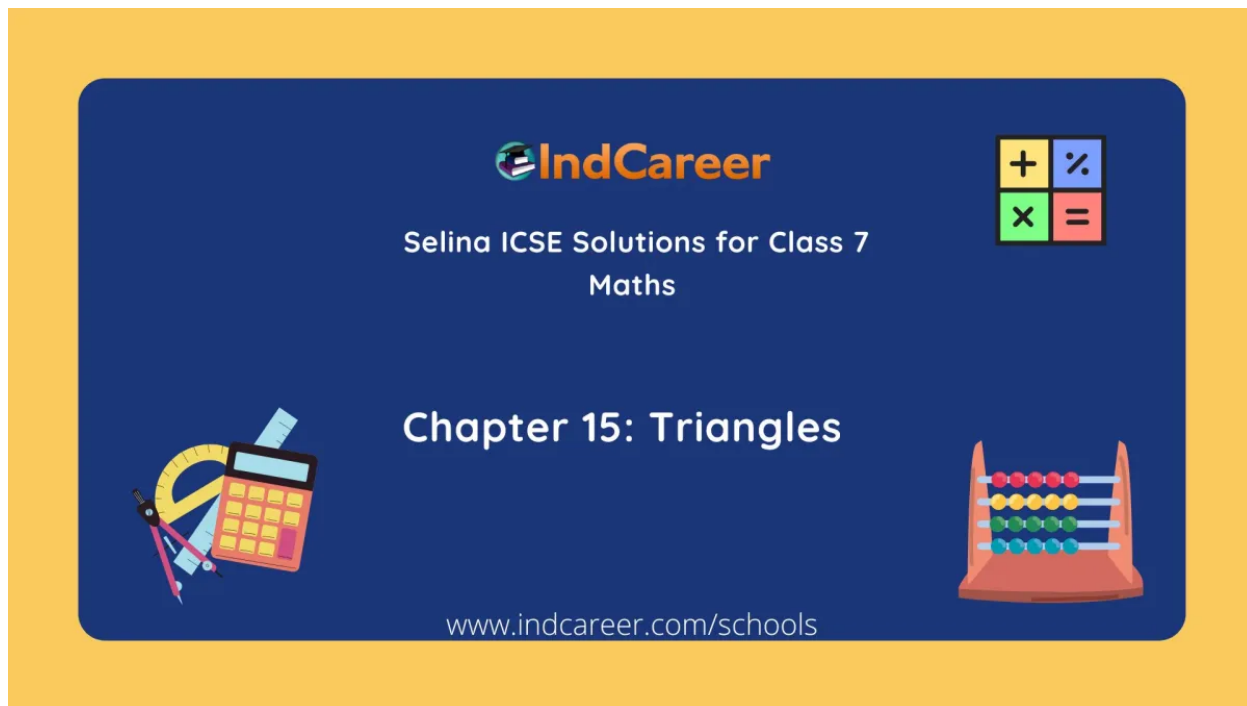


Selina Class 7 ICSE Solutions Mathematics : Chapter 15- Triangles



For any clarifications or questions you can write to **info@indcareer.com**

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Chapter 15- Triangles

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Selina Class 7 ICSE Solutions Mathematics : Chapter 15- Triangles

Selina 7th Maths Chapter 15, Class 7 Maths Chapter 15 solutions

Exercise 15A page: 176

1. State, if the triangles are possible with the following angles :

(i) 20° , 70° and 90°

(ii) 40° , 130° and 20°

(iii) 60° , 60° and 50°

(iv) 125° , 40° and 15°

Solution:

In a triangle, the sum of three angles is 180°

(i) 20° , 70° and 90°

$$\text{Sum} = 20^\circ + 70^\circ + 90^\circ = 180^\circ$$

Here the sum is 180° and therefore it is possible.

(ii) 40° , 130° and 20°

$$\text{Sum} = 40^\circ + 130^\circ + 20^\circ = 190^\circ$$

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Here the sum is not 180° and therefore it is not possible.

(iii) 60° , 60° and 50°

$$\text{Sum} = 60^\circ + 60^\circ + 50^\circ = 170^\circ$$

Here the sum is not 180° and therefore it is not possible.

(iv) 125° , 40° and 15°

$$\text{Sum} = 125^\circ + 40^\circ + 15^\circ = 180^\circ$$

Here the sum is 180° and therefore it is possible.

2. If the angles of a triangle are equal, find its angles.

Solution:

In a triangle, the sum of three angles is 180°

$$\text{So each angle} = 180^\circ / 3 = 60^\circ$$

3. In a triangle ABC, $\angle A = 45^\circ$ and $\angle B = 75^\circ$, find $\angle C$.

Solution:

In a triangle, the sum of three angles is 180°

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

Substituting the values

$$45^\circ + 75^\circ + \angle C = 180^\circ$$

By further calculation

$$120^\circ + \angle C = 180^\circ$$

So we get

$$\angle C = 180^\circ - 120^\circ = 60^\circ$$

4. In a triangle PQR, $\angle P = 60^\circ$ and $\angle Q = \angle R$, find $\angle R$.

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Solution:

Consider $\angle Q = \angle R = x$

$$\angle P = 60^\circ$$

We can write it as

$$\angle P + \angle Q + \angle R = 180^\circ$$

Substituting the values

$$60^\circ + x + x = 180^\circ$$

By further calculation

$$60^\circ + 2x = 180^\circ$$

$$2x = 180^\circ - 60^\circ = 120^\circ$$

So we get

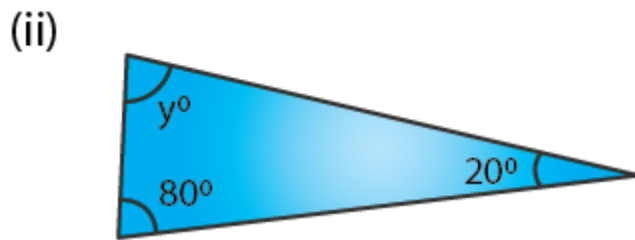
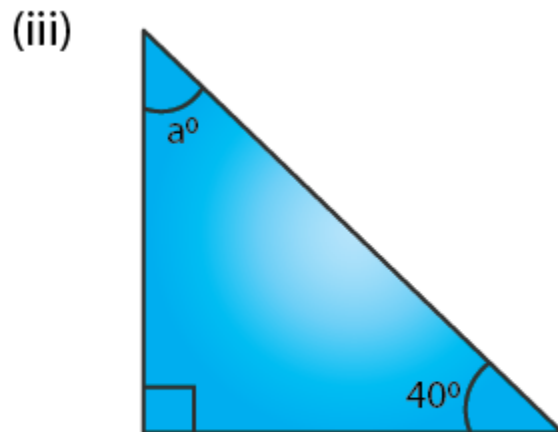
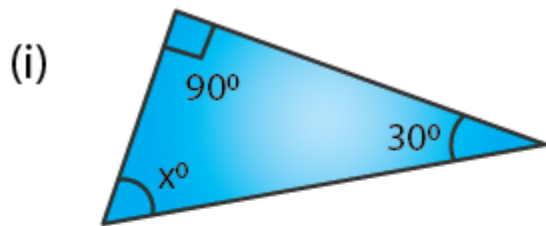
$$x = 120^\circ / 2 = 60^\circ$$

$$\angle Q = \angle R = 60^\circ$$

Therefore, $\angle R = 60^\circ$.

5. Calculate the unknown marked angles in each figure:

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**Solution:**

In a triangle, the sum of three angles is 180°

(i) From figure (i)

$$90^\circ + 30^\circ + x = 180^\circ$$

By further calculation

$$120^\circ + x = 180^\circ$$

So we get

$$x = 180^\circ - 120^\circ = 60^\circ$$

Therefore, $x = 60^\circ$.

(ii) From figure (ii)

$$y + 80^\circ + 20^\circ = 180^\circ$$

By further calculation

$$y + 100^\circ = 180^\circ$$

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So we get

$$y = 180^\circ - 100^\circ = 80^\circ$$

Therefore, $y = 80^\circ$.

(iii) From figure (iii)

$$a + 90^\circ + 40^\circ = 180^\circ$$

By further calculation

$$a + 130^\circ = 180^\circ$$

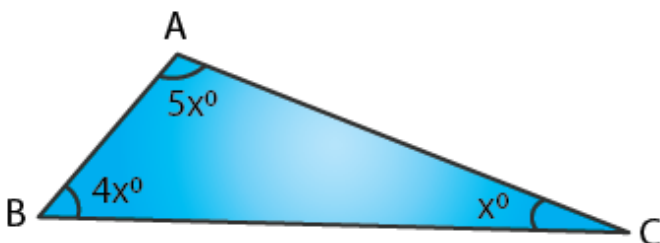
So we get

$$a = 180^\circ - 130^\circ = 50^\circ$$

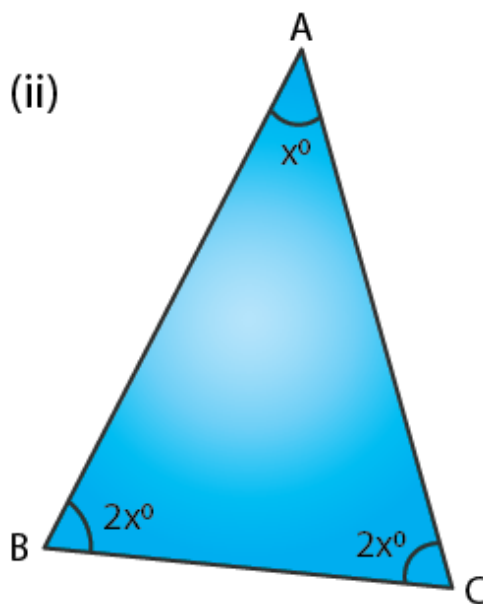
Therefore, $a = 50^\circ$.

6. Find the value of each angle in the given figures:

(i)



(ii)



Solution:

(i) From the figure (i)

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

Substituting the values

$$5x^\circ + 4x^\circ + x^\circ = 180^\circ$$

By further calculation

$$10x^\circ = 180^\circ$$

$$x = 180/10 = 18^\circ$$

So we get

$$\angle A = 5x^\circ = 5 \times 18^\circ = 90^\circ$$

$$\angle B = 4x^\circ = 4 \times 18^\circ = 72^\circ$$

$$\angle C = x = 18^\circ$$

(ii) From the figure (ii)

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

Substituting the values

$$x^\circ + 2x^\circ + 2x^\circ = 180^\circ$$

By further calculation

$$5x^\circ = 180^\circ$$

$$x^\circ = 180^\circ/5 = 36^\circ$$

So we get

$$\angle A = x^\circ = 36^\circ$$

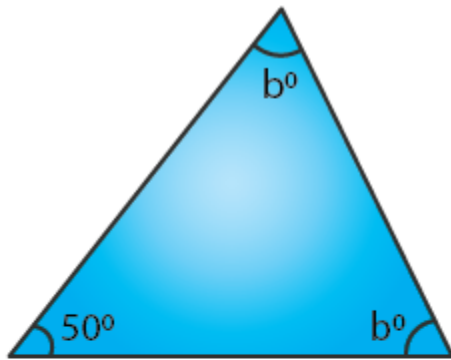
$$\angle B = 2x^\circ = 2 \times 36^\circ = 72^\circ$$

$$\angle C = 2x^\circ = 2 \times 36^\circ = 72^\circ$$

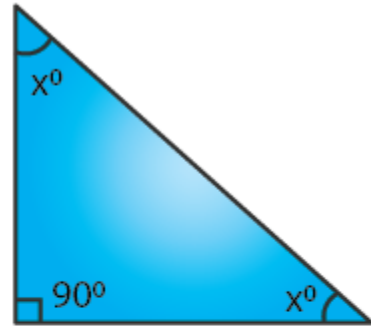
7. Find the unknown marked angles in the given figure:

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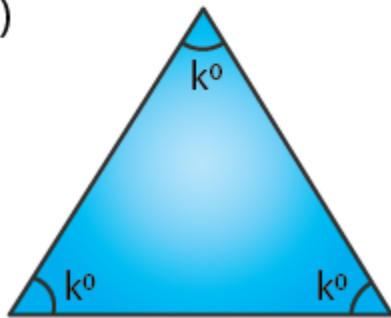
(i)



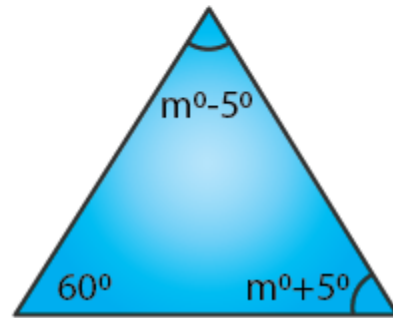
(ii)



(iii)



(iv)

**Solution:**

(i) From the figure (i)

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

Substituting the values

$$b^\circ + 50^\circ + b^\circ = 180^\circ$$

By further calculation

$$2b^\circ = 180^\circ - 50^\circ = 130^\circ$$

$$b^\circ = 130^\circ / 2 = 65^\circ$$

Therefore, $\angle A = \angle C = b^\circ = 65^\circ$.

(ii) From the figure (ii)

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

Substituting the values

$$x^\circ + 90^\circ + x^\circ = 180^\circ$$

By further calculation

$$2x^\circ = 180^\circ - 90^\circ = 90^\circ$$

$$x^\circ = 90^\circ / 2 = 45^\circ$$

Therefore, $\angle A = \angle C = x^\circ = 45^\circ$.

(iii) From the figure (iii)

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

Substituting the values

$$k^\circ + k^\circ + k^\circ = 180^\circ$$

By further calculation

$$3k^\circ = 180^\circ$$

$$k^\circ = 180^\circ / 3 = 60^\circ$$

Therefore, $\angle A = \angle B = \angle C = 60^\circ$.

(iv) From the figure (iv)

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

Substituting the values

$$(m^\circ - 5^\circ) + 60^\circ + (m^\circ + 5^\circ) = 180^\circ$$

By further calculation

$$m^\circ - 5^\circ + 60^\circ + m^\circ + 5^\circ = 180^\circ$$

$$2m^\circ = 180^\circ - 60^\circ = 120^\circ$$

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$$m^{\circ} = 120^{\circ}/2 = 60^{\circ}$$

$$\text{Therefore, } \angle A = m^{\circ} - 5^{\circ} = 60^{\circ} - 5^{\circ} = 55^{\circ}$$

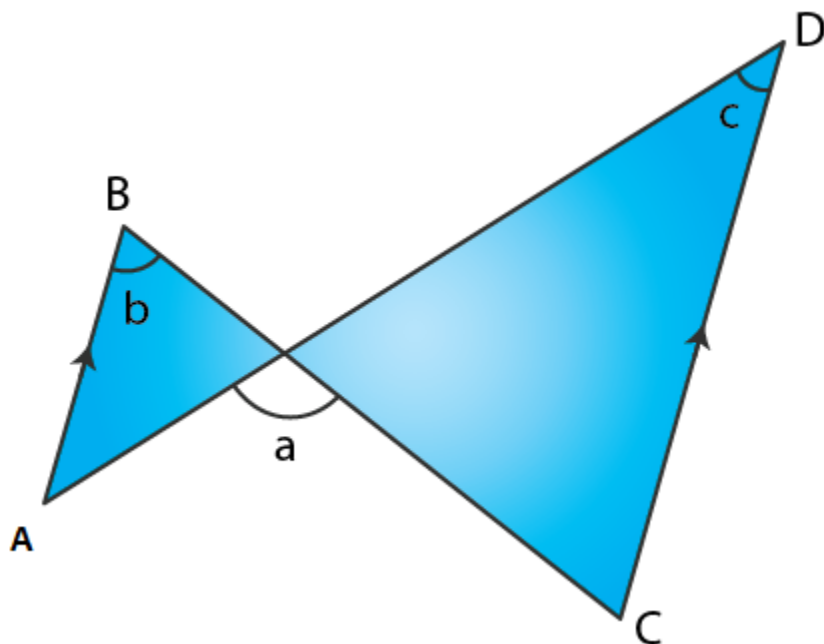
$$\angle C = m^{\circ} + 5^{\circ} = 60^{\circ} + 5^{\circ} = 65^{\circ}$$

8. In the given figure, show that: $\angle a = \angle b + \angle c$

(i) If $\angle b = 60^{\circ}$ and $\angle c = 50^{\circ}$; find $\angle a$.

(ii) If $\angle a = 100^{\circ}$ and $\angle b = 55^{\circ}$; find $\angle c$.

(iii) If $\angle a = 108^{\circ}$ and $\angle c = 48^{\circ}$; find $\angle b$.



Solution:

From the figure

$AB \parallel CD$

$b = \angle C$ and $\angle A = c$ are alternate angles

In triangle PCD

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$$\text{Exterior } \angle APC = \angle C + \angle D$$

$$a = b + c$$

$$(i) \text{ If } \angle b = 60^\circ \text{ and } \angle c = 50^\circ$$

$$\angle a = \angle b + \angle c$$

Substituting the values

$$\angle a = 60 + 50 = 110^\circ$$

$$(ii) \text{ If } \angle a = 100^\circ \text{ and } \angle b = 55^\circ$$

$$\angle a = \angle b + \angle c$$

Substituting the values

$$\angle c = 100 - 55 = 45^\circ$$

$$(iii) \text{ If } \angle a = 108^\circ \text{ and } \angle c = 48^\circ$$

$$\angle a = \angle b + \angle c$$

Substituting the values

$$\angle b = 108 - 48 = 60^\circ$$

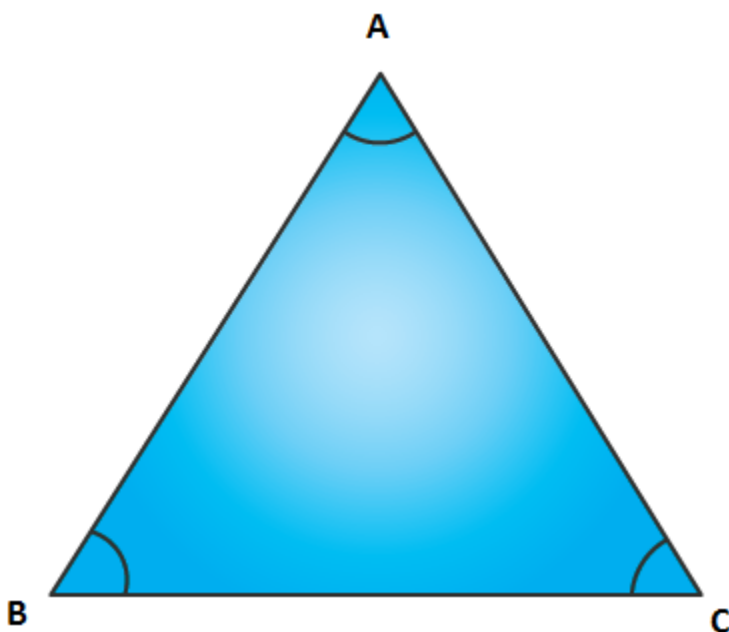
9. Calculate the angles of a triangle if they are in the ratio 4 : 5 : 6.

Solution:

In a triangle, the sum of angles of a triangle is 180°

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

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It is given that

$$\angle A : \angle B : \angle C = 4 : 5 : 6$$

Consider $\angle A = 4x$, $\angle B = 5x$ and $\angle C = 6x$

Substituting the values

$$4x + 5x + 6x = 180^\circ$$

By further calculation

$$15x = 180^\circ$$

$$x = 180^\circ / 15 = 12^\circ$$

So we get

$$\angle A = 4x = 4 \times 12^\circ = 48^\circ$$

$$\angle B = 5x = 5 \times 12^\circ = 60^\circ$$

$$\angle C = 6x = 6 \times 12^\circ = 72^\circ$$

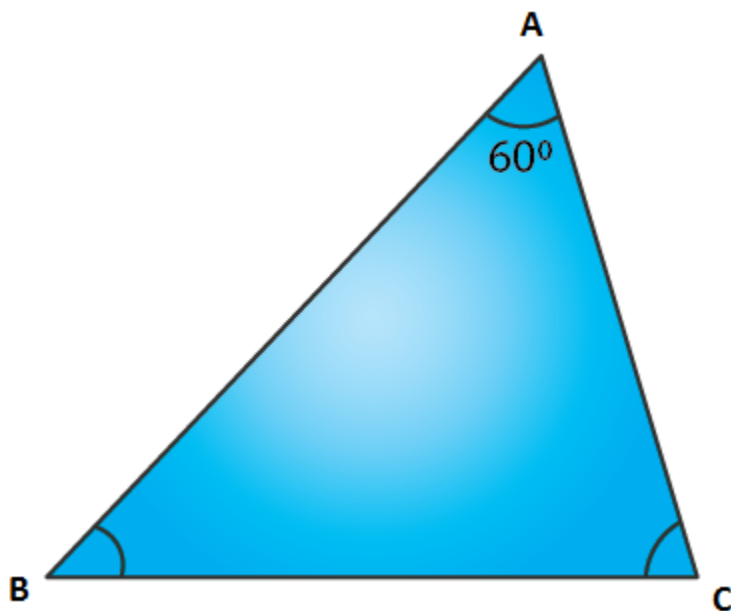
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10. One angle of a triangle is 60° . The, other two angles are in the ratio of 5 : 7. Find the two angles.

Solution:

From the triangle ABC

Consider $\angle A = 60^\circ$, $\angle B : \angle C = 5:7$



In a triangle

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

Substituting the values

$$60^\circ + \angle B + \angle C = 180^\circ$$

By further calculation

$$\angle B + \angle C = 180^\circ - 60^\circ = 120^\circ$$

Take $\angle B = 5x$ and $\angle C = 7x$

Substituting the values

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$$5x + 7x = 120^\circ$$

$$12x = 120^\circ$$

$$x = 120^\circ/12 = 10^\circ$$

So we get

$$\angle B = 5x = 5 \times 10^\circ = 50^\circ$$

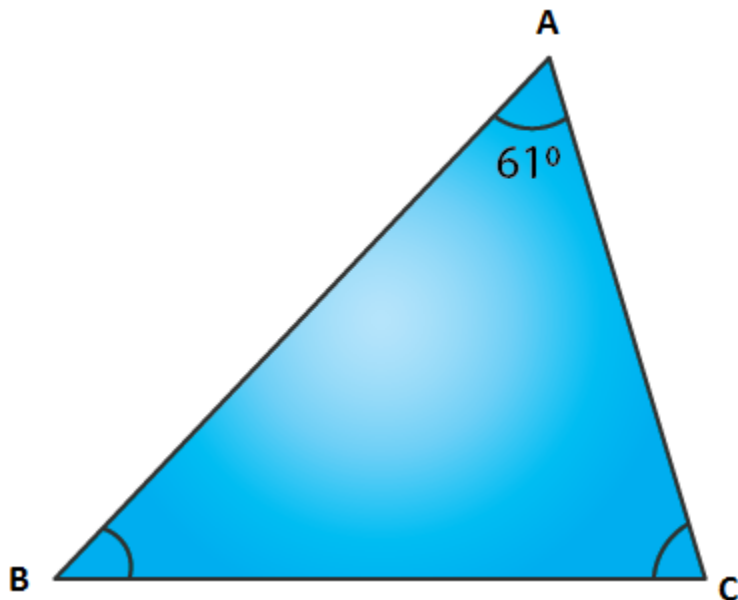
$$\angle C = 7x = 7 \times 10^\circ = 70^\circ$$

11. One angle of a triangle is 61° and the other two angles are in the ratio $1\frac{1}{2} : 1\frac{1}{3}$. Find these angles.

Solution:

From the triangle ABC

Consider $\angle A = 61^\circ$



In a triangle

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

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Substituting the values

$$61^{\circ} + \angle B + \angle C = 180^{\circ}$$

By further calculation

$$\angle B + \angle C = 180^{\circ} - 61^{\circ} = 119^{\circ}$$

$$\angle B : \angle C = 1 \frac{1}{2} : 1 \frac{1}{3} = 3/2 : 4/3$$

Taking LCM

$$\angle B : \angle C = 9/6 : 8/6$$

$$\angle B : \angle C = 9 : 8$$

Consider $\angle B = 9x$ and $\angle C = 8x$

Substituting the values

$$9x + 8x = 119^{\circ}$$

$$17x = 119^{\circ}$$

$$x = 119^{\circ} / 17 = 7^{\circ}$$

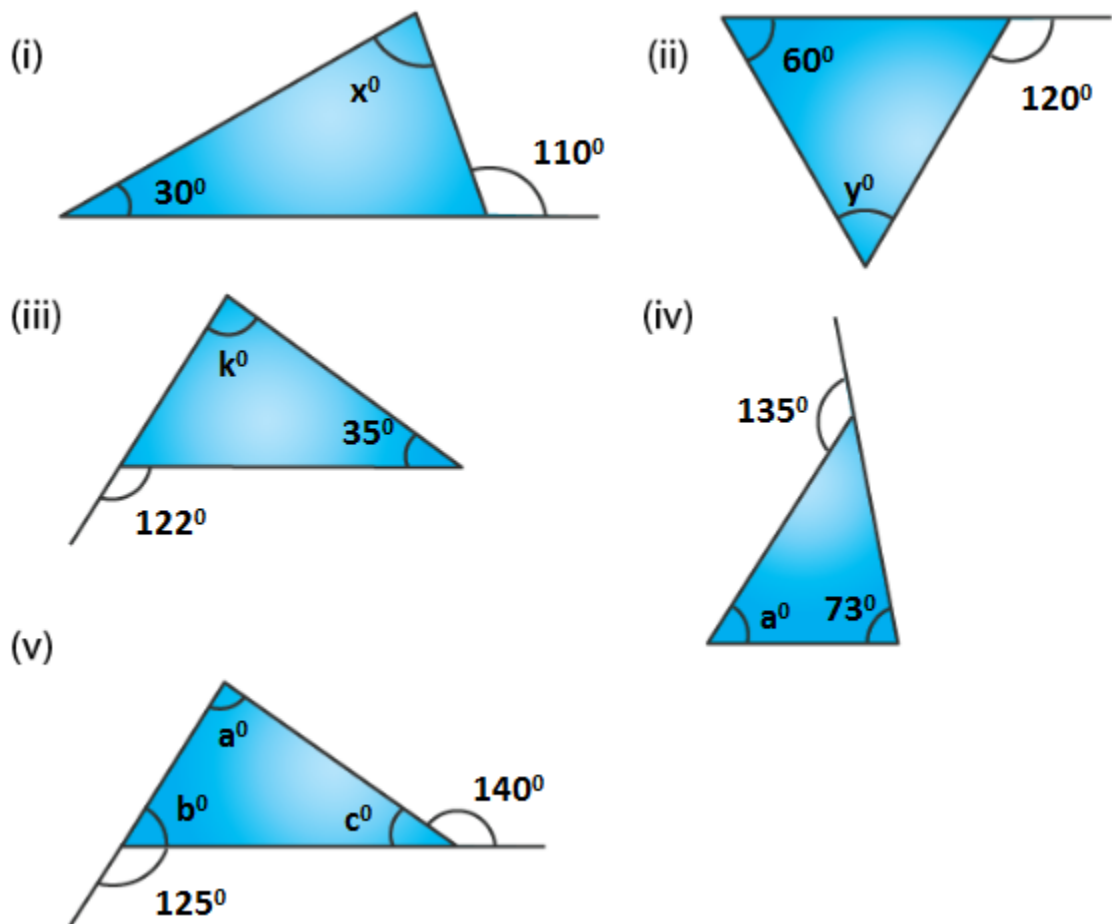
So we get

$$\angle B = 9x = 9 \times 7^{\circ} = 63^{\circ}$$

$$\angle C = 8x = 8 \times 7^{\circ} = 56^{\circ}$$

12. Find the unknown marked angles in the given figures:

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**Solution:**

In a triangle, if one side is produced

Exterior angle is the sum of opposite interior angles

(i) From the figure (i)

$$110^\circ = x^\circ + 30^\circ$$

By further calculation

$$x^\circ = 110^\circ - 30^\circ = 80^\circ$$

(ii) From the figure (ii)

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$$120^\circ = y^\circ + 60^\circ$$

By further calculation

$$y^\circ = 120^\circ - 60^\circ = 60^\circ$$

(iii) From the figure (iii)

$$122^\circ = k^\circ + 35^\circ$$

By further calculation

$$k^\circ = 122^\circ - 35^\circ = 87^\circ$$

(iv) From the figure (iv)

$$135^\circ = a^\circ + 73^\circ$$

By further calculation

$$a^\circ = 135^\circ - 73^\circ = 62^\circ$$

(v) From the figure (v)

$$125^\circ = a + c \dots\dots (1)$$

$$140^\circ = a + b \dots\dots (2)$$

By adding both the equations

$$a + c + a + b = 125^\circ + 140^\circ$$

On further calculation

$$a + a + b + c = 265^\circ$$

We know that $a + b + c = 180^\circ$

Substituting it in the equation

$$a + 180^\circ = 265^\circ$$

So we get

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$$a = 265 - 180 = 85^{\circ}$$

$$\text{If } a + b = 140^{\circ}$$

Substituting it in the equation

$$85^{\circ} + b = 140^{\circ}$$

So we get

$$b = 140 - 85 = 55^{\circ}$$

$$\text{If } a + c = 125^{\circ}$$

Substituting it in the equation

$$85^{\circ} + c = 125^{\circ}$$

So we get

$$c = 125 - 85 = 40^{\circ}$$

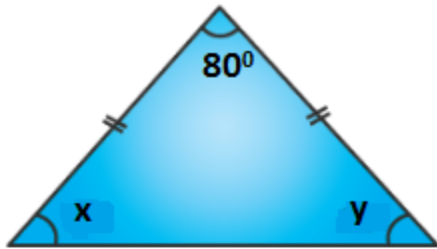
Therefore, $a = 85^{\circ}$, $b = 55^{\circ}$ and $c = 40^{\circ}$.

Exercise 15B page: 180

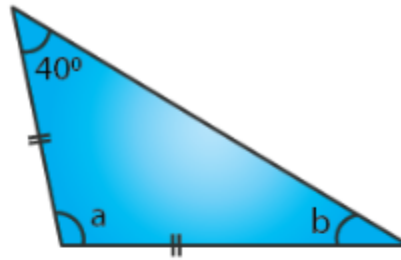
1. Find the unknown angles in the given figures:

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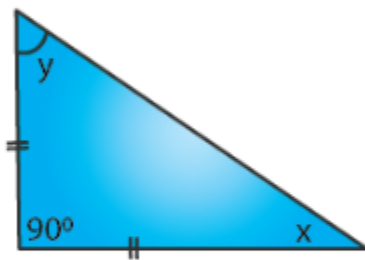
(i)



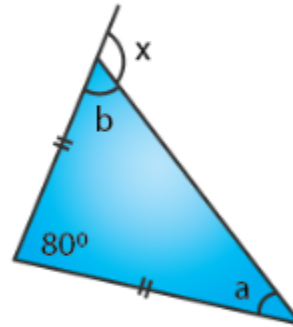
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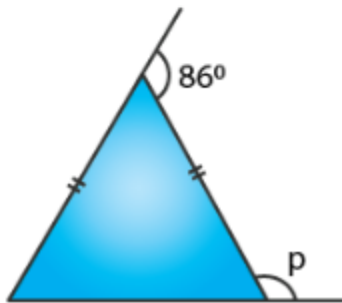
(iii)



(iv)



(v)



Solution:

(i) From the figure (i)

$x = y$ as the angles opposite to equal sides

In a triangle

$$x + y + 80^\circ = 180^\circ$$

Substituting the values

$$x + x + 80^\circ = 180^\circ$$

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By further calculation

$$2x = 180^\circ - 80^\circ = 100^\circ$$

$$x = 100^\circ/2 = 50^\circ$$

Therefore, $x = y = 50^\circ$.

(ii) From the figure (ii)

$b = 40^\circ$ as the angles opposite to equal sides

In a triangle

$$a + b + 40^\circ = 180^\circ$$

Substituting the values

$$a + 40^\circ + 40^\circ = 180^\circ$$

By further calculation

$$a = 180 - 80 = 100^\circ$$

Therefore, $a = 100^\circ$ and $b = 40^\circ$.

(iii) From the figure (iii)

$x = y$ as the angles opposite to equal sides

In a triangle

$$x + y + 90^\circ = 180^\circ$$

Substituting the values

$$x + x + 90^\circ = 180^\circ$$

By further calculation

$$2x = 180 - 90 = 90^\circ$$

$$x = 90/2 = 45^\circ$$

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Therefore, $x = y = 45^\circ$.

(iv) From the figure (iv)

$a = b$ as the angles opposite to equal sides are equal

In a triangle

$$a + b + 80^\circ = 180^\circ$$

Substituting the values

$$a + a + 80^\circ = 180^\circ$$

By further calculation

$$2a = 180 - 80 = 100^\circ$$

$$a = 100^\circ/2 = 50^\circ$$

$$\text{Here } a = b = 50^\circ$$

We know that in a triangle the exterior angle is equal to sum of its opposite interior angles

$$x = a + 80^\circ$$

So we get

$$x = 50 + 80 = 130^\circ$$

Therefore, $a = 50^\circ$, $b = 50^\circ$ and $x = 130^\circ$.

(v) From the figure (v)

In an isosceles triangle consider each equal angle = x

$$x + x = 86^\circ$$

$$2x = 86^\circ$$

So we get

$$x = 86^\circ/2 = 43^\circ$$

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For a linear pair

$$p + x = 180^\circ$$

Substituting the values

$$p + 43^\circ = 180^\circ$$

By further calculation

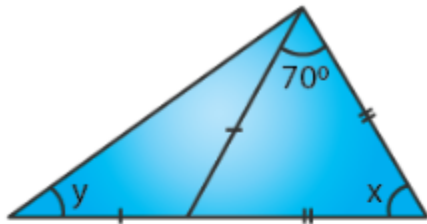
$$p = 180 - 43 = 137^\circ$$

Therefore, $p = 137^\circ$.

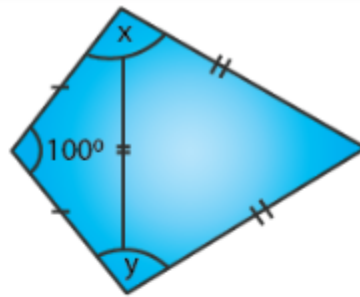
2. Apply the properties of isosceles and equilateral triangles to find the unknown angles in the given figures:

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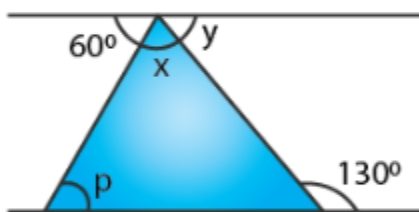
(i)



(ii)



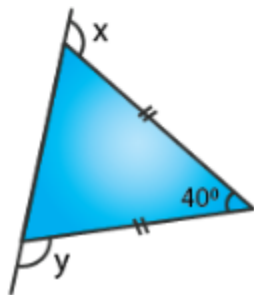
(iii)



(iv)



(v)



Solution:

(i) $a = 70^\circ$ as the angles opposite to equal sides are equal

In a triangle

$$a + 70^\circ + x = 180^\circ$$

Substituting the values

$$70^\circ + 70^\circ + x = 180^\circ$$

By further calculation

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$$x = 180 - 140 = 40^\circ$$

$y = b$ as the angles opposite to equal sides are equal

Here $a = y + b$ as the exterior angle is equal to sum of interior opposite angles

$$70^\circ = y + y$$

So we get

$$2y = 70^\circ$$

$$y = 70^\circ/2 = 35^\circ$$

Therefore, $x = 40^\circ$ and $y = 35^\circ$.

(ii) From the figure (ii)

Each angle is 60° in an equilateral triangle

In an isosceles triangle

Consider each base angle = a

$$a + a + 100^\circ = 180^\circ$$

By further calculation

$$2a = 180 - 100 = 80^\circ$$

So we get

$$a = 80^\circ/2 = 40^\circ$$

$$x = 60^\circ + 40^\circ = 100^\circ$$

$$y = 60^\circ + 40^\circ = 100^\circ$$

(iii) From the figure (iii)

$130^\circ = x + p$ as the exterior angle is equal to the sum of interior opposite angles

It is given that the lines are parallel

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Here $p = 60^\circ$ is the alternate angles and $y = a$

In a linear pair

$$a + 130^\circ = 180^\circ$$

By further calculation

$$a = 180 - 130 = 50^\circ$$

Here $x + p = 130^\circ$

Substituting the values

$$x + 60^\circ = 130^\circ$$

By further calculation

$$x = 130 - 60 = 70^\circ$$

Therefore, $x = 70^\circ$, $y = 50^\circ$ and $p = 60^\circ$.

(iv) From the figure (iv)

$$x = a + b$$

Here $b = y$ and $a = c$ as the angles opposite to equal sides are equal

$$a + c + 30^\circ = 180^\circ$$

Substituting the values

$$a + a + 30^\circ = 180^\circ$$

By further calculation

$$2a = 180 - 30 = 150^\circ$$

$$a = 150/2 = 75^\circ$$

We know that

$$b + y = 90^\circ$$

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Substituting the values

$$y + y = 90^\circ$$

$$2y = 90^\circ$$

$$y = 90/2 = 45^\circ$$

$$\text{where } b = 45^\circ$$

Therefore, $x = a + b = 75 + 45 = 120^\circ$ and $y = 45^\circ$.

(v) From the figure (v)

$$a + b + 40^\circ = 180^\circ$$

So we get

$$a + b = 180 - 40 = 140^\circ$$

The angles opposite to equal sides are equal

$$a = b = 140/2 = 70^\circ$$

$$x = b + 40^\circ = 70^\circ + 40^\circ = 110^\circ$$

Here the exterior angle of a triangle is equal to the sum of its interior opposite angles

In the same way

$$y = a + 40^\circ$$

Substituting the values

$$y = 70^\circ + 40^\circ = 110^\circ$$

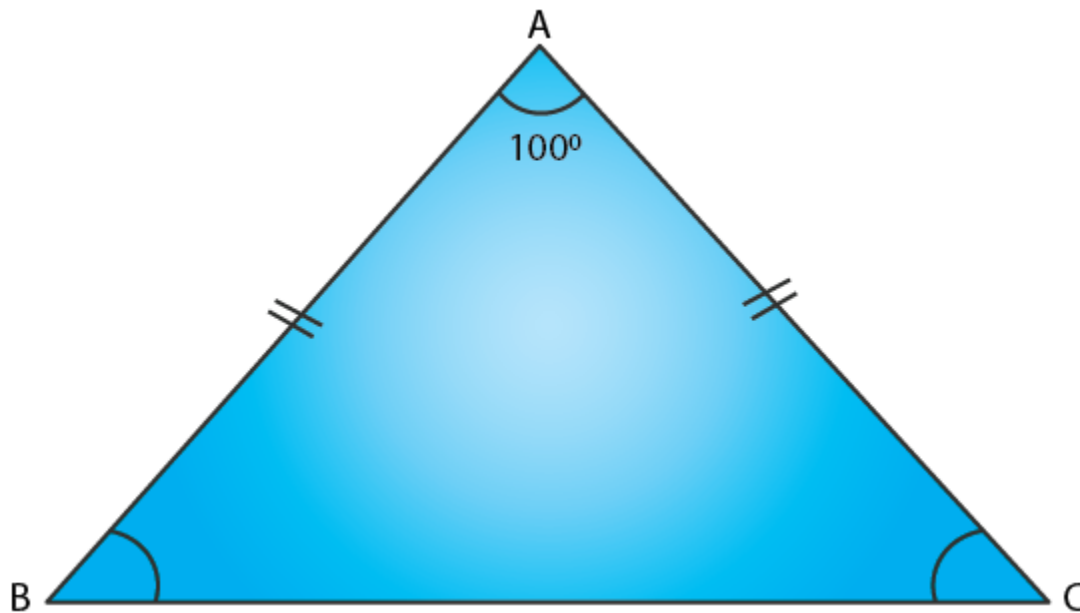
Therefore, $x = y = 110^\circ$.

3. The angle of vertex of an isosceles triangle is 100° . Find its base angles.

Solution:

Consider $\triangle ABC$

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Here $AB = AC$ and $\angle B = \angle C$

We know that

$$\angle A = 100^\circ$$

In a triangle

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

Substituting the values

$$100^\circ + \angle B + \angle B = 180^\circ$$

By further calculation

$$2\angle B = 180^\circ - 100^\circ = 80^\circ$$

$$\angle B = 80/2 = 40^\circ$$

Therefore, $\angle B = \angle C = 40^\circ$.

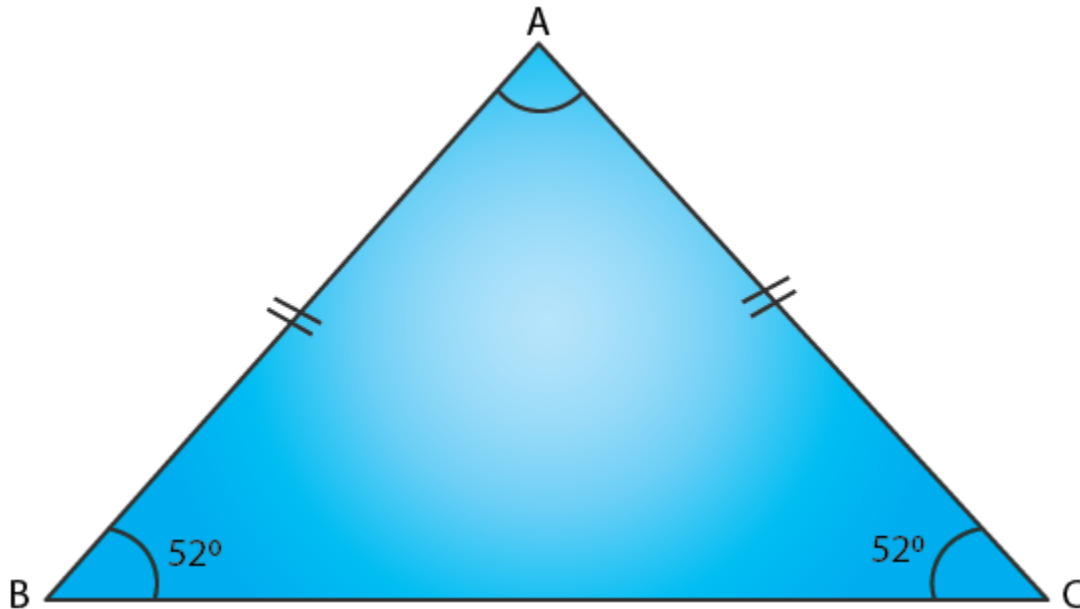
4. One of the base angles of an isosceles triangle is 52° . Find its angle of vertex.

Solution:

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It is given that the base angles of isosceles triangle $ABC = 52^\circ$

Here $\angle B = \angle C = 52^\circ$



In a triangle

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

Substituting the values

$$\angle A + 52^\circ + 52^\circ = 180^\circ$$

By further calculation

$$\angle A = 180 - 104 = 76^\circ$$

Therefore, $\angle A = 76^\circ$.

5. In an isosceles triangle, each base angle is four times of its vertical angle. Find all the angles of the triangle.

Solution:

Consider the vertical angle of an isosceles triangle = x

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So the base angle = $4x$

In a triangle

$$x + 4x + 4x = 180^\circ$$

By further calculation

$$9x = 180^\circ$$

$$x = 180/9 = 20^\circ$$

So the vertical angle = 20°

$$\text{Each base angle} = 4x = 4 \times 20^\circ = 80^\circ$$

6. The vertical angle of an isosceles triangle is 15° more than each of its base angles. Find each angle of the triangle.

Solution:

Consider the angle of the base of isosceles triangle = x°

So the vertical angle = $x + 15^\circ$

In a triangle

$$x + x + x + 15^\circ = 180^\circ$$

By further calculation

$$3x = 180 - 15 = 165^\circ$$

$$x = 165/3 = 55^\circ$$

Therefore, the base angle = 55°

Vertical angle = $55 + 15 = 70^\circ$.

7. The base angle of an isosceles triangle is 15° more than its vertical angle. Find its each angle.

Solution:

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Consider the vertical angle of the isosceles triangle = x°

Here each base angle = $x + 15^\circ$

In a triangle

$$x + 15^\circ + x + 15^\circ + x = 180^\circ$$

By further calculation

$$3x + 30^\circ = 180^\circ$$

$$3x = 180 - 30 = 150^\circ$$

$$x = 150/3 = 50^\circ$$

Therefore, vertical angle = 50° and each base angle = $50 + 15 = 65^\circ$.

8. The vertical angle of an isosceles triangle is three times the sum of its base angles. Find each angle.

Solution:

Consider each base angle of an isosceles triangle = x

$$\text{Vertical angle} = 3(x + x) = 3(2x) = 6x$$

In a triangle

$$6x + x + x = 180^\circ$$

By further calculation

$$8x = 180^\circ$$

$$x = 180/8 = 22.5^\circ$$

Therefore, each base angle = 22.5° and vertical angle = $3(22.5 + 22.5) = 3 \times 45 = 135^\circ$.

9. The ratio between a base angle and the vertical angle of an isosceles triangle is 1 : 4. Find each angle of the triangle.

Solution:

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It is given that the ratio between a base angle and the vertical angle of an isosceles triangle = 1:4

Consider base angle = x

Vertical angle = $4x$

In a triangle

$$x + x + 4x = 180^\circ$$

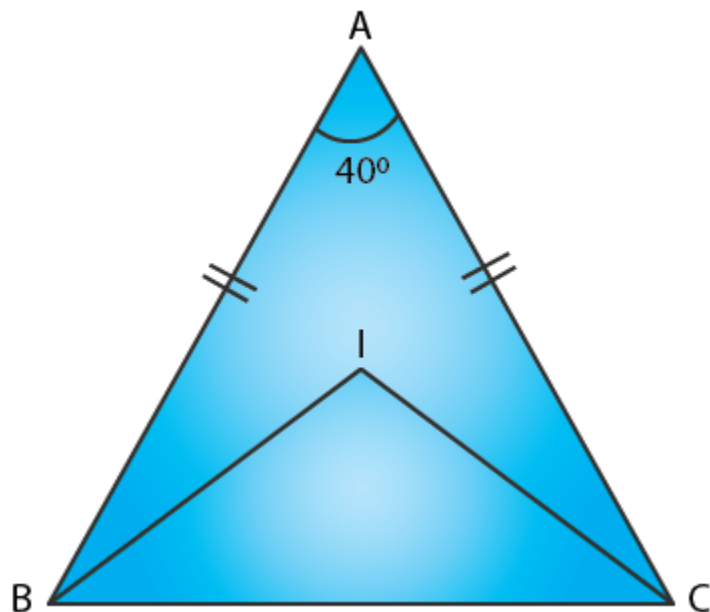
By further calculation

$$6x = 180^\circ$$

$$x = 180/6 = 30^\circ$$

Therefore, each base angle = $x = 30^\circ$ and vertical angle = $4x = 4 \times 30^\circ = 120^\circ$.

10. In the given figure, BI is the bisector of $\angle ABC$ and CI is the bisector of $\angle ACB$. Find $\angle BIC$.



Solution:

In $\triangle ABC$

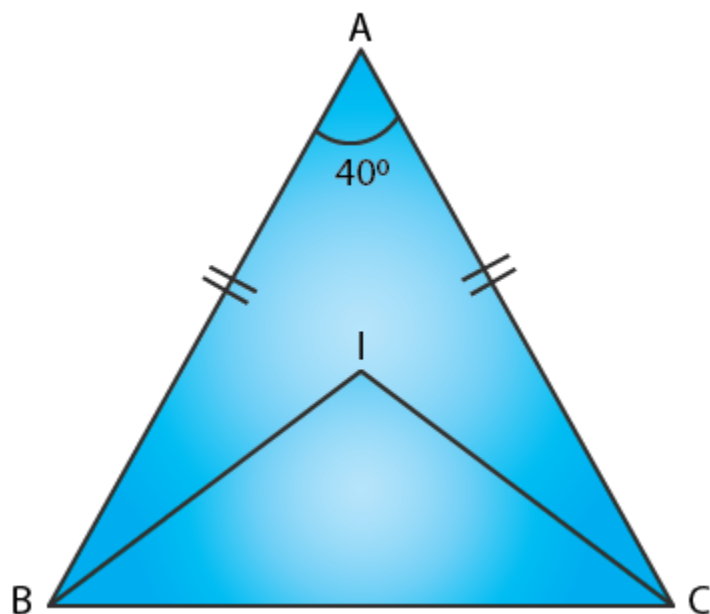
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BI is the bisector of $\angle ABC$ and CI is the bisector of $\angle ACB$

Here $AB = AC$

$\angle B = \angle C$ as the angles opposite to equal sides are equal

We know that $\angle A = 40^\circ$



In a triangle

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

Substituting the values

$$40^\circ + \angle B + \angle B = 180^\circ$$

By further calculation

$$40^\circ + 2\angle B = 180^\circ$$

$$2\angle B = 180 - 40 = 140^\circ$$

$$\angle B = 140/2 = 70^\circ$$

Here BI and CI are the bisectors of $\angle ABC$ and $\angle ACB$

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$$\angle IBC = \frac{1}{2} \angle ABC = \frac{1}{2} \times 70^\circ = 35^\circ$$

$$\angle ICB = \frac{1}{2} \angle ACB = \frac{1}{2} \times 70^\circ = 35^\circ$$

In $\triangle IBC$

$$\angle BIC + \angle IBC + \angle ICB = 180^\circ$$

Substituting the values

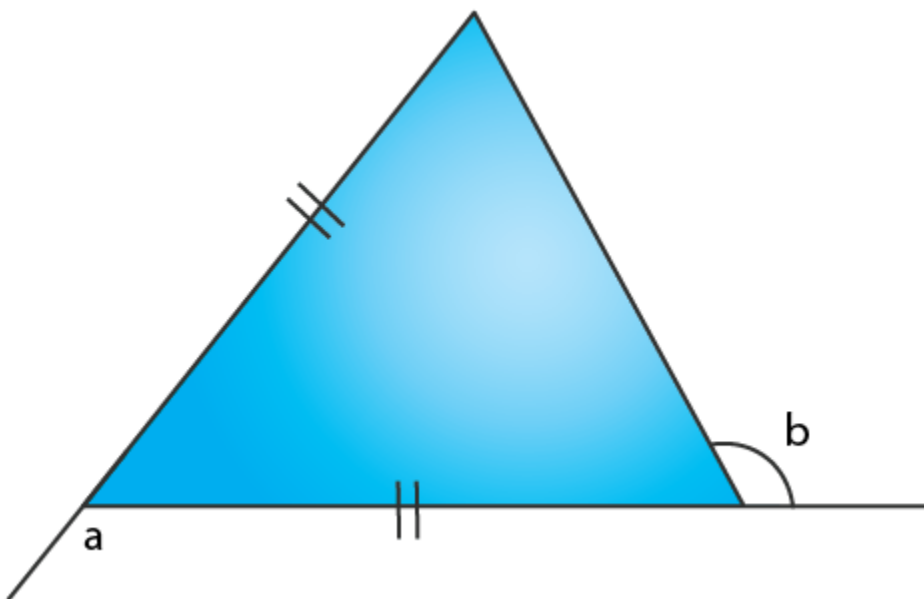
$$\angle BIC + 35^\circ + 35^\circ = 180^\circ$$

By further calculation

$$\angle BIC = 180 - 70 = 110^\circ$$

Therefore, $\angle BIC = 110^\circ$.

11. In the given figure, express a in terms of b.



Solution:

From the $\triangle ABC$

$$BC = BA$$

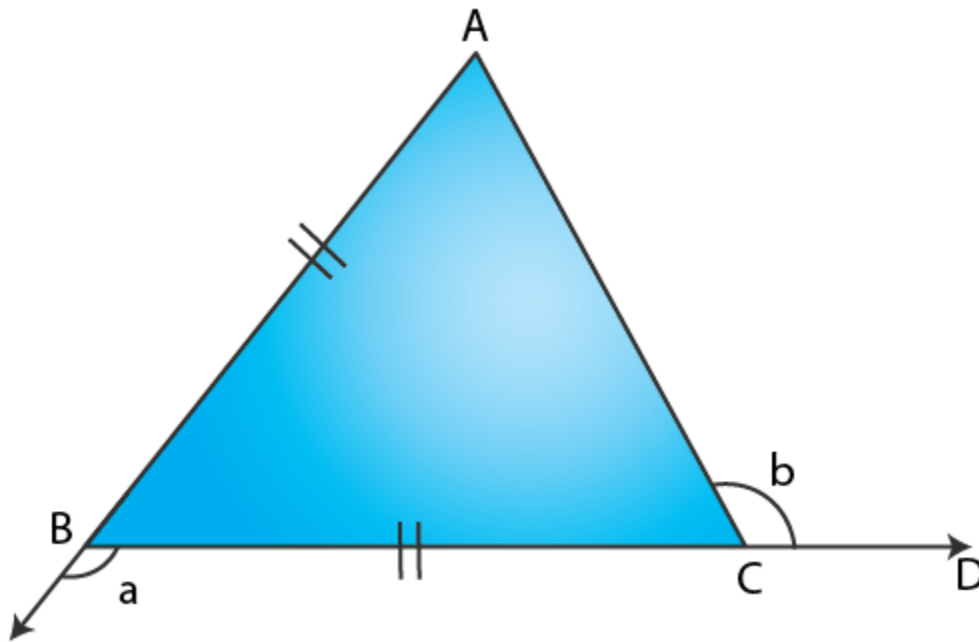
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$$\angle BCA = \angle BAC$$

Here the exterior $\angle CBE = \angle BCA + \angle BAC$

$$a = \angle BCA + \angle BCA$$

$$a = 2\angle BCA \dots\dots (1)$$



$$\text{Here } \angle ACB = 180^\circ - b$$

Where $\angle ACD$ and $\angle ACB$ are linear pair

$$\angle BCA = 180^\circ - b \dots\dots (2)$$

We get

$$a = 2\angle BCA$$

Substituting the values

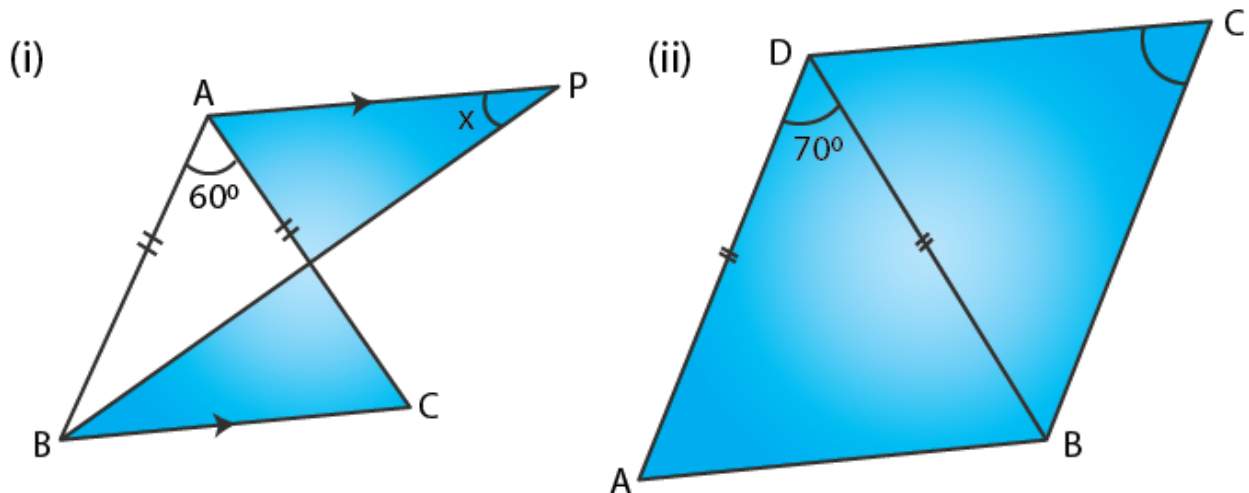
$$a = 2(180^\circ - b)$$

$$a = 360^\circ - 2b$$

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12. (a) In Figure (i) BP bisects $\angle ABC$ and $AB = AC$. Find x .

(b) Find x in Figure (ii) Given: $DA = DB = DC$, BD bisects $\angle ABC$ and $\angle ADB = 70^\circ$.



Solution:

(a) From the figure (i)

$AB = AC$ and BP bisects $\angle ABC$

AP is drawn parallel to BC

Here PB is the bisector of $\angle ABC$

$\angle PBC = \angle PBA$

$\angle APB = \angle PBC$ are alternate angles

$x = \angle PBC$ (1)

In $\triangle ABC$

$\angle A = 60^\circ$

Since $AB = AC$ we get $\angle B = \angle C$

In a triangle

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

Substituting the values

$$60^\circ + \angle B + \angle C = 180^\circ$$

We get

$$60^\circ + \angle B + \angle B = 180^\circ$$

By further calculation

$$2\angle B = 180 - 60 = 120^\circ$$

$$\angle B = 120/2 = 60^\circ$$

$$\frac{1}{2} \angle B = 60/2 = 30^\circ$$

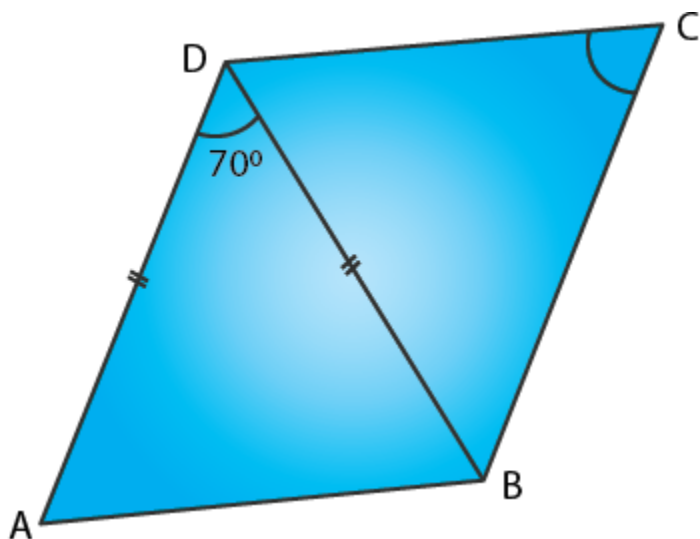
$$\angle PBC = 30^\circ$$

So from figure (i) $x = 30^\circ$

(b) From the figure (ii)

$$DA = DB = DC$$

Here BD bisects $\angle ABC$ and $\angle ADB = 70^\circ$



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In a triangle

$$\angle ADB + \angle DAB + \angle DBA = 180^\circ$$

Substituting the values

$$70^\circ + \angle DBA + \angle DBA = 180^\circ$$

By further calculation

$$70^\circ + 2\angle DBA = 180^\circ$$

$$2\angle DBA = 180 - 70 = 110^\circ$$

$$\angle DBA = 110/2 = 55^\circ$$

Here BD is the bisector of $\angle ABC$

$$\text{So } \angle DBA = \angle DBC = 55^\circ$$

In $\triangle DBC$

$$DB = DC$$

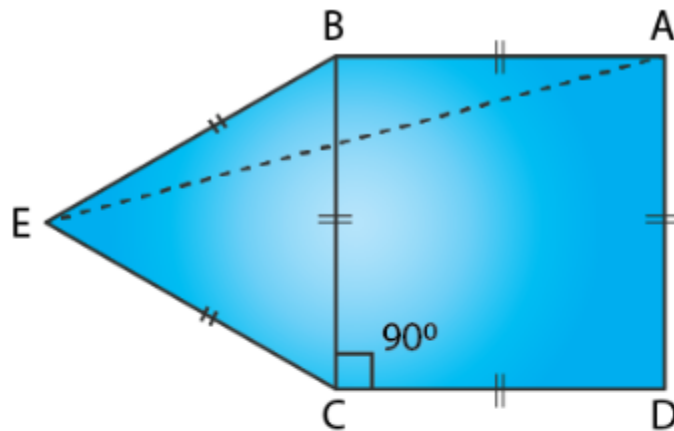
$$\angle DCB = \angle DBC$$

Hence, $x = 55^\circ$.

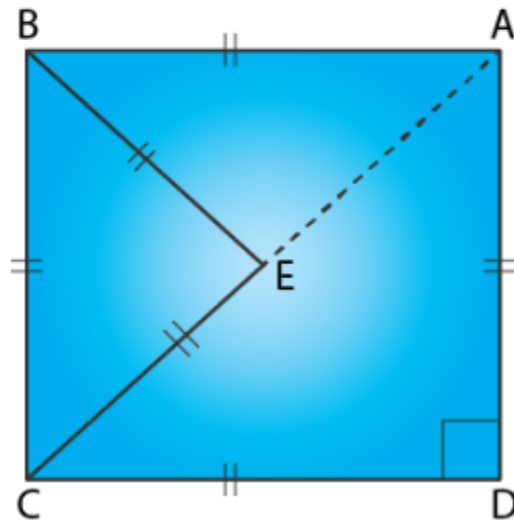
13. In each figure, given below, ABCD is a square and $\triangle BEC$ is an equilateral triangle.

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(i)



(ii)



Find, in each case: (i) $\angle ABE$ (ii) $\angle BAE$

Solution:

The sides of a square are equal and each angle is 90°

In an equilateral triangle all three sides are equal and all angles are 60°

In figure (i) ABCD is a square and $\triangle BEC$ is an equilateral triangle

(i) $\angle ABE = \angle ABC + \angle CBE$

Substituting the values

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$$\angle ABE = 90^\circ + 60^\circ = 150^\circ$$

(ii) In $\triangle ABE$

$$\angle ABE + \angle BEA + \angle BAE = 180^\circ$$

Substituting the values

$$150^\circ + \angle BAE + \angle BAE = 180^\circ$$

By further calculation

$$2\angle BAE = 180 - 150 = 30^\circ$$

$$\angle BAE = 30/2 = 15^\circ$$

In figure (ii) ABCD is a square and $\triangle BEC$ is an equilateral triangle

$$(i) \angle ABE = \angle ABC - \angle CBE$$

Substituting the values

$$\angle ABE = 90^\circ - 60^\circ = 30^\circ$$

(ii) In $\triangle ABE$

$$\angle ABE + \angle BEA + \angle BAE = 180^\circ$$

Substituting the values

$$30^\circ + \angle BAE + \angle BAE = 180^\circ$$

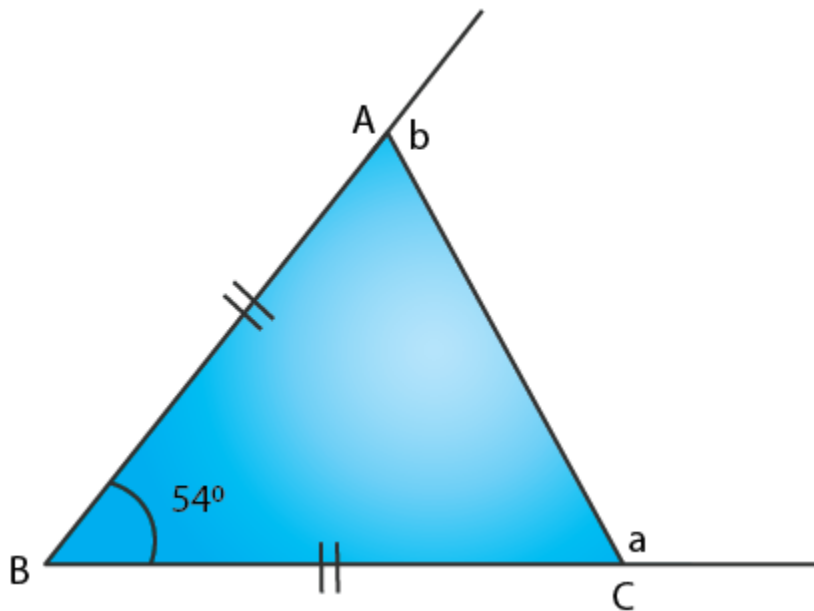
By further calculation

$$2\angle BAE = 180 - 30 = 150^\circ$$

$$\angle BAE = 150/2 = 75^\circ$$

14. In $\triangle ABC$, BA and BC are produced. Find the angles a and h. if $AB = BC$.

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**Solution:**

In $\triangle ABC$, BA and BC are produced

$\angle ABC = 54^\circ$ and $AB = BC$

In $\triangle ABC$

$$\angle BAC + \angle BCA + \angle ABC = 180^\circ$$

Substituting the values

$$\angle BAC + \angle BAC + 54^\circ = 180^\circ$$

$$2\angle BAC = 180 - 54 = 126^\circ$$

$$\angle BAC = 126/2 = 63^\circ$$

$$\angle BCA = 63^\circ$$

In a linear pair

$$\angle BAC + b = 180^\circ$$

Substituting the value

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$$63^\circ + b = 180^\circ$$

So we get

$$b = 180 - 63 = 117^\circ$$

In a linear pair

$$\angle BCA + a = 180^\circ$$

Substituting the value

$$63^\circ + a = 180^\circ$$

So we get

$$a = 180 - 63 = 117^\circ$$

Therefore, $a = b = 117^\circ$.

Exercise 15C page: 185

1. Construct a $\triangle ABC$ such that:

(i) $AB = 6$ cm, $BC = 4$ cm and $CA = 5.5$ cm

(ii) $CB = 6.5$ cm, $CA = 4.2$ cm and $BA = 5.1$ cm

(iii) $BC = 4$ cm, $AC = 5$ cm and $AB = 3.5$ cm

Solution:

(i) Steps of Construction

1. Construct a line segment $BC = 4$ cm.

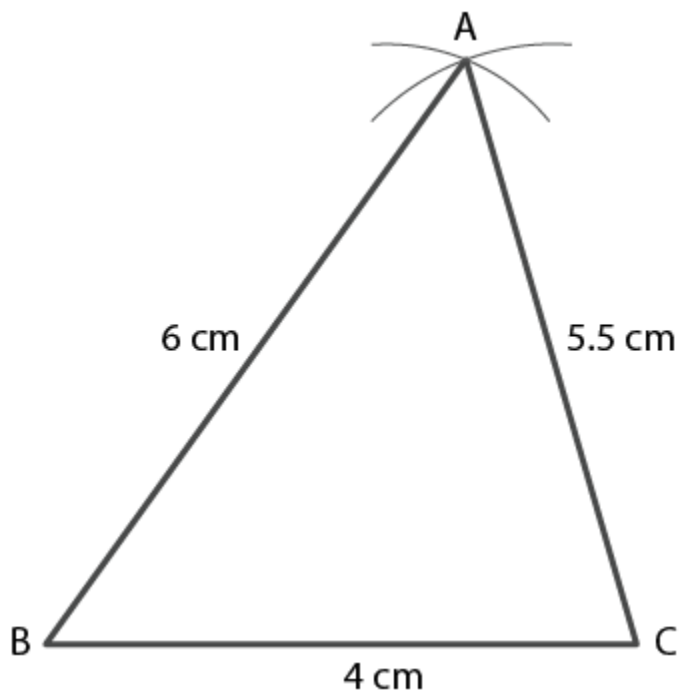
2. Taking B as centre and 6 cm as radius construct an arc.

3. Taking C as centre and 5.5 cm as radius construct another arc which intersects the first arc at the point A.

4. Now join AB and AC.

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Therefore, $\triangle ABC$ is the required triangle.

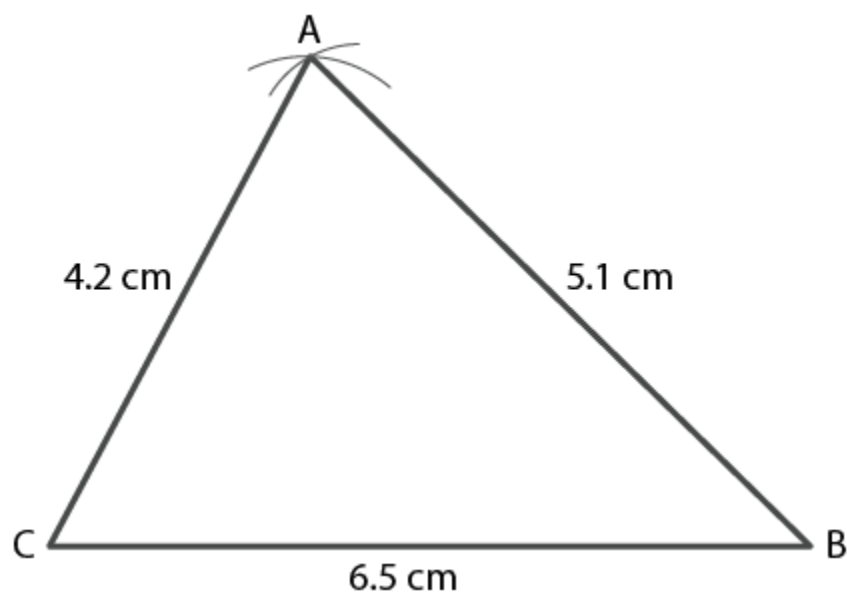


(ii) Steps of Construction

1. Construct a line segment $CB = 6.5$ cm
2. Taking C as centre and 4.2 cm as radius construct an arc.
3. Taking B as centre and 5.1 cm as radius construct another arc which intersects the first arc at the point A.
4. Now join AC and AB.

Therefore, $\triangle ABC$ is the required triangle.

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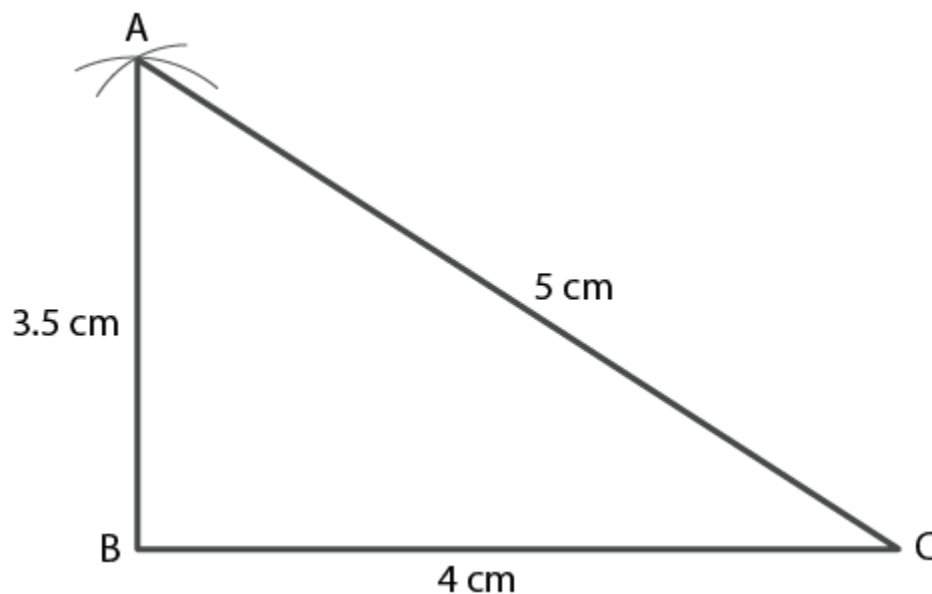


(iii) Steps of Construction

1. Construct a line segment $BC = 4$ cm
2. Taking B as centre and 3.5 cm as radius construct an arc.
3. Taking C as centre and 5 cm as radius construct another arc which intersects the first arc at the point A.
4. Now join AB and AC.

Therefore, $\triangle ABC$ is the required triangle.

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2. Construct a $\triangle ABC$ such that:

- (i) $AB = 7$ cm, $BC = 5$ cm and $\angle ABC = 60^\circ$**
- (ii) $BC = 6$ cm, $AC = 5.7$ cm and $\angle ACB = 75^\circ$**
- (iii) $AB = 6.5$ cm, $AC = 5.8$ cm and $\angle A = 45^\circ$**

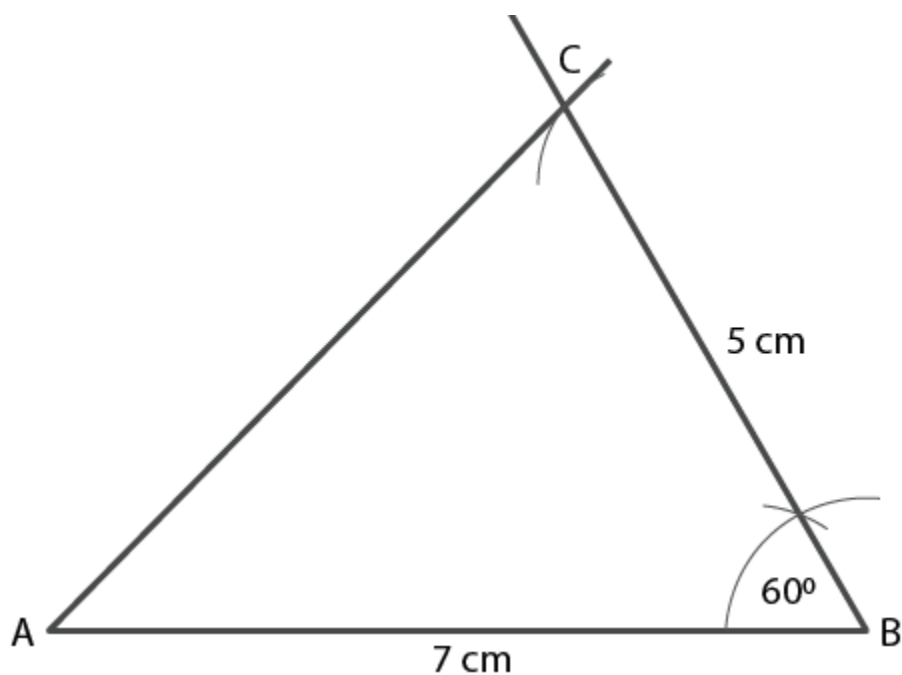
Solution:

(i) Steps of Construction

1. Construct a line segment $AB = 7$ cm.
2. At the point B construct a ray which makes an angle 60° and cut off $BC = 5$ cm.
3. Now join AC.

Therefore, $\triangle ABC$ is the required triangle.

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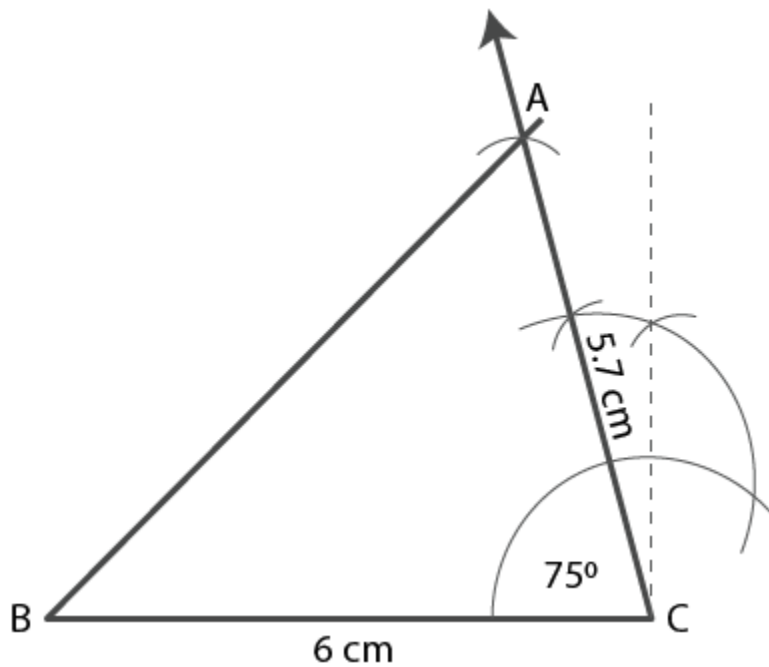


(ii) Steps of Construction

1. Construct a line segment $BC = 6 \text{ cm}$.
2. At the point C construct a ray which makes an angle 75° and cut off $CA = 5.7 \text{ cm}$.
3. Now join AB.

Therefore, $\triangle ABC$ is the required triangle.

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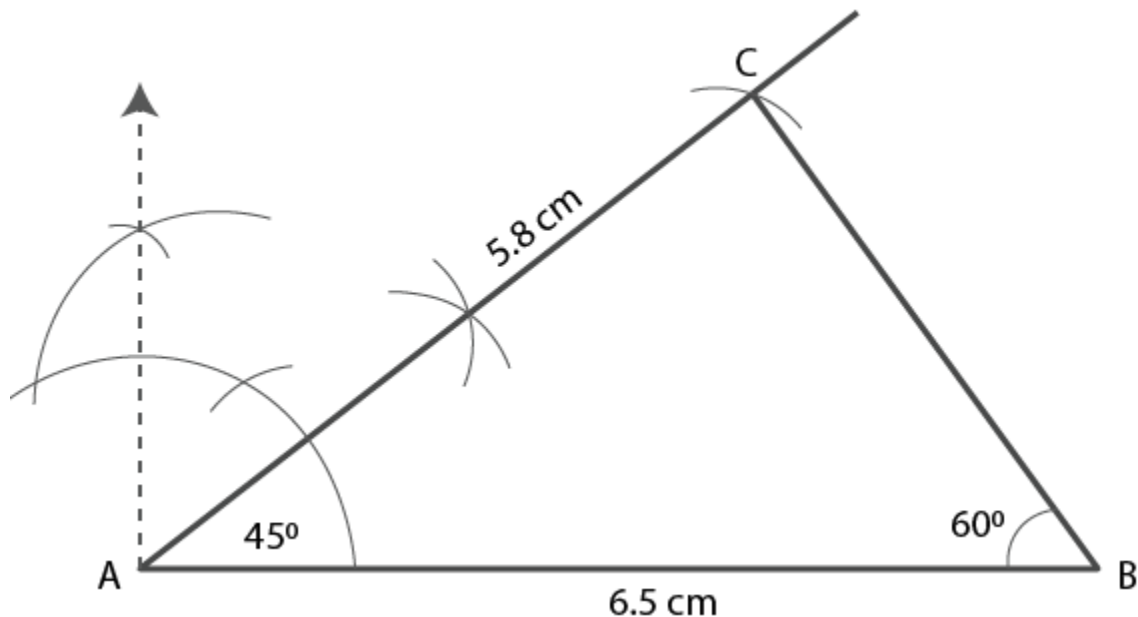


(iii) Steps of Construction

1. Construct a line segment $AB = 6.5$ cm.
2. At the point A construct a ray which makes an angle 45° and cut off $AC = 5.8$ cm.
3. Now join CB.

Therefore, $\triangle ABC$ is the required triangle.

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3. Construct a $\triangle PQR$ such that :

- (i) $PQ = 6 \text{ cm}$, $\angle Q = 60^\circ$ and $\angle P = 45^\circ$. Measure $\angle R$.
- (ii) $QR = 4.4 \text{ cm}$, $\angle R = 30^\circ$ and $\angle Q = 75^\circ$. Measure PQ and PR .
- (iii) $PR = 5.8 \text{ cm}$, $\angle P = 60^\circ$ and $\angle R = 45^\circ$.

Measure $\angle Q$ and verify it by calculations

Solution:

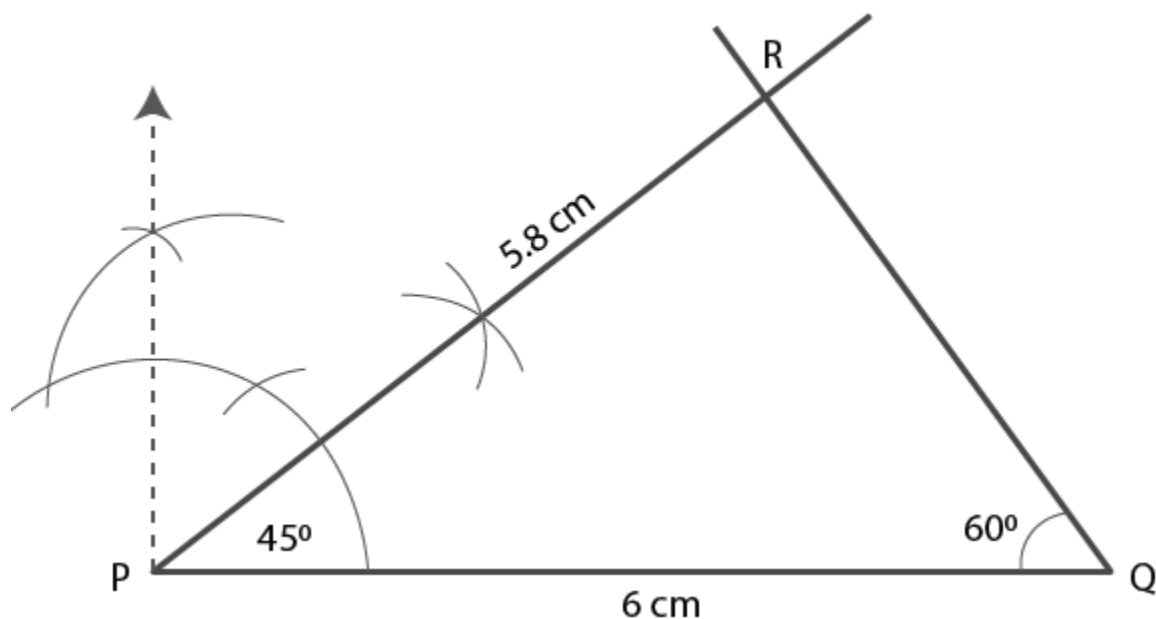
(i) Steps of Construction

1. Construct a line segment $PQ = 6 \text{ cm}$.
2. At point P construct a ray which makes an angle 45° .
3. At point Q construct another ray which makes an angle 60° which intersect the first ray at point R.

Therefore, $\triangle PQR$ is the required triangle.

By measuring $\angle R = 75^\circ$.

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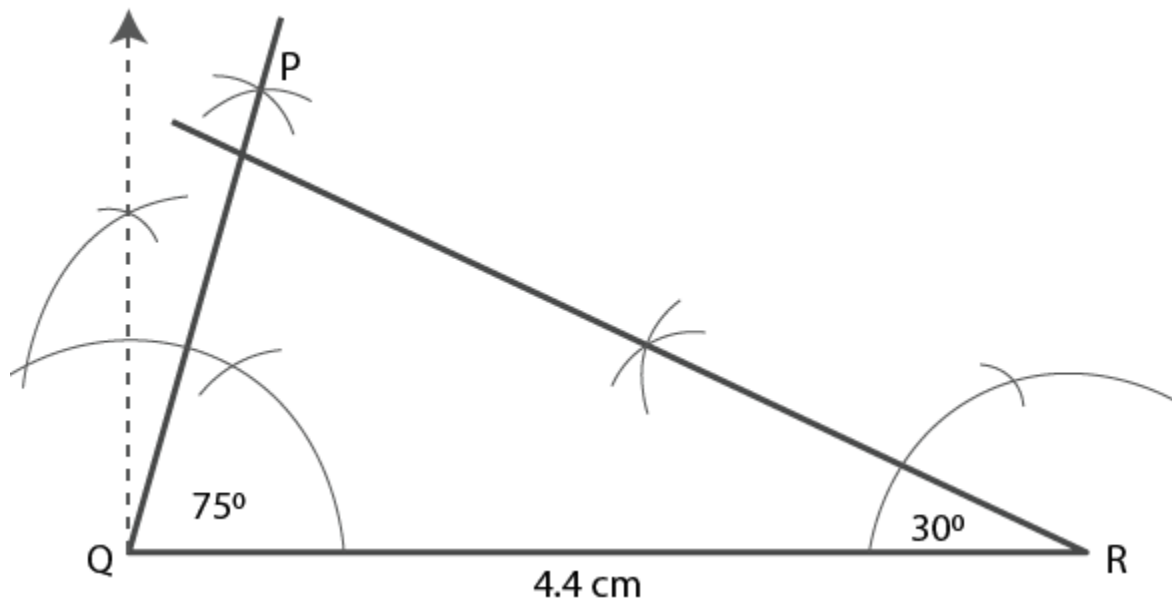
(ii) Steps of Construction

1. Construct a line segment $QR = 4.4$ cm.
2. At point Q construct a ray which makes an angle 75° .
3. At point R construct another ray which makes an angle 30° which intersect the first ray at point P.

Therefore, ΔPQR is the required triangle.

By measuring the length, $PQ = 2.1$ cm and $PR = 4.4$ cm.

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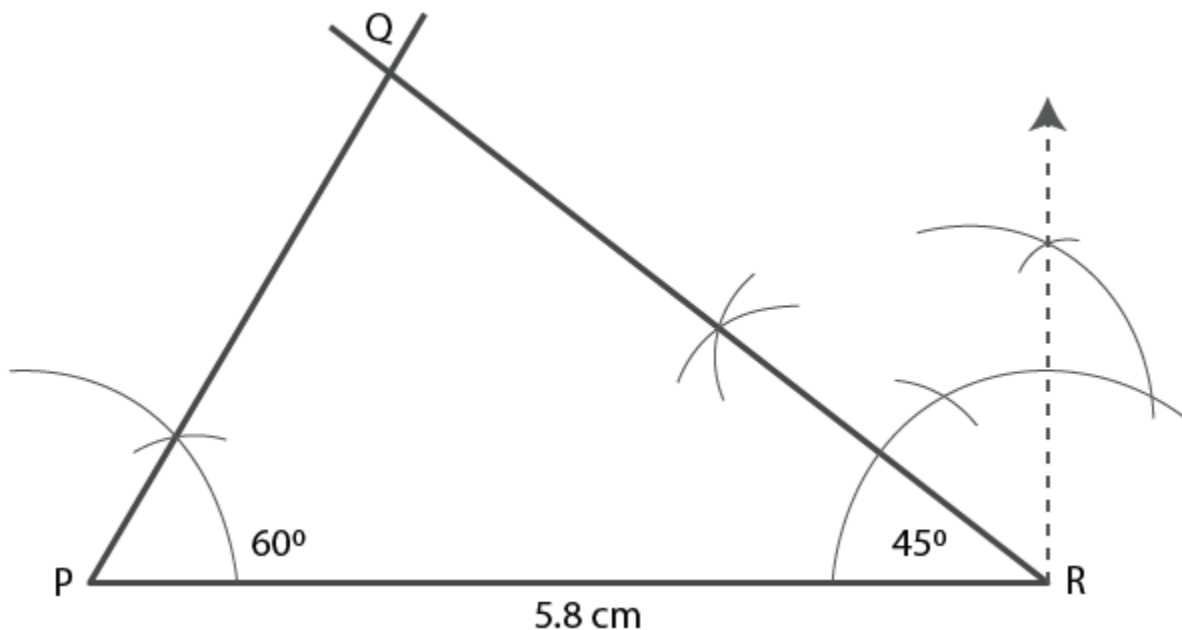
(iii) Steps of Construction

1. Construct a line segment $PR = 5.8$ cm.
2. At point P construct a ray which makes an angle 60° .
3. At point R construct another ray which makes an angle 45° which intersect the first ray at point Q.

Therefore, $\triangle PQR$ is the required triangle.

By measuring $\angle Q = 75^\circ$.

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Verification –

$$\angle P + \angle Q + \angle R = 180^\circ$$

Substituting the values

$$60^\circ + \angle Q + 45^\circ = 180^\circ$$

By further calculation

$$\angle Q = 180 - 105 = 75^\circ$$

4. Construct an isosceles $\triangle ABC$ such that:

(i) base BC = 4 cm and base angle = 30°

(ii) base AB = 6.2 cm and base angle = 45°

(iii) base AC = 5 cm and base angle = 75° .

Measure the other two sides of the triangle.

Solution:

(i) Steps of Construction

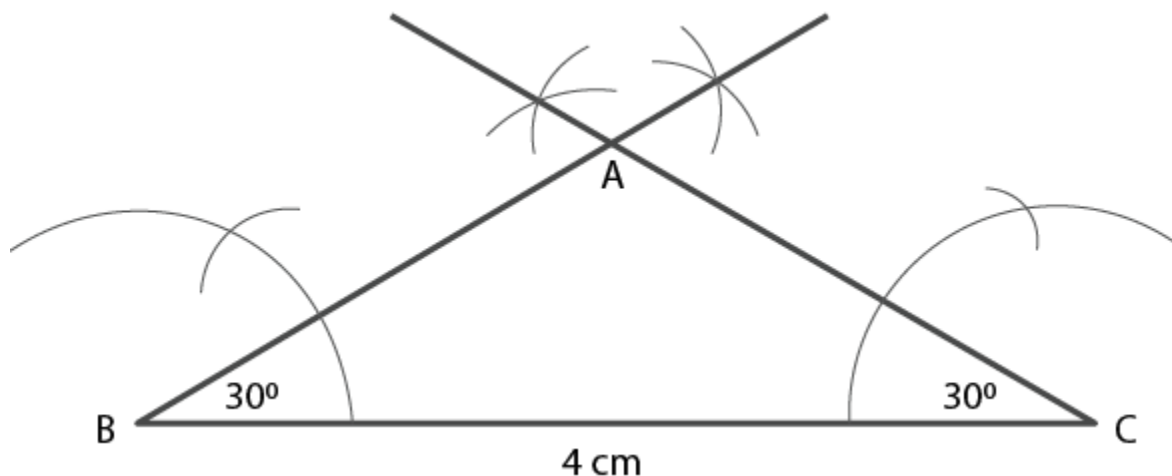
<https://www.indcareer.com/schools/selina-class-7-icse-solutions-mathematics-chapter-15-triangles/>

In an isosceles triangle the base angles are equal

1. Construct a line segment $BC = 4$ cm.
2. At the points B and C construct rays which makes an angle 30° intersecting each other at the point A.

Therefore, $\triangle ABC$ is the required triangle.

By measuring the equal sides, each is 2.5 cm in length approximately.



(ii) Steps of Construction

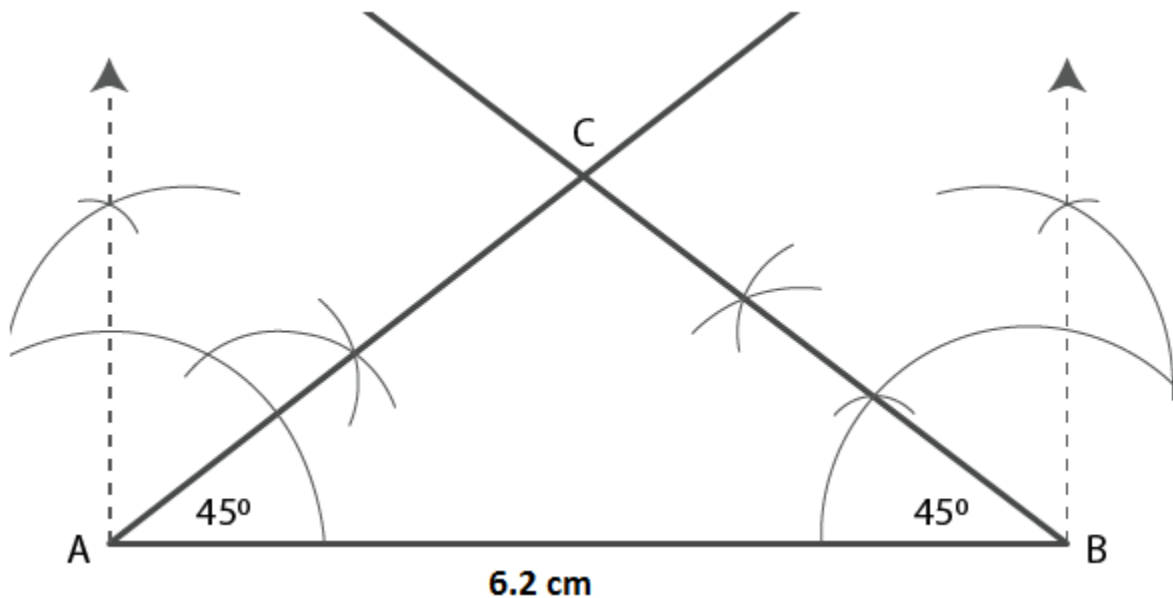
In an isosceles triangle the base angles are equal

1. Construct a line segment $AB = 6.2$ cm.
2. At the points A and B construct rays which makes an angle 45° intersecting each other at the point C.

Therefore, $\triangle ABC$ is the required triangle.

By measuring the equal sides, each is 4.3 cm in length approximately.

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(iii) Steps of Construction

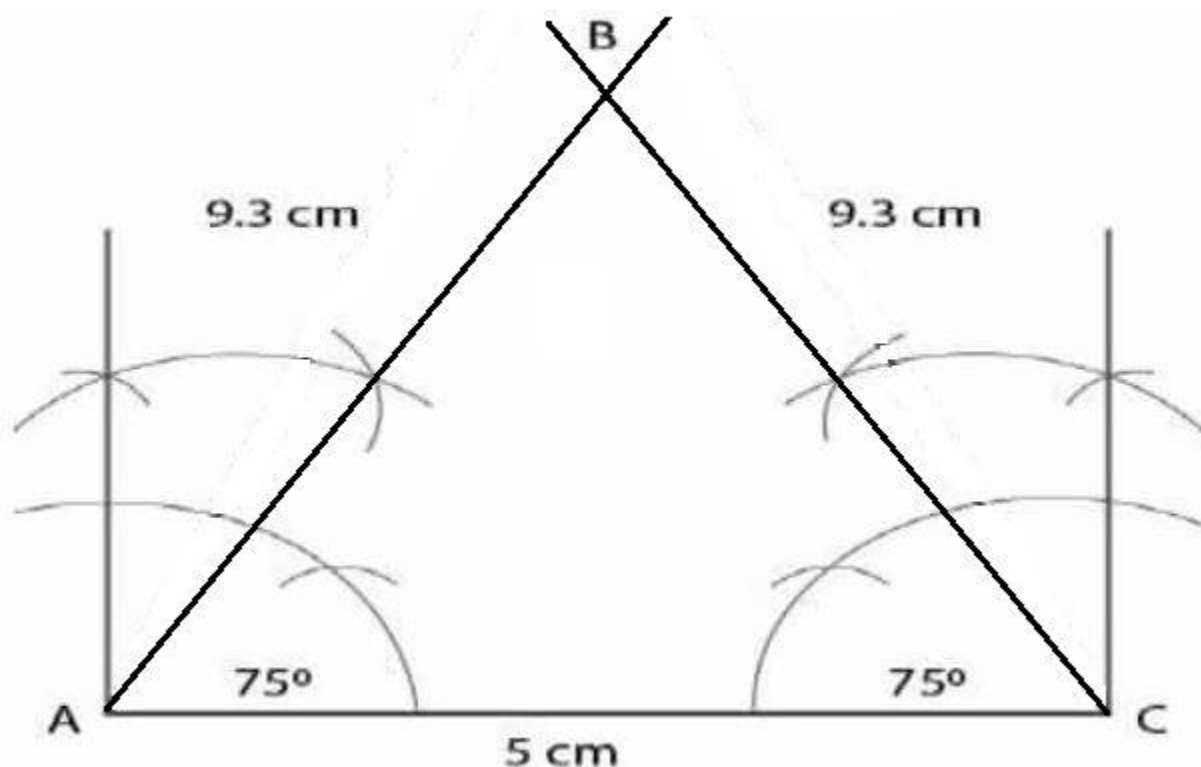
In an isosceles triangle the base angles are equal

1. Construct a line segment $AC = 5$ cm.
2. At the points A and C construct rays which makes an angle 75° intersecting each other at the point B.

Therefore, $\triangle ABC$ is the required triangle.

By measuring the equal sides, each is 9.3 cm in length approximately.

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5. Construct an isosceles $\triangle ABC$ such that:

(i) $AB = AC = 6.5$ cm and $\angle A = 60^\circ$

(ii) One of the equal sides = 6 cm and vertex angle = 45° . Measure the base angles.

(iii) $BC = AB = 5.8$ cm and $\angle B = 30^\circ$. Measure $\angle A$ and $\angle C$.

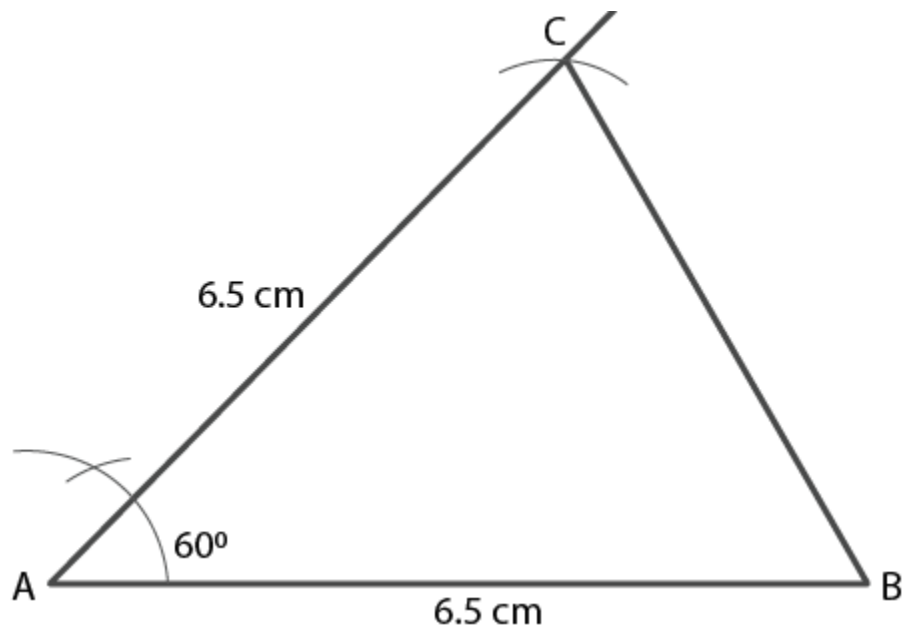
Solution:

(i) Steps of Construction

1. Construct a line segment $AB = 6.5$ cm.
2. At point A construct a ray which makes an angle 60° .
3. Now cut off $AC = 6.5$ cm
4. Join BC.

Therefore, $\triangle ABC$ is the required triangle.

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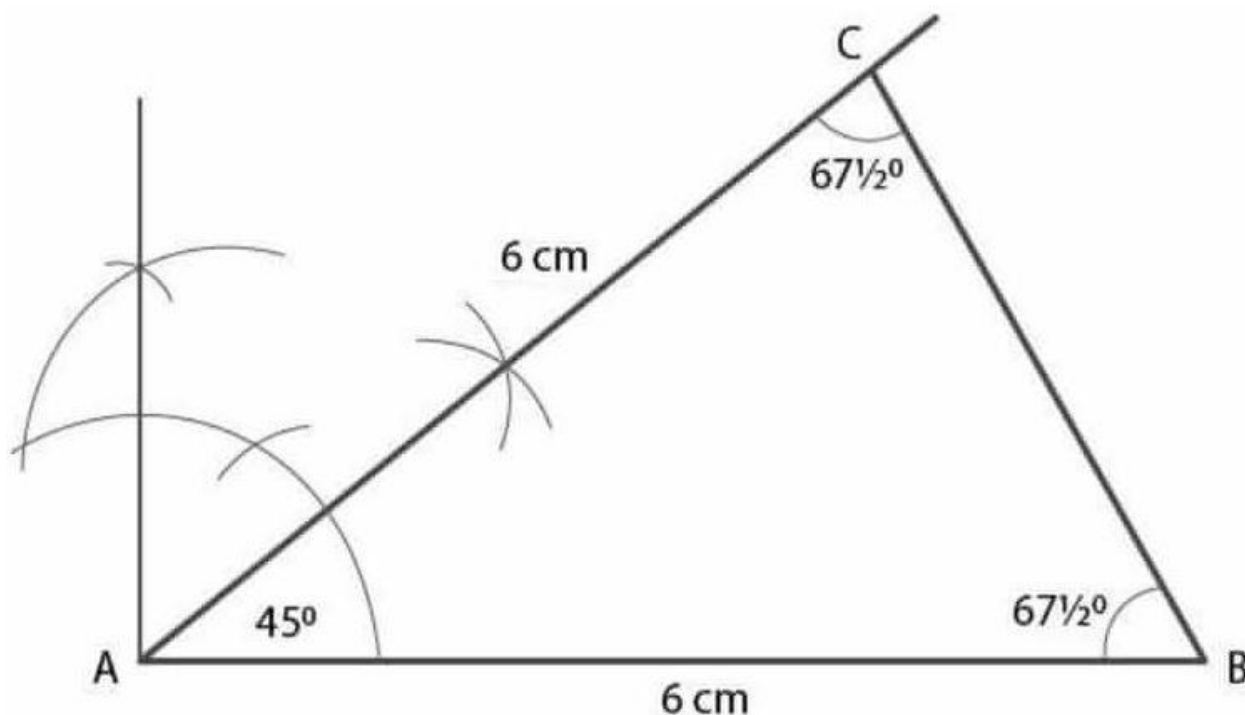
(ii) Steps of Construction

1. Construct a line segment $AB = 6 \text{ cm}$.
2. At point A construct a ray which makes an angle 45° .
3. Now cut off $AC = 6 \text{ cm}$
4. Join BC.

Therefore, $\triangle ABC$ is the required triangle.

By measuring $\angle B$ and $\angle C$, both are equal to $67 \frac{1}{2}^\circ$.

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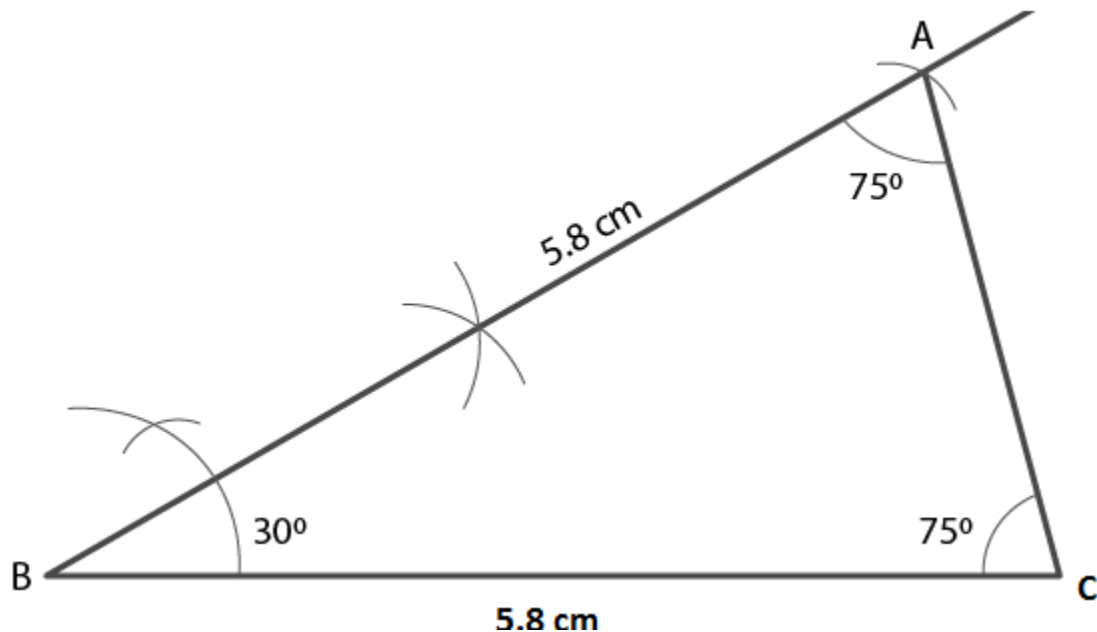
(iii) Steps of Construction

1. Construct a line segment $BC = 5.8$ cm.
2. At point B construct a ray which makes an angle 30° .
3. Now cut off $BA = 5.8$ cm
4. Join AC.

Therefore, $\triangle ABC$ is the required triangle.

By measuring $\angle C$ and $\angle A$ is equal to 75° .

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6. Construct an equilateral triangle ABC such that:

(i) $AB = 5$ cm. Draw the perpendicular bisectors of BC and AC. Let P be the point of intersection of these two bisectors. Measure PA, PB and PC.

(ii) Each side is 6 cm.

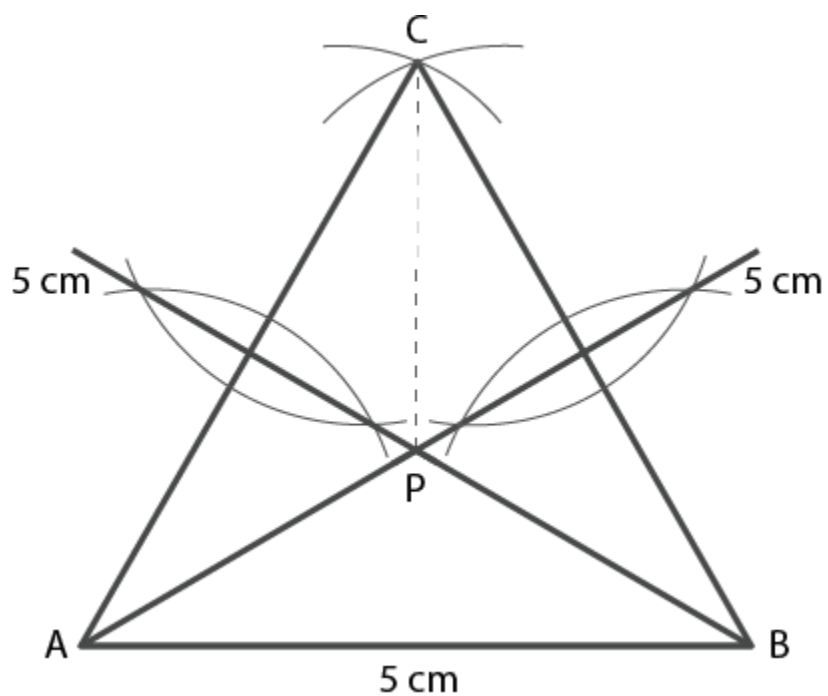
Solution:

(i) Steps of Construction

1. Construct a line segment $AB = 5$ cm.
2. Taking A and B as centres and 5 cm radius, construct two arcs which intersect each other at the point C.
3. Now join AC and BC where $\triangle ABC$ is the required triangle.
4. Construct perpendicular bisectors of sides AC and BC which intersect each other at the point p.
5. Join PA, PB and PC.

By measuring each is 2.8 cm.

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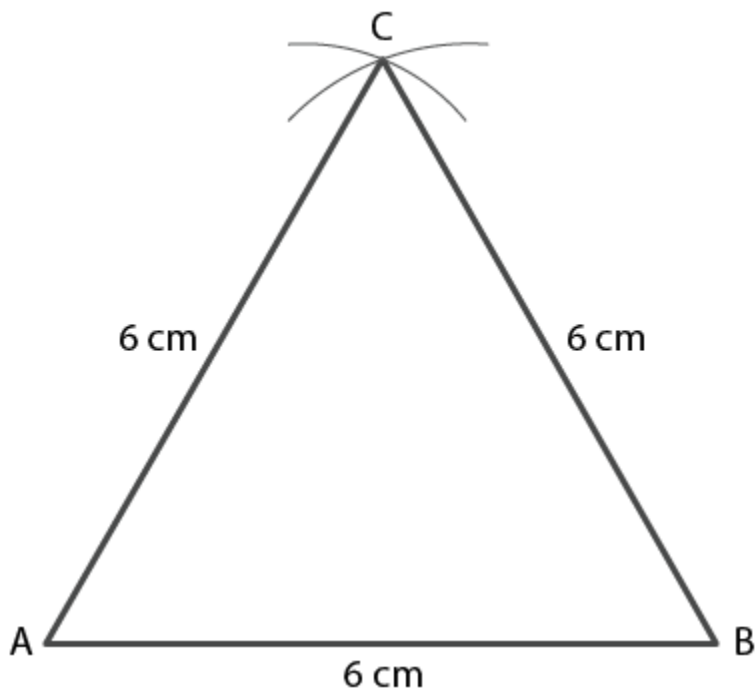


(ii) Steps of Construction

1. Construct a line segment $AB = 6\text{ cm}$.
2. Taking A and B as centres and 6 cm radius, construct two arcs which intersect each other at the point C.
3. Now join AC and BC

Therefore, $\triangle ABC$ is the required triangle.

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7. (i) Construct a $\triangle ABC$ such that $AB = 6$ cm, $BC = 4.5$ cm and $AC = 5.5$ cm. Construct a circumcircle of this triangle.

(ii) Construct an isosceles $\triangle PQR$ such that $PQ = PR = 6.5$ cm and $\angle PQR = 75^\circ$. Using ruler and compasses only construct a circumcircle to this triangle.

(iii) Construct an equilateral triangle ABC such that its one side = 5.5 cm.

Construct a circumcircle to this triangle.

Solution:

(i) Steps of Construction

1. Construct a line segment $BC = 4.5$ cm.
2. Taking B as centre and 6 cm radius construct an arc.
3. Taking C as centre and 5.5 cm radius construct another arc which intersects the first arc at point A.
4. Now join AB and AC

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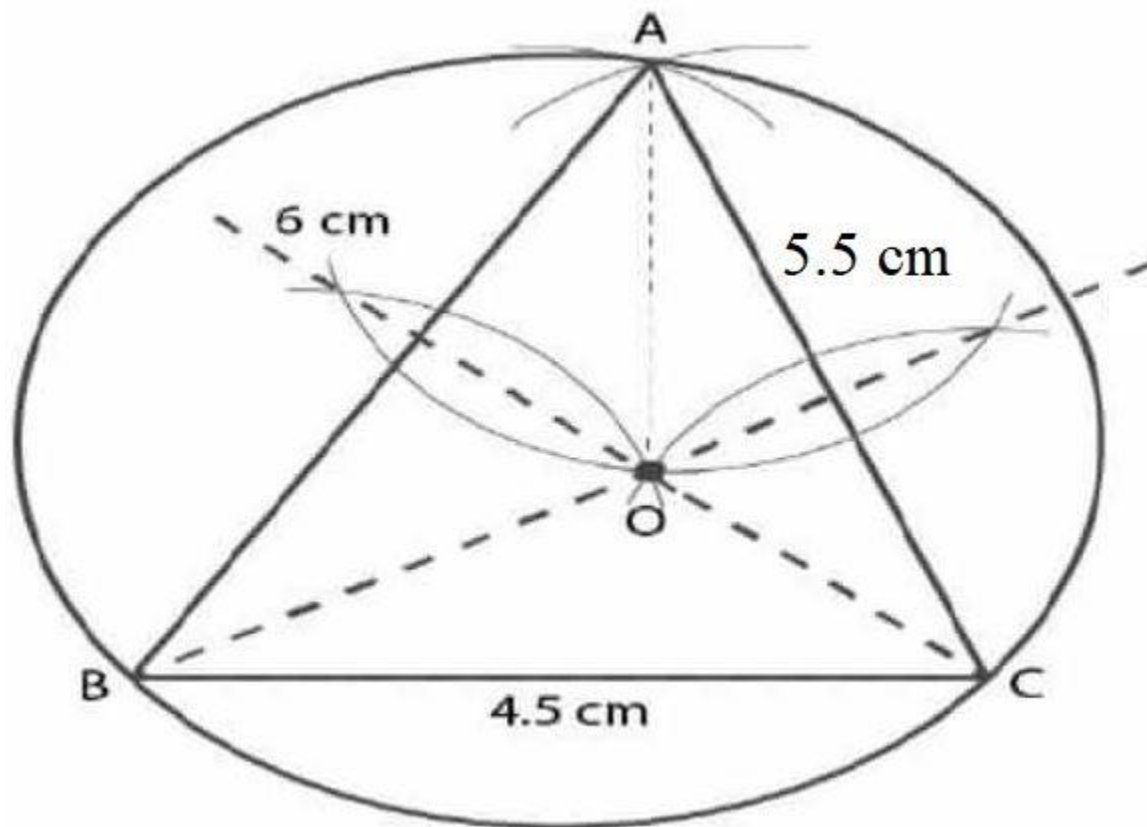
Therefore, $\triangle ABC$ is the required triangle.

5. Construct a perpendicular bisector of AB and AC which intersect each other at the point O.

6. Now join OB, OC and OA.

7. Taking O as centre and radius OA construct a circle which passes through the points A, B and C.

This is the required circumcircle of $\triangle ABC$.



(ii) Steps of Construction

1. Construct a line segment PQ = 6.5 cm.

2. At point Q, construct an arc which makes an angle 75° .

3. Taking P as centre and radius 6.5 cm construct an arc which intersects the angle at point R.

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4. Join PR.

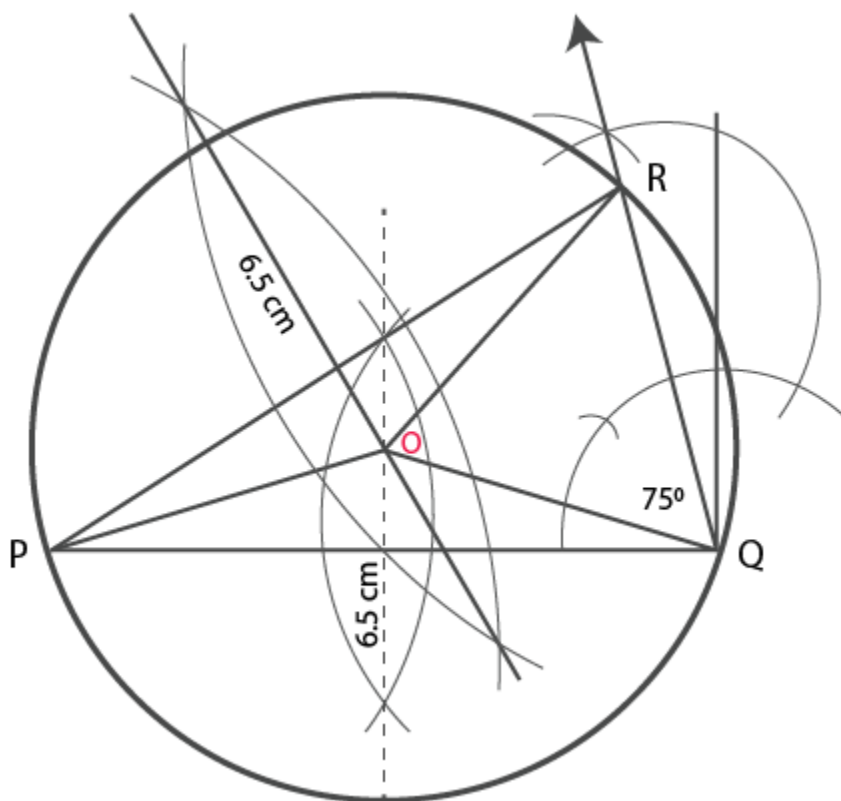
ΔPQR is the required triangle.

4. Construct the perpendicular bisector of sides PQ and PR which intersect each other at the point O.

5. Join OP, OQ and OR.

6. Taking O as centre and radius equal to OP or OQ or OR construct a circle which passes through P, Q and R.

This is the required circumcircle of ΔPQR .



(iii) Steps of Construction

1. Construct a line segment AB = 5.5 cm.

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2. Taking A and B as centres and radius 5.5 cm construct two arcs which intersect each other at point C.

3. Now join AC and BC.

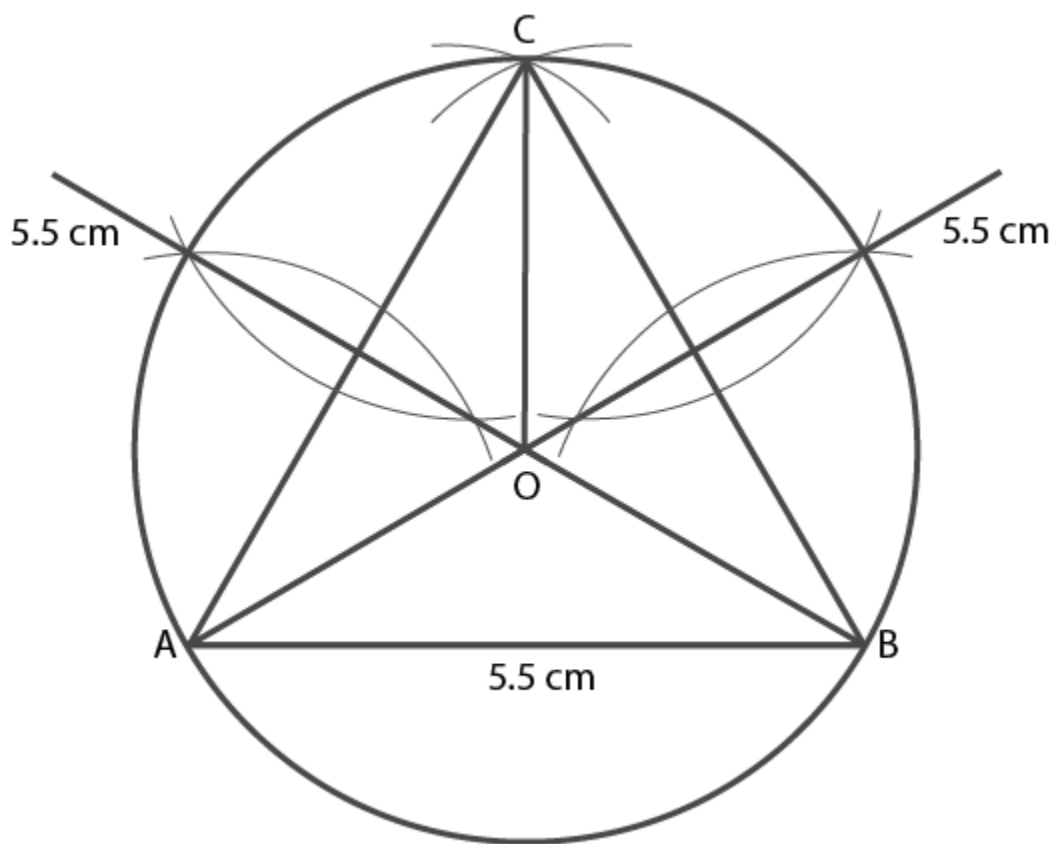
$\triangle ABC$ is the required triangle.

4. Construct perpendicular bisectors of sides AC and BC which intersect each other at the point O.

5. Now join OA, OB and OC.

6. Taking O as centre and OA or OB or OC as radius construct a circle which passes through A, B and C.

This is the required circumcircle.



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8. (i) Construct a $\triangle ABC$ such that $AB = 6$ cm, $BC = 5.6$ cm and $CA = 6.5$ cm. Inscribe a circle to this triangle and measure its radius.

(ii) Construct an isosceles $\triangle MNP$ such that base $MN = 5.8$ cm, base angle $MNP = 30^\circ$. Construct an incircle to this triangle and measure its radius.

(iii) Construct an equilateral $\triangle DEF$ whose one side is 5.5 cm. Construct an incircle to this triangle.

(iv) Construct a $\triangle PQR$ such that $PQ = 6$ cm, $\angle QPR = 45^\circ$ and angle $PQR = 60^\circ$. Locate its incentre and then draw its incircle.

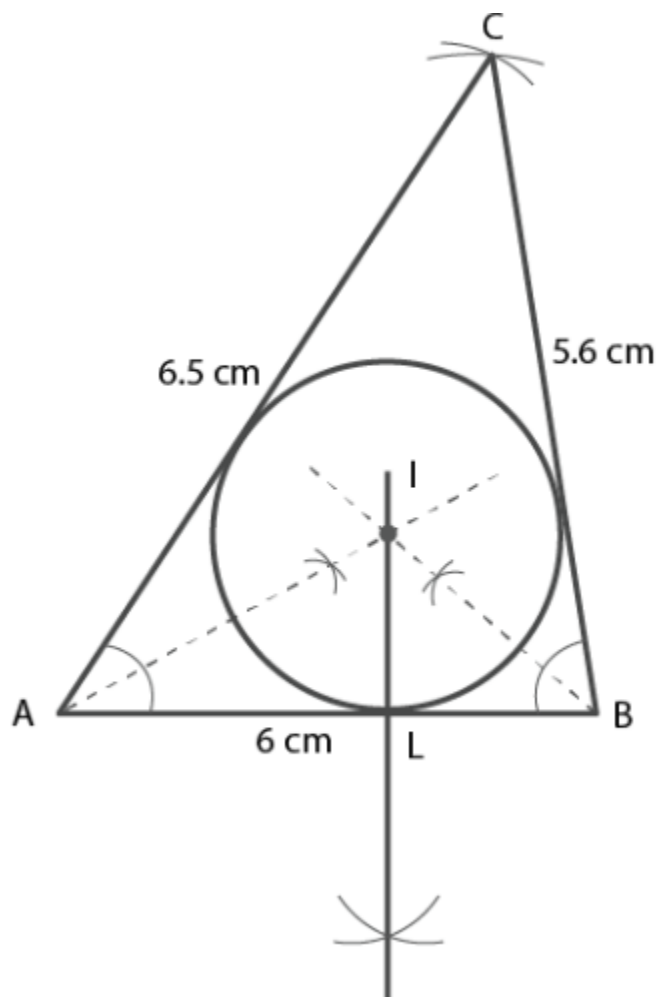
Solution:

(i) Steps of Construction

1. Construct a line segment $AB = 6$ cm.
2. Taking A as centre and 6.5 cm as radius and B as centre and 5.6 cm as radius construct arcs which intersect each other at point C.
3. Now join AC and BC.
4. Construct the angle bisector of $\angle A$ and $\angle B$ which intersect each other at point I.
5. From the point I construct IL which is perpendicular to AB.
6. Taking I as centre and IL as radius construct a circle which touches the sides of $\triangle ABC$ internally.

By measuring the required incircle the radius is 1.6 cm.

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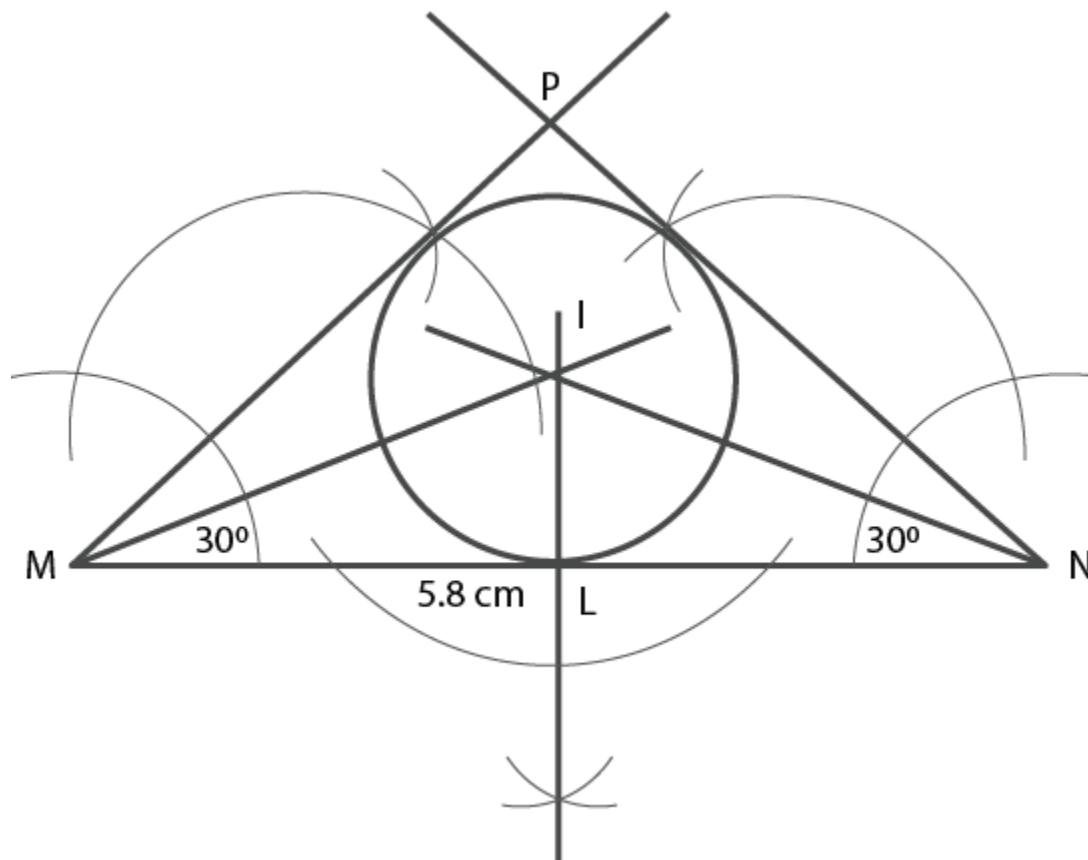


(ii) Steps of Construction

1. Construct a line segment $MN = 5.8$ cm.
2. At points M and N construct two rays which make an angle 30° each intersecting each other at point P.
3. Construct the angle bisectors of $\angle M$ and $\angle N$ which intersect each other at point I.
4. From the point I draw perpendicular IL on MN.
5. Taking I as centre and IL as radius construct a circle which touches the sides of $\triangle PMB$ internally.

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By measuring the required incircle the radius is 0.6 cm.

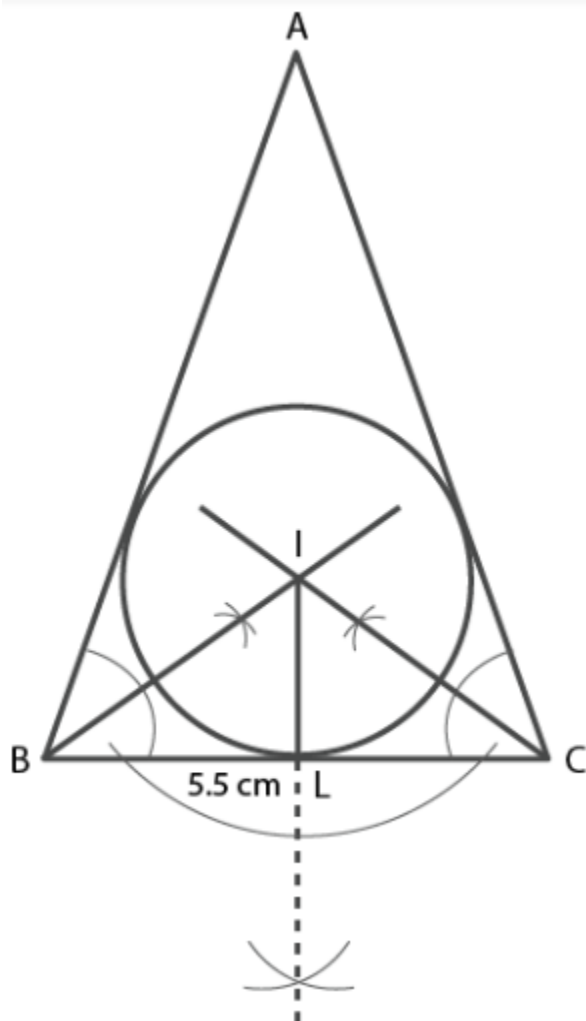


(iii) Steps of Construction

1. Construct a line segment BC = 5.5 cm.
2. Taking B and C as centres and 5.5 cm radius construct two arcs which intersect each other at point A.
3. Now join AB and AC.
4. Construct the perpendicular bisectors of $\angle B$ and $\angle C$ which intersect each other at the point I.
5. From the point I construct IL which is perpendicular to BC.
6. Taking I as centre and IL as radius construct a circle which touches the sides of $\triangle ABC$ internally.

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This is the required incircle.



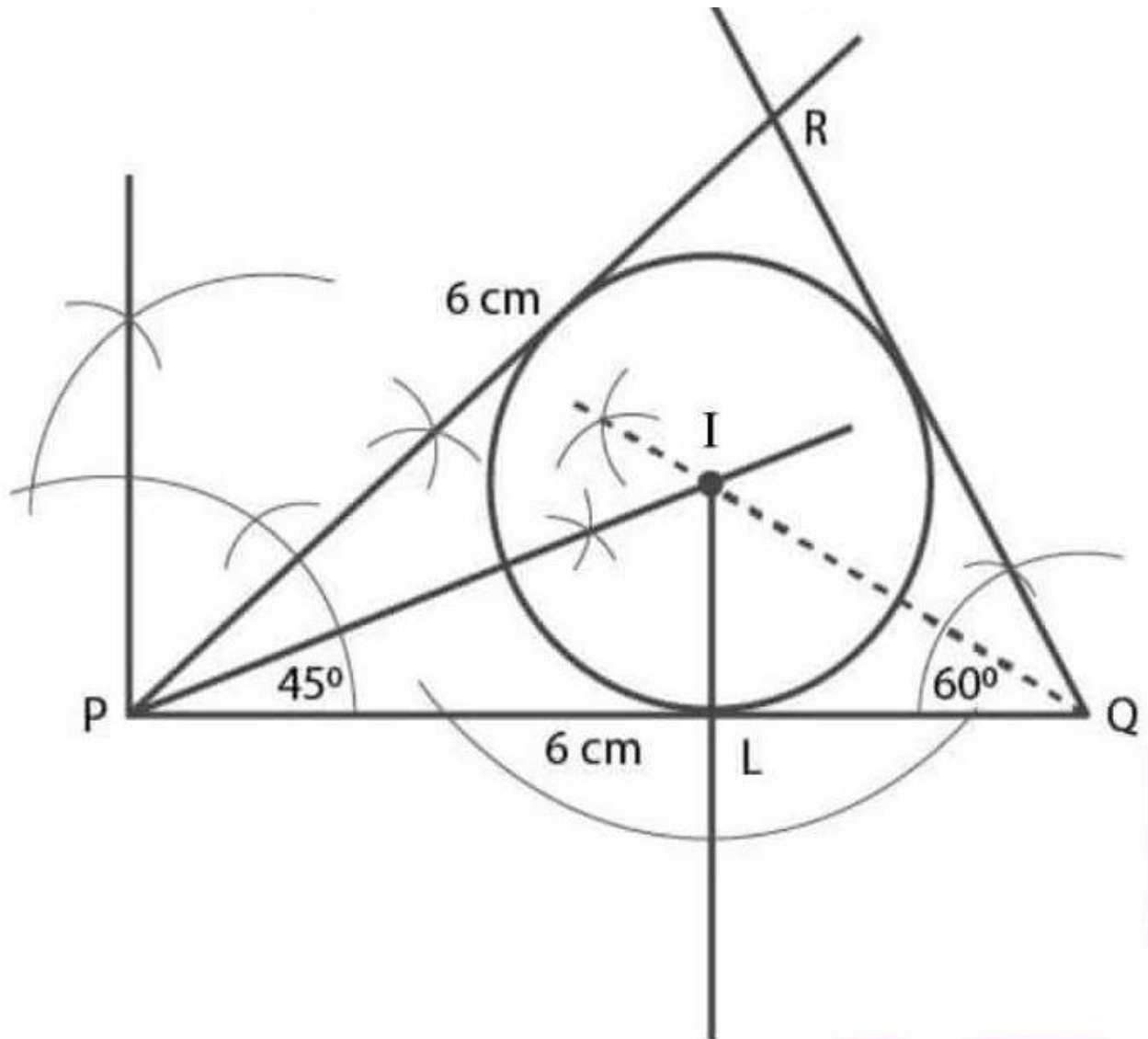
(iv) Steps of Construction

1. Construct a line segment $PQ = 6$ cm.
2. At the point P construct rays which make an angle of 45° and at point Q which makes an angle 60° that intersects each other at point R.
3. Construct the bisectors of $\angle P$ and $\angle Q$ which intersect each other at point I.
4. From the point I construct IL which is perpendicular to PQ.

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5. Taking I as centre and IL as radius construct a circle which touches the sides of $\triangle PQR$ internally.

This is the required incircle where the point I is incentre.



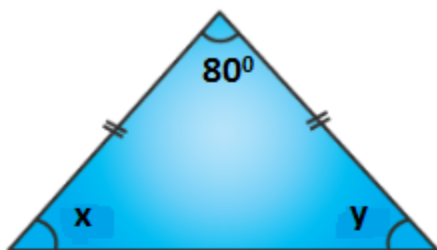
Exercise 15B

Exercise 15B page: 180

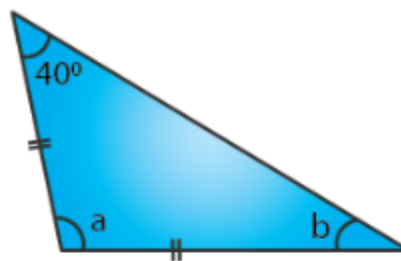
1. Find the unknown angles in the given figures:

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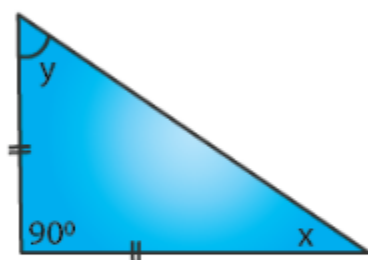
(i)



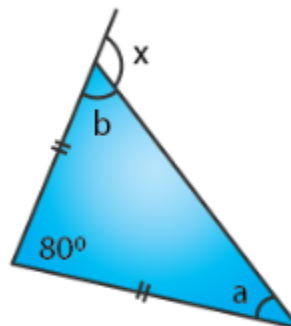
(ii)



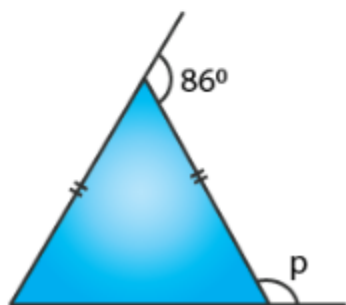
(iii)



(iv)



(v)



Solution:

(i) From the figure (i)

$x = y$ as the angles opposite to equal sides

In a triangle

$$x + y + 80^\circ = 180^\circ$$

Substituting the values

$$x + x + 80^\circ = 180^\circ$$

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By further calculation

$$2x = 180^\circ - 80^\circ = 100^\circ$$

$$x = 100^\circ/2 = 50^\circ$$

Therefore, $x = y = 50^\circ$.

(ii) From the figure (ii)

$b = 40^\circ$ as the angles opposite to equal sides

In a triangle

$$a + b + 40^\circ = 180^\circ$$

Substituting the values

$$a + 40^\circ + 40^\circ = 180^\circ$$

By further calculation

$$a = 180 - 80 = 100^\circ$$

Therefore, $a = 100^\circ$ and $b = 40^\circ$.

(iii) From the figure (iii)

$x = y$ as the angles opposite to equal sides

In a triangle

$$x + y + 90^\circ = 180^\circ$$

Substituting the values

$$x + x + 90^\circ = 180^\circ$$

By further calculation

$$2x = 180 - 90 = 90^\circ$$

$$x = 90/2 = 45^\circ$$

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Therefore, $x = y = 45^\circ$.

(iv) From the figure (iv)

$a = b$ as the angles opposite to equal sides are equal

In a triangle

$$a + b + 80^\circ = 180^\circ$$

Substituting the values

$$a + a + 80^\circ = 180^\circ$$

By further calculation

$$2a = 180 - 80 = 100^\circ$$

$$a = 100^\circ/2 = 50^\circ$$

$$\text{Here } a = b = 50^\circ$$

We know that in a triangle the exterior angle is equal to sum of its opposite interior angles

$$x = a + 80^\circ$$

So we get

$$x = 50 + 80 = 130^\circ$$

Therefore, $a = 50^\circ$, $b = 50^\circ$ and $x = 130^\circ$.

(v) From the figure (v)

In an isosceles triangle consider each equal angle = x

$$x + x = 86^\circ$$

$$2x = 86^\circ$$

So we get

$$x = 86^\circ/2 = 43^\circ$$

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For a linear pair

$$p + x = 180^\circ$$

Substituting the values

$$p + 43^\circ = 180^\circ$$

By further calculation

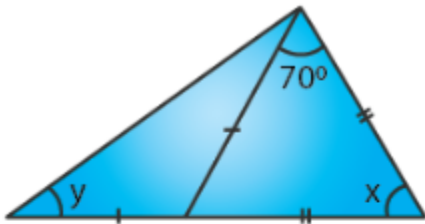
$$p = 180 - 43 = 137^\circ$$

Therefore, $p = 137^\circ$.

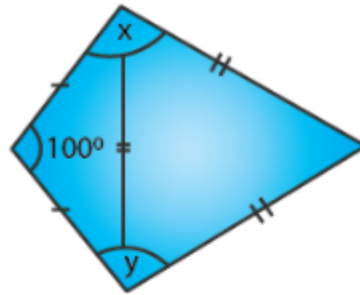
2. Apply the properties of isosceles and equilateral triangles to find the unknown angles in the given figures:

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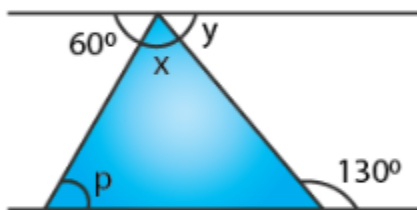
(i)



(ii)



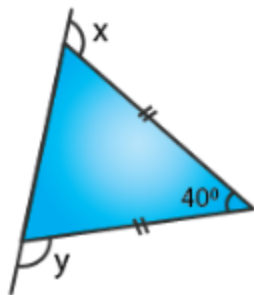
(iii)



(iv)



(v)



Solution:

(i) $a = 70^\circ$ as the angles opposite to equal sides are equal

In a triangle

$$a + 70^\circ + x = 180^\circ$$

Substituting the values

$$70^\circ + 70^\circ + x = 180^\circ$$

By further calculation

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$$x = 180 - 140 = 40^\circ$$

$y = b$ as the angles opposite to equal sides are equal

Here $a = y + b$ as the exterior angle is equal to sum of interior opposite angles

$$70^\circ = y + y$$

So we get

$$2y = 70^\circ$$

$$y = 70^\circ/2 = 35^\circ$$

Therefore, $x = 40^\circ$ and $y = 35^\circ$.

(ii) From the figure (ii)

Each angle is 60° in an equilateral triangle

In an isosceles triangle

Consider each base angle = a

$$a + a + 100^\circ = 180^\circ$$

By further calculation

$$2a = 180 - 100 = 80^\circ$$

So we get

$$a = 80^\circ/2 = 40^\circ$$

$$x = 60^\circ + 40^\circ = 100^\circ$$

$$y = 60^\circ + 40^\circ = 100^\circ$$

(iii) From the figure (iii)

$130^\circ = x + p$ as the exterior angle is equal to the sum of interior opposite angles

It is given that the lines are parallel

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Here $p = 60^\circ$ is the alternate angles and $y = a$

In a linear pair

$$a + 130^\circ = 180^\circ$$

By further calculation

$$a = 180 - 130 = 50^\circ$$

$$\text{Here } x + p = 130^\circ$$

Substituting the values

$$x + 60^\circ = 130^\circ$$

By further calculation

$$x = 130 - 60 = 70^\circ$$

Therefore, $x = 70^\circ$, $y = 50^\circ$ and $p = 60^\circ$.

(iv) From the figure (iv)

$$x = a + b$$

Here $b = y$ and $a = c$ as the angles opposite to equal sides are equal

$$a + c + 30^\circ = 180^\circ$$

Substituting the values

$$a + a + 30^\circ = 180^\circ$$

By further calculation

$$2a = 180 - 30 = 150^\circ$$

$$a = 150/2 = 75^\circ$$

We know that

$$b + y = 90^\circ$$

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Substituting the values

$$y + y = 90^\circ$$

$$2y = 90^\circ$$

$$y = 90/2 = 45^\circ$$

$$\text{where } b = 45^\circ$$

Therefore, $x = a + b = 75 + 45 = 120^\circ$ and $y = 45^\circ$.

(v) From the figure (v)

$$a + b + 40^\circ = 180^\circ$$

So we get

$$a + b = 180 - 40 = 140^\circ$$

The angles opposite to equal sides are equal

$$a = b = 140/2 = 70^\circ$$

$$x = b + 40^\circ = 70^\circ + 40^\circ = 110^\circ$$

Here the exterior angle of a triangle is equal to the sum of its interior opposite angles

In the same way

$$y = a + 40^\circ$$

Substituting the values

$$y = 70^\circ + 40^\circ = 110^\circ$$

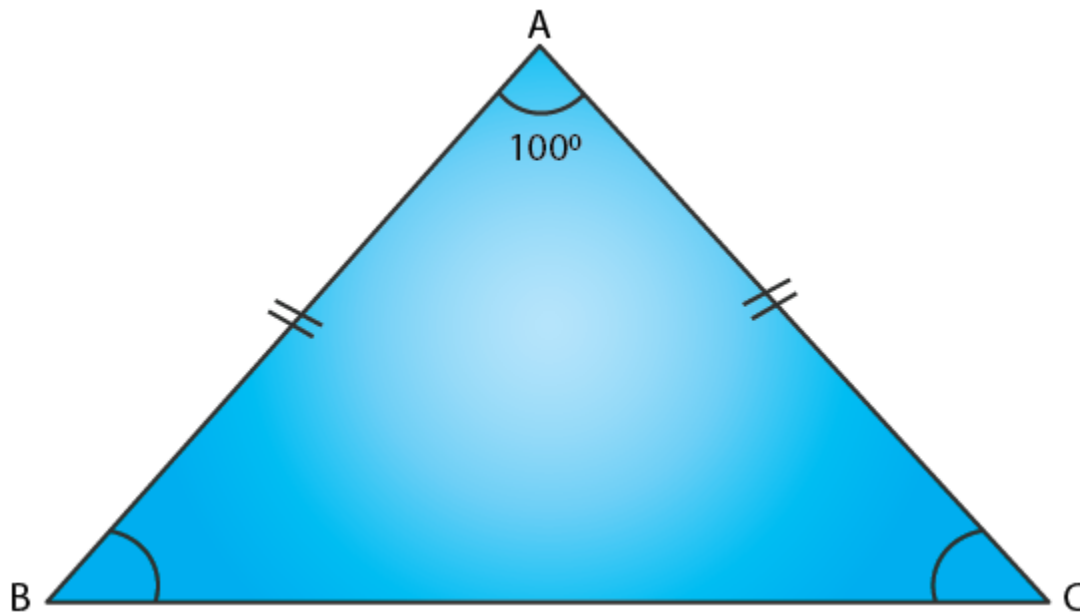
Therefore, $x = y = 110^\circ$.

3. The angle of vertex of an isosceles triangle is 100° . Find its base angles.

Solution:

Consider $\triangle ABC$

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Here $AB = AC$ and $\angle B = \angle C$

We know that

$$\angle A = 100^\circ$$

In a triangle

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

Substituting the values

$$100^\circ + \angle B + \angle B = 180^\circ$$

By further calculation

$$2\angle B = 180^\circ - 100^\circ = 80^\circ$$

$$\angle B = 80/2 = 40^\circ$$

Therefore, $\angle B = \angle C = 40^\circ$.

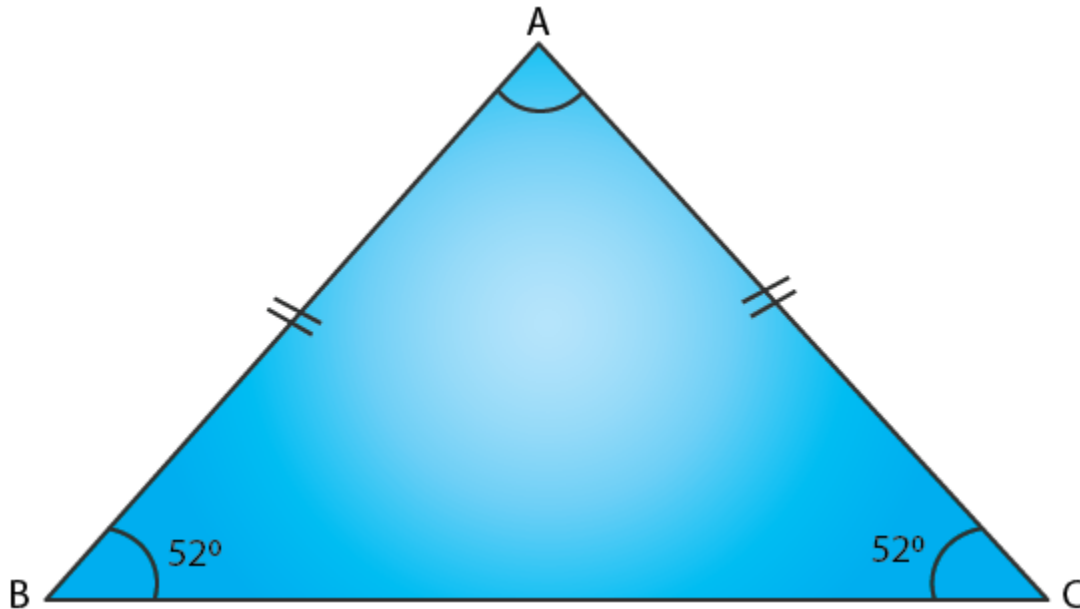
4. One of the base angles of an isosceles triangle is 52° . Find its angle of vertex.

Solution:

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It is given that the base angles of isosceles triangle $ABC = 52^\circ$

Here $\angle B = \angle C = 52^\circ$



In a triangle

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

Substituting the values

$$\angle A + 52^\circ + 52^\circ = 180^\circ$$

By further calculation

$$\angle A = 180 - 104 = 76^\circ$$

Therefore, $\angle A = 76^\circ$.

5. In an isosceles triangle, each base angle is four times of its vertical angle. Find all the angles of the triangle.

Solution:

Consider the vertical angle of an isosceles triangle = x

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So the base angle = $4x$

In a triangle

$$x + 4x + 4x = 180^\circ$$

By further calculation

$$9x = 180^\circ$$

$$x = 180/9 = 20^\circ$$

So the vertical angle = 20°

$$\text{Each base angle} = 4x = 4 \times 20^\circ = 80^\circ$$

6. The vertical angle of an isosceles triangle is 15° more than each of its base angles. Find each angle of the triangle.

Solution:

Consider the angle of the base of isosceles triangle = x°

So the vertical angle = $x + 15^\circ$

In a triangle

$$x + x + x + 15^\circ = 180^\circ$$

By further calculation

$$3x = 180 - 15 = 165^\circ$$

$$x = 165/3 = 55^\circ$$

Therefore, the base angle = 55°

Vertical angle = $55 + 15 = 70^\circ$.

7. The base angle of an isosceles triangle is 15° more than its vertical angle. Find its each angle.

Solution:

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Consider the vertical angle of the isosceles triangle = x°

Here each base angle = $x + 15^\circ$

In a triangle

$$x + 15^\circ + x + 15^\circ + x = 180^\circ$$

By further calculation

$$3x + 30^\circ = 180^\circ$$

$$3x = 180 - 30 = 150^\circ$$

$$x = 150/3 = 50^\circ$$

Therefore, vertical angle = 50° and each base angle = $50 + 15 = 65^\circ$.

8. The vertical angle of an isosceles triangle is three times the sum of its base angles. Find each angle.

Solution:

Consider each base angle of an isosceles triangle = x

$$\text{Vertical angle} = 3(x + x) = 3(2x) = 6x$$

In a triangle

$$6x + x + x = 180^\circ$$

By further calculation

$$8x = 180^\circ$$

$$x = 180/8 = 22.5^\circ$$

Therefore, each base angle = 22.5° and vertical angle = $3(22.5 + 22.5) = 3 \times 45 = 135^\circ$.

9. The ratio between a base angle and the vertical angle of an isosceles triangle is 1 : 4. Find each angle of the triangle.

Solution:

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It is given that the ratio between a base angle and the vertical angle of an isosceles triangle = 1:4

Consider base angle = x

Vertical angle = $4x$

In a triangle

$$x + x + 4x = 180^\circ$$

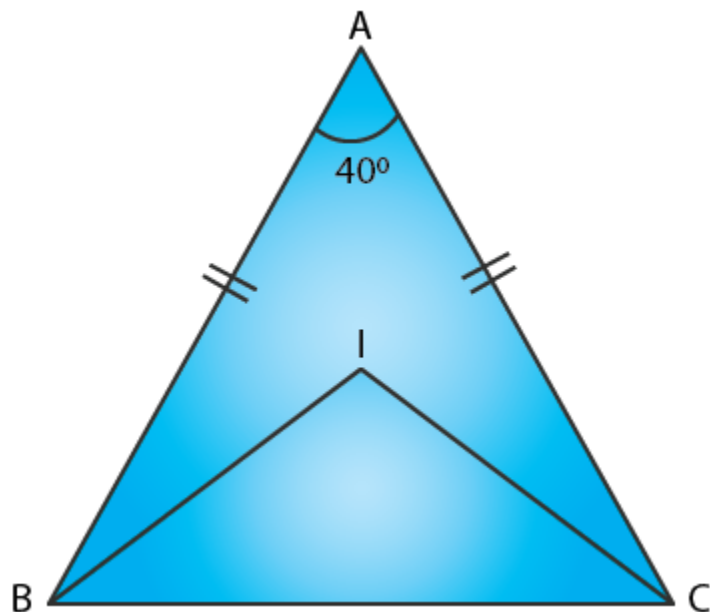
By further calculation

$$6x = 180^\circ$$

$$x = 180/6 = 30^\circ$$

Therefore, each base angle = $x = 30^\circ$ and vertical angle = $4x = 4 \times 30^\circ = 120^\circ$.

10. In the given figure, BI is the bisector of $\angle ABC$ and CI is the bisector of $\angle ACB$. Find $\angle BIC$.



Solution:

In $\triangle ABC$

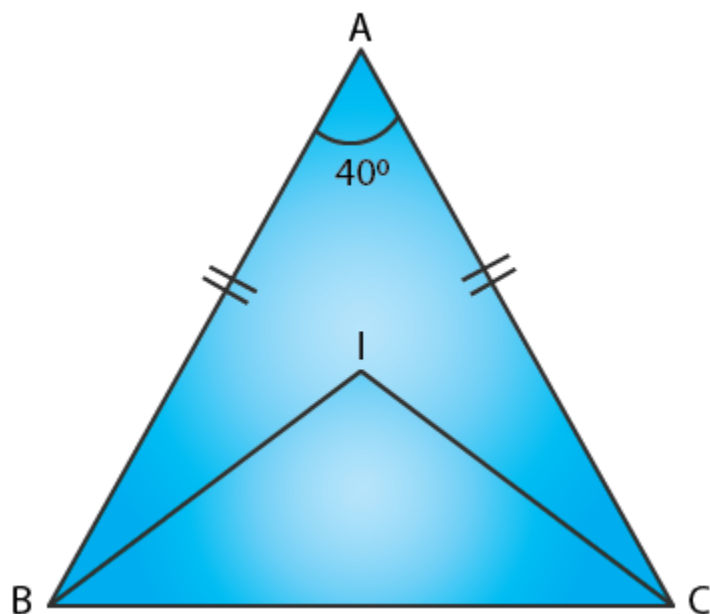
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BI is the bisector of $\angle ABC$ and CI is the bisector of $\angle ACB$

Here $AB = AC$

$\angle B = \angle C$ as the angles opposite to equal sides are equal

We know that $\angle A = 40^\circ$



In a triangle

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

Substituting the values

$$40^\circ + \angle B + \angle B = 180^\circ$$

By further calculation

$$40^\circ + 2\angle B = 180^\circ$$

$$2\angle B = 180 - 40 = 140^\circ$$

$$\angle B = 140/2 = 70^\circ$$

Here BI and CI are the bisectors of $\angle ABC$ and $\angle ACB$

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$$\angle IBC = \frac{1}{2} \angle ABC = \frac{1}{2} \times 70^\circ = 35^\circ$$

$$\angle ICB = \frac{1}{2} \angle ACB = \frac{1}{2} \times 70^\circ = 35^\circ$$

In $\triangle IBC$

$$\angle BIC + \angle IBC + \angle ICB = 180^\circ$$

Substituting the values

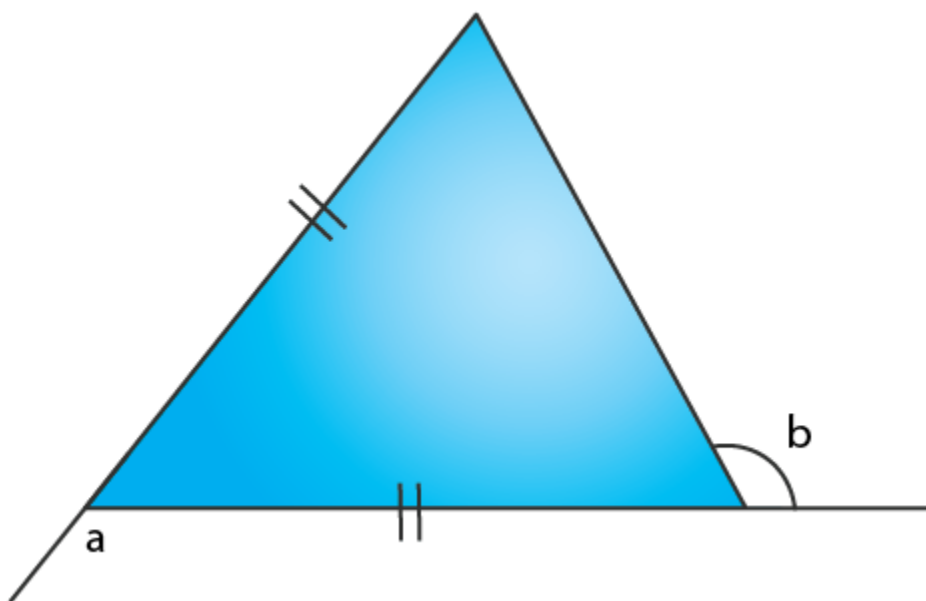
$$\angle BIC + 35^\circ + 35^\circ = 180^\circ$$

By further calculation

$$\angle BIC = 180 - 70 = 110^\circ$$

Therefore, $\angle BIC = 110^\circ$.

11. In the given figure, express a in terms of b .



Solution:

From the $\triangle ABC$

$$BC = BA$$

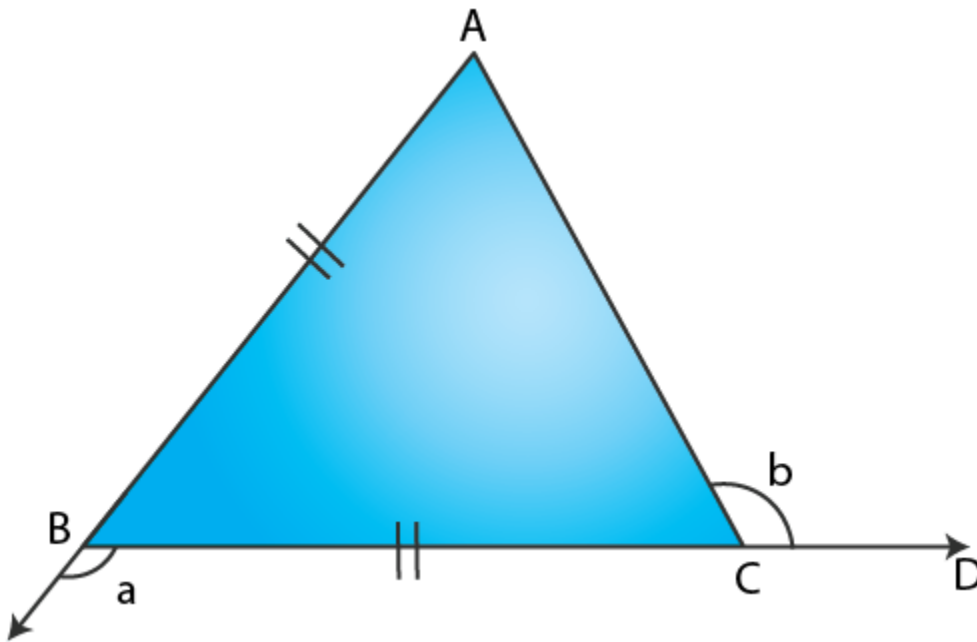
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$$\angle BCA = \angle BAC$$

Here the exterior $\angle CBE = \angle BCA + \angle BAC$

$$a = \angle BCA + \angle BCA$$

$$a = 2\angle BCA \dots\dots (1)$$



$$\text{Here } \angle ACB = 180^\circ - b$$

Where $\angle ACD$ and $\angle ACB$ are linear pair

$$\angle BCA = 180^\circ - b \dots\dots (2)$$

We get

$$a = 2\angle BCA$$

Substituting the values

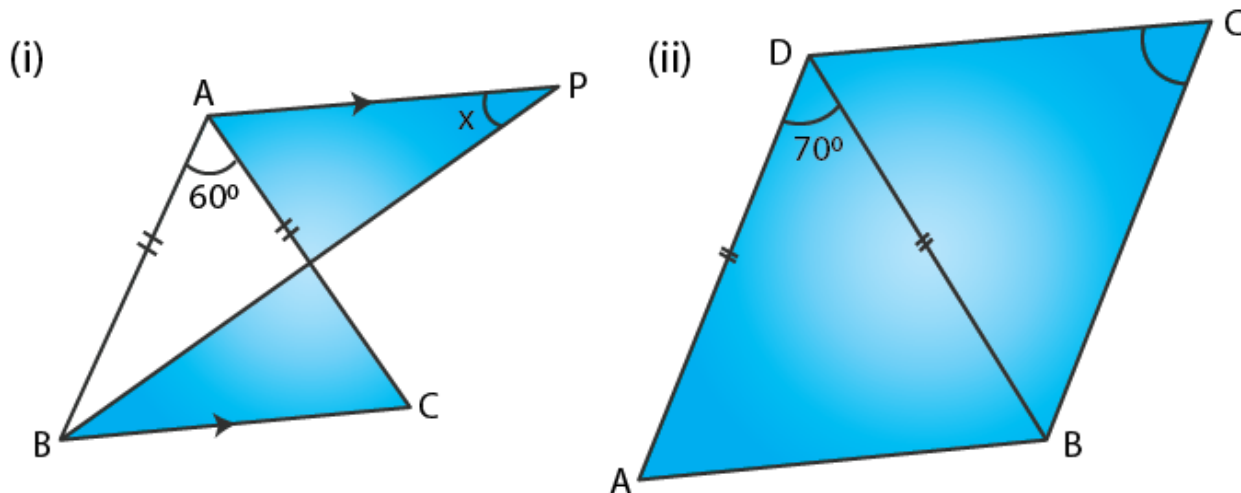
$$a = 2(180^\circ - b)$$

$$a = 360^\circ - 2b$$

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12. (a) In Figure (i) BP bisects $\angle ABC$ and $AB = AC$. Find x .

(b) Find x in Figure (ii) Given: $DA = DB = DC$, BD bisects $\angle ABC$ and $\angle ADB = 70^\circ$.



Solution:

(a) From the figure (i)

$AB = AC$ and BP bisects $\angle ABC$

AP is drawn parallel to BC

Here PB is the bisector of $\angle ABC$

$\angle PBC = \angle PBA$

$\angle APB = \angle PBC$ are alternate angles

$x = \angle PBC$ (1)

In $\triangle ABC$

$\angle A = 60^\circ$

Since $AB = AC$ we get $\angle B = \angle C$

In a triangle

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

Substituting the values

$$60^\circ + \angle B + \angle C = 180^\circ$$

We get

$$60^\circ + \angle B + \angle B = 180^\circ$$

By further calculation

$$2\angle B = 180 - 60 = 120^\circ$$

$$\angle B = 120/2 = 60^\circ$$

$$\frac{1}{2} \angle B = 60/2 = 30^\circ$$

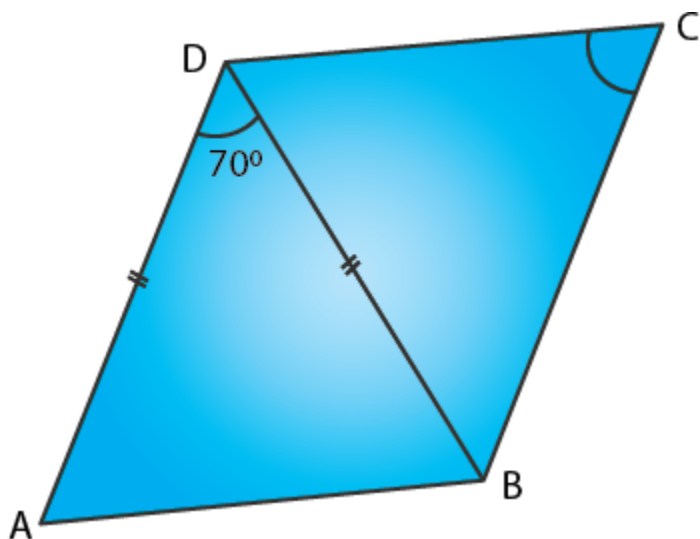
$$\angle PBC = 30^\circ$$

So from figure (i) $x = 30^\circ$

(b) From the figure (ii)

$$DA = DB = DC$$

Here BD bisects $\angle ABC$ and $\angle ADB = 70^\circ$



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In a triangle

$$\angle ADB + \angle DAB + \angle DBA = 180^\circ$$

Substituting the values

$$70^\circ + \angle DBA + \angle DBA = 180^\circ$$

By further calculation

$$70^\circ + 2\angle DBA = 180^\circ$$

$$2\angle DBA = 180 - 70 = 110^\circ$$

$$\angle DBA = 110/2 = 55^\circ$$

Here BD is the bisector of $\angle ABC$

$$\text{So } \angle DBA = \angle DBC = 55^\circ$$

In $\triangle DBC$

$$DB = DC$$

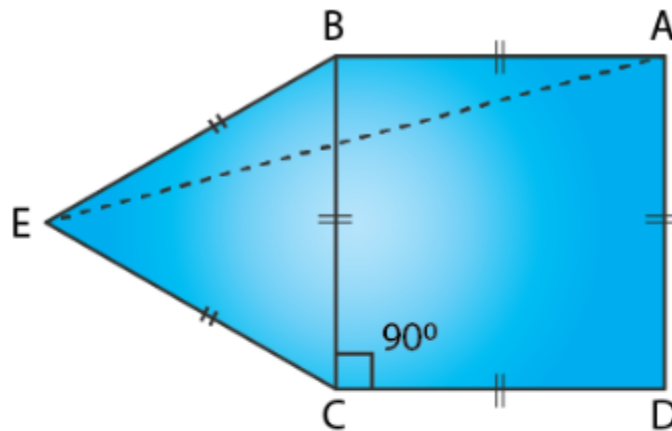
$$\angle DCB = \angle DBC$$

Hence, $x = 55^\circ$.

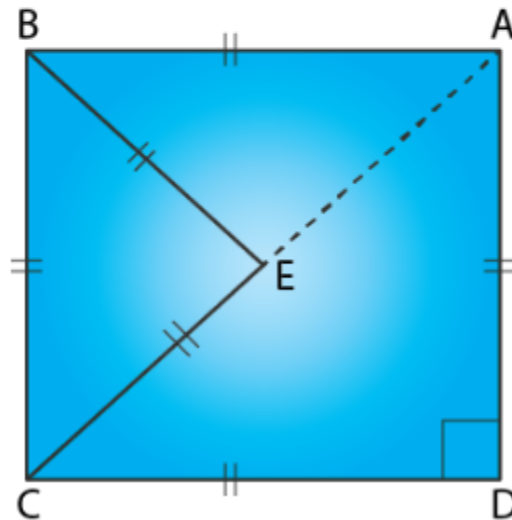
13. In each figure, given below, ABCD is a square and $\triangle BEC$ is an equilateral triangle.

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(i)



(ii)



Find, in each case: (i) $\angle ABE$ (ii) $\angle BAE$

Solution:

The sides of a square are equal and each angle is 90°

In an equilateral triangle all three sides are equal and all angles are 60°

In figure (i) ABCD is a square and $\triangle BEC$ is an equilateral triangle

(i) $\angle ABE = \angle ABC + \angle CBE$

Substituting the values

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$$\angle ABE = 90^\circ + 60^\circ = 150^\circ$$

(ii) In $\triangle ABE$

$$\angle ABE + \angle BEA + \angle BAE = 180^\circ$$

Substituting the values

$$150^\circ + \angle BAE + \angle BAE = 180^\circ$$

By further calculation

$$2\angle BAE = 180 - 150 = 30^\circ$$

$$\angle BAE = 30/2 = 15^\circ$$

In figure (ii) ABCD is a square and $\triangle BEC$ is an equilateral triangle

$$(i) \angle ABE = \angle ABC - \angle CBE$$

Substituting the values

$$\angle ABE = 90^\circ - 60^\circ = 30^\circ$$

(ii) In $\triangle ABE$

$$\angle ABE + \angle BEA + \angle BAE = 180^\circ$$

Substituting the values

$$30^\circ + \angle BAE + \angle BAE = 180^\circ$$

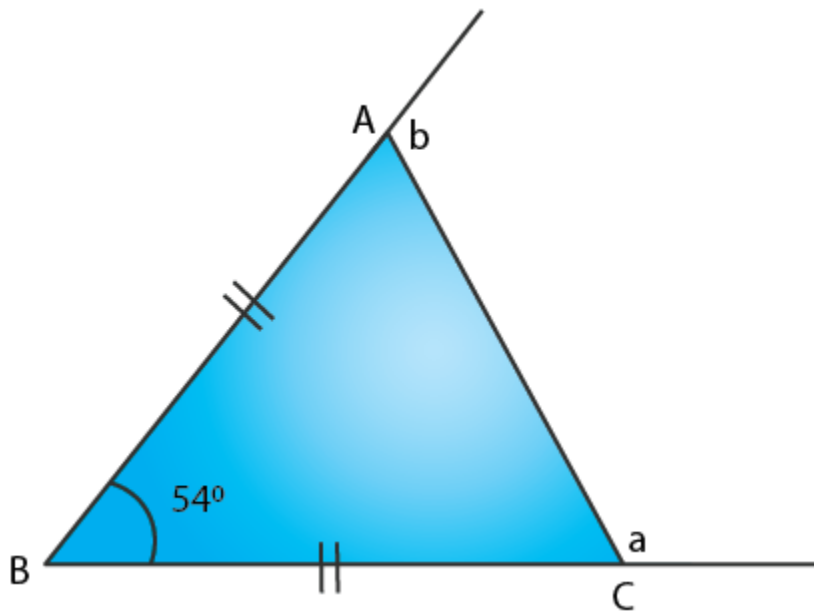
By further calculation

$$2\angle BAE = 180 - 30 = 150^\circ$$

$$\angle BAE = 150/2 = 75^\circ$$

14. In $\triangle ABC$, BA and BC are produced. Find the angles a and h. if $AB = BC$.

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**Solution:**

In $\triangle ABC$, BA and BC are produced

$$\angle ABC = 54^\circ \text{ and } AB = BC$$

In $\triangle ABC$

$$\angle BAC + \angle BCA + \angle ABC = 180^\circ$$

Substituting the values

$$\angle BAC + \angle BAC + 54^\circ = 180^\circ$$

$$2\angle BAC = 180 - 54 = 126^\circ$$

$$\angle BAC = 126/2 = 63^\circ$$

$$\angle BCA = 63^\circ$$

In a linear pair

$$\angle BAC + b = 180^\circ$$

Substituting the value

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$$63^\circ + b = 180^\circ$$

So we get

$$b = 180 - 63 = 117^\circ$$

In a linear pair

$$\angle BCA + a = 180^\circ$$

Substituting the value

$$63^\circ + a = 180^\circ$$

So we get

$$a = 180 - 63 = 117^\circ$$

Therefore, $a = b = 117^\circ$.

Exercise 15C page: 185

1. Construct a $\triangle ABC$ such that:

(i) $AB = 6$ cm, $BC = 4$ cm and $CA = 5.5$ cm

(ii) $CB = 6.5$ cm, $CA = 4.2$ cm and $BA = 5.1$ cm

(iii) $BC = 4$ cm, $AC = 5$ cm and $AB = 3.5$ cm

Solution:

(i) Steps of Construction

1. Construct a line segment $BC = 4$ cm.

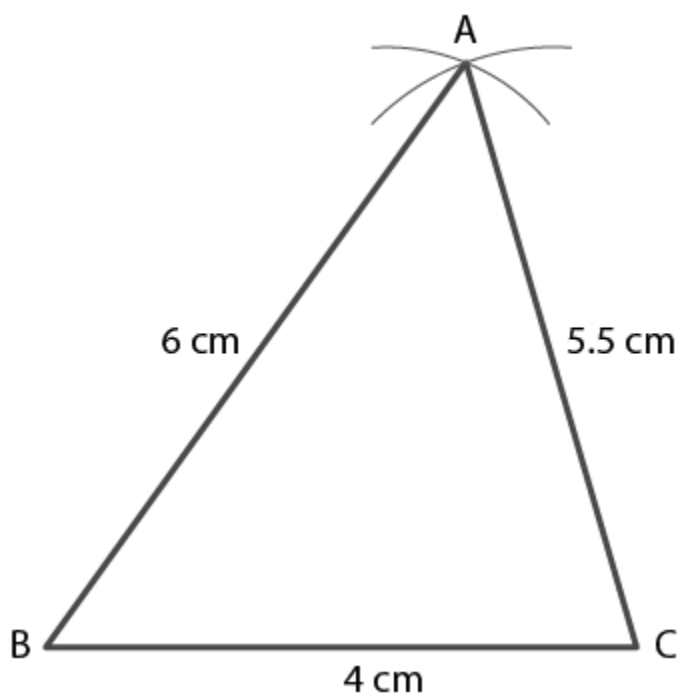
2. Taking B as centre and 6 cm as radius construct an arc.

3. Taking C as centre and 5.5 cm as radius construct another arc which intersects the first arc at the point A.

4. Now join AB and AC.

Therefore, $\triangle ABC$ is the required triangle.

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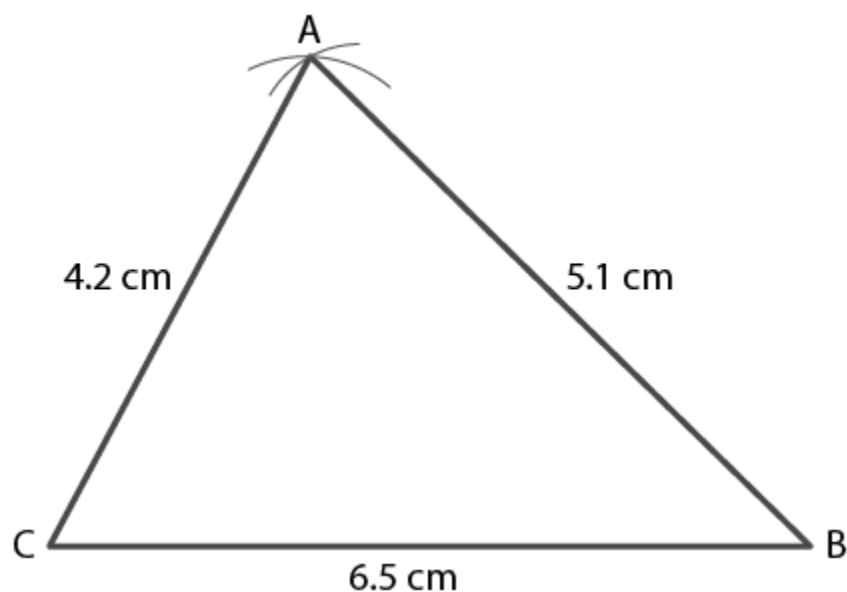


(ii) Steps of Construction

1. Construct a line segment $CB = 6.5$ cm
2. Taking C as centre and 4.2 cm as radius construct an arc.
3. Taking B as centre and 5.1 cm as radius construct another arc which intersects the first arc at the point A.
4. Now join AC and AB.

Therefore, $\triangle ABC$ is the required triangle.

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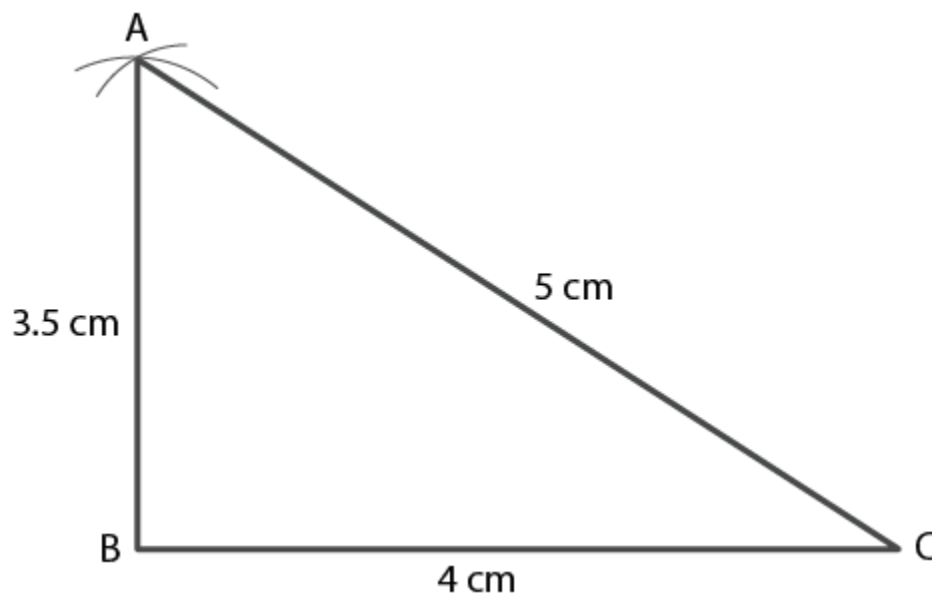


(iii) Steps of Construction

1. Construct a line segment $BC = 4$ cm
2. Taking B as centre and 3.5 cm as radius construct an arc.
3. Taking C as centre and 5 cm as radius construct another arc which intersects the first arc at the point A.
4. Now join AB and AC.

Therefore, $\triangle ABC$ is the required triangle.

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2. Construct a $\triangle ABC$ such that:

- (i) $AB = 7$ cm, $BC = 5$ cm and $\angle ABC = 60^\circ$**
- (ii) $BC = 6$ cm, $AC = 5.7$ cm and $\angle ACB = 75^\circ$**
- (iii) $AB = 6.5$ cm, $AC = 5.8$ cm and $\angle A = 45^\circ$**

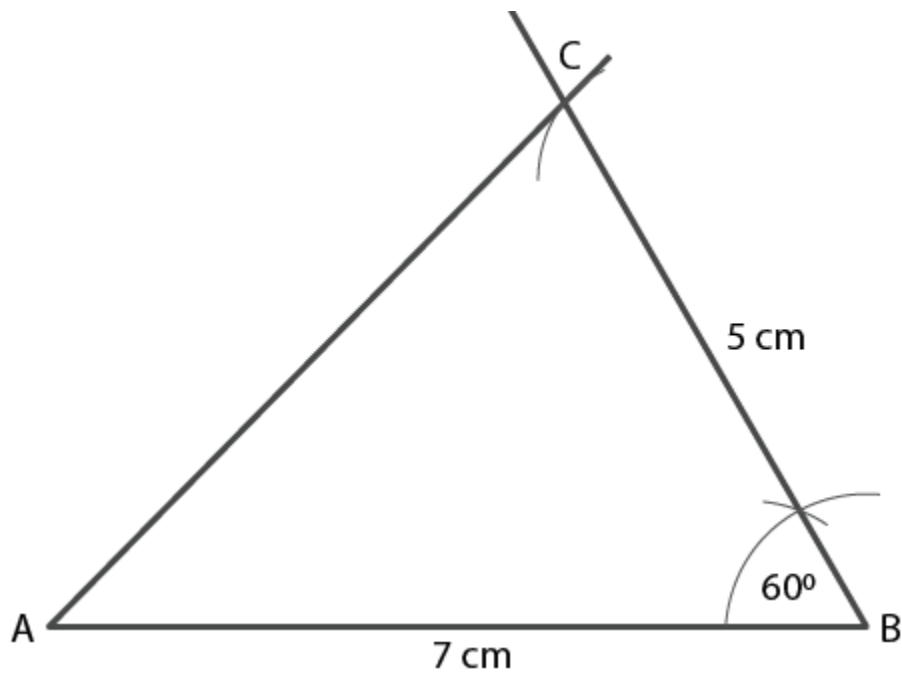
Solution:

(i) Steps of Construction

1. Construct a line segment $AB = 7$ cm.
2. At the point B construct a ray which makes an angle 60° and cut off $BC = 5$ cm.
3. Now join AC.

Therefore, $\triangle ABC$ is the required triangle.

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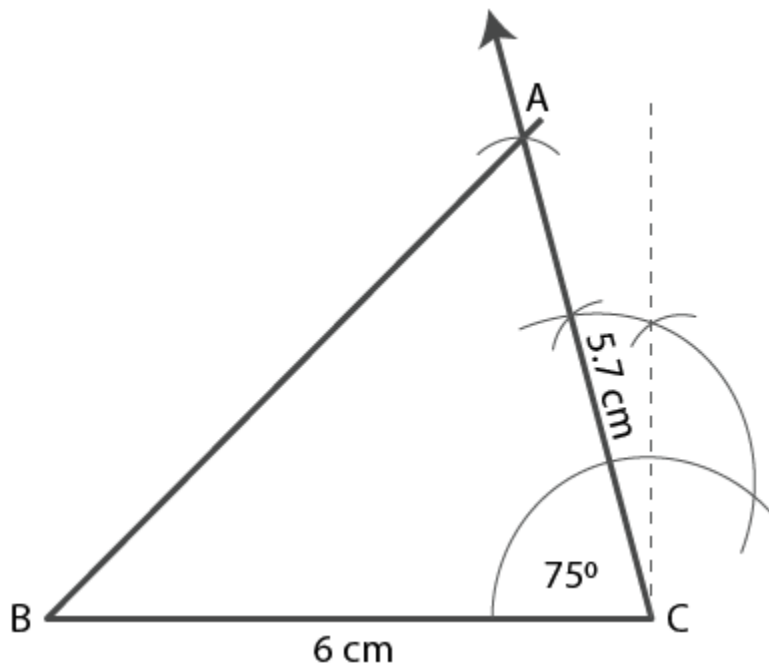


(ii) Steps of Construction

1. Construct a line segment $BC = 6$ cm.
2. At the point C construct a ray which makes an angle 75° and cut off $CA = 5.7$ cm.
3. Now join AB.

Therefore, $\triangle ABC$ is the required triangle.

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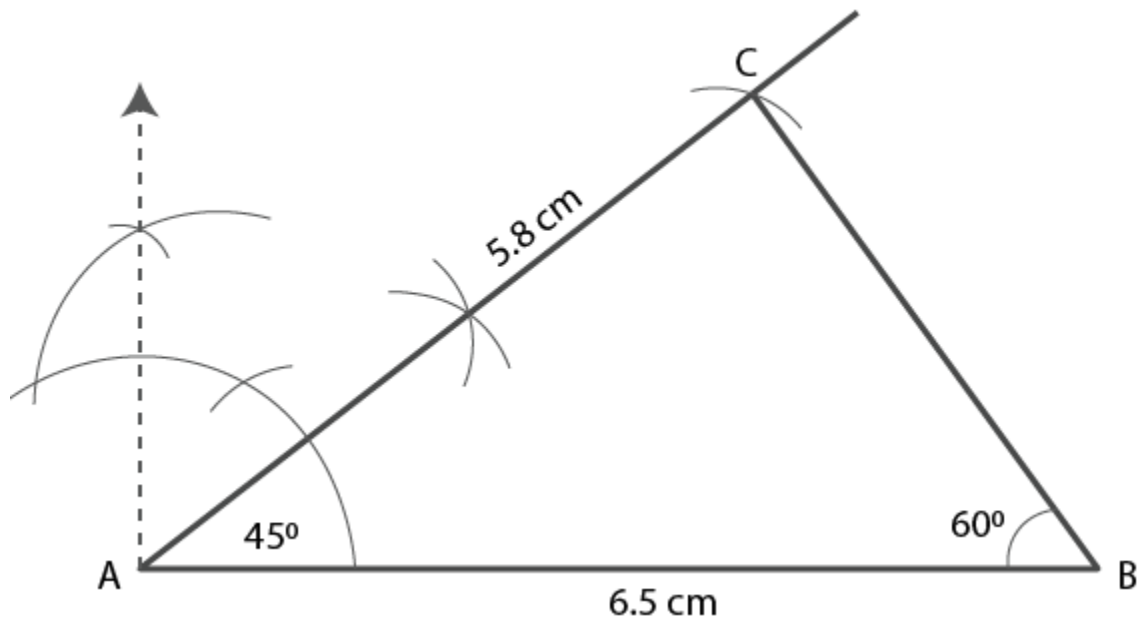


(iii) Steps of Construction

1. Construct a line segment $AB = 6.5$ cm.
2. At the point A construct a ray which makes an angle 45° and cut off $AC = 5.8$ cm.
3. Now join CB.

Therefore, $\triangle ABC$ is the required triangle.

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3. Construct a $\triangle PQR$ such that :

- (i) $PQ = 6$ cm, $\angle Q = 60^\circ$ and $\angle P = 45^\circ$. Measure $\angle R$.**
- (ii) $QR = 4.4$ cm, $\angle R = 30^\circ$ and $\angle Q = 75^\circ$. Measure PQ and PR .**
- (iii) $PR = 5.8$ cm, $\angle P = 60^\circ$ and $\angle R = 45^\circ$.**

Measure $\angle Q$ and verify it by calculations

Solution:

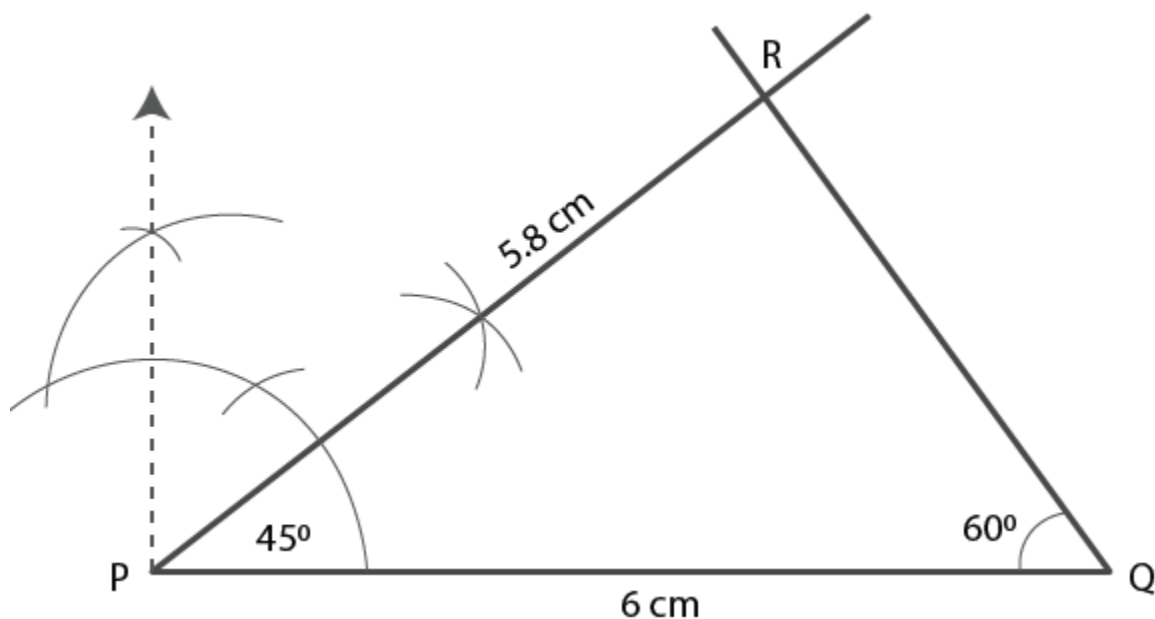
(i) Steps of Construction

1. Construct a line segment $PQ = 6$ cm.
2. At point P construct a ray which makes an angle 45° .
3. At point Q construct another ray which makes an angle 60° which intersect the first ray at point R.

Therefore, $\triangle PQR$ is the required triangle.

By measuring $\angle R = 75^\circ$.

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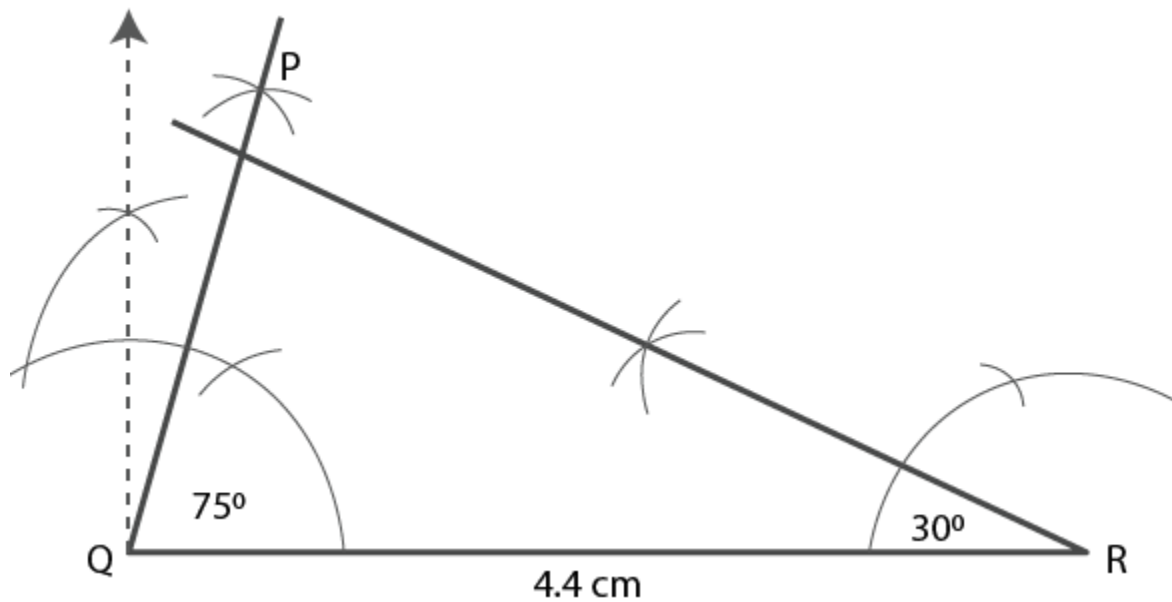
(ii) Steps of Construction

1. Construct a line segment $QR = 4.4$ cm.
2. At point Q construct a ray which makes an angle 75° .
3. At point R construct another ray which makes an angle 30° which intersect the first ray at point P.

Therefore, ΔPQR is the required triangle.

By measuring the length, $PQ = 2.1$ cm and $PR = 4.4$ cm.

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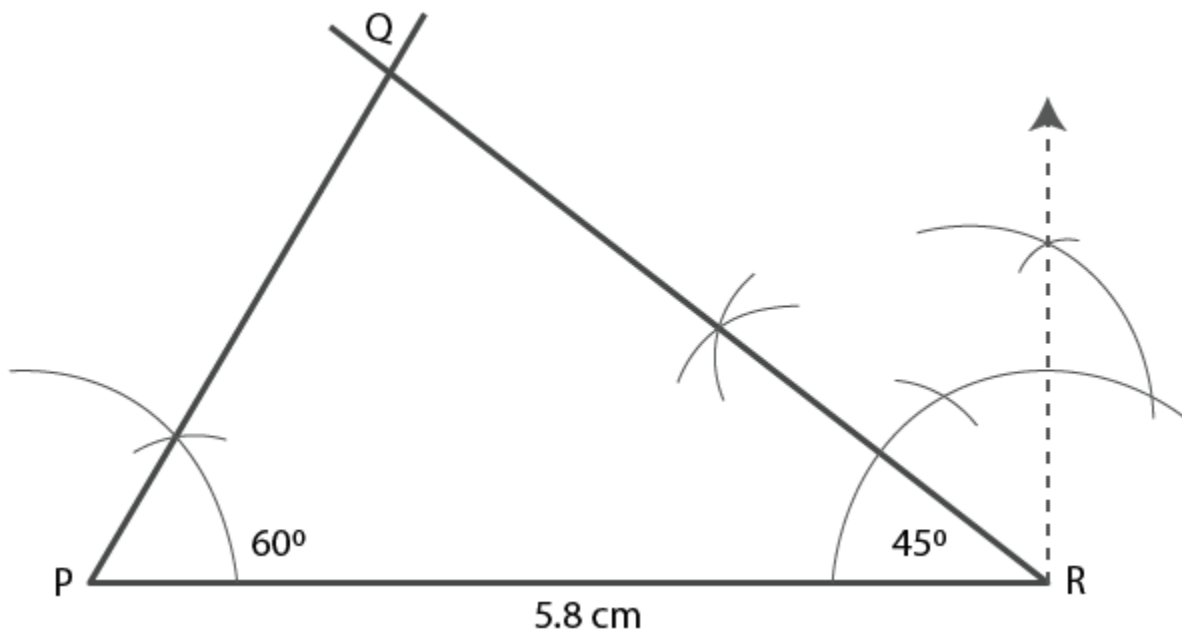
(iii) Steps of Construction

1. Construct a line segment $PR = 5.8$ cm.
2. At point P construct a ray which makes an angle 60° .
3. At point R construct another ray which makes an angle 45° which intersect the first ray at point Q.

Therefore, $\triangle PQR$ is the required triangle.

By measuring $\angle Q = 75^\circ$.

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Verification –

$$\angle P + \angle Q + \angle R = 180^\circ$$

Substituting the values

$$60^\circ + \angle Q + 45^\circ = 180^\circ$$

By further calculation

$$\angle Q = 180 - 105 = 75^\circ$$

4. Construct an isosceles $\triangle ABC$ such that:

(i) base BC = 4 cm and base angle = 30°

(ii) base AB = 6.2 cm and base angle = 45°

(iii) base AC = 5 cm and base angle = 75° .

Measure the other two sides of the triangle.

Solution:

(i) Steps of Construction

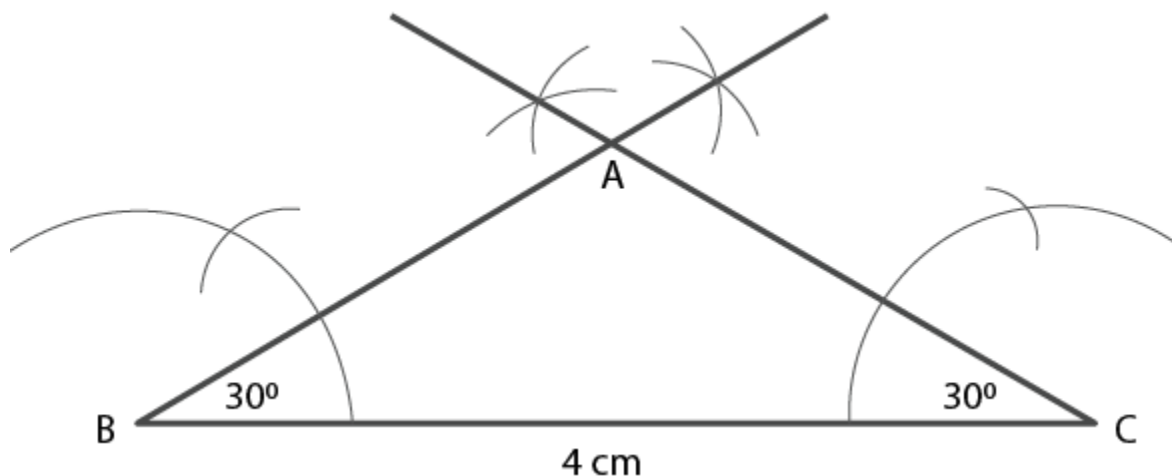
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In an isosceles triangle the base angles are equal

1. Construct a line segment $BC = 4\text{ cm}$.
2. At the points B and C construct rays which makes an angle 30° intersecting each other at the point A.

Therefore, $\triangle ABC$ is the required triangle.

By measuring the equal sides, each is 2.5 cm in length approximately.



(ii) Steps of Construction

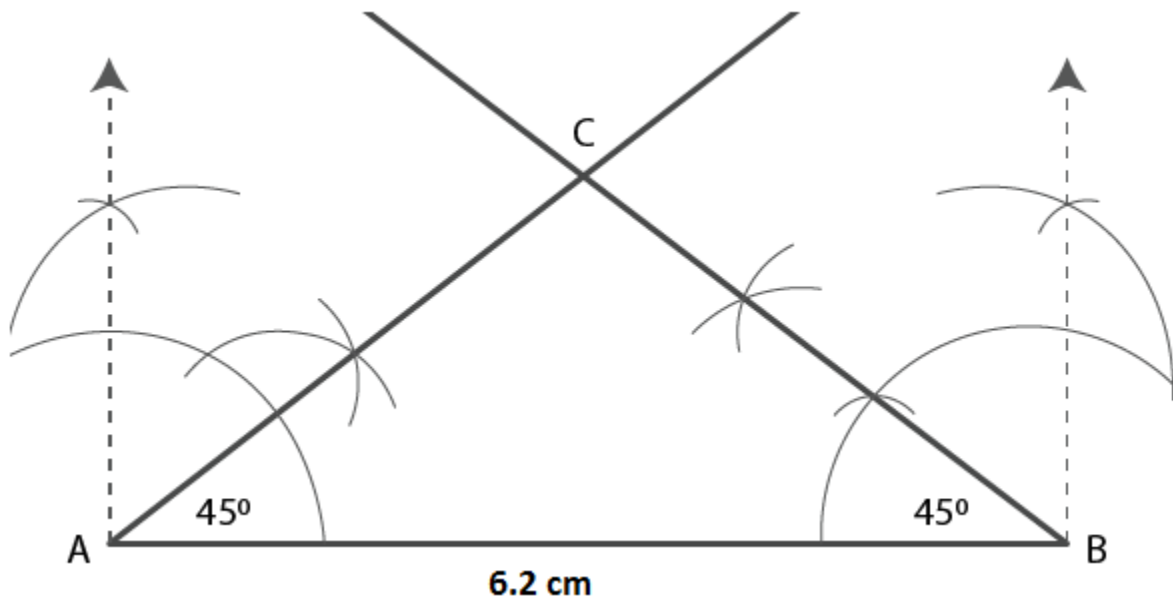
In an isosceles triangle the base angles are equal

1. Construct a line segment $AB = 6.2\text{ cm}$.
2. At the points A and B construct rays which makes an angle 45° intersecting each other at the point C.

Therefore, $\triangle ABC$ is the required triangle.

By measuring the equal sides, each is 4.3 cm in length approximately.

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(iii) Steps of Construction

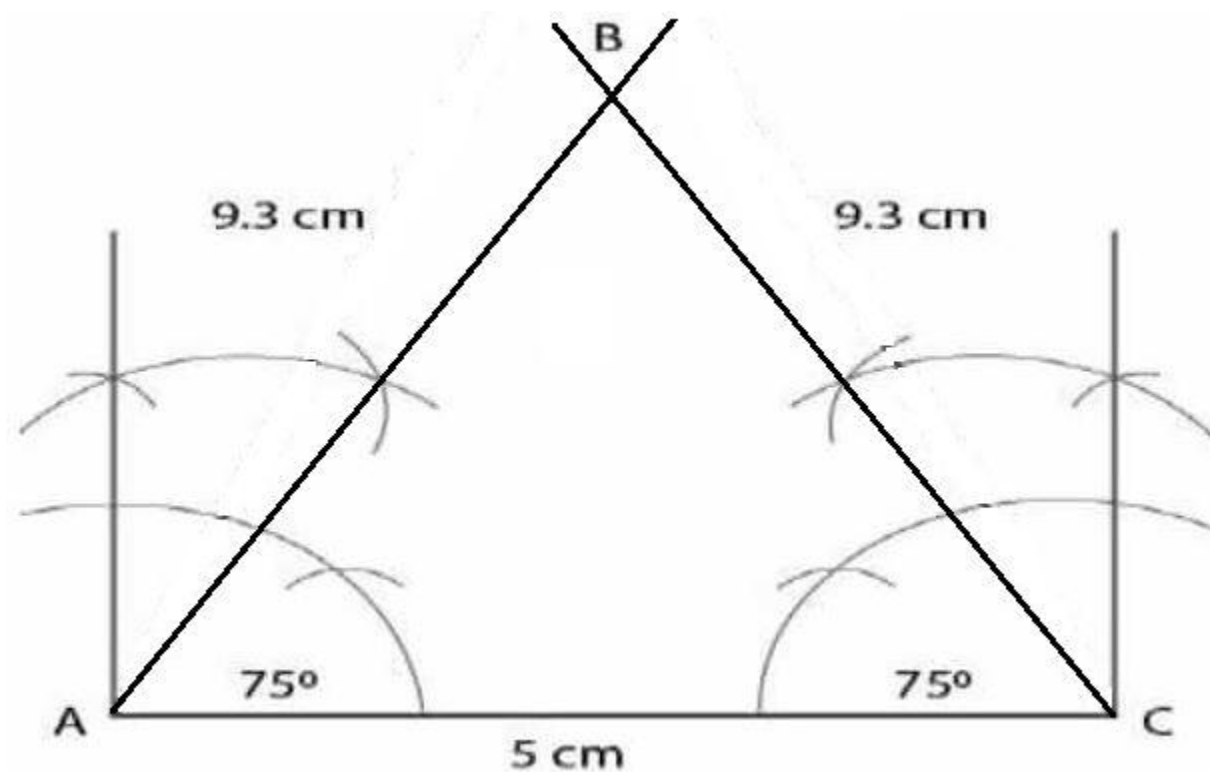
In an isosceles triangle the base angles are equal

1. Construct a line segment $AC = 5$ cm.
2. At the points A and C construct rays which makes an angle 75° intersecting each other at the point B.

Therefore, $\triangle ABC$ is the required triangle.

By measuring the equal sides, each is 9.3 cm in length approximately.

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5. Construct an isosceles $\triangle ABC$ such that:

(i) $AB = AC = 6.5$ cm and $\angle A = 60^\circ$

(ii) One of the equal sides = 6 cm and vertex angle = 45° . Measure the base angles.

(iii) $BC = AB = 5.8$ cm and $\angle B = 30^\circ$. Measure $\angle A$ and $\angle C$.

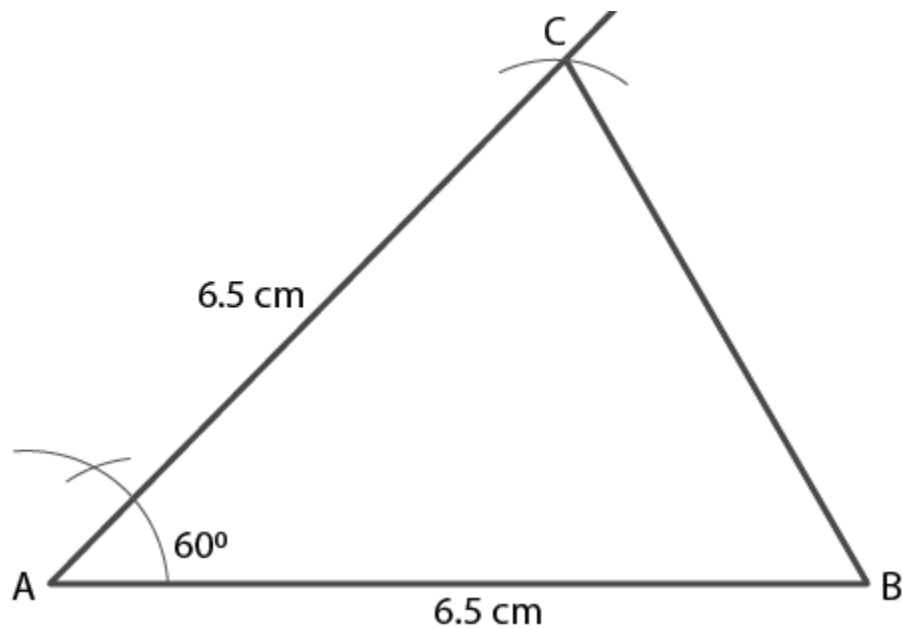
Solution:

(i) Steps of Construction

1. Construct a line segment $AB = 6.5$ cm.
2. At point A construct a ray which makes an angle 60° .
3. Now cut off $AC = 6.5$ cm
4. Join BC.

Therefore, $\triangle ABC$ is the required triangle.

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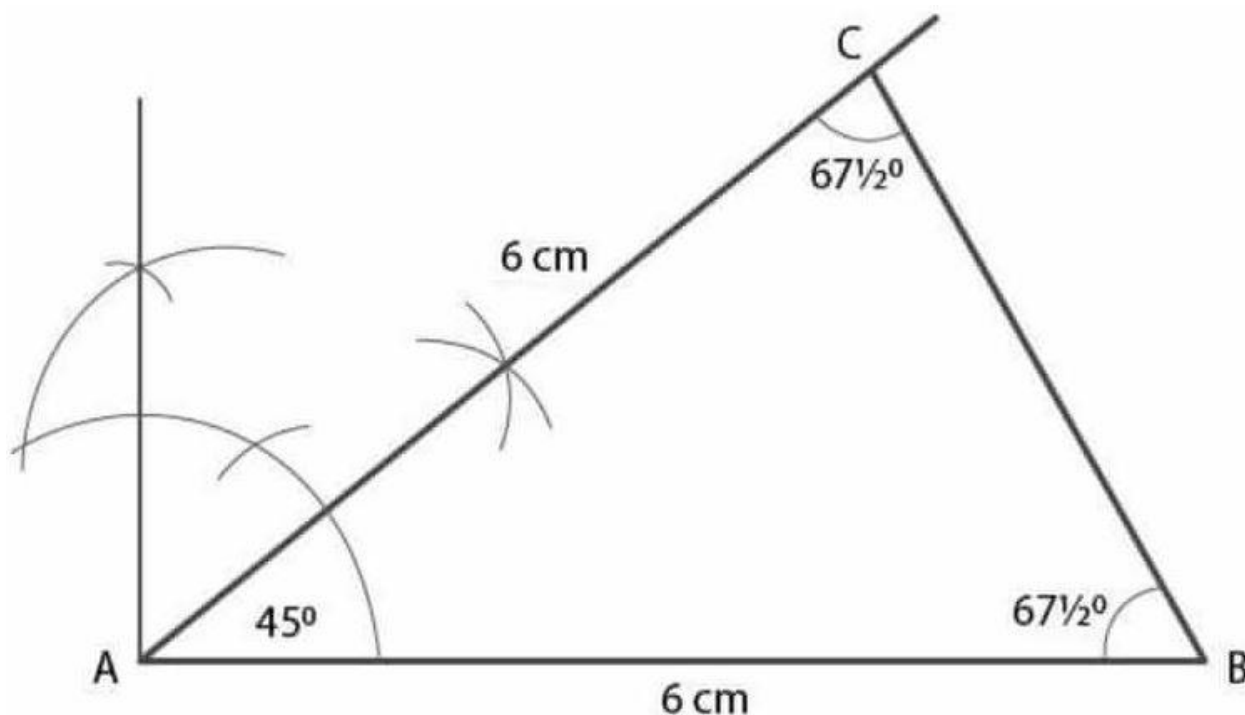
(ii) Steps of Construction

1. Construct a line segment $AB = 6 \text{ cm}$.
2. At point A construct a ray which makes an angle 45° .
3. Now cut off $AC = 6 \text{ cm}$
4. Join BC.

Therefore, $\triangle ABC$ is the required triangle.

By measuring $\angle B$ and $\angle C$, both are equal to $67 \frac{1}{2}^\circ$.

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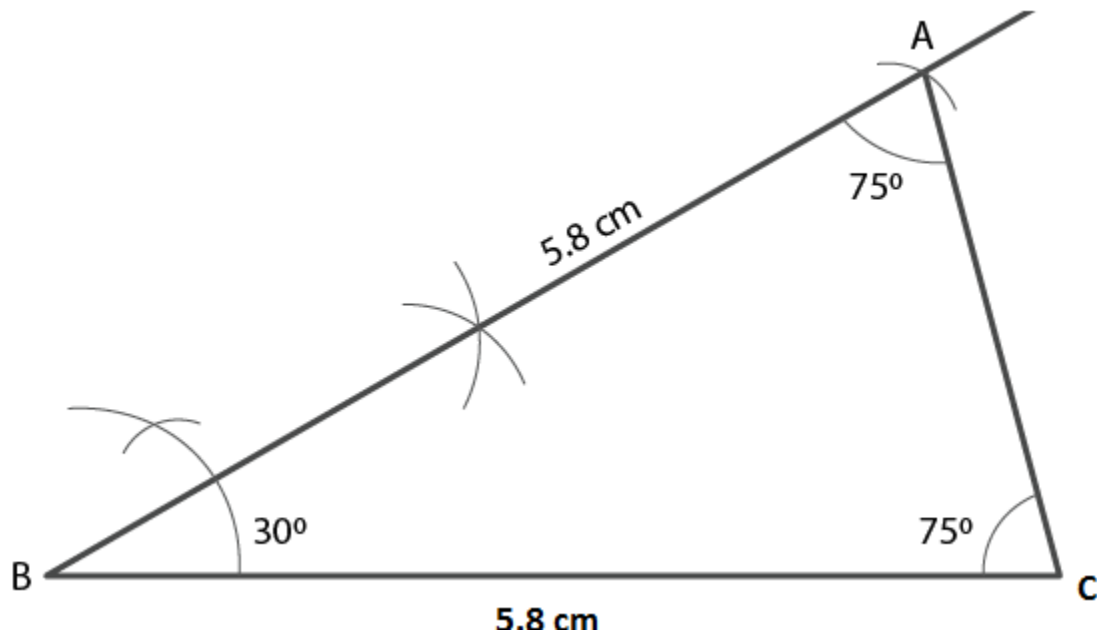
(iii) Steps of Construction

1. Construct a line segment $BC = 5.8$ cm.
2. At point B construct a ray which makes an angle 30° .
3. Now cut off $BA = 5.8$ cm
4. Join AC.

Therefore, $\triangle ABC$ is the required triangle.

By measuring $\angle C$ and $\angle A$ is equal to 75° .

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6. Construct an equilateral triangle ABC such that:

(i) $AB = 5$ cm. Draw the perpendicular bisectors of BC and AC. Let P be the point of intersection of these two bisectors. Measure PA, PB and PC.

(ii) Each side is 6 cm.

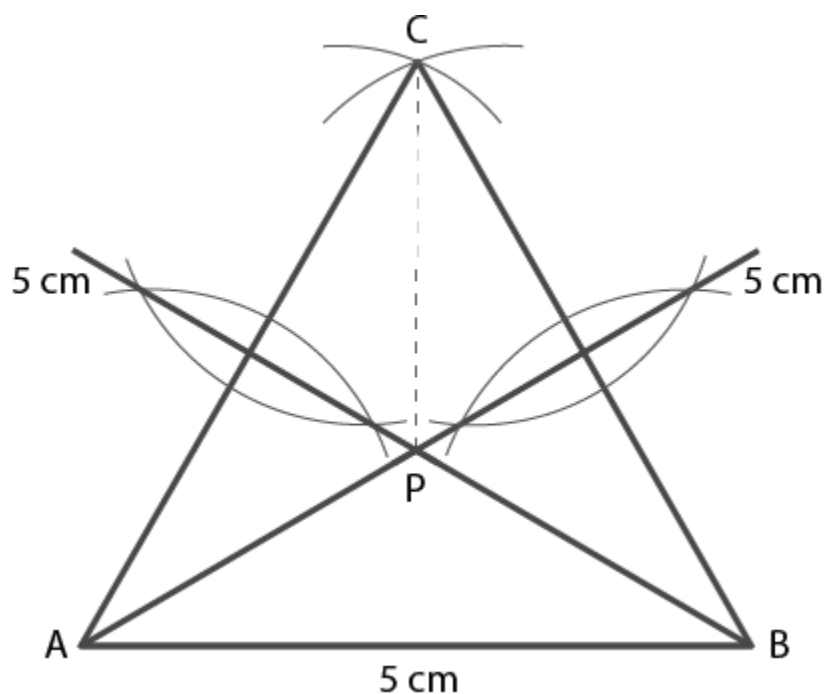
Solution:

(i) Steps of Construction

1. Construct a line segment $AB = 5$ cm.
2. Taking A and B as centres and 5 cm radius, construct two arcs which intersect each other at the point C.
3. Now join AC and BC where $\triangle ABC$ is the required triangle.
4. Construct perpendicular bisectors of sides AC and BC which intersect each other at the point p.
5. Join PA, PB and PC.

By measuring each is 2.8 cm.

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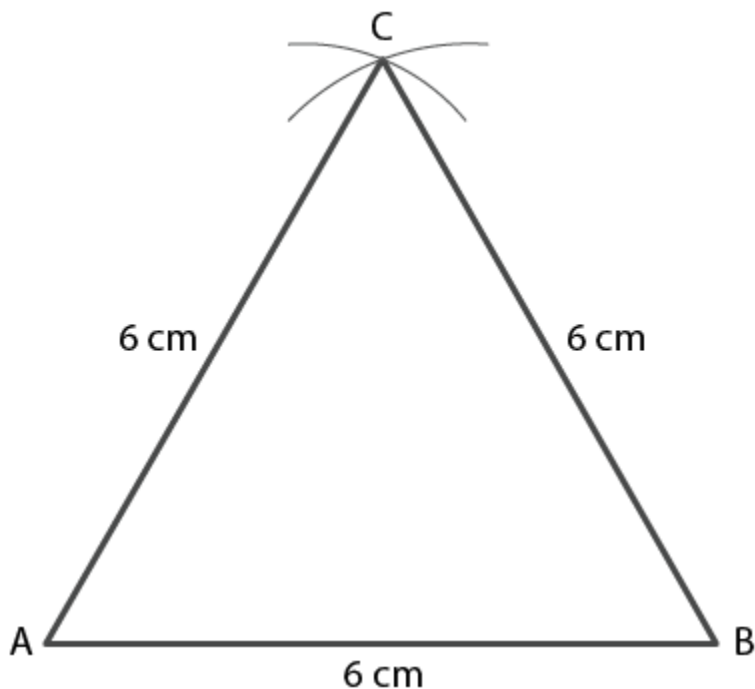


(ii) Steps of Construction

1. Construct a line segment $AB = 6\text{ cm}$.
2. Taking A and B as centres and 6 cm radius, construct two arcs which intersect each other at the point C.
3. Now join AC and BC

Therefore, $\triangle ABC$ is the required triangle.

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7. (i) Construct a $\triangle ABC$ such that $AB = 6$ cm, $BC = 4.5$ cm and $AC = 5.5$ cm. Construct a circumcircle of this triangle.

(ii) Construct an isosceles $\triangle PQR$ such that $PQ = PR = 6.5$ cm and $\angle PQR = 75^\circ$. Using ruler and compasses only construct a circumcircle to this triangle.

(iii) Construct an equilateral triangle ABC such that its one side = 5.5 cm.

Construct a circumcircle to this triangle.

Solution:

(i) Steps of Construction

1. Construct a line segment $BC = 4.5$ cm.
2. Taking B as centre and 6 cm radius construct an arc.
3. Taking C as centre and 5.5 cm radius construct another arc which intersects the first arc at point A.
4. Now join AB and AC

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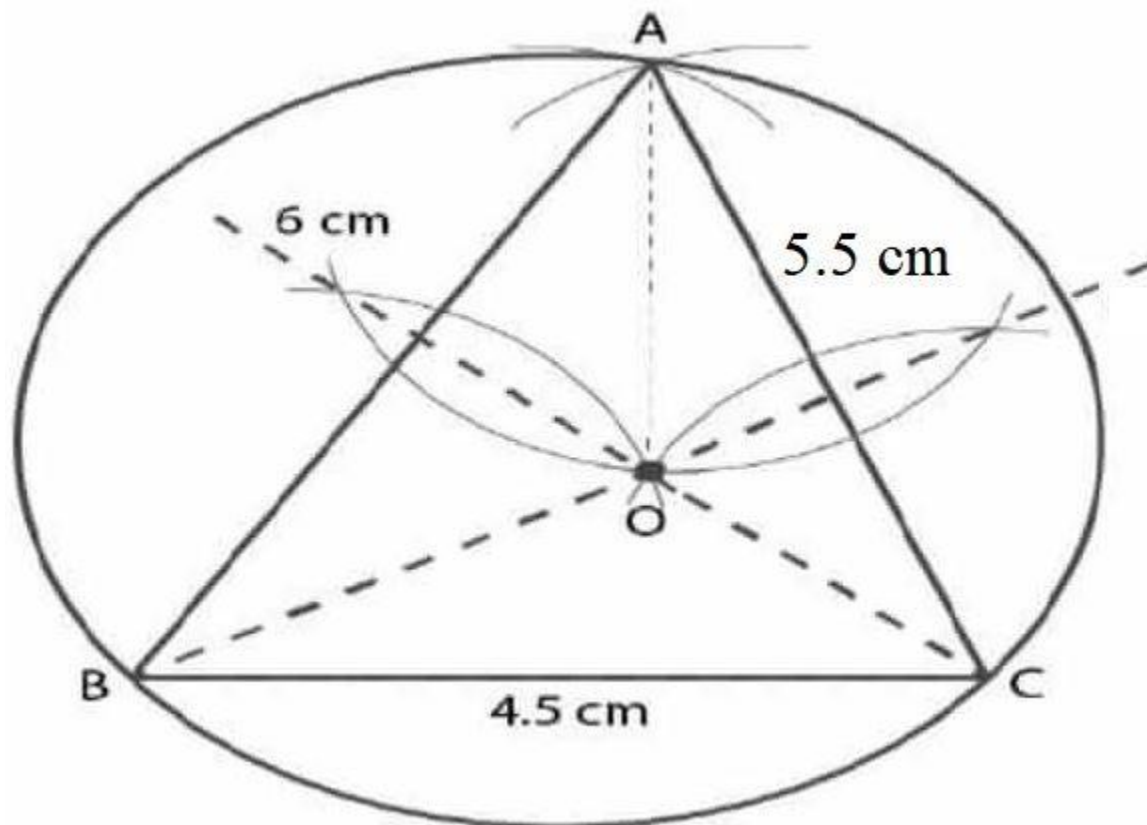
Therefore, $\triangle ABC$ is the required triangle.

5. Construct a perpendicular bisector of AB and AC which intersect each other at the point O.

6. Now join OB, OC and OA.

7. Taking O as centre and radius OA construct a circle which passes through the points A, B and C.

This is the required circumcircle of $\triangle ABC$.



(ii) Steps of Construction

1. Construct a line segment $PQ = 6.5$ cm.

2. At point Q, construct an arc which makes an angle 75° .

3. Taking P as centre and radius 6.5 cm construct an arc which intersects the angle at point R.

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4. Join PR.

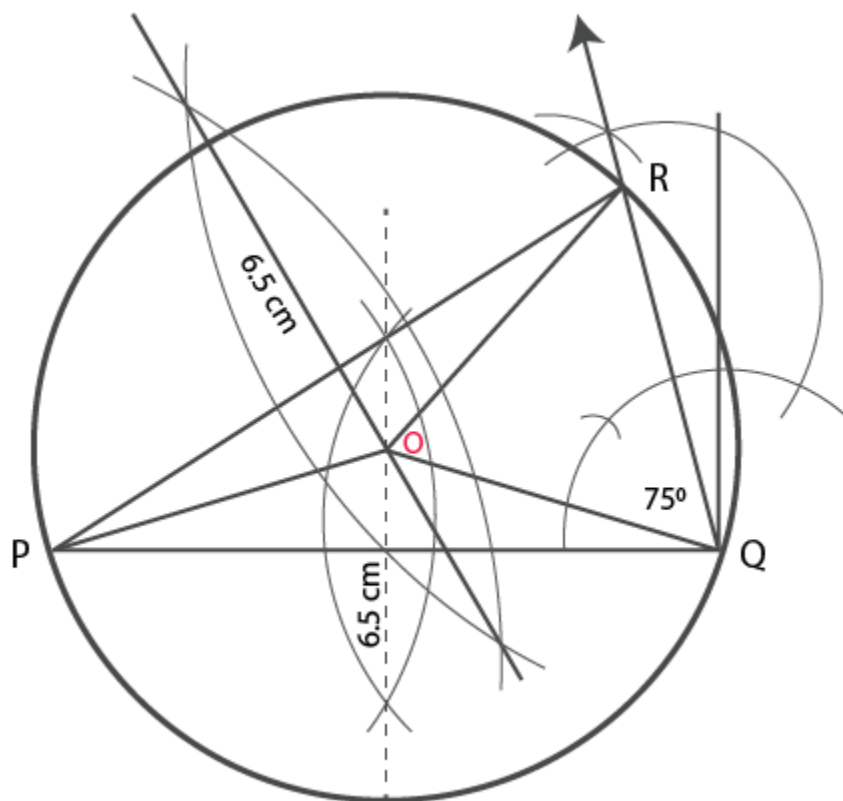
ΔPQR is the required triangle.

4. Construct the perpendicular bisector of sides PQ and PR which intersect each other at the point O.

5. Join OP, OQ and OR.

6. Taking O as centre and radius equal to OP or OQ or OR construct a circle which passes through P, Q and R.

This is the required circumcircle of ΔPQR .



(iii) Steps of Construction

1. Construct a line segment AB = 5.5 cm.

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2. Taking A and B as centres and radius 5.5 cm construct two arcs which intersect each other at point C.

3. Now join AC and BC.

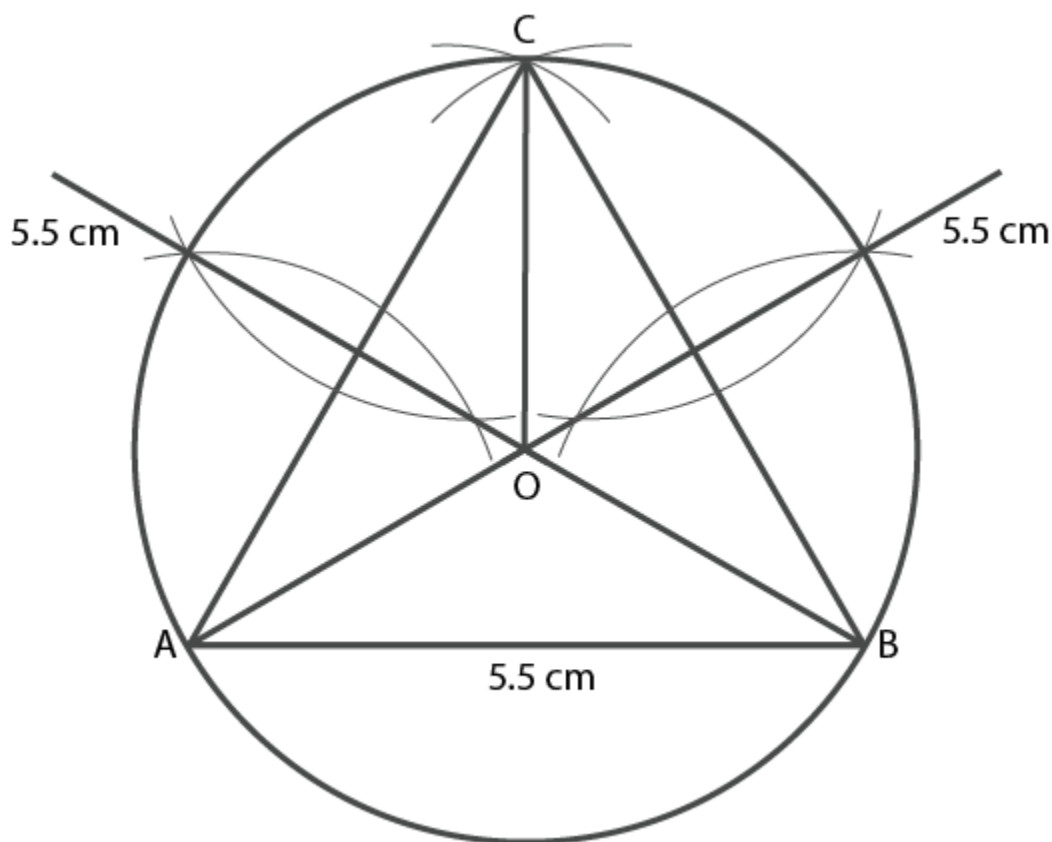
$\triangle ABC$ is the required triangle.

4. Construct perpendicular bisectors of sides AC and BC which intersect each other at the point O.

5. Now join OA, OB and OC.

6. Taking O as centre and OA or OB or OC as radius construct a circle which passes through A, B and C.

This is the required circumcircle.



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8. (i) Construct a $\triangle ABC$ such that $AB = 6$ cm, $BC = 5.6$ cm and $CA = 6.5$ cm. Inscribe a circle to this triangle and measure its radius.

(ii) Construct an isosceles $\triangle MNP$ such that base $MN = 5.8$ cm, base angle $MNP = 30^\circ$. Construct an incircle to this triangle and measure its radius.

(iii) Construct an equilateral $\triangle DEF$ whose one side is 5.5 cm. Construct an incircle to this triangle.

(iv) Construct a $\triangle PQR$ such that $PQ = 6$ cm, $\angle QPR = 45^\circ$ and angle $PQR = 60^\circ$. Locate its incentre and then draw its incircle.

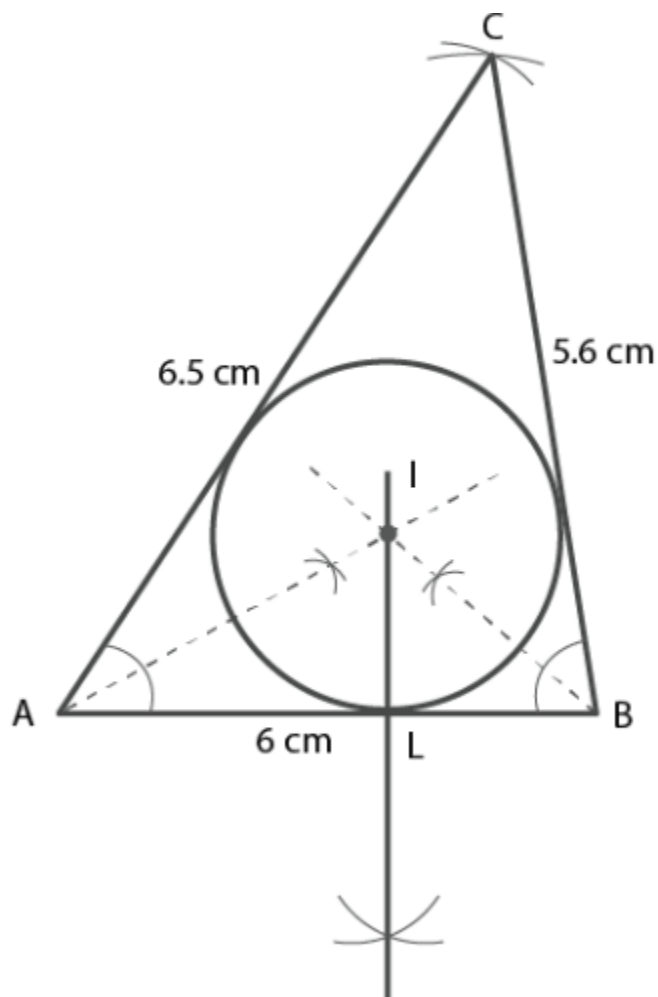
Solution:

(i) Steps of Construction

1. Construct a line segment $AB = 6$ cm.
2. Taking A as centre and 6.5 cm as radius and B as centre and 5.6 cm as radius construct arcs which intersect each other at point C.
3. Now join AC and BC.
4. Construct the angle bisector of $\angle A$ and $\angle B$ which intersect each other at point I.
5. From the point I construct IL which is perpendicular to AB.
6. Taking I as centre and IL as radius construct a circle which touches the sides of $\triangle ABC$ internally.

By measuring the required incircle the radius is 1.6 cm.

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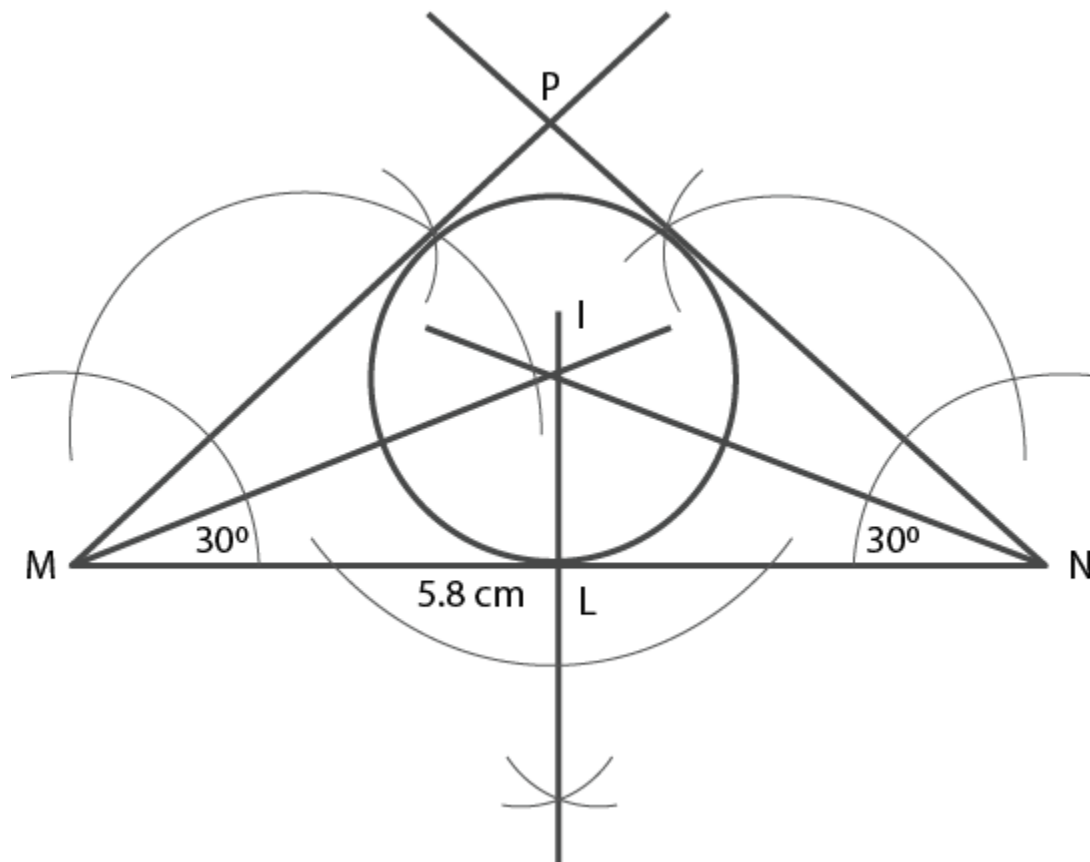


(ii) Steps of Construction

1. Construct a line segment $MN = 5.8$ cm.
2. At points M and N construct two rays which make an angle 30° each intersecting each other at point P.
3. Construct the angle bisectors of $\angle M$ and $\angle N$ which intersect each other at point I.
4. From the point I draw perpendicular IL on MN.
5. Taking I as centre and IL as radius construct a circle which touches the sides of $\triangle PMB$ internally.

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By measuring the required incircle the radius is 0.6 cm.

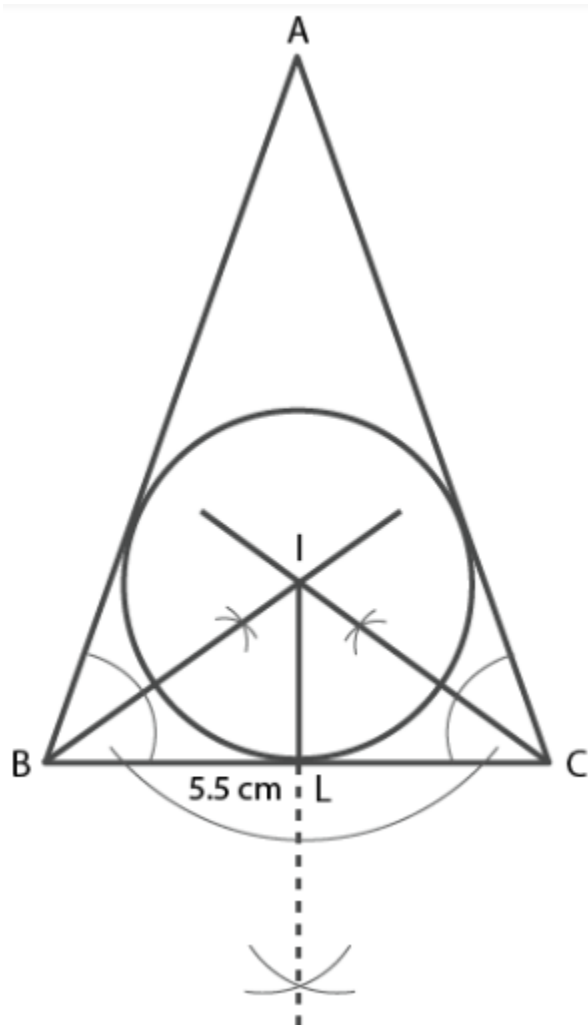


(iii) Steps of Construction

1. Construct a line segment BC = 5.5 cm.
2. Taking B and C as centres and 5.5 cm radius construct two arcs which intersect each other at point A.
3. Now join AB and AC.
4. Construct the perpendicular bisectors of $\angle B$ and $\angle C$ which intersect each other at the point I.
5. From the point I construct IL which is perpendicular to BC.
6. Taking I as centre and IL as radius construct a circle which touches the sides of $\triangle ABC$ internally.

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This is the required incircle.



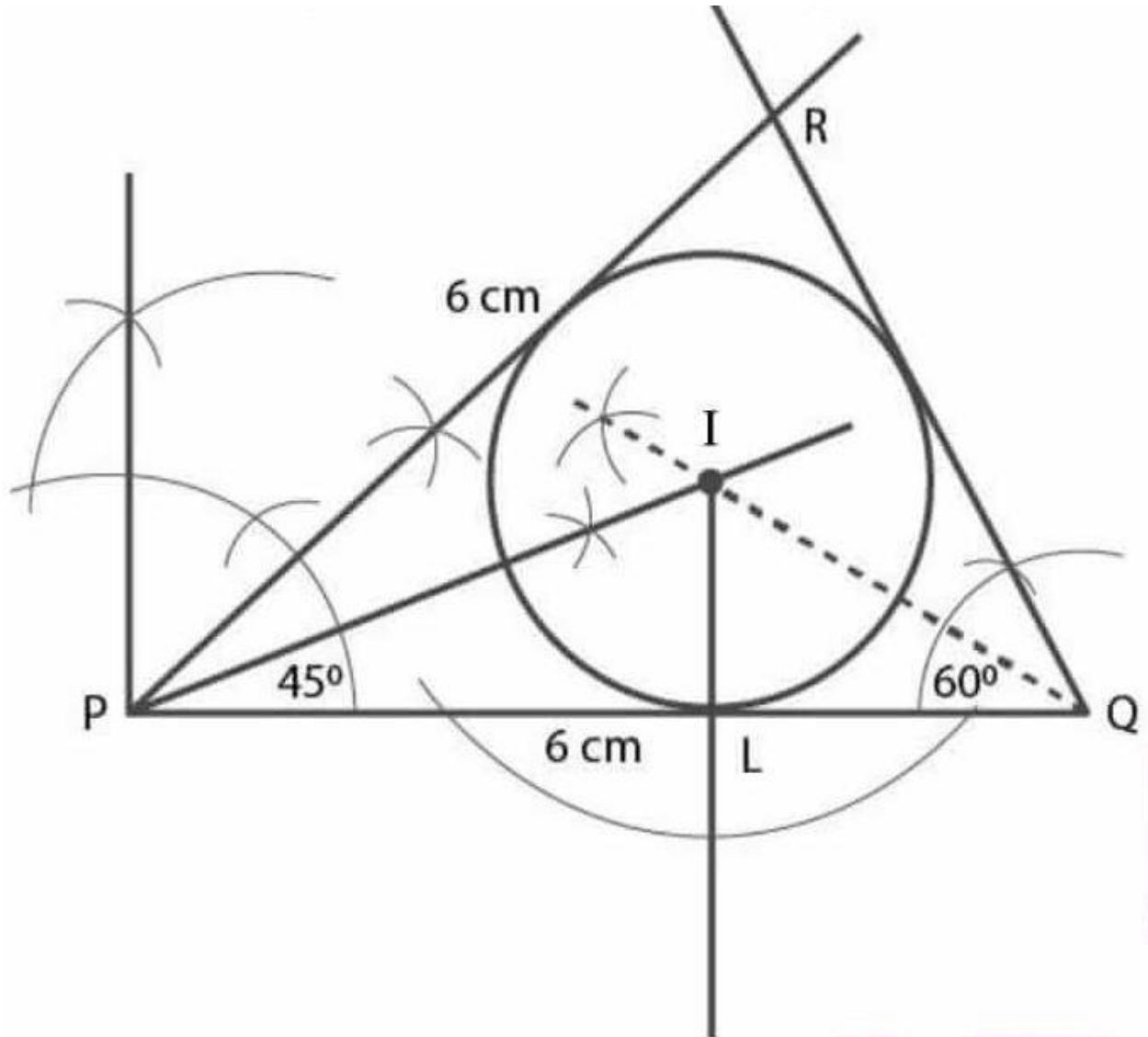
(iv) Steps of Construction

1. Construct a line segment $PQ = 6$ cm.
2. At the point P construct rays which make an angle of 45° and at point Q which makes an angle 60° that intersects each other at point R.
3. Construct the bisectors of $\angle P$ and $\angle Q$ which intersect each other at point I.
4. From the point I construct IL which is perpendicular to PQ.

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5. Taking I as centre and IL as radius construct a circle which touches the sides of $\triangle PQR$ internally.

This is the required incircle where the point I is incentre.



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