

EXERCISE 4

1. Write down the angles marked with letters. Write whether the angles are complimentary or supplementary?

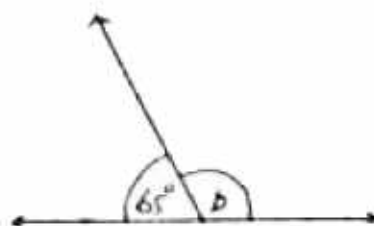
Sol:



(i)

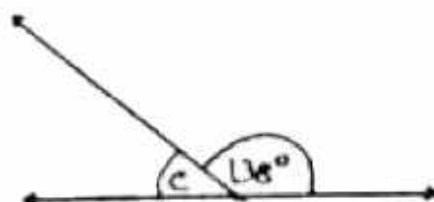
$$\begin{aligned} \text{(i)} \quad m\angle a + 50^\circ &= 180^\circ \\ m\angle a &= 180^\circ - 50^\circ \\ m\angle a &= 130^\circ \end{aligned}$$

(Supplementary angles)



$$\begin{aligned} \text{(ii)} \quad m\angle b + 65^\circ &= 180^\circ \\ m\angle b &= 180^\circ - 65^\circ \\ m\angle b &= 115^\circ \end{aligned}$$

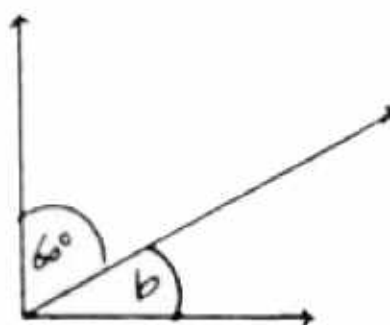
(Supplementary angles)



(iii)

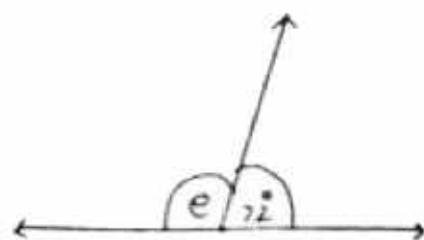
$$\begin{aligned} \text{(iii)} \quad m\angle c + 138^\circ &= 180^\circ \\ m\angle c &= 180^\circ - 138^\circ \\ m\angle c &= 42^\circ \end{aligned}$$

(Supplementary angles)



$$\begin{aligned} \text{(iv)} \quad m\angle b + 60^\circ &= 90^\circ \\ m\angle b &= 90^\circ - 60^\circ \\ m\angle b &= 30^\circ \end{aligned}$$

(Complementary angles)

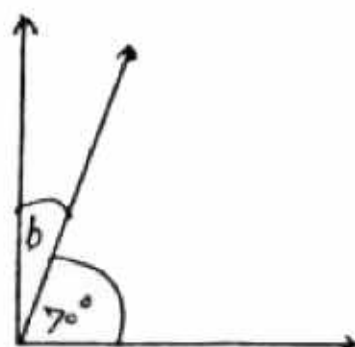


$$(v) \quad m\angle e + 72^\circ = 180^\circ$$

$$m\angle e = 180^\circ - 72^\circ$$

$$m\angle e = 108^\circ$$

(Supplementary angles)



$$(vi) \quad m\angle b + 70^\circ = 90^\circ$$

$$m\angle b = 90^\circ - 70^\circ$$

$$m\angle b = 20^\circ$$

(Complementary angles)

2. Two angles are supplementary and the greater exceeds the smaller by 30° . How many degrees are there in each angle?

Sol: The size of small angle = x

Let

The size of large angle = $x + 30^\circ$

According to statement

$$x + (x + 30^\circ) = 180^\circ$$

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

$$2x + 30^\circ = 180^\circ$$

$$2x = 180^\circ - 30^\circ$$

$$2x = 150^\circ$$

$$x = \frac{150^\circ}{2}$$

$$x = 75^\circ$$

The size of small angle = 75°

The size of large angle = $x + 30^\circ = 75^\circ + 30^\circ = 105^\circ$

angles = $75^\circ, 105^\circ$

3. If 40° is added to an angle, the resulting angle is equal to the supplement of the original angle. Find the original angle.

Sol: Let the required angle = x

size of the angle after adding = $x + 40^\circ$

The supplement of 1st angle = $180^\circ - x$

According to statement

$$x + 40^\circ = 180^\circ - x$$

$$x + x = 180^\circ - 40^\circ$$

$$2x = 140^\circ$$

$$x = \frac{140^\circ}{2}$$

$$x = 70^\circ$$

4. The sum of two angles is 100° , and the difference between their supplements is 100° . Find the angles.

Let the size of 1st angle = x°

The size of 2nd angle = $100^\circ - x^\circ$

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

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

$$= 180^\circ - 100^\circ + x^\circ$$

According to the statement

$$(180^\circ - 100^\circ + x^\circ) - (180^\circ - x^\circ) = 100^\circ$$

$$180^\circ - 100^\circ + x^\circ - 180^\circ + x^\circ = 100^\circ$$

$$2x^{\circ} - 100^{\circ} = 100^{\circ}$$

$$2x = 100^{\circ} + 100^{\circ}$$

$$2x = 200^{\circ}$$

$$x = \frac{200^{\circ}}{2}$$

$$x = 100^{\circ}$$

The size of 1st angle = 100°

$$\begin{aligned}\text{The size of 2nd angle} &= 100^{\circ} - 100^{\circ} \\ &= 0^{\circ}\end{aligned}$$

5. The sum of two angles is 100° , the supplement of the first angle exceeds the supplement of the second angle 40° . Find the angles.

Sol: Let the size of 1st angle = x°

The size of 2nd angle = $100^{\circ} - x^{\circ}$

The supplement of 1st angle = $180^{\circ} - x^{\circ}$

$$\begin{aligned}\text{The supplement of 2nd angle} &= 180^{\circ} - (100^{\circ} - x) \\ &= 180^{\circ} - 100^{\circ} + x^{\circ} \\ &= 80^{\circ} + x^{\circ}\end{aligned}$$

According to the statement

$$180^{\circ} - x^{\circ} - 40^{\circ} = 80^{\circ} + x^{\circ}$$

$$-x^{\circ} - x^{\circ} = 80^{\circ} + 40^{\circ} - 180^{\circ}$$

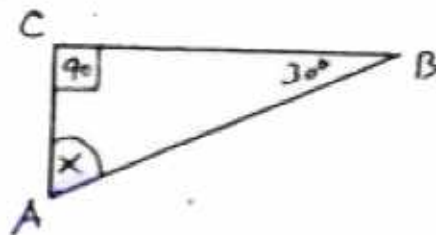
$$-2x^{\circ} = -60^{\circ}$$

$$x^{\circ} = 30^{\circ}$$

$$\text{1st angle} = 30^{\circ}$$

$$\begin{aligned}\text{2nd angle} &= 100^{\circ} - 30^{\circ} \\ &= 70^{\circ}\end{aligned}$$

6. Write the equation for the given triangle and solve it.



Sol: The sum of angles of any triangles = 180°

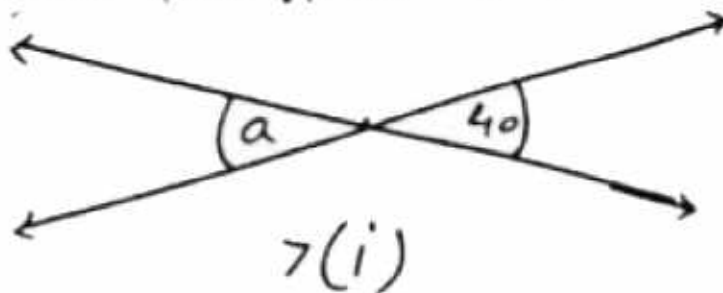
$$\begin{aligned}\text{The sum of angles of } \triangle ABC &= x + 90^{\circ} + 30^{\circ} \\ &= x + 120^{\circ}\end{aligned}$$

According to the statement

$$\begin{aligned}x + 120^{\circ} &= 180^{\circ} \\ x &= 180^{\circ} - 120^{\circ} \\ x &= 60^{\circ}\end{aligned}$$

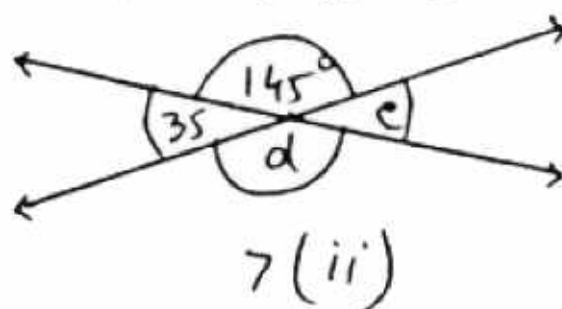
7. Write down the angles marked with letters.

- 7(i) $m\angle a = 40^{\circ}$ (vertically opp. angles)



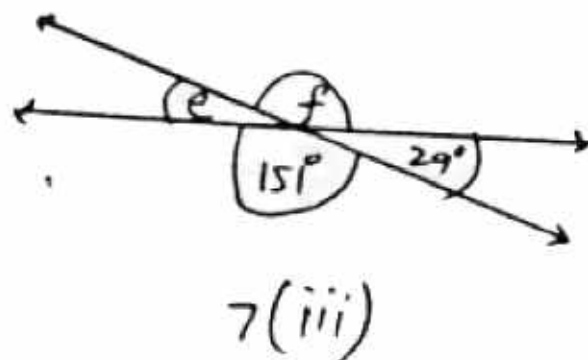
7(ii) $m\angle c = 35^\circ$ (vertically opp. angles)

$m\angle d = 145^\circ$ (vertically opp. angles)

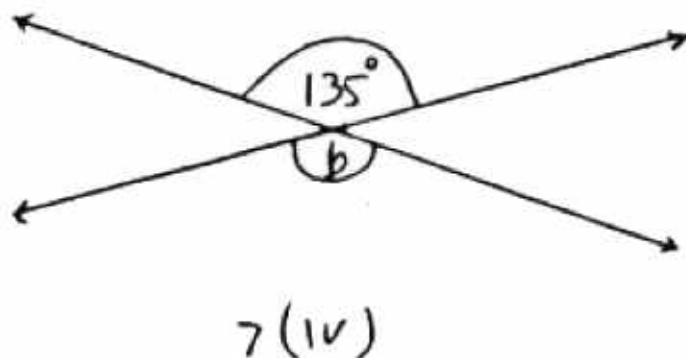


7(iii) $m\angle e = 29^\circ$ (vertically opp. angles)

$m\angle f = 151^\circ$ (vertically opp. angles)



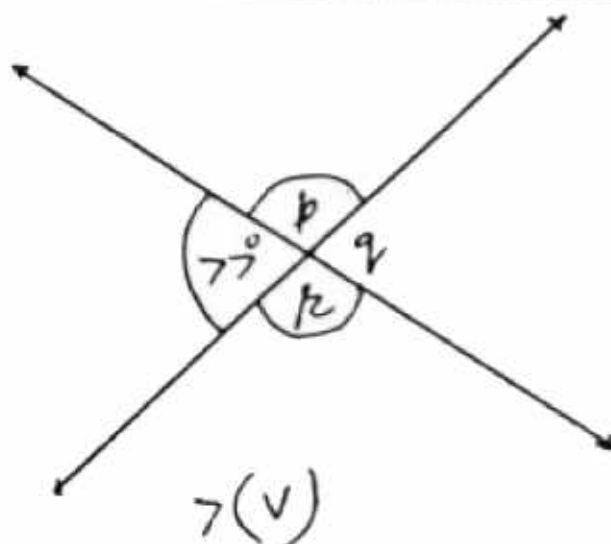
7(iv) $m\angle b = 135^\circ$ (vertically opp. angles)



7(v) $m\angle q = 70^\circ$ (vertically opp. angles)

$m\angle p = 180 - 77^\circ$ (supplementary angles)

$= 103^\circ$



(vertically opp. angles) $m\angle r = m\angle p$

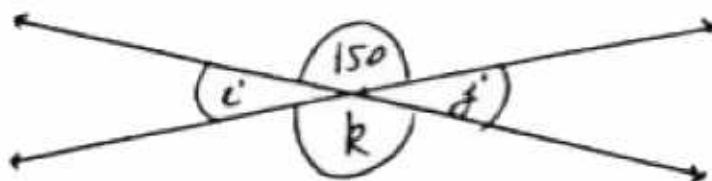
$$\hookrightarrow \text{(i)} \quad = 103^\circ$$

7(vi)

(vertically opp. angles) $m\angle k = 150^\circ$

(supplementary angles) $m\angle i + 150^\circ = 180^\circ$

$$m\angle i = 180^\circ - 150^\circ$$



7(vi)

$$m\angle i = 30^\circ \quad \text{(i)}$$

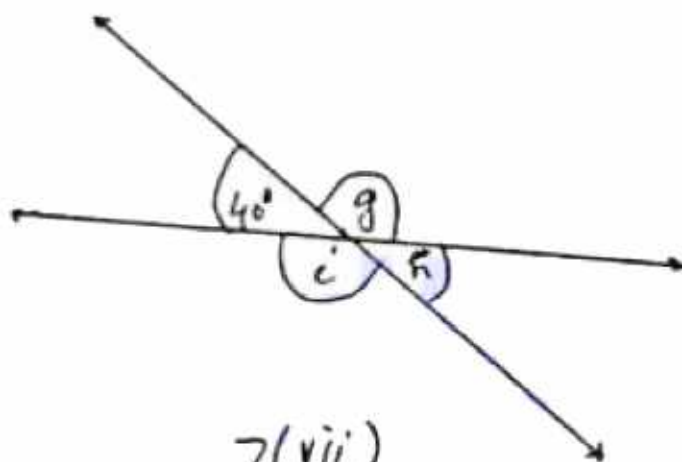
(vertically opp. angles) $m\angle j = m\angle i$ and

$$\text{from (i)} \quad m\angle j = 30^\circ$$

7(vii)

(vertically opp. angles) $m\angle h = 40''$ (supplementary angles) $m\angle 40 + \angle g = 180''$

$$m\angle g = 180'' - 40$$



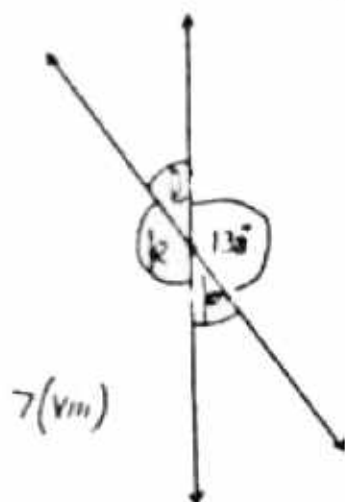
$$m\angle g = 140'' \quad (i)$$

(vertically opp. angles) $m\angle i = m\angle g$ and

$$\text{from (i)} \quad = 140''$$

(vertically opp. angles) $m\angle k = 138''$ 7(viii)(supplementary angles) $m\angle p + 138'' = 180''$

$$m\angle p = 180'' - 138''$$



$$m\angle p = 42'' \quad (i)$$

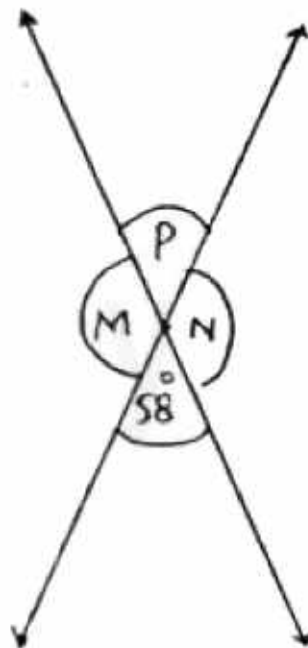
(vertically opp. angles) $m\angle l = m\angle p$ and

$$\text{from (i)} \quad m\angle l = 42''$$

(vertically opp. angles) $m\angle P = 58''$ 7(ix)

(supplementary angles) $m\angle N + 58'' = 180''$

$$m\angle N = 180'' - 58$$



$$m\angle N = 122'' \quad (i)$$

(vertically opp. angles) $m\angle M = m\angle N$ and

$$\text{from (i)} \quad = 122''$$

7(x)



(supplementary angles) $m\angle a + 22^\circ = 180^\circ$

$$m\angle a = 180^\circ - 22^\circ$$

$$m\angle a = 158^\circ$$

(supplementary angles) $m\angle b + 68^\circ = 180^\circ$

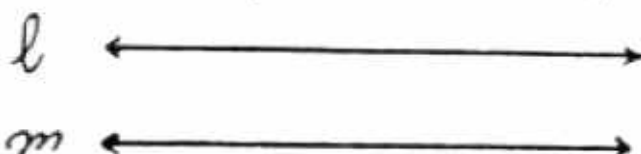
$$m\angle b = 180^\circ - 68^\circ$$

$$m\angle b = 112^\circ$$

(i) **PARALLEL LINES**

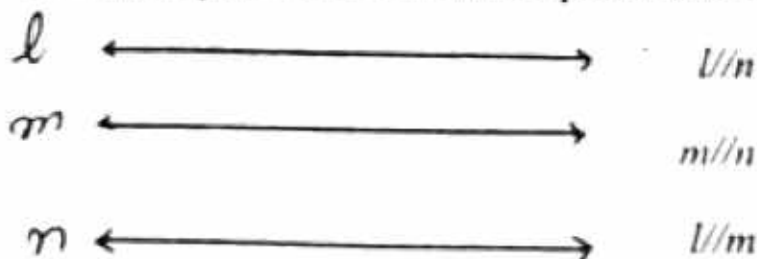
Parallel lines are two straight lines in the same plane which never meet.

The lines a and b are parallel, we write $a \parallel b$.



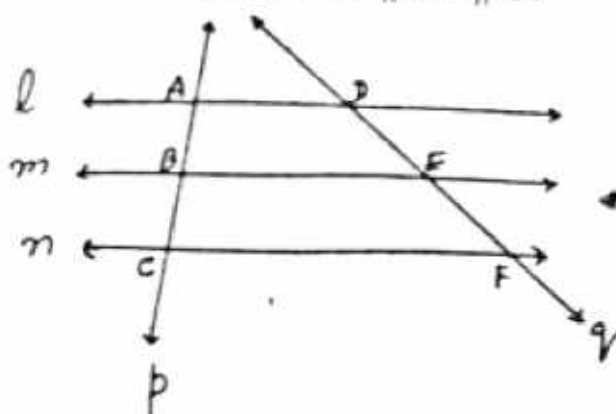
(ii) **Properties of Parallel Lines**

(a) Two lines parallel to a third are parallel to each other.

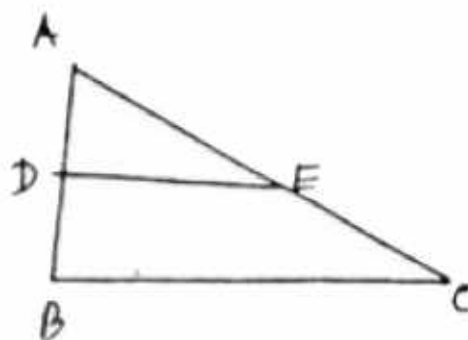


(b) If three parallel lines are intercepted by two transversals in such a way that the two intercepts on one transversal are equal to each other, the two intercepts on the second transversal are also equal.

i.e. if $\overline{AD} \parallel \overline{BE} \parallel \overline{CF}$



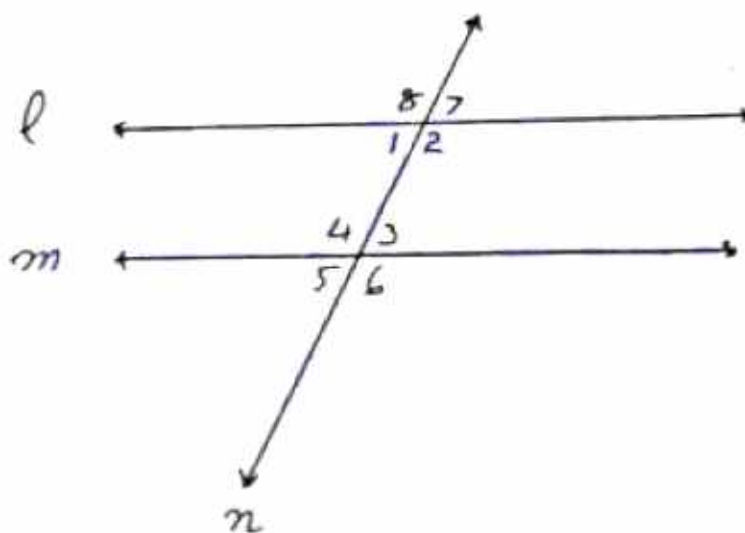
(c) If a line bisects one side of a triangle and is parallel to a second side, then it bisects the third side.



i.e. if $\triangle ABC$ with $\overline{BD} \cong \overline{DA}$, $\overline{DE} \parallel \overline{BC}$ then $\overline{AE} \cong \overline{CE}$

Transversal

A transversal is a line that intersects two lines in different points.



If a transversal "t" intersects two parallel lines a and b, the angles formed are identified as follows:

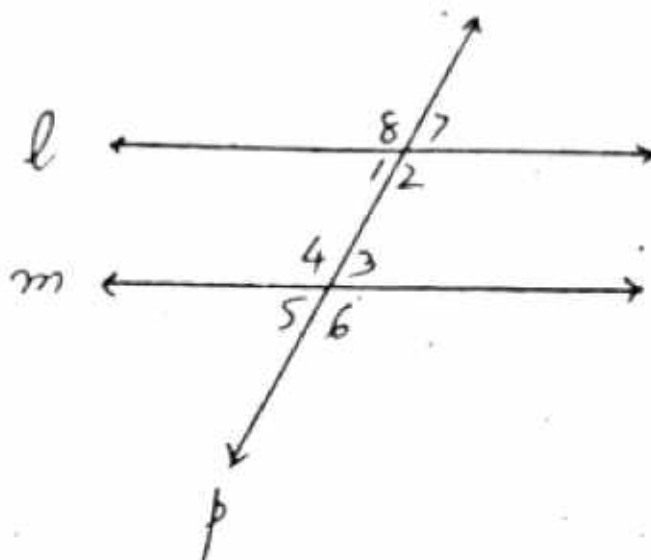
1. Four interior angles : $\angle 1, \angle 2, \angle 3, \angle 4$
2. Four exterior angles : $\angle 5, \angle 6, \angle 7, \angle 8$
3. Two pairs of alternate interior angles $\angle 1$ and $\angle 3$; and $\angle 4$
4. Two pairs of alternate exterior angles $\angle 5$ and $\angle 7$; $\angle 6$ and $\angle 8$
5. Two pairs of interior angles on the same side of the transversal: $\angle 2$ and $\angle 3$; $\angle 1$ and $\angle 4$.
6. Four pairs of corresponding angles: $\angle 3$ and $\angle 7$; $\angle 4$ and $\angle 8$; $\angle 2$ and $\angle 6$; $\angle 1$ and $\angle 5$.

Relation Between the Pairs of Angles

If two parallel lines are cut by a transversal, the corresponding angles are equal.

$$[\angle 1 = \angle 2, \angle 2 = \angle 3, \angle 1 = \angle 3]$$

- d) If two parallel lines are cut by a transversal, the alternate interior angles are equal.



$a \parallel b$, lines a and b are cut by the transversal c at point M and N to form the pairs of alternate interior angles.

$(\angle 1, \angle 2)$ and $(\angle 3, \angle 4)$

$$\angle 1 = \angle 2, \angle 3 = \angle 4$$

- e) If two parallel lines are intercepted by a transversal, then pairs of interior angles on the same side of transversal are supplementary.

$AB \parallel CD$, lines are cut by the transversal t , angles a, b, c and d are formed.

(i) $m\angle 2 = m\angle 4$

$$m\angle 1 = m\angle 3$$

(ii) $m\angle 3 = m\angle 7$

$$m\angle 4 = m\angle 8$$

$$m\angle 6 = m\angle 2$$

$$m\angle 5 = m\angle 1$$

(iii) $m\angle 7 = m\angle 5$

$$m\angle 6 = m\angle 8$$

(iv) $m\angle 2 + m\angle 3 = 180^\circ$

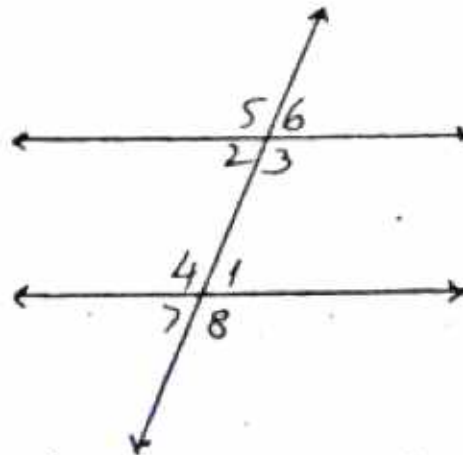
$$m\angle 1 + m\angle 4 = 180^\circ$$

(v) $m\angle 5 + m\angle 8 = 180^\circ$

$$m\angle 6 + m\angle 7 = 180^\circ$$

Exercise 2.1

1. Look at the given figure and answer the following questions.



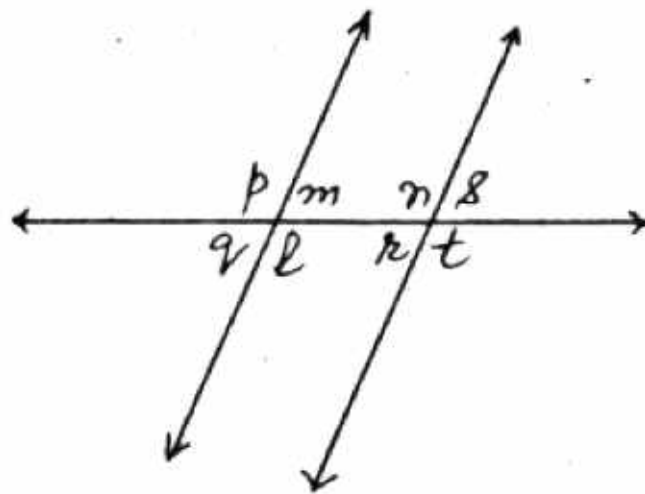
- (a) The pair of alternative angles
- (b) The pair of corresponding angles
- (c) The pair of complementary angles
- (d) The pair of supplementary angles
- (e) The pair of vertical angles

Answers:

- a) The pair of alternative interior angles: $(\angle 1, \angle 2)$ and $(\angle 3, \angle 4)$
- b) The pair of corresponding angles:
 $\angle 1, \angle 6; \angle 3, \angle 8; \angle 2, \angle 7; \angle 5, \angle 4$
- c) The pair of complementary angles: No one
- d) The pair of supplementary angles:
 $(\angle 4, \angle 1); (\angle 4, \angle 7); (\angle 7, \angle 8); (\angle 8, \angle 1)$
 $(\angle 5, \angle 6); (\angle 5, \angle 2); (\angle 2, \angle 3); (\angle 3, \angle 6)$
- e) The pair of vertical angles:

$(\angle 5, \angle 3); (\angle 6, \angle 2); (\angle 4, \angle 6); (\angle 1, \angle 7)$

2. Look at the given figure and answer the following questions.



- (a) The pair of alternative interior angles
- (b) The pair of corresponding angles
- (c) The pair of complementary angles
- (d) The pair of supplementary angles
- (e) The pair of vertical angles

Answers:

The alternate interior angles : $(\angle n, \angle l), (\angle m, \angle r)$

The corresponding angles:

$(\angle p, \angle n); (\angle m, \angle s); (\angle q, \angle r); (\angle l, \angle t)$

The complementary angles: No one

The supplementary angles:

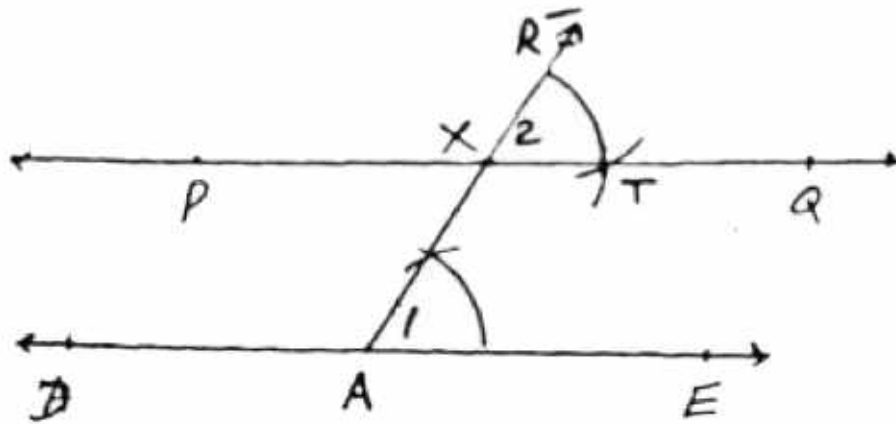
$(\angle p, \angle m); (\angle p, \angle q); (\angle q, \angle l); (\angle l, \angle m)$

$(\angle n, \angle s); (\angle n, \angle r); (\angle r, \angle t); (\angle t, \angle s)$

The vertical angles: $(\angle p, \angle l); (\angle m, \angle q); (\angle n, \angle t); (\angle r, \angle s)$

3. Take a point 'X' outside a line $\overleftrightarrow{DE}$. Draw a line through

'X' which cuts $\overleftrightarrow{DE}$ at some point. Making corresponding angles congruent draw a line parallel to $\overleftrightarrow{DE}$.



Steps of Construction:

- (i) Draw a line $\overleftrightarrow{DE}$.
- (ii) Take any point "X" which lay outside of $\overleftrightarrow{DE}$.
- (iii) Take any point "A" on $\overleftrightarrow{DE}$.
- (iv) Join "A" with "X" then extend it
- (v) Draw corresponding angles $\angle 1$ & $\angle 2$ with the help of compasses.
- (vi) Extend $\overleftrightarrow{AX}$ on both sides.

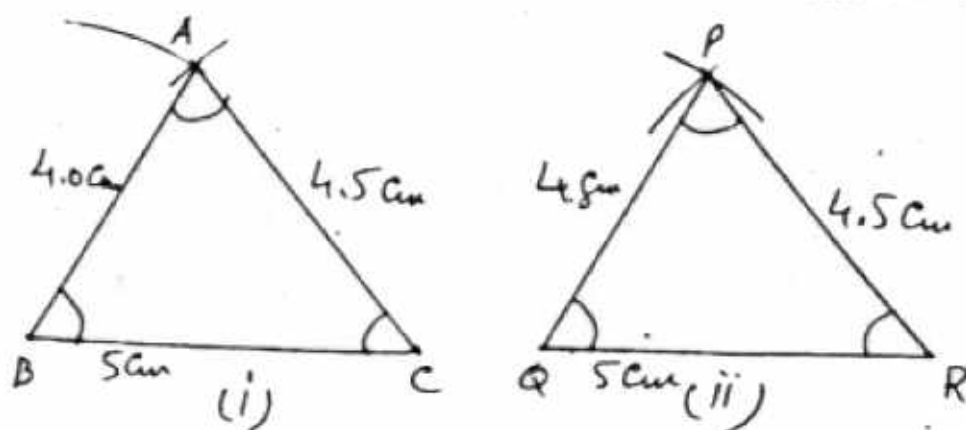
$\overleftrightarrow{PQ} \parallel \overleftrightarrow{DE}$ which passes through X.

CONGRUENT AND SIMILAR FIGURES

Congruent Figures

The word congruent comes from Latin meaning "together agree". Two geometrical figures which have the same size and shape are congruent.

One figure is congruent to the other. The symbol for congruent is $\cong$. Thus two segments are congruent when they have the same size.



In figure (i) and (ii)

$$m\overline{AB} = m\overline{PQ}$$

$$m\overline{BC} = m\overline{QR}$$

$$m\overline{CA} = m\overline{RP}$$

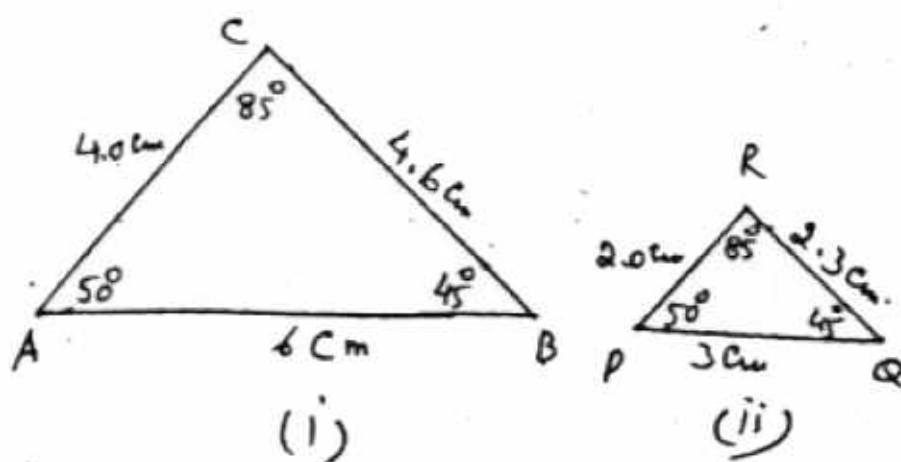
$$m\angle B = m\angle Q$$

$$m\angle C = m\angle R$$

$$m\angle A = m\angle P$$

Similar Figures

In the polygons below, the members of each pair are similar to each other.



In figure (i) and (ii)

$$m\angle A = 50^\circ, \quad m\angle P = 50^\circ$$

$$m\angle B = 45^\circ, \quad m\angle Q = 45^\circ$$

$$m\angle C = 85^\circ, \quad m\angle R = 85^\circ$$

$$\frac{m\overline{AC}}{m\overline{PR}} = \frac{4}{2} = \frac{2}{1}$$

$$\frac{m\overline{AB}}{m\overline{PQ}} = \frac{6}{3} = \frac{2}{1}$$

$$\frac{m\overline{BC}}{m\overline{QR}} = \frac{4.6}{2.3} = \frac{2}{1}$$

Exercise 14.4

Tell Whether or not the Figures in Question 1-3 are Similar:

1. All squares; Yes
all rectangles; No
all regular hexagons. Yes
2. Two rectangles with sides 8, 12, 10 and 15.

Ans. These are similar figures

$$\frac{10}{15} = \frac{8}{12}$$

$$\frac{2}{3} = \frac{2}{3}$$

3. Two rhombuses with angles of 55° and 125° .

Ans. These are similar figures because the four.

4. The sides of a polygon are 5cm, 6cm, 7cm, 8cm, and 9cm. In a similar polygon the sides corresponding to 6cm is 12cm. Find the other sides of the second polygon.

Ans. According to the given condition the ratio among

corresponding sides is $\frac{6}{12} = \frac{1}{2}$.

$$\frac{6}{12} = \frac{1}{2} = \frac{7}{a} = \frac{8}{b} = \frac{5}{c} = \frac{4}{d} = \frac{9}{e}$$

$$\frac{7}{a} = \frac{1}{2} \Rightarrow a = 7 \times 2 = 14 \text{ cm}$$

$$\frac{8}{b} = \frac{1}{2} \Rightarrow b = 8 \times 2 = 16 \text{ cm}$$

$$\frac{5}{c} = \frac{1}{2} \Rightarrow c = 5 \times 2 = 10 \text{ cm}$$

$$\frac{4}{d} = \frac{1}{2} \Rightarrow d = 4 \times 2 = 8 \text{ cm}$$

$$\frac{9}{e} = \frac{1}{2} \Rightarrow e = 9 \times 2 = 18 \text{ cm}$$

5. The sides of a quadrilateral are 2cm, 4cm, 6cm, and 7cm. The longest side of a similar quadrilateral is 21cm. Find the other sides.

Ans. The longest side of quadrilateral is 7cm. Thus, the ratio between the biggest sides $\frac{7}{21} = \frac{1}{3}$.

According to the statement the ratio between the corresponding sides is $\frac{1}{3}$.

$$\frac{1}{3} = \frac{6}{a} = \frac{5}{b} = \frac{4}{c} = \frac{2}{d}$$

Thus

$$\frac{6}{a} = \frac{1}{3} \Rightarrow a = 6 \times 3 = 18 \text{ cm} \quad \text{therefore}$$

$$\frac{5}{b} = \frac{1}{3} \Rightarrow b = 5 \times 3 = 15 \text{ cm}$$

$$\frac{4}{c} = \frac{1}{3} \Rightarrow c = 4 \times 3 = 12 \text{ cm}$$

$$\frac{2}{d} = \frac{1}{3} \Rightarrow d = 2 \times 3 = 6 \text{ cm}$$

While a, b, c, d are the rest sides of quadrilateral.

6. The sides of a polygon are 5cm, 2cm, 7cm, 3cm, 4cm. Find the sides of a similar polygon whose side corresponding to 2cm is 6cm. What is the ratio of the perimeters of these two polygons?

Sol: According to the statement the ratio between the correspondign sides is $\frac{2}{6} = \frac{1}{3}$.

$$\frac{1}{3} = \frac{5}{a} = \frac{7}{b} = \frac{3}{c} = \frac{4}{d} \quad \text{thus}$$

$$\frac{5}{a} = \frac{1}{3} \Rightarrow a = 5 \times 3 = 15 \text{ cm}$$

$$\frac{7}{b} = \frac{1}{3} \Rightarrow b = 7 \times 3 = 21 \text{ cm}$$

$$\frac{3}{c} = \frac{1}{3} \Rightarrow c = 3 \times 3 = 9 \text{ cm}$$

$$\frac{4}{d} = \frac{1}{3} \Rightarrow d = 4 \times 3 = 12 \text{ cm}$$

While a, b, c, d are the rest sides of polygon.

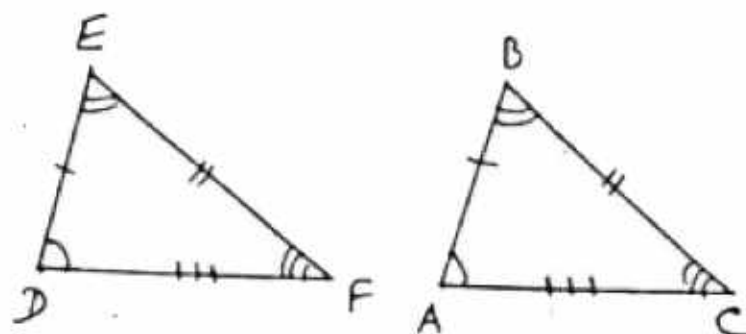
$$\begin{aligned} \text{The perimeter of 1st polygon} &= 5 + 2 + 7 + 3 + 4 \\ &= 21 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{The perimeter of 2nd polygon} &= 15 + 21 + 9 + 12 + 6 \\ &= 63 \text{ cm} \end{aligned}$$

$$\text{The ratio between the perimeter} = \frac{21}{63} = \frac{1}{3} \quad \downarrow \quad 1 : 3$$

7. What are the congruent pairs of corresponding sides and

corresponding angles?



$$\begin{array}{l|l} \overline{AB} \cong \overline{DE} & \angle A \cong \angle D \\ \overline{AC} \cong \overline{DF} & \angle B \cong \angle E \\ \overline{BC} \cong \overline{FE} & \angle C \cong \angle F \end{array}$$

8. Are all similar figures congruent? Explain why?

Sol: All similar figures are equal in size and shape.
Therefore, similar figures are congruent.

9. Are all congruent figures similar? Explain why?

Sol: All congruent figures have same shape but differ in size.
Therefore, congruent figures are not similar.

Exercise 7.4

1. Fill in the blanks.

(a) If $\triangle ABC \cong \triangle FDE$, then

(i) $\overline{AB} =$ _____ (ii) $\overline{BC} =$ _____

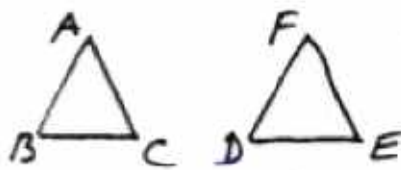
(iii) $\overline{AC} =$ _____ (iv) $m\angle A =$ _____

(v) $m\angle B =$ _____ (vi) $m\angle C =$ _____

(b) In $\triangle PQR$, the angle included between side PR and QR is _____

- (c) In , the side included between $\angle E$ and $\angle F$ is _____
- (d) $\because \overline{AB} = \overline{QP}, m\angle B = m\angle P, \overline{BC} = \overline{PR}$, then by _____
condition, $\triangle ABC \cong \triangle QPR$
- (e) If $m\angle A = m\angle R, m\angle B = m\angle P, \overline{AB} = \overline{RP}$ then by _____
congruence condition, $\triangle ABC \cong \triangle RPQ$.

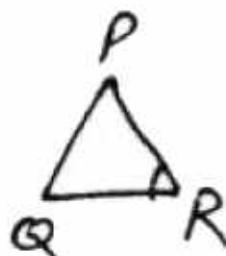
Answers:



(a)

- (i) $\overline{AB} \cong \overline{FD}$ (ii) $\overline{BC} \cong \overline{DE}$
 (iii) $\overline{AC} \cong \overline{FE}$ (iv) $\angle A \cong \angle F$
 (v) $\angle B \cong \angle D$ (vi) $\angle C \cong \angle E$

mid angle $\angle R$



(b)

mid side $\overline{FE}$

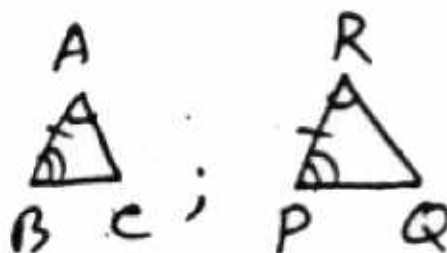


(c)

$$m\angle A = m\angle R$$

$$m\angle B = m\angle P$$

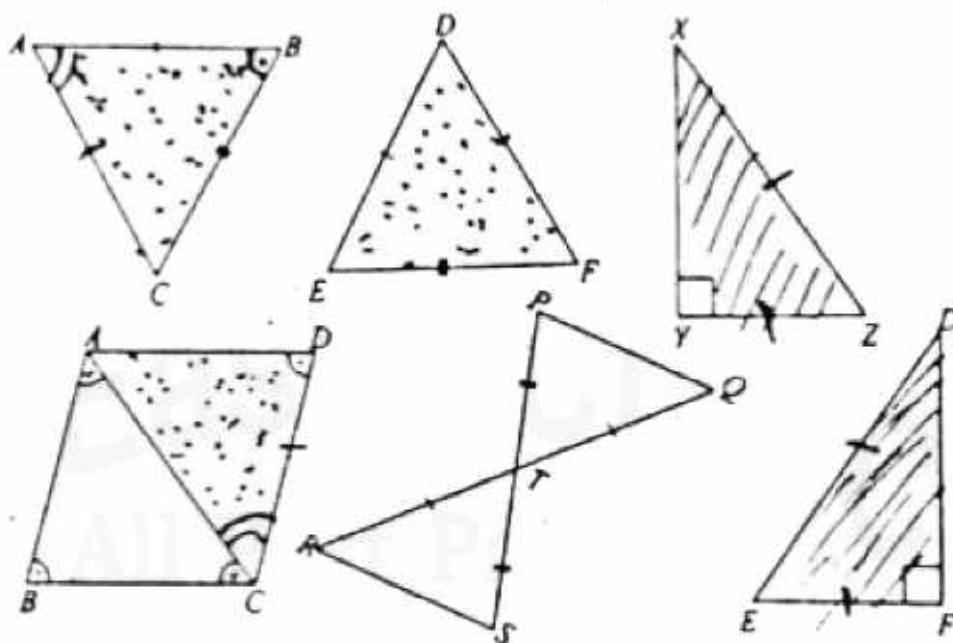
$$\overline{AB} = \overline{RP}$$



(d)

$$\triangle ABC \cong \triangle RPQ \quad \text{ASA} \cong \text{ASA}$$

2. In figure, the pairs of corresponding equal parts in a pair of triangles are shown with similar markings. Specify the two triangles which become congruent. Also, write the congruence of two triangles in symbolic form.



Sol:

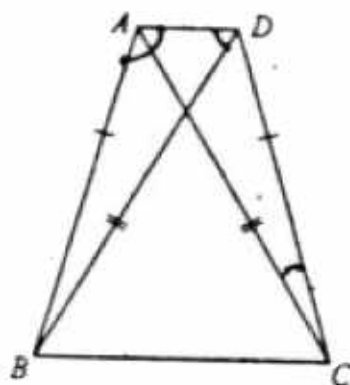
- (i) $\triangle ABC \cong \triangle DEF$ $SSS \cong SSS$
- (ii) $\triangle XYZ \cong \triangle DFE$ $RHS \cong RHS$
- (iii) $\triangle ABC \cong \triangle CDA$ $ASA \cong ASA$
- (iv) $\triangle PQT \cong \triangle SRT$ $SAS \cong SAS$

3. In figure, ABC and DBC are two triangles on a common base $\overline{BC}$ such that $\overline{AB} = \overline{DC}$ and , where A and D lie on the same side of BC . In $\triangle ADB$ and $\triangle DAC$, state the corresponding parts so that $\triangle ADB \cong \triangle DAC$.

Which condition do you use to establish the congruence?

If $m\angle DCA = 40^\circ$ and $m\angle BAD = 100^\circ$,

Find $\angle ADB$.



Sol: Now $\triangle ABC$ and $\triangle DCB$

common $\overline{BC} \cong \overline{CB}$

given $\begin{cases} \overline{AB} \cong \overline{DC} \\ \overline{AC} \cong \overline{DB} \end{cases}$

Now $\triangle ADB$ and $\triangle DAC$

$\overline{DA} \cong \overline{AD}$

$\overline{DB} \cong \overline{AC}$

$\overline{BA} \cong \overline{CD}$

$\triangle ADB \cong \triangle DAC$

SSS $\cong$ SSS

$m\angle DCA = 40^\circ$ now

$m\angle BAD = 100^\circ$ and

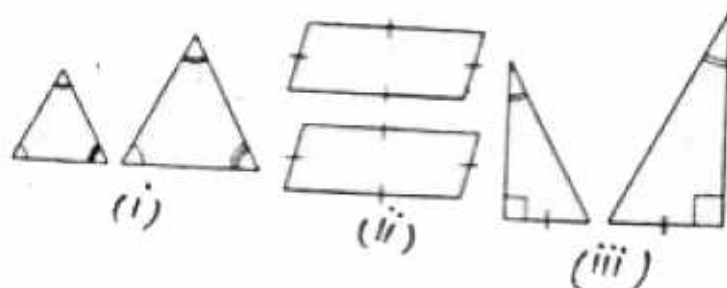
$m\angle ABD = 40^\circ$ therefore

$m\angle ADB = 180^\circ - 100^\circ - 40^\circ$

$= 180^\circ - 140^\circ$

$= 40^\circ$

4. Identify the following figure as congruent, similar or neither.

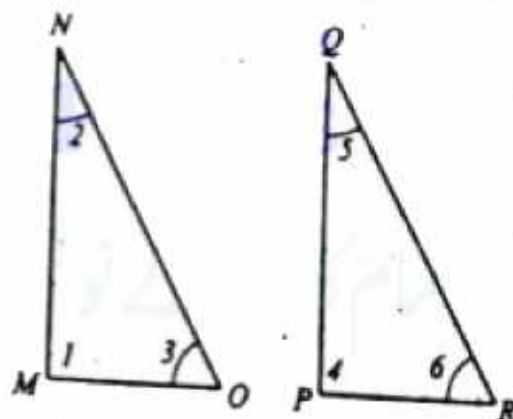


Sol: (i) congruent (ii) congruent
(iii) congruent

No one is similar

5. Identify the corresponding parts in $\triangle MNO$ and $\triangle PQR$.

- (i) $\overline{MN} \leftrightarrow$
(ii) $\overline{NO} \leftrightarrow$
(iii) $\overline{PR} \leftrightarrow$
(iv) $\angle$ $\leftrightarrow$

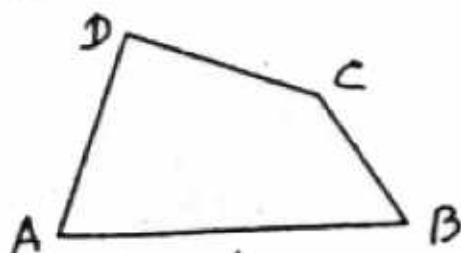


Answers:

- (i) $\overline{MN} \leftrightarrow \overline{PQ}$
(ii) $\overline{NO} \leftrightarrow \overline{QR}$
(iii) $\overline{PR} \leftrightarrow \overline{MO}$
(iv) $\angle 1 \leftrightarrow \angle 4$

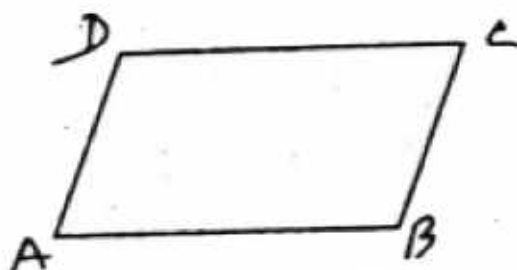
Quadrilaterals:

A quadrilateral is a polygon with four sides.



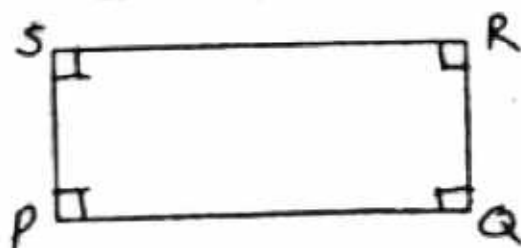
Parallelogram:

A parallelogram is a quadrilateral with two pairs of parallel sides.



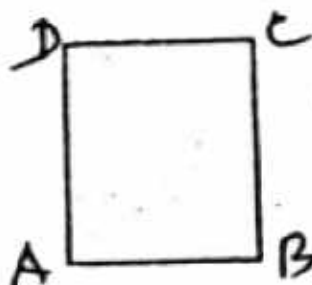
Rectangle

A rectangle is a parallelogram containing a right angle.



Square

A square is an equilateral rectangle.

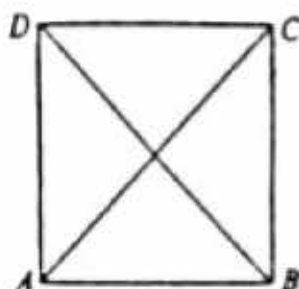


Properties of Congruency

Four Sides of a Square are Equal

ABCD is a square. Measure $\overline{AB}$, $\overline{BC}$, $\overline{CD}$ and $\overline{DA}$. We find that.

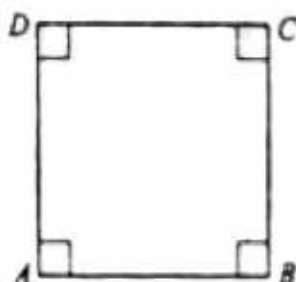
$$m\overline{AB} = m\overline{BC} = m\overline{CD} = m\overline{DA} = 2.8\text{cm.}$$



Four Angles of a Square are Right Angles

ABCD is a square. Measure angle A, B, C, D with protractor. We find that

$$m\angle A = m\angle B = m\angle C = m\angle D = 90^\circ$$

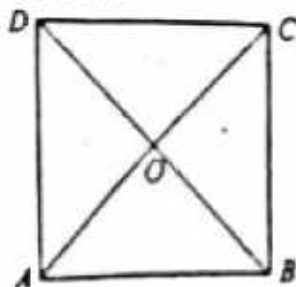


Diagonals of a Square Bisect Each Other:

Consider a square ABCD, the diagonals and intersect at 'O'. We find that

$$m\overline{OA} = m\overline{OC} = 1.9\text{cm and}$$

$$m\overline{OB} = m\overline{OD} = 1.9\text{cm}$$



7.5.2 Opposite Sides of a Rectangle are Equal

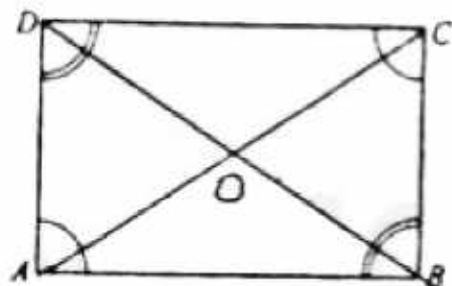
Consider Rectangle

Let us consider a rectangle $ABCD$.

$\overline{AB}, \overline{CD}$ and $\overline{AD}, \overline{BC}$ are opposite pairs of rectangle $ABCD$.

We find that $m\overline{AB} = m\overline{CD} = 4.5\text{cm}$ and

$m\overline{AD} = m\overline{BC} = 2.8\text{cm}$



$$m\overline{AB} = m\overline{DC} \quad (i)$$

$$m\overline{AD} = m\overline{BC} \text{ and}$$

$$m\angle A = m\angle B = m\angle C = m\angle D = 90^\circ \quad (ii)$$

$$(iii)$$

$$m\overline{OA} = m\overline{OC},$$

$$m\overline{OB} = m\overline{OD}$$

$$m\overline{OA} = m\overline{OC} = m\overline{OB} = m\overline{OD}$$

Properties of Parallelogram

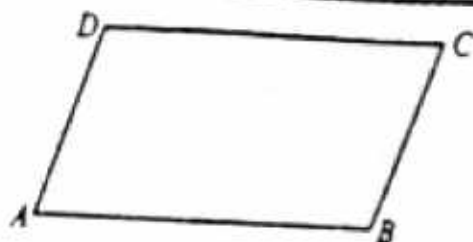
► **The opposite sides of a parallelogram are equal.**

$ABCD$ is a parallelogram. $\overline{AB}, \overline{CD}$ and $\overline{AD}, \overline{BC}$ are pairs of opposite sides.

We find that

$$m\overline{AB} = m\overline{CD} = 3.9\text{cm} \quad \text{and}$$

$$m\overline{AD} = m\overline{BC} = 2.0\text{cm}$$



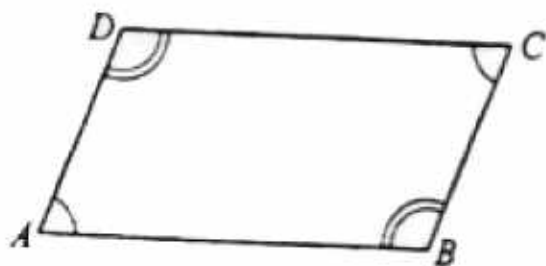
- *The opposite angles of a parallelogram are equal.*

$ABCD$ is a parallelogram. $\angle A, \angle C$ and $\angle B, \angle D$ are pairs of opposite angles.

We find that

$$m\angle A = m\angle C = 70^\circ \text{ and}$$

$$m\angle B = m\angle D = 110^\circ$$

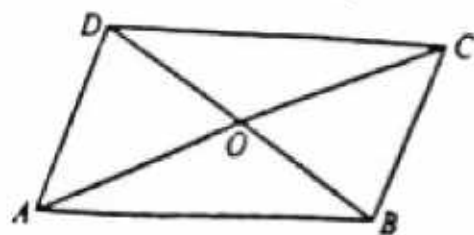


- *The diagonals of a parallelogram bisect each other.*

A parallelogram $ABCD$, the diagonals $\overline{AC}$ and $\overline{BD}$ intersect at O . We find that

$$m\overline{OA} = m\overline{OC} = 2.5\text{cm}$$

and $m\overline{OD} = m\overline{OB} = 2.5\text{cm}$



Exercise 2.5

I. Fill in the blanks:

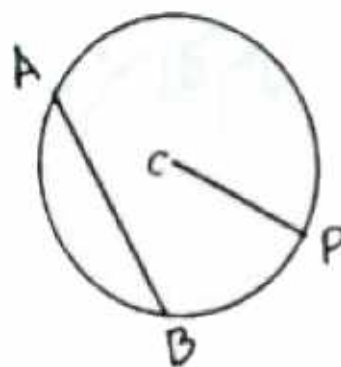
- (i) A parallelogram that contains a right angle is _____.
- (ii) An equilateral rectangle is a _____.
- (iii) A polygon with four sides is a _____.
- (iv) The diagonals of a parallelogram _____ each other.
- (v) The **opposite angles of a parallelogram are** _____.

Answers:

- | | | |
|---------------|---------------|---------------------|
| (i) Rectangle | (ii) Square | (iii) Quadrilateral |
| (iv) Bisect | (v) Congruent | |



A circle is the set of points in a plane which are at a constant distance from a fixed point in the plane.



Centre

The fixed point C is called the centre of the circle.

Radial Segment

P is any point on the circumference of the circle with centre O. $\overline{OP}$ is called the radial segment of the circle.

Radius

A radius of a circle is the length of a segment joining the centre to any point on the circle. In the given figure is $\overline{mC'P}$ the radius. Usually represented by 'r'.

Chord

A chord of a circle is a segment connecting any two points on the circle. In the given figure $\overline{AB}$ is a chord.

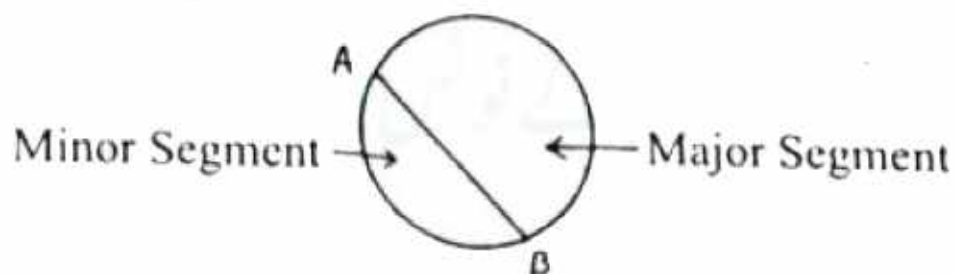
Segment of a Circle

A chord $\overline{AB}$ of a circle divides the circle in two parts.

These are called segment of the circle.

Minor Segment

The included area between minor arc and the chord is minor segment.



Major Segment

The included area between major arc and chord is called major segment.

Diameter

A diameter of a circle is a chord that passes through the centre. The length of a diameter of a circle is twice the length of the radius of the same circle.

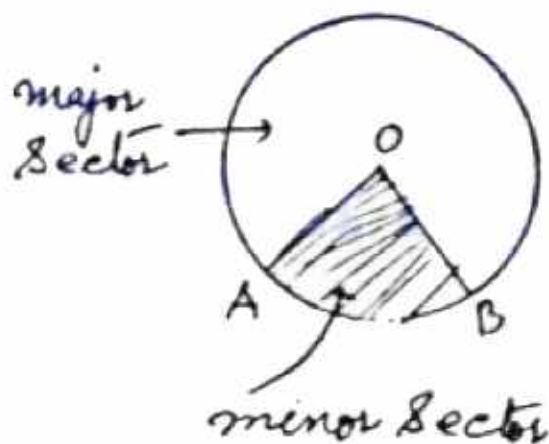
$$\text{Diameter} = 2 \times \text{radius}$$

Equal Circles

Equal circles are circles having equal radii or equal diameter

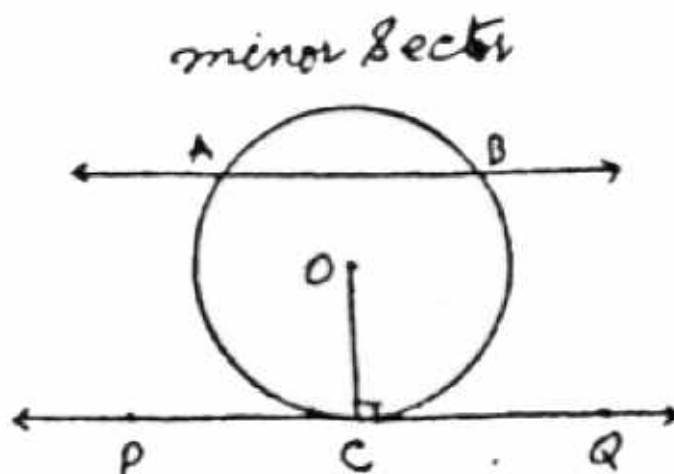
Sector

A sector is the circular region bounded by an arc of a circle and its two corresponding radial segments is called a sector of the circle. In the figure, region AOB is the sector of the circle with centre at O .



Secant

A secant is a line which intersects a circle in two points.



A tangent to a circle is the line perpendicular to radius of the circle at its outer extremity.

The point on the circle at which the radius and tangent meet is known as the Point of Contact or Point of Tangency.

Angle in a Semi-Circle is a Right Angle

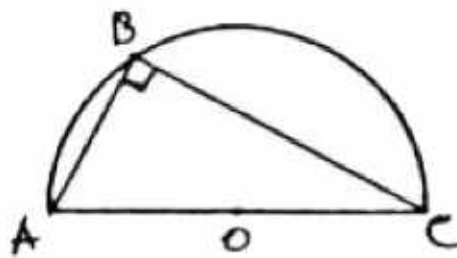
- 1- Draw a line-segment $\overline{AB}$ of any length. Mark the mid point of $\overline{AB}$ as O .
- 2- Draw a semi-circle on $\overline{AB}$ with radius $\overline{OA}$.
- 3- Take any point C on the semi-circle. Join A with C and B with C .

Thus, $\angle ACB$ is an angle in the semi-circle APB .

- 4- Now take a protractor and place it along $\overline{AC}$ so that the centre of the protractor falls on C .

We note that the measure of the $\angle ACB$ by looking at the marking on the protractor corresponding to arm $\overline{CB}$ of $m\angle ACB$ is of 90° , i.e. $m\angle ACB = 90^\circ$ or a right angle.

Thus, angle in a semi-circle is a right angle.



Angles in the Same Segment are Equal:

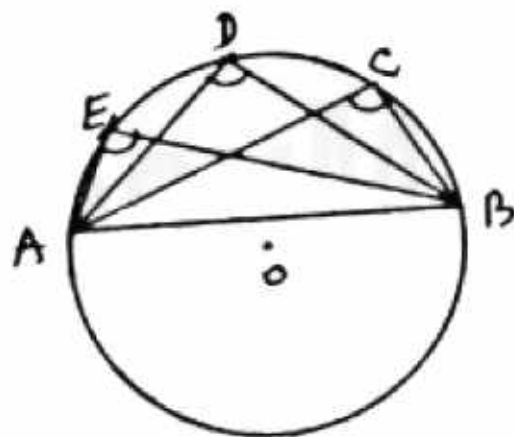
Draw a circle with centre ' O '. Take two points B and C on the circle and join them. $\overline{BC}$ divides the circle into two parts.

Draw angles, $\angle BAC$ and $\angle BDC$ in the same segment as shown in the figure. Take a sheet of tracing paper and

make a trace copy of $\angle BAC$. Place the trace copy of $\angle BAC$ on $\angle BDC$.

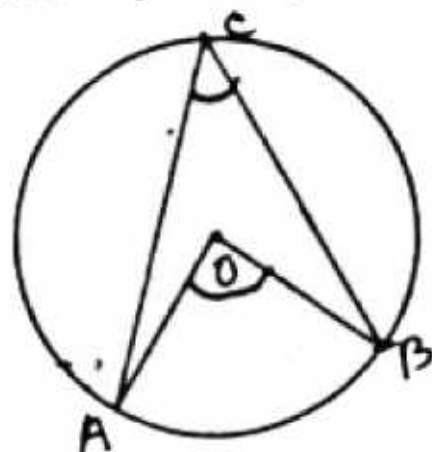
A falls on D and $\overline{AB}$ falls on $\overline{DC}$.

So that we observe that $\overline{BD}$ falls on $\overline{AC}$. Thus $\angle BAC = \angle BDC$, this shows that angles in the same segment are equal.

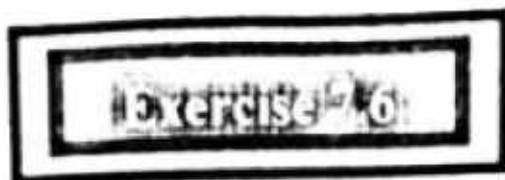


Central Angle

The central angle of a minor arc of a circle is double that the angle subtended by corresponding major arc.



$$m\angle AOB = m2\angle ACB$$



1- Fill in the blanks:

- (i) In a plane the set of points whose distance from a fixed point is same is called _____.
- (ii) The distance of a point of a circle from its centre is called _____.
- (iii) A line segment whose end points lie on the circle is called _____.
- (iv) A chord that passes through the centre of the circle is called _____.
- (v) Half of a circle is called _____.
- (vi) An arc which is greater than a semicircle is called _____.
- (vii) One and only one circle can be constructed with a given centre and given _____.
- (viii) A region bounded by an arc and two of its radial segments is called _____.
- (ix) A straight line that intersects a circle at two points is called _____.
- (x) Angle in a semi-circle is a _____.

Answers:

- | | |
|------------------|-----------------|
| (i) circle | (ii) radius |
| (iii) chord | (iv) diameter |
| (v) semicircle | (vi) major arc |
| (vii) radius | (viii) sector |
| (ix) secant line | (x) right angle |