AREA AND ITS BOUNDARY

Concepts Covered

- Plane figures, Perimeter, Perimeter of Rectangle and Square
- Perimeter of Regular Shapes, Area of Triangle, Area of Rectangle and Square
- Perimeter and Area of Parallelogram, Perimeter and Area of a Trapezium

Introduction

What is a 2D figure?

- A two-dimensional shape is a plane figure that can be drawn on a flat surface.
- It has only two dimensions which are length and width. It has no thickness or depth
- Example: Rectangle, Circle, Square etc

Basic Unit Conversions

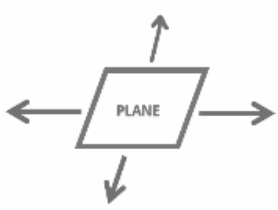
Length	Volume	Weight
1 km = 1000 m	1 kl = 1000 L	1 kg = 1000 g
1 m = 0.001 km	1 l = 0.001 kL	1 g = 0.001 kg
1 m = 1000 mm	1 l = 1000 mL	1 g = 1000 mg
1 mm = 0.001 m	1 ml = 0.001 L	1mg = 0.001 g

Plane

A plane is a flat, two-dimensional surface that extends indefinitely in both dimensions.

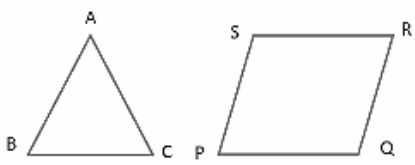
Plane Figure

A figure lying on a plane is called a plane figure. A plane figure is a closed figure and it has no free end means the starting point and the ending point of the plane figure are the same. It is called a simple closed figure because it does not cross itself. A plane figure is basically made up of line segments or curves or both. The part of the plane which is enclosed by a simple closed figure is called a plane region. Triangles, Rectangles, Squares and Circles are some examples of plane figures.



Perimeter

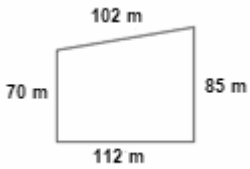
The perimeter (P) of a closed plane figure is the sum of the lengths of all its bounding sides, means the line segments enclosing the figure. Perimeter is measured in units of length such as centimetre (cm) and metre (m).
In the figure, ABC is a triangle and PQRS is a quadrilateral.
The perimeter of the ΔABC = AB + BC + CA.
The perimeter of the quadrilateral PQRS = PQ + QR + RS + SP.
The applications of the perimeter are widely used in our daily life.
For Example:
(i) A farmer who wants to fence his field.
(ii) An engineer who plans to build a compound wall on all sides of a house.



Triangle Quadrilateral

Example:

Anurag walks around a playground in his daily morning walk. How far does he walk every morning? The playground is of the shape of a quadrilateral having sides of length 112 m, 85 m, 70 m and 102 m.



Solution: Perimeter of the playground
= 112 m + 85 m + 70 m + 102 m
= 369 m
Hence, Anurag walks 369 m around the playground, i.e., around the perimeter.

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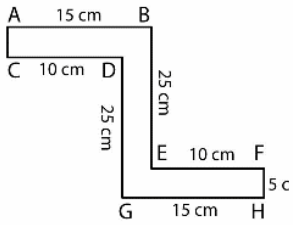
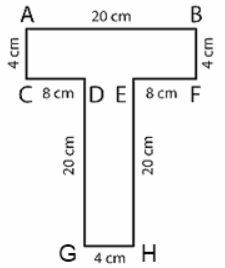
Example:

Find the perimeter of the given closed figures.

Solution: (i) Required perimeter
= AB + AC + BE + EF + FH + HG + GD + CD
= 15 + 5 + 25 + 10 + 5 + 15 + 25 + 10 = 110 cm

(ii) Required perimeter
= AB + AC + CD + DG + BF + EF + EH + GH
= 20 + 4 + 8 + 20 + 4 + 8 + 20 + 4 = 88 cm





Perimeter of a Rectangle

A rectangle is a closed figure with four sides and it is a special type of parallelogram. The important properties of a rectangle are:

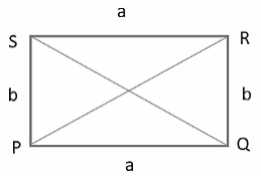
(I) All four angles of a rectangle are right angles, i.e., 90° (∠P = ∠Q = ∠R = ∠S).
(II) The opposite sides of a rectangle are equal in measure. (PQ = RS = a & PS = QR = b)
(III) The diagonals of a rectangle bisect each other and are also equal. (PR = QS)

Perimeter of a rectangle

It is defined as the sum of all the sides of a rectangle. In a rectangle, the opposite sides of a rectangle are equal and so, the perimeter will be twice the sum of the length and breadth of the rectangle and it is denoted by the alphabet "P".

Perimeter of the rectangle = 2(Length + Breadth) ⇒ P = 2(a + b)

Where, a = Length of the rectangle.
b = Breadth of the rectangle.



Rectangle

Example:

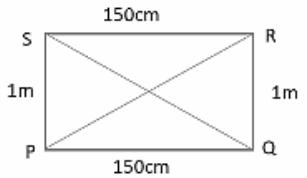
An athlete takes 10 rounds of a rectangular park, 50 m long and 25 m wide. Find the total distance covered by him.

Solution: Length of the rectangular park = 50 m
Breadth of the rectangular park = 25 m
Therefore, the total distance covered by the athlete in one round will be the perimeter of the park.
By the formula,
Perimeter of the rectangular park = 2 × (length + breadth) = 2 × (50 m + 25 m) = 2 × 75 m = 150 m
∴The distance covered by the athlete in one round = 150 m.
Therefore, distance covered in 10 rounds = 10 × 150 m = 1500 m
The total distance covered by the athlete is 1500 m.

Example:

Find the perimeter of a rectangle whose length and breadth are 150 cm and 1 m respectively.

Solution: ∵ Length = 150 cm and Breadth = 1 m = 100 cm
∴ Perimeter of the rectangle = 2 × (length + breadth)
= 2 × (150 cm + 100 cm) = 2 × (250 cm) = 500 cm = 5 m



Example:

Find the cost of fencing a rectangular park of length 250 m and breadth 175 m at the rate of Rs. 12 per metre.

Solution: Length of the rectangular park = 250 m
Breadth of the rectangular park = 175 m
Hence, to calculate the cost of fencing we require perimeter.
Perimeter of the rectangle = 2 × (length + breadth)
⇒ 2 × (250 m + 175 m) = 2 × (425 m) = 850 m
Cost of fencing 1m of park = 12 Rs.
∴The total cost of fencing the park = 850 × 12 = Rs.10200

Perimeter of a Square

A square is a closed figure with four sides and is a special type of parallelogram. The important properties of a square are:

(I) All the four angles of a square are right angles i.e., 90°. (∠P =∠Q =∠R =∠S)
(II) All the four sides of a square are equal in measure. (PQ = RS = PS = QR = a)
(III) The diagonals of a square bisect each other and are also equal. (PR = QS)

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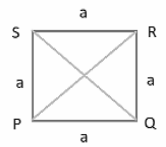
Perimeter of a Square

It is defined as the sum of all the sides of a square. In a square, all the four sides are equal and so;

Perimeter of a square = 4 × (Length of one side) ⇒ P = 4 × a = 4a

Where, a = Length of one side of the square.



Square

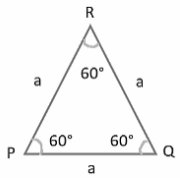
Perimeter of an Equilateral Triangle

Equilateral Triangle: An Equilateral triangle is a triangle in which all the three sides are equal and the angles are also equal. The value of each angle of an equilateral triangle is 60° therefore, it is also known as an equiangular triangle.

Perimeter of an equilateral triangle = 3 × length of a side

P = 3 × a = 3a

Where, a = Length of one side of an equilateral triangle.



Equilateral Triangle

Perimeter of an Isosceles Triangle

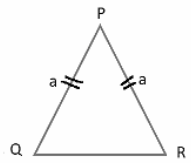
Isosceles Triangle: An isosceles triangle is a triangle that has two sides of equal length and two equal angles.

Perimeter of an Isosceles Triangle = (2 × length of equal side) + Length of the third side

⇒ P = 2a + b

Where, a = Length of equal sides.

b = Length of the other side.



Isosceles Triangle

Perimeter of Regular Polygons

A polygon is a simple closed curve which is made up of line segments. The name 'Polygon' can be understood this way: 'poly' = many and 'gon'= side and hence a polygon is a two-dimensional geometric figure that has a finite number of sides. Based on the number of sides, we have the following polygon shapes.

Number of Sides	Type of Polygon
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
9	Nonagon
10	Decagon

Perimeter of Regular Pentagon

A regular pentagon has all five sides equal.

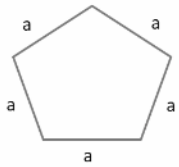
⇒ Perimeter of a regular pentagon = 5 × length of one side

⇒ P = 5 × a = 5a

Note: Perimeter of a regular hexagon will be = 6 × length of one side = 6 × a = 6a

Perimeter of an octagon will be = 8 × length of one side = 8 × a = 8a

Generally, for an n-sided polygon;



Regular Pentagon

Perimeter of an n-sided regular polygon = n × Length of one side

Example:

Find the distance covered by Samaina if she takes three rounds of a square park of side 70 m.

Solution: Perimeter of the square park = 4 × length of a side

⇒ 4 × 70 m = 280 m

⇒ Distance covered in one round = 280 m

Therefore, distance covered in three rounds = 3 × 280 = 840 m.

Example:

Sonalika runs around a square field of side 75 m and Mahesh runs around a rectangular field with the length of 160 m and the breadth of 105 m. Who covers more distance and by how much in one round?

Solution: Distance covered by Sonalika in one round = Perimeter of the square

= 4 × length of a side = 4 × 75 m = 300 m

Distance covered by Mahesh in one round = Perimeter of the rectangle

= 2 × (length + breadth) = 2 × (160 m + 105 m)

= 2 × 265 m = 530 m

Difference in the distance covered = 530 m – 300 m = 230 m.

Therefore, Mahesh covers more distance by 230 m.

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Example:

The perimeter of a regular hexagon is 18 cm. How long is its one side?

Solution: Perimeter = 18 cm (Given)

We know that a regular hexagon has 6 sides.

By the formula;

Perimeter of a regular hexagon = 6 × length of one side = 6 × a = 6a

∴ 6a = 18cm

⇒ a = $\frac{18}{6}$ = 3 cm

Therefore, the length of each side of the regular hexagon is a = 3 cm.

Check Your Concept - 1

(i) A rectangular tabletop measures 2 m 25 cm by 1 m 50 cm. What is the perimeter of the table-top?

(A) 750 cm or 7.50 m (B) 750 m or 7.50 cm

(C) 650 cm or 6.50 m (D)700 cm or 7.0 m

(ii) A rectangular piece of land measures 0.7 km by 0.5 km. Each side is to be fenced with 4 rows of wires. What is the length of the wire needed?

(A) 9.6 m (B) 9.6 km

(C) 96000 m (D) 3.5 km

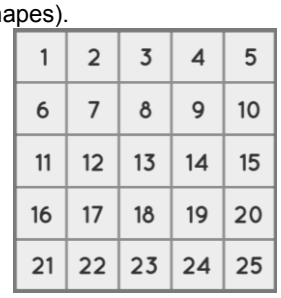
(iii) Two sides of a triangle are 12 cm and 14 cm. The perimeter of the triangle is 36 cm. What is its third side?

(A) 10 cm (B) 9 cm

(C) 8 cm (D) 168 cm

What is Area?

- The space enclosed by a plane figure is referred to as its area (2 Dimensional shapes).
- Square units are used to measure area.
- The area of a plane figure is the number of squares required to completely cover it. Example: The area of the square given below will be the number of squares of the unit side required to completely cover the square.



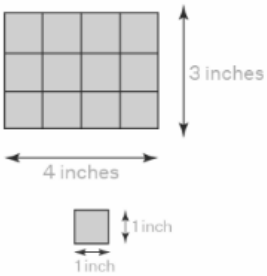
Since it would be silly to always count all those squares to find the area we just multiply both sides.

Hence we can get formulae for the area as

Area of Rectangle

The area occupied by a rectangle within its boundary is called the area of the rectangle. The area of a rectangle is the number of unit squares that can fit into a rectangle. Some examples of rectangular shapes are the flat surfaces of laptop monitors, blackboards, painting canvas, etc.

The figure shows that the rectangle is divided into unit squares. Each unit square is of length =1 inch and breadth = 1 inch. We already know that area is measured in terms of square units.



Area of a unit square = (1 inch) × (1 inch) = 1 inch^2 or 1 square inches

The number of squares = 12 squares

∴ Area of the rectangle = 12 × 1 square inches = 12 square inches

which can also be interpreted as:

Area of the rectangle = (Length × Breadth)

= 4 × 3 = 12 square inches

Example:

Find the area of a rectangle whose length and breadth are 16 cm and 4 cm respectively.

Solution: Length of the rectangle = 16 cm

Breadth of the rectangle = 4 cm

Area of the rectangle = length × breadth = 16 cm × 4 cm = 64 sq. cm.

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Example:

The area of a rectangular piece of cardboard is 38 sq. cm and its length is 19 cm. What is the width of the cardboard?

Solution: Area of the rectangle = 38 sq. cm

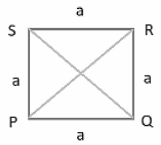
Length = 19 cm and Width = ?

Area of a rectangle = length × width

⇒ Width of the rectangle = $\frac{\text{Area of rectangle}}{\text{Length}} = \frac{38 \text{ sq cm}}{19 \text{ cm}}$ = 2 cm

Thus, the width of the rectangular cardboard is 2 cm.

Area of Square



Square

The formula for the area of a square when the sides are given is

Area of a square, A = Side × Side

$A = a^2$

Where a is the side of the square

Example:

Find the area of a square plot of side 9 m.

Solution: Side of the square = 9 m

Area of the square = side × side

⇒ 9 m × 9 m = 81 sq. m.

Example:

Mahesh wants to cover the floor of a room 3 m wide and 4 m long by squared tiles. If each square tile is of side 0.5 m, then find the number of tiles required to cover the floor of the room.

Solution: Total area of tiles must be equal to the area of the floor of the room.

Length of the room = 4 m

Breadth of the room = 3 m

Area of the floor = length × breadth = 4 m × 3 m = 12 sq. m

Area of one square tile = side × side = 0.5 m × 0.5 m = 0.25 sq. m

Number of tiles required = $\frac{\text{Area of the floor}}{\text{Area of one tile}} = \frac{12}{0.25} = \frac{1200}{25}$ = 48 tiles.

Check Your Concept - 2

(i) Area of which of the following is length x breadth?

(A) Rectangle (B) Square

(C) Isosceles Triangle (D) Equilateral

(ii) The width of a rectangle in terms of area is

(A) length/ area (B) area/length

(C) area x length (D) None of these

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Solved Examples

(1) Find the perimeter of each of the following shapes:
(a) A triangle of sides 3 cm, 4 cm, and 5 cm.
(b) An equilateral triangle of side 9 cm.
(c) An isosceles triangle with equal sides 8 cm each and a third side 6 cm.

Solution: **(a)** Perimeter of triangle = 3 + 4 + 5
= **12 cm**

(b) Perimeter of an equilateral triangle = 3 × side length (∵ All the three sides are equal)
= 3 × 9
= 27 cm

(c) Perimeter of isosceles triangle = 8 + 8 + 6 (∵ Two sides are equal)
= 22 cm

(2) The perimeter of a regular pentagon is 100 cm. How long is each side?

Solution: Perimeter of regular pentagon = 100 cm
⇒ 5 × side = 100 cm
∴ Side = 100 / 5
⇒ Side = 20 cm
∴ The side of the pentagon is **20 cm.**

(3) Two sides of a triangle are 12 cm and 14 cm. The perimeter of the triangle is 36 cm. What is its third side?

Solution: Let x cm be the third side
Given: Perimeter of triangle = 36 cm
⇒ 12 + 14 + x = 36
⇒ 26 + x = 36
⇒ x = 36 – 26
⇒ x = 10 cm
∴ The third side of the triangle is **10 cm.**

(4) Find the cost of fencing a rectangular park of length 175 m and breadth 125 m at the rate of Rs. 12 per metre.

Solution: Given: Length = 175 cm and Breadth = 125 m
⇒ Perimeter of rectangular park = 2 (Length + Breadth)
= 2 (175 + 125)
= 2 (300)
= 2 × 300
= 600 m
∴ Cost of fencing = 12 × 600
= Rs. 7200
∴ The cost of fencing is **Rs. 7,200**

(5) Sweety runs around a square park of side 75 m. Bulbul runs around a rectangular park with length 60 m and breadth 45 m. Who covers less distance?

Solution: By the formula, Perimeter of square = 4 × side
= 4 × 75
= 300 m
∴ The distance covered by Sweety is **300 m**

∵ Perimeter of rectangular park = 2 (Length + Breadth)
= 2 (60 + 45)
= 2 (105)
= 2 × 105
= 210 m
∴ The distance covered by Bulbul is **210 m**
Hence, Bulbul covers less distance than Sweety.

(6) Find the area of the rectangles whose sides are:
(a) 3 cm and 4 cm **(b) 12 m and 21 m** **(c) 2 km and 3 km** **(d) 2 m and 70 cm**

Solutions: By the formula, we know that
Area of rectangle = Length × Breadth
(a) l = 3 cm and b = 4 cm
⇒ Area = l × b = 3 × 4
= **12 cm^2**

(b) l = 12 m and b = 21 m
⇒ Area = l × b = 12 × 21
= **252 m^2**

(c) l = 2 km and b = 3 km
⇒ Area = l × b = 2 × 3
= **6 km^2**

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(d) l = 2 m and b = 70 cm = 0.70 m
⇒ Area = l × b = 2 × 0.70
= **1.40 m^2**

(7) Find the areas of the squares whose sides are:
(a) 10 cm **(b) 14 cm** **(c) 5 m**
Solutions: (a) Area of square = $side^2$
= 10^2
= **100 cm^2**

(b) Area of square = $side^2$
= 14^2
= **196 cm^2**

(c) Area of square = $side^2$
= 5^2
= **25 m^2**

(8) The length and breadth of three rectangles are as given below:
(a) 9 m and 6 m **(b) 17 m and 3 m** **(c) 4 m and 14 m**
Which one has the largest area and which one has the smallest?
Solutions: (a) Area of rectangle = l × b
= 9 × 6
= **54 m^2**

(b) Area of rectangle = l × b
= 17 × 3
= **51 m^2**

(c) Area of rectangle = l × b
= 4 × 14
= **56 m^2**
Area of rectangle 56 m^2.
Therefore, (c) has the largest area and (b) has the smallest area.

(9) What is the cost of tiling a rectangular plot of land 500 m long and 200 m wide at the rate of 8 Rs. per hundred sq. m.?
Solution: Area of land = length × breadth
= 500 × 200
= 1,00,000 m^2
∴ Cost of tiling 1,00,000 sq. metre of land = (8 × 1,00,000) / 100
= **Rs. 8000**

(10) A floor is 5 m long and 4 m wide. A square carpet of sides 3 m is laid on the floor. Find the area of the floor that is not carpeted.
Solution: Area of the floor = l × b = 5 × 4
= 20 m^2
Area of square carpet = 3 × 3
= 9 m^2
∴Area of floor that is not carpeted = 20 – 9
= 11 m^2
Hence, the area of the floor that is not carpeted is **11 m^2**

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Exercise

FILL IN THE BLANKS

(1) If the length of a rectangle is equal to the breadth of the rectangle, then the rectangle becomes a _____.
(2) The side of an equilateral triangle is 672 cm long, then the perimeter of the triangle is _____.
(3) If the sum of the length and the breadth of a rectangle is 1009 cm, then the perimeter of the rectangle is _____.
(4) _____ is a rectangle whose all sides are equal.
(5) The amount of surface enclosed by a figure is called its ____.
(6) For fencing the plot, we need to calculate its _____.
(7) _____ is the sum of all sides.
(8) The shape of your classroom blackboard is _____.

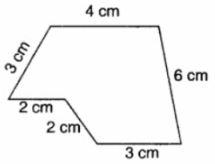
TRUE OR FALSE

(1) For tiling a rectangular plot, we must calculate its area.
(2) The length and breadth of a rectangle are 1.5 m and 1 m respectively, then the area is 1.5 m^2.
(3) The perimeter of a square is 4 times the length of the side.
(4) To find the length of fencing of a square playground, we must find its perimeter.
(5) Area is also known as the measure of the boundary.
(6) With all the sides of a square equal to 6 cm, the area of the square is 40 cm.
(7) If the perimeter of a square carrom board is 480 cm, then each side length is 120 cm.
(8) With each side equals 12 cm, the perimeter of the triangle is 48 cm.
(9) To determine the cost of painting a wall, we must first determine the wall's perimeter.
(10) The amount of space occupied by an object is called its perimeter.

OBJECTIVE TYPE QUESTION

(1) Sanjana went to a rectangular park 20 m long and 10 m wide. She took one complete round of it. The distance covered by her is
(A) 30 m (B) 60 m
(C) 20 m (D) 10 m

(2) A page is 25 cm long and 20 cm wide. Find the perimeter of this page.
(A) 90 cm (B) 45 cm
(C) 500 cm (D) 5 cm



(3) The perimeter of the given figure is
(A) 20 cm (B) 10 cm
(C) 24 cm (D) 15 cm

(4) Meenakshi wants to put a lace border all around a rectangular table cover that is 2 m long and 1 m wide. Find the length of the lace required by Meenakshi.
(A) 3 m (B) 4 m
(C) 5 m (D) 6 m

(5) Find the cost of fencing a rectangular park of length 10 m and breadth 5 m at the rate of ₹ 10 per metre.
(A) ₹ 300 (B) ₹ 600
(C) ₹ 150 (D) ₹ 1200

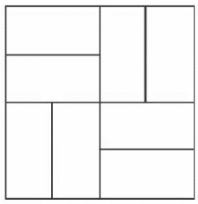
(6) Find the distance travelled by Shobhita if she takes 5 rounds of a square park of side 10 m.
(A) 200 m (B) 100 m
(C) 400 m (D) 800 m

(7) A rectangular piece of land measures 0.5 km by 0.25 km. Each side is to be fenced with 4 rounds of wire. What is the length of the wire needed?
(A) 2 km (B) 3 km
(C) 4 km (D) 6 km

(8) Which of the following has a larger perimeter?
(A) A regular octagon of side 3 cm (B) A regular hexagon of side 3 cm
(C) A regular pentagon of side 3 cm (D) A regular heptagon of side 3 cm

(9) If the perimeter of a triangle is 100 cm and the length of two sides is 30 cm and 40 cm, the length of the third side will be
(A) 30 cm (B) 40 cm
(C) 50 cm (D) 60 cm

(10) How many rectangles are there in the figure which are not squares? **(2016)**
(A) 24 (B) 16
(C) 14 (D) 12



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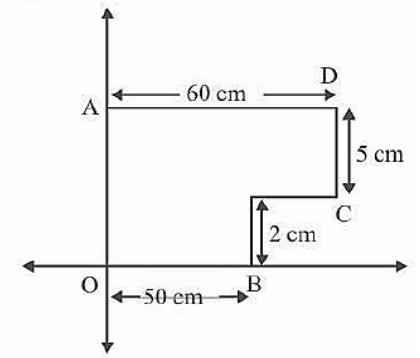
(11) Find the area of figure AOBCD from the given figure. **(2017)**



(A) $400\ cm^2$
(B) $300\ cm^2$
(C) $200\ cm^2$
(D) All of these

Answer Key

CHECK YOUR CONCEPT

(1) **(i)** (A) **(ii)** (B) **(iii)** (A)
(2) **(i)** (A) **(ii)** (B)

FILL IN THE BLANKS

(1) Square
(2) 2016 cm
(3) 2018 cm
(4) Square
(5) Area
(6) Perimeter
(7) Perimeter
(8) Rectangle

TRUE OR FALSE

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

OBJECTIVE TYPE QUESTIONS

(1) (B)
(2) (A)
(3) (A)
(4) (D)
(5) (A)
(6) (A)
(7) (D)
(8) (A)
(9) (A)
(10) (D)
(11) (A)

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