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| Chapter Thumbnail  | Congruence of Triangles |
| Topic Thumbnail  | Congruency Criteria |

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| Plag%  | 0% |
| Reading score  | 87.7 |

**Topic thumbnail**

[**https://www.google.com/search?q=congruence+of+triangles+v&tbm=isch&ved=2ahUKEwj8x4Swvp7xAhUXXisKHYLqC24Q2-cCegQIABAA&oq=congruence+of+triangles+v&gs\_lcp=CgNpbWcQA1AAWABgrwFoAHAAeACAAQCIAQCSAQCYAQCqAQtnd3Mtd2l6LWltZw&sclient=img&ei=qifLYPzKHZe8rQGC1a\_wBg#imgrc=zDyJ5f-wL7-U1M**](https://www.google.com/search?q=congruence+of+triangles+v&tbm=isch&ved=2ahUKEwj8x4Swvp7xAhUXXisKHYLqC24Q2-cCegQIABAA&oq=congruence+of+triangles+v&gs_lcp=CgNpbWcQA1AAWABgrwFoAHAAeACAAQCIAQCSAQCYAQCqAQtnd3Mtd2l6LWltZw&sclient=img&ei=qifLYPzKHZe8rQGC1a_wBg#imgrc=zDyJ5f-wL7-U1M) **(Only triangles NO TEXT)**

**Introduction**

We have seen many triangular shapes in our day-to-day life like railing of bridges for support, triangular frames of building, etc. Are these figures congruent?

Every time we cannot use superimposition method to check the congruency of the triangles. Then, how will we do it?

Let’s discuss it.

We know that if two triangles have all the corresponding sides equal and all the included angles equal then the triangles are congruent. Such triangles look identical to each other and if positioned well, then, they will coincide each other.

There are **four basic rules of congruency** that are needed to be followed and if any one of the four rules stand true then those triangles will be congruent.

* **SSS (Side-Side-Side)**
* **SAS (Side-Angle-Side)**
* **ASA (Angel-Side-Angle)**
* **RHS (Right Angle-Hypotenuse-Side)**

Let’s understand each criterion one by one in detail.

<https://cdn.britannica.com/74/22074-050-04A1F97E/truss-bridge-forces-lines-tension-compression.jpg> **(Only image no TEXT)**

[**https://qph.fs.quoracdn.net/main-qimg-a83b5caabc84a23287c363cabcf3a421.webp**](https://qph.fs.quoracdn.net/main-qimg-a83b5caabc84a23287c363cabcf3a421.webp)

**SSS Criteria**

Two friends are playing a game of constructing a toy with three sticks. They need to draw the same toy. The first friend completed his toys by joining the sticks but the second friend didn’t know how to make it. First one helped him and told the lengths of sticks which were 4 cm, 6 cm and 7 cm.

Then, the second friend also completed with the help of these same dimensions. Are these toys congruent?

We know if all three sides of one triangle are the same in measure to the three corresponding sides of another triangle, then the triangles are congruent.

This criterion is called **SSS** criteria.

Here, SSS represents side-side-side.

Hence, both toys are congruent by SSS criteria.

Let’s take an example.

**Find the congruency relation of given triangles in the image.**

In the given figure,

AB = 4.5 cm = PR

BC = 7.1 cm = PQ

AC = 6 cm = QR

Since all the three sides of triangle ABC are equal to the corresponding sides of triangle RPQ. Therefore, by SSS congruence rule, the two triangles, ABC and RPQ are congruent.

That is, **ΔABC ≅ ΔRPQ**

Let’s move to the next criterion.

<http://prnt.sc/15p3omt>

**SAS Criteria**

A question is given by a teacher to the students to establish a relation between two triangles given in the figure.

On the next day only one student answers the question. The student said the given triangles are congruent.

Teacher asked How?

He replied, “If two sides and the angle included between them of a triangle are equal to the two corresponding sides and angle included between them of another triangle, then the triangles are called congruent.”

Hence, this criterion is called SAS.

Here, SAS represents side-angle-side.

His solution of that question is given as:

In the given figure,

AB = 8 cm = PQ

BC = 7 cm = QR

∠B = ∠Q = 40°

Therefore, the length of two sides and the included angle of triangle ABC are equal to corresponding sides and angle of triangle PQR.

So, triangle ABC is congruent to triangle PQR.

We can write, **ΔABC ≅ ΔPQR**

Two criterions are complete. Let’s move to the third one.

<http://prnt.sc/15p3rra>

**ASA Criteria**

Consider the following two triangular field shown in the figure.

Can you guess the relation between them?

Here we can see that:

∠XYZ = 70° = ∠FGE and ∠XZY = 50° = ∠FEG.

Along with the two angles, side YZ is equal to side GE. So, here we have 2 equal angles and the included side also equal.

So, are they congruent?

Let’s understand

**ASA Congruence Rule**

ASA congruence rule states that **if two angles and the included side between these two angles, are equal to corresponding two angles and the side contained between them of another triangle then the two triangles will be congruent to each other.**

Hence, **∆XYZ ≅ ∆FGE**

Let’s move to the last criteria of congruency.

<http://prnt.sc/15p3tvx>

**RHS Criteria**

In a room, there are two ladders placed against the two walls as shown in the figure.

Ladder PR is placed against the wall PQ and ladder MO is placed against the wall MN.

Here we can see that there are two right-angled triangles, PQR and MNO.

Can you find any relation between them?

PQ = MN

MO = PR (hypotenuse of both triangles)

What can be said?

Let’s have a look on the definition.

**RHS Congruence Rule**

The RHS rule states that if in two right-angled triangles, the length of the hypotenuse and one side of the first triangle, is equal to the length of the hypotenuse and the corresponding side of the second triangle, then the two triangles are said to be congruent.

Therefore, **∆PQR ≅ ∆MNO**

Let’s solve some examples based on these criteria.

<http://prnt.sc/15p3wot>

**Apply the Concept!**

**Example 1:**

**Prove that in the given figure QR bisects ∠PQS.**

First, we would show that both the triangles, PQR and SQR are congruent.

PQ = QS (given)

PR = RS (given)

QR = QR (common)

Therefore, by SSS criteria ∆PQR ≅ ∆SQR

Hence, ∠PQR = ∠SQR (by Corresponding parts of congruent triangles - CPCT)

It means QR bisects ∠PQS.

<http://prnt.sc/15p3z5y>

**Example 2:**

**In the given figure, is ∆MNO ≅ ∆PON or ∆MNO ≅ ∆ONP?**

<http://prnt.sc/15p4378>

In∆MNO and ∆PON

MO = PN (hypotenuse)

NO = NO (common)

Therefore, by RHS criteria ∆MNO ≅ ∆PON

Also, ∆MNO cannot be said to be congruent to ∆ONP because in this congruency the given correspondence is not satisfied.

That is, if ∆MNO ≅ ∆ONP then by CPCT we get NO = NP which is wrong.

**Did you know?**The congruence of triangles is a major operation that is used in the field of architecture. The big roofs like that of an airport or beautiful buildings use this concept in their structural design and equal distribution of the weight of the structure.

**Common Errors**

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| **Incorrect** | In the given figure, **∆ABC ≅ ∆PQR** by **ASA criteria.** | In the given figure, **∆XYZ ≅ ∆DEF** by **SAS criteria.** |
| **Correct** | ∆ABC and ∆PQR are not congruent by ASA criteria. | ∆XYZ and ∆DEF are not congruent by SAS criteria. |
| **Reason** | Although, two angles and one side of one triangle is equal to the two angles and a side of another triangle but they are not congruent. Because, ASA states that two triangles are congruent if the included sides between two equal angles are equal.Here, PQ is not included between two angles. | Although, two sides and an angle of one triangle is equal to the two sides and an angle of another triangle but they are not congruent. Because, SAS states that two triangles are congruent if included angles between two equal sides are equal.Here, ∠XYZ and ∠DFE are not included between two equal sides. |

**Q&A**

**Let’s keep the grey cells ticking by answering the questions below**

**Question 1:**

What is the expanded form for the ASA congruency rule?

Angle-Side-Angle

**Question 2:**

Define RHS congruency.

The RHS rule states that if in two right-angled triangles, the length of the hypotenuse and one side of the first triangle, is equal to the length of the hypotenuse and corresponding side of the second triangle, then the two triangles are said to be congruent.

**Question 3:**

Which sides are considered for applying the ASA congruence rule?

The included side between the two angles of one triangle and the side between the corresponding equal angles of the other triangles are considered.

**Question 4:**

Check whether the following two triangles ABC and DEF are congruent or not.

AB = 10 cm, BC = 8 cm, CA = 12 cm and DE = 12 cm, EF = 8 cm, FD = 10 cm

AB = 10 cm = FD

BC = 8 cm = EF

CA = 12 cm = DE

Therefore, by SSS criteria ∆ABC ≅ ∆DFE

**Question 5:**

Find the value of ∠CAT if in ∆CAT and ∆AOT, CT = TO, ∠CTA = ∠OTA and ∠OAT = 60°.

CT = TO

∠CTA = ∠OTA

AT = AT (common)

Therefore, by SAS criteria ∆CTA ≅ ∆OTA

Hence, ∠OAT = ∠CAT = 60° (by CPCT)