👯 Class 7 Geometric Twins Worksheet by Thinking Juggernaut 👯

Mastering Congruence - Finding Triangle Twins!

⏱️ Time: 60 minutes | 📊 Total: 15 Questions | 💯 Marks: 30

📋 What are Geometric Twins?

Just like human twins look identical, **geometric twins** are triangles that are exactly the same in shape and size - we call them **CONGRUENT TRIANGLES**! 👯

In this worksheet, you'll become a detective 🔍 who identifies which triangles are twins (congruent) and proves why they're twins using special criteria!

Instructions:

- Read each problem carefully - look for matching sides and angles
- Draw neat diagrams and label them properly
- State which congruence criterion you're using (SSS, SAS, ASA, or RHS)
- Write the congruence statement correctly (order matters!)
- Show all your reasoning clearly

🎯 The 4 Ways to Prove Triangles are Twins

1️⃣ SSS (Side-Side-Side)

All three sides of one triangle equal the three sides of another triangle.

AB = DE, BC = EF, CA = FD

2️⃣ SAS (Side-Angle-Side)

Two sides and the angle between them in one triangle equal the corresponding parts in another.

AB = DE, ∠B = ∠E, BC = EF

3 ASA (Angle-Side-Angle)

Two angles and the side between them in one triangle equal the corresponding parts in another.

$\angle A = \angle D$, $AB = DE$, $\angle B = \angle E$

4 RHS (Right-Hypotenuse-Side)

In right triangles, if the hypotenuse and one other side are equal, they're congruent!

$\angle B = \angle E = 90°$, $AC = DF$, $AB = DE$

Section A: Basic Twin Detection (5 Questions - 2 marks each)

Easy Level - Spot the Twins!

Q1. Are these triangles twins?

Triangle ABC: AB = 5 cm, BC = 6 cm, CA = 7 cm
Triangle PQR: PQ = 5 cm, QR = 6 cm, RP = 7 cm

Task: State whether they are congruent and name the criterion. Write the congruence statement.

Q2. Twin Check!

Triangle DEF: DE = 8 cm, $\angle E = 70°$, EF = 9 cm
Triangle XYZ: XY = 8 cm, $\angle Y = 70°$, YZ = 9 cm

Task: Are they congruent? Which criterion proves it? Write $\triangle DEF \cong \triangle$___

Q3. Right Triangle Twins!

Triangle ABC: ∠B = 90°, AC (hypotenuse) = 13 cm, AB = 5 cm
Triangle PQR: ∠Q = 90°, PR (hypotenuse) = 13 cm, PQ = 5 cm

Task: Prove they are congruent using RHS criterion.

Q4. Angle-Side-Angle Match!

Triangle KLM: ∠K = 45°, KL = 10 cm, ∠L = 60°
Triangle STU: ∠S = 45°, ST = 10 cm, ∠T = 60°

Task: Use ASA criterion to prove congruence. Write the statement.

Q5. NOT Twins - Explain Why!

Triangle ABC: AB = 6 cm, ∠A = 50°, ∠B = 60°
Triangle PQR: PQ = 6 cm, ∠P = 50°, ∠R = 70°

Task: These are NOT congruent. Explain why none of the four criteria apply.

Section B: Intermediate Twin Challenges (5 Questions - 2 marks each)

Medium Level - Think Deeper!

Q6. Isosceles Triangle Twins!

In triangle ABC, AB = AC = 8 cm and ∠A = 50°.
In triangle DEF, DE = DF = 8 cm and ∠D = 50°.

Task: Prove △ABC ≅ △DEF. Which criterion applies? (Hint: Use the property that base angles of isosceles triangles are equal)

Q7. Hidden Twin Information!

In triangles PQR and XYZ:
PQ = XY, QR = YZ, and ∠Q = ∠Y = 90°

Task: Find PR and XZ using Pythagoras theorem if PQ = 3 cm and QR = 4 cm. Then prove the triangles are congruent.

Q8. Overlapping Twins!

In the figure (imagine), AC and BD intersect at O. We know:
AO = CO and BO = DO

Task: Prove that △AOB ≅ △COD using the information given. Which criterion?

Q9. Complete the Twin Information!

△ABC ≅ △PQR by ASA criterion.
Given: ∠A = 40°, AB = 7 cm, ∠B = 65°

Task: Find ∠P, PQ, and ∠Q. Also find the third angle in both triangles.

Q10. Median Creates Twins!

In triangle ABC, AB = AC (isosceles). D is the midpoint of BC.
AD is the median.

Task: Prove that △ABD ≅ △ACD. What does this tell you about ∠ADB and ∠ADC?

Section C: Advanced Twin Problems (5 Questions - 2 marks each)

Challenge Level - Master Detective!

Q11. Parallel Lines Create Twins!

In the figure (imagine), AB || CD. A line segment PQ intersects them at M and N.
If AM = CN and ∠AMP = ∠CNQ (alternate angles are equal)

Task: Given that MP = NQ, prove △AMP ≅ △CNQ. What can you conclude about AP and CQ?

Q12. Equilateral Triangle Division!

Triangle ABC is equilateral with side 12 cm. Points D, E, F are midpoints of AB, BC, CA respectively.

Task: Prove that △AEF ≅ △BFD ≅ △CDE. What is the length of each side of these smaller triangles?

Q13. Square's Hidden Twins!

ABCD is a square with side 10 cm. Diagonals AC and BD intersect at O.

Task: Prove that △AOB ≅ △BOC ≅ △COD ≅ △DOA. Name all four congruent triangles and the criteria used.

Q14. Altitude Creates Twin Triangles!

In triangle ABC, ∠B = 90°. BD is drawn perpendicular to AC.
Given: AB = 12 cm, BC = 9 cm

Task: First find AC using Pythagoras theorem. Then prove that △ABD and △CBA share a special relationship (similar, not congruent). Why aren't they twins?

Q15. Twin Detective Challenge!

You have 6 sticks: two of 5 cm, two of 7 cm, and two of 9 cm.

Task: (a) How many different triangles can you make using these sticks? (b) If you make two triangles using all 6 sticks, will they be congruent? (c) Which criterion proves it?

💡 Worked Example: Finding Geometric Twins

Problem: In triangles ABC and XYZ, AB = 6 cm, BC = 8 cm, ∠B = 90°, XY = 6 cm, YZ = 8 cm, and ∠Y = 90°. Are they twins (congruent)?

Solution:

Step 1: Identify what we know

- Both triangles are right-angled (∠B = ∠Y = 90°)
- AB = XY = 6 cm
- BC = YZ = 8 cm

Step 2: Find the hypotenuse using Pythagoras theorem

$AC^2 = AB^2 + BC^2 = 6^2 + 8^2 = 36 + 64 = 100$

$AC = 10$ cm

Similarly, $XZ = 10$ cm

Step 3: Apply congruence criterion

Since both are right triangles with equal hypotenuse and one equal side:

$\triangle ABC \cong \triangle XYZ$ by RHS criterion

Answer: Yes, they are geometric twins! 👯

📊 Scoring Guide - How Good a Twin Detective Are You?

Total Marks: 30

- 🏆 Master Detective: 26-30 marks (You've mastered congruence!)
- ⭐ Expert Detective: 21-25 marks (Excellent understanding!)
- 👍 Good Detective: 16-20 marks (You're getting there!)
- 📚 Junior Detective: 11-15 marks (Keep practicing!)
- 🔍 Apprentice Detective: Below 11 marks (Review the concepts and try again!)

🔑 Answer Key with Detailed Solutions

Section A: Basic Twin Detection

A1. Yes, they are congruent by SSS criterion
$\triangle ABC \cong \triangle PQR$

Solution: All three corresponding sides are equal:
• $AB = PQ = 5$ cm
• $BC = QR = 6$ cm
• $CA = RP = 7$ cm

Therefore, by SSS (Side-Side-Side) criterion, the triangles are congruent twins! 👯

A2. Yes, congruent by SAS criterion

△DEF ≅ △XYZ

Solution: Two sides and the included angle are equal:

- DE = XY = 8 cm (side)
- ∠E = ∠Y = 70° (included angle)
- EF = YZ = 9 cm (side)

Therefore, by SAS (Side-Angle-Side) criterion, they are geometric twins!

A3. △ABC ≅ △PQR by RHS criterion

Solution:

In △ABC and △PQR:

- ∠B = ∠Q = 90° (both right angles)
- AC = PR = 13 cm (hypotenuse)
- AB = PQ = 5 cm (one side)

Therefore, by RHS (Right angle-Hypotenuse-Side) criterion, the right triangles are congruent.

A4. △KLM ≅ △STU by ASA criterion

Solution: Two angles and the included side are equal:

- ∠K = ∠S = 45° (angle)
- KL = ST = 10 cm (included side)
- ∠L = ∠T = 60° (angle)

Therefore, by ASA (Angle-Side-Angle) criterion, they are congruent twins!

A5. NOT congruent - criteria not satisfied

Explanation:

- We have one side (AB = PQ = 6 cm) and two angles in each triangle
- However, ∠B = 60° but we don't know ∠Q
- We know ∠A = ∠P = 50°, but ∠B ≠ ∠R (60° ≠ 70°)
- The angles given are not in the right positions for ASA or AAS

• We don't have information about other sides for SSS or SAS
Therefore, none of the four congruence criteria can be applied. Not twins! ❌

Section B: Intermediate Twin Challenges

A6. △ABC ≅ △DEF by SAS criterion

Solution:
Since both are isosceles triangles with equal sides from the vertex:
• AB = DE = 8 cm (side)
• ∠A = ∠D = 50° (included angle)
• AC = DF = 8 cm (side)
Therefore, by SAS criterion, they are congruent.
Bonus: The base angles in △ABC are equal, and same for △DEF. Each base angle = (180° - 50°)/2 = 65°

A7. PR = XZ = 5 cm; Triangles are congruent by RHS

Solution:
Step 1: Find hypotenuse using Pythagoras theorem
$PR^2 = PQ^2 + QR^2 = 3^2 + 4^2 = 9 + 16 = 25$
PR = 5 cm
Similarly, $XZ^2 = XY^2 + YZ^2 = 3^2 + 4^2 = 25$
XZ = 5 cm

Step 2: Apply RHS criterion
• ∠Q = ∠Y = 90° (right angles)
• PR = XZ = 5 cm (hypotenuse)
• PQ = XY = 3 cm (one side)
Therefore, △PQR ≅ △XYZ by RHS criterion! 👯

A8. △AOB ≅ △COD by SAS criterion

Solution:
In △AOB and △COD:
• AO = CO (given)

• ∠AOB = ∠COD (vertically opposite angles are equal)
• BO = DO (given)
Therefore, by SAS criterion, △AOB ≅ △COD
This proves that AB = CD and ∠A = ∠C (corresponding parts of congruent triangles)

A9. ∠P = 40°, PQ = 7 cm, ∠Q = 65°; Third angle = 75° in both

Solution:
Since △ABC ≅ △PQR, corresponding parts are equal:
• ∠A = ∠P = 40°
• AB = PQ = 7 cm
• ∠B = ∠Q = 65°

Finding the third angle:
∠C = 180° - (∠A + ∠B) = 180° - (40° + 65°) = 75°
∠R = ∠C = 75° (corresponding angles)

A10. △ABD ≅ △ACD by SSS; ∠ADB = ∠ADC = 90°

Solution:
In △ABD and △ACD:
• AB = AC (given - isosceles triangle)
• BD = DC (D is midpoint of BC)
• AD = AD (common side)
Therefore, △ABD ≅ △ACD by SSS criterion

Since the triangles are congruent:
∠ADB = ∠ADC (corresponding angles)
But ∠ADB + ∠ADC = 180° (linear pair)
Therefore, ∠ADB = ∠ADC = 90°
Conclusion: The median from vertex angle of isosceles triangle is perpendicular to the base! 📐

Section C: Advanced Twin Problems

A11. △AMP ≅ △CNQ by SAS; Therefore AP = CQ

Solution:
In △AMP and △CNQ:
• AM = CN (given)
• ∠AMP = ∠CNQ (given - alternate angles)
• MP = NQ (given)
Therefore, △AMP ≅ △CNQ by SAS criterion

Conclusion: Since corresponding parts of congruent triangles are equal:
AP = CQ (corresponding sides)
This shows that parallel lines create congruent triangles! 🎯

A12. All three triangles are congruent by SSS; Each side = 6 cm

Solution:
Since ABC is equilateral with side 12 cm, and D, E, F are midpoints:
• AD = DB = BE = EC = CF = FA = 6 cm (half of 12 cm)
• AE = 6 cm, AF = 6 cm (midpoint property)
• Similarly, all segments from vertices to opposite midpoints = 6 cm

For △AEF, △BFD, and △CDE:
All three sides of each triangle = 6 cm
Therefore, △AEF ≅ △BFD ≅ △CDE by SSS criterion
Bonus: These three small triangles are also equilateral! Each is an exact replica (twin) of the others. 👯‍♀️👯‍♀️

A13. All four triangles congruent by SAS criterion

Solution:
In a square, diagonals bisect each other at right angles.
Therefore: AO = BO = CO = DO (diagonals bisect each other)

Proving △AOB ≅ △BOC:
• AO = BO (half diagonal)
• ∠AOB = ∠BOC = 90° (diagonals perpendicular)
• BO = CO (half diagonal)

Therefore, △AOB ≅ △BOC by SAS

Similarly:
• △BOC ≅ △COD by SAS
• △COD ≅ △DOA by SAS
• △DOA ≅ △AOB by SAS

Conclusion: All four triangles are congruent twins! 👯👯👯👯
Each is a right isosceles triangle with two sides = 5√2 cm (half the diagonal)

A14. AC = 15 cm; NOT congruent - different sizes

Solution:
Step 1: Find AC using Pythagoras theorem
$AC^2 = AB^2 + BC^2 = 12^2 + 9^2 = 144 + 81 = 225$
AC = 15 cm

Step 2: Why aren't △ABD and △CBA congruent?
Compare the triangles:
• △ABD: sides are AB = 12 cm, BD, AD
• △CBA: sides are CB = 9 cm, BA = 12 cm, AC = 15 cm

Although both are right triangles:
• They have different dimensions
• △CBA is larger than △ABD
• They are SIMILAR (same shape) but not CONGRUENT (different size)

Answer: They are NOT geometric twins because congruent means same shape AND same size. These triangles have the same shape but different sizes, so they're similar, not congruent. ❌👯

A15. (a) Only 1 type of triangle; (b) Yes, congruent; (c) SSS criterion

Solution:
(a) Different triangles possible:
With sides 5 cm, 7 cm, and 9 cm, there is only ONE type of triangle possible.
(All scalene triangles with these dimensions are identical)

(b) Making two triangles:
• Triangle 1: sides 5 cm, 7 cm, 9 cm
• Triangle 2: sides 5 cm, 7 cm, 9 cm
Yes, they WILL be congruent! 👯

(c) Criterion:
SSS (Side-Side-Side) criterion proves congruence
All three corresponding sides are equal (5 = 5, 7 = 7, 9 = 9)

Conclusion: When you have two sets of identical sticks, you'll always create geometric twins! 🎯

🎓 Tips to Become a Master Twin Detective!

- **Remember the 4 Criteria:** Memorize SSS, SAS, ASA, and RHS - these are your detective tools! 🔍
- **Draw and Label:** Always draw neat diagrams with proper labels - visual representation helps identify twins
- **Order Matters:** When writing △ABC ≅ △DEF, corresponding vertices must be in matching order
- **Look for Right Angles:** If you see 90°, think RHS for right triangles!
- **Check Given Information:** Count what you know - 3 sides? SSS. 2 sides + included angle? SAS
- **Common Mistakes to Avoid:**
  - Don't use AAA (three angles) - it proves similarity, not congruence!
  - For SAS, the angle must be BETWEEN the two sides
  - For ASA, the side must be BETWEEN the two angles
  - RHS only works for RIGHT triangles
  - Corresponding vertices must match in congruence statements
- **Real-World Twin Hunting:** Look for congruent triangles in bridges, roofs, kites, and geometric art! 🌉

- **Practice Proof Writing:** Always state: "In △___ and △___: ... Therefore, △___ ≅ △___ by ___ criterion"

🎉 **Congratulations, Twin Detective!** 🎉

You've mastered the art of finding geometric twins through congruence!

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