雙語教學主題(國中八年級下學期教材): 平行四邊形

Topic: introducing parallelograms

Vocabulary
parallelogram, diagonal, inverse, converse,
CPCTC=corresponding parts of congruent triangles are congruent
midsegment, midpoint

We have learned a lot about triangles. Hope you are very familiar with all the theorems concerning triangles because we are going to use them again and again later in the class. In this lesson, we will focus on another important polygon--parallelogram. Let's get started.

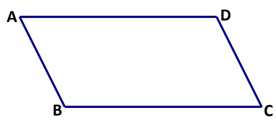
A parallelogram is a quadrilateral with two pairs of parallel opposite sides. We denote it as ▱. For example, ▱ABCD means that quadrilateral ABCD is a parallelogram.
We can see lots of parallelogram shapes in our daily life. For instance:

A parallelogram is in some way a symmetric shape. It has two pairs of opposite sides and two pairs of opposite angles. It also has a pair of diagonals. Look at the pictures above, the shape of the parallelogram looks beautiful and even. Do you agree? Please share some examples of parallelograms in your daily life with us.

We first look at the basic theorems about sides and angles in a parallelogram.

Theorem 1:
Quadrilateral ABCD is a parallelogram as shown in Figure 1.

$\overline{AB} // \overline{CD}$ and $\overline{BC} // \overline{AD}$



Then

Figure 1

(1) $\overline{AB} = \overline{CD}$ and $\overline{BC} = \overline{AD}$

(2) $\angle A = \angle C$ and $\angle B = \angle D$

Pf:

We need to use the theorems of triangles we learned before to discuss the theorems of parallelograms. So we create triangles in Figure 1 by connecting point B and point D as shown in Figure 2. $\overline{BD}$ is a diagonal of parallelogram ABCD.

We also label some of the angles in Figure 2.

In Figure 2, we have two triangles △ABD and △CDB.

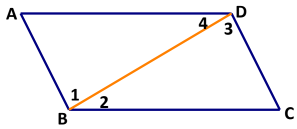


Figure 2

(1) In △ABD and △CDB,

∠1=∠3, …①

∠2=∠4 …② ($\overline{AB} // \overline{CD}$ and $\overline{BC} // \overline{AD}$, alternative interior angles are congruent.

$\overline{BD} = \overline{BD}$ (self reflexive theorem)

⇒△ABD≅△CDB (ASA congruence theorem)

⇒ $\overline{AB} = \overline{CD}$ and $\overline{BC} = \overline{AD}$ (Corresponding sides are congruent.)

and ∠A=∠C …③ (Corresponding angles are congruent. CPCTC)

(2) ∠ABC=∠1+∠2

=∠3+∠4

=∠CDA (from ① and ②)

⇒∠A=∠C (from ③)

∠ABC =∠CDA#

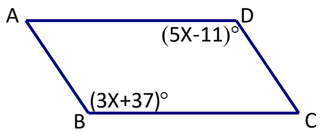
Conclusion:

A parallelogram can be separated into two congruent triangles by one of the diagonals.

Two pairs of opposite sides are congruent and two pairs of opposite angles are congruent in a parallelogram.

Following with some examples.

Ex 1:



In ▱ABCD, ∠B=(3x+37)° and ∠D=(5x-11)°

Find the measure of ∠B.

Sol:

The opposite angles are congruent in a parallelogram.

⇒5x-11=3x+37

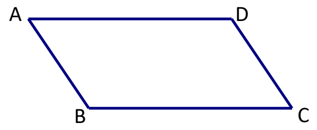
⇒2x=48

⇒ x=24

So ∠B =(3·24+37)° (replace x with 24)

=109°#

Ex 1-1:



Given the perimeter of ▱ABCD is 40.

$\overline{BC}=2\overline{AB}-1$. Find the measure of $\overline{CD}$.

Sol:

Let $\overline{AB}$ be x.

The perimeter of ▱ABCD

$=\overline{AB}+\overline{BC}+\overline{CD}+\overline{AD}$

=x+2x-1+x+2x-1 (Both pairs of opposite side lengths are congruent.)

=40 (given)

$\Rightarrow$ 6x-2=40

$\Rightarrow$ x=7 (simplifying)

So $\overline{CD}=\overline{AB}$=x=7 #

Can you see any relation between the two consecutive interior angles in a parallelogram? It's quite obvious. Yes! Any pair of consecutive interior angles is supplementary. Please share your results and reasons with your classmates sitting near you.

For teachers.

Theorem 2:

Quadrilateral ABCD is a parallelogram as shown in Figure 1.

Figure 1

$\overline{AB}//\overline{CD}$ and $\overline{BC}//\overline{AD}$

Then

$\angle A+\angle B=180°$ and $\angle C+\angle D=180°$

$\angle A+\angle D=180°$ and $\angle B+\angle C=180°$

Pf:

Because

$\overline{BC}//\overline{AD} \Rightarrow \angle A+\angle B=180°$ and $\angle C+\angle D=180°$

(parallel line theorem: consecutive interior angles are supplementary)

Similarly,

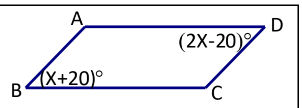
$\overline{AB}//\overline{CD} \Rightarrow \angle A+\angle D=180°$ and $\angle B+\angle C=180°$ #

Conclusion:

Any pair of consecutive interior angles are supplementary in a parallelogram. #

Ex 2:

In ▱ABCD, $\angle B=(x+20)^\circ$ and $\angle D=(2x-20)^\circ$



Find the measure of $\angle C$.

Sol:

The opposite angles in a parallelogram are congruent.

$\angle B=\angle D$

$x+20=2x-20$ (simplifying)

$x=40$

$\angle B=x+20$ (replacing x with 40)

$=60$

And the consecutive interior angles are supplementary in a parallelogram,

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

Then

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

$=120^\circ$ #

For proving theorem 1 (2), we can also do it this way.

Theorem 1 (2):

Quadrilateral ABCD is a parallelogram as shown in the figure.

$\overline{AB} // \overline{CD}$ and $\overline{BC} // \overline{AD}$

Then

(2) $\angle A=\angle C$ and $\angle B=\angle D$

Pf:

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

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

Then $\angle A=180^\circ-\angle B$

$=\angle C$

Similarly, $\angle B=\angle D$ #

From theorem 1, we found that one of the diagonals can separate a parallelogram into two congruent triangles. There are more useful theorems of diagonals in a parallelogram. See theorem 3.

Theorem 3:

In ▱ABCD, two diagonals $\overline{AC}$ and $\overline{BD}$ intersect each other at point O as shown in Figure 1.

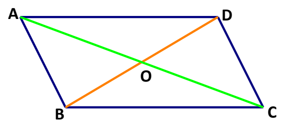


Figure 1

Then

$\Delta AOB \cong \Delta COD$ and $\Delta AOD \cong \Delta COB$

Pf:

We label the angles shown in Figure 2.

In ΔAOB and ΔCOD ,

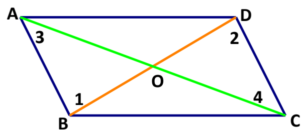


Figure 2

$\angle 1 = \angle 2$

$\angle 3 = \angle 4$ (congruent alternate interior angles)

$\overline{AB} = \overline{CD}$ (The quadrilateral ABCD is ▱ABCD.)

$\Rightarrow \Delta AOB \cong \Delta COD$ (ASA congruence theorem)

Similarly,

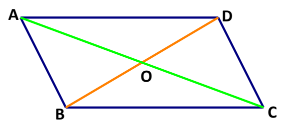
$\Delta AOD \cong \Delta COB$ #

Conclusion:

A parallelogram can be separated into two pairs of congruent triangles by its two diagonals.

Theorem 4:

In ▱ABCD, two diagonals $\overline{AC}$ and $\overline{BD}$ intersect each other at point O as shown in Figure 1.



Prove: $\overline{AO} = \overline{CO}$ and $\overline{BO} = \overline{DO}$

Figure 1

Pf:

Let's label some angles in Figure. 1 as shown in Figure 2..

In ΔAOB and ΔCOD,

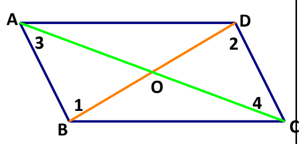


Figure 2

$\angle 1 = \angle 2$

$\angle 3 = \angle 4$ (Alternate interior angles are congruent.)

$\overline{AB} = \overline{CD}$ (Quadrilateral ABCD is a parallelogram.)

$\Rightarrow \Delta AOB \cong \Delta COD$ (ASA congruence theorem)

$\Rightarrow \overline{AO}=\overline{CO}$ and $\overline{BO}=\overline{DO}$ # (Corresponding line segments are congruent.)

(Sometimes we just abbreviate the reason as **CPCTC**)

Conclusion:

Two diagonals bisect each other in a parallelogram.

We will discuss one theorem in terms of area in a parallelogram.

Theorem 5:

In ▱ABCD, two diagonals $\overline{AC}$ and $\overline{BD}$ intersect each other at point O as shown in Figure 1.

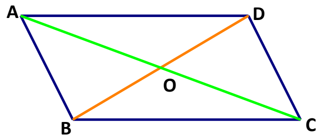


Figure 1

Then:

The area of the four triangles ΔAOB, ΔCOD, ΔAOD, and ΔCOB are equal

Pf:

ΔAOB≅ΔCOD and ΔAOD≅ ΔCOB (theorem 3)

So the area of ΔAOB=the area of ΔCOD…①

the area of ΔAOD=the area of ΔCOB…②

We have to build a link between these two pairs of triangles.

Let's look into ΔAOB and ΔAOD,

These two triangles have equivalent bases

$\overline{BO}=\overline{DO}$ (theorem 4)

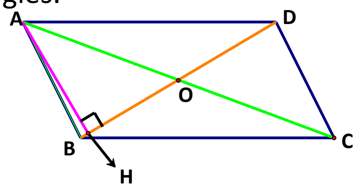


Figure 2

Normally we need heights when considering the area of a triangle., so here we construct the height of ΔAOB as shown in Figure 2.

$\overline{AH} \perp \overline{BO}$ And $\overline{AH}$ intersects $\overline{BO}$ at point H.

The area of ΔAOB= $\frac{1}{2}\overline{AH}\cdot\overline{BO}$

$=\frac{1}{2}\overline{AH}\cdot\overline{DO}$ $(\overline{BO}=\overline{DO})$

=the area of ΔAOD …③

From①, ②, and ③,

the area of ΔAOB=the area of ΔCOD

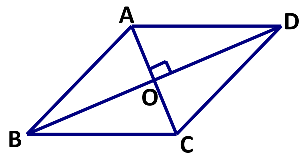
=the area of ΔAOD

=the area of ΔCOB#

Conclusion:

Two diagonals of a parallelogram divide the parallelogram into four triangles of equal area.

Ex 3:



In ▱ABCD, two diagonals $\overline{AC}$ and $\overline{BD}$ intersect each other at point O. $\overline{AC} \perp \overline{BD}$. If $\overline{AC}=7$, $\overline{BD}=12$.

Find

(1) the area of ΔAOD

(2) the area of ▱ABCD

Sol:

Method 1

(1) $\overline{AC} \perp \overline{BD}$, ΔAOD is a right triangle, then

the area of $\Delta AOD=\frac{1}{2}\overline{AO}\cdot\overline{DO}$

Two diagonals bisect each other, so

$\overline{AO}=\frac{1}{2}\overline{AC}=\frac{1}{2}\cdot 7$ (theorem 4)

$=\frac{7}{2}$

$\overline{DO}=\frac{1}{2}\overline{BD}=\frac{1}{2}\cdot 12$

$=6$ (replace with the given)

the area of $\Delta AOD=\frac{1}{2}\overline{AO}\cdot\overline{DO}=\frac{1}{2}\cdot\frac{7}{2}\cdot 6$ (replace with the given)

$=\frac{21}{2}$ #

(2) from theorem 4, the area of four triangles ΔAOB, ΔCOD, ΔAOD, and ΔCOB are equal

Therefore

▱ABCD=aΔAOB+aΔCOD+aΔAOD+aΔCOB (a stands for the area)

$=4\cdot a\Delta AOD$

$=4\cdot\frac{21}{2}$

$=42$ #

Method 2 (Consider it as a reverse proving. We have a quite good result here.)

(2) The area of ▱ABCD=the area of (ΔAOB+ΔCOD+ΔAOD+ΔCOB)(懶惰，哈哈）

$$=\frac{1}{2}\overline{AO}\cdot\overline{BO}+\frac{1}{2}\overline{CO}\cdot\overline{DO}+\frac{1}{2}\overline{AO}\cdot\overline{DO}+\frac{1}{2}\overline{CO}\cdot\overline{BO}$$

$$=\frac{1}{2}\overline{AO}\cdot(\overline{BO}+\overline{DO})+\frac{1}{2}\overline{CO}\cdot(\overline{BO}+\overline{DO})$$

$$=\frac{1}{2}(\overline{BO}+\overline{DO})(\overline{AO}+\overline{CO}) \qquad \text{(simplifying)}$$

$$=\frac{1}{2}\overline{AC}\cdot\overline{BD} \qquad \cdots\text{important result}$$

$$=\frac{1}{2}7\cdot 12=42 \qquad \text{(replace with the given)}$$

(1) Since the area of four triangles ΔAOB, ΔCOD, ΔAOD, and ΔCOB are equal

$\Rightarrow$ the area of ΔAOD$=\frac{1}{4}\cdot$the area of ▱ABCD

$$=\frac{1}{4}\cdot 42$$

$$=\frac{21}{2}$$ #

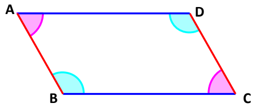
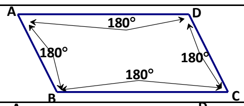
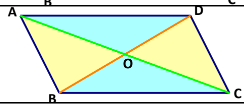
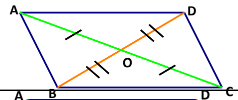
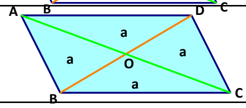
Attention

From *Method 2*,

The area of ▱ABCD $=\frac{1}{2}\overline{AC}\cdot\overline{BD}$ when $\overline{AC}\perp\overline{BD}$

From the process above we know: if two diagonals are perpendicular to each other in any quadrilateral, then the area of the quadrilateral equals half of the product of its two diagonals. It’s always true no matter what kind of quadrilaterals it is. Cool!

Theorems of a parallelogram:

Theorem of a parallelogram	Diagram shown
1. (1) $\overline{AB}=\overline{CD}$ and $\overline{BC}=\overline{AD}$ (2) $\angle A=\angle C$ and $\angle B=\angle D$	
2. $\angle A+\angle B=180°$ and $\angle C+\angle D=180°$ $\angle A+\angle D=180°$ and $\angle B+\angle C=180°$	
3. $\Delta AOB \cong \Delta COD$ and $\Delta AOD \cong \Delta COB$	
4. $\overline{AO}=\overline{CO}$ and $\overline{BO}=\overline{DO}$	
5. $a\Delta AOB=a\Delta COD$ $=a\Delta AOD=a\Delta COB$(a stands for area)	

There are so many great theorems of parallelograms we learned above. But how do we identify whether a quadrilateral is a parallelogram in order to use these theorems? For instance, if a quadrilateral has two pairs of congruent opposite sides, will it be a parallelogram? Or if a quadrilateral has two pairs of congruent opposite angles, will it be a parallelogram? What we do here is look at a quadrilateral and identify it as a parallelogram, so we can use all the other information we know about parallelograms. We are going to use all the theorems identified as part of the parallelogram in reverse to describe whether a quadrilateral is a parallelogram.
(在上面，我們學了很多平行四邊形的性質。現在我們想要知道，什麼情況下一個四邊形會是一個平行四邊形?是四邊形有一雙對邊相等就是平行四邊形?是有一雙對角相等就保證四邊形是一個平行四邊形?我們在這裡要做的是利用部分平行四邊形的性質反過來看，是否一個四邊形會是一個平行四邊形。)
Let’s study it together. Remember the definition of a parallelogram? That is, if both pairs of opposite sides are parallel in a quadrilateral, it is a parallelogram. So, no matter what information we have in hand to identify whether a quadrilateral is a parallelogram, we always need to prove that both pairs of opposite sides in the quadrilateral are parallel at the end. Of course, sometimes we can also end up with the theorems we have already proved beforehand.
(還記得平行四邊形的定義?兩雙對邊分別平行的四邊形稱為平行四邊形。所以在下面的平行四邊形的推理判別過程中，最基本簡單的方向就是利用題目給的條件，推出四邊形的兩雙對邊分別平行即可。)

Theorem 6(1) (converse of theorem 1):

If $\overline{AB} = \overline{CD}$ and $\overline{BC} = \overline{AD}$ in a quadrilateral ABCD, then quadrilateral ABCD is a parallelogram.

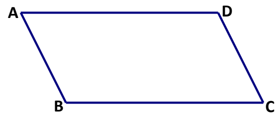


Figure 1

Pf:

Analysis: we need to get parallel sides. From what we learned before, the first thing that comes to mind is the converse of parallel line property. We have many congruent sides here. If we can turn congruent sides into congruent angles, then we might apply the converse of parallel line property.

(分析:根據過去經驗，我們需要得到直線間的平行結果，第一個想到的是平行線的逆性質，需要用到一些角度關係。加上我們有很多邊長相等的條件，所以我們製造三角形，就可以利用三角形全等把邊長的關係轉移到角度的關係。)

So we connect $\overline{BD}$ as shown in Figure 2.

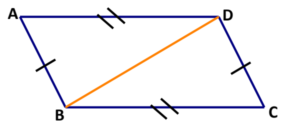


Figure 2

In ΔABD and ΔCDB,

$\overline{AB} = \overline{CD}$ and $\overline{BC} = \overline{AD}$ (given)

$\overline{BD} = \overline{BD}$ (reflexive property)

$\Rightarrow \Delta AOB \cong \Delta COD$ (SSS congruence theorem)

$\Rightarrow \angle ABD = \angle CDB$ (CPCTC)

$\Rightarrow \overline{AB} // \overline{CD}$ (alternate interior angles converse)

Similarly,

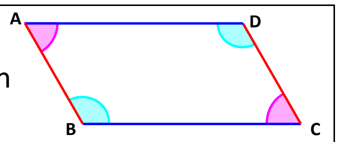
$\overline{BC} // \overline{AD}$

Then quadrilateral ABCD is a parallelogram.

(Both pairs of opposite sides are parallel.)

Theorem 7 (converse of theorem 1(2)):

If $\angle A = \angle C$ and $\angle B = \angle D$ in a quadrilateral ABCD, then quadrilateral ABCD is a parallelogram.



Pf:

The sum of the interior angles of a quadrilateral is 360°.

i.e. $\angle A + \angle B + \angle C + \angle D = 360°$.

$\Rightarrow 2\angle A + 2\angle B = 360°$. (replace $\angle C$ with $\angle A$ and $\angle D$ with $\angle B$)

$\angle A + \angle B = 180°$.

$\Rightarrow \overline{BC} // \overline{AD}$ (consecutive interior angles converse)

Similarly,

$\overline{AB} // \overline{CD}$

Therefore,

Quadrilateral ABCD is a parallelogram. (Both pairs of opposite sides are parallel.)

Theorem 8 (converse of theorem 3):

In quadrilateral ABCD as shown in Figure 1, If $\Delta AOB \cong \Delta COD$ and $\Delta AOD \cong \Delta COB$, then quadrilateral ABCD is a parallelogram.

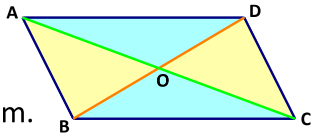
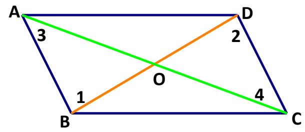


Figure 1



Pf:

Let's label some angles first.

In Figure 2, $\Delta AOB \cong \Delta COD$

$\angle 1 = \angle 2$ and $\angle 3 = \angle 4$ (CPCTC)

Then

$\overline{AB} // \overline{CD}$ and $\overline{BC} // \overline{AD}$ (alternate interior angles converse)

Therefore,

Quadrilateral ABCD is a parallelogram. (Both pairs of opposite sides are parallel.)

Theorem 9 (converse of Theorem 4):

In quadrilateral ABCD as shown in Figure 1,

If $\overline{AO} = \overline{CO}$ and $\overline{BO} = \overline{DO}$,then quadrilateral ABCD is a parallelogram.

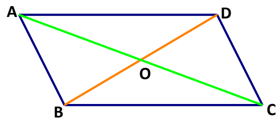


Figure 1

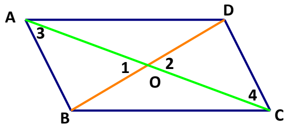


Figure 2

pf:

We label some angles as shown in Figure 2.

In ΔAOB and ΔCOD,

$\overline{AO} = \overline{CO}$

$\overline{BO} = \overline{DO}$ (given)

$\angle 1 = \angle 2$ (congruent vertical angles)

$\Rightarrow \Delta AOB \cong \Delta COD$ (SAS triangle congruence theorem)

$\Rightarrow \angle 3 = \angle 4$ (CPCTC)

$\Rightarrow \overline{AB} // \overline{CD}$ (alternate interior angles converse)

Similarly,

$\overline{BC} // \overline{AD}$

Therefore,

Quadrilateral ABCD is a parallelogram. (Both pairs of opposite sides are parallel.

Note that it's not the only way of reasoning for the proofs we discuss above.
Please take some time to try different ways of reasoning and share them with others.
Be aware that you can only use the proved theorems to do your reasoning.

The last theorem we are going to discuss is a bit different. Most of the theorems above relate both pairs of sides or angles. But this one, we will focus on only one pair of sides. Let's look into it.

Theorem 10:

In quadrilateral ABCD as shown in Figure 1,

If $\overline{AB} // \overline{CD}$ and $\overline{AB} = \overline{CD}$,then quadrilateral ABCD is a parallelogram.

Figure 1

(Analysis: given a pair of parallel opposite sides already. We only need to prove if the other pair of opposite sides is parallel.)

Pf:

Connect the diagonal $\overline{BD}$ (to create triangles) as shown in Figure 2.

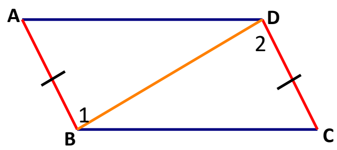


Figure 2

In ΔABD and ΔCDB,

$\overline{AB} = \overline{CD}$ (given)

$\angle 1 = \angle 2$ ($\overline{AB} // \overline{CD}$, congruent alternate interior angles)

$\overline{BD} = \overline{BD}$ (reflexive property)

$\Rightarrow \Delta ABD \cong \Delta CDB$ (SAS triangle congruence theorem)

$\Rightarrow \overline{BC} = \overline{AD}$ (CPCTC)

Then quadrilateral ABCD is a parallelogram. # (from Theorem 6(1))

Let's work on one application of these theorems. This example is the one I love most. There is a famous and important property named TRIANGLE MIDSEGMENT PROPERTY.

(各位老師好，在這裡我分享了一個我喜歡的平行四邊形的推論。老師們如果沒

有興趣，可以跳過不看。不好意思。

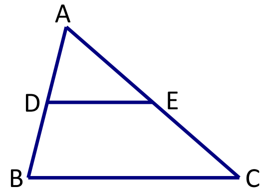
我們可以在八年級時由平行四邊形得到三角形兩腰中點連線性質。他們到九年級再次學到的時候會更熟悉，應用更能得心應手。)

TRIANGLE MIDSEGMENT PROPERTY:

In △ABC, point D and point E are midpoints of $\overline{AB}$ and $\overline{AC}$ respectively. That is: $\overline{AD}=\overline{BD}$, $\overline{AE}=\overline{CE}$.

Then

(1) $\overline{DE}//\overline{BC}$ and (2) $\overline{DE}=\frac{1}{2}\overline{BC}$



It will be introduced in the ninth grade and a formal proof will be given. However, after our discussion on the following example of parallelograms on the coordinate plane, you will learn the property NOW without too much effort. Let's move on.

Ex 4:

Three points (-3,4), (-1,-2), and (3,2) are given on a coordinate plane as shown in Figure 1.

Find the fourth point engaging the given three points to form a parallelogram.

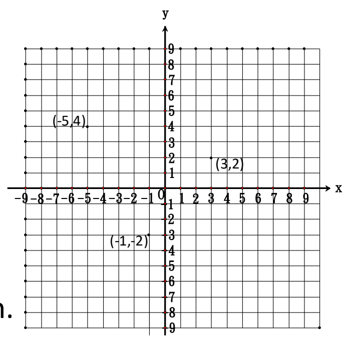


Figure 1

Sol:

The two diagonals bisect each other in a parallelogram.

This means the intersection point of the two diagonal is the midpoint of the two diagonals.

And

The midpoint formula on a coordinate plane is:

The coordinates of the midpoint of segment AB is

$$\left(\frac{a_1+b_1}{2},\frac{a_2+b_2}{2}\right)$$ when given A(a_1, a_2), B (b_1, b_2)

We will have multiple choices for the fourth point. But why?

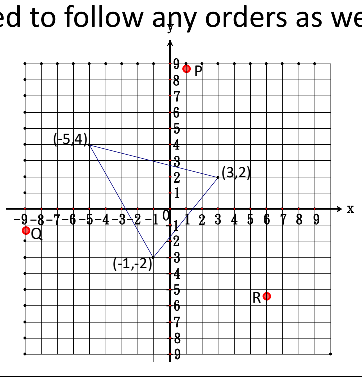
Because the given points are not labeled, we don't need to follow any orders as we always do in math to join the vertices.

(If we label the points as point A, point B, and point C, then the fourth vertex point D has only one choice.)

(各位老師，題目如果標示所給點的名稱，例如:

點 A, 點 B, 和點 C, 那麼要形成平行四邊形的

第四個頂點的選擇就只有一個。)



Now please plot the possible position for the fourth point on the plane on your worksheet.. Figure 2.

Do you have similar results like mine?

Yeah!

The red points P, Q, and R in Figure 2 are
the possible positions for the fourth vertex.

Let's look at point $R(r_1,r_2)$ in Figure 3.

If quadrilateral WDRK is a parallelogram,
then the diagonal $\overline{DK}$ and $\overline{WR}$ bisect each other.

Let the intersection point be $I(i_1,i_2)$.

Point I is the midpoint of segment DK

$$I(i_1,i_2) \text{ is } \left(\frac{-1+3}{2},\frac{-2+2}{2}\right) \quad \cdots ①$$

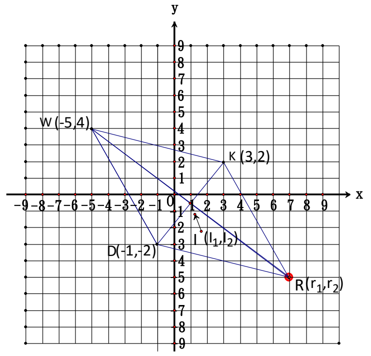


Figure 3

On the other hand,

Point I is also the midpoint of segment WR

$$I(i_1,i_2) \text{ is } \left(\frac{-5+r_1}{2},\frac{4+r_2}{2}\right) \quad \cdots ②$$

$$\Rightarrow \frac{-5+r_1}{2}=1,\ \frac{4+r_2}{2}=0 \qquad \text{(from ① and ②)}$$

$$\Rightarrow r_1=7,\ r_2=-4 \qquad \text{(simplifying)}$$

So we get the first possible fourth vertex is R(7, -4)

Following the same procedure, we can easily get the other two possible fourth vertices (Please refer to Figure 4.). They are:

P(-1, 8) and Q(-9, 0)

The answer for the possible fourth point is

(7, -4), (-1, 8), and (-9, 0)

We get the answer already. (不再寫類似的過程了，請原諒。)

Now we are going to get the
TRIANGLE MIDSEGMENT PROPERTY.

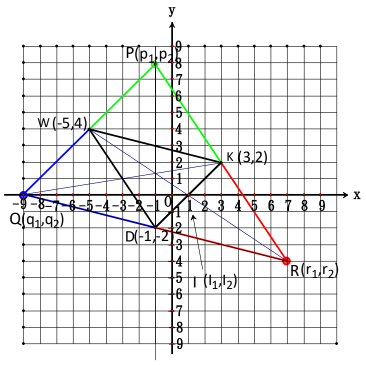


Figure 4

In Figure 4, quadrilateral PWDK, WQDK, and WDRK are all parallelograms.

In ▱ WQDK and ▱ WDRK,

$\overline{WK}//\overline{QD}$ and $\overline{WK}=\overline{QD}$

$\overline{WK}//\overline{DR}$ and $\overline{WK}=\overline{DR}$

One important fact,

$\overline{QD}$ and $\overline{DR}$ are both parallel to $\overline{WK}$, and point D is the **common point** on both $\overline{QD}$ and $\overline{DR}$, so $\overline{QD}$ and $\overline{DR}$ are **on the same segment** QR.

The conclusion is:

In ΔPQR, point W and point K are the midpoints of $\overline{PQ}$ and $\overline{PR}$, then

(1) $\overline{WK} // \overline{QR}$,

(2) $\overline{WK} = \frac{1}{2}, \overline{QR}$ ($\overline{WK} = \overline{QD}$, $\overline{WK} = \overline{DR}$)

Similarly,

$\overline{WD} // \overline{PR}$, $\overline{WD} = \frac{1}{2}, \overline{PR}$, and $\overline{DK} // \overline{PQ}$, $\overline{DK} = \frac{1}{2}, \overline{PQ}$

Wala! We got the TRAINGLE MIDSEGMENT PROPERTY!

Of course, you will learn this property again in the ninth grade with a formal introduction.

Look forward to it!

Reference:

https://www.google.com.tw/search?q=parallelogram+in+real+life&tbm=isch&ved=2ahUKEwiAxN3bysmBAxWObd4KHTxPAEAQ2-cCegQIABAA&oq=parallelogram+in+re&gs_lcp=CgNpbWcQARgAMgUIABCABDIECAAQHjIECAAQHjIECAAQHjIECAAQHjIGCAAQCBAeMgYIABAIEB4yBggAEAUQHjIGCAAQBRAeMgYIABAFEB46BAgjECdQvQ5Y1k1gzmhoAHAAeACAATaIAcACkgEBN5gBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=4H0TZYDUEI7b-Qa8noGABA&bih=247&biw=546#imgrc=s_4i267MMwgN4M

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