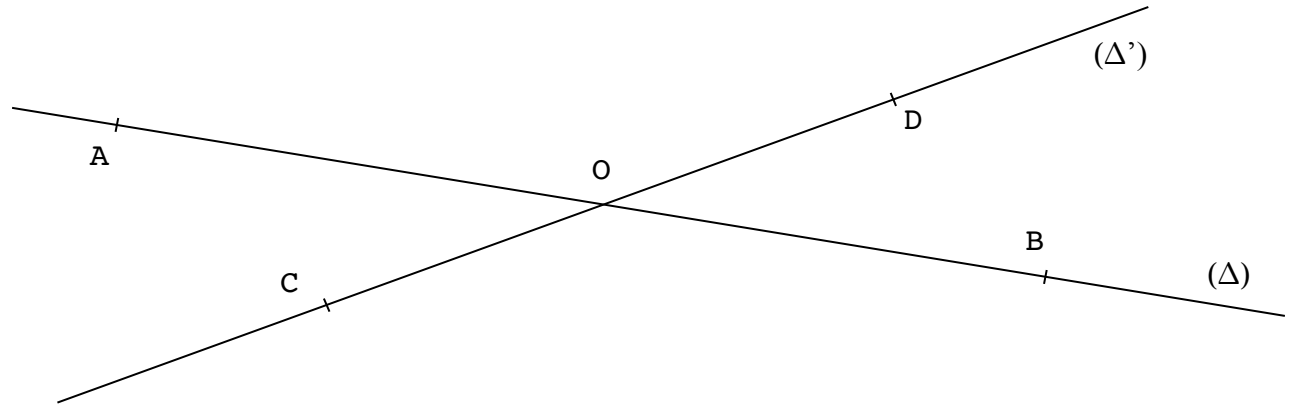
# I Straight lines

(Δ) and (Δ') (reads: "Δ **prime**" or "Δ **dash**") are two **lines** or two **straight lines**. If A and B are two different points, only one _____ **goes through** A and B.

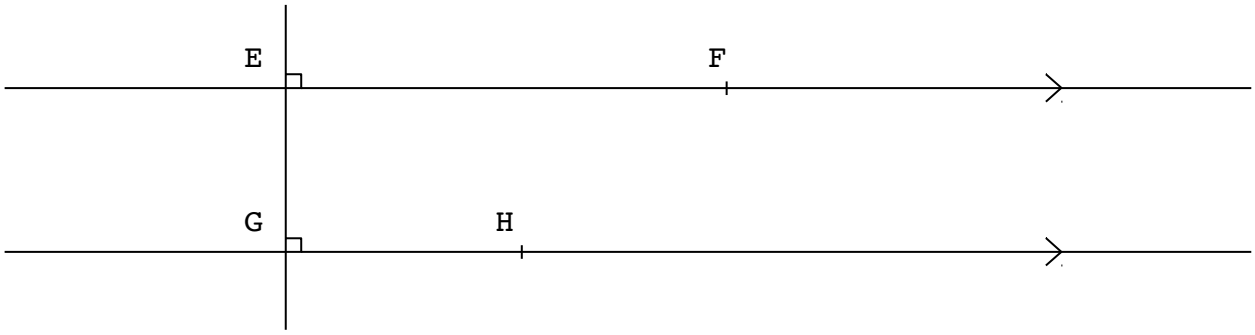
Point O **belongs to** line (AB): points O, A and B are **aligned**.

If (Δ) _____ _____ A, O and B and (Δ') _____ _____ C, O and D, (Δ) and (Δ') **intersect at** O. Therefore, O is the **intersection** point of the two lines (Δ) and (Δ').



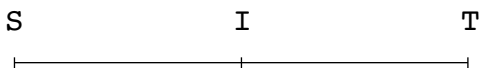

If two lines are **parallel**, they do not intersect. The distance between the two lines is always the same. If two lines intersect at right angle, they are said to be perpendicular.

The **perpendicular to** (EF) **at** E intersects the **parallel to** (EF) **through** H **at** point G. Therefore, (GH) is the perpendicular to (EG) at G. The 2 arrows on (EF) and (GH) indicate that those straight lines are parallel.




A straight line extends indefinitely in both directions, whereas a **half line** (or a **ray**) [OB) extends indefinitely only in one direction from a fixed point.

[ST] is a **line segment** of **ends** S and T and of length 6 cm. The points S and T are the **end-points** of the line segment. The length of the line segment is the distance between its ____-_____. I is the **midpoint** of [ST]. It is the only point that belongs to the ____ _____ and is equidistant from the two end-points.




The _____ _____ that _____ [ST] at I and is perpendicular to (ST) is called the **perpendicular bisector** of the _____ _____ [ST]. It is the **locus** / ˈləʊ.kəs/ (plural: **loci** / ˈləʊ.saɪ/ ) of all the points that are **equidistant** from the two end-points of the line segment.

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Vocabulary: aligned – to belong to – dash – end – end-point – equidistant – geometry – to go through – half line – intersection – to intersect (at) – (straight) line – line segment – locus *(loci)* – midpoint – parallel (to ...) (through ...) – perpendicular (to ...) (at ...) – perpendicular bisector – prime – ray

# III Quadrilaterals

A **quadrilateral** is a polygon with 4 vertices and 4 sides. It is formed by four intersecting lines.

A **trapezium** (US: trapezoid) is a quadrilateral that has one pair of opposite sides parallel.
The area of a trapezium is $h\frac{(a+b)}{2}$, where ***a*** and ***b*** are the lengths of the parallel sides (or **bases**), and ***h*** the distance between them (also called the height of the trapezium).

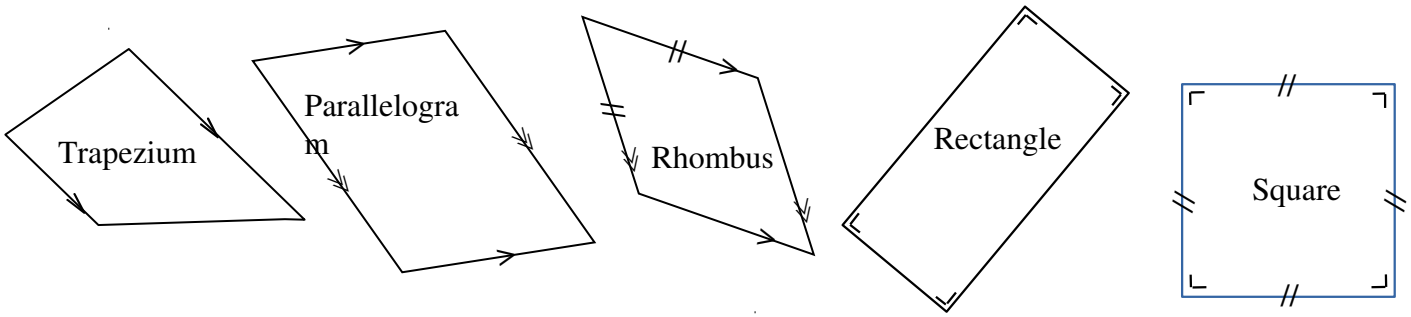
A quadrilateral that has both pairs of opposite sides parallel is called a **parallelogram**. Note that both pairs of opposite sides in a _____ are the same length.
**Diagonals** in a parallelogram **bisect** each other. This property is characteristic of a parallelogram.

A parallelogram with adjacent sides equal in length is called a **rhombus** (plural **rhombuses** or ***rhombi***) whereas a parallelogram with adjacent sides unequal in length is called a rhomboid. It is important to remember the word rhombus, since it does not remind of the French word.
Diagonals in a _____ _____ each other at right _____. The area of a rhombus is equal to half the product of its diagonals.

A **rectangle** is a quadrilateral with all 4 angles right angles. Therefore, it is also a _____ since its two pairs of opposite sides are parallel. The area of a rectangle is equal to the product of its **length** by its **breadth** (or **width**)

Diagonals in a _____ bisect each other and ___ the _____ length.

If the four sides of a rectangle are the same length, it is called a **square**.
Diagonals in a _____ bisect each other __ _____ _____ and ___ ___ same _____.
The area of a square is equal to the square of its side, or half the square of its diagonal.

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*Exercise 4:*

*Let a square and a rectangle (with a length unequal to its width) have the same perimeter, 60 cm.*

*The length of the rectangle is **L** (capital L). Its breadth is **b** (small b).*

a) *Let* $L = 15 + x$ *(in centimetres) so that **x** is a _____ real number. What does **b** equal?*

b) *Prove that the surface area of the square is greater than the surface area of the rectangle.*

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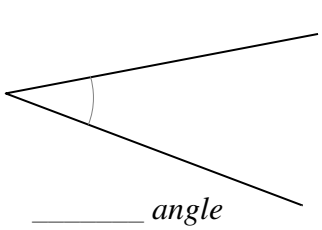
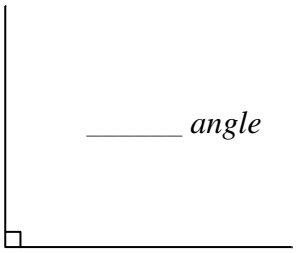
Vocabulary: base – breadth – to bisect – diagonal – length – parallelogram – quadrilateral – rectangle – rhombus (*rhombuses*, *rhombi*) – square – trapezium – width

# IV Angles

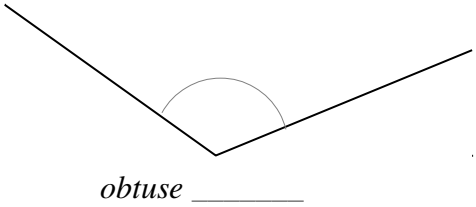
Two half lines extending from a common fixed point form an **angle** . The point is called the vertex, the two rays are called the **sides** (or the **arms**) of the angle.



_____ *angle*



_____ *angle*



*obtuse* _____

The measure of an **acute** angle lies between 0 and 90 degrees.

The measure of a right angle is equal to 90°

*straight angle*

An **obtuse** angle has a size between 90 and 180 degrees.

If the point O belongs to the line segment [AB] and is not one of the end points (in other words, if O is neither **superimposed with** A nor with B), then ∠AOB measures 180°, it is called a **flat** or a **straight** angle, whereas ∠AOA or ∠OAB are both a null (or zero) angle.

If the measure of an angle is greater than 180° and less than 360°,
the angle is called a **reflex** angle.

A **round angle** is a complete turn.

*reflex angle*

The measure of ∠ABC is written $|\angle ABC|$

The **bisector** (or **interior bisector**) of an angle is the line that divides an angle into two equal angles.

To bisect an angle with **straightedge** and compass, one draws a circle whose center is the vertex. The circle meets the angle at two points: one on each **leg**. Using each of these points as a center, draw two circles of the same size. The intersection of the circles (two points) determines a line that is the angle bisector.

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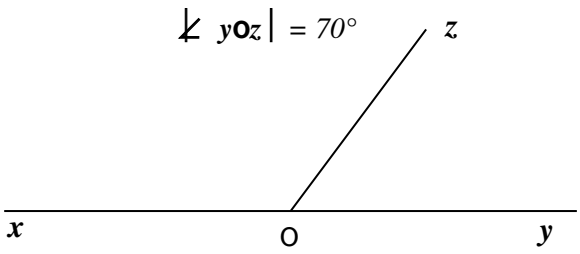
*Exercise 5:*

*Draw* [O***u***), *the bisector of* ∠***y***O***z**, and* [O***v***), *the bisector of* ∠***z***O***x*** *(use a pair of compasses)*
∠***u***O***z*** *and* ∠***z***O***v*** *are* ***adjacent*** *and* ***complementary****, because their measures* ***add up to*** *90°:*
*"angles in a right angle add up to 90°".*

∠***y***O***z*** *and* ∠***z***O***x*** *are* _____ *and* ***supplementary****,*
*because their measures* ____ __ __ *180°:*
*"Angles in a* _____ *angle add up to 180°"*

*Prove that* ∠***y***O***u*** *and* ∠***v***O***x*** *are complementary.*

*Draw* [O***w***), *the bisector of* ∠***u***O***v****, and calculate* $|\angle yOw|$

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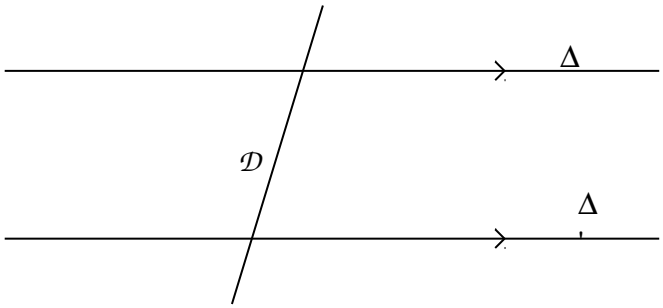
Vocabulary : acute – to add up to – adjacent – angle – arm – (interior) bisector – complementary – flat – leg – obtuse – reflex – round angle – side – straight – straightedge – superimposed with – supplementary

The line $\mathcal{D}$, which cuts two other lines, is called a **transversal**.

The four angles that **lie between** $\Delta$ and $\Delta'$ are **interior** angles, whereas the four lying outside those two lines are **exterior** angles.




An interior (or exterior) angle formed by the transversal's cutting of one line and an interior (or exterior) angle formed at the other line together constitute a pair of **alternate angles** if they lie on opposite sides of the transversal.

An interior angle at one line with an exterior angle at the other line constitute a pair of **corresponding angles** if they lie on the same side of the transversal.

A straight line transversal to two parallel lines $\Delta$ and $\Delta'$ defines corresponding and alternate angles equal in size.
Conversely, if a pair of corresponding angles (resp. alternate angles) are the same size, then the pair of lines cut by the transversal are parallel.

Here on the figure all the obtuse angles are the same size, and so are all the acute angles.

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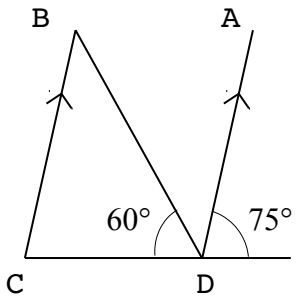
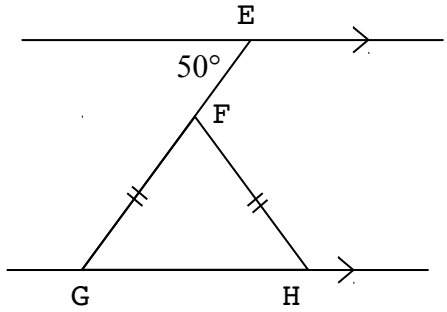
*Exercise 6 : fill in the gaps*

- ***Vertically opposite** angles ____ always the same size.*
- *Since Δ and Δ' are parallel, the measures of two _____ angles are equal. There are four different pairs of _____ angles.*
- *There are two pairs of _____ interior angles and two pairs of _____ exterior angles. Since Δ and Δ' are parallel, two _____ angles _____ the same _____ since one of them is _____ opposite to the other alternate angle corresponding angle.*
- *Since Δ and Δ' are parallel, two interior angles that lie on the same side of the transversal are _____ , since their measures add up to _____.*
- *Since Δ and Δ' are _____ _____ , two exterior _____ _____ that lie on the same side of the _____ _____ are also _____ _____, since the first one is adjacent and supplementary to the other one corresponding angle.*

*Exercise 7 : calculate*




|∠ADB| , |∠DCB| , |∠CBD|




|∠FGH| , |∠HFG| , |∠HFE|

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Vocabulary: alternate angles – corresponding angles – exterior angles – interior angles – to lie between – transversal – vertically opposite angles