

Master Lesson Plan
for
Lines and Angles

Board	Standard	Subject	Chapter	Language
NCERT	STD IX	Mathematics	Lines and Angles	English

CURRICULAR GOALS	CG-4: Analyses characteristics and properties of two-dimensional geometric shapes and develops mathematical arguments to explain geometric relationships
COMPETENCIES AS PER NCF/NIPUN BHARAT	C-4.1: Describes relationships including congruence of two-dimensional geometric shapes (such as lines, angles, triangles) to make and test conjectures and solve problems
SDG(Sustainable Development Goals)	SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Learning Teaching Materials	Road Map/Railway map, Straws and Paper Tape
Technology aids	PPT
Cross-Cutting Themes	Educational Technology - PPTs for every component Values and Dispositions - VC_Points of view

MS_Objectives_Lines and Angles

Objective: Teachers will be able to get an overview of the asset objectives in the MLP for the chapter 'Lines and Angles'.

[**Notes to the teacher:** This asset lays down the proposed plan for transacting this chapter. It states the asset objectives of the MLP. This asset is for the teacher's reference and need not be taught to the students.]

Students will be able to –

- recognise the application of angles and lines in the practical everyday examples
- recall the types of angles, angle pairs and their properties
- delineate parallel and intersecting lines
- explain that the sum of linear pair of angles is 180 degrees
- use a systematic process for problem solving to solve questions related to the linear pair axiom
- derive that vertically opposite angles are equal
- identify a systematic procedure to solve problems related to angle pairs
- apply the knowledge of axioms and properties of angle pairs to solve problems
- conclude that lines which are parallel to the same line are parallel to each other
- apply the knowledge of all concepts of lines and angles to solve problems
- appreciate the views of his/her parents with an open mind
- apply the knowledge of angle sum property of triangles and exterior angle theorem.

Time to teach	Asset type	Theme	Sub Theme
5 minutes	Main Script	Line, Curve & Angle	Adjacent angles Angle made by a transversal Angle sum property of a Triangle Condition for a line to be parallel Corresponding angles axiom Intersecting and Non intersecting lines Intersecting lines Linear pair Lines parallel to same line Parallel lines Transversal Transversal of parallel lines

DD_Angles and lines around us

Objective: Students will be able to recognise the application of angles and lines in the practical everyday examples.

Teaching Aids: PPT

Teaching Learning Material (TLM): Road map/Railway map

Notes to the teacher: This asset presents a few applications or use of 'Lines and Angles' in the real world. The teacher can use the PPT along with interaction with the students to present the content. Teacher to show students the examples in the powerpoint and prompt students to identify the application of lines and angles. Teacher to give students time to think how angles/lines are applied in the shown examples.

Parallel and intersecting lines around you

Teacher to show the images of railway lines and road marking as examples for parallel lines. Teacher can use the TLM to show intersecting lines.

Angles around you

Teacher to prompt students to identify angles in each of the below figures. After giving students time to think, show the angle type.

Acute angle: Angle between fingers

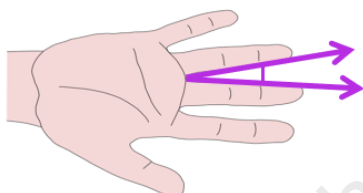


Image source: freesvg.org/hand-palm - Attribution: OpenClipart

Right angle: Staircase

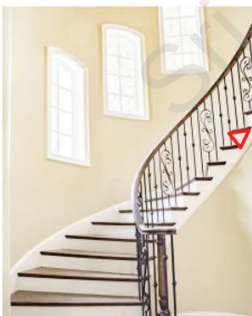


Image source: pixabay.com/photos/luxury-real-estate-stair-winding-1689964/ - Attribution: palmettophoto1

Obtuse angle: Angle between blades of windmill



Image source: openclipart.org/detail/244476/windmill-energy-sources-1 - Attribution: Firkin

Straight angle (180°): Foldable table when opened

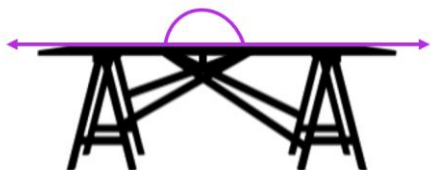


Image source: pixabay.com/vectors/table-office-work-desk-office-desk-2717748/ - Attribution: BedexpStock

Angles around you

Complementary angle: Angles formed between hour, minute and second hand when clock shows three



Image source: pixabay.com/illustrations/clock-time-watch-hours-minutes-4314041/ - Attribution: TheDigitalArtist

Supplementary angle: Angle between the spider web

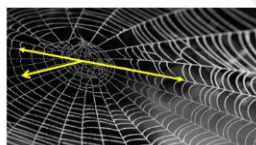


Image source: pexels.com/photo/spider-web-34225/ - Attribution: Pixabay

Adjacent angle: Second hand on a clock when it is between the hour and minute hands, pattern of the stem on some leaves, spokes of a bicycle tyre, white part of a cross section of an orange



Image source:

Clock: freesvg.org/twenty-minutes-before-one - Attribution: OpenClipart

Wheel: freesvg.org/bike-wheel - Attribution: OpenClipart

Orange: freesvg.org/orange-apelsinas - Attribution: OpenClipart

Leaf: pixabay.com/photos/rosenblatt-leaf-wet-water-pearls-2645882/ - Attribution: Alexas_Fotos

Linear pair: Ladder placed against a wall

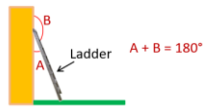


Image source: pixabay.com/photos/wood-ladder-wooden-ladder-garden-3076978/ - Attribution: Susannehs

Vertically opposite angles: Ironing board

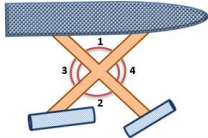


Image source: OC

Reflex angle: Outer angle formed by compass



Image source: freesvg.org/open-compass - Attribution: OpenClipart

Time to teach	Asset type	Theme	Sub Theme
5 minutes	Day-to-day Relevance	Line, Curve & Angle	Line Measure of angles - degree Other angles(acute, obtuse and reflex angles)

QA_Recap of Angles

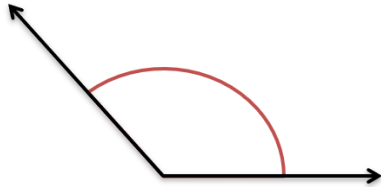
Objective: Students will be able to recall the types of angles, angle pairs and their properties.

Teaching Aids: PPT

Notes to the teacher: The teacher may present the following questions in the class to enable the students to recollect the concepts learnt in the previous classes.

Q1. Identify and define each of the following angles/angle pairs.

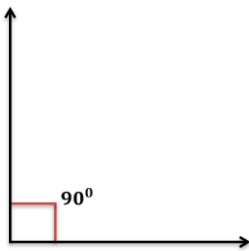
a)



Answer: Obtuse angle.

Definition: An angle that is greater than 90° but less than 180° is an obtuse angle.

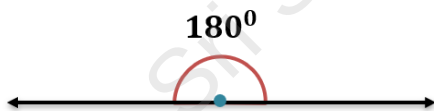
b)



Answer: Right angle.

Definition: An angle that measures 90° is a right angle.

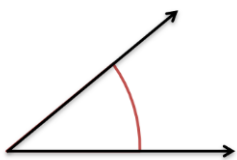
c)



Answer: Straight angle

Definition: An angle that measures 180° is a straight angle.

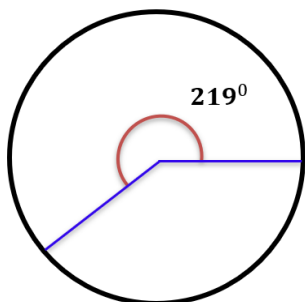
d)



Answer: Acute angle

Definition: An angle that is less than 90° is an acute angle.

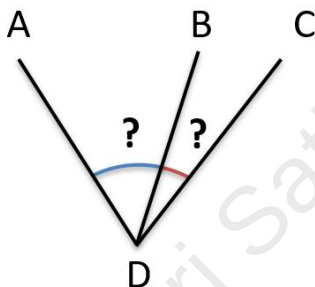
e)



Answer: Reflex angle.

Definition: An angle which is greater than 180° but less than 360° is a reflex angle.

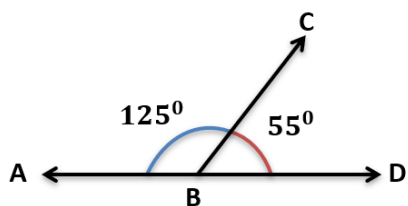
f) What type of angles are $\angle ADB$ and $\angle BDC$?



Answer: Adjacent angles.

Definition: Two angles are adjacent if they have a common vertex, a common arm and their non-common arms are on different sides of the common arm.

g) What type of angles are $\angle ABC$ and $\angle CBD$?

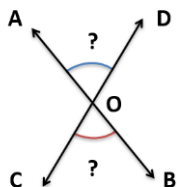


Answer: Linear Pair. $\angle ABC$ and $\angle CBD$ form a linear pair.

Definition: If the non-common arms of two adjacent angles form a straight line, then the pair of angles is called a linear pair. (or)

If the sum of two adjacent angles is equal to 180° , then they form a linear pair.

h) What type of angles are $\angle AOD$ and $\angle COB$?



Answer: Vertically opposite angles. $\angle AOD$ and $\angle COB$ are vertically opposite angles.

Definition: If two lines intersect each other, then the opposite angles formed by these lines are called vertically opposite lines.

Q2. Fill in the blanks with the correct answer:

1. If $\angle ABC + \angle PQR = 90^\circ$, then $\angle ABC$ and $\angle PQR$ are called _____.

Answer: Complementary angles.

2. If $\angle XYZ + \angle PQR = 180^\circ$, then $\angle XYZ$ and $\angle PQR$ are called _____.

Answer: Supplementary angles.

3. If points P, Q, R lie on the same straight line, then P, Q and R are said to be _____ points.

Answer: Collinear points.

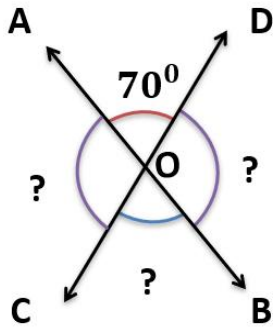
4. If A, B and C are the vertices of a triangle, then A, B and C are _____ points.

Answer: Non-collinear points.

5. $\angle ABC$ and $\angle CBD$ form a linear pair. If $\angle ABC = 45^\circ$, then $\angle CBD =$ _____.

Answer: 135°

Q3. In the following figure, straight lines AB and CD intersect at O. Measure of $\angle AOD = 70^\circ$. Find the measures of $\angle COB$, $\angle AOC$ and $\angle BOD$.



Answer:

$\angle COB = \angle AOD$ (Vertically opposite angles)

$\therefore \angle COB = 70^\circ$

$\angle AOC + \angle AOD = 180^\circ$ (Linear pair)

$\therefore \angle AOC = 180^\circ - 70^\circ$

$\angle AOC = 110^\circ$

$\angle BOD = \angle AOC$ (Vertically opposite angles)

$\therefore \angle BOD = 110^\circ$

Hence $\angle COB = 70^\circ$, $\angle AOC = 110^\circ$ and $\angle BOD = 110^\circ$

Time to teach	Asset type	Theme	Sub Theme
8 minutes	Questions to Assess	Line, Curve & Angle	Adjacent angles Angles based on direction (right, straight and complete) Angles of special measures Collinear and Non collinear points Linear pair Other angles (acute, obtuse and reflex angles) Vertically opposite angle

MS_Parallel and Intersecting lines

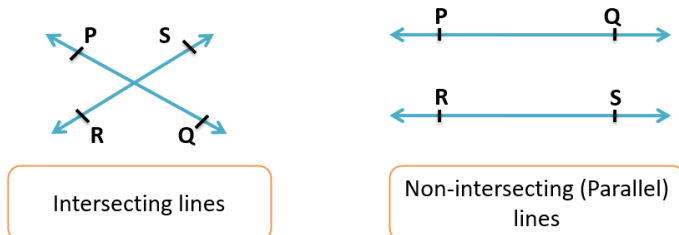
Objective: Students will be able to delineate parallel and intersecting lines.

Teaching Aids: PPT

Notes to the teacher: The teacher may introduce the asset by recalling what a line is. A line extends indefinitely in two directions.

Draw two lines in a notebook. Do they meet? If the lines are extended, do they meet?

We can draw two lines in two different ways.



The point where two lines meet is called the *point of intersection*.

Distance between parallel lines

Do you notice anything with respect to the distance between the two lines in each case (intersecting and non-intersecting/parallel)? The distance between parallel lines remains the same.

How do we know whether two lines are parallel? Do we keep extending them indefinitely?

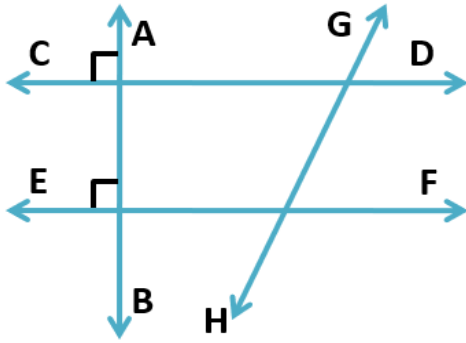
To know whether two lines are parallel,

- Draw a perpendicular to one of the parallel lines and make it intersect the other.
- Repeat the process at some distance away along the parallel line.
- Measure the lengths of these two perpendiculars (i.e between the parallel lines).
- If they are the same, the two lines are parallel.



This distance is called the *distance between parallel lines*.

Can you identify the intersecting and non-intersecting (parallel) lines in the figure?



Answer: Intersecting lines - GH and CD, GH and EF, AB and CD, AB and EF.

Non-intersecting (parallel lines) - CD and EF

Can you give examples for intersecting and non-intersecting lines from daily life?

Sample answers:

Intersecting lines - Scissors, Hands of a clock.

Non-intersecting lines - Handrails, Railway track.

Time to teach	Asset type	Theme	Sub Theme
5 minutes	Main Script	Line, Curve & Angle	Intersecting and Non intersecting lines Intersecting lines Line Lines parallel to same line Parallel lines

MS_Linear pair axiom

Objective: Students will be able to explain that the sum of linear pair of angles is 180 degrees.

Teaching Aids: PPT

Notes to the teacher: The teacher may introduce the asset by recalling that when the sum of two adjacent angles is 180° , then they are called a linear pair/adjacent angles.

What is an axiom?

Axiom is a statement or proposition which is regarded as accepted, or self-evidently true.

Axiom 1: If a ray stands on a line, then the sum of two adjacent angles so formed is 180° .

Here the 'Given Information' is 'ray stands on a line'.

What we are concluding is 'sum of two adjacent angles so formed is 180° '

When we interchange the 'Given Information' and 'Conclusion', the converse is formed.

In this case when we interchange the 'Given Information' and 'Conclusion' it becomes:

Given Information is 'If the sum of two adjacent angles formed is 180° '

Conclusion 'then the ray stands on a line'

Converse of Axiom 1: If the sum of two adjacent angles formed is 180, then the ray stands on a line

How can we check whether the converse is true?

We can draw different adjacent angles as shown in the figure.

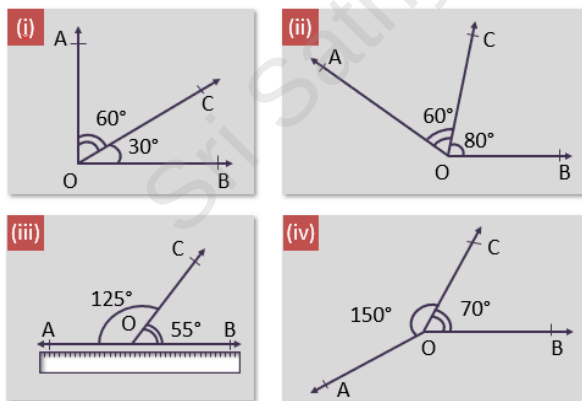


Image Source: Ruler: OC

Keep the ruler in the non-common arm (e.g. OB in (i)).

Does the other non-common arm lie along the ruler?

This occurs only for figure iii where OA and OB lie along the ruler.

We can see that $\angle AOC + \angle COB = 125^\circ + 55^\circ = 180^\circ$.

From this, you may conclude that the statement 'If the sum of two adjacent angles formed is 180° then the ray stands on a line' is true.

We can state this as an axiom:

Axiom 2: If the sum of two adjacent angles is 180° , then the non-common arms of the angles form a line.

Axioms 1 and 2 are together known as Linear Pair Axiom.

Time to teach	Asset type	Theme	Sub Theme
10 minutes	Main Script	Line, Curve & Angle	Adjacent angles Linear pair

QA_Linear Pair

Objective: Students will be able to use a systematic process for problem solving to solve questions related to the linear pair axiom.

Teaching Aids: PPT

Notes to the teacher: The following questions are variations of the questions in the textbook exercise. The teacher may use the following questions to enhance the ability of the students to solve problems related to the linear pair axiom. The teacher may also encourage students to maintain the '=' signs one below the other to improve clarity in presentation.

Q1. Fill in the blanks.

- a. If a ray stands on a line, then the sum of the two adjacent angles so formed is ____.

Answer: 180°

- b. If the sum of two adjacent angles is 180° , then the non-common arms of the angles form a ____.

Answer: line

- c. When the sum of two adjacent angles is 180° , then they are called a _____ of angles.

Answer: linear pair

- d. If the measure of an angle is 180° , the two arms of the angle will form a _____.

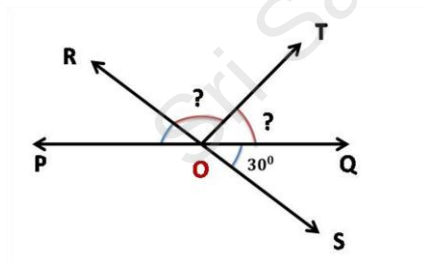
Answer: straight line

- e. If $\angle ABC = y$, then reflex $\angle ABC =$ _____.

Answer: $360^\circ - y$

Q2. Answer the following.

1. In the following figure lines PQ and RS intersect at O. If $\angle POR + \angle QOT = 80^\circ$ and $\angle QOS = 30^\circ$, find $\angle QOT$ and reflex $\angle ROT$.



Given:

$$\angle POR + \angle QOT = 80^\circ \text{ and } \angle QOS = 30^\circ$$

To find : $\angle QOT$ and reflex $\angle ROT$

Solution:

$$\angle POR = \angle QOS \text{ (Vertically opposite angles)}$$

$$\angle POR = 30^\circ \text{ (given } \angle QOS = 30^\circ)$$

$$\angle POR + \angle QOT = 80^\circ \text{ (Given)}$$

$$30^\circ + \angle QOT = 80^\circ$$

$$\angle QOT = 80^\circ - 30^\circ$$

$$\angle QOT = 50^\circ$$

$$\angle POR + \angle ROT + \angle QOT = 180^\circ (\because \angle POQ \text{ is a straight angle})$$

$$30^\circ + \angle ROT + 50^\circ = 180^\circ$$

$$\therefore \angle ROT = 180^\circ - 30^\circ - 50^\circ$$

$$\angle ROT = 100^\circ$$

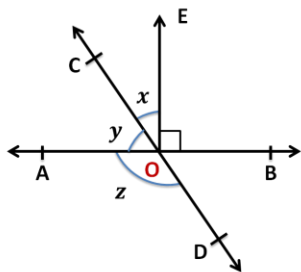
$$\therefore \text{reflex } \angle ROT = 360^\circ - 100^\circ \\ = 260^\circ$$

Answer:

$$\angle QOT = 50^\circ$$

$$\text{reflex } \angle ROT = 260^\circ$$

2. In the following figure, lines AB and CD intersect at O. If $\angle EOB = 90^\circ$ and $x : y = 1 : 4$, find z.



Given:

AB and CD intersect at O

$\angle EOB = 90^\circ$ and $x : y = 1 : 4$

To find: z

Solution:

$$\angle AOE + \angle EOB = 180^\circ (\text{linear pair})$$

$$\angle AOE + 90^\circ = 180^\circ (\text{Given } \angle EOB = 90^\circ)$$

$$\angle AOE = 180^\circ - 90^\circ$$

$$\angle AOE = 90^\circ$$

But $\angle AOE = \angle AOC + \angle COE$ (from the figure)

$$\therefore \angle AOC + \angle COE = 90^\circ$$

$$\therefore x + y = 90^\circ$$

But $x : y = 1 : 4$ (given)

$$\text{So, } y = \frac{4}{5} \times 90^\circ$$

$$y = 72^\circ$$

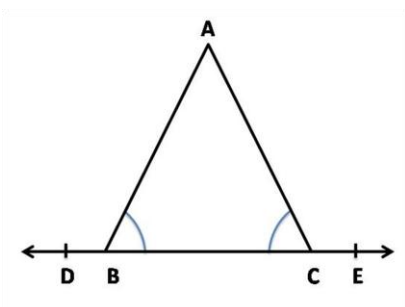
$$y + z = 180^\circ (\text{linear pair})$$

$$\text{So, } z = 180^\circ - 72^\circ$$

$$z = 108^\circ$$

Answer: $z = 108^\circ$

3. In the following figure, if $\angle ABC = \angle ACB$, then prove that $\angle ABD = \angle ACE$.



Given: $\angle ABC = \angle ACB$

To prove: $\angle ABD = \angle ACE$

Proof:

$\angle ABD + \angle ABC = 180^\circ$ (linear pair)

So $\angle ABD = 180^\circ - \angle ABC$ ----- (1)

$\angle ACB + \angle ACE = 180^\circ$ (linear pair)

So $\angle ACE = 180^\circ - \angle ACB$ ----- (2)

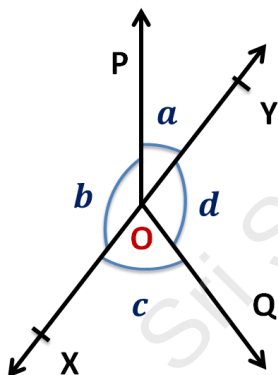
$\angle ABC = \angle ACB$ (given)

$180^\circ - \angle ABC = 180^\circ - \angle ACB$

$\angle ABD = \angle ACE$ [from (1) and (2)]

Hence proved.

4. In the following figure, if $a + b = c + d$, then prove that XOY is a straight line.



Given: $a + b = c + d$

To prove: XOY is a straight line

Proof:

$a + b + c + d = 360^\circ$ (Angle at a point)

$a + b + a + b = 360^\circ$ (given $a + b = c + d$)

$2a + 2b = 360^\circ$

$2(a + b) = 360^\circ$

$a + b = 360^\circ \div 2$

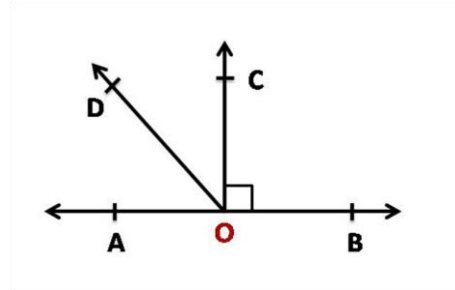
$a + b = 180^\circ$

$\angle XOY = 180^\circ$

So, XOY is a straight line.

Hence proved.

5. In the following figure, AOB is a straight line. Ray OC is perpendicular to line AB. OD is another ray lying between rays OA and OC. Prove that $\angle DOC = \frac{1}{2}(\angle DOB - \angle AOD)$.



Given:

1. Ray $OC \perp$ line AB
2. Ray OD lies between rays OA and OC.

To Prove: $\angle DOC = \frac{1}{2}(\angle DOB - \angle AOD)$

Proof:

$$\angle AOC + \angle COB = 180^\circ \text{ (linear Pair)}$$

$$\angle AOC + 90^\circ = 180^\circ \text{ (given Ray } OC \perp \text{ line AB)}$$

$$\therefore \angle AOC = 90^\circ$$

$$\angle DOC = \angle AOC - \angle AOD \text{ (from the left side of the figure)}$$

$$\therefore \angle DOC = 90^\circ - \angle AOD \text{ -----(1)}$$

$$\angle DOC = \angle DOB - \angle COB \text{ (from the right side of the figure)}$$

$$= \angle DOB - 90^\circ \text{ -----(2)}$$

$$2\angle DOC = 90^\circ - \angle AOD + \angle DOB - 90^\circ \text{ [Adding (1) and (2)]}$$

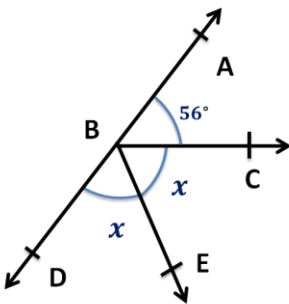
$$2\angle DOC = \angle DOB - \angle AOD$$

$$\therefore \angle DOC = \frac{1}{2}(\angle DOB - \angle AOD)$$

Hence proved.

6. It is given that $\angle ABC = 56^\circ$ and AB is produced to D. Ray BE bisects $\angle CBD$. Draw a figure from the given information. Find $\angle ABE$ and reflex $\angle EBD$.

Figure:



Given:

1. $\angle ABC = 56^\circ$

2. Ray BE bisects $\angle CBD$

To Find:

1. $\angle ABE$
2. Reflex $\angle EBD$

Solution:

$\angle CBE = \angle EBD$ (Ray BE bisects $\angle CBD$)

Let $\angle CBE = x$

So $\angle EBD = x$

$\angle DBC + \angle ABC = 180^\circ$ (linear pair)

$$2x + 56^\circ = 180^\circ$$

$$2x = 180^\circ - 56^\circ$$

$$= 124^\circ$$

$$\therefore x = 62^\circ$$

So $\angle CBE = \angle EBD = 62^\circ$

$\angle ABE = 56^\circ + x$ (from the figure)

$$\angle ABE = 56^\circ + 62^\circ$$

$$= 118^\circ$$

$$\text{Reflex } \angle EBD = 360^\circ - \angle EBD$$

$$= 360^\circ - 62^\circ$$

$$= 298^\circ$$

Answer:

$\angle ABE = 118^\circ$ and Reflex $\angle EBD = 298^\circ$

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Questions to Assess	Line, Curve & Angle	Bisectors of an angle Linear pair Measure of angles - degree

MS_Vertically opposite angles

Objective: Students will be able to derive that vertically opposite angles are equal.

Teaching Aids: PPT

Teaching Learning Material (TLM): StrawModel to show that vertically opposite angles are equal.

What do you need? 4 straws and paper tape.

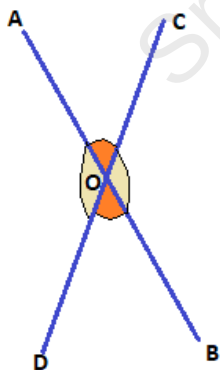
Get ready: Take a pair of straws, keep one straw above the other and fix it tightly using paper tape as shown in the figure. Prepare two TLMs like this.



Image Source - OC

How to use: The teacher may use the TLM to show that the vertically opposite angles are equal, as explained in the asset content, before proving the result.

Notes to the teacher: The teacher can start the class by drawing two lines AB and CD intersecting at O and asking students to identify two pairs of vertically opposite angles.



The vertically opposite angles in the figure are i) $\angle AOC$, $\angle BOD$ and ii) $\angle AOD$, $\angle BOC$

[Notes to the teacher: The teacher may use the TLM to demonstrate that $\angle AOC = \angle BOD$ and $\angle AOD = \angle BOC$ as follows.



Image Source - OC

Step 1) The teacher asks to imagine the two intersecting line segments as AB and CD and the point of intersection as O.

Step 2) Now the teacher bends line segment AO on OB and line segment CO on OD as follows.

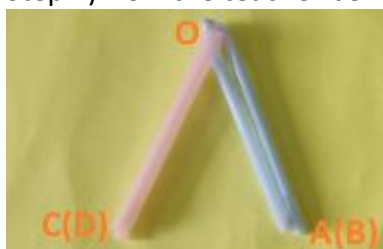


Image Source - OC

$\angle AOC$ overlaps on $\angle BOD$. Thus $\angle AOC = \angle BOD$.

Step 3) Now the teacher takes the second straw model, names the line segments as AB and CD as in step1. The teacher bends segment AO on OB and segment DO on OC as follows:

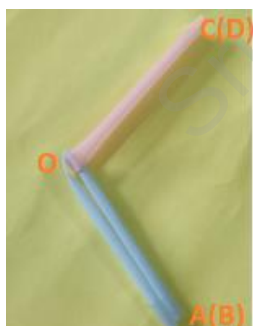


Image Source - OC

$\angle AOD$ overlaps on $\angle BOC$. Thus, $\angle AOD = \angle BOC$.]

Theorem:

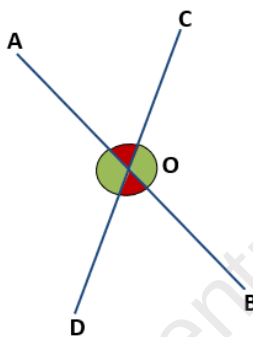
Statement: If two lines intersect each other, then the vertically opposite angles are equal.

[Notes to the teacher: The teacher may involve the students in the following steps of proving

the theorem.

- Draw a labelled diagram to represent the information given in the statement of the theorem.
- Given: Write the information given in the figure.
- To prove: Write what is to be proved.
- Construction: Write about any additions to the figure, required to prove the theorem.
- Proof: Write the proof of the theorem step by step using the above information.]

Proof of the theorem:



Given: Line segments AB and CD intersect at O.

To prove: $\angle AOC = \angle BOD$ and $\angle AOD = \angle BOC$.

Proof:

[Notes to the teacher: Before starting the proof, the teacher may ask the students about linear pair of angles and explain that if a ray stands on a line, then the sum of two adjacent angles x, y is 180° . The pair of angles x, y is called a linear pair of angles. To prove that $\angle AOC = \angle BOD$, the teacher asks students to identify two linear pairs of angles involving $\angle AOC$ and $\angle BOD$ in the figure and write the corresponding relations as follows.]

$\angle AOC, \angle AOD$ is a linear pair of angles.

Thus, $\angle AOC + \angle AOD = 180^\circ$. -----(i)

$\angle BOD$ and $\angle AOD$ is also a linear pair of angles. Thus,

$\angle BOD + \angle AOD = 180^\circ$. -----(ii)

From equations (i) and (ii),

$\angle AOC + \angle AOD = \angle BOD + \angle AOD$.

Hence, $\angle AOC = \angle BOD$.

[Notes to the teacher: Now the teacher encourages students to prove that $\angle AOD = \angle BOC$. The teacher asks students to identify two linear pairs of angles involving $\angle AOD$ and $\angle BOC$ and write the corresponding relations.]

Examples:

[Notes to the teacher:

While solving problems, the teacher may encourage the students to do the following steps.

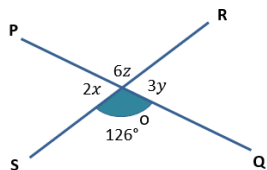
→ Read the question and draw a labelled figure, to represent the information given in the question.

→ Use the figure, and break down the question into what is given and what is to be

proved/obtained.

→Use the information step by step to prove the result/obtain the unknowns.]

1) In the figure, find the values of x , y and z .



Given: $\angle SOQ = 126^\circ$

To find x , y , z .

We have $6z = 126^\circ$ (Vertically opposite angles)

$$z = \frac{126^\circ}{6} = 21^\circ$$

$2x + 126^\circ = 180^\circ$ (Linear pair of angles)

$$2x = 180^\circ - 126^\circ = 54^\circ$$

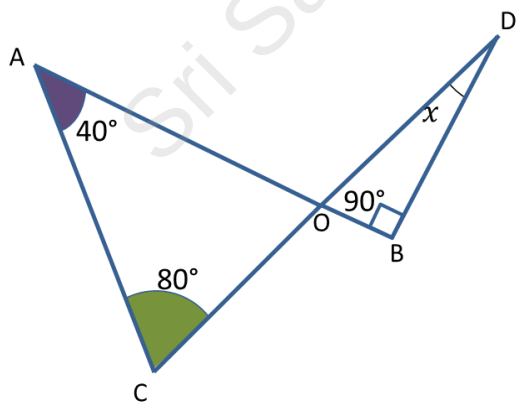
$$x = \frac{54^\circ}{2} = 27^\circ$$

$3y = 2x = 54^\circ$ (Vertically opposite angles)

$$y = \frac{54^\circ}{3} = 18^\circ$$

Thus, $x = 27^\circ$, $y = 18^\circ$ and $z = 21^\circ$.

2) In the figure, find the value of x .



Solution: In $\triangle AOC$,

$\angle ACO + \angle CAO + \angle AOC = 180^\circ$ (Angle sum property of a triangle.)

$$80^\circ + 40^\circ + \angle AOC = 180^\circ$$

$$\angle AOC = 180^\circ - 120^\circ = 60^\circ$$

AB and CD intersect at point O.

$\therefore \angle DOB = \angle AOC = 60^\circ$ (Vertically opposite angles.)

Now in $\triangle DOB$,

$\angle DBO + \angle BDO + \angle DOB = 180^\circ$ (Angle sum property of a triangle.)

$90^\circ + x + 60^\circ = 180^\circ, x = 180^\circ - 150^\circ = 30^\circ$

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Main Script	Line, Curve & Angle	Vertically opposite angle

MS_Solving Problems

Objective: Students will be able to identify a systematic procedure to solve problems related to angle pairs.

Teaching Aids: PPT

Notes to the teacher: The teacher may give the students the following guidelines to help them to solve problems systematically.

Mathematical problems may seem complicated at first sight. But if we follow a systematic approach, we will realise that it is not only quite easy but also interesting to solve problems and arrive at the right answer.

Let us understand how to approach problems related to lines and angles.

1. Read the question at least two times.
2. Divide the question into 2 parts: What are the given facts? What are you required to

find or prove?

3. If a figure is given, relate the question to the figure. That is, write the given measures of the angles in the figure. And mark the angles whose measure you have to find, with a question mark or a variable like x , y , z , a , b , c , etc.
4. In case the figure is not given in the question, draw a figure to suit the given data. Then follow step 3 above.
5. Now make any extra construction if needed. Sometimes you may need to draw a line parallel to the given lines and sometimes you may need to extend the given lines.
6. If the question states that certain lines are parallel, then identify the transversals to those lines.
7. From the given angles and the angles you need to find, group the linear pairs, corresponding angles, alternate interior angles, angles on the same side of the transversal, vertically opposite angles, angles in a triangle or exterior and interior opposite angles of a triangle, etc.
8. Proceed from the known to unknown arriving at one conclusion at a time or finding one angle at a time. You will see that you have solved the problem.
9. When you are required to prove that 2 lines are parallel with certain given angle measures, identify the transversal of those lines first.
10. From the given angles identify a linear pair, corresponding angles, alternate interior angles, angles on the same side of the transversal, vertically opposite angles. If the corresponding angles/ alternate interior angles/ angles on the same side of the transversal are not directly given, calculate them using the given facts.
11. Then apply any one of the 3 conditions for lines to be parallel and you will be able to prove that the lines are parallel.

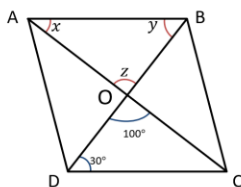
Let us now solve a few problems using the above approach.

Example 1:

ABCD is a parallelogram. The diagonals AC and BD intersect at O. $\angle BDC = 30^\circ$ and $\angle DOC = 100^\circ$. Find the angle measures of $\triangle AOB$.

Method of systematic solution:

1. Read the question twice.
2. Given: ABCD is a parallelogram. The diagonals AC and BD intersect at O. $\angle BDC = 30^\circ$ and $\angle DOC = 100^\circ$.
To find: Angle measures of AOB
3. Here the figure is not given. So let us draw the figure first.



4. We have marked the given measures in the above figure. We have to find the measures of $\angle OAB$, $\angle AOB$ and $\angle OBA$. Let $\angle OAB = x$, $\angle OBA = y$ and $\angle AOB = z$.
5. Now as ABCD is a parallelogram, let us identify the parallel lines and the transversal. $AB \parallel DC$. AC is one transversal and BD is another transversal.

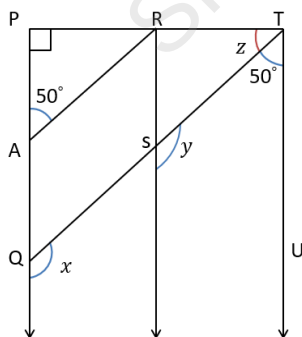
[Notes to the teacher: If students suggest that $AD \parallel BC$, the teacher may agree with them and ask them to choose the lines whose angles with the transversals are given]

6. Take lines $AB \parallel DC$ for which BD is a transversal.
Can you observe any pairs of corresponding angles or alternate interior angles which include the given angle $\angle BDC$?
Yes. $\angle BDC$ and y are alternate interior angles.
So $y = 30^\circ$
7. Can you observe any other angle pair which includes the given angle $\angle DOC$?
Yes. $\angle DOC$ and $\angle AOB$ are vertically opposite angles. Hence they are equal.
So $\angle AOB = 100^\circ$.
8. In $\triangle AOB$, $\angle OBA = 30^\circ$ and $\angle AOB = 100^\circ$,
So, $\angle OAB = 180^\circ - (100^\circ + 30^\circ)$ (Applying angle sum property of a triangle)
 $\angle OAB = 50^\circ$

Example 2:

In the following figure, $PQ \parallel RS \parallel TU$. $TP \perp PQ$. If $\angle QTU = 50^\circ$, find the values of x , y and z . If $\angle PAR = 50^\circ$, prove that $AR \parallel QT$.

[Notes to the teacher: The solution to this problem is given below. The teacher may explain how the answer is arrived at using the steps of systematic problem solving]



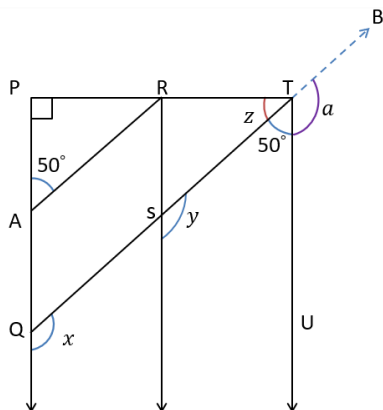
Solution:

Given: $PQ \parallel RS \parallel TU$. $TP \perp PQ$. $\angle QTU = 50^\circ$ and $\angle PAR = 50^\circ$.

To find: x , y and z

To prove: $AR \parallel QT$

Extend QT to B. Let $\angle BTU = a$.



From the figure,

$$a + 50^\circ = 180^\circ \text{ (Linear Pair)}$$

$$\therefore a = 130^\circ$$

$PQ \parallel RS \parallel TU$ and QT is a transversal.

x , y and a are corresponding angles of these parallel lines.

So they are equal.

$$\therefore x = 130^\circ \text{ and } y = 130^\circ$$

$$\angle PQT + x = 180^\circ \text{ (linear pair)}$$

$$\angle PQT + 130^\circ = 180^\circ$$

$$\angle PQT = 50^\circ$$

In $\triangle PQT$, $\angle P = 90^\circ$ and $\angle PQT = 50^\circ$,

So, $z = 180^\circ - (90^\circ + 50^\circ)$ (Applying angle sum property of a triangle)

$$z = 40^\circ$$

For lines AR and QT, PQ is a transversal.

$\angle PQT$ and $\angle PAR$ are corresponding angles.

$$\text{But } \angle PQT = \angle PAR = 50^\circ$$

So $AR \parallel QT$ (Converse of corresponding angles axiom).

So, we see that the above systematic approach makes problem solving easy and interesting.

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Main Script	Line, Curve & Angle	Angle made by a transversal Angle sum property of a Triangle

			Condition for a line to be parallel Corresponding angles axiom Linear pair Lines parallel to same line Parallel lines Transversal Transversal of parallel lines Vertically opposite angle
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QA_Angle pairs

Objective: Students will be able to apply the knowledge of axioms and properties of angle pairs to solve problems.

Teaching Aids: Worksheet

Notes to the teacher: Teacher may present the questions and allow the students to write or say the answers before revealing to them.

I. Choose the correct option in each of the following:

1) Lines AB and CD intersect at O. If $\angle AOC = (3x - 10)^\circ$ and $\angle BOD = (20 - 2x)^\circ$, then the value of x is

a) 6° b) 12° c) 36° d) None of these

Ans: (a)

Vertically opposite angles are equal.

$$\angle AOC = \angle BOD.$$

$$3x - 10 = 20 - 2x, \text{ Solving } x = 6$$

2) If two interior angles on the same side of a transversal intersecting two parallel lines are in the ratio 5:4 then the greater of the two angles is

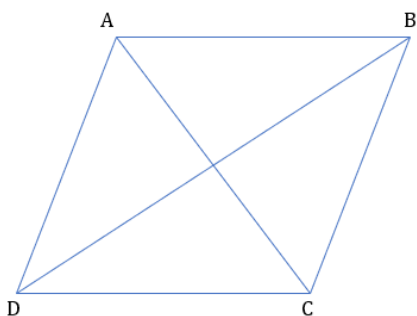
- a) 64° b) 100° c) 120° d) 136°

Ans: (b)

When a transversal intersects two parallel lines, the sum of angles on the same side of the transversal is 180° . If these angles are in the ratio, 5:4, the greater angle is $\frac{5}{9} \times 180^\circ = 100^\circ$

3) In the following figure, given ABCD is a rhombus and $\angle DCB = 120^\circ$, then $\angle DBA$ is:

- a) 20° b) 30° c) 40° d) 60°



Ans: (b)

BC is the transversal intersecting two parallel lines AB and DC. Sum of the angles on the same side of the transversal is 180° .

$$\text{Thus, } \angle DCB + \angle ABC = 180^\circ$$

$$120^\circ + \angle ABC = 180^\circ$$

$$\angle ABC = 180^\circ - 120^\circ = 60^\circ \text{ and } \angle DBA = \frac{1}{2} \times \angle ABC = \frac{1}{2} \times 60^\circ = 30^\circ$$

4. The given rectangular flag is of Scotland. Let vertices of the rectangle be P, Q, R and S and let the diagonals PR and QS intersect each other at O. Select the correct pair of vertically opposite angles.

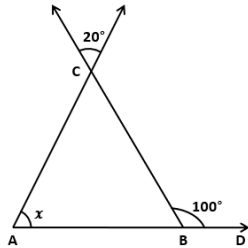


Image source: pixabay.com/vectors/britain-europe-scotland-flag-151038/ - Attribution: OpenClipart-Vectors

a) $\angle POQ, \angle POS$ b) $\angle POQ, \angle QOR$ c) $\angle POQ, \angle SOR$ d) $\angle POS, \angle QOR$

Ans: (c) and (d)

II. Find x in the following figure,



Solution:

In $\triangle ABC$, $\angle C = 20^\circ$ (Vertically opposite angles).

$\angle B + 100^\circ = 180^\circ$. (Linear pair).

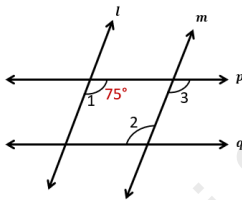
$\angle B = 180^\circ - 100^\circ = 80^\circ$.

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

$x + 80^\circ + 20^\circ = 180^\circ$.

$x = 180^\circ - 80^\circ - 20^\circ = 80^\circ$.

III. In the following figure, $p \parallel q$ and $l \parallel m$, where $\angle 1 = 75^\circ$. Find the value of $\angle 2$.



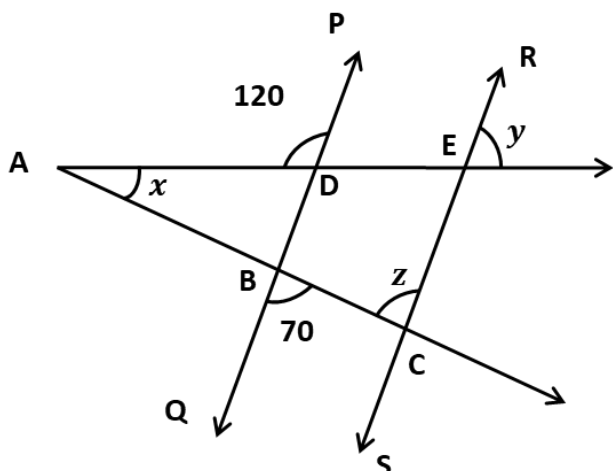
Solution:

$\angle 1 = \angle 3$ (corresponding angles since l and m are parallel and p is the transversal)

$\angle 3 = \angle 2$ (alternate interior angles since p and q are parallel and m is the transversal)

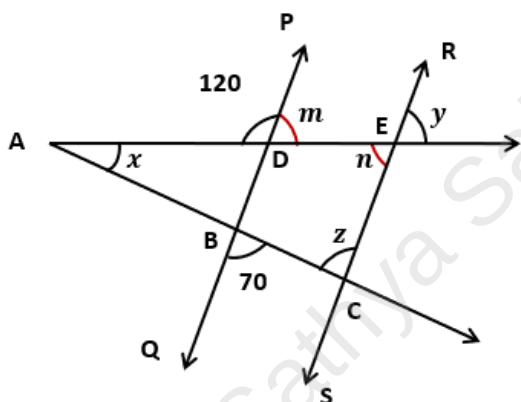
Hence, $\angle 2 = \angle 1 = 75^\circ$

IV. In the following figure find x , y and z , if $PQ \parallel RS$.



Solution:

Let $\angle PDE = m$ and $\angle DEC = n$.



$\angle z = 70^\circ$ (alternate interior angles since $PQ \parallel RS$ and BC is a transversal)

$\angle m + 120^\circ = 180^\circ$ (Linear Pair)

$\angle m = 180^\circ - 120^\circ = 60^\circ$

$\angle y = \angle m = 60^\circ$ (Corresponding angles since $PQ \parallel RS$ and AE is a transversal)

$\angle n = \angle y = 60^\circ$ (Vertically opposite angles)

In $\triangle ACE$,

$\angle x + \angle z + \angle n = 180^\circ$ (Angle sum property)

$\angle x = 180^\circ - \angle z - \angle n$

$\angle x = 180^\circ - 70^\circ - 60^\circ = 50^\circ$

V. Mona went to an electric shop to buy a fan for her new house. During her search, she found a four blade fan where A, B, C and D represent the four blades and they intersect each other at O. She was given the information that reflex of $\angle DOB = 280^\circ$. Find $\angle AOD$.



Image source: Fan: pixabay.com/photos/air-conditioning-fan-ceiling-387006/ - Attribution: PublicDomainImages

Solution:

reflex of $\angle DOB = 280^\circ$ (Given)

$$\angle DOB = 360^\circ - 280^\circ = 80^\circ$$

$$\angle DOB + \angle AOD = 180^\circ \text{ (Linear Pair)}$$

$$80^\circ + \angle AOD = 180^\circ$$

$$\angle AOD = 180^\circ - 80^\circ = 100^\circ$$

Time to teach	Asset type	Theme	Sub Theme
15 minutes	Questions to Assess	Line, Curve & Angle	Transversal of parallel lines Vertically opposite angle

MS_Parallelism of Multiple Lines

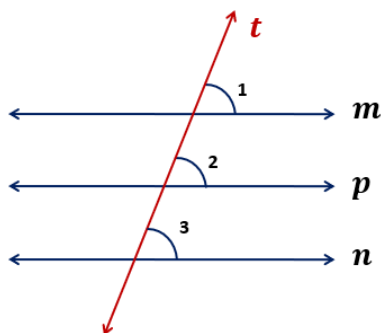
Objective: Students will be able to conclude that lines which are parallel to the same line are parallel to each other.

Teaching Aids: PPT

Notes to the teacher: The teacher may use statements and questions as given below to help the students arrive at the conclusion that lines parallel to the same line are parallel to each other.

If two lines p and n are parallel to a given line m , will p and n be parallel to each other? Let us find out.

Look at the following lines. It is given that line $p \parallel$ line m and line $n \parallel$ line m .



Let us draw a transversal t for the lines m , p and n .

Now, what can you say about $\angle 1$ and $\angle 2$? Are they equal?

Answer: Yes. $\angle 1 = \angle 2$ (by corresponding angles axiom)

Now you know that line $n \parallel$ line m .

What can you say about $\angle 1$ and $\angle 3$?

Answer: $\angle 1 = \angle 3$ (by corresponding angles axiom)

$\angle 1 = \angle 2$ and $\angle 1 = \angle 3$. So, what is the relation between $\angle 2$ and $\angle 3$?

Answer: $\angle 2 = \angle 3$.

With reference to lines p and n and the transversal t , what kind of angles are $\angle 2$ and $\angle 3$?

Answer: Corresponding angles.

So, for lines p and n cut by the transversal t , the corresponding angles are equal.

Now, what can we conclude about lines p and n ?

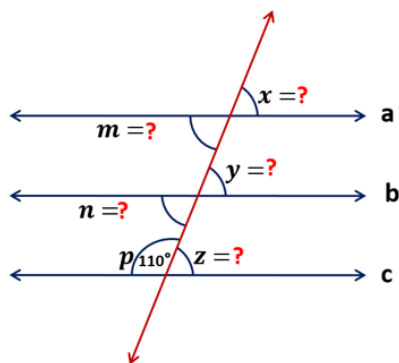
Answer: Line $p \parallel$ line n . (by the converse of corresponding angles axiom)

If we draw more lines parallel to line m , all of them will be parallel to each other.

This result is stated as the following theorem: **Lines parallel to the same line are parallel to each other.**

Let us apply the above theorem to solve a problem.

Question: In the following figure, $a \parallel b$ and $a \parallel c$. If $p = 110^\circ$, find the values of x , y , z , m and n



Solution:

$a \parallel b$ and $a \parallel c. \therefore b \parallel c.$

$p + z = 180^\circ$ (linear pair)

$110^\circ + z = 180^\circ$

$z = 70^\circ$

$z = n$ (Alternate interior angles theorem)

$z = m$ (Alternate interior angles theorem)

$z = y$ (Corresponding angles axiom)

$z = x$ (Corresponding angles axiom)

Hence $x = 70^\circ, y = 70^\circ, m = 70^\circ$ and $n = 70^\circ$

Time to teach	Asset type	Theme	Sub Theme
10 minutes	Main Script	Line, Curve & Angle	Angle made by a transversal Condition for a line to be parallel Lines parallel to same line Parallel lines Transversal Transversal of parallel lines

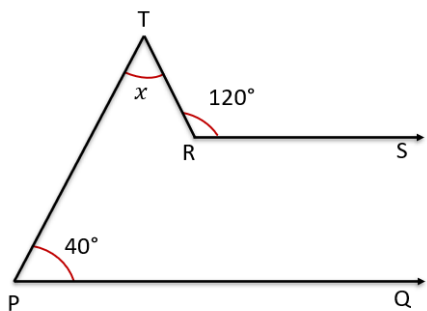
QA_Lines Parallel to the Same Line

Objective: Students will be able to apply the knowledge of all concepts of lines and angles to solve problems.

Teaching Aids: Worksheet

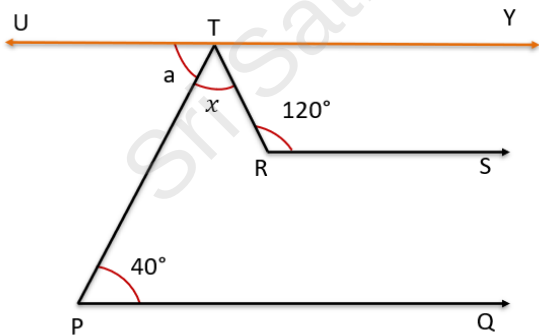
Notes to the teacher: The teacher may use the following questions and the attached worksheet to enhance the ability of students to solve problems related to parallel lines. The teacher may frequently ask the students to identify the corresponding angles, alternate interior angles and interior angles on the same side of the transversal. The students should also be made to repeat the theorems and axioms as frequently as possible so that the rules get fixed in their minds.

Q1. In the following figure, $PQ \parallel RS$. $\angle QPT = 40^\circ$, $\angle TRS = 120^\circ$ and $\angle PTR = x$. Find x .



Solution:

Through, T, draw UY parallel to PQ.



Now $PQ \parallel RS \parallel UY$.

Let $\angle UTP = a$.

$PQ \parallel UY$ and TP is a transversal.

$\therefore \angle UTP = \angle TPQ$ (Alternate interior angles are equal)

$$a = 40^\circ$$

$RS \parallel UY$ and TR is a transversal.

$\therefore \angle UTR = \angle TRS$ (Alternate interior angles are equal)

$$a + x = 120^\circ$$

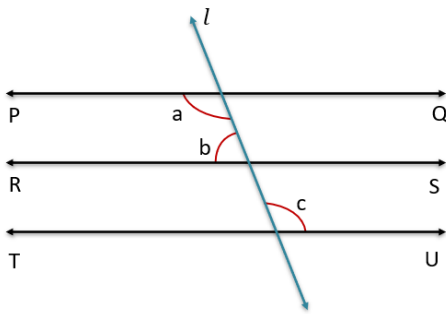
$$40^\circ + x = 120^\circ$$

$$x = 120^\circ - 40^\circ$$

$$x = 80^\circ$$

Answer: $x = 80^\circ$

Q2. In the following figure, $PQ \parallel RS$ and $RS \parallel TU$. Also, $b : c = 4 : 5$. Find a .



Solution:

$PQ \parallel RS$ and $RS \parallel TU$.

$\therefore PQ \parallel TU$.

$\therefore a = c$ (Alternate interior angles are equal)

$b : c = 4 : 5$

If $b = 4x$, then $c = 5x$.

$PQ \parallel RS$

$\therefore a + b = 180^\circ$ (Interior angles on the same side of the transversal are supplementary)

$c + b = 180^\circ$ (Substituting c for a as $a = c$)

$$5x + 4x = 180^\circ$$

$$9x = 180^\circ$$

$$x = 20^\circ$$

$$c = 5x$$

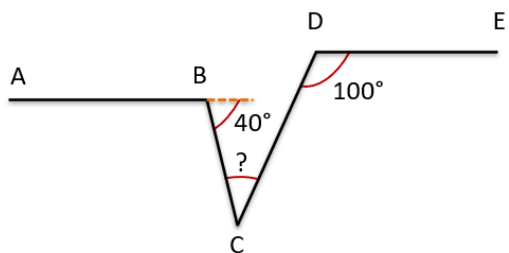
$$c = 100^\circ$$

$$\therefore a = 100^\circ$$

Answer: $a = 100^\circ$

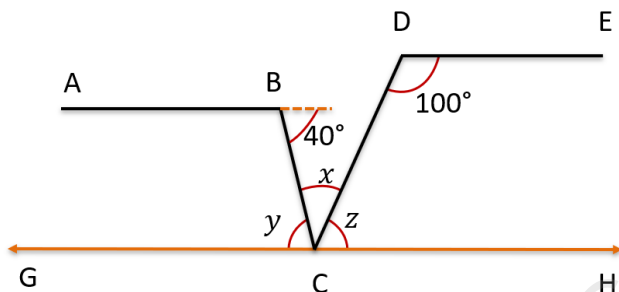
Q3. The following figure represents the route taken by Shyam as he travels from point A to point E. Shyam starts from point A and walks along the straight road, AB. There is an obstacle at point B. So he turns right making an angle of 40° with the path ahead and walks along the road represented by BC. At C, he takes a left turn and walks along the road

represented by CD. He then turns 100° to the right, and walks along the road DE and reaches his destination, E. If $AB \parallel DE$, find $\angle BCD$.



Solution:

Through C, draw $GH \parallel AB$. Let $\angle BCD = x$, $\angle GCB = y$ and $\angle HCD = z$.



$AB \parallel DE$ and $GH \parallel AB$.

So $GH \parallel DE$. DC is a transversal.

$\therefore z + 100^\circ = 180^\circ$ (Interior angles on the same side of the transversal are supplementary)

$$\therefore z = 180^\circ - 100^\circ$$

$$\therefore z = 80^\circ$$

$GH \parallel AB$ and BC is a transversal.

$$\therefore y = 40^\circ \text{ (Alternate interior angles are equal)}$$

$$x + y + z = 180^\circ \text{ (Sum of angles at a point on a line is } 180^\circ)$$

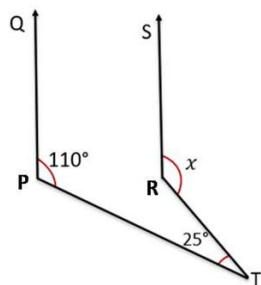
$$x + 40^\circ + 80^\circ = 180^\circ$$

$$x + 120^\circ = 180^\circ$$

$$x = 60^\circ$$

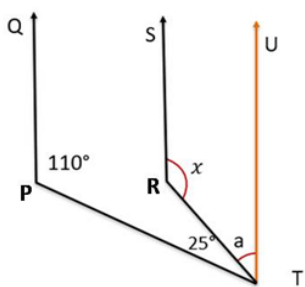
Answer: $\angle BCD = 60^\circ$

Q4. In the following figure, $PQ \parallel RS$. $\angle QPT = 110^\circ$ and $\angle PTR = 25^\circ$. Find x .



Solution:

Through T, draw $TU \parallel RS$. Let $\angle RTU = a$.



$TU \parallel RS$ and $PQ \parallel RS$.

So $TU \parallel PQ$. PT is a transversal.

$\therefore \angle QPT + \angle PTU = 180^\circ$ (Interior angles on the same side of the transversal are supplementary)

$$110^\circ + (25^\circ + a) = 180^\circ$$

$$135^\circ + a = 180^\circ$$

$$a = 45^\circ$$

Now, $TU \parallel RS$ and RT is a transversal.

$\therefore \angle TRS + \angle RTU = 180^\circ$ (Interior angles on the same side of the transversal are supplementary)

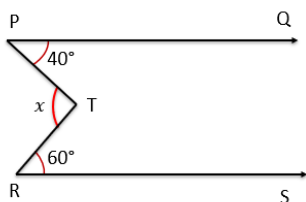
$$x + a = 180^\circ$$

$$x + 45^\circ = 180^\circ$$

$$x = 135^\circ$$

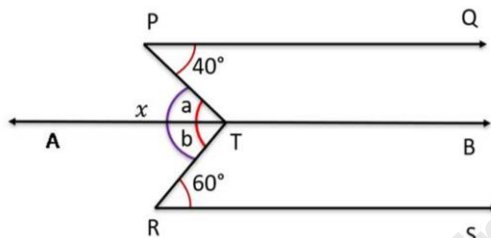
Answer: $x = 135^\circ$

Q5. In the following figure, $PQ \parallel RS$. $\angle QPT = 40^\circ$, $\angle SRT = 60^\circ$ and $\angle PTR = x$. Find x



Solution:

Through T, draw $AB \parallel PQ$. Let $\angle ATP = a$ and $\angle ATR = b$.



From the figure,

$$x = a + b \dots \dots \dots (1)$$

$AB \parallel PQ$ and $PQ \parallel RS$

$\therefore AB \parallel RS$. RT is a transversal.

$\angle ATR = \angle SRT$ (Alternate interior angles are equal)

$$b = 60^\circ$$

$AB \parallel PQ$ and PT is a transversal.

$\angle ATP = \angle QPT$ (Alternate interior angles are equal)

$$a = 40^\circ$$

$$x = a + b \dots \dots \dots \text{from (1)}$$

$$x = 40^\circ + 60^\circ$$

$$x = 100^\circ$$

Answer: $x = 100^\circ$

Time to teach	Asset type	Theme	Sub Theme
20 minutes	Questions to Assess	Line, Curve & Angle	Angle made by a transversal Condition for a line to be parallel Corresponding angles axiom Linear pair Lines parallel to same line Parallel lines Transversal Transversal of parallel lines Vertically opposite angle

VC_Points of view

Objective: Students will be able to appreciate the views of his/her parents with an open mind.

Teaching Aids: PPT

Concept:

What we see of an object or a situation depends upon from where we are viewing. People may differ in their opinion, based on from where each is viewing the same situation.

In a situation involving more than one person, if you draw a line to represent an individual point of view, you may find the lines intersecting each other! How can we minimise these intersections? If two points of view are supplementary, namely, together they provide a complete picture, wouldn't life be smooth?

Oftentimes, teenagers find it difficult to see where the parents are coming from! If only they can understand a parent's perspective, they will accept their concerns and make considered decisions.

Notes to the teacher:

1. Please narrate the following story, and ask the students to consider the Discussion Questions.
2. Let the students volunteer to answer each question.
3. After all the questions are answered, you could summarise the discussion and provide them points to reflect upon.

Story:

The teacher points at a news item from the day's newspaper titled 'Missing boy found in Bengaluru' and reads this part aloud: "Vinod Rao, aged 16, hailing from Hyderabad was reported missing for over a week. He was found near the railway station in Bengaluru doing odd jobs to survive. Vinod left his home after an argument with his parents about buying a new smartphone for him. Vinod's parents were relieved to hear that he was fine and were waiting to welcome him home."

The teacher gave the following details as well. Vinod was a good student and he had two younger siblings. His father worked as a middle level manager in a private company. His mother takes private tuitions in her spare time to generate some additional income for the family. Vinod had a smartphone that was two years old. He wanted to buy one of the latest

smartphones which had better speed and storage.

Vinod's father told him that he could not afford the phone at that time but that he would buy him one when he gets his annual bonus early next year. Mother too wanted Vinod to focus on studies at this time as his board examinations were drawing closer. Vinod was very unhappy and locked himself in his study room. He didn't want to eat his dinner. Parents were hoping that he would be alright by morning, but to their horror, they found that he left home at daybreak without informing anyone.

Vinod's parents met his friends, playmates, and even his teachers, but nobody had a clue as to where he was. The family was in utter shock. After a serious search, his parents reported the missing child to the police and furnished all details about Vinod. They were delighted when the police found Vinod safe and healthy two days later. Vinod will be reunited with his family later today!

Questions for students' consideration:

1. Was Vinod right in insisting on getting a new smart phone before the board examinations, also knowing that his parents could not afford it at that time?
2. Were the parents too strict with Vinod? After all, several of Vinod's friends had better smartphones than his and he is a good student. Do you feel that he deserved one too?
3. Do you think that parents don't seem to understand the peer pressure on a child and they tend to talk about their own childhood instead?

POINTS TO PONDER:

- Parents wish the very best for their child. They, however, see life through the prism of their own experience. They feel that a child of that age should focus on studies and avoid distractions. They want the child to understand their economic limitations too.
- In life, we readily appreciate the small acts of people around us, but when it comes to parents, we take their sacrifices for granted.
- Parents do not expect us to pay back for nurturing us but let us appreciate or treasure the unconditional sacrifice of our parents.

Time to teach	Asset type	Theme	Sub Theme
12 minutes	Value Content	Peace	Understanding

QA_Angles In Triangles

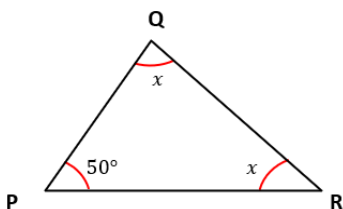
Objective: Students will be able to apply the knowledge of angle sum property of triangles and exterior angle theorem.

Teaching Aids: PPT

Notes to the teacher: Teacher may present the questions and allow the students to write or say the answers before revealing them.

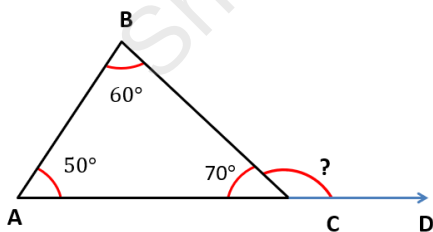
I. Multiple Choice Questions

1. In a $\triangle PQR$, $\angle P = 50^\circ$ and $\angle Q = \angle R = x$. Value of $x =$



a) 75° b) 65° c) 60° d) 80°

2. In a $\triangle ABC$, $\angle A = 50^\circ$, $\angle B = 60^\circ$ and $\angle C = 70^\circ$, the exterior angle $\angle BCD =$



a) 130° b) 120° c) 110° d) 140°

3. The exterior angle of a triangle is equal to the sum of two _____.

a) Vertical angles b) Interior angles c) Interior opposite angles d) None

4. The exterior angle of an equilateral triangle is _____

a) 100° b) 110° c) 130° d) 120°

Answers:

1. b
2. c
3. c
4. d

II) Solve the following questions:

1) In the given ΔPQR , find the values of x and y .

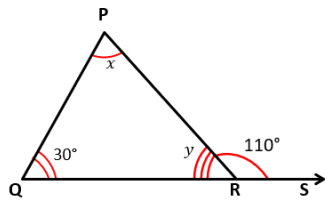


Image Source: OC

Answer:

Given $\angle PRS = 110^\circ$ and $\angle PQR = 30^\circ$,

$\angle QPR = x^\circ$ and $\angle PRQ = y^\circ$

From Exterior angle theorem, $\angle PRS = \angle PQR + \angle QPR$

$$\Rightarrow 110^\circ = 30^\circ + x$$

$$\Rightarrow x = 110^\circ - 30^\circ = 80^\circ$$

So, $\angle QPR = x = 80^\circ$

From Angle sum property of triangles, Sum of angles of a triangle = 180°

$$\Rightarrow \angle PQR + \angle QPR + \angle PRQ = 180^\circ$$

$$\Rightarrow 30^\circ + 80^\circ + y = 180^\circ$$

$$\Rightarrow y = 180^\circ - 110^\circ = 70^\circ$$

$$\text{So, } \angle PRQ = y = 70^\circ$$

2) In the given triangle $\triangle ABC$, find the value of p and q .

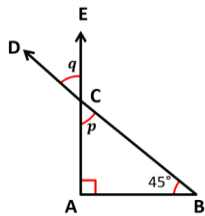


Image Source: OC

By Angle Sum Property of Triangle, Sum of angles of a triangle = 180°

$$\text{So, } \angle ACB + \angle ABC + \angle CAB = 180^\circ$$

$$\Rightarrow p + 45^\circ + 90^\circ = 180^\circ$$

$$\Rightarrow p + 135^\circ = 180^\circ$$

$$\Rightarrow p = 180^\circ - 135^\circ = 45^\circ$$

$$\text{So, } \angle ACB = 45^\circ$$

In the given triangle ABC, $\angle ACB$ and $\angle DCE$ are vertically opposite angles

$$\text{So, } q = \angle DCE = \angle ACB = 45^\circ$$

3) In the given figure, if $PQ \perp PS$, $PQ \parallel SR$, $\angle SQR = 28^\circ$ and $\angle QRT = 65^\circ$, then find the values of x and y .



Sri Sathya Sai
VIDYA VAHINI
श्री सत्यसाई विद्या वाहिनी

Sri Sathya Sai Central Trust

Annexure to Master Lesson Plan

What is the purpose of this Master lesson Plan?	This Master Lesson Plan (MLP) prepared by Sri Sathya Sai Vidya Vahini (SSSVV), covers the entire chapter for the given board. The MLP for the chapter given in the textbook is broken down into smaller modules known as assets. Any chapter can be taught using the 7 asset types in SSSVV methodology. Several different assets together complete the entire chapter. Depending on the requirement, each asset is supported by teaching aids such as animated presentation, audio, video, and learning aids such as worksheets. The MLP is for the teacher's preparation and the teaching aids are for use in the classroom.
How to use it?	You can prepare for your class with this MLP by following 3 simple steps: 1. Read your textbook; 2. Go through the information given in the assets (document & multimedia); 3. Prepare your teaching notes. Great! Now you are ready to transact the chapter.
Duration	Kindly note the duration given for each asset. Due care has been taken in planning the assets, to ensure the chapter is completed within the time specified by the Board. Note: Preparation time is not included in the asset duration. The teaching time depends on the duration of the teaching aids and is not impacted by the length of the MLP.
What is a 'Main Script' (MS) Asset?	The Main Script asset is there for explaining the main concepts of the chapter clearly. The information given in the textbook is simplified, organised and structured to give more clarity. Additionally, you may find a video or mnemonics or a graphic organiser to deepen the understanding of the concept.
How to teach using the MS asset?	Please use the blackboard, slides and interaction to develop the concept.
What is an 'Inquisitive Questions' (IQ) asset?	The Inquisitive Questions asset uses questions to promote higher order thinking like the n th why, what-if, new perspectives, cause-effect, and others, creating curiosity.
How to teach using the IQ asset?	You may use the questions to connect with the students, encourage exploration to engage them in the learning process. You may allow multiple responses and instead of rejecting any of the responses, ask why, before revealing the suggested answer or hints.
What is a 'Day to day Relevance' (DD) Asset?	The Day to Day Relevance asset helps students understand the practical relevance of every topic, making them eager participants in the classroom. If students connect the concepts to their environment, they would learn meaningfully without dislike or simply memorizing for exams.
How to teach using the DD	You may use the asset by asking questions about their experience and use it to establish why they are learning the topic. If necessary you may substitute with a

asset?	recent or local example.
What is an 'Interesting Aside' (IA) asset?	The Interesting Aside asset uses attention grabbing tidbits or anecdotes to bring joy and satisfy the child's hunger to know more. This is a quick/short asset intended to bring attention back to the main concept being taught.
How to teach using the IA asset?	You may use this asset to give a piece of interesting information relevant to the topic, without prolonged explanation/discussion. You may suggest appropriate books for further reading.
What is a 'Suggested Activity' (SA) Asset?	The Suggested Activity asset provides a detailed step by step procedure for the teacher to conduct a hands-on activity. This promotes Activity Based Learning.
How to teach using the SA asset?	You may use this asset to energise your students to learn by doing simple, fun-filled activities based on the topic. The asset includes - preparation, activity, and follow-up. You may engage the students in the preparation and follow-up stages to develop collaboration and responsibility. You could try it once, yourself, before the actual delivery to be more comfortable with it. Note: The duration mentioned in the asset is usually for the activity part only.
What is a 'Value Content' (VC) Asset?	The Value Content asset integrates Universal Human Values (such as empathy, inclusivity, respect for nature that translates into responsible behaviour) seamlessly into the curriculum, as the "End of education is character".
How to teach using the VC asset?	You may use this asset to engage with the students to bring out their innate values and connect with the intrinsic values in the topic/concept. The asset includes pointers on the specific pedagogical technique followed.
What is a 'Questions to Assess' (QA) asset?	The Questions to Assess asset uses an interactive approach to check learning of different types of learners, and provides feedback to the teacher for appropriate action. The questions cater to all the levels of Bloom's Taxonomy. Questions from 'Apply' level and above enable students to reflect on their learning.
How to teach using the QA asset?	You may go through the slides to understand its flow and know when to click for the answer (slides include suggested answers). While presenting in the class, you may display the question and encourage multiple responses, before revealing the answer. In some cases, this asset may include extra questions/worksheet that can be given as homework.