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Chapter-7: Congruence of Triangles

Exercise 7.1 (Page 137)

Q1. Complete the following statements:

a) Two-line segments are congruent if ___________.
b) Among two congruent angles, one has a measure of 70°; the measure of the other angle is ___________.
c) When we write ∠A = ∠B, we actually mean ___________.

Solution

a) they have same length.
b) 70°.
c) m ∠A = m ∠B. (m stands for measure of the angle)

Q2. Give any two real-life examples for congruent shapes.

Solution

a) Cards of same playing card deck.

b) Same postage stamps.

Q 3. If ΔABC ≅ ΔFED under the correspondence ABC ↔ FED, write all the corresponding congruent parts of the triangles.

Difficulty Level: Easy

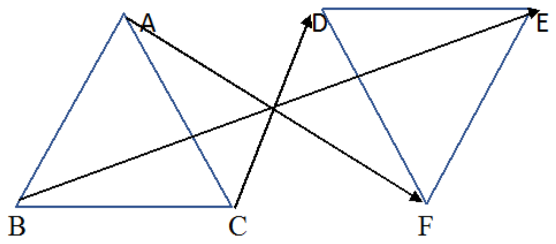
What is the given/known?
Two triangles which are congruent.

What is the unknown? Triangles
ABC and FED are congruent (ΔABC ≅ ΔFED) under the correspondence ABC ↔ FED

Reasoning:
Two congruent triangles have exactly the same three sides and exactly the same three angles. According to the given correspondence, triangle ABC can be placed on triangle FED in such a way that A falls on F, B falls on E and C falls on D. So, while taking about congruence of triangles, measure of sides, measure of angles and matching of vertices are equally important.

Solution:

Given, ΔABC ≅ ΔFED under the correspondence ABC ↔ FED. The correspondence is shown with arrow in the following figure.



It is clear from the figure that

$$\angle A \leftrightarrow \angle F, \angle B \leftrightarrow \angle E, \angle C \leftrightarrow \angle D$$
$$\overline{AB} \leftrightarrow \overline{FE}, \overline{BC} \leftrightarrow \overline{ED}, \overline{AC} \leftrightarrow \overline{FD}$$

Q 4. If ΔDEF ≅ ΔBCA, write the part(s) of ΔBCA that correspond to

(i) $\angle E$ (ii) $\overline{EF}$ (iii) $\angle F$ (iv) $\overline{DF}$.

Difficulty Level: Easy

What is the given/known?

Two ΔDEF and ΔBCA which are congruent.

What is the unknown?

The part(s) of ΔBCA that correspond to different angles and sides.

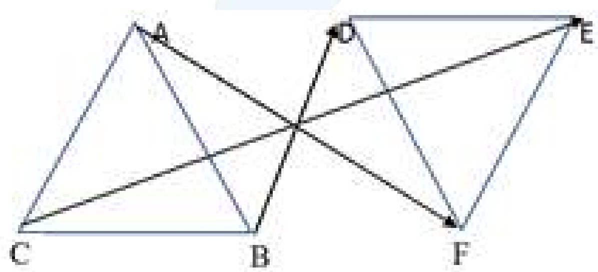
Reasoning:

This question is based on the concept of congruence of triangles. As it is given in the question, two triangles DEF and BCA are congruent. We can place triangle DEF on BCA such that D falls on B, F falls on A, F falls on A and D falls on C.

Solution:

Since, ΔDEF ≅ ΔBCA

For better understanding of this concept it is best to visualize it with the help of figure.



(i) $\angle E \leftrightarrow \angle C$

(ii) $\overline{EF} \leftrightarrow \overline{CA}$

(iii) $\angle F \leftrightarrow \angle A$

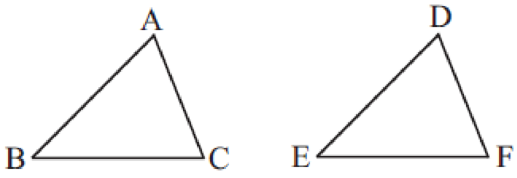
(iv) $\overline{DF} \leftrightarrow \overline{BA}$

Chapter-7: Congruence of Triangles

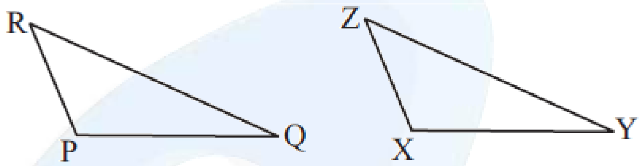
Exercise 7.2 (Page 149)

Q 1. Which congruence criterion do you use in the following?

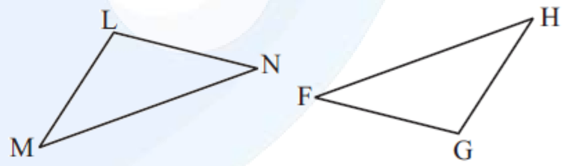
(a) Given:
AC = DF
AB = DE
BC = EF
So, ΔABC ≅ ΔDEF



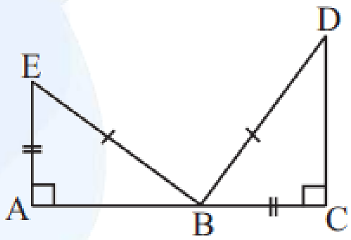
(b) Given:
ZX = RP
RQ = ZY
∠PRQ = ∠XZY
So, ΔPQR ≅ ΔXYZ



(c) Given:
∠MLN = ∠FGH
∠NML = ∠GFH
ML = FG
So, ΔLMN ≅ ΔGFH

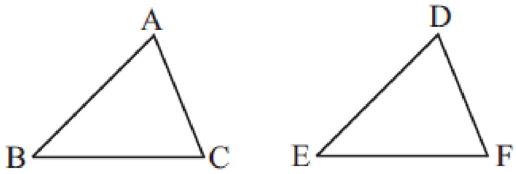


(d) Given: EB = DB
AE = BC
∠A = ∠C = 90°
So, ΔABE ≅ ΔCDB



(a) Difficulty Level: Easy

What is given /known?



In ΔABC and ΔDEF
AC = DF
AB = DE
BC = EF

What is the unknown?
Congruence criterion by which these two triangles are congruent.

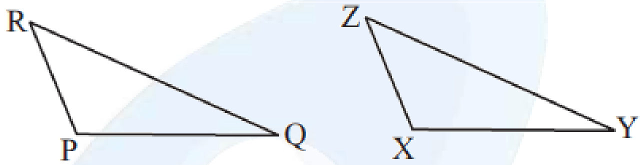
Reasoning:
Three sides of a triangle ABC are equal to the corresponding three sides of the other triangle DEF. So, SSS congruence criterion can be used.

Solution:
Given, AC = DF, AB = DE and BC = EF. The three sides of a triangle ABC are equal to the corresponding three sides of the other triangle DEF. So, by SSS congruence criterion, the two triangles are congruent.

(b) Difficulty Level- Easy

What is given /known?

ZX = RP
RQ = ZY
∠PRQ = ∠XZY



What is unknown/to be proved?
Congruence criterion by which the two triangles are congruent.

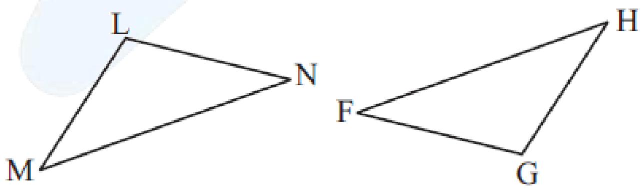
Reasoning:
The two sides and one angle of a triangle PRQ are equal to the corresponding two sides and one angle of the other triangle XYZ. So, SSS congruence criterion can be used.

Solution:
Given, ZX = RP, RQ = ZY, ∠PRQ = ∠XZY. The two sides and one angle of a triangle PRQ are equal to the corresponding two sides and one angle of the other triangle XYZ. So, by SAS congruence criterion, the two triangles are congruent.

(c) Difficulty Level: Easy

What is given /known?

Given:
∠MLN=∠FGH
∠NML=∠GFH
ML = FG



What is the unknown?
By which congruence criterion two triangles are congruent.

Reasoning:
The two angles and one side of a triangle LMN are equal to the corresponding two sides and one angle of the other triangle GFH. So, by using congruency criterion based on two angels and one side (ASA) of triangles can be used.

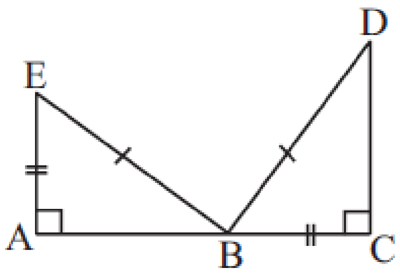
Solution:

Given, ∠MLN = ∠FGH, ∠NML = ∠GFH and ML = FG. The two sides and one angle of triangle LMN are equal to the two sides and one angle of the other triangle GFH. So, by ASA congruence criterion, the two triangles are congruent.

(d) Difficulty Level: Easy

What is given /known?

In ΔABE and ΔCDB
EB = DB
AE = BC
∠A = ∠C = 90°



What is the unknown?

By which congruence criterion two triangles are congruent.

Reasoning:

In this case, the hypotenuse and one side of a right-angled triangle are respectively equal to the hypotenuse and one side of another right-angled triangle. congruency is based on of a right-angle, hypotenuse and one side (RHS) criterion.

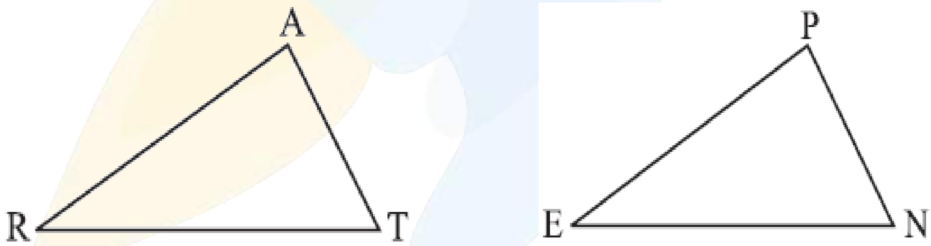
Solution:

Since, EB = DB, AE = BC, ∠A = ∠C = 90°. The hypotenuse and one side of a right-angled triangle ABE are equal to the hypotenuse and one side of the other right-angled triangle CDB. So, by RHS congruence criterion, the two triangles are congruent.

Q 2. You want to show that ΔART ≅ ΔPEN,

(a) If you have to use SSS criterion, then you need to show

(i) AR = (ii) RT = (iii) AT =



(b) If it is given that ∠T = ∠N and you are to use SAS criterion, you need to have

(i) RT = and (ii) PN =

(c) If it is given that AT = PN and you are to use ASA criterion, you need to have

(i) ZA (ii) ZT

Answer:

(a) If you have to use SSS criterion, then you need to show

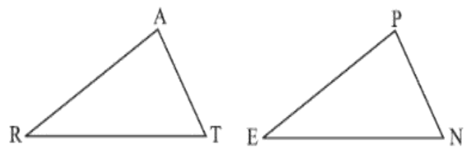
(i) AR = PE (ii) RT = EN (iii) AT = PN

(b) If it is given that ∠T = ∠N and you are to use SAS criterion, you need to have

(i) RT = EN and (ii) PN = AT

(c) If it is given that AT = PN and you are to use ASA criterion to show that

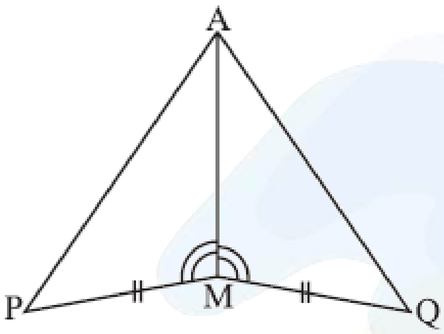
$\Delta ART \cong \Delta PEN$, you need to have



(i) $\angle RAT = \angle EPN$
(ii) $\angle RTA = \angle ENP$

Q3. You have to show that $\Delta AMP \cong \Delta AMQ$. In the following proof, supply the missing reasons.

Steps	Reasons
(i) PM = QM	(i) ….
(ii) $\angle PMA = \angle QMA$	(ii) ….
(iii) AM = AM	(iii) ….
(iv) $\Delta AMP \cong \Delta AMQ$	(iv) ….



Difficulty Level: Low

Steps	Reasons
(i) PM = QM	(i) Given
(ii) $\angle PMA = \angle QMA$	(ii) Given
(iii) AM = AM	(iii) Common
(iv) $\Delta AMP \cong \Delta AMQ$	(iv) SAS congruence rule

Q4. In ΔABC, $\angle A = 30°$, $\angle B = 40°$ and $\angle C = 110°$.
In ΔPQR, $\angle P = 30°$, $\angle Q = 40°$ and $\angle R = 110°$.
A student says that $\Delta ABC \cong \Delta PQR$ by AAA congruence criterion.
Is he justified? Why or why not?

Difficulty Level: Medium

What is given /known?

In ΔABC, $\angle A = 30°$, $\angle B = 40°$ and $\angle C = 110°$

In ΔPQR, $\angle P = 30°$, $\angle Q = 40°$ and $\angle R = 110°$

What is the unknown?

Justification that ΔABC ≅ ΔPQR by AAA congruence criterion.

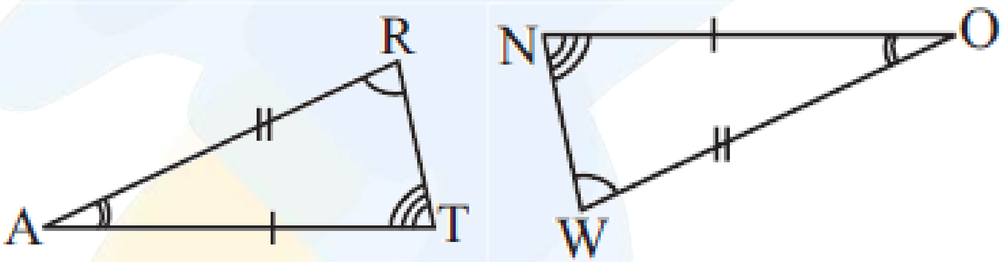
How can you use the known information to arrive at the solution?

In this question, it is given that the angle measure of all the angles of triangle ABC, ∠A = 30°, ∠B = 40° and ∠C = 110° is equal to the measure of all the angles of another triangle PQR, ∠P = 30°, ∠Q = 40° and ∠R =110° and you can justify the congruence of ΔABC and ΔPQR by AAA criterion or not. You can justify your answer by using the property based on AAA congruence of two triangles. We know that there is no such thing as AAA congruence of two triangles: Two triangles with equal corresponding angles need not to be congruent. In such a correspondence, one of them can be an enlarged copy of the other (They would be congruent only if they are exact copies of one another).

Solution:

No, AAA property cannot justify ΔABC ≅ ΔPQR because, this property represents that these two triangles have their respective angles of equal measures, but it gives no information about their sides. Two triangles with equal corresponding angles need not to be congruent. In such a correspondence, one of them can be an enlarged copy of the other. Therefore, AAA does not prove that the two triangles ABC and PQR are congruent.

Q5. In the figure, the two triangles are congruent. The corresponding parts are marked. We can write ΔRAT ≅?



Difficulty Level: Medium

What is given /known?

The given two triangles are congruent, and their corresponding parts are marked on the given figure.

$\overline{NO} = \overline{AT}, \overline{AR} = \overline{OW}$.

∠W = ∠R, ∠A = ∠O and ∠T = ∠N

What is the unknown?

Congruence of ΔRAT?

How can you use the known information to arrive at the solution?

This question is based on the concept of congruence of two triangle when two angles and one side (or two angles and one side) of the triangles are equal. If two angles and one side of a triangle are equal to the corresponding two angles and one side of another triangle then the two triangles can be congruent by ASA Congruence criterion, by using this criterion you can find out the triangle congruent to RAT.

Solution:

From the figure, it can be observed that

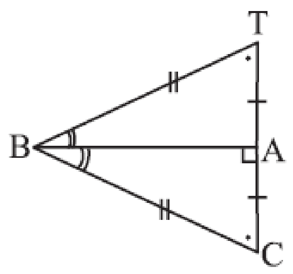
$$\angle RAT = \angle WON$$

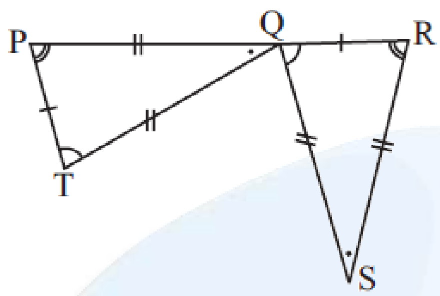
$$\angle ART = \angle NOW$$

$$\overline{AR} = \overline{OW}$$

Therefore, ΔRAT ≅ WON (By ASA congruence criterion)

Q6. Complete the congruence statement:

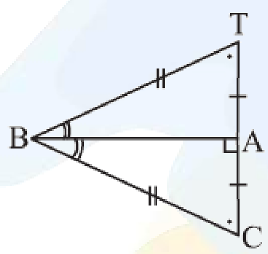


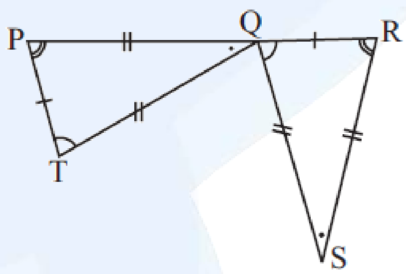


$\Delta BCA \cong ?$ $\Delta QRS \cong ?$

Difficulty Level: Medium

What is given /known?





What is the unknown?

Congruence of triangles.

$$(\text{i})\, \Delta BCA \cong ? \qquad (\text{ii})\, \Delta QRS \cong ?$$

From figure, in the triangles BTA and BCA,

B ↔ B, A ↔ A and T ↔ C

And in triangle QRS and TPO,

P ↔ R, T ↔ Q and O ↔ S

Reasoning:

This question is based on the concept of congruence of triangles, if the corresponding parts of two triangles are equal then the two triangles are congruent to each other. In first triangle, corresponding parts of triangle BTA are congruent to the triangle BCA and the corresponding parts of triangle QRS are congruent to triangle TPO. Thus, by applying congruence based on sides of a triangle, two triangles can be proved congruent.

Solution:

In triangle BAT and triangle BCA, Corresponding parts are congruent.

B ↔ B, A ↔ A and T ↔ C.

So, by SSS congruence rule, ΔBCA ≅ BTA

Similarly, in triangle QRS and TPO, corresponding parts are congruent.
So, by SSS congruence rule,

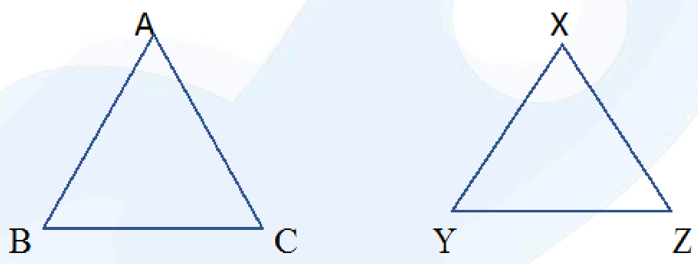
P ↔ R, T ↔ Q and O ↔ S
ΔQRS ≅ TPO

Q7. In a squared sheet, draw two triangles of equal areas such that

i) the triangles are congruent.
ii) the triangles are not congruent.
iii) What can you say about their perimeters?

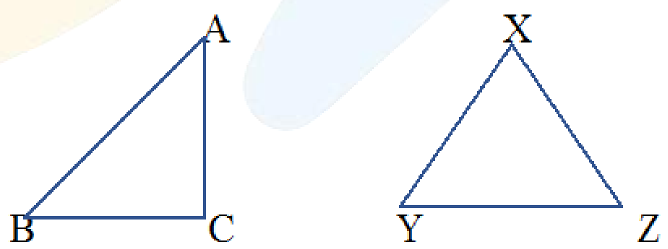
Solution:

Draw two triangles of equal areas,
(i)



Triangles ABC and XYZ have the same area and are congruent to each other.
Such that, $\overline{AB} = \overline{DE}, \overline{BC} = \overline{EF} and \overline{AC} = \overline{DF}$
On adding, we get
$\overline{AB} + \overline{BC} + \overline{AC} = \overline{DE} + \overline{EF} + \overline{DF}$
i.e. perimeter of both the triangles are equal.

(ii)



Here, we have drawn two triangles ABC and PQR, which are not congruent to each other.
Such that,

$\overline{AB} \neq \overline{XY}, \overline{BC} \neq \overline{YZ} and \overline{AC} \neq \overline{XZ}$

On adding, we get

$\overline{AB} + \overline{BC} + \overline{AC} = \overline{XY} + \overline{YZ} + \overline{XZ}$

Also, the perimeter of both the triangles will not be the same.

Q8. Draw a rough sketch of two triangles such that they have five pairs of congruent parts but still the triangles are not congruent.

Difficulty Level: Medium

What is given /known?

Two triangles that have five pairs of congruent parts.

What is unknown/to be proved?

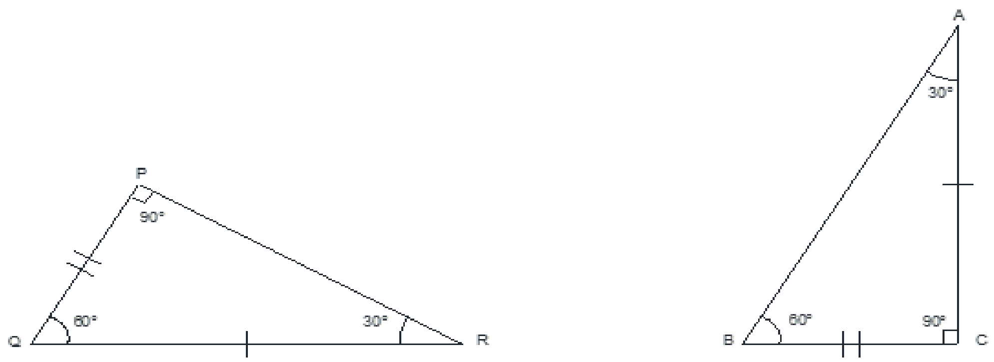
Despite having five pairs of congruent parts, the triangles are not congruent

Solution:

In triangle PQR and ABC,

$$\overline{PQ} = \overline{BC}(Given)$$
$$\overline{QR} = \overline{AC}(Given)$$
$$\angle Q = \angle B(Given)$$
$$\angle P = \angle C(Given)$$
$$\angle R = \angle A(Given)$$

All angles and two sides are equal except one side. Hence triangle PQR is not congruent to triangle ABC.



Q9. If ΔABC and ΔPQR are to be congruent, name one additional pair of corresponding parts. What criterion did you use?

Difficulty Level: Low

What is the unknown?

Name one additional pair of corresponding parts and the criterion used.

How can you use the known information to arrive at the solution?

In this question, if two triangles ABC and PQR are to be congruent, we must name one additional pair of corresponding part and the criterion used. For better understanding of this question, visualize it with the help of figure. In triangles ABC and PQR it is given that, <B = 90° and <Q= 90°, <C =<R. Now, find out the side between these two angles that would be your one additional pair of corresponding part. Also, by reminding the criterion based on angle and the side of a right- angled triangle, you can find out the criterion used.

Solution:

In triangle ABC and PQR,

Given, $<B = <Q = 90^{o}$

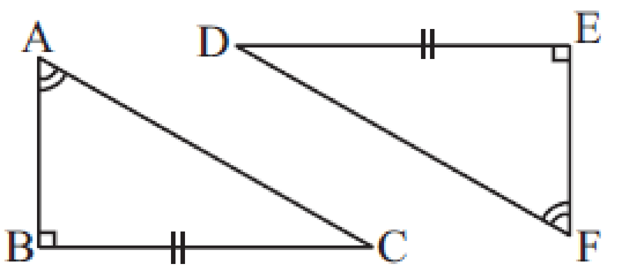
$<C = <R$

Then one additional pair is,

$\overline{BC} = \overline{QR}$

Therefore, $\Delta ABC \cong \Delta PQR$ (By ASA congruence rule)

Q10. Explain, why



$\Delta ABC \cong \Delta FED$.

Difficulty Level: Easy

What is given /known?

Two right angles triangles ΔABC and ΔFED in which one side and one angle are equal.

What is the unknown/to be proved?

Why $\Delta ABC \cong \Delta FED$?

How can you use the known information to arrive at the solution?

This question is based on congruence of a right-angled triangle. In this question, one angle and a side of a right-angled triangle are equal to the corresponding one angle and a side of another right-angled triangle. Now, by using congruence based on right-angled triangle, you can find the reason why these two triangles are congruent.

Solution:

Given,

In ΔABC and ΔFED,

$\angle A = \angle F$

$\angle B = \angle E = 90^{\circ}$

BC = ED

Therefore, $\Delta ABC \cong \Delta FED$ (By RHS congruence rule)