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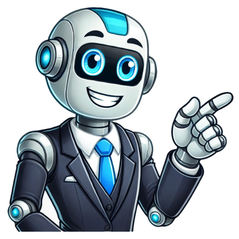

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I have read and accept the privacy policy Example Video Questions Lesson Share to Google Classroom Example Video Questions Lesson Share to Google Classroom Here we are comparing the unit fractions of one half and one third.One third means one whole divided into two parts.One third means one whole divided into three parts.We can see that one half is bigger than one third.The bigger the denominator on the bottom of the fraction, the more parts we have divided into.The bigger fraction will have a smaller denominator and the smaller fraction will have the bigger denominator.‘3’ is bigger than ‘2’ and so, 1 / 2 is greater than 1 / 3 .The greater than sign, ‘>’ always points at the smaller fraction. To compare the size of two unit fractions, look at the denominators. The unit fraction with the smaller denominator is the larger fraction and the unit fraction with the larger denominator is the smaller fraction. A unit fraction is a fraction that has a numerator of 1. The numerator is the number on top of the fraction, above the dividing line. All unit fractions have a ‘1’ on top. It does not matter what number is the denominator at the bottom of the fraction. For example, below is an example of 1 / 4 . It is a unit fraction because it has a ‘1’ on top. It means 1 whole divided into 4 equal parts. Here is a list of some common unit fractions. A fraction wall is a common way to show the size of fractions. We will use the fraction wall to compare unit fractions. We can divide one whole into two equal parts to make 1 / 2 . We can divide one whole into three equal parts to make 1 / 3 . We can divide one whole into four equal parts to make 1 / 4 . We can divide one whole into five equal parts to make 1 / 5 . We can divide one whole into six equal parts to make 1 / 6 . We can divide one whole into seven equal parts to make 1 / 7 . We can keep dividing into smaller and smaller parts if needed. We can compare the size of each unit fraction. Below is a fraction wall showing the size of each unit fraction. We can see that 1 / 2 is larger than 1 / 3 , which is larger than 1 / 4 , which is larger than 1 / 5 , which is larger than 1 / 6 , which is larger than 1 / 7 and so on. We can see the size of each unit fraction below. We will look at an example of comparing two unit fractions. In this example we have 1 / 2 compared to 1 / 3 . The line in the fraction can be thought of as a division operation. 1 / 2 means one whole divided by 2. 1 / 3 means one whole divided by 3. We can see that one half is a bigger fraction than one third. One third is smaller than one half because the fraction has been divided into more parts. Dividing into a greater number of parts means that each part must be smaller because there are more of them. As a rule the smaller the denominator, the larger the unit fraction. We can use this rule to help compare all unit fractions. This rule only works for fractions that have a numerator of 1. In this example we will compare 1 / 3 and 1 / 4 . We can see that 1 / 3 is a larger fraction than 1 / 4 . This is because with 1 / 4 we have divided one whole into 4 parts, which are smaller than the parts produced when dividing into 3 parts. Remember that the smaller the denominator, the larger the fraction. 3 is smaller than 4 and so 1 / 3 is larger than 1 / 4 . We say that 1 / 3 is greater than 1 / 4 . We write 1 / 3 > 1 / 4 . > is the symbol for ‘greater than’. When using the inequality signs of < or >, the symbol can be thought of as an arrow that points to the smaller fraction. Here is another example. We have 1 / 7 compared to 1 / 4 . We can see that 1 / 7 is a smaller fraction than 1 / 4 . Since both fractions are unit fractions, the one with the largest denominator is the smallest fraction. 7 is larger than 4 and so, 1 / 7 is less than 1 / 4 . We can write this as 1 / 7 < 1 / 4 . ‘ The < symbol points to 1 / 7 because this fraction is smaller than 1 / 4 . How to Order Unit Fractions Unit fractions can be ordered from smallest to largest by arranging them from the largest denominator to the smallest denominator. The unit fraction with the largest denominator is the smallest and the unit fraction with the smallest denominator is the largest. We can simply look at the denominators and write the fractions going from largest denominator to smallest. Here is an example of ordering unit fractions. We have the following fractions: Look for the largest denominator first because this is the smallest fraction. 1 / 6 contains a 6 as the denominator, which is the largest number on the bottom of these fractions. Therefore it is the smallest fraction and we write it first. The next largest denominator is 5 and so 1 / 5 is the 2nd smallest of these units fractions. Then we have 1 / 3 and finally, 1 / 2 . We can write the fractions in order by simply looking at the denominators and go from largest to smallest. This is the opposite to the order than normal counting numbers usually go. When teaching ordering unit fractions, it is possible that your child may put the fractions in the wrong order from largest to smallest because it is so natural to write numbers from smallest to largest. Simply refer back to the visual images of the unit fractions to remind them that the larger the numerator, the smaller the fraction. Here is another example of ordering a list of unit fractions from smallest to largest. We have: We write the unit fractions in order by going from largest denominator down to smallest. In order we have 1 / 10 , 1 / 8 , 1 / 4 and finally, 1 / 3 . 1 / 10 is the smallest of these fractions and 1 / 3 is the largest of these fractions. Now try our lesson on Equivalent Fractions where we learn how different fractions can be the same size. Equivalent Fractions Dividing Fractions and Whole Numbers Word Problems Prepare the child through and through so they divide fractions and whole numbers with word problems. Let them take the reciprocal of the divisor and multiply it with the dividend, and they’re good to go! Dividing Mixed Numbers Word Problems Give 5th grade and 6th grade students a good round of practice to hone their skills in fraction division. Convert mixed numbers into improper fractions, and proceed to divide them as usual. Dividing Mixed Numbers and Fractions Word Problems The road to mastery in word problems on dividing mixed numbers and fractions is made smooth with our printable worksheets. Read the problems, identify the dividends and divisors, and find the answers. Themed Fraction Division Word Problems If grade 6 and grade 7 learners are bent on proving they're real gifted at tackling fraction division, nothing can stop them! With our themed word problems pdfs, problem-solving is at its most exciting. Home > Grade Levels > Grade 5 > Identifying the need to divide in a story-based math problem is often difficult and almost cryptic at times. There is a solid strategy that you should begin to deploy and use regularly and this diagramming word problems. Start by identifying the variables, in most cases, those are the values or integers that are found in either number or word form. Circle these variables and any units that are attached to them. The second part of this strategy is essential, scan the problem for words and phrases that indicate an operation. In the problems on this page the variables will be mostly in fractional form. To spot the division operation the most commonly used terminology include: cut up, as much, equally shared, each group, half, parts, per, share. These lessons and worksheets will help you become comfortable with breaking down fraction division problems that are presented in word problems. Aligned Standard: Grade 5 Fractions - 5.NF.7 Answer Keys - These are for all the unlocked materials above. There are lots of problems that involve sweets here. I had a bit of sweet tooth that day (chocolate craving). When you hit 60, you'll understand! Homework 1 - Rosey has a box of chocolates. She has 3/8 of the chocolate in the box. She wants to share this box with her 3 friends. How much of the box will each friend get? You would approach this word problem by dividing 3 into the fraction. Homework 2 - Jasper bought 3/4 of a pound of cake. If his 2 children share this equally, how much will each child get? Students have difficulty when dividing fraction in half, but remember that it is the same thing as multiplying by one half. Homework 3 - Domino has a box that is 3/6 full of candies. He then evenly separated the box among 20 children. How much of the candies will each child get? Practice Worksheets I used to tackle these types of problems at dinner on Fridays when we have guests over. Especially when the conversation got a little stale or someone walked away for a bit. It usually make the math easy and take food last. Practice 1 - William has 2/3 of the goggles. He divides the goggles among 7 friends. How much of the goggles will each friend get? Practice 2 - Ella has 3/8 kg of baby corns. She wants to share the baby corns among 6 friends. How much of the baby corns will each friend get? Practice 3 - 10 people share 2/6 of a pound of the ice cream. How much of a pound of the ice cream will each person get? Math Skill Quizzes It is amazing how food and culinary type situations lend themselves to fraction-based math. Quiz 1 - Audrey made muffins for her children. She made 3/6 of a pack of muffins. She distributes the muffins equally among 5 children. How much of a pack of muffins will each child get? Quiz 2 - Zac bought a bag of sugar candy. He wants to share this bag with his 4 friends. The bag has 2/8 of a kg of sugar candies. How much of the sugar candy will each friend get? Quiz 3 - Chelsea has 5/7 of a box of candles. She wants to share the box among 6 friends. How much of the box will each friend get? Working with whole numbers is easy but getting familiar with the fractions and the operation between them is a bit more complicated. There are multiple methods of doing fraction division. Some people like will often work around fraction and skip to using a decimal format, but that will not work for all the problems that you with come across. I tend to find that students have the most success by using a simple three step process to easily divide fractions. We will work through an example of this strategy. Example: ¾ ÷ ⅜ Step 1- Flip the Second Fraction: You will take the reciprocal of the second fraction (the divisor). This means that you replace the numerator with the denominator and vice versa. In this case the divisor Step 2- Multiply the Fractions: Now that you have found the reciprocal of the division, you will multiply the fractions. If you remember back to fraction multiplication, you multiply the numerators together and the denominators together to form your product. Here is a walkthrough of this process: Step 3- Reduce: Note that you may not need to do this if it is already in the simplest form. You will simplify the numerator and denominator that goes on both equally. In our example 12 does just the trick, so this reduces to: This is one of the quickest methods of dividing fractions. The top and bottom numbers are being multiplied with the same number. Since the number is the reciprocal of its bottom part, the bottom automatically becomes one. Dividing anything by one eventually leaves the value untouched and unchanged. Math Reading Kindergarten Vocabulary Spelling Spelling by Grade Grade 1 Grade 2 Grade 3 Grade 4 Grade 5 Grammar & Writing Science Science by Grade Kindergarten Grade 1 Grade 2 Grade 3 Cursive | Bookstore Math Fraction Word Problems: Discover a vast collection of free printable worksheets tailored for Grade 5 students, aimed at enhancing their understanding and mastery of fractions through real-life scenarios. Dive into a world of learning with Quizizz! Unit Fraction Word Problems Multiply/Divide Fraction Word Problems Fraction Word Problems with Division Add/Sub Fraction Word Problems Addition & Subtraction Fraction Word Problems Multiply and Divide Fraction Word Problems Fraction Word Problems (+, - , *) Fraction Word Problems (like denominators) Choose the operation with fraction word problems Multiply or Divide Fraction (word problems) Fraction Word Problems worksheets for Grade 5 are an essential tool for teachers looking to help their students master the challenging world of math. These worksheets provide a variety of real-life scenarios that require students to apply their understanding of fractions, decimals, and percentages to solve problems. By incorporating these worksheets into their lesson plans, teachers can ensure that their students are developing strong problem-solving skills and a solid foundation in math. Additionally, these Grade 5 worksheets cover a wide range of topics, including addition, subtraction, multiplication, and division of fractions, as well as converting between fractions, decimals, and percentages. This comprehensive collection of Fraction Word Problems worksheets for Grade 5 is an invaluable resource for any teacher looking to support their students' growth in math. Quizizz is an innovative platform that offers a variety of engaging and interactive resources for teachers, including Fraction Word Problems worksheets for Grade 5. With Quizizz, teachers can easily create and share custom quizzes, polls, and presentations to supplement their lesson plans and engage their students in a fun and interactive way. In addition to Fraction Word Problems worksheets, Quizizz also offers a vast library of Math Word Problems covering various topics and grade levels. Teachers can search for and assign these quizzes to their students, track their progress, and provide instant feedback to help them improve their understanding of the subject matter. By incorporating Quizizz into their teaching strategies, educators can enhance their students' learning experience and ensure they are well-prepared for success in Grade 5 Math and beyond. Get 150+ Free Math Worksheets! These Dividing fractions by fractions word problems worksheets will help you understand how to divide fractions with fractions using interesting word problems. Also, after practicing our free worksheets students will get a better hold on fraction division and mixed fraction division too. 6 Dividing Fractions by Fractions Word Problems Worksheets Practice fraction by fraction division word problems using these free worksheets. Now, some types of dividing fractions by fractions word problems are discussed below. Understanding Division of Fractions Dividing fractions is almost like multiplying fractions. When dividing fractions, we multiply the first fraction by the reciprocal of the second fraction. Before explaining how to divide fractions, it is crucial to define a few keywords or concepts. A fraction has 2 parts. One is the denominator and the other is the numerator. For example, 3/7 is a simple fraction whose numerator is 3 and the denominator is 7. Now, we’ll discuss the division of fractions procedure. Let’s look at some easy steps- Step 1: Keep the first fraction constant. Step 2: Switch the division symbol for a multiplication symbol. Step 3: Flip the second fraction to use the reciprocal. Step 4: Simplify them. Step 5: Multiply the denominators and numerators. Here, for more clarity, a photo has been added. 6 Activities to Understand Dividing Fractions by Fractions Word Problems Here we will explore some fun activities to understand and practice the concept of fraction by fraction division using various word problems. Simple Fraction by Fraction Division Word Problems When the top and bottom of a fraction are both whole numbers and cannot get any smaller, the fraction is said to be in its simplest form. For example: is a simple fraction. Simple fractions by fractions division word problems are very easy to solve. For clarity of understanding, a simple fractions-by-fractions division word problem-solving image is given. Worksheets related to the previous discussion can be found in the section below. Fun Word Problems for Dividing Fractions and Whole Numbers by Fraction One can solve the word problem for dividing fractions and whole numbers by using the steps given below in this picture. Now practice the activity from the following worksheet. Divide Fractions by Cross Cancelling Word Problems The division of fractions can be simplified by using cross-canceling shortcuts. This is amazing since it will result in smaller numbers when you divide and smaller numbers are simpler to work with. I’m adding a diagram to show the process of cross-cancelling which helps you understand cross-cancelling easily. Now, for more clarity of understanding, a Divide Fractions by cross-canceling word problem-solving image is given. Practice the exercise from the next worksheet. Solve Mixed Numbers Division by Fraction Word Problems We will now divide a mixed number by a fraction. For clarity of understanding, an image is attached below. Now, we solve word problems related to mixed numbers division by fraction. A mixed numbers division by fraction word problem solution is added below for you. Solve the worksheet below. Mixed Numbers by Mixed Numbers Complex Word Problems Next, we will solve mixed numbers by mixed numbers division of complex word problems. A mixed number by mixed numbers complex word problem solution is added below for your better understanding. Worksheets related to the previous discussion can be found in the section below. Autumn Themed Dividing Fraction by Fraction Word Problems Autumn is a lovely time of year. So, today we will be solving fraction word problems with an autumn theme. Solve the fascinating worksheet that follows. Download Free Worksheet PDF Download the free compiled worksheets of dividing fractions by fractions word problems. In this article, we used some fundamental methods of simple fractions, mixed fractions, dividing whole numbers with fractions and mixed fractions, and some autumn-themed word problems to teach dividing fractions by fractions word problems. We hope these free worksheets are suitable for grade 3 students to practice and understand the prime concept of fraction division.Hello, I am Tania Ahmed. I have a bachelor’s degree in architecture from RUET. I enjoy learning new things. Therefore, I work as a graphic designer and content developer for the You’ve Got This Math project of SOFTEKO. I always think of math in a fun and creative way. So, I present my thoughts about mathematics creatively in my articles. I hope my articles make math easier and more enjoyable for kids to learn. Sample Grade 5 Word Problem Worksheet Math Reading Kindergarten Vocabulary Spelling Spelling by Grade Grade 1 Grade 2 Grade 3 Grade 4 Grade 5 Grammar & Writing Science Science by Grade Kindergarten Grade 1 Grade 2 Grade 3 Cursive | Bookstore Step into real-world scenarios with our engaging collection of fraction division word problems worksheets, where you'll use fraction division to solve intriguing word problems. Equipped with answer keys, this pdf resource features both whole and mixed fractions. Download these free worksheets, and prepare to excel at dividing fractions! Example Video Questions Lesson Share to Google Classroom Example Video Questions Lesson Share to Google Classroom Here we are comparing the unit fractions of one half and one third.One half means one whole divided into two parts.One third means one whole divided into three parts.We can see that one half is bigger than one third.The bigger the denominator on the bottom of the fraction, the more parts we have divided into.The bigger fraction will have a smaller denominator and the smaller fraction will have the bigger denominator.‘3’ is bigger than ‘2’ and so, 1 / 2 is greater than 1 / 3 .The greater than sign, ‘>’ always points at the smaller fraction. To compare the size of two unit fractions, look at the denominators. The unit fraction with the smaller denominator is the larger fraction and the unit fraction with the larger denominator is the smaller fraction. A unit fraction is a fraction that has a numerator of 1. The numerator is the number on top of the fraction, above the dividing line. All unit fractions have a ‘1’ on top. It does not matter what number is the denominator at the bottom of the fraction. For example, below is an example of 1 / 4 . It is a unit fraction because it has a ‘1’ on top. It means 1 whole divided into 4 equal parts. Here is a list of some common unit fractions. A fraction wall is a common way to show the size of fractions. We will use the fraction wall to compare unit fractions. We can divide one whole into two equal parts to make 1 / 2 . We can divide one whole into three equal parts to make 1 / 3 . We can divide one whole into four equal parts to make 1 / 4 . We can divide one whole into five equal parts to make 1 / 5 . We can divide one whole into six equal parts to make 1 / 6 . We can divide one whole into seven equal parts to make 1 / 7 . We can keep dividing into smaller and smaller parts if needed. We can compare the size of each unit fraction. Below is a fraction wall showing the size of each unit fraction. We can see that 1 / 2 is larger than 1 / 3 , which is larger than 1 / 4 , which is larger than 1 / 5 , which is larger than 1 / 6 , which is larger than 1 / 7 and so on. We can see the size of each unit fraction below. We will look at an example of comparing two unit fractions. In this example we have 1 / 2 compared to 1 / 3 . The line in the fraction can be thought of as a division operation. 1 / 2 means one whole divided by 2. 1 / 3 means one whole divided by 3. We can see that one half is a bigger fraction than one third. One third is smaller than one half because the fraction has been divided into more parts. Dividing into a greater number of parts means that each part must be smaller because there are more of them. As a rule the smaller the denominator, the larger the unit fraction. We can use this rule to help compare all unit fractions. This rule only works for fractions that have a numerator of 1. In this example we will compare 1 / 3 and 1 / 4 . We can see that 1 / 3 is a larger fraction than 1 / 4 . This is because with 1 / 4 we have divided one whole into 4 parts, which are smaller than the parts produced when dividing into 3 parts. Remember that the smaller the denominator, the larger the fraction. 3 is smaller than 4 and so 1 / 3 is larger than 1 / 4 . We say that 1 / 3 is greater than 1 / 4 . We write 1 / 3 > 1 / 4 . > is the symbol for ‘greater than’. When using the inequality signs of < or >, the symbol can be thought of as an arrow that points to the smaller fraction. Here is another example. We have 1 / 7 compared to 1 / 4 . We can see that 1 / 7 is a smaller fraction than 1 / 4 . Since both fractions are unit fractions, the one with the largest denominator is the smallest fraction. 7 is larger than 4 and so, 1 / 7 is less than 1 / 4 . We can write this as 1 / 7 < 1 / 4 . ‘ The < symbol points to 1 / 7 because this fraction is smaller than 1 / 4 . How to Order Unit Fractions Unit fractions can be ordered from smallest to largest by arranging them from the largest denominator to the smallest denominator. The unit fraction with the largest denominator is the smallest and the unit fraction with the smallest denominator is the largest. We can simply look at the denominators and write the fractions going from largest denominator to smallest. Here is an example of ordering unit fractions. We have the following fractions: Look for the largest denominator first because this is the smallest fraction. 1 / 6 contains a 6 as the denominator, which is the largest number on the bottom of these fractions. Therefore it is the smallest fraction and we write it first. The next largest denominator is 5 and so 1 / 5 is the 2nd smallest of these units fractions. Then we have 1 / 3 and finally, 1 / 2 . We can write the fractions in order by simply looking at the denominators and go from largest to smallest. This is the opposite to the order than normal counting numbers usually go. When teaching ordering unit fractions, it is possible that your child may put the fractions in the wrong order from largest to smallest because it is so natural to write numbers from smallest to largest. Simply refer back to the visual images of the unit fractions to remind them that the larger the numerator, the smaller the fraction. Here is another example of ordering a list of unit fractions from smallest to largest. We have: We write the unit fractions in order by going from largest denominator down to smallest. In order we have 1 / 10 , 1 / 8 , 1 / 4 and finally, 1 / 3 . 1 / 10 is the smallest of these fractions and 1 / 3 is the largest of these fractions. Now try our lesson on Equivalent Fractions where we learn how different fractions can be the same size. Equivalent Fractions Math Reading Kindergarten Vocabulary Spelling Spelling by Grade Grade 1 Grade 2 Grade 3 Grade 4 Grade 5 Grammar & Writing Science Science by Grade Kindergarten Grade 1 Grade 2 Grade 3 Cursive | Bookstore Example Video Questions Lesson Share to Google Classroom Example Video Questions Lesson Share to Google Classroom To calculate a unit fraction of an amount, divide the amount by the denominatorThe number on the bottom of a fraction, below the dividing line. of the fraction. The denominator is the number on the bottom of our fraction, which is 5. 1 / 5 is said as 'one fifth'. To find one fifth of an amount, divide it by 5. 50 ÷ 5 = 10. Therefore, 1 / 5 of 50 gramsA gram is a measurement of weight. An egg is about 50 grams. is 10 grams. Supporting Lessons Introduction to Fractions Multiplication Grid: Quick 16 A unit fraction is a fraction that has a numerator of 1. This means that the number on the top of a unit fraction must be a 1. The denominator on the bottom of a unit fraction can be any other whole number. Unit fractions are called this because they have a numerator of 1. Unit means 1. The name of unit fraction tells us that this fraction must have a numerator that is equal to 1. The first examples of unit fractions are: Unit Fraction Name 1/2 One half 1/3 One third 1/4 One quarter 1/5 One fifth 1/6 One sixth After the first few unit fractions shown above, the rest of the unit fractions are pronounced by saying "one" then the number then "th". For example, 1/10 is pronounced as "one tenth". Here is a poster showing the size of unit fractions and pictures of unit fractions. Unit fractions always have a numerator of 1. The number on the bottom can be any other whole number. The numerator of a fraction is the number on the top of it. The numerator tells us how many parts we have. The denominator of a fraction is the number on the bottom of it. The denominator tells us how many parts there are in total. One quarter is an example of a unit fraction because it has a 1 on top as its numerator. The denominator of one quarter is a 4, which means that the shape is divided into 4 parts. We can see that the larger the denominator of a unit fraction, the more parts we have divided the amount into and the smaller the size of the fraction. A unit fraction must have a numerator of 1. A fraction that is not a unit fraction is called a non-unit fraction. Non-unit fractions have a numerator that is larger than 1. How to Find Unit Fractions of Amounts To find a unit fraction of an amount, divide the amount by the denominator of the fraction. For example to find 1/3 of 18, divide 18 by 3. 18 ÷ 3 = 6 and so, one third of 18 is 6. 1/3 is a unit fraction with a denominator of 3. To find 1/3 of 18, divide 18 by 3. Unit fractions can be represented using a bar model. The full bar represents the total amount and this can be divided up into equal parts to represent the unit fractions. Here the whole bar is worth 18 and we can divide it into 3 equal parts to find one third. 18 ÷ 3 = 6 and so, 1/3 of 18 = 6. We can work this out by thinking, "What number do I need to multiply 3 by to get 18?" 3 × 6 = 18 and so one third of 18 is 6. Here is another example of finding a unit fraction of a number. In this problem we are asked to find 1/2 of 10. To find a unit fraction of a number, divide the number by the denominator of the fraction. To find 1/2 of 10, divide 10 by 2. 10 ÷ 2 = 5 and so, one half of 10 is 5. Here is another example of calculating a unit fraction of an amount. In this unit fraction problem, we have to find 1/4 of £44. If there are units in a unit fraction problem, simply ignore them, do the calculation and then put them back in at the end. We divide by the denominator of the fraction. The denominator is 4. 44 ÷ 4 = 11 and so, £44 ÷ 4 = £11. One quarter of £44 is £11. Here is an example of finding the unit fraction 1/3 of 36 m. To find a unit fraction of an amount, divide by the denominator. The denominator of one third is 3. To find one third, divide by 3. 36 ÷ 3 = 12 and so, 36 m ÷ 3 = 12 m. One third of 36 metres is 12 metres. One over a whole number For fractions of a measurement unit, see Unit prefix. Slices of approximately 1/8 of a pizza A unit fraction is a positive fraction with one as its numerator, 1/n. It is the multiplicative inverse (reciprocal) of the denominator of the fraction, which must be a positive natural number. Examples are 1/1, 1/2, 1/3, 1/4, 1/5, etc. When an object is divided into equal parts, each part is a unit fraction of the whole. Multiplying two unit fractions produces another unit fraction, but other arithmetic operations do not preserve unit fractions. In modular arithmetic, unit fractions can be converted into equivalent whole numbers, allowing modular division to be transformed into multiplication. Every rational number can be represented as a sum of distinct unit fractions; these representations are called Egyptian fractions based on their use in ancient Egyptian mathematics. Many infinite sums of unit fractions are meaningful mathematically. In geometry, unit fractions can be used to characterize the curvature of triangle groups and the tangencies of Ford circles. Unit fractions are commonly used in fair division, and this familiar application is used in mathematics education as an early step toward the understanding of other fractions. Unit fractions are common in probability theory due to the principle of indifference. They also have applications in combinatorial optimization and in analyzing the pattern of frequencies in the hydrogen spectral series. The unit fractions are the rational numbers that can be written in the form $1\,n$, {\displaystyle {\frac {1}{n}},} where n {\displaystyle n} can be any positive natural number. They are thus the multiplicative inverses of the positive integers. When something is divided into n {\displaystyle n} equal parts, each part is a $1\,/\,n$ {\displaystyle 1/n} fraction of the whole.[1] Multiplying any two unit fractions results in a product that is another unit fraction:[2] $1\times 1=1$, $1\times y=1\times y$. {\displaystyle {\frac {1}{x}}\times {\frac {1}{y}}={\frac {1}{xy}}.} However, adding,[3] subtracting,[3] or dividing two unit fractions produces a result that is generally not a unit fraction: $1+1=2$, $y+y=y\times y$ {\displaystyle {\frac {1}{x}}+{\frac {1}{y}}={\frac {x+y}{xy}}} $1-1=y-y=x-x\,y$ {\displaystyle {\frac {1}{x}}-{\frac {1}{y}}={\frac {y-x}{xy}}} $1\div 1=y=y\,x$. {\displaystyle {\frac {1}{x}}\div {\frac {1}{y}}={\frac {y}{x}}.} As the last of these formulas shows, every fraction can be expressed as a quotient of two unit fractions.[4] In modular arithmetic, any unit fraction can be converted into an equivalent whole number using the extended Euclidean algorithm.[5][6] This conversion can be used to perform modular division: dividing by a number x {\displaystyle x} , modulo y {\displaystyle y} , can be performed by converting the unit fraction $1\,/\,x$ {\displaystyle 1/x} into an equivalent whole number modulo y {\displaystyle y} , and then multiplying by that number.[7] In more detail, suppose that x {\displaystyle x} is relatively prime to y {\displaystyle y} (otherwise, division by x {\displaystyle x} is not defined modulo y {\displaystyle y}). The extended Euclidean algorithm for the greatest common divisor can be used to find integers a {\displaystyle a} and b {\displaystyle b} such that Bézout's identity is satisfied: $a\,x+b\,y=\gcd(x,y)=1$. In modulo- y {\displaystyle y} arithmetic, the term b y {\displaystyle by} can be eliminated as it is zero modulo y {\displaystyle y} . This leaves a $x\equiv 1{\pmod {y}}$. That is, a {\displaystyle a} is the modular inverse of x {\displaystyle x} , the number that when multiplied by x {\displaystyle x} produces one. Equivalently,[5][6] $a\equiv 1\,x{\pmod {y}}$. {\displaystyle a\equiv {\frac {1}{x}}{\pmod {y}}.} Thus division by x {\displaystyle x} (modulo y {\displaystyle y}) can instead be performed by multiplying by the integer a {\displaystyle a} .[7] Several constructions in mathematics involve combining multiple unit fractions together, often by adding them. See also: List of sums of reciprocals § Finitely many terms Any positive rational number can be written as the sum of distinct unit fractions, in multiple ways. For example, $4\,5=1\,2+1\,4+1\,20=1\,3+1\,5+1\,6+1\,10$. {\displaystyle {\frac {4}{5}}={\frac {1}{2}}+{\frac {1}{4}}+{\frac {1}{20}}={\frac {1}{3}}+{\frac {1}{5}}+{\frac {1}{6}}+{\frac {1}{10}}.} These sums are called Egyptian fractions, because the ancient Egyptian civilisations used them as notation for more general rational numbers. There is still interest today in analyzing the methods used by the ancients to choose among the possible representations for a fractional number, and to calculate with such representations.[8] The topic of Egyptian fractions has also seen interest in modern number theory; for instance, the Erdős–Graham problem[9] and the Erdős–Straus conjecture[10] concern sums of unit fractions, as does the definition of Ore's harmonic numbers.[11] A pattern of spherical triangles with reflection symmetry across each triangle edge. Spherical reflection patterns like this with 2 x {\displaystyle 2x} , 2 y {\displaystyle 2y} , and 2 z {\displaystyle 2z} triangles at each vertex (here, x , y , $z=2\,,\,3\,,\,5$ {\displaystyle x,y,z=2,3,5}) only exist when $1\,x+1\,y+1\,z>1$ {\displaystyle {\frac {1}{x}}+{\frac {1}{y}}+{\frac {1}{z}}>1} . In geometric group theory, triangle groups are classified into Euclidean, spherical, and hyperbolic cases according to whether an associated sum of unit fractions is equal to one, greater than one, or less than one respectively.[12] See also: List of sums of reciprocals § Infinitely many terms Many well-known infinite series have terms that are unit fractions. These include: The harmonic series, the sum of all positive unit fractions. This sum diverges, and its partial sums $1\,1+1\,2+1\,3+\cdots +1\,n$ {\displaystyle {\frac {1}{1}}+{\frac {1}{2}}+{\frac {1}{3}}+\cdots +{\frac {1}{n}}} grow logarithmically in the number of terms. Many well-known infinite series have terms that are neither unit fractions nor integers. The sum of the reciprocals of the triangular numbers is 2:[13] $\sum _{n=1}^{\infty }{\frac {1}{\frac {1}{2}n(n+1)}}=2$ {\displaystyle \sum _{n=1}^{\infty }{\frac {1}{{\frac {1}{2}}n(n+1)}}=2} The sum of the reciprocals of the square numbers is the Basel problem, solved by Leonhard Euler in 1735:[14] $\sum _{n=1}^{\infty }{\frac {1}{n^{2}}}=1+{\frac {1}{4}}+{\frac {1}{9}}+{\frac {1}{16}}+\cdots ={\frac {\pi ^{2}}{6}}.$ Similarly, Apéry's constant is an irrational number, the sum of the cubed unit fractions.[15] The binary geometric series is[16] $1+{\frac {1}{2}}+{\frac {1}{4}}+{\frac {1}{8}}+{\frac {1}{16}}+\cdots =2.$ A Hilbert matrix is a square matrix in which the elements on the i {\displaystyle i} th antidiagonal all equal the unit fraction $1\,/\,i$ {\displaystyle 1/i} . That is, it has elements $B_{i,j}={\frac {1}{i+j-1}}.$ For example, the matrix $\begin{bmatrix}1&{\frac {1}{2}}&{\frac {1}{3}}\\{\frac {1}{2}}&{\frac {1}{3}}&{\frac {1}{4}}\\{\frac {1}{3}}&{\frac {1}{4}}&{\frac {1}{5}}\end{bmatrix}$ is a Hilbert matrix. It has the unusual property that all elements in its inverse matrix are integers.[19] Similarly, Richardson (2001) defined a matrix whose elements are unit fractions whose denominators are Fibonacci numbers: $C_{i,j}={\frac {1}{F_{i+j-1}}},$ where F i {\displaystyle F_{i}} denotes the i {\displaystyle i} th Fibonacci number. He calls this matrix the Filbert matrix and it has the same property of having an integer inverse.[20] Fractions with tangent Ford circles differ by a unit fraction Two fractions a / b {\displaystyle a/b} and c / d {\displaystyle c/d} (in lowest terms) are called adjacent if $a\,d-b\,c=\pm 1$, {\displaystyle ad-bc=\pm 1,} which implies that they differ from each other by a unit fraction: $|\,1\,a-1\,b\,|=|\,a\,d-b\,c\,|\,b\,d=1\,b\,d$. {\displaystyle \left|{\frac {1}{a}}-{\frac {1}{b}}\right|={\frac {|ad-bc|}{bd}}={\frac {1}{bd}}.} For instance, $1\,2$ {\displaystyle {\frac {1}{2}}} and $3\,5$ {\displaystyle {\frac {3}{5}}} are adjacent: $1\cdot 5-2\cdot 3=-1$, {\displaystyle 1\cdot 5-2\cdot 3=-1} so $3\,5-1\,2=1\,10$ {\displaystyle {\frac {3}{5}}-{\frac {1}{2}}={\frac {1}{10}}} . However, some pairs of fractions whose difference is a unit fraction are not adjacent in this sense: for instance, $1\,3$ {\displaystyle {\frac {1}{3}}} and $2\,3$ {\displaystyle {\frac {2}{3}}} differ by a unit fraction, but are not adjacent, because for them $a\,d-b\,c=3$ {\displaystyle ad-bc=3} .[21] This terminology comes from the study of Ford circles. These are a system of circles that are tangent to the number line at a given fraction and have the squared denominator of the fraction as their diameter. Fractions a / b {\displaystyle a/b} and c / d {\displaystyle c/d} are adjacent if and only if their Ford circles are tangent circles.[21] In mathematics education, unit fractions are often introduced earlier than other kinds of fractions, because of the ease of explaining them visually as equal parts of a whole.[22][23] A common practical use of unit fractions is to divide food equally among a number of people, and exercises in performing this sort of fair division are a standard classroom example in teaching students to work with unit fractions.[24] A six-sided die has probability 1/6 of landing on each side In a uniform distribution on a discrete space, all probabilities are equal unit fractions. Due to the principle of indifference, probabilities of this form arise frequently in statistical calculations.[25] Unequal probabilities related to unit fractions arise in Zipf's law. This states that, for many observed phenomena involving the selection of items from an ordered sequence, the probability that the n {\displaystyle n} th item is selected is proportional to the unit fraction $1\,/\,n$ {\displaystyle 1/n} .[26] In the study of combinatorial optimization problems, bin packing problems involve an input sequence of items with fractional sizes, which must be placed into bins whose capacity (the total size of items placed into each bin) is one. Research into these problems has included the study of restricted bin packing problems where the item sizes are unit fractions.[27][28] One motivation for this is as a test case for more general bin packing methods. Another involves a form of pinwheel scheduling, in which a collection of messages of equal length must each be repeatedly broadcast on a limited number of communication channels, with each message having a maximum delay between the start times of its repeated broadcasts. An item whose delay is k {\displaystyle k} times the length of a message must occupy a fraction of at least $1\,/\,k$ {\displaystyle 1/k} of the time slots on the channel it is assigned to, so a solution to the scheduling problem can only come from a solution to the unit fraction bin packing problem with the channels as bins and the fractions $1\,/\,k$ {\displaystyle 1/k} as item sizes.[27] Even for bin packing problems with arbitrary item sizes, it can be helpful to round each item size up to the next larger unit fraction, and then apply a bin packing algorithm specialized for unit fraction sizes. In particular, the harmonic bin packing method does exactly this, and then packs each bin using items of only a single rounded unit fraction size.[28] The hydrogen spectral series, on a logarithmic scale. The frequencies of the emission lines are proportional to differences of pairs of unit fractions. The energy levels of photons that can be absorbed or emitted by a hydrogen atom are, according to the Rydberg formula, proportional to the differences of two unit fractions. An explanation for this phenomenon is provided by the Bohr model, according to which the energy levels of electron orbitals in a hydrogen atom are inversely proportional to square unit fractions, and the energy of a photon is quantized to the difference between two levels.[29] Arthur Eddington argued that the fine-structure constant was a unit fraction. He initially thought it to be 1/136 and later changed his theory to 1/137. This contention has been falsified, given that current estimates of the fine structure constant are (to 6 significant digits) 1/137.036.[30] 17-animal inheritance puzzle, a puzzle involving fair division into unit fractions Submultiple, a number that produces a unit fraction when used as the numerator with a given denominator Superparticular ratio, one plus a unit fraction, important in musical harmony ^ Cavey, Laurie O.; Kinzel, Margaret T. (February 2014), "From whole numbers to invert and multiply", Teaching Children Mathematics, 20 (6): 374–383, doi:10.5951/teacchilmath.20.6.0374, JSTOR 10.5951/teacchilmath.20.6.0374 ^ Solomon, Pearl Gold (2007), The Math We Need to Know and Do in Grades 6 9: Concepts, Skills, Standards, and Assessments, Corwin Press, p. 157, ISBN 978-1-4129-1726-1 ^ a b Betz, William (1957), Algebra for Today, First Year, Gin