

Triangle Inequality Theorem

Name: _____ Date: _____ Score: _____ / 24

Quick Review

The **Triangle Inequality Theorem** says that in any triangle, the sum of the lengths of *any two sides* must be **greater than** the third side. If even one pair fails this test, the three lengths *cannot* form a triangle — the short sides just won't reach. A quick shortcut: three lengths form a triangle exactly when the two *smaller* ones add to more than the largest. You can also use it to find the *range* for a missing side: it must be greater than the difference of the other two and less than their sum.

◇ **Example:** Can side lengths 4, 6, and 9 form a triangle?

⇒ We check the Triangle Inequality: every pair of sides must add up to more than the remaining side. The fastest check is to add the two *smallest* sides and compare to the largest. Here the two smallest are 4 and 6, and $4 + 6 = 10$. Is 10 greater than the largest side, 9? Yes! Since $10 > 9$, the three lengths can form a triangle.

Answer: Yes, $4 + 6 > 9$

PRACTICE

State whether the lengths form a triangle, or find the missing range.

- | | | | |
|---------------|-------|---|-------|
| 1. 3, 4, 5 | _____ | 12. 5, 6, 10 | _____ |
| 2. 6, 8, 10 | _____ | 13. 3, 9, 5 | _____ |
| 3. 2, 2, 5 | _____ | 14. 11, 7, 6 | _____ |
| 4. 1, 1, 3 | _____ | 15. Two sides 5 and 8 : range for third side | _____ |
| 5. 7, 7, 7 | _____ | 16. Two sides 6 and 10 : range for third side | _____ |
| 6. 5, 12, 13 | _____ | 17. Two sides 7 and 7 : range for third side | _____ |
| 7. 2, 3, 6 | _____ | 18. Two sides 9 and 4 : range for third side | _____ |
| 8. 4, 4, 7 | _____ | 19. Two sides 12 and 5 : range for third side | _____ |
| 9. 10, 1, 1 | _____ | 20. Largest possible whole-number side with 6 and 9 | _____ |
| 10. 9, 12, 15 | _____ | | |
| 11. 8, 8, 16 | _____ | | |

Word Problems

21. A builder has three boards measuring 5 ft, 7 ft, and 13 ft. Can they be joined end-to-end to form a triangular frame? Explain.

22. A triangular sign has two sides measuring 8 in and 11 in. What whole-number lengths are possible for the third side?

23. A camper has tent poles of 6 ft, 6 ft, and 11 ft. Will they form a triangular tent opening? _____
24. A jeweler is designing a triangular pendant. Two sides are set at 4 cm and 9 cm. What is the largest whole-number length the third side could be? _____



Answer Keys

- | | |
|--------------------------------------|---|
| 1. <input type="text" value="yes"/> | 13. <input type="text" value="no"/> |
| 2. <input type="text" value="yes"/> | 14. <input type="text" value="yes"/> |
| 3. <input type="text" value="no"/> | 15. <input type="text" value="3 < x < 13"/> |
| 4. <input type="text" value="no"/> | 16. <input type="text" value="4 < x < 16"/> |
| 5. <input type="text" value="yes"/> | 17. <input type="text" value="0 < x < 14"/> |
| 6. <input type="text" value="yes"/> | 18. <input type="text" value="5 < x < 13"/> |
| 7. <input type="text" value="no"/> | 19. <input type="text" value="7 < x < 17"/> |
| 8. <input type="text" value="yes"/> | 20. <input type="text" value="14"/> |
| 9. <input type="text" value="no"/> | 21. <input type="text" value="No; 5 + 7 = 12, which is not greater than 13"/> |
| 10. <input type="text" value="yes"/> | 22. <input type="text" value="4 in through 18 in"/> |
| 11. <input type="text" value="no"/> | 23. <input type="text" value="Yes; 6 + 6 = 12 > 11"/> |
| 12. <input type="text" value="yes"/> | 24. <input type="text" value="12 cm"/> |

Step-by-Step Explanations

- | | |
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| <p>1. $3 + 4 = 7 > 5$, so yes.</p> <p>2. $6 + 8 = 14 > 10$, so yes.</p> <p>3. $2 + 2 = 4$, which is not greater than 5, so no.</p> <p>4. $1 + 1 = 2$, which is not greater than 3, so no.</p> <p>5. $7 + 7 = 14 > 7$, so yes — an equilateral triangle.</p> <p>6. $5 + 12 = 17 > 13$, so yes.</p> <p>7. $2 + 3 = 5$, which is not greater than 6, so no.</p> <p>8. $4 + 4 = 8 > 7$, so yes.</p> <p>9. $1 + 1 = 2$, which is not greater than 10, so no.</p> <p>10. $9 + 12 = 21 > 15$, so yes.</p> <p>11. $8 + 8 = 16$, which is not greater than 16, so no.</p> <p>12. $5 + 6 = 11 > 10$, so yes.</p> <p>13. $3 + 5 = 8$, which is not greater than 9, so no.</p> <p>14. $7 + 6 = 13 > 11$, so yes.</p> | <p>15. It must be between $8 - 5 = 3$ and $8 + 5 = 13$.</p> <p>16. It must be between $10 - 6 = 4$ and $10 + 6 = 16$.</p> <p>17. It must be between $7 - 7 = 0$ and $7 + 7 = 14$.</p> <p>18. It must be between $9 - 4 = 5$ and $9 + 4 = 13$.</p> <p>19. It must be between $12 - 5 = 7$ and $12 + 5 = 17$.</p> <p>20. The third side is less than $6 + 9 = 15$, so the largest whole number is 14.</p> <p>21. By the Triangle Inequality, the two shorter sides must add to more than the longest. Since $5 + 7 = 12 < 13$, the boards cannot form a triangle.</p> <p>22. The third side must be greater than $11 - 8 = 3$ and less than $11 + 8 = 19$. So whole-number lengths from 4 in up to 18 in work.</p> <p>23. The two shorter sides (6 and 6) add to 12, which is greater than 11, so the poles can form a triangle.</p> <p>24. The third side must be less than $4 + 9 = 13$ cm, so the largest whole-number length is 12 cm.</p> |
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