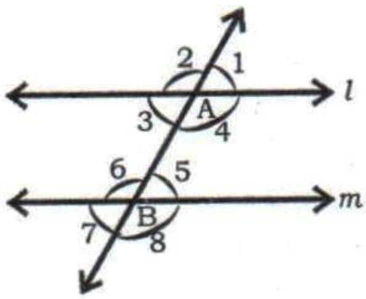
MATHEMATICS

Chapter 5: Lines and Angles

Lines and Angles

1. Two angles are said to be complementary if the sum of their measures is 90^{o}.
2. Two angles are said to be supplementary if the sum of their measures is 180^{o}.
3. Two angles with the same vertex, one arm common and the other arms lying on opposite sides of the common arm are called adjacent angles.
4. Two adjacent angles are said to form a linear pair of angles if their non-common arms are two opposite rays.
5. The sum of the measures of a linear pair angles is always 180^{o}.
6. The sum of all angles formed on the same side of a line at a given point on the line is 180^{o}.
7. The sum of all angles around a point is 360^{o}.
8. Two angles are called a pair of vertically opposite angles if their arms from two pairs of opposite rays.
9. If two lines intersect each other then the vertically opposite angles are equal.
10. Two lines 'l' and 'm' are said to be parallel, if they lie in the same plane and do not intersect when produced however far on either side and is written as l||m.
11. A line which intersects two or more lines at distinct points is called a transversal.
12. Angles made by parallel lines and transversal:



   i. $[\angle 1, \angle 5], [\angle 2, \angle 6], [\angle 3, \angle 7]$ and $[\angle 4, \angle 8]$ are called pair of corresponding angles. Check for angle sign

   ii. $[\angle 3, \angle 5]$ and $[\angle 4, \angle 6]$ are called pair of alternate interior angles or simply alternate angles.

   iii. $[\angle 4, \angle 5]$ and $[\angle 3, \angle 6]$ are called pairs of interior angles on the same side of the transversal.

13. If two parallel lines are cut by a transversal, then

   i. The alternate angles are equal

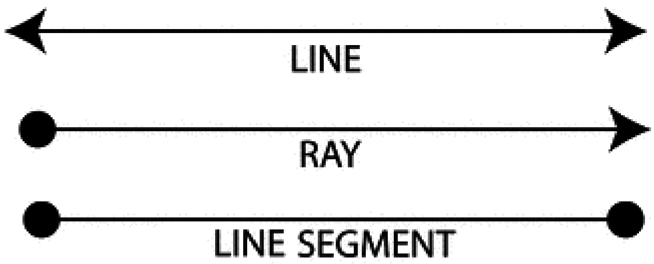
   ii. The corresponding angles are equal and

   iii. The interior angles on the same side of the transversal are supplementary.

14. Two lines are parallel if, when they are cut by a transversal, they make a pair of
    i. Corresponding angles equal or
    ii. Alternate angles equal or
    iii. Interior angles on the same side of the transversal supplementary.
15. Two lines which are parallel to the same line are parallel to each other.
16. If three parallel lines are intersected by two transversals, the ratio of the intercepts made on one transversal is the same as the ratio of the intercepts made on the other transversal.

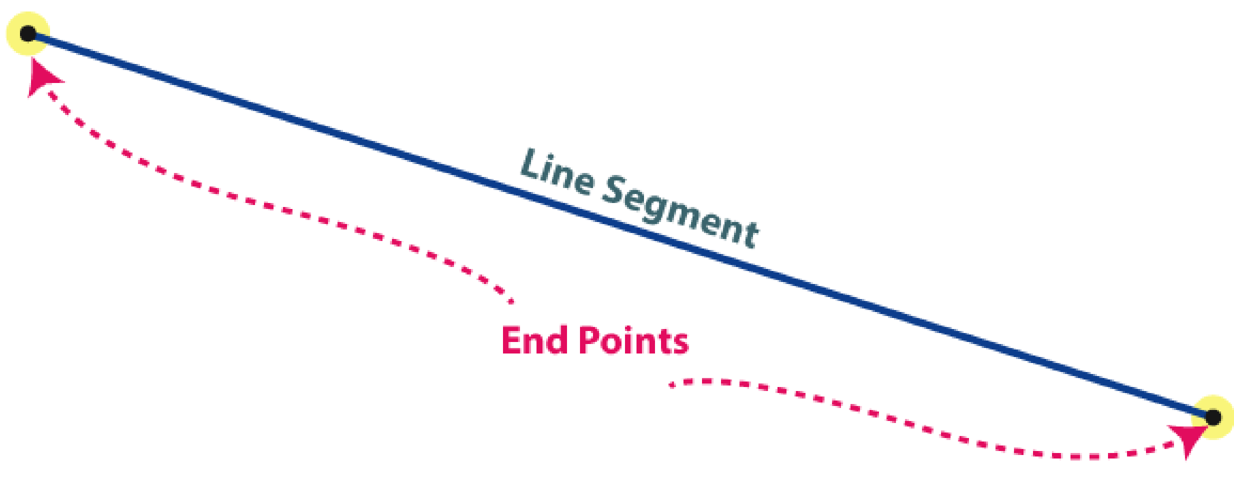
Line, line segment and ray

- If we take a point and draw a straight path that extends endlessly on both the sides, then the straight path is called as a line.
- A ray is a part of a line with one endpoint.
- A line segment is a part of a line with two endpoints.



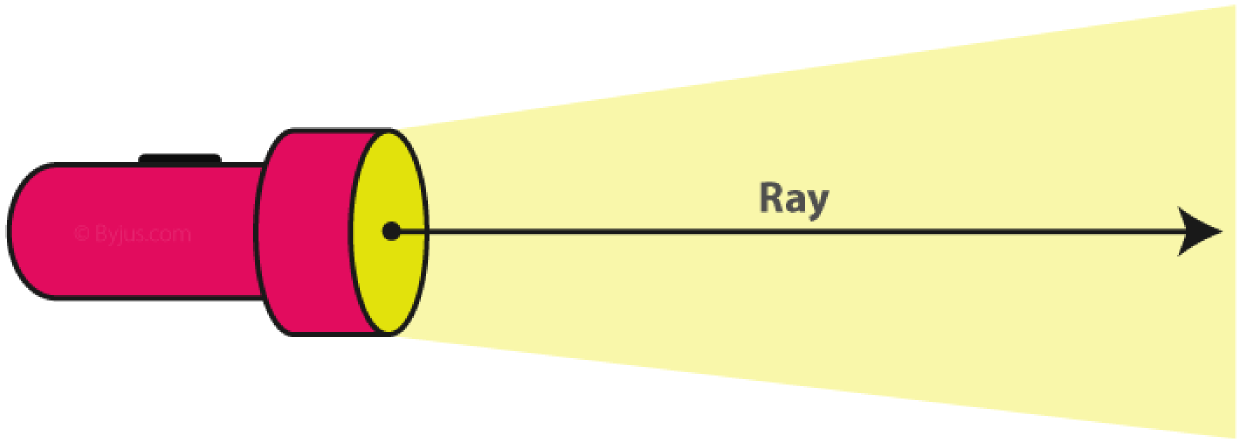
We come across many shapes in daily life. Consider a triangle, a square or any other shape. To draw any of these figures, one begins with a line or a line segment or a curve. Depending upon the number and arrangement of these lines we get distinct types of shapes and figures. For example, a triangle is a figure enclosed by 3 line segments, Pentagon is a polygon bounded by 5 line segments and so on. We have already discussed line now let us see what is line segment and ray.

Line Segment



A line segment is a part of a line having two endpoints. Figures such as a triangle, polygon, hexagon, square are made of different numbers of line segments. The measure of a line segment is called its length. In contrast to the infinitely extending line, a line segment has a fixed length and can be measured easily. A line segment with A and B as two endpoints is represented as $\overline{AB}$

Ray



Ray is another part of a line. It is a combination of a line and a line segment that has an infinitely extending end and one terminating end. As its one end is non-terminating, its length cannot be measured. A ray is represented by

$\overrightarrow{AB}$

where one end is symbolized by an endpoint and the infinitely extending part by an arrow.

Angles

What is an angle? In Plane Geometry, a figure which is formed by two rays or lines that shares a common endpoint is called an angle. The word “angle” is derived from the Latin word “angulus”, which means “corner”. The two rays are called the sides of an angle, and the common endpoint is called the vertex. The angle that lies in the plane does not have to be in the Euclidean space. In case if the angles are formed by the intersection of two planes in the Euclidean or the other space, the angles are considered dihedral angles. The angle is represented using the symbol “∠”. The angle measurement between the two rays can be denoted using the Greek letter θ, α, β etc. If the angles are measured from a line, we can find two different types of angles, such as a positive angle and a negative angle.

Positive Angle: If the angle goes in counterclockwise, then it is called a positive angle.

Negative Angle: If the angle goes clockwise direction, then it is called a negative angle.

Label the Angles

There are two different ways to label the angles. They are:

Method 1: Give a name to the angle. Generally, the angle is named using the lower case letter like "a", "x", etc or by using the Greek Letters alpha (α), beta (β), theta (θ), etc.

Method 2: By using the three letters on the shapes, we can define the angle. The middle letter should be the vertex (actual angle).

For example, ABC is a triangle. To represent the angle A is equal to 60 degrees, we can define it as $\angle BAC = 60°$

Measure the Angle

The angles are generally measured in degrees (°). An important geometrical tool that helps to measure the angles in degree is a "protractor". A protractor has two sets of numbers going in opposite directions. One set goes from 0 to 180 degree on the outer rim and the other set goes from 180 to 0 degree on the inner rim.

Types of Angles

The angles are classified under the following types:

Acute Angle – an angle measure less than 90 degrees

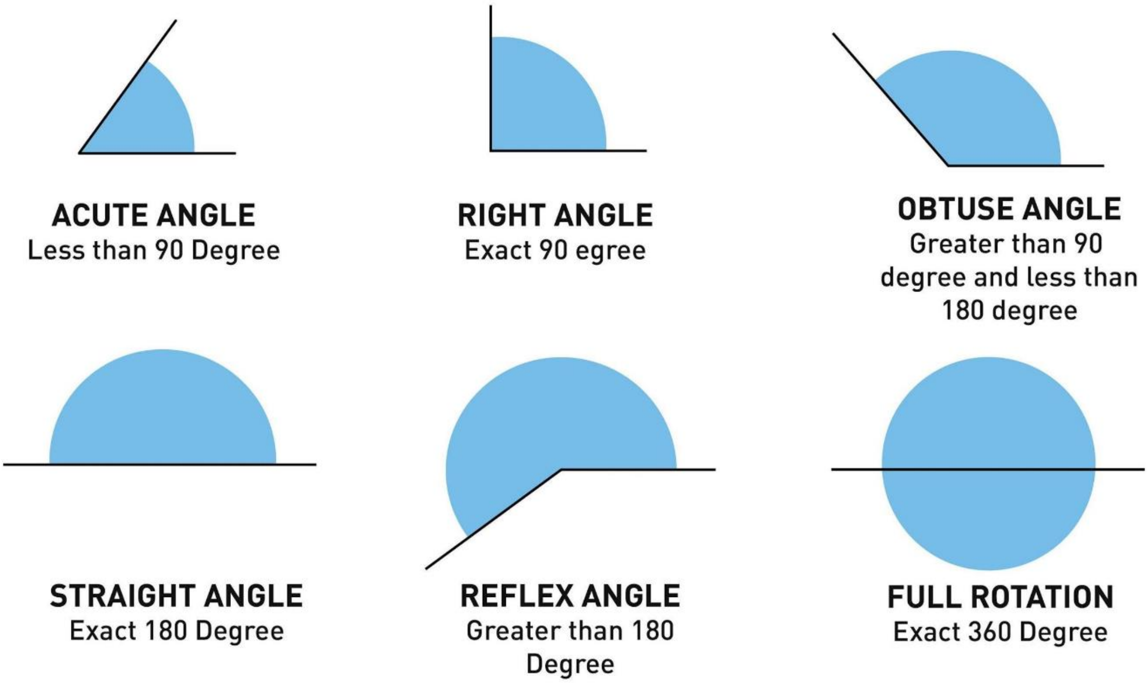
Right Angle – an angle is exactly at 90 degrees

Obtuse Angle – an angle whose measure is greater than 90 degrees and less than 180 degrees

Straight Angle – an angle which is exactly at 180 degrees

Reflex Angle – an angle whose measure is greater than 180 degrees and less than 360 degrees

Full Angle – an angle whose measure is exactly at 360 degrees



Based on these angles and the lines, it is further classified into different types such as complementary angles, supplementary angles, adjacent angles, vertical angles, alternate interior angles, alternate exterior angles, and so on.

- Corresponding Angles
- Alternate Interior Angles
- Alternate Exterior Angles
- Interior Angles on the Same Side of Transversal
- Supplementary Angles
- Adjacent Angles
- Vertical Angles

Now let us discuss some of the important theorems based on the lines and angles:

- If two parallel lines are cut by a transversal, then the alternate interior angles are of the same measure.
- If two parallel lines are cut by a transversal, then the alternate exterior angles are of the same measure.
- If two parallel lines are cut by a transversal, then the corresponding angles are of the same measure.
- If two parallel lines are cut by a transversal, then the interior angles on the same side of the transversal are supplementary.
- Vertical angles are congruent when the straight line intersects the lines. The lines may be either parallel or non-parallel

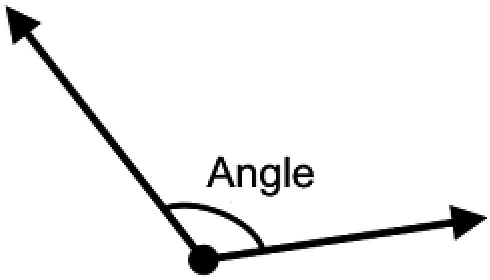
Properties of Angles

The following are the important properties of angles:

The sum of all the angles on one side of a straight line is always equal to 180 degrees,

The sum of all the angles around the point is always equal to 360 degrees.

- An angle is formed when two rays originate from the same end point.
- The rays making an angle are called the arms of the angle.
- The end point is called the vertex of the angle.

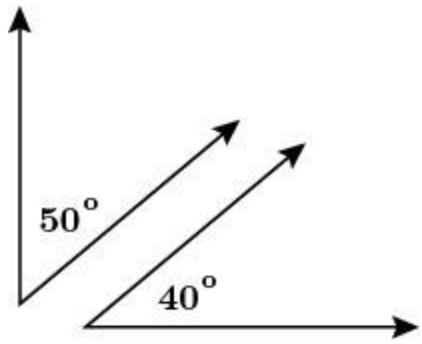


Complementary Angles

Two angles whose sum is 90^0 are called complementary angles.

Example: $50^0 + 40^0 = 90^0$

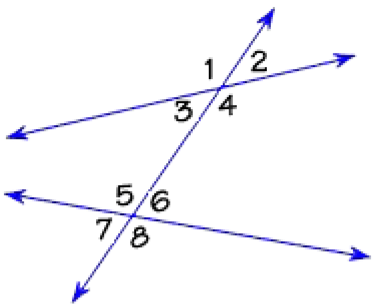
$\therefore$ 50^0 and 40^0 angles are complementary angles.



Parallel Lines and a Transversal

Transversal intersecting two lines

Transversal is a line that intersects two or more lines at different points.



Corresponding Angles:

(i) ∠1 and ∠5 (ii) ∠2 and ∠6

(iii) ∠3 and ∠7 (iv) ∠4 and ∠8

Alternate Interior Angles:

(i) ∠3 and ∠6 (ii) ∠4 and ∠5

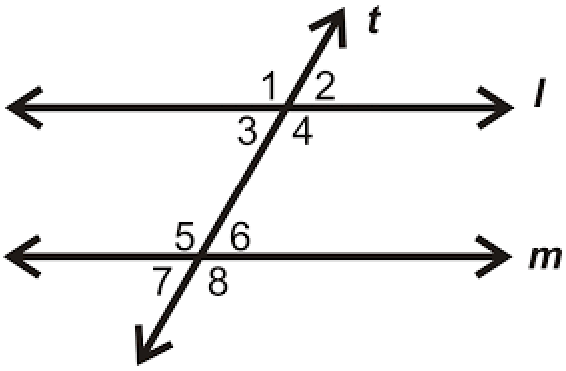
Alternate Exterior Angles:

(i) ∠1 and ∠8 (ii) ∠2 and ∠7

Interior angles on the same side of the transversal:

(i) ∠3 and ∠5 (ii) ∠4 and ∠6

Transversal of Parallel Lines



If a transversal intersects two parallel lines, then each pair of corresponding angles is equal.

(i) ∠1=∠5 (ii) ∠2=∠6

(iii) ∠3=∠7 (iv) ∠4=∠8

If a transversal intersects two parallel lines, then each pair of alternate interior angles is equal.

(i) ∠3=∠6 (ii) ∠4=∠5

If a transversal intersects two parallel lines, then each pair of interior angles on the same side of the transversal is supplementary.

(i) $\angle 3+\angle 5=180^0$ (ii) $\angle 4+\angle 6=180^0$

Checking if two or more lines are parallel

There are three conditions to check whether the two lines are parallel. They are:

(i) If a transversal intersects two lines such that a pair of corresponding angles is equal, then the two lines are parallel to each other.

(ii) If a transversal intersects two lines such that a pair of alternate interior angles is equal, then the two lines are parallel.

(iii) If a transversal intersects two lines such that a pair of interior angles on the same side of the transversal is supplementary, then the two lines are parallel.

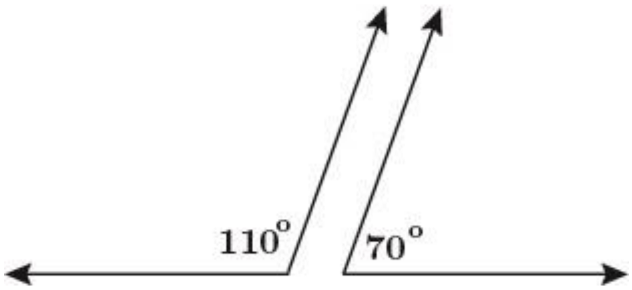
Intersecting Lines and Pairs of Angles

Supplementary angles

Two angles whose sum is 180^0 are called supplementary angles.

Example: $110^0 + 70^0 = 90^0$

∴ 1100 and 700 angles are supplementary angles.



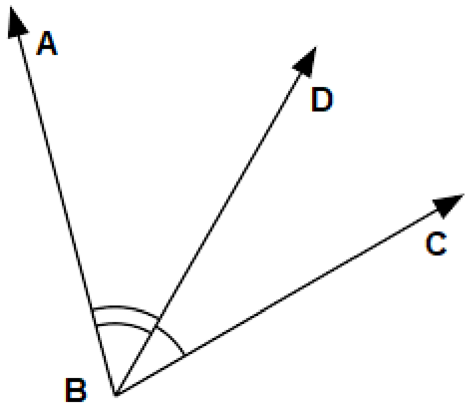
Adjacent Angles

Two angles are adjacent, if they have

(i) A common vertex

(ii) A common arm

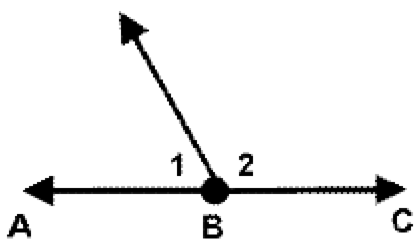
(iii) Their non-common arms on different sides of the common arm.



Here ∠ABD and ∠DBC are adjacent angles.

Linear Pair

Linear pair of angles are adjacent angles whose sum is equal to 180∘.

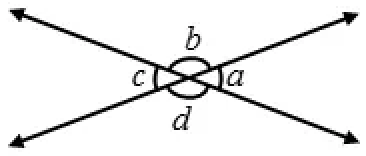


Here, 1 and 2 are linear pair of angles.

Vertically Opposite Angles

Vertically opposite angles are formed when two straight lines intersect each other at a common point.

Vertically opposite angles are equal.



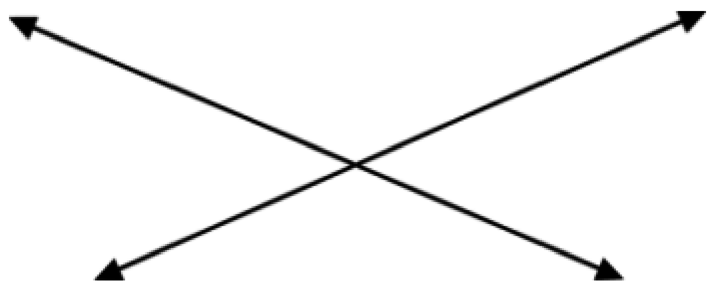
Here, the following pairs of angles are vertically opposite angles.

(i) a and c

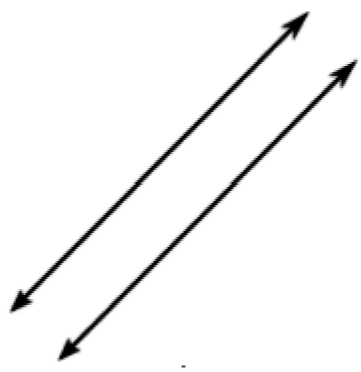
(ii) b and d

Intersecting and Non-Intersecting lines

Intersecting lines are lines which intersect at a common point called the point of intersection.



Parallel lines are lines which do not intersect at any point. Parallel lines are also known as non- intersecting lines.



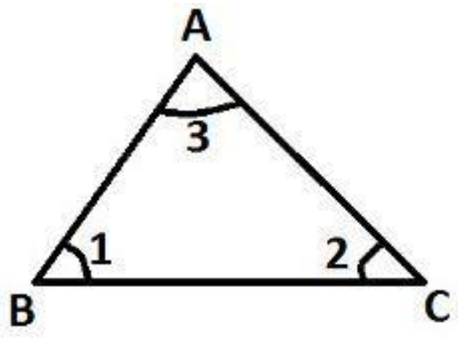
Basic Properties of a Triangle

All the properties of a triangle are based on its sides and angles. By the definition of triangle, we know that, it is a closed polygon that consists of three sides and three vertices. Also, the sum of all three internal angles of a triangle equal to 180°.

In the beginning, we start from understanding the shape of triangles, its types and properties, theorems based on it such as Pythagoras theorem, etc. In higher classes, we deal with trigonometry, where the right-angled triangle is the base of the concept. Let us learn here some of the fundamentals of the triangle by knowing its properties.

Sum of Interior Angles in a Triangle

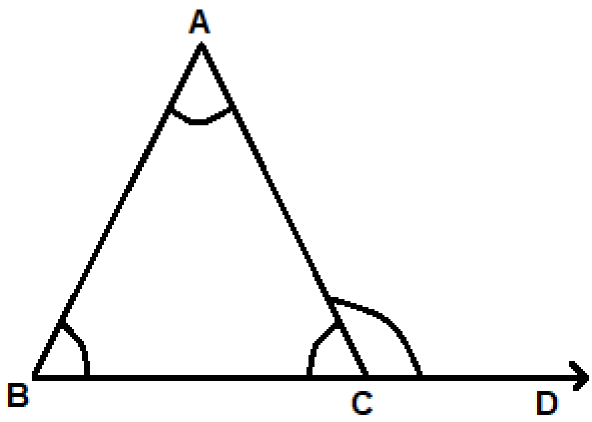
Angle sum property of a triangle: Sum of all interior angles of a triangle is 180^0.



In △ABC, $\angle 1 + \angle 2 + \angle 3 = 180^0$

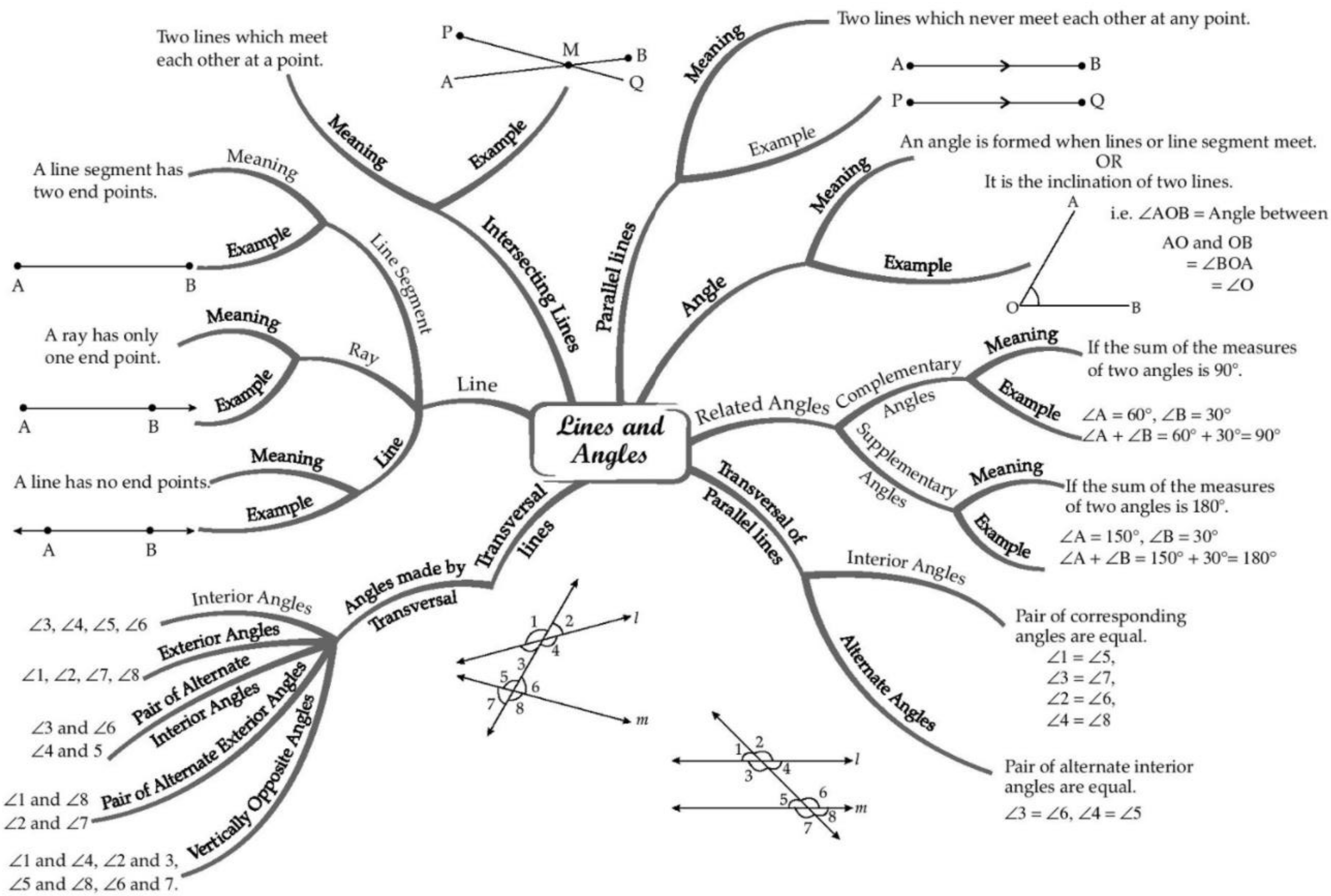
The exterior angle of a triangle = Sum of opposite internal angles

If a side of a triangle is produced, then the exterior angle so formed is equal to the sum of the two interior opposite angles.



In △ABC, $\angle CAB + \angle ABC = \angle ACD$.

CHAPTER - 5 LINES AND ANGLES



Important Questions

Multiple Choice Questions :

Question 1. (180°, 5°) pair of angle is given :

(a) complementary

(b) supplementary

(c) None of these

Question 2. What is the measure of the complement of 65°?

(a) 25°

(b) 55°

(c) 65°

(d) 45°

Question 3. Complementary to 0° angle is :

(a) 90°

(b) 95°

(c) 75°

(d) None of these

Question 4. Identify which of the following pairs of angles are complementary.

(a) 65°, 115°

(b) 130°, 50°

(c) 63°, 27°

(d) 112°, 68°

Question 5. Complementary to 70° angle is :

(a) 20°

(b) 30°

(c) 40°

(d) None of these

Question 6. What happens to the measurement of an angle after the extension of its arms?

(a) Doubles

(b) Triples

(c) Remains the same

(d) Cannot be said

Question 7. Complementary to 95° angle is :

(a) 5°

(b) 0°

(c) 10°

(d) None of these

Question 8. What is the supplement of 105°?

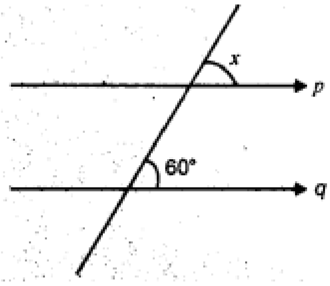
(a) 65°

(b) 75°

(c) 85°

(d) 95°

Question 9. Find the value of x in the given figure if lines p ∥ q :



(a) x = 60°

(b) 50°

(c) 75°

(d) none of these

Question 10. Identify which of the following pairs of angles are supplementary.

(a) 45°, 45°

(b) 63°, 27°

(c) 112°, 68°

(d) 80°, 10°

Question 11. Measure of the supplement of 0° :

(a) 180°

(b) 90°

(c) 175°

(d) None of these

Question 12. What do we call an angle whose measurement is exactly equal to 0°?

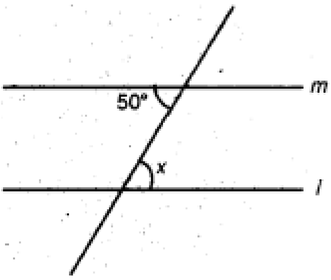
(a) An obtuse angle

(b) A straight angle

(c) A zero angle

(d) A right angle

Question 13. If in the given figure l ∥ m then :



(a) x = 50°

(b) x = 60°

(c) No relation

Question 14. What are the lines which lie on the same plane and do not intersect at any point called?

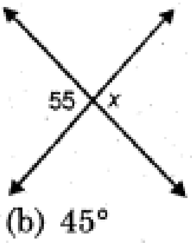
(a) Perpendicular lines

(b) Intersecting lines

(c) Parallel lines

(d) Collinear lines

Question 15.In the given figure value of x is :



(a) 55°

(b) 45°

(c) 65°

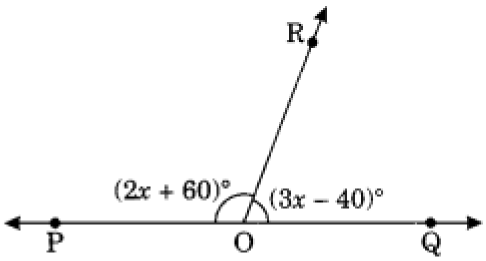
(d) None of these

Very Short Questions :

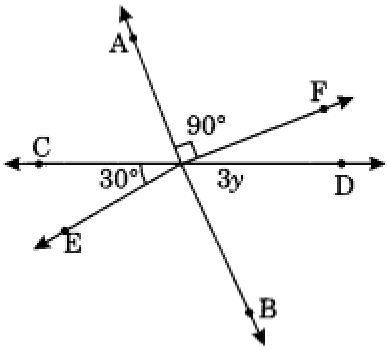
1. Find the angles which is $\frac{1}{5}$ of its complement.

2. Find the angles which is $\frac{2}{3}$ of its supplement.

3. Find the value of x in the given figure.



4. In the given figure, find the value of y.



5. Find the supplements of each of the following:

(i) 30°

(ii) 79°

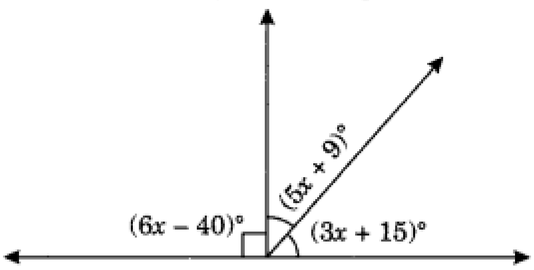
(iii) 179°

(iv) x°

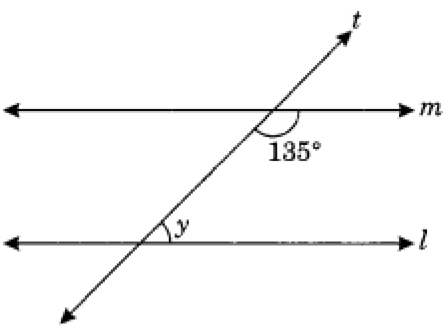
(v) $\frac{2}{5}$ of right angle

6. If the angles (4x + 4)° and (6x – 4)° are the supplementary angles, find the value of x.

7. Find the value of x.

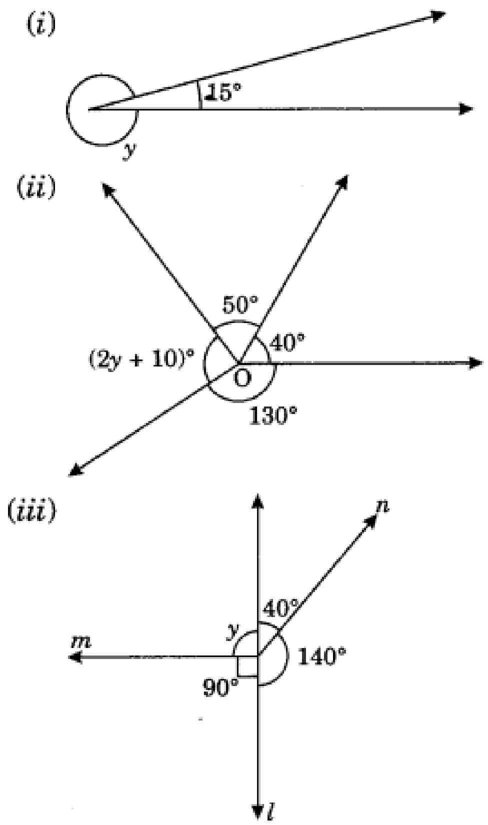


8. Find the value of y.

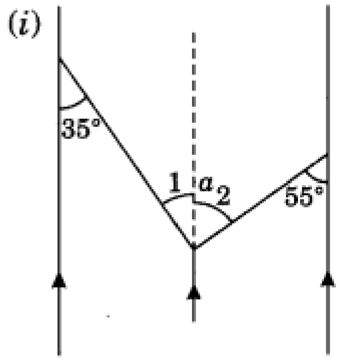


Short Questions :

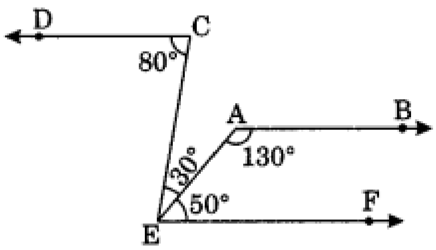
1. Find the value of y in the following figures:



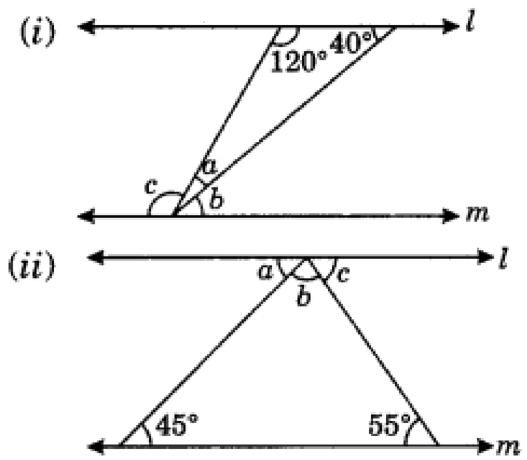
2. In the following figures, find the lettered angles.



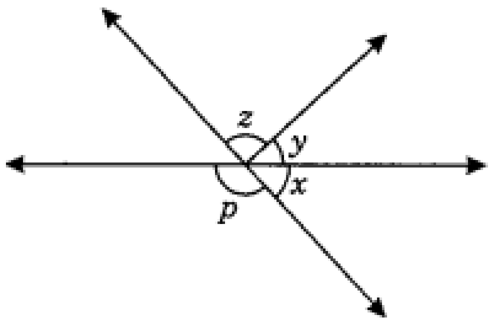
3. In the given figure, prove that AB || CD.



4. In the given figure l || m. Find the values of a, b and c.

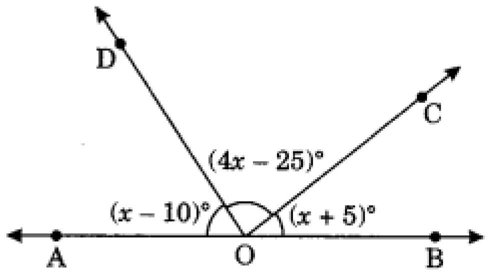


5. In the adjoining figure if x : y : z = 2 : 3 : 4, then find the value of z.



Long Questions :

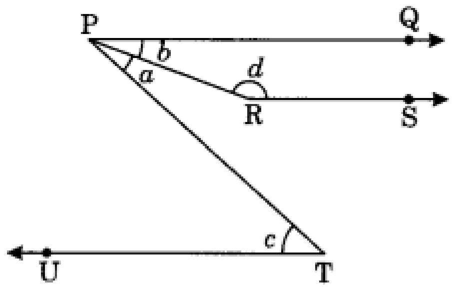
1. In the following figure, find the value of ∠BOC, if points A, O and B are collinear.



2. In given figure, PQ, RS and UT are parallel lines.

(i) If c = 57° and a = $\frac{c}{3}$, find the value of d.

(ii) If c = 75° and a = $\frac{2}{5}$c , find



3. An angle is greater than 45˚. Is its complementary angle greater than 45˚

or equal to 45˚ or less than 45˚?

4. In the adjoining figure, p ‖ q. Find the unknown angles.

Assertion and Reason Questions:

1.) Assertion: When the sum of the measures of two angles is 90°, the angles are called complementary angles.

Reason: Two acute angles can be complementary to each other.

a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion

b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.

c.) assertion is true but the reason is false.

d.) both assertion and reason are false.

2.) Assertion: The sum of the measures of two complementary angles is 90°.

Reason: When the sum of the measures of two angles is 90°, the angles are called complementary angles.

a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion

b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.

c.) assertion is true but the reason is false.

d.) both assertion and reason are false.

ANSWER KEY -

Multiple Choice questions :

1. (c) None of these
2. (a) 25°
3. (a) 90°
4. (c) 63°, 27°
5. (a) 20°
6. (c) Remains the same
7. (d) None of these
8. (b) 75°
9. (a) x = 60°
10. (c) 112°, 68°

11. (a) 180°

12. (c) A zero angle

13. (a) x = 50°

14. (c) Parallel lines

15. (a) 55°

Very Short Answer :

1. Let the required angle be x°

its complement = (90 – x)°

As per condition, we get

$$\frac{1}{5} \text{ of } (90 - x)^\circ = x^\circ$$

$$\Rightarrow \quad \frac{1}{5} \times (90 - x)^\circ = x^\circ$$

$$\Rightarrow \quad \frac{1}{5} \times 90^\circ - \frac{1}{5} \times x^\circ = x^\circ$$

$$\Rightarrow \quad 18^\circ - \frac{1}{5}x^\circ = x^\circ$$

$$\Rightarrow \quad x^\circ + \frac{1}{5}x^\circ = 18^\circ$$

$$\Rightarrow \quad \frac{6}{5}x^\circ = 18^\circ$$

$$\therefore \quad x^\circ = 18 \times \frac{5}{6}^\circ = 15^\circ$$

Thus, the required angle be 15°.

2. Let the required angle be x°.

its supplement = (180 – x)°

As per the condition, we get

$\frac{2}{3}$ of (180 – x)° = x°

$$\Rightarrow \quad \frac{2}{3} \times (180 - x)^\circ = x^\circ$$

$$\Rightarrow \quad \frac{2}{3} \times 180^\circ - \frac{2}{3} \times x^\circ = x^\circ$$

$$\Rightarrow \quad 120^\circ - \frac{2}{3}x^\circ = x^\circ$$

$$\Rightarrow \quad x^\circ + \frac{2}{3}x^\circ = 120^\circ$$

$$\Rightarrow \quad \frac{5}{3}x^\circ = 120^\circ$$

$$\therefore \quad x^\circ = 120^\circ \times \frac{3}{5} = 72^\circ$$

Thus, the required angle be 72°.

3. ∠POR + ∠QOR = 180° (Angles of linear pair)

⇒ (2x + 60°) + (3x – 40)° = 180°

⇒ 2x + 60 + 3x – 40 = 180°

⇒ 5x + 20 = 180°

⇒ 5x = 180 – 20 = 160

⇒ x = 32

Thus, the value of x = 32.

4. Let the angle opposite to 90° be z.

z = 90° (Vertically opposite angle)

3y + z + 30° = 180° (Sum of adjacent angles on a straight line)

⇒ 3y + 90° + 30° = 180°

⇒ 3y + 120° = 180°

⇒ 3y = 180° – 120° = 60°

⇒ y = 20°

5. Thus the value of y = 20°.

(i) Supplement of 30° = 180° – 30° = 150°

(ii) Supplement of 79° = 180° – 79° = 101°

(iii) Supplement of 179° = 180° – 179° = 1°

(iv) Supplement of x° = (180 – x)°

(v) Supplement of $\frac{2}{5}$ of right angle

$= 180^\circ - \frac{2}{5} \times 90^\circ = 180^\circ - 36^\circ = 144^\circ$

6. (4x + 4)° + (6x – 4)° = 180° (∵ Sum of the supplementary angle is 180°)

$\Rightarrow 4x + 4 + 6x - 4 = 180°$

$\Rightarrow 10x = 180°$

$\Rightarrow x = 18°$

Thus, $x = 18°$

7. $(6x - 40)° + (5x + 9)° + (3x + 15)° = 180°$ ($\because$ Sum of adjacent angles on straight line)

$\Rightarrow 6x - 40 + 5x + 9 + 3x + 15 = 180°$

$\Rightarrow 14x - 16 = 180°$

$\Rightarrow 14x = 180 + 16 = 196$

$\Rightarrow x = 14$

Thus, $x = 14$

8. $l \parallel m$, and t is a transversal.

$y + 135° = 180°$ (Sum of interior angles on the same side of transversal is 180°)

$\Rightarrow y = 180° - 135° = 45°$

Thus, $y = 45°$

Short Answer :

1. (i) $y + 15° = 360°$ (Sum of complete angles round at a point)

$\Rightarrow y = 360° - 15° = 345°$

Thus, $y = 345°$

(ii) $(2y + 10)° + 50° + 40° + 130° = 360°$ (Sum of angles round at a point)

$\Rightarrow 2y + 10 + 220 = 360$

$\Rightarrow 2y + 230 = 360$

$\Rightarrow 2y = 360 - 230$

$\Rightarrow 2y = 130$

$\Rightarrow y = 65$

Thus, $y = 65°$

(iii) $y + 90° = 180°$ (Angles of linear pair)

$\Rightarrow y = 180° - 90° = 90°$

[$40° + 140° = 180°$, which shows that l is a straight line]

2. (i) Let a be represented by $\angle 1$ and $\angle 2$

$\angle a = \angle 1 + \angle 2$

$\angle 1 = 35°$ (Alternate interior angles)

$\angle 2 = 55°$ (Alternate interior angles)

$\angle 1 + \angle 2 = 35° + 55°$

$\angle a = 90°$

Thus, $\angle a = 90°$

3. $\angle CEF = 30° + 50° = 80°$

$\angle DCE = 80°$ (Given)

$\angle CEF = \angle DCE$

But these are alternate interior angle.

CD || EF ......(i)

Now $\angle EAB = 130°$ (Given)

$\angle AEF = 50°$ (Given)

$\angle EAB + \angle AEF = 130° + 50° = 180°$

But these are co-interior angles.

AB || EF ...(ii)

From eq. (i) and (ii), we get

AB || CD || EF

Hence, AB || CD

Co-interior angles/Allied angles: Sum of interior angles on the same side of transversal is 180°.

4. (i) We have l || m

$\angle b = 40°$ (Alternate interior angles)

$\angle c = 120°$ (Alternate interior angles)

$\angle a + \angle b + \angle c = 180°$ (Sum of adjacent angles on straight angle)

$\Rightarrow \angle a + 40° + 120° = 180°$

$\Rightarrow \angle a + 160° = 180°$

$\Rightarrow \angle a = 180° - 160° = 20°$

Thus, $\angle a = 20°$, $\angle b = 40°$ and $\angle c = 120°$.

(ii) We have l || m

$\angle a = 45°$ (Alternate interior angles)

$\angle c = 55°$ (Alternate interior angles)

$\angle a + \angle b + \angle c = 180°$ (Sum of adjacent angles on straight line)

$\Rightarrow 45 + \angle b + 55 = 180°$

$\Rightarrow \angle b + 100 = 180°$

$\Rightarrow \angle b = 180° – 100°$

$\Rightarrow \angle b = 80°$

5. Let $x = 2s°$

$y = 3s°$

and $z = 4s°$

$\angle x + \angle y + \angle z = 180°$ (Sum of adjacent angles on straight line)

$2s° + 3s° + 4s° = 180°$

$\Rightarrow 9s° = 180°$

$\Rightarrow s° = 20°$

Thus $x = 2 \times 20° = 40°$, $y = 3 \times 20° = 60°$ and $z = 4 \times 20° = 80°$

Long Answer :

1. We have A, O and B are collinear.

$\angle AOD + \angle DOC + \angle COB = 180°$ (Sum of adjacent angles on straight line)

$(x – 10)° + (4x – 25)° + (x + 5)° = 180°$

$\Rightarrow x – 10 + 4x – 25 + x + 5 = 180°$

$\Rightarrow 6x – 10 – 25 + 5 = 180°$

$\Rightarrow 6x – 30 = 180°$

$\Rightarrow 6x = 180 + 30 = 210$

$\Rightarrow x = 35$

So, $\angle BOC = (x + 5)° = (35 + 5)° = 40°$

2. (i) We have $\angle c = 57°$ and $\angle a = \frac{\angle c}{3}$

$\angle a = 573 = 19°$

PQ || UT (given)

$\angle a + \angle b = \angle c$ (Alternate interior angles)

$19° + \angle b = 57°$

$\angle b = 57° – 19° = 38°$

PQ || RS (given)

$\angle b + \angle d = 180°$ (Co-interior angles)

$38° + \angle d = 180°$

$\angle d = 180° – 38° = 142°$

Thus, $\angle d = 142°$

(ii) We have ∠c = 75° and $\angle a = \frac{2}{5}\angle c$

$$\angle a = \frac{2}{5} \times 75^\circ = 30^\circ$$

PQ || UT (given)

∠a + ∠b = ∠c

30° + ∠b = 75°

∠b = 75° – 30° = 45°

Thus, ∠b = 45°

3. Let us assume the complementary angles be p and q,

We know that, sum of measures of complementary angle pair is 90^o.

Then,

= p + q = 90^o

It is given in the question that p > 45^o

Adding q on both the sides,

= p + q > 45^o + q

= 90o > 45^o + q

= 90o – 45^o > q

= q < 45^o

Hence, its complementary angle is less than 45^o.

4. By observing the figure,

∠d = ∠125^o … [∵ corresponding angles]

We know that, Linear pair is the sum of adjacent angles is 180^o

Then,

= ∠e + 125^o = 180^o … [Linear pair]

= ∠e = 180^o – 125^o

= ∠e = 55^o

From the rule of vertically opposite angles,

∠f = ∠e = 55^o

∠b = ∠d = 125^o

By the property of corresponding angles,

∠c = ∠f = 55^o

∠a = ∠e = 55^o

Assertion and Reason Answers:

1) b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.

2) a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion.