Student's Favourite Academy
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Selina ICSE Solutions for Class 9 Maths Chapter 11 Inequalities

Exercise 11

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Solution 1:

In $\triangle$ ABC,

AB = AC[Given]

$\therefore \angle ACB = \angle B$[angles opposite to equal sides are equal]

$\angle B = 70^0$[Given]

$\Rightarrow \angle ACB = 70^0$ ....(i)

Now,

$\angle ACB + \angle ACD = 180^0$[BCD is a straight line]

$\Rightarrow 70^0 + \angle ACD = 180^0$

$\Rightarrow \angle ACD = 110^0$ ....(ii)

In $\triangle$ ACD,

$\angle CAD + \angle ACD + \angle D = 180^0$

$\Rightarrow \angle CAD + 110^0 + \angle D = 180^0$ [From (ii)]

$\Rightarrow \angle CAD + \angle D = 70^0$

But $\angle D = 40^0$ [Given]

$\Rightarrow \angle CAD + 40^0 = 70^0$

$\Rightarrow \angle CAD = 30^0$ ....(iii)

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In Δ ACD,

$\angle$ ACD = 110^0[From (ii)]

$\angle$ CAD = 30^0[From (iii)]

$\angle$ D = 40^0 [Given]

$\therefore \angle D > \angle CAD$
$\Rightarrow AC > CD$

[Greater angle has greater side opposite to it]

Also,

AB = AC[Given]

Therefore, AB > CD.

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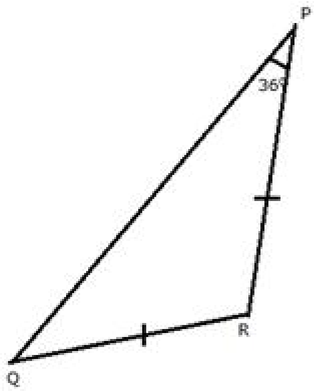
Solution 2:



In Δ PQR,

QR = PR[Given]

∴ ∠P = ∠Q[angles opposite to equal sides are equal]

∠P = 36^0[Given]

⇒∠Q = 36^0

In Δ PQR,

∠P + ∠Q + ∠R = 180^0

⇒$36^0 + 36^0$ + ∠R = 180^0

⇒∠R + 72^0 = 180^0

⇒∠R = 108^0

Now,

∠R = 108^0

∠P = 36^0

∠Q = 36^0

Since ∠R is the greatest, therefore, PQ is the largest side.

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Solution 3:

The sum of any two sides of the triangle is always greater than third side of the triangle.

Third side < 13 + 8 = 21 cm.

The difference between any two sides of the triangle is always less than the third side of the triangle.

Third side > 13 - 8 = 5 cm.

Therefore, the length of the third side is between 5 cm and 9 cm, respectively.

The value of a = 5 cm and b = 21 cm.

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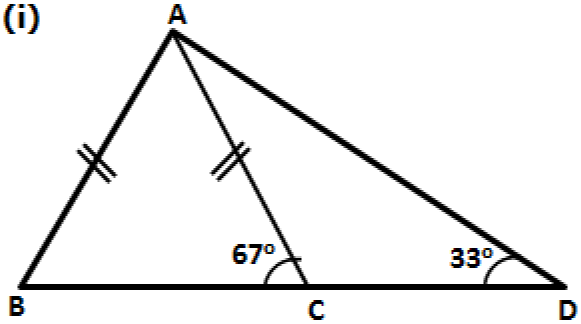
Solution 4:

(i)



In ΔABC,

AB = AC

$\Rightarrow \angle ABC = \angle ACB$ (angles opposite to equal sides are equal)

$\Rightarrow \angle ABC = \angle ACB = 67°$

$\Rightarrow \angle BAC = 180° - \angle ABC - \angle ACB$ (angle sum property)

$\Rightarrow \angle BAC = 180° - 67° - 67° = 46°$

Since $\angle BAC < \angle ABC$, we have

$BC < AC$ ....(1)

Now, $\angle ACD = 180° - \angle ACB$ (linear pair)

$\Rightarrow \angle ACD = 180° - 67° = 113°$

Thus, in ΔACD,

$\angle CAD = 180° - \angle ACD - \angle ADC$

$\Rightarrow \angle CAD = 180° - 113° - 33° = 34°$

Since $\angle ADC < \angle CAD$, we have

$AC < CD$ ....(2)

From (1) and (2), we have

$BC < AC < CD$

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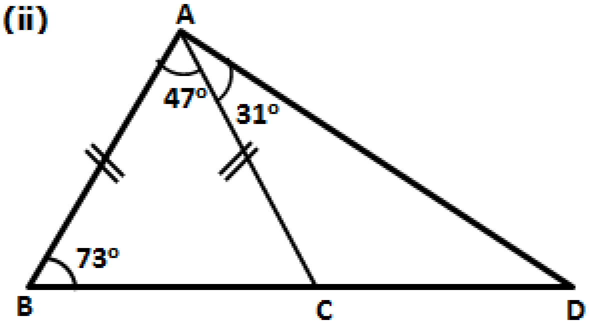
(ii)



In ΔABC,

$\angle BAC < \angle ABC$

$\Rightarrow BC < AC \quad ....(1)$

Now, $\angle ACB = 180° - \angle ABC - \angle BAC$

$\Rightarrow \angle ACB = 180° - 73° - 47°$

$\Rightarrow \angle ACB = 60°$

Now, $\angle ACD = 180° - \angle ACB$

$\Rightarrow \angle ACD = 180° - 60° = 120°$

Now, in ΔACD,

$\angle ADC = 180° - \angle ACD - \angle CAD$

$\Rightarrow \angle ADC = 180° - 120° - 31°$

$\Rightarrow \angle ADC = 29°$

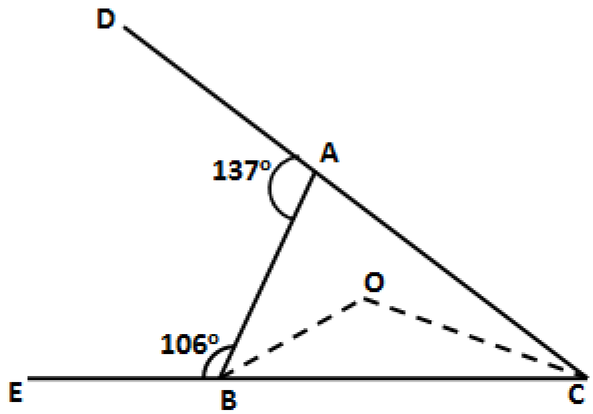
Since $\angle ADC < \angle CAD$, we have

$AC < CD \quad ....(2)$

From (1) and (2), we have

$BC < AC < CD$

Solution 5:



$\angle BAC = 180° - \angle BAD = 180° - 137° = 43°$

$\angle ABC = 180 - \angle ABE = 180° - 106° = 74°$

Thus, in ΔABC,

$\angle ACB = 180° - \angle BAC - \angle ABC$

$\Rightarrow \angle ACB = 180° - 43° - 74° = 63°$

Now, $\angle ABC = \angle OBC + \angle ABO$

$\Rightarrow \angle ABC = 2\angle OBC$ (OB is biosector of $\angle ABC$)

$\Rightarrow 74° = 2\angle OBC$

$\Rightarrow \angle OBC = 37°$

Similarly,

$\angle ACB = \angle OCB + \angle ACO$

$\Rightarrow \angle ACB = 2\angle OCB$ (OC is bisector of $\angle ACB$)

$\Rightarrow 63° = 2\angle OCB$

$\Rightarrow \angle OCB = 31.5°$

Now, in ΔBOC,

$\angle BOC = 180° - \angle OBC - \angle OCB$

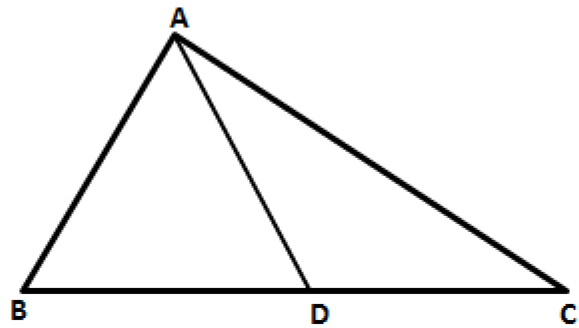
$\Rightarrow \angle BOC = 180° - 37° - 31.5°$

$\Rightarrow \angle BOC = 111.5°$

Since, $\angle BOC > \angle OBC > \angle OCB$, we have

$BC > OC > OB$

Solution 6:



AD > AC (given)

$\Rightarrow \angle C > \angle ADC$ ....(1)

Now, $\angle ADC > \angle B + \angle BAC$ (Exterior Angle Property)

$\Rightarrow \angle ADC > \angle B$ ....(2)

From (1) and (2), we have

$\angle C > \angle ADC > \angle B$

$\Rightarrow \angle C > \angle B$

$\Rightarrow AB > AC$

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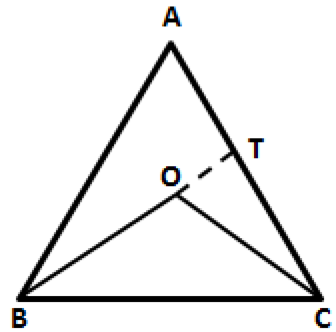
Solution 7:



Construction: Produce BO to meet AC at T.

In ΔABT,

$AB + AT > BT$ (Sum of two sides of a Δ is greater than third side)

$\Rightarrow AB + AT > BO + OT \quad ....(1)$

Also, in ΔOCT,

$OT + TC > OC \quad ....(2)$

Adding (1) and (2), we have

$AB + AT + OT + TC > BO + OT + OC$

$\Rightarrow AB + AT + TC > BO + OC$

$\Rightarrow AB + AC > OB + OC$

$\Rightarrow OB + OC < AB + AC$

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Solution 8:

In △ BEC,

$\angle B + \angle BEC + \angle BCE = 180^0$

$\angle B = 65^0$ [Given]

$\angle BEC = 90^0$[CE is perpendicular to AB]

$\Rightarrow 65^0 + 90^0 + \angle BCE = 180^0$

$\Rightarrow \angle BCE = 180^0 - 155^0$

$\Rightarrow \angle BCE = 25^0 = \angle DCF$ …………(i)

In △ CDF,

$\angle DCF + \angle FDC + \angle CFD = 180^0$

$\angle DCF = 25^0$ [From (i)]

$\angle FDC = 90^0$[AD is perpendicular to BC]

$\Rightarrow 25^0 + 90^0 + \angle CFD = 180^0$

$\Rightarrow \angle CFD = 180^0 - 115^0$

$\Rightarrow \angle CFD = 65^0$ …………(ii)

Now, $\angle AFC + \angle CFD = 180^0$[AFD is a straight line]

$\Rightarrow \angle AFC + 65^0 = 180^0$

$\Rightarrow \angle AFC = 115^0$ ………(iii)

In △ ACE,

$\angle ACE + \angle CEA + \angle BAC = 180^0$

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$\angle$ BAC = 60^0 [Given]

$\angle$ CEA = 90^0[CE is perpendicular to AB]

$\Rightarrow \angle ACE + 90^0 + 60^0 = 180^0$

$\Rightarrow \angle ACE = 180^0 - 150^0$

$\Rightarrow \angle ACE = 30^0$ ....(iv)

In Δ AFC,

$\angle AFC + \angle ACF + \angle FAC = 180^0$

$\angle$ AFC = 115^0 [From (iii)]

$\angle$ ACF = 30^0[From (iv)]

$\Rightarrow 115^0 + 30^0 + \angle FAC = 180^0$

$\Rightarrow \angle FAC = 180^0 - 145^0$

$\Rightarrow \angle FAC = 35^0$ ....(v)

In Δ AFC,

$\angle$ FAC = 35^0[From (v)]

$\angle$ ACF = 30^0[From (iv)]

$\therefore \angle FAC > \angle ACF$
$\Rightarrow CF > AF$

In Δ CDF,

$\angle$ DCF = 25^0[From (i)]

$\angle$ CFD = 65^0[From (ii)]

$\therefore \angle CFD > \angle DCF$
$\Rightarrow DC > DF$

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Solution 9:

$\angle ACB = 74^0$ .....(i)[Given]

$\angle ACB + \angle ACD = 180^0$[BCD is a straight line]

$\Rightarrow 74^0 + \angle ACD = 180^0$

$\Rightarrow \angle ACD = 106^0$ ....(ii)

In Δ ACD,

$\angle ACD + \angle ADC + \angle CAD = 180^0$

Given that AC = CD

$\Rightarrow \angle ADC = \angle CAD$

$\Rightarrow 106^0 + \angle CAD + \angle CAD = 180^0$[From (ii)]

$\Rightarrow 2\angle CAD = 74^0$

$\Rightarrow \angle CAD = 37^0 = \angle ADC$...........(iii)

Now,

$\angle BAD = 110^0$[Given]

$\angle BAC + \angle CAD = 110^0$

$\angle BAC + 37^0 = 110^0$

$\angle BAC = 73^0$ ....(iv)

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In Δ ABC,

$\angle B + \angle BAC + \angle ACB = 180^0$

$\Rightarrow \angle B + 73^0 + 74^0 = 180^0$[From (i) and (iv)]

$\Rightarrow \angle B + 147^0 = 180^0$

$\Rightarrow \angle B = 33^0$ ....(v)

$\therefore \angle BAC > \angle B$ [From (iv) and (v)]

$\Rightarrow BC > AC$

But,

$AC = CD$ [Given]

$\Rightarrow BC > CD$

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Solution 10:

(i) $\angle$ ADC + $\angle$ ADB = 180^0[BDC is a straight line]

$\angle$ ADC = 90^0[Given]

90^0 + $\angle$ ADB = 180^0

$\angle$ ADB = 90^0 ....(i)

In Δ ADB,

$\angle$ ADB = 90^0[From (i)]

$\therefore$ $\angle$ B + $\angle$ BAD = 90^0

Therefore, $\angle$ B and $\angle$ BAD are both acute, that is less than 90^0.

$\therefore$ AB > BD ....(ii)[Side opposite 90^0 angle is greater than

side opposite acute angle]

(ii) In Δ ADC,

$\angle$ ADB = 90^0

$\therefore$ $\angle$ C + $\angle$ DAC = 90^0

Therefore, $\angle$ C and $\angle$ DAC are both acute, that is less than 90^0.

$\therefore$ AC > CD ....(iii)[Side opposite 90^0 angle is greater than

side opposite acute angle]

Adding (ii) and (iii)

AB + AC > BD + CD

$\Rightarrow$AB + AC > BC

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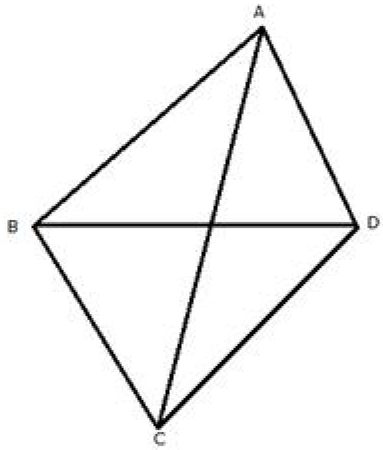
Solution 11:



Const: Join AC and BD.

(i) In Δ ABC,

AB + BC > AC....(i)[Sum of two sides is greater than the third side]

In Δ ACD,

AC + CD > DA....(ii)[Sum of two sides is greater than the third side]

Adding (i) and (ii)

AB + BC + AC + CD > AC + DA

AB + BC + CD > AC + DA - AC

AB + BC + CD > DA ....(iii)

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(ii)In △ACD,

CD + DA > AC....(iv)[Sum of two sides is greater than the third side]

Adding (i) and (iv)

AB + BC + CD + DA > AC + AC

AB + BC + CD + DA > 2AC

(iii) In △ABD,

AB + DA > BD....(v)[Sum of two sides is greater than the third side]

In △BCD,

BC + CD > BD....(vi)[Sum of two sides is greater than the third side]

Adding (v) and (vi)

AB + DA + BC + CD > BD + BD

AB + DA + BC + CD > 2BD

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Solution 12:

(i) In Δ ABC,

AB = BC = CA[ABC is an equilateral triangle]

$\therefore \angle A = \angle B = \angle C$

$\therefore \angle A = \angle B = \angle C = \frac{180^\circ}{3}$

$\Rightarrow \angle A = \angle B = \angle C = 60^\circ$

In Δ ABP,

$\angle A = 60^0$

$\angle ABP < 60^0$

$\therefore \angle A > \angle ABP$

$\Rightarrow BP > PA$

[Side opposite to greater side is greater]

(ii) In Δ BPC,

$\angle C = 60^0$

$\angle CBP < 60^0$

$\therefore \angle C > \angle CBP$

$\Rightarrow BP > PC$

[Side opposite to greater side is greater]

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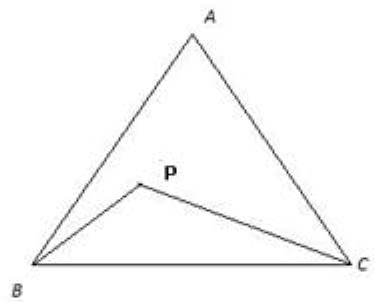
Solution 13:



Let $\angle PBC = x$ and $\angle PCB = y$

then,

$\angle BPC = 180^0 - (x + y)$ ....(i)

Let $\angle ABP = a$ and $\angle ACP = b$

then,

$\angle BAC = 180^0 - (x + a) - (y + b)$

$\Rightarrow \angle BAC = 180^0 - (x + y) - (a + b)$

$\Rightarrow \angle BAC = \angle BPC - (a + b)$

$\Rightarrow \angle BPC = \angle BAC + (a + b)$

$\Rightarrow \angle BPC > \angle BAC$

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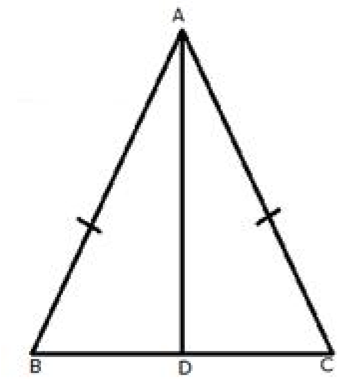
Solution 14:



We know that exterior angle of a triangle is always greater than each of the interior opposite angles.

∴ In △ABD,

∠ADC > ∠B ....(i)

In △ABC,

AB = AC

∴ ∠B = ∠C .....(ii)

From (i) and (ii)

∠ADC > ∠C

(i) In △ADC,

∠ADC > ∠C

∴ AC > AD ....(iii) [side opposite to greater angle is greater]

(ii) In △ABC,

AB = AC

⇒AB > AD[From (iii)]

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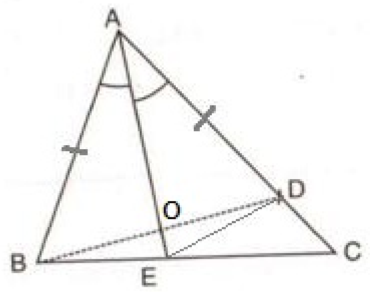
Solution 15:



Const: Join ED.

In $\triangle$ AOB and $\triangle$ AOD,

AB = AD[Given]

AO = AO[Common]

$\angle$ BAO = $\angle$ DAO[AO is bisector of $\angle$ A]

$\therefore$ $\Delta AOB \cong \Delta AOD$ [SAS criterion]

Hence,

BO = OD.........(i)[cpct]

$\angle$ AOB = $\angle$ AOD ....(ii)[cpct]

$\angle$ ABO = $\angle$ ADO $\Rightarrow$ $\angle$ ABD = $\angle$ ADB ....(iii)[cpct]

Now,

$\angle$ AOB = $\angle$ DOE[Vertically opposite angles]

$\angle$ AOD = $\angle$ BOE[Vertically opposite angles]

$\Rightarrow$ $\angle$ BOE = $\angle$ DOE ......(iv)[From (ii)]

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(i) In Δ BOE and Δ DOE,

BO = CD[From (i)]

OE = OE[Common]

$\angle$ BOE = $\angle$ DOE[From (iv)]

$\therefore$ ΔBOE $\cong$ ΔDOE [SAS criterion]

Hence, BE = DE[cpct]

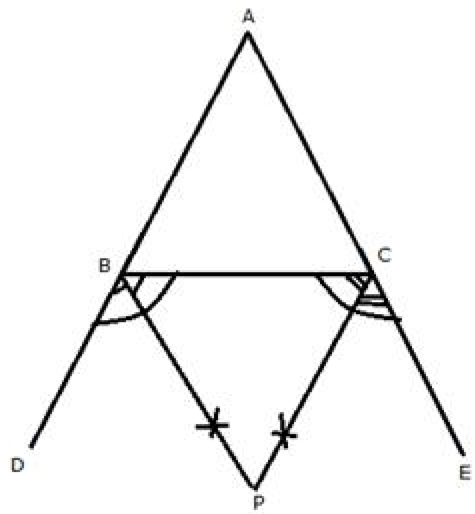
(ii) In Δ BCD,

$\angle$ ADB = $\angle$ C + $\angle$ CBD[Ext. angle = sum of opp. int. angles]

$\Rightarrow \angle$ ADB > $\angle$ C

$\Rightarrow \angle$ ABD > $\angle$ C[From (iii)]

Solution 16:



In Δ ABC,

AB > AC,

$\Rightarrow \angle ABC < \angle ACB$

$\therefore 180^0 - \angle ABC > 180^0 - \angle ACB$

$$\Rightarrow \frac{180^0 - \angle ABC}{2} > \frac{180^0 - \angle ACB}{2}$$

$$\Rightarrow 90^o - \frac{1}{2}\angle ABC > 90^o - \frac{1}{2}\angle ACB$$

$\Rightarrow \angle CBP > \angle BCP$ [BP is bisector of $\angle CBD$ and CP is bisector of $\angle BCE$]

$\Rightarrow PC > PB$ [side opposite to greater angle is greater]

Solution 17:

Since AB is the largest side and BC is the smallest side of the triangle ABC

$AB > AC > BC$

$\Rightarrow 180^* - z^* > 180^* - y^* > 180^* - x^*$

$\Rightarrow -z^* > -y^* > -x^*$

$\Rightarrow z^* < y^* < x^*$

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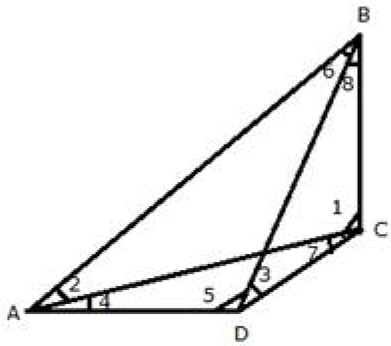
Solution 18:



In the quad. ABCD,

Since AB is the longest side and DC is the shortest side.

(i) $\angle 1 > \angle 2$[AB > BC]

$\angle 7 > \angle 4$[AD > DC]

$\therefore \angle 1 + \angle 7 > \angle 2 + \angle 4$

$\Rightarrow \angle C > \angle A$

(ii) $\angle 5 > \angle 6$[AB > AD]

$\angle 3 > \angle 8$[BC > CD]

$\therefore \angle 5 + \angle 3 > \angle 6 + \angle 8$

$\Rightarrow \angle D > \angle B$

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Solution 19:

(i) Since AB > AC

$\angle ACB > \angle ABC$

$\Rightarrow 180° - z > 180° - y$
$\Rightarrow -z > -y$
$\Rightarrow z < y........(i)$

Also since AC > BC

$\angle ABC > \angle BAC$

$\Rightarrow 180° - y > 180° - x$
$\Rightarrow -y > -x$
$\Rightarrow y < x........(ii)$

From (i) and (ii)

$z < y < x$

(ii) y > x > z[Given]

Taking y > x

$\Rightarrow (180° - \angle ABC) > (180° - \angle BAC)$
$\Rightarrow -\angle ABC > -\angle BAC$
$\Rightarrow \angle ABC < \angle BAC$
$\Rightarrow AC < BC........(i)$

Again taking x > z

$\Rightarrow (180° - \angle BAC) > (180° - \angle ACB)$
$\Rightarrow -\angle BAC > -\angle ACB$
$\Rightarrow \angle BAC < \angle ACB$
$\Rightarrow BC < AB........(ii)$

From (i) and (ii)

Ac < BC < AB

Writing in descending order

AB > BC > AC

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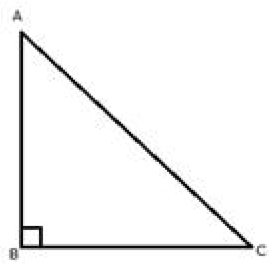
Solution 20:

(i)



$\because \angle B = 90^\circ$ [Given]

$\angle A + \angle B + \angle C = 180^\circ$

$\Rightarrow \angle A + \angle C + 90^\circ = 180^\circ$

$\Rightarrow \angle A + \angle C = 90^\circ$

$\Rightarrow \angle A < 90^\circ$ and $\angle C < 90^\circ$

Hence, $\angle B > \angle A \Rightarrow AC > BC$

Similarly, $\angle B > \angle C \Rightarrow AC > AB$

Hence, hypotenuse is the greatest side.

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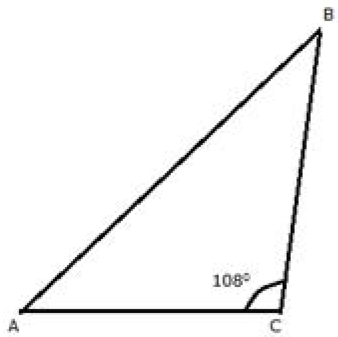
(ii)



$\because \angle ACB = 108^\circ$ [Given]

$\angle A + \angle B + \angle ACB = 180^\circ$

$\Rightarrow \angle A + \angle B + 108^\circ = 180^\circ$

$\Rightarrow \angle A + \angle B = 72^\circ$

$\Rightarrow \angle A < 72^\circ$ and $\angle B < 72^\circ$

Hence, $\angle ACB > \angle A \Rightarrow AB > BC$

Similarly, $\angle ACB > \angle B \Rightarrow AB > AC$

Therefore, AB is the largest side.

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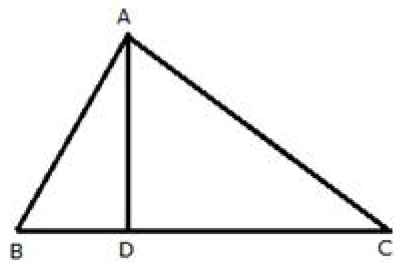
Solution 21:



In $\triangle$ ABD,

AB + BD >AD ....(i)

In $\triangle$ ACD,

AC + DC > AD ....(ii)

Adding (i) and (ii)

AB + BD + AC + DC > 2AD

AB + BD + DC + AC > 2AD

AB + BC + AC > 2AD

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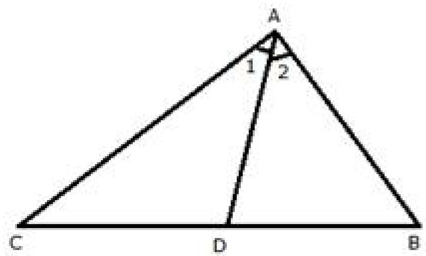
Solution 22:



In $\triangle$ ADC,

$\angle$ ADB = $\angle$ 1 + $\angle$ C.............(i)

In $\triangle$ ADB,

$\angle$ ADC = $\angle$ 2 + $\angle$ B.................(ii)

But AC > AB[Given]

$\Rightarrow \angle B > \angle C$

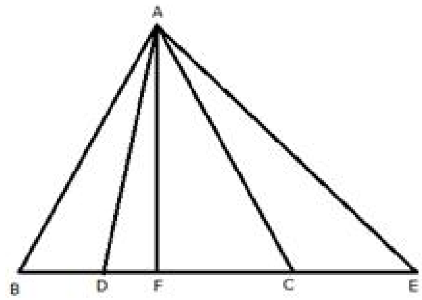
Also given, $\angle$ 2 = $\angle$ 1[AD is bisector of $\angle$ A]

$\Rightarrow \angle 2 + \angle B > \angle 1 + \angle C$ ....(iii)

From (i), (ii) and (iii)

$\Rightarrow \angle ADC > \angle ADB$

Solution 23:



We know that the bisector of the angle at the vertex of an isosceles triangle bisects the base at right angle.

Using Pythagoras theorem in $\triangle$ AFB,

$AB^2 = AF^2 + BF^2$..............(i)

In $\triangle$ AFD,

$AD^2 = AF^2 + DF^2$..............(ii)

We know ABC is isosceles triangle and AB = AC

$AC^2 = AF^2 + BF^2$ ....(iii)[From (i)]

Subtracting (ii) from (iii)

$AC^2 - AD^2 = AF^2 + BF^2 - AF^2 - DF^2$

$AC^2 - AD^2 = BF^2 - DF^2$

Let 2DF = BF

$AC^2 - AD^2 = (2DF)^2 - DF^2$

$AC^2 - AD^2 = 4DF^2 - DF^2$

$AC^2 = AD^2 + 3DF^2$

$\Rightarrow AC^2 > AD^2$

$\Rightarrow AC > AD$

Similarly, AE > AC and AE > AD.

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Solution 24:

The sum of any two sides of the triangle is always greater than the third side of the triangle.

In ΔCEB,

$CE + EB > BC$

$\Rightarrow DE + EB > BC \quad [CE = DE]$

$\Rightarrow DB > BC \ldots\ldots (i)$

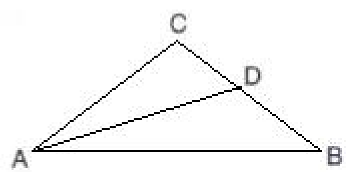
In ΔADB,

$AD + AB > BD$

$\Rightarrow AD + AB > BD > BC \quad [\text{from}(i)]$

$\Rightarrow AD + AB > BC$

Solution 25:



Given that, AB > AC

$\Rightarrow \angle C > \angle B \ldots\ldots (i)$

Also in ΔADC

$\angle ADB = \angle DAC + \angle C \quad [\text{Exterior angle}]$

$\Rightarrow \angle ADB > \angle C$

$\Rightarrow \angle ADB > \angle C > \angle B \quad [\text{From}(i)]$

$\Rightarrow \angle ADB > \angle B$

$\Rightarrow AB > AD$