Comprehensive Notes

of

Central Board of Secondary Education

Class IX

Mathematics

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Chapter - 6 (Perimeter and Area)

by

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Introduction

Perimeter and Area are important concepts in geometry used in daily life such as:

- fencing fields,
- designing rooms,
- constructing roads,
- making circular tracks,
- estimating paint or tiles.

Definitions

- Perimeter → Total length around a closed figure.
- Area → Surface enclosed inside a figure.

Perimeter of a Square:

Definition:

A square has:

- four equal sides,
- four right angles.

If each side of a square is a, then:

$$\text{Perimeter} = 4a$$

Example 1

Find the perimeter of a square whose side is 8 cm.

Solution

$$P = 4a$$
$$P = 4 \times 8 = 32 \text{ cm}$$

Answer

Perimeter = 32 cm

Example 2

A square playground has perimeter 60 m. Find its side.

Solution

$$4a = 60$$
$$a = \frac{60}{4} = 15$$

Answer

Side = 15 m

Perimeter (Circumference) of a Circle:

The perimeter of a circle is called its circumference.

Important Terms

- Radius (r) → Distance from centre to circle.
- Diameter (d) → Distance across the circle through centre.

$$d = 2r$$

The C/D Ratio:

Ancient mathematicians discovered:

$$\frac{C}{D}$$

is always constant for every circle.

This constant is called:

$$\pi$$

Thus,

$$\frac{C}{D} = \pi$$

Therefore:

$$C = \pi D$$

Since $D = 2r$,

$$C = 2\pi r$$

Value of π

$$\pi \approx 3.14$$

or

$$\pi = \frac{22}{7}$$

Example

Find circumference of a circle of radius 7 cm.

Solution

$$C = 2\pi r$$
$$= 2 \times \frac{22}{7} \times 7$$
$$= 44 \text{ cm}$$

Answer

Circumference $= 44$ cm

π Is Irrational:

An irrational number:

- cannot be written as $\frac{p}{q}$,
- has non-terminating non-repeating decimals.

π is irrational because:

$$\pi = 3.1415926535 \ldots$$

Its digits continue forever without repetition.

Length of an Arc of a Circle:

An arc is part of the circumference.

If:

- radius $= r$

- central angle $= \theta^\circ$

then:

$$\text{Arc Length} = \frac{\theta}{360^\circ} \times 2\pi r$$

Example

Find length of arc subtending 90°in a circle of radius 14 cm.

Solution

$$L = \frac{90}{360} \times 2 \times \frac{22}{7} \times 14$$
$$= \frac{1}{4} \times 88$$
$$= 22 \text{ cm}$$

Answer

Arc length $= 22$ cm

Problems, Puzzles, and Paradoxes on Perimeter:

Sometimes figures with nearly same shapes may have:

- different perimeters,
- same areas,
- or strange geometric behaviour.

Example Puzzle

Two rectangles:

- 6×4

- 8×2

Both have area:

$$24 \text{ sq units}$$

But perimeters:

$$2(6 + 4) = 20$$
$$2(8 + 2) = 20$$

Same area and same perimeter.

But another pair may have:

- same area,
- different perimeter.

This shows area and perimeter are independent concepts.

Area of a Rectangle:

Formula

If:

- length $= l$
- breadth $= b$

then:

$$\text{Area} = l \times b$$

Example

Find area of rectangle with:

- length = 12 cm
- breadth = 5 cm

Solution

$$A = 12 \times 5 = 60$$

Answer

Area = 60 sq cm

Area of a Triangle:

Formula

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$$

Example

Base = 10 cm
Height = 8 cm

Solution

$$A = \frac{1}{2} \times 10 \times 8$$
$$= 40 \text{ sq cm}$$

Answer

Area = 40 sq cm

Heron's Formula:

Used when all three sides of a triangle are known.

If sides are:

- a
- b
- c

then semi-perimeter:

$$s = \frac{a + b + c}{2}$$

Area:

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

Example:

Find area of triangle with sides:

- 5 cm
- 6 cm
- 7 cm

Solution

$$s = \frac{5 + 6 + 7}{2}$$
$$= \frac{18}{2} = 9$$

Now,

$$A = \sqrt{9(9-5)(9-6)(9-7)}$$
$$= \sqrt{9 \times 4 \times 3 \times 2}$$
$$= \sqrt{216}$$
$$= 14.7 \text{ sq cm (approx)}$$

Answer

Area ≈ 14.7 sq cm

Squaring a Rectangle:

To "square a rectangle" means:

- constructing a square having same area as rectangle.

If rectangle dimensions are:

- length $= l$
- breadth $= b$

then area:

$$lb$$

Required square side:

$$\sqrt{lb}$$

Example

Rectangle:

- 16 cm
- 9 cm

Area:

$$16 \times 9 = 144 \text{ cm}^2$$

Square side:

$$\sqrt{144} = 12$$

Answer

Side of equivalent square = 12 cm

Area of a Circle:

Formula

$$A = \pi r^2$$

Example

Radius = 7 cm

Solution

$$A = \frac{22}{7} \times 7 \times 7$$
$$= 154 \text{ sq cm}$$

Answer

Area = 154 sq cm

Area of Sector of a Circle:

A sector is a "slice" of a circle.

If:

- radius $= r$
- central angle $= \theta°$

then:

$$\text{Sector Area} = \frac{\theta}{360°} \times \pi r^2$$

Example:

Find area of sector with:

- radius $= 14$ cm
- angle $= 90°$

Solution

$$A = \frac{90}{360} \times \frac{22}{7} \times 14 \times 14$$
$$= \frac{1}{4} \times 616$$
$$= 154 \text{ sq cm}$$

Answer

Sector area $= 154$ sq cm

Brahmagupta's Formula:

Used to find area of a cyclic quadrilateral.

A cyclic quadrilateral is one whose vertices lie on a circle.

If sides are:

- a, b, c, d

Semi-perimeter:

$$s = \frac{a + b + c + d}{2}$$

Area:

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

Example

Sides:

- 5 cm
- 6 cm
- 7 cm
- 8 cm

Solution

$$s = \frac{5 + 6 + 7 + 8}{2}$$

$$= \frac{26}{2} = 13$$

$$A = \sqrt{(13-5)(13-6)(13-7)(13-8)}$$
$$= \sqrt{8 \times 7 \times 6 \times 5}$$
$$= \sqrt{1680}$$
$$\approx 40.98$$

Answer

Area ≈ 40.98 sq cm

Practice Worksheet

Section A – MCQs

1. Perimeter of square of side 9 cm is:

   (a) 18 cm

   (b) 27 cm

   (c) 36 cm

   (d) 81 cm

2. Circumference of circle formula is:

   (a) πr^2

   (b) $2\pi r$

   (c) r^2

   (d) $2r$

3. π is:

   (a) Rational

   (b) Irrational

   (c) Integer

   (d) Whole number

4. Area of rectangle =:

   (a) $2(l + b)$

   (b) $l \times b$

(c) $l + b$

(d) l^2

5. Area of triangle formula:

(a) bh

(b) $\frac{1}{2}bh$

(c) $2bh$

(d) $b + h$

6. Diameter of circle with radius 10 cm:

(a) 5

(b) 10

(c) 20

(d) 40

7. Semi-perimeter means:

(a) Double perimeter

(b) Half perimeter

(c) Area

(d) Radius

8. Arc is:

(a) Centre

(b) Diameter

(c) Part of circle

(d) Radius

9. Area of circle with radius 1:

(a) π

(b) 2π

(c) 1

(d) 2

10. Heron's formula is used for:

(a) Square

(b) Rectangle

(c) Triangle

(d) Circle

11. Sector is:

(a) Full circle

(b) Half circle

(c) Slice of circle

(d) Line

12. Side of square with perimeter 48 cm:

(a) 10

(b) 12

(c) 14

(d) 16

13. Circumference of radius 14 cm:

(a) 44

(b) 88

(c) 22

(d) 14

14. Area of 5 cm × 8 cm rectangle:

(a) 13

(b) 26

(c) 40

(d) 80

15. If angle of sector is 180°, sector is:

(a) Quarter circle

(b) Full circle

(c) Semicircle

(d) Arc

16. π approximately equals:

(a) 2.14

(b) 3.14

(c) 4.14

(d) 1.14

17. Area of square side 6 cm:

(a) 12

(b) 24

(c) 36

(d) 18

18. Radius is:

(a) Half diameter

(b) Double diameter

(c) Equal to diameter

(d) None

19. Area of triangle with base 4 and height 10:

(a) 40

(b) 20

(c) 14

(d) 10

20. A cyclic quadrilateral lies on:

(a) Rectangle

(b) Triangle

(c) Circle

(d) Line

Section B – True/False

1. Perimeter measures boundary length.
2. Area of circle is $2\pi r$.
3. π is irrational.
4. Arc length depends on central angle.
5. Heron's formula uses all three sides.
6. Area of rectangle is $l + b$.
7. Diameter is twice radius.
8. Sector area depends on angle.
9. A square can have same area as rectangle.
10. Brahmagupta's formula is for cyclic quadrilateral.

Section C – Fill in the Blanks

1. Perimeter of square = _____
2. Circumference of circle = _____
3. Diameter = _____ × radius
4. Area of rectangle = _____
5. Area of triangle = _____
6. π is an _____ number.
7. Arc is a part of _____.

8. Area of circle = _____
9. Semi-perimeter means _____ perimeter.
10. Heron's formula is used for _____.
11. Sector is a _____ of circle.
12. Radius is half the _____.
13. $\pi \approx$_____
14. A quadrilateral on a circle is called _____ quadrilateral.
15. Area is measured in _____ units.
16. Perimeter is measured in _____ units.
17. Rectangle has opposite sides _____.
18. A square has _____ equal sides.
19. Circumference is also called _____ of circle.
20. A semicircle is half of a _____.

Section D – Solve the Following

1. Find perimeter of square of side 15 cm.
2. Find circumference of circle of radius 21 cm.
3. Find area of rectangle 18 cm × 9 cm.
4. Find area of triangle with base 12 cm and height 7 cm.
5. Find area of circle of radius 14 cm.
6. Find arc length for angle 60°and radius 7 cm.
7. Find area of sector with angle 120°and radius 14 cm.
8. Find area of triangle with sides 13 cm, 14 cm, 15 cm using Heron's formula.

9. Find side of square equal in area to rectangle 25×16.
10. Find area of cyclic quadrilateral with sides 4 cm, 5 cm, 7 cm, 8 cm.

Answer Key

MCQ Answers

1-c	8-c	15-c
2-b	9-a	16-b
3-b	10-c	17-c
4-b	11-c	18-a
5-b	12-b	19-b
6-c	13-b	20-c
7-b	14-c	

True/False Answers

1. True
2. False
3. True
4. True
5. True
6. False
7. True
8. True
9. True
10. True

Fill in the Blanks Answers

1. $4a$
2. $2\pi r$
3. 2
4. $l \times b$
5. $\frac{1}{2}bh$
6. irrational
7. circle
8. πr^2
9. half
10. triangle
11. slice
12. diameter
13. 3.14
14. cyclic
15. square
16. linear
17. equal
18. four
19. perimeter
20. circle

Answers – Section D

1. 60 cm
2. 132 cm
3. 162 sq cm
4. 42 sq cm
5. 616 sq cm
6. $\frac{22}{3}$cm
7. $\frac{616}{3}$sq cm
8. 84 sq cm
9. 20 cm
10. $\sqrt{540} \approx 23.24$ sq cm

End of Chapter