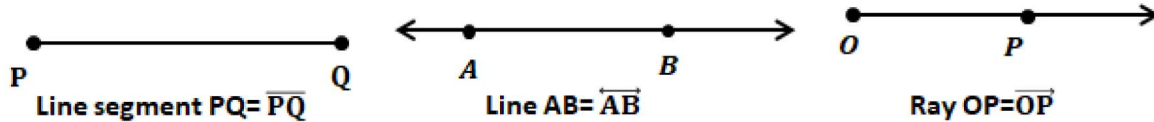


CHAPTER

5

VII-MATHEMATICS-NCERT-2023-24
5. Lines and Angles (Notes)PREPARED BY: BALABHADRA SURESH
<https://sureshmathsmaterial.com/>

1. A line segment has two end points.
2. If we extend the two end points of a line segment in either direction endlessly, we get a line.
3. A line has no end points.
4. A ray has one end point (namely its starting point).



5. An angle is made up of two rays starting from a common starting/initial point
6. **Types of angles:**

| Name | Acute angle | Right angle | Obtuse angle | Straight angle | Reflex angle | Complete angle |
|--------------|---|----------------|---|-----------------|---|-----------------|
| Measure | $0^\circ < x < 90^\circ$ <i>Between 0° and 90°</i> | $y = 90^\circ$ | $90^\circ < z < 180^\circ$ <i>Between 90° and 180°</i> | $s = 180^\circ$ | $180^\circ < t < 360^\circ$ <i>Between 180° and 360°</i> | $u = 360^\circ$ |
| Illustration | | | | | | |

7. **Complementary Angles:** The sum of the measures of two angles is 90° , the angles are called complementary angles.
Ex: $50^\circ, 40^\circ$; $25^\circ, 65^\circ$
8. The complement of $x^\circ = 90^\circ - x^\circ$

THINK, DISCUSS AND WRITE

1. Can two acute angles be complement to each other?

Sol: Yes.

2. Can two obtuse angles be complement to each other?

Sol: No, Sum of two obtuse angles is greater than 90° .

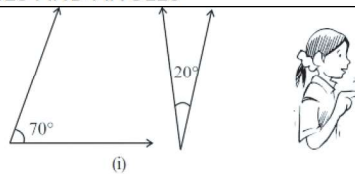
3. Can two right angles be complement to each other?

Sol: No, sum of two right angles is 180° .**TRY THESE**

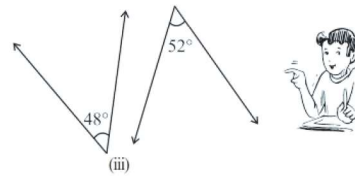
1. Which pairs of following angles are complementary?

Sol: (i) $70^\circ + 20^\circ = 90^\circ$ $70^\circ, 20^\circ$ are complementary angles.

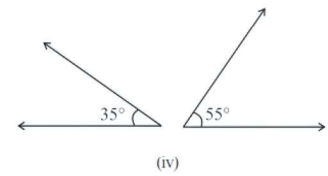
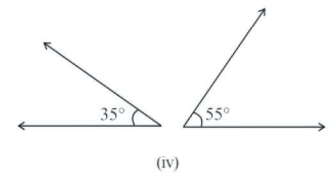
(ii) $75^{\circ} + 25^{\circ} = 100^{\circ}$

 $75^{\circ}, 25^{\circ}$ are not complementary angles.

(iii) $48^{\circ} + 52^{\circ} = 100^{\circ}$

 $48^{\circ}, 52^{\circ}$ are not complementary angles.

(iv) $35^{\circ} + 55^{\circ} = 90^{\circ}$

 $35^{\circ}, 55^{\circ}$ are complementary angles.

2. What is the measure of the complement of each of the following angles?

(i) 45° (ii) 65° (iii) 41° (iv) 54°

Sol: (i) The complementary angle of $45^{\circ} = 90^{\circ} - 45^{\circ} = 45^{\circ}$

(ii) The complementary angle of $65^{\circ} = 90^{\circ} - 65^{\circ} = 25^{\circ}$

(iii) The complementary angle of $41^{\circ} = 90^{\circ} - 41^{\circ} = 49^{\circ}$

(iv) The complementary angle of $54^{\circ} = 90^{\circ} - 54^{\circ} = 36^{\circ}$

3. The difference in the measures of two complementary angles is 120° . Find the measures of the angles.

Sol: Let the complementary angles are x and $x + 12^{\circ}$

Sum of complementary angles = 90°

$$x + x + 12^{\circ} = 90^{\circ}$$

$$2x + 12^{\circ} = 90^{\circ}$$

$$2x = 90^{\circ} - 12^{\circ}$$

$$2x = 78^{\circ}$$

$$\frac{2x}{2} = \frac{78^{\circ}}{2}$$

$$x = 39^{\circ}$$

$$x + 12^{\circ} = 39^{\circ} + 12^{\circ} = 51^{\circ}$$

\therefore The complementary angles are 39° and 51°

Supplementary Angles: The sum of the measures of two angles is 180° , the angles are called supplementary angles.

The supplement of $x^{\circ} = 180^{\circ} - x^{\circ}$

THINK, DISCUSS AND WRITE

1. Can two obtuse angles be supplementary?

Sol: No, sum of two obtuse angles is greater than 180° .

2. Can two acute angles be supplementary?

Sol: No, sum of two acute angles is less than 180° .

3. Can two right angles be supplementary?

Sol: Yes, sum of two right angles is 180° .

TRY THESE

1. Find the pairs of supplementary angles.

Sol: (i) $110^\circ + 50^\circ = 160^\circ$

110° and 50° are not supplementary angles.

(ii) $105^\circ + 65^\circ = 170^\circ$

105° and 65° are not supplementary angles.

(iii) $50^\circ + 130^\circ = 180^\circ$

50° and 130° are supplementary angles.

(iv) $45^\circ + 45^\circ = 90^\circ$

45° and 45° are not supplementary angles.

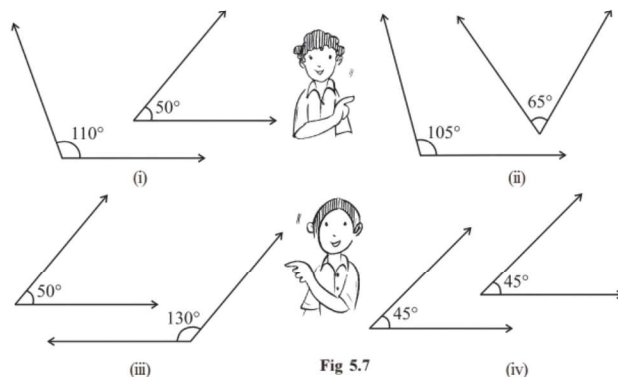


Fig 5.7

2. What will be the measure of the supplement of each one of the following angles?

The supplement of $x^\circ = 180^\circ - x^\circ$

(i) The supplement of $100^\circ = 180^\circ - 100^\circ = 80^\circ$

(ii) The supplement of $90^\circ = 180^\circ - 90^\circ = 90^\circ$

(iii) The supplement of $55^\circ = 180^\circ - 55^\circ = 125^\circ$

(iv) The supplement of $125^\circ = 180^\circ - 125^\circ = 55^\circ$

3. Among two supplementary angles the measure of the larger angle is 44 more than the measure of the smaller. Find their measures.

Sol: Let smaller angle = x

The larger angle = $x + 44^\circ$

Sum of two supplementary angles = 180°

$$x + x + 44^\circ = 180^\circ$$

$$2x + 44^\circ = 180^\circ$$

$$2x = 180^\circ - 44^\circ$$

$$2x = 136^\circ$$

$$\frac{2x}{2} = \frac{136^\circ}{2}$$

$$x = 68^\circ$$

Hence, smaller angle = 68°

Larger angle = $68^\circ + 44^\circ = 112^\circ$

EXERCISE 5.1

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

(i) Complement of $20^\circ = 90^\circ - 20^\circ = 70^\circ$

(ii) Complement of $63^\circ = 90^\circ - 63^\circ = 27^\circ$

(iii) Complement of $57^\circ = 90^\circ - 57^\circ = 33^\circ$

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

(i) Supplement of $105^\circ = 180^\circ - 105^\circ = 75^\circ$

(ii) Supplement of $87^\circ = 180^\circ - 87^\circ = 93^\circ$

(iii) Supplement of $154^\circ = 180^\circ - 154^\circ = 26^\circ$

3. 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: (i) $65^\circ + 115^\circ = 180^\circ$

$65^\circ, 115^\circ$ are supplementary angles.

(ii) $63^\circ + 27^\circ = 90^\circ$

$63^\circ, 27^\circ$ are complementary angles.

(iii) $112^\circ + 68^\circ = 180^\circ$

$112^\circ, 68^\circ$ are supplementary angles.

(iv) $130^\circ + 50^\circ = 180^\circ$

$35^\circ, 55^\circ$ are supplementary angles.

(v) $45^\circ + 45^\circ = 90^\circ$

$45^\circ, 45^\circ$ are complementary angles.

(vi) $80^\circ + 10^\circ = 90^\circ$

$80^\circ, 10^\circ$ are complementary angles.

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

Sol: Let the complementary angles are x and x

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

$$2x = 90^\circ$$

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

$$x = 45^\circ$$

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

Sol: Let the supplementary angles are x and x

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

$$2x = 180^\circ$$

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

$$x = 90^\circ$$

6. 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: $\angle 2$ will increase with the same measure as the decrease in $\angle 1$.

7. Can two angles be supplementary if both of them are:

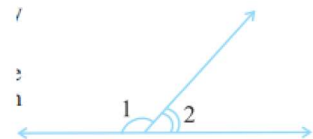
(i) acute? No (ii) obtuse? No (iii) right? Yes

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

Sol: Let the angle = 50°

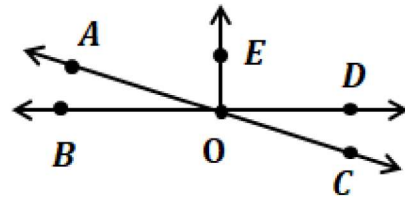
Its complementary angle = $90^\circ - 50^\circ = 40^\circ$ is less than 45°

If an angle is greater than 45° its complementary angle less than 45° .

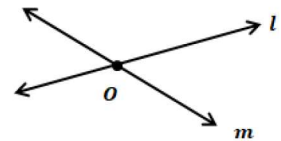


9. Fill in the blanks:

- (i) If two angles are complementary, then the sum of their measures is 90° .
 (ii) If two angles are supplementary, then the sum of their measures is 180° .
 (iii) If two adjacent angles are supplementary, they form a **linear pair**.

10. In the adjoining figure, name the following pairs of angles.**(i) Obtuse vertically opposite angles.****Sol:** $\angle AOD$, $\angle BOC$ **(ii) Adjacent complementary angles.****Sol:** $\angle EOA$, $\angle AOB$ **(iii) Equal supplementary angles.****Sol:** $\angle EOB$, $\angle EOD$ **(iv) Unequal supplementary angles.****Sol:** $\angle EOA$, $\angle EOC$ **(v) Adjacent angles that do not form a linear pair.****Sol:** $\angle AOB$, $\angle AOE$; $\angle AOE$, $\angle EOD$; $\angle EOD$, $\angle COD$ **Intersecting Lines**

- If two lines have one common point, they are called intersecting lines.
- Two lines l and m intersect if they have a point in common.
- This common point O is their point of intersection.

**TRY THESE****1. Find examples from your surroundings where lines intersect at right angles .****Sol:** (i) Adjacent edges of table.

(ii) Adjacent walls of a house.

(iii) Edges of black board.

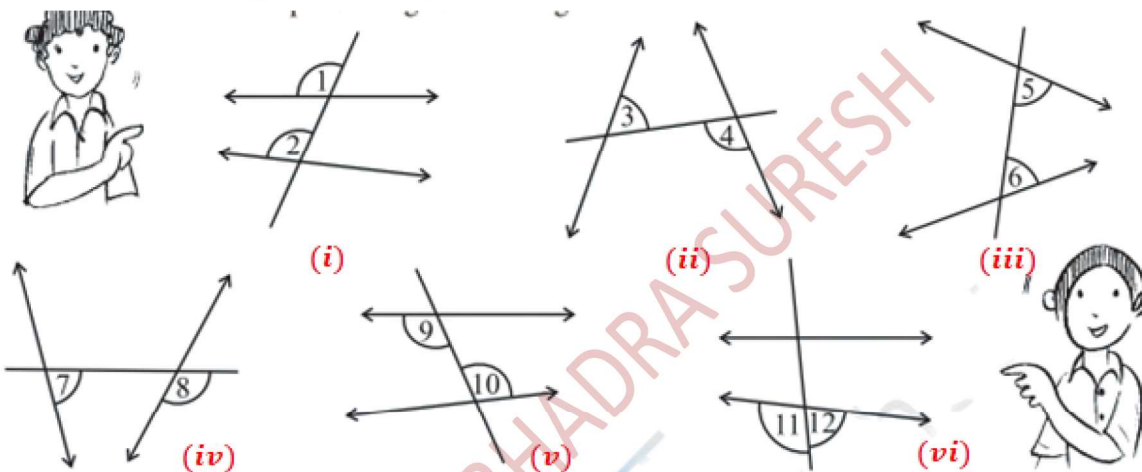
2. Find the measures of the angles made by the intersecting lines at the vertices of an equilateral triangle.**Sol:** 60° **3. Draw any rectangle and find the measures of angles at the four vertices made by the intersecting lines.****Sol:** Each angle= 90° .**4. If two lines intersect, do they always intersect at right angles?****Sol:** No, two intersecting lines do not always intersect at right angles.**Transversal :** A line that intersects two or more lines at distinct points is called a transversal.

Angles made by a Transversal:

| | | |
|--|--|--|
| Interior angles | $\angle 3, \angle 4, \angle 5, \angle 6$ | |
| Exterior angles | $\angle 1, \angle 2, \angle 7, \angle 8$ | |
| Pairs of Corresponding angles | $\angle 1$ and $\angle 5, \angle 2$ and $\angle 6, \angle 3$ and $\angle 7, \angle 4$ and $\angle 8$ | |
| Pairs of Alternate interior angles | $\angle 3$ and $\angle 6, \angle 4$ and $\angle 5$ | |
| Pairs of interior angles on the same side of the transversal | $\angle 3$ and $\angle 5, \angle 4$ and $\angle 6$ | |

TRY THESE

Name the pairs of angles in each figure:

**Sol:** (i) $\angle 1$ and $\angle 2$ are pair of corresponding angles.(ii) $\angle 3$ and $\angle 4$ are pair of alternate interior angles.(iii) $\angle 5$ and $\angle 6$ are pair of interior angles on the same side of the transversal (Co-interior angles)(iv) $\angle 7$ and $\angle 8$ are pair of corresponding angles.(v) $\angle 9$ and $\angle 10$ are pair of alternate interior angles.(vi) $\angle 11$ and $\angle 12$ are pair of exterior angles.**Transversal of Parallel Lines:**

If two parallel lines are cut by a transversal then

(i) Each pair of corresponding angles are equal in measure.

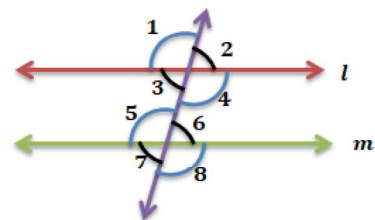
$$\angle 1 = \angle 5; \angle 2 = \angle 6; \angle 3 = \angle 7; \angle 4 = \angle 8$$

(ii) Each pair of alternate interior angles are equal.

$$\angle 3 = \angle 6; \angle 4 = \angle 5$$

(iii) Each pair of interior angles on the same side of the transversal are supplementary.

$$\angle 3 + \angle 5 = 180^\circ; \angle 4 + \angle 6 = 180^\circ$$



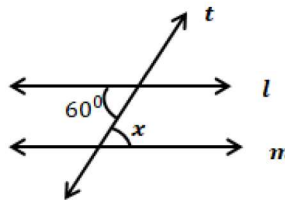
(iv) each pair of exterior angles on the same side of the transversal are supplementary

$$\angle 1 + \angle 7 = 180^\circ; \angle 2 + \angle 8 = 180^\circ$$

TRY THESE

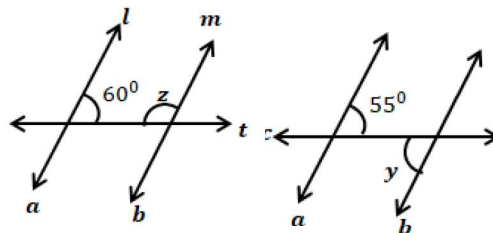
(i) Lines $l \parallel m$; t is a transversal $\angle x = ?$

Sol: $\angle x = 60^\circ$ (Corresponding angles are equal)



(ii) Lines $a \parallel b$; c is a transversal $\angle y = ?$

Sol: $\angle y = 55^\circ$ (Alternate interior angles)



(iii) l_1, l_2 be two lines t is a transversal Is $\angle 1 = \angle 2$?

Sol: $l_1 \nparallel l_2$, so $\angle 1 \neq \angle 2$

(iv) Lines $l \parallel m$; t is a transversal $\angle z = ?$

Sol: Interior angles on the same side of the transversal are supplementary

$$z + 60^\circ = 180^\circ$$

$$z = 180^\circ - 60^\circ = 120^\circ$$

(v) Lines $l \parallel m$; t is a transversal $\angle x = ?$

Sol: $\angle x = 120^\circ$ (Corresponding angles)

(vi) Lines $l \parallel m, p \parallel q$; Find a, b, c, d

Sol: $a + 60^\circ = 180^\circ$ ($p \parallel q$, Interior angles on the same side are supplementary)

$$a = 180^\circ - 60^\circ = 120^\circ$$

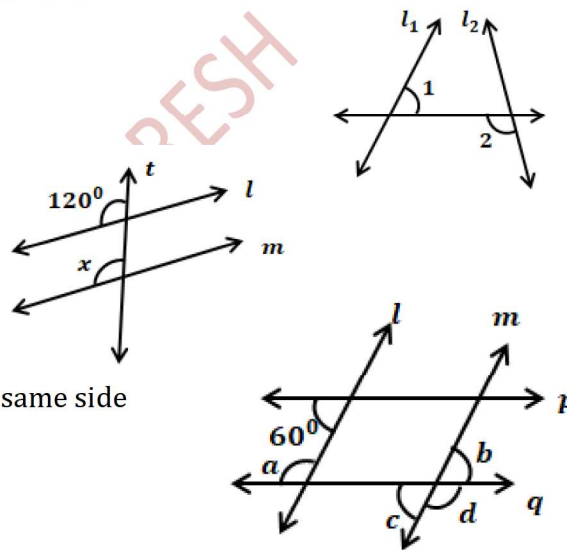
$$b = 60^\circ (l \parallel m; \text{alternate interior angles})$$

$$c = b = 60^\circ (\text{Vertically opposite angles})$$

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

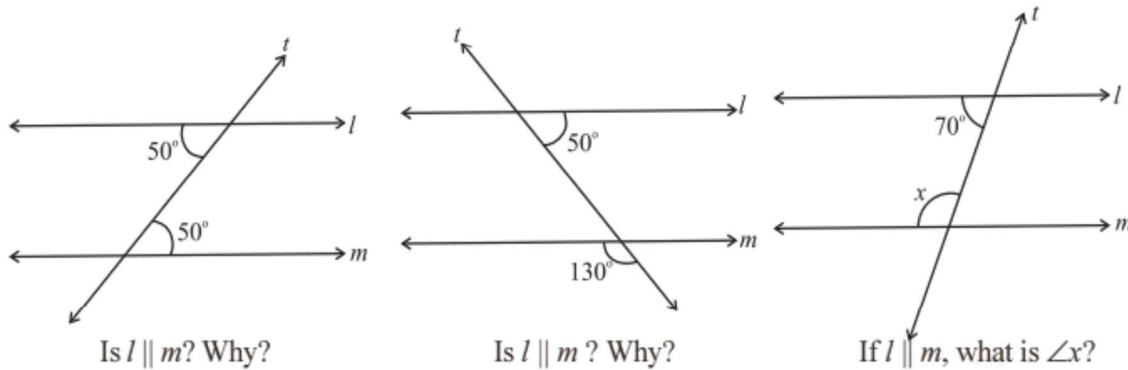
$$d + 60^\circ = 180^\circ$$

$$d = 180^\circ - 60^\circ = 120^\circ$$



CHECKING FOR PARALLEL LINES

- (i) When a transversal cuts two lines, such that pairs of corresponding angles are equal, then the lines have to be parallel.
- (ii) When a transversal cuts two lines, such that pairs of alternate interior angles are equal, the lines have to be parallel.
- (iii) 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.



(i) Alternate interior angles are equal. So, $l \parallel m$.

(ii) Corresponding angles are equal. So, $l \parallel m$.

(iii) If, $l \parallel m$ then

$x + 70^\circ = 180^\circ$ (Interior angles on the same side of the transversal are supplementary)

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

EXERCISE 5.2

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

(i) **If $a \parallel b$, then $\angle 1 = \angle 5$.**

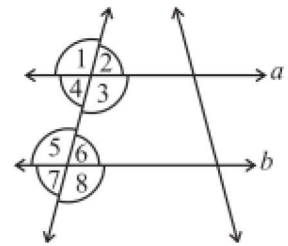
Sol: Corresponding angle property

(ii) **If $\angle 4 = \angle 6$, then $a \parallel b$.**

Sol: Alternate interior angle property.

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

Sol: Interior angles on the same side of the transversal are supplementary.



2. In the adjoining figure, identify

(i) **the pairs of corresponding angles.**

Sol: $\angle 1, \angle 5$; $\angle 2, \angle 6$; $\angle 3, \angle 7$; $\angle 4, \angle 8$.

(ii) **the pairs of alternate interior angles.**

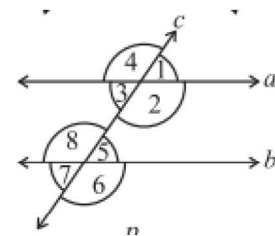
Sol: $\angle 2, \angle 8$; $\angle 3, \angle 5$.

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

Sol: $\angle 2, \angle 5$; $\angle 3, \angle 8$.

(iv) **the vertically opposite angles.**

Sol: $\angle 1, \angle 3$; $\angle 2, \angle 4$; $\angle 5, \angle 7$; $\angle 6, \angle 8$.



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

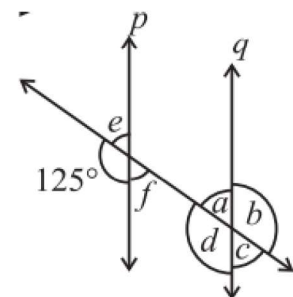
Sol: $d = 125^\circ$ (Corresponding angles)

$$b = d = 125^\circ \text{ (Vertically opposite angles)}$$

$$e + 125^\circ = 180^\circ \text{ (Linear pair)}$$

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

$$f = e = 55^\circ \text{ (Vertically opposite angles)}$$



$$c = f = 55^\circ \text{ (Corresponding angles)}$$

$$a = c = 55^\circ \text{ (Vertically opposite angles)}$$

$$\therefore a = 55^\circ; b = 125^\circ; c = 55^\circ; d = 125^\circ; e = 55^\circ; f = 55^\circ.$$

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

(i) $y = 110^\circ$ (Corresponding angles)

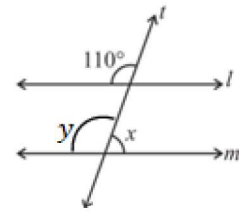
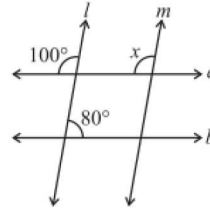
$$x + y = 180^\circ \text{ (Linear pair)}$$

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

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

$$x = 70^\circ$$

(ii) $x = 100^\circ$ (Corresponding angles)



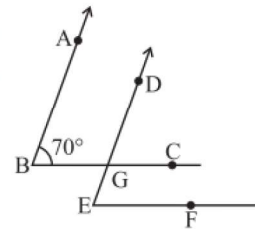
5. In the given figure, the arms of two angles are parallel. If $\angle ABC = 70^\circ$, then find (i) $\angle DGC$ (ii) $\angle DEF$

Sol: (i) $\angle DGC = \angle ABC$ (Corresponding angles property)

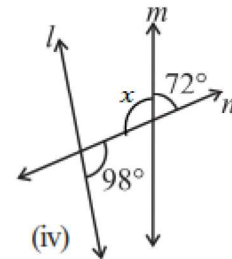
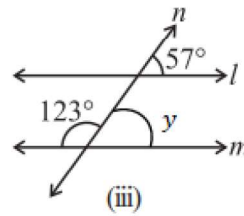
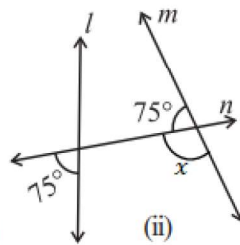
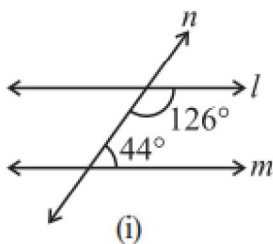
$$\angle DGC = 70^\circ$$

(ii) $\angle DEF = \angle DGC$ (Corresponding angles property)

$$\angle DEF = 70^\circ$$



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



(i) $44^\circ + 126^\circ = 170^\circ$

Interior angles on the same side of the transversal are not supplementary. So, $l \not\parallel m$

(ii) $x + 75^\circ = 180^\circ$ (Linear pair)

$$x = 180^\circ - 75^\circ = 105^\circ$$

Corresponding angles 75° and 105° are not equal. So, $l \not\parallel m$.

(iii) $y + 123^\circ = 180^\circ$ (Linear pair)

$$y = 180^\circ - 123^\circ = 57^\circ$$

Corresponding angles are equal (57°). So, $l \parallel m$.

(iv) $x + 72^\circ = 180^\circ$ (Linear pair)

$$x = 180^\circ - 72^\circ = 108^\circ$$

Alternate interior angles 98° and 108° are not equal. So, $l \not\parallel m$