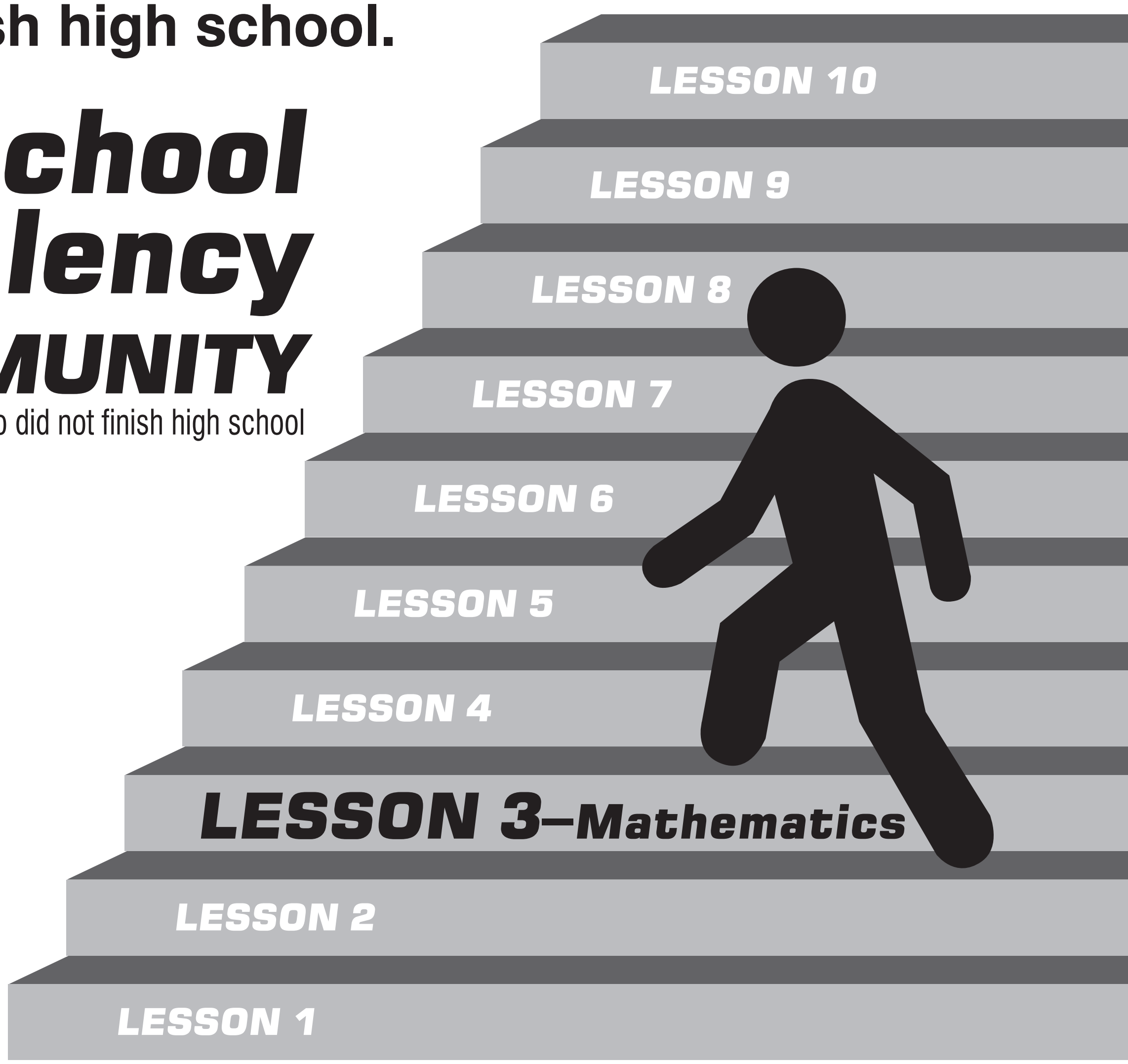
Steps to Success

There's never been a better time to finish high school.

High School Equivalency in the COMMUNITY

a 'Mail-In' program for adults who did not finish high school



Third Step–
TERRIFIC WORK!

LESSON 3
Mathematical Reasoning

Understanding math vocabulary is important because the test questions may include these words. Your understanding of one word may prove to be a key in your ability to answer the question correctly.

Test takers will be provided a virtual, onscreen Texas Instruments TI-30XS scientific calculator and calculator reference tool to use on most of the math test. You can purchase this calculator to practice or you can come to the school and practice with an online calculator.

Vocabulary to Know

Product–The answer to a multiplication sentence. *Example:* 4 x 2 = 8. **8 is the product**—the answer

Quotient–The answer to a division sentence. *Example:* 8÷4 = 2. **2 is the quotient**—the answer

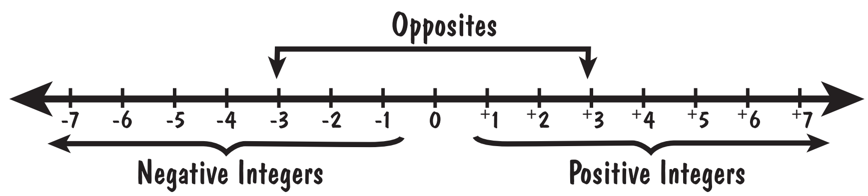
Difference–The answer to a subtraction sentence. *Example:* 10 - 6 = 4. **4 is the difference**—the answer.

Sum–The answer to an addition sentence. *Example:* 6 + 4 = 10. **10 is the sum**—the answer.

Whole Numbers–The numbers 0, 1, 2, 3, *etc*. There are no fractions, decimals, or negatives.

Integers–The set of whole numbers and their opposite. Look at the number line shown below.

The number line goes on forever in both directions. This is indicated by the arrows.



- Whole numbers greater than zero are called positive integers. These numbers are to the right of zero on the number line.
- Whole numbers less than zero are called negative integers. These numbers are to the left of zero on the number line.
- The integer zero is neutral. It is neither positive nor negative.
- The sign of an integer is either positive (+) or negative (-), except zero, which has no sign.
- Two integers are opposites if they are each the same distance away from zero, but on opposite sides of the number line. One will have a positive sign, the other a negative sign. In the number line above, +3 and -3 are labeled as opposites.

Absolute Value–The distance a number is from 0 on the number line. A (-7) is the same distance from 0 as a (+7). Think of it this way, 7 miles uphill is the same distance as 7 miles downhill. Absolute value is always positive. | | is the symbol for absolute value.

Example: |-7|=7 and |-5|=5

LESSON 3
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The following are rules that will help with adding, subtracting, multiplying, and dividing integers.

Rules for Adding Integers

- If the signs are the same, add the numbers and keep the sign.

Example: **-2 + -3= -5 and 3 + 4= 7**

- If the signs are different, subtract the numbers and keep the sign of the number with the largest absolute value. (Different signs find the difference)

Example: **-2 + 3 = 1 and 6 + -8 = -2**

Rules for Subtracting Integers *(Keep, Change, Change)*

- Keep the sign of the first number in the problem
- Change the subtraction (-) sign to an addition (+) sign
- Change the sign of the number behind the subtraction sign to its opposite (change a negative to a positive and a positive to a negative)
- Now use the rules for adding integers.

Example: **(-7) - (-4)**
(-7) + (+4) = -3

So, when subtracting think—***Keep, Change, Change***—then use the addition rules.

Rules for Multiply/Dividing Integers

- If the signs are the same, the product or quotient is positive.

Example: **(-4) • (-2) = (+8)**

Example: **(-8) ÷ (-4) = (+2)**

- If the signs are different, the product or quotient is negative.

Example: **(-4) • (+2) = (-8)**
Example: **(-8) ÷ (+2) = (-4)**

ASSIGNMENT 1

DIRECTIONS

Evaluate the following expressions.
Show your work on a separate sheet of paper. Use the rules.

1. 20 - -9 = ____	2. -8 + 12 = ____
3. -7 + -3 = ____	4. 7 + -14 = ____
5. -6 ÷ -6 = ____	6. 1 + 20 = ____
7. 19 - 6 = ____	8. 17 × -15 = ____
9. 9 × 17 = ____	10. -9 × -20 = ____
11. -6 - 10 = ____	12. 15 + 14 = ____
13. -1 - -5 = ____	14. -6 + 13 = ____
15. 6 ÷ -3 = ____	16. 6 - 10 = ____
17. 10 + 6 = ____	18. -14 - 11=____
19. 20 - 6 = ____	20. 15 - -7 = ____

LESSON 3
Mathematical Reasoning

DIRECTIONS
Answer the following word problems.

21. Denver is approximately 5,280 feet above sea level. New Orleans is approximately 10 feet below sea level. What is the approximate difference, in feet?

____

22. A lobster fishing boat drops its traps to depth of about 20 meters. A crab fishing boat drops its traps to a depth of about 120 meters. Which expression can be used to find about how many times deeper the crab trap goes than the lobster trap?

A. -20 ÷ (-120)

B. 20 ÷(-120)

C. -120 ÷ (-20)

D. -120 ÷20

23. Absolute value is used to determine distance from zero. It can also be used to determine distance from other numbers. For example |7-3|= 4 shows that 7 is a distance of 3 units from 4. What pair of numbers are equal distances from 2?

A. -5 and 9

B. -4 and 4

C. 7 and 5

D. 0 and -2

24. Which list is in order from least to greatest?

A. 0, -2, 14, 31, -35

B. -35, -2, 0, 14, 31

C. 14, -2, -35, 0, -31

D. 31, 14, 0, -2, -35

25. Joe played golf with Sam on a special par 3 course. They played nine holes. The expected number of strokes on each hole was 3. A birdie is 1 below par. An eagle is 2 below par. A bogie is one above par. A double bogie is 2 above par. On nine holes, Frank made par on 1 hole, got 2 birdies, one eagle, four bogies, and one double bogie. How many points above or below par was Frank's score?

____

26. Find the difference in height between the top of a hill 973 feet high and a crack caused by an earthquake 79 feet below sea level.

____

27. In Detroit the high temperatures in degrees Fahrenheit for five days in January were -12°, -8°, -3°, 6°, -15°. What was the average temperature for these five days?

____

28. Hightop Roofing was $3765 in the "red" (owed creditors this amount) at the end of June. At the end of December they were $8756 in the "red." Did they make or lose money between June and December? How much?

____

LESSON 3
Mathematical Reasoning

ASSIGNMENT 2

Data Analysis

The High School Equivalency test will test you for the understanding of how data are collected and then analyzed using measures of central tendency and range.

Vocabulary to Know

Data—information that is collected and analyzed – referred to as a set of data.

Measures of central tendency–measures that describe the center of a data set-such as, mean, median, mode

Mean–the average value of a data set

Median–the middle value of a data set listed in order from least to greatest. If there is an even number of values in the data set, then the median is the average of the two middle numbers.

Mode–the item that occurs most often in a data set

Range–the difference between the greatest and least items of a data set. The spread of a data set can be described by its range.

Value–how much a digit represents

Example: We will use Robin's running data to find these measures of tendency. Robin is training for a 5-kilometer race. Each day, she runs 5 kilometers and records her time to the nearest minute. Here are the data she collected one week 20, 24, 22, 22, 21, 20, 25.

***Example 1:* Find the *mean* of the running data.**

a. Find the sum of all the items in the data set.

   20 + 24 + 22 + 22 + 21 + 20 + 25 = 154

b. Count the number of items in the data set: 7

c. Divide the sum by the number of items in the data set. 154 ÷ 7 = 22.
   The mean is 22 minutes.

***Example 2:* Find the *median* of the running data.**

a. List the data in order from least to greatest. 20, 20, 21, <u>22</u>, 22, 24, 25

b. The middle value Is 22. **The median is 22 minutes.**

c. If the data set has an even number of values, identify the two middle values in the ordered list. 20, 20, <u>21, 22</u>, 22, 24. 21 and 22 are the middle values.

d. Find the average of the two middle numbers. The average of these two numbers will be your median. 21 + 22 = 43

e. 43 ÷ 2 = 21.5

***Example 3:* Find the *mode* of the running data.**

a. Group items in the data set that are the same. 20, 20   21 22, 22   24   25

b. Find the items that occur the most often. A set of data might have one mode, or more than one mode, or no modes. The items 20 and 22 both occur most often. **The modes are 20 minutes and 22 minutes.**

Example 4: Look back at Robin's running data. Find the *range*.

a. Identify the items with the greatest value and the least value.

   Greatest value: 25   Least value: 20

b. Subtract the item with least value from the item with greatest value.

   25 - 20 = 5. **The range is 5.**

LESSON 3
Mathematical Reasoning

DIRECTIONS
Calculate the mean, median, and mode of each data set.

1. **Number of siblings in families:**
   5, 1, 4, 3, 4, 3, 2, 1, 3, 3, 2, 4, 4
   Mean ________________
   Median ________________
   Mode ________________

2. **Ages (in years) of employees in a department:**
   24, 35, 58, 22, 33, 35, 29, 28, 64, 48
   Mean ________________
   Median ________________
   Mode ________________

DIRECTIONS
Find the range for each set of data.

3. **Wages for office staff:**
   $340, $478, $370, $370, $865
   Range ________________

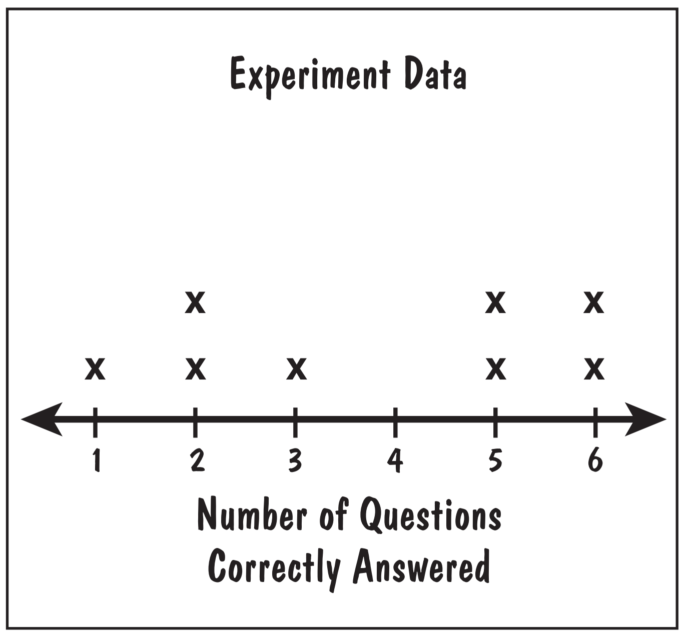
4. **Hours worked by sales department:**
   35, 48, 29, 35, 35, 50
   Range ________________

5. **The age range for players on a soccer team is 10 years. The youngest player is 15 years old. What is the age of the oldest player**
   A. 25 years
   B. 20 years
   C. 12.5 years
   D. 5 years

DIRECTIONS
Complete the following graph using what you know about mean, median, and mode.

6. **A speech pathologist collects data from 10 people for an experiment. Each person answers 6 questions. The speech pathologist records the number of questions that each person correctly answered and puts each person's data in the line plot. The median of the data is 3.5, and the mode of the data is 2. Complete the line plot so that the plot matches the pathologist's data.**

   Place an X onto the graph as many times as necessary to represent the data.



LESSON 3
Mathematical Reasoning

Scientific Notation

By using exponents, we can reformat numbers. For very large or very small numbers, it is sometimes simpler to use ***"scientific notation"*** (so called, because scientists often deal with very large and very small numbers).

The format for writing a number in scientific notation is fairly simple: (first digit of the number) followed by (the decimal point) and then (all the rest of the digits of the number), times (10 to an appropriate power). The conversion is fairly simple.

Example: **Write 124 in scientific notation.**

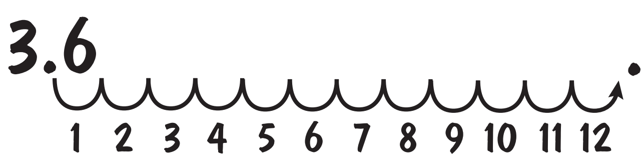
This is not a very large number, but it will work nicely for an example. To convert this to scientific notation, first write "1.24". This is not the same number, but $(1.24)(100) = 124$ is the same number, and $100 = 10^2$. Then, in scientific notation, 124 is written as 1.24×10^2.

Actually, converting between "regular" notation and scientific notation is even simpler. All you really need to do is count decimal places.

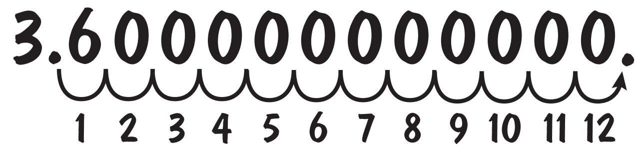
Example: **Write in decimal notation: 3.6×10^{12}**

Since the exponent on 10 is positive, they are looking for a LARGE number. Move the decimal point to the right, in order to make the number LARGER. Since the exponent on 10 is "12", move the decimal point twelve places over.

First, move the decimal point twelve places over. Make little loops when counting off the places, to keep track:



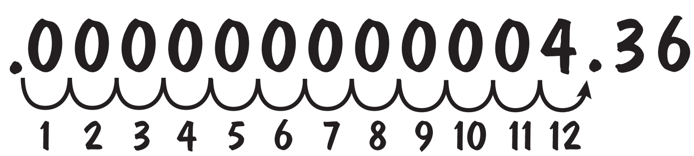
Then fill in the loops with zeroes



In other words, the number is ***3,600,000,000,000*** or ***3.6 trillion***

Example: **Write 0.000 000 000 043 6 in scientific notation.**

In scientific notation, the number part (as opposed to the ten-to-a-power part) will be "4.36". Count how many places the decimal point has to move to get from where it is now to where it needs to be:



Then the power on 10 has to be -11: "eleven", because that's how many places the decimal point needs to be moved, and "negative", because it is a SMALL number. So, in scientific notation, **the number is written as 4.36×10^{-11}**

Example: **Convert 4.2×10^{-7} to decimal notation.**

Since the exponent on 10 is negative, this is a small number. Since the exponent is a seven, move the decimal point seven places. Since the number is small, move the decimal point to the left. **The answer is 0.000000 42**

LESSON 3
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Example: **Convert 0.000 000 005 78 to scientific notation.**

This is a small number, so the exponent on 10 will be negative. The first “interesting” digit in this number is the 5, so that’s where the decimal point will need to go. To get from where it is to right after the 5, the decimal point will need to move nine places to the right. Then the power on 10 will be a negative 9, and **the answer is 5.78×10^{-9}**

Example: **Convert 93,000,000 to scientific notation.**

This is a large number, so the exponent on 10 will be positive. The first “interesting” digit in this number is the leading 9, so that’s where the decimal point will need to go. To get from where it is to right after the 9, the decimal point will need to move seven places to the left. Then the power on 10 will be a positive 7, and **the answer is 9.3×10^{7}**

Just remember: However many spaces you moved the decimal, that’s the power on 10. If you have a small number (smaller than 1, in absolute value), then the power is negative; if it’s a large number (bigger than 1, in absolute value), then the exponent is positive.

Warning: A negative on an exponent and a negative on a number mean two very different things! ***For instance:***

$-0.00036 = -3.6 \times 10^{-4}$

$0.00036 = 3.6 \times 10^{-4}$

$36{,}000 = 3.6 \times 10^{4}$

$-36{,}000 = -3.6 \times 10^{4}$

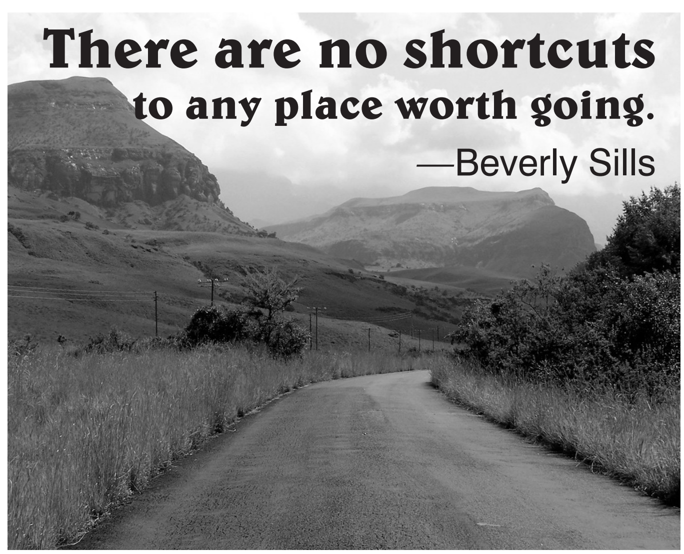
Don’t confuse these!

ASSIGNMENT 3

DIRECTIONS

Write each number in standard format.

1. 6.971×10^{-4} = ____________
2. 5.898×10^{-1} = ____________
3. 5.97×10^{5} = ____________
4. 9.79×10^{2} = ____________
5. 7.6491×10^{-2} = ____________
6. 5.939×10^{-9} = ____________
7. 2.693×10^{-3} = ____________
8. 6.4011×10^{4} = ____________
9. 5.02×10^{9} = ____________
10. 9.74×10^{-5} = ____________



LESSON 3
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DIRECTIONS
Write each number in scientific notation.

11. 51644000 = ______________________

12. 4776700 = ______________________

13. 887900000 = ______________________

14. 0.0003529 = ______________________

15. 0.000000023740 = ______________________

16. 45.327 = ______________________

17. 0.0000009970 = ______________________

18. 59232 = ______________________

19. 9728.5 = ______________________

20. 0.000006370 = ______________________

References

www.ple.plato
www.ged.com