# SIMILARITY AND CONGRUENCY WORKBOOK

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>PAGE NUMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Relationships</td>
<td>1-14</td>
</tr>
<tr>
<td>Congruent Triangles (Proofs)</td>
<td>15-22</td>
</tr>
<tr>
<td>Similar Triangles (Proofs)</td>
<td>23-30</td>
</tr>
<tr>
<td>Missing Sides in Similar Triangles</td>
<td>31-39</td>
</tr>
<tr>
<td>Metric Relations</td>
<td>40-50</td>
</tr>
<tr>
<td>Practice Test</td>
<td>51-54</td>
</tr>
</tbody>
</table>
SIMILARITY and CONGRUENCY – PARALLELS AND TRANSVERSALS – 01

1. Identify the parallel lines and transversal, then label the marked pair of angles as either:

- corresponding \( \cong \)
- alt. int. \( \cong \)
- alt. ext. \( \cong \)
- consecutive interior = 180

The angles are:

a) \[ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad
2. Find the measure of each angle indicated by ‘?’
Describe your reasoning using the terms:

{ corresponding \(\cong\), alt. int. \(\cong\), alt. ext. \(\cong\), consecutive interior }
3. Solve for ‘x’

Explain your answer by using the appropriate terms (corresponding, alt int, alt ext, cons int)

a) \( x = \) \_

reason \_

b) \( x = \) \_

reason \_

c) \( x = \) \_

reason \_

d) \( x = \) \_

reason \_
4. Solve for ‘x’
Explain your answer by using the terms:

a. 
\[ \begin{align*}
10x - 8 & = 6x + 2 \\
x & = \_\_\_\_\_\_\_ \\
Explanation: \_\_\_\_\_\_\_\_\_\_ \\
\end{align*} \]

b. 
\[ \begin{align*}
7x + 6 & = 11x - 6 \\
x & = \_\_\_\_\_\_\_ \\
Explanation: \_\_\_\_\_\_\_\_\_\_ \\
\end{align*} \]

c. 
\[ \begin{align*}
7x + 18 & = 9x + 6 \\
x & = \_\_\_\_\_\_\_ \\
Explanation: \_\_\_\_\_\_\_\_\_\_ \\
\end{align*} \]

d. 
\[ \begin{align*}
7x - 3 & = 20x - 6 \\
x & = \_\_\_\_\_\_\_ \\
Explanation: \_\_\_\_\_\_\_\_\_\_ \\
\end{align*} \]

Complementary angles = 90
Supplementary angles = 180
Vertically opposite
Corresponding
Alt. interior
Alt. exterior
Consecutive interior = 180
1. Find the measure of angle A

Justify your work using the following terms:

- **interior angles of a triangle** = 180
- **complementary** = 90
- **supplementary** = 180
- **corresponding**
- **vertically opposite**
- **alt interior**
- **alt. exterior**
2. ABCD is a **parallelogram**.

What is the measure of angle ABC?

**Justify your work using the following terms:**

- interior angles of a triangle = 180
- complementary = 90
- supplementary = 180
- corresponding ≅
- vertically opposite ≅
- alt interior ≅
- alt. exterior ≅
3. Lines $\overline{DE}$ and $\overline{FG}$ are parallel. Angle ACB = $80^\circ$ and angle CIG = $120^\circ$.

What is the measure of angle CHF?

Justify your work using the following terms:

- interior angles of a triangle = 180
- complementary = 90
- supplementary = 180
- corresponding
- vertically opposite
- alt interior
- alt. exterior
SIMILARITY and CONGRUENCY – PARALLELS AND TRANSVERSALS – 03

1. What is the value of $x$ given the following parallel lines and transversal?
Justify your answer by using the appropriate terms

\[ 26x + 4 \]
\[ 18x - 92 \]

2. What is the value of $x$ given the following parallel lines and transversal?
Justify your answer by using the appropriate terms

\[ 13.5x + 4 \]
\[ 11.5x - 58.5 \]

3. What is the value of $x$ given the following triangle and straight line?
Justify your answer by using the appropriate terms
4. In the diagram below, triangle ABC is isosceles and quadrilateral BFEC is a parallelogram.

What is the measure of angle BAC? (angle A)

Justify your work using the following terms:

- interior angles of a triangle = 180
- complementary = 90
- supplementary = 180
- corresponding =
- vertically opposite =
- alt interior =
- alt. exterior =
5. What is the value of \( x \)?
   
   **Justify your work using the following terms:**
   
   - interior angles of a triangle = 180
   - complementary = 90
   - supplementary = 180
   - corresponding \( \cong \)
   - vertically opposite \( \cong \)
   - alt interior \( \cong \)
   - alt. exterior \( \cong \)
6. What is the value of $x$? 

**Justify your work using the following terms:**

- **interior angles of a triangle** = 180
- **complementary** = 90
- **supplementary** = 180
- **corresponding** \( \cong \)
- **vertically opposite** \( \cong \)
- **alt interior** \( \cong \)
- **alt. exterior** \( \cong \)
SIMILARITY and CONGRUENCY – PARALLELS AND TRANSVERSALS – 04

1. Use the picture above to identify the special name for the angle pairs.

a. \( \angle 2 \) and \( \angle 6 \) _______________________

b. \( \angle 1 \) and \( \angle 9 \) _______________________

c. \( \angle 9 \) and \( \angle 16 \) _______________________

d. \( \angle 9 \) and \( \angle 4 \) _______________________

e. \( \angle 14 \) and \( \angle 16 \) _______________________

f. \( \angle 10 \) and \( \angle 4 \) _______________________

g. \( \angle 2 \) and \( \angle 11 \) _______________________

h. \( \angle 10 \) and \( \angle 15 \) _______________________

i. \( \angle 9 \) and \( \angle 3 \) _______________________

j. \( \angle 15 \) and \( \angle 7 \) _______________________

k. \( \angle 4 \) and \( \angle 5 \) _______________________

l. \( \angle 3 \) and \( \angle 6 \) _______________________

12
2. In the figure at right:
   - a \parallel b
   - \angle 1 = 108^\circ
   - \angle 2 = 47^\circ

   Find the measure of each angle.
   a. \angle 3 = ________________
   b. \angle 4 = ________________
   c. \angle 5 = ________________
   d. \angle 6 = ________________
   e. \angle 7 = ________________
   f. \angle 8 = ________________
   g. \angle 9 = ________________
   h. \angle 10 = ________________

3. Solve for the missing values \( x \).

4. Solve for the missing values of \( x \) and \( y \).
5. Solve for the missing values of $x$ and $y$.

\[
\begin{align*}
(3x + 5)^\circ \\
(6x - 14)^\circ \\
(y + 8)^\circ
\end{align*}
\]

6. Solve for the missing values of $x$ and $y$.

\[
\begin{align*}
(8x + 40)^\circ \\
(7y)^\circ \\
(6x)^\circ \\
(3y - 10)^\circ
\end{align*}
\]

7. Solve for the missing values of $x$, $y$, and $z$.

\[
\begin{align*}
(3z + 18)^\circ \\
(x)^\circ \\
72^\circ \\
(3y)^\circ
\end{align*}
\]
Theorems of Congruence (Isometry) – The two are exactly the same.

SSS          SAS          ASA

1. Why are these two triangles isometric?

2. Why are these two triangles not necessarily isometric?
3. Prove that $\triangle AMP \cong \triangle BMP$.

4. Why are these two triangles not necessarily isometric?

5. Why are these two triangles isometric?
6. For each of the sets of triangles below, say if they are isometric or not. Justify each answer.
7. For each of the sets of triangles below, say if they are isometric or not. Justify each answer.

a)

b)

c)

8. For each of the sets of triangles below, say if they are isometric or not. Justify each answer.

a)

b)

c)
1. State if the two triangles are isometric (congruent)
   If they are, state how you know... (SSS, SAS, ASA)
2. State what additional information is required in order to PROVE that the triangles are congruent for the reason given.

11) ASA

12) SAS

13) SAS

14) ASA

15) SAS

16) ASA

17) SSS

18) SAS
3. Are the following pairs of triangles congruent? 
   If so, identify the theorem (SSS, SAS, ASA) that proves the congruency. 
   If not, explain why (give a reason).

   Congruence: 
   \( \triangle ABD \cong \Delta \) ___
   \( \triangle EFG \cong \Delta \) ___
   \( \triangle EMN \cong \Delta \) ___
   
   Reason:
   Reason:
   Reason:

   Congruence: 
   \( \triangle STU \cong \Delta \) ___
   \( \triangle YZA \cong \Delta \) ___
   \( \triangle CDE \cong \Delta \) ___
   
   Reason:
   Reason:
   Reason:
7) \[ \triangle KJM \cong \triangle \quad \]
Reason:

8) \[ \triangle NPR \cong \triangle \quad \]
Reason:

9) \[ \triangle STU \cong \triangle \quad \]
Reason:

10) \[ \triangle XYZ \cong \triangle \quad \]
Reason:

11) \[ \triangle DEG \cong \triangle \quad \]
Reason:

12) \[ \triangle HJK \cong \triangle \quad \]
Reason:

13) \[ \triangle STV \cong \triangle \quad \]
Reason:

14) \[ \triangle WXY \cong \triangle \quad \]
Reason:

15) \[ \triangle BCF \cong \triangle \quad \]
Reason:
### SIMILARITY and CONGRUENCY – SIMILAR TRIANGLES – 01

| Theorems of Similarity: SAME SHAPE, DIFFERENT SIZES |
|-----------------|-----------------|-----------------|
| SSS             | SAS             | AA              |

5. Line $AB \parallel CD$

Prove that $\triangle AOB \sim \triangle COD$

6. Line $AD \parallel BC$

Prove that $\triangle AID \sim \triangle CIB$
7. Are the two triangles below similar?  
**Justify your answer.**

8. Prove that $\triangle ABC \sim \triangle ADE$.

9. Is $\triangle ABC \sim \triangle ADE$?  
**Justify** your answer.
10. Is \( \triangle ABC \sim \triangle DEF \)? 
Justify your answer.

11. Which theorem of similarity can be used to prove the following pairs of triangles are similar?
1. Are the triangles below similar or not. Justify your answer (with a similarity statement).

2. Are the triangles below similar or not. Justify your answer (with a similarity statement).

3. Are the triangles below similar or not. Justify your answer (with a similarity statement).
4. Are the triangles below similar or not. 
   Justify your answer (with a similarity statement).

5. Are the triangles below similar or not. 
   Justify your answer (with a similarity statement).

6. Are the triangles below similar or not. 
   Justify your answer (with a similarity statement).
7. The triangles below are similar.
Find the missing length marked ‘y’

8. The triangles below are similar.
Find the missing length marked ‘?’
State if the triangles in each pair are similar. If so, state how you know they are similar by completing a similarity statement. If not, explain why.

1. 

2. 

3. 

4.
5. 

Similar? ____________

Proof ________________

6. 

Similar? ____________

Proof ________________

7. 

Similar? ____________

Proof ________________
SIMILARITY and CONGRUENCY – MISSING LENGTHS – 01

1. Find the missing value of ‘x’

2. Find the missing value of ‘x’.

3. The pair of triangles below are similar. Find the value of length EC.
4. The pair of triangles below are **similar**. Find the missing **length** marked ‘?’

5. The pair of triangles below are similar. Find the **value** of length **$AB$**.
6. The pair of triangles below are similar. 
Find the value of ‘x’

7. The pair of triangles below are similar. 
Solve for the value of x.
1. Find the missing value of ‘x’

2. Find the missing value of ‘x’.

3. The pair of triangles below are similar.  
   Find the value of length X.
4. The pair of triangles below are similar. Find the missing value of ‘x’.

5. The pair of triangles below are similar. Find the value of ‘x’.
1. Consider triangle RST shown at right.

Which of the following triangles is definitely congruent to triangle RST?

A)  
B)  
C)  
D)  

Answer: ____________________

2. Find the missing value of ‘x’.

Answer: ‘x’ = ________________
3. Diagonal BD is drawn in parallelogram ABCD shown below.

The following is part of a procedure used to prove that triangle ABD and CDB are congruent. Complete the missing parts.

<table>
<thead>
<tr>
<th>Step</th>
<th>Part</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BD ∼ BD (same side)</td>
<td>because the opposite sides of a parallelogram are congruent.</td>
</tr>
<tr>
<td>2</td>
<td>∠ADB ∼ ∠CBD</td>
<td>because...</td>
</tr>
<tr>
<td>3</td>
<td>∠ABD ∼ ∠CDB</td>
<td>because...</td>
</tr>
<tr>
<td>4</td>
<td>In conclusion, triangles ABD and CDB are congruent</td>
<td>( _____ _____ _____ )</td>
</tr>
</tbody>
</table>

4. Are the following sets of triangles similar or not? If so, state the similarity proof.

a) Similar? ____________
   Proof ________________
5. Find the missing value of ‘x’.
6. Find the missing value of ‘x’.

7. Triangles ACB and DCE are similar.
What is the length of the line between B and E?
1. Find the missing values. Show all your work.
2. Find the missing values. Show all your work.

\[
\begin{align*}
a^2 &= c \cdot d \\
b^2 &= c \cdot e \\
h^2 &= d \cdot e \\
a \cdot b &= c \cdot h \\
c &= d + e \\
a^2 + b^2 &= c^2 \\
a^2 &= d^2 + h^2 \\
b^2 &= e^2 + h^2
\end{align*}
\]
3. Find the missing values. Show all your work.

\[
\begin{align*}
a^2 &= cd \\
b^2 &= ce \\
h^2 &= de \\
a \cdot b &= c \cdot h \\
c &= d + e \\
a^2 + b^2 &= c^2 \\
a^2 &= d^2 + h^2 \\
b^2 &= e^2 + h^2
\end{align*}
\]
4. Find the missing values. Show all your work.

\[
\begin{align*}
a^2 &= c \cdot d \\
b^2 &= c \cdot e \\
h^2 &= d \cdot e \\
a \cdot b &= c \cdot h \\
c &= d + e \\
a^2 + b^2 &= c^2 \\
a^2 &= d^2 + h^2 \\
b^2 &= e^2 + h^2
\end{align*}
\]
5. Find the missing values. Show all your work.
1. Find the missing value of ‘x’.

\[
\begin{align*}
\triangle ABC & : a = c \cdot d \\
b & = c \cdot e \\
h & = d \cdot e \\
a \cdot b & = c \cdot h \\
c & = d + e \\
a^2 + b^2 & = c^2 \\
a^2 & = d^2 + h^2 \\
b^2 & = e^2 + h^2
\end{align*}
\]

2. Find the missing value of ‘x’.

\[
\begin{align*}
\triangle ABC & : 13.88 \text{ cm} \\
\angle B & = \text{right angle} \\
AB & = 8 \text{ cm} \\
AD & = 4 \text{ cm}
\end{align*}
\]
3. Find the missing value. Show all your work.

4. Find the missing values of ‘d’ and ‘a’. Show all your work.
5. How far is the bottom of the tree house off the ground?

6. If the length of the base of the building is as tall as the total height, how tall is the wall? Show all your work.
1. Find the value of ‘?’ to the nearest tenth of a unit.
   Show all work and include all formulas.

   ![Triangle Diagram]

   Answer: The value of the ‘?’ is ______________ units.

2. Find the height of triangle below to the nearest tenth.

   ![Triangle Diagram]

   Answer: The height of the triangle is ______________ cm.
3. Metric Relations.
   Label the triangle and solve for ST, TU, and TR.

\[
\begin{align*}
m_{ST} &= \underline{\quad} \\
m_{TU} &= \underline{\quad} \\
m_{TR} &= \underline{\quad}
\end{align*}
\]
4. Find the length of side UT

\[ m \text{ UT} = \underline{\text{_______________}} \]
1. Among the following pairs of triangles, identify which pairs of triangles are similar.

**Answer:** Set(s) __________________________________ are similar sets of triangles.

2. Among the following pairs of triangles, identify which are isometric (congruent).

**Answer:** Set(s) __________________________________ are isometric sets of triangles.
2. In each case below, identify the missing value.

a) $d_1 \parallel d_2 \parallel d_3$

Answer: $? = \underline{_______________}$

b)

Answer: $? = \underline{_______________}$
3. In the following equilateral triangle, determine the measure of segment CE.

\[ \text{Answer: Measurement CE is } \underline{\text{______________}} \text{ cm} \]
4. A computer-controlled saw must cut out triangle GBE from a larger piece of rectangular steel, as shown in the following diagram.

Determine the distance from point D at which the saw must start cutting.

Answer: The distance from point D to point E is: _____________ cm.