Plane Geometry

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SECTION I LINES AND ANGLES

Line A geometrical straight line is a set of points that extends endlessly in both the directions.

Axiom-1 A line contains infinitely many points.

Axiom-2 Through a given point, infinitely many lines pass.

Axiom-3 Given two distinct points A and B, there is one and only one line that contains both the points.

Parallel Lines If two lines have no point in common, they are said to be *parallel lines*

Intersecting Lines If two lines have a point in common, they are said to be *intersecting lines*. Two lines can intersect at the most at one point.

Line Segment and Ray A part (or portion) of a line with two end points is called a *line segment* and a part of a line with one end point is called a *ray*. A line segment $\overline{AB}$ and its length is denoted as AB. Ray AB (i.e., A towards B) is denoted as $\vec{AB}$ and ray BA (i.e., B towards A) is denoted as $\vec{BA}$.

Collinear Points Three or more than three points are said to be *collinear* if there is a line which contains them all.

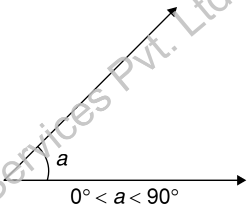
Concurrent Lines Three or more than three lines are said to be *concurrent* if there is a point which lies on all of them.

Angle An *angle* is a figure formed by two rays with a common initial point. The two rays forming an angle are called *arms* of the angle and the common initial point is called *vertex* of the angle.

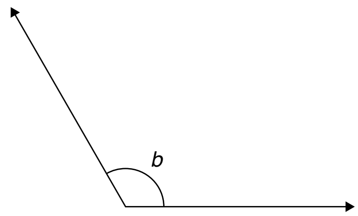
Types of Angles

An angle is said to be:

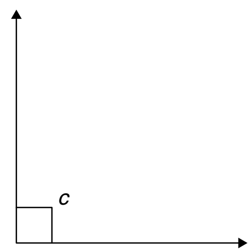
(i) *Acute*, if $a < 90°$.



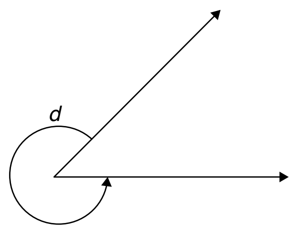
(ii) *Obtuse*, if $90° < b < 180°$.



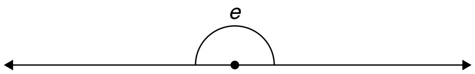
(iii) *Right angle*, if $c = 90°$



(iv) *Reflex angle*, if $180° < d < 360°$



(v) *Straight angle*, if $e = 180°$



(vi) *Complete angle*: An angle whose measure is 360º, is called a *complete angle*.

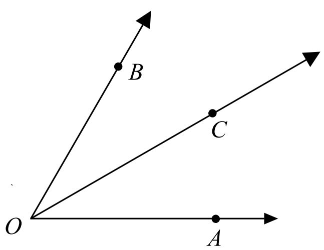
Complementary Angles Two angles, the sum of whose measures is 90º, are called *complementary angles,* e.g. 50º and 40º is a pair of complementary angles.

Supplementary Angles Two angles, the sum of whose measures is 180º, are called *supplementary angles*, e.g. 72º and 108º is a pair of supplementary angles.

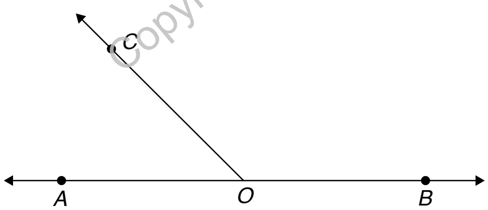
Adjacent Angles Two angles are called *adjacent angles* if

(i) they have the same vertex.
(ii) they have a common arm.
(iii) uncommon arms are on either side of the common arm.

E.g. $\angle AOC$ and $\angle BOC$ are adjacent angles.

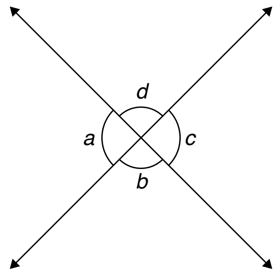


Linear Pair: Two adjacent angles are said to form a linear pair of angles if their non-common arms are two opposite rays.
E.g. $\angle AOC$ and $\angle BOC$ form a linear pair.



Linear Pair Axiom: If a ray stands on a line, then the sum of the two adjacent angles so formed is 180º. Conversely, if the sum of two adjacent angles is 180º; then the non-common arms of the angles are two opposite rays.

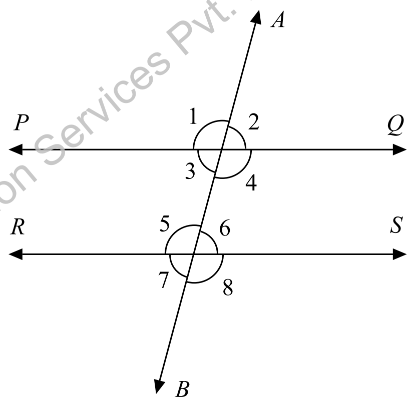
Vertically Opposite Angles: When two lines intersect, four angles are formed. The angles opposite to each other are called *vertically opposite angles*.



a and c are vertically opposite angles, $\angle a = \angle c$.

b and d are vertically opposite angles, $\angle b = \angle d$.

Angles made by a transversal* with two parallel lines Suppose $PQ \parallel RS$ and a transversal AB cuts them, then



(a) Pair of corresponding angles are
(1 and $\angle 5$), ($\angle 2$ and $\angle 6$),
($\angle 4$ and $\angle 8$) and ($\angle 3$ and $\angle 7$)
(b) Pair of alternate angles are
($\angle 3$ and $\angle 6$) and ($\angle 4$ and $\angle 5$)
(c) Pair of interior angles (consecutive interior angles or cointerior angles) on the same side of the transversal are
($\angle 3$ and $\angle 5$) and ($\angle 4$ and $\angle 6$)

Key Results to Remember

If two parallel lines are intersected by a transversal, then

(i) each pair of corresponding angles are equal.
(ii) each pair of alternate angles are equal.
(iii) interior angles on the same side of the transversal are supplementary.

Triangle A plane figure bounded by three lines in a plane is called a *triangle*.

*A line which intersects two or more lines at distinct points is called a transversal of the given lines.

SECTION 2 TRIANGLES

Types of Triangles (On the basis of sides)

Scalene triangle A triangle two of whose sides are equal is called a *scalene triangle*.

Isosceles triangle A triangle two of whose sides are equal in length is called an *isosceles triangle*.

Equilateral triangle A triangle all of whose sides are equal is called an *equilateral triangle*.

Types of Triangles (On the basis of angles)

Acute triangle A triangle, each of whose angle is acute, is called an *acute triangle* or *acute-angled triangle*.

Right triangle A triangle with one right angle is called a *right triangle* or a *right-angled triangle*.

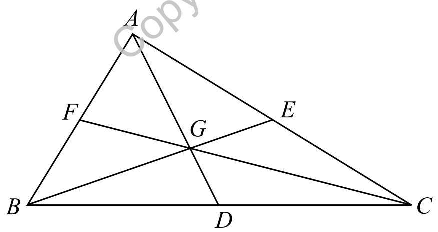
Obtuse triangle A triangle with one angle an obtuse angle, is known as *obtuse triangle* or *obtuse-angled triangle*.

Some Important Terms Related to a Triangle

1. **Median** The median of a triangle corresponding to any side is the line segment joining the midpoint of that side with the opposite vertex.

   In the figure given below, AD, BE and CF are the medians.

   The medians of a triangle are concurrent i.e., they intersect each other at the same point.

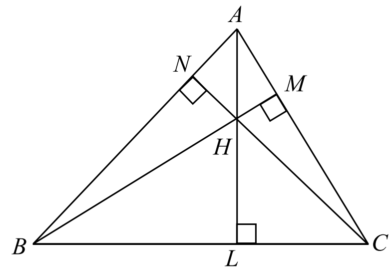


2. **Centroid** The point of intersection of all the three medians of a triangle is called its *centroid.*

   In the above figure G is the centroid of ΔABC.

   Note: The centroid divides a median in the ratio 2:1.

3. **Altitudes** The *altitude* of a triangle corresponding to any side is the length of perpendicular drawn from the opposite vertex to that side.



In the figure given above, AL, BM and CN are the altitudes.

Note:

The altitudes of a triangle are concurrent.

4. **Orthocentre** The point of intersection of all the three altitudes of a triangle is called its *orthocentre*. In the figure given above H is the orthocentre of ΔABC.

Note:

The orthocentre of a right-angled lies at the vertex containing the right angle.

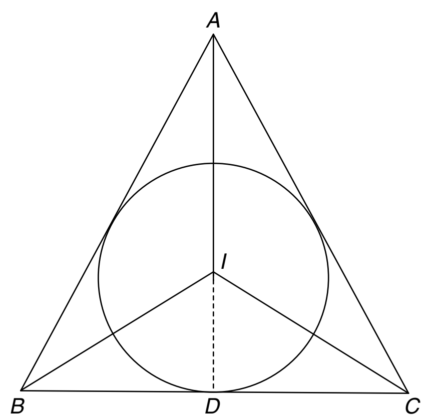
5. **Incentre of a triangle** The point of intersection of the internal bisectors of the angles of a triangle is called its *incentre*.

   In the figure given below, the internal bisectors of the angles of ΔABC intersect at I.

   $\therefore$ I is the Incentre of ΔABC.

   Let, $ID \perp BC$

   Then, a circle with centre I and radius ID is called the *incircle* of ΔABC.

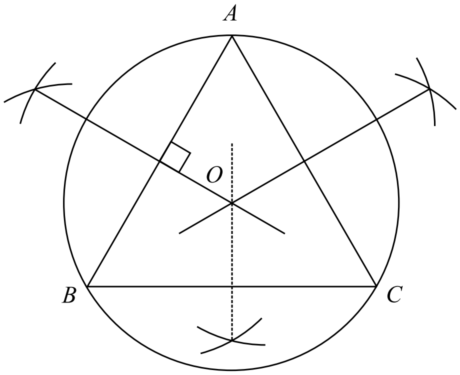


Note:

The incentre of a triangle is equidistant from its sides.

6. **Circumcentre of a triangle** The point of intersection of the perpendicular bisectors of the sides of a triangle is called its *circumcentre*.

    In the figure given below, the right bisectors of the sides of ΔABC intersect at O.



$\therefore$ O is the *circumcentre* of ΔABC with O as centre and radius equal to $OA = OB = OC$. We draw a circle passing through the vertices of the given Δ. This circle is called the *circumcircle* of ΔABC.

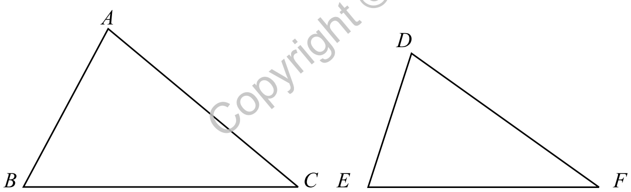
Note: The circumcentre of a triangle is *equidistant* from its *vertices*.

congruent triangles

Two triangles are *congruent* if and only if one of them can be superposed on the other, so as to cover it exactly.

Thus, congruent triangles are exactly identical

For example, If $\Delta ABC \cong \Delta DEF$ then we have



$$\angle A = \angle D,\ \angle B = \angle E,\ \angle C = \angle F;$$

and $AB = DE,\ BC = EF$ and $AC = DF.$

Similar Triangles

Congruent figures Two geometric figures having the same shape and size are known as *congruent figures.*

Similar figures Two figures (plane or solid) are said to be *similar* if they have the same shape irrespective of their sizes.

Note: Two similar figures may not be congruent as their size may be different.

For examples,

1. Any two lines segments are similar.
2. Any two equilateral triangles are similar.
3. Any two squares are similar.
4. Any two circles are similar.
5. Any two rectangles are similar.

Similar triangles Two triangles are similar if

(a) their corresponding angles are equal.

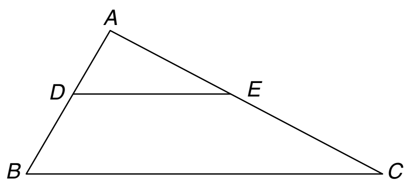
(b) their corresponding sides are proportional.

Key Results To Remember

1. The sum of all the angles round a point is equal to 360º.
2. Two lines parallel to the same line are parallel to each other.
3. The sum of three angles of a triangle is 180º.
4. If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles. (Exterior Angle Theorem)
5. If two sides of a triangle are unequal, the longer side has greater angle opposite to it.
6. In a triangle, the greater angle has the longer side opposite to it.
7. The sum of any two sides of a triangle is greater than the third side.
8. If a, b, c denote the sides of a triangle then
    (i) If $c^2 < a^2 + b^2$, triangle is acute angled.
    (ii) If $c^2 = a^2 + b^2$, triangle is right angled.
    (iii) If $c^2 > a^2 + b^2$, triangle is obtuse angled.
9. Two triangles are congruent if:
    (i) Any two sides and the included angle of one triangle are equal to any two sides and the included angle of the other triangle. (SAS congruence theorem)
    (ii) Two angles and the included side of one triangle are equal to the corresponding two angles and the included side of the other triangle. (ASA congruence theorem)
    (iii) The three sides of one triangle are equal to the corresponding three sides of the other triangle. (SSS congruence theorem)

> ***Note:***
>
> Two right triangles are congruent if the hypotenuse and one side of one triangle are respectively equal to the hypotenuse and the corresponding side of the other triangle.
> (RHS Congruence theorem)
>
> **10.** The line segments joining the mid-points of any two sides of a triangle is parallel to the third side and equal to half of it.
>
> **11. Basic Proportionality Theorem** If a line is drawn parallel to one side of a triangle, to intersect the other two sides in distinct points, the other two sides are divided in the same ratio.

In the figure given below, In a ΔABC



If $DE \parallel BC$

Then, $\dfrac{AD}{DB} = \dfrac{AE}{EC}$

Illustration 1: In the figure given above, D and E are the points on the AB and AC respectively such that $DE \parallel BC$. If $AD = 8$ cm, $AB = 12$ cm and $AE = 12$ cm. Find CE

Solution: In ΔABC, $DE \parallel BC$

$\dfrac{AD}{DB} = \dfrac{AE}{EC}$ (Basic Proportionality Theorem)

$\Rightarrow \quad \dfrac{8}{12-8} = \dfrac{12}{EC}$

$\Rightarrow \quad \dfrac{8}{4} = \dfrac{12}{EC}$

or $\quad EC = 6$ cm

> **12.** If a line divides any two sides of a triangle in the same ratio, the line is parallel to the third side.

Explanation In the above figure (given in point 11). In ΔABC

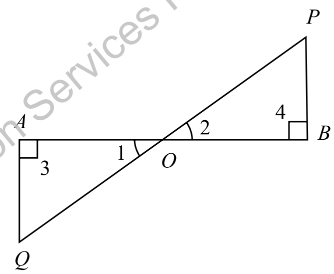
if $\dfrac{AD}{DB} = \dfrac{AE}{EC}$, then $DE \parallel BC$.

Similarity Theorems

> **13. AAA Similarity** If in two triangles, corresponding angles are equal, then the triangles are similar.
>
> **Corollary** (AA-similarity): If two angles of one triangle are respectively equal to two angles of another triangle then the two triangles are similar.

Illustration 2: In the figure given below, QA and PB are perpendiculars to AB. If $AO = 15$ cm, $BO = 9$ cm, $PB = 12$ cm, find AQ.

Solution:



In Δs AOQ and BOP

$\angle 1 = \angle 2$ [vertically opposite angles]

$\angle 3 = \angle 4$ [each 90º]

$\therefore \quad \Delta\, AOQ \sim \Delta BOP$ [AA Similarity Criterion]

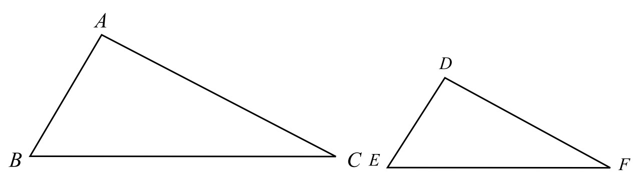
$\therefore \quad \dfrac{AO}{BO} = \dfrac{AQ}{BP}$ (corresponding sides of $\sim\Delta$s)

or $\quad \dfrac{15}{9} = \dfrac{AQ}{12}$

or $\quad \dfrac{5}{1} = \dfrac{AQ}{4} \Rightarrow AQ = 20$ cm.

> **14. SSS-Similarity** If the corresponding sides of two triangles are proportional then they are similar.

Explanation: In Δs ABC and DEF,

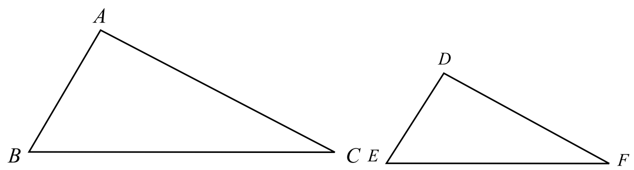


if $\dfrac{AB}{DE} = \dfrac{BC}{EF} = \dfrac{AC}{DF}$

Then $\Delta ABC \sim \Delta DEF$ [SSS Similarity]

> **15. SAS-Similarity** If in two triangles, one pair of corresponding sides are proportional and the included angles are equal, then the two triangles are similar.

Explanation In Δs ABC and DEF,



if $\angle A = \angle D$ and $\dfrac{AB}{DE} = \dfrac{AC}{DF}$

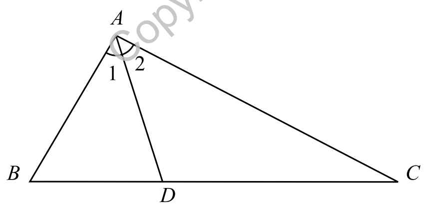
or $\angle B = \angle E$ and $\dfrac{AB}{DE} = \dfrac{BC}{EF}$

or $\angle C = \angle F$ and $\dfrac{AC}{DF} = \dfrac{BC}{EF}$,

then $\Delta ABC \sim \Delta DEF$ [SAS-Similarity]

> **16. Internal Bisector Property** The internal bisector of an angle of a triangle divides the opposite side in the ratio of the sides containing the angle.

Explanation In ΔABC, if $\angle 1 = \angle 2$

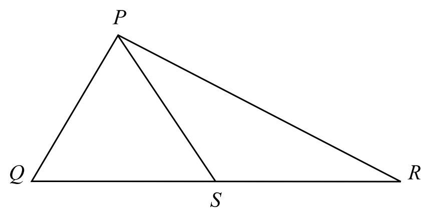


Then $\dfrac{AB}{AC} = \dfrac{BD}{CD}$

> **17.** If a line segment drawn from the vertex of an angle of a triangle to its opposite side divides it in the ratio of the sides containing the angle, then the line segment bisects the angle.

Illustration 3: In ΔPQR, $PQ = 6$ cm, $PR = 8$ cm,

Solution: $QS = 1.5$ cm, $RS = 2$ cm



$\therefore \dfrac{PQ}{PR} = \dfrac{6}{8} = \dfrac{3}{4}$ and $\dfrac{QS}{RS} = \dfrac{1.5}{2} = \dfrac{3}{4}$

Thus, $\dfrac{PQ}{PR} = \dfrac{QS}{RS}$

$\therefore$ PS is the bisector of $\angle P$.

> **18. Pythagoras Theorem** In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

Explanation In a right ΔABC, right angled at B

$$AC^2 = AB^2 + BC^2$$

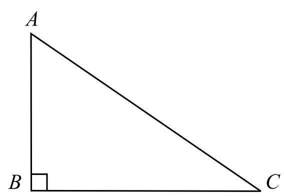
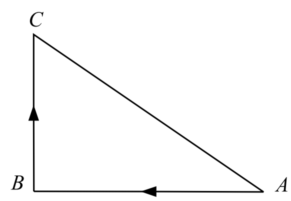


Illustration 4: a man goes 15 m west and then 8 m due north. How far is he from the starting point.

Solution: Let, the initial position of the man be A.



Let, $AB = 15$ m and $BC = 8$ m

$\therefore$ $AC^2 = AB^2 + BC^2$ (Pythagoras Theorem)

$= (15)^2 + (8)^2$

$= 225 + 64$

$= 289$

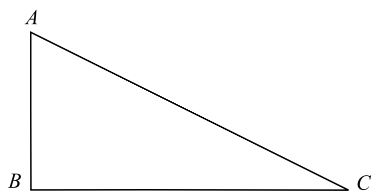
$$AC = \sqrt{289}$$
$$= 17 \text{ m}$$

Hence, the man is 17 m away from the starting point.

19. Converse of Pythagoras Theorem. In a triangle, if the square of one side is equal to the sum of the squares of the other two sides, then the angle opposite the first side is a right angle.

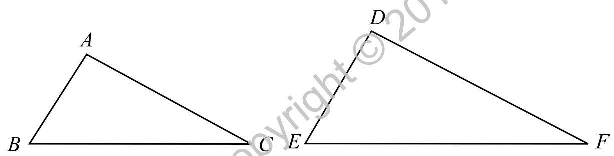
Explanation In a ΔABC if $AB^2 + BC^2 = AC^2$

Then, $\angle ABC = 90^\circ$



20. Area Theorem The ratio of the areas of two similar Ds is equal to the ratio of the squares of any two corresponding sides

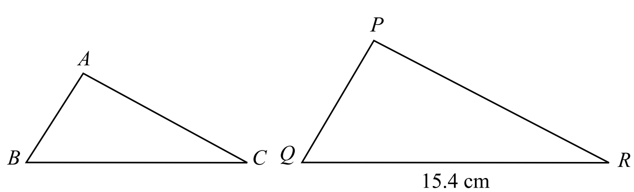
Explanation If $\Delta ABC \sim \Delta DEF$,



then $$\frac{ar(\Delta ABC)}{ar(\Delta DEF)} = \frac{AB^2}{DE^2} = \frac{AC^2}{DF^2} = \frac{BC^2}{EF^2}$$

Illustration 5: The areas of two similar Δs ABC and PQR are 64 cm^2 and 121 cm^2, respectively. If $QR = 15.4$ cm, find BC.

Solution: Since $\Delta ABC \sim \Delta PQR$



$$\therefore \quad \frac{ar(\Delta ABC)}{ar(\Delta PQR)} = \frac{BC^2}{QR^2} \quad \text{(Area Theorem)}$$

i.e., $$\frac{64}{121} = \frac{BC^2}{(15.4)^2} \Rightarrow \frac{8}{11} = \frac{BC}{15.4}$$

$$\therefore \quad BC = 11.2 \text{ cm}$$

21. The ratio of the areas of two similar triangles is equal to the

(i) ratio of the squares of the corresponding medians

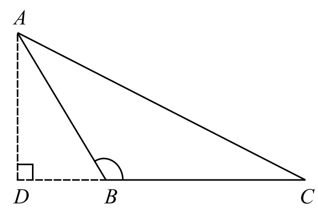
(ii) ratio of the squares of the corresponding altitudes

(iii) ratio of the squares of the corresponding angle bisector segments

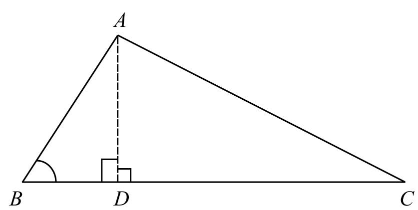
22. If two similar triangles have equal areas, then the Ds are congruent.

23. In two similar triangles, the ratio of two corresponding sides is same as the ratio of their perimeters.

24. Obtuse Angle Property in a DABC, if $\angle B$ is obtuse then $AC2 = AB2 + BC2 + 2\ BC \times BD$ where $AD \perp BC$

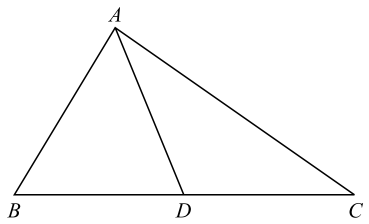


25. Acute Angle Property In a DABC, if $\angle C$ is acute, then $AB2 = AC2 + BC2 - 2BC \times CD$ where $AD \perp BC$



26. Apollonius Theorem The sum of the squares on any two sides of a triangle is equal to the sum of twice the square of the median, which bisects the third side and half the square of the third side.

Explanation In the given ΔABC,

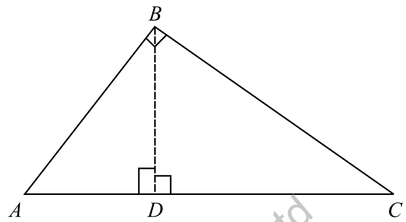


$$AB^2 + AC^2 = 2AD^2 + \frac{1}{2}BC^2$$

or $AB^2 + AC^2 = 2[AD^2 + BD^2]$

> **27.** If a perpendicular is drawn from the vertex of the right angle of a right triangle to the hypotenuse, the triangles on each side of the perpendicular are similar to the whole triangle and to each other. Also the square of the perpendicular is equal to the product of the lengths of the two parts of the hypotenuse.

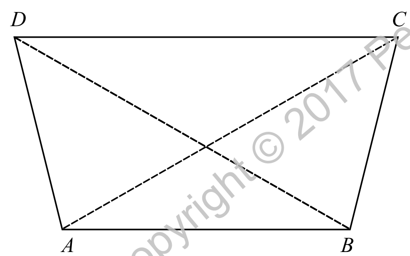
Explanation In the figure given below,
ABC is a right triangle, right angled at B and $BD \perp AC$, then



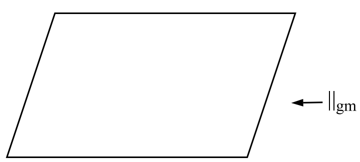
(i) $\Delta ADB \sim \Delta ABC$ (AA Similarity)
(ii) $\Delta BDC \sim \Delta ABC$ (AA Similarity)
(iii) $\Delta ADB \sim \Delta BDC$ also $BD^2 = AD \times CD$

SECTION 3 QUADRILATERALS AND PARALLELOGRAMS

Quadrilateral A plane figure bounded by four line segments AB, BC, CD and DA is called a *quadrilateral*, written as quad. $ABCD$ or $\angle ABCD$.



Various types of Quadrilaterals

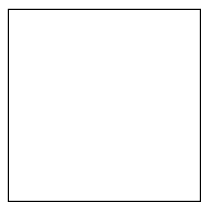


(i) Parallelogram A quadrilateral in which opposite sides are parallel is called *parallelogram*, written as $\|_{gm}$.

(ii) Rectangle A parallelogram each of whose angles is 90° is called a *rectangle*, written as rect. $ABCD$.

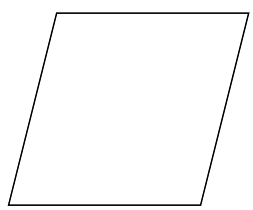
Rectangle

(iii) Square A rectangle having all sides equal is called a *square*.



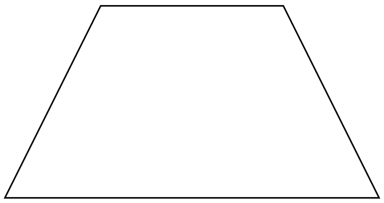
Square

(iv) Rhombus A quadrilateral having all sides equal is called a *rhombus*



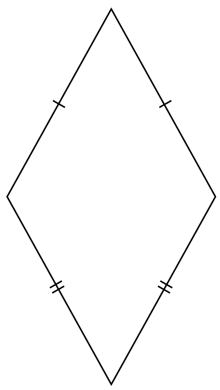
Rhombus

(v) Trapezium A quadrilateral in which two opposite sides are parallel and two opposite sides are non-parallel is called a *trapezium.*



Trapezium

(vi) Kite A quadrilateral in which pairs of adjacent sides are equal is known as *kite.*



Key Results to Remember

1. The sum of all the four angles of a quadrilateral is 360°.
2. In a parallelogram
   (i) opposite sides are equal.
   (ii) opposite angles are equal.
   (iii) each diagonal bisects the parallelogram.
   (iv) the diagonal bisect each other.
3. A quadrilateral is a ||gm
   (i) if both pairs of opposite sides are equal.
   or (ii) if both pairs of opposite angles are equal.
   or (iii) if the diagonals bisect each other.
   or (iv) if a pair of opposite sides are equal and parallel.
4. The diagonals of a rectangle are equal.
5. If the diagonals of a ||gm are equal, it is a rectangle.
6. Diagonals of a rhombus are perpendicular to each other.
7. Diagonals of a square are equal and perpendicular to each other.
8. The figure formed by joining the mid-points of the pairs of consecutive sides of a quadrilateral is a ||gm.
9. The quadrilateral formed by joining the mid-points of the consecutive sides of a rectangle is a rhombus.
10. The quadrilateral formed by joining the mid-points of the consecutive sides of a rhombus is a rectangle.
11. If the diagonals of a quadrilateral are perpendicular to each other, then the quadrilateral formed by joining the mid-points of its sides, is a rectangle.
12. The quadrilateral formed by joining the mid-points of the sides of a square, is also a square.

SECTION 4 POLYGONS

Polygon A closed plane figure bounded by line segments is called a *polygon.*

The line segments are called its *sides* and the points of intersection of consecutive sides are called its *vertices*. An angle formed by two consecutive sides of a polygon is called an *interior angle* or simply an *angle* of the polygon.

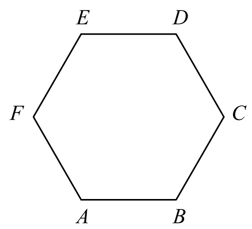
No. of sides	*Name*
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
9	
10	Decagon

A polygon is named according to the number of sides, it has.

In general, a polygon of n sides is called *n-gon.* Thus, a polygon having 18 sides is called 18-gon.

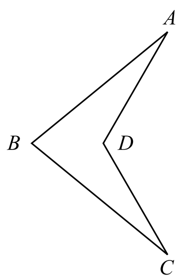
Diagonal of a Polygon Line segment joining any two non-consecutive vertices of a polygon is called its *diagonal*.

Convex Polygon If all the (interior) angles of a polygon are less than 180°, it is called a *convex polygon*. In the figure given below, *ABCDEF* is a convex polygon. In fact, it is a convex hexagon.



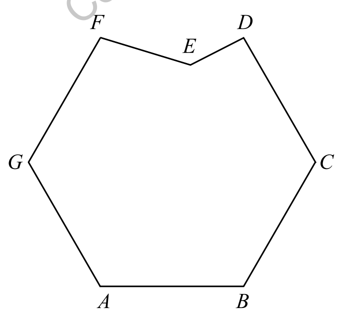
(In other words, a polygon is a convex polygon if the line segment joining any two points inside it lies completely inside the polygon).

Concave Polygon If one or more of the (interior) angles of a polygon is greater than 180° i.e., reflex, it is called

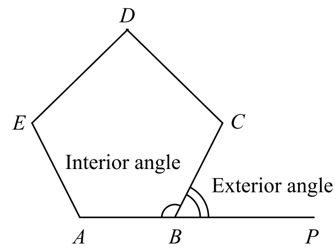


⇐ Concave polygon

concave (or re-entrant) *polygon*. In the figure given below, *ABCDEFG* is a concave polygon. In fact, it is a concave heptagon.



Exterior Angle of Convex Polygon If we produce a side of polygon, the angle it makes with the next side is called an *exterior angle*. In the diagram given below, *ABCDE* is a pentagon. Its side *AB* has been produced to *P*, then $\angle CBP$ is an exterior angle.



Note:

Corresponding to each interior angle, there is an exterior angle. Also, as an exterior angle and its adjacent interior angle make a straight line, we have **an exterior angle + adjacent interior angle = 180°**

Regular Polygon A polygon is called regular polygon if all of its sides have equal length and all its angles have equal size.

Thus, in a regular polygon

(i) all sides are equal in length.

(ii) all interior angles are equal in size.

(iii) all exterior angles are equal size.

Note:

All regular polygons are convex.

Key Results to Remember

1. (a) If there is a polygon of n sides ($n \geq 3$), we can cut it into $(n - 2)$ triangles with a common vertex and so *the sum of the interior angles of a polygon of n sides would be*

$$(n - 2) \times 180° = (n - 2) \times 2 \text{ right angles}$$
$$= (2n - 4) \text{ right angles}$$

(b) If there is a regular polygon of n sides ($n \geq 3$), then its each interior angle is equal to

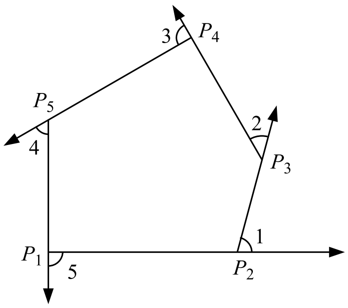
$$\left(\frac{2n-4}{n} \times 90\right)$$

(c) Each exterior angle of a regular polygon of n sides is equal to

$$= \left(\frac{360}{n}\right)^{\circ}$$

2. The sum of all the exterior angles formed by producing the sides of a convex polygon in the same order is equal to four right angles.

Explanation If in a convex polygon $P_1P_2P_3P_4P_5$, all the sides are produced in order, forming exterior angles $\angle 1$, $\angle 2$, $\angle 3$, $\angle 4$ and $\angle 5$, then $\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 = 4$ right angles.



3. If each exterior angle of a regular polygon is $x°$, then the number of sides in the polygon $= \dfrac{360°}{x}$.

Note:

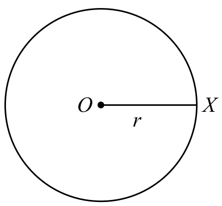
Greater the number of sides in a regular polygon, greater is the value of its each interior angle and smaller is the value of each exterior angle.

4. If a polygon has n sides, then the number of diagonals of the polygon

$$= \frac{n(n-1)}{2} - n.$$

SECTION 5 CIRCLES AND TANGENTS

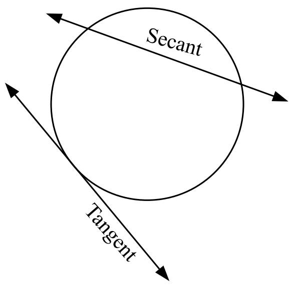
Circle A circle is a set of all those points in a plane, each one of which is at given constant distance from a given fixed point in the plane.



The fixed point is called the *centre* and the given constant distance is called the *radius* of the circle.

A circle with centre O and radius r is usually denoted by $C(O, r)$.

Tangent A line meeting a circle in only one point is called a *tangent* to the circle. The point at which the tangent line meets the circle is called the *point of contact*.

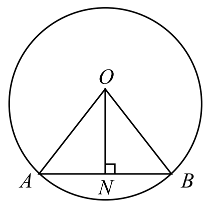


Secant A line which intersects a circle in two distinct points is called a *secant line*.

Key Results to Remember

1. The perpendicular from the centre of a circle to a chord bisects the chord.

Explanation If $ON \perp AB$, then $AN = NB$.

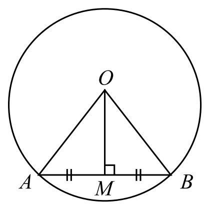


Note:

The converse of above theorem is true and can be stated as point 2.

2. The line joining the centre of a circle to the midpoint of a chord is perpendicular to the chord.

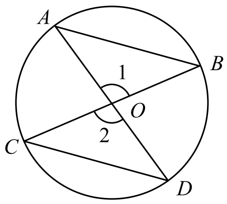
Explanation If $AM = MB$, then $OM \perp AB$.



Cor. The perpendicular bisectors of two chords of a circle intersect at its centre.

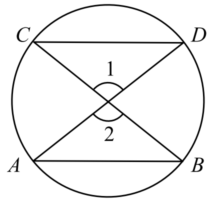
> **3.** Equal chords of a circle subtend equal angles at the centre.

Explanation If $AB = CD$, then $\angle 1 = \angle 2$



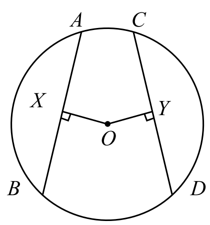
> **4.** (Converse of above theorem) If the angles subtended by two chords at the centre of a circle are equal then the chords are equal.

Explanation If $\angle 1 = \angle 2$, then $AB = CD$



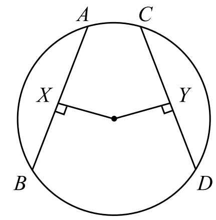
> **5.** Equal chords of a circle are equidistant from the centre.

Explanation If the chords AB and CD of a circle are equal and if $OX \perp AB$ and $OY \perp CD$ then $OX = OY$.



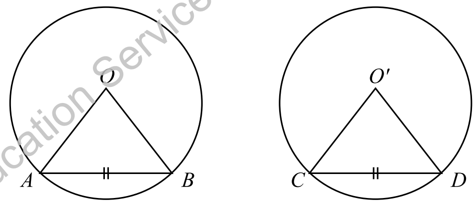
> **6.** (Converse above theorem) Chords equidistant from the centre of the circle are equal.

Explanation If $OX \perp AB$ $OY \perp CD$ and $OX = OY$, then chords $AB = CD$



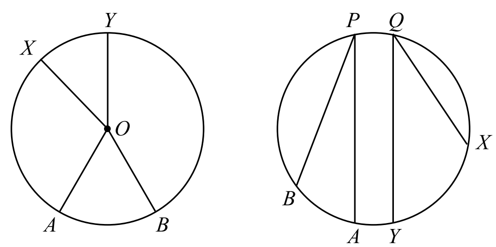
> **7.** In equal circles (or in the same circle), equal chords cut of equal arcs.

Explanation If the chords $AB = CD$, then arc AB = are CD.



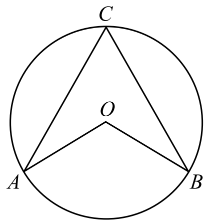
> **8.** In equal circles (or in the same circle) if two arcs subtend equal angles at the centre (or at the circum-ference), the arcs are equal.

Explanation If $\angle BOA = \angle XOY$, then arc AB = arc XY or if $\angle BPA = \angle XQY$, then arc AB = arc XY.



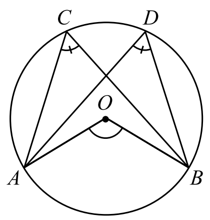
> **9.** The angle subtended by an arc of a circle at the centre is double the angle subtended by it at any point on the remaining part of the circle.
> (The theorem is popularly known as Degree Measure Theorem).

Explanation A circle, centre O, with $\angle AOB$ at the centre, $\angle ACB$ at the circumference, standing on the same arc AB, then $\angle AOB = 2\angle ACB$



10. Angles in the same segment of a circle are equal.

Explanation A circle, centre O, $\angle ACB$ and $\angle ADB$ are angles at the circumference, standing on the same arc, then

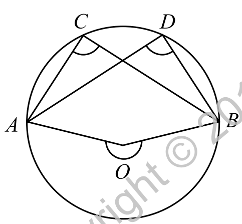


$\angle ACB = \angle ADB$

(angles in same arc)

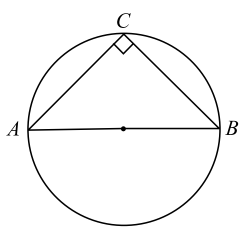
or

(angles in same segment)



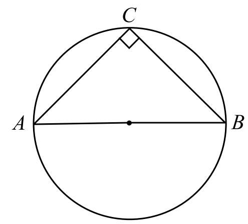
11. The angle in a semicircle is a right angle.

Explanation In the figure given below $\angle ACB = 90°$

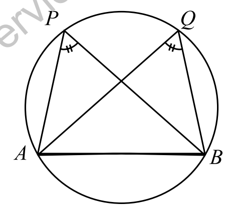


12. (Converse of above theorem) The circle drawn with hypotenuse of a right triangle as diameter passes through its opposite vertex.

Explanation The circle drawn with the hypotenuse AB of a right triangle ACB as diameter passes through its opposite vertex C.

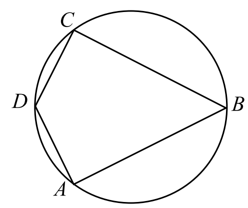


13. If $\angle APB = \angle AQB$, and if P, Q are on the same side of AB, then A, B, Q, P are concyclic i.e., lie on the same circle.



14. The sum of the either pair of the opposite angles of a cyclic quadrilateral is 180°.

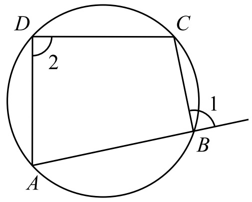
Explanation If $ABCD$ is a cyclic quadrilateral, then $\angle A + \angle C = \angle B + \angle D = 180°$



15. (Converse of above theorem) If the two angles of a pair of opposite angles of a quadrilateral are supplementary then the quadrilateral is cyclic.

16. If a side of a cyclic quadrilateral is produced then the exterior angle is equal to the interior opposite angle.

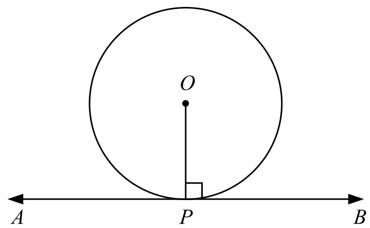
Explanation If the side AB of a cyclic quadrilateral $ABCD$ is produced then $\angle 1 = \angle 2$.



THEOREMS ON TANGENTS

17. A tangent at any point of a circle is perpendicular to the radius through the point of contact.

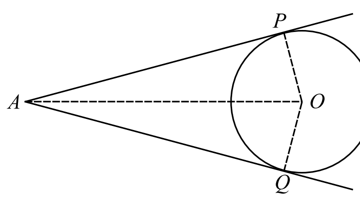
Explanation If AB is a tangent at a point P to a circle C (O, r) then $PO \perp AB$



18. (Converse of above theorem) A line drawn through the end of a radius and perpendicular to it, is a tangent to the circle.

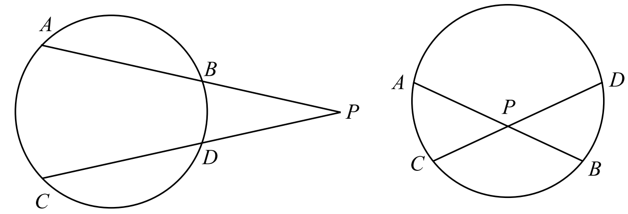
19. The lengths of two tangents drawn from an external point to a circle are equal.

Explanation If two tangents AP and AQ are drawn from a point A to a circle $C(O, r)$, then $AP = AQ$



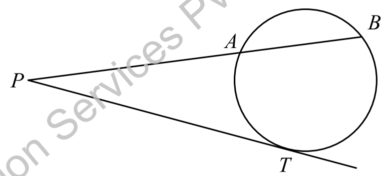
20. If two chords AB and CD intersect internally (ii) or externally (i) at a point P then

$$PA \times PB = PC \times PD$$



(i) (ii)

21. If PAB is a secant to a circle intersecting the circle at A and B is a tangent segment then $PA \times PB = PT^2$ (refer the figure below).
(popularly known as Tangent-Secant theorem)



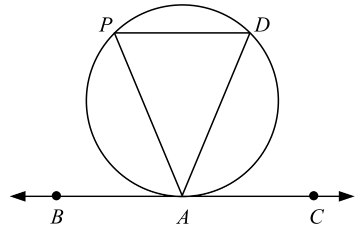
22. Alternate Segment Theorem:

In the figure below, if BAC is the tangent at A to a circle and if AD is any chord, then

$$\angle DAC = \angle APD \text{ and}$$

$$\angle PAB = \angle PDA$$

(Angles in alternate segment)

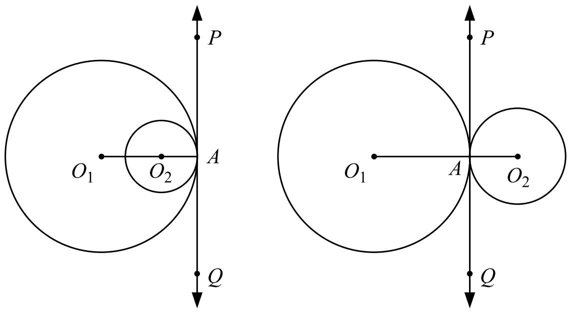


Note:

The converse of the above theorem is true.

23. If two circles touch each other internally or externally, the point of contact lies on the line joining their centres.

Explanation If two circles with centre O_1 and O_2 which touch each other internally (i) or externally (ii), at a point A then the point A lies on the line $O_1 O_2$, i.e., three points A, O_1 and O_2 are collinear.

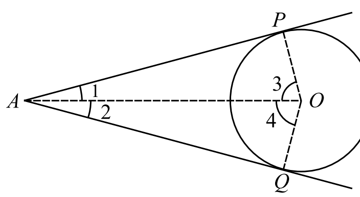


SOME USEFUL RESULTS

1. There is one and only one circle passing through three non-collinear points.
2. Two circles are congruent if and only if they have equal radii.
3. Of any two chords of a circle, the one which is greater is nearer to the centre.
4. Of any two chords of a circle, the one which is nearer to the centre is greater.
5. If two circles intersect in two points, then the line through the centres is the perpendicular bisector of the common chord.
6. Angle in a major segment of a circle is acute and angle in a minor segment is obtuse.
7. If two tangents are drawn to a circle from an external point then
   (i) they subtend equal angles at the centre.
   (ii) they are equally inclined to the segment, joining the centre to that point.

Explanation In a circle $C(O,r)$, A is a point outside it and AP and AQ are the tangents drawn to the circle

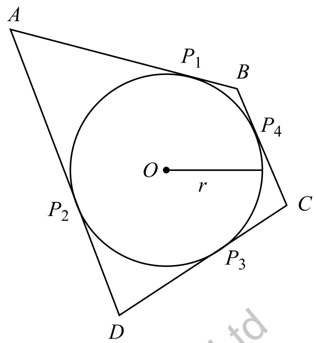
Then, $\angle 1 = \angle 2$ and $\angle 3 = \angle 4$



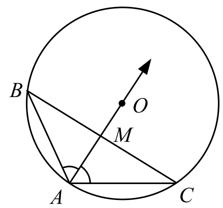
8. If a circle touches all the four sides of a quadrilateral then the sum of opposite pair of sides are equal.

Explanation If $ABCD$ is a circumscribed quadrilateral.

Then, $AB + CD = AD + BC$

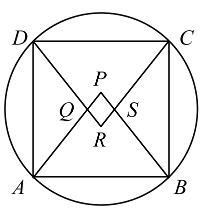


9. If two chords AB and AC of a circle are equal, then the bisector of $\angle BAC$ passes through the centre O of the circle.



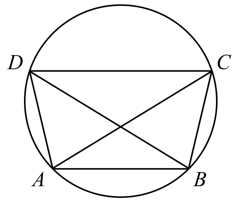
10. The quadrilateral formed by angle bisectors of a cyclic quadrilateral is also cyclic.

Explanation If $ABCD$ is a cyclic quadrilateral in which AP, BP, CR and DR are the bisectors of $\angle A$, $\angle B$, $\angle C$ and $\angle D$, respectively, then quadrilateral $PQRS$ is also cyclic.



11. A cyclic trapezium is isoceles and its diagonals are equal.

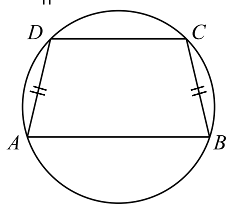
Explanation If ABC cyclic trapezium such that $AB \parallel DC$, then $AD = BC$ and $AC = BD$



12. If two opposite sides of a cyclic quadrilateral are equal, then the other two sides are parallel.

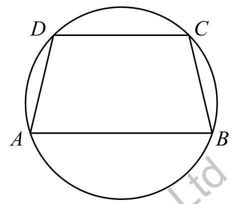
Explanation A cyclic quadrilateral $ABCD$ in which $AD = BC$

Then, $AB \parallel CD$



13. An isoceles trapezium is always cyclic.

Explanation A trapezium $ABCD$ in which $AB \parallel CD$ and $AD = BC$



Then $ABCD$ is a cyclic trapezium.

14. Any four vertices of a regular pentagon are *concyclic* (lie on the same circle).

Exercise-1

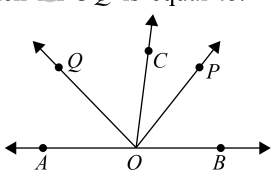
1. An angle is equal to one-third of its supplement. Its measure is equal to:

(a) 40° (b) 50°
(c) 45° (d) 55°

2. The complement of 30°20′ is:

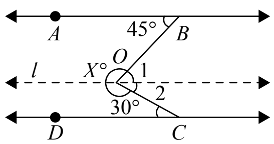
(a) 69°40′ (b) 59°40′
(c) 35°80′ (d) 159°40′

3. In the given figure, OP bisect $\angle BOC$ and OQ bisects $\angle AOC$. Then $\angle POQ$ is equal to:



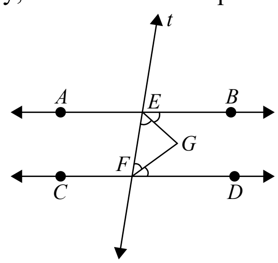
(a) 90° (b) 120°
(c) 60° (d) 100°

4. In the given, $AB \parallel CD$. Then X is equal to:



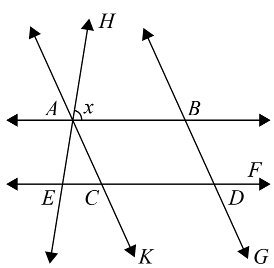
(a) 290° (b) 300°
(c) 280° (d) 285°

5. In the adjoining figure, $AB \parallel CD$, t is the transversal, EG and FG are the bisectors of $\angle BEE$ and $\angle DFE$ respectively, then $\angle EGF$ is equal to:



(a) 90° (b) 75°
(c) 80° (d) 110°

6. In the given figure, $AB \parallel CD$ and $AC \parallel BD$. If $\angle EAC = 40°$, $\angle FDG = 55°$, $\angle HAB = x$; then the value of x is:



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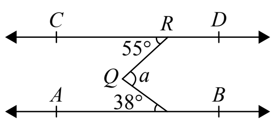
(a) 95° (b) 70°
(c) 35° (d) 85°

7. Find the measure of an angle, if six times its complement is 12° less than twice its supplement:
(a) 48° (b) 96°
(c) 24° (d) 58°

8. If two parallel lines are intersected by a transversal, then the bisectors of the two pairs of interior angles enclose a:
(a) Trapezium (b) Rectangle
(c) Square (d) none of these

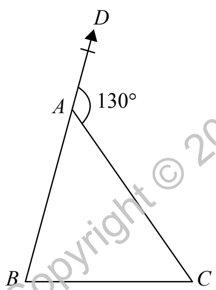
9. In fig., $AB \parallel CD$, $\angle a$ is equal to:



(a) 93° (b) 103°
(c) 83° (d) 97°

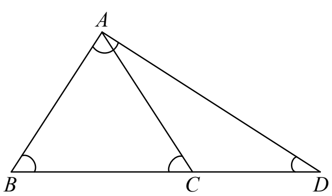
10. The complement of an angle exceeds the angle by 60°. Then the angle is equal to:
(a) 25° (b) 30°
(c) 15° (d) 35°

11. In the following figure, $\angle B:\angle C = 2 : 3$, find $\angle B + \angle C$.



(a) 120° (b) 52°
(c) 78° (d) 130°

12. In the given figure, $\angle B = \angle C = 55°$ and $\angle D = 25°$. Then:

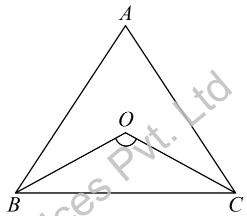


(a) $BC < CA < CD$
(b) $BC > CA > CA$
(c) $BC < CA$, $CA > CD$
(d) $BC > CA$, $CA < CD$

13. In a ΔABC, if $2\angle A = 3\angle B = 6\angle C$, Then $\angle A$ is equal to:
(a) 60° (b) 30°
(c) 90° (d) 120°

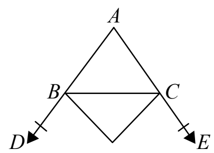
14. A, B, C are the three angles of a Δ. If $A - B = 15°$ and $B - C = 30°$. Then $\angle A$ is equal to:
(a) 65° (b) 80°
(c) 75° (d) 85°

15. In ΔABC, the angle bisectors of $\angle B$ and $\angle C$ meet at O. If $\angle A = 70°$, then $\angle BOC$ is equal to:



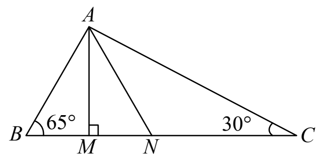
(a) 135° (b) 125°
(c) 115° (d) 110°

16. The sides AB and AC of ΔABC have been produced to D and E respectively. The bisectors of $\angle CBD$ and $\angle BCE$ meet at O. If $\angle A = 40°$, then $\angle BOC$ is equal to:

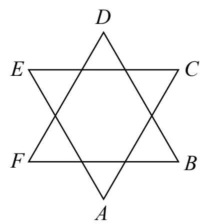


(a) 60° (b) 65°
(c) 75° (d) 70°

17. In the given figure, $AM \perp BC$ and AN is the bisector of $\angle A$. What is the measure of $\angle MAN$.
(a) 17.5° (b) 15.5°
(c) 20° (d) 25°

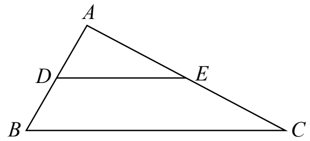


18. In the adjoining figure $\angle A + \angle B + \angle C + \angle D + \angle E + \angle F =$



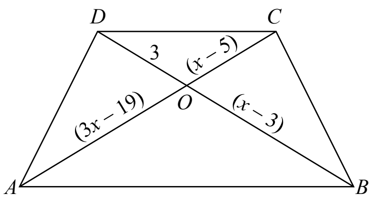
(a) 270° (b) 300°
(c) 360° (d) 330°

19. In the given figure, $DE \parallel BC$ if $AD = 1.7$ cm, $AB = 6.8$ cm and $AC = 9$ cm, find AE.



(a) 2.25 cm (b) 4.5 cm
(c) 1.25 cm (d) 2.5 cm

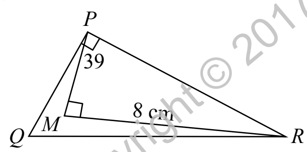
20. In the given figure, $AB \parallel DC$, find the value of x.



(a) $x = 8$ (b) $x = 9$
(c) $x = 8$ or 9 (d) $x = 10$

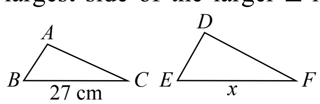
21. If the bisector of an angle of Δ bisects the opposite side, then the Δ is:
(a) Scalene (b) Isosceles
(c) Right triangle (d) None of these

22. In the given figure $\angle QPR = 90°$, $QR = 26$ cm, $PM = 6$ cm, $MR = 8$ cm and $\angle PMR = 90°$, find the area of ΔPQR.



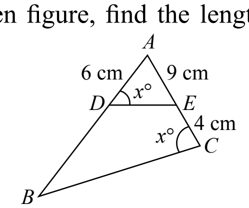
(a) 180 cm^2 (b) 240 cm^2
(c) 120 cm^2 (d) 150 cm^2

23. The areas of two similar Δs are 81 cm^2 and 144 cm^2. If the largest side of the smaller Δ is 27 cm, then the largest side of the larger Δ is:



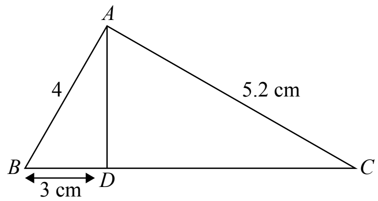
(a) 24 cm (b) 48 cm
(c) 36 cm (d) None of these

24. In the given figure, find the length of BD.



(a) 13.5 cm (b) 12 cm
(c) 14.5 cm (d) 15 cm

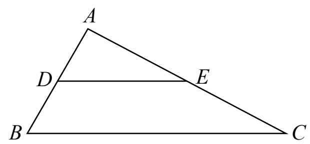
25. In the given figure $\angle BAD = \angle CAD$. $AB = 4$ cm, $AC = 5.2$ cm, $BD = 3$ cm. Find BC.



(a) 6.9 cm (b) 9.6 cm
(c) 3.9 cm (d) 9.3 cm

26. A ladder 15 m long reaches a window which is 9 m above the ground on one side of street. Keeping its foot at the same point, the ladder is turned to the other side of the street to reach a window 12 m high. What is the width of the street:
(a) 31 m (b) 12 m
(c) 30 m (d) 21 m

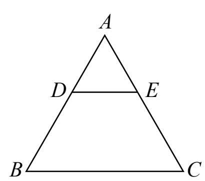
27. In, ΔABC, D and E are the mid-points of AB and AC respectively. Find the ratio of the areas of ΔADE and ΔABC.



(a) $\frac{1}{2}$ (b) $\frac{1}{4}$
(c) $\frac{3}{4}$ (d) $\frac{1}{8}$

28. A vertical stick 12 cm long casts a shadow 8 cm long on the ground. At the same time a tower casts the shadow 40 m long on the ground. Find the height of the tower.
(a) 600 m (b) 160 m
(c) 60 m (d) 52 m

29. D and E are the points on the sides AB and AC respectively of ΔABC such that $AD = 8$ cm, $BD = 12$ cm, $AE = 6$ cm and $EC = 9$ cm. Then find BC/DE.



(a) $\frac{5}{2}$ (b) $\frac{2}{5}$

(c) $\frac{5}{7}$ (d) $\frac{5}{3}$

30. In an equilateral ΔABC, if $AD \perp BC$, then:

(a) $3AB^2 = 2AD^2$ (b) $2AB^2 = 3AD^2$

(c) $3AB^2 = 4AD^2$ (d) $4AB^2 = 3AD^2$

31. In a right angled ΔABC, rt. angled at A, $AD \perp BC$. Then:

(a) $AD^2 = BD \times CD$ (b) $AD^2 = AB \times AC$

(c) $AD^2 = BD \times AB$ (d) $AD^2 = CD \times AC$

32. If $ABCD$ is a ||gm and AC and BD be its diagonals, then:

(a) $AB^2 + BC^2 + CD^2 + DA^2 = AC^2 - BD^2$

(b) $AB^2 + BC^2 + CD^2 + DA^2 = AC^2 + BD^2$

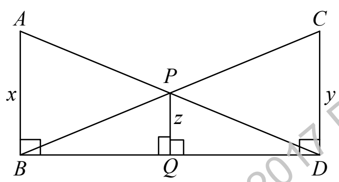
(c) $4AD^2 = 2AC^2 + 2BD^2$

(d) $4AB^2 = 2AC^2 - 2BC^2$

33. In the given figure, $\angle ABD = \angle CBD = \angle PQB = 90°$. Then:

(a) $\frac{1}{x} - \frac{1}{y} = \frac{1}{z}$ (b) $\frac{1}{x} + \frac{1}{z} = \frac{1}{y}$

(c) $\frac{1}{x} + \frac{1}{y} = \frac{1}{z}$ (d) $\frac{1}{y} - \frac{1}{x} = \frac{1}{z}$

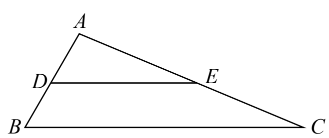


34. The area of two similar Δs are 121 cm^2 and 81 cm^2 respectively. What is the ratio of their corresponding heights (altitudes):

(a) $\frac{11}{9}$ (b) $\frac{22}{9}$

(c) $\frac{11}{18}$ (d) None of these

35. In the given figure, $DE \parallel BC$ and $DE : BC = 3:5$ the ratio of the areas of ΔADE and the trapezium $BCED$.



(a) $\frac{9}{25}$ (b) $\frac{12}{25}$

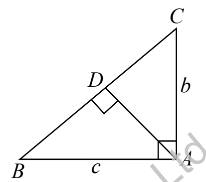
(c) $\frac{3}{4}$ (d) $\frac{9}{16}$

36. In a ΔABC, AD intersects ∠A and BC. If $BC = a$, $AC = b$ and $AB = c$, Then:

(a) $CD = \frac{b+c}{ab}$ (b) $CD = \frac{ab}{b+c}$

(c) $CD = \frac{bc+ab}{ac}$ (d) $CD = \frac{ac}{bc+ab}$

37. In the given figure, what is the length of AD in terms of b and c:



(a) $\frac{bc}{b^2+c^2}$ (b) $\frac{b^2+c^2}{bc}$

(c) $\frac{\sqrt{b^2+c^2}}{bc}$ (d) $\frac{bc}{\sqrt{b^2+c^2}}$

38. ABC is a Δ in which $AB = AC$ and D is a point on AC such that $BC^2 = AC \times CD$. Then:

(a) $BD = DC$ (b) $BD = BC$

(c) $BD = AB$ (d) $BD = AD$

39. Two poles of ht. a and b metres are p metres apart ($b > a$). The height of the point of intersection of the lines joining the top of each pole to the foot of the opposite pole is:

(a) $\frac{a+b}{ab}$ (b) $\frac{p}{a+b}$

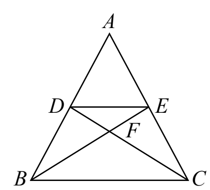
(c) $\frac{ab}{a+b}$ (d) $\frac{a+b}{p}$

40. ABC is a right Δ, right-angled at C. If $AB = c$, $BC = a$ and $CA = b$ and p is the length of the perpendicular from C on AB. Then:

(a) $\frac{1}{p^2} + \frac{1}{a^2} = \frac{1}{b^2}$ (b) $\frac{1}{p^2} + \frac{1}{b^2} = \frac{1}{a^2}$

(c) $\frac{1}{a^2} = \frac{1}{b^2} + \frac{1}{p^2}$ (d) $\frac{1}{p^2} = \frac{1}{a^2} + \frac{1}{b^2}$

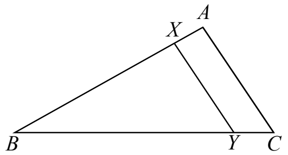
41. In the given figure $DE \| BC$ and $AD : DB = 5:4$, Then $\frac{ar(\Delta DFE)}{ar(\Delta CFB)}$



(a) $\dfrac{25}{81}$ (b) $\dfrac{25}{16}$

(c) $\dfrac{16}{25}$ (d) $\dfrac{16}{81}$

42. In the fig. $XY \parallel AC$ and XY divides triangular region ABC into two part equal in area. Then $\dfrac{AX}{AB}$ is equal to:



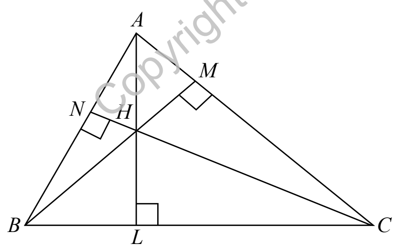
(a) $\dfrac{1}{\sqrt{2}}$ (b) $\dfrac{\sqrt{2}+2}{\sqrt{2}}$

(c) $\dfrac{1}{2}$ (d) $\dfrac{\sqrt{2}-1}{\sqrt{2}}$

43. A point O in the interior of a rectangular $ABCD$ is joined with each of the vertices A, B, C and D. Then:
(a) $OA^2 + OC^2 = OB^2 - OD^2$
(b) $OA^2 + OC^2 = OB^2 + OD^2$
(c) $OA^2 = OB^2 = OC^2 + OD^2$
(d) $OA^2 + OD^2 = OB^2 + OC^2$

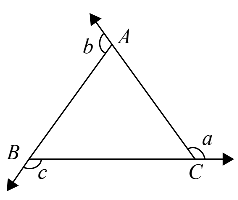
44. In ΔABC, the median BE intersects AC at E, if BG = 6 cm, where G is the centroid, then BE is equal to:
(a) 7 cm (b) 9 cm
(c) 8 cm (d) 10 cm

45. If H is the orthocentre of ΔABC, then the orthocentre of ΔHBC is (fig. given):



(a) N (b) M
(c) A (d) L

46. If the sides of a triangle are produced then the sum of the exterior angles i.e., $\angle a + \angle b + \angle c$ is equal to:



(a) 180° (b) 90°
(c) 360° (d) 270°

47. Incentre of a triangle lies in the interior of:
(a) an isosceles triangle only
(b) any triangle
(c) an equilateral triangle only
(d) a right triangle only

48. In a ΔABC, the bisectors of $\angle B$ and $\angle C$ *intersect* each other at apoint O. Then $\angle BOC$ is equal to:

(a) $90° - \dfrac{1}{2}\angle A$ (b) $120° + \dfrac{1}{2}\angle A$

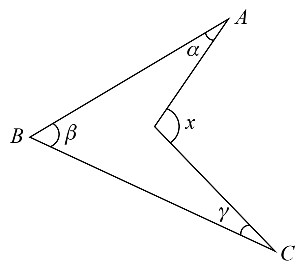
(c) $90° + \dfrac{1}{2}\angle A$ (d) $120° - \dfrac{1}{2}\angle A$

49. In a ΔABC, the sides AB and AC are produced to P and Q respectively. The bisectors of $\angle OBC$ and $\angle QCB$ intersect at a point O. Then $\angle BOC$ is equal to:

(a) $90° + \dfrac{1}{2}\angle A$ (b) $90° - \dfrac{1}{2}\angle A$

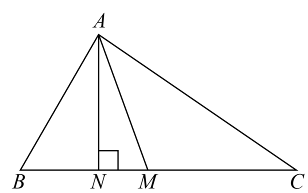
(c) $120° + \dfrac{1}{2}\angle A$ (d) $120° - \dfrac{1}{2}\angle A$

50. In the given figure, which of the following is true:



(a) $x = \alpha + \beta + \gamma$ (b) $x + \beta = \alpha + \gamma$
(c) $x + \gamma = \beta + \alpha$ (d) $x + \alpha = \beta + \gamma$

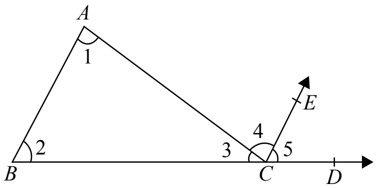
51. In the given figure, In a ΔABC, $\angle B = \angle C$. If AM is the bisector of $\angle BAC$ and $AN \perp BC$, then $\angle MAN$ is equal to:



(a) $\dfrac{1}{2}(\angle B + \angle C)$ (b) $\dfrac{1}{2}(\angle C - \angle B)$

(c) $\angle B + \angle C$ (d) $\dfrac{1}{2}(\angle B - \angle C)$

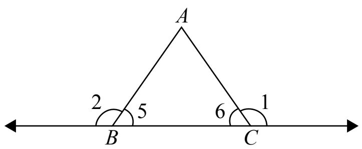
52. In the given figure, side BC of ΔABC is produced to form ray BD and $CE \parallel BA$. Then $\angle ACD$ is equal to:



(a) $\angle A - \angle B$ (b) $\frac{1}{2}(\angle A + \angle B)$

(c) $\angle A + \angle B$ (d) $\frac{1}{2}(\angle A - \angle B)$

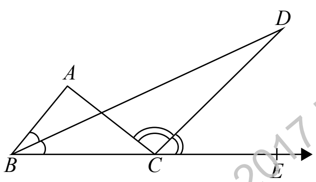
53. In the given figure, the side BC of a ΔABC is produced on both sides. Then $\angle 1 + \angle 2$ is equal to:



(a) $\angle A + 180°$ (b) $180° - \angle A$

(c) $\frac{1}{2}(\angle A + 180°)$ (d) $\angle A + 90°$

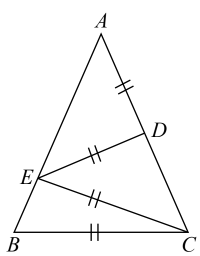
54. In the figure, BD and CD are angle bisectors of $\angle ABC$ and $\angle ACE$, respectively. Then $\angle BDC$ is equal to:



(a) $\angle BAC$ (b) $2\angle BAC$

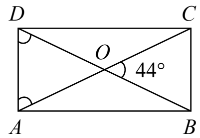
(c) $\frac{1}{2}\angle BAC$ (d) $\frac{1}{3}\angle BAC$

55. In fig, $AB = AC$, D is a point on AC and E on AB such that $AD = ED = EC = BC$. Then $\angle A{:}\angle B$:



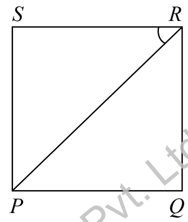
(a) 1:2 (b) 2:1
(c) 3:1 (d) 1:3

56. The diagonals of a rectangle $ABCD$ meet at 0. If $\angle BOC = 44°$, then $\angle OAD$ is equal to:



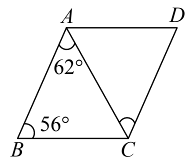
(a) 90° (b) 60°
(c) 100° (d) 68°

57. $PQRS$ is a square. The $\angle SRP$ is equal to:



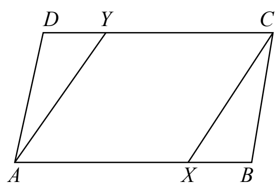
(a) 45° (b) 90°
(c) 100° (d) 60°

58. $ABCD$ is a rhombus with $\angle ABC = 56°$, then $\angle ACD$ is equal to:



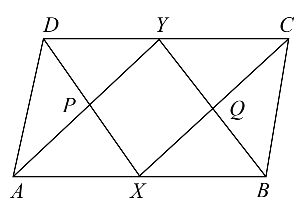
(a) 90° (b) 60°
(c) 56° (d) 62°

59. $ABCD$ is a parallelogram and X, Y are the mid-points of sides AB and CD respectively. Then quadrilateral $AXCY$ is a:



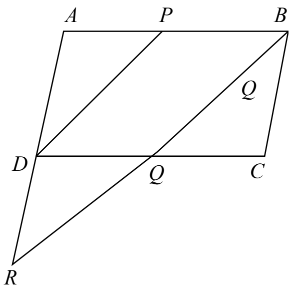
(a) parallelogram (b) rhombus
(c) square (d) rectangle

60. X, Y are the mid-points of opposite sides AB and DC of a parallelogram $ABCD$. AY and DX are joined intersecting in P; CX and BY are joined intersecting in Q. Then $PXQY$ is a:



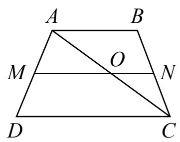
(a) Rectangle (b) Rhombus
(c) Parallelogram (d) Square

61. P is the mid-point of side AB to a parallelogram $ABCD$. A line through B parallel to PD meets DC at Q and AD produced at R. Then BR is equal to:



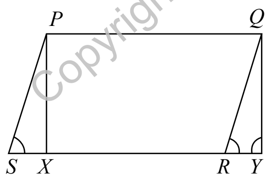
(a) BQ (b) $\frac{1}{2}$
(c) $2BQ$ (d) None of these

62. $ABCD$ is a trapezium in which $AB \parallel CD$. M and N are the mid-points of AD and respectively. If AB = 12 cm an MN = 14 cm. Find CD.



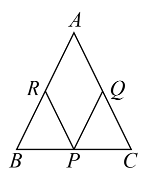
(a) 2 cm (b) 5 cm
(c) 12 cm (d) 16 cm

63. $PQRS$ is a parallelogram. PX and QY are, respectively, the perpendicular form P and Q to SR and SR produced. The PX is equal to:



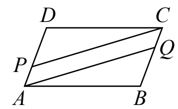
(a) QY (b) $2QY$
(c) $\frac{1}{2}Q$ (d) XR

64. In a ΔABC, P, Q and R are the mid-points of sides BC, CA and AB respectively. If AC = 21 cm, BC = 29 cm and AB = 30 cm. The perimeter of the quad. $ARPQ$ is:



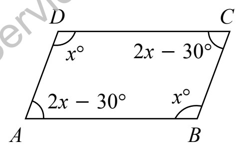
(a) 91 cm (b) 60 cm
(c) 51 cm (d) 70 cm

65. $ABCD$ is a parallelogram. P is a point on AD such that $AP = \frac{1}{3}AD$ and Q is a point on BC such that $CQ = \frac{1}{3}BC$. Then $AQCP$ is a:



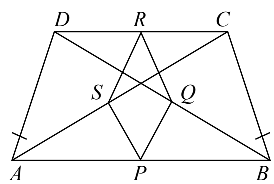
(a) Parallelogram (b) Rhombus
(c) Rectangle (d) Square

66. Find the measure of each angle of a parallelogram, if one of its angles is 30° less than twice the smallest angle.



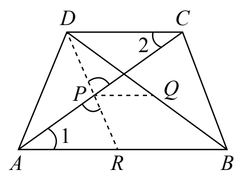
(a) 60°, 100°, 90°, 20°
(b) 80°, 40°, 120°, 90°
(c) 100°, 90°, 90°, 80°
(d) 70°, 110°, 70°, 110°

67. $ABCD$ is a trapezium in which $AB \parallel DC$ and $AD = BC$. If P, Q, R, S be respectively the mid-point of BA, BD and CD, CA. The $PQRS$ is a:



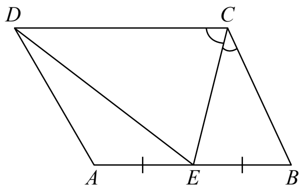
(a) Rhombus (b) Rectangle
(c) Parallelogram (d) Square

68. $ABCD$ is a trapezium and P, Q are the mid-points of the diagonals AC and BD. Then PQ is equal to:



(a) $\frac{1}{2}(AB)$ (b) $\frac{1}{2}(CD)$
(c) $\frac{1}{2}(AB - CD)$ (d) $\frac{1}{2}(AB + CD)$

69. *ABCD* is a parallelogram, E is the mid-point of *AB* and *CE* bisects $\angle BCD$. The $\angle DEC$ is:



(a) 60° (b) 90°
(c) 100° (d) 120°

70. The angles of a quadrilateral are respectively 100°, 98° and 92°. The fourth angle is equal to:
(a) 90° (b) 95°
(c) 70° (d) 75°

71. The measure of each angle of a regular hexagon is:
(a) 110° (b) 130°
(c) 115° (d) 120°

72. The interior angle of a regular polygon is 108°. The number of sides of the polygon is:
(a) 6 (b) 7
(c) 8 (d) 5

73. The number of diagonals in a hexagon is:
(a) 9 (b) 8
(c) 10 (d) 7

74. If the number of diagonals of a polygon is 27, then the number of sides is:
(a) 10 (b) 9
(c) 11 (d) 6

75. One angle of a pentagon is 140°. If the remaining angles are in the ratio 1:2:3:4. The size of the greatest angle is:
(a) 150° (b) 180°
(c) 160° (d) 170°

76. The exterior angle of a regular polygon is $\frac{1}{3}$ of its interior angle. The number of the sides of the polygon is:
(a) 9 (b) 8
(c) 10 (d) 12

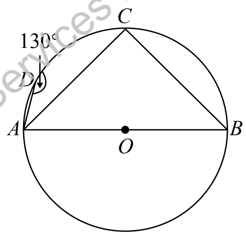
77. The ratio of the measure of an angle of a regular octagon to the measure of its exterior angle is:
(a) 3:1 (b) 2:1
(c) 1:3 (d) 1:2

78. *ABCDE* is a regular pentagon. Diagonal *AD* divides $\angle CDE$ in to parts, then the ratio of $\dfrac{\angle ADE}{\angle ADC}$ is equal to:
(a) 3:1 (b) 1:4
(c) 1:3 (d) 1:2

79. The difference between an exterior angle of $(n - 1)$ sided regular polygon and an exterior angle of $(n - 2)$ sided regular polygon is 6°, then the value of n is:
(a) 14 (b) 15
(c) 13 (d) 12

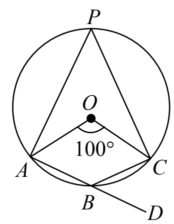
80. The radius of a circle is 13 cm and the length of one of its chords is 10 cm. What is the distance of the chord from the centre:
(a) 10 cm (b) 15 cm
(c) 12 cm (d) 9 cm

81. In the given figure, *ABCD* is a cyclic quadrilateral whose side *AB* is a diameter of the circle through *A*, *B* and *C*. If $\angle ADC = 130°$, find $\angle CAB$.



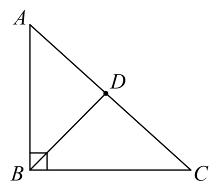
(a) 40° (b) 50°
(c) 30° (d) 130°

82. In the given figure, *O* is the centre of the circle, Find $\angle CBD$.



(a) 140° (b) 50°
(c) 40° (d) 130°

83. In a ΔABC, $\angle B$ is a right angle, $AC = 6$ cm and *D* is the mid-point of *AC*. Find the length of *BD*.

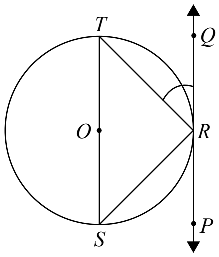


(a) 4 cm (b) $\sqrt{6}$ cm
(c) 3 cm (d) 4.5 cm

84. A cyclic quadirateral whose opposite angles are equal, is a:

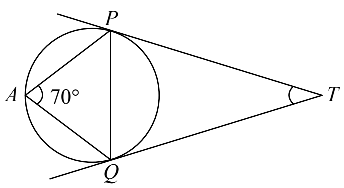
(a) Parallelogram but not a rhombus
(b) Rhombus
(c) Rectangle
(d) Square but not a rectangle

85. In the given figure, *ST* is a diameter of the circle with centre *O* and *PQ* is the tangent at a point *R*. If $\angle TRQ = 40$, what is $\angle RTS$:



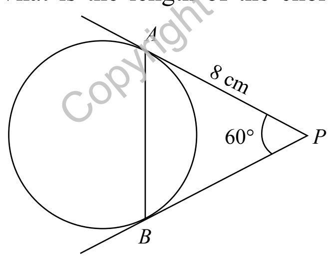
(a) 40° (b) 50°
(c) 60° (d) 30°

86. In the given figure, *TP* and *TQ* are tangents to the circle. If $\angle PAQ = 70°$, what is $\angle PTQ$?



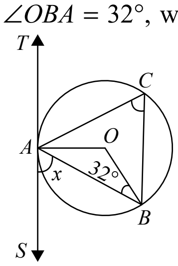
(a) 30° (b) 45°
(c) 60° (d) 40°

87. In the given figure, *PA* and *PB* are tangents from a point *P* to a circle such that *PA* = 8 cm and $\angle APB = 60°$. What is the length of the chord *AB*?



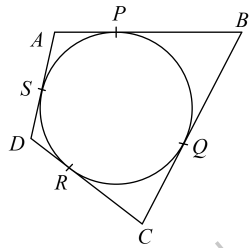
(a) 8 cm (b) 10 cm
(c) 6 cm (d) 12 cm

88. In the given figure, *TAS* is a tangent to the circle at the point *A*. If $\angle OBA = 32°$, what is the value of *x*:



(a) 64° (b) 40°
(c) 58° (d) 50°

89. In the given figure, a circle touches all the four sides of quadrilateral *ABCD* whose sides *AB* = 6 cm, *BC* = 7 cm and *CD* = 4 cm. Find *AD*.

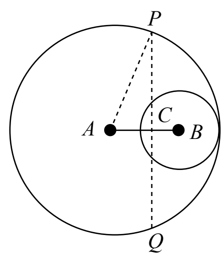


(a) 5 cm (b) 4 cm
(c) 3 cm (d) 2 cm

90. *AB* and *CD* are two parallel chords of a circle such that *AB* = 10 cm and *CD* = 24 cm. If the chords are on opposite sides of the centre and the distance between them is 17 cm, what is the radius of the circle:

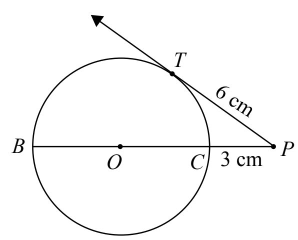
(a) 14 cm (b) 10 cm
(c) 13 cm (d) 15 cm

91. In the given figure, two circle with centres *A* and *B* of radii 5 cm and 3 cm touch each other internally. If the perpendicular bisector of segment *AB* meets the bigger circle in *P* and *Q*, find the length of *PQ*.



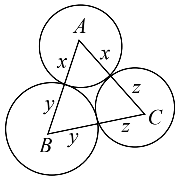
(a) $4\sqrt{6}$ cm (b) $\sqrt{24}$ cm
(c) $8\sqrt{3}$ cm (d) $4\sqrt{3}$ cm

92. In the given figure *O* is the centre of the circle and *PT* is a tangent at *T*. If *PC* = 3cm, *PT* = 6 cm, calculate the radius of the circle.



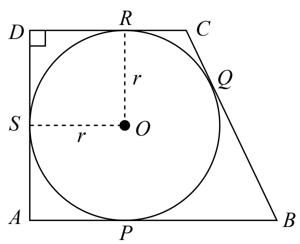
(a) 9 cm (b) 4.5 cm
(c) 8 cm (d) 12 cm

93. With the vertices of a ΔABC as centres, three circles are described, each touching the other two externally. If the sides of the Δ are 9 cm, 7 cm and 6 cm, find the radii of the circles:



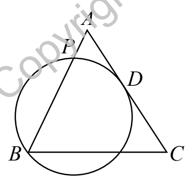
(a) 4cm, 7cm and 3cm
(b) 7cm, 5cm and 2cm
(c) 5cm, 4cm and 3cm
(d) 4cm, 5cm and 2cm

94. In the given figure, $ABCD$ is a quadrilateral in which $\angle O = 90$. A circle $C(0, r)$ touches the sides AB, BC, CD and DA at P, Q, R, S respectively. If $BC = 38$ cm, $CD = 25$ cm and $BP = 27$ cm, find the value of r.



(a) 14 cm (b) 15 cm
(c) 10 cm (d) 16 cm

95. In the given figure, ABC is an isosceles Δ in which $AB = AC$. A circle through B touches AC at its mid-point D and intersects AB at P. Then which of the following is correct:



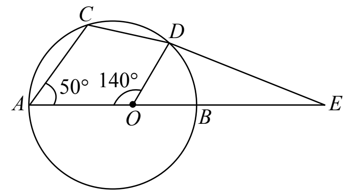
(a) $AP = \frac{3}{4}AB$ (b) $AP = \frac{2.5}{3}AB$

(c) $AP = \frac{4}{5}AB$ (d) $AP = \frac{1}{4}AB$

96. ABC is a right angled Δ with $BC = 6$ cm and $AB = 8$ cm. A circle with centre O is inscribed in ΔABC. The radius of the circle is:
(a) 4 cm (b) 3 cm
(c) 2 cm (d) 1 cm

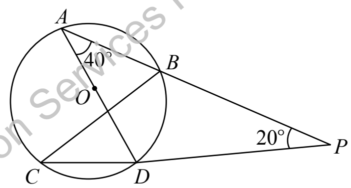
97. If all the sides of a parallelogram touch a circle, then the parallelogram is a:
(a) Rectangle (b) Rhombus
(c) Square (d) None

98. In the given figure, O is the centre of a circle. If $\angle AOD = 140°$ and $\angle CAB = 50°$, what is $\angle EDB$:



(a) 70° (b) 40°
(c) 60° (d) 50°

99. PBA and PDC are two secants. AD is the diameter of the circle with centre at O. $\angle A = 40$, $\angle P = 20°$. Find the measure of $\angle DBC$.

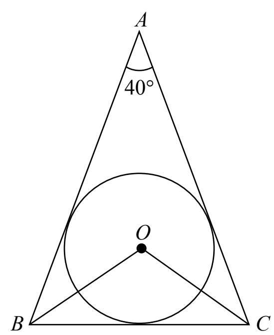


(a) 30° (b) 45°
(c) 50° (d) 40°

100. In the given figure, O is the centre of the circle. Then $\angle x + \angle y$ is equal to:
(a) $2\angle z$ (b) $\frac{\angle z}{2}$
(c) $\angle z$ (d) None

101. In a circle of radius 5 cm, AB and AC are two equal chords such that $AB = AC = 6$ cm. What is the length of the chord BC.
(a) 9.6 cm (b) 11 cm
(c) 12 cm (d) 9 cm

102. In the given figure O is the centre of incircle for ΔABC. Find $\angle BOC$ if $\angle BAC = 40°$.



(a) 100° (b) 120°
(c) 90° (d) 110°

103. If an equilateral triangle ABC be inscribed in a circle, then the tangents at their vertices will form another Δ.

(a) scalene (b) equilateral
(c) Isosceles (d) Right Δ

104. The radius of the incircle of a Δ is 4 cm and the segments into which one side is divided by the point of contact are 6 cm and 8 cm, then the length of the shortest side of the Δ is:

(a) 12 cm (b) 15 cm
(c) 13 cm (d) 14 cm

Exercise-2
(Based on Memory)

1. The two sides of a right triangle containing the right angle measure 3cm and 4cm. The radius of the incircle of the triangle is:

(a) 3.5 cm (b) 1.75 cm
(c) 1 cm (d) 0.875 cm

2. If two diameters of a circle intersect each other at right angles, then the quadrilateral formed by joining here end points is a:

(a) Rhombus (b) Rectangle
(c) Square (d) Parallelogram

3. Of all the chords of a circle passing through a given point in it, the smallest is that which:

(a) Is trisected at the point
(b) Is bisected at the point
(c) Passes through the centre
(d) None of these

4. In a circular lawn, there is a 16 m long path in the form of a chord. If the path is 6 m away from the centre of the lawn, then find the radius of the circular lawn.

(a) 16 m (b) 6 m
(c) 10 m (d) 8 m

5. The number of tangents that can be drawn to two non-intersecting circles:

(a) 4 (b) 3
(c) 2 (d) 13

6. In a triangle ABC, the length of the sides AB, AC and BC are 3, 5 and 6 cm respectively. If a point D on BC is drawn such that the line AD bisects the angle A internally, then what is the length of BD?

(a) 2 cm (b) 2.25 cm
(c) 2.5 cm (d) 3 cm

7. In a triangle ABC, $\angle A = x°$, $\angle B = y°$ and $\angle C = (y + 20)°$. If $4x - y = 10$, then the triangle is:

(a) Right-angle (b) Obtuse-angled
(c) Equilateral (d) None of these

8. If the sides of a right triangle are x, $x + 1$ and $x - 1$, then the hypotenuse:

(a) 5 (b) 4
(c) 1 (d) 0

9. If one of the diagonals of a rhombus is equal to its side, then the diagonals of the rhombus are in the ratio:

(a) $\sqrt{3}:1$ (b) $\sqrt{2}:1$
(c) 3:1 (d) 2:1

10. If P and Q are the mid points of the sides CA and GB respectively of a triangle ABC, right-angled at C. Then the value of 4 $(AQ^2 + BP^2)$ is equal to:

(a) 4 BC^2 (b) 5 AB^2
(c) 2 AC^2 (d) 2 BC^2

11. In a quadrilateral $ABCD$, $\angle B = 90°$ and $AD^2 = AB^2 + BC^2 + CD^2$, then $\angle ACD$ is equal to:

(a) 90° (b) 60°
(c) 30° (d) None of these

12. $ABCD$ is a square, F is mid point of AB and E is a point on BC such that BE is one-third of BC. If area of $\Delta FBE = 108$ m^2, then the length of AC is:

(a) 63 m (b) $36\sqrt{2}$ m
(c) $63\sqrt{2}$ m (d) $72\sqrt{2}$ m

13. We have an angle of $2\frac{1}{2}^{\circ}$. How big it will look through a glass that magnifies things three times?

(a) $2\frac{1}{2}^{\circ} \times 4$ (b) $2\frac{1}{2}^{\circ} \times 3$

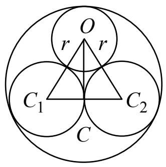
(c) $2\frac{1}{2}^{\circ} \times 2$ (d) None of these

14. Two circles with radii 'a' and 'b' respectively touch each other externally. Let 'c' be the radius of a circle that touches these two circle as well as a common tagent to the two circles. Then:

(a) $\frac{1}{\sqrt{a}} - \frac{1}{\sqrt{b}} = \frac{1}{\sqrt{c}}$ (b) $\frac{1}{\sqrt{a}} - \frac{1}{\sqrt{b}} = \frac{1}{\sqrt{c}}$

(c) $\frac{1}{\sqrt{a}} + \frac{1}{\sqrt{b}} = \frac{1}{\sqrt{c}}$ (d) None of these

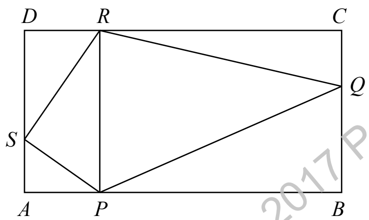
15. Two circles of unit radius touch each other and each of them touches internally a circle of radius two, as shown in the following figure. The radius of the circle which thouches all the three circles:



(a) 5   (b) $\frac{3}{2}$

(c) $\frac{2}{3}$ (d) None of these

16. *ABCD* is a parallelogram *P*, *Q*, *R* and *S* are points on sides *AB*, *BC*, *CD* and *DA* respectively such that *AP* = *DR*. If the area of the parallelogram *ABCD* is 16 cm^2, then the area of the quadrilateral *PQRS* is:

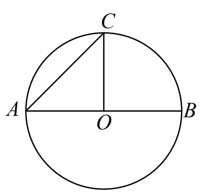


(a) 6 cm^2 (b) 6.4 cm^2
(c) 4 cm^2 (d) 8 cm^2

17. Let *ABC* be an acute-angled triangle and *CD* be the altitude through *C*. If *AB* = 8 and *CD* = 6, then the distance between the mid-points of *AD* and *BC* is:

(a) 36   (b) 25
(c) 27   (d) 5

18. In the accompanying figure, *AB* is one of the diameters of the circle and *OC* is perpendicular to it through the centre *O*. If *AC* is $7\sqrt{2}$ cm, then what is the area of the circle in cm^2?

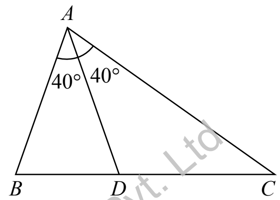


(a) 24.5   (b) 49
(c) 98   (d) 154

19. The circumcentre of a triangle is always the point of intersection of the:

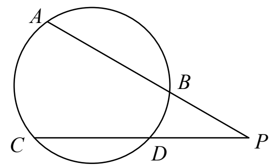
(a) Medians
(b) Bisectors
(c) Perpendiculars
(d) Perpendiculars dropped from the, vertices on the opposite side of the triangle

20. In the following figure, If *BC* = 8 cm, *AB* = 6 cm, *AC* 9 cm, then *DC* is equal to:



(a) 7 cm   (b) 4.8 cm
(c) 7.2 cm   (d) 4.5cm

21. If, in the following figure, *PA* = 8 cm, *PD* = 4 cm, *CD* equal to 3 cm, then *AB* is:



(a) 3.0 cm   (b) 3.5 cm
(c) 4.0 cm   (d) 4.5 cm

22. The number of tangents that can be drawn to two non-intersecting circle is:

(a) 4   (b) 3
(c) 2   (d) 1

23. With the vertices of a ΔABC as centers, three circles are described each touching the other two externally. If the sides of the triangle are 4, 6 and 8 cm respectively, then the sum of the radii of the three circles equals:

(a) 10   (b) 14
(c) 12   (d) 9

24. If 6440 soldiers were asked to stand in rows to from a perfect square, it was found that 40 soldiers were left out. What was the number of soldiers in each row?

(a) 40   (b) 80
(c) 64   (d) 60

25. The perimeters of two similar triangles *ABC* and *PQR* and 36 cm and 24 cm respectively. If *PQ* = 10 cm, the length of *AB* is:

(a) 16 cm   (b) 12 cm
(c) 14 cm   (d) 15 cm

26. If an angle is its own complementary angle, then its measure is:

(a) 30 (b) 45
(c) 60 (d) 90

27. The sum of the interior angles of a polygon is 1620°. The number of sides of the polygon are

(a) 9 (b) 11
(c) 15 (d) 12

28. How many sides a regular polygon has with its interior angle eight times its exterior angle?

(a) 16 (b) 24
(c) 18 (d) 20

29. The intercepts made by three parallel lines on a transverse line (l_1) are in the ratio 1:1. A second transverse line (l_2) making an angle of 30° with (l_1) is drawn. The corresponding intercepts on (l_2) are in the ratio:

(a) 1:1 (b) 2:1
(c) 1:2 (d) 1:3

30. The ratio of the sides of two regular polygons is 1:2 and of their interior angles, 3:4. The number of sides in each polygon is:

(a) 5, 10 (b) 10, 5
(c) 6, 8 (d) 9, 12

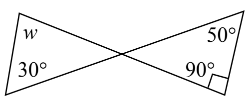
31. The degree measure of each of the three angles of a triangle is an integer. Which of the following could NOT be the ratio of their measures?

(a) 2:3:4 (b) 3:4:5
(c) 5:6:7 (d) 6:7:8

32. Three lines are drawn in a plane. Which of the following could NOT be the total number of points of intersection?

(a) 0
(b) 1
(c) 2
(d) All of the above could be the total number of points of intersection

33. In the figure given below, what is the value of w?

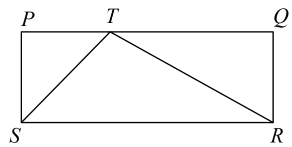


(a) 100 (b) 110
(c) 120 (d) 130

Note:

The diagram is not drawn to scale.

34. In the figure below, what is the ratio of the area of the triangle *STR* to the area of the rectangle *PQRS*?

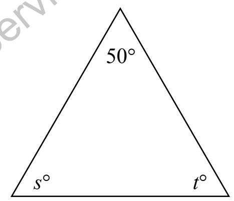


(a) 1:4 (b) 1:3
(c) 1:2 (d) 2:1

Note:

The diagram is not drawn to scale.

35. In the figure above, if $s < 50° < t$, then:



(a) $t < 80$ (b) $s + t < 130$
(c) $50 < t < 80$ (d) $t > 80$

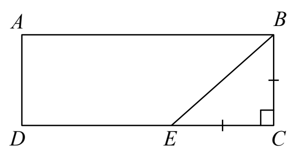
Note:

The diagram is not drawn to scale

36. The radius of the circumcircle of an equilateral triangle of side 12 cm is:

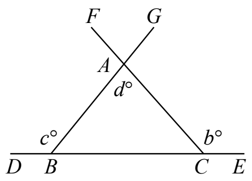
(a) $\left(\frac{4}{3}\right)\sqrt{3}$ (b) $4\sqrt{2}$
(c) $4\sqrt{3}$ (d) 4
(e) None of above

37. In the diagram below, *ABCD* is a rectangle. The area of isosceles right triangle *BCE* is 14, and $DE = 3EC$. What is the area of *ABCD*?



(a) 112 (b) 56
(c) 84 (d) $3\sqrt{28}$

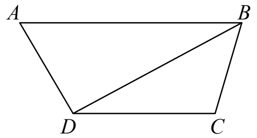
38. It is given that $d° = 70°$, $b° = 120°$. Then:



(a) $c° = 130°$
(b) $a° = 110°$
(c) Both (a) and (b) are correct
(d) Both (a) and (b) are wrong

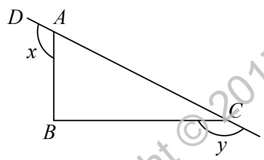
39. In the quadrilateral *ABCD*:

$AB + BC + CD + DA$ *is*



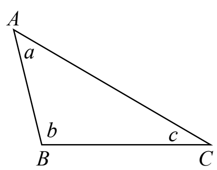
(a) Greater than 2*BD*
(b) Less than 2BD
(c) Equal to 2*BD*
(d) None of these

40. It is given that $AB \perp BC$. Which one of the following is true?



(a) $x + y = 180°$ (b) $x + y = 270°$
(c) $x + y = 300°$ (d) Cannot be said

41. ABC is a triangle. It is given that $a + c > 90°$, then b is:



(a) Greater than 90° (b) Less than 90°
(d) Equal to 90° (d) Cannot be said

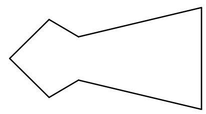
42. Which of the following are possible measure for the angles of a parallelogram?
(a) 90, 90, 90, 90
(b) 40, 70, 50, 150
(c) 50, 130, 50, 130

(1) (a) only (2) (b) only
(3) (c) only (4) (b) and (c) only

43. Find the distance of aperpendicular from the centre of a circle to the chord if the diameter of the circle is 30 cm and its chord is 24cm.
(a) 6 cm (b) 7 cm
(c) 9 cm (d) 10 cm

44. The medians *AD*, *BE* and *CF* of a triangle *ABC* intersect in G. Which of the following is true for any ΔABC?
(a) $GB + GC = 2GA$
(b) $GB + GC < GA$
(c) $GB + GC > GA$
(d) $GB + GC = GA$
(e) None of these

45. Find the sum of the degree measure of the internal angles in the polygon shown below.



(a) 600° (b) 720°
(c) 900° (d) 1080°
(e) 750°

46. A semi-circle is drawn with AB as its diameter. From C, a point on AB, a line perpendicular to AB is draw meeting the circumference of the semi-circle at D. Given that AC = 2 cm and CD = 6 cm the area of the semicircle (in cm^2) will be:

(a) 32π cm^2 (b) 50π cm^2
(c) 40.5π cm^2 (d) 81π cm^2
(e) undeterminable

47. An equilateral triangle BPC is drawn inside a square ABCD. What is the value of the angle APD in degrees:
(a) 75 (b) 90
(c) 12 (d) 135
(e) 150

48. The angles of a quadrilateral are in the ratio of 2:4:7:5. The smallest angle of the quadrilateral is equal to the smallest angle of a triangle. One of the angles of the triangle is twice the smallest angle of the triangle. What is the second largest angle of the triangle?

(a) 80° (b) 60°
(c) 120° (d) Cannot be determined

[CBI (PO), 2010]

49. Angle '*A*' of the quadrilateral *ABCD* is 26° less than angle *B*. Angle *B* is twice angle *C* and angle *C* is 10° more than the angle *D*. What would be the measure of angle '*A*'?

(a) 104° (b) 126°
(c) 56° (d) 106°

[Corporation Bank PO, 2009]

50. The ratio between the angles of a quadrilateral is 3:4:6:5. Two-thirds the largest angle of the quadrilateral is equal to the smaller angle of a parallelogram? What is the value of adjacent angle of the parallelogram?

(a) 120° (b) 110°
(c) 100° (d) 130°

[OBC PO, 2010]

51. The ratio between the adjacent angles of a parallelogram are 2:3. The smallest angle of a quadrilateral is equal to the half of the smallest angle of a parallelogram. The highest angle of a quadrilateral is 4 times greater than its smallest angle. What is the sum of the highest angle of a quadrilateral and the smallest angles of a parallelogram?

(a) 252° (b) 226°
(c) 144° (d) 180°

[Union Bank of India PO, 2011]

52. One of the angles of a triangle is two-thirds angle of sum of adjacent angles of parallelogram. Remaining angles of the triangle are in ratio 5:7 respectively. What is the value of second largest angle of the triangle?

(a) 25°
(b) 40°
(c) 35°
(d) Cannot be determined

[Corporation Bank PO, 2011]

53. Smallest angle of a triangle is equal to two-thirds the smallest angle of a quadrilateral. The ratio between the angles of the quadrilateral is 3:4:5:6. Largest angle of the triangle is twice its smallest angle. What is the sum of second largest angle of the triangle and largest angle of the quadrilateral?

(a) 160º (b) 180º
(c) 190º (d) 170º

[Bank of Baroda PO Examination, 2011]

54. The largest and the second largest angles of a triangle are in the ratio of 3:2, respectively. The smallest angle is 20% of the sum of the largest and the second largest angles. What is the sum of the smallest and the second largest angles?

(a) 80º (b) 60º
(c) 100º (d) 90º

[Bank of Baroda PO, 2010]

55. *a* and *b* are two sides adjacent to the right angle of a right-angle triangle and *p* is the perpendicular drawn to the hypotenuse from the opposite vertex. Then p^2 is equal to:

(a) $a^2 + b^2$ (b) $\frac{1}{a^2} + \frac{1}{b^2}$
(c) $\frac{a^2b^2}{a^2 + b^2}$ (d) $a^2 - b^2$

[SSC, 2014]

56. Two chords of lengths *a* metres and *b* metres subtend angles 60°and 90° at the centre of the circle, respectively. Which of the following is true?

(a) $b = \sqrt{2}a$ (b) $a = \sqrt{2}b$
(c) $a = 2b$ (c) $b = 2a$

[SSC, 2014]

57. In a $\Delta ABC, \angle A + \frac{1}{2}\angle B + \angle C = 140°$, then ∠B is:

(a) 50° (b) 80°
(c) 40° (d) 60°

[SSC, 2014]

58. The radius of a circle is 6 cm. The distance of a point lying outside the circle from the centre is 10 cm. The length of the tangent drawn from the outside point to the circle is:

(a) 5 cm (b) 6 cm
(c) 7 cm (d) 8 cm

[SSC, 2014]

59. If *ABCD* is a cyclic quadrilateral in which $\angle A = 4x°$, $\angle B = 7x°$, $\angle C = 5y°$, $\angle D = y°$, then *x*:*y* is:

(a) 3:4 (b) 4:3
(c) 5:4 (d) 4:5

[SSC, 2014]

60. *G* is the centroid of the equilateral Δ*ABC*. If *AB* = 10 cm, then length of *AG* is:

(a) $\frac{5\sqrt{3}}{3}$ cm (b) $\frac{10\sqrt{3}}{3}$ cm
(c) $5\sqrt{3}$ cm (d) $10\sqrt{3}$ cm

[SSC, 2014]

61. Two chords *AB* and *CD* of a circle with centre *O*, intersect each other at *P*. If $\angle AOD = 100°$ and $\angle BOC = 70°$, then the value of $\angle APC$ is

(a) 80° (b) 75°
(c) 85° (d) 95°

[SSC, 2014]

62. *ABCD* is a cyclic quadrilateral and *AD* is a diameter. If $\angle DAC = 55°$, then value of $\angle ABC$ is:
(a) 55° (b) 35°
(c) 145° (d) 125°
[SSC, 2014]

63. In ΔABC a straight line parallel to *BC* intersects *AB* and *AC* at *D* and *E*, respectively. If *AB* = 2*AD*, then *DE*:*BC* is:
(a) 2:3 (b) 2:1
(c) 1:2 (d) 1:3
[SSC, 2014]

64. *ABC* is an isosceles triangle such that *AB* = *AC* and *AD* is the median to the base *BC* with $\angle ABC = 35°$. Then $\angle BAD$ is:
(a) 35° (b) 55°
(c) 70° (d) 110°
[SSC, 2014]

65. A man goes 24 m due west and then 10 m due north. Now, the distance of him from the starting point is:
(a) 17 m (b) 26 m
(c) 28 m (d) 34 m
[SSC, 2014]

66. $\angle A$, $\angle B$, $\angle C$ are three angles of a triangle. If $\angle A - \angle B = 15°$, $\angle B - \angle C = 30°$, then $\angle A$, $\angle B$ and $\angle C$ are:
(a) 80°, 60°, 40° (b) 70°, 50°, 60°
(c) 80°, 65°, 35° (d) 80°, 55°, 45°
[SSC, 2013]

67. If *ABC* is an equilateral triangle and *D* is a point on *BC* such that $AD \perp BC$, then:
(a) *AB*:*BD* = 1:1 (b) *AB*:*BD* = 1:2
(c) *AB*:*BD* = 2:1 (d) *AB*:*BD* = 3:2
[SSC, 2013]

68. ΔABC is an isosceles triangle and $\overline{AB} = \overline{AC} = 2a$ units, $\overline{BC} = a$ units. Draw $\overline{AD} \perp \overline{BC}$ and find the length of $\overline{AD}$.
(a) $\sqrt{15}a$ units (b) $\sqrt{\frac{15}{2}}a$ units
(c) $\sqrt{17}a$ units (d) $\sqrt{\frac{17}{2}}a$ units
[SSC, 2013]

69. All sides of a quadrilateral *ABCD* touch a circle. If *AB* = 6 cm, *BC* = 7.5 cm, *CD* = 3 cm, then *DA* is:
(a) 3.5 cm (b) 4.5 cm
(c) 2.5 cm (d) 1.5 cm
[SSC, 2013]

70. In a right-angled triangle, the product of two sides is equal to half of the square of the third side, i.e., hypotenuse. One of the acute angles must be:
(a) 60° (b) 30°
(c) 45° (d) 15°
[SSC, 2013]

71. If two concentric circles are of radii 5 cm and 3 cm, then the length of the chord of the larger circle which touches the smaller circle is:
(a) 6 cm (b) 7 cm
(c) 10 cm (d) 8 cm
[SSC, 2013]

72. Inside a square *ABCD*, ΔBEC is an equilateral triangle. If *CE* and *BD* intersect at *O*, then $\angle BOC$ is equal to:
(a) 60° (b) 75°
(c) 90° (d) 120°
[SSC, 2013]

73. A point *D* is taken from the side *BC* of a right-angled triangle *ABC*, where *AB* is hypotenuse. Then:
(a) $AB^2 + CD^2 = BC^2 + AD^2$
(b) $CD^2 + BD^2 = 2AD^2$
(c) $AB^2 + AC^2 = 2AD^2$
(d) $AB^2 = AD^2 + BD^2$
[SSC, 2013]

74. Let *C* be a point on a straight line *AB*. Circles are drawn with diameters *AC* and *AB*. Let *P* be any point on the circumference of the circle with diameter *AB*. If *AP* meets the other circle at *Q*, then:
(a) $QC \parallel PB$
(b) *QC* is never parallel to *PB*
(c) $QC = \frac{1}{2}PB$
(d) $QC \parallel PB$ and $QC = \frac{1}{2}PB$
[SSC, 2013]

75. An isosceles triangle *ABC* is right-angled at *B*. *D* is a point inside the triangle *ABC*. *P* and *Q* are the feet of the perpendiculars drawn from *D* on the sides *AB* and *AC*, respectively of ΔABC. If *AP* = *a* cm, *AQ* = *b* cm and $\angle BAD = 15°$, then find sin 75°.
(a) $\frac{2b}{\sqrt{3}a}$ (b) $\frac{a}{2b}$
(c) $\frac{\sqrt{3}a}{2b}$ (d) $\frac{2a}{\sqrt{3}b}$
[SSC, 2013]

76. Each interior angle of a regular octagon in radians is:
(a) $\frac{\pi}{4}$ (b) $\frac{3\pi}{4}$
(c) $\frac{2\pi}{3}$ (d) $\frac{1}{3}\pi$
[SSC, 2013]

77. D and E are two points on the sides AC and BC, respectively of ΔABC such that DE = 18 cm, CE = 5 cm and $\angle DEC = 90°$. If tan ($\angle ABC$) = 3.6, then find AC:CD.

(a) BC:2CE (b) 2CE:BC
(c) 2CD:CE (d) CE:2BC

[SSC, 2013]

78. D is a point on the side BC of a triangle ABC such that $AD \perp BC$. E is a point on AD for which AE:ED = 5:1. If $\angle BAD = 30°$ and tan ($\angle ACB$) = 6 tan ($\angle DBE$), then find $\angle ACB$.

(a) 30° (b) 45°
(c) 60° (d) 15°

[SSC, 2013]

79. If the internal bisectors of $\angle ABC$ and $\angle ACB$ of ΔABC meet at O and also $\angle BAC = 80°$, then $\angle BOC$ is equal to:

(a) 50° (b) 160°
(c) 40° (d) 130°

[SSC Assistant Grade III, 2013]

80. O is the incenter of ΔABC. If $\angle BOC = 116°$, then $\angle BAC$ is:

(a) 42° (b) 62°
(c) 58° (d) 52°

[SSC Assistant Grade III, 2013]

81. Inside a triangle ABC, a straight line parallel to BC intersects AB and AC at the points P and Q, respectively. If $AB = 3PB$, then PQ:BC is:

(a) 1:3 (b) 3:4
(c) 1:2 (d) 2:3

[SSC Assistant Grade III, 2013]

82. O is the circumcentre of ΔABC. If $\angle BAC = 85°$, $\angle BCA = 75°$, then $\angle OAC$ is equal to:

(a) 70° (b) 60°
(c) 80° (d) 100°

[SSC Assistant Grade III, 2012]

83. The distance between the centres of the two circles with radii 4 cm and 9 cm is 13 cm. The length of the direct common tangent (between two points of contact) is:

(a) 13 cm (b) $\sqrt{153}$ cm
(c) 12 cm (d) 18 cm

[SSC Assistant Grade III, 2012]

84. The external bisector of $\angle ABC$ of ΔABC intersects the straight line through A and parallel to BC at the point D. If $\angle ABC = 50°$, then measure of $\angle ADB$ is:

(a) 65° (b) 55°
(c) 40° (d) 20°

[SSC Assistant Grade III, 2012]

85. AB is a diameter of a circle with centre at O. DC is a chord of it such that $DC \parallel AB$. If $\angle BAC = 20°$, then $\angle ADC$ is equal to:

(a) 120° (b) 110°
(c) 115° (d) 100°

[SSC Assistant Grade III, 2012]

86. The tangents drawn at P and Q on the circumference of a circle intersect at A. If $\angle PAQ = 68°$, then the measure of the $\angle APQ$ is:

(a) 56° (b) 68°
(c) 28° (d) 34°

[SSC Assistant Grade III, 2012]

87. If the incentre of an equilateral triangle lies inside the triangle and its radius is 3 cm, then the side of the equilateral triangle is:

(a) $9\sqrt{3}$ cm (b) $6\sqrt{3}$ cm
(c) $3\sqrt{3}$ cm (d) 6 cm

[SSC, 2012]

88. Suppose ΔABC be a right-angled triangle where $\angle A$ = 90° and $AD \perp BC$. If Area (ΔABC) = 40 cm^2, Area (ΔACD) = 10 cm^2 and AC = 9 cm, then the length of BC is:

(a) 12 cm (b) 18 cm
(c) 4 cm (d) 6 cm

[SSC, 2012]

89. Two circles touch each other externally at P. AB is a direct common tangent to the two circles, A and B are points of contact and $\angle PAB = 35°$. Then $\angle ABP$ is:

(a) 35° (b) 55°
(c) 65° (d) 75°

[SSC, 2012]

90. The length of the common chord of two intersecting circles is 24 cm. If the diameters of the circles are 30 cm and 26 cm, then the distance between the centres in cm is:

(a) 13 (b) 14
(c) 15 (d) 16

[SSC, 2012]

91. In ΔABC, D and E are points on AB and AC respectively such the $DE \parallel BC$ and DE divides the ΔABC into two parts of equal areas. Then ratio AD:BD is:

(a) 1:1 (b) $1:\sqrt{2}-1$
(c) $1:\sqrt{2}$ (d) $1:\sqrt{2}+1$

[SSC, 2012]

92. X and Y are centres of circles of radii 9 cm and 2 cm respectively, XY = 17 cm. Z is the centre of a circle of radius r cm which touches the above circles externally. Given that $\angle XZY = 90°$, the value of r is:

(a) 13 cm (b) 6 cm
(c) 9 cm (d) 8 cm

[SSC, 2012]

93. *I* is the incentre of a triangle *ABC*. If $\angle ABC = 65°$ and $\angle ACB = 55°$, then the value of $\angle BIC$ is:
(a) 130° (b) 120°
(c) 140° (d) 110°

[SSC, 2012]

94. If the radii of two circles be 6 cm and 3 cm and the length of the transverse common tangent be 8 cm, then the distance between the two centres is:
(a) $\sqrt{145}$ cm (b) $\sqrt{140}$ cm
(c) $\sqrt{150}$ cm (d) $\sqrt{135}$ cm

[SSC, 2012]

95. The ratio between the numbers of sides of two regular polygons is 1:2 and the ratio between their interior angles is 2:3. The number of sides of these polygons is respectively:
(a) 6 (b) 8
(c) 4 (d) 5

[SSC, 2012]

96. The angles of a triangle are in Arithmetic Progression. The ratio of the least angle in degrees to the number of radians in the greatest angle is $60:\pi$ .The angles in degrees are:
(a) 30°, 60°, 90° (b) 35°, 55°, 90°
(c) 40°, 50°, 90° (d) 40°, 55°, 85°

[SSC, 2012]

97. *A*, *B*, *C* are three points on a circle. The tangent at *A* meets *BC* produced at *T*, $\angle BTA = 40°$, $\angle CAT = 44°$. The angle subtended by *BC* at the centre of the circle is:
(a) 84° (b) 92°
(c) 96° (d) 104°

[SSC, 2011]

98. If the length of a chord of a circle at a distance of 12 cm from the centre is 10 cm, then the diameter of the circle is:
(a) 13 cm (b) 15 cm
(c) 26 cm (d) 30 cm

[SSC, 2011]

99. In ΔABC, *P* and *Q* are the middle points of the sides *AB* and *AC* respectively. *R* is a point on the segment *PQ* such that *PR*:*RQ* = 1:2. If *PR* = 2 cm, then *BC* =
(a) 4 cm (b) 2 cm
(c) 12 cm (d) 6 cm

[SSC, 2011]

100. If O is the circumcentre of ΔABC and $\angle OBC = 35°$, then the $\angle BAC$ is equal to:
(a) 55° (b) 110°
(c) 70° (d) 35°

[SSC, 2011]

101. If I is the incentre of ΔABC and ∠BIC = 135°, then ΔABC is:
(a) acute angled (b) equilateral
(c) right angled (d) obtuse angled

[SSC, 2011]

102. What is the length of the radius of the circum-circle of the equilateral triangle, the length of whose side is $6\sqrt{3}$ cm?
(a) $6\sqrt{3}$ cm (b) 6 cm
(c) 5.4 cm (d) $3\sqrt{6}$ cm

[SSC, 2010]

103. The ratio of the adjacent angles of a parallelogram is 7:8. Also, the ratio of the angles of quadrilateral is 5:6:7:12. What is the sum of the smaller angle of the parallelogram and the second largest angle of the quadrilateral?
(a) 168º (b) 228º
(c) 156º (d) 224º
(e) None of these

[IOB PO, 2011]

104. One of the angles of a triangle is two-thirds of the sum of the adjacent angles of parallelogram. Remaining angles of the triangle are in the ratio 5:7. What is the value of the second largest angle of the triangle?
(a) 25° (b) 40°
(c) 35° (d) Cannot be determined
(e) None of these

[Corporation Bank PO, 2011]

105. Angle '*A*' of a quadrilateral *ABCD* is 26° less than angle *B*. Angle *B* is twice angle *C* and angle *C* is 10° more than angle *D*. What would be the measure of angle *A*?
(a) 104° (b) 126°
(c) 56° (d) 132°
(e) 106°

[Corporation Bank PO, 2009]

106. A number when subtracted by $\frac{1}{7}$ of itself gives the same value as the sum of all the angles of a triangle. What is the number?
(a) 224 (b) 210
(c) 140 (d) 350
(e) 187

[Corporation Bank PO, 2009]

ANSWER KEYS

Exercise–I

1. (c)	**2.** (b)	**3.** (a)	**4.** (d)	**5.** (a)	**6.** (d)	**7.** (a)	**8.** (b)	**9.** (a)	**10.** (c)	**11.** (b)	**12.** (d)
13. (c)	**14.** (b)	**15.** (b)	**16.** (d)	**17.** (a)	**18.** (c)	**19.** (a)	**20.** (a)	**21.** (b)	**22.** (c)	**23.** (c)	**24.** (a)
25. (a)	**26.** (d)	**27.** (b)	**28.** (c)	**29.** (a)	**30.** (c)	**31.** (a)	**32.** (b)	**33.** (c)	**34.** (a)	**35.** (d)	**36.** (b)
37. (d)	**38.** (b)	**39.** (c)	**40.** (d)	**41.** (a)	**42.** (d)	**43.** (b)	**44.** (b)	**45.** (b)	**46.** (c)	**47.** (b)	**48.** (c)
49. (b)	**50.** (a)	**51.** (d)	**52.** (c)	**53.** (a)	**54.** (c)	**55.** (d)	**56.** (d)	**57.** (a)	**58.** (d)	**59.** (a)	**60.** (c)
61. (c)	**62.** (d)	**63.** (a)	**64.** (c)	**65.** (a)	**66.** (a)	**67.** (a)	**68.** (c)	**69.** (b)	**70.** (c)	**71.** (d)	**72.** (d)
73. (a)	**74.** (b)	**75.** (c)	**76.** (b)	**77.** (a)	**78.** (d)	**79.** (c)	**80.** (c)	**81.** (a)	**82.** (d)	**83.** (c)	**84.** (c)
85. (b)	**86.** (d)	**87.** (a)	**88.** (c)	**89.** (c)	**90.** (c)	**91.** (a)	**92.** (b)	**93.** (d)	**94.** (a)	**95.** (d)	**96.** (c)
97. (b)	**98.** (d)	**99.** (a)	**100.** (c)	**101.** (a)	**102.** (d)	**103.** (b)	**104.** (c)				

Exercise–I

1. (c)	**2.** (c)	**3.** (d)	**4.** (c)	**5.** (a)	**6.** (b)	**7.** (a)	**8.** (a)	**9.** (a)	**10.** (b)	**11.** (a)	**12.** (b)
13. (d)	**14.** (c)	**15.** (c)	**16.** (d)	**17.** (d)	**18.** (d)	**19.** (b)	**20.** (b)	**21.** (d)	**22.** (d)	**23.** (d)	**24.** (b)
25. (d)	**26.** (b)	**27.** (b)	**28.** (c)	**29.** (a)	**30.** (a)	**31.** (d)	**32.** (d)	**33.** (b)	**34.** (c)	**35.** (d)	**36.** (c)
37. (a)	**38.** (c)	**39.** (a)	**40.** (b)	**41.** (b)	**42.** (c)	**43.** (c)	**44.** (c)	**45.** (c)	**46.** (b)	**47.** **(e)**	**48.** (b)
49. (d)	**50.** (c)	**51.** (d)	**52.** (c)	**53.** (b)	**54.** (d)	**55.** (c)	**56.** (a)	**57.** (b)	**58.** (d)	**59.** (b)	**60.** (b)
61. (d)	**62.** (c)	**63.** (c)	**64.** (b)	**65.** (b)	**66.** (c)	**67.** (c)	**68.** (b)	**69.** (d)	**70.** (c)	**71.** (d)	**72.** (b)
73. (a)	**74.** (d)	**75.** (c)	**76.** (b)	**77.** (c)	**78.** (c)	**79.** (d)	**80.** (d)	**81.** (d)	**82.** (a)	**83.** (c)	**84.** (a)
85. (b)	**86.** (a)	**87.** (b)	**88.** (b)	**89.** (b)	**90.** (b)	**91.** (b)	**92.** (b)	**93.** (b)	**94.** (a)	**95.** (c)	**96.** (a)
97. (d)	**98.** (c)	**99.** (c)	**100.** (a)	**101.** (c)	**102.** (b)	**103.** (a)	**104.** (c)	**105.** **(e)**	**106.** (b)		

EXPLANATORY ANSWERS

Exercise-I

1. **(c)** Let the measured of the required angle be x degree. Then, its supplement = $180 - x$

Now, angle $= \frac{1}{3}$ (its supplement)

$x = \frac{1}{3}(180 - x)$

$3x + x = 180° \Rightarrow x = 45°$.

2. **(b)** complement of $30°20' = 90° - (30°20') = 90° - (30° + 20')$

$= (89° - 30°) + (1° - 20')$

$= 59° + 60' - 20' \quad [\because \quad 1° = 60']$

$= 59° + 40' = 59°40'$.

3. **(a)** Since OP bisects $\angle BOC$,

$\therefore \quad \angle BOC = 2\angle POC$

Again, OQ bisects $\angle AOC$, $\therefore$,

$\angle AOC = 2\angle QOC$

Since ray OC stands on line AB, $\therefore$,

$\angle AOC + \angle BOC = 180° \quad \Rightarrow \quad 2\angle QOC + 2\angle POC = 180°$

$\Rightarrow \quad 2\angle QOC + \angle POC = 180°$

$\Rightarrow \quad \angle QOC + \angle POC = 90°$

$\Rightarrow \quad \angle POQ = 90°$.

The above sum can also be restated as follows; The angle between the bisectors of a linear pair of angles is a right angle.

4. **(d)** Through O, draw a line l parallel to both AB and CD. Then

$\angle 1 = 45° \quad$ (alt. $\angle$S)

and $\angle 2 = 30° \quad$ (alt. $\angle$S)

$\therefore \quad \angle BOC = \angle 1 + \angle 2 = 45° + 30° = 75°$

So, $X = 360° - \angle BOC = 360° - 75° = 285°$

Hence $X = 285°$.

5. **(a)** AB || CD and t transversal intersects them at E and F

$\angle BEF + \angle EFD = 180°$ (co-interior angles)

$$\Rightarrow \frac{1}{2}\angle BEF + \frac{1}{2}\angle EFD = 180°$$

$\Rightarrow \angle BEF + \Delta EFD = 90°$

In $\angle EFG$

$\angle EFG + \angle FEG + \angle EGF = 180°$

$\therefore \angle EGF + 90° = 180°$

$\therefore \angle EGF = 90°$.

The above result can be restated as:

If two parallel lines are cut by a transversal, then the bisectors of the interior angles on the same side of the transversal intersect each other at right angles.

6. **(d)**

$\angle DCK = \angle FDG = 55°$ (corr. $\angle s$)

$\therefore \angle ACE = \angle DCK = 55°$ (vert. opp. $\angle s$)

So, $\angle AEC = 180° - (40° + 55°) = 85°$

$\therefore \angle HAB = \angle AEC = 85°$ (corr. $\angle s$)

Hence, $x = 85°$.

7. **(a)** Let, the measure of the required angled be $x°$.

Then, measure of its complement = $(90 - x)°$ measure of its supplement = $(180 - x)°$

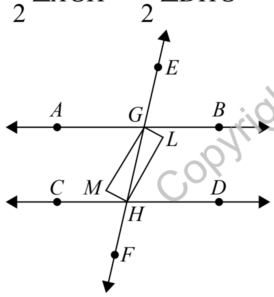
$6(90° - x) = 2(180° - x) - 12°$

$\Rightarrow 540° - 6x = 360° - 2x - 12°$

$\Rightarrow 4x = 192° \Rightarrow x = 48°$.

8. **(b)** $\angle AGH = \angle DHG$ (alt. int. angles)

$$\frac{1}{2}\angle AGH = \frac{1}{2}\angle DHG \Rightarrow \angle HGM = \angle GHL$$



Thus, lines GM and HL are intersected by a transversal GH at G and H respectively such that pair of alternate angles are equal, i.e., $\therefore \angle HGM = \angle GHL$

$\therefore GM \parallel HL$

Similarly, $GL \parallel HM$

So, $GMHL$ is a $\parallel_{gm}$.

Since $AB \parallel CD$ and EF is a transversal

$\therefore \angle BGH + \angle DHG = 180°$ [co-interior angles]

$$\therefore \frac{1}{2}\angle BGH + \frac{1}{2}\angle DHG = 90°$$

$\Rightarrow \angle LGH + \angle LHG = 90°$

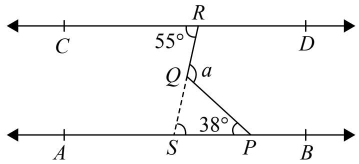
But $\angle LGH + \angle LHG + \angle GLH = 180°$

$\therefore 90° + \angle GLH = 180° \Rightarrow \angle GLH = 90°$

Thus, in $\parallel_{gm}$ $GMHL$, we have $\angle GLH = 90°$

Hence, $GMHL$ is a rectangle.

9. **(a)** CD || AB (Given)



Produce RQ to meet AB in S

$\angle CRS = \angle PSR$ (at. int. $\angle s$)

But $\angle CRS = 55°$

$\therefore \angle PSR = 55°$

Now in QSP

$\angle QSP + \angle QPS + \angle PQS = 180°$

$55° + 38° + \angle SQP = 180°$

$\therefore \angle SQP = 180° - 93° = 87°$

But angle a and $\angle PQS$ are linear

$\angle a = 180° - 87°$

$\angle a = 93°$

10. **(c)** Let, the angle be $x \Rightarrow$ Its complement = $90° - x$

According to the question

$(90 - x) = x + 60° \Rightarrow x = 15°$

11. **(b)** $\angle DAC = \angle B + \angle C$

(Exterior angle prop. of a Δ)

$130° = 2x + 3x$

$5x = 130°$

$x = 26°$

$\therefore \angle B = 52°; \angle C = 78°$.

12. **(d)** $\angle B = \angle C \Rightarrow AB = BC$

$\angle CAD = 30°$

$\therefore \angle CAD > \angle CDA \Rightarrow CD > AC$

(In a Δ, greater angle has longer side opposite to it)

$\angle BAC = 180° - 110° = 70° > \angle ABC$

$\Rightarrow BC > AB$ and $BC > AC$

$\therefore BC > CA$ and $CA < CD$

13. **(c)** Let, $2\angle A + 3\angle B = 6\angle C = K$

$$\therefore \angle A = \frac{K}{2}, \angle B = \frac{K}{3}, \angle C = \frac{K}{6}$$

But $\angle A + \angle B + \angle C = 180°$

$$\therefore \frac{k}{2} + \frac{k}{3} + \frac{k}{6} = 180°$$

$K = 180°$

Hence, $\angle A = \dfrac{180°}{2} = 90°$.

14. **(b)** Since A, B and C are the angles of a Δ,

$\therefore A + B + C = 180°$

Now $A - B = 15°$; $B - C = 30°$; $\therefore B = C + 30°$

$\therefore \angle A = B + 15° = C + 30° + 15° = C + 45°$

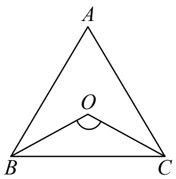
$\therefore A + B + C = (C + 45°) + (C + 30°) + C$

$3C = 180° - 75° = 105°$

$C = 35°$

$\therefore \quad \angle A = 35° + 45° = 80°.$

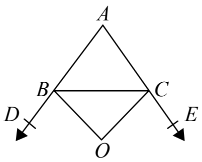
15. (b) $\angle BOC = 90° + \frac{1}{2}\angle A$



$\therefore \quad \angle BOC = 90° + \frac{1}{2}(70°) = 90° + 35°$

$\angle BOC = 125°.$

16. (d) $\angle BOC = 90° - \frac{1}{2}\angle A$



$\therefore \quad \angle BOC = 90° - \frac{1}{2}(40°)$

$= 90° - 20°$

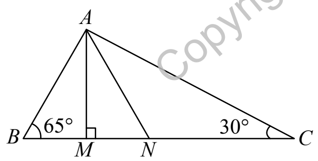
$\angle BOC = 70°.$

17. (a) $\angle MAN = \frac{1}{2}(\angle B - \angle C)$

$\angle MAN = \frac{1}{2}(65° - 30°)$

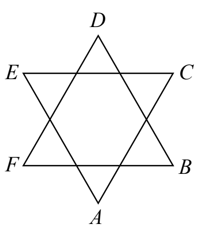
$= \frac{1}{2} \times 35°$

$\angle MAN = 17.5°.$



18. (c) In ΔACE

$\angle A + \angle C + \angle E = 180°$



Similarly in ΔDFB

$\angle D + \angle F + \angle B = 180°$

$\therefore \quad (\angle A + \angle C + \angle E) + (\angle A + \angle C + \angle E) = 360°.$

19. (a) Since $DE \parallel BC$, $\therefore \quad \frac{AB}{AD} = \frac{AC}{AE}$

$\therefore \quad \frac{68}{17} = \frac{9}{AE}$

or, $AE = \frac{9}{4} = 2.25$ cm.

20. (a) Since, the diagonals of a trapezium divide each other proportionally

$\therefore \quad \frac{AO}{OC} = \frac{BO}{OD}$

$\frac{3x-19}{x-5} = \frac{x-3}{3}$

$\Rightarrow \quad 3(3x-19) = (x-3)(x-5)$

$\Rightarrow \quad 9x - 57 = x^2 - 8x + 15$

$\Rightarrow \quad x^2 - 17x + 72 = 0$

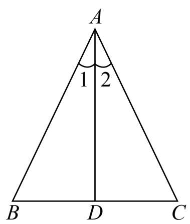
$\Rightarrow \quad x = 8$ or $x = 9$.

21. (b) Since $\angle 1 = \angle 2$

$\therefore \quad \frac{AB}{AC} = \frac{BD}{CD}$

But $BD = CD$ (given)

$\therefore \quad \frac{AB}{AC} = 1$



$AB = AC$ $\therefore$ the given Δ is isosceles

22. (c) $PR = \sqrt{PM^2 + MR^2} = \sqrt{36 + 64} = 10$ cm

$PQ = \sqrt{QR^2 - PR^2} = \sqrt{26^2 - 10^2} = 24$ cm

$\therefore \quad$ ar$(\Delta PQR) = 1 \times 10 \times 12 = 120$ cm^2.

23. (c) Solution Let ABC and DEF be the two similar Δs having area 81 cm^2 and 144 cm^2 respectively: Let BC = 27 cm

Then since $\Delta ABC \sim \Delta DEF$

$\therefore \quad \frac{ar(\Delta ABC)}{ar(\Delta DEF)} = \frac{BC^2}{EF^2}$ (area Theorem)

$\frac{81}{144} = \frac{(27)^2}{x^2} \Rightarrow \frac{9}{12} = \frac{27}{x}$

$\therefore \quad x = 36$ cm.

24. (a) In ΔsADE and ΔABC

$\angle A = \angle A$ [common]

$\angle ADE = \angle ACB = x°$(Given)

$\therefore \quad \Delta ADE \sim \Delta ACB$ (AA Similarly)

$\frac{AD}{AC} = \frac{AE}{AB}$

(corresponding sides of ~ Δs are proportional)

$\frac{6}{13} = \frac{9}{AB}$

$AB = \frac{39}{2} = 19.5$ cm

Hence $BD = AB - AD = 19.5 - 6 = 13.5$ cm.

25. **(a)** In ΔABC, AD is the bisector of $\angle A$

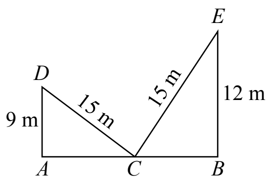
$\frac{AB}{AC} = \frac{BD}{CD}$ (Internal bisector prop.)

$\frac{4}{5.2} = \frac{3}{DC} \Rightarrow DC = 3.9$ cm

But $BC = BD + CD = 3$ cm $+ 3.9$ cm $= 6.9$ cm.

26. **(d)** $AC = \sqrt{DC^2 - AD^2} = \sqrt{15^2 - 9^2}$

$= \sqrt{144} = 12$ cm



$CB = \sqrt{CE^2 - BE^2} = \sqrt{15^2 - 12^2}$

$= \sqrt{81} = 9$ m

∴ Width of the street $(AC + BC) = AB = 12 + 9 = 21$ m.

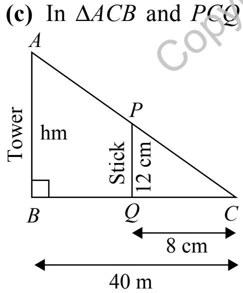
27. **(b)** Clearly $DE \parallel BC$ (by converse of BPT)

∴ $\Delta ADE \sim ABC$ ($\angle A = \angle A$ and $\angle ADE = \angle B$)

∴ $\frac{ar(\Delta ADE)}{ar(\Delta ABC)} = \frac{AD^2}{AB^2}$ (Area Theorem)

$= \frac{AD^2}{(2AD)^2} = \frac{1}{4}$ ($\because$ $AB = 2AD$)

28. **(c)** In ΔACB and PCQ



$\angle C = \angle C$ (common)

$\angle ABC = \angle PQC$ (each 90°)

∴ $\Delta ACB \sim \Delta PC$ (AA Similarity)

∴ $\frac{AB}{PQ} = \frac{BC}{QC}$

$\frac{h}{12} = \frac{4000}{8}$

$h = 60$ m.

29. **(a)** Since $\frac{AD}{DB} = \frac{AE}{EC} = \frac{2}{3}$

∴ $DE \parallel BC$ (by converse of BPT)

∴ $\Delta ADE \sim \Delta ABC$ (AA similarity)

$\frac{AD}{AB} = \frac{DE}{BC}$

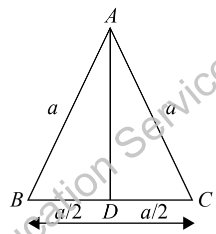
$\frac{8}{20} = \frac{DE}{BC}$

$\frac{2}{5} = \frac{DE}{BC} \Rightarrow \frac{BC}{DE} = \frac{5}{2}$.

30. **(c)** Lat $AB = BC = AC = a$

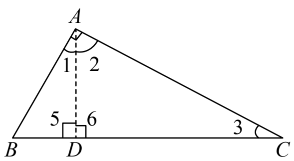
$AB^2 = AD^2 + BD^2$ (Pythagoras Theorem)

$a^2 = AD^2 + \frac{a^2}{4}$



$\frac{3a^2}{4} = AD^2$.

31. **(a)** Since $\angle 1 + \angle 2 = \angle 2 + 3$ (Each 90°)



∴ $\angle 1 = \angle 3$ [Each 90°]

Also $\angle 5 = \angle 6$

∴ $\Delta ADB \sim \Delta CDA$ [AA Similarity]

$\frac{AD}{CD} = \frac{DB}{AD} \Rightarrow AD^2 = BD \times CD$.

32. **(b)** Since diagonals of ||gm bisect each other, ∴ M will be the mid-point of each of the diagonal AC and BD

∴ In ΔABC $AB^2 + BC^2 = 2(AM^2 + MB^2)$ [Appolonius Theorem]

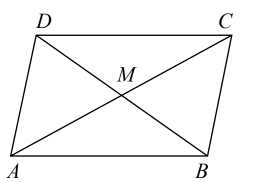
In ΔADC $AD^2 + CD^2 = 2(AM^2 + DM^2)$

$= 2(AM^2 + MB^2)$ [$\because$ $DM = BM$]

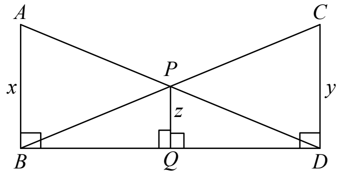
Adding $AB^2 + BC^2 + CD^2 + DA^2$

$= 4AM^2 + 4MB^2$

$= (2AM)^2 + (2MB)^2 = AC^2 + BD^2$.



33. (c) Since $\angle ABD = \angle CDB = \angle PQB = 90°$



$\therefore \quad AB \parallel PQ \parallel CD \Rightarrow \Delta BQP \sim \Delta BDC$ (AA simlarity)

$$\frac{BQ}{BD} = \frac{QP}{DC} \qquad \cdots(1)$$

Also $\Delta DQP \sim \Delta DBA$ (AA similarity)

$$\frac{DQ}{BD} = \frac{QP}{BA} \qquad \cdots(2)$$

Adding (1) and (2), $\dfrac{BD}{BD} = QP\left(\dfrac{1}{DC} + \dfrac{1}{BA}\right)$

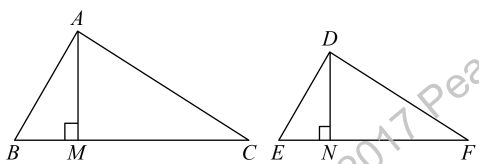
$$= \frac{1}{PQ} = \frac{1}{BA} + \frac{1}{CD} \quad \Rightarrow \quad \frac{1}{z} = \frac{1}{x} + \frac{1}{y}.$$

34. (a)

$$\frac{ar(\Delta ABC)}{ar(\Delta DEF)} = \frac{AM^2}{DN^2}$$

$$\frac{121}{81} = \frac{AM^2}{DN^2}$$

$$\therefore \frac{AM}{DN} = \frac{11}{9}$$



35. (d) $\Delta ADE \sim \Delta ABC$ (AA Similarity)

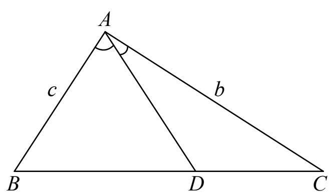
$$\therefore \quad \frac{ar(\Delta ADE)}{ar(\Delta ABC)} = \frac{DE^2}{BC} = \frac{9}{25} \text{ (area Them.)}$$

Let $ar(\Delta ADE) = 9x$ sq units. Then, $ar(\Delta ABC) = 25x$ sq. units

Now ar(trap. $BCED$) $= ar(\Delta ABC) - ar(\Delta ADE) = 16x$ sq. units

Hence $\dfrac{ar(\Delta ADE)}{ar(\text{trap } BCED)} = \dfrac{9x}{16x} = \dfrac{9}{16}$.

36. (b) Since AD bisects $\angle BAC$



$$\frac{c}{b} = \frac{BD}{CD} \quad \text{(Internal bisector prop.)}$$

Adding 1 to both the sides

$$\frac{c+b}{b} = \frac{BD+CD}{CD}$$

$$\frac{c+b}{b} = \frac{a}{CD} \quad \Rightarrow \quad CD = \frac{ab}{b+c}.$$

Similarly it can be proved that $BD = \dfrac{ac}{b+c}$

Also $BD + CD = BC$

$$\therefore \quad BD + \frac{ab}{b+c} = a$$

$$BD = a - \frac{ab}{b+c} \quad \Rightarrow \quad \frac{ab+ac-ab}{b+c} = \frac{ac}{b+c}.$$

37. (d) $ar(\Delta ABC) = \dfrac{1}{2}bc$

Also $ar(\Delta ABC) = \dfrac{1}{2}BC \times AD = \dfrac{1}{2}\sqrt{b^2+c^2} \times AD$

$[\because \ BC^2 = b^2 + c^2]$

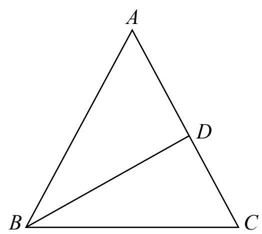
$$\therefore \quad \frac{1}{2}\sqrt{b^2+c^2} \times AD = \frac{1}{2}bc \quad \Rightarrow \quad AD = \frac{bc}{\sqrt{b^2+c^2}}.$$

38. (b) Since $BC^2 = AC \times CD$

$\therefore \dfrac{BC}{CD} = \dfrac{AC}{BC}$ and $\angle C = \angle C$

$\therefore \Delta ABC \sim \Delta BDC$ (SAS Similarity)

$$\frac{AB}{BD} = \frac{BC}{DC} = \frac{AC}{BC}$$



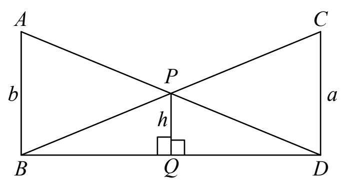
But $AB = AC$

$$\therefore \quad \frac{1}{BD} = \frac{1}{BC} \quad \Rightarrow \quad BD = BC.$$

39. (c) $\dfrac{1}{h} = \dfrac{1}{a} + \dfrac{1}{b}$

$$\frac{1}{h} = \frac{a+b}{ab}$$

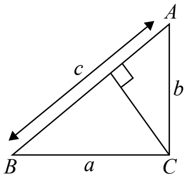
$$\therefore \quad h = \frac{ab}{a+b}.$$



40. (d) $p = \dfrac{ba}{\sqrt{b^2+a^2}}$

$$\frac{1}{p^2}=\frac{b^2+a^2}{b^2a^2}$$

$$\frac{1}{p^2}=\frac{1}{a^2}+\frac{1}{b^2}.$$



41. **(a)** $\Delta ADE \sim \Delta AB\,C(\because \quad DE \parallel BC \quad \therefore \quad AA$ Similrity)

$$\frac{AD}{AB}=\frac{DE}{BC}$$

$$\therefore \quad \frac{5x}{5x+4x}=\frac{DE}{BC}$$

$$\frac{5}{9}=\frac{DE}{BC}$$

Now, $\dfrac{ar(\Delta DFE)}{ar(\Delta CFB)}=\dfrac{5^2}{9^2}=\dfrac{25}{81}.$

42. **(d)** $ar(\Delta ABC) = 2\ ar(\Delta XBY)$

$$\frac{ar(\Delta XBY)}{ar(\Delta ABC)}=\frac{1}{2} \qquad \cdots(1)$$

But $\Delta XBY \sim \Delta ABC$ ($\because \quad XY \parallel AC$)

$$\therefore \quad \frac{ar(\Delta XBY)}{ar(\Delta ABC)}=\frac{XB^2}{AB^2} \text{ (Area Thm.)} \qquad \cdots(2)$$

$$\therefore \quad \frac{XB}{AB}=\frac{1}{\sqrt{2}}$$

$$\frac{AB-AX}{AB}=\frac{1}{\sqrt{2}}$$

$$\therefore \quad \frac{AX}{AB}=\frac{\sqrt{2}-1}{\sqrt{2}}.$$

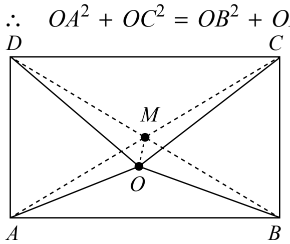
43. **(b)** Since the diagonals of a rectangle are equal and bisect each other. Let AC and BD intersect at M. Therefore M is the mid-point of AC and BD and $AM = DM$

From ΔAOC, $OA^2 + OC^2 = 2(AM^2 + MO^2)$

[Applloinus Thm.]

also in ΔODB, $OB^2 + OB^2 = 2(MO^2 + DM^2) = 2(MO^2 + AM^2)$

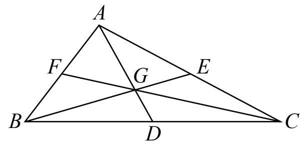
$\therefore \quad OA^2 + OC^2 = OB^2 + OD^2.$



44. **(b)** We know that the centroid of a Δ divides each median in the ratio of 2 : 1

$$\therefore \quad BG:BE=2:3 \quad \Rightarrow \quad BE=\frac{3}{2}BG$$

$$\Rightarrow \quad BE=\frac{3}{2}\times 6=9 \text{ cm.}$$



45. **(b)** Let the altitudes AL, BM and CN of ΔABC intersect at H. Then H is the orthocentre of ΔABC.

In ΔABC, $HL \perp BC$ and $BN \perp CH$.

Thus, the two altitudes HL and BN of ΔHBC, intersects at A.

46. **(c)** Since every exterior angle is equal to sum of interior opposite angles,

So, $\angle a = A + B$, $\angle b = B + C$ and $\angle c = A + C$

$\therefore \quad \angle a + \angle b + \angle c = 2(A + B + C) = 2 \times 180° = 360°.$

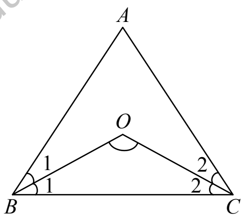
47. **(b)** Incentre of every triangle lies in its interior.

48. **(c)** In ΔABC, $\angle A + \angle B + \angle C = 180°$

$$\frac{1}{2}\angle A+\frac{1}{2}\angle B+\frac{1}{2}\angle C=90°$$

$$\frac{1}{2}\angle A+\angle 1+\angle 2=90°$$

$$\angle 1+\angle 2=90°-\frac{1}{2}\angle A \qquad \cdots(1)$$



Now in ΔBOC,

$\angle 1 + \angle 2 + \angle BOC = 180°$

$$\left(90°-\frac{1}{2}\angle A\right)+\angle BOC=180° \text{ (using(i))}$$

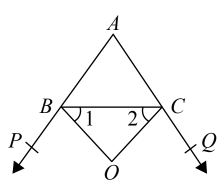
$$\Rightarrow \quad \angle BOC=90°+\frac{1}{2}\angle A.$$

49. **(b)** We have $\angle B + \angle CBP = 180°$ (Linear pair)

$$\Rightarrow \quad \frac{1}{2}\angle B+\angle CBP=90°$$

$$\Rightarrow \quad \frac{1}{2}\angle B+\angle 1=90°$$

$$\Rightarrow \quad \angle 1=90°-\frac{1}{2}\angle B \qquad \cdots(1)$$



Similarly, $\angle 2=90°-\dfrac{1}{2}\angle C$

In ΔOBC, we have $\angle 1 + \angle 2 + \angle BOC = 180°$

(Angle sum prop.)

$$\Rightarrow \left(90° - \frac{1}{2}\angle B\right) + \left(90° - \frac{1}{2}\angle C\right) + \angle BOC = 180°$$

$$\Rightarrow \angle BOC = \frac{1}{2}(\angle B + \angle C)$$

$$= \frac{1}{2}(\angle A + \angle B + \angle C) - \frac{1}{2}\angle A$$

$$= \frac{1}{2} \times 180° - \frac{1}{2}\angle A$$

$$\angle BOC = 90° - \frac{1}{2}\angle A.$$

50. **(a)** Join B and D and produce BD to E

Then, $p + q = \beta$ and $s + t = x$

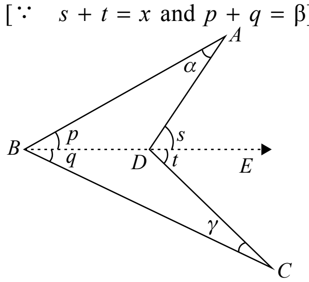
Now, $s = p + \alpha$ (Exterior angle of a Δ prop.)

Similarly, $t = q + \gamma$ (Exterior angle of a Δ prop.)

Adding, $s + t = p + q + \alpha + \gamma$

$x = \alpha + \beta - \gamma$

[$\because$ $s + t = x$ and $p + q = \beta$]



51. **(d)** Since AM is the bisector of $\angle A$,

$$\therefore \angle MAB = \frac{1}{2}\angle A \quad \cdots(1)$$

In rt-angled ΔANB, we have:

$\angle B + \angle NAB = 90° \Rightarrow \angle NAB = 90° - \angle B \quad \cdots(2)$

$$\therefore \angle MAN = \angle MAB - \angle NAB$$

$$= \frac{1}{2}\angle A - (90° - \angle B)$$

$$= \frac{1}{2}\angle A - 90° + \angle B$$

$$= \frac{1}{2}\angle A - \frac{1}{2}(\angle A + \angle B + \angle C) + \angle B$$

$$\left(\because \frac{1}{2}(\angle A + \angle B + \angle C) = 90°\right)$$

$$= \frac{1}{2}(\angle B - \angle C).$$

52. **(c)** $CE \parallel BA$ and AC is the transversal

$\therefore \angle 4 = \angle 1$ (alt. int. $\angle s$)

Again, $CE \parallel BA$ and BD is the transversal

$\therefore \angle 5 = \angle 2$ (corr. $\angle s$)

$\therefore \angle 4 + \angle 5 = \angle 1 + \angle 2$

$\therefore \angle ACD = \angle A + \angle B.$

53. **(a)** $\angle 1 = \angle A + \angle 5$ and

$\angle 2 = \angle A + \angle 6$ [Ext. angle prop. of a Δ]

$\angle 1 + \angle 2 = 2\angle A + \angle 5 + \angle 6$

$= 2\angle A + (180° - \angle A) = \angle A + 180°$

The given question can be restated as the sum of two exterior angles exceeds $\angle A$ of the ΔABC by 2 right angles.

54. **(c)** In ΔABC, $\angle ACE = \angle ABC + \angle BAC$

Similarly in ΔBCD, $\angle BDC = \angle DCE - \angle DBC$

[Ext. angle prop. of a Δ]

But $\angle DCE = \frac{1}{2}\angle ACE$ and

$$\frac{1}{2}\angle DBC = \frac{1}{2}\angle ABC$$

Now, $\angle BDC = \angle DCE - \angle DBC$

$$= \frac{1}{2}\angle ACE - \frac{1}{2}\angle ABC$$

$$= \frac{1}{2}(\angle ACE - \angle ABC)$$

$$= \frac{1}{2}(\angle ACE + \angle BAC - \angle ACE)$$

$$\therefore \angle BDC = \frac{1}{2}\angle BAC.$$

55. **(a)** In ΔBCE, $BC = EC$, $\therefore \angle B = \angle BEC$

In ΔCDE, $ED = EC$, $\therefore \angle ECD = \angle EDC$

and In ΔADE, $AD = ED$, $\therefore \angle AED = \angle A$

Now $\angle B = \angle BEC = \angle A + \angle ECD$

$= \angle A + \angle EDC = \angle A + \angle EAD + \angle AED$

$= \angle A + \angle A + \angle A = 3\angle A$

$$\therefore \frac{\angle B}{\angle A} = \frac{3}{1}$$

or, $\angle A : \angle B = 1 : 3.$

56. **(d)** In the rectangle $ABCD$.

$AB = CD$ and $AD = BC$.

Since the diagonals of a rectangle bisect each other,

$\therefore OA = OD$ i.e., $\angle ODA = \angle OAD$.

But, $\angle AOD = 44°$ (Vertically opposite angle to $\angle BOC$)

$$\therefore \angle OAD = \frac{1}{2}(180° - 44°) = \frac{1}{2}(136°) = 68°$$

Hence, $\angle OAD = 68°$

57. **(a)** $PQRS$ is a square

$SP = SR$ and $\angle S = 90°$

and $\angle SRP = \angle SPR = \frac{1}{2}(90°) = 45°$

Hence, $\angle SRP = 45°$.

58. **(d)** Since $AB = BC$

$$\therefore \angle BAC = \angle BCA = \frac{1}{2}(180° - 56°) = 62°$$

Also as $AB \parallel CD$ and AC transversal

So $\angle BAC = 62° = \angle ACD$

(Alternate interior angles)

$\therefore \angle ACD = 62°.$

59. **(a)** Since X and Y are the mid-points of AB and DC respectively.

$\therefore \quad AX = \frac{1}{2}AB$ and $CY = \frac{1}{2}DC$

But $\therefore \quad AB = DC \quad \Rightarrow \quad \frac{1}{2}AB = \frac{1}{2}DC \quad \Rightarrow \quad AX = CY$

Also, $AB \parallel DC$ [$\because$ $ABCD$ is a parallelogram]

$\Rightarrow \quad AX \parallel YC$

Thus, in quadrilateral $AXCY$,

$AX \parallel YC$ and $AX = YC$

Hence, quad, $AXCY$ is a parallelogram.

60. **(c)** Proceeding as in Q. No. 4, we can prove that $AXCY$ is a parallelogram

Similarly, $BXDY$ is a parallelogram.

Now, $AXCY$ is a parallelogram

$\Rightarrow \quad AY \parallel CX$

[$\because$ Opposite sides of a parallelogram are parallel]

$\Rightarrow \quad PY \parallel QX$ ...(1)

Also, $BXDY$ is a parallelogram

$\Rightarrow \quad DX \parallel BY$

[$\because$ Opposite sides of a parallelogram are parallel]

$\Rightarrow \quad PX \parallel QY$ ...(2)

Thus, in a quadrilateral $PXQY$, we have

$PY \parallel QX$ and $PX \parallel QY$ [From (i) and (ii)]

$\Rightarrow \quad PXQY$ is a parallelogram.

61. **(c)** In ΔARB, P is the mid-point of AB and $PD \parallel BR$.

$\Rightarrow \quad D$ is the mid-point of AR.

$\because$ $ABCD$ is a parallelogram

$\Rightarrow \quad DC \parallel AB \quad \Rightarrow \quad DQ \parallel AB$

Thus, in ΔRAB, D is the mid-point of AR and $DQ \parallel AB$.

$\therefore \quad Q$ is the mid-point of $RB \quad \Rightarrow \quad BR = 2BQ$.

62. **(d)** $ABCD$ is a trapezium in which $AB \parallel DC$ and M, N are the mid-points of AD and BC.

Hence, $MN \parallel AB$ and $MN \parallel DC$.

In ΔACB,

ON passes through the mid-point N of BC and $ON \parallel AB$

$\therefore \quad ON = \frac{1}{2}AB = \frac{1}{2}(12 \text{ cm}) = 6 \text{ cm}$

But $MO = MN - ON = (14 - 6)$ cm $= 8$ cm

Again MO passes through the mid-point M of AD and $MO \parallel DC$

$\therefore \quad MO = \frac{1}{2}DC = \frac{1}{2}CD$

Hence, $CD = 2(MO) = 2(8) = 16$ cm.

63. **(a)** Consider Δs PSX and QRY, in which $\angle X = \angle Y = 90°$

[$\because$ $PX \perp SR$ and $QY \perp SR$.]

and $SX = RY$

[$\because$ $SX = SY - XY$ and $RY = SY - SR = SY - PQ = SY - XY$]

and $PS = QR$ [Sides of a parallelogram]

$\therefore \quad \Delta PSX \cong \Delta QRY$ [R.H.S. axiom]

$\therefore \quad PX = QY$

[Corresponding parts of congruent Δs are congruent]

64. **(c)** ABC is a Δ and P, Q, R are the mid-points of sides BC, CA and AB resp.

$\therefore \quad PQ \parallel AB$

and $PQ = \frac{1}{2}AB = \frac{1}{2}(30) = 15$ cm.

Similarly, $RP \parallel AC$

and $RP = \frac{1}{2}AC = \frac{1}{2}(21) = 10.5$ cm.

$\therefore \quad$ Perimeter of $ARPQ = (AR + RP + PQ + QA)$ cm.

$= (15.0 + 10.5 + 15.0 + 10.5)$ cm

$= 51$ cm.

65. (a) $ABCD$ is a parallelogram.

$\Rightarrow \quad AD = BC$ and $AD \parallel BC$.

$\Rightarrow \quad \frac{1}{3}AD = \frac{1}{2}BC$ and $AD \parallel BC$.

$\Rightarrow \quad AP = CQ$ and $AP \parallel CQ$.

Thus, $APCQ$ is a quad. Such that one pair of opposite side AP and CQ are parallel and equal.

Hence, $APCQ$ is a parallelogram.

66. (a) In a parallelogram $ABCD$,

$\angle A + \angle D = 180°$

Let, $\angle D = x°$, $\angle A = 2x - 30°$

$\therefore \quad (2x° - 30°) + x° = 180°$

$\Rightarrow \quad 3x° = 180° + 30°$

$\Rightarrow \quad 3x° = 210°$ or $x = \frac{210°}{3}$

$\therefore \quad x° = 70°$

$\therefore \quad \angle D = 70° = \angle B$

and $\angle A = 2x - 30° = 110° = \angle C$.

67. (a) In ΔBDC, Q and R are the mid-points of BD and CD respectively.

$\therefore \quad QR \parallel BS$ and $QR = \frac{1}{2}BC$.

Similarly, $PS \parallel BC$ and $PS = \frac{1}{2}BC$.

$\therefore \quad PS \parallel QR$ and $PS = QR$ $\left[\text{each equal to} \frac{1}{2}BC\right]$.

Similarly $PQ \parallel SR$ and $PQ = SR$ $\left[\text{each equal to} \frac{1}{2}AD\right]$.

$\therefore \quad PS = QR = SR = PQ$ [$\because$ $AD = BC$]

Hence, $PQRS$ is a rhombus.

68. **(c)** Since $AB \parallel DC$ and transversal AC cuts them at A and C cresp.

$\therefore \quad \angle 1 = \angle 2$ ...(1)

[$\because$ Alternate angles are equal.]

Now, in ΔAPR and ΔDPC, $\angle 1 = \angle 2$

$AP = CP$ [$\because$ P is the mid-point of AC]

And $\angle 3 = \angle 4$. [Vertically opposite angles]

So, $\Delta APR \cong \Delta DPC[ASA]$.

$\Rightarrow$ $AR = DC$ and $PR = DP$ $\cdots(2)$

Again, P and Q are the mid-points of sides DR and DB respectively in ΔDRB.

$\therefore$ $PQ = \frac{1}{2}RB = \frac{1}{2}(AB - AR)$. [$\because$ $AR = DC$].

$\therefore$ $PQ = \frac{1}{2}(AB - DC)$.

69. **(b)** $AB \parallel DC$ and EC cuts them

$\Rightarrow$ $\angle BEC = \angle ECD$

$\Rightarrow$ $\angle BEC = \angle ECB$ [$\because$ $\angle ECD = \angle ECB$].

$\Rightarrow$ $EB = BC$ $\Rightarrow$ $AE = AD$.

Now, $AE = AD$ $\Rightarrow$ $\angle ADE = \angle AED$

$\Rightarrow$ $\angle ADE = \angle EDC$

[$\because$ Alternate Int. angles].

$\therefore$ DE bisects $\angle ADC$

Again, $\angle ADC + \angle BCD = 180°$ [Co. Int. angles].

$\Rightarrow$ $\frac{1}{2}\angle ADC + \frac{1}{2}\angle BCD = 90°$

$\Rightarrow$ $\angle EDC + \angle DCE = 90°$

But, $\angle EDC + \angle DEC + \angle DCE = 180°$

[$\because$ sum of the $\angle$s of a Δ is 180°]

$\therefore$ $\angle DEC = 180 - 90°$

$\therefore$ $\angle DEC = 90°$.

70. **(c)** $100° + 98° + 92° + x° = 360$

(sum of the angles of a quad)

$\because$ $290° + x = 360$ or $x = 360° - 290° = 70°$

71. **(d)** Let, the measure of each angle be $x°$. Then, sum of all the angles = $6x°$

We have,

Sum of all interior angle of a polygon = $(2n - 4)$ right. angle

$\therefore$ Sum of all interior angles of a hexagon

$= (2 \times 6 - 4)$ right angles

= 8 right angle = 720°

$6x° = 720°$ or $x = 120°$.

72. **(d)** Let there be n sides of the polygon. Then, each interior angles is of measure $\left(\frac{2n-4}{n}\times 90\right)^\circ$

$\therefore \frac{2n-4}{n}\times 90 = 108 \Rightarrow 180n - 360 = 108n$

$\Rightarrow$ $72n - 360°$ $\Rightarrow$ $n = 5$

SO, the polygon has 5 sides.

73. **(a)** We know the no. of diagonals of a polygon of n sides is $\frac{n(n-1)}{2} - n$

$\therefore$ for a hexagon, $n = 6$

$\frac{6(6-1)}{2} - 6 = \frac{6\times 5}{2} - 6 = 15 - 6 = 9.$

74. **(b)** Since the no. of diagonals of a polygon of n sides is $\frac{n(n-1)}{2} - n$

$\therefore$ $\frac{n(n-1)}{2} - n = 27 \Rightarrow n^2 - n - 2n = 54$

$\because$ $n^2 - 3n - 54 = 0$

$\Rightarrow (n - 9)(n + 6) = 0$

$\Rightarrow$ $n = 9$ or $n = -6$

$\therefore$ $n = 9$.

75. **(c)** One angle of the pentagon is 140°

Since the remaining angles are in the ratio 1:2:3:4, $\therefore$, let the remaining angles be $x°$, $(2x)°$, $(3x)°$ and $(4x)°$

But the sum of interior angles of a pentagon $(2.5 - 4) \times 90 = 6 \times 90° = 540°$

$\therefore$ $140 + x + 2x + 3x + 4x = 540$

$\Rightarrow$ $10x = 400$ $\Rightarrow$ $x = 40$

$\therefore$ The angles of the pentagon are 140°, 40°, 80°,120° and 160°

Hence the size of the greatest angle = 160°.

76. **(b)** Let there be n sides of the polygon. Then each exterior angle $= \left(\frac{360}{n}\right)^\circ$ and each interior angle $= \left(\frac{2n-4}{n}\times 90\right)^\circ$

We have

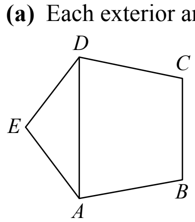
Exterior angle $= \frac{1}{3}$ (interior angle)

$\Rightarrow$ $\frac{360}{n} = \frac{1}{3}\left(\frac{2n-4}{n}\times 90\right)$

$\Rightarrow$ $360 = 60(n - 2)$ $\Rightarrow$ $6 = n - 2$ $\Rightarrow$ $n = 8$

Thus the polygon has 8 sides.

77. **(a)** Each exterior angle of a regular octagon $= \frac{360°}{8} = 45°$



Each exterior angle of a regular octagon

$= (180 - 45°) = 135°$

$\therefore$ Required ratio $= \frac{135}{45} = 3:1.$

78. **(d)** Here number of sides = 5

$\therefore$ Each interior angle $= \left(\frac{2n-4}{n}\right)$ right. angles

$= \frac{2\times 5 - 4}{5}\times 90° = 108°$

In ΔAEA, $\angle AED = 108°$ and $AE = ED$

$\therefore \quad \angle EDA = \angle EAD = \dfrac{180 - 108}{2} = 36°$

$\therefore \quad \angle ADC = \angle EDC - \angle EDA = (108 - 36)° = 72°$

$\therefore \quad \dfrac{\angle ADE}{\angle ADC} = \dfrac{36}{72} = \dfrac{1}{2}.$

79. **(c)** Each ext. angle of $(n - 1)$ sided regular polygon $= \left(\dfrac{360}{n-1}\right)^{\circ}$ and each ext. angle of (n + 2) sided regular polygon $= \left(\dfrac{360}{n-2}\right)^{\circ}$

According to the question, $\dfrac{360}{n-2} = 6$

(Since greater is the number of sides, smaller is the value of each ext. angle)

$\Rightarrow \quad 360\,(n + 2) - 360\,(n - 1) = 6\,(n - 1)(n + 2)$

$\Rightarrow \quad 60(n + 2 - n + 1) = n^2 + n - 2$

$\Rightarrow \quad 180 = n^2 + n - 2 \Rightarrow \quad n^2 + n - 182 = 0$

$\Rightarrow \quad (n + 14)\,(n - 13) = 0$

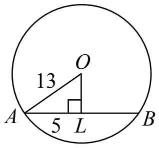
$\Rightarrow \quad n = -14$ or $n = 13$

$\Rightarrow \quad n = 13 \qquad (\because \quad n$ cannot be negative)

80. **(c)** $OA = 13$ cm, $AB = 10$ cm

From O, draw $OL \quad AB$

We know that the perpendicular from the centre of a circle to a chord bisects the chord.



$\therefore \quad AL = \dfrac{1}{2} AB = 5$ cm

In right ΔOLA,

$OA^2 = OL^2 + LA^2$ (Pythagoras them.)

$169 - 25 = OL^2$

$OL\sqrt{144} = 12$ cm.

81. **(a)** Since ABCD is a cyclic quadrilateral

$\therefore \quad \angle ADC + \angle ABC = 180°$

$\Rightarrow \quad 130° + \angle ABC = 180°$

$\Rightarrow \quad \angle ABC = 50°$

Also, $\angle ACB = 90°$

$\therefore$ In ΔABC,

$\angle ACB + \angle ABC + \angle CAB = 180°$ (ASP)

$\Rightarrow \quad 90° + 50° + \angle CAB = 180° \quad \Rightarrow \quad \angle CAB = 40°.$

82. **(d)** $\angle AOC = 2\ \angle APC$

$\therefore \quad \angle APC = 50°$

Also, $ABCP$ is a cyclic quad.

$\therefore \quad \angle ABC = \angle APC$

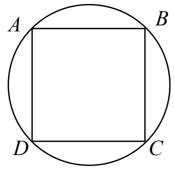
$\therefore \quad \angle ABC = 50°$

$\therefore \quad \angle CBD = 180 - 50 = 130°.$

83. **(c)** $BD = DA = DC$

$\therefore \quad BD = 3$ cm.

84. **(c)** A cyclic quadrilateral whose opposite angles are equal is a rectangle



$\Rightarrow$ In a cyclic quad.

$\angle A + \angle C = 180°$

But $\angle A = \angle C$

$\therefore \quad \angle A = \angle C = 90°$

Similarly, $\angle B = \angle D = 90°$ and hence $ABCD$ is a rectangle.

85. **(b)** Since ST is a diameter

$\therefore \quad \angle TRS = 90°$

Also, $\angle TRQ = \angle TSR$ (angles in alternate segments.)

$\therefore \quad \angle TSR = 40°$

Hence, $\angle STR = 50°$.

86. **(d)** $\angle TPQ = \angle PAQ = 70°$

($\angle s$ in the alternate segments)

$TP = TQ \Rightarrow \angle TQP = \angle TPQ = 70°$

$\therefore \quad \angle PTQ = 180° - 70° - 70° = 40°.$

87. **(a)** $PA = PB$

$\therefore \quad \angle PAB = \angle PBA$

Also, $\angle PAB + \angle PBA = 180° - \angle APB$

$180° - 60 = 120°$

$\therefore \quad \angle PAB = \angle PBA = 60$

i.e., ΔPAB is an equilateral triangle

$\therefore \quad AB = 8$ cm.

88. **(c)** $OA = OB \Rightarrow \angle OAB = \angle OBA = 32°$

$\therefore \quad \angle OAB + \angle OBA = 32° + 32° = 64°$

$\therefore \quad \angle AOB = 180 - 64 = 116°$

$\Rightarrow \quad \angle ACB = \dfrac{1}{2} \angle AOB = 58°$

(Degree Measure Thm.)

Also, $\angle ACB = \angle BAS$

(angles in alternate segments)

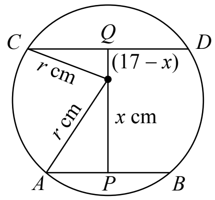
$\therefore \quad \angle BAS = x = 58°$

89. **(c)** Since $ABCD$ is a circumscribed quadrilateral

$\therefore \quad AB + CD = BC + AD \Rightarrow 6 + 4 = 7 + AD$

$\therefore \quad AD = 10 - 7 = 3$cm.

90. **(c)**



In right Δs OAP and OQC, we have
$OA^2 = OP^2 + AP^2$ and $OC^2 = OQ^2 + CQ^2$
$r^2 = x^2 + 5^2$ and $r^2 = (17 - x)^2 + 12^2$
$\Rightarrow$ $x^2 + 25 = 289 + x^2 - 34x + 144$
$\Rightarrow$ $34x = 408 \Rightarrow x = 12$ cm
$\therefore$ $r^2 = 122 + 52 = 169$
$\therefore$ $r = 13$ cm

91. **(a)** If two circle touch internally then distance between their centres is equal to the difference of their radii.
$\therefore$ $AB = (5 - 3)$ cm $= 2$ cm
Also, the common chord PQ is the ^ bisector of AB
$\therefore$ $AC = CB = 1$ cm
In right. ΔACP, we have
$AP^2 = AC^2 + CP^2$
$\Rightarrow$ $25 - 1 = CP^2$
$\therefore$ $CP = \sqrt{24}$ cm
Hence, $PQ = 2CP = 2\sqrt{24} = 4\sqrt{6}$ cm.

92. **(b)** Since PT is a tangent and PCB is a secant to the circle
$\therefore$ $PC \times PB = PT^2$
$\Rightarrow$ $3 \times PB = 62$ $\Rightarrow$ $PB = 12$ cm
$\Rightarrow$ $3 + BC = 12$ $\Rightarrow$ $BC = 9$ cm
$\therefore$ radius of the circle $= \frac{1}{2}BC = 4.5\,\text{cm}$

93. **(d)** Let $AB = 9$ cm, $BC = 7$ cm and $CA = 6$ cm
The, $x + y = 9$ cm
$y + z = 7$ cm
$z + x = 6$ cm
Adding, we get $2(x + y + z) = 22°$
$\Rightarrow$ $x + y + z = 11$
$\therefore$ $z = (11 - 9) = 2$, $x = (11 - 7) = 4$
and $y = (11 - 6) = 5$
Hence, the radii of the given circles are 4 cm., 5 cm and 2 cm respectively

94. **(a)** $OR = OS$, $OR \perp DR$ and $OS \perp DS$
$\therefore$ $ORDS$ is a square
Also, $BP = BQ$, $CQ = CR$ and $DR = DS$
$\therefore$ $BQ = BP = 27$ cm $\Rightarrow$ $BC - CQ = 27$ cm
$\Rightarrow$ $38 - CQ = 27$ cm
$\Rightarrow$ $CQ = 11$ cm
$\Rightarrow$ $CR = 11$ cm
$\Rightarrow$ $CD - DR = 11$
$\Rightarrow$ $25 - DR = 11$
$\Rightarrow$ $DR = 14$ cm
$\Rightarrow$ $r = 14$ cm.

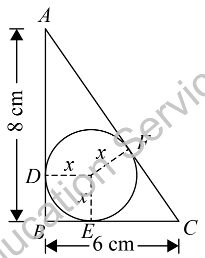
95. **(d)** Since AD is the tangent to the circle from A and APB is a secant
$\therefore$ $AP \times AB = AD^2$

$$\Rightarrow \quad AP \times AB = \left(\frac{1}{2}AC\right)^2 = \frac{1}{4}AC^2$$

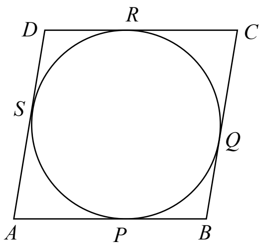
$$\Rightarrow \quad AP \times AB = \frac{1}{4}AB^2 \quad (\therefore\ AC = AB)$$

$$\Rightarrow \quad AP = \frac{1}{4}AB.$$

96. **(c)** Draw $OD \perp AB$,
$OE \perp BC$ and $OF \perp AC$.
Let $OD = OE = OF = x$
Then, $AF = AD = (8 - x)$; $CF = CE = (6 - x)$
$\therefore$ $AC = \sqrt{AB^2 + BC^2} = \sqrt{8^2 + 6^2} = 10\,\text{cm}$
So, $AC = AF + FC \Rightarrow (8 - x) + (6 - x) = 10$
or, $x = 2$.



97. **(b)** We have,



$AP = AS$
$BP = BQ$
$CR = CQ$
$DR = DS$
$\therefore$ $AB + CD = AP + BP + CR + DR$
$= AS + BQ + CQ + DS$
$= (AS + DS) + (BQ + CQ)$
$= AD + BC$
Since, $AB = CD$ and $AD = BC$
($\because$ opposite sides of a $\|_{gm}$ are equal)
$\Rightarrow$ $AB = AD$
$\therefore$ $CD = AB = AD = BC$
Hence $ABCD$ is a rhombus.

98. **(d)** $\angle BOD = 180 - \angle AOD = 180 - 140 = 40°$
$OB = OD$ $\Rightarrow$ $\angle OBD = \angle ODB = 70°$
Also, $\angle CAB + \angle BCD = 180$ [$\because$ $ABCD$ is cyclic]
$\Rightarrow$ $50° + 70° + \angle ODC = 180$ $\Rightarrow$ $\angle ODC = 60°$
$\therefore$ $\angle EDB = 180° - (60° + 70°) = 50°$

99. **(a)** In ΔADP

Ext $\angle ADC$ = Interior ($\angle A + \angle P$)

$= 40° + 20° =$

$\therefore\ \angle ABC = \angle ADC = 60°$

Since AD is the diameter

$\Rightarrow\ \angle ABD = 90°$

$\therefore\ \angle DBA = \angle ABD - \angle ABC = 90° - 60° = 30°$

100. **(c)** $\angle QSR = \angle QTR \dfrac{z}{2}$

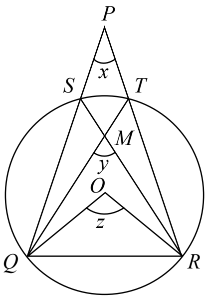
$\therefore\ \angle PSM = \angle PTM = 180° = \dfrac{z}{2}$

Also, $\angle SMR = y$

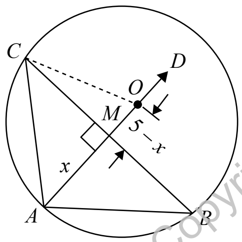
$\therefore$ In quadrilateral PSMT

$180 - \dfrac{z}{2} + 180 - \dfrac{z}{2} + y + x = 360.$

$\Rightarrow\ x + y = z$



101. **(a)** Let, AD be the bisector of BC and passes through the centre. Join CO



Also, $BM = CM$

In right ΔAMC, we have $CM^2 = 36 - x^2$ ...(1)

Also, In right ΔOMC

$CM^2 = 25 - (5 - x)2$ ...(2)

From (1) and (2),

$36 - x = 25 - (25 + x^2 - 10x)$

$10x = 36,\ x = 3.6$ cm

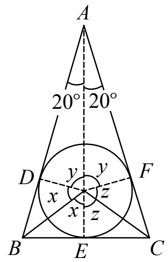
$CM = \sqrt{36 - (3.6)^2} = \sqrt{23.04}$ cm $= 4.8$ cm

and $BC = 2CM = 2 \times 4.8 = 9.6$ cm.

102. **(d)** AO is joined

Since the circle is the incircle for ΔABC, AO, BO, and CO are the angle bisectors of $\angle A$, $\angle B$ and $\angle C$ respectively

$\angle DAO = \angle FAO = \dfrac{1}{2}\angle BAC = 20°$



$\angle OFA = 90°$

In ΔAOF, $\angle AOF = \angle AOD = 70° = y$

From the figure

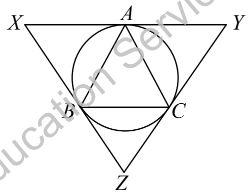
$x + x + y + y + z + z = 360°$

$\Rightarrow\ 2(x + z) + 2y = 360°$

$\Rightarrow\ 2 \times \angle BOC = 140° = 360°$

$\therefore\ \angle BCO = 110°.$

103. **(b)** Let, xy, yz, and zx be the tangents to the circle at the vertices of an equilateral ΔABC



Since XY is as tangent to the circle at the point A,

$\therefore\ \angle XAB = \angle ACB = 60°$

Similarly, $\angle ABX = 60°$

$\therefore$ In ΔAXB, $\angle AXB = 180 - (60° + 60°) = 60°$

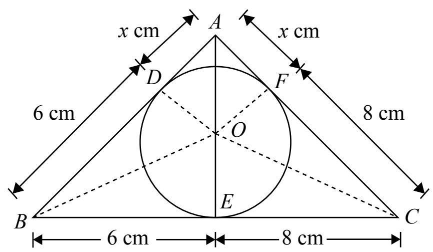
Similarly it can be shown that $\angle Y = 60°$ and $\angle Z = 60°$

$\therefore\ \Delta XYZ$ is an equilateral D

104. **(c)** $BD = BE = 6$ cm and $AB = (s + 6$ cm$)$

$BC = (6 + 8)$ cm $= 14$ cm

$AC = (x + 8)$ cm



Hence, $S = \dfrac{a + b + c}{2} = \dfrac{2x + 28}{2} = x + 14$

Now ar. (ΔABC) = ar. (ΔOBC)

+ ar. (ΔOCA) + ar. (ΔOAB)

$\Rightarrow\ \sqrt{S(S-a)(S-b)(S-c)} = \dfrac{1}{2}\angle OE \times BC$

$+ \dfrac{1}{2} OF \times AC + \dfrac{1}{2} \times OD \times AB$

$$\Rightarrow \quad \sqrt{(x+14)(x)(6)(8)} = \frac{1}{2}\times 4\times 14$$

$$+\frac{1}{2}\times 4\times(x+8)+\frac{1}{2}\times 4x(6+x)$$

$\Rightarrow \quad 4\sqrt{3x^2+42x} = 4(14+x)$

$\Rightarrow$ $2x^2 - 14x - 196 = 0$

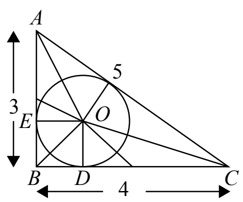
or, $x^2 - 7x - 98 = 0$

$\therefore$ $x = 7$, $x = -14$ (not possible)

$\therefore$ Shortest side = 6 + 7 = 14 = 13 cm.

Exercise-2
(Based on Memory)

1. **(c)** If the in circle of a triangle ABC touches BC at D, then $|BD - CD| = |AB - AC|$



In our case, $AC = 5$, $AB = 3$

$\Rightarrow$ $AC - AB = 2$

$\therefore$ $CD - BD = 2$

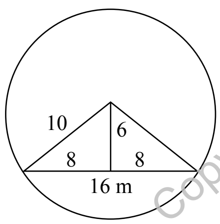
In our case, $BC = 4$

$\Rightarrow$ $BD + BD = 4$ and $- BD + DC = 22$

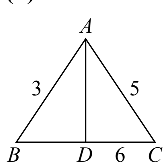
$\Rightarrow$ $CD = 3$

$\Rightarrow$ $BD = 1 = OE$ = Radius of the in circle.

4. **(c)**



6. **(b)**



$BD{:}DC = 3{:}5$

$\therefore$ Divided $BC = 6$ in the ratio 3:5

$\Rightarrow$ $BD = 2.25$, $CD = 3.75$.

7. **(a)** $x + y + (y + 20) = 5 \quad \Rightarrow \quad x + 2y = 160$

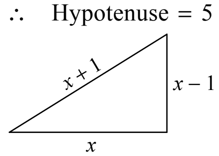
$4x - y = 10 \quad \Rightarrow \quad y = 70, x = 20$

$\therefore$ The angles of the triangle are 20°, 70°, 90°.

8. **(a)** Let, $(x + 1)$ be the hypotenuse

$\therefore$ $(x + 1)^2 = x^2 + (x + 1)^2 \quad \Rightarrow \quad x = 4$

$\therefore$ Hypotenuse = 5



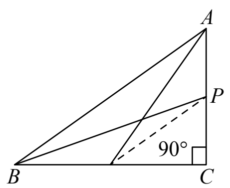
10. **(b)** $AQ^2 = AC^2 + QC^2$

$BP^2 = BC^2 + CP^2$

$AQ^2 + BP^2 = (AC^2 + BC^2) + (QC^2 + CP^2) = AB^2 + PQ^2$

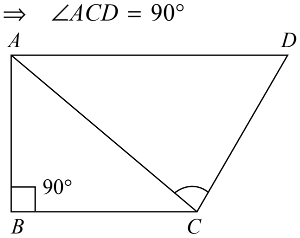
$$= AB^2 + \left(\frac{1}{2}AB\right)^2 \qquad \left[\because \quad PQ = \frac{1}{2}AB\right]$$

$$= \frac{5}{4}AB^2 = 4(AQ^2 + BP^2) = 5AB^2$$

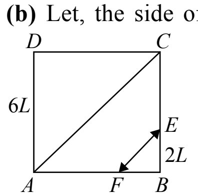


11. **(a)** $AB^2 + BC^2 + CD^2 = AC^2 + CD^2 = AD^2$

$\Rightarrow$ $\angle ACD = 90°$



12. **(b)** Let, the side of the square be $6L$



Then $\frac{1}{2}\times 3L\times 2L = 108 \quad \Rightarrow \quad L = 6$

$\therefore$ Side of the square = 60 m

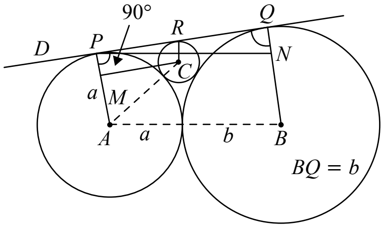
$\Rightarrow$ $AC^2 = AD^2 + DC^2 = (36)^2 + (36)^2 = 2 \times (36)^2$

$\Rightarrow$ AC = $36\sqrt{2}$.

13. **(d)** Measure of the angle will not change.

14. **(c)** $PR = MC = \sqrt{AC^2 - AM^2}$

$\therefore\ \sqrt{(a+c)^2-(a-c)^2} = 2\sqrt{ac}$



Similarly, $QR = 2\sqrt{ac}$

Now, $PQ = PR + RQ = 2\sqrt{ac} + 2\sqrt{bc}$ $\cdots(1)$

Draw PN Parallel to AB

$\therefore\ PN = AB = a + b$,

$QN = BQ - BN = b - a$

$\therefore\ PQ^2 = PN^2 - QN^2 = (a + b)^2 - (a - b) = 4ab$

$\Rightarrow\ PQ = 2\sqrt{ab}$ $\cdots(2)$

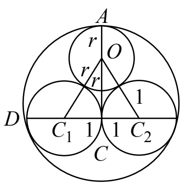
$\therefore$ From (i) and (ii)

$\Rightarrow\ \dfrac{1}{\sqrt{c}} = \dfrac{1}{\sqrt{a}} + \dfrac{1}{\sqrt{b}}.$

15. **(c)** $CC_1 = 1$, $OC1 = 1 + \text{r}$

$OC = AC - AO = CD - AO = 2 - \text{r}$

[AC and CD are the radii of the bigger circle]



$\therefore\ CO_1^2 = CC_1^2 + OC^2$

$\Rightarrow\ (1 + r)^2 = 1^2 + (2 + r)^2$

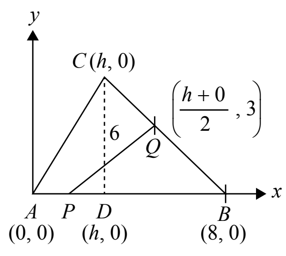
$\Rightarrow\ r = \dfrac{2}{3}.$

16. **(d)** Area of ($\Delta PRS + \Delta PQR$)

$= \dfrac{1}{2} AD(AP + PB)$

$= \dfrac{1}{2} AD \times AB = 8 \text{ cm}^2.$

17. **(d)** Let, $AD = h$ coordinates of P are $\left(\dfrac{h}{2}, 0\right)$.



$CD = 6$

$$PQ = \sqrt{\left(\frac{h}{2} - \left(\frac{h+8}{2}\right)^2\right) + (0.3)^2} = \sqrt{16+9} = 5.$$

18. **(d)** Let, $OA = OC = \text{Radius} = x$

$\therefore\ AO^2 + OC^2 = AC^2 \ \Rightarrow\ 2x^2 = 98 \ \Rightarrow\ x = 7$

$\therefore$ Area of the circle $= \pi x^2 = \dfrac{22}{7} \times 49 = 154 \text{ cm}^2$.

20. **(b)** Using the sine fomula, we have

$\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

$\therefore\ \dfrac{\sin 40°}{BD} = \dfrac{\sin(40° + C)}{6}$

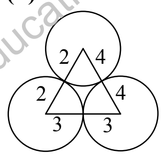
$\Rightarrow\ \dfrac{\sin 40°}{B - DC} = \dfrac{\sin[180 - (40 + C)]}{6} = \dfrac{\sin(140 - C)}{6}$ $\cdots(1)$

Also $\dfrac{\sin 40°}{DC} = \dfrac{\sin(140° - C)}{9}$ $\cdots(2)$

$\therefore$ From (i) and (ii) give

$\dfrac{DC}{8 - DC} = \dfrac{9}{6} = \dfrac{3}{2} \ \Rightarrow\ 5DC = 24 \ \Rightarrow\ DC = 4.8.$

23. **(d)**



Sum of radii = 2 + 3 + 4 = 9 cm.

27. **(b)** The sum of the interior angles of a polygon of n side $= (2n - 4) \times \dfrac{\pi}{2}$

$\therefore\ (2n + 4) \times \dfrac{\pi}{2} = 1620 \ \Rightarrow\ n = 11.$

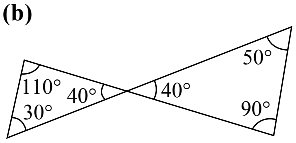
28. **(c)** Let, n the number of sides of the polygon.

$\therefore$ Interior angle = 8 × Exterior angle.

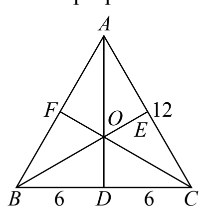
$\Rightarrow\ \dfrac{(2n-4) \times \dfrac{\pi}{2}}{n} = 8 \times \dfrac{2\pi}{n}$

$\Rightarrow\ n = 18.$

33. **(b)**



36. **(c)** Circumcircle of a triangle is the point of intersection of the perpendicular bisectors of the sides of the triangle.



O is the circumcentre of the ΔABC, whose sides

$AB = BC = CA = 12$ cm

$\therefore$ From ΔADC

$AC^2 = AD^2 + CD^2 \Rightarrow AD = \sqrt{(12)^2 - 6^2} = 6\sqrt{3}$

Since, triangle is equilateral, therefore circumcentre = centroid

$\therefore$ $AO{:}OD = 2{:}1$

i.e., $AO = 4\sqrt{3}$,

$OD = 2\sqrt{3}$ $[\because AD = 6\sqrt{3}]$

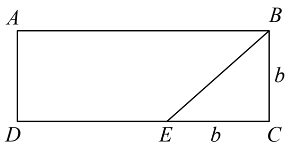
$\therefore$ Radius of the circumcircle

$= 4\sqrt{3} = OA = OB = OC$.

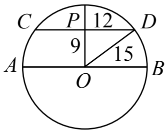
37. **(a)** Area of $\Delta BCE = \frac{1}{2} \times b \times b \Rightarrow b^2 = 28$

Area of rectangle $ABCD = (DE + EC) \times b$

$= 4EC \times b = 4b^2 = 112$.

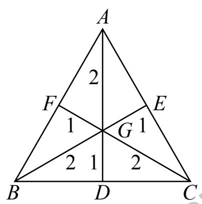


43. **(c)** OP is perpendicular from the centre of the circle on the chord CD.



$OP^2 \sqrt{(15)^2 (12)^2} = 9$ cm.

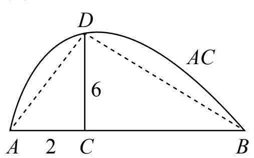
44. **(c)**



45. **(c)** The sum of the internal angles of a polygon of n sides = $(n - 2) \times 180°$

If $n = 7$, then the sum of the interior angles of the polygon $= (7 - 2) \times 180° = 900°$.

46. **(b)**



$CD^2 = AC \times CB$

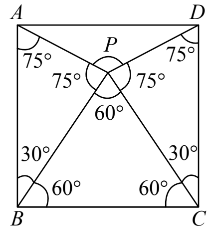
$(6)2 = 2 \times CB$

$CB = 18$

$AB = AC + CB = 18 + 2 = 20$

Area of semicircle $= \frac{1}{2}\pi r^2 = \frac{1}{2}\pi \times (10)^2 = 50\pi$ cm^2

47. **(e)** ΔBPC is an equilateral triangle



$\therefore$ $<CPD = <CDP = 75°$

Similarly $<BAP = <BPA = 75°$

Hence, $<APD = 360° - (75° + 75° + 60°)$

$= 360° - 210° = 150°$

48. **(b)** The sum of an angles of the quadrilateral = 360°

$2x + 4x + 7x + 5x = 360°$

$18x = 360°$

$x = 20°$

Smallest angle of the quadrilateral

$= 2 \times 20° = 40°$

According to question.

Smallest angle of the quadrilateral

= Smallest angle of a triangle

$\therefore$ Smallest angle of triangle = 40°

And its twice = 80°

Remaining angle of a triangle

$= 180° - (40° + 80°) = 60°$

So, the angles of triangle will be 40°, 60° and 80°

$\therefore$ Second largest angle = 60°

49. **(d)** Suppose $\angle A = x°$

$\angle B = x + 26$

$\angle C = \frac{x + 26}{2} = \frac{x}{2} + 13$

$\angle D = \frac{x}{2} + 3$

$\therefore$ $x + x + 26 + \frac{x}{2} + 13 + \frac{x}{2} + 3 = 360°$

$3x + 42 = 360° \left(\because \frac{x}{2} + \frac{x}{2} = x\right)$

$3x = 318°$

$x = 106°$

So, the angle $A = 106°$

50. **(c)** $3x + 4x + 6x + 5x = 360$

$x = 20°$

Largest angle of quadrilateral $= 6x$

$= 6 \times 20 = 120°$

Smaller angle of parallelogram

$= 120 \times \frac{2}{3} = 80°$

So the adjacent angle = 100°

51. **(d)** Suppose adjacent angle of parallelogram be $2x°$ and $3x°$.

Then, according to theorem, $2x° + 3x° = 180°$

$\Rightarrow$ $5x° = 180°$

$\Rightarrow \quad x° = \dfrac{180°}{5} = 36°$

Smaller angle of parallelogram = 2 × 36° = 72°

Smaller angle of quadrilateral = 36°

∴ Highest angle = 4 × 36° = 144°

Hence, required sum of angles = 144° + 36° = 180°

52. (c) An angle of a triangle

$= \dfrac{2}{3} \times 180° = 120°$

Remaining 180° – 120° = 60° is the ratio of 5:7.

So, $5x + 7x = 60$

$12x = 60$

$x = 5$

So, angles are 5 × 5 = 25°

and 7 × 5 = 35° and 120°

So, value of second largest angle of triangle is 35°.

53. (b) Let, the angles of the quadrilateral be $3x$, $4x$, $5x$ and $6x$, respectively.

Then, $3x + 4x + 5x + 6x = 360°$

$\Rightarrow \quad 18x = 360°$

$\Rightarrow \quad x = 20°$

∴ Smallest angle of the triangle

$= 3 \times 20 \times \dfrac{2}{3} = 40°$

∴ Largest angle of the triangle

= 40° × 2 = 80°

∴ Second largest angle of the triangle

= 180° – (40° + 80°) = 60°

and largest angle of the quadrilateral = $6x$

= 6 × 20° = 120°

Hence, required sum

= 60° + 12° = 180°

54. (d) Largest angle:second largest angle = 3:2

Smallest angle $= (3x + 2x)\dfrac{20}{100} = x$

Sum of three angles = 180°

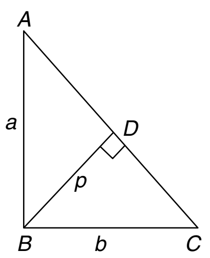
$3x + 2x + x = 180°$

$x = 30°$

Smallest + second largest angle

$x + 2x = 3x = 3 \times 30° = 90°$

55. (c)



$BD \perp AC$

$AB \perp BC$

Hypotenuse of $\Delta ABC = \sqrt{AB^2 + BC^2} = \sqrt{a^2 - b^2}$

Area of $\Delta ABC = \dfrac{1}{2} \times AB \times BC = \dfrac{1}{2} \times AC \times BD$

$\Rightarrow \quad AB \times BC = AC \times BD$

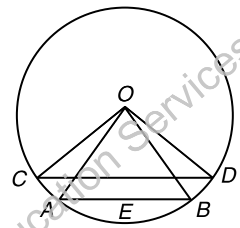
$\Rightarrow \quad ab = \sqrt{a^2 + b^2} \times p$

On squaring both sides we have,

$a^2b^2 = (a^2 + b^2)p^2$

$\therefore \quad p^2 = \dfrac{a^2b^2}{a^2 + b^2}$

56. (a)



Let, the radius of circle be r unit.

In ΔOCD, $\angle COD = 90°$

$\therefore \quad CD^2 = OC^2 + OD^2$

$\Rightarrow \quad b^2 = r^2 + r^2 = 2r^2$ ···(1)

In ΔOAB,

$OE \perp AB$

$\angle OAB = 60°$

$AE = \dfrac{a}{2}$

$\therefore \quad \cos 60° = \dfrac{AE}{OA}$

$\Rightarrow \quad \dfrac{1}{2} = \dfrac{\frac{a}{2}}{r}$

$\Rightarrow \quad \dfrac{1}{2} = \dfrac{a}{2r} \quad \Rightarrow \quad a = r$ ···(2)

From equations (1) and (2), we have,

$b^2 = 2a^2 \Rightarrow \quad b = \sqrt{2}a$

57. (b) $\angle A + \angle B + \angle C = 180°$ ···(1)

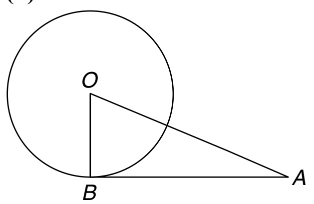
$\angle A + \dfrac{\angle B}{2} + \angle C = 140°$ ···(2)

By equation (1) – (2), we have,

$\dfrac{\angle B}{2} = 180° - 140° = \dfrac{\angle B}{2} = 40°$

$\Rightarrow \quad \angle B = 80°$

58. (d)



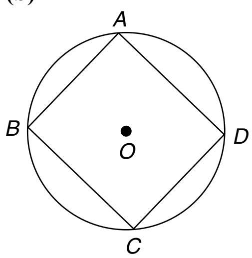
$OB = 6$ cm, $OA = 10$ cm

$\Rightarrow \quad OBA = 90°$

$\therefore \quad AB = \sqrt{OA^2 - OB^2} = \sqrt{10^2 - 6^2}$

$= \sqrt{100-36} = \sqrt{64} = 8$ cm

59. (b)



The sum of opposite angles of a concyclic quadrilateral is 180°.

$\therefore \quad \angle A + C = 180°$

$\Rightarrow \quad 4x + 5y = 180° \quad \cdots(1)$

$\therefore \quad \angle B + \angle D = 180°$

$\Rightarrow \quad 7x + y = 180° \quad \cdots(2)$

By equation (2) × 5 − (1), we have,

$$\begin{array}{l} 35x + 5y = 900° \\ 4x + 5y = 180° \\ - \quad - \quad - \\ \hline 31x \quad = 720 \end{array}$$

$x = \frac{720}{31}$

From equation (2),

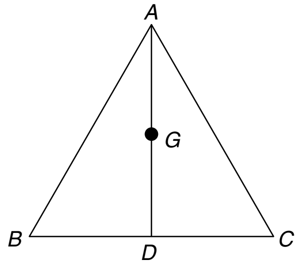
$7x + y = 180°$

$\Rightarrow \quad 7 \times \frac{720}{31} + y = 180°$

$\Rightarrow \quad y = 180 - \frac{5040}{31} = \frac{5580 - 5040}{31} = \frac{540}{31}$

$\therefore \quad x : y = \frac{720}{31} : \frac{540}{31} = 4:3$

60. (b)



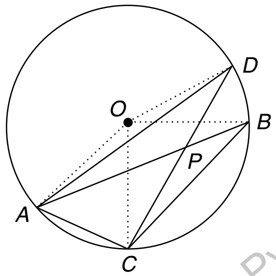
$AB = 10$ cm, $BD = 5$ cm and $\angle ADB = 90°$

$\therefore \quad AD = \sqrt{AB^2 - BD^2} = \sqrt{10^2 - 5^2} = \sqrt{100-25}$

$= \sqrt{75} = 5\sqrt{3}$ cm

$AG = \frac{2}{3} AD = \frac{2}{3} \times 5\sqrt{3} = \frac{10}{\sqrt{3}}$ cm

61. (d)



We have $\angle AOD = 100°$

$\therefore \quad \angle ACD = \angle ACP = \frac{100}{2} = 50°$

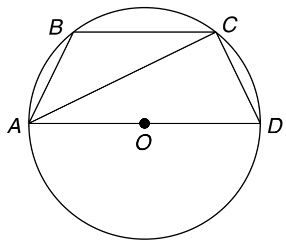
(The angle subtended at the centre is twice to that of angle at the circumference by the same arc)

Again, $\angle BOC = 70°$

$\therefore \quad \angle BAC = \frac{70}{2} = 35° = \angle PAC$

$\therefore \quad \angle APC = 180° - 50° - 35° = 95°$

62. (c)



In ΔACD

$\angle DAC = 55°$

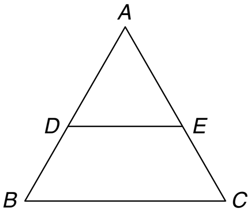
$\angle ACD = 90°$

$\angle D = 180° - 50° - 90° = 35°$

$\therefore \quad \angle ABC + \angle ADC = 180°$

$\Rightarrow \quad \angle ABC = 180° - 35° = 145°$

63. (c)



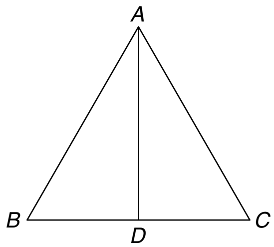
$$\frac{AB}{AD} = \frac{2}{1}$$

$\Delta ADE \sim \Delta ABC$

$$\frac{AB}{AD} = \frac{BC}{DE} = \frac{2}{1}$$

$$\therefore \quad \frac{DE}{BC} = \frac{1}{2}$$

64. **(b)**



$BD = DC$

$AB = AC$

$\therefore \quad \angle ADB = \angle ADC = 90°$

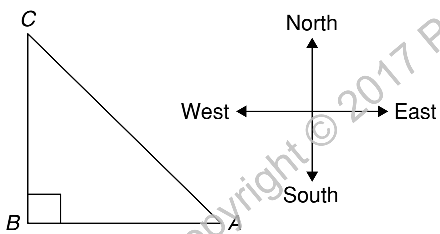
$\angle ABC = 35°$

In ΔABD

$\angle BAD + \angle ABD = 90°$

$\therefore \quad \angle BAD = 90° - 35° = 55°$

65. **(b)**



$\angle ABC = 90°$

$AB = 24$ metres, $BC = 10$ metres

$\therefore \quad AC = \sqrt{AB^2 + BC^2} = \sqrt{24^2 + 10^2}$

$\sqrt{576 + 100} = \sqrt{676} = 26$ metres

66. **(c)** $\angle A + \angle B + \angle C = 180°$ $\cdots(1)$

$(\angle B - \angle C) - (\angle A - \angle B) = 30° - 15°$

$\Rightarrow \quad 2\angle B - \angle A - \angle C = 15°$ $\cdots(2)$

By adding (1) and (2), we get,

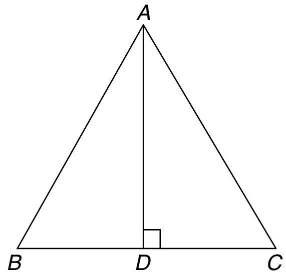
$3\angle B = 180° + 15° = 195°$

$\Rightarrow \quad \angle B = 65°, \quad \because \quad \angle A - \angle B = 15°$

$\Rightarrow \quad \angle A = 15° + 65° = 80°$

$\angle C = \angle B - 30° = 65° - 30° = 35°$

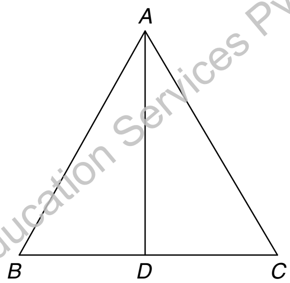
67. **(c)**



Let, AB be $2x$ units.

$\Rightarrow \quad BD = DC = x$ units $\Leftrightarrow AB : BD = 2:1$

68. **(b)**



Let, $AB = AC = 2a$ units.

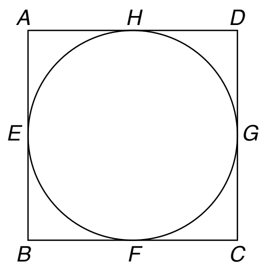
$\Rightarrow \quad BC = a$ units

$\Rightarrow \quad BD = DC = \frac{a}{2}$ units

$$\Rightarrow \quad AD = \sqrt{AB^2 - BD^2} = \sqrt{4a^2 - \frac{a^2}{4}} = \sqrt{\frac{15a^2}{4}}$$

$$= \sqrt{\frac{15}{2}}a \text{ units}$$

69. **(d)**



$AE = AH$, $BE = BF$, $GC = FC$, $GD = HD$

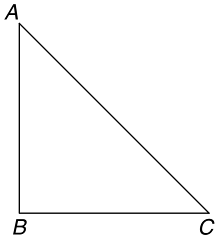
$\Rightarrow \quad AE + BE + GC + GD = AH + BF + FC + HD$

$\Rightarrow \quad AB + CD = AD + BC$

$\Rightarrow \quad 6 + 3 = AD + 7.5$

$\Rightarrow \quad AD = 9 - 7.5 = 1.5$ cm

70. (c)



$$AB \times BC = \frac{AC^2}{2}$$

$\Rightarrow \quad AC^2 = 2AB \times BC$

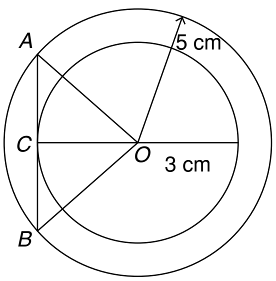
$\Rightarrow \quad AB^2 + BC^2 = 2AB \times BC$

$\Rightarrow \quad (AB - BC)^2 = 0$

$\Rightarrow \quad AB = BC$

$\therefore \quad \angle BAC = \angle ACB = 45°$

71. (d)

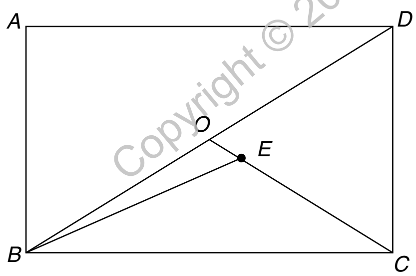


$OC = 3$ cm, $\quad OA = 5$ cm

$\therefore \quad AC = \sqrt{5^2 - 3^2} = 4$

$\therefore \quad AB = 2AC = 8$ cm

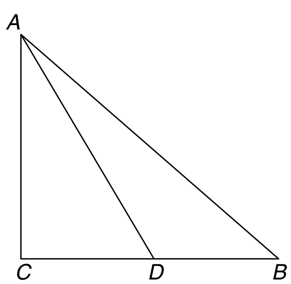
72. (b)



$\angle OBC = 45°, \angle OCB = 60°$

$\therefore \quad \angle BOC = 180° - 60° - 45° = 75°$

73. (a)



$AC^2 + BC^2 = AB^2$

$AD^2 = AC^2 + CD^2$

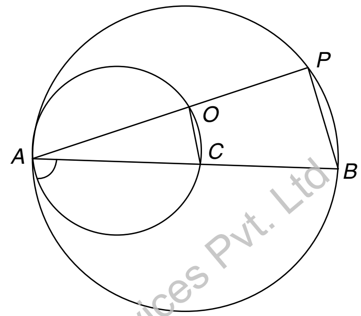
$\Rightarrow \quad AD^2 - CD^2 = AC^2$

$\therefore \quad AB^2 + AC^2 = AC^2 + BC^2 + AD^2 - CD^2$

$\Rightarrow \quad AB^2 = BC^2 + AD^2 - CD^2$

$\Rightarrow \quad AB^2 + CD^2 = BC^2 + AD^2$

74. (d)



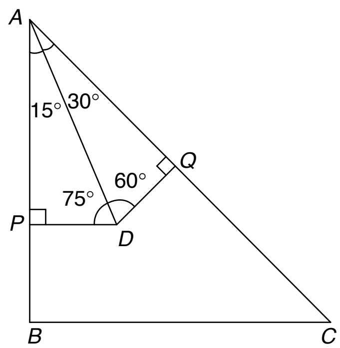
$\angle PAB = \angle QAC$

$\angle APB = \angle AQC = 90°$

$\angle QCA = \angle PBA; \ AC = BC$

$QC = \frac{1}{2} PB$

75. (c)



From ΔAQD, $\sin 60° = \frac{AQ}{AD}$

$\Rightarrow \quad \frac{\sqrt{3}}{2} = \frac{b}{AD} \quad \Leftrightarrow \quad AD = \frac{2b}{\sqrt{3}}$

From ΔAPD,

$$\sin 75° = \frac{AP}{AD} = \frac{a}{\frac{2b}{\sqrt{3}}} = \frac{\sqrt{3}a}{2b}$$

76. (b) Each angle of a regular octagon

$= \frac{1}{8}(2n - 4)$ right angles

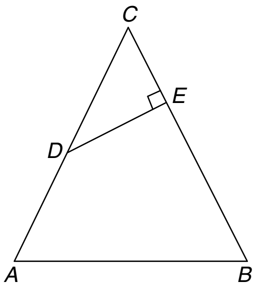
$= \frac{1}{8}(2 \times 8 - 4) \times 90°$

$= \frac{12 \times 90°}{8} = 135°$

$\because\ 180° = \pi$ radian

$\therefore\ 135° = \dfrac{\pi}{180} \times 135° = \dfrac{3\pi}{4}$ radian

77. (c)



$\angle DEC = 90°$, $DE = 18$ cm, $CE = 5$ cm

$\tan C = \dfrac{DE}{CE} = \dfrac{18}{5} = 3.6$

$\tan \angle ABC = 3.6$

$\therefore\ \angle C = \angle B \quad \therefore\ AC = AB$

$\angle C + \angle D = 90°$

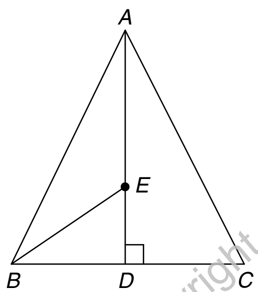
$\Rightarrow\ 2\angle C + 2\angle D = 180°$

$\angle C + \angle A + \angle B = 180°$

$\Rightarrow\ 2C + \angle A = 180°$

$\therefore\ \angle A = 2\angle D \quad \therefore\ \dfrac{AC}{CB} = \dfrac{2CD}{CE}$

78. (c)



$\angle BDA = 30°$, $\angle ABD = 60°$

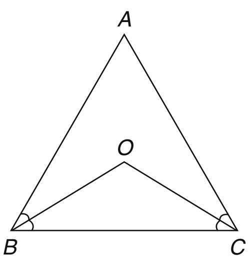
$$\frac{\tan ACB}{\tan DBE} = \frac{\frac{AD}{DC}}{\frac{DE}{BD}} = \frac{AD}{DC} \times \frac{BD}{DE} = 6\frac{BD}{DC}$$

$\therefore\ 6\dfrac{BD}{DC} = 6 \quad \Rightarrow \quad BD = DC$

$\therefore\ \angle ACB = 60°$

$\therefore\ \Delta ABC$ is an equilateral triangle.

79. (d)



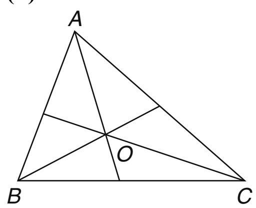
$\angle BAC = 80°$

$\therefore\ \angle ABC + \angle ACB = 100°$

$\therefore\ \angle OBC + \angle OCB = 50°$

$\therefore\ \angle BOC = 180° - 50° = 130°$

80. (d)



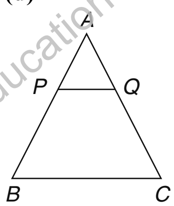
The point of intersection of internal bisectors of a triangle is called in-centre.

$\angle BOC = 90° + \dfrac{\angle A}{2}$

$\Rightarrow\ 116° = 90° + \dfrac{\angle A}{2} \Leftrightarrow \dfrac{\angle A}{2} = 116 - 90° = 26°$

$\therefore\ \angle A = 26° \times 2 = 52°$

81. (d)



$\Delta APQ - \Delta ABC$

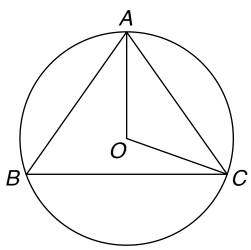
$\therefore\ \dfrac{AP}{PB} = \dfrac{AQ}{AC} = \dfrac{PQ}{BC}$

Now, $\dfrac{AB}{PB} = \dfrac{3}{1} \Rightarrow \dfrac{AB}{AB - AP} = \dfrac{3}{1}$

$\Rightarrow\ \dfrac{AB - AP}{AB} = \dfrac{1}{3} \Rightarrow 1 - \dfrac{AP}{AB} = \dfrac{1}{3}$

$\Rightarrow\ \dfrac{AP}{AB} = 1 - \dfrac{1}{3} = \dfrac{2}{3} = \dfrac{PQ}{BC}$

82. (a)



$\angle ABC = 180° - 85° - 75° = 20°$

$\angle AOC = 40°$

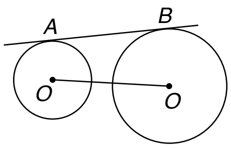
$OA = OC$

$\therefore\ \angle OAC = \angle OCA$

$\therefore\ \angle OAC + \angle OCA = 180° - 40° = 140°$

$\therefore\ \angle OAC = 70°$

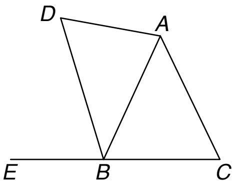
83. (c)



Required distance $= \sqrt{(r_1 + r_2)^2 - (r_1 - r_2)^2}$

$= \sqrt{4r_1r_2} = \sqrt{4 \times 9 \times 4} = 2 \times 3 \times 2 = 12\text{cm}$

84. (a)



BD is external bisector of $\angle ABC$.

$\angle ABC = 50°$

$AD \parallel BC$

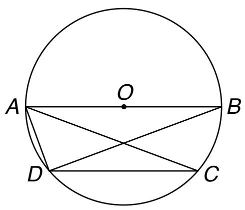
$\therefore \quad \angle DAB = 50°$

$\angle ABE = 180° - 50° = 130°$

$\therefore \quad \angle DBA = \dfrac{130°}{2} = 65°$

$\therefore \quad \angle ADB = 180° - 65° - 50° = 65°$

85. (b)



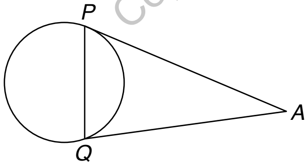
$\therefore \quad \angle BAC = \angle BDC = 20°$

(On the same are BC)

$\angle ADB = 90°$ (Angle of semi-circle)

$\therefore \quad \angle ADC = 90° + 20° = 110°$

86. (a)



$AP = AQ$

$\therefore \quad \angle APQ = \angle AQP$

$\therefore \quad \angle APQ + \angle AQP = 180° - 68° = 112°$

$\therefore \quad \angle APQ = \dfrac{112}{2} = 56°$

87. (b) From the formula:

Inradius $= \dfrac{\text{side}}{2\sqrt{3}}$

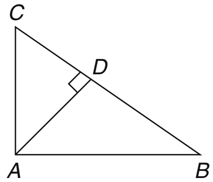
$\Rightarrow \quad 3 = \dfrac{\text{side}}{2\sqrt{3}} \quad \Rightarrow \quad \text{side} = 3 \times 2\sqrt{3}\text{ cm} = 6\sqrt{3}\text{ cm.}$

88. (b) In ΔACD and ΔABC,

$\angle CDA = \angle CAB = 90°$

$\angle C$ is common.

$\therefore \ \Delta ACD \sim \Delta ABC$

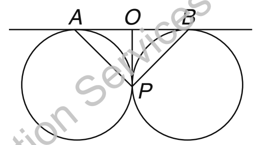


$\therefore \quad \dfrac{\Delta ACD}{\Delta ABC} = \dfrac{AC^2}{BC^2}$

$\Rightarrow \quad \dfrac{10}{40} = \dfrac{9^2}{BC^2} \quad \Rightarrow \quad BC^2 = 4 \times 9^2$

$\therefore \quad BC = (2 \times 9) = 18\text{ cm}$

89. (b)



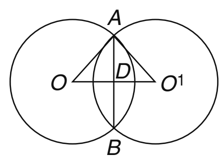
$OA = OP$

$\therefore \quad \angle PAB = OPA = 35°$

$\therefore \quad \angle AOP = 110° \Rightarrow \angle POB = 70°$

$\therefore \quad \angle ABP = \dfrac{180° - 70°}{2} = \dfrac{110}{2} = 55°$

90. (b)

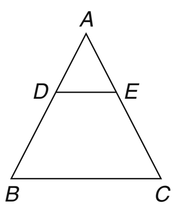


$OD = \sqrt{15^2 - 12^2} = \sqrt{225 - 144} = \sqrt{81} = 9\text{ cm}$

$O'D = \sqrt{13^2 - 12^2} = \sqrt{169 - 144} = \sqrt{25} = 5\text{ cm}$

$\therefore \quad OO' = (9 + 5) = 14\text{ cm}$

91. (b)



$DE \parallel BC$

$\angle ADE = \angle ABC$

$\angle AED = \angle ACB$

$\therefore \ \Delta ADE \sim \Delta ABC$

From the question,

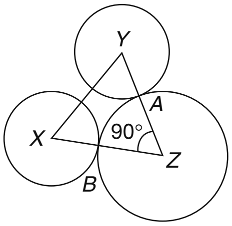
$\dfrac{\Delta BDEC}{\Delta ADE} = \dfrac{1}{1} \quad \Rightarrow \quad \dfrac{\Delta BDEC}{\Delta ADE} + 1 = 1 + 1$

$\Rightarrow \dfrac{\Delta ABC}{\Delta ADE} = 2 = \dfrac{AB^2}{AD^2}$

$\Rightarrow \dfrac{AB}{AD} = \sqrt{2} \quad \Rightarrow \dfrac{AB}{AD} - 1 = \sqrt{2} - 1$

$\Rightarrow \dfrac{BD}{AD} = \sqrt{2} - 1 \quad \Rightarrow \dfrac{AD}{BD} = \dfrac{1}{\sqrt{2} - 1}$

92. (b) $XZ = r + 9$



$YZ = r + 2$

$\therefore XY^2 = XZ^2 + ZY^2$

$\Rightarrow 17^2 = (r+9)^2 + (r+2)^2$

$\Rightarrow 289 = r^2 + 18r + 81 + r^2 + 4r + 4$

$\Rightarrow 2r^2 + 22r + 85 - 289 = 0$

$\Rightarrow 2r^2 + 22r - 204 = 0$

$\Rightarrow r^2 + 11r - 102 = 0$

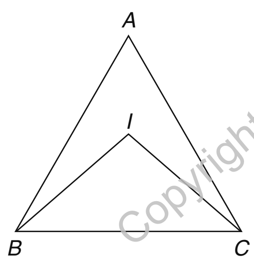
$\Rightarrow r^2 + 17r - 6r - 102 = 0$

$\Rightarrow r(r+17) - 6(r+17) = 0$

$\Rightarrow (r-6)(r+17) = 0$

$\Rightarrow r = 6$ cm

93. (b)

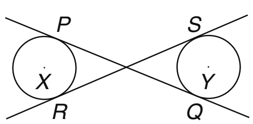


$\angle IBC = \dfrac{1}{2}\angle ABC = \dfrac{65}{2} = 32.5°$

$\angle ICB = \dfrac{1}{2}\angle ACB = \dfrac{55}{2} = 27.5°$

$\therefore \angle BIC = 108° - 32.5° - 27.5° = 120°$

94. (a)



Length of transverse tangent

$= \sqrt{XY^2 - (r_1 + r_2)^2}$

$\Rightarrow 8 = \sqrt{XY^2 - 9^2}$

$\Rightarrow 64 = XY^2 - 81$

$\Rightarrow XY^2 = 64 + 81 = 145$

$\Rightarrow XY = \sqrt{145}$ cm

95. (c) Each interior angle $= \dfrac{(2n-4) \times 90°}{n}$

$\therefore \dfrac{\dfrac{(2n-4) \times 90°}{n}}{\dfrac{(4n-4) \times 90°}{2n}} = \dfrac{2}{3}$

$\Rightarrow \dfrac{2n-4}{4n-4} = \dfrac{1}{3}$

$\Rightarrow 6n - 12 = 4n - 4$

$\Rightarrow 6n - 4n = 12 - 4 = 8$

$\Rightarrow 2n = 8 \Rightarrow n = 4$

96. (a) Angles of triangle $= (a-d)°, a°, (a+d)°$

$\therefore a - d + a + a + d = 180°$

$\Rightarrow 3a = 180° \Rightarrow a = 60°$

$\therefore \dfrac{a-d}{a+d} = \dfrac{60}{\pi} = \dfrac{60}{180} = \dfrac{1}{3}$

$\Rightarrow \dfrac{60-d}{60+d} = \dfrac{1}{3} \quad \Rightarrow 180 - 3d = 60 + d$

$4d = 120° \quad \Rightarrow d = 30°$

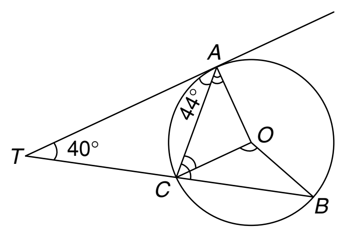
$\therefore$ Angles of triangle:

$a - d = 60° - 30° = 30°$

$a = 60°$

$a + d = 60 + 30 = 90°$

97. (d)



$\angle ACB = 40° + 44° = 84°$

$\therefore \angle ACO = 90° - 44° = 46° = \angle OAC$

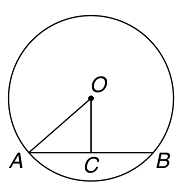
$\Rightarrow \angle OCB = \angle ACB - \angle ACO$

$= 84° - 46° = 38° = \angle OBC$

$\therefore \angle BOC = 180° - (\angle OCB + \angle OBC)$

$= 180° - (38° + 38°) = 104°$

98. (c)



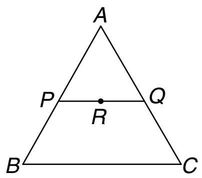
$OC = 12\text{cm}; AC = CB = 5$ cm

$\therefore$ Radius $OA = \sqrt{OC^2 + AC^2}$

$= \sqrt{12^2 + 5^2} = \sqrt{144 + 25} = \sqrt{169} = 13$ cm

$\therefore$ Diameter of circle $= (2 \times 13) = 26$ cm

99. **(c)**



$\frac{PR}{RQ} = \frac{1}{2} \Rightarrow \frac{2}{RQ} = \frac{1}{2}$

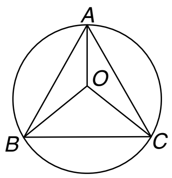
$\therefore RQ = 4$ cm

$\therefore PQ = PR + RQ = (2 + 4) = 6$ cm

The line joining the mid-points of two sides of a triangle is parallel to and half of the third side.

$\therefore BC = 2PQ = (2 \times 6) = 12$ cm

100. **(a)** The point where the right bisectors of the sides meet, is called the circum-centrre.



$OB = OC =$ radius

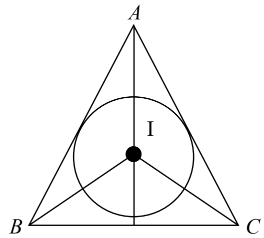
$\therefore \angle OBC = \angle OCB = 35°$

$\therefore \angle BOC = 180 - 70 = 110°$

$\therefore \angle BAC = 55°$

The angle subtended at the centre by an arc is twice to that at the circumference.

101. **(c)** The point where internal bisectors of angles of a triangle meet is called in-centre



$\angle BIC = 135°$

$\therefore \frac{1}{2}(\angle B + \angle C) = 45°$

$\Rightarrow \angle B + \angle C = 90°$

$\therefore \angle A = 90°$

Therefore, the triangle is the right angled triangle.

102. **(b)** The length of the radius of the circum-circle of an equilateral triangle $= \frac{\text{Side}}{\sqrt{3}} = \frac{6\sqrt{3}}{\sqrt{3}}$ cm. $= 6$ cm

103. **(a)** Sum of the adjacent angles of a parallelogram is 180°.

Smaller angle of the parallelogram $= \frac{7}{15} \times 180 = 84°$

Second largest angle of the quadrilateral $= \frac{7}{30} \times 360 = 84°$

$\therefore$ Required sum = 84 + 84 = 168°

104. **(c)** Sum of the adjacent angles of a parallelogram = 180°

$\therefore$ one angle of triangle $= \frac{2}{3} \times 180 = 120°$

Sum of remaining two angles = 180 − 120 = 60°

$\therefore$ second largest angle $= \frac{60}{12} \times 7 = 35°$

105. **(e)** $A + B + C + D = 360°$

$\Rightarrow B - 26° + B + \frac{B}{2} + \frac{B}{2} - 10° = 360°$

$\Rightarrow B = 132°; A = 132° - 26° = 106°$

106. **(b)** $\frac{6x}{7} = 180 \Rightarrow x = 210$