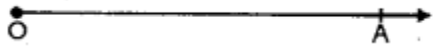


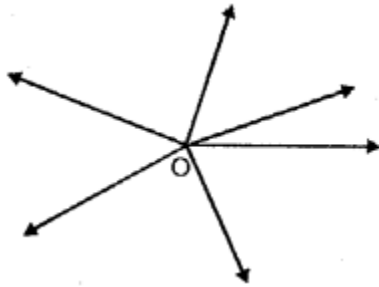
Angles

IMPORTANT POINTS

1. Ray. A ray is a half-line: It has one end point and other end is open. It can not be measured like a line. Here, OA is a ray.

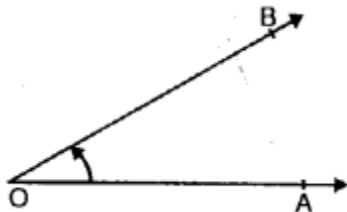


From a point, infinite numbers of rays can be drawn.



2. Angle: When two rays meet at a point, then an angle is formed. Angle is measured in degrees with the help of an instrument known as a protractor.

The point where the two rays meet is called an initial point or vertex of the angle and the two rays which form the angle, are called the sides of the angle e.g., two rays OA and OB meet at O.



∴ Angle AOB is formed. Vertex is always kept between the end points.

The angle can be denoted as $\angle AOB$, or $\angle BOA$, here sign ' $\angle$ ' denotes the angle.

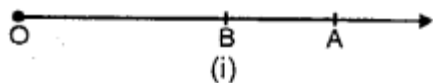
The angle is also denoted with letters A, B, C etc. or numbers 1, 2, 3 etc. also.

3. Parts of an angle: Angle has three parts : Interior, exterior and the angle itself.

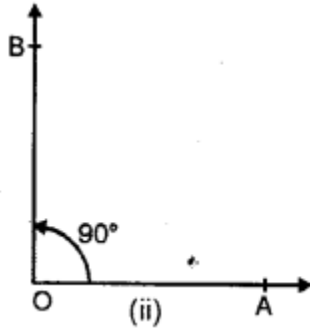
4. Comparison of Angles: Two angles can be compared with respect to their magnitude. Any angle of greater measure is greater.

5. Kinds of Angles :

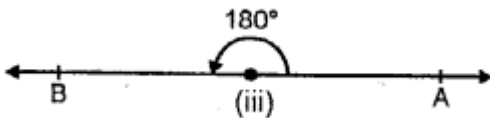
(i) Zero angle: When two rotating rays (sides of angles) coincide each other, then zero angle is formed.



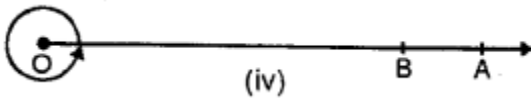
(ii) Right angle: An angle of 90° is called a right angle.



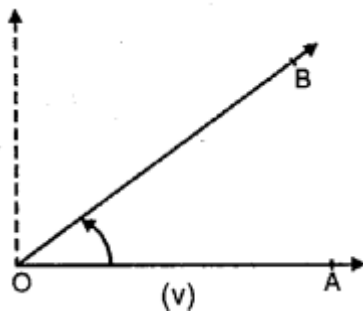
(iii) Straight Angle: An angle of 180° is called a straight angle.



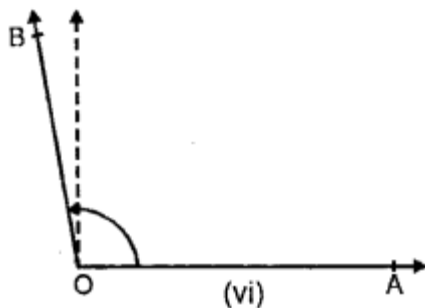
(iv) Complete Angle: When a ray completes a revolution on rotating it, then a complete angle is formed.



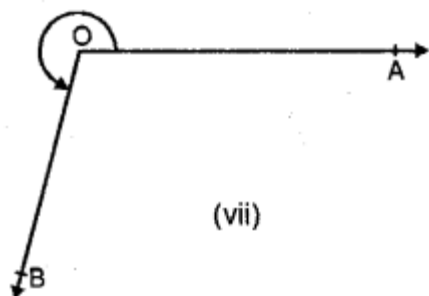
(v) Acute angle : An angle less than 90° is called an acute angle.



(vi) Obtuse angle : An angle greater than 90° and less than 180° is called an obtuse angle.



(vii) Reflex Angle: An angle greater than the 180° and less than 360°



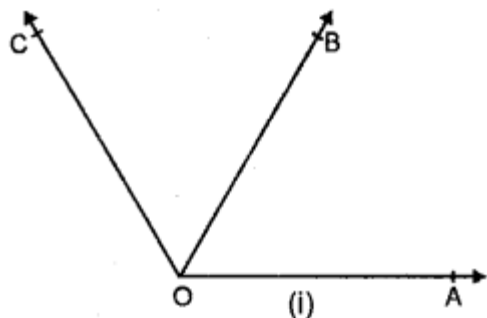
Note:

$1^\circ = 60 \text{ minutes } (60')$

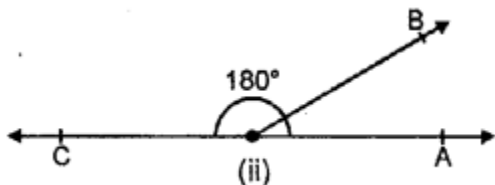
$1' = 60 \text{ seconds } (60'')$

6. Pairs of angles :

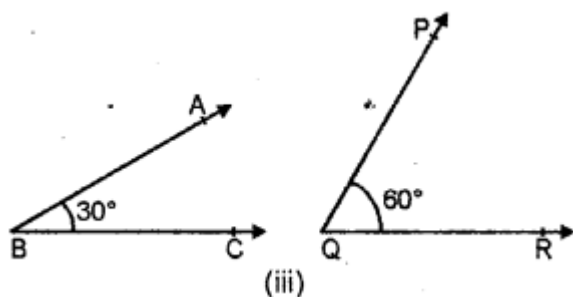
(i) Adjacent Angles: Two angles with same vertex and one common arm and the other arms lying in opposite sides of it are called adjacent angles, $\angle AOB$ and $\angle BOC$ are adjacent angles.



(ii) Linear Pair: A linear pair is a pair of adjacent angles whose sum is equal to 180° . $\angle AOB$ and $\angle BOC$ are a linear pair as $\angle AOB + \angle BOC = 180^\circ$.

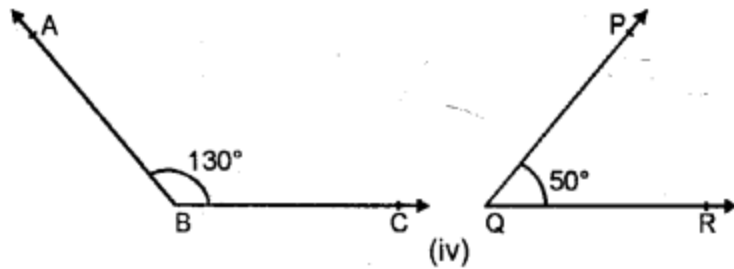


(iii) Complementary Angle: Two angles whose sum is 90° are called complementary angles. $\angle ABC$ and $\angle PQR$ are complementary angles as $\angle ABC + \angle PQR = 30^\circ + 60^\circ = 90^\circ$.



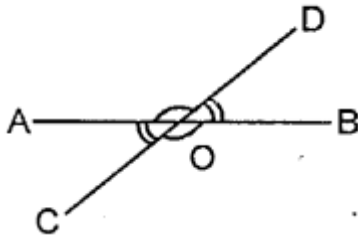
(iv) Supplementary Angles: Two angles whose sum is 180° , are called supplementary

angles. $\angle ABC$ and $\angle PQR$ are supplementary angles, because $\angle ABC + \angle PQR = 130^\circ + 50^\circ = 180^\circ$.



(v) Vertically Opposite Angles: When two lines intersect each other, then the pairs of opposite angles so formed are called vertically opposite angles.

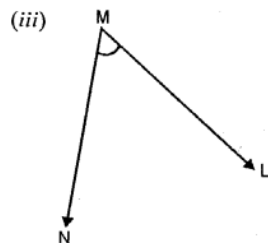
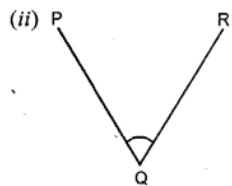
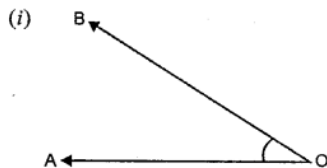
$\angle 1$ and $\angle 2$ are vertically opposite angles. Similarly, $\angle 3$ and $\angle 4$ are vertically opposite angles.



EXERCISE 24 (A)

Question 1.

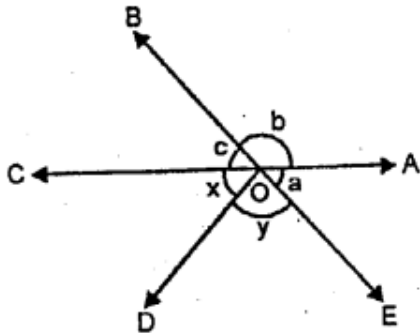
For each angle given below, write the name of the vertex, the names of the arms and the name of the angle.



Solution:

- (i) In figure (i) O is the vertex, OA, OB are its arms and name of the angle is $\angle AOB$ or $\angle BOA$ or simply $\angle O$.
- (ii) In figure (ii) Q is the vertex, QP and QR its arms and the name of the angle is $\angle PQR$ or $\angle RQP$ or simply $\angle Q$.
- (iii) In figure (iii), M is the vertex, MN and ML and its anus, and name of the angle is $\angle LMN$ or $\angle NML$ or simply $\angle M$.

P.Q . Name the angles marked by letters a, b, c, x and y.



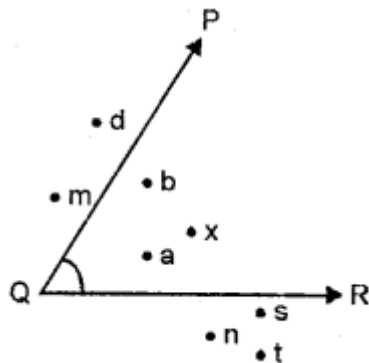
Solution:

$a = \angle AOE$, $b = \angle AOB$, $c = \angle BOC$ $d = \angle COD$ $e = \angle DOE$

Question 2.

Name the points :

- (i) in the interior of the angle PQR,
(ii) in the exterior of the angle PQR.

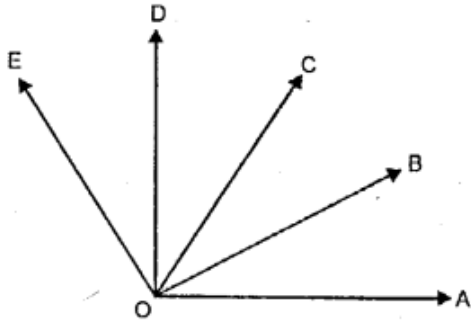


Solution:

- (i) a, b and x
(ii) d, m, n, s, and t.

Question 3.

In the given figure, figure out the number of angles formed within the arms OA and OE.



Solution:

$\angle AOE$, $\angle AOD$, $\angle AOC$, $\angle AOB$, $\angle BOC$, $\angle BOD$, $\angle BOE$, $\angle COD$, $\angle COE$ and $\angle DOE$.

Question 4.

Add :

(i) $29^\circ 16' 23''$ and $8^\circ 27' 12''$

(ii) $9^\circ 45' 56''$ and $73^\circ 8' 15''$

(m) $56^\circ 38'$ and $27^\circ 42' 30''$

(iv) 47° and $61^\circ 17' 4''$

Solution:

(i) $29^\circ 16' 23''$ and $8^\circ 27' 12''$

$$29^\circ 16' 23'' + 8^\circ 27' 12''$$

$$= 37^\circ 43' 35''$$

$$\begin{array}{r} 29^\circ 16' 23'' \\ + 8^\circ 27' 12'' \\ \hline \end{array}$$

$$37^\circ 43' 35''$$

$$\hline$$

(ii) $9^\circ 45' 56''$ and $73^\circ 8' 15''$

$$\begin{array}{r} 9^\circ 45' 56'' \\ + 73^\circ 8' 15'' \\ \hline \end{array}$$

$$82^\circ 53' 71''$$

$$\hline$$

Since, $60'' = 1'$ $\therefore 71'' = 1' 11''$

and $\therefore 82^\circ 53' 71'' = 82^\circ 54' 11''$

(iii) $56^\circ 38'$ and $27^\circ 42' 30''$

$$56^\circ 38' + 27^\circ 42' 30''$$

$$= 84^\circ 20' 30''$$

$$(1^\circ = 60')$$

$$\begin{array}{r} 56^\circ 38' 0'' \\ + 27^\circ 42' 30'' \\ \hline \end{array}$$

$$84^\circ 80' 30''$$

$$\hline$$

$$84^\circ 80' 30''$$

$$\hline$$

(iv) 47° and $61^\circ 17' 4''$

$$\begin{array}{r} 47^\circ 0' 0'' \\ + 61^\circ 17' 4'' \\ \hline \end{array}$$

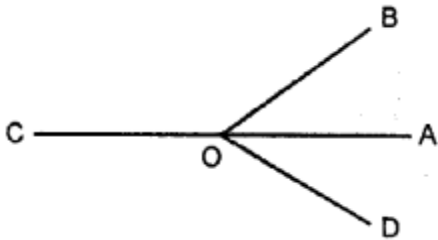
$$108^\circ 17' 4''$$

$$\hline$$

Question 5.

In the figure, given below name :

- (i) three pairs of adjacent angles.
- (ii) two acute angles,
- (iii) two obtuse angles
- (iv) two reflex angles.

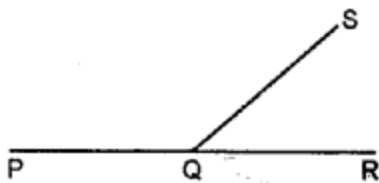
**Solution:**

- (i) Three pairs of adjacent angles are
 $\angle AOB$ and $\angle BOC$;
 $\angle BOC$ and $\angle COD$;
 $\angle COD$ and $\angle DOA$.
- (ii) Two acute angles are
 $\angle AOB$ and $\angle AOD$.
- (iii) Two obtuse angles are
 $\angle BOC$ and $\angle COD$.
- (iv) Two reflex angles are
 $\angle AOB$ and $\angle COD$.

Question 6.

In the given figure ; PQR is a straight line. If :

- (i) $\angle SQR = 75^\circ$; find $\angle PQS$.
- (ii) $\angle PQS = 110^\circ$; find $\angle RQS$

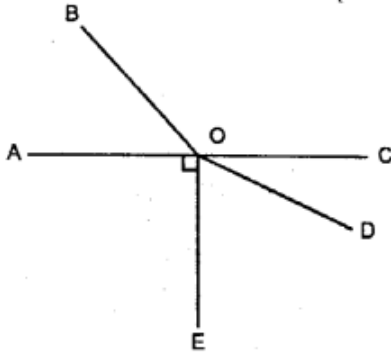
**Solution:**

- (i) From figure,
 $\angle PQS + \angle SQR = 180^\circ$ [Linear pair of angles]
 $\Rightarrow \angle PQS + 75^\circ = 180^\circ$
 $\Rightarrow \angle PQS = 180^\circ - 75^\circ$
 $\Rightarrow \angle PQS = 105^\circ$
- (ii) From figure again,
 $\angle PQS + \angle RQS = 180^\circ$
 $\Rightarrow 110^\circ + \angle RQS = 180^\circ$
 $\angle RQS = 180^\circ - 110^\circ$
 $\angle RQS = 70^\circ$

Question 7.

In the given figure ; AOC-is a straight line. If angle AOB = 50° , angle AOE = 90° and angle COD = 25° ; find the measure of :

- (i) angle BOC
- (ii) angle EOD
- (iii) obtuse angle BOD
- (iv) reflex angle BOD
- (v) reflex angle COE.

**Solution:**

(i) $\angle AOB + \angle BOC = 180^\circ$ (Linear pairs of angle)

$$\Rightarrow 50^\circ + \angle BOC = 180^\circ$$

$$\Rightarrow \angle BOC = 180^\circ - 50^\circ = 130^\circ$$

$$\Rightarrow \angle BOC = 130^\circ$$

(ii) $\angle EOD + \angle COD = 90^\circ$ ($\because \angle AOE = 90^\circ$)

$$\Rightarrow \angle EOD + 25^\circ = 90^\circ$$

$$\Rightarrow \angle EOD + 25^\circ = 90^\circ$$

$$\Rightarrow \angle EOD = 90^\circ - 25^\circ$$

$$\Rightarrow \angle EOD = 65^\circ$$

(iii) $\angle BOD = \angle BOC + \angle COD$

$$= 130^\circ + 25^\circ = 155^\circ$$

(iv) Reflex $\angle BOD = 360^\circ - \angle BOD$

$$= 360^\circ - 155^\circ = 205^\circ$$

(v) Reflex $\angle COE = 360^\circ - \angle COE$

$$= 360^\circ (\angle COD + \angle EOD)$$

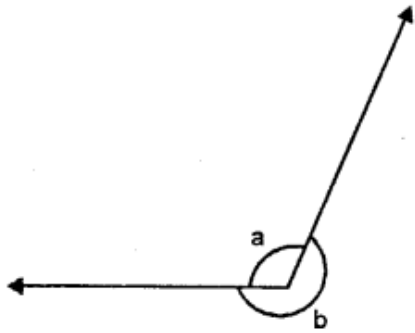
$$= 360^\circ - (25^\circ + 65^\circ)$$

$$= 360^\circ - 90^\circ = 270^\circ$$

Question 8.

In the given figure if :

- (i) $a = 130^\circ$; find b.
- (ii) $b = 200$; find a.
- (iii) $a = \frac{5}{3}$ right angle, find b



Solution:

(i) From figure, $a + b = 360^\circ$

$$\Rightarrow 130^\circ + 6 = 360$$

$$\Rightarrow 6 = 360^\circ - 130^\circ$$

$$\Rightarrow b = 230^\circ$$

(ii) From figure,

$$a + b = 360^\circ$$

$$\Rightarrow a + 200^\circ = 360^\circ$$

$$\Rightarrow a = 360^\circ - 200^\circ$$

$$\Rightarrow a = 160^\circ$$

(iii) Here, $a = \frac{5}{3}$ right angle

$$= \frac{5}{3} \times 90^\circ = 150^\circ$$

$$a = 150^\circ$$

$$\text{Here, } a + b = 360^\circ$$

$$\Rightarrow 150^\circ + b = 360^\circ (\because a = 150^\circ)$$

$$\Rightarrow b = 360^\circ - 150^\circ$$

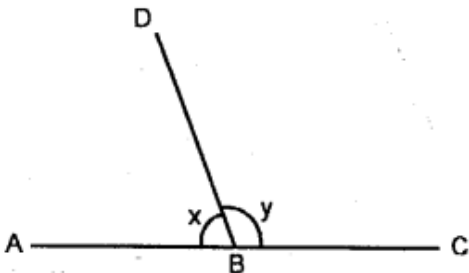
$$b = 210^\circ$$

Question 9.

In the given diagram, ABC is a straight line.

(i) If $x = 53^\circ$, find y .

(ii) If $y = 1\frac{1}{2}$ right angles ; find x .



Solution:

(i) From the figure,

$$\angle ABD + \angle DBC = 180^\circ \text{ (Linear pair of angles)}$$

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

$$\Rightarrow 53^\circ + y = 180^\circ (\because x = 53^\circ)$$

$$\Rightarrow y = 180^\circ - 53^\circ$$

$$\Rightarrow y = 127^\circ$$

(ii) From figure again,

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

$$1 + \frac{3}{2} \times 90 = 180^\circ$$

$$\Rightarrow x + \frac{1}{2} \text{ right angles} = 180^\circ$$

$$\Rightarrow x + \frac{3}{2} \times 90 = 180^\circ$$

$$\Rightarrow x + 135^\circ = 180^\circ$$

$$\Rightarrow x = 180^\circ - 135^\circ$$

$$\Rightarrow x = 45^\circ$$

Question 10.

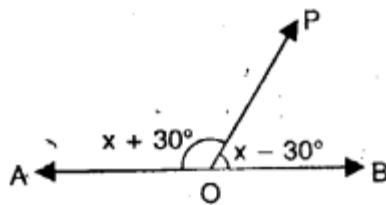
In the given figure, AOB is a straight line. Find the value of x and also answer each of the following :

(i) $\angle AOP = \dots\dots\dots$

(ii) $\angle BOP = \dots\dots\dots$

(iii) which angle is obtuse ?

(iv) which angle is acute ?



Solution:

$$\angle AOP = x + 30^\circ$$

$$\angle BOP = x - 30^\circ$$

But $\angle AOP + \angle BOP = 180^\circ$ ($\because \angle AOB$ is a straight angle)

$$\Rightarrow x + 30^\circ + x - 30^\circ = 180^\circ$$

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

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

$$(i) \angle AOP = x + 30^\circ = 90^\circ + 30^\circ = 120^\circ$$

$$(ii) \angle BOP = x - 30^\circ = 90^\circ - 30^\circ = 60^\circ$$

(iii) $\angle AOP$ is an obtuse angle

(iv) $\angle BOP$ is an acute angle

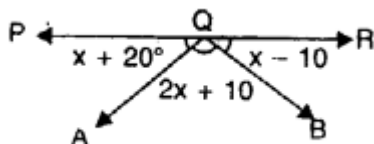
Question 11.

In the given figure, PQR is a straight line. Find x . Then complete the following:

(i) $\angle AQB = \dots\dots\dots$

(ii) $\angle BQP = \dots\dots\dots$

(iii) $\angle AQR = \dots\dots\dots$



Solution:

PQR is a straight line

$$\angle AQP = x + 20^\circ$$

$$\angle AQB = 2x + 10^\circ$$

$$\angle BQR = x - 10^\circ$$

$$\text{But } \angle AQP + \angle AQB + \angle BQR = 180^\circ$$

$$\Rightarrow x + 20^\circ + 2x + 10^\circ + x - 10^\circ = 180^\circ$$

$$\Rightarrow 4x + 20^\circ = 180^\circ$$

$$\Rightarrow 4x = 180^\circ - 20^\circ = 160^\circ$$

$$\Rightarrow x = \frac{160}{4}^\circ = 40^\circ$$

$$(i) \angle AQB = 2x + 10^\circ = 2 \times 40^\circ + 10^\circ = 80^\circ + 10^\circ = 90^\circ$$

$$\angle AQP = x + 20^\circ = 40^\circ + 20^\circ = 60^\circ$$

$$\angle BQR = x - 10^\circ = 40^\circ - 10^\circ = 30^\circ$$

$$(ii) \angle BQP = \angle AQP + \angle AQB = 60^\circ + 90^\circ = 150^\circ$$

$$(iii) \angle AQR = \angle AQB + \angle BQR = 90^\circ + 30^\circ = 120^\circ$$

Question 12.

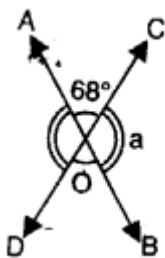
In the given figure, lines AB and CD intersect at point O.

(i) Find the value of $\angle a$.

(ii) Name all the pairs of vertically opposite angles.

(iii) Name all the pairs of adjacent angles.

(iv) Name all the reflex angles formed and write the measure of each.



Solution:

Two lines AB and CD intersect each other at O

$$\angle AOC = 68^\circ$$

(i) $\because$ AOB is a line

$$\angle AOC + \angle BOC = 180^\circ$$

$$\Rightarrow 68^\circ + a = 180^\circ$$

$$\Rightarrow a = 180^\circ - 68^\circ = 112^\circ$$

(ii) $\angle AOC$ and $\angle BOD$ and $\angle BOC$ and $\angle AOD$ are the two pairs of vertically opposite angles.

(iii) $\angle AOC$ and $\angle BOC$; $\angle BOC$ and $\angle BOD$; $\angle BOD$ and $\angle DOA$;

$\angle DOA$ and $\angle AOC$ are the pairs of adjacent angles

(iv) $\angle BOC$ and $\angle DOA$ are reflex angles and also $\angle AOC$ and $\angle BOD$ are also reflex angles

$$\text{Ref. } \angle BOC = 180^\circ + 68^\circ = 248^\circ$$

$$\text{Ref. } \angle DOA = 180^\circ + 68^\circ = 248^\circ$$

$$\text{Ref. } \angle AOC = 180^\circ + 112^\circ = 292^\circ$$

$$\text{and ref. } \angle BOD = 180^\circ + 112^\circ = 292^\circ$$

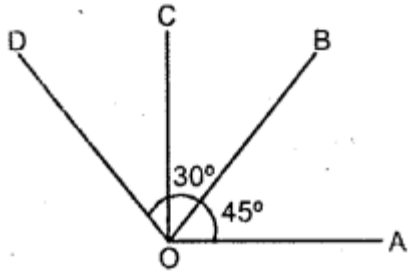
Question 13.

In the given figure :

(i) If $\angle AOB = 45^\circ$, $\angle BOC = 30^\circ$ and $\angle AOD = 110^\circ$;
find : angles $\angle COD$ and $\angle BOD$.

(ii) If $\angle BOC = \angle DOC = 34^\circ$ and $\angle AOD = 120^\circ$;
find : angle $\angle AOB$ and angle $\angle AOC$.

(iii) If $\angle AOB = \angle BOC = \angle COD = 38^\circ$
find : reflex angle $\angle AOC$ and reflex angle $\angle AOD$.



Solution:

$$\begin{aligned} \text{(i) } \angle COD &= \angle AOD - \angle AOC \\ &= \angle AOD - (\angle AOB + \angle BOC) \\ &= 110^\circ - (45^\circ + 30^\circ) \\ &= 110^\circ - 75^\circ = 35^\circ \end{aligned}$$

$$\begin{aligned} \angle BOD &= \angle AOD - \angle AOB \\ &= 110^\circ - 45^\circ \\ &= 65^\circ \end{aligned}$$

$$\begin{aligned} \text{(ii) } \angle AOB &= \angle AOD - \angle BOD \\ &= \angle AOD - (\angle BOC + \angle COD) \\ &= 120^\circ - (34^\circ + 34^\circ) \\ &= 120^\circ - 68^\circ \\ &= 52^\circ \end{aligned}$$

$$\begin{aligned} \angle AOC &= \angle AOB + \angle BOC \\ &= 52^\circ + 34^\circ \\ &= 86^\circ \end{aligned}$$

$$\begin{aligned} \text{(iii) Reflex } \angle AOC &= 360^\circ - \angle AOC \\ &= 360^\circ - (\angle AOB + \angle BOC) \\ &= 360^\circ - (38^\circ + 38^\circ) \\ &= 360^\circ - 76^\circ = 284^\circ \end{aligned}$$

$$\begin{aligned} \text{Reflex } \angle AOD &= 360^\circ - \angle AOD \\ &= 360^\circ - (\angle AOB + \angle BOC + \angle COD) \end{aligned}$$

$$\begin{aligned}
 &= 360^\circ - (38^\circ + 38^\circ + 38^\circ) \\
 &= 360^\circ - 114^\circ \\
 &= 246^\circ
 \end{aligned}$$

EXERCISE 24 (B)

Question 1.

Write the complement angle of :

- (i) 45°
- (ii) x°
- (iii) $(x - 10)^\circ$
- (iv) $20^\circ + y^\circ$

Solution:

- (i) Complement angle of 45°
 $= 90^\circ - 45^\circ = 45^\circ$
- (ii) Complement angle of x°
 $= 90^\circ - x^\circ = (90 - x)^\circ$
- (iii) Complement angle of $(x - 10)^\circ = 90^\circ - (x - 10)^\circ$
 $= 90^\circ - x + 10^\circ = 100^\circ - x$
- (iv) Complement angle of $20^\circ + y^\circ$
 $= 90^\circ - (20^\circ + y^\circ)$
 $= 90^\circ - 20^\circ - y^\circ = 70^\circ - y^\circ$

Question 2.

Write the supplement angle of :

- (i) 49°
- (ii) 111°
- (iii) $(x - 30)^\circ$
- (iv) $20^\circ + y^\circ$

Solution:

- (i) Supplement angle of 49°
 $= 180^\circ - 49^\circ = 131^\circ$
- (ii) Supplement angle of 111°
 $= 180^\circ - 111^\circ = 69^\circ$
- (iii) Supplement of $(x - 30)^\circ = 180^\circ - (x - 30)^\circ$
 $= 180^\circ - x + 30^\circ = 210^\circ - x^\circ$
- (iv) Supplement of $20^\circ + y^\circ = 180^\circ - (20^\circ + y^\circ)$
 $= 180^\circ - 20^\circ - y^\circ$
 $= 160^\circ - y^\circ$

Question 3.

Write the complement angle of :

- (i) $\frac{1}{2}$ of 60°
- (ii) $\frac{1}{5}$ of 160°

$$(iii) \frac{2}{5} \text{ of } 70^\circ \quad (iv) \frac{1}{6} \text{ of } 90^\circ$$

Solution:

$$\begin{aligned} (i) \text{ Complement angle of } \left(\frac{1}{2} \text{ of } 60^\circ \right) \\ = 90^\circ - \left(\frac{1}{2} \text{ of } 60^\circ \right) \\ = 90^\circ - 30^\circ = 60^\circ \end{aligned}$$

$$\begin{aligned} (ii) \text{ Complement angle of } \frac{1}{5} \text{ of } 160^\circ \\ = 90^\circ - \left(\frac{1}{5} \times 160^\circ \right) \\ = 90^\circ - 32^\circ = 58^\circ \end{aligned}$$

$$\begin{aligned} (iii) \text{ Complement angle of } \left(\frac{2}{5} \text{ of } 70^\circ \right) \\ = 90^\circ - \left(\frac{2}{5} \text{ of } 70^\circ \right) \\ = 90^\circ - 28^\circ = 62^\circ \end{aligned}$$

$$\begin{aligned} (iv) \text{ Complement angle of } \frac{1}{6} \text{ of } 90^\circ \\ = 90^\circ - \left(\frac{1}{6} \text{ of } 90^\circ \right) \\ = 90^\circ - 15^\circ = 75^\circ \end{aligned}$$

Question 4.

$$(i) 50\% \text{ of } 120^\circ \quad (ii) \frac{1}{3} \text{ of } 150^\circ$$

$$(iii) 60\% \text{ of } 100^\circ \quad (iv) \frac{3}{4} \text{ of } 160^\circ$$

Solution:

(i) Supplement angle of 50% of $120^\circ = 180^\circ - (50\% \text{ of } 120^\circ)$

$$= 180^\circ - \left(\frac{120^\circ \times 50}{100} \right)$$

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

(ii) Supplement angle of $\left(\frac{1}{3} \text{ of } 150^\circ \right)$

$$= 180^\circ - \left(\frac{1}{3} \text{ of } 150^\circ \right)$$

$$= 180^\circ - 50^\circ = 130^\circ$$

(iii) Supplement angle of 60% of $100^\circ = 180^\circ - (60\% \text{ of } 100^\circ)$

$$= 180^\circ - \left(\frac{60}{100} \times 100 \right)$$

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

(iv) Supplement of $\frac{3}{4}$ of 160

$$= 180^\circ - \left(\frac{3}{4} \text{ of } 160^\circ \right)$$

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

$$= 60^\circ$$

Question 5.

Find the angle :

(i) that is equal to its complement ?

(ii) that is equal to its supplement ?

Solution:

(i) 45° is equal to its complement.

(ii) 90° is equal to its supplement.

Question 6.

Two complementary angles are in the ratio 7 : 8. Find the angles.

Solution:

Let two complementary angles are $7x$ and $8x$

$$\therefore 7x + 8x = 90^\circ$$

$$\Rightarrow 15x = 90^\circ$$

$$\Rightarrow x = \frac{90}{15}^\circ$$

$$\Rightarrow x = 6^\circ$$

$\therefore$ Two complementary angles are

$$7x = 7 \times 6^\circ = 42^\circ$$

$$8x = 8 \times 6^\circ = 48^\circ$$

Question 7.

Two supplementary angles are in the ratio 7 : 11. Find the angles.

Solution:

Let two supplementary angles are $7x$ and $11x$

$$\therefore 7x + 11x = 180^\circ$$

$$\Rightarrow 18x = 180^\circ$$

$$\Rightarrow x = \frac{180}{18}$$

$$\Rightarrow x = 10^\circ$$

Two supplementary angles are

$$7x = 7 \times 10^\circ = 70^\circ$$

$$11x = 11 \times 10^\circ = 110^\circ$$

Question 8.

The measures of two complementary angles are $(2x - 7)^\circ$ and $(x + 4)^\circ$. Find x .

Solution:

We know that, sum of two complementary angles = 90°

$$\therefore (2x - 7) + (x + 4) = 90^\circ$$

$$2x - 7 + x + 4 = 90^\circ$$

$$\Rightarrow 2x + x - 7 + 4 = 90^\circ$$

$$\Rightarrow 3x - 3 = 90^\circ$$

$$\Rightarrow 3x = 90 + 3$$

$$\Rightarrow 3x = 93$$

$$\Rightarrow x = \frac{93}{3}$$

$$x = 31$$

Question 9.

The measures of two supplementary angles are $(3x + 15)^\circ$ and $(2x + 5)^\circ$. Find x .

Solution:

We know that, sum of two supplementary angles = 180°

$$\therefore (3x + 15)^\circ + (2x + 5)^\circ = 180^\circ$$

$$3x + 15 + 2x + 5 = 180^\circ$$

$$\Rightarrow 3x + 2x + 15 + 5 = 180^\circ$$

$$\Rightarrow 5x + 20^\circ = 180^\circ$$

$$\Rightarrow 5x = 180^\circ - 20^\circ$$

$$\Rightarrow 5x = 160^\circ$$

$$\Rightarrow x = \frac{160}{5}$$

$$\Rightarrow x = 32^\circ$$

Question 10.

For an angle x° , find :

- (i) the complementary angle
- (ii) the supplementary angle
- (iii) the value of x° if its supplementary angle is three times its complementary angle.

Solution:

For an angle x ,

- (i) Complementary angle of $x^\circ = (90^\circ - x)$
- (ii) Supplementary angle of $x^\circ = (180^\circ - x)$
- (iii) $\because$ Supplementary angle = 3 (complementary angle)

$$180^\circ - x = 3(90^\circ - x)$$

$$\Rightarrow 180^\circ - x = 270^\circ - 3x$$

$$\Rightarrow -x + 3x = 270^\circ - 180^\circ$$

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

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

$$\therefore x = 45^\circ$$

REVISION EXERCISE**Question 1.**

Explain what do you understand by :

- (i) Adjacent angles ?
- (ii) Complementary angles ?
- (iii) Supplementary angles ?

Solution:

(i) **Adjacent Angles:** Two angles are called adjacent angles if (a) they have a common vertex (b) they have one common arm and (iii) the other two arms of the angles are on the opposite sides of the common arm.

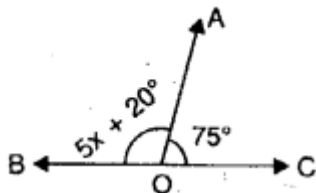
(ii) **Complementary Angles :** Two angles whose sum is 90° are called complementary angles to each other.

(iii) **Supplementary Angles :** Two angles whose sum is 180° are called supplementary angles to each other.

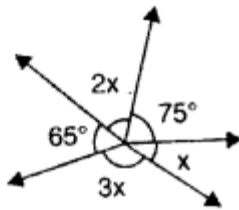
Question 2.

Find the value of 'x' for each of the following figures :

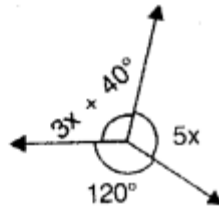
(i)



(ii)



(iii)



Solution:

(i) In figure (i) BOC is a straight line

$$\therefore \angle AOC + \angle AOB = 180^\circ$$

$$\Rightarrow 75^\circ + 5x + 20^\circ = 180^\circ$$

$$\Rightarrow 5x + 95^\circ = 180^\circ$$

$$\Rightarrow 5x = 180^\circ - 95^\circ = 85^\circ$$

$$\Rightarrow x = \frac{85^\circ}{5} = 17^\circ$$

$$\therefore x = 17^\circ$$

(ii) In figure (ii), angles are on a point

$$\therefore \text{Their sum} = 360^\circ$$

$$\Rightarrow 75^\circ + 2x + 65^\circ + 3x + x = 360^\circ$$

$$\Rightarrow 6x + 140^\circ = 360^\circ$$

$$\Rightarrow 6x = 360^\circ - 140^\circ = 220^\circ$$

$$\Rightarrow x = \frac{220^\circ}{6} = \frac{110^\circ}{3}$$

$$\Rightarrow x = \left(36\frac{2}{3}\right)^\circ$$

$$\therefore x = 36\frac{2}{3}^\circ$$

(iii) In figure (iii) angles are on a point

$$\therefore \text{Their sum} = 360^\circ$$

$$\Rightarrow 5x + 3x + 40^\circ + 120^\circ = 360^\circ$$

$$\Rightarrow 8x + 160^\circ = 360^\circ$$

$$\Rightarrow 8x = 360^\circ - 160^\circ = 200^\circ$$

$$\Rightarrow x = \frac{200^\circ}{8} = 25^\circ \quad \Rightarrow x = 25^\circ$$

Question 3.

Find the number of degrees in an angle that is (i) of a right angle (ii) 0.2 times of a straight line angle.

Solution:

$\frac{3}{5}$

(i) $\frac{3}{5}$ of a right angle

$$= \frac{3}{5} \times 90^\circ \quad (\because 1 \text{ right angle} = 90^\circ)$$

$$= 3 \times 18^\circ = 54^\circ$$

(ii) 0.2 times of a straight line angle

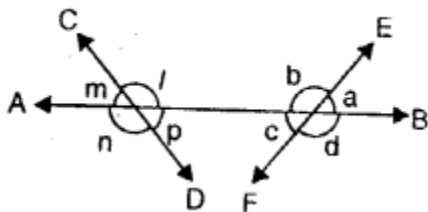
$$= 0.2 \text{ of } 180^\circ \quad (\because \text{Straight line angle} = 180^\circ)$$

$$= \frac{2}{10} \times 180^\circ = 36^\circ$$

Question 4.

In the given figure; AB, CD and EF are straight lines. Name the pair of angles forming :

- (i) straight line angles.
- (ii) vertically opposite angles.



Solution:

In the given figure, AB, CD and EF are straight lines on intersecting, angles are formed a, b, c, d, l, m, n and p.

(i) In the figure pairs of straight line angles are $\angle a, \angle b; \angle b, \angle c; \angle c, \angle d; \angle d, \angle a$
 $\angle l, \angle m; \angle m, \angle n; \angle n, \angle p$ and $\angle p, \angle l$

(ii) Pairs of vertically angles are $\angle a, \angle c; \angle b, \angle d; \angle l, \angle n; \angle m, \angle p$

Question 5.

Find the complement of :

(i) $\frac{2}{5}$ of 210°

(ii) 0.4 times of 130°

Solution:

We know that two angles are called complementary when their sum is 90° . Now

$$(i) \frac{2}{5} \text{ of } 210^\circ = \frac{2}{5} \times 210^\circ = 2 \times 42^\circ = 84^\circ$$

$$\therefore \text{Its complement will be} = 90^\circ - 84^\circ = 6^\circ$$

$$(ii) 0.4 \text{ times of } 130^\circ = \frac{4}{10} \times 130^\circ$$

$$= 4 \times 13^\circ = 52^\circ$$

$$\text{Its complement will be} = 90^\circ - 52^\circ = 38^\circ$$

Question 6.

Find the supplement of :

$$(i) \frac{5}{7} \text{ of } 154^\circ \quad (ii) 0.7 \text{ times of } 150^\circ$$

Solution:

We know that two supplementary angles are those whose sum is 180° . Now

$$(i) \frac{5}{7} \text{ of } 154^\circ = \frac{5}{7} \times 154^\circ = 5 \times 22^\circ = 110^\circ$$

$$\therefore \text{Its supplement} = 180^\circ - 110^\circ = 70^\circ$$

$$(ii) 0.7 \text{ of } 150^\circ = \frac{7}{10} \times 150^\circ = 7 \times 15^\circ = 105^\circ$$

$$\therefore \text{Its supplement} = 180^\circ - 105^\circ = 75^\circ$$

Question 7.

Two complementary angles are in the ratio 8: 7. Find the angles.

Solution:

Ratio between two complementary angles
are = 8 : 7

$$\text{Sum of ratios} = 8 + 7 = 15$$

$$\text{But sum of two complementary angles} = 90^\circ$$

$$\therefore \text{First angle} = 90^\circ \times \frac{8}{15} = 48^\circ$$

$$\text{and second angle} = 90^\circ \times \frac{7}{15} = 42^\circ$$

Hence complementary angles are 48° and 42°

Question 8.

Two supplementary angles are in the ratio 7 : 5. Find the angles.

Solution:

Ratio between two supplementary angles
are = 7 : 5

$$\therefore \text{Sum of ratios} = 7 + 5 = 12$$

$$\text{But sum of two supplementary angles} = 180^\circ$$

$$\therefore \text{First angle} = 180^\circ \times \frac{7}{12} = 15^\circ \times 7 = 105^\circ$$

$$\text{and second angle} = \frac{180^\circ \times 5}{12} = 15^\circ \times 5 = 75^\circ$$

$$\therefore \text{Two supplementary angles are } 105^\circ \text{ and } 75^\circ$$

Question 9.

Two supplementary angles are $(5x - 82^\circ)$ and $(4x + 73^\circ)$. Find the value of x .

Solution:

$$\therefore \text{Sum of two supplementary angles} = 180^\circ$$

$$\therefore (5x - 82^\circ) + (4x + 73^\circ) = 180^\circ$$

$$\Rightarrow 5x - 82^\circ + 4x + 73^\circ = 180^\circ$$

$$\Rightarrow 9x - 9^\circ = 180^\circ \Rightarrow 9x = 180^\circ + 9^\circ = 189^\circ$$

$$\Rightarrow x = \frac{189^\circ}{9} = 21^\circ$$

$$\therefore x = 21^\circ$$

Question 10.

Find the angle formed by the arms of a clock at:

(i) 3 O'clock

(ii) 6 O'clock

(iii) 9 O'clock

(iv) 12 O'clock

Solution:

We know that sum of angles at a point = 360°
and on the face of a clock there are 12 marks on it.

(i) Now at 3 O'clock, the hour hand is on 3
while minute hand is at 12

$$\therefore \text{Angle between them} = \frac{3}{12} \times 360^\circ = 3 \times 30^\circ = 90^\circ$$

(ii) At 6 O'clock, hour hand is at 6 and minute
hand is at 12

$$\therefore \text{Angle between them} = \frac{6}{12} \times 360^\circ = 180^\circ$$

(iii) At 9 O'clock, hour hand is at 9 and minute
hand is at 12

$$\therefore \text{Angle between them} = \frac{9}{12} \times 360^\circ = 270^\circ$$

(iv) At 12 O'clock, hour hand and minute hand
are both on 12°

$$\therefore \text{Angle between them} = \frac{12}{12} \times 360^\circ = 360^\circ$$

or 0° as both hands coincide each other.

Question 11.

For an angle y° , find :

(i) its supplementary angle.

(ii) its complementary angle.

(iii) the value of y° if its supplement is four times its complement.

Solution:

For an angle y

(i) Its supplementary angle = $180^\circ - y$

(ii) Its complementary angle = $90^\circ - y$

(iii) $\therefore$ Supplementary angle of $y = 4$

(Complementary angle of y)

$$\therefore 180^\circ - y = 4(90^\circ - y)$$

$$\Rightarrow 180^\circ - y = 360^\circ - 4y$$

$$\Rightarrow 4y - y = 360^\circ - 180^\circ$$

$$\Rightarrow 3y = 180^\circ \Rightarrow y = \frac{180^\circ}{3} = 60^\circ$$

$$\therefore y = 60^\circ$$

Question 12.

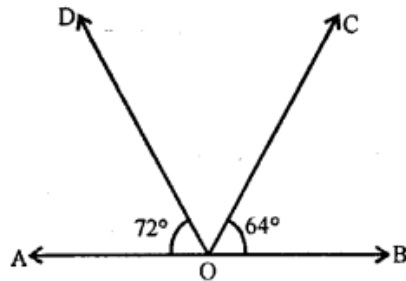
Use the adjoining figure to find :

- (i) $\angle BOD$
(ii) $\angle AOC$

Solution:

$$\angle AOD = 72^\circ$$

$$\angle BOC = 64^\circ$$



But sum of angles on the same side of a line = 180°

$$\therefore \angle AOD + \angle COD + \angle BOC = 180^\circ$$

$$\Rightarrow 72^\circ + \angle COD + 64^\circ = 180^\circ$$

$$\angle COD = 180^\circ - (72^\circ + 64^\circ)$$

$$= 180^\circ - 136^\circ = 44^\circ$$

$$(i) \text{ Now } \angle BOD = \angle BOC + \angle COD \\ = 64^\circ + 44^\circ = 108^\circ$$

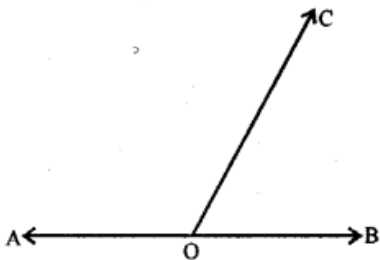
$$(ii) \angle AOC = \angle AOD + \angle COD \\ = 72^\circ + 44^\circ = 116^\circ$$

Question 13.

Two adjacent angles forming a linear pair are in the ratio 7:5, find the angles.

Solution:

In the figure, $\angle AOC$ and $\angle BOC$ are adjacent angles which form a linear pair



$$\therefore \angle AOC + \angle BOC = 180^\circ$$

But $\angle AOC : \angle BOC = 7 : 5$

Let $\angle AOC = 7x$ and $\angle BOC = 5x$

$$\therefore 7x + 5x = 180^\circ \Rightarrow 12x = 180^\circ$$

$$\Rightarrow x = \frac{180^\circ}{12} = 15^\circ$$

$$\therefore \angle AOC = 7x = 7 \times 15 = 105^\circ$$

$$\text{and } \angle BOC = 5x = 5 \times 15 = 75^\circ$$

Question 14.

Find the angle that is three times its complementary angle.

Solution:

Let given angle = x

Let complementary angle of a given angle is y

$$\therefore \text{then } x + y = 90$$

$$\text{But } x = 3y$$

$$\therefore 3y + y = 90^\circ \Rightarrow 4y = 90^\circ \Rightarrow y = \frac{90^\circ}{4} = 22.5^\circ$$

$$\therefore \text{complementary} = x = 90^\circ - 22.5^\circ = 67.5^\circ$$

Question 15.

An angle is one-thirds of a straight line angle; find :

(i) the angle

(ii) the complement and the supplement of the angle obtained above.

Solution:

Straight angle = 180°

$$\therefore \text{given angle} = \frac{1}{3} \times 180^\circ = 60^\circ$$

$$(i) \text{ complement of the given angle} \\ = 90^\circ - 60^\circ = 30^\circ$$

$$(ii) \text{ Supplement of the given angle} \\ = 180^\circ - 60^\circ = 120^\circ$$