

Geometric constructions

School Grade: K8/K9

Table of contents

Geometric constructions 3

Perpendicular Bisector 4

Parallel lines 6

Angle Bisector 10

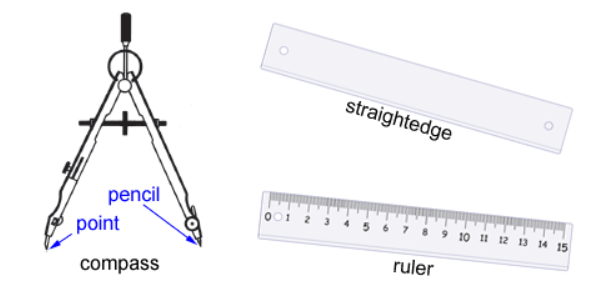
Constructing Angles Using a Protractor 11

Examples 12

[References](#_heading=h.2et92p0) 16

# Geometric constructions

As you are familiar with various shapes, you can draw them with your hands. You are well aware with the geometric constructions of a line segment of a certain measurement, a square, a rectangle or a triangle with the help of a ruler. In this section, we are going to learn some more geometric constructions with the help of a compass, a ruler and (sometimes a protractor). You will get to learn about the way to construct perpendicular bisector, angle bisector and parallel lines.



Obrázok, na ktorom je text, zariadenie, kompas

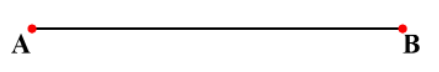
Automaticky generovaný popis

**Protractor**

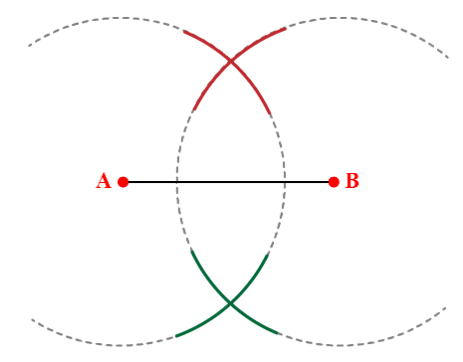
**Perpendicular Bisector**

To carry out this construction, we will use the fact that any point on the perpendicular bisector of a line segment is equidistant from the two end-points of the line segment.

Suppose we have a line segment AB



Taking A and B as centers, and a radius of more than half of AB , draw arcs on both sides of AB, to intersect each other, as shown below.



The reason you require the radius of your arcs to be more than half of AB is that if the radius is less than half of AB, the arcs will not intersect.

Let the two points of the intersection so obtained be P and Q. Draw a line through P and Q. This is the required perpendicular bisector.

Obrázok, na ktorom je text, lietanie, pestrofarebné, čiara

Automaticky generovaný popis

Here, POQ is the perpendicular bisector of AB.

**Parallel lines**

These two lines are parallel to each other.

Obrázok, na ktorom je text, anténa, zariadenie

Automaticky generovaný popis

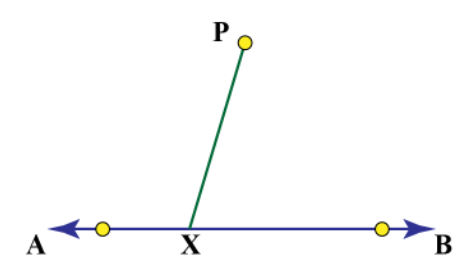
We will learn how to construct parallel lines using a ruler and a compass.

Let AB be a line and P be a point outside the line AB

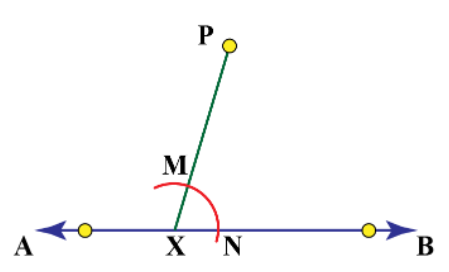
Obrázok, na ktorom je text, atletické hry, šport, tenis

Automaticky generovaný popis

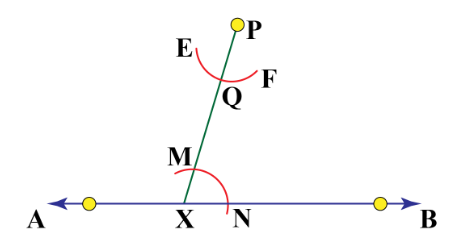
Draw a transversal through the point P intersecting the line AB, say at X.



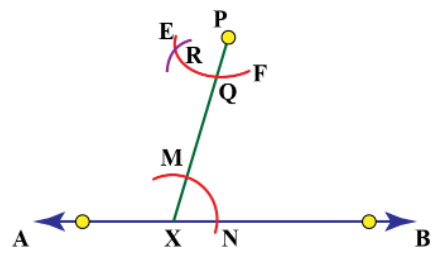
Taking X as a center and any radius, draw an arc intersecting the segment PX at M and AB at point N.



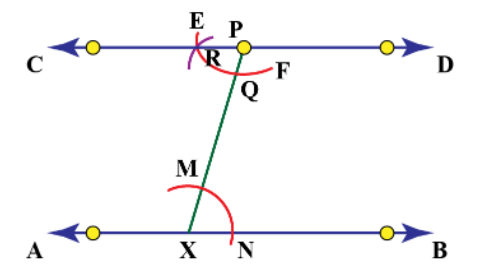
Now, taking P as a center and the same radius, draw an arc EF intersecting the segment PX at Q.



Taking Q as a center and same radius, draw an arc intersecting the arc EF at R.



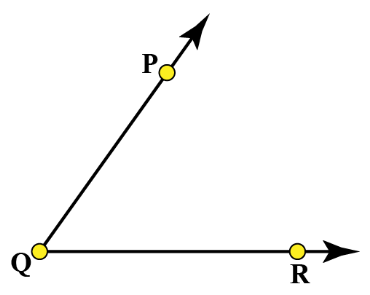
Join R and P and extend it on both sides to draw the line CD



Here, the line CD is parallel to the line AB.

**Angle Bisector**

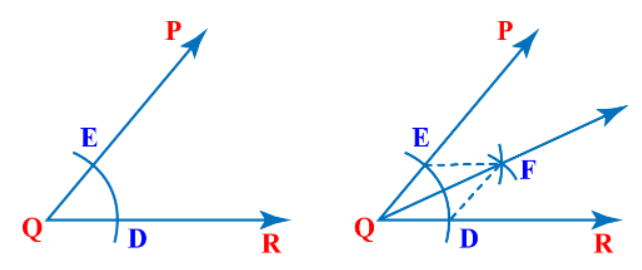
Suppose we have ∠PQR and we want to bisect this angle.



Let Q be the center and with any radius, draw an arc intersecting the ray QP and QR, say at the points E and D respectively.

Now, taking D and E as centers and the same radius, draw arcs intersecting each other say at F.

Draw the ray QF.



Here, QP is the angle bisector of ∠PQR.

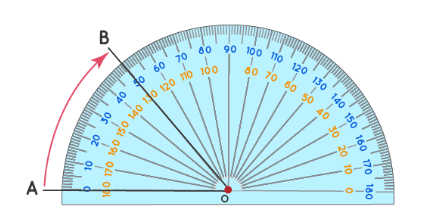
**Constructing Angles Using a Protractor**

An angle can be constructed either by using a protractor and a ruler or a compass and a ruler. Let us now look at the steps of constructing a 50° angle using a protractor.

Draw a line segment OA.

Place the center of the protractor at point O.

Starting from point A in the clockwise direction and mark a point at 50 degrees by looking at the outer circle of the protractor. Label this point as B.

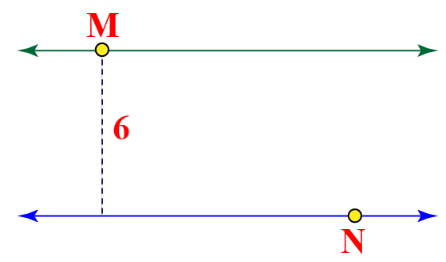


The ∠BOA is the required 50° angle.

**Example 1**

The green and blue lines are parallel, and M and N are points on the green and blue lines respectively.

If the shortest distance from M to the blue line is 6 units.



What will be the shortest distance from N to the green line?

**Solution**

The given lines are parallel, so they are equidistant throughout.

This means that the perpendicular distance from M to the blue line is equal to the perpendicular distance from N to the green line. Hence, this distance is equal to 6 units.

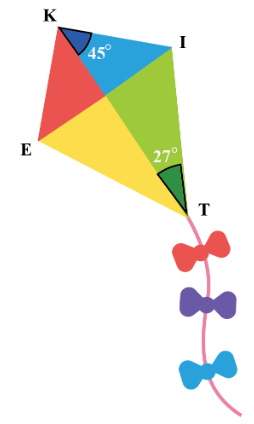
In fact, the shortest distance between the two lines is the perpendicular distance between them.

So, the shortest distance from N to the green line is 6 units.

**Example 2**

Ryan is flying a kite.

The kite has two angles bisected as shown below.



Can you find the measures of the angles ∠EKI and ∠ITE?

**Solution**

The angles ∠EKI and ∠ITE are bisected by the line KT↔.

KT↔ divides the angles  ∠EKI and  ∠ITE in two equal angles respectively.

Thus,

∠EKI=2×45°=90°

and

∠ITE=2×27°=54°

**Example 3**

Ms. Amy asked Mia to justify the construction of a perpendicular bisector of a line segment.

Obrázok, na ktorom je text

Automaticky generovaný popis

Can you help her justify this?

**Solution**

In ΔPAQ and ΔPBQ:

1. PA = PB (arcs of equal radius)

2. QA = QB (again, arcs of equal radius)

3. PQ = PQ (common)

By the SSS criterion, the two triangles are congruent, which means that

∠APO = ∠BPO

In ΔAPO with ΔBPO:

1. PA = PB (arcs of equal radius)

2. ∠APO = ∠BPO (just shown)

3. PO = PO (common)

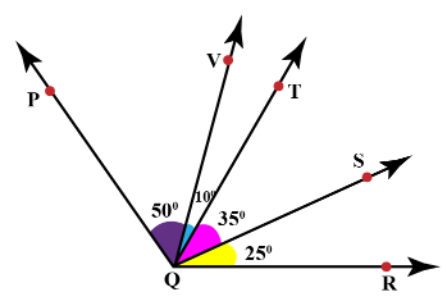
By the SAS criterion, the two triangles are congruent, which means that AO = BO, and also:

∠AOP = ∠BOP = 180°/2=90°

POQ is the perpendicular bisector of AB.

**Example 4**

∠PQR is divided into different angles.



Can you determine the angle bisector of ∠PQR∠PQR?

**Solution**

Notice that,

∠PQT=∠PQV+∠VQT=50°+10°=60°∠PQT=∠PQV+∠VQT=50°+10°=60°

∠TQR=∠TQS+∠SQR=35°+25°=60°∠TQR=∠TQS+∠SQR=35°+25°=60°

This means that ∠PQT=∠TQR

So, ray QT is the angle bisector of  ∠PQR.

# References

<https://www.cuemath.com/geometry/geometric-construction/>

<https://www.cuemath.com/geometry/construction-of-angles/>

<https://www.math.net/geometric-construction>

<https://www.mathsisfun.com/geometry/constructions.html>