

# 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 &lt; x &lt; 13"/>                             |
| 4. <input type="text" value="no"/>   | 16. <input type="text" value="4 &lt; x &lt; 16"/>                             |
| 5. <input type="text" value="yes"/>  | 17. <input type="text" value="0 &lt; x &lt; 14"/>                             |
| 6. <input type="text" value="yes"/>  | 18. <input type="text" value="5 &lt; x &lt; 13"/>                             |
| 7. <input type="text" value="no"/>   | 19. <input type="text" value="7 &lt; x &lt; 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 &gt; 11"/>                      |
| 12. <input type="text" value="yes"/> | 24. <input type="text" value="12 cm"/>  |

### Step-by-Step Explanations

- |  |  |
|--|--|
| <p>1. <math>3 + 4 = 7 &gt; 5</math>, so yes.</p> <p>2. <math>6 + 8 = 14 &gt; 10</math>, so yes.</p> <p>3. <math>2 + 2 = 4</math>, which is not greater than 5, so no.</p> <p>4. <math>1 + 1 = 2</math>, which is not greater than 3, so no.</p> <p>5. <math>7 + 7 = 14 &gt; 7</math>, so yes — an equilateral triangle.</p> <p>6. <math>5 + 12 = 17 &gt; 13</math>, so yes.</p> <p>7. <math>2 + 3 = 5</math>, which is not greater than 6, so no.</p> <p>8. <math>4 + 4 = 8 &gt; 7</math>, so yes.</p> <p>9. <math>1 + 1 = 2</math>, which is not greater than 10, so no.</p> <p>10. <math>9 + 12 = 21 &gt; 15</math>, so yes.</p> <p>11. <math>8 + 8 = 16</math>, which is not greater than 16, so no.</p> <p>12. <math>5 + 6 = 11 &gt; 10</math>, so yes.</p> <p>13. <math>3 + 5 = 8</math>, which is not greater than 9, so no.</p> <p>14. <math>7 + 6 = 13 &gt; 11</math>, so yes.</p> | <p>15. It must be between <math>8 - 5 = 3</math> and <math>8 + 5 = 13</math>.</p> <p>16. It must be between <math>10 - 6 = 4</math> and <math>10 + 6 = 16</math>.</p> <p>17. It must be between <math>7 - 7 = 0</math> and <math>7 + 7 = 14</math>.</p> <p>18. It must be between <math>9 - 4 = 5</math> and <math>9 + 4 = 13</math>.</p> <p>19. It must be between <math>12 - 5 = 7</math> and <math>12 + 5 = 17</math>.</p> <p>20. The third side is less than <math>6 + 9 = 15</math>, 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 <math>5 + 7 = 12 &lt; 13</math>, the boards cannot form a triangle.</p> <p>22. The third side must be greater than <math>11 - 8 = 3</math> and less than <math>11 + 8 = 19</math>. 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 <math>4 + 9 = 13</math> cm, so the largest whole-number length is 12 cm.</p> |
|--|--|



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