

Master Lesson Plan

For

The Triangle and its Properties

Board	Standard	Subject	Chapter	Language	Reference Link	Creation date
CBSE	STD VII	Mathematics	The Triangle and its Properties	English	The Triangle and its Properties	2019-09-07 13:04:36

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The Triangle and its Properties

1. MS_Objectives_The Triangle and its Properties

Notes to the teacher:

This asset lays down the proposed plan for transacting this chapter.

It states the asset objectives of the MLP. This asset is for teacher's reference and need not be taught to the students

- Students will be able to :
- List triangular shapes seen in daily life.
- Define a triangle, identify its parts and discuss triangles based on sides and angles.
- Define median of a triangle, centroid of a triangle and explain position of the centroid in different triangles.
- Define altitude of a triangle and explain the position of the altitude in different triangles.
- Explain exterior angle property of triangle with proof and suitable illustrations.
- Solve problems based on exterior angle property of triangle.
- Explain the angle sum property of triangle with proof and suitable illustrations.
- Solve problems based on angle sum property of triangle.
- Analyse problems based on the angle sum property of triangles.
- Explain the properties of Equilateral triangle and Isosceles triangle with suitable illustrations.
- Appreciate interesting facts about triangles.
- Demonstrate the properties of Equilateral triangles.
- Demonstrate the properties of Isosceles triangles.
- Show the length of sides property in different types of triangles.
- Solve problems based on Pythagoras Theorem.
- Analyse problems based on Pythagoras Theorem.
- Adapt a positive attitude to stay blissful despite trials and tribulations in life.

Time to teach	Asset Type	Theme	SubTheme
3 Minutes	Main Script	Triangle	

2. DD_Triangles around us

Triangles around us

Triangles are seen almost everywhere in the world around us. They are commonly found on bridges, rooftops of buildings, billiard ball racks, sign posts on roads, design of products etc.,

1. Bridges

We often observe that the metallic bridges over railway tracks or flyovers are designed using triangles.

The triangular structure adds to the strength of the bridge.



2. Rooftops

The rooftops of buildings are often made triangular so that rain water or snow falls off the building easily.



3. Road signs

We find road signs are often triangular in shape. These are warning signs that indicate to the driver about the possible hazard ahead on the road.



4. Billiard ball racks

On a billiard table, the pool balls are arranged in the shape of equilateral triangle using the Billiard ball racks.



5. Design of articles

Many products are designed in triangular shape for aesthetics. Example : Samosas in shape of triangle, Clothes Hangers etc.



Image Source:

<https://pixabay.com/en/railway-bridge-truss-bridge-bridge-1594192/>

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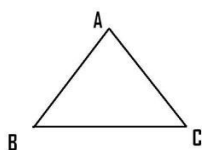
Time to teach	Asset Type	Theme	SubTheme
4 Minutes	Day-to-day Relevance	Triangle	Properties of triangles, Properties of triangles

3. MS_Introduction to triangles

Introduction to Triangles

‘ Tri ‘ Means three and “ **Triangle** ” means three angles.

Definition : Triangle is a simple closed figure made up of three line segments. Shown below is a triangle named ΔABC .

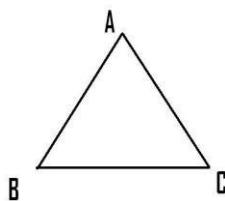


Parts of a triangle:

A triangle consists of 1) sides, 2) angles and 3) vertices.

1. Sides:

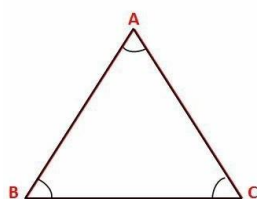
A triangle has three sides.



In ΔABC , the three sides are AB, BC, and CA.

2. Angles:

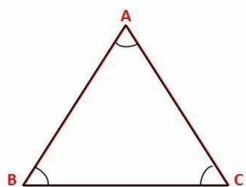
A triangle consists of three angles.



In $\triangle ABC$, the three angles are $\angle CAB$, $\angle ABC$, $\angle BCA$. The angles can also be named as $\angle BAC$, $\angle CBA$, $\angle ACB$ or simply as $\angle A$, $\angle B$, $\angle C$.

3. Vertices:

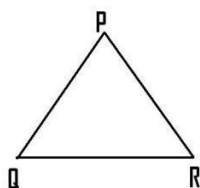
A triangle has three vertices.



In $\triangle ABC$, the three vertices are A, B, C.

Identifying parts of a triangle

Consider the triangle PQR

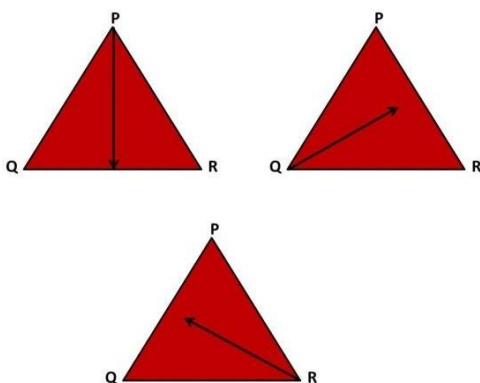


The sides of $\triangle PQR$ are PQ, QR, RP

The angles of $\triangle PQR$ are $\angle RPQ$, $\angle PQR$, $\angle QRP$

The vertices of $\triangle PQR$ are P, Q, R

Observe the following $\triangle PQR$

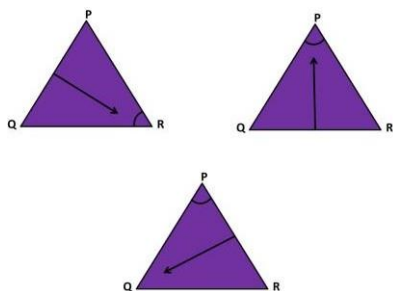


Side opposite to vertex P is QR

Side opposite to vertex Q is RP

Side opposite to vertex R is PQ

Angle/Vertex opposite to side PQ is $\angle R$



Angle /Vertex opposite to side QR is $\angle P$

Angle/Vertex opposite to side RP is $\angle Q$

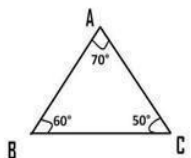
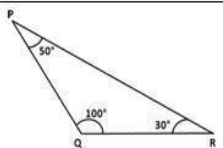
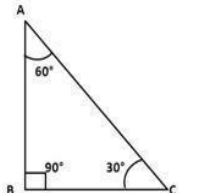
Classification of Triangles

Triangles are classified based on their angles and sides.

Classification of triangles based on angles:

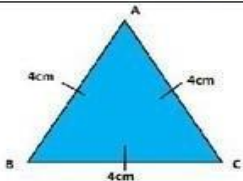
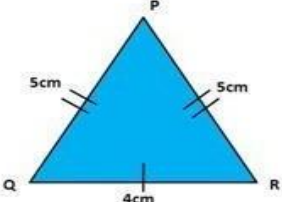
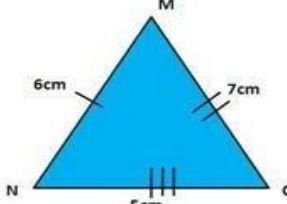
Based on their angles, the triangles are classified into three types .

1) Acute angled 2) Obtuse Angled 3) Right Angled triangle.

SL. No	Type of Triangle	Definition	Example
1	Acute angled triangle	A triangle whose all angles are less than 90°	
2	Obtuse angled triangle	A triangle whose one angle is Obtuse i.e., greater than 90° but less than 180°	
3.	Right angled triangle	A triangle whose one angle is of measure 90°	

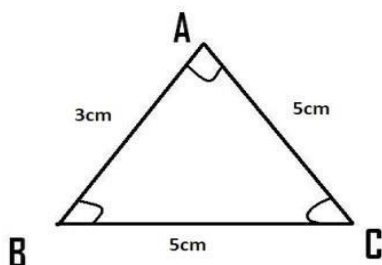
Classification of triangles based on sides

Based on their sides, triangles are classified into three types – **Equilateral, Isosceles and Scalene**

Sl No	Type of Triangle	Definition	Example
1.	Equilateral	A triangle whose all sides are equal to one another.	
2.	Isosceles	A triangle with any two sides equal to each other.	
3.	Scalene	A triangle in which all sides are unequal.	

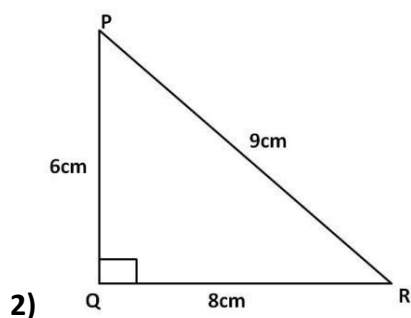
Observe the following triangles

1)



In $\triangle ABC$, two sides are equal to 5cm and all angles are acute.

So $\triangle ABC$ is an Isosceles acute angled triangle.



$\angle PQR$ is 90° and all sides are unequal.

So $\triangle PQR$ is a right angled scalene triangle.

The classification of triangles can be better understood with the help of following flowchart.

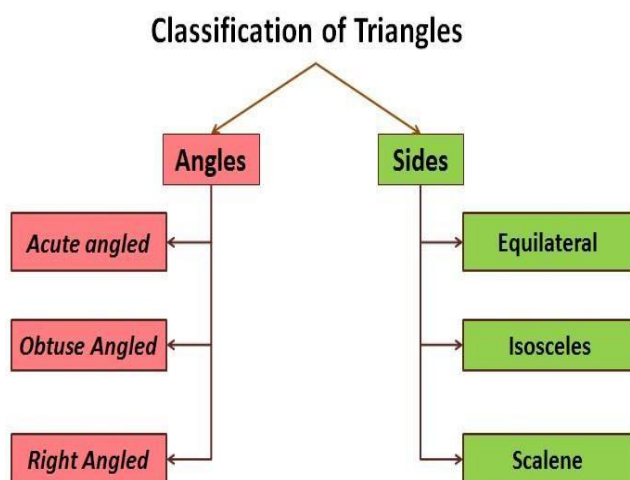


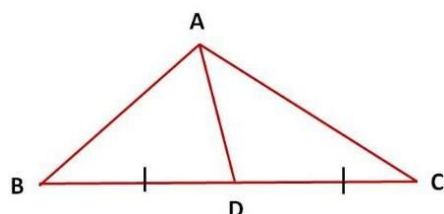
Image Source : Original Contribution by chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
15 Minutes	Main Script	Triangle	Properties of triangles, Properties of triangles

4. MS_Median of a triangle

Median of a triangle

Definition: A median of a triangle is a line segment that joins any vertex of the triangle to the midpoint of its opposite side.

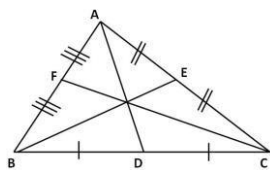


In the above $\triangle ABC$, the line segment AD joins the vertex A to the midpoint D of its opposite side BC .

AD is the median of the triangle.

Number of medians in a triangle

Any triangle has three sides, so it has exactly three medians.

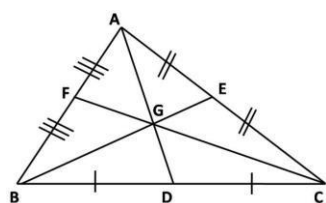


In the above $\triangle ABC$, D, E and F are the midpoints of sides BC, CA and AB.

The line segments AD, BE and CF are the three medians of triangle $\triangle ABC$.

Centroid of a triangle

The three medians of a triangle intersect at a point in the triangle called the 'Centroid'.



In the above $\triangle ABC$, the medians AD, BE and CF meet at a point G.

Position of the Centroid:

Consider the different types of triangles and observe the position of the centroid.

S. No	Type of triangle	Figure
1	Acute angled triangle	
2	Obtuse angled triangle	
3	Right angled triangle	

The medians and centroid always lie in the **interior** of the triangle.

Image Source: Original Contribution : chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
5 Minutes	Main Script	Triangle	Median & Altitude , Median & Altitude

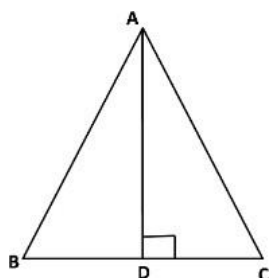
5. MS_Altitude of a triangle

Altitude of a triangle

Introduction

Any triangle consists of three sides. Any side of the triangle can be chosen as its base.

Definition: The altitude of a triangle is a line segment drawn from any vertex of the triangle to the opposite side (base) of the triangle perpendicularly



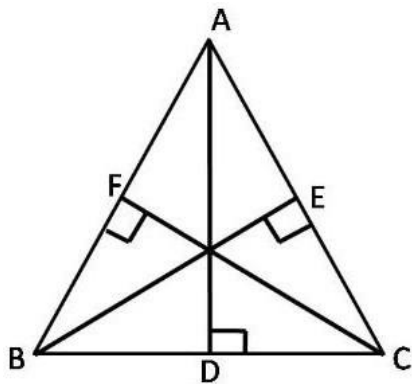
In the above $\triangle ABC$,

The line segment AD is drawn from vertex A to the base BC perpendicularly.

AD is an altitude of the $\triangle ABC$

Altitudes of a triangle

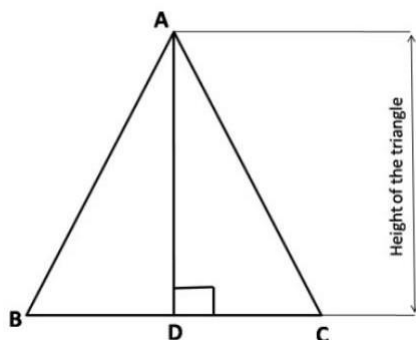
Any triangle has three vertices and hence any triangle can have maximum of three altitudes.



Observe the above $\triangle ABC$.

The three altitudes of the triangle are AD, BE, and CF.

Altitude as a measure of height

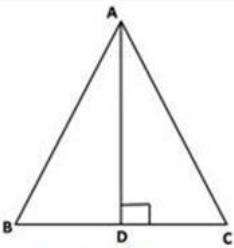
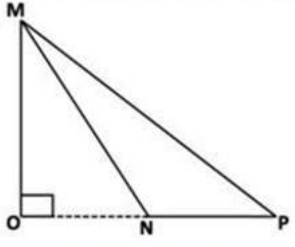
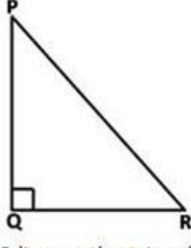


In the above $\triangle ABC$, the altitude AD is perpendicular to the base BC of the triangle. Hence it is the shortest distance between the vertex A and the base. Hence the altitude AD can be considered as a measure of the height of the triangle.

Any altitude of the triangle is a measure of its height.

Position of the altitude in different triangles:

The position of the altitude is not the same in all triangles. Observe the following triangle

Sl No	Type of Triangle	Position of Altitude
1	Acute angled triangle	 AD lies inside the triangle
2.	Obtuse angled triangle	 MO lies outside the triangle
3.	Right angled triangle	 PQ lies on the triangle

For an Acute angled triangle, the **altitude AD lies inside the triangle.**

For an Obtuse angled triangle, the base NP is extended to meet the altitude at O . The **altitude MO lies outside the triangle.**

For a Right angled triangle, the side PQ itself acts as an altitude as it is perpendicular to the base QR from vertex P. Similarly the side QR is also another altitude of the triangle. Thus the **altitudes PQ and QR lie on the triangle.**

Image Source: Original Contribution by chinni.wgl@gmail.com

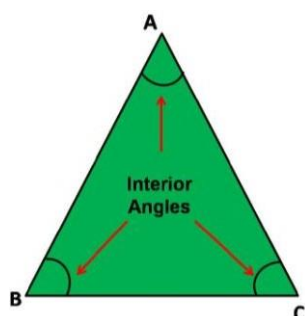
Time to teach	Asset Type	Theme	SubTheme
5 Minutes	Main Script	Triangle	Median & Altitude , Median & Altitude

6. MS_Exterior angle property

Exterior Angle property

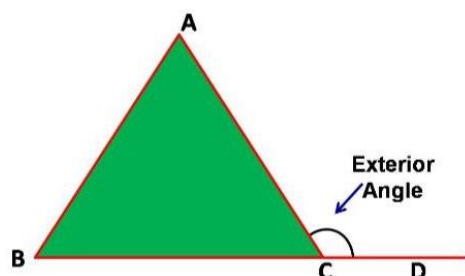
Interior and Exterior angles of a triangle

Consider $\triangle ABC$ as shown below.



The angles inside the triangle formed by the sides are called 'Interior' angles.

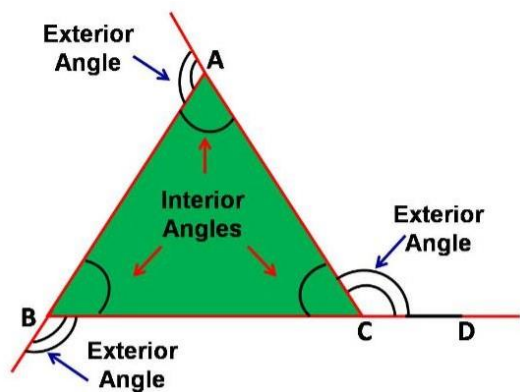
Extend the side BC as shown below.



$\angle ACD$ is an exterior angle of $\triangle ABC$. It is formed by the sides AC and the extension of side BC. It lies outside the triangle and hence is called as 'exterior' angle.

Exterior angles of a triangle

Consider the triangle shown below.



In $\triangle ABC$ shown above, it consists of 3 interior angles and 3 exterior angles. An exterior angle is formed when any side of the triangle is extended outwards.

Definition: The angle formed by any side of the triangle and the extension of its adjacent side is called the exterior angle of the triangle.

Note : Observe that each exterior angle and its adjacent interior angle forms a linear pair.

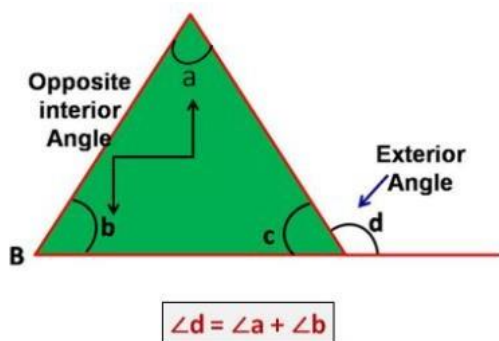
Exterior angle + Adjacent interior angle = 180°

In above figure, $\angle ACD + \angle ACB = 180^\circ$

Exterior angle property of a triangle

This property states that “Exterior angle of a triangle is equal to the sum of its opposite interior angles”.

Consider the triangle shown below.



In the above triangle $\angle d$ is the exterior angle.

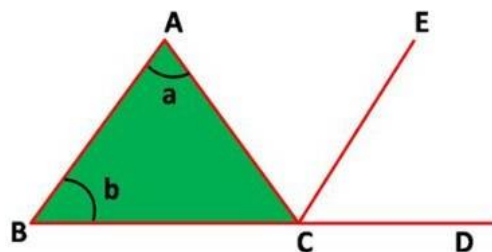
$\angle a$, $\angle b$, $\angle c$ are the interior angles.

The interior angles opposite to $\angle d$ are $\angle a$ and $\angle b$ while $\angle c$ is adjacent to exterior angle.

Therefore, according to the property $\angle d = \angle a + \angle b$

Proof of Exterior angle property

Construct $\triangle ABC$. Extend the base BC to D. From C, draw a line CE parallel to AB.



Given: In $\triangle ABC$, $\angle ACD$ is an exterior angle.

To show: $\angle ACD = \angle a + \angle b$

Construction : From C, draw CE parallel to AB.

Proof:

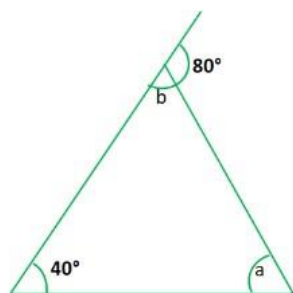
Steps	REASON
1. $\angle a = \angle ACE$	AB $\parallel$ CE and AC is transversal (so alternate angles are equal)
2. $\angle b = \angle ECD$	AB $\parallel$ CE and BD acts as transversal (so corresponding angles are equal)
3. $\angle a + \angle b = \angle ACE + \angle ECD$	Adding steps 1 and 2
4. $\angle a + \angle b = \angle ACD$	From figure, $\angle ACE + \angle ECD = \angle ACD$

This proves the exterior angle property of the triangle.

$$\angle ACD = \angle a + \angle b$$

Illustration

Consider the following figure



Applying exterior angle property we get,

$$80^\circ = 40^\circ + a$$

$$a = 80^\circ - 40^\circ$$

$$a = 40^\circ$$

We know that,

$$\text{Exterior angle} + \text{Adjacent interior angle} = 180^\circ$$

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

$$b = 180^\circ - 80^\circ$$

$b = 100^\circ$

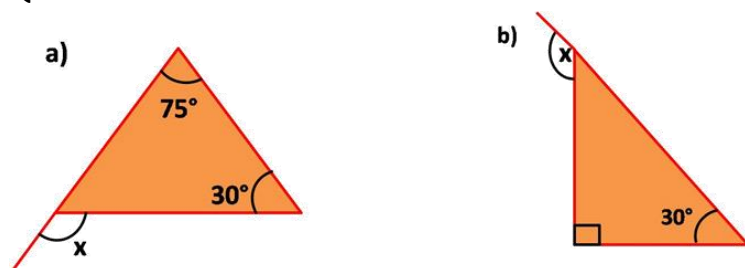
Image Source : Original Contribution by chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
15 Minutes	Main Script	Triangle	Exterior angle and properties, Exterior angle and properties

7. QA_Find the unknown angles

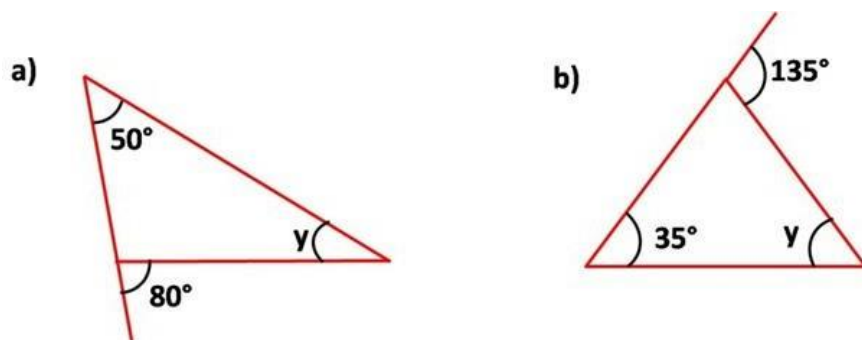
Find the unknown angles

Question: 1 Find the value of the unknown exterior angle 'x' in the following figures.



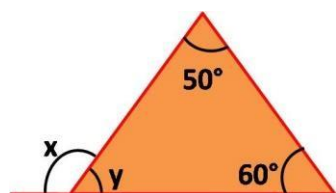
Question: 2

Find the value of the unknown interior angle 'y' in the following figures.



Question: 3

Find the value of 'x' and 'y' in the given figure.



Question: 4

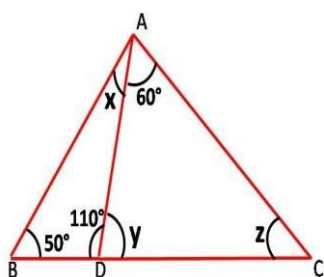
In a triangle, measure of an exterior angle is 120° and one of the opposite interior angles are in the ratio of 7:5. Find the measure of the opposite interior angles.

Question: 5

In a triangle, measure of an exterior angle is 140° and both the opposite interior angles are equal. Find the measure of both the opposite interior angles.

Question: 6

In the given figure, find the value of x , y and z .

**Answers:****Question: 1**

1. $x = 75^\circ + 30^\circ = 105^\circ$
2. $x = 90^\circ + 30^\circ = 120^\circ$

Question: 2

- a) $50^\circ + y = 80 \Rightarrow y = 30^\circ$
- b) $35^\circ + y = 135^\circ \Rightarrow y = 100^\circ$

Question 3

$$x = 50^\circ + 60^\circ = 110^\circ$$

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

$$y = 70^\circ$$

Question 4

Let the opposite interior angles be $7x$ and $5x$

$$7x + 5x = 120^\circ \quad 12x = 120^\circ$$

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

$$= 10$$

So, the opposite interior angles are 70° and 50° .

Question 5

Let the opposite interior angle be x

$$x + x = 140^\circ \quad 2x = 140^\circ$$

$$x = 70^\circ$$

So each opposite interior angle is 70° .

Question 6

In triangle ADC, Exterior angle is 110°

$$\therefore 60^\circ + z = 110^\circ$$

$$z = 50^\circ$$

Also $110^\circ + y = 180^\circ$ (linear pair)

$$y = 70^\circ$$

Also, In triangle ABD, exterior angle is $y = 70^\circ$

$$\therefore 50^\circ + x = 70^\circ$$

$$x = 20^\circ$$

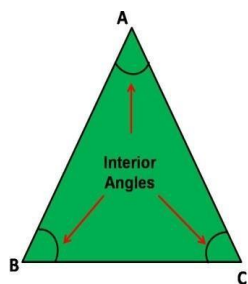
Image Source: Original Contribution by chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
15 Minutes	Assessments	Triangle	Exterior angle and properties, Exterior angle and properties

8. MS_Angle sum property

Angle Sum property

Consider a triangle ABC as shown below:



The angles inside the triangle formed by the sides are called **interior angles**.

Theorem:

Angle sum property of a triangle states that

“The sum of the three interior angles of a triangle will add up to 180° ”

According to this property, the sum of the three angles of a triangle will always be 180° for any triangle –

Equilateral, Scalene, Isosceles, Acute angled, Obtuse angled or Right angled.

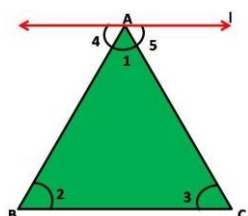
Mathematically, in $\triangle ABC$,

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

Proof of Angle Sum Property :

Construct a $\triangle ABC$ with angles $\angle 1, \angle 2, \angle 3$

Draw a line 'l' through A parallel to base BC



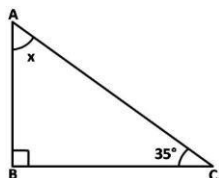
Given : $\triangle ABC$ with line l parallel to BC

To prove: $\angle 1 + \angle 2 + \angle 3 = 180^\circ$

Steps	Reason
(1) $\angle 2 = \angle 4$ $\angle 3 = \angle 5$	(1) $l \parallel BC$, AB is transversal alternate angles are equal so $\angle 2 = \angle 4$ Also, $l \parallel BC$, AC is transversal alternate angles are equal so $\angle 3 = \angle 5$
(2) $\angle 2 + \angle 3 = \angle 4 + \angle 5$	(2) Adding the two equations in step (1)
(3) $\angle 1 + \angle 2 + \angle 3 = \angle 1 + \angle 4 + \angle 5$	(3) Adding $\angle 1$ to both sides of equation in step (2)
(4) $\angle 4 + \angle 1 + \angle 5 = 180^\circ$	Linear angle theorem
(3) $\angle 1 + \angle 2 + \angle 3 = 180^\circ$	Putting equation from step (4) Into step (3)

Sum of interior angles of a triangle is 180° .**Illustrations**

1. Consider the triangle ABC,



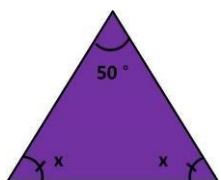
The unknown angle 'x' can be obtained using angle sum property

$$x + 90^\circ + 35^\circ = 180^\circ$$

$$x = 180^\circ - 90^\circ - 35^\circ$$

$$x = 55^\circ$$

2. Consider the triangle shown below,



The unknown angle 'x' can be obtained using angle sum property.

In the above triangle, two base angles are equal to x° .

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

$$50^\circ + 2x^\circ = 180^\circ \quad 2x^\circ = 180^\circ - 50^\circ$$

$$x = 65^\circ$$

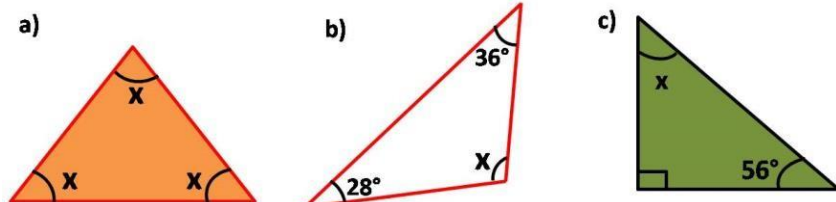
All images created using MS Powerpoint tools.

Time to teach	Asset Type	Theme	SubTheme
15 Minutes	Main Script	Triangle	Angle sum property, Angle sum property

9. QA_Solve the Problems

Solve the Problems

1. Find the value of 'x' in the following triangles



2. In $\triangle ABC$, DE is parallel to BC. Find x, y and z.

3. If the angles of a triangle are in the ratio 1 : 4 : 5, find the angles.

4. The acute angles of a right angled triangle are in the ratio of 2:3. Find the angles.

5. In $\triangle PQR$, if $p = 2q$ and $2r = 3q$, then calculate the angles of the triangle.

Solutions :

1. a) $x + x + x = 180^\circ$

$$3x = 180^\circ$$

$$x = 60^\circ$$

b) $28^\circ + 36^\circ + x = 180^\circ$

$$x = 180^\circ - 36^\circ - 28^\circ$$

$$x = 116^\circ$$

c) $x + 90^\circ + 56^\circ = 180^\circ$

$$x = 180^\circ - 90^\circ - 56^\circ$$

$$x = 34^\circ$$

2. As $DE \parallel BC$, AB acts as transversal

So $y = 50^\circ$ (corresponding angles are equal)

In $\triangle ADE$, $30^\circ + x + y = 180^\circ$

$$30^\circ + x + 50^\circ = 180^\circ$$

$$x = 100^\circ$$

AS $DE \parallel BC$, AC acts as transversal

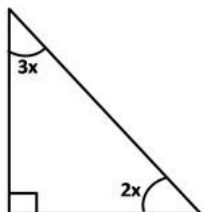
$z = x = 100^\circ$ (corresponding angles are equal)

$$3. 1x + 4x + 5x = 180^\circ \quad 10x = 180^\circ$$

$$x = 18$$

So, angles of the triangle $1x, 4x, 5x$ are $18^\circ, 72^\circ, 90^\circ$

4.



$$2x + 3x + 90^\circ = 180^\circ$$

$$5x + 90^\circ = 180^\circ \quad 5x = 90^\circ$$

$$x = 18^\circ$$

So the two acute angles are

$$2x = 2 \times 18^\circ = 36^\circ$$

$$3x = 3 \times 18^\circ = 54^\circ$$

$$5. p + q + r = 180^\circ$$

$$2q + q + 3q/2 = 180^\circ$$

$$(4q + 2q + 3q)/2 = 180^\circ \quad 9q = 180^\circ \times 2$$

$$\mathbf{q = 40^\circ}$$

$$p = 2q$$

$$= 2 \times 40^\circ = 80^\circ$$

$$\mathbf{p = 80^\circ}$$

$$r = 3q/2 = (3 \times 40^\circ)/2$$

$$\mathbf{r = 60^\circ}$$

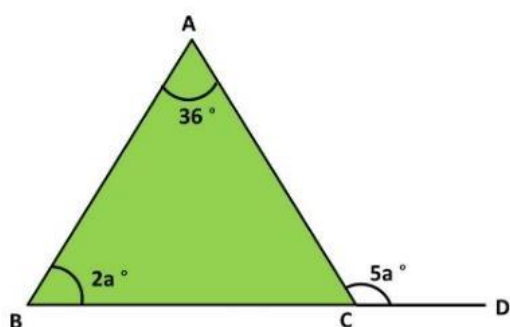
Image Source : Original Contribution chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
15 Minutes	Assessments	Triangle	Angle sum property, Angle sum property

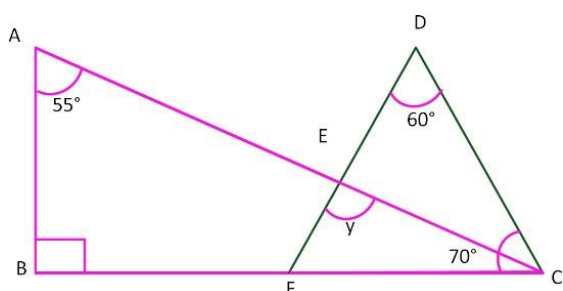
10. IQ Think Hard and find the angles

Think Hard - Find the angles

1. One angle of a triangle is 45° . Find the remaining two angles if their difference is 25° .
2. The sum of two angles of a triangle is equal to its third angle. Determine the measure of the third angle.
3. In the following figure, determine all the angles of the triangle ABC.



4. $\triangle ABC$ is right angled at B. Also $\angle BAC = 55^\circ$, $\angle FDC = 60^\circ$ and $\angle DCF = 70^\circ$. Find the unknown angle 'y'. Point of intersection of AC and DF is E.



Answers:

Q1. Let the remaining two angles be x and $x-25^\circ$

By angle sum property,

$$45^\circ + x + (x - 25^\circ) = 180^\circ \quad 2x + 20^\circ = 180^\circ$$

$$x = 80^\circ$$

The two angles are 80° and $(80^\circ - 25^\circ) = 55^\circ$.

Q2. Let the three angles of the triangle be x, y and z . Let the third angle be ' z '.

Here, $x + y = z$

By angle sum property of a triangle,

$$(x + y) + z = 180^\circ$$

$$z+z=180^\circ$$

$$z=90^\circ$$

The third angle is 90° .

Q3. By exterior angle property,

$$5a^\circ=2a^\circ+36^\circ$$

$$a^\circ=12^\circ$$

So, the three angles of triangle ABC are

$$36^\circ, 2a^\circ \text{ and } \angle ACB$$

By angle sum property,

$$36^\circ+2a^\circ+\angle ACB=180^\circ$$

$$36^\circ+24^\circ+\angle ACB=180^\circ$$

$$\angle ACB=120^\circ$$

Q4. In $\triangle FCD$,

$$60^\circ + 70^\circ + \angle DFC = 180^\circ \text{ (angle sum property)}$$

$$130^\circ + \angle DFC = 180^\circ$$

$$\angle DFC = 50^\circ$$

In $\triangle ABC$,

$$55^\circ + 90^\circ + \angle BCA = 180^\circ \text{ (angle sum property)}$$

$$145^\circ + \angle BCA = 180^\circ$$

$$\angle BCA = 35^\circ$$

In $\triangle FCE$,

$$y + \angle EFC + \angle FCE = 180^\circ \text{ (angle sum property)}$$

$$y + \angle DFC + \angle BCA = 180^\circ \text{ (as } \angle EFC = \angle DFC \text{ and } \angle FCE = \angle BCA)$$

$$y + 50^\circ + 35^\circ = 180^\circ$$

$$y = 95^\circ$$

Image Source : Original Contribution chinni.wgl@gmail.com

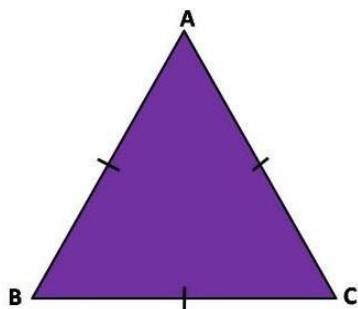
Time to teach	Asset Type	Theme	SubTheme
15 Minutes	Inquisitive Questions	Triangle	Angle sum property, Angle sum property

11. MS_Special Triangles

Special Triangles

Equilateral triangle:

A triangle in which all three sides are equal is called an Equilateral triangle.

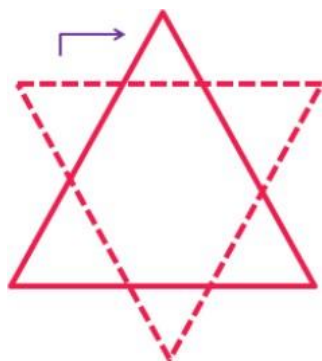


In the above $\triangle ABC$,

$$AB=BC=AC$$

$\therefore \triangle ABC$ is an Equilateral triangle.

If we superimpose any two congruent Equilateral triangles and rotate the upper triangle over the lower triangle, we find that all the angles also perfectly overlap. This means that all the angles are equal.



Let each angle of the Equilateral triangle be 'x'

According to angle sum property,

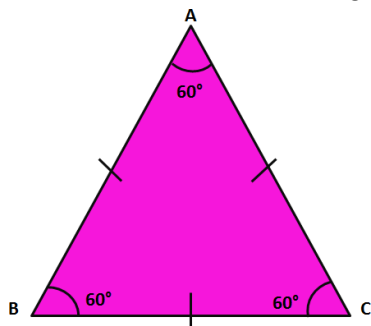
$$x + x + x = 180^\circ$$

$$3x = 180^\circ$$

$$x = 60^\circ$$

$\therefore$ Each angle in Equilateral triangle is 60° .

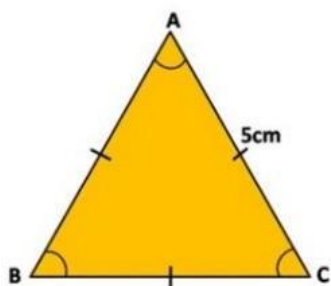
Properties of Equilateral Triangle



1. All three sides are of equal length.
2. All three angles are equal to 60°

Illustration :

1. Observe the following triangle



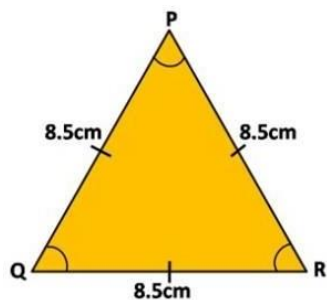
The measure of sides AB and BC can be found.

In Equilateral triangle, all sides are equal ie $AB=BC=AC$

As $AC = 5\text{cm}$

So, $AB=BC=5\text{cm}$

2. Observe the following triangle



The measure of all the angles can be found.

The above triangle is an Equilateral triangle as $PQ=QR=RP=8.5\text{cm}$.

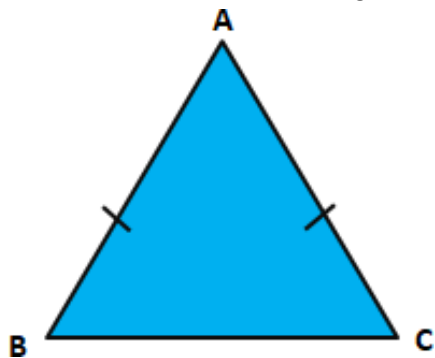
In an Equilateral triangle all angles are 60° each.

So,

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

Isosceles Triangle

A triangle in which any two sides are equal is called an Isosceles triangle.

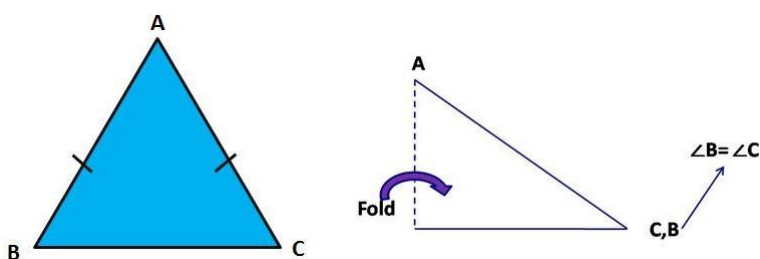


In the above $\triangle ABC$,

$$AB = AC$$

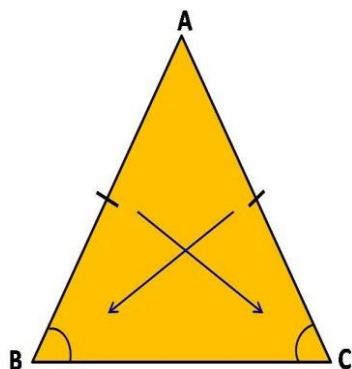
$\therefore \triangle ABC$ is an Isosceles triangle

If we fold the $\triangle ABC$ into two halves along $\angle A$, we see that side AB overlap with side AC (since $AB = AC$) and we see that $\angle B$ overlaps with $\angle C$.



Hence, the angles $\angle B$ and $\angle C$ opposite to the equal sides AC and AB are equal.

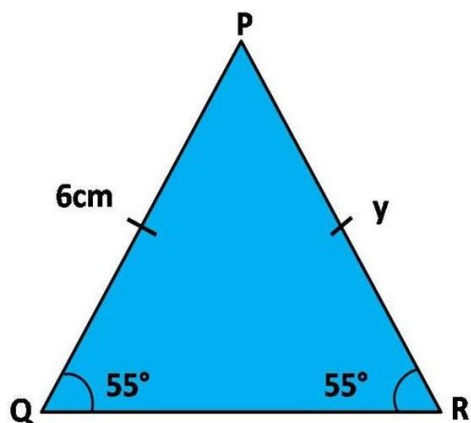
Properties of Isosceles Triangle



1. Two sides of the triangle are equal in length.
2. Angles opposite to equal sides are equal and vice versa.

Illustrations

1. The measure of side 'y' in the $\triangle PQR$



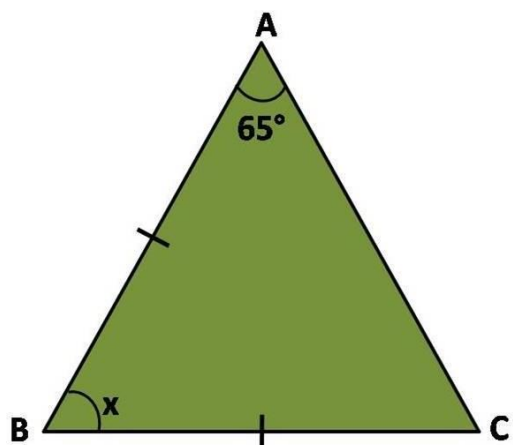
In Isosceles triangle, sides opposite to equal angles are equal.

As $PQ = PR$

$6\text{cm} = y$

$\Rightarrow y = 6\text{cm}$

2. The measure of angle 'x' in the triangle ABC given below



By angle sum property, in $\triangle ABC$

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

$$65^\circ + x + 65^\circ = 180^\circ \text{ (As } \triangle ABC \text{ is isosceles } \Rightarrow \angle A = \angle C)$$

$$x = 50^\circ$$

Image Source: Original Contribution by chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
10 Minutes	Main Script	Triangle	Special triangles(Equilateral & Isosceles triangle), Special triangles(Equilateral & Isosceles triangle)

12. IA_ Triangles in Architecture

Triangles in Architecture

Introduction

Geometry and Architecture are fundamentally linked to each other. The most commonly used geometric shape in architecture is the triangle.

Triangles are used in the design of structures and buildings as they provide strength and stability. The triangle is a stable shape. It can bear a lot of weight because its base is wide.

The most common forms of triangles used in architecture are Equilateral and Isosceles triangles. This is so because their symmetry aids in distributing the weight.

Equilateral Triangle

1. A common example of an equilateral triangle used in architecture is Pyramids of Giza in Egypt. Each of the four sides that form the Pyramid are made up of Equilateral triangles.



The triangular structure provides strength and hence the pyramids are standing strong for over 4000 years now.

2. The Disney Epcot center dome is made up entirely of triangles.



This structural design keeps the dome very strong.

Isosceles Triangle

1. Isosceles triangles are found in modern architecture . The Flatiron building in New York city is built on a triangular block.



It has stood over 100 years. This is a proof of the strength due to triangular structure.

Image Source: <https://pixabay.com/photos/pyramids-egypt-egyptian-ancient-2371501/>

<https://pixabay.com/en/epcot-disney-world-florida-1909805/>

<https://pixabay.com/en/flatiron-building-manchattan-new-york-1401035/>

Time to teach	Asset Type	Theme	SubTheme
3 Minutes	Interesting Asides	Triangle	Properties of triangles, Properties of triangles

13. SA_Activity to verify properties of Equilateral triangle

Activity to verify properties of Equilateral triangle

Aim: To verify through an activity the properties of an equilateral triangle.

Materials required: Ruler, pencil, protractor, 3 sticks of same size (which can be pasted on a paper), gum, 6"x 6" chart paper or any white sheet of paper

Setting of Activity: Indoor

Type of activity: Demonstration by students

Individual activity

Instructions to teacher

Teacher should inform the students prior to the day of the experiment regarding the materials to be brought on the day of the activity. Teacher should ask each student to bring his or her own material.

Teacher asks questions to recall equilateral triangles before the start of the activity.

Questions to recall

1.What is an equilateral triangle?

Expected Answer: A triangle in which all three sides are equal is called an equilateral triangle.

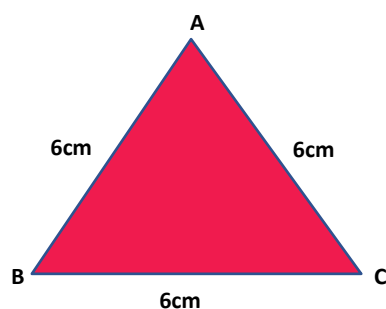
2.What are the properties of an equilateral triangle?

Expected answer: In an equilateral triangle, all sides are equal and all angles are equal. Each angle is 60° .

Procedure:

Step 1: Paste the sticks on the chart paper or white sheet so as to form a triangle. Name the triangle as ABC

Step 2: Measure the length of each side and write the measurements along the sides as shown below. Note the length of each side in the observation.



Step 3: Measure all the angles using a protractor and note the observation.

Observation:

Length of side **AB**=.....

Length of side **BC**=.....

Length of side **CA**=.....

Measure of angle **A**=.....

Measure of angle **B**=.....

Measure of angle **C**=.....

All sides of the triangle are equal and all the angles are equal to 60° .

Conclusion: Properties of an equilateral triangle are verified.

Time to teach	Asset Type	Theme	SubTheme
12 Minutes	Suggested Activity	Triangle	Special triangles(Equilateral & Isosceles triangle), Special triangles(Equilateral & Isosceles triangle)

14. SA_Activity to verify the properties of Isosceles triangle

Activity to verify properties of Isosceles triangle

Aim: To verify the properties of an Isosceles triangle.

Materials required: Scale, pencil, protractor, 2 sticks of same size and one stick of different size(which can be pasted on a paper), gum, $6'' \times 6''$ chart paper or a white sheet of paper.

Setting of Activity: Indoor

Type of Activity: Demonstration by students
Individual activity

Instructions to teacher:

Teacher should inform the students about the materials required prior to the day of the experiment. Teacher should ask the students to bring their own materials on the day of the activity.

Before starting the activity, teacher asks questions to recall the properties of Isosceles triangle.

Questions to recall:

1. What is an Isosceles triangle?

Expected answer: A triangle in which any two sides are equal is called an Isosceles triangle.

2. What are the properties of an Isosceles triangle?

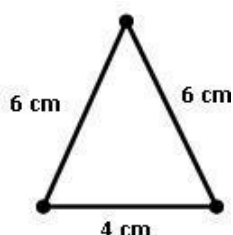
Expected answer: Two sides are equal.

Two base angles opposite to the two equal sides are equal.

Procedure:

Step 1: Paste the sticks on the chart paper so as to form a triangle. Name it as ABC.

Step 2: Measure the length of the sides. Write the measurements along the sides as shown below. Enter the measurements in the observation.



Step 3: Measure all the angles using a protractor and note the observation.

Observation:

Length of side **AB**=.....

Length of side **BC**=.....

Length of side **CA**=.....

Measure of angle **A**=.....

Measure of angle **B**=.....

Measure of angle **C**=.....

Two sides of the triangle are equal. The base angles opposite to the equal sides are also equal.

Conclusion: Properties of an isosceles triangle are verified.

Time to teach	Asset Type	Theme	SubTheme
12 Minutes	Suggested Activity	Triangle	Special triangles(Equilateral & Isosceles triangle), Special triangles(Equilateral & Isosceles triangle)

15. SA_Activity based on length of sides property

Activity on length of sides property

Aim : To verify the sum of the lengths of any two sides of a triangle is greater than the third side in different triangles.

Resources required :

1. A set of 9 sticks of sizes- 4 cm, 4 cm, 4 cm, 6 cm, 6 cm, 7 cm, 8 cm, 9 cm, 10 cm – sets of 4 or 5 (according to class size)
2. Observation sheet – 1 each per team

Triangle (Stick the triangles in below boxes)	Measure of sides (cm)	Sum of two sides (cm)	Third Side (cm)	Sum of two sides > third side
Equilateral $\triangle ABC$	AB =	AB + BC =	CA =	Yes/No
	BC =	BC + CA =	AB =	Yes/No
	CA =	CA + AB =	BC =	Yes/No
Isosceles $\triangle DEF$	DE =	DE + EF =	FD =	Yes/No
	EF =	EF + FD =	DE =	Yes/No
	FD =	FD + DE =	EF =	Yes/No
Scalene $\triangle GHI$	GH =	GH + HI =	IG =	Yes/No
	HI =	HI + IG =	GH =	Yes/No
	IG =	IG + GH =	HI =	Yes/No

3. Gum – 1 each per team.

4. Pen – 1 each per team.

5. Pencil-1 each per team

6. Eraser-1 each per team

7. Ruler -1 each per team

Type of activity : Experiment by students.

1. The activity involves constructing an Equilateral, Isosceles and Scalene triangles using given sticks of different sizes.

2. Teacher prepares the set of 9 sticks (one set per team) prior to the activity.

3. Teacher prepares the print out of observation sheet or could draw the observation table on the board and ask each team to bring a plain white sheet and copy the observation table.

3. Before starting the activity, teacher asks questions to recapitulate the different types of triangles.

Questions to recall:

1. How are triangles classified based on their side?

Expected Answer: Triangles are classified as Equilateral, Isosceles and Scalene triangles based on their sides.

2. Define the above triangles.

Expected Answer:

A triangle in which all sides are equal is called an Equilateral triangle.

A triangle in which any two sides are equal is called an Isosceles triangle.

A triangle in which all sides are unequal is called a Scalene triangle.

Procedure :

1. Teacher divides the class into groups of 6 students each.
2. Teacher distributes one set of 9 sticks to each group.
3. Teacher explains that each group has to construct an Equilateral, Isosceles and Scalene triangles using the given 9 sticks.

- The students in each group measure the sticks using a ruler and construct the three triangles using the given sticks.
- Teacher asks each pair of students in the group to stick the constructed triangle on the observation sheet (to ensure equal participation of all team members). Also they could name the triangles as triangle ABC, DEF and PQR.
- After all the 3 triangles are constructed and stuck on the observation sheet, the students are instructed to measure the length of the sides of each triangle and enter it along the sides of the triangle stuck on the observation sheet as well as enter them in the column in the observation table.
- The students complete the calculation in the observation table.

Observation:

Triangle	Measure of sides (cm)	Sum of two sides (cm)	Third Side (cm)	Sum of two sides > third side
Equilateral	AB =4	AB + BC =8	CA =4	YES
	BC =4	BC + CA =8	AB =4	YES
	CA =4	CA + AB=8	BC =4	YES
Isosceles	DE =6	DE + EF =13	FD =6	YES
	EF =7	EF + FD =13	DE =6	YES
	FD =6	FD + DE =12	EF =7	YES
Scalene	GH =8	GH + HI =17	IG =10	YES
	HI =9	HI + IG =19	GH =8	YES
	IG =10	IG + GH =18	HI =9	YES

From the last column, we observe that the sum of any 2 sides is always greater than the third side.

This result is true for all triangles –Equilateral, Isosceles and Scalene.

Conclusion :

In all triangles, the sum of the lengths of any two sides of a triangle is greater than the third side.

Question to Ponder

What can you say about the difference between any two sides of a triangle?

Expected answer: The difference between any two sides of a triangle will be lesser than the third side.

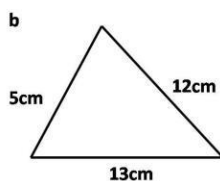
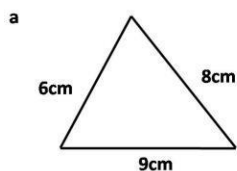
Image Source : Original Contribution by chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
20 Minutes	Suggested Activity	Triangle	Properties of triangles, Properties of triangles

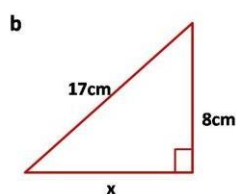
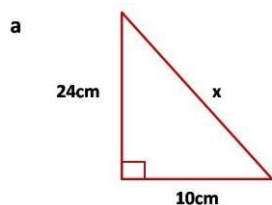
16. QA_Assessment on Pythagoras theorem

Assessment on Pythagoras theorem

1. Which of the following triangles is a right angled triangle?



2. Find the value of 'x' in each of the following triangles.

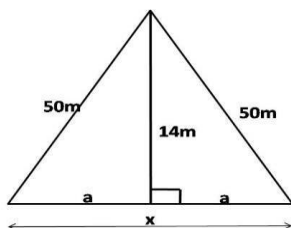


3. Find 'k' if the following is a Pythagorean triplet { 14, k, 50}.

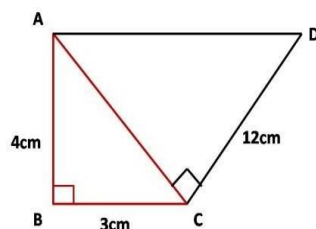
4. In triangle PQR, PQ = 12cm and QR = 9cm. Find PR (the triangle is right angled at Q).

5. A man goes 12m east and then 5m north. Find the distance between the initial and final positions.

6. Find the unknown length in the given figure.



7. In the following figure, find the length of AD.



Solutions

1. a)

$$6^2 + 8^2 \neq 9^2$$

$$36 + 64 \neq 81$$

$$100 \neq 81$$

So, it is not a right triangle

1. b)

$$5^2 + 12^2 = 13^2$$

$$25 + 144 = 169$$

$$169 = 169$$

So, it is a right triangle

2. a)

$$24^2 + 10^2 = x^2$$

$$x^2 = 576 + 100$$

$$x^2 = 676$$

$$x = 26 \text{ cm}$$

2. b)

$$x^2 + 8^2 = 17^2$$

$$x^2 = 17^2 - 8^2$$

$$x^2 = 289 - 64 = 225$$

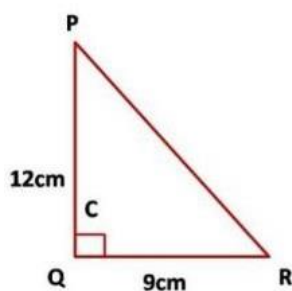
$$x = 15 \text{ cm}$$

$$3. 14^2 + k^2 = 50^2$$

$$k^2 = 2500 - 196 = 2304$$

$$k = 48$$

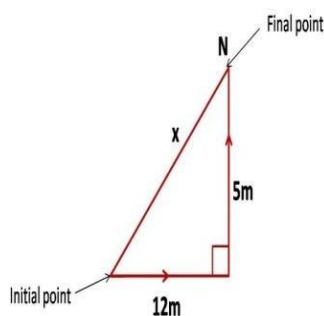
4.



$$PR^2 = 12^2 + 9^2 = 144 + 81 = 225$$

$$PR = 15 \text{ cm}$$

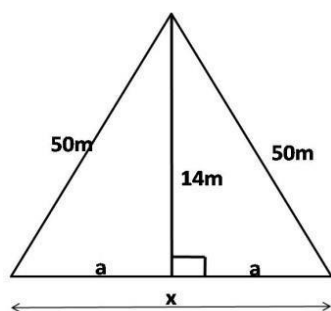
5. Let 'x' be the distance between initial point and final point.



$$x^2 = 12^2 + 5^2 = 144 + 25 = 169$$

$$x = 13 \text{ m}$$

6.



$$14^2 + a^2 = 50^2$$

$$a^2 = 50^2 - 14^2$$

$$a = 48$$

$$x = a + a = 96 \text{ m}$$

7. In $\triangle ABC$,

$$AC^2 = 4^2 + 3^2 = 25$$

$$AC = 5 \text{ cm}$$

In $\triangle ACD$,

$$AC^2 + CD^2 = AD^2$$

$$5^2 + 12^2 = AD^2$$

$$AD^2 = 25 + 144$$

$$AD^2 = 169$$

$$AD = 13 \text{ cm}$$

$$AD = 13$$

$$AD = 13 \text{ cm}$$

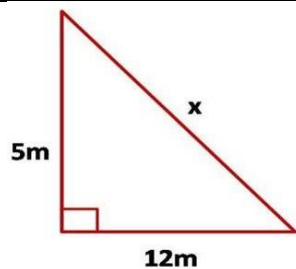
Image Source: Original contribution by chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
20 Minutes	Assessments	Triangle	Pythagoras property(Right- angled triangle), Pythagoras property(Right- angled triangle)

17. IQ_Crack the answers

Crack the answers

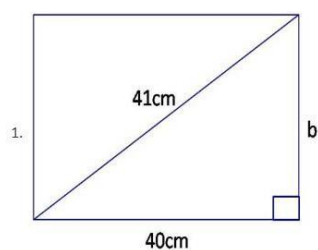
1. Find the perimeter of the rectangle whose length is 40 cm and a diagonal is 41 cm.
2. A rhombus has diagonals of lengths 6 cm and 8 cm. Find the length of its sides.
3. A tree is broken by wind as shown in the figure:



If the point from where it broke is 5 m above the ground and its top touches the ground at a distance of 12 m from its foot, find out the total height of the tree before it broke.

4. A rectangle with diagonals of length 20 cm has sides in the ratio 2:1. Find the area of the rectangle.

Solutions:



Length of rectangle $l = 40\text{cm}$

Let breadth of rectangle be 'b'

By Pythagoras theorem, $40^2 + b^2 = 41^2$

$$b^2 = 41^2 - 40^2$$

$$b^2 = 1681 - 1600$$

$$b^2 = 81$$

$$b = 9$$

$$\text{Perimeter of rectangle} = 2(l+b)$$

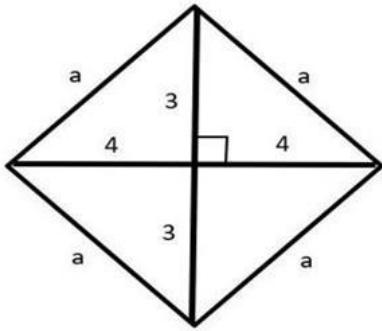
$$= 2(40+9)$$

$$= 2 \times 49$$

$$= 98 \text{ cm}$$

$$\text{Perimeter} = 98 \text{ cm}$$

2.



Diagonals of Rhombus bisect each other perpendicularly.

Let side of Rhombus be 'a'.

By Pythagoras theorem,

$$3^2 + 4^2 = a^2$$

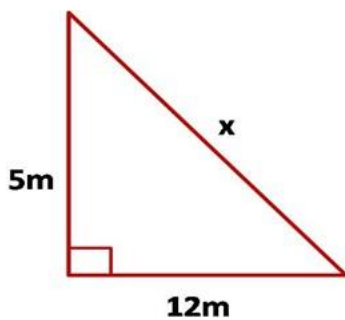
$$9 + 16 = a^2$$

$$a^2 = 25$$

$$a = 5\text{cm}$$

Each side of rhombus = 5cm

3.



Let the broken part of the tree be of length 'x' m.

By Pythagoras theorem,

$$5^2 + 12^2 = x^2$$

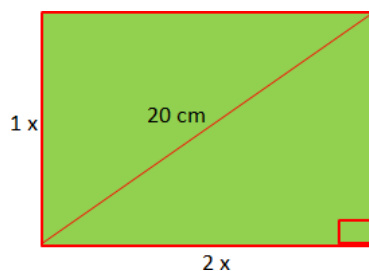
$$25 + 144 = x^2$$

$$x^2 = 169$$

$$x = 13\text{m}$$

Total height of tree = 5m + 13m = 18m

4.



Let the sides of the rectangle be $2x$ and $1x$

By Pythagoras theorem,

$$(2x)^2 + (1x)^2 = 20^2$$

$$4x^2 + 1x^2 = 400$$

$$5x^2 = 400$$

$$x^2 = 80$$

$$x = \sqrt{80}$$

$$\therefore \text{Length } l = 2x = 2\sqrt{80}$$

$$\text{Breadth } b = 1x = 1\sqrt{80}$$

$$\begin{aligned} \text{Area of rectangle} &= l \times b = 2\sqrt{80} \times 1\sqrt{80} \\ &= 2 \times 80 \end{aligned}$$

$$\text{Area of rectangle} = 160 \text{ cm}^2$$

Image Source : Original Contribution by chinni.wgl@gmail.com

Time to teach	Asset Type	Theme	SubTheme
12 Minutes	Inquisitive Questions	Triangle	Pythagoras property(Right- angled triangle), Pythagoras property(Right- angled triangle)

18. VC_Try-Angle

A triangle in which all the three sides are of equal lengths is called an equilateral triangle.

Domain: Classroom

Just as three sides of equal lengths make an equilateral triangle, when we adopt 3 important aspects in life, we become a complete human being.

These are called 3 sides of "Try-angle"

What are those 3 sides of this "Try-angle"?

The following story gives the answer.

Once a teacher told a class of students that a truly blissful person is one who keeps smiling even in the midst of his difficulties.

The students couldn't agree. "How is it possible to smile when we are truly in difficulty? It is impossible," they said.

The teacher told them to go and meet an old man in the village who has gone through a series of struggles in his life yet keeps smiling.

The students became curious. They went and knocked at his door. It was opened by the old man himself. He was crippled and was moving in a wheelchair. His body frame and his look suggested that he has gone through a lot of struggles in life. He welcomed them with a broad smile on his face and asked them what brought them there.

The students asked him, "Please tell us how you continue to keep smiling despite all your difficulties and suffering?"

The man said smilingly, "What difficulties are you talking about? I'm 73, and I've never faced any difficulty in my life so far. The Lord has always been good to me. He has always protected me and saved me. This being the truth, how can I tell you how I keep smiling in the midst of difficulties?" Thus the old man refused to acknowledge that he had problems.

The students got the answer. It was the old man's

1. Love for the Lord
2. Contentment
3. A positive outlook

that made him smile through his difficulties.

Students! When you adopt these 3 attitudes, you will be able to face any challenges in life & stay blissful.

Time to teach	Value Type	Value Sub Type	Value Attribute
5 Minutes	Love		Stories

19. MS_Summary_The Triangle and its Properties

Summary

- Triangular shapes are often seen in our daily life.
- Every triangle consists of three angles and three sides.
- Triangles are classified based on their sides as Equivalent, Isosceles and Scalene.
- Triangles are classified based on their angles as Acute angled, Obtuse angled and Right angled triangles.

- A median of a triangle is a line segment that joins any vertex of the triangle to the midpoint of its opposite side. A triangle has 3 medians.
- An altitude of a triangle is a line segment drawn from any vertex of the triangle to the opposite (base) of the triangle perpendicularly. A triangle has 3 altitudes.
- The angle formed by any side of a triangle and the extension of its adjacent side is called the exterior angle of the triangle.
- Exterior angle of a triangle is equal to the sum of its opposite interior angles. This is called the exterior angle property of a triangle.
- Sum of three angles of a triangle is 180° . This is called Angle Sum Property of a Triangle.
- In an Equilateral triangle, all three sides are of equal length and all three angles are equal to 60° .
- In an Isosceles triangle, two sides of the triangles are equal in length and the angles opposite to the equal sides are also equal. The vice versa is also true.
- In architecture, the most common types of triangles used are Equilateral and Isosceles triangles. This is because their symmetry aids in distributing the weight.
- The sum of the lengths of any two sides of a triangle is greater than the third side.
- The difference between any two sides of a triangle will be lesser than the third side. This is called length of sides property of a triangle.
- In a right angled triangle, the square on the hypotenuse is equal to the sum of the squares of the other two sides. This property is called as Pythagoras property.
- Just as triangle is complete with three sides, similarly, the three values of love for God, contentment and positive attitude help us to become a complete human being.

Time to teach	Asset Type	Theme	SubTheme
5 Minutes	Main Script	Triangle	