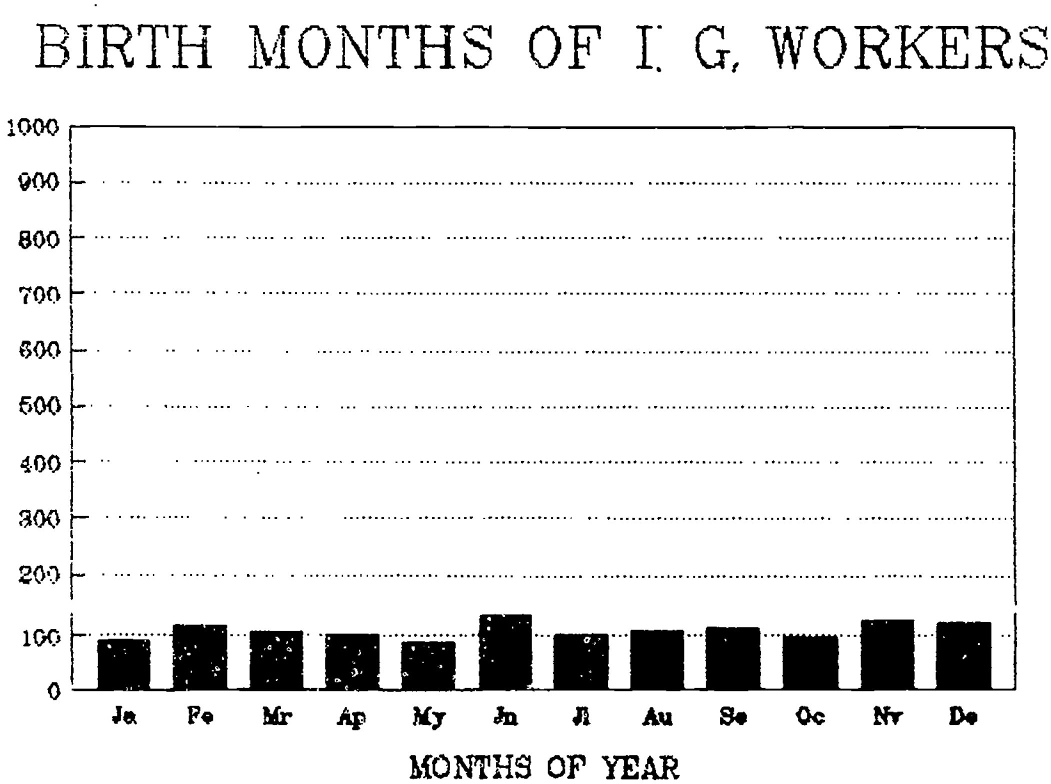
Another way to represent data is in a histogram. This type of graph shows information in the form of bars, either vertical or horizontal. These graphs are frequently used in newspapers to display statistical information.

The following histogram shows the birth months of individuals.

BIRTH MONTHS OF WORKERS



This histogram shows the same information with the increments changed. See how different the facts appear.



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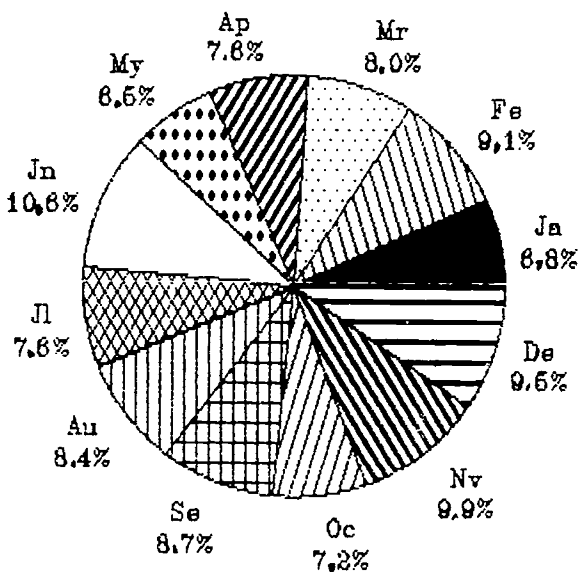
The following (FAKE!) information shows the number of pieces produced each month at as well as the number of pieces scrapped. Represent this information in a histogram.

	Finished	Scrapped
January	5,000	200
February	5,200	210
March	6,000	230
April	6,300	240
May	6,300	200
June	4,000	100
July	4,200	120
August	4,000	120
September	5,000	150
October	5,500	170
November	5,000	140
December	3,000	70

C) Pie Charts

Pie charts, or circle graphs, are yet another way to show information. They are frequently used when we are showing how the parts within a whole compare to each other Here is the birthday information shown as a pie chart

BIRTH MONTHS OF I. G. WORKERS



I.G. BIRTH MONTH DATA

****

1) Out of a monthly take-home pay of $2000, Cheryl has the following regular expenses:

Rent	$700
Food	400
Car Payment	200
Insurance	100
Karate School (Sarah)	40
Dancing School (Pete`	40
Clothing	50
Utilities, Phone	125

Draw a Pie Chart to show how Cheryl spends her pay

BASIC MATH II

Module: Statistics

Lesson: Data Analysis

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Find the mean.
2. Find the median.
3. Find the mode.
4. Find the range.
5. Determine when to use each method of analysis.
6. Chart and analyze given data.

A) Arithmetic Mean

1) Find the mean for the graphs we have done so far.

2) Does the mean tell us something significant about all of them? Does it tell us anything significant about any of them?

B) Median

1) Find the median for each of the graphs we have done so far Is it a better measure of "average" than the mean was?

DATA ANALYSIS DAY TWO

A) Mode

1) For what graphs, if any, is the mode the best way to find the "average". Why?

B) Range

Develop the ranges for the previous graphs.

Which are significant?   Which are not?

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CONTROL CHART FORMULAS

$\bar{X}$ and R CHARTS

x = individual reading

R = range = highest value minus smallest value (in subgroup)

$\bar{X}$ = average reading

Calculation: $\bar{X} = \dfrac{\text{sum of the x measurements (in subgroup)}}{\text{number of x measurements (in subgroup)}}$

$\bar{R}$ = average range

Calculation: $\bar{R} = \dfrac{\text{sum of the R measurements (of subgroups)}}{\text{number of R measurements (of subgroups)}}$

$\bar{\bar{X}}$ = average of average readings (Grand Average)

Calculation: $\bar{\bar{X}} = \dfrac{\text{sum of the } \bar{X} \text{ measurements (of subgroups)}}{\text{number of } \bar{X} \text{ measurements (of subgroups)}}$

CONTROL LIMIT CALCULATIONS

$\bar{X}$ CHART

UPPER CONTROL LIMIT = $UCL_{\bar{X}} = \bar{\bar{X}} + (A_2 \times \bar{R})$

LOWER CONTROL LIMIT = $LCL_{\bar{X}} = \bar{\bar{X}} - (A_2 \times \bar{R})$

RANGE CHART

UPPER CONTROL LIMIT = $UCL_R = D_4 \times \bar{R}$

LOWER CONTROL LIMIT = $LCL_R = D_3 \times \bar{R}$

The Paper Bag Experiment

This consists of giving each student a bag with five squares each of which is a different color They are told to imagine that these represent prizes in a cereal box and the experiment is to determine how many trials (boxes of cereal) must be done (purchased) before all five prizes have been obtained

C) Paper-Bag Experiment Results Evaluated

Mean

Median

Mode

Range

For Graph Module:

Graphs and data from Inland Fisher Guide were used to illustrate points and for sample problems.

A) Arithmetic Mean

The arithmetic mean is the numerical value which most people intend when they speak about "the average " It is, in fact, only one of several measures of average or, speaking mathematically, "measures of central tendency "

Mean averages are found by adding up all the numerical values of the items to be averaged and dividing this total by the number of items.

Example:

The test scores from the line graph example were: 88, 92, 80, 72, 84, and 100 Finding their mean would look like this:

Step 1: 88 + 92 + 80 + 72 + 84 + 100 = 516

Step 2: 516 -- 6 (the number of tests) = 86

****

1) Find the mean of the rainfall data

2) Find the mean for the finished and scrap data.

3) Does the mean tell us something significant about all of them? Does it tell us anything significant about anv of them?

B) Median

Another measure of central tendency is called the median. The median average is the center point in an ordered list of raw data. They can be arranged low to high or high to low, it doesn't matter since the middle will still be the same.

For the test scores discussed in the mean average section, 88, 92, 80, 72, 84, and 100, we would arrange them in numerical order:

72, 80, 84, 88, 92, 100

and then, because there are an even number of entries it is necessary to find the mean average of the middle two, 84 and 88, to compute the median.

84 + 88 = 172

172 -- 2 = 86

When there are an odd number of readings, the median is easy to find because one number will be the middle number.

Example: If the test scores had been 94, 78, 86, 96, and 100, they would look like this when lined up in order:

78, 86, 94, 96, 100

and the median would be 94 because it falls in the middle.

****

1) Find the median for each of the graphs we have done so far. Is it a better measure of "average" than the mean was?

C) Mode

The mode or modal average of a group of numbers is the number that occurs most often in the group. There can be one, two or no modes for a sample. If there are more than two, we usually do not draw any meaningful conclusions from the mode as measure of the data.

Examples:

If the sample was that of test scores and the student received the following grades:

88, 72, 96, 88, 100, and 88

the data has a mode of 88 and we could say that the student "usually" gets an 88 on his test.

****

1) For what graphs that we have done, if any, is the mode the best way to find the "average". Why?

D) Range

The range of a sample of data is the difference between the largest and smallest measurement in the sample It is used to evaluate the centrality of the readings For example, if a student got 88, 92, and 90 on three tests we could observe that he is likely to score somewhere around 90 on later tests

On the other hand, another student might score 80, 90 and 100 on the three tests The range of his grades shakes confidence in predictions of future results.

****

Develop the ranges for the previously studied samples

Which are significant? Which are not?

E) Paper-Bag Experiment Results Evaluated

Mean

Median

Mode

Range

BASIC MATH II

Module: Probability

Lesson: Probability Basics

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Demonstrate an understanding of probability.
2. Solve word problems involving probability.
3. Demonstrate an understanding of dependent and independent events.
4. Demonstrate an understanding of the probability of a single event versus long-range probability.
5. Demonstrate an understanding of the terms normal distribution and standard deviation.

A) Probability = Favorable Outcomes / Total Outcomes

Example: If a coin is tossed, the probability of getting a head is 1/2

If a fair die is rolled, the probability of getting a four is 1/6

****

1) Find the following probabilities:

a) The probability of pulling a queen from a deck of fifty-two cards?

b) The probability of pulling a red card from a deck of fifty-two cards?

c) The probability of getting a twelve if two fair dice are tossed?

d) The probability of getting a seven if two fair dice are tossed?

B) Dependent Versus Independent Events

An independent event is one where the outcome of any event does not affect the outcome of another event

A dependent event is one where a previous event affects the probability of this event happening.

Example: Tossing a die and getting a 5 and then tossing a coin and getting a head INDEPENDENT

Pulling a card from a deck and getting a king Pulling the next card and getting a king DEPENDENT

For the following, decide if the events are dependent or independent:

a) A dice is tossed and comes up a five It is tossed again. Is the second result affected by the first?

b) A card is pulled from a deck It is a queen It is then put back Another card is drawn Dependent or independent?

c) The number 105 is the daily lottery number The next day a number is drawn for the lottery Does the result the day before affect the outcome?

d) A card is drawn from a deck It is a king It is placed on the table. Another card is drawn Has the probability of getting a king changed? Has the probability of getting a queen changed? Are the events independent?

C) Probability of a Single Event Versus Long-range Probability

For independent events, the combined probability of an event occurring equals the sum of the individual event probabilities less the probability that they both occur

Example: The probability of getting the number six on two rolls of a die is 1/6 + 1/6 - 1/36

****

1) Find the probability of getting two heads and one tail if three coins are tossed.

2) Toss four coins twenty-five times and record the results

D) The Normal Distribution

BASIC MATH II

Module: Measurement and Geometry

Lesson: Measurement Systems

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Identify units of measure for length, capacity, and weight in the British measurement system.
2. Identify metric prefixes, their meanings, and what they are used to measure.
3. Convert one unit of measure to another.
4. Convert British to metric and metric to British units of measure.

Conversion of Measurements

A) British Measurement System

1) Length

12 inches = 1 foot
3 feet = 1 yard
5,280 feet = 1 mile
1,760 yards = 1 mile

2) Capacity

3 tsps. = 1 tblsp.
2 tblsp. = 1 ounce
8 ounces = 1 cup
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon

3) Weight

16 ounces = 1 pound (lb)
2000 lbs. = 1 ton

To convert from one measure to another, set up a fraction with the measure you are going to in the top and the measure you are leaving in the bottom. Perform a fraction multiplication to get your answer.

Example: Convert 30 inches to feet

$$\frac{30 \text{ in.}}{1} * \frac{1 \text{ foot}}{12 \text{ in.}} = \frac{5}{2} \text{ ft.} = 2\text{-}1/2 \text{ ft.}$$

****

Convert the following measures:

1) 50 ounces to pounds

2) 48 inches to yards

3) 2 gallons to pints

B) Metric Measurement System

Prefixes		Measures	
Kilo	1,000 of	Length	Meter
Deci	1/10 of	Capacity	Liter
Centi	1/100 of	Weight	Gram
Milli	1/1000 of		

To convert metric measures, set up metric equivalent fractions and multiply.

Example: Convert 2 meters to cemtimeters

$$\frac{2 \text{ meters}}{1} = \frac{100 \text{ centimeters}}{1 \text{ meter}} = 200 \text{ centimeters}$$

****

Convert the following metric measures:

1) 4 5 meters to millimeters

2) 6,000 grams to kilograms

3) 2 liters to milliliters

C) Convert English to Metric or Metric to English

Length

1 in	=	2.54 cm
1 ft	=	30.48 cm.
1 yd	=	.9144 m.
1 mi.	=	1.609 km.

Capacity

1 qt	=	9464 l
1 gal	=	3.785 l

Weight

1 oz.	=	28.35 g.
1 lb	=	453.6 g.

To convert from one measure to another, create a measurement fraction and multiply.

Example: Convert 50 ounces to grams

$$\frac{50 \text{ ounces}}{1} * \frac{28.35 \text{ g.}}{1 \text{ oz.}} = 1417.5 \text{ g. or } 1.4175 \text{ kg.}$$

****

Convert the following:

1) 30 pounds to grams

2) 10 feet to meters

3) 5 liters to pints

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A) Addition of Measures

To add measures, we either have to convert all the measurements to one unit, for example, put everything in terms of inches -- 3 feet 5 inches added to 10 inches could be added as 41 inches + 10 inches, or we can add them column by column and then rename any column that exceeds its limit in terms of the next highest unit of measure

Example:

a) 10 inches + 22 inches = 32 inches = 2 feet 8 inches

b) 1 foot 10 inches
   + 10 inches

1 foot 20 inches or 2 feet 8 inches

****

Solve the following:

1. 1 yd. 2 ft. 3 in. + 2 ft. 2 in.

2. 2 yd 1 ft. 8 in. + 49 in.

3. I need to put shelf lining in four places. They measure:
   a) one yard
   b) two feet and 4 inches
   c) eighteen inches
   d) forty-eight inches

How many feet of shelf paper will I need in all?

B) To Subtract Measures

To subtract measures we sometimes need to rename a unit in terms of the next lower unit, for example, "borrow" a foot and call it twelve inches instead.

Example:

2 feet 4 inches - 10 inches =

1 foot 16 inches - 10 inches = 1 foot 6 inches

****

1. 2 yd. 2 ft. 9 in - 1 yd. 1 ft. 4 in.

2 5 yd. 1 ft. 4 in. - 1 yd. 2 ft. 6 in.

3. Cassie bought five yards of fabric. She used two feet seven inches for a craft project. Her Mom cut twenty-two inches off for dusters. How much fabric is left?

C) Multiplication of Measures

Example:

3 times 4 yds. 5 in. = 12 yds. 15 in. = 12 yds. 1 ft. 3 in.

****

1. Six times 2 qts. 2 pts.

2. Four times 30 inches = ? yards

3. Sharon measures two closets for shelves. One closet needs three shelves, each of which is 24 inches long. The other closet is 33 inches across and she is putting two shelves in it. How much lumber does she need in all. If the lumber is sold in eight foot lengths, how many pieces of lumber must she purchase?

D) Division of Measures

Example:

```
        0 yd.    1 ft.     0 in.    4 in. remaining
    ________________________________
  5) 1 yard   2 feet    4 inches
              5 feet
              ------
                        4 inches
```

****

1) A gallon of liquid is to be divided into six equal portions. What is the size of each portion?

2) A board six feet ten inches long is to be divided into seven equal pieces. How long will each piece be?

BASIC MATH II

Module: Measurement and Geometry

Lesson: Geometry Basics

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Determine perimeter and circumference.
2. Determine area.
3. Determine volume.
4. Solve word problems involving perimeter, circumference, area, and volume.

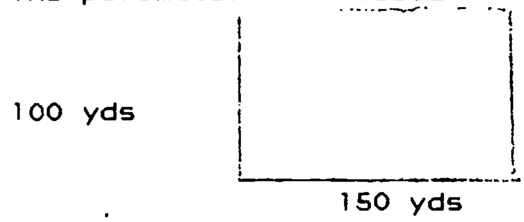
A) PERIMETER AND CIRCUMFERENCE

PERIMETER OF ANY POLYGON EQUALS THE SUM OF THE SIDES

PERIMETER OF A RECTANGLE: $P = 2(L + W)$

CIRCUMFERENCE OF A CIRCLE: $C = \pi * D$ (π = 22/7)

EXAMPLE: The perimeter of a field with measurements



would be: $P = 2(150 \text{ yds} + 100 \text{ yds}) = 2(250 \text{ yds}) = 500 \text{ yds}$

****

1 Baseboard is sold in linear feet. How much wood is needed to run baseboard around a room with a length of 16 feet and a width of 13 feet if there are two thirty-six inch doors in the room?

2 The dimensions of a rectangular yard to be fenced are fifty feet by thirty feet. How much fencing is needed?

3. A circular pool also needs to be fenced in. The pool is fifteen feet wide and is surrounded by a three foot deck. How much fencing will be needed?

B) AREA

AREA OF A RECTANGLE: A = L * W

AREA OF A CIRCLE: A = π * R^2

EXAMPLE: The Area of a room with dimensions of 20 feet by 24 feet would be

A = L * W = 20 feet * 24 feet = 480 square feet

****

1 Grass seed covers 400 square feet. How much do we need for the yard we just fenced in the perimeter problem?

2. The pool which was fenced in needs to be painted. The pool is five feet deep. If the bottom and sides need to be painted, what area must be covered?

C) VOLUME

THE VOLUME OF ANY FIGURE WHOSE WALLS ARE PERPENDICULAR TO THE FLOOR IS FOUND BY MULTIPLYING THE AREA OF THE FLOOR BY THE HEIGHT OF THE FIGURE.

VOLUME OF A BOX OR ROOM: $V = L * W * H$

VOLUME OF A CYLINDER: $V = \pi * R^2 * H$

EXAMPLE: The volume of a room with dimensions 20 feet by 24 feet with a standard ceiling of 8 feet would be:

V = 20 feet * 24 feet * 8 feet = 3840 cubic feet

****

1) How much water is needed to fill the pool described in the earlier prcblem?

The conference room needs a new floor covering. Some of the students want it to be carpeted. Figure out how much carpet will be needed. Carpet Queen has two grades of carpet, one for $15.99 a square yard and one for $17.99 a square yard. See how much it will cost to do the job.

The ceiling in the conference room is badly in need of repainting. A can of ceiling white paint covers 400 square feet of ceiling. If a gallon of paint costs $10.99, figure out how much paint you will need and what it will cost to do the job.

Kathy has decided that she wants the front wall of the classroom wallpapered. Each roll of wallpaper is thirty-three feet long and twenty inches wide. If the pattern she really likes costs twenty dollars a roll, how much will it cost to paper the wall?

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Some members of the class would prefer to put vinyl flooring in the room. They have seen an advertisement for Congoleum flooring in a nice brick pattern for $22.95 per square yard What would it cost to cover the floor of the conference room with that?

The class thinks that a blackboard is old-fashioned. They would like to replace it with one of those boards which can be written on with markers. A salesman has quoted a price of seven dollars per square foot. How much will it cost to replace the present board?

Some of the students want to put a wallpaper border around the front wall, somewhat like a picture frame. If each roll of border covers five linear yards and the cost of a roll is $8.39, how much will this cost to do?

Kathy is tired of having bare table tops She wants to buy Adhesive covering to put on them. Each roll is three feet long and eighteen inches wide. They are on sale this week two rolls for five dollars What will it cost to make Miss Safford happy?

Kathy is planning a big graduation party and wants to make a tablecloth for one of the round tables. She wants the cloth to overhang the table six inches all around. What will the diameter of the cloth have to be? What area will it have? If she has to buy fringe to sew around the edge, how much should she buy?

Kathy thinks that a chair rail would add a nice touch to the conference room. If the molding she prefers cost $ 49 a foot, what will it cost to put it around the entire conference room?

Management has agreed to install a supplementary air cooling system in the conference room. How many cubic feet will the unit have to be able to cool, assuming we close the outside doors?

BASIC MATH II

Module: Linear Algebra

Lesson: Real Number System

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Demonstrate an understanding of the following terms: counting numbers, whole numbers, integers, rational numbers, and irrational numbers.
2. Demonstrate an understanding of opposites and absolute value.
3. Demonstrate an understanding of the Pythagorean Theorem.
4. Estimate square roots of given numbers.
5. Calculate square roots of given numbers.

REAL NUMBER SYSTEM

A) The Number Line

```
<--+---+---+---+---+---+---+---+---+---+---+---+---+---+---+-->
  -7  -6  -5  -4  -3  -2  -1   0  +1  +2  +3  +4  +5  +6  +7
```

Counting Numbers	(1,2,3,4,...)
Whole Numbers	(0,1,2,3,4,...)
Integers	(...-4,-3,-2,-1,0,1,2,3,4,...)
Rational Numbers	(x/y, where x and y are integers) (1/2, 4/7, -2/3,.....)
Irrational Numbers	($\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, ..., π, ...)

****

What group do the following numbers fall into:

1) +250

2) $-\sqrt{7}$

3) 0

4) $\sqrt{8}/4$

Do some of them fall into more than one category?

Could you generalize what you found in the last question?

B) Opposites and Absolute Value

-7 -6 -5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5 +6 +7

Every Real Number has an opposite which is exactly the same distance from 0 but in the opposite direction

The Opposite of +8 is -8

The Opposite of -4/5 is +4/5

We call the distance that a number is from 0 its Absolute Value. We write it | |.

The Absolute Value of 10, |10| , is 10
The Absolute Value of -10, |-10| , is 10

Two numbers which are Opposites have the same Absolute Value

|3/4| = |-3/4| = 3/4

The Absolute Value is always a positive number.

|-19| = 19

The Opposite of the Absolute Value will always be ???

- |-15| = - |15| = -15

****

Find the following:

1) |-19|

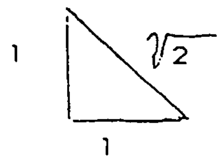
2) |17|

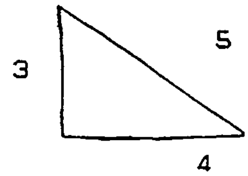
3) |- 875|

4) -|-31|

5) |4|

C) Pythagorean Theorem





Generalized Formula $c = \sqrt{a^2 + b^2}$

Table of Approximate Square Roots

N	N
1	1
2	1.414
3	1.732
4	2
5	2.236
6	2.449
7	2.646
8	2.828
9	3
10	3.162
11	-----
12	-----
13	-----
14	-----
15	-----
16	4
17	-----
18	-----
20	-----

****

Guess (Educated!) the following square roots and then find the actual values using your calculator

1) Square roots of:

53

224

9,999

BASIC MATH II

Module: Linear Algebra

Lesson: Basic Language of Algebra

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Identify the four basic operations in math, their symbols, and key words.
2. Write out math problems in numerical form when given them in written form.
3. Define the term variable.
4. Demonstrate an understanding of substitution.
5. Explain what a mathematical term is.
6. Write out mathematical terms when given examples in written form.
7. Explain what a mathematical expression is.
8. Write out mathematical expressions when given examples in written form.

BASIC LANGUAGE OF ALGEBRA

A) Operations

There are four basic operations in Math:

Operation	Symbol	Keywords
Addition	+	Added to, Total, In all, Sum of, All together
Subtraction	-	Difference, Less, More than, Gave away
Multiplication	X, *, ( )	Times, Multiples, Product, Each
Division	/ , --, --	Divided by, Equal portions, Each, Quotient of

Example:

4 + 6 + 8 + 9

510 - 432

3 * 4 * 7

224 -- 8

****

Write the following mathematically:

1) The product of 12 and 32

2) Six boxes with 64 in each

3) The quotient of 144 and 12

8) Variables

Variables are letters or symbols which hold the place of a number which we do not know at the moment

Example: a, t, x, ?, $\square$ are all variables

In a formula, we use the initial of the missing number to serve as the variable

Example: $P = 2L + 2W$
In this formula, P holds the place of perimeter, L holds the place of length, and W holds the place of width

When we know the value of the variable, we replace it with that value. This is called substitution

Example: $x + y + z$

If $x = 4$, $y = 7$, and $z = 1/2$, what does $x + y + z$ equal?

Answer: $4 + 7 + 1/2$ is 11-1/2

****

1) What does $a + b$ equal if $a = 5$, and $b = 200$?

2) What does $x * y$ equal if $x = 7$ and $y = 7$?

3) What does k/m equal if k is 6 and m is 3?

C) Terms

A mathematical term is the product of one or more constants (real numbers) and variables

Example:

The following are terms:

4

16(x)(y) (or 16xy)

z

45*x*x*x (or $45x^3$)

****

Write the following as mathematical terms:

1) Six times 4

2) A variable number of six-packs

3) Forty hours times a varying hourly rate

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D) Expressions

Expressions are mathematical phrases which are the sum of terms

Example:

$3 + x$

$A + B + C$

$2L + 2W$

$m + t + w + t + f$

****

Write the following as expressions:

1) The total of two weeks pay

2) Six days scrap figures

3) The average score of three people on a test

4) The product of forty hours times a regular hourly rate added to the product of 15 hours times overtime rate

BASIC MATH II

Module: Linear Algebra

Lesson: Signed Numbers

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Define signed numbers.
2. Add using signed numbers.
3. Subtract using signed numbers.
4. Demonstrate an understanding of how the commutative property of numbers can make addition and multiplication problems easier to solve.
5. Multiply using signed numbers.
6. Divide using signed numbers.
7. Demonstrate an understanding of the distributive property.
8. Explain the order of operations followed when solving algebra problems.
9. Solve word problems involving signed numbers.

SIGNED NUMBER OPERATIONS

A) Signed Numbers

All Real Numbers, except zero, have both a distance from zero (Absolute Value) and a direction (+ or −) We use the number line, frequently, to illustrate how the basic operations work for signed numbers.

Example:

+15 is 15 units in a positive direction

−27 is 27 units in a negative direction

B) Addition of Signed Numbers

To add signed numbers, we start at zero with the first number and proceed in the direction and distance indicated. From that location we proceed in the direction and distance indicated by the second number, and so on.

−7 −6 −5 −4 −3 −2 −1 0 +1 +2 +3 +4 +5 +6 +7

Example:

+2 + (+4) ends up at +6

−2 + (−3) ends up at −5

+4 + (−3) ends up at +1

****

−7 −6 −5 −4 −3 −2 −1 0 +1 +2 +3 +4 +5 +6 +7

Using the number line above, add the following together:

1)	+2 + (+5) =	+1 + (+4) =
2)	−2 + (−5) =	−1 + (−4) =
3)	+2 + (−5) =	+1 + (−4) =
4)	−2 + (+5) =	−1 + (+4) =

5) Can you develop a pattern based on the answers?

SIGNED NUMBER OPERATIONS

RULE FOR ADDING SIGNED NUMBERS

1) Take the Absolute Value of the two numbers

2) Were the signs the same?

Yes	No
Add the Absolute Values	Take the difference of the Absolute Values
Glue on the sign of the original addends	Use the original sign of the number with the larger absolute value

****

1) Add together +5 + (-4) =

2) Add together +6 + (+8) + (-7) =

3) Add together -17 + (-6) + (+23) =

4) Electric usage at the Inland Fisher Guide plant was $81,000 the first week of June. The second week it went down $1,280. The third week it was $3,900 more than the second week. The fourth week of June it dropped by $5,300 What was the usage that fourth week?

C) Subtraction of Signed Numbers

Do the following subtractions the way you have always done them:

1) 45 - 23 =

2) 30 - 30 =

3) 7800 - 900 =

Now add these signed numbers together:

1) +45 + (-23) =

2) +30 + (-30) =

3) +7800 + (-900) =

Can you generalize your answers to create a rule which would replace subtraction as a process?

RULE FOR SUBTRACTING SIGNED NUMBERS

Change every subtraction to the addition of the opposite and proceed as if the problem had been an addition problem from the start

Examples:

67 - 17 =	+67 + (-17)	= +50
-67 - 17 =	-67 + (-17)	= -84
67 - (-17) =	+67 + (+17)	= +84
-67 - (-17) =	-67 + (+17)	= -50

****

Solve the following:

1) 89 + 17 + (-19) + (-6) =

2) -91 - (-13) - (+110) =

3) 17 - 15 - 31 - (-45) =

4) The temperature in the Dept. 5 workarea was 64 degrees when the workers arrived at 7:00. By noon it had risen 20 degrees. At three, when they clocked out, it had risen another 13 degrees. By the following morning, it had dropped by 29 degrees. What was the temperature when they clocked in on that second day?

5) GM stock opened one Monday at 43-3/4. It closed on Monday up 1-1/2, on Tuesday down 2-3/4, on Wednesday down 1/2, on Thursday up 1-1/2, and Friday up 1-1/4. What was the closing price of GM stock on Friday?

D) Commutative Properties of Addition (and Multiplication)

Commutative Property

In an addition problem, I can move the numbers around and add them in any order I want to.

Examples:

$4 + 5 + 6 = 4 + 6 + 5 = 6 + 4 + 5 = 5 + 6 + 4$

$$\begin{array}{r} 4 \\ 2 \\ 7 \\ 6 \\ 8 \\ +\ \underline{3} \\ 30 \end{array} \quad = \quad \begin{array}{r} 4 \\ 6 \\ 2 \\ 8 \\ 7 \\ +\ \underline{3} \\ 30 \end{array} \quad = \quad \begin{array}{r} 10 \\ \\ 10 \\ \\ +\ \underline{10} \\ 30 \end{array}$$

****

Can you rearrange the following to make the solution easier?

1) $+45 - 15 - 25 + 70 - 65 =$

2) Kathy's checkbook balance was a slim $6.00. During the month she deposited one thousand dollars, wrote checks for $401, $178, and $256 She made another deposit of $345 and wrote two more checks for $150 each. Can you write a signed number addition statement to represent this information ? What was her balance at the end of the month? Could you have used the commutative law to rearrange the problem?

SIGNED NUMBER OPERATIONS - DAY TWO

A) Multiplication of Signed Numbers

-7 -6 -5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5 +6 +7

(+3)(+2) = +6

(+3)(-2) = -6

The commutative law is true for addition, too, so

(-2)(+3) = -6 also

When we multiply signed numbers we concentrate on the second number and think about its' absolute value (magnitude) and its' sign direction. To decide the answer to a signed number multiplication problem, we multiply the absolute value of the two numbers to come up with the number part. Then we look at the sign of the second number. If it is negative, it reverses the sign of the first number. If it is positive, the sign of the first number is unchanged.

Therefore,

(-3)(-2) = 6 in a positive direction, +6

****

Multiple the following:

1) (+80)(+2) =

2) (+90)(:5) =

3) (+20)(-4) =

4) (-6)(-10) =

5) GM stock opened Monday at 44-1/2 For three consecutive days, it dropped 1/2. What was it selling for on Thursday morning? Could you have solved this problem in more than one way?

6) A person weighing 150 pounds lost five pounds a month for three months and then two pounds a month for the next three months. Write a math sentence to represent this problem and then solve it.

SIGNED NUMBER OPERATIONS - DAY TWO

B) Division

****

Solve the following as you always have:

1) 12 divided by 3

2) 25/5

3) $4\overline{)48}$

Multiply these signed numbers

1) (+12)(+1/3) =

2) (+25)(+1/5) =

3) (+48)(+1/4) =

Do you remember how you divided fractions in grammar school?

$$1/2 \div 1/3 = 1/2 * 3/1 = 3/2$$

You changed the division to multiplication and flipped the second number (replaced it with its' reciprocal). We will do the same for signed numbers

Example:

$$(+6) \div (+2) = (+6) * (+1/2) = +3$$

$$(-8) \div (-2) = (-8) * (-1/2) = +4$$

****

Solve the following:

1) $(+8) \div (-6) =$

2) $(-9) \div (-3) =$

3) $(+1000) \div (-20) =$

C) Distributive Property

When we found the perimeter of the rectangle, there were several ways to write the solution:

P = L + W + L + W if we started at one place and walked around the figure.

P = 2(L + W) if we realized that you could walk halfway around and just double the figure.

P = 2L + 2W if we rearranged (commuted) the first solution and wrote L + L as two of L and W + W as two of W.

If you look at the last two solutions and write one equal to the other,

2(L + W) = 2L + 2W

you have an example of what we call the distributive property of real numbers. In words, it says that, if you have a number multiplied by the sum of two other numbers, you can find the answer by multiplying each one individually and adding the answers together.

Example:

4(2 + ¯,) = 4(2) + 4(7)

4(9) = 8 + 28

36 = 36

It is also true of the numbers are signed.

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

-8(+8) = -24 + (-40)

-64 = -64

****

Solve the following:

1) +9(+6 + (+7)) =

2) +5(+5 + (-4)) =

3) -6(-4 - (-3)) =

D) Order of Operations

When we have mixed operations in one expression, we work left to right and do all the multiplication and division before we do the addition and subtraction.

$+4 + (-6) + (+4)*(-3)$ would be solved

$+4 + (-6) + (-12) = -2 + (-12) = -14$

****

Solve the following:

1) $+6 + (+3)*(+5) =$

2) $+8 + (-4)/(-2) =$

3) $-7 - (9)(3) + 20 =$

4) $300 - (8)(7) - 56 =$

BASIC MATH II

Module: Linear Algebra

Lesson: Linear Equations

Lesson Objectives:

Upon completion of this lesson students will be able to:

1. Define and demonstrate an understanding of substitution.
2. Define and demonstrate an understanding of the Cartesian Coordinate system.
3. Identify the basic format followed in creating linear equations.
4. Solve and graph linear equations.
5. Solve and graph changes made to the value of x or y in a a given equation.

LINEAR EQUATIONS DAY ONE

A) Substitution

We frequently are called upon in Algebra to evaluate an algebraic expression or equation where we are told the value of the variable(s). This process is called substitution.

Example:

1) What is $x + y$ equal to if x is $+4$ and y is $+7$?

$$x + y = +4 + (+7) = +11$$

2) What is $4xy$ equal to if $x = +5$ and $y = +6$?

$$4xy = 4(+5)(+6) = +120$$

3) What is $4xy$ equal to when $x = -5$ and $y = -3$?

$$4xy = 4(-5)(-3) = +60$$

****

Evaluate the following:

1) $2x + 3y - 5z$

a) When $x = +4$, $y = +8$, $z = +3$

b) When $x = -2$, $y = +9$, and $z = +4$

c) When $x = 45$, $y = -.25$, and $z = .15$

2) $40x + 1.5xy$

a) When x is \$15.64 and y is 0

b) When x is \$15.64 and y is 10

B) Cartesian Coordinates

The graphs we have looked at so far in this course have generally only shown positive values for the items we were measuring. That is because most of the things we discussed were objects or dates or people, things which do not exist in a negative manner The graphs we studied were, however, only one-fourth of graph known as the Cartesian Coordinate System In the Cartesian system, it is possible to plot points where one or both of the variables is negative.

****

Place the following points on the graph above:

1) x = 5, y = 8 2) x = -7, y = 3

3) x = -6, y = -2 4) x = 3, y = -5

C) Linear Equations

There are many equations which occur in science and business which can be put into the following form:

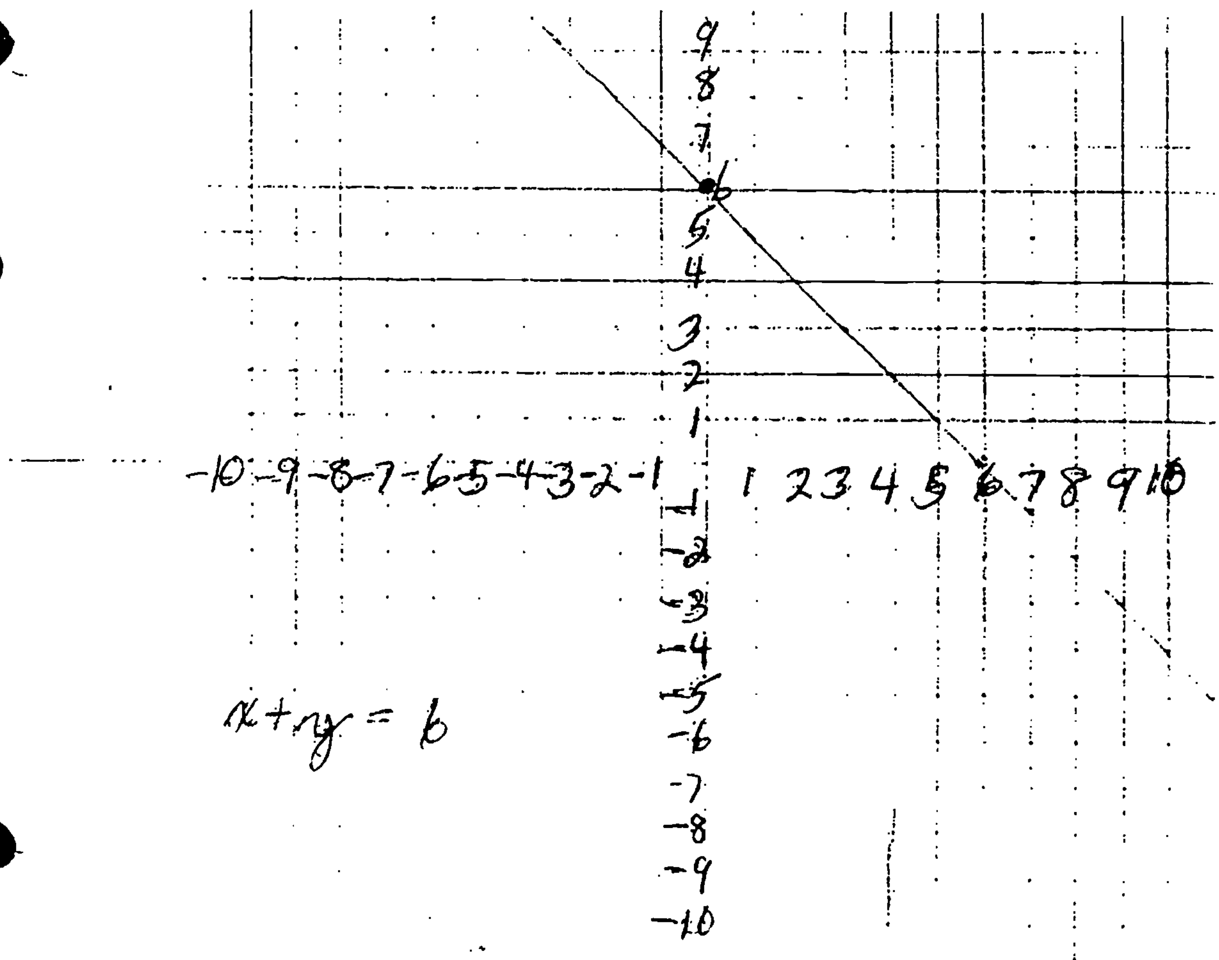
$Ax + By = C$, where A, B, and C are real numbers that do not change (constants) and x and y are real numbers which vary

The graph of an equation of this form is a straight line and we can graph the line if we can identify two points on it. Since zero as a multiplier is a convenient term-zapper--that is, the term it is in will disappear--it is a common practice to substitute zero for x and find out what y would be, and then substitute zero for y to see what x would turn out to be.

Example: $x + y = 6$

If we substitute $x = 0$, y turns out to be 6 so we have one of the points, (0,6)

If we substitute $y = 0$, x turns out to be 6 and we have the other point, (6,0). Now we can draw the graph of the equation.

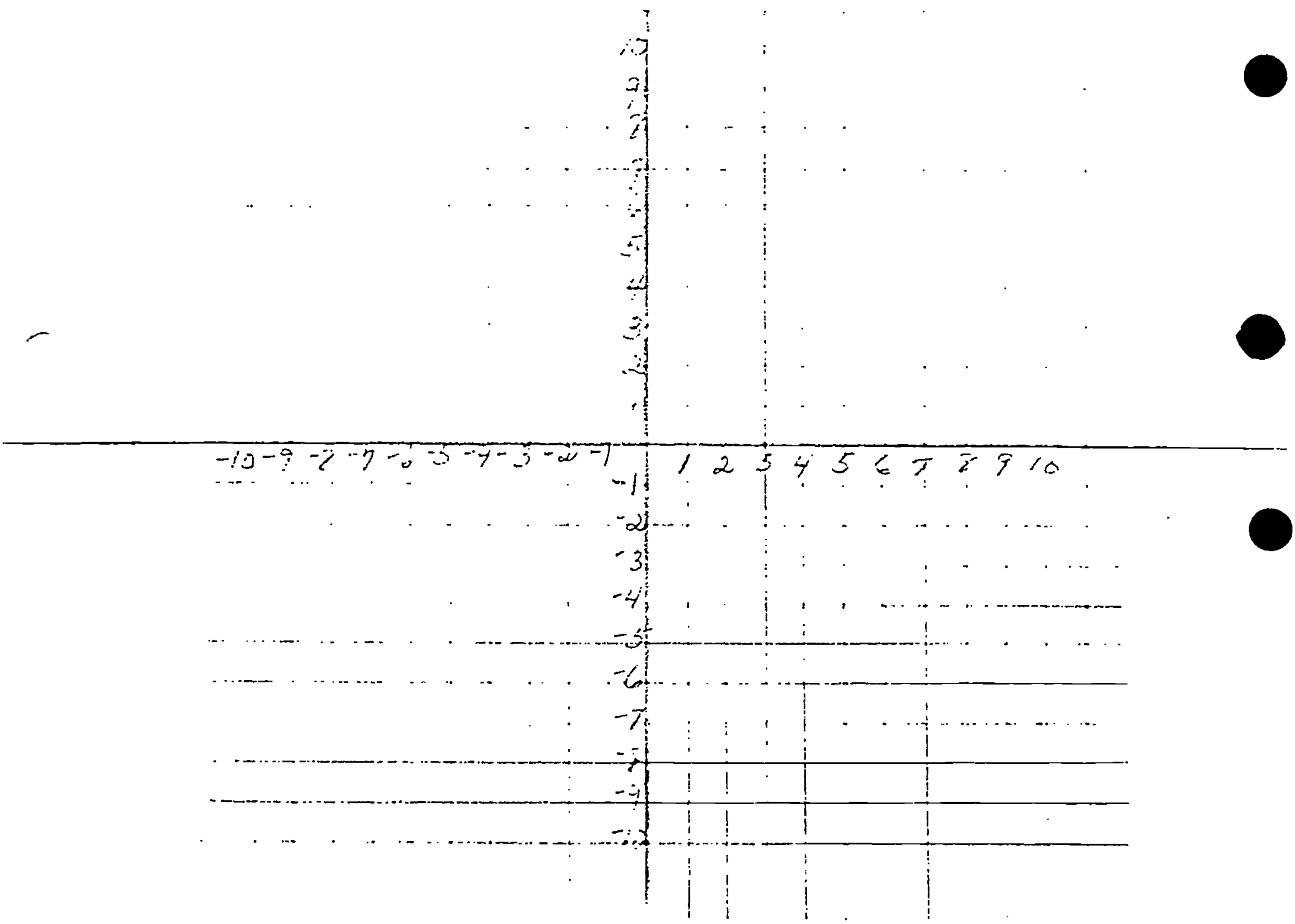


Once the line is graphed, we can see other values at a glance. We can ask what is questions like, what will the value of y be if x is 9. The graph will tell us, if only approximately.

****

Graph the following equation

$$3x + 2y = 12$$



What would y be when x is +7?
What would x be when y is -3?

MATH PRETEST

1) 0 06 renamed as an equal percent is

a) 60% b) 6% c) 600% d) .6%

2) 3/4 renamed as an equal percent is

a) 3/4% b) 3/400% c) 400/300% d) 75%

3) 40% of 25 is

a) 10 b) 1000 c) 100 d) 62.5

4) 36 is 75% of

a) 48 b) 2.08 c) 18 d) 4.8

5) John Smith wins an election 90 to 60. What percent of the vote did he get?

a) 90% b) 60% c) 40% d)65%

6) Mary buys a $250 sewing machine. She gets a 20% discount. How much does she pay for the sewing machine?

a) $230 b) $50 c) $200 d) $150

7) If 3 lbs of a certain chemical costs $4, how many pounds of that chemical can be purchased with $23?

a) 17 25 lbs b) 276 lbs. c) 22 lbs. d) 18.25 lbs.

8) 112 inches equal how many feet?

a) 10 feet b) 9 feet c) 10-1/4 feet d) 9-1/3 feet

9) One meter is about as long as

a) 15 inches b) one foot c) one yard d) 1/10 mile

10) A kilometer is the same as

a) 1/10 meter b) 10 meters c) 100 meters d) 1000 meters

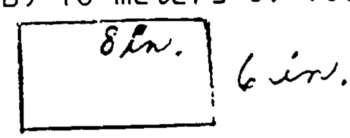


Figure A

11) In Figure A, the perimeter is

a) 48 inches b) 28 inches c) 14 inches d) 24 inches

12) In Figure A, the area is

a) 48 sq in. b) 28 sq.in c) 14 sq.in. d) 24 sq.in.

13) If two fair coins are tossed, the probability that they both come up heads is

a) 1/3 b) 1/2 c) 1/4 d) none of these

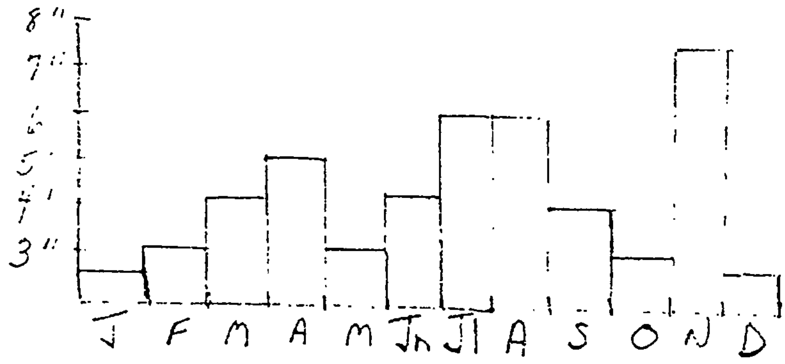


Figure B. Average Rainfall by Month

14) The graph in Figure B shows that the average rainfall for the state is highest in

a) June b) November c) May d) January

15) The difference between the highest rainfall and the lowest rainfall is

a) 3 inches b) 6 inches c) 4 inches d) 5 inches

16) What is the mean rainfall for the state shown

a)

17) What is the mode of the rainfall shown in Figure B?

a) 4 5 inches b) 8 inches c) 5 inches d) None of these

18) Which is greater

a) 5 7 b) -8 c) 18/3 d) -200

19) The quotient of 0.735 / 1.75 is

a) 42 b) 0.42 c) 0 0042 d) 4.2

20) The sum of -8 + 5 is

a) -13 b) 13 c) 3 d) -3

21) 3 - (-6) equals: a) -9 b) -3 c) 9 d) 3

22) The product of (-2) (-5) is

a) -7 b) 10 c) -10 d) 7

23) The quotient of -16 and +8 is

a) -2 b) 2 c) -8 d) 8

24) The expression 8[x(y - x)] when x is 4 and y is -3 equals

a) 32 b) 64 c) -224 d) -32

25) 8[9 - 2(5 - 4)] equals

a) 346 b) 70 c) 56 d) 58

26) 2x + 3y + 5 - 3x - 2y - 4 equals

a) x - y - 1 b) 5x + 5y + 9 c) -x -y -1 d) -x + y + 1

27) 2x(3y - 2z -4) is the same as

a) 6xy - 4xz - 8x b) 6xy - 2z - 4 c) 6xy + 4z + 8

28) If 2 * 2 * 2 * 2 were written in base exponent form, the exponent would be

a) 2 b) 3 c) 4 d) none, there is no variable

29) Find the solution for the equation 4x + 5x = 45

a) -5 b) 10 c) 5 d) -10

30) The graph of the that equation would be

a) one point b) a straight line c) a parabola
d) it cannot be graphed from the information given

MATH POSTTEST

1) 0 08 renamed as an equal percent is

a) 80% b) 8% c) 800% d) 8%

2) 3/4 renamed as an equal percent is

a) 3/4% b) 3/400% c) 400/300% d) 75%

3) 40% of 25 is

a) 10 b) 1000 c) 100 d) 62.5

4) 24 is 75% of

a) 32 b) 2 08 c) 18 d) 4 8

5) John Smith won an election 120 to 80. What percent of the vote did he get?

a) 90% b) 60% c) 40% d)65%

6) Mary bought a $300 sewing machine She got a 20% discount How much did she pay for the sewing machine?

a) $240 b) $60 c) $180 d) $250

7) If 3 lbs of a certain chemical costs $4, how many pounds of that chemical can be purchased with $23?

a) 17 25 lbs b) 276 lbs c) 22 lbs d) 18.25 lbs

8) 136 inches equal how many feet?

a) 11 feet b) 3-7/9 feet c) 13-1/2 feet d) 11-1/3 feet

9) One meter is about as long as

a) 15 inches b) one foot c) one yard d) 1/10 mile

10) A kilometer is the same as

a) 1/10 meter b) 10 meters c) 100 meters d) 1000 meters

11) If two fair coins are tossed, the probability that they both come up heads is

a) 1/3 b) 1/2 c) 1/4 d) none of these

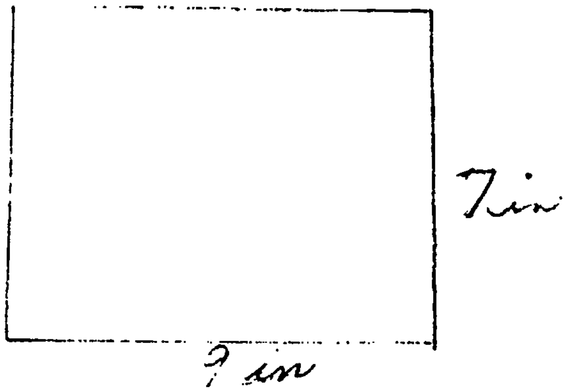


Figure A

12) In Figure A, the perimeter is

a) 24 inches b) 63 inches c) 16 inches d) 32 inches

13) In Figure A, the area is

a) 48 sq.in. b) 54 sq.in. c) 16 sq.in. d) 63 sq.in.

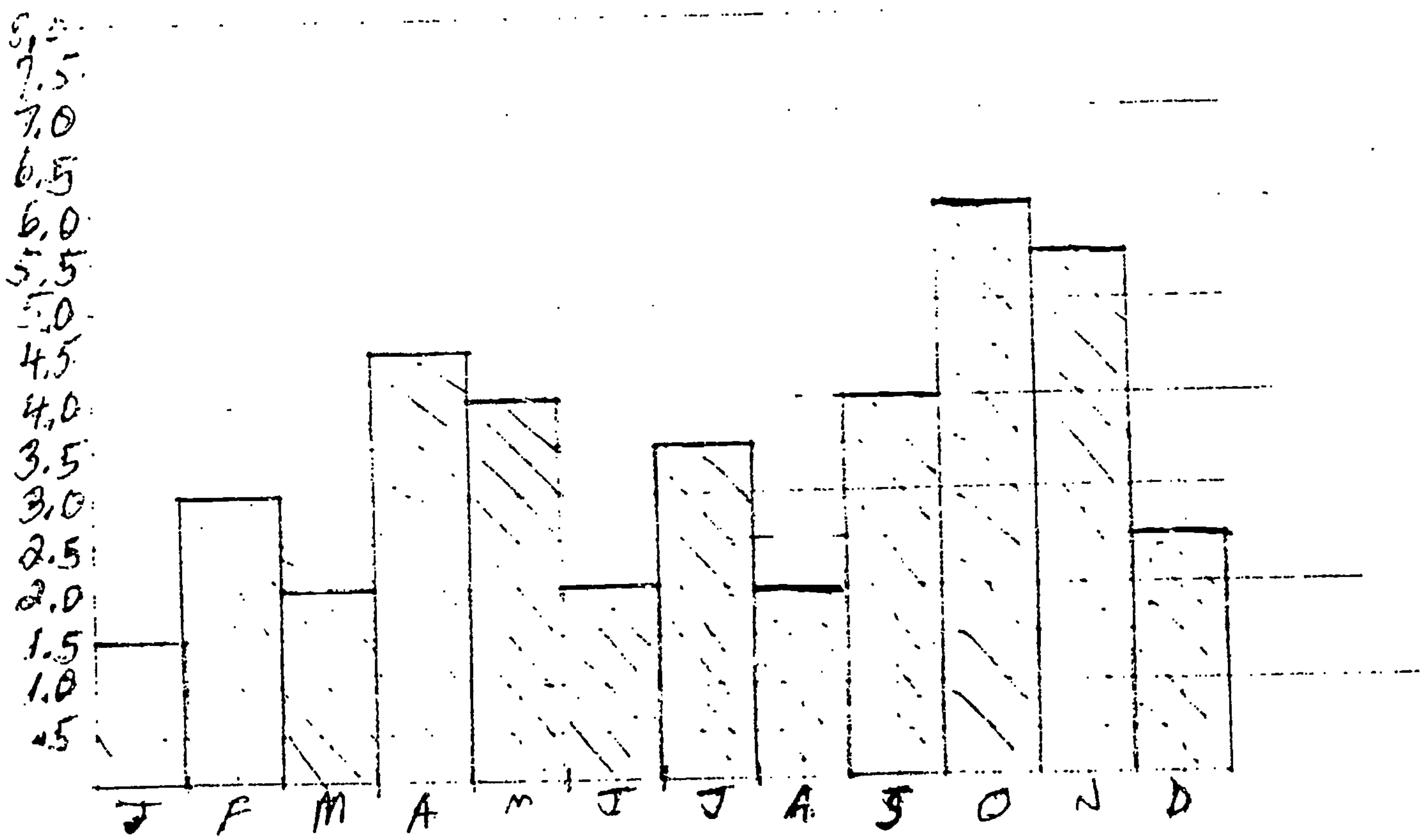


Figure B Average Precipitation by Month

14) The graph in Figure B shows that the average rainfall for the state is highest in

a) June b) November c) April d) October

15) The difference between the highest rainfall and the lowest rainfall is

a) 3 inches b) 6 inches c) 4.5 inches d) 5.5 inches

16) What is the mean rainfall for the state shown

a) 2.0 in b) 3.0 in. c) 3.4 in. d) 4.3 in.

17) What is the mode of the rainfall shown in Figure B?

a) 4.5 inches b) 8 inches c) 5 inches d) None of these

18) Which is greater

a) 5.7 b) -8 c) 18/3 d) -200

19) The quotient of 0.735 / 1.75 is

a) 42 b) 0.42 c) 0.0042 d) 4.2

20) The sum of -8 + 5 is

a) -13 b) 13 c) 3 d) -3

21) 3 - (-6) equals: a) -9 b) -3 c) 9 d) 3

22) The product of (-2) (-5) is

a) -7 b) 10 c) -10 d) 7

23) The quotient of -16 and +8 is

a) -2 b) 2 c) -8 d) 8

24) The expression 8xy - 4y when x is 4 and y is -3 equals

a) 224 b) -84 c) -224 d) +84

25) 8[9 - 2(5 - 4)] equals

a) 346 b) 70 c) 56 d) 58

26) 2x + 3y + 5 - 3x - 2y - 4 equals

a) x - y - 1 b) 5x + 5y + 9 c) -x -y -1 d) -x + y + 1

27) $2x(3y - 2z - 4)$ is the same as

a) $6xy - 4xz - 8x$ b) $6xy - 2z - 4$ c) $6xy + 4z + 8$

28) If 2 * 2 * 2 * 2 were written in base exponent form, the exponent would be

a) 2 b) 3 c) 4 d) none, there is no variable

29) Find the solution for the equation $4x + 5x = 45$

a) -5 b) 10 c) 5 d) -10

30) The graph of the that equation would be

a) one point b) a straight line c) a parabola
d) it cannot be graphed from the information given

MATH PRETEST - FORM B

1) In the number 34,125.897 the digit 7 is in the __ place

   a) tenths   b) thousandths   c) hundredths   d) none of these

2) Which is larger 896.213 or 896.2113?

3) 3/4 + 1/6 would equal

   a) 4/10   b) 11/12   c) 1 1/12   d) 5/24

4) Three-fourths of a twenty-four can case of soda would be how many cans?

   a) twelve   b) eighteen   c) sixteen   d) thirty-six

5) The portion of a unit which is represented by 0.16 could be renamed as an equal percent as

   a) 60%   b) 16%   c) 160%   d) .16%

6) 3/4 of a quantity renamed as an equal percent of that quantity is

   a) 3/4%   b) 3/400%   c) 400/300%   d) 75%

7) 60% of 25 is

   a) 15   b) 10   c) 100   d) 62.5

8) 30 is 75% of

   a) 40   b) 2.08   c) 22.5   d) 4.8

9) John Smith wins an election 180 to 120. What percent of the vote did he get?

   a) 90%   b) 60%   c) 40%   d) 65%

10) Mary buys a $250 sewing machine. She gets a 20% discount. How much does she pay for the sewing machine?

   a) $230   b) $50   c) $200   d) $150

11) If 3 lbs. of a certain chemical costs $4, how many pounds of that chemical can be purchased with $23?

   a) 17.25 lbs.   b) 276 lbs.   c) 22 lbs.   d) 18.25 lbs.

12) 123 inches equal how many feet?

   a) 10 feet   b) 9 feet   c) 10-1/4 feet   d) 9-1/3 feet

13) One meter is about as long as

a) 15 inches b) one foot c) one yard d) 1/10 mile

14) A kiloliter is the same as

a) 1/10 liter b) 10 liters c) 100 liters d) 1000 liters

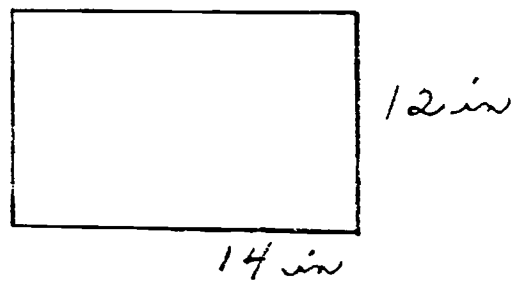


Figure A

15) In Figure A, the perimeter is

a) 52 inches b) 26 inches c) 168 inches d) 24 inches

16) In Figure A, the area is

a) 52 sq.in. b) 26 sq.in. c) 168 sq.in. d) 24 sq.in

17) If two fair coins are tossed, the probability that they both come up heads is

a) 1/3 b) 1/2 c) 1/4 d) none of these

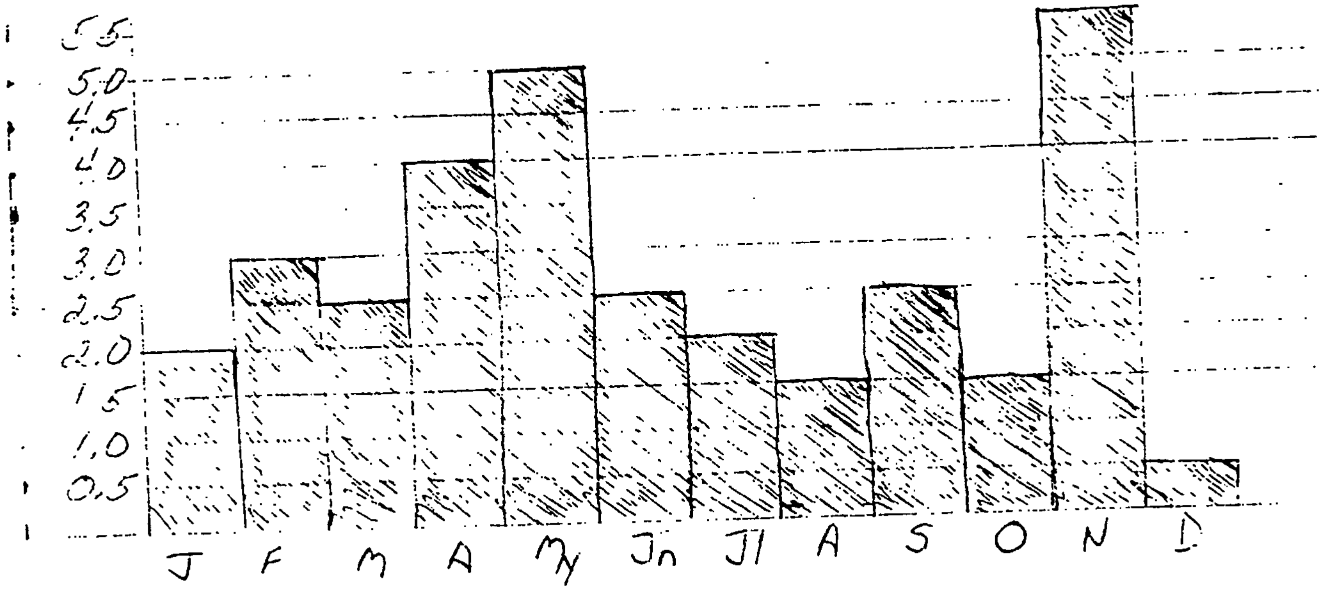


Figure B. Average Rainfall by Month

18) The graph in Figure B shows that the average rainfall for the state is highest in

a) June b) November c) May d) January

19) The difference between the highest rainfall and the lowest rainfall is

a) 3 inches b) 6 inches c) 4 inches d) 5 inches

20) What is the mean rainfall for the state shown

a)

21) What is the mode of the rainfall shown in Figure B?

a) 4.5 inches b) 8 inches c) 5 inches d) None of these

22) The quotient of 0.735 / 1.75 is

a) 42 b) 0.42 c) 0.0042 d) 4.2

23) A roll of ribbon containing 25 yards costs $10.00. If Erika wants to make bows that use 1 1/2 yds each, how many bows can she get out of the roll?

a) 25 bows b) 15 bows c) 16 bows d) 37 bows

24) The price of each bow in problem 23 would be

a) $.40 b) $.60 c) $.80 d) $1.00

25) What is the simple interest on a loan of $4,000 if the monthly interest rate is 1.5% and the loan is for one

GM QUALITY OPERATOR MATH PRETEST B -- ANSWER KEY

1. b
2. 896.213
3. b
4. b
5. b

6. d
7. a
8. a
9. b
10. c

11. a
12. c
13. c
14. d
15. a

16. c
17. c
18. b
19. d
20. 2.71

21. d
22. b
23. c
24. b
25. b

QUALITY OPERATOR MATH PRETEST B

1) In the number 34,125.897 the digit 9 is in the __ place

   a) tens b) tenths c) hundredths d)none of these

2) Which is larger 896.213 or 896.2113?

3) 1/4 + 5/6 would equal

   a) 6/10 b) 13/12 c) 1 1/12 d) 5/24

4) Two-thirds of a twenty-four can case of soda would be how many cans?

   a) twelve b) eighteen c) sixteen d) thirty-six

5) The portion of a unit which is represented by 0.06 could be renamed as an equal percent as

   a) 60% b) 6% c) 600% d).6%

6) 3/4 of a quantity renamed as an equal percent is

   a) 3/4% b) 3/400% c) 400/300% d) 75%

7) 40% of 25 is

   a) 10 b) 1000 c) 100 d) 62.5

8) 36 is 75% of

   a) 48 b) 2.08 c) 18 d) 4.8

9) John Smith wins an election 90 to 60. What percent of the vote did he get?

   a) 90% b) 60% c) 40% d)65%

10) Mary buys a $250 sewing machine. She gets a 20% discount. How much does she pay for the sewing machine?

   a) $230 b) $50 c) $200 d) $150

11) If 3 lbs. of a certain chemical costs $4, how many pounds of that chemical can be purchased with $23?

   a) 17.25 lbs. b) 276 lbs. c) 22 lbs. d) 18.25 lbs.

12) 112 inches equal how many feet?

   a) 10 feet b) 9 feet c) 10-1/4 feet d) 9-1/3 feet

13) One meter is about as long as

a) 15 inches b) one foot c) one yard d) 1/10 mile

14) A kilometer is the same as

a) 1/10 meter b) 10 meters c) 100 meters d) 1000 meters

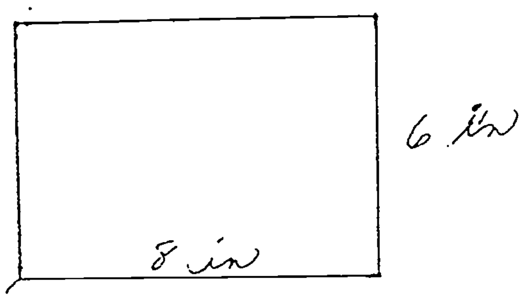


Figure A

15) In Figure A, the perimeter is

a) 48 inches b) 28 inches c) 14 inches d) 24 inches

16) In Figure A, the area is

a) 48 sq.in. b) 28 sq.in. c) 14 sq.in. d) 24 sq.in

17) If two fair coins are tossed, the probability that they both come up heads is

a) 1/3 b) 1/2 c) 1/4 d) none of these

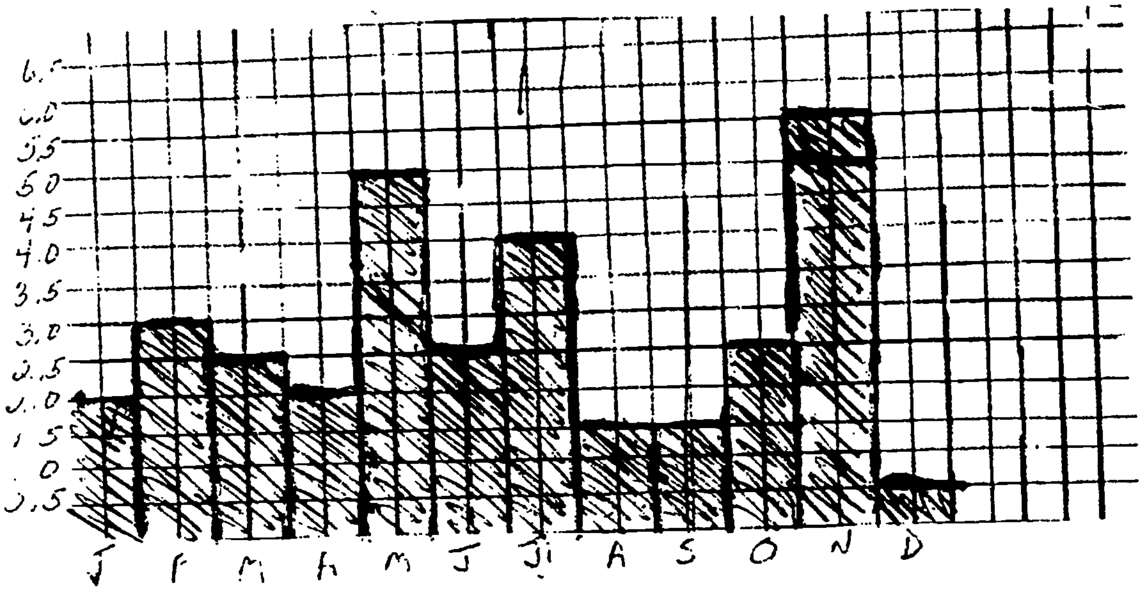


Figure B. Average Rainfall by Month

18) The graph in Figure B shows that the average rainfall for the state is highest in

a) June b) November c) May d) January

19) The difference between the highest rainfall and the lowest rainfall is

a) 3 inches b) 6 inches c) 4 inches d) 5 inches

20) What is the mean rainfall for the state shown

a)

21) What is the mode of the rainfall shown in Figure B?

a) 4.5 inches b) 3 inches c) 5 inches d) None of these

22) The quotient of 0.735 / 1.75 is

a) 42 b) 0.42 c) 0.0042 d) 4.2

23) A roll of ribbon containing 25 yards costs $10.00. If Erika wants to make bows that use 1 1/2 yds each, how many bows can she get out of the roll?

a) 25 bows b) 15 bows c) 16 bows d) 37 bows

24) The price of each bow in problem 23 would be

a) $.40 b) $.60 c) $.80 d) $1.00

25) What is the simple interest on a loan of $5,000 if the monthly interest rate is 1.8% and the loan is for one

year?

a) \$1,080 b) \$500 c) \$216 d) \$180

GM QUALITY OPERATOR PRETEST A -- ANSWER KEY

1. c
2. 1st
3. b or c
4. c
5. b

6. d
7. a
8. a
9. b
10. c

11. a
12. d
13. c
14. d
15. b

16. a
17. c
18. b
19. d
20. 2.71

21. d
22. b
23. c
24. b
25. a