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TEACHER GUIDE

SUBJECT	:	MATHEMATICS
CLASS	:	GRADE 8
TASK	:	INFORMAL ACTIVITIES GEOMETRY OF 2D
DURATION	:	TERM 2
NUMBER	:	14 ACTIVITIES

This document consists of 54 pages including cover page

ACKNOWLEDGEMENTS

Acknowledgement is made to the following authors, whose books were referred to during the compilation of this document.

MD, Phillips., J, Basson., J, Odendaal. (2015) Mind Action Series Mathematics Grade 8 and 9 3rd edn., Sanlamhof: Allcopy Publishers.

Kevin Smith. (2017) Maths Handbook and Study Guide. Berlut Books CC.

3. SPACE AND SHAPE

GEOMETRY OF 2D SHAPES

TRIANGLES

A triangle is polygon with 3 straight sides

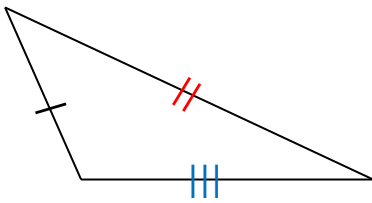
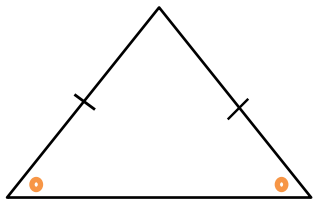
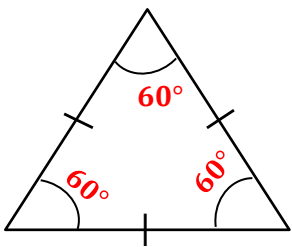
CLASSIFICATION OF TRIANGLES

Triangles are classified according to their properties. They can be classified in two ways:

- 1. According to the lengths of the sides of the triangles.**
- 2. According to the sizes of the angles in the triangles.**

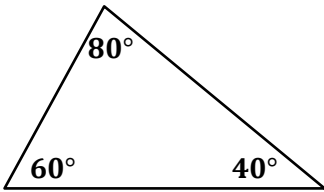
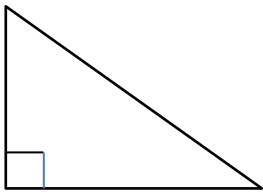
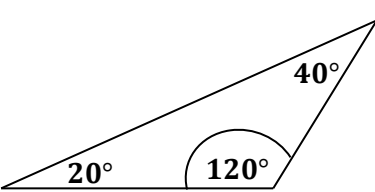
CLASSIFYING TRIANGLES ACCORDING TO THEIR SIDES

Triangles are named according to the number of sides they have which are equal/unequal.

Scalene	Isosceles	Equilateral
		
The sides of a scalene triangle are all different lengths. All of the angles in the triangle are different.	An isosceles triangle has two sides which are equal in lengths. The angles opposite equal sides are equal.	All three sides of an equilateral triangle are equal. Each angle in the triangle is equal to 60°.

CLASSIFYING TRIANGLES ACCORDING TO THEIR ANGLES.

Triangles are also named according to their angles.

Acute –angled	Right – angled	Obtuse
		
All three angles of the triangle are acute .	One angle of a triangle is a right angle .	One angle of the triangle is obtuse . The other two angles are acute .

An acute angle an angle between 0° and 90° .

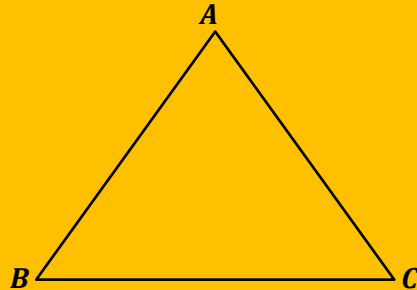
A right angle is equal to 90° .

An obtuse angle is an angle between 90° and 180° .

PROPERTIES OF TRIANGLES

NOTATION USED IN TRIANGLES

Examine triangle ABC below



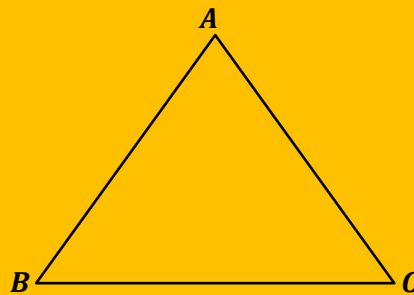
The angle at vertex A is referred to as $\hat{A}$. It can also be written as $B\hat{A}C$ or $C\hat{A}B$.

The angle at vertex B is referred to as $\hat{B}$. It can also be written as $A\hat{B}C$ or $C\hat{B}A$.

The angle at vertex C is referred to as $\hat{C}$. It can also be written as $A\hat{C}B$ or $B\hat{C}A$.

THE SUM OF ANGLES IN A TRIANGLE

The sum of the interior angles of a triangle is 180° .



In any triangle ABC: $\hat{A} + \hat{B} + \hat{C} = 180^\circ$

Reason: sum of $\angle$'s of a Δ

CLASSWORK 1**DATE:**

1. Explain the properties of the following triangles in terms of sides.

Level 1

1.1 A scalene

All sides are not equal

1.2 Equilateral

All sides are equal

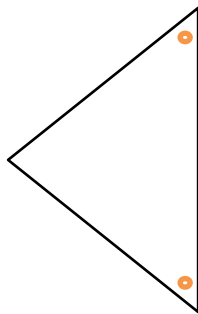
1.3 Isosceles

Two sides are equal

2. Identify the following triangles:

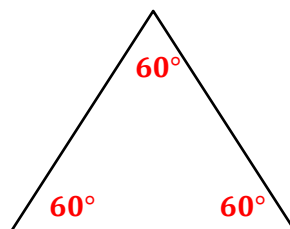
Level 1

2.1



Isosceles

2.2



Equilateral

HOMEWORK 2**DATE:**

1. Explain the properties of the following triangles in terms of angles.

Level 1

- 1.1 Equilateral

All angles are equal

- 1.2 Isosceles

Two angles are equal

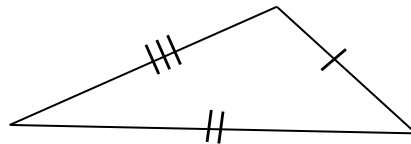
- 1.3 Scalene

All angles are not equal

2. Identify the following triangles:

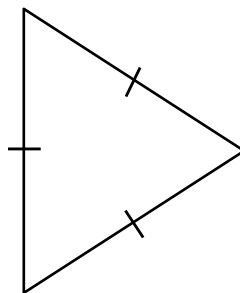
Level 1

- 2.1



Scalene

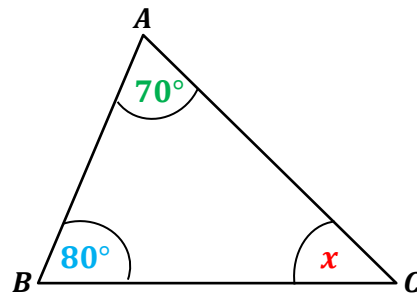
- 2.2



Equilateral

Determine with reason the value of x in each of the following:

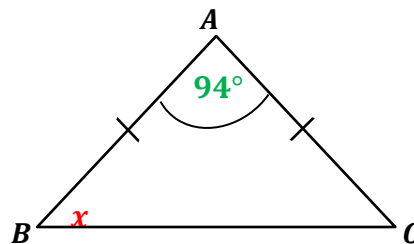
Example 1



Solution:

Statement	Reason
$x + 70^\circ + 80^\circ = 180^\circ$	sum of $\angle$'s of a Δ
$x + 150^\circ = 180^\circ$	
$x + 150^\circ - 150^\circ = 180^\circ - 150^\circ$	
$\therefore x = 30^\circ$	

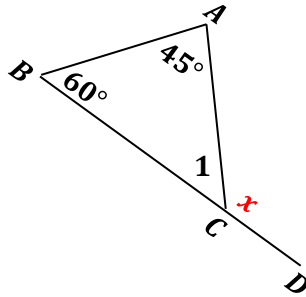
Example 2



Solution:

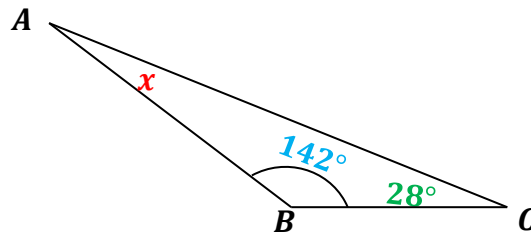
Statement	Reason
$AB = AC$	given
$\therefore \hat{B} = \hat{C} = x$	$\angle$'s opp. = sides
$\hat{A} + \hat{B} + \hat{C} = 180^\circ$	sum of $\angle$'s of a Δ
$94^\circ + x + x = 180^\circ$	
$2x + 94^\circ = 180^\circ$	
$2x + 94^\circ - 94^\circ = 180^\circ - 94^\circ$	
$2x = 86^\circ$	
$\therefore x = 43^\circ$	

3.

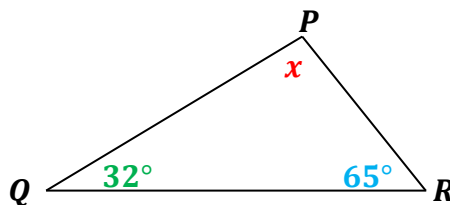


Solution:

Statement	Reason
$x + \hat{C}_1 = 180^\circ$	$\angle$'s on a str. line
but $\hat{C}_1 + 45^\circ + 60^\circ = 180^\circ$	sum of $\angle$'s of a Δ
$\therefore \hat{C}_1 + 105^\circ = 180^\circ$	
$\hat{C}_1 + 105^\circ - 105^\circ = 180^\circ - 105^\circ$	
$\therefore \hat{C}_1 = 75^\circ$	
$\therefore x + 75^\circ = 180^\circ$	
$x + 75^\circ - 75^\circ = 180^\circ - 75^\circ$	
$\therefore x = 105^\circ$	

CLASSWORK 3**DATE:****Determine with reason the value of x in each of the following: Level 2****1.**

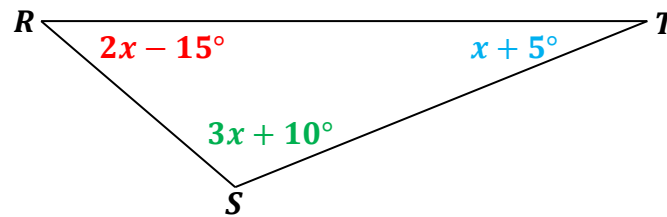
Statement	Reason
$x + 28^\circ + 142^\circ = 180^\circ$	sum of $\angle$'s of a Δ
$x + 170^\circ = 180^\circ$	
$x + 170^\circ - 170^\circ = 180^\circ - 170^\circ$	
$\therefore x = 10^\circ$	

2.**Level 2**

Statement	Reason
$x + 32^\circ + 65^\circ = 180^\circ$	sum of $\angle$'s of a Δ
$x + 97^\circ = 180^\circ$	
$x + 97^\circ - 97^\circ = 180^\circ - 97^\circ$	
$\therefore x = 83^\circ$	

3.

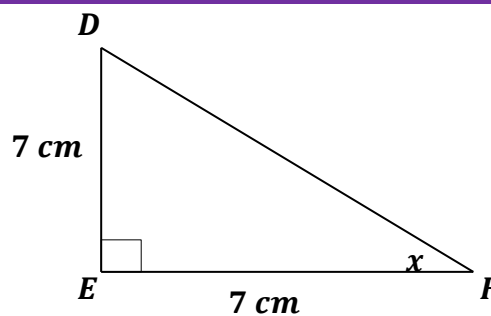
Level 3



Statement	Reason
$\hat{R} + \hat{S} + \hat{T} = 180^\circ$	sum of $\angle$'s of a Δ
$\therefore (2x - 15^\circ) + (3x + 10^\circ) + (x + 5^\circ) = 180^\circ$	
$2x + 3x + x - 15^\circ + 10^\circ + 5^\circ = 180^\circ$	
$6x + 0^\circ = 180^\circ$	
$6x = 180^\circ$	
$\therefore x = 30^\circ$	

4.

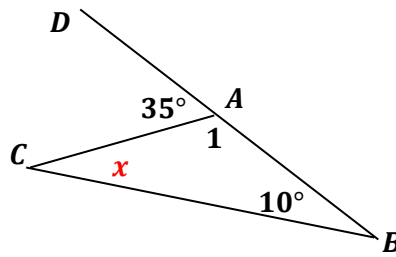
Level 3



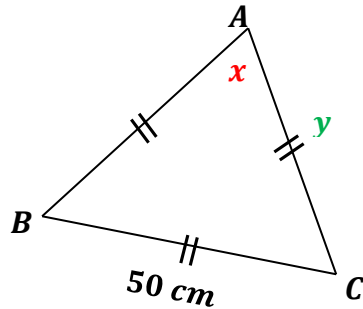
Statement	Reason
$DE = EF$	given
$\therefore \hat{D} = \hat{F} = x$	$\angle$'s opp. = sides
$\hat{D} + \hat{E} + \hat{F} = 180^\circ$	sum of $\angle$'s of a Δ
$x + 90^\circ + x = 180^\circ$	
$2x + 90^\circ = 180^\circ$	
$2x + 90^\circ - 90^\circ = 180^\circ - 90^\circ$	
$2x = 90^\circ$	
$\therefore x = 45^\circ$	

5.

Level 3



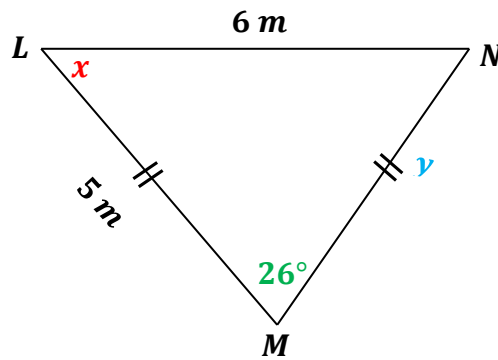
Statement	Reason
$x + \hat{A}_1 + 10^\circ = 180^\circ$	sum of $\angle$'s of a Δ
but $\hat{A}_1 + 35^\circ = 180^\circ$	$\angle$'s on a str. line
$\hat{A}_1 + 35^\circ - 35^\circ = 180^\circ - 35^\circ$	
$\therefore \hat{A}_1 = 145^\circ$	
$\therefore x + 145^\circ + 10^\circ = 180^\circ$	
$x + 155^\circ = 180^\circ$	
$x + 155^\circ - 155^\circ = 180^\circ - 155^\circ$	
$\therefore x = 25^\circ$	

HOMEWORK 4**DATE:****Determine with reasons the value of x and/or y in each of the following:****1.****Level 1**

Statement	Reason
$AB = BC = AC$	given
$\therefore \hat{A} = \hat{B} = \hat{C} = x$	$\angle$'s of equilateral Δ
$x + x + x = 180^\circ$	sum of $\angle$'s of a Δ
$3x = 180^\circ$	
$\therefore x = 60^\circ$	
$\therefore y = 50 \text{ cm}$	sides of equilateral Δ

2.

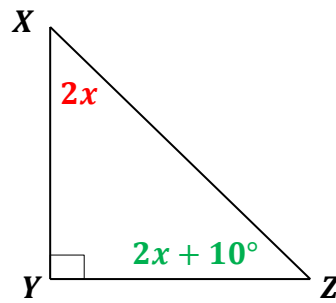
Level 3



Statement	Reason
$LM = MN$	given
$\therefore \hat{L} = \hat{N} = x$	$\angle$'s opp. = sides in a Δ
$x + x + 94^\circ = 180^\circ$	sum of $\angle$'s of a Δ
$2x + 94^\circ - 94^\circ = 180^\circ - 94^\circ$	
$2x = 86^\circ$	
$\therefore x = 43^\circ$	
$\therefore y = 50 \text{ m}$	= sides of an isosceles Δ

3.

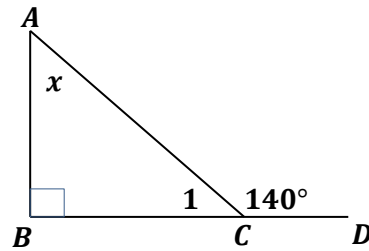
Level 3



Statement	Reason
$\hat{X} + \hat{Z} = 90^\circ$	sum of $\angle$'s of a Δ
$2x + (2x + 10^\circ) = 90^\circ$	
$2x + 2x + 10^\circ = 90^\circ$	
$4x + 10^\circ = 90^\circ$	
$4x + 10^\circ - 10^\circ = 90^\circ - 10^\circ$	
$4x = 80^\circ$	
$\therefore x = 20^\circ$	

4.

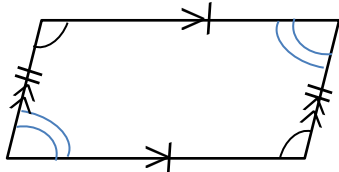
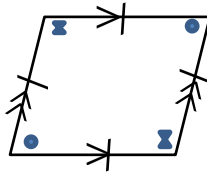
Level 3

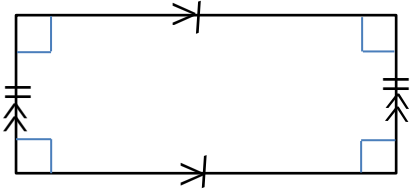
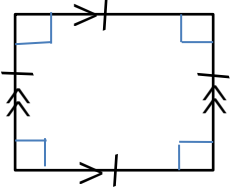


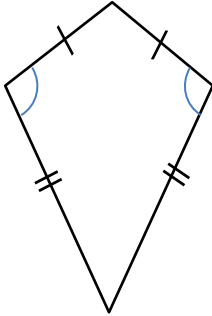
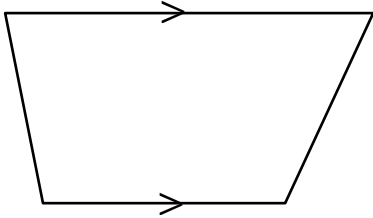
Statement	Reason
$x + \hat{C}_1 + 90^\circ = 180^\circ$	sum of $\angle$'s of a Δ
but $\hat{C}_1 + 140 = 180^\circ$	$\angle$'s on a str. line
$\hat{C}_1 + 140^\circ - 140^\circ = 180^\circ - 140^\circ$	
$\therefore \hat{C}_1 = 40^\circ$	
$\therefore x + 40^\circ + 90^\circ = 180^\circ$	
$x + 130^\circ = 180^\circ$	
$x + 130^\circ - 130^\circ = 180^\circ - 130^\circ$	
$\therefore x = 50^\circ$	

QUADRILATERALS

A quadrilateral is a polygon made up of four straight sides. The interior angles of quadrilateral add up to 360° .

Parallelogram		Rhombus	
			
Definition: A quadrilateral with two pairs of opposite sides parallel.		Definition: A parallelogram with equal adjacent sides.	
Properties		Properties	
Sides	Opposite sides are parallel and equal .	Sides	Opposite sides are parallel and all sides are equal .
Angles	Opposite angles are equal .	Angles	Opposite angles are equal .

Rectangle		Square	
			
Definition: A parallelogram with interior angles equal to 90° .		Definition: A rectangle with equal adjacent sides or a rhombus with interior angles equal to 90° .	
Properties		Properties	
Sides	Opposite sides are parallel and equal .	Sides	Opposite sides are parallel and all sides are equal .
Angles	Interior angles equal to 90° .	Angles	Interior angles equal to 90° .

Kite		Trapezium	
			
Definition: A quadrilateral with two pairs of adjacent sides equal.		Definition: A quadrilateral with one pair of opposite sides parallel.	
Properties		Properties	
Sides	Two pairs of adjacent sides are equal.	Sides	One pair of opposite sides are parallel.
Angles	One pair of opposite angles between unequal sides are equal.	Angles	

NB: The properties of quadrilaterals in terms of sides and angles must be investigated in Grade 8 and in terms of diagonals in Grade 9.

CLASSWORK 5**DATE:**

1. Distinguish between the following quadrilaterals: Level 3

1.1 A parallelogram and a rhombus.

A parallelogram is a quadrilateral having opposite sides equal but a rhombus has all sides equal.

1.2 A rectangle and a square.

A rectangle has all angles equal to 90° and opposite sides equal but a square has all angles equal to 90° and all sides are equal.

1.3 A parallelogram and a rectangle

A parallelogram has opposite sides and angles equal but a rectangle has opposite sides equal and all angles equal to 90° .

2. State with reason whether the following statements are true or false.

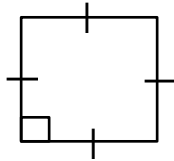
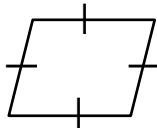
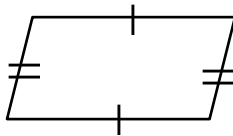
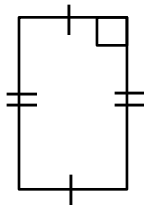
Level 1

2.1 A rectangle is a special kind of a parallelogram.

True, a rectangle has all the properties of a parallelogram.

2.2 A rhombus is a special kind of a square.

False, rhombus does not have angle equal to 90° .

HOMEWORK 6**DATE:****1. Identify the following quadrilaterals:****Level 1****1.1****A square****1.2****A rhombus****1.3****A parallelogram****1.5****A rectangle****2. State with reason whether the following statements are true or false:****Level 3****2.1 A rectangle is a special kind of square and square is not a special kind of rectangle.****False, a rectangle does not have all sides equal but a square has all the properties of a rectangle. I.e. the opposite sides of a square are equal.****2.2 A square is a special kind of rhombus but rhombus is not a special kind of a square.****True, square has all the properties of rhombus, but rhombus does not have angles equal to 90° .**

CLASSWORK 7**DATE:**

1. Define the following quadrilateral: **Level 2**

1.1 A kite.

A quadrilateral with two pairs of adjacent sides equal.

1.2 A trapezium.

A quadrilateral with one pair of opposite sides parallel.

2. Complete the following statement: **Level 1**

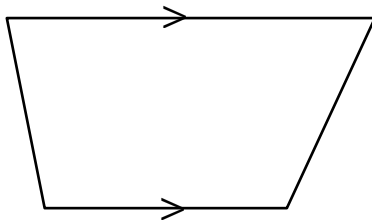
In a kite, equal angles are between _____ sides.

unequal.

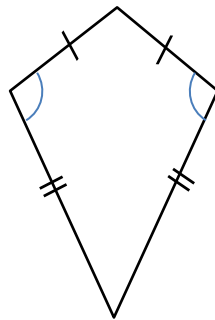
HOMEWORK 8**DATE:**

Draw the following quadrilaterals and indicate their properties on the diagram:
Level 2

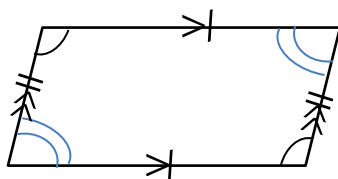
1. A trapezium.



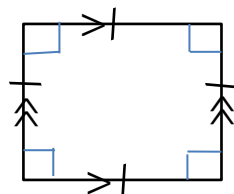
2. A kite.



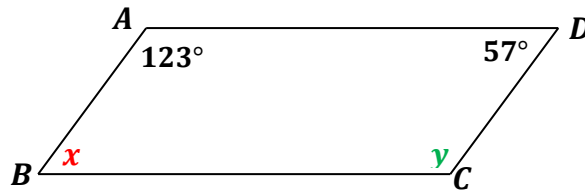
3. A parallelogram.



4. A square



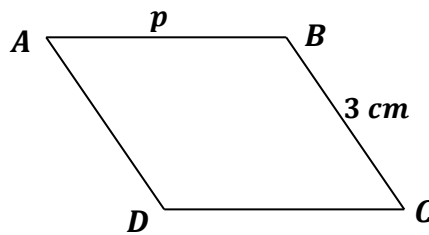
Example 1: Determine the values of x and y in parallelogram ABCD below.



Solution:

Statement	Reason
$x = 57^\circ$	opp. $\angle$'s of a parm
$y = 123^\circ$	opp. $\angle$'s of a parm

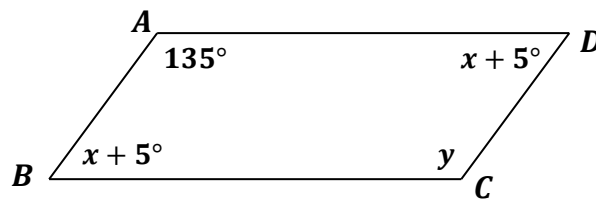
Example 2: ABCD is a rhombus. Determine the values of p .



Solution:

Statement	Reason
$\therefore p = 3 \text{ cm}$	sides of a rhombus

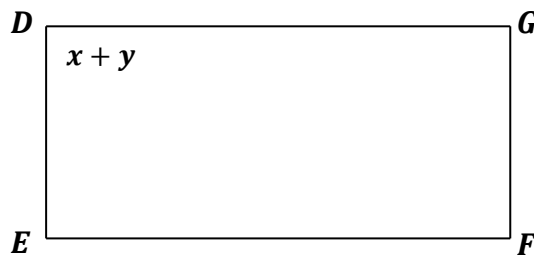
Example 3: ABCD is a parallelogram. Determine the value of x and y .



Solution:

Statement	Reason
$y = 135^\circ$	opp. $\angle$'s of a parm.
$x + 5^\circ + y + x + 5^\circ + 135^\circ = 360^\circ$	sum of $\angle$'s of quad.
$x + 5^\circ + 135^\circ + x + 5^\circ + 135^\circ = 360^\circ$	
$2x + 280^\circ =$	
$2x + 280^\circ - 280^\circ = 360^\circ - 280^\circ$	
$2x = 80^\circ$	
$\therefore x = 40^\circ$	

Example 4: DEFG is a rectangle with an interior angle equal to $x + y$. Calculate the value of x if $x = y$.

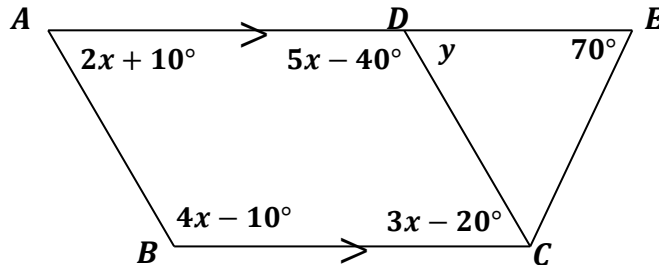


Solution:

Statement	Reason
$x + y = 90^\circ$	$\angle$'s of a rectangle
$x = y$	given
$\therefore x = 45^\circ$	

Example 5: In a trapezium ABCE, $AE \parallel BC$ with $\hat{E} = 70^\circ$

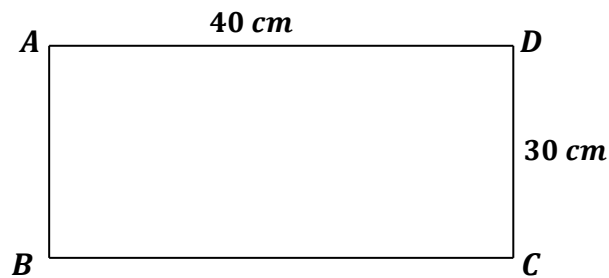
1. Calculate the value of x .
2. Show that ABCD is a parallelogram.
3. Show that $CD = CE$.



Solution:

Statement	Reason
1. $2x + 10^\circ + 4x - 10^\circ + 3x - 20^\circ + 5x - 40^\circ = 360^\circ$ $14x - 60^\circ = 360^\circ$ $14x = 420^\circ$ $\therefore x = 30^\circ$	sum of $\angle$'s of quad.
2. ABCD a parm (if $\hat{A} = \hat{BCD}$ and $\hat{B} = \hat{ADC}$) $\hat{A} = 2(30^\circ) + 10^\circ = 70^\circ$ $\hat{BCD} = 3(30^\circ) - 20^\circ = 70^\circ$ $\hat{B} = 4(30^\circ) - 10 = 110^\circ$ $\hat{ADC} = 5(30^\circ) - 40^\circ = 110^\circ$ $\therefore$ ABCD is a parm.	opp. $\angle$'s are =
3. $CD = CE$ (if $y = 70^\circ$) $y + (5x - 40^\circ) = 180^\circ$ $y + 110^\circ = 180^\circ$ $\therefore y = 70^\circ$ $\therefore CD = CE$	$\angle$'s on a str. line sides opp. = $\angle$'s

Example 6: ABCD is a rectangle with $AD = 40$ cm and $DC = 30$ cm.
Calculate the length of AB and BC.

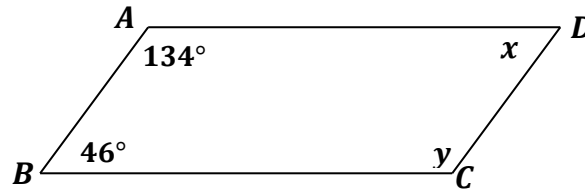


Solution:

Statement	Reason
$AB = DC = 30$ cm	opp. sides of rectangle
$BC = AD = 40$ cm	opp. sides of rectangle

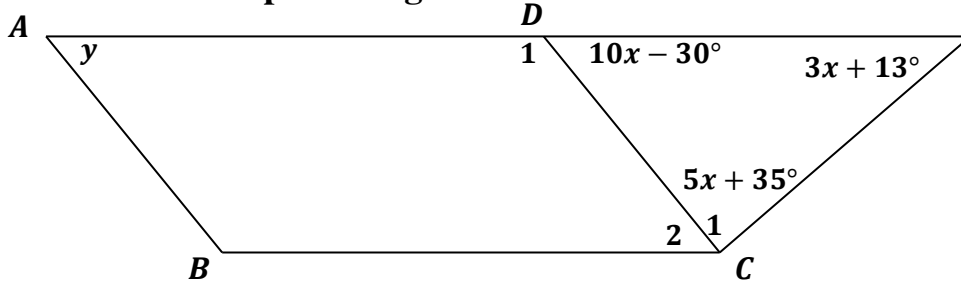
CLASSWORK 9**DATE:**

1. ABCD is a parallelogram. Determine the values of x and y .

**Level 1**

Statement	Reason
$x = 46^\circ$	opp. $\angle$'s of a parm
$y = 134^\circ$	opp. $\angle$'s of a parm

2. ABCD is a parallelogram. Determine the values of x and y .

**Level 4**

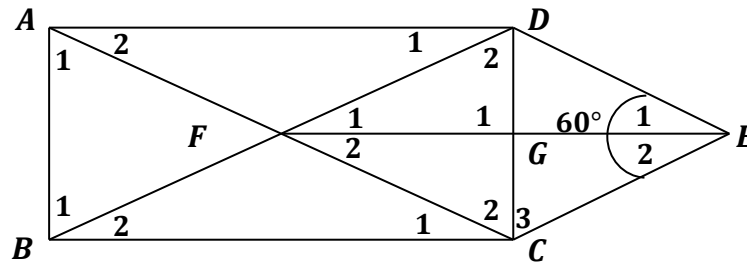
Statement	Reason
$(10x - 30^\circ) + (3x + 13^\circ) + (5x + 35^\circ) = 180^\circ$	sum of $\angle$'s of a Δ
$10x - 30^\circ + 3x + 13^\circ + 5x + 35^\circ = 180^\circ$	
$18x + 18^\circ = 180^\circ$	
$18x + 18^\circ - 18^\circ = 180^\circ - 18^\circ$	
$18x = 162^\circ$	
$\therefore x = \frac{162^\circ}{18} = \frac{54}{6} = 9$	
$y = 10x - 30^\circ$	
$y = 10(9^\circ) - 30^\circ$	
$\therefore y = 90^\circ - 30^\circ = 60^\circ$	
	corr. $\angle$'s, ABCD is a parm (AB DC)

3. ABCD is a rectangle and DECF is a rhombus. $\widehat{DEC} = 60^\circ$.

Level 1

3.1 Calculate with reason the size of, $\widehat{F}_1 + \widehat{F}_2$,

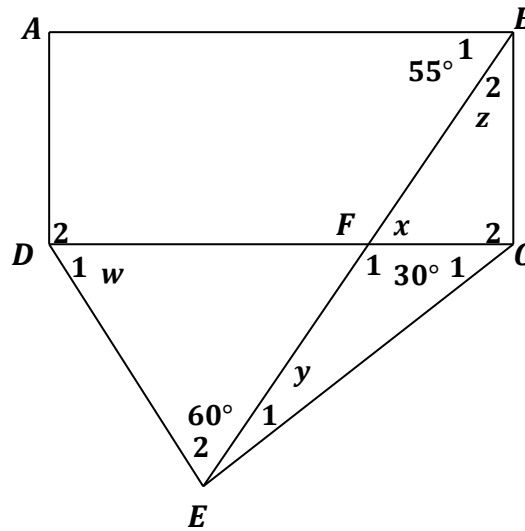
3.2 Calculate with reason the length of DE if EC = 4 cm



Statement	Reason
3.1 $\widehat{F}_1 + \widehat{F}_2 = 60^\circ$	opp. $\angle$'s of a rhombus
3.2 DE = EC = 4 cm	sides of rhombus

HOMEWORK 10**DATE:**

1. ABCD is a rectangle. Determine the value of w , x , y and z . Level 2/3



Statement	Reason
$x = 55^\circ$	alt. $\angle$'s, ABCD is a rectangle ($AB \parallel DC$)
$y + 30^\circ + \hat{F}_1 = 180^\circ$	sum of $\angle$'s of a Δ
but $\hat{F}_1 + 55^\circ = 180^\circ$	$\angle$'s on a str. line
$\therefore \hat{F}_1 = 125^\circ$	
$\therefore y + 30^\circ + 125^\circ = 180^\circ$	
$y + 155^\circ = 180^\circ$	
$\therefore y = 25^\circ$	
$w + 60^\circ + y + 30^\circ = 180^\circ$	sum of $\angle$'s of a Δ
$w + 60^\circ + 25^\circ + 30^\circ = 180^\circ$	
$w + 115^\circ = 180^\circ$	
$\therefore w = 65^\circ$	
$z + 55^\circ = 90^\circ$	$\angle$'s of rectangle
$\therefore z = 35^\circ$	

2. ABCD is a kite with $\hat{A} = 140^\circ$, $\hat{C} = 60^\circ$, $AD = 17$ cm and $BC = 25$ cm. Determine with reasons:

2.1 AB

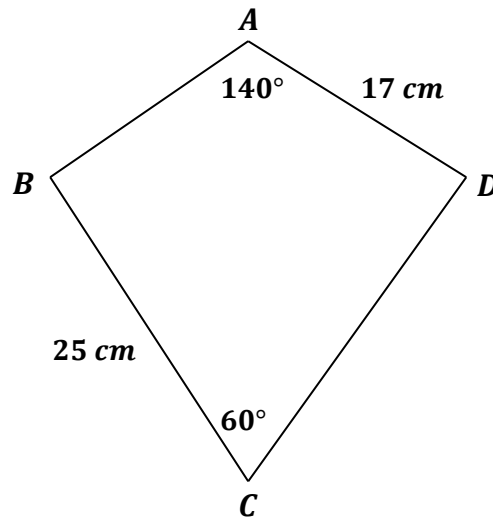
Level 1

2.2 DC

Level 1

2.3 $\hat{D}$

Level 4

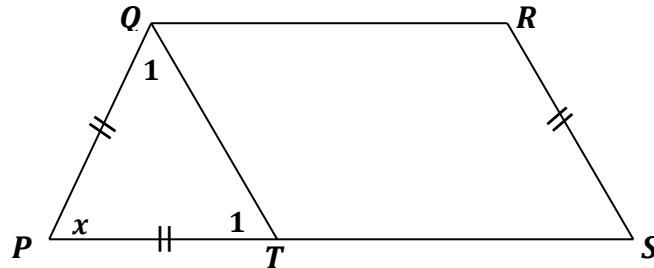


Statement	Reason
2.1 $AB = AD = 17$ cm	pair of adj. sides
2.2 $DC = BC = 25$ cm	pair of adj. sides
2.3 $\hat{D} + \hat{A} + \hat{B} + \hat{C} = 360^\circ$	sum of $\angle$'s of quad.
but $\hat{D} = \hat{B}$	$\angle$'s between unequal sides
$\hat{D} + 140^\circ + \hat{D} + 60^\circ = 360^\circ$	
$2\hat{D} + 200^\circ = 360^\circ$	
$2\hat{D} + 200^\circ - 200^\circ = 360^\circ - 200^\circ$	
$2\hat{D} = 160^\circ$	
$\therefore \hat{D} = 80^\circ$	

3. TQRS is a parallelogram. PTS is a straight line. $PT = PQ = SR$.

3.1 Calculate with reasons the size of the unknown angle indicated by letter x . Level 4

3.2 Why is PQRS a trapezium? Level 3



Statement	Reason
3.1 $QT = RS$	opp. sides of a parm.
$\therefore \triangle PTQ$ is an equilateral	
$\therefore \hat{P} = \hat{T}_1 = \hat{Q}_1$	
$x + x + x = 180^\circ$	sum of $\angle$'s of a Δ
$3x = 180^\circ$	
$\therefore x = 60^\circ$	
3.2 $TS \parallel QS$	opp. sides of parm.
$PTS \parallel QS$	PTS a str. line
$\therefore PQRS$ is a trapezium	one pair of opp. sides $\parallel$

4. ABCD is a quadrilateral with angles given in terms of x . Side ED is produced to C such that EDC forms one of the straight sides of quadrilateral ABCE. Show that:

4.1 ABDE is a parallelogram.

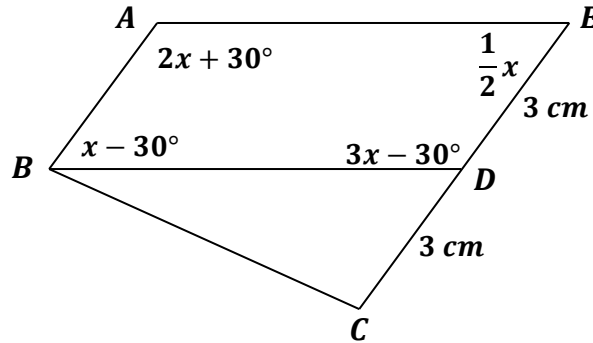
Level 4

4.2 ABCE is a trapezium.

Level 3

4.3 $AB = \frac{1}{2} EC$ if it is given that $ED = DC = 3$ cm.

Level 4



Statement	Reason
4.1 ABDE a parm (if $\hat{A} = \hat{BDE}$ and $\hat{ABD} = \hat{E}$)	
$2x + 30^\circ + x - 30^\circ + 3x - 30^\circ + \frac{1}{2}x = 360^\circ$	sum of $\angle$'s of quad.
$\frac{7}{2}x - 30^\circ = 360^\circ$	
$\frac{13}{2}x = 390^\circ$	
$13x = 780^\circ$	
$\therefore x = 60^\circ$	
$\hat{A} = 2(60^\circ) + 30^\circ = 150^\circ$	
$\hat{BDE} = 3(60^\circ) - 30^\circ = 150^\circ$	
$\hat{ABD} = 60^\circ - 30^\circ = 30^\circ$	
$\hat{E} = \frac{1}{2}(60^\circ) = 30^\circ$	opp. $\angle$'s are =
$\hat{A} = \hat{BDE}$ and $\hat{ABD} = \hat{E}$	
$\therefore$ ABCD is a parm.	$\angle$'s on a str. line

4.3 ABCE a trapezium (if $AB \parallel EDC$)

$$AB \parallel ED$$

$$AB \parallel EDC$$

$\therefore$ ABCE is a trapezium

4.2 $AB = ED$

$$ED = CD$$

$$\therefore 2AB = EC$$

$$\therefore AB = \frac{1}{2}EC$$

opp. sides of parm.

EDC a str. line

one pair of opp. sides $\parallel$

proved

given

CONGRUENT SHAPES

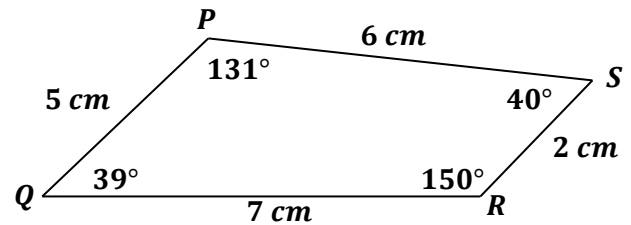
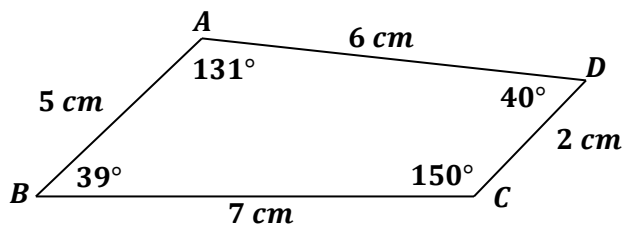
Two shapes are congruent if they are exactly the same size and shape. They are identical in all respects.

In congruent shapes:

- corresponding sides are equal
- corresponding angles are equal

The symbol used for congruency is $\equiv$

Example 1: State why the two shapes are congruent.



Solution: $AB = PQ = 5\text{ cm}$ and $\hat{A} = \hat{P} = 131^\circ$

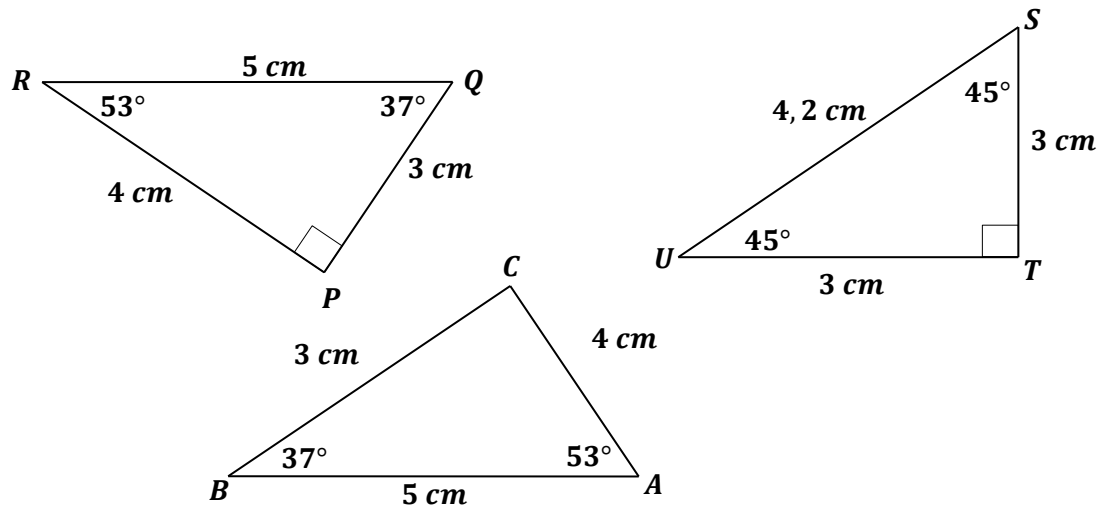
$BC = QR = 7\text{ cm}$ $\hat{B} = \hat{Q} = 39^\circ$

$CD = RS = 2\text{ cm}$ $\hat{C} = \hat{R} = 150^\circ$

$AD = PS = 6\text{ cm}$ $\hat{D} = \hat{S} = 40^\circ$

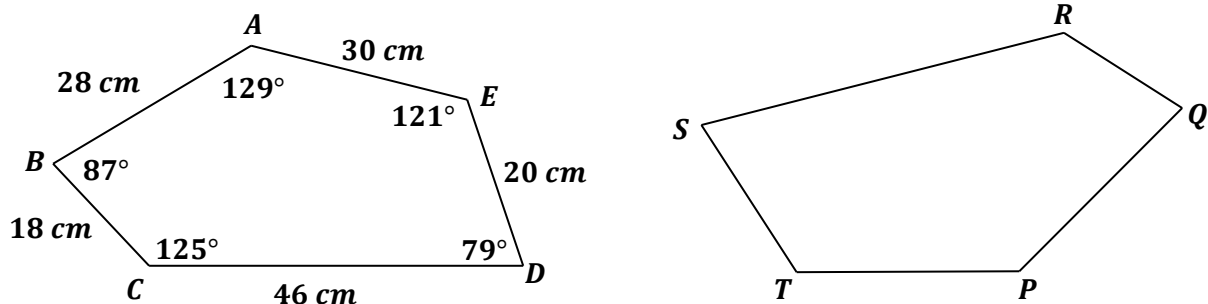
$ABCD \equiv PQRS$ as all corresponding sides and angles are equal.

Example 2: State which of the shapes below are congruent:



Solution: $PQ = AC$ and $\hat{P} = \hat{C}$
 $QR = AB$ and $\hat{Q} = \hat{A}$
 $PR = BC$ and $\hat{R} = \hat{B}$
 $\therefore \triangle PQR \equiv \triangle CAB$

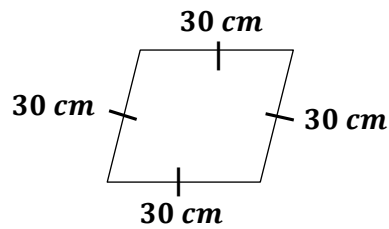
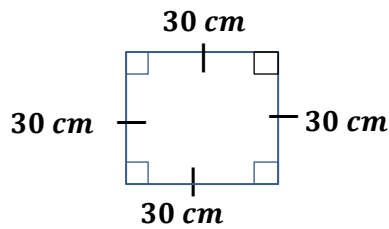
Example 3: It is given that $ABCDE \equiv PQRST$. Determine the length of all of the unknown sides and angles of all of the unknown sides and angles of PQRST.



Solution: As $ABCDE \equiv PQRST$

$AB = PQ = 28\text{cm}$ and $\hat{A} = \hat{P} = 129^\circ$
 $BC = QR = 18\text{cm}$ and $\hat{B} = \hat{Q} = 87^\circ$
 $CD = RS = 46\text{cm}$ and $\hat{C} = \hat{R} = 125^\circ$
 $DE = ST = 20\text{cm}$ and $\hat{D} = \hat{S} = 79^\circ$
 $AE = PT = 30\text{cm}$ and $\hat{E} = \hat{T} = 121^\circ$

Example 4: State whether the shapes below are congruent or not and give a reason for your answer.

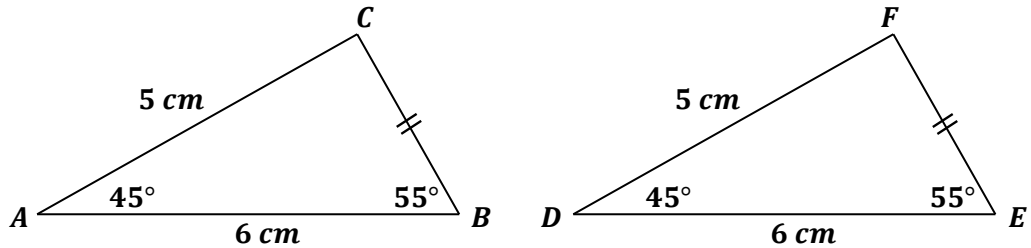


Solution: Corresponding sides are all equal. However the corresponding angles are not. So in order for a shape to be congruent, the corresponding sides and angles have to be equal. Therefore the quadrilaterals are not congruent.

CLASSWORK 11**DATE:**

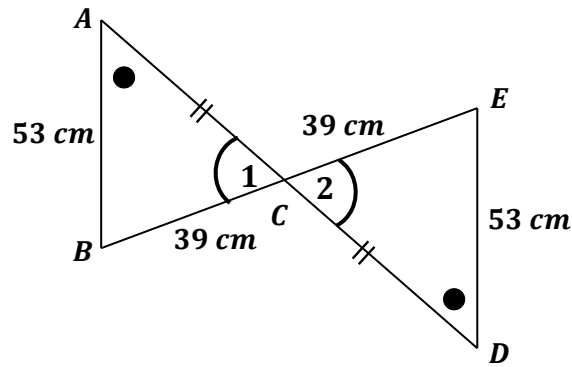
1. Show that the following triangles are congruent. Use your knowledge about the properties of triangles and make use of congruency notation. Level 4

1.1



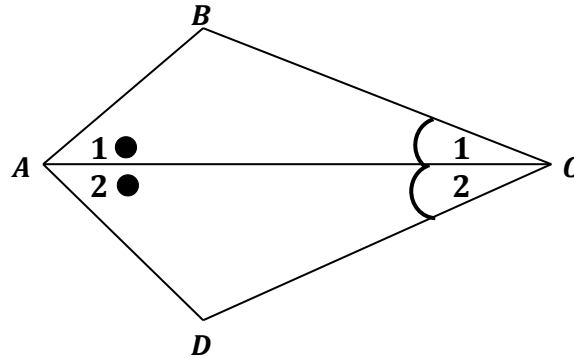
Statement	Reason
In $\triangle ABC$ and $\triangle DEF$:	
$\hat{A} = \hat{D} = 45^\circ$	given
$\hat{B} = \hat{E} = 55^\circ$	given
$\hat{C} = \hat{F}$	sum of $\angle$'s in a $\triangle$
$AB = DE = 6\text{ cm}$	given
$BC = EF$	given
$AC = DF = 5\text{ cm}$	given
$\therefore \triangle ABC \equiv \triangle DEF$	corr. sides and $\angle$'s are =

1.2



Statement	Reason
In $\triangle ABC$ and $\triangle DEC$:	
$\hat{A} = \hat{D}$	given
$\hat{C}_1 = \hat{C}_2$	vert. opp. $\angle$'s
$\hat{B} = \hat{E}$	sum of $\angle$'s in a $\triangle$
$AB = DE = 53 \text{ cm}$	given
$BC = EC = 39 \text{ cm}$	given
$AC = DC$	given
$\therefore \triangle ABC \equiv \triangle DEC$	corr. sides and $\angle$'s are =

2. ABCD is kite. Show that the two triangles in the kite are congruent.
Use your knowledge of the properties of a kite and make use of congruency notation.
Level 4

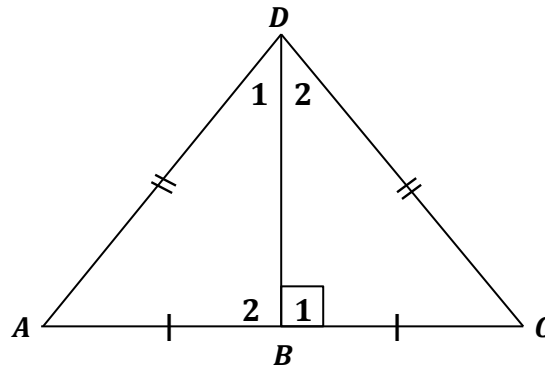


Statement	Reason
In $\triangle ABC$ and $\triangle ADC$:	
$\hat{A}_1 = \hat{A}_2$	given
$\hat{C}_1 = \hat{C}_2$	given
$\hat{B} = \hat{D}$	sum of $\angle$'s in a $\triangle$
$AB = AD$	pair of adj. sides of a kite
$BC = DC$	pair of adj. sides of a kite
$AC = AC$	common side
$\therefore \triangle ABC$ and $\triangle ADC$	corr. sides and $\angle$'s are =

HOMEWORK 12**DATE:**

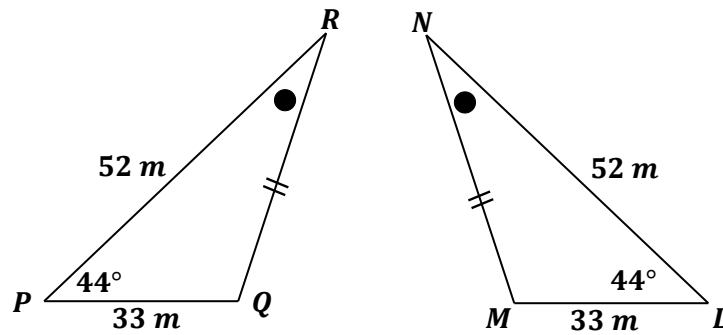
1. Show that the following triangles are congruent. Use your knowledge about the properties of triangles and make use of congruency notation. Level 4

1.1



Statement	Reason
In $\triangle ABD$ and $\triangle CBD$:	
$\hat{A} = \hat{C}$	$\angle$'s opp. = sides in a $\triangle/\triangle ACD$ is an isosceles $\triangle$
$\hat{B}_2 = \hat{B}_1 = 90^\circ$	supplementary $\angle$'s on a str. line
$\hat{D}_1 = \hat{D}_2$	sum of $\angle$'s in a $\triangle$
$AB = CB$	given
$AD = CD$	given
$BD = BD$	common side
$\triangle ABD \equiv \triangle CBD$	corr. sides and $\angle$'s are =

1.2



Statement	Reason
In $\triangle PQR$ and $\triangle LMN$:	
$\hat{P} = \hat{L}$	given
$\hat{R} = \hat{N}$	given
$\hat{Q} = \hat{M}$	sum of $\angle$'s in a $\triangle$
$PQ = ML = 33 \text{ m}$	given
$QR = MN$	given
$PR = LN = 52 \text{ m}$	given
In $\triangle PQR$ and $\triangle LMN$:	corr. sides and $\angle$'s are =

2. PQST is a parallelogram and PRSU is a rectangle. Show that the two triangles in the parallelogram are congruent. Use your knowledge of the properties of a parallelogram and make use of congruency notation. Level 4



Statement	Reason
$\widehat{R}_2 = 90^\circ = \widehat{U}_2$	int. $\angle$'s of a rectangle
$\therefore \widehat{R}_1 = 90^\circ = \widehat{U}_1$	supp. $\angle$'s on a straight line
In $\triangle PQR$ and $\triangle STU$:	
$\widehat{Q} = \widehat{T}$	opp. $\angle$'s of a parm
$\widehat{R}_1 = \widehat{U}_2$	already proved
$\widehat{P}_1 = \widehat{S}_1$	sum of $\angle$'s of $\triangle$
$PQ = ST$	opp. sides of a parm
$QR = TU$	given
$PR = SU$	opp. sides of a rectangle.
$\therefore \triangle PQR$ and $\triangle STU$	corr. sides and $\angle$'s are =

SIMILAR SHAPES

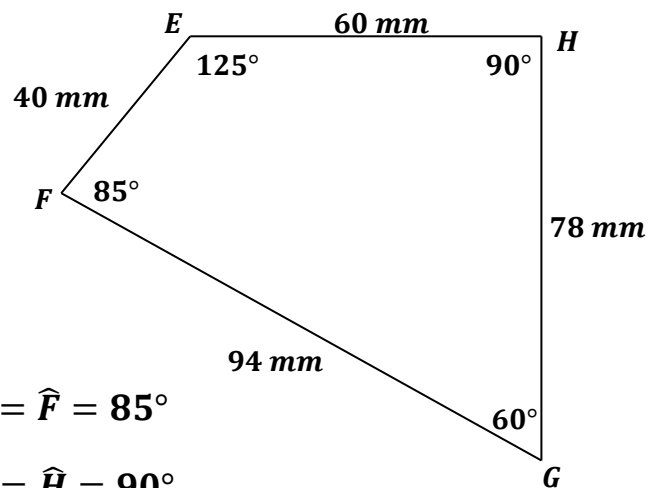
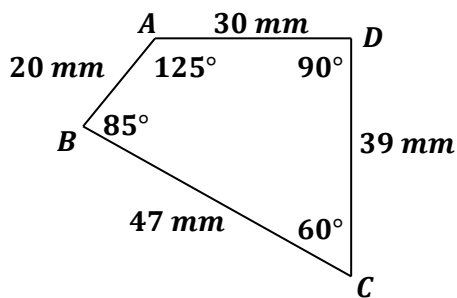
Two shapes are similar if they have the same shape but not necessarily the same size. The one shape is the enlargement or reduction of the other.

For the two shapes to be similar, BOTH of the following conditions must be satisfied:

1. The corresponding angles must be equal.
2. The ratios of the corresponding sides must be in the same proportion.

The symbol used for similarity is $///$ or $|||$.

Example 1: Polygon EFGH is an enlargement of polygon ABCD. The sides of EFGH have been multiplied by a factor of 2. The two polygons are similar. Observe the following from the diagrams below:



Solution: $\hat{A} = \hat{E} = 125^\circ$

$\hat{B} = \hat{F} = 85^\circ$

$\hat{C} = \hat{G} = 60^\circ$

$\hat{D} = \hat{H} = 90^\circ$

$$\frac{EF}{AB} = \frac{40 \text{ mm}}{20 \text{ mm}} = 2$$

$$\frac{FG}{BC} = \frac{94 \text{ mm}}{47 \text{ mm}} = 2$$

$$\frac{GH}{CD} = \frac{78 \text{ mm}}{39 \text{ mm}} = 2$$

$$\frac{EH}{AD} = \frac{60 \text{ mm}}{30 \text{ mm}} = 2$$

or

$$\frac{AB}{EF} = \frac{20 \text{ mm}}{40 \text{ mm}} = \frac{1}{2}$$

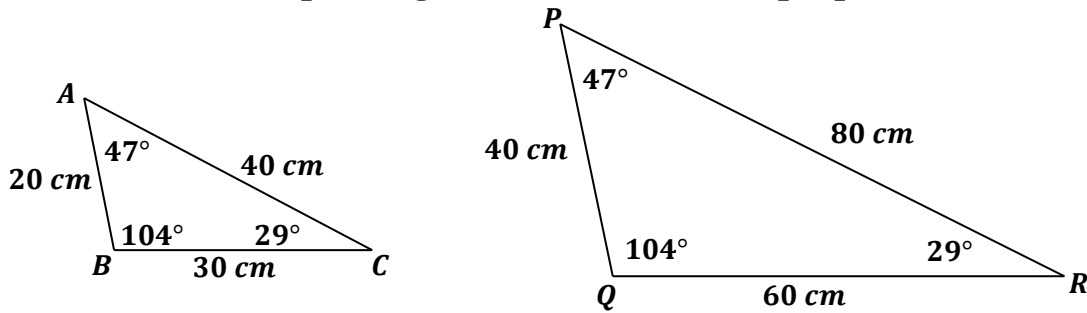
$$\frac{BC}{FG} = \frac{47 \text{ mm}}{94 \text{ mm}} = \frac{1}{2}$$

$$\frac{CD}{GH} = \frac{39 \text{ mm}}{78 \text{ mm}} = \frac{1}{2}$$

$$\frac{AD}{EH} = \frac{30 \text{ mm}}{60 \text{ mm}} = \frac{1}{2}$$

$\therefore$ The corresponding angles are equal and corresponding sides are in the same proportion.

Example 2: The triangles shown below are similar. Show that the ratios of the corresponding sides are in the same proportion.

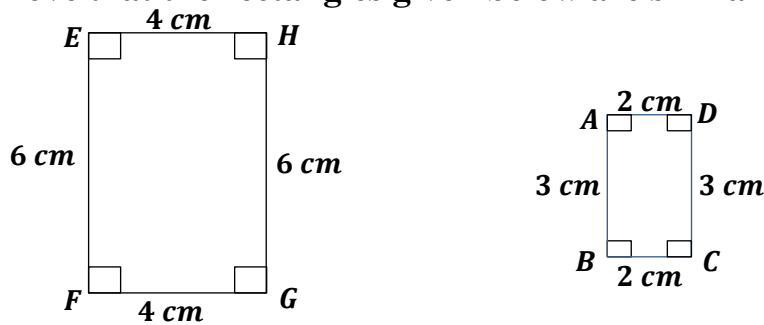


Solution: $\frac{PQ}{AB} = \frac{40 \text{ cm}}{20 \text{ cm}} = 2$ $\frac{QR}{BC} = \frac{60 \text{ cm}}{30 \text{ cm}} = 2$ $\frac{PR}{AC} = \frac{80 \text{ cm}}{40 \text{ cm}} = 2$

or

$$\frac{AB}{PQ} = \frac{20 \text{ cm}}{40 \text{ cm}} = \frac{1}{2} \quad \frac{BC}{QR} = \frac{30 \text{ cm}}{60 \text{ cm}} = \frac{1}{2} \quad \frac{AC}{PR} = \frac{40 \text{ cm}}{80 \text{ cm}} = \frac{1}{2}$$

Example 3: Prove that the rectangles given below are similar.



Solution: $\hat{E} = \hat{A} = 90^\circ$ $\hat{F} = \hat{B} = 90^\circ$

$\hat{G} = \hat{C} = 90^\circ$ $\hat{H} = \hat{D} = 90^\circ$

$$\frac{AB}{EF} = \frac{3 \text{ cm}}{6 \text{ cm}} = \frac{1}{2} \quad \frac{BC}{FG} = \frac{2 \text{ cm}}{4 \text{ cm}} = \frac{1}{2}$$

$$\frac{CD}{GH} = \frac{3 \text{ cm}}{6 \text{ cm}} = \frac{1}{2} \quad \frac{AD}{EH} = \frac{2 \text{ cm}}{4 \text{ cm}} = \frac{1}{2}$$

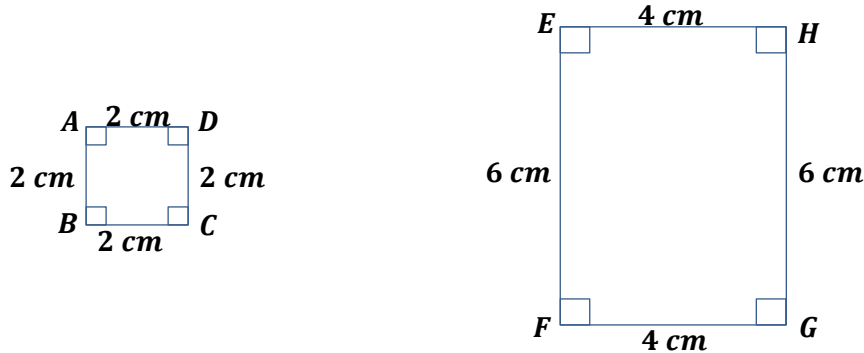
or

$$\frac{EF}{AB} = \frac{6 \text{ cm}}{3 \text{ cm}} = 2 \quad \frac{FG}{BC} = \frac{4 \text{ cm}}{2 \text{ cm}} = 2$$

$$\frac{GH}{CD} = \frac{6 \text{ cm}}{3 \text{ cm}} = 2 \quad \frac{EH}{AD} = \frac{4 \text{ cm}}{2 \text{ cm}} = 2$$

The corresponding angles are equal and the corresponding sides are in the same proportion.

Example 4: State whether the shapes below are similar or not and give a reason for your answer.



Solution: $\hat{A} = \hat{E} = 90^\circ$

$\hat{B} = \hat{F} = 90^\circ$

$\hat{C} = \hat{G} = 90^\circ$

$\hat{D} = \hat{H} = 90^\circ$

$$\frac{EF}{AB} = \frac{6 \text{ cm}}{2 \text{ cm}} = 3$$

$$\frac{FG}{BC} = \frac{4 \text{ cm}}{2 \text{ cm}} = 2$$

$$\frac{GH}{CD} = \frac{6 \text{ cm}}{2 \text{ cm}} = 3$$

$$\frac{EH}{AD} = \frac{4 \text{ cm}}{2 \text{ cm}} = 2$$

or

$$\frac{AB}{EF} = \frac{2 \text{ cm}}{6 \text{ cm}} = \frac{1}{3}$$

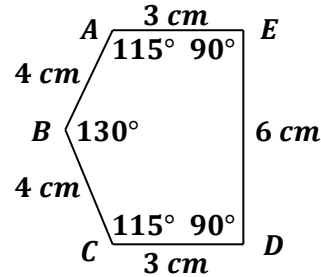
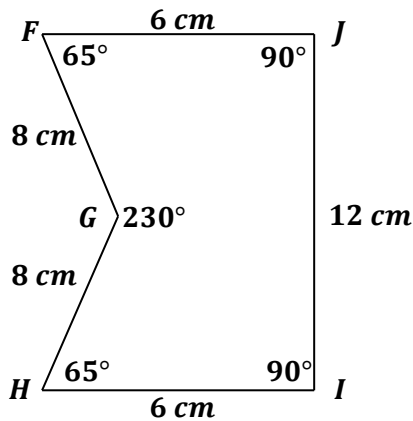
$$\frac{BC}{FG} = \frac{2 \text{ cm}}{4 \text{ cm}} = \frac{1}{2}$$

$$\frac{CD}{GH} = \frac{2 \text{ cm}}{6 \text{ cm}} = \frac{1}{3}$$

$$\frac{AD}{EH} = \frac{2 \text{ cm}}{4 \text{ cm}} = \frac{1}{2}$$

- The corresponding angles are equal.
- The ratios of the corresponding sides are not all the same.
- Polygon EFGH is not an enlargement of polygon ABCD.
- ABCD is a square and EFGH is a rectangle.
- Therefore the two polygons are not similar.

Example 5: Consider the two polygons below:



Solution: $\hat{F} = 65^\circ$ $\hat{A} = 115^\circ$ $\hat{F} \neq \hat{A}$

$\hat{G} = 230^\circ$ $\hat{B} = 130^\circ$ $\hat{G} \neq \hat{B}$

$\hat{H} = 65^\circ$ $\hat{C} = 115^\circ$ $\hat{H} \neq \hat{C}$

$\hat{I} = 90^\circ$ $\hat{D} = 90^\circ$ $\hat{I} = \hat{D}$

$\hat{J} = 90^\circ$ $\hat{E} = 90^\circ$ $\hat{J} = \hat{E}$

$$\frac{AB}{FG} = \frac{20 \text{ mm}}{40 \text{ mm}} = \frac{1}{2}$$

$$\frac{BC}{GH} = \frac{20 \text{ mm}}{40 \text{ mm}} = \frac{1}{2}$$

$$\frac{CD}{HI} = \frac{30 \text{ mm}}{60 \text{ mm}} = \frac{1}{2}$$

$$\frac{DE}{IJ} = \frac{35 \text{ mm}}{70 \text{ mm}} = \frac{1}{2}$$

$$\frac{AE}{FJ} = \frac{30 \text{ mm}}{60 \text{ mm}} = \frac{1}{2}$$

or

$$\frac{FG}{AB} = \frac{40 \text{ mm}}{20 \text{ mm}} = 2$$

$$\frac{GH}{BC} = \frac{40 \text{ mm}}{20 \text{ mm}} = 2$$

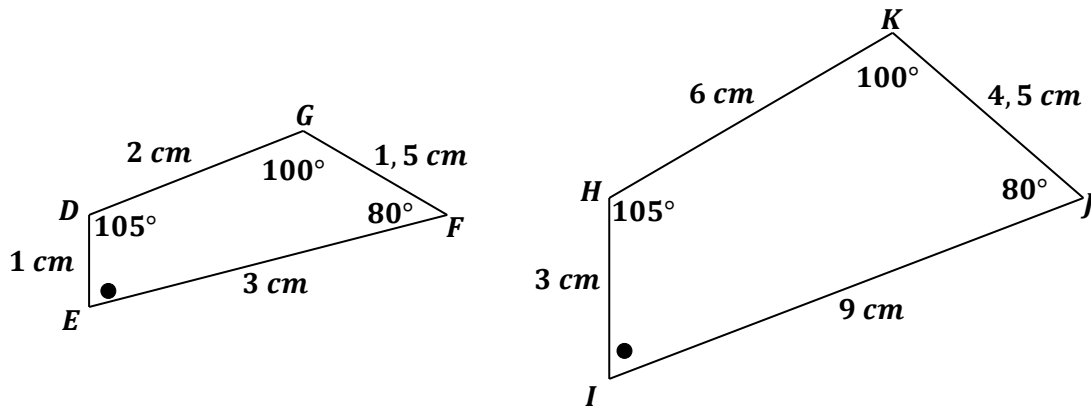
$$\frac{HI}{CD} = \frac{60 \text{ mm}}{30 \text{ mm}} = 2$$

2

$$\frac{IJ}{DE} = \frac{70 \text{ mm}}{35 \text{ mm}} = 2$$

$$\frac{FJ}{AE} = \frac{60 \text{ mm}}{30 \text{ mm}} = 2$$

- The corresponding angles are not all equal.
- The ratios of the corresponding sides are equal.
- Polygon ABCDE is not a reduction of polygon FGHJI.
- Therefore the two polygons are not similar.

CLASSWORK 13**DATE:****1. Show with reasons why the following polygons are similar. Level 4****1.1**

$$\hat{D} = \hat{H} = 105^\circ$$

$$\hat{E} = \hat{I}$$

$$\hat{F} = \hat{J} = 80^\circ$$

$$\hat{G} = \hat{K} = 100^\circ$$

$$\frac{HI}{DE} = \frac{3 \text{ cm}}{1 \text{ cm}} = 3$$

$$\frac{IJ}{EF} = \frac{9 \text{ cm}}{3 \text{ cm}} = 3$$

$$\frac{JK}{FG} = \frac{4.5 \text{ cm}}{1.5 \text{ cm}} = 3$$

$$\frac{HK}{DG} = \frac{6 \text{ cm}}{2 \text{ cm}} = 3$$

or

$$\frac{AB}{EF} = \frac{1 \text{ cm}}{3 \text{ cm}} = \frac{1}{3}$$

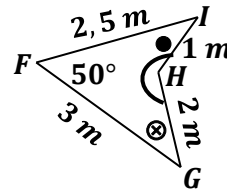
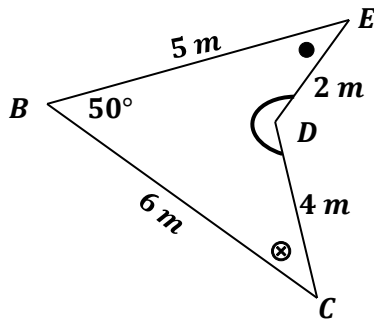
$$\frac{BC}{FG} = \frac{3 \text{ cm}}{9 \text{ cm}} = \frac{1}{3}$$

$$\frac{CD}{GH} = \frac{1.5 \text{ cm}}{4.5 \text{ cm}} = \frac{1}{3}$$

$$\frac{AD}{EH} = \frac{2 \text{ cm}}{6 \text{ cm}} = \frac{1}{3}$$

$\therefore$ The corresponding angles are equal and corresponding sides are in the same proportion.

1.2



$$\hat{F} = \hat{B} = 50^\circ$$

$$\hat{G} = \hat{C}$$

$$\hat{H} = \hat{D}$$

$$\hat{I} = \hat{D}$$

$$\frac{FG}{BC} = \frac{3\text{ m}}{6\text{ m}} = \frac{1}{2}$$

$$\frac{GH}{CD} = \frac{2\text{ m}}{4\text{ m}} = \frac{1}{2}$$

$$\frac{HI}{DE} = \frac{1\text{ m}}{2\text{ m}} = \frac{1}{2}$$

$$\frac{FI}{BE} = \frac{2.5\text{ m}}{5\text{ m}} = \frac{1}{2}$$

or

$$\frac{BC}{FG} = \frac{6\text{ m}}{3\text{ m}} = 2$$

$$\frac{CD}{GH} = \frac{4\text{ m}}{2\text{ m}} = 2$$

$$\frac{DE}{HI} = \frac{2\text{ m}}{1\text{ m}} = 2$$

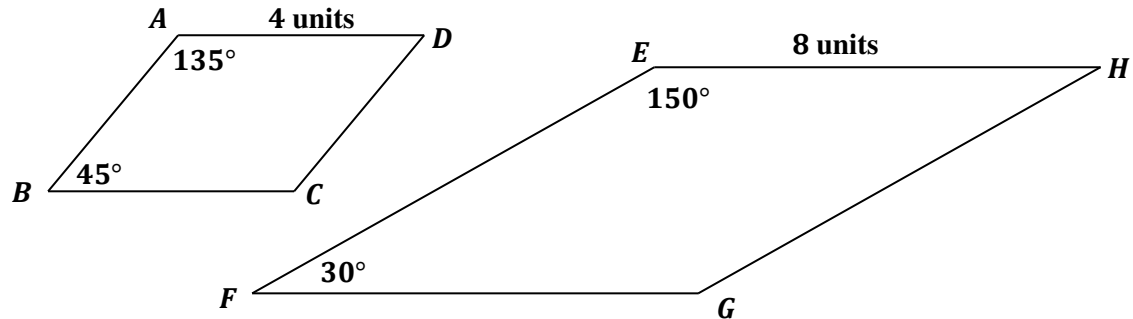
$$\frac{BE}{FI} = \frac{5\text{ m}}{2.5\text{ m}} = 2$$

$\therefore$ The corresponding angles are equal and corresponding sides are in the same proportion.

2. Explain why the following pairs of rhombuses are not similar:

Rhombuses ABCD and EFGH

Level 4



$$\hat{E} = 150^\circ$$

$$\hat{A} = 135^\circ$$

$$\hat{E} \neq \hat{A}$$

$$\hat{F} = 30^\circ$$

$$\hat{B} = 45^\circ$$

$$\hat{F} \neq \hat{B}$$

$$\hat{G} = 150^\circ$$

$$\hat{C} = 135^\circ$$

$$\hat{G} \neq \hat{C}$$

$$\hat{H} = 30^\circ$$

$$\hat{D} = 45^\circ$$

$$\hat{H} \neq \hat{D}$$

$$\frac{EF}{AB} = \frac{8 \text{ cm}}{4 \text{ cm}} = 2$$

$$\frac{FG}{BC} = \frac{8 \text{ cm}}{4 \text{ cm}} = 2$$

$$\frac{GH}{CD} = \frac{8 \text{ cm}}{4 \text{ cm}} = 2$$

$$\frac{EH}{AD} = \frac{8 \text{ cm}}{4 \text{ cm}} = 2$$

or

$$\frac{AB}{EF} = \frac{4 \text{ cm}}{8 \text{ cm}} = \frac{1}{2}$$

$$\frac{BC}{FG} = \frac{4 \text{ cm}}{8 \text{ cm}} = \frac{1}{2}$$

$$\frac{CD}{GH} = \frac{4 \text{ cm}}{8 \text{ cm}} = \frac{1}{2}$$

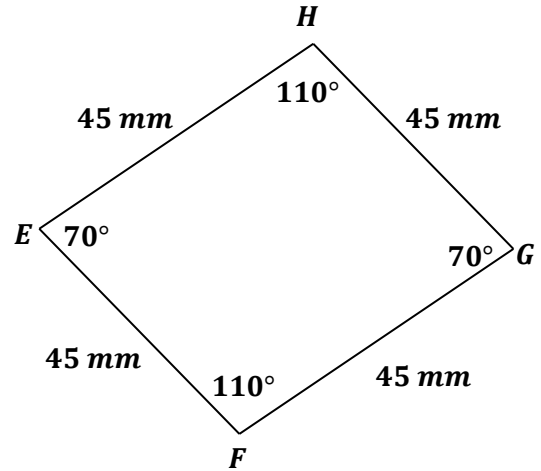
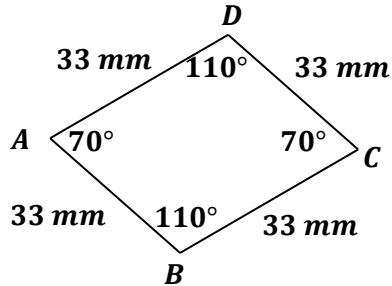
$$\frac{AD}{EH} = \frac{4 \text{ cm}}{8 \text{ cm}} = \frac{1}{2}$$

- The corresponding angles are not equal.
- The ratios of the corresponding sides are equal.
- Polygon EFGH is not an enlargement of polygon ABCD.
- Therefore the two polygons are not similar.

HOMEWORK 14**DATE:**

1. Show with reasons why the following polygons are similar.

1.1



$$\hat{E} = \hat{A} = 70^\circ$$

$$\hat{F} = \hat{B} = 110^\circ$$

$$\hat{G} = \hat{C} = 70^\circ$$

$$\hat{H} = \hat{D} = 110^\circ$$

$$\frac{AB}{EF} = \frac{33 \text{ mm}}{45 \text{ mm}} = \frac{11}{15}$$

$$\frac{BC}{FG} = \frac{33 \text{ mm}}{45 \text{ mm}} = \frac{11}{15}$$

$$\frac{CD}{GH} = \frac{33 \text{ mm}}{45 \text{ mm}} = \frac{11}{15}$$

$$\frac{AD}{EH} = \frac{33 \text{ mm}}{45 \text{ mm}} = \frac{11}{15}$$

or

$$\frac{EF}{AB} = \frac{45 \text{ mm}}{33 \text{ mm}} = \frac{15}{11}$$

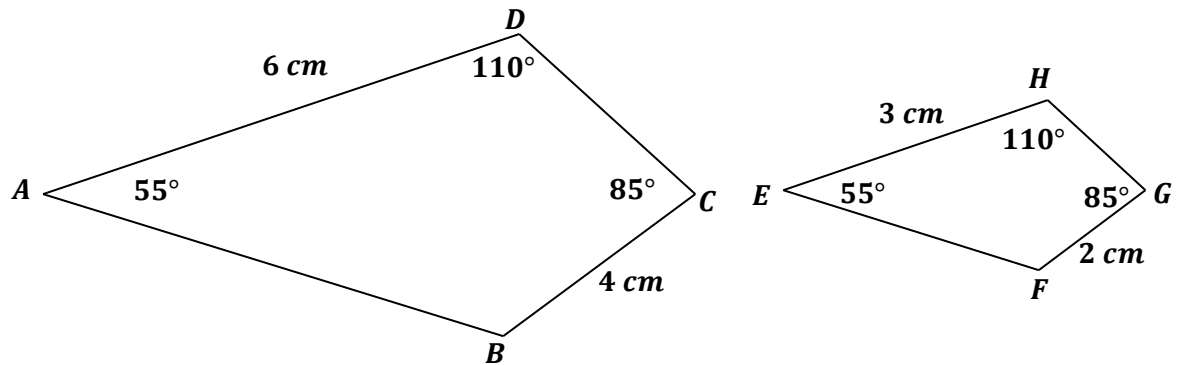
$$\frac{FG}{BC} = \frac{45 \text{ mm}}{33 \text{ mm}} = \frac{15}{11}$$

$$\frac{GH}{CD} = \frac{45 \text{ mm}}{33 \text{ mm}} = \frac{15}{11}$$

$$\frac{EH}{AD} = \frac{45 \text{ mm}}{33 \text{ mm}} = \frac{15}{11}$$

$\therefore$ The corresponding angles are equal and corresponding sides are in the same proportion.

1.2



$$\hat{E} = \hat{A} = 55^\circ$$

$$\hat{F} = \hat{B}$$

$$\hat{G} = \hat{C} = 85^\circ$$

$$\hat{H} = \hat{D} = 110^\circ$$

$$\frac{EF}{AB} = \frac{3 \text{ cm}}{6 \text{ cm}} = \frac{1}{2}$$

$$\frac{FG}{BC} = \frac{2 \text{ cm}}{4 \text{ cm}} = \frac{1}{2}$$

$$\frac{GH}{CD} = \frac{2 \text{ cm}}{4 \text{ cm}} = \frac{1}{2}$$

$$\frac{EH}{AD} = \frac{3 \text{ cm}}{6 \text{ cm}} = \frac{1}{2}$$

or

$$\frac{AB}{EF} = \frac{6 \text{ cm}}{3 \text{ cm}} = 2$$

$$\frac{BC}{FG} = \frac{4 \text{ cm}}{2 \text{ cm}} = 2$$

$$\frac{CD}{GH} = \frac{4 \text{ cm}}{2 \text{ cm}} = 2$$

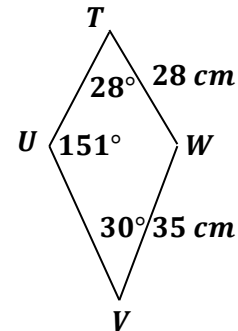
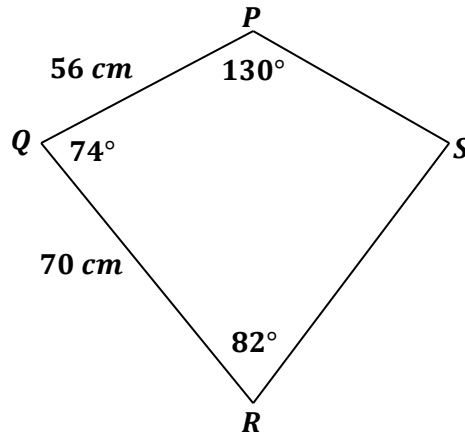
$$\frac{AD}{EH} = \frac{6 \text{ cm}}{3 \text{ cm}} = 2$$

∴ The corresponding angles are equal and corresponding sides are in the same proportion.

2. Explain why the following pairs of polygons are not similar:

2.1 Kites PQRS and TUVW

Level 4



$$\hat{T} = 130^\circ$$

$$\hat{P} = 135^\circ$$

$$\hat{T} \neq \hat{P}$$

$$\hat{U} = 30^\circ$$

$$\hat{Q} = 45^\circ$$

$$\hat{U} \neq \hat{Q}$$

$$\hat{V} = 150^\circ$$

$$\hat{R} = 135^\circ$$

$$\hat{V} \neq \hat{R}$$

$$\hat{W} = 30^\circ$$

$$\hat{S} = 45^\circ$$

$$\hat{W} \neq \hat{S}$$

$$\frac{TU}{PQ} = \frac{28 \text{ cm}}{56 \text{ cm}} = \frac{1}{2}$$

$$\frac{UV}{QR} = \frac{35 \text{ cm}}{70 \text{ cm}} = \frac{1}{2}$$

$$\frac{VW}{RS} = \frac{35 \text{ cm}}{70 \text{ cm}} = \frac{1}{2}$$

$$\frac{TW}{PS} = \frac{28 \text{ cm}}{56 \text{ cm}} = \frac{1}{2}$$

or

$$\frac{PQ}{TU} = \frac{56 \text{ cm}}{28 \text{ cm}} = 2$$

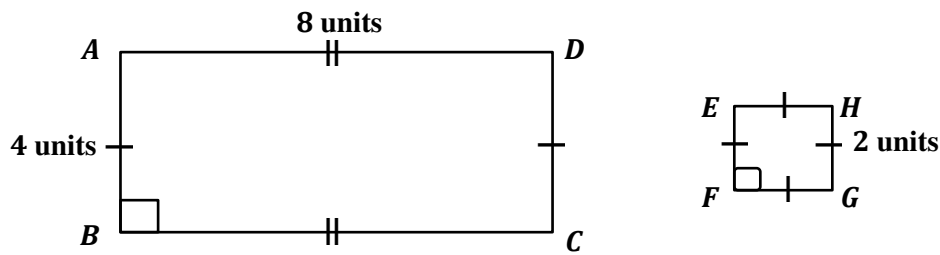
$$\frac{QR}{UV} = \frac{70 \text{ cm}}{35 \text{ cm}} = 2$$

$$\frac{RS}{VW} = \frac{70 \text{ cm}}{35 \text{ cm}} = 2$$

$$\frac{PS}{TW} = \frac{56 \text{ cm}}{28 \text{ cm}} = 2$$

- The corresponding angles are not equal.
- The ratios of the corresponding sides are equal.
- Polygon TUVW is not a reduction of polygon PQRS.
- Therefore the two polygons are not similar.

2.2 Rectangle ABCD and square



$$\hat{E} = \hat{A} = 90^\circ$$

$$\hat{F} = \hat{B} = 90^\circ$$

$$\hat{G} = \hat{C} = 90^\circ$$

$$\hat{H} = \hat{D} = 90^\circ$$

$$\frac{EF}{AB} = \frac{2 \text{ cm}}{4 \text{ cm}} = \frac{1}{2}$$

$$\frac{FG}{BC} = \frac{2 \text{ cm}}{8 \text{ cm}} = \frac{1}{4}$$

$$\frac{GH}{CD} = \frac{2 \text{ cm}}{4 \text{ cm}} = \frac{1}{2}$$

$$\frac{EH}{AD} = \frac{2 \text{ cm}}{8 \text{ cm}} = \frac{1}{4}$$

or

$$\frac{AB}{EF} = \frac{4 \text{ cm}}{2 \text{ cm}} = 2$$

$$\frac{BC}{FG} = \frac{8 \text{ cm}}{2 \text{ cm}} = 4$$

$$\frac{CD}{GH} = \frac{4 \text{ cm}}{2 \text{ cm}} = 2$$

$$\frac{AD}{EH} = \frac{8 \text{ cm}}{2 \text{ cm}} = 4$$

- The corresponding angles are equal.
- The ratios of the corresponding sides are not all the same.
- Polygon EFGH is not a reduction of polygon ABCD.
- ABCD is a square and EFGH is a rectangle.
- Therefore the two polygons are not similar.