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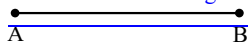- Transversal line
- Parallel lines

➤ DEFINITIONS

❖ **Point**

A fine dot made by a sharp pencil or a geometrical figure having no length, breadth and height is called a point.

❖ **Line Segment**

A geometrical figure obtained by joining two points is called a line segment.
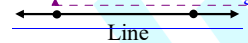
A————————B

Here figure, AB is a line segment.
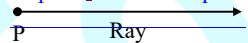
It has definite length.

❖ **Line**

If we extend the two end points in either direction endlessly, we get a line figure.

It has no definite length.

Line

❖ **Ray**

A ray is a geometrical figure which has one end point, P is an end point.
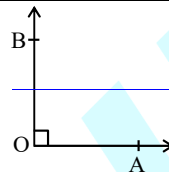
P   Ray

❖ **Angles**

An angle is formed when two rays/two lines/two line segments initiate from the same initial point.

We find many examples of angles in out our surroundings like between two walls of a room, between edges of a table, road crossing, etc.
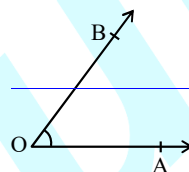
❖ **Right angle**

An angle of measure 90° is called a right angle.
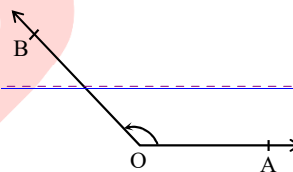
In figure ∠BOA is a right angle.

❖ **Acute angle**

An angle whose measure is between 0° and 90° is called an acute angle as in figure.
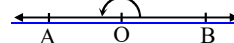
❖ **Obtuse angle**

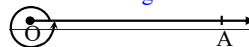An angle whose measure is more than 90° but less than 180° is called an obtuse angle as in figure.

❖ **Straight angle**

An angle of 180° is called a straight angle as in figure.

A   O   B

❖ **Complete angle**

An angle of 360° is called a complete angle as in figure.

O   A

❖ **Complementary Angles**

Two angles are said to be complementary if the sum of their measures is 90°, and each angle is said to be complement of each other.

For example, (45°, 45°), (10°, 80°), (20°, 70°), (30°, 60°).

Note :

(a) If two angles are complement of each other then each angle is an acute angle, but any two acute angles need not be complementary, for example,

20° and 60° are acute angles but are not complement of each other.

(b) Two obtuse angles and two right angles cannot be complement of each other.

❖ **Supplementary Angles**

Two angles are said to be supplementary if sum of their measures is 180°, and each angle is said to be supplement of each other.

For example, (10°, 170°), (20°, 160°), (30°, 150°), (40°, 140°), (50°, 130°) etc. are all pairs of supplementary angles.

Note :

(a) Two acute angles cannot be supplement of each other.

(b) Two right angles are always supplementary.

(c) Two obtuse angles cannot be supplement of each other.
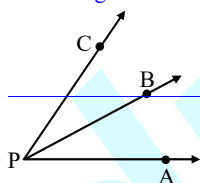
❖ **Adjacent Angles**

Two angles are called adjacent angles if

(i) they have a common vertex (in figure, point P is common vertex).

(ii) they have a common arm (in figure, PB is common arm).

(iii) their other arms lie on the opposite sides of the common arm (in figure, PC and PA)

So, in figure, $\angle APB$ and $\angle BPC$ are adjacent angles.

Note :

(a) $\angle APB$ and $\angle APC$ are not adjacent angles because their other arms PB and PC are not on the opposite sides of the common arm PA.

(b) If a ray stands on a line then the sum of the adjacent angles so formed is 180°.

❖ **Linear Pair Angles**

Two adjacent angles are said to form a linear pair if their non-common arms are two opposite rays.

If In figure, $\angle POQ$ and $\angle QOR$ form a linear pair as their non-common arms OP and OR are two opposite rays i.e., POR is a line.
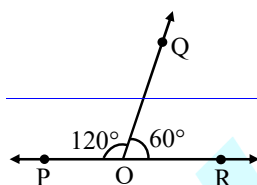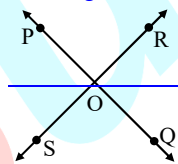

Note :

(a) Two linear pair angles can also be adjacent angles but it is not necessary that two adjacent angles will be linear pair angles.

(b) A pair of supplementary angles forms a linear pair when placed adjacent to each other.
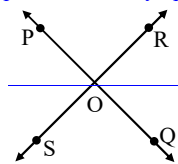
❖ **Vertically Opposite Angles**

Two angles formed by two intersecting lines having no common arm are called vertically opposite angles.

In figure, two lines PQ and RS are intersecting at point O. We observe that with the intersection of these lines, four angles have been formed.

$\angle POR$ and $\angle SOQ$ form a pair of vertically opposite angles, while angles $\angle POS$ and $\angle SOQ$ ROQ form another pair of vertically opposite angles.

Note :
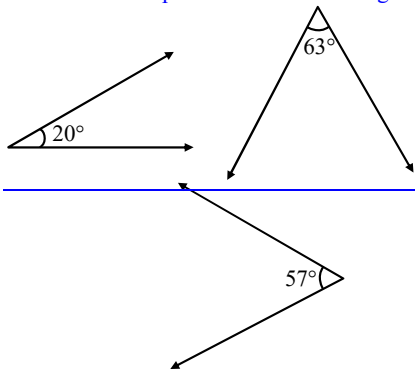Vertically opposite angles are always equal.

Important Facts :

(1) The sum of all angles formed on the same side of a line at a given point on a line is 180°.
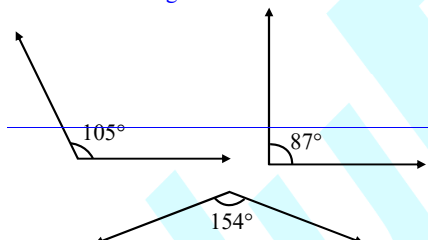
(2) The sum of all angles around a point is 360°.

❖ **EXAMPLES** ❖

Ex.1 Find the complement of the following angles:

63°

20°

57°

Sol. Complement of 20° = 90° – 20° = 70°.

Complement of 63° = 90° – 63° = 27°.

Complement of 57° = 90° – 57° = 33°.

Ex.2 Find the supplement of each of the following angles :

105°

87°

154°

Sol. Supplement of 105° = 180° – 105° = 75°.

Supplement of 87° = 180° – 87° = 93°.

Supplement of 154° = 180° – 154° = 26°.

Ex.3 Find the angle which is equal to its complement.

Sol. Let angel angle = x

The complement of x = 90° – x

According to the question :

angle = complement of angle

so, x = 90° – x

⇒ x + x = 90°

⇒ 2x = 90°

⇒ x = 45°

So, angle is 45°.

Ex.4 In the adjoining figure

A C

1

2

5

O

3

4

D B

E
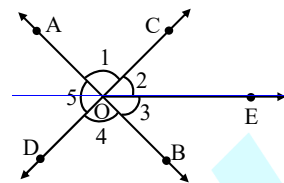
(i) Is ∠1 adjacent to ∠2 ?

(ii) Is ∠AOC adjacent to ∠AOE ?

(iii) Do ∠COE and ∠EOD form a linear pair?

(iv) Are ∠BOD and ∠DOA supplementary ?

(v) Is ∠1 vertically opposite to ∠4 ?

(vi) What is the vertically opposite angele of ∠5 ?

Sol. (i) **Yes**, ∠1 is adjacent to ∠2 (by definition of adjacent angles)

(ii) **No**, ∠AOC is not adjacent to ∠AOE as OC and OE are not opposite of side OA (common arm)

(iii) **Yes**, ∠COE and ∠EOD form a linear pair as ∠COE + ∠EOD = 180°.

(iv) **Yes**, ∠BOD and ∠DOA are supplementary angles.

∵ ∠BOD + ∠DOA = 180°

(v) **Yes**, ∠1 and ∠4 are vertically opposite angeles.

(vi) The vertically opposite angelse of ∠5 is ∠COB.

Ex.5 Find the values of the angles x, y and z in each of the following :

55°

y

x

z

(i)

40°

x

25°

y z
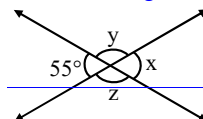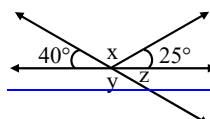
(ii)

Sol. (i) ∠x = 55° (vertically opposite angle)

∠x + ∠y = 180° (linear pair angles)

55° + ∠y = 180°

∠y = 180° – 55°

∠y = 125°

$$\angle z = \angle y$$
$$\angle z = 125°. \text{ (vertically opposite angles)}$$
$$\text{(ii) } 40° + \angle x + 25° = 180°$$

(angles on a straight line)
$$\angle x + 65° = 180°$$

(angles on a straight line)
$$\angle x = 180° - 65°$$
$$\Rightarrow \quad \angle x = 115°$$
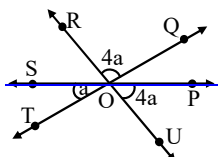$$\angle z = 40°$$
$$\angle y + \angle z = 180°$$

(vertically opposite angles)
$$\angle y = 180° - 40°$$

(linear pair angles)
$$\angle y = 140°$$

Ex.6 Determine the value of a.

Sol. Since $\angle ROQ$ and $\angle TOU$ are vertically opposite angles.
$$\angle TOU = \angle ROQ$$
$$\Rightarrow \quad \angle TOU = 4a$$
$$(\because \angle ROQ = 4a \text{ given})$$
$$\therefore \angle SOT + \angle TOU + \angle UOP = 180°$$

(angles on straight line)
$$a + 4a + 4a = 180°$$
$$9a = 180°$$
$$a = \frac{180°}{90°}$$
$$a = 20°.$$

Hence, a = 20°.

➢ **INTERSECTING LINES**

Two lines are said to be intersecting if they have a point in common. This common point is called the point of intersection of intersecting lines.
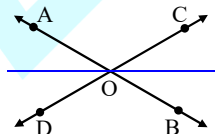
In figure, AB and CD are intersecting lines and O is intersecting point.

For example, letter X made up of line segments contains intersecting lines.

➢ **TRANSVERSAL LINE**

A line that intersects two or more lines at distinct points is called a transversal line.
In figure, t is a transversal to lines p and q.
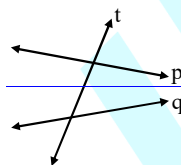
➢ **PARALLEL LINES**

Two lines *l* and *m* are said to be parallel if (i) they lie in the same place plane (ii) they do not intersect when produced indefinitely in either direction and we write *l* || *m* (which is read as '*l* is parallel to *m*')
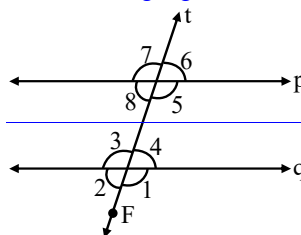*l* || *m* also implies that *m* || *l*.
The distance between two parallel lines is same everywhere or if the perpendicular distances between two lines are equal, lines are parallel, other wise not.
For example, the distance between two Railway lines.

Angles formed when a transversal cuts two lines :
Let two lines p and q be cut by a transversal t, then the following angles are formed.

◈ **Exterior Angles**
Angles which do not contain the segment of the transversal between the two lines are called exterior angles.
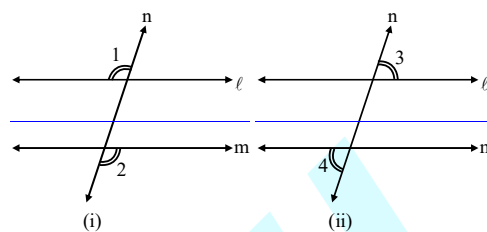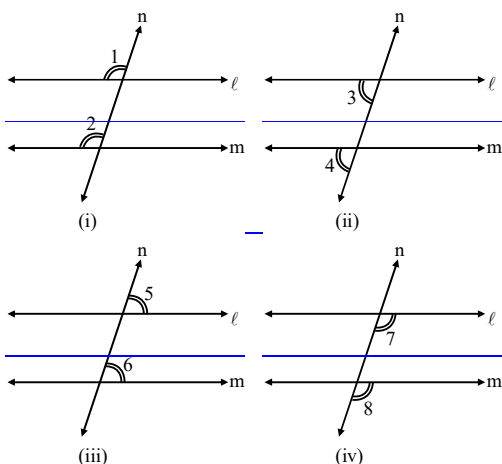
◈ **Interior Angles**
The angles whose arms include the line segment of the transversal between the two lines are called interior angles.
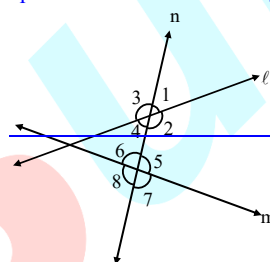
◈ **Corresponding Angles**
Observe the angles marked in each of the figure.

(i)   (ii)

(iii)   (iv)

The angles which
(i) have different vertices
(ii) lie on the same side of the transversal and
(iii) are in corresponding positions (above or below, left or right). relative to the two lines are called corresponding angles.
In other words, two angles on the same side of the transversal either above or below the two given lines are called corresponding angles.

◈ **Alternate Interior Angles**

(i)   (ii)
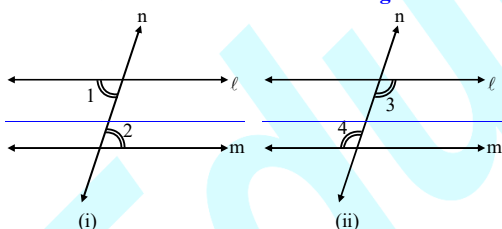
Alternate interior angles :
(i) have different vertices,
(ii) lie on opposite side of the transversal, and
(iii) lie between the two lines.
In other words, A pair of angles in which one arm of each of the angele lies on opposite side of the transversal and other arm of the angle is the segment of the transversal, made by the two line is called a pair of alternate interior angles.

◈ **Alternate Exterior Angles**

(i)   (ii)

A pair of angles in which one arm of both the angles is an on opposite side of the transversal and whose other arms do not include the segment of the transversal, made by the two lines, and are directed in opposite sides of segment of the transversal is called a pair of alternate exterior angles.

S. No.	Name of angles	Angles
(i)	Interior angelsles	$\angle 2, \angle 4, \angle 5$ and $\angle 6$
(ii)	Exterior angles	$\angle 1, \angle 3, \angle 7$ and $\angle 8$
(iii)	Pairs of corresponding angles	$\angle 1 \& \angle 5, \angle 2 \& \angle 7, \angle 3 \& \angle 6, \angle 4 \& \angle 8$
(iv)	Pairs of alternate interior angles	$\angle 4 \& \angle 5$ and $\angle 2 \& \angle 6$
(v)	Pairs of alternate exterior angles	$\angle 3 \& \angle 7$ and $\angle 1 \& \angle 8$
(vi)	Pairs of interior angles on the same side of the transversal	$\angle 4 \& \angle 6$ and $\angle 2 \& \angle 5$
(vii)	Pairs of exterior angles on the same side of the transversal	$\angle 3 \& \angle 8$ and $\angle 1 \& \angle 7$

Note :
(i) If two or more parallel lines are cut by a transversal, then each pair of the corresponding angles have equal measure.
(ii) If two parallel lines are cut by a transversal, the pair of alternate (interior as well as exterior) angles are equal.).

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CAREER POINT, CP Tower, Road No.1, IPIA, Kota (Raj.), Ph: 0744-3040000   Lines and Angles   **38**

(iii) If two parallel lines are cut by a transversal, then each pair of interior angles as well as exterior angles on the same side of the transversal are supplementary.
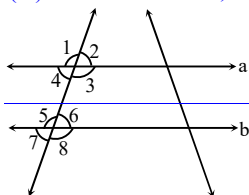
❖ **EXAMPLES** ❖

Ex.7 State the property that is used in each of the following statements :

(i) If a ∥ b, then ∠1 = ∠5

(ii) If ∠4 = ∠6, then a ∥ b

(iii) If ∠4 + ∠5 = 180°, then a ∥ b

Sol. (i) If a ∥ b, then ∠1 = ∠5.
(if lines are parallel then corresponding angles are equal or corresponding angle property)

(ii) If ∠4 = ∠6, then a ∥ b (if alternate interior angles are equal ten the lines are parallel or alternate interior angle property)

(iii) If ∠4 + ∠5 = 180°, then a ∥ b [as interior angles on the same side (co-interior angles) of the transversal are supplementary].

Ex.8 In the adjoining figure, identify

(i) the pairs of corresponding angles

(ii) the pairs of alternate interior angles

(iii) the pairs of interior angles on the same side of the transversal

(iv) the vertically opposite angles
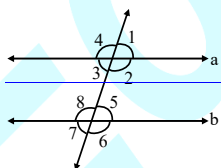
Sol. (i) The pairs of corresponding angles are :
(∠1, ∠5), (∠2, ∠6), (∠4, ∠8) and (∠3, ∠7).

(ii) The pairs of alternate interior angles are :
(∠2, ∠8) and (∠3, ∠5).

(iii) The pairs of interior angles on the same side of the transversal are (∠3, ∠8) and (∠2, ∠5).

(iv) The pairs of vertically opposite angles are (∠1, ∠3), (∠4, ∠2), (∠5, ∠7) and (∠6, ∠8).

Ex.9 In figure, p ∥ q. Find the values of a, b, c, d, e and f.

Sol. ∠e + ∠125° = 180° (linear pair angles)
∠e = 180° − 125°
∠e = 55°
∠f = ∠e (vertically opposite angles)
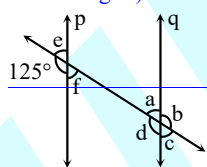
⇒ ∠f = 55° (∵ ∠e = 55° from (1))
∴ p ∥ q.
So, ∠a = ∠f (alternate interior angles)
∠a = 55° (∵ ∠f = 55°)
⇒ ∠c = ∠a (vertically opposite angles)
⇒ ∠e = 55° (∵ ∠a = 55°)
∠d = 125° (corresponding angles)
∠b = ∠d (vertically opposite angles)
⇒ ∠b = 125° (∵ ∠d = 125°)

Ex.10 Find the value of x, if l ∥ m.
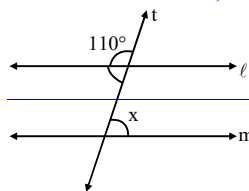
Sol. ∵ l ∥ m and t is transversal

$110°$ t

a ℓ

x m
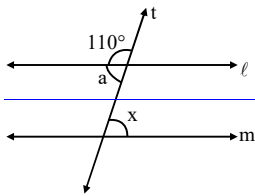
So, $\angle a + 110° = 180°$ (linear pair angles)

$\angle a = 180° - 110°$

$\angle a = 70°$

$\angle x = \angle a$ (alternate interior angles)

$\angle x = 70°$

$(\because \angle a = 70°)$

Ex.11 Find the value of x, if $l \parallel m$.

l m

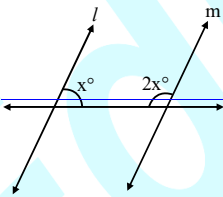$100°$ $x°$ a

$80°$ b
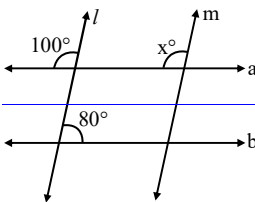
Sol. $\because$ $l \parallel m$

So, $\angle x = 100°$. (corresponding angles)

Ex.12 Find the value of x, if $l \parallel m$.

Sol. $\because$ $l \parallel m$

l m

$x°$ $2x°$

$x + 2x = 180°$ (co-interior angles on the same side of transversal are supplementary)

$\Rightarrow$ $3x = 180°$

$\Rightarrow$ $x = \dfrac{180°}{3}$

$x = 60°$.

Hence, $x = 60°$.

Ex.13 In the given figures below, decide whether $l \parallel m$.

n

(i)

$126°$ l

$44°$ m

(ii)

l m

$75°$ n

$75°$

(iii)

n

$57°$ l

$123°$ m
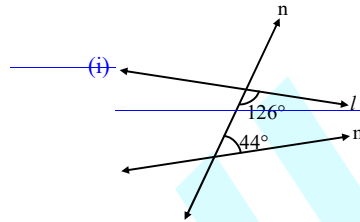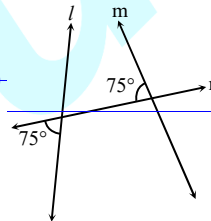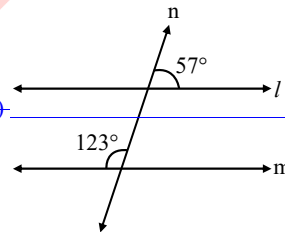
Sol. (i) Sum of co-interior angles
$= 126° = + 44° = 170°$
$\neq 180°$.

$\because$ Sum of co-interior angles $\neq 180°$.

So, l is not paralle to m ($l \not\parallel m$).
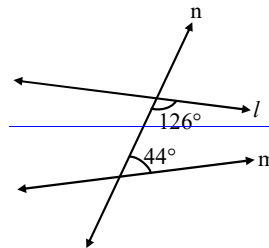
n

$126°$ l

$44°$ m

(ii) $\angle x + 75° = 180°$ (linear pair angles)

$\angle x = 180° - 75°$

$\Rightarrow \angle x = 105°$

and $\angle 1 = 75°$ (given)

$\therefore \angle 1$ and $\angle x$ are corresponding angles and as these are not equal so, ($l \nparallel m$).
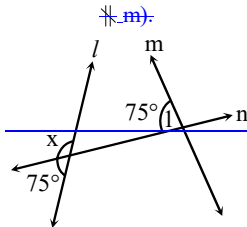
(iii) $\angle 1 + 123° = 180°$ (linear pair)

$\angle 1 = 180° - 123°$

$\angle 1 = 57°$

$\angle 2 = 57°$ (given)

as $\angle 1 = \angle 2$, which are corresponding angles so, $l \parallel m$.
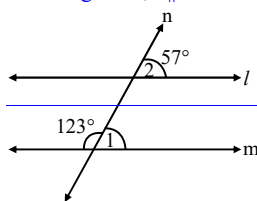
Ex.14 In figure below, $l \parallel m$. Find the values of x, y, z and t.
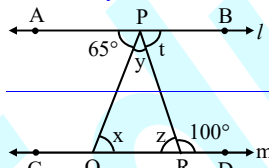
Sol. $\because$ $l \parallel m$ and PQ is transversal

$\therefore \angle x = \angle APQ$

(alternate angles)

$\Rightarrow \angle z x + \angle PRD = 180° 65°$

($\because \angle APQ = 65°$)

Now, $\angle z + \angle PRD = 180°$

(linear pair)

$\angle z + 100° = 180°$

$\angle z = 180° - 100°$

$\angle z = 80°$.

As $l \parallel m$ and PR is transversal.

$\therefore \angle t = \angle z$

(alternate angles)

$\angle t = 80°$

($\because \angle z = 80°$)

Now, $65° + \angle y + \angle t = 180°$

(angles on straight line)

$65° + \angle y + 80° = 180°$

$145° + \angle y = 180°$

$\angle y = 180° - 45°$

$\angle y = 35°$

EXERCISE # 1

Q.1 Observe the following figures and complete the table :

S. No.	Figures	Lines	Rays	Line Segments

		Line l $\leftrightarrow$ (XY)	$\overrightarrow{XY}$ & $\overrightarrow{YX}$	$\overline{XY}$
(i)	X Y ℓ			
(ii)	O P m			
(iii)	A R P Q B			
(iv)	X Y P Q R S n			

Q.2 Name the initial point of the following rays :
$\overrightarrow{PQ}, \overrightarrow{QR}, \overrightarrow{AB}, \overrightarrow{OP}$

Q.3 Differentiate between a line, a line segment, and a ray.

Q.4 State whether the following statement are true (T) or false (~~T~~F) :

(i) A point has no length and no breadth.

(ii) A ray $\overrightarrow{AB}$ has one end point B.

(iii) The length of a line can be measured using a ruler.

(iv) A line segment extends endlessly on both sides.

(v) Infinite number of lines can be drawn through a point.

(vi) Infinite number of rays can be drawn from a point.

(vii) The number of points on a line segment can be counted.

Q.5 Fill in the blanks :

(i) The shortest distance between two points is known as a…….

(ii) The point O is known as an ……. of the ray $\overrightarrow{OP}$.

(iii) An angle of 180° is called a …….. angle.

Q.6 Observe the following figures and complete the table :

S. No	Figures	Naming angles in three ways			Arms	
(i)	B, l, O, A	$\angle AOB$	$\angle BOA$	$\angle 1$	OB	OA
(ii)	X, x, O, Y					
(iii)	P, Q, a, O					

S. No	Figures	Naming angles in three ways			Arms	
(i)	B, l, O, A	$\angle AOB$	$\angle BOA$	$\angle 1$	OB	OA
(ii)	X, x, O, Y					
(iii)	P, Q, a, O					

Q.7 Which pairs of the following angles are complementary ?

and

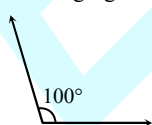(i)
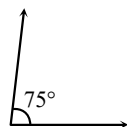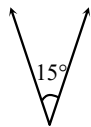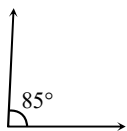
and

(ii)
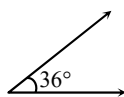
and
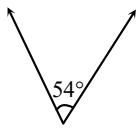
(iii)
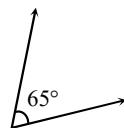
and
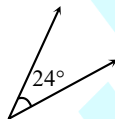
(iv)

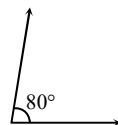**Q.8** Find the complement of each of the following angles :

(i) 45°   (ii) 75°   (iii) 80°
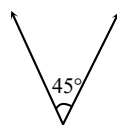
(iv) $22\frac{1}{2}°$ (v) 50.5°

Q.9 Find the pairs of supplementary angles in the following figures :
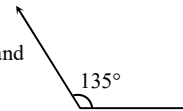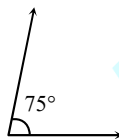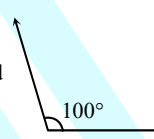

and

(i)

and

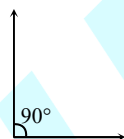(ii)

and

(iii)

and
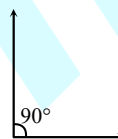
(iv)

Q.10 Find the supplement of each of the following angles :

(i) 95°   (ii) 110°

(iii) $115\frac{1}{2}°$ (iv) $135\frac{1}{2}°$

Q.11 Fill in the blanks :

(i) The supplement of an obtuse angle is an ………

(ii) The supplement of an acute angle is an …….

(iii) The supplement of a right angle is a …...

Q.12 Fill in the blanks :

(i) If two angles are complementary, then the sum of their measures is ……

(ii) If two angles are supplementary, then the sum of their measures is …….

(iii) Two angles forming a linear pair are …..

(iv) If two adjacent angles are supplementary, they form a ……

(v) Two lines intersect at a point. If one pair of vertically opposite angles are acute angles then other pair of vertically opposite angles are …….

Q.13 Observe the figure which of the following are pairs of adjacent angles. Justify your answer.
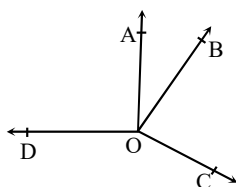
(i) ∠AOB and ∠BOD

(ii) ∠AOD and ∠BOC

(iii) ∠AOC and ∠BOC

(iv) ∠AOD and ∠AOB

(v) ∠BOC and ∠BOA

Q.14 Observe the ~~angels~~ angles marked with 1 and 2 in the figure. Are they adjacent ? If not, why?
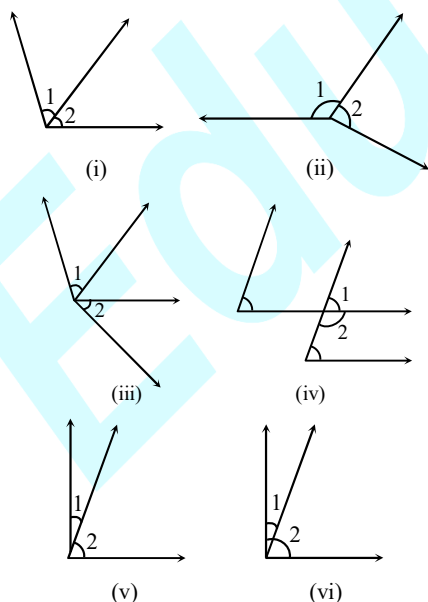
Q.15 Two angles form a linear pair. If one of them is :
(i) an acute angle   (ii) an obtuse angle
(iii) a right angle
then what type of the angle is the other ?

Q.16 Two angles are supplementary. Can both of them be :
(i) acute angles ?   (ii) obtuse angles ?
(iii) right angles ?

Q.17 Observe the following figure and write :
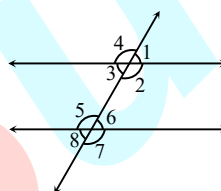
(i) Linear pairs of angles
(ii) Vertically opposite angles
(iii) Adjacent pairs of angeles

Q.18 Find the value of the letters given in each of the figures below :
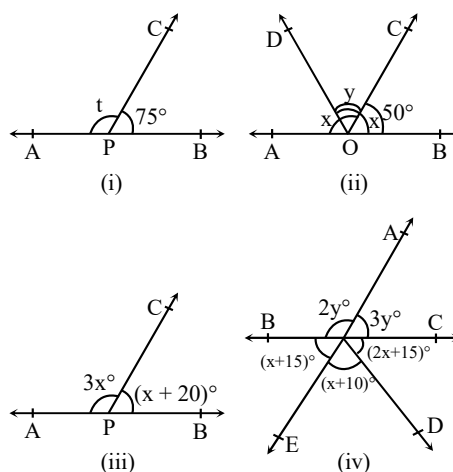
Q.19 In the figure, OE ⊥ AC.
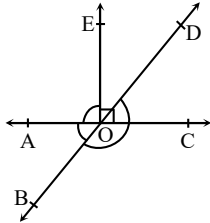
(i) Find out angles forming a linear pair.

(ii) Find out the pair of supplementary angles.

(iii) Find out the pair of vertically opposite angles.

(iv) Find out the pair of complementary angles.

Q.20 If an angle is more than 30°, then its complementary angle is :

(i) greater than 60°

(ii) less than 60°

(iii) equal to 60°

Q.21 In the figure, if ray $\overrightarrow{OC}$ rotates to the left of its initial position then,
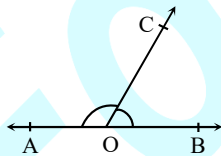
(i) ∠AOC will decrease or increase

(ii) ∠COB will increase or decrease

(iii) Suppose ∠AOC decrease, what changes should take place in ∠BOC so that both the angles still remain supplementary.

Q.22 In the given figure, is ∠1 adjacent to ∠2 ? Justify your answer.
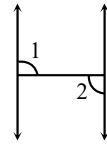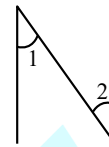
(i)   (ii)

Q.23 In the figure, name the following pairs of angles :
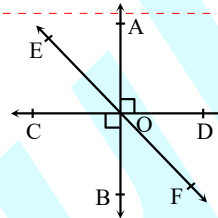
(i) Equal supplementary angles

(ii) Vertically opposite angels

(iii) Unequal supplementary angles

(iv) Adjacent complementary angles

(v) Obtuse vertically opposite angles

(vi) Adjacent angles that do not form a linear pair.

Note : In Q.No. 24 to 37 the parallel lines are indicated by big arrows (>).

Q.24 In the following figure, find the transversal line :
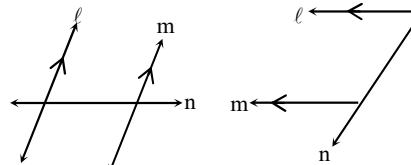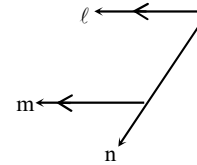
(i)   (ii)
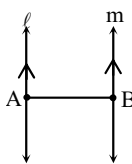
(iii)   (iv)
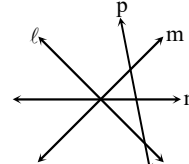
(v)

(i) (ii)
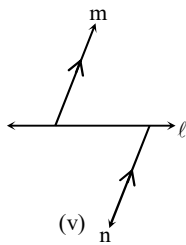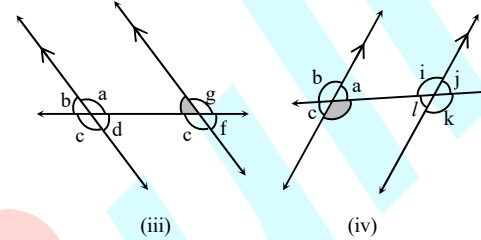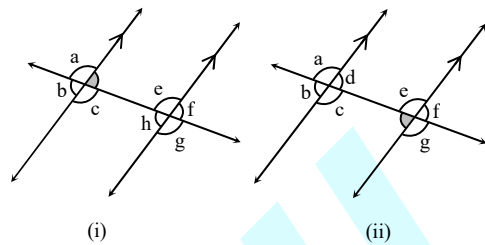
Q.25 Mark the pairs of remaining exterior angles with the numerals 3 and 4, in figure.

(iii) (iv)

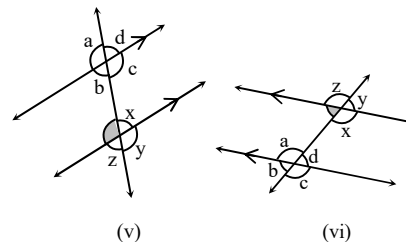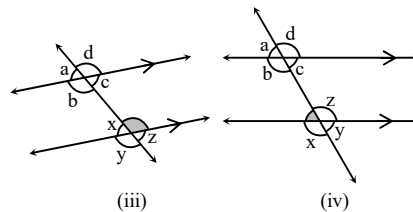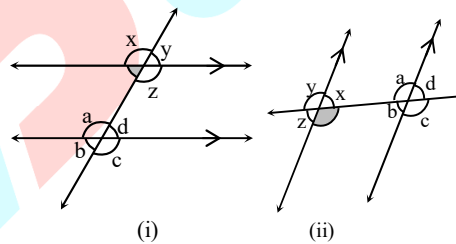**Q.28** Write down the angle that is alternate to the shaded angle in the following diagrams :

Q.26 Mark the remaining interior angles with the numerals 3 and 4, in figure

(i) (ii)

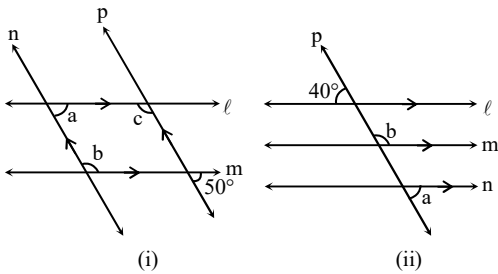(iii) (iv)

Q.27 In figure, write down the angle that corresponds to the shaded angle :

(v) (vi)

Q.29 In the following figure, find the value of each marked letter.

(i)   **(ii)**
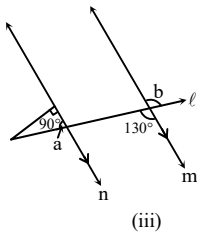
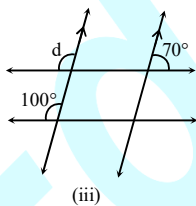**(iii)**

Q.30 Write down the measure of the angle marked in each of the following diagrams, if line marked with arrow are parallel.
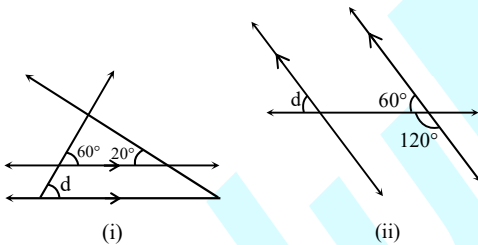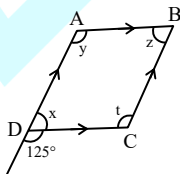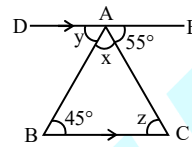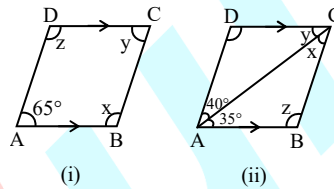
(i)   **(ii)**

(iii)

Q.31 In figure, AB ∥ CD find the values of x, y, z and t.

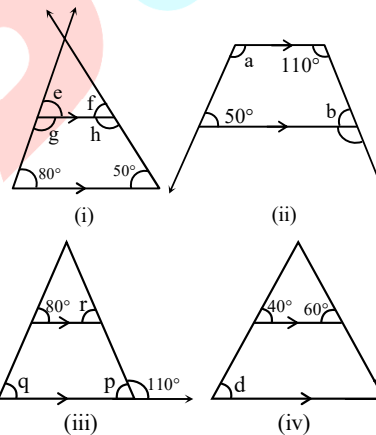**Q.32** In figure, DE ∥ BC find the values of x, y and z.

Q.33 In figure, AB ∥ CD and AD ∥ BC. Find the values of x, y and z.

(i)   **(ii)**

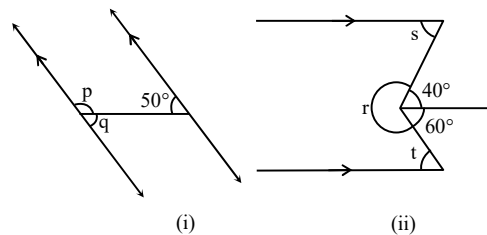**Q.34** Find the size of each marked angle in the following figure.
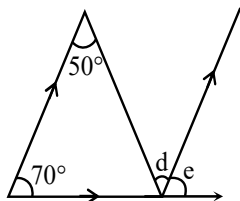
(i)   **(ii)**

(iii)   **(iv)**

Q.35 Find the size of each angle marked with a letter in figure

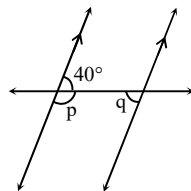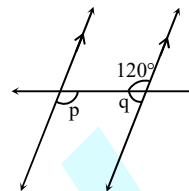**(i)**   **(ii)**
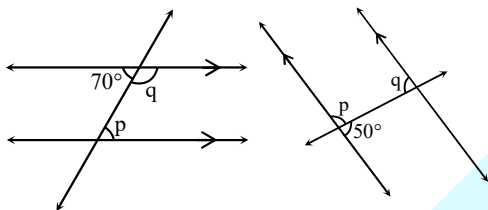
       Lines and Angles   **38**
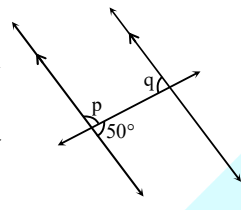
(iii)

(iii)　　　　　(iv)

Q.36 In the following figure, use the information given to find the measures of p and q. Then find the sum of p and q.
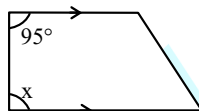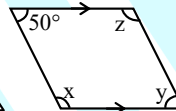

(i)　　　　　(ii)
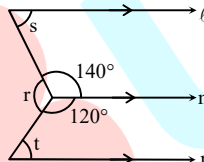
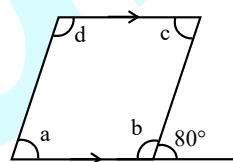**Q.37** Find the size of each marked angle.

(i)　　　　　(ii)

(iii)　　　　　(iv)

ANSWER KEY

1. O

S.No.	Lines	Rays	Line Segments
(ii)		Ray m $\overrightarrow{OP}$	$\overline{OP}$
(iii)			$\overline{AR}, \overline{RP}, \overline{PQ}, \overline{QB}, \overline{AP}$, $\overline{PB}, \overline{RQ}, \overline{AB}, \overline{AQ}, \overline{RB}$
(iv)	Line n $\overleftrightarrow{XS}, \overleftrightarrow{XR}, \overleftrightarrow{XQ}, \overleftrightarrow{XP}, \overleftrightarrow{XY}, \overleftrightarrow{YP}$, $\overleftrightarrow{PQ}, \overleftrightarrow{QR}, \overleftrightarrow{RS}, \overleftrightarrow{YQ}, \overleftrightarrow{YR}, \overleftrightarrow{QS}$ $\overleftrightarrow{YS}, \overleftrightarrow{PS}, \overleftrightarrow{PR}$, etc.	Ray $\overrightarrow{XS}, \overrightarrow{XR}, \overrightarrow{XQ}, \overrightarrow{XP}$, $\overrightarrow{XY}, \overrightarrow{YS}, \overrightarrow{YR}, \overrightarrow{YQ}$, etc.	$\overline{XY}, \overline{XP}, \overline{XQ}, \overline{XR}$, $\overline{XS}, \overline{QS}, \overline{QY}, \overline{PR}$ etc.

　　　Lines and Angles　　**38**

2. P, Q, A, O

4. (i) T (ii) F (iii) F (iv) F (v) T (vi) T (vii) F

5. (i) Line segment (ii) Initial point (iii) Straight

6. (ii) ∠XOY, ∠YOX, ∠x, OX, OY (ii) ∠POQ, ∠QOP, ∠a, OP, OQ

7. Complementary : (i), (iii)

8. (i) 45° (ii) 15° (iii) 10° (iv) $67\frac{1}{2}°$ (v) 39.5°

9. Supplementary angles : (i), (ii) and (iv)

10. (i) 85° (ii) 70° (iii) $64\frac{1}{2}°$ (iv) $44\frac{1}{2}°$

11. (i) acute angle (ii) obtuse angle (iii) right angle

12. (i) 90° (ii) 180° (iii) Supplementary (iv) Linear pair (v) Obtuse angles

13. (i) no (ii) no (iii) no (iv) yes (v) yes

14. Adjacent angle : (i), (ii) and (iv)

15. (i) obtuse angle (ii) acute angle (iii) a right angle

16. (i) no (ii) no (iii) yes

17. (i) Linear pair : ∠1, ∠2 ; ∠2, ∠3 ; ∠3, ∠4 ; ∠4, ∠1 ; ∠6, ∠7 ; ∠7, ∠8 ; ∠8, ∠5 ; ∠5, ∠6

　　(ii) Vertically opposite angles : ∠1, ∠3 ; ∠2, ∠4 ; ∠6, ∠8 ; ∠5, ∠7

　　(iii) Adjacent angeles : ∠1, ∠2 ; ∠2, ∠3 ; ∠3, ∠4 ; ∠4, ∠1 ; ∠6, ∠7 ; ∠7, ∠8 ; ∠8, ∠5 ; ∠5, ∠6

18. (i) 105° (ii) x = 130°, y = 80° (iii) 40° (iv) x = 35°, y = 36°

19. (i) ∠EOC and ∠EOA ; ∠EOD and ∠EOB ; ∠AOB and ∠AOD ; ∠DOC and ∠COB ; ∠BOC and ∠AOB

　　(ii) ∠EOC and ∠EOA; ∠EOD and ∠EOB; ∠AOB and ∠AOD; ∠DOC and ∠COB; ∠BOC and ∠AOB

　　(iii) ∠AOB and ∠DOC ; ∠AOD and ∠BOC　　　(iv) ∠EOD and ∠DOC

20. (ii) Less than 60°

21. (i) decrease (ii) increase (iii) ∠COB should not be a straight angle.

22. (i) No (ii) No

23. (i) ∠AOC and ∠AOD; ∠COB and ∠BOD; ∠AOC and ∠BOC; ∠AOD and ∠BOD

　　(ii) ∠AOD and ∠COB; ∠AOC and ∠BOD; ∠AOE and ∠BOF; ∠EOC and ∠DOF; ∠EOD and ∠COF; ∠BOE and ∠AOF

　　(iii) ∠EOC and ∠EOD; ∠FOD and ∠FOC; ∠AOF and ∠FOB; ∠AOE and ∠EOB

　　(iv) ∠AOE and ∠EOC; ∠DOF and ∠FOB

　　(v) ∠EOB and ∠AOF; ∠EOD and ∠COF

　　(vi) ∠EOA and ∠EOC; ∠DOF, ∠BOF; ∠AOD and ∠AOE; ∠EOC and ∠COB; ∠COB and ∠BOF; ∠FOD and ∠DOA

24. (i) line n (ii) line n (iii) line AB (iv) line p (v) line l

25.

26.
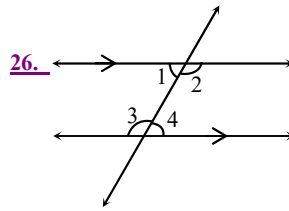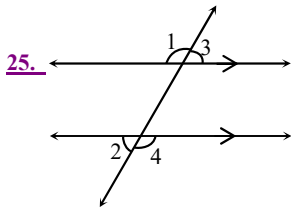
27. (i) f (ii) b (iii) b (iv) k   **28.** (i) d   (ii) a (iii) b (iv) c (v) c (vi) d

29. (i) a = 50°, b = 130°, c = 130°   (ii) a = 40°, b = 140°   (iii) a = 50°, b = 130°

30. (i) d = 60°   (ii) d = 60°   (iii) d = 100°   **31.** x = 55°, y = 125°, z = 55°, t = 125°

32. x = 80°, y = 45°, z = 55°   **33.** (i) x = 115°, y = 65°, z = 115° (ii) x = 40°, y = 35°, z = 105°

34. (i) e = 80°, f = 50°, g = 100°, h = 130°   (ii) a = 130°, b = 70° (iii) p = 70°, q = 80°, r = 70° (iv) d = 40°, e = 120°

35. (i) p = 130°, q = 50° (ii) s = 40°, t = 60°, r = 260° (iii) d = 50°, e = 70°

36. (i) p = 70°, q = 110°, p + q = 180° (ii) p = 130°, q = 50°, p + q = 180° (iii) p = 140°, q = 40°, p + q = 180°

   (iv) p = 120°, q = 60°, p + q = 180°.

37. (i) x = 85°   (ii) x = 130°, y = 50°, z = 130° (iii) r = 100°, s = 40°, t = 60° (iv) a = 80°, b = 100°, c = 80°, d = 100°

EXERCISE # 2

Q.1 Find the complement of each of the following angles :

(i) 40° _____(ii) 86°

(iii) 55°

____ _____(iv) 34°

(v) 0° _____(vi) 90°

Q.2 Find the supplement of each of the following angles :
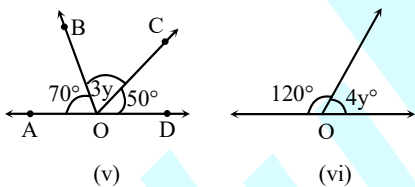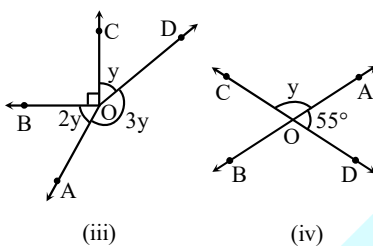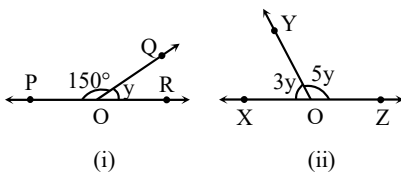
(i) 80° ____ ____(ii) 130°

(iii) 145°

____(iv) 90°

(v) 0° _____ (vi) 180°

Q.3 Find 'y' in each of the following figures :

(i)   (ii)

(iii)   (iv)
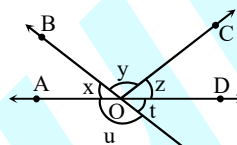

(v)   (vi)

Q.4 Can two angles be complement, if both of them be

(i) acute

(ii) right

(iii) obtuse ?

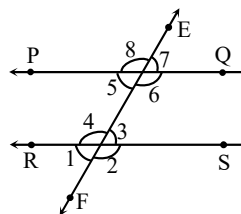**Q.5** Name the two pairs of supplementary angles in the figure :
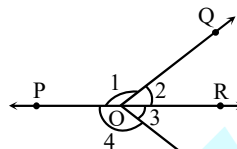
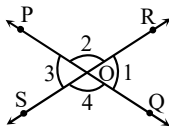**Q.6** Observe the following figure and answer the questions :

(i) Are ∠u and ∠t supplementary ?

(ii) Is ∠y vertically opposite to ∠u ?

(iii) Do ∠AOB and ∠BOD form a linear pair?

(iv) Is ∠BOC adjacent to ∠BOD ?

(v) Is ∠x adjacent to ∠y ?

**Q.7** Name the linear pairs, and pairs of vertically opposite angles in the following figure.


Q.8 In figure below, ∠1 = 52°, find the other angles.

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Q.9 In the given figure (below) identify

(i) the pairs of corresponding angles.

(ii) the pairs of alternate interior angles.

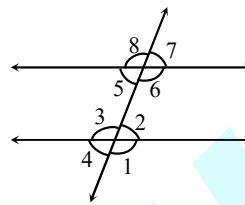(iii) the pairs of consecutive interior angles.
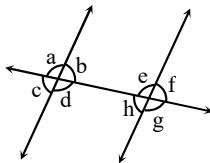
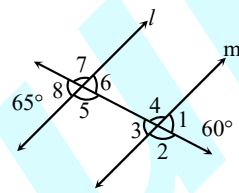**Q.10** State the property that is used in each of the following statement :

(i) If $l \parallel m$, then $\angle d = \angle h$

(ii) If $\angle d = \angle f$, then $l \parallel m$

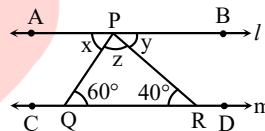(iii) If $\angle c + \angle f = 180°$, then $l \parallel m$
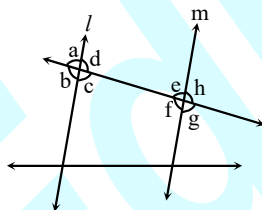
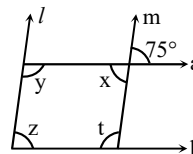**Q.11** In the figure below, if $\angle 1 = 55°$, find all the remaining angles.

Q.12 In the figure given below, $\angle 1 = 60°$, $\angle 8 = 65°$. Is $l \parallel m$?

Q.13 In the given figure, $l \parallel m$, find x, y and z.

Q.14 In the given figure, a $\parallel$ b and $l \parallel m$, find the measures of the angles x, y, z and t.

Q.15 Two interior angles on the same side of the transversal measure $(a - 6)°$ and $(5a - 6)°$. Find the measure of each angle.
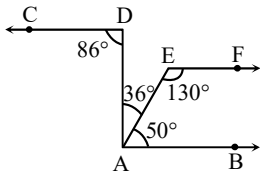
Q.16 In the figure below, prove that CD $\parallel$ EF.

C — D

86° E · F ·

36° | 130°

50°

A · · B

Q.17 In the adjoining figure, p ∥ q and p ∥ r.

(i) Is q ∥ r ? Why ?

(ii) Find the values of a, b and c.

70° p

a q

b

c r

Q.18 In the figure below left side, $l \parallel m$, If $\angle 1 = (2x + 50)°$, $\angle 3 = (x + 4y)°$ and $\angle 5 = (5y + 10)°$, find the angles $\angle 1$, $\angle 3$ and $\angle 5$.

A B

60°

O

70°

C D

R

x y

P O Q

Q.1918 In the figure find ∠AOC if AB ∥ CD.

A B

60°

O

70°

C D

Q.2019 If ray PO stands on line RS such that ∠POS = ∠POR then ∠POR = 90°.
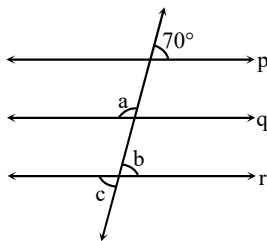
Q.2120 In figure below, if x – y = 40°, find x and y.

R

x y

P O Q

Q.2221 In figure below, p ∥ q and t is transversal. Find the values of a, b, c.
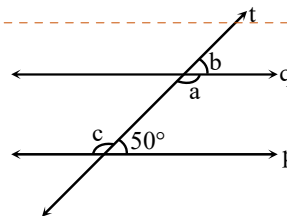
t

b q

a

c 50°

p
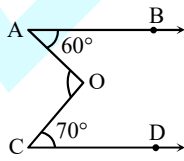
Q.2322 In figure below, find the values of a, b, c, d, e
and f.
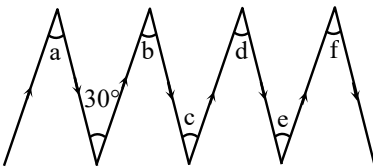
ANSWER KEY

1. (i) 50° (ii) 4° (iii) 35° (iv) 56° (v) 90° (vi) 0°

2. (i) 100° (ii) 50° (iii) 35° (iv) 90° (v) 180° (vi) 0°

3. (i) y = 30° (ii) (22.5)° (iii) 45° (iv) 125° (v) 20° (vi) 15°

4. (i) Not always (ii) no (iii) no   **5.** (∠1, ∠2) and (∠3, ∠4)

6. (i) yes (ii) no (iii) yes (iv) no (v) yes

7. Linear paired angles are : (∠1, ∠2), (∠1, ∠4), (∠2, ∠3), (∠4, ∠3), (∠5, ∠6), (∠5, ∠8), (∠6, ∠7), (∠7, ∠8) ;
Vertically opposite angles : (∠1, ∠3), (∠4, ∠2), (∠5, ∠7), (∠6, ∠8)

8. ∠3 = 52°, ∠2 = ∠4 = 128°

9. (i) (a, e), (b, f), (c, h), (d, g) (ii) (b, h), (d, e) (iii) (b, e), (d, h)

10. (i) corresponding angles are equal (ii) if alternate interior angles are equal, lines are parallel
(iii) cointerior angles are supplementary

11. ∠3 = ∠6 = ∠8 = 55°, ∠4 = ∠2 = ∠5 = ∠7 = 125°   **12.** No

13. x = 60°, y = 40°, z = 80°   **14.** x = 75°, t = 105°, z = 75°, y = 105°

15. 26°, 154°

17. (i) yes (ii) b = c = 70°, a = 110°

18. 130° (**Hint :** through O, draw a line parallel to AB or CD)

20. x = 110°, y = 70°

21. ∠a = 130°, ∠b = 50°, ∠c = 130°

22. a = b = c = d = e = f = 30°

Centered, Indent: Left: 0 cm, First line: 0 cm, Space Before: 0 pt, After: 0 pt, Adjust space between Latin and Asian text, Adjust space between Asian text and numbers, Border: Bottom: (Single solid line, Auto, 3 pt Line width), Tab stops: Not at 0.