

Find the lowest common multiple of:

19.  $x^2 + 7x - 8$ ,  $x^2 - 1$ ,  $x + x^2$ , and  $3ax^2 - 6ax + 3a$ .

20.  $x^2 - a^2$ ,  $a - 2x$ ,  $a^2 + 2ax$ , and  $a^3 - 3a^2x + 2ax^2$ .

21.  $m^3 - x^3$ ,  $m^2 + mx$ ,  $m^2 + mx + x^2$ , and  $(m + x)x^2$ .

22.  $2 - 3x + x^2$ ,  $x^2 + 4x + 4$ ,  $x^2 + 3x + 2$ , and  $1 - x^5$ .

23.  $x^2 - y^2$ ,  $x^4 + x^2y^2 + y^4$ ,  $x^3 + y^3$ , and  $x^2 + xy + y^2$ .

24.  $x^3 + x^2y + xy^2 + y^3$  and  $x^3 - x^2y + xy^2 - y^3$ .

25.  $a^2 + 4a + 4$ ,  $a^2 - 4$ ,  $4 - a^2$ , and  $a^4 - 16$ .

26.  $a^2 - (b + c)^2$ ,  $b^2 - (c + a)^2$ , and  $c^2 - (a + b)^2$ .

27.  $2(ax^2 - x^3)^2$ ,  $3x(a^2x - x^3)^3$ , and  $6(a^2x^2 - a^4)$ .

28.  $(yz^2 - xyz)^2$ ,  $y^2(xz^2 - x^3)$ , and  $x^2z^2 + 2xz^3 + z^4$ .

SUGGESTION.—In solving the following, use the factor theorem.

29.  $x^3 - 6x^2 + 11x - 6$  and  $x^3 - 9x^2 + 26x - 24$ .

30.  $x^3 - 5x^2 - 4x + 20$  and  $x^3 + 2x^2 - 25x - 50$ .

31.  $x^3 - 4x^2 + 5x - 2$  and  $x^3 - 8x^2 + 21x - 18$ .

32.  $x^3 + 5x^2 + 7x + 3$  and  $x^3 - 7x^2 - 5x + 75$ .

33.  $x^3 + 2x^2 - 4x - 8$ ,  $x^3 - x^2 - 8x + 12$ ,  $x^3 + 4x^2 - 3x - 18$ .

## GLOSSARY

**Abscissa.** A distance measured along or parallel to the  $x$ -axis.

**Absolute Term.** A term that does not contain an unknown number.

**Absolute Value.** The value of a number without regard to its sign.

**Addends.** Numbers to be added.

**Addition.** The process of finding a simple expression for the algebraic sum of two or more numbers.

**Affected Quadratic.** A quadratic equation that contains both the second and first powers of one unknown number.

**Algebra.** That branch of mathematics which treats of general numbers and the nature and use of equations. It is an extension of arithmetic and it uses both figures and letters to express numbers.

**Algebraic Expression.** A number represented by algebraic symbols.

**Algebraic Numbers.** Positive and negative numbers, whether integers or fractions.

**Algebraic Sum.** The result of adding two or more algebraic numbers.

**Antecedent.** The first term of a ratio.

**Arrangement.** When a polynomial is arranged so that in passing from left to right the several powers of some letter are successively *higher* or *lower*, the polynomial is said to be arranged according to the *ascending* or *descending* powers, respectively, of that letter.

**Axes of Reference.** Two straight lines that intersect, usually at right angles, used to locate a point or points in a plane.

**Axiom.** A principle so simple as to be self-evident.

**Binomial.** An algebraic expression of two terms.

**Binomial Formula.** The formula or principle by means of which any indicated power of a binomial may be expanded.

**Binomial Quadratic Surd.** A binomial surd whose surd or surds are of the second order.

**Binomial Surd.** A binomial, one or both of whose terms are surds.

**Clearing an Equation of Fractions.** The process of changing an equation containing fractions to an equation without fractions.

**Coefficient.** When one of the two factors into which a number can be resolved is a *known* number, it is usually written first and called the *coefficient* of the other factor.

In a broader sense, either one of the two factors into which a number can be resolved may be considered the *coefficient* of the other.

**Co-factor.** Same as *Coefficient*.

**Common Factor.** A factor of each of two or more numbers.

**Common Multiple.** An expression that exactly contains each of two or more given expressions.

**Complete Quadratic.** Same as *Affected Quadratic*.

**Complex Fraction.** A fraction one or both of whose terms contains a fraction.

**Compound Expression.** Same as *Polynomial*.

**Conditional Equation.** An equation that is true for only certain values of its letters.

**Conjugate Surds.** Two binomial quadratic surds that differ only in the sign of one of the terms.

**Consequent.** The second term of a ratio.

**Consistent Equations.** Same as *Simultaneous Equations*.

**Coördinates.** See *Rectangular Coördinates*.

**Couplet.** The two terms of a ratio.

**Cube.** Same as *Third Power*.

**Cube Root.** One of the three equal factors of a number.

**Cubic Surd.** A surd of the third order.

**Degree of an Expression.** The term of highest degree in any rational integral expression determines the *degree of the expression*.

**Degree of a Term.** The sum of the exponents of the literal factors of a rational integral term determines the *degree of the term*.

**Denominator.** The *divisor* in an algebraic fraction.

**Dependent Equations.** Two or more equations that express the same relation between the unknown numbers involved are often called *dependent equations*, for each may be *derived* from any one of the others.

**Derived Equations.** Same as *Dependent Equations*.

**Difference.** The result of subtracting one number from another.

That is, the *difference* is the algebraic number that added to the subtrahend gives the minuend.

**Dissimilar Fractions.** Fractions that have different denominators.

**Dissimilar Terms.** Terms that contain different letters or the same letters with different exponents.

**Dividend.** In division, the number that is divided.

**Division.** The process of finding one of two factors when their product and one of the factors is given.

**Divisor.** In division, the number by which the dividend is divided.

**Elimination.** The process of deriving from a system of simultaneous equations another system involving fewer unknown numbers.

**Entire Surd.** A surd that has no rational coefficient except unity.

**Equation.** A statement of the equality of two numbers or expressions.

**Equation of the First Degree.** Same as *Simple Equation*.

**Equation of the Second Degree.** Same as *Quadratic Equation*.

**Equivalent Equations.** Two equations that have the same roots, each equation having all the roots of the other.

**Even Root.** A root whose index is an even number.

**Evolution.** The process of finding any required root of a number.

**Exponent.** A small figure or letter placed at the right and a little above a number to indicate how many times the number is to be used as a factor.

**Extremes.** The first and fourth terms of a proportion.

**Factor.** Each of two or more numbers whose product is a given number.

**Factoring.** The process of separating a number into its factors.

**Formula.** An expression of a principle or a rule in symbols.

**Fourth Proportional.** The fourth number of four different numbers that form a proportion.

**Fourth Root.** One of the four equal factors of a number.

**Fraction.** In algebra, an indicated division.

**Fractional Equation.** An equation that involves an unknown number in any denominator.

**Fractional Expression.** An expression, any term of which is a fraction.

**Fulcrum.** The point or edge upon which a lever rests.

**General Number.** A literal number to which any value may be assigned.

**Graph.** A picture (line or lines) every point of which exhibits a pair of corresponding values of two related quantities.

**Graph of an Equation.** The line or lines containing all the points, and only those, whose coördinates satisfy a given equation.

**Higher Equation.** An equation that contains a higher power of the unknown number than the second.

**Highest Common Factor.** The common factor of two or more expressions that has the largest numerical coefficient and is of the highest degree.

It is equal to the product of all the common factors of the expressions.

**Homogeneous Equation.** An equation *all* of whose terms are of the same degree with respect to the unknown numbers.

**Identical Equation.** An equation whose members are identical, or such that they may be reduced to the same form.

**Identity.** Same as *Identical Equation*.

**Imaginary Number.** A number that involves an indicated even root of a negative number.

**Incomplete Quadratic.** Same as *Pure Quadratic*.

**Inconsistent Equations.** Two or more equations that are not satisfied in common by any set of values of the unknown numbers.

**Independent Equations.** Two or more equations that express different relations between the unknown numbers involved, and so cannot be reduced to the same equation.

**Indeterminate Equation.** An equation that is satisfied by an unlimited number of sets of values of its unknown numbers.

**Index of a Power.** Same as *Exponent*.

**Index of a Root.** A small figure or letter written in the opening of a radical sign to indicate what root of a number is sought.

**Integer.** Same as *Whole Number*.

**Integral Equation.** An equation that does not involve an unknown number in any denominator.

**Integral Expression.** An expression that contains no fraction.

**Inverse Ratio.** Same as *Reciprocal Ratio*.

**Involution.** The process of finding any required power of an expression.

**Irrational Equation.** An equation involving an irrational root of an unknown number.

**Irrational Expression.** An expression that contains an irrational number.

**Irrational Number.** A number that cannot be expressed as an integer or as a fraction with integral terms.

**Known Number.** A general number or a number whose value is known.

**Lever.** Any sort of a bar resting on a fixed point or edge.

**Like Terms.** Same as *Similar Terms*.

**Linear Equation.** Same as *Simple Equation*.

**Literal Coefficient.** A coefficient composed of letters.

**Literal Equation.** An equation one or more of whose known numbers is expressed by letters.

**Literal Numbers.** Letters that are used for numbers.

**Lowest Common Denominator.** The denominator of lowest degree, having the least numerical coefficient, to which two or more fractions can be reduced.

It is equal to the lowest common multiple of the given denominators.

**Lowest Common Multiple.** The expression having the smallest numerical coefficient and of lowest degree that will exactly contain each of two or more given expressions.

**Lowest Terms.** When the terms of a fraction have no common factor, the fraction is said to be in its lowest terms.

**Mean Proportional.** A number that serves as both means of a proportion.

**Means.** The second and third terms of a proportion.

**Members of an Equation.** In an equation, the number on the left of the sign of equality is called the *first member* of the equation, and the number on the right is called the *second member*.

**Minimum Point of a graph.** The point of a graph that has the algebraically least ordinate.

**Minuend.** In subtraction, the number from which the subtraction is made.

**Mixed Coefficient.** A coefficient composed of both figures and letters.

**Mixed Expression.** An expression some of whose terms are integral and some fractional.

**Mixed Number.** Same as *Mixed Expression*.

**Mixed Surd.** A surd that has a rational coefficient.

**Monomial.** An algebraic expression of one term only.

**Multiplicand.** In multiplication, the number multiplied.

**Multiplication.** When the multiplier is a positive integer, the process of taking the multiplicand as many times as there are units in the multiplier.

In general, the process of finding a number that is obtained from the multiplicand just as the multiplier is obtained from unity.

**Multiplier.** In multiplication, the number by which the multiplicand is multiplied.

**Negative Number.** A number less than zero.

**Negative Term.** A term preceded by  $-$ .

**Numerator.** The *dividend* in an algebraic fraction.

**Numerical Coefficient.** A coefficient composed of figures.

**Numerical Equation.** An equation all of whose known numbers are expressed by figures.

**Odd Root.** A root whose index is odd.

**Order of a radical or of a surd** is indicated by the index of the root or by the denominator of the fractional exponent.

**Ordinate.** A distance measured along or parallel to the  $y$ -axis.

**Origin.** The intersection of the axes of reference.

**Perfect Square.** An expression that may be separated into two equal factors.

**Polynomial.** An algebraic expression of more than one term.

**Positive Number.** A number greater than zero.

**Positive Term.** A term preceded by  $+$ , expressed or understood.

**Power of a Number.** The product obtained when the number is used a certain number of times as a factor.

**Prime Number.** A number that has no factors except itself and 1.

**Prime to Each Other.** Expressions that have no common prime factor except 1 are said to be *prime to each other*.

**Principal Root.** A real root of a number that has the same sign as the number itself.

**Product.** The result of multiplying one number by another.

**Proportion.** An equality of ratios.

**Pure Quadratic.** An equation that contains only the second power of the unknown number.

**Quadratic Equation.** An equation that, when simplified, contains the *square* of the unknown number, but no higher power.

**Quadratic Form.** An expression that contains but two powers of an unknown number or expression, the exponent of one power being twice that of the other.

**Quadratic Surd.** A surd of the second order.

**Quotient.** The result of dividing one number by another.

**Radical.** An indicated root of a number.

**Radical Equation.** Same as *Irrational Equation*.

**Radical Sign.** Same as *Root Sign*.

**Radicand.** A number whose root is required.

**Ratio.** The relation of two numbers that is expressed by the quotient of the first divided by the second.

**Rational Expression.** An expression that contains no irrational number.

**Rationalization.** The process of multiplying an expression containing a surd by any number that will make the product rational.

**Rationalizing Factor.** The factor by which a surd expression is multiplied to render the product rational.

**Rationalizing the Denominator.** The process of reducing a fraction having an irrational denominator to an equal fraction having a rational denominator.

**Rational Number.** A number that is, or may be, expressed as an integer or as a fraction with integral terms.

**Real Number.** A number that does not involve the even root of a negative number.

**Reciprocal of a number** is 1 divided by the number.

**Reciprocal of a Fraction** is the fraction *inverted* or 1 divided by the fraction.

**Reciprocal Ratio.** The ratio of the reciprocals of two numbers is called the reciprocal ratio of the numbers.

**Rectangular Coördinates.** The abscissa and ordinate of a point referred to two perpendicular axes are called the rectangular coördinates of the point.

**Reduction.** The process of changing the form of an expression without changing its value.

**Remainder in subtraction.** Same as *Difference*.

**Root of an Equation.** Any number that satisfies the equation.

**Root of a Number.** When the factors of a number are all equal, one of the factors is called a root of the number.

**Root Sign.** The symbol  $\sqrt{\quad}$  written before a number denotes that a root of the number is sought.

**Satisfied.** When an equation is reduced to an identity by the substitution of certain known numbers for the unknown numbers, the equation is said to be satisfied.

**Second Power.** When a number is used *twice* as a factor, the product is called the second power of the number.

**Second Root.** Same as *Square Root*.

**Sign of Addition** is +, read '*plus*.'

**Sign of a Fraction.** The sign written before the dividing line of a fraction.

**Sign of Continuation** is ..., read '*and so on*' or '*and so on to*.'

**Sign of Deduction** is  $\therefore$ , read '*therefore*' or '*hence*.'

**Sign of Division** is  $\div$ , read '*divided by*.'

Division is also indicated by a fraction, the numerator being the dividend and the denominator the divisor.

**Sign of Equality** is =, read '*is equal to*' or '*equals*.'

**Sign of Multiplication** is  $\times$  or the dot ( $\cdot$ ), read '*multiplied by*.'

Multiplication is also indicated by the absence of sign.

**Sign of Ratio** is a colon ( $:$ ), read '*is to*.'

**Sign of Subtraction** is  $-$ , read '*minus*.'

**Signs of Aggregation.** Signs used to group numbers that are to be regarded as a single number.

They are *parentheses*, ( $)$ ; *brackets*, [ $]$ ; *braces*,  $\{ \}$ ; the *vinculum*,  $\overline{\quad}$ ; and the *vertical bar*,  $|$ .

**Signs of Direction.** Same as *Signs of Quality*.

**Signs of Opposition.** Same as *Signs of Quality*.

**Signs of Quality.** The signs + and  $-$  when used to denote positive and negative numbers.

**Similar Fractions.** Fractions that have the same denominator.

**Similar Radicals.** Radicals that in their simplest form are of the same order and have the same radicand.

**Similar Terms.** Terms that contain the same letters with the same exponents.

**Simple Equation.** An integral equation that involves only the first power of one unknown number in any term when similar terms have been united.

**Simple Expression.** Same as *Monomial*.

**Simplest Form of a Radical.** A radical is in its simplest form when the index of the root is as small as possible, and when the radicand is integral and contains no factor that is a perfect power whose exponent corresponds with the index of the root.

**Simultaneous Equations.** Two or more equations that are satisfied by the same set or sets of values of the unknown numbers form a system of simultaneous equations.

**Solving an Equation.** Finding the roots of an equation.

**Square.** Same as *Second Power*.

**Square Root.** One of the two equal factors of a number.

**Substitution.** When a particular number takes the place of a letter, or general number, the process is called **substitution**.

**Subtraction.** The process of finding one of two numbers when their sum and the other number are given.

Subtraction is the *inverse* of addition.

**Subtrahend.** In subtraction, the number that is subtracted.

**Sum.** See *Algebraic Sum*.

**Surd.** The indicated root of a *rational* number that cannot be obtained exactly.

**Symmetrical Equation.** An equation that is not affected by interchanging the unknown numbers involved.

**Term.** An algebraic expression whose parts are not separated by the signs + or -.

**Terms of a Fraction.** The numerator and denominator of a fraction.

**Third Power.** When a number is used *three* times as a factor, the product is called the **third power** of the number.

**Third Proportional.** The consequent of the second ratio when the means of a proportion are identical.

**Third Root.** Same as *Cube Root*.

**Transposition.** The process of removing a term from one member of an equation to the other.

**Trinomial.** An algebraic expression of three terms.

**Trinomial Square.** A trinomial that is a perfect square.

**Unknown Number.** A number whose value is to be found.

**Unlike Terms.** Same as *Dissimilar Terms*.

**Whole Number.** A unit or an aggregate of units.

**X-axis.** The horizontal *axis of reference* is usually called the **x-axis**.

**Y-axis.** The vertical *axis of reference* is usually called the **y-axis**.



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