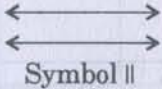
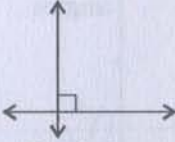


Learn and Remember

Line segment: A line-segment has two end points.

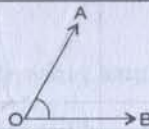
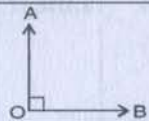
Ray: A ray has only one end point (its vertex).


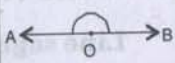
Line: A line is made up of a infinite number of points and it has only length *i.e.*, it does not has any thickness (or width). A line is endless it can be extended in both directions.

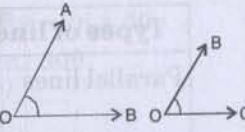
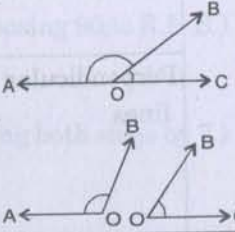
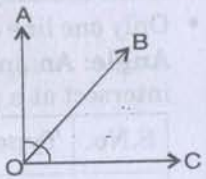
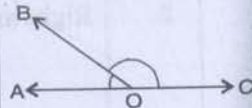
Types of lines	Definition	Figure
Parallel lines	Two lines, lying in a plane and having no common intersecting point, are called parallel lines.	 Symbol
Perpendicular lines	Two lines which lie in a single plane and intersect each other at right angle, are perpendicular lines.	 Symbol ⊥

- A line contains infinitely many points.
- Only one line can pass through any two particular points.

Angle: An angle is formed when two lines or line segments intersect at a point.

S.No.	Types of angles	Property	Figures
1.	Acute angle	Less than 90° . ($\angle AOB$ is an acute angle.)	
2.	Right angle	Equal to 90° . ($\angle AOB$ is a right angle.)	

S.No.	Types of angles	Property	Figures
3.	Obtuse angle	More than 90° but less than 180° . ($\angle AOB$ is a obtuse angle.)	
4.	Straight angle	Equal to 180° . ($\angle AOB$ is a straight angle.)	

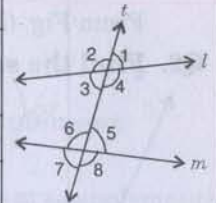
S.No.	Pairs of angles	Condition	Figures
1.	Complementary angles	Two angles whose sum is 90° , are complementary to each other. <i>i.e.</i> , $\angle AOB + \angle BOC = 90^\circ$	
2.	Supplementary angles	Two angles whose sum is 180° , are supplementary to each other. <i>i.e.</i> , $\angle AOB + \angle BOC = 180^\circ$	
3.	Adjacent angles	$\angle AOB$ and $\angle BOC$ are adjacent angles. Adjacent angles must have a common vertex (O) and a common arm (<i>e.g.</i> , OB) but no common interior.	
4.	Linear pair	Adjacent ($\angle AOB$ and $\angle BOC$) and supplementary (<i>i.e.</i> , $\angle AOB + \angle BOC = 180^\circ$).	

Two lines intersect at a single point this, point is called the point of intersection.

Vertically opposite angles: When two lines intersect, the vertically opposite angles so formed are equal.

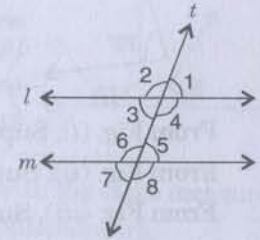
Transversal: A line which intersects two or more lines at distinct points.

When a transversal cuts two non-parallel lines:

S.No.	Types of angle	Angle shown	Figure
1.	Interior	$\angle 3, \angle 4, \angle 5, \angle 6$	
2.	Exterior	$\angle 1, \angle 2, \angle 7, \angle 8$	
3.	Corresponding	$\angle 2, \angle 6; \angle 1, \angle 5;$ $\angle 3, \angle 7; \angle 4, \angle 8;$	
4.	Alternate interior	$\angle 3, \angle 5; \angle 4, \angle 6;$	
5.	Alternate exterior	$\angle 1, \angle 7; \angle 2, \angle 8;$	
6.	Interior, on the same side of transversal	$\angle 3, \angle 6; \angle 4, \angle 5;$	

When two *parallel* lines are intersected by a *transversal* then

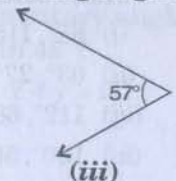
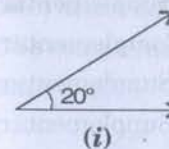
- The pair of corresponding angles so formed are equal.
i.e., $\angle 2 = \angle 6, \angle 1 = \angle 5, \angle 3 = \angle 7, \angle 4 = \angle 8$.
- Each pairs of alternate angles (interior) is equal.
i.e., $\angle 3 = \angle 5$ and $\angle 4 = \angle 6$.
- Interior angles on the same side of the transversal line are supplementary.
i.e., $\angle 3 + \angle 6 = 180^\circ, \angle 4 + \angle 5 = 180^\circ$.



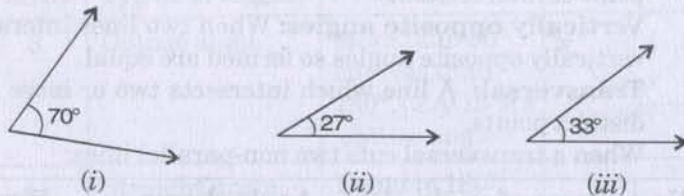
TEXTBOOK QUESTIONS SOLVED

Exercise 5.1 (Page No. 101-103)

Q1. Find the complement of each of the following angles:

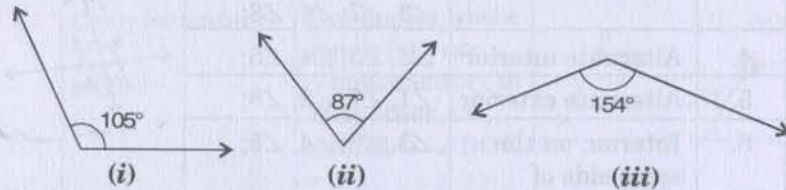


Sol. Complement = 90° - given angle.

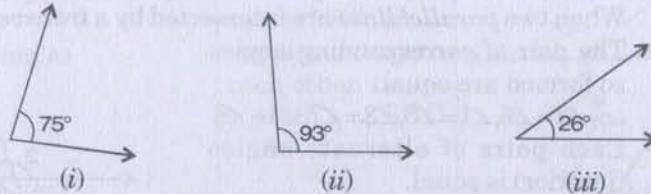


From Fig. (i), Complement of $20^\circ \Rightarrow 90^\circ - 20^\circ = 70^\circ$.
 From Fig. (ii), Complement of $63^\circ \Rightarrow 90^\circ - 63^\circ = 27^\circ$.
 From Fig. (iii), Complement of $57^\circ \Rightarrow 90^\circ - 57^\circ = 33^\circ$.

Q2. Find the supplement of each of the following angles:



Sol. Supplement angle = 180° - given angle.



From Fig. (i), Supplement of $105^\circ \Rightarrow 180^\circ - 105^\circ = 75^\circ$.
 From Fig. (ii), Supplement of $87^\circ \Rightarrow 180^\circ - 87^\circ = 93^\circ$.
 From Fig. (iii), Supplement of $154^\circ \Rightarrow 180^\circ - 154^\circ = 26^\circ$.

Q3. Identify which of the following pairs of angles are complementary and which are supplementary:

- (i) $65^\circ, 115^\circ$ (ii) $63^\circ, 27^\circ$ (iii) $112^\circ, 68^\circ$
 (iv) $130^\circ, 50^\circ$ (v) $45^\circ, 45^\circ$ (vi) $80^\circ, 10^\circ$

Sol. Whose sum is 90° , they are called complementary angles and whose sum is 180° , they are called supplementary angles.

- (i) $65^\circ, 115^\circ \Rightarrow 65^\circ + 115^\circ = 180^\circ$ Supplementary angles
 (ii) $63^\circ, 27^\circ \Rightarrow 63^\circ + 27^\circ = 90^\circ$ Complementary angles
 (iii) $112^\circ, 68^\circ \Rightarrow 112^\circ + 68^\circ = 180^\circ$ Supplementary angles
 (iv) $130^\circ, 50^\circ \Rightarrow 130^\circ + 50^\circ = 180^\circ$ Supplementary angles

- (v) $45^\circ, 45^\circ \Rightarrow 45^\circ + 45^\circ = 90^\circ$ Complementary angles
 (vi) $80^\circ, 10^\circ \Rightarrow 80^\circ + 10^\circ = 90^\circ$ Complementary angles

Q4. Find the angle which is equal to its complement.

Sol. Let x be two equal angles of its complement.

Then, sum of two equal angles = 90° .

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

$$\Rightarrow 2x = 90^\circ$$

$$\Rightarrow x = \frac{90^\circ}{2} = 45^\circ$$

or $x = 45^\circ$ each

So, 45° is equal to its complement.

Q5. Find the angle which is equal to its supplement.

Sol. Let x be two equal angles of its supplement.

Then $x + x = 180^\circ$ (\because angles are supplement)

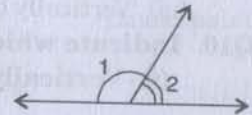
$$\Rightarrow 2x = 180^\circ$$

$$\Rightarrow x = \frac{180^\circ}{2}$$

or $x = 90^\circ$

So, 90° is equal to its supplement.

Q6. In the given figure, $\angle 1$ and $\angle 2$ are supplementary angles. If $\angle 1$ is decreased, what changes should take place in $\angle 2$ so that both the angles still remain supplementary.



Sol. If $\angle 1$ is decreased then $\angle 2$ will increase with the same measure. So that both the angles still remain supplementary.

Q7. Can two angles be supplementary if both of them are:
 (i) acute? (ii) obtuse? (iii) right?

- Sol.** (i) No, because sum of two acute angles is less than 180° ,
 (ii) No, because sum of two obtuse angles is more than 180° ,
 (iii) Yes, because sum of two right angles is 180° .

Q8. An angle is greater than 45° . Is its complementary angle greater than 45° or equal to 45° or less than 45° ?

Sol. Let the complementary angles be x and y . i.e., $x + y = 90^\circ$.

Given, $x > 45^\circ$

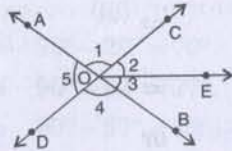
Adding y to both sides,

$$\begin{aligned} \Rightarrow x + y &> 45^\circ + y \\ \Rightarrow 90^\circ &> 45^\circ + y && (\because x + y = 90^\circ) \\ \Rightarrow 90^\circ - 45^\circ &> y \\ \text{or } y &< 45^\circ \end{aligned}$$

So, its complementary angle is less than 45° .

Q9. In the adjoining figure:

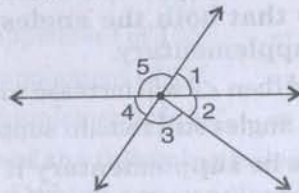
- Is $\angle 1$ adjacent to $\angle 2$?
- Is $\angle AOC$ adjacent to $\angle AOE$?
- Do $\angle COE$ and $\angle EOD$ form a linear pair?
- Are $\angle BOD$ and $\angle DOA$ supplementary?
- Is $\angle 1$ vertically opposite to $\angle 4$?
- What is the vertically opposite angle of $\angle 5$?



- Sol.** (i) Yes, in $\angle AOE$, OC is common arm.
 (ii) No, they have no non-common arms on opposite side of common arm.
 (iii) Yes, they form linear pair.
 (iv) Yes, they are supplementary.
 (v) Yes, they are vertically opposite angles.
 (vi) Vertically opposite angle of $\angle 5$ is $\angle COB$.

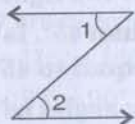
Q10. Indicate which pairs of angles are:

- Vertically opposite angles.
- Linear pairs.



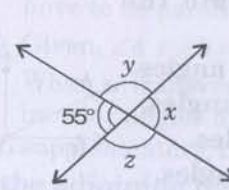
- Sol.** (i) Vertically opposite angles, $\angle 1, \angle 4$; $\angle 5, \angle 2 + \angle 3$.
 (ii) Linear pairs $\angle 1, \angle 5$; $\angle 5, \angle 4$.

Q11. In the following figure, is $\angle 1$ adjacent to $\angle 2$? Give reasons.

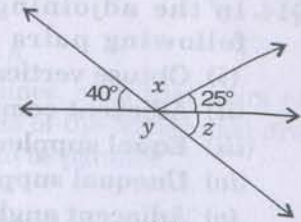


- Sol.** $\angle 1$ and $\angle 2$ are not adjacent angles because their vertex is not common.

Q12. Find the values of the angles x, y and z in each of the following:



(i)



(ii)

- Sol.** (i) $x = 55^\circ$ (Vertically opposite angles)

Now, $55^\circ + y = 180^\circ$ (Linear pair)

$$y = 180^\circ - 55^\circ = 125^\circ$$

Now, $y = z$ (Vertically opposite angles)

So, $z = 125^\circ$

Thus, $x = 55^\circ, y = 125^\circ$ and $z = 125^\circ$.

- (ii) Given, $40^\circ + x + 25^\circ = 180^\circ$ (Angles on straight line)

$$\Rightarrow 65^\circ + x = 180^\circ$$

$$\Rightarrow x = 180^\circ - 65^\circ = 115^\circ$$

Now, $40^\circ + y = 180^\circ$ (Linear pair)

$$\Rightarrow y = 180^\circ - 40^\circ = 140^\circ \quad \dots(i)$$

Now, $y + z = 180^\circ$ (Linear pair)

$$\Rightarrow 140^\circ + z = 180^\circ$$

$$\Rightarrow z = 180^\circ - 140^\circ = 40^\circ \quad [\text{From (i)}]$$

Thus, $x = 115^\circ, y = 140^\circ$ and $z = 40^\circ$.

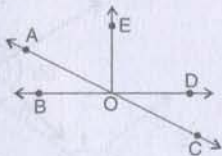
Q13. Fill in the blanks:

- If two angles are complementary, then the sum of their measures is _____.
- If two angles are supplementary, then the sum of their measures is _____.
- Two angles forming a linear pair are _____.
- If two adjacent angles are supplementary, they form a _____.
- If two lines intersect at a point, then the vertically opposite angles are always _____.
- If two lines intersect at a point, and if one pair of vertically opposite angles are acute angles, then the other pair of vertically opposite angles are _____.

- Sol. (i) 90° (ii) 180° (iii) supplementary
 (iv) linear pair (v) equal (vi) obtuse angles.

Q14. In the adjoining figure, name the following pairs of angles:

- (i) Obtuse vertically opposite angles.
 (ii) Adjacent complementary angles.
 (iii) Equal supplementary angles.
 (iv) Unequal supplementary angles.
 (v) Adjacent angles that do not form a linear pair.

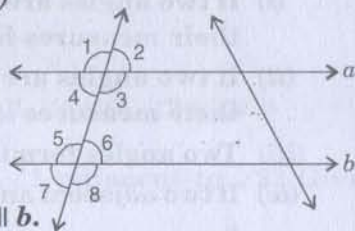


- Sol. (i) Obtuse vertically opposite angles means greater than 90° and equal $\angle AOD = \angle BOC$.
 (ii) Adjacent complementary angles means angles have common vertex, common arm, non-common arms are on either side of common arm and sum of angles is 90° .
i.e., $\angle EOA, \angle AOB$.
 (iii) Equal supplementary angles means sum of angles is 180° and supplement angles are equal.
i.e., $\angle BOE, \angle EOD$.
 (iv) Unequal supplementary angles means sum of angle is 180° and supplement angles are unequal.
i.e., $\angle AOE, \angle EOC$; $\angle AOD, \angle DOC$ and $\angle AOB, \angle BOC$.
 (v) Adjacent angles that do not form a linear pair mean, angles have common ray but the angles in a linear pair are not supplementary.
i.e., $\angle AOB, \angle AOE$; $\angle AOE, \angle EOD$; $\angle EOD, \angle COD$.

Exercise 5.2 (Page No. 110-111)

Q1. State the property that is used in each of the following statements?

- (i) If $a \parallel b$, then $\angle 1 = \angle 5$.
 (ii) If $\angle 4 = \angle 6$, then $a \parallel b$.
 (iii) If $\angle 4 + \angle 5 = 180^\circ$, then $a \parallel b$.



- Sol. (i) Given, $a \parallel b$ then $\angle 1 = \angle 5$

(Corresponding angles property)

Because if two parallel lines are cut by a transversal, each pair of corresponding angles are equal in measure.

- (ii) Given, $\angle 4 = \angle 6$ then $a \parallel b$.

(Alternate interior angles property)

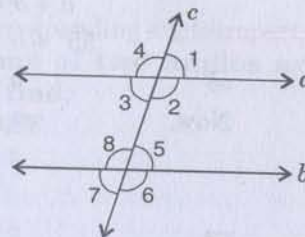
Because, when a transversal cuts two lines such that pairs of alternate interior angles are equal, then lines have to be parallel.

- (iii) Given, $\angle 4 + \angle 5 = 180^\circ$ then $a \parallel b$.

When a transversal cuts two lines, such that pairs of interior angles on the same side of the transversal are supplementary, the lines have to be parallel.

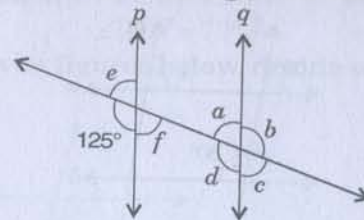
Q2. In the adjoining figure, identify:

- (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:
 $\angle 1, \angle 5$; $\angle 2, \angle 6$; $\angle 4, \angle 8$ and $\angle 3, \angle 7$.
 (ii) The pairs of alternate interior angles:
 $\angle 3, \angle 5$ and $\angle 2, \angle 8$.
 (iii) The pair of interior angles on the same side of the transversal:
 $\angle 3, \angle 8$ and $\angle 2, \angle 5$.
 (iv) The vertically opposite angles are:
 $\angle 1, \angle 3$; $\angle 2, \angle 4$; $\angle 6, \angle 8$ and $\angle 5, \angle 7$.

Q3. In the adjoining figure, $p \parallel q$. Find the unknown angles.



- Sol. Given, $p \parallel q$ and cut by a transversal line. We have to find angles e, f, a, b, c and d .

We know, $125^\circ + e = 180^\circ$ (Linear pair)

$$e = 180^\circ - 125^\circ = 55^\circ \quad \dots(i)$$

We also know,

$$e = f \quad (\text{Vertically opposite angles})$$

$$\Rightarrow e = 55^\circ \quad \text{[From equation (i)]}$$

$$\Rightarrow f = 55^\circ \quad \dots(ii)$$

We know,

$$a = f \quad \text{(Alternate interior angles property)}$$

$$f = 55^\circ \quad \text{[From equation (ii)]}$$

$$\Rightarrow a = 55^\circ \quad \dots(iii)$$

We know,

$$a + b = 180^\circ \quad \text{(Linear pair)}$$

$$55^\circ + b = 180^\circ \quad \text{[From equation (iii)]}$$

$$\Rightarrow b = 180^\circ - 55^\circ = 125^\circ \quad \dots(iv)$$

$$\text{Now, } a = c \text{ and } b = d \quad \text{(Vertically opposite angles)}$$

$$a = 55^\circ \text{ and } b = 125^\circ$$

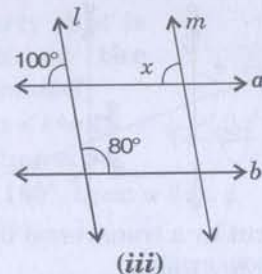
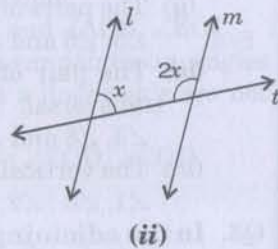
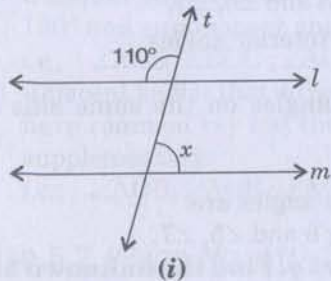
[From equations (iii) and (iv)]

$$\Rightarrow c = 55^\circ \text{ and } d = 125^\circ$$

Thus, the measure of angles,

$$a = 55^\circ, b = 125^\circ, c = 55^\circ, d = 125^\circ, e = 55^\circ \text{ and } f = 55^\circ.$$

Q4. Find the value of x in each of the following figures if $l \parallel m$:



Sol. From Fig. (i), given $l \parallel m$ and t is transversal line.

Interior vertically opposite angle between lines l and $t = 110^\circ$.

$$\text{So, } 110^\circ + x = 180^\circ \quad \text{(Supplementary angles property)}$$

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

$$\text{Thus, } x = 70^\circ.$$

From Fig. (ii), given $l \parallel m$ and t is transversal lines.

$$\text{then } x + 2x = 180^\circ \quad \text{(Supplementary angles property)}$$

$$\Rightarrow 3x = 180^\circ$$

$$\Rightarrow x = \frac{180^\circ}{3}$$

$$\Rightarrow x = 60^\circ$$

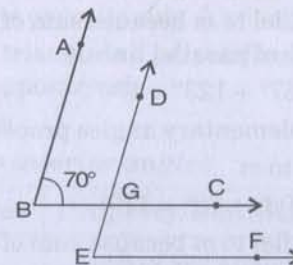
From Fig. (iii), given $l \parallel m$ and $a \parallel b$

$$\text{then, } x = 100^\circ \quad \text{(Corresponding angles property)}$$

Q5. In the given figure, the arms of two angles are parallel. If $\angle ABC = 70^\circ$, then find:

(i) $\angle DGC$

(ii) $\angle DEF$



Sol. (i) Given, $AB \parallel DE$ and BC is a transversal line and $\angle ABC = 70^\circ$.

$$\text{We know, } \angle ABC = \angle DGC \quad \text{(Corresponding angles)}$$

$$\text{So, } \angle DGC = 70^\circ \quad \dots(i)$$

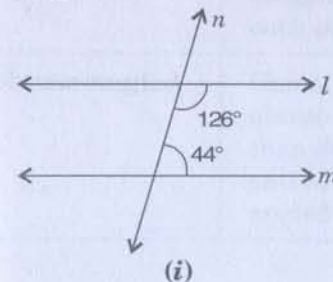
(ii) Given, $BC \parallel EF$ and DE is a transversal line

$$\text{and } \angle DGC = 70^\circ \quad \text{[From equation (i)]}$$

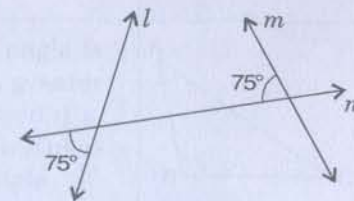
$$\text{We know, } \angle DGC = \angle DEF \quad \text{(Corresponding angles)}$$

$$\text{So, } \angle DEF = 70^\circ.$$

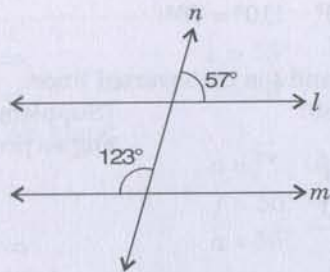
Q6. In the given figures below, decide whether l is parallel to m .



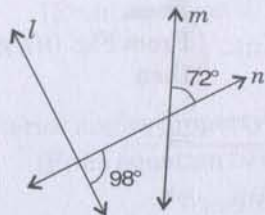
(i)



(ii)



(iii)



(iv)

Sol. From Fig. (i), $126^\circ + 44^\circ = 170^\circ$.

l is not parallel to m because sum of angles does not obey the property of parallel lines.

From Fig. (ii), $75^\circ + 75^\circ = 150^\circ$.

l is not parallel to m because sum of angles does not obey the property of parallel lines.

From Fig. (iii), $57^\circ + 123^\circ = 180^\circ$.

Due to supplementary angles property of parallel lines.

So, l is parallel to m .

From Fig. (iv), $98^\circ + 72^\circ = 170^\circ$.

l is not parallel to m because sum of angles does not obey the property of parallel lines.

□□