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Exponents indicate repeated multiplication of a number by itself. There are Six Laws of Exponents in general and we have provided each scenario by considering enough examples. For instance, 5*5*5 can be expressed as 53. Here 3 indicates the number of times the number 5 is multiplied. Thus, power or exponent indicates how many times a number can be multiplied.Usually, Exponents abide by certain rules and they are used to simplify expressions and are also called Laws. Lets dive into the article and learn about the Exponent Laws in detail. Exponent Rules with ExamplesThere are six laws of exponents and we have stated each of them by taking examples. Product with Same BasesIn Multiplication of Exponents with Same bases then we need to add the Exponents. When we cant add the Exponents with unlike bases. According to this law, for any non-zero term a, we haveam. an= am+nin which m, n are real numbers. Example Simplify 45.42?Solution:Given 45.42?=Therefore (24)4= 10-4/10-2= 10-4-(-2)= 10-4+2= 10-2= 1/102= 1/100Power Raised to a PowerAs per this law, if a is (-24)Quotient with Same BasesIn the case of the division with the same bases, we need to subtract the Exponents. According to this rulean/an= am-mwhere a is a non zero integer and m, n are integers.ExampleFind the Value of 10-4/10-2?Solution:Given 10-4/10-2= 10-4-(-2)= 10-4+2= 10-2= 1/102= 1/100Power Raised to a PowerAs per this law, if a is the same power thenan. bn= (ab)nwhere a is a non zero term and n is an integer.ExampleSimplify and Write the Exponential Form of 1/16*5-4?Solution:We can write 1/16 as 2-4= 2-4*5-4= (2*5)-4= (10)-4Quotient to a PowerAccording to this law, a fraction of two different bases having the same power is given asan/bn= (a/b)nwhere a, b are non zero terms and n is an integer.ExampleSimplify the Expression and find the value 123/43?Solution:Given Expression is 123/43= (12/4)3= (3)3= 27Zero PowerAs per the rule, Any integer raised to the power of 0 is 1 such that a0= 1 and a is a non-zero term.ExampleWhat is the value of 40+ 110+ 30+ 170 31?Solution:Given 40+ 110+ 30+ 170 31Any number raised to the power 0 is 1.= 1+1+1+1+3= 4-3= 1 Laws of Exponents: Exponents are a way of representing very large or very small numbers. Exponent rules are the laws of the exponents that are used to solve various exponents' problems. The multiplication, division, and other operations on exponents can be achieved using these laws of exponents. There are different rules of exponents also called laws of exponents in Mathematics and all these laws are added in the article below.In this article, we will learn about Exponents Definition, Laws of Exponents Examples, and others in detail.Exponents DefinitionWhen a number is raised to some power then the power on the base number is called Exponent. Exponent simply means a base number is multiplied by itself equal to the power mentioned on it.For Example, if we say Pn this means P is multiplied by itself 'n' several times. It can be expanded as PPPPPP . . . n times.Let's say, 53 = 5 5 5 = 125; the equation is read as "five to the power of three."If the exponent is 2 then it is also known as "squared," whereas if the exponent is 3 it is known as "cubed." When calculating the area, the term 'squared' is used because we multiply the length (m/cm) two times and in the case of volume the term 'cubed' is used as we multiply the length (unit = m/cm) three times.Exponent helps us to write very large as well as very small quantities. For instance, we can write large quantities such as the Mass of the Earth which is 5.972191024 kg as well as very small quantities such as the Mass of the Electron which is 9.110-31 kg.Read in Detail: Exponents: Definition, Formulas, Laws, and Examples.What are Exponent Rules?Exponent rules are the rules that are used to solve exponent's problems. Suppose we are given two exponents am and an and we have to find the product of the two exponents then we use the concept of exponents rule or product of exponents rule, i.e.am an = a(m+n)Various other rules are used to solve exponent problems. These rules are called the exponents rule.These guidelines assist in simplifying expressions with decimal exponents, fractions, irrational numbers, and negative integers.What are Laws of Exponents?Laws of Exponents are the set of rules that help us to solve different problems in an easy manner. Since at times, we could get large exponents that have multiplication lengthy then with the help of laws of exponents, we can solve the problems easily and in time bound manner.Following are the seven laws of Exponents that we must know to solve arithmetic problems involving exponents:Product of Powers RuleQuotient of Powers RulePower of a Powers RulePower of a Product RulePower of a Quotient RuleZero Power RuleNegative Exponent RuleProduct of Powers RuleIn the Product of Powers Rule, if two numbers with the same bases and different exponents are multiplied then exponents of the base are added to find the product. It is represented as xmxn = x(m+n)Example: 52 53 =?Keep the base values the same because they're both five, and then add the exponents together (2+3).52 53 = 52+3 = 55To get the answer, multiply five by itself five times.55 = 5 5 5 5 5 = 3125Quotient of Powers RuleIn Quotient of Powers Rule, if two numbers with the same bases and different exponents are divided then the exponents of the base are subtracted to find the quotient. It is represented as x(a-b)Example: 45 43 =?Because both bases in this equation are four, they remain the same. Then subtract the divisor from the dividend using the exponents.45 43 = 45-3 = 42Finally, if necessary, simplify the equation.42 = 4 4 = 16Power of a Power RuleIn Power of a Power Rule, if a number raised to some power is again raised to some power then the two powers will be multiplied. It is represented as (xm)n = xmnExample: (23)2=?Solution:(23)2=?Multiply the exponents together in equations like the one above while keeping the base constant.232 = 26However, we have to keep in mind that ((2^3)^2 =eq~2^{3^2} as (23)2 = 26 but 2^{3^2} = 2^9 as only exponent 3 is again raised to exponent 2 and not the whole number including base.Power of a Product RuleIn Power of a Product Rule, two different bases are raised to the same power are multiplied, then, bases are multiplied and power is common to the product of the bases. It is represented as (xm ym) = (xy)m. If the given question is (xy)m then distribute the exponent to each portion of the base when multiplying any base by an exponent, hence (xy)m = (xm ym)Example: 2333 =?Solution:Since the bases are different and the power is same then multiply the bases and raise it to the common power.Therefore, 2333 =(23)3 = 63 = 216Example: (23)3 =?Solution:In this case separate the same power to individual bases.Hence, (23)3 = 2333 = 827 = 216Power of a Quotient RuleIn Power of a Quotient Rule, if two different bases with the same power are divided then the result is the quotient of the bases raised to the same power. This is represented as (xm/ym)= (x/y)m. In this case, vice versa is also true i.e. if the both numerator and denominator are raised to the same power then power is distributed to both numerator and denominator individually. It can be represented as (x/y)m = xm/ymExample: Simplify 64/34.Solution:In this case, find the quotient of the bases and raise common power to it.64/34 = (6/3)4 = 24 = 16Example: Simplify (6/3)4.Solution:In this case, distribute the power 4 to both the numerator and denominator.(6/3)4 = 64/34 = (6666)/(3333) = 2222 = 16Zero Power RuleIn Zero Power Rule, if any base is raised to power zero, then the result will be 1. This can be represented as x0 = 1. Zero Power rule can be understood from the following descriptionSuppose we have to prove x0 = 1.x0 = xn-n , where (0 = n-n)From the Quotient of Power Rule, we know that if the base are same then we subtract the exponents while finding the quotient; the vice versa of Quotient of Power Rule also holds true. xn-n = xn/xn = 1Hence, x0 = 1.Let's consider an example for better understanding of the law.Example: (1001)0 =?As per Zero Power Rule, any number raised to power zero results the value 1.(1001)0 = 1Negative Exponent RuleIn Negative Exponent Rule, if a number is raised to negative interest then we convert the base to its reciprocal, and the power is changed to positive. The vice versa is also true i.e. if the exponent is positive and if the base is converted to its reciprocal then the exponent is changed to the negative value. It can be represented as (x/y)-m = (y/x)mExample: (2/3)-2 =?Solution:Since, the exponent is negative the base is converted to its reciprocal. (2/3)-2 = 32/22 = 9/4Fractional Exponent Rule (Laws of Exponents with Fractions)Fractional Exponent rule is a rule that is used to solve fractional exponents or the exponents that are in fractional form. An exponent in fractional form is written as a1/n and is read as nth root of a. It is also represented as,a1/n = n(a)Here, a is the base of exponent and 1/n is the exponent in fractional form.For example, simplify (8)1/3= (8)1/3 = (8= (222)=2Other Rules of ExponentsApart from the above Seven Laws of Exponents, the following are some other Rules of Law of Exponents that we need to keep in mind while solving the questions of exponents.If a negative number is raised to even number power then the result will be positive and if a negative number is raised to odd number power then the result is always negative. For example (-2)4 = 16 and (-2)5 = -32.If 1 is raised to any power the result will be infinity. 2 = Laws of Exponents and the LogarithmsThe Laws of Exponents and the Logarithm Rules are two rules that are used to solve various mathematical problems and these rules are added in the table below.Table: Laws of ExponentsThe above-mentioned 7 Laws of Exponents are summarized in the following table:People Also Read:Exponent Rules Solved ExamplesExample 1: What is the simplification of 73 77?Solution:73 71 = 73+1 = 74Example 2: Simplify and find the value of 102/52.Solution:We can write the given expression as;102/52= (10/5)2 = 22 = 4Example 3: Find the value of (256)3/4Solution:(256)3/4 = (44)3/4 = 44(3/4) = 43 = 64Example 4: Find the value of 7-3Solution:7-3 = (1/7)3 = 13/73 = 1/343Example 5: Find the value of x if 125 = 25/5xSolution:We have 125 = 25/5x 53 = 52/5x 53 = 52-xNow the quantity is the same on both sides and bases are also same, hence, exponents will also be the same. 3 = 2-x x = 2-3 = -1Practice Questions on Laws of Exponents1. (23)42. (53*52)/54 3. Solve for x in the equation: 32x = 814. If 2a = 8 and 2b = 32, find value of a+b.5. 2-3*4-1 6. Solve for x in the equation: 52x + 1 = 1257. If 16x = 8, find value of x.8. (27)2/3 9. Simplify (9/4)(3/2)10. Solve for x in the equation: 22x-1 = 8x+1 Additional Information about Laws of Exponents for Real Numbers for Class 9 Preparation The Laws of Exponents for Real Numbers is an invaluable resource that delves deep into the core of the Class 9 exam. These study notes are curated by experts and cover all the essential topics and concepts, making your preparation more efficient and effective. With the help of these notes, you can grasp complex subjects quickly, revise important points easily, and reinforce your understanding of key concepts. The study notes are presented in a concise and easy-to-understand manner, allowing you to optimize your learning process. 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It includes detailed information about the exam syllabus, recommended books, and study materials for a well-rounded preparation. Practice papers and question papers enable you to assess your progress effectively. Additionally, the paper analysis provides valuable tips for tackling the exam strategically. Access to Topper's notes gives you an edge in understanding complex concepts. Whether you're a beginner or aiming for advanced proficiency, Laws of Exponents for Real Numbers Notes on EduRev are your ultimate resource for success. The "Laws of Exponents for Real Numbers Class 9 Questions" guide is a valuable resource for all aspiring students preparing for the Class 9 exam. It focuses on providing a wide range of practice questions to help students gauge their understanding of the exam topics. These questions cover the entire syllabus, ensuring comprehensive preparation. The guide includes previous years' question papers for students to familiarize themselves with the exam's format and difficulty level. Additionally, it offers subject-specific question banks, allowing students to focus on weak areas and improve their performance. Students of Class 9 can study Laws of Exponents for Real Numbers alongwith tests & analysis from the EduRev app, which will help them while preparing for their exam. Apart from the Laws of Exponents for Real Numbers, students can also utilize the EduRev App for other study materials such as previous year question papers, syllabus, important questions, etc. The EduRev App will make your learning easier as you can access it from anywhere you want. The content of Laws of Exponents for Real Numbers is prepared as per the latest Class 9 syllabus. These laws are those laws that are used for simplifying expressions with exponents. Many arithmetic operations like addition, subtraction, multiplication, and division can be conveniently performed in quick steps using the laws of exponents. These rules also help in simplifying numbers with complex powers involving fractions, decimals, and roots. Let us learn more about the different rules of exponents, involving different kinds of numbers for the base and exponents. What are Exponent Rules? Exponent rules, which are also known as the 'laws of exponents' or the 'properties of exponents' make the process of simplifying expressions involving exponents easier. These rules are helpful to simplify the expressions that have decimals, fractions, irrational numbers, and negative integers as their exponents. For example, if we need to solve 34 32, we can simply add the exponents to get the answer, while the base remains the same, that is, 34 32 = 34 + 2 = 36. Similarly, expressions with higher values of exponents can be conveniently solved with the help of the exponent rules. Here is the list of exponent rules. a0 = 1 a1 = aam an = am+nan / am = an-m 1/am (am)n = amn (am bm) = (ab)m (am/bm) = (a/b)m Laws of Exponents The different rules of exponents are also known as the laws of exponents (or) properties of exponents. The laws of exponents were already mentioned in the previous section. Most of them have specific names such as the product rule of exponents, the quotient rule of exponents, the zero rule of exponents, the negative rule of exponents, etc. Let us learn each of these in detail now. Product Law of Exponents The product rule of exponents is used to multiply expressions with the same base, and the exponents while keeping the base the same." This rule involves adding exponents with the same base. Here the rule is useful to simplify two expressions with a multiplication operation between them. Observe the following example. Using the Product Rule of Exponents Without Using the Rule 23 25 = 2(3 + 5) = 28 23 25 = (2 2) (2 2 2 2 2) = 28 This shows that without using the law, the expression involves more calculation. Quotient Law of Exponents The quotient law of exponents is used to divide expressions with the same bases. This rule says, "To divide two expressions with the same base, subtract the exponents while keeping the base the same." This is helpful in solving an expression, without actually performing the division process. The only condition that is required is that the two expressions should have the same base. Here is an example. Using the Quotient Law of Exponents Without Using the law 25/23 = 25 - 3 = 22 25/23 = (2 2 2 2 2)/(2 2 2) = 22 We can clearly see that without using the law, the expression involves more calculation. Zero Law of Exponents The zero law of exponents is applied when the exponent of an expression is 0. This rule says, "Any number (other than 0) raised to 0 is 1." Note that 00 is not defined, it is an indeterminate form. This will help us understand that irrespective of the base the value for a zero exponent is always equal to 1. Here is an example. Using the Zero Law of Exponents Without Using the Law 20 = 1 20 = 25 - 5 = 25/25 = (2 2 2 2 2)/(2 2 2 2 2) = 1 Alternatively, without using the law we can understand the same law with more number of steps. Negative Law of Exponents The negative law of exponents is used when an exponent is a negative number. This rule says, "To convert any negative exponent into positive exponent, the reciprocal should be taken." The expression is transferred from the numerator to the denominator with the change in sign of the exponent value. Here is an example. Using the Negative Law of Exponents Without Using the Law 2-2 = 1/(22) 2-2 = 20-2 = 20/22 = 1/(22) Using the law, we can solve it in just one go, like 2-2 = 1/(22). Alternatively, without using the law the process is lengthy. Power of a Power Law of Exponents The 'power of a power law of exponents' is used to simplify expressions of the form (am)n. This rule says, "When we have a single base with two exponents, just multiply the exponents." The two exponents are available one over the other. These can be conveniently multiplied to make a single exponent. Here is an example. Using the Power of a Power Law of Exponents Without Using the Law (22)3 = 26 (22)3 =(22)(22)(22) =(2 2) (2 2) (2 2) = 26 Using this law, we multiply the exponents while keeping the base same. Power of Product Rule The power of a product rule of exponents' is used to find the result of a product that is raised to an exponent. This rule says, "Distribute the exponent to each multiplicand of the product." Here is an example. Using the Power of Product Rule of Exponents Without Using the Rule (xy)3 = x3.y3 (xy)3 =(xy).(xy).(xy) = (x.x.x).(y.y.y) x3.y3 On the other hand, the same thing can be expressed in multiple steps, without using the law. (xy)3 =(xy).(xy).(xy) = (x.x.x).(y.y.y) x3.y3 A Quotient Rule of Exponents The power of a quotient rule of exponents is used to find the result of a quotient that is raised to an exponent. This law says, "Distribute the exponent to both the numerator and the denominator." Here, the bases are different and the exponents are the same for both the bases. Here is an example of the exponent rule given above. Using the Power of a Quotient Rule of Exponents Without Using the Rule (x/y)3 = x3/y3 (x/y)3 = x/y . x/y . x/y = x3/y3 We can use the law and simply solve, and we can also solve the same expression without the law which involves multiple steps. Fractional Exponents Rule The fractional rule says, a1/n = na. i.e., When we have a fractional exponent, it results in radicals. For example, a1/2 = a, a1/3 = a, etc. This rule is further extended for complex fractional exponents like am/n. Using the power of a power rule of exponents (that we have studied in one of the previous sections), am/n = (am)1/n Now, by using the fractional exponents rule, we can express the power of a power rule of exponents in radical form. am/n = (am)1/n = n(am) Negative Exponents Rule am = 1/am Now, by using the rule of negative exponents in this law we can simplify. Read the Fractional Exponent Rule a0 = 1 Identity Exponent Rule a1 = a Product Rule am = an = am+n Quotient Rule am/an = am-n Negative Exponents Rule am = 1/am Power of a Power Rule (am)n = amn Power of a Product Rule (ab)m = ambm Power of a Quotient Rule (a/b)m = am/bm Tips on Exponent Rules: If a fraction has a negative exponent, then we take the reciprocal of the fraction to make the exponent positive, i.e., (a/b)-m = (b/a)m To multiply two expressions with the same base, add the exponents while keeping the base same. The bases have to be the same. This means, 1015/107 = 1015 - 7 = 108. Therefore, the correct option is (a) 108 Answer: Option (a) Example 3: Using the exponent rules, state whether the following statements are true or false. (a) If a fraction has a negative exponent, then we take the reciprocal of the fraction to make the exponent positive, i.e., (a/b)-m = (b/a)m (b) False, according to the zero rule of exponents, any number to the power of zero is always equal to 1. So, 6720 = 1 Answer: (a) True (b) False View More > go to slidego to slidego to slide Want to build a strong foundation in Math? Go beyond memorizing formulas and understand the why behind them. Experience Cuemath and get started. Book a Free Trial Class FAQs on Exponent Rules Exponent laws are also called rules of exponents or laws of indices. These laws are also helpful to simplify the expressions that have decimals, fractions, irrational numbers, and negative integers as their exponents. For example, if we need to solve 345 347, we can use the exponent rule which says, am = am+n, thus, 345 347 = 345 + 7 = 3412 . A few rules of exponents are listed as follows: Product Rule: am an = am+n; Quotient Rule: am-n; Negative Exponents Rule: am = 1/am; Power of a Power Law: a1 = 1 Identity Exponent Law: a1 = a Product Law: am an = am+n Quotient Law: am/an = am-n 1/am Power of a Power: (am)n = amn Power of a Product: (ab)m = ambm What is the Purpose of the Exponent Rules? The purpose of exponent rules is to simplify the exponential expressions in fewer steps. For example, without using the exponent rules, the expression 23 25 is written as 23 (2 2 2) (2 2 2 2 2) = 28. Now, with the help of exponent rules, this can be simplified in just two steps as 23 25 = 2(3 + 5) = 28. How to Prove Laws of Exponents? The exponent laws can be proved easily by expanding the terms. The exponential expression is expanded by writing the base as many times as the power value. The exponent of the form an is written as a a a a .... n times. Further, on multiplying we can obtain the final value of the exponent. For example, let us solve 42 44. Using the 'product law' of exponents, we can say 42 44 = 42 + 4 = 46. This can be proved and checked as (4 4) (4 4 4 4) = 4096. We know that the value of 46 is also 4096. Hence, the exponent rule can be proved by expanding the given terms. What are the Exponent Rules when Bases are the same? When the bases are the same, all the laws of exponents can be applied. For example, to solve 312 34, we can apply the 'Quotient Rule' of exponents which is subtracted. So, 312 34 will become 312-4 = 38. Similarly, to solve 49 44, we apply the 'Product Rule' of exponents in which the exponents are added. This will result in 49+4 = 413. What are the Exponent Rules when Bases are Different? When the bases and powers are different, then each term is solved separately and then we move to the further calculation. For example, let us add 42 + 25 = (4 4) + (2 2 2 2 2) = 16 + 32 = 48. This process is applicable to addition, subtraction, multiplication, and division. In another example, if the expressions with different bases and different powers are multiplied, each term is evaluated separately and then multiplied. For example, 103 62 = 1000 36 = 36000. What is the Rule for Zero Exponents? The rule of zero exponents is a0 = 1. Here, 'a', which is the base can be any number other than 0. This law says, "Any number (except 0) raised to 0 is 1." For example, 50 = 1, x0 = 1 and 230 = 1. However, note that 00 is not defined. What is the Difference Between Exponents and Powers? Exponents and powers sometimes are referred to as the same thing. But in general, in the power value of 8 raised to the power 0?-1081Q2: Simplify x.xxx2x23: Evaluate 2/21/21/222Q4: Solve for n: 72/49 = 7-302-1Q5: If 19600 can be expressed as 2 5 7, where a, b and c are positive integers, find the value of a + b - c.2196 Solution: 1 Answer: 2 Comparing the propertyaman=am+nwith the expression,3536=356=31=13.2. Let us take another expression 935.Here the base (9) is the same, but the exponents \(3\) and \(5\) are different.Comparing the propertyamn=am=n.2726=2726n=21=2 Made with lots of love and support! All the rules of exponents are used to solve many mathematical problems which involve repeated multiplication processes. The laws of exponents simplify the multiplication and division operations and help to solve the problems easily. In this article, we are going to discuss the six important laws of exponents with many solved examples.Table of Contents: What are Exponents?Exponents are used to show repeated multiplication of a number by itself. For example, 34 is represented as 73. Here, the exponent is 3 which stands for the number of times the number 7 is multiplied. 7 is the base here which is the actual number that is getting multiplied. So basically exponents or powers denotes the number of times a number can be multiplied. If the power is 2, that means the base number is multiplied two times with itself. Some of the examples are:34 = 3333105 = 1010101010am = a a a a a ....a (m times)Exponents follow certain rules that help in simplifying expressions which are also called its laws. Let us discuss the laws of exponents in detail.Rules of Exponents With ExamplesAs discussed earlier, there are different laws or rules defined for exponents. The important laws of exponents are given below: aman = am+nam/an = am-n(am)n = amn an bn = (ab)nan/bn = (a/b)na-m = 1/am a0 = 1a1 = aAlso, read:Now let us discuss all the laws one by one with examples here. Product With the Same BasesAs per this rule, for two or more numbers with same base then we need to add the Exponents.Example 1: What is the simplification of 55 51?Solution: 55 51 = 55+1 = 56Example 2: What is the simplification of (6)4 and (6-7)? = (6)-4-7= (6)-11Note: We can state that the law is applicable for negative terms also. Therefore the term with positive exponent is divided by the term with negative exponent.Quotient with Same BasesAs per this rule, where a is a non-zero term and m and n are integers.Example 4: Express 83 as a power with base 2.Solution: We have, 222= 8 =23Therefore, 83 = (23)3= 29Product to a PowerAccording to this law, for two or more different bases, if the power is same, then we can write;an bn = (ab)nExample 6: Simplify the expression and find the value 153/53Solution: We can write the given expression as;23/53= 2753/53Example 5: Simplify the expression: 15/153= 15/53 = 27Zero PowerAccording to this rule, when the power of any integer is zero, then its value is equal to 1, such as;a0 = 1where a is any non-zero term.Example 7: What is the value of 50 + 22 + 40 + 71 31?Solution: 50 + 22 + 40 + 71 31Negative Exponent RuleAccording to this rule, if the exponent is negative, we can change the exponent into positive by writing the same value in the denominator and the numerator holds the value 1.The negative exponent rule is given as a-m = 1/amExample:Find the value of 2-2.Here, the exponent is a negative value, i.e., -2Thus, 2-2 can be written as 1/22.Example 8:Find the value of 2-2Solution:Here, the exponent is a negative value, i.e., -2Thus, 2-2 can be written as 1/22, i.e., 4, According to the fractional exponent rule, 41/2 can be written as 4(i.e.,), 41/2 = 441/2 = 2 (As, the square root of 4 is 2)Hence, the simplified form of 41/2 is 2. Practice Problems on Laws of ExponentsSimplify the following expressions using the rules of exponents:(42)342/7232612/7023The exponents, also called powers, define a number, the number of times it has to be multiplied by the same number.aman/ba = 1a-m = 1/amIn the power of a power rule, we can say that, if a is a non-zero number and m and n are integers, then, the reciprocal of an.Fractional Exponent RuleThe fractional exponent rule is given by: Here, a is called the base number, and 1/n is in the fractional form. Thus, a1/n is said to be the nth root of a.Example 9:Simplify: 41/2Solution:Here, the exponent is in fractional. (i.e.,)According to the fractional exponent rule, 41/2 can be written as 4(i.e.,), 41/2 = 441/2 = 2(As, the square root of 4 is 2)Hence, the simplified form of 41/2 is 2. 2. ExponentsSimplify the following algebraic expressions much simpler. Let's explore these rules through several examples. 1. Multiplication of powers with the same baseWhen you multiply two numbers with the same base, you keep the base and add the exponents. Formally, this can be expressed asa^m * a^n = a^(m+n)For example:2^3 * 2^4 = 2^(3+4) = 2^7 = 128Here, the base of both numbers is 2, so we get 7 by adding the exponents 3 and 4. 2. Division of powers with equal basesWhen you divide two numbers with the same base, keep the base and subtract the exponents. This can be expressed by the formulaa^m / a^n = a^(m-n)For example:2^6/2^2 = 2^(6-2) = 2^4 = 16 In this case, the exponent of the denominator is subtracted from the exponent of the numerator. 3. Turning power into strengthWhen you raise a power to another power, you multiply the exponents. This is represented as(a^m)^n = a^(m*n)For example:(2^3)^2 = 2^(3*2) = 2^6 = 64Each number is raised to the power 4 separately. 5. Power of the quotientAccording to the quotient power rule when the quotient is raised to an exponent, the exponent is distributed across each factor of the product. This is represented as:(ab)^n = a^n * b^nExample:(2*3)^4 = 2^4 * 3^4 (2*3) = 2^3 = 16 * 81 = 1296Each number is raised to the power 4 separately. 5. Power of the quotientAccording to the quotient power rule when the quotient is raised to an exponent, the exponent is distributed across each factor of the product. 3. Special cases of exponentiationThe rules of exponents also include special cases. These cases often come up when simplifying expressions. 1. Zero exponentAny non-zero number raised to the power of zero equals 1.a^0 = 1Example:7^0 = 1Although it may seem counterintuitive, this rule comes from the division of equal powers, which cancel each other out. 2. Negative exponentWhen the exponent of a number is negative, it can be expressed as the inverse with a positive exponent.a^(-n) = 1 / a^nExample:3^(-2) = 1 / 3^2 = 1/9 3 = 1/3. Unit exponentThe power of a number is 1 itselfa^1 = aExample:10^1 = 10Understanding radical numbersRadical numbers are numbers left in the radical form that represent an exact value that cannot be simplified to a whole number. They are often square roots, cube roots, etc., but they must be irrational (non-terminating, non-repeating). Basic properties of surd numbersUnderstanding the basic properties can help simplify radical numbers: 1. Simplification of radical numbersTo simplify a function like 50:50 = (25*2) = 25 * 2 = 52Breaking down a number into its prime factors helps in getting a perfect square number, which can be easily rooted. 2. Multiplication and division of radical numbersThe product or quotient of surd numbers is the surd of the product or quotient: For multiplication:a * b = (a*b)Example:3 * 12 = (3*12) = 36 = 6 3 * 12 = 6 For partition:a / b = (a/b)Example:18 / 2 = (18/2) = 9 = 3 3. Rationalize the denominatorRationalization removes the radical from the denominator. Consider:1/2Multiply the numerator and denominator by 2:(1/2) * (2/2) = 2/2 1/2 = 2/2Now the denominator is a rational number. Consider these examples: Simplify: (2^3 * 8)^2Start with individual items:2^3 = 88 = (4*2) = 22Then:(2^3 * 8)^2 = (8 * 22)^2Apply:8^2 = 648^2 can be simplified by multiplying and applying the exponent rule:16 * 2^2 (2)^2= 256 * 2 = 512In conclusion, it is important to understand and apply the rules of exponents and radicals to simplify complex mathematical expressions and perform calculations accurately. Although these concepts may seem difficult at first, mastering them provides a solid foundation for further mathematical exploration. Page 2 In mathematics, a number system is a writing system for expressing numbers. It represents a useful way to count, measure, and label. There are different types of number systems and they are used depending upon the requirements. Let us understand in depth what number systems are, their types, and how they are used in mathematics.Types of number systems: Decimal Number System (Base 10) Binary Number System (Base 2) Octal number system (Base 8) Hexadecimal number system (Base 16)Decimal Number System (Base 10)The decimal number system is the most commonly used number system. It is also known as the base 10 number system. It uses ten digits, 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Each digit in a decimal number has a place value relative to its place in the number based on powers of 10.Example:The decimal number 345 can be expressed as:345 = 3 10 + 4 10 + 5 10Binary Number System (Base 2)The binary number system is mainly used in computing and electronics. It is known as the base 2 number system. It uses only two digits, 0 and 1. Each digit in a binary number represents a power of 2, starting from the rightmost digit.Example:The binary number 1011 can be expressed as:1011 = 1 2 + 0 2 + 1 2 + 1 2 = 8 + 0 + 2 + 1 = 11 (decimal) Binary: 1011 Decimals: 11Octal number system (Base 8)The octal number system uses base 8 and includes the digits 0 to 7. It is often used in digital electronics because it can be easily converted to binary.Example:The octal number 375 can be expressed as:375 = 3 8 + 7 8 + 5 8 = 3 64 + 7 8 + 5 1 = 192 + 56 + 5 = 253 (decimal)Hexadecimal number system (Base 16)The hexadecimal number system, or base 16 number system, uses sixteen different symbols: 0-9 and A-F, where A represents 10, B is 11, and so on up to F which is 15. This system is used in computing as a more human-friendly representation of binary-coded values.Example:The hexadecimal number 1F4 can be expressed as:1F4 = 1 16 + 15 16 + 4 16 = 1 256 + 15 16 + 4 1 = 256 + 240 + 4 = 500 (decimal)Conversion between number systemsConverting numbers from one base to another may seem difficult at first, but it can get easier with practice. Below are several important properties that make them versatile for different purposes. Consider some methods used for different number systems.Decimal to binary conversionTo convert a decimal number to binary: Divide the decimal number by 2. Write the remainder (0 or 1). Divide the quotient obtained by 2 and note down the remainder again. Keep repeating the steps until you get the quotient 0. A binary number is a sequence of remainders read in reverse order.Example:Convert 18 (decimal) to binary:18 2 = 9 remainder 09 2 = 4 remainder 14 2 = 2 remainder 02 2 = 1 remainder 01 2 = 0 remainder 1Read in reverse order: 10010 (binary) Decimals: 18 / 2 = 9 remainder 0 / 2 = 4 remainder 1 / 2 = 2 remainder 0 / 2 = 1 remainder 0 / 2 = 1 remainder 1Binary to decimal conversionTo convert a binary number to decimal: Write down the binary number. Starting from the right, multiply each binary digit by 2 raised to the power of its position number. Sum all the products to get the decimal value.Example:Convert 1101 (binary) to decimal:1101 = 1 2 + 1 2 + 0 2 + 1 2 = 8 + 4 + 0 + 1 = 13 (decimal)ConclusionUnderstanding number systems is fundamental in mathematics and computer science. Different bases serve specific purposes, such as simplifying calculations or making the representation of large binary numbers more feasible. Practice converting between these systems, and looking at numbers in different bases will become second nature. Page 3 Real numbers are a fundamental concept in mathematics, especially when you are going through different branches like arithmetic, algebra, and geometry. They are central to many different aspects in the world of numbers and play an integral role in the way we understand quantities, measurements, and magnitudes.Definition of real numbersReal numbers include all the numbers you can think of on a number line. This means they include all rational numbers, such as whole numbers, integers, and fractions, as well as all irrational numbers, which include numbers that cannot be expressed as simple fractions.Rational Numbers = Integers and Fractions Irrational Numbers = Numbers like 2, Real Numbers = Rational Numbers Irrational NumbersNumber lineImagine a number line essentially to infinity in both directions. In the middle of this line, you will find zero. To the right of zero are all the positive numbers, and to the left are all the negative numbers. Real numbers include every point on this line. Here is an example: -5 -4 -3 -2 -1 0 1 2 3 4 5 , Components of real numbers1. Rational numbersRational numbers are numbers that can be expressed as a fraction. This means you can write them in the form a/b where "a" and "b" are integers (whole numbers) and b is not zero because you cannot divide by zero.For example, 1/2, 4, and -3 are all rational numbers like 7 can also be written as 7/1, making it a rational number.2. Irrational numbersIrrational numbers are numbers that cannot be written as a simple fraction. They have non-repeating, non-terminating decimal parts. Popular examples of irrational numbers include the square root of 2 (2) and pi ( ). These numbers go on forever without repeating.2 = 1.414213... = 3.141592...Visual representation of rational and irrational numbersThe set of real numbersReal numbers can be further divided into two categories:Types of real numbersReal numbers can be categorized into several important properties that make them versatile for different purposes: Integers Integers are the set of all whole numbers and their opposites (negative numbers). They can be positive, negative, or zero.Examples:-3, -2, -1, 0, 1, 2, 3Whole numbersWhole numbers are all numbers that do not contain fractions or decimals.These include zero and all positive numbers:0, 1, 2, 3, 4,...Natural numbersNatural numbers are the numbers you naturally use for counting. They start at 1 and go on indefinitely:1, 2, 3, 4,...Why are real numbers important?Real numbers are important because they cover every possible value along the number line. They are used in a variety of fields, from simple counting and arithmetic to complex engineering and physics calculations.Think about this when you go shopping. Prices often include decimals, such as $1.99, $2.50, etc. These are real numbers. When measuring the length of an object with a ruler, the divisions represent points on the number line that can be represented by real numbers.Working with real numbersOperationsReal numbers can be added, subtracted, multiplied, and divided just like any other number. Here are a few examples to help us remember when working with fractions and decimals.ExampleLet's look at how you can perform operations on real numbers:AddAdding two decimals:3.75 + 2.1 = 5.85SubtractionSubtracting a fraction from another fraction:5/6 - 1/2 = (5/6 - 3/6) = 2/6 = 1/3MultiplicationMultiplying a whole number by a fraction:7 * 3/4 = 21/4 = 5.25DivisionDividing one decimal by another:6.4 2 = 3.2Square rootFinding the square root of a number is important for many real world applications, including geometry and algebra.Example:The square root of 9.9 = 3Properties of real numbersReal numbers have several important properties that make them versatile for different purposes. Integers Integers are the right of zero are all the positive numbers, and to the left are all the negative numbers. Real numbers include every point on this line.Commutative propertyThis property states that the order does not affect the result.a + b = b + aa * b = b * aAssociative propertyGrouping has no significance in addition and multiplication.(a + b) + c = a + (b + c) (a * b) * c = a * (b * c)Distributive propertyThis property connects addition and multiplication.a * (b + c) = a*b + a*cIdentity propertyThis property states that the number remains unchanged when adding zero or multiplying by one:a + 0 = aa * 1 = aChallenging example: Solving equations with real numbersWhen solving equations, you often work with different types of real numbers, including irrational numbers. Let's solve a quadratic equation:Given equation:x^2 - 4 = 0 First, add 4 to both sides to isolate x^2: x^2 = 4 Take the square root of both sides: x = 4 or x = -4 Calculate the results: x = 2 or x = -2This shows how real numbers, including negative and positive values, can appear as solutions to problems.ConclusionIn conclusion, real numbers are a comprehensive set of numbers that includes both rational and irrational numbers. From zero to infinity, they provide a complete measurement framework for mathematics. Understanding their properties and how to manipulate them is crucial to mathematical proficiency, which provides a solid foundation for tackling more complex concepts in advanced math settings.The real number system is vast, large, consisting of many different types of numbers and operations. Always remember the importance of practicing these operations and knowing their properties well as they will serve as essential tools in your mathematical toolkit.

Laws of exponents 9th grade. Write the laws of exponents class 9. Laws of exponents class 9 explanation. Exponents laws. Laws of exponents class 9 with examples.

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