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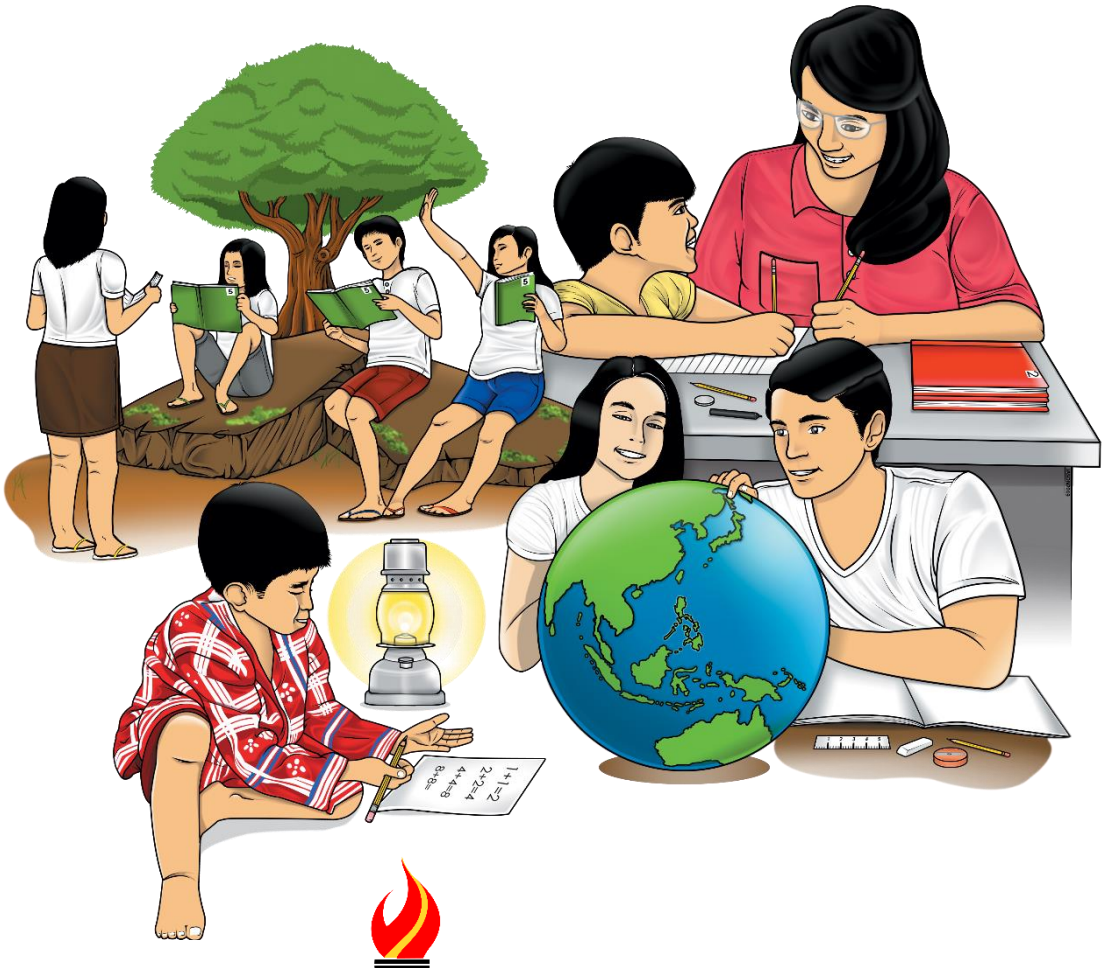
Mathematics

Quarter 3 – Module 7:
Trapezoids and Kite



ALTERNATIVE DELIVERY MODE
ADM

Mathematics – Grade 9
Alternative Delivery Mode
Quarter 3 – Module 8: Trapezoids and Kite
First Edition, 2020

Published by the Department of Education
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Undersecretary: Diosdado M. San Antonio

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Printed in the Philippines by _____

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Mathematics

Quarter 3 – Module 7:
Trapezoids and Kite

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

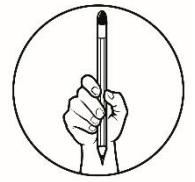
Thank you.

What I Need to Know

LEARNING COMPETENCY

The learners will be able to:

- Prove theorems on Trapezoid and kite
- Solve problems involving Trapezoid and kite (**M9GE – IIId – 2)**



What I Know

Let see how much knowledge you have about the module. Answer and write the letter that you think is the best answer to each question on a sheet of paper. Answer all items.

1. A trapezoid have _____ sides.
   a.) 2 b.) 3 c.) 4 d.) 5

2. The mid-segment of a trapezoid connects the midpoints of the _____.
   a.) bases b.) legs c.) leg and base d.) base and leg

3. The two parallel sides of a trapezoid are called _____?
   a.) legs b.) bases c.) altitudes d.) sides

4. Which of the following is **NOT** considered a type of trapezoid?
   a.) scalene trapezoid c.) right trapezoid
   b.) obtuse trapezoid d.) isosceles trapezoid

5. Find the median of a trapezoid with bases of lengths 9 cm and 7 cm.
   a.) 8 cm b.) 9 cm c.) 10 cm d.) 11 cm

6. Which of the following has congruent diagonals?
   a.) Scalene trapezoid c.) Kite
   b.) Right Trapezoid d.) Isosceles trapezoid

7. Which of the following quadrilaterals has diagonals that do not bisect each other.

a.) Rhombus
b.) Square
c.) Isosceles Trapezoid
d.) Rectangle

8. Which of the following statements is **TRUE**?

a.) A trapezoid has four congruent sides.
b.) A trapezoid can have three right angles.
c.) Base angles of an isosceles trapezoid are congruent.
d.) The diagonals of an isosceles trapezoid bisect each other.

9. An isosceles trapezoid shares some common properties with which triangle?

a.) Equilateral triangle
b.) Isosceles triangle
c.) Acute triangle
d.) Obtuse triangle

10. Which of the following statements about isosceles trapezoid is **TRUE**?

a.) Opposite angles are complementary.
b.) Opposite angles are congruent.
c.) Diagonals are congruent.
d.) All sides are congruent.

Lesson 1

TRAPEZOIDS AND KITE

In the previous topic, you have learned about midline theorem. You were able to write the proof for midline theorem and solve problems involving midline theorem. This module will help you understand more on trapezoid and kite.

What's In

Activity No. 1: Hide and Seek

Look around the corner and give or create an example of a trapezoid, and a kite that can be seen inside your house; using a ruler and protractor, measure its sides and angles and draw to show that it is a trapezoid, and a kite.

Example:

What's New

Activity 2

"Mathematical Investigation"

In this activity, the students will think, explore, and give the definition based on the given figure.

Figure # 1

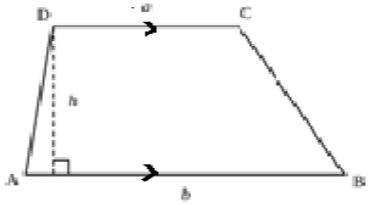
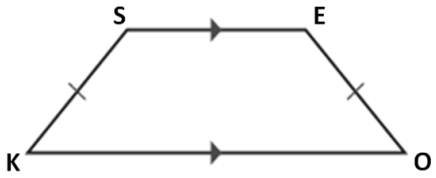


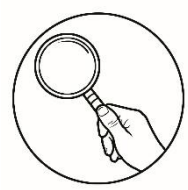
Figure # 2



Guide questions (Verify your answers using the markings on the figures).

1. In figure #1, which sides are the bases? Why do we say that these sides are the bases?
2. In figure #1, which sides are the legs? Why do we say that these sides are the legs?
3. In figure #2, which sides are the bases? Why do we say that these sides are the bases?
4. In figure #2, which sides are the legs? Why do we say that these sides are the legs?

What do you notice from figure 1 and figure 2?

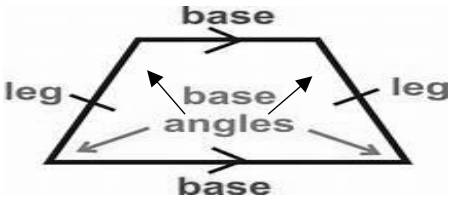


What is It

1. Trapezoid is a quadrilateral with exactly one pair of parallel sides.

The parallel sides are called **bases.**

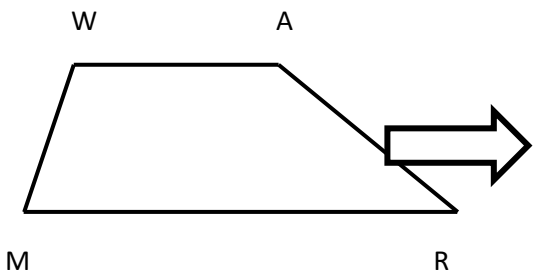
The non-parallel sides are called **legs.**



The **base angles** of a trapezoid are consecutive angles whose common side is a base of the trapezoid.

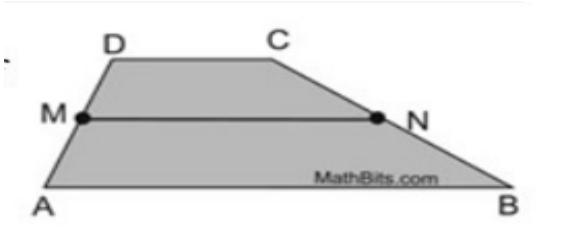
Trapezoids have two pairs of base angles.

Example



Legs→ $\overline{WM}$ and $\overline{AR}$
Bases→ $\overline{WA}$ and $\overline{MR}$
Lower Base Angles:
∠WMR and ∠ARM
Upper Base Angles:
∠MWA and ∠RAW

The **median of a trapezoid** is a segment joining the midpoints of the legs of the trapezoid.



Theorem

The median of a trapezoid is parallel to the bases and the length of which is equal to half the sum of the lengths of the bases.

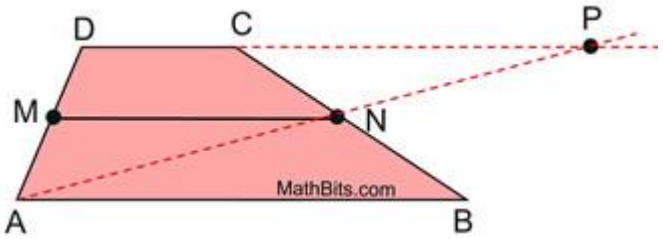
In trapezoid ABCD, $\overline{MN}$ is the median. Length of the median = ½ (length of the upper base + length of the lower base)

Given: Trapezoid ABCD

Median $\overline{MN}$

Prove: $\overline{MN} \parallel \overline{AB}$; $\overline{MN} \parallel \overline{CD}$, and

$$|MN| = \frac{|DC|+|AB|}{2}$$



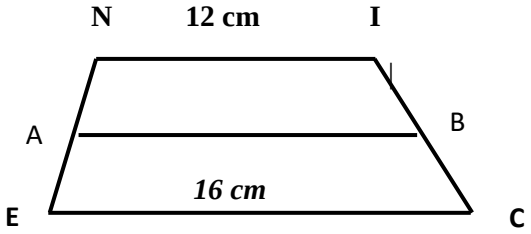
Proof:

	Statements		Reasons
1.	*Trapezoid ABCD* $\overline{MN}$ is the median	1.	Given
2.	Draw $\overline{AN}$, extending until it intersects with the extension of $\overline{DC}$, at *P*.	2.	Two points determine exactly one line.
3.	*N is the* midpoint of $\overline{BC}$. *M* is the midpoint of $\overline{AD}$.	3.	A median of a trapezoid joins the midpoints of the legs.
4.	$\overline{BN} \cong \overline{NC}$.	4.	Midpoint of a segment divides the segment into two congruent segments.
5.	$\overline{AB} \parallel \overline{DC}$.	5.	Bases of a trapezoid are parallel.
6.	$\angle ABN \cong \angle PCN$	6.	If 2 $\parallel$ lines are cut by a transversal, then the alternate interior ∠s are congruent.
7.	$\angle ANB \cong \angle PNC$	7.	Vertical ∠s are congruent.
8.	$\Delta ABN \cong \Delta PCN$	8.	ASA postulate: If 2 ∠s and the included side of one Δ are congruent to the corresponding parts of another Δ, then the Δs are congruent.
9.	$\overline{AN} \cong \overline{NP}$; $\overline{AB} \cong \overline{CP}$	9.	CPCTC-corresponding parts congruent Δs are congruent.
10.	*N* is midpoint of $\overline{AP}$.	10.	Midpoint of a segment divides the segment into two congruent segments.
11.	$\overline{MN}$ is the mid-segment of ΔADP.	11.	Mid-segment of a Δ joins the midpoints of two sides of the Δ.
12.	$\overline{MN} \parallel \overline{DP}$ $(\overline{DC})$*	12.	Mid-segment of Δ is parallel to the third side of the Δ.
13.	$\overline{MN} \parallel \overline{AB}$	13.	If 2 lines are $\parallel$ to the same line, then they are $\parallel$ to each other.
14.	$\lvert MN \rvert$ = ½ $\lvert DP \rvert$ *or*	14.	The length of the mid-segment of a Δ is

	$(2\|MN\| = \|DP\|)$		one-half of the length of the third side.
15.	$\|DP\| = \|CP\| + \|DC\|$	15.	Segment Addition Postulate
16.	$\|AB\| = \|CP\|$	16.	Congruent segments have equal length (#9).
17.	$\|DP\| = \|AB\| + \|DC\|$	17.	Substitution
18.	$2\|MN\| = \|AB\| + \|DC\|$	18.	Substitution
19.	$\|MN\| = \frac{\|DC\|+\|AB\|}{2}$	19.	Division

https://mathbitsnotebook.com/Geometry/Quadrilaterals/QDTrapKite.html#

Example: Given trapezoid NICE below, find |AB|.



$|AB| = ½ (|NI| + |EC|)$

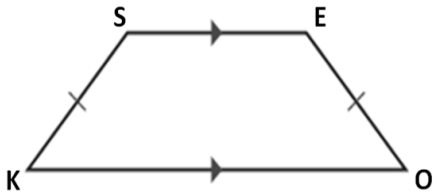
$|AB| = ½ (12 + 16)$

$|AB| = ½ (28)$

$|AB| = 14$ cm

1.1 An isosceles trapezoid is a trapezoid whose nonparallel sides are congruent.

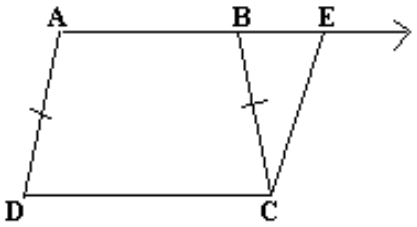
If the legs of a trapezoid are congruent, then the trapezoid is an isosceles trapezoid.



Property	Illustration/Example
1. The bases are parallel.	$\overline{SE} // \overline{KO}$
2. The legs are congruent.	$\overline{SK} \cong \overline{EO}$

Theorem

If a trapezoid is isosceles, then each pair of base angles are congruent.



Given: □ABCD is an isosceles trapezoid. $\overline{AD} \cong \overline{BC}$ and $\overline{AB} \parallel \overline{CD}$.

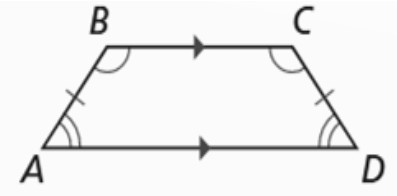
Prove that: ∠C ≅ ∠D and ∠A ≅ ∠B

Proof:

Statements	Reasons
1) □ABCD is a trapezoid.	1) Given
2) $\overline{AB} \parallel \overline{CD}$	2) Given
3) $\overline{AD} \cong \overline{BC}$	3) Given
4) $\overline{AD} \parallel \overline{CE}$	4) By construction
5) □ADCE is a parallelogram.	5) By Properties of parallelogram.
6) $\overline{DA} \cong \overline{CE}$ and $\overline{DC} \cong \overline{AE}$	6) By properties of parallelogram.
7) $\overline{CE} \cong \overline{BC}$	7) $\overline{AD} \cong \overline{BC}$ and $\overline{AD} \cong \overline{CE}$ (Transitive property)
8) ∠CEB ≅ ∠CBE	8) If $\overline{CE} \cong \overline{BC}$ then angles opposite to them are congruent.
9) ∠DAB ≅ ∠ABC	9) Property of parallelogram and linear pair angles
10) m∠A + m∠D = 180^0 and m∠B + m∠C = 180^0	10) Interior angles on the same side of the transversal are supplementary.
11) m∠A + m∠D = m∠C + m∠B	11) Transitivity (Right sides are same so left sides are equal).
12) ∠D ≅ ∠C	12) From #9 above (∠A ≅ ∠B)

https://www.ask-math.com/trapezoid-and-its-theorems.html

Property	Illustration/Example
3. The lower base angles of an isosceles trapezoid are congruent.	∠BAD ≅ ∠CDA
4. The upper base angles of an isosceles trapezoid are congruent.	∠ABC ≅ ∠DCB



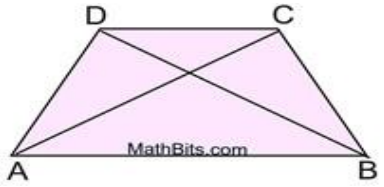
Theorem

If a quadrilateral is an isosceles trapezoid, then the diagonals are congruent.

If a quadrilateral is an isosceles trapezoid, then the diagonals are congruent.

Given: Isosceles Trapezoid ABCD

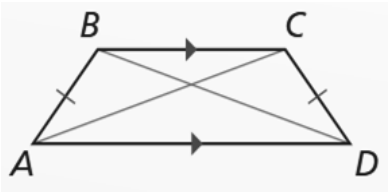
Prove: $\overline{AC} \cong \overline{BD}$



	Statements		Reasons
1.	Isosceles Trapezoid ABCD	1.	Given
2.	$\angle DAB \cong \angle CBA$	2.	Base angles of an isosceles trapezoid are congruent.
3.	$\overline{AB} \parallel \overline{CD}$	3.	Bases of a trapezoid are parallel.
4.	$\overline{AD} \cong \overline{BC}$	4.	An isos. trap. has congruent legs.
5.	$\overline{AB} \cong \overline{AB}$	5.	Reflexive property.
6.	ΔDAB ≅ ΔCBA	6.	SAS postulate: If 2 sides and the included ∠ of one Δ are congruent to the corresponding parts of another Δ, then the Δs are congruent.
7.	$\overline{AC} \cong \overline{BD}$	7.	CPCTC: Corresponding parts of congruent Δs are congruent

https://mathbitsnotebook.com/Geometry/Quadrilaterals/THIsos2Pf.html

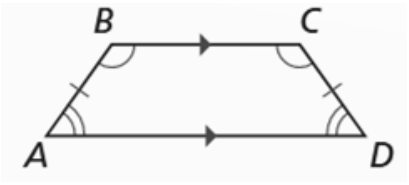
Property	Illustration/Example
5. The diagonals of an isosceles trapezoid are congruent.	$\overline{BD} \cong \overline{CA}$



Theorem

If a quadrilateral is an isosceles trapezoid, then the opposite angles are supplementary.

If a quadrilateral is an isosceles trapezoid, then the opposite angles are supplementary.



Given: Isosceles Trapezoid ABCD

Prove: ∠A and ∠C are supplementary

and

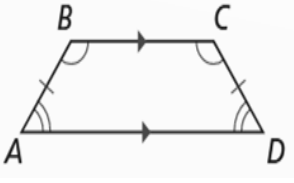
∠B and ∠D are supplementary.

Proof:

	Statements		Reasons
1.	Isosceles trapezoid *ABCD*	1.	Given
2.	$\angle D \cong \angle A$ $\angle B \cong \angle C$	2.	Base angles of an isosceles trapezoid are congruent.
3.	$\overline{AD} \parallel \overline{BC}$	3.	Bases of a trapezoid are parallel.
4.	$\angle D$ and $\angle C$ are supplementary, and $\angle A$ and $\angle B$ are supplementary.	4.	If 2 $\parallel$ lines are cut by a transversal, the interior ∠s on the same side of transversal are supplementary.
5.	$\angle A$ and $\angle C$ are supplementary, and $\angle D$ and $\angle B$ are supplementary.	5.	Substitution

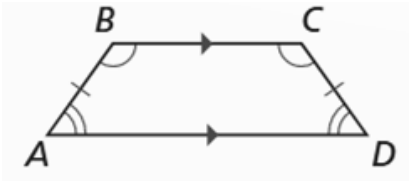
https://mathbitsnotebook.com/Geometry/Quadrilaterals/THIsos3Pf.html

Property	Illustration/Example
6. The opposite angles of an isosceles trapezoid are supplementary.	$\angle A$ and $\angle C$ are supplementary, and $\angle D$ and $\angle B$ are supplementary.
7. Any lower base angle of an isosceles trapezoid is supplementary to any upper base angle.	$m\angle A + m\angle B = 180^0$ $m\angle D + m\angle C = 180^0$ $m\angle A + m\angle C = 180^0$ $m\angle D + m\angle B = 180^0$



Let us apply the different properties of the trapezoid in solving the following exercises.

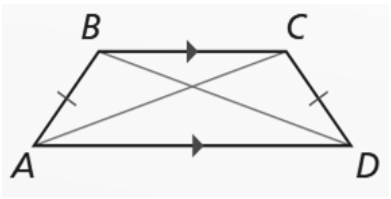
Example 1: In the figure below, □ABCD is an isosceles trapezoid. Find the measure of angle C if m∠D = 70^0.



Solution: In an isosceles trapezoid, any lower base angle is supplementary to any upper base angle. Thus,

$$m\angle C + m\angle D = 180^0$$
$$m\angle C + 70^0 = 180^0$$
$$m\angle C = 180^0 - 70^0$$
$$m\angle C = 110^0$$

Example 2: In the figure below, □ABCD is an isosceles trapezoid. Find the length of $\overline{AC}$ if |BD| = 9 cm.

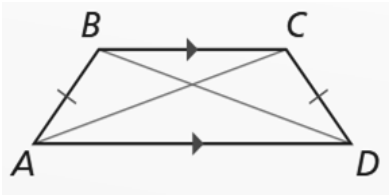


Solution: The diagonals of an isosceles trapezoid are congruent, $\overline{AC} \cong \overline{BD}$.

Thus, |AC| = |BD|

|AC| = 9 cm

Example 3: In the figure below, □ABCD is an isosceles trapezoid. Find the value of x if length of $\overline{AC}$ if |AC| = 5x - 30 cm ad |BD|= 60 cm.

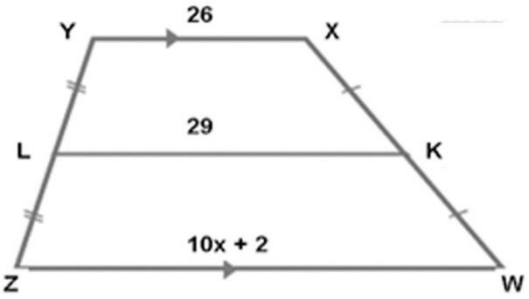


Solution: The diagonals of an isosceles trapezoid are congruent, $\overline{AC} \cong \overline{BD}$.

Thus, |AC| = |BD|

$$5x - 30 = 60$$
$$5x = 60 + 30$$
$$5x = 90$$
$$x = 18$$

Example 4: In the figure below, □YXWZ is a trapezoid. Find the length of $\overline{ZW}$.



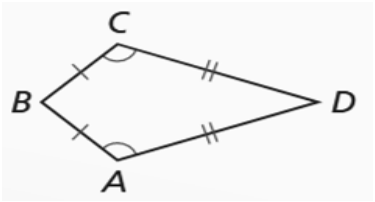
Solution: The median (midsegment) of a trapezoid measures one-half the sum of the lengths of the bases.

Therefore,

$$|LK| = ½(|YX| + |ZW|)$$
$$29 = ½(26 + 10x + 2)$$
$$29 = ½(10x + 28)$$
$$29 = 5x + 14$$
$$29 - 14 = 5x$$
$$15 = 5x$$
$$3 = x \text{ ; then}$$
$$|ZW| = 10x + 2$$
$$|ZW| = 10(3) + 2$$
$$|ZW| = 32 \text{ units}$$

2. A kite is a quadrilateral with two distinct pairs of consecutive sides that are congruent.

In contrast to parallelograms where opposite sides are congruent, in a kite the congruent sides are consecutive.



In the figure at the left, □ABCD is a kite.

$$\overline{AB} \cong \overline{BC} \quad , \quad \overline{CD} \cong \overline{AD}$$

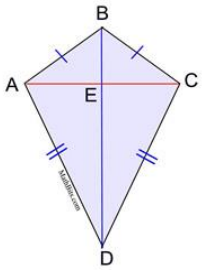
Theorem

If a quadrilateral is a kite, then the diagonals are perpendicular.

If a quadrilateral is a kite, its diagonals are perpendicular.

Given: Kite ABCD

Prove: $\overline{BD} \perp \overline{AC}$



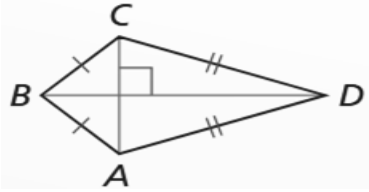
Proof:

	Statements		Reasons
1.	□ABCD is a kite	1.	Given
2.	$\overline{AB} \cong \overline{BC}$ and $\overline{CD} \cong \overline{DA}$	2.	A kite has 2 distinct pairs of congruent consecutive sides.
3.	$\overline{BD} \cong \overline{BD}$ and $\overline{BE} \cong \overline{BE}$	3.	Reflexive property.
4.	ΔBAD ≅ ΔBCD	4.	SSS: If 3 sides of one Δ are congruent to the corresponding parts of another Δ, then the Δs are congruent.
5.	$\angle ABD \cong \angle CBD$	5.	CPCTC: Corresponding parts of congruent Δs are congruent.
6.	ΔBAE ≅ ΔBCE	6.	SAS: If 2 sides and the included ∠ of one Δ are congruent to the corresponding parts of another Δ, then the Δs are congruent.
7.	$\angle BEA \cong \angle BEC$.	7.	CPCTC: Corresponding parts of congruent Δs are congruent.
8.	$\angle BEA$ and $\angle BEC$ are supplementary.	8.	Angles forming a linear pair are supplementary.
9.	$m\angle BEA + m\angle BEC = 180°$.	9.	The sum of the measures of two supplementary ∠s is 180°.

10.	$m\angle BEA = m\angle BEC$	10.	Congruent ∠s have equal measures.
11.	$m\angle BEA + m\angle BEA = 180°$.	11.	Substitution
12.	$2m\angle BEA = 180°$.	12.	Add (or combine like terms).
13.	$m\angle BEA = 90°$.	13.	Division
14.	$\angle BEA$ is a right angle.	14.	A right ∠ has a measure of 90°.
15.	$\overline{BD} \perp \overline{AC}$	15.	Perpendicular lines form right angles.

https://mathbitsnotebook.com/Geometry/Quadrilaterals/ThKite2Pf.html

Property	Illustration/Example
1. Diagonals of a kite are perpendicular.	$\overline{CA} \perp \overline{BD}$



Theorem

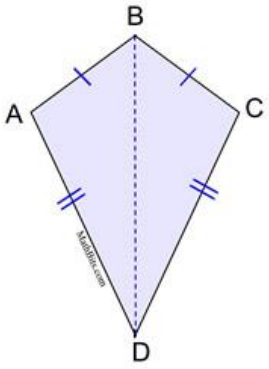
If a quadrilateral is a kite, then it has one pair of opposite congruent angles.

If a quadrilateral is a kite, it has one pair of opposite angles congruent.

Given: Kite ABCD

Prove: ∠A ≅ ∠C

$\angle B \cong \angle D$

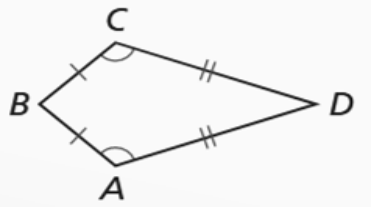


Proof:

	Statements		Reasons
1.	Kite ABCD	1.	Given
2.	Draw $\overline{BD}$.	2.	Two points determine exactly one line.
3.	$\overline{AB} \cong \overline{BC}$ and $\overline{CD} \cong \overline{DA}$	3.	A kite has 2 distinct pairs of congruent consecutive sides.
4.	$\overline{BD} \cong \overline{BD}$	4.	Reflexive property.
5.	ΔBAD ≅ ΔBCD	5.	SSS: If 3 sides of one Δ are congruent to the corresponding parts of another Δ, then the Δs are congruent.
6.	∠A ≅ ∠C	6.	CPCTC: Corresponding parts of congruent Δs are congruent.
7.	Assume $\angle B \cong \angle D$.	7.	Assumption leading to a contradiction.
8.	$\square ABCD$ is parallelogram	8.	If a quadrilateral has 2 pairs of opposite congruent ∠s, then it is a parallelogram.
9.	$\angle B \ncong \angle D$	9.	Contradiction steps 9 and 1. (A kite is not a parallelogram.)

https://mathbitsnotebook.com/Geometry/Quadrilaterals/ThKite1Pf.html

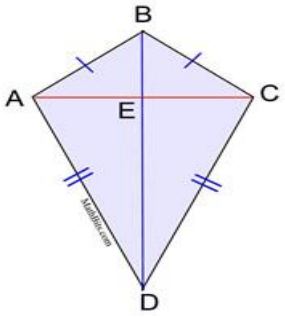
Property	Illustration/Example
2. Kite has exactly one pair of opposite congruent angles.	∠BCD ≅ ∠BAD



Theorem

If a quadrilateral is a kite, it has one diagonal that bisects the other diagonal.

If a quadrilateral is a kite, it has one diagonal that bisects the other diagonal.



Given: Kite ABCD

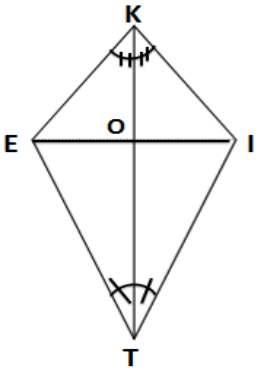
Prove: Diagonal $\overline{BD}$ bisects diagonal $\overline{AC}$.

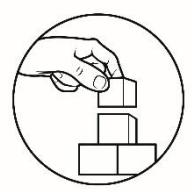
	Statements		Reasons
1.	Kite *ABCD*	1.	Given
2.	$\overline{AB} \cong \overline{BC}$ and $\overline{CD} \cong \overline{DA}$	2.	A kite has 2 distinct pairs of congruent consecutive sides.
3.	$\overline{BD} \cong \overline{BD}$ and $\overline{BE} \cong \overline{BE}$	3.	Reflexive property.
4.	ΔBAD ≅ ΔBCD	4.	SSS: If 3 sides of one Δ are congruent to the corresponding parts of another Δ, then the Δs are congruent.
5.	$\angle ABD \cong \angle CBD$	5.	CPCTC: Corresponding parts of congruent Δs are congruent.
6.	ΔBAE ≅ ΔBCE	6.	SAS: If 2 sides and the included ∠ of one Δ are congruent to the corresponding parts of another Δ, then the Δs are congruent.
7.	$\overline{AE} \cong \overline{EC}$	7.	CPCTC: Corresponding parts of congruent Δs are congruent.
8.	Diagonal $\overline{BD}$ bisects diagonal $\overline{AC}$.	8.	A segment bisector forms two congruent segments.

There is only ONE diagonal that bisects the other. Diagonal $\overline{AC}$ does not bisect diagonal $\overline{BD}$. Since $\overline{AB}$ is not congruent to $\overline{AD}$ and $\overline{BC}$ is not congruent to $\overline{CD}$ by the definition of a kite, then $\overline{BE}$ and $\overline{ED}$ cannot be sides of two congruent triangle.

https://mathbitsnotebook.com/Geometry/Quadrilaterals/ThKite6Pf.html

Property	Illustration/Example
3. Kite has only one diagonal that bisects the other diagonal.	Diagonal $\overline{KT}$ bisects diagonal $\overline{IE}$. *This means* $\overline{EO} \cong \overline{IO}$.
4. Kite has a diagonal that bisects each of the noncongruent angles.	Diagonal $\overline{KT}$ bisects ∠EKI and ∠ETI. This means ∠KTI ≅ ∠KTE and ∠IKT ≅ ∠EKT





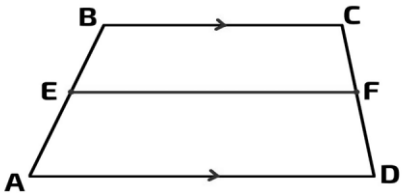
What's More

TEST YOURSELF!

Activity 3:

Given is Trapezoid ABCD at the right.
Identify the following.

1. Legs
2. Bases
3. Lower base angles
4. Upper base angles
5. Median

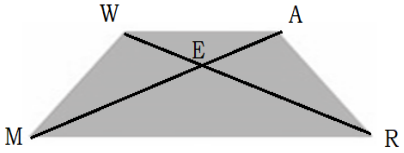


Using the same figure.

6. If |BA| = 10 cm, then |BE| = _____ and |AE| = _____.
7. If |CF| = 7.5 cm, then |DF| = _____ and |CD| = _____.
8. If |BC| = 20 cm and |AD| = 30 cm, then |EF| = _____.
9. If |BC| = 12 cm and |EF| = 18 cm, then |AD| = _____.
10. If |BC| = 23 cm, |EF| = 29 cm, and |AD| = 11x + 2, then x = _____, and |AD| = _____.

Activity 4:

A. Given is Isosceles Trapezoid WARM with diagonals WR and AM that intersect at E.
|WM| = 17 cm, |WR| = 21 cm, |AE| = 6 cm and m∠WMR = 52º.



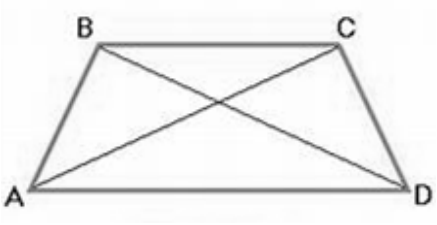
Find the following:

1. |AR|
2. |AM|
3. |EM|
4. |WE|
5. |ER|
6. m∠ARM
7. m∠MWA
8. m∠WAR
9. m∠WMR + m∠WAR
10. m∠WMR + m∠ARM

B. Given at the right is Isosceles Trapezoid ABCD.

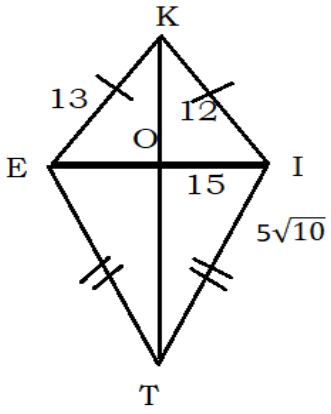
|BD| = 7x and |CA| = 2x + 5 cm. Find

11. the value of x
12. |BD|
13. |CA|



Given: □**KITE** is a kite. Point O is the intersection of diagonals KT and EI. Find the following:

1. m∠KOI
2. |KO|
3. |OI|
4. |EI|
5. |KI|
6. |ET|
7. Area of the kite



If m∠KET = 110^0, m∠ETI = 50^0, m∠EKT = 45^0, then

8. m∠IEK = _____.
9. m∠TKI = _____.
10. m∠EKI = _____.
11. m∠EIK = _____.
12. m∠ITK = _____.
13. m∠KOE = _____.
14. m∠TOI = _____.
15. m∠KET + m∠EKI + m∠KIT + m∠ITE = _____.

What I Have Learned

- A **Trapezoid** is a quadrilateral with at least one pair of parallel sides.

  The parallel sides are called **bases.**

  The non-parallel sides are called **legs.**

  The **base angles** of a trapezoid are consecutive angles with a common side which is a base of the trapezoid.

- Length of the Median = ½ (length of upper base + length of lower base)

  The **median of a trapezoid** is a segment joining the midpoints of the legs.

- An **isosceles trapezoid** is a trapezoid whose non-parallel sides are congruent.

Properties of an Isosceles Trapezoid

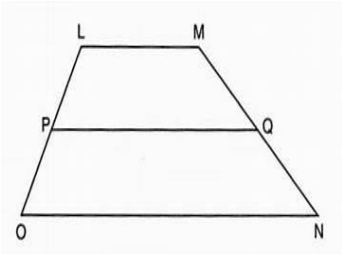
1. The bases are parallel.
2. The legs are congruent.
3. The lower base angles are congruent.
4. The upper base angles are congruent.
5. The diagonals are congruent.
6. The opposite angles are supplementary.
7. Any lower base angle is supplementary to any upper base angle.

- A **kite** is a quadrilateral with two distinct pairs of consecutive sides that are congruent.
- In contrast to parallelograms where opposite sides are congruent, in a kite the congruent sides are consecutive.

Properties of a Kite

1. Diagonals are perpendicular.
2. Has exactly one pair of opposite congruent angles.
3. Has only one diagonal that bisects the other diagonal.
4. Has a diagonal that bisects each of the noncongruent angles.
5. Area of a kite = ½ (d_1d_2)

Given: □LMNO is a trapezoid with $\overline{PQ}$ as the median. Answer each of the following items.



1. If |PQ| = 20 cm, |LM| = x + 3 cm and |ON| = x + 6 cm, what is the value of x?
2. If |LM| = x – 2 cm, |ON| = x + 4 cm and |PQ| = 24 cm, what is the value of x?
3. If |PQ| = 24 cm, |LM| = x + 4 cm and |ON| = x + 8 cm, what is |LM|?
4. If |PQ| = 24 cm, |LM| = x – 3 cm and |ON| = x + 7 cm, what is |ON|?
5. If |LM| = 12 cm, |PQ| = x + 3 cm and |ON| = x + 10 cm, what is the value of x?
6. If |LM| = 18 cm, |PQ| = x – 2 cm and |ON| = x + 3 cm, what is the value of x?
7. If |ON| = 30 cm, |PQ| = x + 1 cm and |LM| = x – 6 cm, what is |PQ|?
8. If |ON| = 34 cm, |PQ| = x – 1 cm and |LM| = x – 7 cm, what is |LM|?
9. If |LM| = 2x, |PQ| = 3x and |ON| = 2(x+5), what is |PQ|?
10. If |LM| = 2x + 2 cm, |PQ| = 3x + 3 cm and |ON| = 2(x+6), what is |LM|?

Assessment

Read and answer each of the following questions accurately. Write the letter of the correct answer on your answer sheet.

1. To find the length of the mid-segment of a trapezoid, add the lengths of the _____ and divide by two.
   a.) legs b.) sides c.) bases d.) diagonals
2. The trapezoid has how many sides that are parallel to each other.
   a.) 1 b.) 2 c.) 3 d.) 4
3. Which of the following statements describes a trapezoid?
   a.) A quadrilateral that has two parallel sides and two non-parallel congruent sides.
   b.) A quadrilateral that has one pair of parallel sides.
   c.) A quadrilateral that has no parallel sides.
   d.) It is any quadrilateral.
4. Which of the following is true about isosceles trapezoids?
   a.) Its diagonals are congruent.
   b.) Its opposite angles are congruent.
   c.) Its diagonals are perpendicular to each other.
   d.) Its area is the product of the lengths of any two adjacent sides.

5. The median of a trapezoid measures 20 cm. One of the bases measures 12 cm. Find the length of the other base.
   a.) 20 cm b.) 24 cm c.) 28 cm d.) 32 cm

6. The legs of an isosceles trapezoid are _____.
   a.) parallel c.) congruent
   b.) supplementary d.) perpendicular

7. The lengths of the diagonals of an isosceles trapezoid are represented by 4x – 47 and 2x + 31. What is the value of x?
   a.) 37 b.) 39 c.) 67 d.) 76

8. Which of the following is **not** a characteristic of an isosceles trapezoid?
   a.) A lower base angle is a supplement of an upper base angle.
   b.) Diagonals bisect each other.
   c.) Diagonals are congruent.
   d.) Legs are congruent.

9. The lower base angles of an isosceles trapezoid measure $(3y - 17^{o})$ and $(2y + 13^{o})$. What is the value of y?
   a.) 24^{o} b.) 30^{o} c.) 35^{o} d.) 50^{o}

10. Isosceles trapezoid ABCD has parallel bases AB and CD, and diagonals intersect at E. If |AE| = 10 cm, |BE| = 3x – 2 cm and |DE| = 4x + 1 cm, how long is $\overline{CE}$?
   a.) 4 cm b.) 10 cm c.) 17 cm d.) 27 cm

11. In quadrilateral ABCD, if |AB| = |BC|, |CD| = |DA| and |AB|≠|CD|, then the quadrilateral is a _____.
   a.) kite b.) rectangle c.) rhombus d.) trapezoid

12. Which quadrilateral has exactly one pair of opposite congruent angles?
   a.) Trapezoid b.) Rectangle c.) Parallelogram d.) Kite

13. The diagonals of a kite _____.
   a.) are perpendicular c.) are congruent
   b.) are parallel d.) bisect each other

14. Find the area of a kite whose diagonals measure 8 cm and 20 cm.
   a.) 35 sq. cm b.) 65 sq. cm c.) 70 sq. cm d.) 80 sq. cm

15. □ABCD is a kite. Find the perimeter if |AB| = 6 cm and |AD| = 14 cm.
   a.) 25 cm b.) 40 cm c.) 23 cm d.) 94 cm

Additional Activities

Create your own real-life problem that will lead to forming trapezoid and kite. Provide illustration of the problem and guide questions that will result to trapezoid and kite.

_____

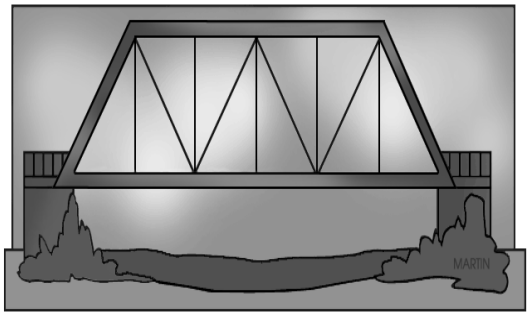
_____

_____

_____

_____

PROBLEM-BASED LEARNING WORKSHEET



Isaac is an engineer who wants to build a bridge to help the community in a remote area to transport their goods. The bridge is going to look like the figure at the left. The top of the bridge measures 70 meters and the bottom of the bridge measures 90 meters. He wants to build an extra support beam halfway between the parallel bases.

LET'S ANALYZE

1) What is the shape of the bridge? _____
2) What is the length of the
   a. top of the bridge? _____
   b. bottom of the bridge? _____.
3) If the support beam is halfway between the parallel bases, what does it represent in relation to the shape of the bridge? _____
4) What is the length of the support beam? _____

Answer Key

What I Know

1.	C
2.	B
3.	B
4.	B
5.	A
6.	D
7.	C
8.	C
9.	B
10.	C

What's More

Activity 3

1.	AB and CD
2.	BC and AD
3.	∡A and ∡D
4.	∡B and ∡ C
5.	EF
6.	5 and 5
7.	7.5 and 15
8.	25
9.	24
10.	3 and 35

Activity 4

1.	17
2.	21
3.	15
4.	6
5.	15
6.	52°
7.	128°
8.	128°
9.	180°
10.	104°
11.	x =1
12.	BD = 7
13.	CA = 7

Activity 5

1.	90°
2.	12
3.	5
4.	10
5.	13
6.	$5\sqrt{10}$
7.	135 u^2
8.	45°
9.	45°
10.	90°
11.	45°
12.	25°
13.	90°
14.	90°
15.	360°

What I Can Do Worksheet

1.	15.5
2.	23
3.	22
4.	29
5.	16
6.	25
7.	23
8.	22
9.	15
10.	10

Assessment

1.	C
2.	B
3.	B
4.	A
5.	C
6.	C
7.	B
8.	B
9.	B
10.	C
11.	A
12.	D
13.	A
14.	D
15.	B

Problem-Based Learning

1.	trapezoid	
2.	a. 70 m	b. 90 m
3.	Mid segment	
4.	80 meters	

References

Mathematics 9 Learner's Material, Department of Education

Nivera, G. C and Lapinid, M. R (©2013). *Grade 9 Mathematics: Patterns and Practicalities.* Don Bosco Press, Inc.

Dawkin, P. (©2018). *Paul's Online Math Notes*. Retrieved from: http://tutorial.math.lamar.edu/Classes/Alg/SystemsTwoVrble.aspx#Sys_Two_Ex1_a
http://depedk12manuals.blogspot.com

E-SITES

To further explore the relationships of geometric figures using measurements, and if it possible to connect the internet, you may visit the following links:

http://blowtheblowfish.wordpress.com/201
http://www.educationworld.com/lessonandactivites
http://www.teacherplanet.com/kites
http://youtube/Quadrilaterals:kites as a geometric shapes
http://youtube/Constructing a kite
http://youtube/proving quadrilateral kite
http://study.com/academy/practice/quiz-worksheet
http://study.com/learn/quadrilaterals-quizzes.html
http://proproofs.com/…/story.php?title=quadrilateral-quiz
http://www.mrpillarski.files.wordpress.com/2010/02/exam
http://www.mathworldhouse.com/sheets
http://www.calcworkshop.com.trapezoid/kite

For inquiries or feedback, please write or call:

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