Congruent triangles snowflake activity answer key pdf

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 CLASS-IX SUB- MATHEMATICS TOPIC: TRIANGLES If there is a single most important shape in engineering, it is the triangle. Unlike a rectangle, a triangle cannot be deformed without changing the length of one of its sides or breaking one of its joints. In fact, one of the simplest ways to strengthen a rectangle is to add supports that form triangles at the rectangle's corners or across its diagonal length. A single support between two diagonal corners greatly strengthens a rectangle by turning it into two triangles. Triangulation of material, adds strength by eliminating lateral movement. Triangles are used to make rafters in buildings and curved domes. Some bridges have triangular structures, and the Egyptians made triangular-shaped pyramids. The shapes help surveyors use triangulation to determine the distance of a specific point from two other points of a known distance apart. Triangulation may be used to measure distances around corners and when digging tunnels, and carpenters use a right-angled triangle to take measurements The Idea of Congruence of two Objects: Two figures with exactly the same size and shape. F B A C E D Congruency in real life(hyperlink) How much do you need to know. . . about two triangles to prove that they are congruent? Corresponding Parts If all six pairs of corresponding parts (sides and angles) are congruent, then the triangles are congruent. 1. AB DE 2. BC EF 3. AC DF 4. A D A C ABC DEF 5. B E 6. C F B E D F Do you need all six ? NO ! SSS SAS ASA AAS Side-Side (SSS) B E A 1. AB DE 2. BC EF 3. AC DF C F D ABC DEF Side-Angle-Side (SAS) B E A 1. AB DE 2. A D 3. AC DF C F D ABC DEF included angle Angle-Side-Angle (ASA) B E A 1. A D 2. AB DE 3. B E C F D ABC DEF included side Angle-Side (AAS) B E A 1. A D 2. B E C F D ABC DEF 3. BC EF Non-included side Warning: No SSA Postulate There is no such thing as an SSA postulate! E B F A C D NOT CONGRUENT Warning: No AAA Postulate There is no such thing as an AAA postulate! E B A C D NOT CONGRUENT F The Congruence Criateria: Axiom: 7. 1 (SAS congruence rule): Two triangles are congruent if two sides and the included angle of one triangle are equal to the sides and included angle of the other triangle. Why? So, (Because they are vertically opposite angles) Why? (CPCT) Why? (as one pair of alternate interior angles are equal) Why? (ii)AC=CA Why? (since they are alternate interior angle) (As it is the common arm) Hence, By ASA congruence condition, Isosceles triangle property Converse of isosceles triangle property: hyperlink Let us do this snowflake activity Inequalities in a Triangle Let us Construct 3 different scalene triangle (that is a triangle in which all sides are of different lengths). • Measure the lengths of the sides. • Now, measure the angles. What do you observe? In Δ ABC of Fig -1, BC is the longest side and AC is the shortest side. Also, ∠ A is the largest and ∠ B is the smallest. • Repeat this activity for other two triangles. We arrive at a very important result of inequalities in a triangle. • If two sides of a triangle are unequal, the angle opposite to the longer side is larger (or greater). Now let us Construct 3 different triangles in which all angles are of different measure. • Measure the angles of these triangles. • Now, measure the length of sides. What do you observe? In Δ ABC of Fig -1, ∠ A is the largest and BC is the longest side and side BC is the side opposite to ∠ A Repeat this activity for other two triangles. We arrive at a very important result of another inequality in a triangle. • In any triangle, the side opposite to the larger (greater) angle is longer. Let us perform an activity to prove these inequalities. (Hyperlink) YUMPU automatically turns print PDFs into web optimized ePapers that Google loves. Copy CongruentTrianglesWinterSnowflake Extended embed settings The purpose of this warm-up is to elicit the idea that the number of triangles added at each iteration of the snowflake follows a pattern, which will be investigated further in the following activity (MP1). While students may notice and wonder many things about these images, the relationship between the total number of triangles at each iteration and the one before should be a focus of the discussion. Display the table for all to see. Ask students to think of at least one thing they notice and at least one thing they wonder. Give students 1 minute of quiet think time, and then 1 minute to discuss the things they notice and wonder with their partner, followed by a whole-class discussion. What do you notice? What do you wonder? iteration total number of triangles added since the first 0 3 $3+3(4)=15$ 3 $3 + 3 (4)+3 (4)^2 = 63$ n $3+3(4)+3(4)^2+ . . . +3(4)^{n-1}$ Ask students to share the things they noticed and wondered. Record and display their responses for all to see. If possible, record the relevant reasoning on or near the image. After all responses have been recorded without commentary or editing, ask students, “Is there anything on this list that you are wondering about?” Encourage students to respectfully disagree, ask for clarification or point out contradicting information. If the pattern of the sums in the right column does not come up during the conversation, ask students to discuss where they see the pattern in the images. The goal of this activity is for students to use what they have learned previously about the identity $x^n-1 = (x-1)(x^{n-1}+. . . + x^2+x+1)$ to derive the formula for the sum of the first n terms of the geometric sequence, also known as the formula for the sum of a geometric series. Monitor for students who begin multiplying out $(1-r)(1+r+r^2+ . . . +r^{n-1})$ in order to notice the pattern to share during the discussion. Ask students to close their books or devices and display the opening part of the task statement through the equation $s = 3+3(4)+3(4^2)+ . . . +3(4^{n-1})$ along with the first three iterations of the Koch Snowflake from the warm-up for all to see. Invite students to explain in their own words where the terms in the equation are from, making sure students understand that each term is of the form $3(4^{n-1})$ for different values of n. Ask “How many terms does the nth iteration have?” (It has n terms from 3, where $n=1$, to $3(4^{n-1})$.) Tell students that their goal for this activity is to figure out how to add up all n terms without having to type n numbers into a calculator. Arrange students in groups of 2. Allow students to open their books or devices and ask them to work on the first question on their own and then check their solution with their partner before moving on. Earlier, we learned that the nth term of a geometric sequence with an initial value of a and a common ratio of r is $a(r^{n-1})$. For a Koch Snowflake, it turns out that we can find the number of triangles added on at each iteration by having $a=3$ and $r=4$. The sum s of the first n terms in this geometric sequence tell us how many triangles total make up the nth iteration of the snowflake $\displaystyle s = 3+3(4)+3(4^2)+ . . . +3(4^{n-1})$ More generally, the sum of the first n terms of any geometric sequence can be expressed as $\displaystyle s = a+a(r)+a(r^2)+ . . . +a(r^{n-1})$ or $\displaystyle s = a(1+r+r^2+ . . . +r^{n-1})$ What would happen if we multiplied each side of this equation by $(1-r)$? (hint: $(x-1)(x^3+x^2+x+1)=x^4-1$.) Rewrite the new equation in the form of $s = $. Use this new formula to calculate how many triangles after the original are in the first 5, 10, and 15 iterations of the Koch Snowflake. If the initial triangle has sides that are each one unit long, find an equation for the perimeter P of the Koch Snowflake after the nth iteration and graph (n,P) for iterations 0 through 5. Some students may be confused by the hint for the first problem since $(1-r)$ does not quite match $(x-1)$. Encourage these students to test multiplying a simple case such as $(1-x)(1+x+x^2+x^3)$ and see the result. The goal of this discussion is to make sure students understand how the formula for the sum of the first n terms of a geometric sequence is derived. Begin the discussion by selecting previously identified students to share the work they did to determine what would happen if we multiplied by $(1-r)$, pointing out the telescoping effect when expanding the product of the two polynomials that students saw in an earlier lesson if not mentioned by students. For the last question, ask students to write out the first 5 terms in the sequence as a sum, $3+3(4)+3(4^2)+3(4^3)+3(4^4)$, and compare it to the formula, $3 \frac{1-4^5}{1-4}$, in order to help students make connections between the structure of the two expressions (MP7). Specifically, how multiplying the $3+3(4)+3(4^2)+3(4^3)+3(4^4)$ by $(1-4)$ and expanding the terms results in $3(1-4^5)$. It is important for students to understand that whenever terms in a sequence are changing by a common ratio, as generalized by $a+a(r)+a(r^2)+ . . . +a(r^{n-1})$, we can use the formula $s = a \frac{1-r^{n}}{1-r}$ to find the sum s of all n terms. Engagement: Develop Effort and Persistence. Encourage and support opportunities for peer interactions. Prior to the whole-class discussion, invite students to share their work with a partner. Display sentence frames to support student conversation such as: “I noticed . . . .”, “The thing that is changing is . . . .”, and “Why do you think . . . ?” Students may need to highlight where triangles were added in order to see the pattern. Supports accessibility for: Language; Social-emotional skills The goal of this activity is for students to use the formula for the sum of the first n terms of a geometric sequence in a non-geometric context. Since students have only just learned the formula, it is important during the discussion that the sum for the total amount of the antibiotic in Han after 15 days is written out using both the sum of 30 terms (with ellipses) and the formula side by side. Before students begin, tell them that the reason some drugs must be taken at a certain dose for a certain period of time is that they are only effective after the amount of the drug in the body builds up to a specific level. Speaking, Reading: MLR5 Co-Craft Questions. Use this routine to help students interpret the language of geometric sequences and to increase awareness of language used to talk about geometric sequences. Display only the task prompt of this problem (“Han is prescribed a course of antibiotics for an infection. He is told to take a 150 mg dose of the antibiotic regularly every 12 hours for 15 days. Han is curious about the antibiotic and learns that at the end of the 12 hours, only 5% of the dose is still in his body.”), and ask students to write down possible mathematical questions that could be asked about the situation. Invite students to compare their questions before revealing the remainder of the question. Listen for and amplify any questions involving sums or geometric sequences. Design Principle(s): Maximize meta-awareness; Support sense-making Representation: Internalize Comprehension. Represent the same information through different modalities by using images. Show 150 mg and then the 7.5 mg that is left after 12 hours, then add 150 mg and show the 7.875 after 12 hours. Students should notice the very gradual increase in the amounts that are left after 12 hours. Supports accessibility for: Conceptual processing; Visual-spatial processing Han is prescribed a course of antibiotics for an infection. He is told to take a 150 mg dose of the antibiotic regularly every 12 hours for 15 days. Han is curious about the antibiotic and learns that at the end of the 12 hours, only 5% of the dose is still in his body. How much of the antibiotic is in the body right after the first, second, and third doses? When will the total amount of the antibiotic in Han be highest over the course of the 15 day treatment? Explain your reasoning. Some students may have trouble interpreting "at the end of the 12 hours, only 5% of the dose is still in his body". They may not realize that it describes a growth factor, and mistakenly conclude, for example, that the amount of the drug in his body is always the amount in the most recent pill plus 5% of the amount in the previous pill. Explain that this statement tells us that the growth factor of the drug in his body is 5% (per 12 hours), and that no matter how much is currently there, 95% of it will be gone in 12 hours. Here are some questions for discussion: “What are the a and r values in this situation? What do they represent?” (The a value is 150 and this is the amount of each dose in milligrams. The r value is 0.05, which is the amount of the drug in the system after 12 hours.) “Do you think it is easier to use the formula when answering the first question or to work out the terms and add them up?” (I think figuring out the terms and adding them is easier, but for anything more than 4 or 5 terms, I would probably use the formula.) “How many pills will Han take over the treatment course?” (Since Han takes 1 pill every 12 hours for 15 days, that is 2 pills a day for 30 pills total.) Select students to share their solutions for the last question. Display for all to see both the formula solution, $150 \frac{1-0.05^{30}}{1-0.05}$, and the written out solution, $150 + 150(0.05)+150(0.05)^2+ . . . + 150(0.05)^{29}$ to help students see the polynomial pattern and connect each to the identity $x^n-1 = (x-1)(x^{n-1}+. . . + x^2+x+1)$. Display the geometric sequence $\frac{3}{10}$, $\frac{3}{100}$, $\frac{3}{1000}$, $\frac{3}{10000}$, . . . for all to see and ask students what they would need to do to figure out the approximate sum of the first 30 terms of this sequence. After a brief quiet think time, select 2–3 students to suggest ideas for figuring out the sum, focusing on identifying a (the starting term) and r (the common ratio) values in order to use the sum formula $s=a\frac{1-r^{n}}{1-r}$. Give students time to work out the sum of the first 30 terms. If needed, display the general form $s = a(1+r+r^2+ . . . +r^{n-1})$ for all to see and tell students that they may want to use this form to help accurately identify a and r. Conclude the discussion by selecting students to share their results, recording the formula $s= \frac{3}{10} \frac{1-\left(\frac{1}{10}\right)^{30}}{1-\frac{1}{10}}$ for all to see. The sum of the first 30 terms is approximately 0.333333. . . Students are likely to notice that this value appears to be the same as $\frac13$. Ask students if they think adding more than the first 50 terms of the sequence together will ever get a value larger than $\frac13$. Select 2–3 students to share their thinking. It may surprise students to learn that it will not, since for each term added the sum will only be moved closer to the value of $\frac13$, but never above it. To help students understand why the sum will never increase beyond $\frac13$, it may be helpful to rewrite the sum of the first 30 terms in the sequence in decimal form, $0.3 + 0.03 + 0.003 + 0.0003 + . . . + 0.3(0.1)^{29}$, to see that each additional term only increases the precision of the sum. This particular topic, finite geometric series, is one studied further in future math classes. CCSS Standards Addressing Sometimes identities can help us see and write a pattern in a simpler form. Imagine a chessboard where 1 grain of rice is placed on the first square, 2 on the second, 4 on the third, and so on. How many grains of rice are on the 64-square chessboard? Trying to add up 64 numbers is difficult to do one at a time, especially because the first 20 squares have more than one million grains of rice on them! If we write out what this sum s is, we have $\displaystyle s = 1 + 2 + 4 + . . . + 2^{63}$ If we rewrite this expression as $2^{63}+ . . . + 2^2 + 2 + 1$, we have an expression similar to one we’ve seen before, $x^{n-1} + x^{n-2} + . . . +x^2+x+1$. In an earlier lesson, we showed that $(x - 1)(x^{n-1} + x^{n-2} + . . . +x^2+x+1)$ is equivalent to the simpler expression $(x^{n} -1)$. Using this identity with $x=2$ and $n=64$, we have $\displaystyle \begin{align*} (2^{64-1} + 2^{64-2} + . . . +2^2+2+1) &= s \\ (2 - 1)(2^{64-1} + 2^{64-2} + . . . +2^2+2+1) &= (2-1)s \\ 2^{64}-1 &= (2-1)s \\ \frac{2^{64}-1}{2-1} &= s \\ 2^{64}-1 &= s\\ \end{align*}$ This means that the sum total of all the grains of rice is $2^{64}-1$, or $18,\!446,\!744,\!073,\!709,\!551,\!615$. More generally, for any geometric sequence starting at a with a common ratio r, the sum s of the first n terms is given by $s=a\frac{1-r^{n}}{1-r}$.

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