MENSURATION

SYNOPSIS

AREA:

1. The area of a simple closed figure is the measure of the region enclosed by the boundary of the figure.
2. The area is measured in square units. A square meter is the area of a square whose side is one meter. A square centimeter is the area of a square whose side is one centimeter

Definition: A closed plane figure bounded by three line segments is called triangle.

a. Area of triangle of base 'b' units and height 'h' units is

$$A = \frac{1}{2} \times \text{base} \times \text{height sq.units}$$

b. Area of a triangle whose sides are 'a' units, ' b' units and 'c' units as per Heron's formula.

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

Where $s = \frac{\text{semi perimeter}}{2} = \frac{a+b+c}{2}$

c. **Area of right angled triangle:** In a right angled triangle, the sides making right angle are 'a' and ' b' units, then the

Area $= \frac{1}{2} \times a \times b = \frac{1}{2} ab$ sq.units $= \frac{1}{2}$ product of the sides

$$\text{Area of Isosceles right angled triangle} = \frac{1}{2}a^2 \text{ sq.units}$$

Area of isosceles right angled triangle in terms of hypotenuse is

$A = \frac{h^2}{4}$ sq.units

$$\text{Area of an equilateral triangle} = \frac{\sqrt{3}}{4}a^2 \text{ sq.units}$$

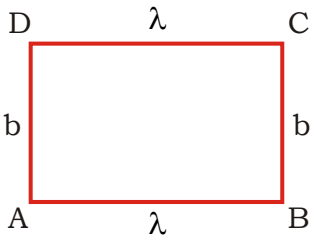
Area of an equilateral triangle with height 'h' units is given as

$$A = \frac{h^2}{\sqrt{3}} \text{ sq.units}$$

Height of an equilateral triangle is $h = \frac{\sqrt{3}}{2}a$ units .

Perimeter of an equilateral triangle is P = 3 $\times$ side units.

Perimeter and area of a rectangle:



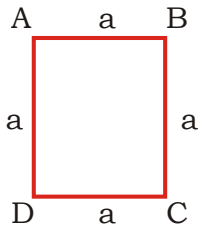
Perimeter= AB + BC + CD + DA

= l + b + l + b = 2 (l + b) units.

$P = 2(l + b)$

Area = l × b sq.units $\quad l = \frac{\text{Area}}{\text{Breadth}}$, $\quad b = \frac{\text{Area}}{\text{length}}$

Perimeter and area of a square:



A square whose each side is equal to 'a' units, then

$Perimeter = 4 \times a$ units

Area = side × side = a^2 sq.units

Side of a square = $\sqrt{\text{Area}}$ units

Relation between various units of area:

Length Units	Area Units
1cm = 10mm	$1cm^2 = (10 \times 10)mm^2 = 100mm^2$
1m = 100cm	$1m^2 = (100 \times 100)cm^2 = 10000cm^2$
1dam = 10m	$1dam^2 = (10 \times 10)m^2 = 100m^2 = 1\,Are$
1hm = 100m	$1hm^2 = (100 \times 100)m^2 = 10000m^2$ $= 1 hectare$

Area of four walls of a room:

1. Area of four walls of a room when the floor is in the shape of a rectangle.

a) If *l*, b and h are the length, breadth and height of a room and A be the total area of the four walls then

$$A = 2h(l + b)\ sq.units$$

b) If the perimeter of a floor is 'p', its height is 'h' and the total area is 'A', then

$$A = ph\ sq.units$$

2. Area of four walls of a room when the floor is in the shape of a square if 'l' and 'h' are the length and height of a room and 'A' is the total area of four walls then

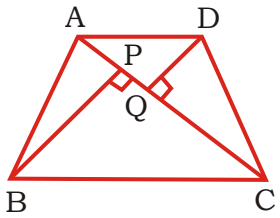
$$A = 4l\ h\ sq.units \quad \text{or} \quad A = ph\ sq.units$$

When 'p' is the perimeter of the room.

Quadrilaterals: A simple closed figure bounded by four line segments is called a quadrilateral.

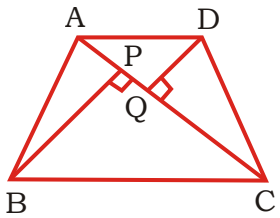
$$\text{Area of quadrilateral} = \frac{1}{2} d(h_1 + h_2)\ \text{sq.units}$$

Where AC = d, BP = h_1, DQ = h_2



$$\text{Area of quadrilateral ABCD} = (\text{Area of triangle ABC}) + (\text{Area of triangle ADC})$$

Parallelogram: A quadrilateral in which both pairs of opposite sides are parallel is called a "parallelogram".

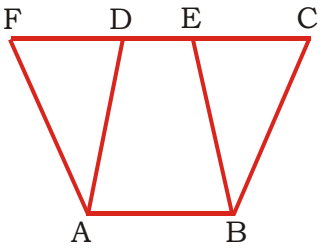


i. The opposite sides are equal
ii. The opposite angles are equal
iii. Diagonals bisects each other
iv. Diagonals are not equal

$$\text{Area of Parallelogram} = \text{base} \times \text{height}$$

Results on areas: Parallelograms on the same base and between the same parallel line are equal in area.

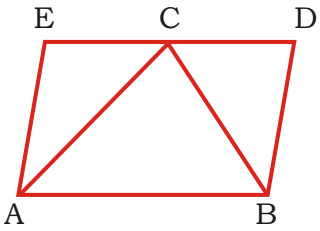
i.



$\therefore$ Area of Parallelogram ABCD = Area of Parallelogram ABEF

Perimeter of a Parallelogram ABCD = AB + BC + CD + DA

ii.



If a triangle and a parallelogram are on the same base and between the same parallel lines then

Area of triangle $= \frac{1}{2}$(Area of parallelogram)

$\therefore$ Area of $\Delta ABC = \frac{1}{2}$(Area of Parallelogram ABDE)

Area of a rectangle = length $\times$ breadth sq.units

Perimeter of a rectangle = $2(l + b)$ units

Diagonal of a rectangle $= \sqrt{l^2 + b^2}$.

Area of a square = Side $\times$ Side = S^2 sq.units.

Perimeter of a square = 4 $\times$ side units

Area of a square $= \frac{(\text{diagonal})^2}{2}$.

WORK SHEET

SINGLE ANSWER TYPE

1. If the side of a sqaure s 'x' then ts area is
   1) x 2) x^2 3) 4x 4) 2x
2. If the side of a square is 'x' then its perimeter is
   1) x 2) x^2 3) 4x 4) 2x
3. Perimeter of rectangle whose length 'l' s and breadth is 'b' is
   1) lb 2) 2(l + b) 3) 2l 4) 2
4. Area of rectangle whose length 'x' is and breadth s 'y'
   1) xy 2)x + y 3) x – y 4) 2(x + y)
5. Area of triangle with base 'b' and height 'h' is
   1) $\frac{1}{2}$bh 2) bh 3) (b + h) 4) All
6. 50^0, 80^0 are two angles of triangle, then triangle is
   1) equilateral 2) isosceles 3) scalene 4) can't say
7. 45^0, 90^0 are two angles of a triangle, then triangle is
   1) acute triangle 2) obtuse triangle
   3) isosceles 4) scalene
8. 3cm, 4cm, 5cm are the side of _____ triangle
   1) equilateral 2) acute 3) obtuse 4) right
9. Each angle in a square is
   1) 30^0 2) 60^0 3) 90^0 4) 120^0
10. Sum of any two sides of a triangles _____ the third side.
    1) equal to 2) less than 3) greater than 4) all
11. The diagonals of a square divide the square into 4 _____ triangles
    1) right angled 2) isosceles 3) right isosceles 4) all
12. If the side of a square is 60cm then its perimeter is _____
    1) 240cm 2) $240cm^2$ 3) 150cm 4) 3600cm
13. In a triangle angles ratio is 1 : 1 : 1 then sides ratio is
    1) $1 : 1 : \sqrt{2}$ 2) $1:\sqrt{2}:1$ 3) $\sqrt{2}:1:1$ 4) None
14. Height of an angles ratio is 1 : 1 : 1 then sides ratio is
    1) $\sqrt{3}a$ 2) $\sqrt{3}a/4$ 3) $\frac{\sqrt{3}a}{2}$ 4) $\frac{\sqrt{3}a^2}{4}$
15. In a triangle angles are in the ratio 1 : 1 : 2 then corresponding sides ratio is
    1) $1:1:\sqrt{2}$ 2) $1:\sqrt{2}:1$ 3) 1 : 1 : 1 4) $1:\sqrt{3}:2$
16. In a triangle angles are in the ratio 1 : 2 : 3 then sides ratio is
    1) $1:\sqrt{3}:2$ 2) $1:3:\sqrt{2}$ 3) $1:\sqrt{3}:\sqrt{2}$ 4) $1:\sqrt{3}:\sqrt{2}$
17. Area of isosceles right angle triangle is $32cm^2$ then length of its hypotenuse
    1) 8 2) $8\sqrt{2}$ 3) 4 4) $2\sqrt{8}$
18. Area of an equilateral triangle is $64\sqrt{3}$ then its perimeter is
    1) 4 2) 8 3) 48 4) 84

19. d_1, d_2 are length of diagonals of rhombus then its area is

1) d_1d_2 2) $d_1\left(\frac{d_2}{4}\right)$ 3) $\left(\frac{d_1}{2}\right)d_2$ 4) $\frac{1}{2}d_1(h_1+h_2)$

20. a, b are lengths of parallel sides and 'h' is the distance between parallel sides of a trapezium then its area is

1) $\frac{1}{2}ah$ 2) $a\frac{h}{2}+\frac{1}{2}bh$ 3) h(a + b) 4) abh

21. The diagonal of a quadrilateral is 'd' heights of the vertices opposite to the diagonal are h_1 and h_2 then its area is

1) dh_1h_2 2) $\frac{1}{2}dh_1h_2$ 3) $\frac{1}{2}dh_1+h_2$ 4) $d\left(\frac{h_1}{2}+\frac{h_2}{2}\right)$

22. In which of the following diagonals need not to bisect each other
1) Rhombus 2) square 3) parallelogram 4) trapezium

23. The ratio of angles in a quadrilateral is 1 : 2 : 3 : 4 the its smallest angle is
1) 36^0 2) 63^0 3) 72^0 4) 144^0

24. The angle in a quadrilateral are x, x+ 10, x + 20, 2x – 30 then ts greatest angle is
1) 141^0 2) 114^0 3) 72^0 4) 92^0

25. Area of trapezium is $\frac{1}{2}(a^2-b^2)cm^2$ where a,b are parallel sides in it, then distance between a & b is _____
1) a + b 2) b + a 3) b – a 4) a – b

26. Base and height of a parallelogram are 12cm, and 7cm then its area is
1) $84cm^2$ 2) 84cm 3) $96cm^2$ 4)$42cm^2$

27. In a ΔABC, BC = 8cm, altitude from A to BC is 6cm then its area is
1) $48cm^2$ 2) $24cm^2$ 3) $42cm^2$ 4) None

28. In a quadrilateral ABCD, AC = 10cm, lengths of perpendiculars from B to D to AC are 5cm, 7cm, respectively then its area is
1) $60cm^2$ 2) $50cm^2$ 3) $100cm^2$ 4) $120cm^2$

29. In a quadrilateral, diagonals intersect at right angle and have length equal to 6cm and 7cm then its area is

1) $\frac{21}{2}cm^2$ 2) $21cm^2$ 3) $\frac{42}{2}cm^2$ 4) both 2 & 3

30. The area of parallelogram ABCD is $102cm^2$, distance between AB and CD is 8.5cm then length of AB is
1) 10cm 2) 11cm 3) 6cm 4) 12cm

31. If d is the length of the diagonal of square then ts area is

1) d^2 2) $\frac{d}{2}$ 3) $\frac{1}{2}d.d$ 4) $\sqrt{d}$

32. In a parallelogram ABCD, DP $\perp$ AC and AC = 10cm, DP = 4cm, AB = 8cm then distance between AB and CD is
1) 10cm 2) 8cm 3) 6cm 4) None

33. ABCD is a parallelogram whose area is $60cm^2$ and $DP \perp AC$, AC = 12cm then the length of DP = _____
1) 10cm 2) 6cm 3) 5cm 4) 9cm

34. The parallel sides of a trapezium are $6\frac{1}{2}cm$ and $5\frac{1}{2}cm$ and distance between them is $2\frac{2}{3}cm$, then side of a square which has the same area as trapezium
1) 16cm 2) 4cm 3) 8cm 4) 2cm

35. The area of rhombus is $25cm^2$ one of the diagonal is 10cm long then the length f other diagonal is
1) 20cm 2) 15cm 3) 10cm 4) 5cm

36. The diagonal of a square is 18cm, and then side of the square is
1) 9cm 2) $2\sqrt{9}\,cm$ 3) $9\sqrt{2}\,cm$ 4) $\sqrt{2}\,cm$

MULTI ANSWER TYPE

37. If one of whose diagonals of a parallelogram is 88cm and offset of one of the vertices to this diagonal is 40cm, then its area is
1) 3520 cm^2 2) 0.352 m^2 3) $35.20\times10^2\,cm^2$ 4) $3.520\times10^3\,cm^2$

38. The base of a triangular field is three times its height. If the cost of cultivating the field is Rs. 36.72 per hectare is Rs. 495.72. Then
1) the base of the triangular field is 900m
2) the base of the triangular field is 1200m
3) the height of the triangular field is 300m
4) the height of the triangular field is 400m

39. If the altitude of an equilateral triangle is $2\sqrt{3}$, then its
1) area is $4\sqrt{3}\,cm^2$ 2) side is 4cm 3) area is $\frac{8}{\sqrt{3}}cm^2$ 4) side is 6cm

REASONING ANSWER TYPE

40. *Statement-I*: Sides of a right angled triangle are 9cm, 12cm, 15cm, then its area is 108 sq.cm.

Statement-II: Area of a right triangle is $\frac{1}{2}\times b\times h$.

1) Both Statements are true, Statement II is the correct explanation of Statement I.
2) Both Statements are true, Statement II is not correct explanation of Statement I.
3) Statement I is true, Statement II is false.
4) Statement I is false, Statement II is true.

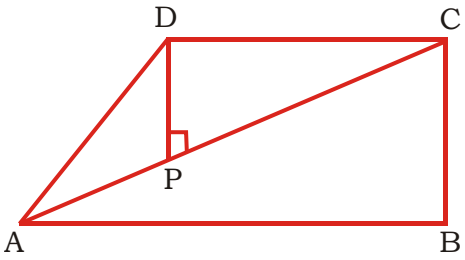
41. *Statement-I*: Area of rhombus is $480cm^2$.
Statement-II: If the diagonals of a rhombus are 48 cm and 20 cm are stated in statement 1.
1) Both Statements are true, Statement II is the correct explanation of Statement I.

2) Both Statements are true, Statement II is not correct explanation of Statement I.
3) Statement I is true, Statement II is false.
4) Statement I is false, Statement II is true.

COMPREHENSION TYPE

Writeup:1

In the figure ABCD is a parallelogram and DP is perpendicular to AC



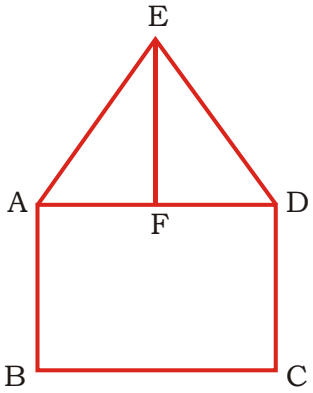
42. If the area of a parallelogram is 70sq.cm and AC = 14cm, then the length of DP is
1) 5 cm 2) 840 cm 3) 980 cm 4) 3 cm

43. If AC = 16cm, DP = 5 cm, AB = 10cm, then the distance between AB and CD is
1) 80 cm^2 2) 50 cm^2 3) 8 cm 4) 16 cm

44. If AD = 6cm, AC = 9cm, DP = 4cm, then the distance between AD and BC is
1) 6 cm 2) 54 cm 3) 24 cm 4) 3 cm

Writeup:2

In the given figure ABCD is a square, AC = BD = $4\sqrt{2}$cm, AE = DE = 2.5 cm.



Read the above passage and answers the questions below.

45. EF =
1) 1.5 cm 2) 2.5 cm 3) 3 cm 4) 4cm

46. Area of ABCD =
1) 16cm^2 2) 14cm^2 3) 17cm^2 4) 12cm^2

47. Area of ABCDE =
1) 22cm^2 2) 19cm^2 3) 17cm^2 4) 20 cm^2

MATRIX MATCHING TYPE

48.

Column - I	Column - II
a) In an equilateral triangle angles are in the ratio 1 : 1 : 1, then side are in the ratio	1) $1:1:\sqrt{2}$
b) The area of isosceles right triangle of side 'a' units	2) $\frac{1}{2}a^2$ sq.units
c) Area of an equilateral triangle whose height is 'h' units	3) $1:\sqrt{3}:2$
d) If the angles in a triangle are in the ratio 1 : 1 : 2,	4) $\frac{h^2}{\sqrt{3}}$ sq.units
	5) 1 : 1 : 1

INTEGER ANSWER TYPE

49. If the base of an isosceles triangle is 8cm and each of its equal sides is 5cm, then its area is_____sq.cm.

KEY & HINTS

WORK SHEET (KEY)				
1) 2	2) 3	3) 2	4) 1	5) 1
6) 2	7) 3	8) 4	9) 3	10) 3
11) 4	12) 1	13) 4	14) 3	15) 1
16) 1	17) 2	18) 3	19) 3	20) 2
21) 4	22) 4	23) 1	24) 2	25) 4
26) 1	27) 2	28) 1	29) 4	30) 4
31) 3	32) 4	33) 3	34) 1	35) 4
36) 3	37) 1,2,3,4	38) 1,3	39) 1,2	40) 4
41) 1	42) 1	43) 3	44) 1	45) 1
46) 1	47) 2	48) 5,2,4,1	49) 12	

37. bh = 88 × 40 = 3520 sq.cm

38. Area of field = $\frac{495.72}{36.72}$ = 13.5 hectare = 135000 m^2

Now, if h = x, b = 3x

$\therefore \frac{1}{2} \times b \times h = 135000$

39. Height of an equilateral triangle = $\frac{\sqrt{3}}{2} \times \text{side}$

$\therefore \quad 2\sqrt{3} = \frac{\sqrt{3}}{2} \times \text{side} \quad \Rightarrow \text{side} = 4\text{cm}$

$\therefore$ Area of an equilateral triangle = $\frac{\sqrt{3}}{4} \times (\text{side})^2 = \frac{\sqrt{3}}{4} \times 4 \times 4 = 4\sqrt{3}\ \text{cm}^2$

40. Conceptual

41. bh = 70; Area of triangle $= \frac{1}{2} \times AC \times DP = \frac{1}{2} \times 14 \times DP = 35 \Rightarrow DP = 5\text{cm}$

42. Area of parallelogram = $2\left(\frac{1}{2} \times 16 \times 5\right) = 2(8 \times 5)$

A = 2 × 40 = 80cm^2

The distance between AB and CD is h

AB × distance between AB and CD = 80cm^2

$10 \times h = 80 \Rightarrow h = 8$ cm

43. $9 \times 4 = 6 \times x$; x = 6cm

44. Conceptual

45 – 47 Paragraph

AB = BC = CD = AD = 4 cm $\left(\text{Q Side} = \frac{\text{Digonal}}{\sqrt{2}}\right)$

and EF = 1.5 cm (By Pythagorus theorem)

$\therefore$ Area of ABCDE = Area of ABCD + Area of AED $= (4)^2 + \frac{1}{2} \times 4 \times 1.5 = 19\text{cm}^2$

48. Conceptual

49. $s = \frac{a+b+c}{2} = \frac{8+5+5}{2} = \frac{18}{2} = 9$

$A = \sqrt{9(9-8)(9-5)(9-5)} = \sqrt{9 \times 4 \times 4} = 3 \times 4 = 12\ \text{cm}^2$