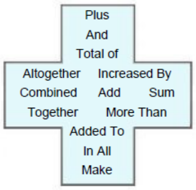
Translating English into Algebra

Key words, signal words, and phrases used on HSE math exams include similar vocabulary in their word problems.

Addition Words +

Above
Accumulate
Add, Add up, Added to
Additional
Addends
Also
Altogether
And
Appreciate
Ascend
Bigger (than)
Both
Combine(d), Collect(ed)
Credit
Deposit
Find the total
Further
Gain
Go (went) up
Greater (than)
Grew by, Grow by
How many in all
How much
In addition to
In all, all together
In excess
Including
Increase(d) (by), Increment
Join
Larger (than)
Lengthen (by), longer (by)
Make, Matches
More (than)
Net
Older (than)
On top of
Perimeter
Plus
Raise, Raised by, Rise
Replace, Save
Sum (of), summation
Tally (up)
Together
Total (is)
Wider (than)
Years older (than)



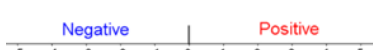
+ ➔ **plus***, positive

Subtraction Words –

Below
Change
Cut (by)
Debit
Decline, Declined by
Decrease(d) by, Decrement
Deduct, Deducted from
Depreciate
Descent
Detract
Difference (of)
Different (by)
Diminished (by)
Discount
Down by
Dropped by
Dwindle
Fall, Fell
Farther
Fewer (than)
Gave, Go (went) down
Grow down
How many left (or less)
How much more (less)
Left over
Less (than)
Lost
Lower, lowered by
Minuend
Minus
Narrower (than)
Nearer
Need to
Reduce, Reduced by
Remain(s)(der) (-ing)
Remove
Shorter (by), shorter than
Smaller (than)
Subtract, Subtracted from
Subtrahend
Take away, take from
Withdraw(al)
Years younger (than)

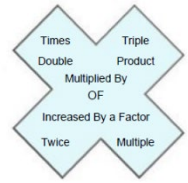
Subtract Gave Take Away
Decrease By Fewer Minus
Shared Fewer Than Less Than
Difference Less

– ➔ **minus***,
negative -5, opposite –(5)



Multiplication Words •× a() *

Amplify, Amplified by
Apiece
Area
As much
By
Double, Doubled, Twice (2 times)
Each
Equal groups
Every
Factors
Fraction of
Gain by a factor of
Go (went) up by a factor of
Groups of
Half, Halve
Increase(d) by a factor of
Intensified by, Intensify by
Interest on
Lots of
Magnified by
Multiple, Multiply, Multiplied by
Of (in connection with fractions, %)
Per
Percent (of), %
Product (of)
Quadruple(d) (4 times)
Thrice, Triple(d) (3 times)
Twice (2 times), Double
Times (as much) (larger) (more)
Times older
Volume



Operator	Function
+	Addition* (Add)
–	Subtraction* (Minus)
× • * a(b)	Multiplication (Times)
a ÷ b, a / b, b \ a, $b\overline{)a}$	Division
a : b	Ratio
$\frac{a}{b}$	Fraction
Condition	**Location in Space**
+	Positive
–	Negative or Opposite

*Is an **operator** when between 2 values, otherwise it is a **condition** when in front.

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Division Words $\div$ $\overline{)\;\;}$ $\frac{n}{d}$ n:d

Average (sum of list of values)÷#values
Cut by a factor of
Decline(d) by a factor of
Decrease(d) by a factor of
Diminished by a factor of
Distribute
Divide, Divided by ($25 \div 5 = 5$),
Divided into ($5\overline{)\,25} = 5$)
Dividend
Divisor
Down by a factor
Dropped by a factor of
Each
Equal pieces (parts/groups)
Evenly divide(d)
Every
Fifth
Find per
Finds each
Fraction
Go (went) down by a factor of
Halved, Half
How many times
Into
Out of
Over
Partition __ times
Parts
Per
Quarter
Quotient (of)
Ratio (of)
Reciprocal (of)
Reduce(d) by a factor of
Share(d) (split) equally
Smaller by a factor of
Split (up), Separated into groups
Subdivide
Times less (smaller) (younger)
Times more (bigger) (older)

Quotient of Per Ratio of
Divided By Half Divisor
Divided Into Percent Split Up

The Quantity of
Twice the sum of
Times the sum of
Times the difference of
Plus the difference of

Relationship Words: Equals =

Is Are Were Was

Will Be Yields Sold For

Alike
Amounts to
Are (equal)
Balance(s) (d)
Coincides (with)
Corresponds (to)
Equal, equals (to), Equivalent (to)
Even
Gives (a result of), Giving
Identical to
Is (equal), Are, Was, Will be
Matches
Represents
Result (is), Results (are), Results in
Sold for
Same (result) as
Was (equal), were (equal)
Will be (equal)
Yields

Inequalities

Approximately equal $\approx$

○ Is not equal $\neq$
○ Exceeds, above $>$
○ Is greater (than) $>$
○ Is more (than) $>$
● Is greater (than) or equal $\geq$
● Is No less than $\geq$
● Is At Least $\geq$
○ Is less (than), Below $<$
○ Is fewer (than) $<$
● Is less (than) or equal $\leq$
● Is At Most, Maximum $\leq$
● Is No more than, Minimum $\leq$
● Does not Exceed $\leq$
● Is not greater (than) $\ngtr$
$\ngtr$ means $\leq$
○ Is not greater (than) or equal $\ngeq$
$\ngeq$ means $<$
● Is not less (than) $\nless$
$\nless$ means $\geq$
○ Is not less (than) or equal $\nleq$
$\nleq$ means $>$

{See graphs on the next page.}

Math Symbols

Absolute Value $|a|$
A quantity of ( ), sum/difference of
Grouping symbols (object of prepositional phrases)
Parenthesis ( ); Brackets [ ]; Braces { }
Empty set $\varnothing$ or { }
Implies $\Rightarrow$ or $\rightarrow$
Infinity (unlimited) ∞
Is similar to $\sim$
Is congruent $\cong$
Is equivalent to $\Leftrightarrow$ or $\equiv$ (defined)
Minus or Plus $\mp$
Plus or Minus $\pm$
Parallel $\|$
Perpendicular $\perp$
Pi ($\pi = 3.14159265358979\ldots$)
Multiplication $\bullet$ or $\times$ or a b

Special Operations

Cube root $\sqrt[3]{n}$
Cube n^3
Square root $\sqrt{n}$
Square n^2

Number Words

0 (n)aught, nil, nothing
1 Once, ace, unique, singular
2 Deuce, duet, dyad, twice, double
3 Tierce, trey, thrice, triple, cube
4 Tetrad, quad-, fourice, quadruple
5 Pentad, quint-, quintuple
6 Sextuple, Hextuple

Value	Greek	Latin
0	ouden-	nulli-
1	mono-	uni-
2	di-	bi-/du-
3	tri-	tri-
4	tetra-	quadr-
5	penta-	quin(t/que-)
6	hexa-	sexa-
7	hepta-	septi-
8	octo-	octo-
9	nona-	no(nus/vem-)
10	deca-	deca-.de-

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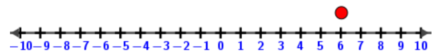
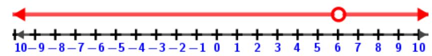
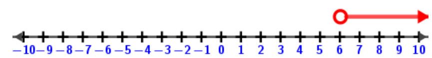
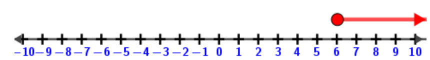
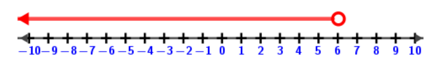
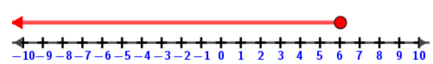
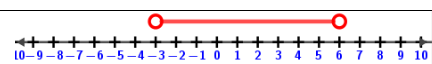
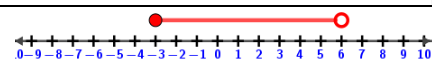
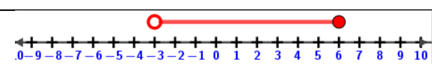
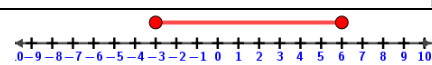
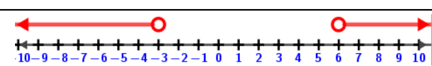
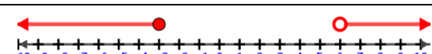
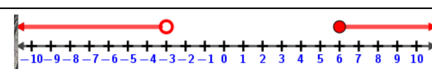
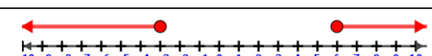
<u>Inequality</u> vs Interval Notation

English Language	Inequality Notation	Number Line	Interval Notation
● Is Equal =	x = 6		[6]
○ Is not equal ≠ x is less than 6 and greater than 6	x ≠ 6		(−∞, 6) ∪ (6, ∞)
○ Exceeds, above >	x > 6		(6, ∞)
○ Is greater (than) >			
○ Is more (than) >			
○ Is **not** less (than) or equal ≰ ≰ means >	x ≰ 6		
● Is greater (than) or equal ≥	x ≥ 6		[6, ∞)
● Is No less than ≥			
● Is At Least ≥			
● Is not less (than) ≮ ≮ means ≥	x ≮ 6		
○ Is less (than), Below <	x < 6		(−∞, 6)
○ Is fewer (than) <			
○ Is **not** greater (than) or equal ≱ ≱ means <	x ≱ 6		
● Is less (than) or equal ≤	x ≤ 6		(−∞, 6]
● Is At Most, Maximum ≤			
● Is No more than, Minimum ≤			
● Does not Exceed ≤			
● Is not greater (than) ≯ ≯ means ≤	x ≯ 6		
x is between a and b	-3 < x < 6		(-3, 6)
x is between a and b, including a	-3 ≤ x < 6		[-3, 6)
x is between a and b, including b	-3 < x ≤ 6		(-3, 6]
x is between a and b, inclusive	-3 ≤ x ≤ 6		[-3, 6]
x is less than a or x is greater than b	x < -3 or x > 6		(−∞,-3) ∪ (6, ∞)
x is less than or equal to a or x is greater than b	x ≤ -3 or x > 6		(−∞,-3] ∪ (6, ∞)
x is less than a or x is greater than or equal b	x < -3 or x ≥ 6		(−∞,-3) ∪ [6, ∞)
x is less than or equal to a or x is greater than or equal to b	x ≤ -3 or x ≥ 6		(−∞,-3] ∪ [6, ∞)

Interactive Lesson on 'line-graphs': https://www.geogebra.org/m/mEs37yMj#material/ns2xr6na

Set Builder Notation is occasionally used with inequality notation as follows: **{x |** ***<u>Use either notation above</u>*** **}.**

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https://en.wikipedia.org/wiki/Arithmetic

Addition, denoted by the symbol +, is the most basic operation of arithmetic. In its simple form, addition combines two numbers, the *addends or terms*, into a single number, the *sum* of the numbers (such as 2 + 2 = 4 or 3 + 5 = 8)

5 + 2 = 7
Inverses
7 – 2 = 5
7 – 5 =2

Subtraction, denoted by the symbol −, is the inverse operation to addition. Subtraction finds the *difference* between two numbers, the *minuend* minus the *subtrahend*: $D = M - S$. Resorting to the previously established addition, this is to say that the difference is the number that, when added to the subtrahend, results in the minuend: $D + S = M$.

Multiplication, denoted by the symbols × or ·, is the second basic operation of arithmetic. Multiplication also combines two numbers into a single number, the *product*. The two original numbers are called the *multiplier* and the *multiplicand*, mostly both are simply called *factors*.

8 × 6 = 48
Inverses
48 ÷ 6 = 8
48 ÷ 8 = 6

Division, denoted by the symbols ÷ or /, is essentially the inverse operation to multiplication. Division finds the *quotient* of two numbers, the *dividend* divided by the *divisor*. Any dividend divided by zero is undefined. For distinct positive numbers, if the dividend is larger than the divisor, the quotient is greater than 1, otherwise it is less than or equal to 1 (a similar rule applies for negative numbers). The quotient multiplied by the divisor always yields the dividend.

Arithmetic operations

Binary operations require two values to be used for a solution. The solid framed boxes demonstrate the binary nature of inverse operations. These operations undo each other, i.e., adding 2 + 3 = 5 results in two inverse operations of subtracting 5 – 3 = 2 or 5 – 2 = 3. Multiplication and Division as well as Exponentiation and Roots have similar results. Inverse operation reverses an operation's order. These operations have equal strength and the order of use is from left to right. **PE(MD)(AS)** or **G(ER)(MD)(AS)**

Addition (+)

$$\left.\begin{array}{c}\text{term} + \text{term}\\ \text{summand} + \text{summand}\\ \text{addend} + \text{addend}\\ \text{augend} + \text{addend}\end{array}\right\} = \text{sum}$$

12 + 7 = 19

Subtraction (-)

$$\left.\begin{array}{c}\text{term - term}\\ \text{minuend} - \text{subtrahend}\end{array}\right\} = \text{difference}$$

19 – 12 = 7 or 19 – 7 = 12

Multiplication $(\times, *, a \cdot b, a(b), etc)$

$$\left.\begin{array}{c}\text{factor} \times \text{factor}\\ \text{multiplier} \times \text{multiplicand}\end{array}\right\} = \text{product}$$

12 × 7 = 84

Division $(\div \overline{)}\ :\ \frac{n}{d})$

$$\left.\begin{array}{c}\dfrac{\text{dividend}}{\text{divisor}}\\[2ex] \dfrac{\text{numerator}}{\text{denominator}}\end{array}\right\} = \begin{array}{l}\text{fraction } \frac{n}{d}\\ \text{quotient} \div \overline{)}\\ \text{ratio to } : \frac{n}{d}\end{array}$$

84 ÷ 12 = 7 84 ÷ 7 = 12

Exponentiation

$$\text{base}^{\text{exponent}} = \text{power}$$

nth root $(\sqrt[n]{\ })$

$$\sqrt[\text{degree}]{\text{radicand}} = \text{root}$$

$$6^3 = 216$$
Inverse
$$\sqrt[3]{216} = 6$$
$$216^{\frac{1}{3}} = 6$$

Commonly misstated division sentences:

a) 25 divided by 5: 25 ÷ 5 = 5
b) 5 divided into 25: $5\overline{)25}$ = 5

Logarithm (log) {These operations are **not** tested.}

$$\log_b(n) = x \text{ is inverse of } b^x = n$$

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Many get the following mathematical statements incorrect by not using the correct vocabulary/syntax:

Problem	Verbal Math Statement (use shows you understand)	Using signed numbers
5 + 6 = 11	**five plus six**	5 + 6 = 11
5 + –6 = –1	**five plus the opposite of six; five plus the negative of six**	5 – 6 = –1
5 – 6	five **minus** six	5 – 6 = **5 + (-6) = -1**
5 – –(6)	five **minus** the **opposite** of six	5 – –(6) = 5 + 6 = 11
5 – (–6)	five **minus negative** six	5 – (–6) = 5 + 6 = 11
5 – –(–6)	five **minus** the **opposite** of **negative** six	5 – **–(–6)** = 5 – **6** = –1

Learning the proper vocabulary for mathematics in the use the plus (+) or minus (–) symbols will assist proper understanding of mathematical symbols and understanding.

How a sign is used in a phrase sets the meaning of that sign.

Plus, what does it mean?

The *plus* (+) sign can mean different things, depending on the context.

- It means to add the two values which are separated by it, a binary operation. { a plus b }
- It is a condition of being a **positive** number which is on the right-hand side of zero on a number line.
  Written "positive signs" are optional, i.e., $^{+}22$ and 22 are equivalent; **positivity** is a condition.

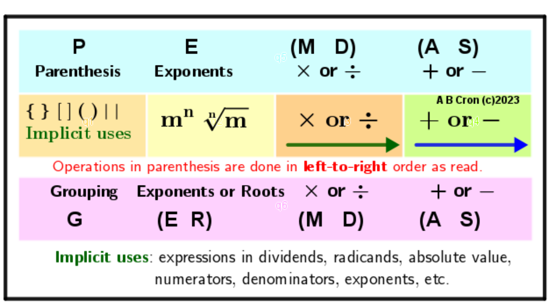
Minus, what does it mean?

The *minus* (–) sign can mean three different things, depending on the context.

- It means to **subtract** the two values separated by it. Between two expressions, it means subtract the second expression from the first one. For example, x – 3 means subtract 3 from x. **It is a binary operation, not a condition.**
- It is a condition of being a **negative** number which is on the left-hand side of zero on a number line. Example: $^{-}2$ can mean negative 2. Negative numbers **require** a negative sign; **negativity** is a condition.
- Or it is a condition modifier, asking for the **opposite** of the value current condition. The opposite of a number is what you add to it to get zero. Example: –2 can mean the opposite of 2, which is negative 2, since 2 + -2 = 0. Likewise, -x means the opposite of x, and x + -x = 0.
  - This third condition of opposite allows one to change any subtraction problem into an addition problem. Meaning that we can apply certain freedoms to arithmetic the subtraction does allow. Everyday usage: **a - b = a + (-b)** is a reminder for students of the rule.

Adapted from: *Algebra: Themes, Tools, Concepts* © 1994 Anita Wah and Henri Picciotto

Math Symbols video: https://www.youtube.com/watch?v=xvcwdh9K9Zw
https://mathsbot.com/activities/wordedExpressions



The major groups are Grouping, Exp/Roots, Mult/Div, Add/Sub (GEMA).
The process is do all operations within groups following EMA.
When all groups are gone perform EMA on remainder.
The sign of a signed number has the lowest precedence.

The reading of an English statement, then writing the equivalent math statement is a daily basic skill need in life.

Operator Examples:
Addition Subtraction
Plus: 3 + 7 Minus: 7 – 3
Multiplication Division
Multiply: 3 × 7 Divide: 21 ÷ 7

Condition Examples:
Positive $^{+}8$ Negative $^{-}7$

Condition Modifier Examples:
Opposite of 8: $–(^{+}8) = {}^{-}8$
Opposite of $^{-}9$: $–(^{-}9) = {}^{+}9$

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Remember these facts:

A. **Prime numbers** have exactly two factors, one factor is the number 1 and the other factor is that number. 5 = 5 x 1 or 1 x 5 = 5 Set of primes is {2, 3, 5, 7, 11, 13, 17, 19, …}

B. **Composite numbers** have more than two factors.

C. All equations and inequalities sentences have a syntax like English, ***Expression* Verb *Expression***: ➔

Expression	*Verb*	*Expression*
3x + 1	=	*5x – 7*
3x + 1	≤	*5x – 7*

D. Basic arithmetic rules (laws)

These all apply in every mathematical field.

a. Commutative Properties: a + b = b + a or ab = ba

b. Associative Properties: a + (b + c) = (a + b) + c or a(bc) = (ab)c

c. Identity Properties: a + 0 = a or a × 1 = a

d. Inverse Properties: a + (-a) = 0 or $a \times \frac{1}{a} = 1, if\ a \neq 0$

Signed Number Arithmetic: a – b = a + (-b); uses the additive inverse property

Simplifying fraction division: $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$; uses the reciprocal property: $\frac{a}{b} \times \frac{b}{a} = 1$

e. Distributive Property: a(b ± c) = ab ± ac; reversing this is called factoring where we do this: ab ± ac = a(b ± c). (± means you can work with either + or –.)

f. Multiplicative Property of Zero: a × 0 = 0

E. **Remember:**

a. **Addition and Subtraction are inverse operations!**

b. **Multiplication and Division are inverse operations!**

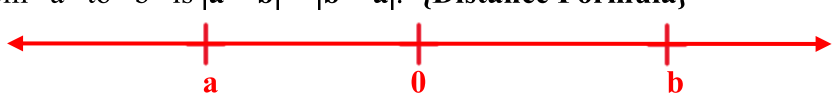
c. **Exponents and Roots are inverse operations!**

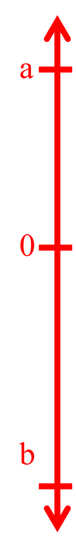
F. Basic mathematical skills needed to pass HSE exams:

- Whole number arithmetic facts to the 16s, all factors of each product, square to 25, and cubes to 10
- Adding and Subtracting Fractions (See 02 GED Math Ref Book, p.7)
- **Signed** (Directed) **Number** arithmetic—numbers with conditional location symbols: positive (+) or negative (–)
  - opposite is a conditional modifier—opposite (–) changes a sign to its opposite condition, negative become positive and positive becomes negative
- Binary operations—two value operations with an arithmetic operator: plus (+), minus (–), times (×), divide (÷)
  - Value1 **Operator** Value2
- **Absolute Value***—the value of a signed number without any conditional symbols:

$$|n| = \begin{cases} n, & \text{if } n \geq 0 \\ -n, & \text{if } n < 0 \end{cases}$$

  - $|-5| = 5$ or $|5| = 5$ {"absolute value of negative five equals five" or "absolute value of five equals five"}
  - |–7| ___ |–9|, |–9| ___ |7|
  - When using absolute value, the result is the **distance** between to values on a number line. If a word problem uses the word "**distance**" or "**implies a distance**", take the **absolute value** of answer. The HSE/GED test does not do diagonal distances. {*But by using a variation of the Pythagorean Theorem, it is done later in math.*}
  - The distance from "a" to "b" is **|a – b| ≡ |b – a|**. **{Distance Formula}**





If a = –6 and b = +8, $|-6 - 8| = |-6 + -8| = |-14| = 14$

$|8 - -6| = |8 + 6| = |14| = 14$.

Algebra uses and enhances by these rules.

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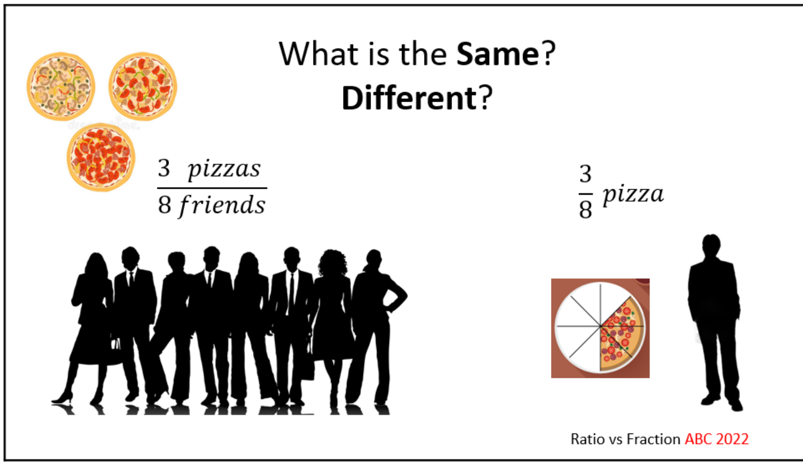
Key words, signal words, and phrases used on HSE math exams include similar vocabulary in their word problems.

Fractions, Ratios, and Rates



Fractions compare *like items* where you have the number of parts over the whole number of parts. (Fractions are rational numbers formed by an integer over a non-negative number.)

$\frac{part}{whole}$ – compare like items (fraction)

A **ratio** is a comparison of 2 or more numbers. The numbers may be *like or unlike items*, the items in the numerator may not be the same type of items in the denominator.

people:animals – comparing unlike items (ratio)

birds:grains of sand in the air or $\frac{birds}{grains\ of\ sand}$

Fractions and ratios do not normally use decimals; rates can have decimals in the numerators; the denominators are 1. The unit is a *ratio of units*.

Hence, "All **ratios** are fractions, but not all **fractions** are ratios."

All ratios must always be in fraction form unless they represent a **Rate**. The rate is miles per hour (mph) or miles per gallon (mpg). For rates, the denominator is 1, and only rates can have decimals. **Rate compares something to one thing**…but it is a ratio, the units allow the user to not use a 1 in the denominator: mpg, mph. But if I have four people per pizza the fraction would $\frac{4}{1}$ or 4:1, but not 4.

miles:gallon — compares fuel consumption per mile (rate)

A **proportion** occurs when two or more ratios are equivalent. 4:6 :: 3:9 :: 12:36.

"There are some fraction rules that ratios do not follow. Do not change a ratio that is an improper fraction to a mixed number. Also, if a ratio in fraction form has a denominator of 1, do not write it as a whole number. Leave it in fraction form." Kaplan, p 260.

Fractions vs Decimals

Decimals are base-ten positional numeral system. While decimal systems have been in use over 2000 years, modern methods were invented less than 500 years ago. They did not become in common usage until after 1790 when the French mandated the metric system in France. **Rational decimals** can be represented by decimal fractions of the form $\frac{a}{10^n}$, where "*a*" is an integer, and "*n*" is a non-negative integer. Rational decimals are either **terminating** or **repeating**. All rational decimals can be represented in a reduced fraction form. If a decimal number cannot be represented in a reduced fraction form, it is called an **irrational decimal**, and the decimal value never terminates or repeats.

Terminating Decimals		Repeating Decimals		Irrational Decimals	
Decimal	Fraction	Decimal	Fraction	Number	Decimal
0.5	$\frac{1}{2}$	0.333333333…	$\frac{1}{3}$	π	3.14159265359…
0.375	$\frac{3}{8}$	0.142857142…	$\frac{1}{7}$	$\sqrt{3}$	1.73205080757…
3.35	$3\frac{7}{20}$	5.272727272…	$5\frac{3}{11}$	$\sqrt[3]{25}$	2.92401773821…

"**Fractions are your friend!**"

Translating English into Algebra

Key words, signal words, and phrases used on HSE math exams include similar vocabulary in their word problems.

The **absolute value** of a number is its distance from zero on a number line.

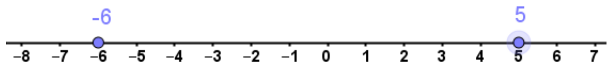
Absolute Value: $|a| = \begin{cases} a \\ -a \end{cases}$ (the answer is ALWAYS the non-negative value, no sign, page 6)

Examples: |3| = 3, |-3| = 3

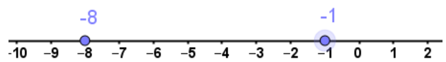
Finding the <u>distance between two points</u> on the number line:

Finding the distance between two location on a number line. |a - b|

a. How far apart are the points of 5 and -6 on a number line?
   |5 - -6| = |11| = 11
   |-6 - 5| = |-11| = 11



b. How far apart are the points -1 and -8 on a number line?
   |-1 - -8| = |-1 + 8| = |7| = 7
   |-8 - -1| = |-8 + 1| = |-7| = 7



When you have the numbers graphed on a number line; you can count the spaces apart. However, we normally subtract the two value and take the absolute value of the difference.

Some Basic Algebraic Concepts

An **algebraic expression** uses numbers, operations, and variables to show number relations. **Variables** are letters (such as a, b, …, x and y) that represent unknown values. Each time a letter is used within the same expression, it represents the same number. If an expression can be simplified, this needs to be done as the first step in solving for a solution.

$$3x + 5 - 2y + 4x$$

An **algebraic equation** consists of two expressions separated by an equality sign.

$$3c - 5 = c + 36$$

An **algebraic inequality** consists of two expressions separated by an inequality sign.

$$5y + 7 < 3y + 15$$

Numbers with <u>Special</u> Properties

<u>Zero</u>, 0, is the **only** value without a positive or negative sign. It is neutral. Zero is the Addition Identity Element

<u>One</u>, 1, is a **factor of every number** known to exist. One is the Multiplication Identity Element

<u>Negative 1</u>, –1, is a **factor of every negative number**, as is 1 is a factor of the negative number.

<u>Math Memes</u>:

Arithmetic is the queen of mathematics
Algebra is a way to do shortcuts in Arithmetic.
Calculus is a way to do shortcuts in Algebra.
Fractions are your **Friends**.
All **ratios** are fractions, but not all **fractions** are ratios.
You must **RISE** before you can **RUN**!
All <u>functions</u> are <u>relations</u>, but **NOT** all <u>relations</u> are <u>functions</u>.

Translating English into Algebra

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Most Missed Questions on the GED® Mathematical Reasoning test

(This page is from an official GED® document.)

Translation Chart @GED

The chart below gives you some of the terms that come up in many word problems. Have students use the chart to assist them in translating or "setting up" word problems into expressions or equations.

English	Math	Example	Translation
What, a number	*x, n,* etc.	Three more than a number is 8.	$n + 3 = 8$
Equivalent, equals, is, was, has, costs	=	Danny **is** 16 years old. A CD **costs** 15 dollars.	$d = 16$ $c = 15$
Is greater than Is less than At least, minimum At most, maximum	> < ≥ ≤	Jenny **has more** money than Ben. Ashley's age **is less than** Nick's. There are **at least** 30 questions on the test. Sam can invite **a maximum** of 15 people to his party.	$j > b$ $a < n$ $t \geq 30$ $s \leq 15$
More, more than, greater, than, added to, total, sum, increased by, together	+	Kecia has 2 **more** video games than John. Kecia and John have a **total** of 11 video games.	$k = j + 2$ $k + j = 11$
Less than, smaller than, decreased by, difference, fewer	–	Jason has 3 **fewer** CDs than Carson. The **difference between** Jenny's and Ben's savings is $75.	$j = c - 3$ $j - b = 75$
Of, times, product of, twice, double, triple, half of, quarter of	× • a(b)=ab *	Emma has **twice** as many books as Justin. Justin has **half** as many books as Emma.	$e = 2 \times j$ or $e = 2j$ $j = \mathrm{e} \times \frac{1}{2}; \mathrm{j} = \frac{1}{2} \times e$ or $j = \frac{e}{2}$
Divided by, per, for, out of, ratio of __ to __	÷ : n/d $\frac{n}{d}$	Sophia has $1 **for** every $2 Daniel has. The **ratio of** Daniel's savings **to** Sophia's savings is 2 to 1.	$s = d \div 2$ or $s = d/2$ or $s = \frac{d}{2}$ $d/s = 2/1$ or $\frac{d}{s} = \frac{2}{1}$ **d:s = 2:1**

Example

Jennifer has 10 fewer DVDs than Brad.

Step 1: j (has) = b (fewer) – 10
Remember, the word "has" is an equal sign and the word "fewer" is a minus sign, so:
Step 2: $j = b - 10$

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Translating English into Algebra

Key words, signal words, and phrases used on HSE math exams include similar vocabulary in their word problems.

English Phrases	Algebraic Expression
what, a number, a value, an unknown, another number	x, y, z, n, ?
format of even numbers	2n
format of odd numbers	2n + 1
twelve more than a number {more than: reverses number order}	x + 12
a number added to eight {reverses number order}	8 + x
a number subtracted from eight	8 - x
a number increased by thirty-three	x + 33
a plus b	a + b
the total of b and c	b + c
five less than a number {less than: reverses number order}	x – 5
seven from thirteen; seven from a number {from switches order}	13 – 7; x - 7
thirteen from seven (answer is negative 6 or -6)	7 – 13
the difference of a number and twelve	x – 12
the difference of fourteen and a number	14 – x
b subtracted from a *or* b less than a {reverses number order}	a - b
the product of *a* and *b* {the commutative property can apply}	$a \cdot b, ab, a(b), (a)(b), a \times b$
the product of three numbers {the associative property can apply}	$a \cdot b \cdot c, a(bc), (ab)c, abc$
twice a number	2n
half (of) a number	$\frac{1}{2}x$ or $\frac{x}{2}$ or $x \div 2$
three-fourths of a number	$\frac{3}{4}x$ or $\frac{3x}{4}$ or $3x \div 4$
Any **fractional part** of a number, n	$\frac{\boldsymbol{a}}{\boldsymbol{b}}n$ or $\frac{an}{b}$ or $an \div b$
two-thirds of a number is thirty.	$\frac{2}{3}x = 30$
the square of a number *or* a number squared	x^2
the square of eight more than a number use ( )	$(x+8)^2 = x^2 + 16x + 64$
The cube of a number *or* a number cube	x^3
the cube of six more than a number or less than a number use ( )	$(x+6)^3$; $(x-6)^3$
the square root of a number $\sqrt{25} = 5$ or $25^{\frac{1}{2}} = 5$	$\sqrt{x}$ or $x^{\frac{1}{2}}$
the square root of a number and 6	$\sqrt{x+6}$
the cube root of a number $\sqrt[3]{27} = 3$ or $27^{\frac{1}{3}} = 3$	$\sqrt[3]{27}$ or $27^{\frac{1}{3}}$
the two-thirds power of n $n^{\frac{2}{3}} = \sqrt[3]{n^2}$ is another way to write it	$n^{\frac{2}{3}} = (\sqrt[3]{n})^2$; $27^{\frac{2}{3}} = (\sqrt[3]{27})^2 = 9$
the cube root of a number decreased by nine	$\sqrt[3]{x} - 9$
a number raised to a negative one power	$n^{-1} = \frac{1}{n}$; $9^{-1} = \frac{1}{9}$

Translating English into Algebra

Key words, signal words, and phrases used on HSE math exams include similar vocabulary in their word problems.

English Phrases	Algebraic Expression
a number raised to the negative second power	$n^{-2} = \frac{1}{n^2}$; $6^{-2} = \frac{1}{6^2}$
a reciprocal of a number to the negative 2 power	$\frac{1}{n^{-2}} = n^2$; $\frac{1}{3^{-2}} = \frac{1}{9^{-1}} = 9$
a value raised to the negative power of a number	$x^{-n} = \frac{1}{x^n}$
seven more (or less) than the square of a number	$x^2 + 7$ $(or\ x^2 - 7)$
twelve percent of a number (% means $\frac{1}{100}$)	$12\%n$ or $\frac{12}{100}n$ or $0.12n$
forty-five times a number	45x
seven times the sum of a number and twelve use ( )	7(x + 12) = 7x + 84
eight times the difference of a number and seven use ( )	8(x – 7) = 8x - 56
the quotient of a number and twelve	$\frac{x}{12}$
the quotient of seventeen and a number	$\frac{17}{x}$
a divided *b*, the quotient of *a* and *b*, *b* divided into *a*	$a \div b$; $\frac{a}{b}$; $b\overline{)\,a}$
the ratio of *b* and *a* All ratios are fraction, but not all fractions are ratios. Only rates can have decimals. Each have different rules.	b to a, $b{:}a$, $\frac{b}{a}$, $b \div a$
the sum of two consecutive numbers	x + (x + 1)
the sum of two consecutive even numbers	x + (x + 2)
the sum of two consecutive odd numbers	x + (x + 2)
the sum of two consecutive square numbers	$x^2 + (x + 1)^2$
the sum of two consecutive cubic numbers	$x^3 + (x + 1)^3$
the sum of three consecutive numbers	x + (x + 1) + (x + 2)
the sum of three consecutive even/odd numbers	x + (x + 2) + (x + 4)
the sum of two consecutive multiples of r	x + (x + r) + (x + 2r)
three is less than five *or* a is less than b	3 < 5 *or* a < b
a half is equal to five tenths	$\frac{1}{2} = 0.5$
twelve is more than six *or* m is greater than n	12 > 6 *or* m > n
fifteen is **not** equal to twenty-five	$15 \neq 25$
a number is **not** less than thirteen	$x \nless 13$ *or* $x \geq 13$
a number is **not** greater than forty	$x \ngtr 40$ *or* $x \leq 40$
A number is **not** greater than or equal to fifteen.	$x \ngeq 15$ *or* $x < 15$
The sum of a number and twenty is forty-five.	x + 20 = 45
Six is three more than a number.	6 = x + 3

Translating English into Algebra

Key words, signal words, and phrases used on HSE math exams include similar vocabulary in their word problems.

English Phrases	**Algebraic Expression**
The product of five and a number is forty-eight.	$5x = 48$
Five times a number subtract ten equals six more than three times the number.	$5x – 10 = 3x + 6$
Six more than four times a number coincides with twenty-three times a number.	$4x + 6 = 23x$
Three times a number plus five is **not** less than or equal to sixty-six.	$3x + 5 \nleq 66$ *or* $3x + 5 > 66$
The difference between five times a number and sixteen is **not** greater than or equal to the sum of a number divided by three and twelve.	$5x – 16 \ngeq \frac{x}{3} + 12$ *or* $5x – 16 < \frac{x}{3} + 12$
Some percent (r%) of the whole equals the part.	$\frac{r}{100} = \frac{part}{whole}$
Percent Increase: % increase = Increase ÷ ***Original Number*** × 100	(404-***160***)÷***160****100=152.5%
Percent Decrease: % decrease = Decrease ÷ ***Original Number*** × 100	(***688***-172)÷***688****100=75%
Simple Interest (I = Prt): Interest = Principal • rate • time	I = 1200•6%•3 (= 216)
The quantity of 5 more than a number multiplied by another number.	$(x + 5)y$

Interactive Websites using this concepts: https://mathsbot.com/activities/wordedExpressions

1)	A number minus 2 all multiplied by 7.	a)	$f + 2$
2)	A number subtracted from another number.	b)	$7(v - 2)$
3)	2 added to a number.	c)	$p^2 + v^2$
4)	The sum of two square numbers.	d)	$6u^2$
5)	8 times by a number.	e)	bq
6)	A number multiplied by another number.	f)	$d - h$
7)	The sum of two square numbers.	g)	$8f$
8)	A number squared then times by 6.	h)	$v^2 + u^2$

See ***Lesson on Percent Increase/Decrease*** for more details. **Kaplan, p. 274f** or Refer to ***00 GED® Formulas Explained*** for more details on some of these concepts.

This lesson discusses finding the above Percent problems including some of the following points: a) finding the original number knowing the percentage decrease/increase and the new value, b) finding the increased/decreased value knowing the original number and the percentage.

Examples: For each of the following statements, use a letter to represent the number: Isla is thinking of and write the statement using letters and numbers.

a) 'I am thinking of a number, and I add three.' ________________
b) 'I am thinking of a number, and I multiply by two and add three.' ________________
c) 'I am thinking of a number, and I add three and multiply by two.' ________________
d) 'I am thinking of a number, and I multiply by three and add two.' ________________
e) 'I am thinking of a number, and I divide by five and subtract one.'________________
f) 'I am thinking of a number, and I add two and multiply by three.' ________________

Translating English into Algebra

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In Algebra, students should:

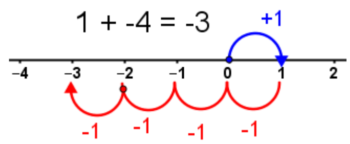
Use and interpret algebraic notation, including:

- ab in place of a × b or a(b)
- 3y in place of y + y + y and 3 × y
- a^2 in place of a × a, a^3 in place of a × a × a; a^2b in place of a × a × b
- $\frac{a}{b}$ in place of a ÷ b (Avoid writing a/b or b\a, they can be misleading, if not clearly written some have read slashes as a 1.)
- coefficients written as fractions rather than as decimals
- parenthesis (), [], or {} are all the same at the HSE level
- ab + ac in place of a(b + c), unless factoring

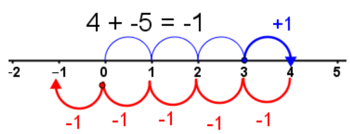
From <*https://colleenyoung.org/2022/01/30/algebraic-notation/*>

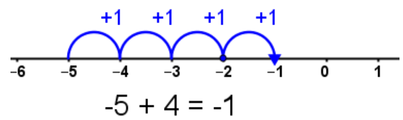
Number line addition/subtraction examples.

1 – 4 ≡ 1 + (-4) result is -3. Begin at +1; move 4 in a negative direction (left).

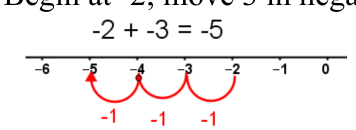


-5 + 4 = -1 Begin at 4; move 5 in negative direction. Begin at -5; move 4 in the positive direction (right).





-2 + (-3) = -5 Begin at -2; move 3 in negative direction (left).



Definitions needed for next page activity:

Every number has a minimum of two factors. Those with only two factors, the number and one are called **prime numbers**. If a number has three or more factors, it is called a **composite number**. The better you are at this skill, the better your overall math ability will be. Learning your factors will simplify solving all math problems.

29: {1, 29}, this is a prime number. The only prime factorization of 29 is 29, by itself.
30: {(1,30),(2,15),(3,10),(5,6)} or more commonly written: {1,2,3,5,6,10,15,30}, composite.
The factor pairs The factor set
The only prime factorization of 30 is 2 × 3 × 5.
32: {1,2,4,8,16,32}, prime factorization is 2^5. Factor pairs: {(1, 32), (2, 16), (4, 8)}
159: {1, 3, 53, 159}, 1+5+9=15 Does 15 divide by 3? Yes. The unique prime factorization is 3 × 53.

Translating English into Algebra

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Completing this chart **will help to be a better math student; find the factors any number.** There are two classes of factor sets: **Prime** and **Composite**. There is only **one** **Prime Factorization Set** for any number.

Numbers	Multiples	Prime Factorization	Factor Sets List of Factor	Total Factors	Factor Pairs Helps with factoring quadratics	Classification
1	1,2,3,…	none	{1}	1	None	Special
2	2,4,6,…	2	{1, 2}	2	{(1•2)}	Prime
3	3,6,9,…	3	{1, 3}	2	{(1•3)}	Prime
4	4,8,12,…	2^2	{1, 2, 4}	3	{(1•4), (2•2)}	Composite
5	5,10,15,…	5	{1, 5}	2	{(1•5)}	Prime
6		2×3	{1, 2, 3, 6}	4	{(1•6), (2•3)}	Composite
7		7	{1, 7}	2	{(1•7)}	
8		2^3	{1, 2, 4, 8}			
9		3^2				
10		2×5				
11						Prime
12					{(1•12), (2•6), (3•4)}	
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						

a) What number is a factor of every number? ______________________

b) Which numbers have exactly two factors? ______________________

c) Write a general description of b)'s factors. ______________________

d) Which numbers have more than two factors? ______________________

e) What are these numbers called? ______________________

Translating English into Algebra

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One (1) is a factor of every **number** and/or **variable/expression**. x has as its factors {1, x}, this is an **important concept** in mathematical reasoning.

Prime numbers have exactly two factors.

There is only **one prime factorization** of any specific value.

A single variable has a coefficient of 1: x = 1•x.

Note: When you have an expression in parenthesis: (3x + 5y) = **1**•(3x + 5y)

And if there is a negative sign, it means: –x = –1•x ; – (3x + 5y) = **–1**•(3x + 5y)

On all values having a negative sign, -1 is a factor, and 1 is a factor.

Number	Prime Factorisation	Factors	Total Factors
1		{1}	1
2	2	{1, 2}	2
3	3	{1, 3}	2
4	2^2	{1, 2, 4}	3
5	5	{1, 5}	2
6	2×3	{1, 2, 3, 6}	4
7	7	{1, 7}	2
8	2^3	{1, 2, 4, 8}	4
9	3^2	{1, 3, 9}	3
10	2×5	{1, 2, 5, 10}	4
11	11	{1, 11}	2
12	2^2×3	{1, 2, 3, 4, 6, 12}	6
13	13	{1, 13}	2
14	2×7	{1, 2, 7, 14}	4
15	3×5	{1, 3, 5, 15}	4
16	2^4	{1, 2, 4, 8, 16}	5
17	17	{1, 17}	2
18	2×3^2	{1, 2, 3, 6, 9, 18}	6
19	19	{1, 19}	2
20	2^2×5	{1, 2, 4, 5, 10, 20}	6
21	3×7	{1, 3, 7, 21}	4
22	2×11	{1, 2, 11, 22}	4
23	23	{1, 23}	2
24	2^3×3	{1, 2, 3, 4, 6, 8, 12, 24}	8
25	5^2	{1, 5, 25}	3

https://mathsbot.com/printables/factors

Common Factors between factor sets are easy to see using their factor sets. The Greatest Common Factor, **GCF**, is the largest of the common factors in a set.

Example 1:

12: {1, 2, 3, 4, 6, 12}
18: {1, 2, 3, 6, 9, 18}
GCF(12, 18) = 6

Example 2:

14: {1, 2, 7, 14}
15: {1, 3, 5, 15}
GCF(14, 15) = 1

The Lowest Common Multiple, **LCM**, can be found using the **prime factors** of a number.

Example 1:

12: 2 × 2 × 3
18: 2 × 3 × 3
LCM: 2 × 2 × 3 × 3 = 36
GCF: 2 × 3

Example 2:

14: 2 × 7
15: 3 × 5 .
LCM: 2 × 3 × 5 × 7
GCF: 1 when no common prime factors

Numbers that have exactly two factors are called **Prime Numbers**.
Numbers that have more than two factors are called **Composite Numbers**.

Factor sets are frequently compared to assisting in finding the **Greatest Common Factor**, **GCF**, of two or more numbers. The GCF is used to determine which factors can be divided out of fractions.

Prime factorizations are frequently used to assist in finding the **Lowest Common Denominator** (**Multiple**), **LCD** (**LCM**), of two or more numbers to make fraction operations simpler to complete.

You will need to learn to factor expressions like this: 5x – 3x factors as (5 – 3)x or 2x.

Or: $\frac{3}{4}x + \frac{2}{3}x$ factors as $\left(\frac{3}{4} + \frac{2}{3}\right)x = \frac{17}{12}x$. There are other kinds of factoring as well; why you need know factors.

Translating English into Algebra

Key words, signal words, and phrases used on HSE math exams include similar vocabulary in their word problems.

Use this page for making your own operator words, this may help you recalling the vocabulary.