# LINES AND ANGLES

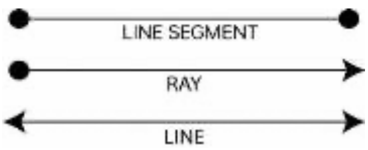
## Concepts Covered

- **Basic Terms and Definitions, Intersecting Lines and Non-intersecting Lines.**
- **Pairs of Angles.**
- **Parallel Lines and a Transversal**
- **Lines Parallel to the same Line.**

## Introduction

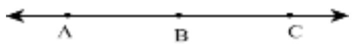
In this chapter, you will study the properties of the angles formed when two lines intersect each other, and also the properties of the angles formed when a line intersects two or more parallel lines at distinct points.

## Basic Terms and Definitions



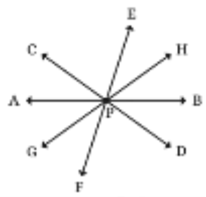

**Line:** A line can be defined as a straight set of points that extend infinitely in opposite directions. It has no ends in both directions.

**Line-segment:** A part (or portion) of a line with two endpoints is called a **line segment.**

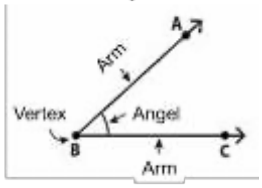



**Ray**: A part of a line with one endpoint is called a **ray**.

**Collinear Points and non - collinear points:** If three or more points lie on the same line, they are called **collinear points**; otherwise they are called **non-collinear points**. Points A, B & C are collinear. Points D and E are non - collinear.

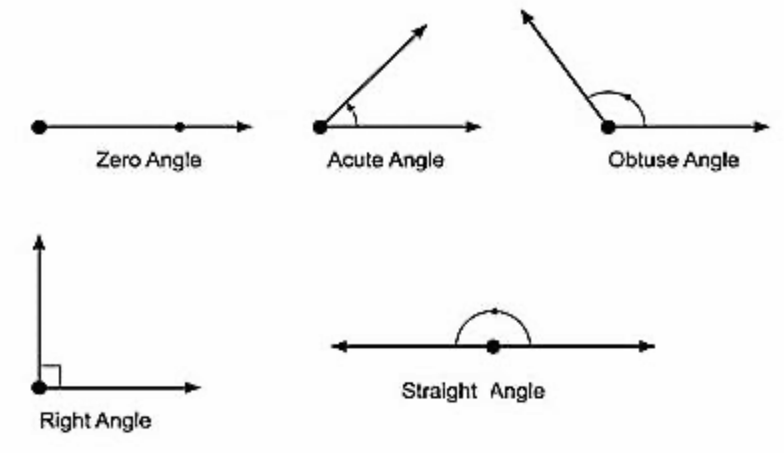


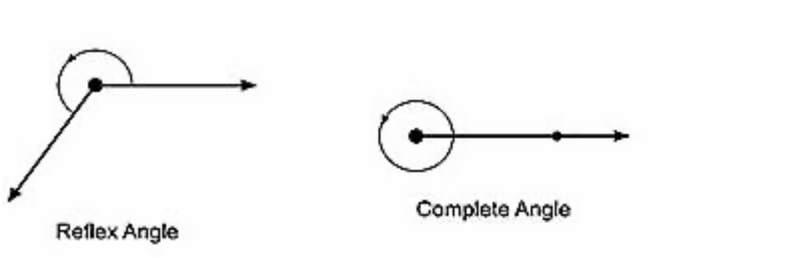

**Concurrent Lines:** When three or more lines meet at a point, they are called concurrent lines, and the point at which they meet is called **the point of concurrence.**




**Angle:** An Angle is formed when two rays originate from the common point. The rays making an angle are called the **arms** of the angle and the common point from where the rays originate is called the **vertex** of the angle.

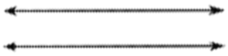
**Different types of angles**: You have studied acute angle, right angle, obtuse angle, straight angle, and reflex angle in earlier classes.
(i) acute angle: $0° < \theta < 90°$
(ii) right angle: $\theta = 90°$
(iii) obtuse angle: $90° < \theta < 180°$
(iv) straight angle : $\theta = 180°$
(v) reflex angle: $180° < \theta < 360°$
(vi) complete angle : $\theta = 360°$
(vi) zero angle: $\theta = 0°$






## Intersecting Lines and Non-intersecting Lines

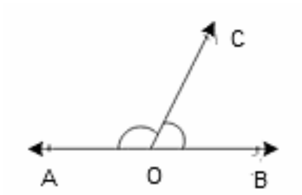
**Intersecting Lines:** Two or more lines which share exactly one common point are called intersecting lines. This common point exists on all these lines and is called the point of intersection.



**Non-intersecting Lines**: Two or more lines that do not intersect each other are called non-intersecting lines.

## Pair of Angles

Let us find out the relation between the angles formed when a ray stands on a line. Draw a figure in which a ray stands on a line as shown. Name the line as AB and the ray as OC. What are the angles formed at point O? They are $\angle AOC$, $\angle BOC$, and $\angle AOB$.
So, we can write $\angle AOC + \angle BOC = 180°$?

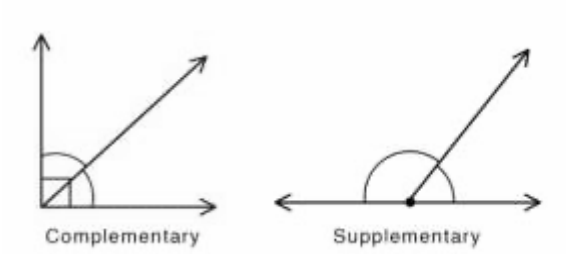



From the above discussion, we can state the following axiom:
**Axiom 1:** If a ray stands on a line, then the sum of two adjacent angles so formed is 180°.

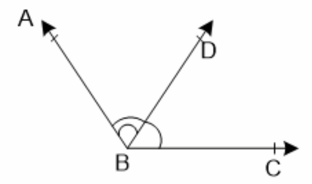
**Axiom 2:** If the sum of two adjacent angles is 180°, then the non-common arms of the angles form a line. For obvious reasons, the two axioms above together are called the **Linear Pair Axiom**.

**Complementary Angles:** When the sum of two angles is 90°, then the angles are known as complementary angles**.** Such angle is called the complement of each other.

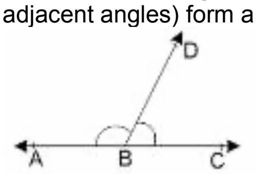
**Supplementary Angles:** When the sum of two angles is 180°, then the angles are known as supplementary angles. Such angles are called the supplement of each other.




**Adjacent angles:** 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. In Fig. $\angle ABD$ and $\angle DBC$ are adjacent angles.
Here, Ray BD is their common arm and point B is their common vertex. Ray BA and ray BC are non-common arms.




**Linear Pair of Angles:** If the non-common arms BA and BC in the above fig. (in adjacent angles) form a line then it will look like:

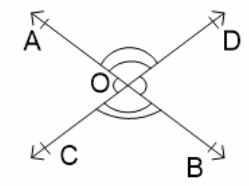



In this case, $\angle ABD$ and $\angle DBC$ are called **linear pair of angles**.

**Note:** Linear pair of angles are always supplementary. But supplementary angles need not form a linear pair.

**Vertically Opposite Angles:** They are formed when two lines, say AB and CD, intersect each other, say at the point O. There are two pairs of vertically opposite angles.

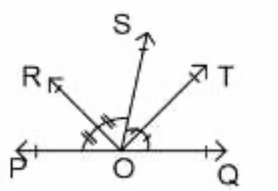
**Theorem 1:** If two lines intersect each other, then the vertically opposite angles are equal.
**Proof:** In the statement above, it is given that 'two lines intersect each other'. So, let AB and CD be two lines intersecting at O as shown in Fig. They lead to two pairs of vertically opposite angles, namely,
(i) $\angle AOC$ and $\angle BOD$ (ii) $\angle AOD$ and $\angle BOC$.
We need to prove that $\angle AOC = \angle BOD$ and $\angle AOD = \angle BOC$.
Now, ray OA stands on line CD.
$\therefore \angle AOC + \angle AOD = 180°$ (Linear pair axiom)
$\Rightarrow \angle AOC = 180° - \angle AOD$ = (1)
Similarly, $\angle AOC + \angle BOC = 180°$
$\Rightarrow \angle AOC = 180° - \angle BOC$ – (2)
From 1 and 2 we can write,
$180° - \angle AOD = 180° - \angle BOC$
or $\angle BOC = 180° - 180° + \angle AOD$



or $\angle BOC = \angle AOD$
Similarly, it can be proved that ∠AOD = ∠BOC

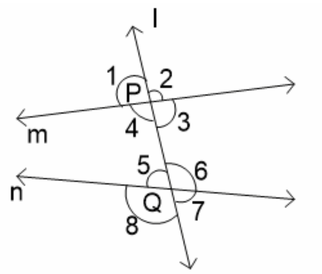
**Example:**

**In Fig. ray OS stands on a line POQ. Ray OR and ray OT are angle bisectors of ∠POS and ∠SOQ, respectively. If ∠POS = x, find ∠ROT.**



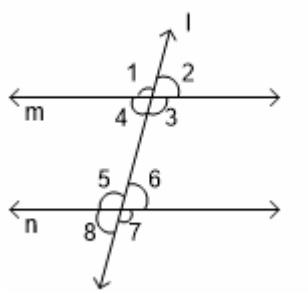

**Solution:** Ray OS stands on the line POQ.
Therefore, $\angle POS + \angle SOQ = 180^\circ$
But, $\angle POS = x$
Therefore, $x + \angle SOQ = 180^\circ$
So, $\angle SOQ = 180^\circ - x$
Now, ray OR bisects $\angle POS$, therefore,
$\angle ROS = \frac{1}{2} \times \angle POS = \frac{x}{2}$
Similarly, $\angle SOT = \frac{1}{2} \times \angle SOQ$
$= \frac{1}{2} \times (180^\circ - X)$
$= 90^\circ - \frac{x}{2}$
Now, $\angle ROT = \angle ROS + \angle SOT$
$= \frac{x}{2} + 90^\circ - \frac{x}{2}$
$= 90^\circ$

## Parallel Lines and a Transversal




A line which intersects two or more lines at distinct points is called a **transversal** (see Fig.). Line l intersects lines m and n at points P and Q respectively. Therefore, line l is a transversal for lines m and n. Observe that four angles are formed at each of the points P and Q.

Let us name these angles as ∠1, ∠2, . . ., ∠8 as shown in Fig.
∠1, ∠2, ∠7 and ∠8 are called **exterior angles**, while ∠3, ∠4, ∠5 and ∠6 are called **interior angles**.



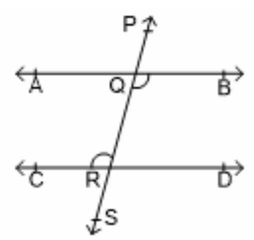

Interior angles on the same side of the transversal are also referred to as **consecutive interior** angles or **allied** angles or **co-interior** angles. Interior angles on the opposite side of the transversal are also referred as **alternate interior angles**. Further, many a times, we simply use the words alternate angles for alternate interior angles.
Now, let us find out the relation between the angles in these pairs when line m is parallel to line n. You know that the ruled lines of your notebook are parallel to each other. So, with ruler and pencil, draw two parallel lines along any two of these lines and a transversal to intersect them as shown in Figure.

Now, measure any pair of corresponding angles and find out the relation between them. You may find that:
∠1 = ∠5, ∠2 = ∠6, ∠4 = ∠8 and ∠3 = ∠7. From this, you may conclude the following axiom.

**Axiom 3:** If a transversal intersects two parallel lines, then each pair of corresponding angles is equal.
Axiom 3 is also referred to as the **corresponding angles axiom**.

**Axiom 4:** If a transversal intersects two lines such that a pair of corresponding angles are equal, then the two lines are parallel to each other.

**Theorem 2:** If a transversal intersects two parallel lines, then each pair of alternate interior angles is equal.
It is given that $AB \parallel CD$. Let $PS$ be the transversal intersecting $AB$ at $Q$ and $CD$ at $R$.
For lines $AB$ and $CD$, with transversal $PS$
$\angle AQP = \angle CRQ$ (Corresponding angles) …(1)
For lines $AB$ and $PS$, $\angle AQP = \angle BQR$ (Vertically opposite angles) …(2)
From 1 and 2
$\angle BQR = \angle CRQ$
Similarly, we can prove $\angle AQR = \angle QRD$
Hence pair of alternate interior angles are equal.
Hence proved.

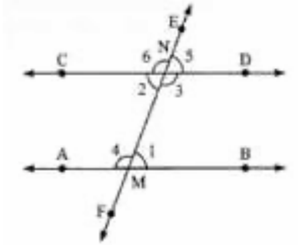



Now, using the converse of the corresponding angles axiom, can we show the two lines parallel if a pair of alternate interior angles are equal? In Fig. the transversal PS intersects lines AB and CD at points Q and R respectively such that ∠BQR = ∠QRC.
Is AB || CD?
∠BQR = ∠PQA (vertically opposite angle) (1)
But, ∠BQR = ∠QRC (Given) (2)
So, from (1) and (2), you may conclude that
∠PQA = ∠QRC
But they are corresponding angles.

So, AB || CD (Converse of corresponding angles axiom)
This result can be stated as a theorem given below:

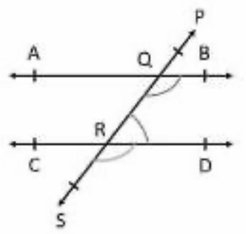
**Theorem 3:** If a transversal intersects two lines such that a pair of alternate interior angles is equal, then the two lines are parallel. In a similar way, you can obtain the following two theorems related to interior angles on the same side of the transversal.

**Theorem 4:** If a transversal intersects two parallel lines, then each pair of interior angles on the same side of the transversal is supplementary.
It is given that $AB$ and $CD$ are two parallel lines and $EF$ is a transversal which intersects them at $M$ and $N$ respectively forming two pairs of interior angles $\angle 1, \angle 3$ and $\angle 2, \angle 4$.



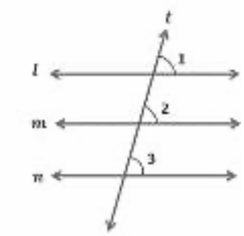

Since ray ND stands on line EF,
$\angle 3 + \angle 5 = 180°$ … … (i) (linear pair of angles)
But $\angle 1 = \angle 5$ … … (ii) (Corresponding angles as $AB \parallel CD$ )
From (i) and (ii), we get
$\angle 1 + \angle 3 = 180°$ …(iii)
Again ray $CN$ stands on $EF$,
$\angle 2 + \angle 6 = 180°$ (Linear pair of angles)
But $\angle 4 = \angle 6$ (Corresponding angles as $AB \parallel CD$ )
$\Rightarrow \angle 2 + \angle 4 = 180°$ ....(iv)
Hence, we can say if a transversal intersects two parallel lines, then each pair of interior angles are supplementary
i.e. $\angle 1 + \angle 3 = 180°$ or $\angle 2 + \angle 4 = 180°$

**Theorem 5:** If a transversal intersects two lines such that a pair of interior angles on the same side of the transversal is supplementary, then the two lines are parallel.
Given :- Two parallel lines $AB$ and $CD$ and a transversal $PS$ intersecting $AB$ at $Q$ and $CD$ at $R$ such that $\angle BQR + \angle DRQ = 180°$
To Prove: $AB \parallel CD$
Proof :- For lines PS




$\angle DRQ + \angle DRS = 180°$ (Linear pair) ... (1)
But, $\angle BQR + \angle DRQ = 180°$ (Given) ... (2)
From (1) and (2)
$\angle DRQ + \angle DRS = \angle BQR + \angle DRQ$
$\angle DRS = \angle BQR$
But they are corresponding angles.
Thus, for lines AB & CD with transversal PS, corresponding angles are equal.
Hence $AB$ and CD are parallel.
Hence proved.

**Theorem 6:** Lines which are parallel to the same line are parallel to each other.
**Proof:** Draw a transversal t for the lines l,m, and, n where line l is parallel to line n and line m is parallel to line n.

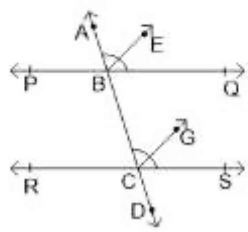



Now,
$\angle 1 = \angle 3$ (1) (corresponding angles axiom)
Similarly, $\angle 2 = \angle 3$ (2) (corresponding angles axiom)
Using (1) & (2) we get, $\angle 1 = \angle 2$.
$\angle 1$ and $\angle 2$ are corresponding angles.
Therefore line l is parallel to m (converse of corresponding angles axiom).

## Example:

**If a transversal intersects two lines such that the bisectors of a pair of corresponding angles are parallel, then prove that the two lines are parallel.**

**Solution:** In Fig. a transversal AD intersects two lines PQ and RS at points B and C respectively. Ray BE is the bisector of ∠ABQ and ray CG is the bisector of ∠BCS; and BE ∥ CG.

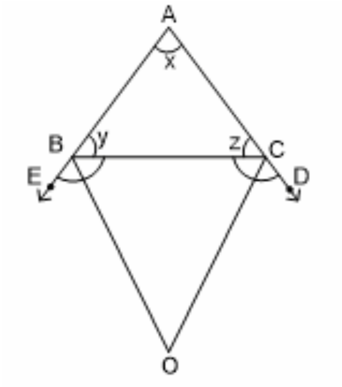



We have to prove that $PQ \parallel RS$.
It is given that ray $BE$ is the bisector of $\angle ABQ$
Therefore, $\angle ABE = \frac{1}{2}\angle ABQ$ (1)
Similarly, ray $CG$ is the bisector of $\angle BCS$.
Therefore, $\angle BCG = \frac{1}{2}\angle BCS$ (2)
But $BE \parallel CG$ and $AD$ is the transversal.
Therefore, $\angle ABE = \angle BCG$
(Corresponding angles axiom) (3)
Substituting (1) and (2) in (3), you get
$\frac{1}{2}\angle ABQ = \frac{1}{2}\angle BCS$
That is, $\angle ABQ = \angle BCS$
But, they are the corresponding angles formed by transversal $AD$ with $PQ$ and $RS$ and are equal.
Therefore, $PQ \parallel RS$ (Converse of corresponding angles axiom).

## Example:

**In Fig. the sides $AB$ and $AC$ of $\triangle ABC$ are produced to points $E$ and $D$ respectively. If bisectors $BO$ and $CO$ of $\angle CBE$ and $\angle BCD$ respectively meet at point $O$, then prove that $\angle BOC = 90° - \frac{1}{2}\angle BAC$.**

**Solution:** Let's assume $\angle BAC$, $\angle ABC$ & $\angle ACB$ as $x°, y°$ & $z°$ respectively




Ray $BO$ is the bisector of $\angle CBE$.

Therefore, $\angle CBO = \frac{1}{2}\angle CBE$

$= \frac{1}{2}(180° - y)$

$= 90° - \frac{y}{2}$ (1)

Similarly, ray $CO$ is the bisector of $\angle BCD$.

Therefore, $\angle BCO = \frac{1}{2}\angle BCD$

$= \frac{1}{2}(180° - z)$

$= 90° - \frac{z}{2}$ (2)

In $\triangle BOC, \angle BOC + \angle BCO + \angle CBO = 180°$ (3)

Substituting (1) and (2) in (3), you get

$\angle BOC + 90° - \frac{z}{2} + 90° - \frac{y}{2} = 180°$

So, $\angle BOC = \frac{z}{2} + \frac{y}{2}$

or, $\angle BOC = \frac{1}{2}(y + z)$ (4)

But, $x + y + z = 180°$ (Angle sum property of a triangle)

Therefore, (4) becomes

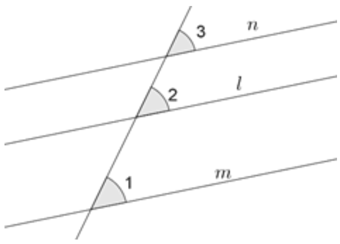
$\angle BOC = \frac{1}{2}(180° - x)$

$= 90° - \frac{x}{2}$

$= 90° - \frac{1}{2}\angle BAC$

## Lines Parallel to the Same Line

Consider a line l, and suppose that we draw two more lines m and n such that l || m and l || n.




Can we say that m || n? Draw any transversal across the three lines, as we have done above, and note that

∠1 = ∠2 (corresponding angles)

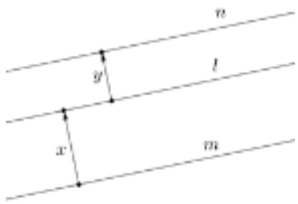
∠2 = ∠3 (corresponding angles)

Thus,

∠1 = ∠3

This proves that m must be parallel to n. We formalize this result in the form of a theorem (also discussed and proved in theorum 6).

**Theorem:** Two or more lines which are parallel to the same line will be parallel to each other.




Consider a line l and consider two more lines m and n such that l || m and l || n, as shown in the figure.

The distance between l and m is x, and the distance between l and n is y. What is the distance between m and n? The theorem above tells us that m and n will also be parallel, and therefore there will be a fixed (constant) distance between them. Clearly, that distance will be x + y.

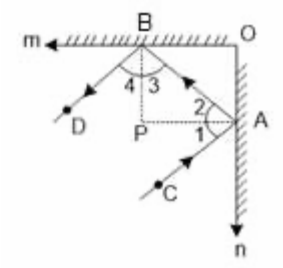
## Solved Example

**(1) In Fig. m and n are two plane mirrors perpendicular to each other. Show that incident ray CA is parallel to reflected ray BD.**

**Solution:** Let us draw PA and PB perpendiculars to n and m respectively.

$\because$ $m \perp n$, $PB \perp m$ and $PA \perp n$

$\therefore$ $\angle APB = 90^\circ$ (Lines perpendicular to two perpendicular lines are also perpendicular.)




Now, in ΔAPB,

$\angle APB + \angle 2 + \angle 3 = 180^\circ$

$\angle 2 + \angle 3 = 180^\circ - \angle APB$

$\angle 2 + \angle 3 = 90^\circ$ (1)

Now,

$\angle 1 = \angle 2$ & $\angle 3 = \angle 4$ ($\angle$ of incidence = $\angle$ of reflection)

$\therefore$ $\angle 1 + \angle 4 = 90^\circ$ (2)

Adding (1) and (2), we have

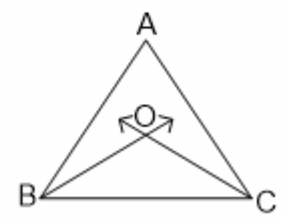
$\angle 1 + \angle 2 + \angle 3 + \angle 4 = 180^\circ$

i.e., $\angle CAB + \angle DBA = 180^\circ$

Hence CA || BD.

**(2) Bisectors of angles B and C of a triangle ABC intersect each other at the point O. Prove that $\angle BOC = 90^\circ + \frac{1}{2}\angle A$.**

**Solution:** In ΔABC




$\angle A + \angle ABC + \angle ACB = 180^\circ$ (Angle sum property of a triangle)

Therefore, $\frac{1}{2}\angle A + \frac{1}{2}\angle ABC + \frac{1}{2}\angle ACB = \frac{1}{2} \times 180^\circ = 90^\circ$

i.e., $\frac{1}{2}\angle A + \angle OBC + \angle OCB = 90^\circ$ ($\because$ BO and CO are bisectors of $\angle B$ and $\angle C$) (1)

But $\angle BOC + \angle OBC + \angle OCB = 180^\circ$ (Angle sum property) (2)

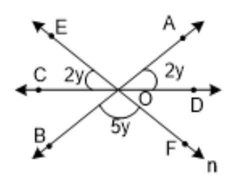
Subtracting (1) from (2), we have

$\angle BOC + \angle OBC + \angle OCB - \frac{1}{2}\angle A - \angle OBC - \angle OCB = 180^\circ - 90^\circ$

i.e., $\angle BOC = 90^\circ + \frac{1}{2}\angle A$

Hence proved.

**(3) In Fig. AB, CD and EF are three lines concurrent at O. Find the value of y.**



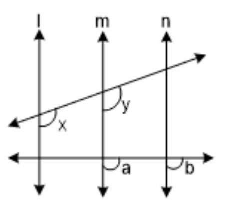

**Solution:** $\angle AOE = \angle BOF = 5y$ (Vertically opposite angles)

Also,

$\angle COE + \angle AOE + \angle AOD = 180^\circ$

So, $2y + 5y + 2y = 180^\circ$ or $9y = 180^\circ$, which gives $y = 20^\circ$.

**(4) In Fig. x = y and a = b Prove that l || n.**




**Solution:** x = y (Given)

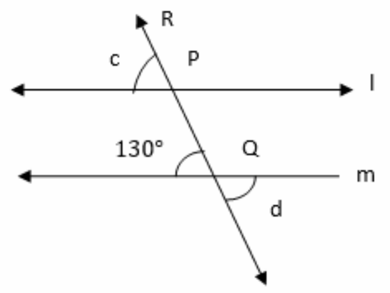
Therefore, l || m (Corresponding angles) (1)

Also, a = b (Given)

Therefore, n || m (Corresponding angles) (2)

From (1) and (2), l || n (Lines parallel to the same line are parallel to each other).

**(5) In the figure shown, l || m and a line R intersect lines l and m at P and Q, respectively. Find the sum 3c +2d?**




**Solution:** Given that, l ∥ m and R is a transversal.

$\therefore$ $130^\circ$ and c are corresponding angles.

$\therefore$ $c = 130^\circ$

Also, d and $130^\circ$ are vertically opposite angles.

So, $d = 130^\circ$

Now,

$3c + 2d = 3 \times 130^\circ + 2 \times 130^\circ$

$= 390^\circ + 260^\circ$

$= 650^\circ$

# Exercise

## FILL IN THE BLANKS

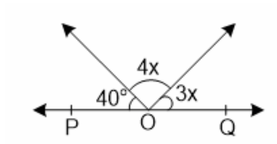
**(1)** If an angle is $45°$ then its complementary angle is ________.
**(2)** If the angles of a triangle are in the ratio of $2 : 3 : 4$, then the largest angles of the triangle is _____.
**(3)** If an angle is $80°$ then its supplementary angle is________.
**(4)** When three or more lines meet at a point, they are called ________ lines.
**(5)** If a transversal intersects two lines such that a pair of corresponding angles are equal, then the two lines are _______ to each other.

## TRUE AND FALSE

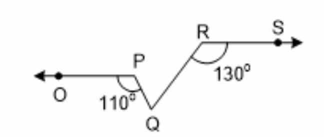
**(1)** The sum of the three angles of a triangle is 180°.
**(2)** When the sum of two angles is $90°$, then the angles are known as supplementary angles.
**(3)** $A = 70°$ and $B = 110°$, then A and B are the complementary angles of each other.
**(4)** If B lies between A and C of line segment AC and $AB = 10, AC = 15$, then $BC^2 = 25$.
**(5)** Two parallel lines meet each other at the origin.
**(6)** A triangle can have two right angles.
**(7)** The two lines which are parallel to the same line are parallel to each other.
**(8)** If a line is perpendicular to one of the two given parallel lines then it is also perpendicular to the other line.

## OBJECTIVE TYPE QUESTIONS

**(1)** In Fig. POQ is a line. The value of x is
(A) 20°
(B) 25°
(C) 30°
(D) 35°




**(2)** In Fig. if OP || RS, ∠ OPQ = 110° and ∠ QRS = 130°, then ∠ PQR is equal to
(A) 40°
(B) 50°
(C) 60°
(D) 70°




**(3)** One angle is equal to three times its supplement. The measure of the angle is
(A) $130°$ (B) $135°$
(C) $90°$ (D) $120°$

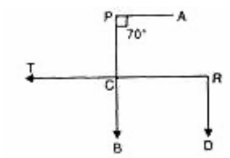
**(4)** Two complementary angles are such that two times the measure of one is equal to three times the measure of the other. The measure of the smaller angle is
(A) $45°$ (B) $30°$
(C) $36°$ (D) None of these

**(5)** Two straight lines $AB$ and $CD$ intersect one another at the point $O$. If $\angle AOC + \angle COB + \angle BOD = 274°$, then $\angle AOD =$
(A) $86°$ (B) $90°$
(C) $94°$ (D) $137°$

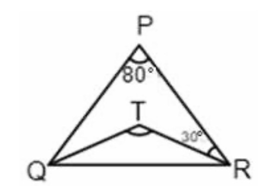
**(6)** Two straight lines $AB$ and $CD$ cut each other at $O$. If $\angle BOD = 63°$, then $\angle BOC =$
(A) $63°$ (B) $117°$
(C) $17°$ (D) $153°$

**(7)** An angle is twice its complement. The angle is
(A) $30°$ (B) $60°$
(C) $90°$ (D) $45°$

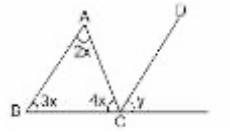
**(8)** PA || CR and CB || RD, ∠APC = 70°. The value of ∠CRD is
(A) 70°
(B) 85°
(C) 110°
(D) 90°



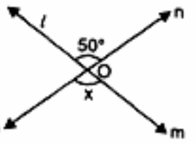

**(9)** In figure, TQ and TR are the bisectors of ∠Q and ∠R if ∠QPR = 80° and ∠PRT = 30°. The value of ∠QTR is
(A) 130°
(B) 140°
(C) 120°
(D) 100°



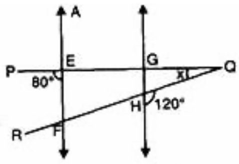
**(10)** In the figure CD is parallel to AB. The value of y is
(A) 50°
(B) 60°
(C) 55°
(D) 65°



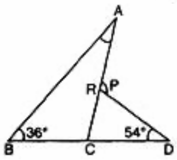

**(11)** In figure the angle x is equal to
(A) 50°
(B) 100°
(C) 110°
(D) 75°



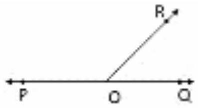

**(12)** In the figure AF is parallel to GH. The value of x is
(A) 30°
(B) 40°
(C) 20°
(D) 60°



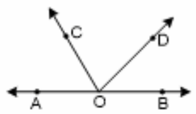

**(13)** In figure ∠BAC = 30°, ∠P is equal to
(A) 60°
(B) 120°
(C) 150°
(D) 90°



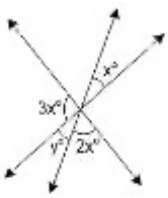

**(14)** Given ∠POR = 3x and ∠QOR = 2x + 10°. If POQ is a straight line, then the value of x is
(A) 30°
(B) 34°
(C) 36°
(D) None of these



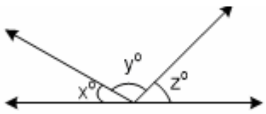

**(15)** In Fig, AOB is a straight line. If ∠AOC = ∠BOD = 45°, then ∠COD =
(A) 85°
(B) 90°
(C) 95°
(D) 100°



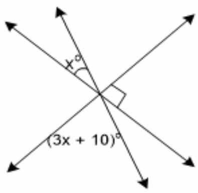

**(16)** In Fig. the value of y is
(A) 20°
(B) 30°
(C) 45°
(D) 60°



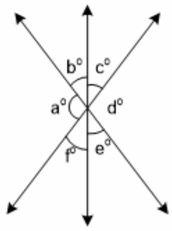

**(17)** In Fig. if $\frac{y}{x} = 5$ and $\frac{z}{x} = 4$, then the value of x is
(A) 8°
(B) 18°
(C) 12°
(D) 15°




**(18)** In Fig. the value of x is
(A) 12°
(B) 15°
(C) 20°
(D) 30°



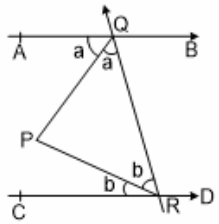

**(19)** In Fig. which of the following statements must be true?
(i) a + b = d + c (ii) a + c + e = 180° (iii) b + f = c + e
(A) (i) only
(B) (ii) only
(C) (iii) only
(D) (ii) and (iii) only




**(20)** If two interior angles on the same side of a transversal intersecting two parallel lines are in the ratio 2:3, then the measure of the larger angle is
(A) 54°
(B) 120°
(C) 108°
(D) 136°

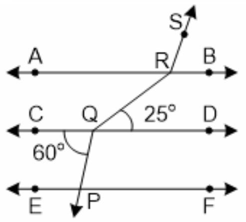
**(21)** In the given figure, it is given that BA || CD, PQ and PR are the bisectors of ∠AQR and ∠CRQ respectively, then find ∠QPR.

(A) 45°
(B) 30°
(C) 60°
(D) 90




**(22)** In Fig. if AB || CD || EF, PQ || RS, ∠ RQD = 25° and ∠ CQP = 60°, then ∠ QRS is equal to

(A) 85°
(B) 135°
(C) 145°
(D) 110°




**(23)** If one angle of a triangle is equal to the sum of the other two angles, then the triangle is

(A) An isosceles triangle
(B) An obtuse triangle
(C) An equilateral triangle
(D) A right triangle

**(24)** An exterior angle of a triangle is $105°$ and its two interior opposite angles are equal. Each of these equal angles is

(A) $37\frac{1}{2}°$
(B) $52\frac{1}{2}°$
(C) $72\frac{1}{2}°$
(D) $75°$

**(25)** The angles of a triangle are in the ratio $5:3:7$. The triangle is

(A) An acute angled triangle
(B) An obtuse angled triangle
(C) A right triangle
(D) An isosceles triangle

**(26)** If one of the angles of a triangle is $130°$, then the angle between the bisectors of the other two angles can be

(A) $50°$
(B) $65°$
(C) $145°$
(D) $155°$

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

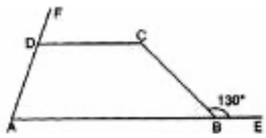
(A) $80°$
(B) $100°$
(C) $120°$
(D) $90°$

**(28)** The sides of a regular octagon are produced to form a star. The measure of the angle of each point of the star is

(A) 90°
(B) 105°
(C) 85°
(D) 60°

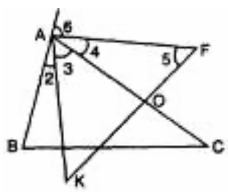
**(29)** In figure points ∠CBE = 130°, then ∠FDC is equal to

(A) 30°
(B) 50°
(C) 75°
(D) 130°




**(30)** In figure, AC is bisector of ∠KAF, AB = 3cm, BC = 5 cm, AC = 4 cm, ∠3 = 30°, ∠KOC = 80°. Find the sum of∠5 & ∠6.

(A) 130°
(B) 100°
(C) 80°
(D) None of these



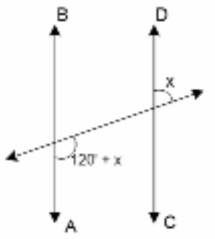

**(31)** PQR, are respectively the mid points of sides BC, CA and AB of a triangle ABC. PR and BQ meet at X, CR and PQ meet at Y, then the value of XY is

(A) $\frac{1}{2}$ AC
(B) $\frac{3}{2}$BC
(C) $\frac{1}{4}$ BC
(D) $\frac{3}{4}$AC

**(32)** Which of the following statements is true?
When two straight lines intersect:
(i) Adjacent angles are complementary
(ii) Adjacent angles are supplementary
(iii) Opposite angles are equal
(iv) Opposite angles are supplementary

(A) (i) and (iii) are correct
(B) (ii) and (iii) are correct
(C) (i) and (iv) are correct
(D) (ii) and (iv) are correct

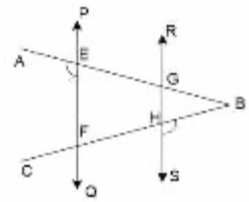
**(33)** In Fig. if AB || CD, then the value of x is
(A) 20 °
(B) 30°
(C) 45 °
(D) 60 °



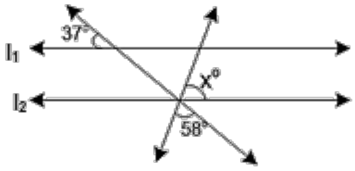

**(34)** AB and CD are two parallel lines. PQ cuts AB and CD at E and F respectively. EL is the bisector of ∠FEB. If ∠LEB = 35°, then ∠CFQ will be
(A) 55 °
(B) 70°
(C) 110 °
(D) 130 °

**(35)** Two lines AB and CD intersect at O. If ∠AOC + ∠COB + ∠BOD = 270°, then ∠AOC =
(A) 70°
(B) 80°
(C) 90°
(D) 180°

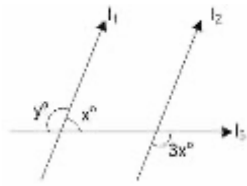
**(36)** In Fig. PQ || RS, ∠AEF = 95°, ∠BHS = 110° and ∠ABC = x°. Then the value of x is
(A) 15°
(B) 25°
(C) 70°
(D) 35°



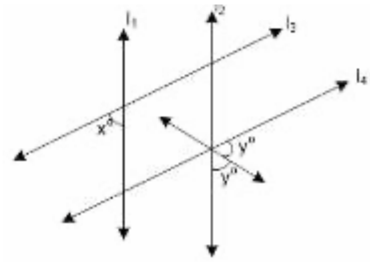

**(37)** In Fig. if $l_1 \parallel l_2$, what is the value of x?
(A) 90°
(B) 85°
(C) 75°
(D) 70°



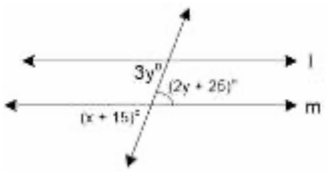

**(38)** In Fig. if $l_1 \parallel l_2$, what is the value of y?
(A) 100°
(B) 120°
(C) 135°
(D) 150 °



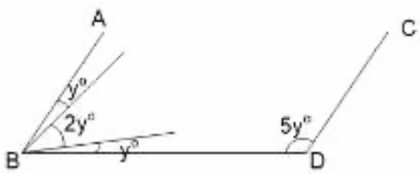

**(39)** In Fig. if $l_1 \parallel l_2$ and $l_3 \parallel l_4$, what is y in terms of x?
(A) 90° + x°
(B) 90° + 2x°
(C) $90° - \frac{x°}{2}$
(D) 90° – 2x°




**(40)** In Fig. if l || m, what is the value of x?
(A) 60°
(B) 50°
(C) 45°
(D) 30°




**(41)** In Fig. if line segment AB is parallel to the line segment CD, what is the value of y?
(A) 12°
(B) 15°
(C) 18°
(D) 20°



# Answer Key

## FILL IN THE BLANKS

**(1)** $45°$
**(2)** $80°$
**(3)** $100°$
**(4)** concurrent
**(5)** parallel

## TRUE AND FALSE

**(1)** True
**(2)** False
**(3)** False
**(4)** True
**(5)** False
**(6)** False
**(7)** True
**(8)** True

## OBJECTIVE TYPE QUESTIONS

| | | | | | |
|---|---|---|---|---|---|
| **(1)** | (A) | **(16)** | (B) | **(31)** | (C) |
| **(2)** | (C) | **(17)** | (B) | **(32)** | (B) |
| **(3)** | (B) | **(18)** | (C) | **(33)** | (B) |
| **(4)** | (C) | **(19)** | (D) | **(34)** | (C) |
| **(5)** | (A) | **(20)** | (C) | **(35)** | (C) |
| **(6)** | (B) | **(21)** | (D) | **(36)** | (B) |
| **(7)** | (B) | **(22)** | (C) | **(37)** | (B) |
| **(8)** | (C) | **(23)** | (D) | **(38)** | (C) |
| **(9)** | (A) | **(24)** | (B) | **(39)** | (C) |
| **(10)** | (B) | **(25)** | (A) | **(40)** | (A) |
| **(11)** | (A) | **(26)** | (D) | **(41)** | (D) |
| **(12)** | (C) | **(27)** | (B) | | |
| **(13)** | (B) | **(28)** | (A) | | |
| **(14)** | (B) | **(29)** | (B) | | |
| **(15)** | (B) | **(30)** | (C) | | |