

HOTS Questions on Class 9 Maths Chapter 6

Measuring Space: Perimeter and Area

Perimeter Comparison Questions

Q25. A square park and a rectangular park have equal areas of 900 m squared. The rectangular park has a length of 45 m. Which park needs more fencing, and by how much?

Answer: Square side = square root of 900 = 30 m, so its perimeter = $4 \times 30 = 120$ m. For the rectangle, breadth = $900 / 45 = 20$ m, so its perimeter = $2(45 + 20) = 130$ m. The rectangular park needs more fencing, by $130 - 120 = 10$ m. This shows that for the same area, a square boundary is shorter than a rectangular one.

Q26. Two circles have radii in the ratio 2:5. Find the ratio of their circumferences.

Answer: Since circumference = $2 \times \pi \times \text{radius}$, circumference is directly proportional to radius. So the ratio of circumferences is also 2:5.

Area Comparison Questions

Q27. A square and a circle have equal perimeters of 88 cm. Find the area enclosed by each shape, and state which one is larger. Use $\pi = 22/7$.

Answer: Square: side = $88 / 4 = 22$ cm, so area = $22 \times 22 = 484$ cm squared. Circle: $2 \times \pi \times r = 88$, so $r = 88 \times 7 / 44 = 14$ cm, giving area = $22/7 \times 14 \times 14 = 616$ cm squared. The circle encloses a larger area than the square, even though both have the same perimeter.

Q28. A rectangle and a square have equal perimeters of 64 cm. The rectangle's length is three times its breadth. Compare the areas of the two figures.

Answer: Square side = $64 / 4 = 16$ cm, area = 256 cm squared. For the rectangle, $l + b = 32$ and $l = 3b$, so $3b + b = 32$, giving $b = 8$ cm and $l = 24$ cm, area = 192 cm squared. The square encloses a larger area than the rectangle, showing that among rectangles of a fixed perimeter, the one closest to a square covers the most area.

Critical Thinking Challenges

Q29. A student claims: 'If the perimeter of a rectangle increases, its area must also increase.' Is this statement true or false? Support your answer with an example.

Answer: This statement is false. Consider a rectangle 10 m by 4 m: perimeter = 28 m, area = 40 m squared. Now consider a rectangle 13 m by 2 m: perimeter = 30 m, area = 26 m squared. Here the perimeter increased from 28 m to 30 m, yet the area decreased from 40 m squared to 26 m squared. Perimeter and area do not always change in the same direction.

Q30. A rectangular sheet of length l and breadth b is folded exactly in half along its length, so the breadth becomes half of the original. Compare the new perimeter and new area with the original ones, using l and b .

Answer: New dimensions are l and $b/2$. New area = $l \times b/2 = (lb)/2$, which is exactly half the original area. New perimeter = $2(l + b/2) = 2l + b$. Original perimeter = $2l + 2b$. The difference is $(2l + 2b) - (2l + b) = b$, so the new perimeter is smaller than the original by exactly b units, while the area is reduced to exactly half. This shows the two quantities do not shrink by the same proportion.

Mixed HOTS Practice Questions on Measuring Space

Advanced HOTS Questions

Q31. A rectangular field has length and breadth in the ratio 5:3, and its perimeter is 96 m. A path 2.5 m wide is built all around it on the outside. Find the new perimeter and the area of the path.

Answer: From the ratio, $l = 5k$ and $b = 3k$, and $2(5k + 3k) = 96$, giving $16k = 96$, $k = 6$. So $l = 30$ m and $b = 18$ m. With the path added, the outer dimensions become 35 m by 23 m. New perimeter = $2(35 + 23) = 116$ m. Path area = $(35 \times 23) - (30 \times 18) = 805 - 540 = 265$ m squared.

Q32. If the side of a square is increased by 20 percent, find the percentage increase in its perimeter and in its area.

Answer: Perimeter is proportional to side, so a 20 percent increase in side gives a 20 percent increase in perimeter. Area is proportional to the square of the side, so the new area becomes $1.2 \times 1.2 = 1.44$ times the original, which is a 44 percent increase.

Q33. The length of a rectangular field is reduced by 10 percent and its breadth is increased by 20 percent. Find the percentage change in its area.

Answer: New area factor = $0.9 \times 1.2 = 1.08$ times the original area, which means an 8 percent increase in area, even though the length itself was reduced.

Challenge-Based Problems

Q34. A rope of length 72 m is used to fence a semicircular ground, that is, the boundary is made up of one straight diameter and one curved semicircular arc. Find the radius of the ground and the area it encloses. Use $\pi = 22/7$.

Answer: Boundary length = $2r + \pi \times r = r(2 + 22/7) = r \times 36/7$. So $r \times 36/7 = 72$, giving $r = 72 \times 7/36 = 14$ m. Area = $0.5 \times \pi \times r^2 = 0.5 \times 22/7 \times 14 \times 14 = 308$ m squared.

Q35. A rectangular sheet measures 36 cm by 24 cm. A small square of side 4 cm is cut away from each of its four corners. Find the area that remains, and explain what happens to the total boundary length (perimeter) of the new shape compared to the original rectangle.

Answer: Original area = $36 \times 24 = 864$ cm squared. Total area removed = $4 \times (4 \times 4) = 64$ cm squared. Remaining area = $864 - 64 = 800$ cm squared. Interestingly, the perimeter does not change. At each corner, cutting out the small square removes two short stretches of the original edge but replaces them with two new edges of exactly the same total length, so nothing is gained or lost overall. The perimeter of the new shape is still $2(36 + 24) = 120$ cm.

Q36. Three identical rectangular tiles, each 20 cm by 10 cm, are placed in a row, joined along their 10 cm edges, to form one large rectangle. Find the perimeter and area of the large rectangle, and find what percentage of total boundary length is saved compared to the three tiles being kept separate.

Answer: Large rectangle dimensions = 60 cm by 10 cm. Its perimeter = $2(60 + 10) = 140$ cm, and its area = 600 cm squared. If kept separate, the three tiles together would have a total perimeter of $3 \times 2(20 + 10) = 180$ cm. The saving is $180 - 140 = 40$ cm, which is $(40/180) \times 100$, approximately 22.2 percent.

Multi-Concept Questions

Q37. A square garden has a side of 50 m. At its centre is a circular fountain of diameter 14 m, surrounded by a circular path 1 m wide. Find (i) the area of the path and (ii) the area of the garden left for grass. Use $\pi = 22/7$.

Answer: Garden area = $50 \times 50 = 2500$ m squared. Fountain radius = 7 m, fountain area = $\frac{22}{7} \times 7 \times 7 = 154$ m squared. Outer radius including the path = 8 m, so combined area of fountain and path = $\frac{22}{7} \times 8 \times 8 = 1408/7$, about 201.14 m squared. Path area alone = $201.14 - 154 = 47.14$ m squared. Area left for grass = $2500 - 154 - 47.14 = 2298.86$ m squared.

Q38. A trapezium-shaped field has parallel sides of 36 m and 24 m, and its two slanting sides are equal, each measuring 10 m. Find the height of the trapezium and its area.

Answer: Since the slanting sides are equal, dropping perpendiculars from the ends of the shorter side splits the difference in the parallel sides equally. Difference = $36 - 24 = 12$ m, so each side triangle has a base of 6 m. Using the Pythagoras idea, height squared = $10^2 - 6^2 = 100 - 36 = 64$, so height = 8 m. Area = $0.5 \times (36 + 24) \times 8 = 0.5 \times 60 \times 8 = 240$ m squared.

Q39. A figure is made of a rectangle 18 m by 12 m, with an equilateral triangle of side 12 m attached to one of its 12 m sides, on the outside. Find (i) the total perimeter of the figure and (ii) its total area. Take the square root of 3 as 1.732.

Answer: (i) The 12 m side shared between the rectangle and the triangle becomes an internal line, so it is excluded from the outer boundary. Perimeter = $18 + 18 + 12 + 12 + 12 = 72$ m (two sides of 18 m, the remaining outer 12 m side of the rectangle, and the two outer 12 m sides of the triangle). (ii) Area of rectangle = $18 \times 12 = 216$ m squared. Area of equilateral triangle = $(\text{square root of } 3 / 4) \times \text{side squared} = (1.732/4) \times 144 = 62.35$ m squared. Total area = $216 + 62.35 = 278.35$ m squared.

