A Fountain Is Made Up Of Two Semicircles And A Quarter Circle. Find The Perimeter Of The Fountain. Round

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Understanding the geometry of various shapes can be both fascinating and practical, especially when it comes to real-world applications such as designing fountains, decorative structures, or architectural elements. In this article, we will explore a specific geometric problem: calculating the perimeter of a fountain that is composed of two semicircles and a quarter circle. We will walk through the problem step-by-step, provide detailed explanations, and discuss how to approach such calculations systematically.

Introduction to the Problem

The problem states that a fountain is made up of two semicircles and a quarter circle. Our goal is to find the perimeter of this fountain, which essentially involves determining the total length of its outer boundary. Since the shapes are portions of circles, the key to solving this problem lies in understanding the properties of circles, semicircles, and quarter circles, and how to compute their arc lengths.

Understanding the Shapes Involved

Before diving into calculations, it’s important to clarify what each shape entails:

Semicircle

- A semicircle is half of a circle.
- It has a diameter (the straight line across the circle's widest part) and an arc (the curved part).
- The length of the arc of a semicircle is half the circumference of the full circle.

Quarter Circle

- A quarter circle is one-fourth of a full circle.
- It is formed by dividing a circle into four equal parts, each representing 90 degrees.
- The arc length of a quarter circle is one-fourth of the circle’s circumference.

Key Concepts and Formulas

To solve the problem, we need to recall some fundamental formulas related to circles:

- **Circumference of a circle:** $C = 2\pi r$
- **Arc length of a semicircle:** $L_{semi} = \pi r$
- **Arc length of a quarter circle:** $L_{quarter} = \frac{\pi r}{2}$

Where:
- r is the radius of the circle.
- π (pi) is approximately 3.1416.

Step-by-Step Solution Approach

To find the perimeter of the fountain, follow these steps:

1. Identify the radii of each shape

- Determine the radii of the semicircles and the quarter circle.
- Often, in these problems, the shapes share common radii or have specified dimensions.

2. Calculate the arc lengths of each shape

- Use the formulas above to compute the lengths of the semicircular and quarter circular arcs.

3. Sum the relevant segments to find the total perimeter

- Add the lengths of the arcs that form the outer boundary.
- Remember to exclude any internal segments that are not part of the perimeter.

4. Round the final answer

- Round the perimeter to the nearest unit or specified decimal place.

Example Problem with Assumed Dimensions

Let’s consider an example where:

- Each semicircle has a radius of 5 meters.
- The quarter circle has a radius of 5 meters as well.

This uniformity simplifies calculations and is a common scenario in geometric problems.

Calculating the Arc Lengths

- Semicircle arc length:

$$ L_{semi} = \pi \times r = 3.1416 \times 5 \approx 15.708 \text{ meters} $$

- Quarter circle arc length:

$$ L_{quarter} = \frac{\pi \times r}{2} = \frac{3.1416 \times 5}{2} \approx 7.854 \text{ meters} $$

Calculating the Perimeter of the Fountain

Assuming the fountain's boundary consists of:

- Two semicircular arcs (each with radius 5 meters),
- One quarter circle arc (with radius 5 meters),
- And the straight segments are the diameters of the semicircles and the

radii of the quarter circle that form the boundary.

Note: The actual perimeter depends on how these shapes are positioned relative to each other. For this example, let's assume:

- The two semicircles are placed side-by-side, sharing a common diameter.
- The quarter circle is connected at a right angle to these semicircles.

Perimeter calculation:

- Sum of the two semicircular arc lengths:

$2 \times 15.708 \approx 31.416 \text{ meters}$

- Add the quarter circle arc length:

7.854 meters

- Add the straight segments (diameters and radii):

- Diameter of semicircles: $2 \times r = 10 \text{ meters}$, but since these are along the boundary, they may be included or excluded based on the shape's configuration.

Suppose, for simplicity, the boundary consists of:

- The curved parts (two semicircles and a quarter circle),
- And straight lines connecting these arcs, which are the diameters and radii, forming the outline.

Assuming the straight segments are:

- The diameters of the semicircles (each 10 meters),
- The radii of the quarter circle (5 meters).

Total straight segments:

- Diameter of semicircles: 10 meters (assuming one straight segment connecting the two semicircles),
- Radius of quarter circle: 5 meters.

Total perimeter:

$$
\text{Perimeter} = \text{Sum of arc lengths} + \text{Straight segments}
$$

$$
= (15.708 + 15.708 + 7.854) + (10 + 5) \approx 39.27 + 15 = 54.27 \text{ meters}
$$

Final step: Round to the nearest whole number:

$$
\boxed{54 \text{ meters}}
$$

Conclusion and Practical Tips

Calculating the perimeter of complex shapes made of circle segments involves understanding the properties of circles and their arcs. When working with such problems:

- Always identify the radii and angles involved.
- Use the appropriate formulas for arc lengths.
- Carefully consider which segments form the outer boundary.
- Break down the shape into manageable parts.
- Sum the lengths of the boundary segments to find the total perimeter.
- Round your answer according to the problem’s instructions.

This approach not only helps in solving geometric problems but also enhances spatial reasoning and problem-solving skills, useful in architecture, engineering, and design.

Additional Resources

- Geometry textbooks for circle and arc properties.
- Online calculators for circle arc lengths.
- Educational videos demonstrating circle segment calculations.
- Geometry software like GeoGebra for visualizing complex shapes.

By mastering these concepts and techniques, you can confidently tackle similar problems involving composite shapes and their perimeters, whether in academic settings or practical applications.

Frequently Asked Questions

How do you determine the perimeter of a fountain made up of two semicircles and a quarter circle?

To find the perimeter, add the lengths of the curved parts (the semicircles and quarter circle), which are calculated using their radii, and include any straight segments if present. Typically, the perimeter is the sum of the arcs' lengths, calculated as fractions of the full circle's circumference.

What is the formula to find the perimeter of a semicircle and a quarter circle with a given radius?

The perimeter of a semicircle is πr (the arc length) plus the diameter (2r), while the quarter circle's arc length is (1/2)πr. When combining these shapes, sum their respective arc lengths to find the total perimeter.

If the radii of the semicircles and quarter circle are known, how can you compute the total perimeter of the fountain?

Calculate each arc length using the formulas: semicircle arc = πr, quarter circle arc = (1/2)πr. Then add these lengths together, along with any straight segments, to find the total perimeter.

Why is it necessary to round the perimeter of the fountain, and how is it typically done?

Rounding is often required to express the perimeter in a simplified, manageable number, especially when the exact value includes irrational numbers like π. It is typically rounded to the nearest whole number or decimal place as specified in the problem.

Can you provide an example calculation of the perimeter if the radii are given as 4 cm for the semicircles and 3 cm for the quarter circle?

Yes. For the semicircles with radius 4 cm: arc length = π × 4 ≈ 12.57 cm; two semicircles together form a full circle, so total semicircular arc = 2 × 12.57 ≈ 25.14 cm. For the quarter circle with radius 3 cm: arc length = (1/2)π × 3 ≈ 4.71 cm. Adding these, total perimeter ≈ 25.14 + 4.71 = 29.85 cm. Rounded to the nearest whole number, the perimeter is approximately 30 cm.

Additional Resources

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Introduction

Fountains have long captivated human imagination, blending artistry with engineering. Whether as ornamental features or functional water displays, their design often involves geometric principles that challenge even seasoned mathematicians. Today, we delve into a fascinating geometrical problem: determining the perimeter of a fountain composed of two semicircles and a quarter circle. This seemingly straightforward question encapsulates the beauty of geometry, inviting us to explore concepts of arcs, radii, and perimeters with precision and clarity.

In this comprehensive analysis, we will unpack the problem statement, interpret the geometric configuration, derive the formula for the perimeter, and demonstrate the calculation steps leading to a rounded final answer. Our goal is to provide a detailed, methodical approach suitable for educational purposes, engineering applications, or design review.

Understanding the Problem Statement

The problem specifies a fountain shape made up of three primary geometric components:

- Two semicircles
- One quarter circle

The key is to understand how these components are arranged and connected. Typically, in problems like this, the components are joined along their radii or diameters to form a continuous shape whose perimeter is to be calculated, excluding the interior boundaries.

Assumption: The semicircles and quarter circle are arranged so that their curved edges form the outer boundary of the fountain. The problem requires us to find the total length of this outer boundary, i.e., the perimeter.

Visualizing the Geometric Configuration

To analyze this problem clearly, let's create a mental image based on common arrangements:

- Imagine a large semicircle with radius R.
- Attached to its diameter, on each side, are two smaller semicircles, each with radius r.
- The quarter circle is positioned at a corner, perhaps connecting the two

semicircles or attached to one of them.

However, since the problem statement does not specify the sizes of the circles or their arrangement explicitly, a typical interpretation is:

> The fountain's outer boundary consists of:
> - A semicircular arc of radius R,
> - A semicircular arc of radius r,
> - A quarter circular arc of radius r or R.

Alternatively, the problem could involve a composite figure where:

- The main semicircle has radius R.
- The smaller semicircle attached along the diameter of the larger one, sharing the same diameter.
- The quarter circle is attached at the intersection point, creating a smooth, continuous boundary.

For clarity, let's define a common configuration used in similar problems:

> Configuration Assumption:
> The fountain's perimeter is composed of:
> - A semicircle of radius R,
> - A semicircle of radius r,
> - A quarter circle of radius r,
> assembled so that their curved boundaries form a continuous outer boundary, with the straight edges (diameters) possibly connected internally.

This assumption aligns with typical geometric problems involving composite circular arcs.

Step-by-Step Approach to the Solution

1. Identifying Known Quantities and Unknowns

Given the problem statement, the main unknown is the perimeter of the fountain, which is the sum of the lengths of the outer arcs.

To proceed, we need:

- The radii of the two semicircles and the quarter circle.
- Clarification on how these arcs are connected.

Since the problem provides no explicit measurements, the most common scenario is that the radii are proportional or equal, or perhaps specific numerical values are given in the original problem (e.g., $R = 7$, $r = 5$). But as no specific values are provided, the solution will be expressed in terms of R and r.

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2. Calculating the Lengths of Circular Arcs

The perimeter of the fountain is the sum of the lengths of the relevant arcs:

- Semicircular arc: length = $\frac{1}{2} \times 2\pi r = \pi r$
- Quarter circle arc: length = $\frac{1}{4} \times 2\pi r = \frac{\pi r}{2}$

Note that:

- The length of a full circle is $2 \pi r$.
- A semicircle is half that, πr.
- A quarter circle is a quarter of a full circle, $\frac{1}{4} \times 2 \pi r = \frac{\pi r}{2}$.

---

3. Summing the Arc Lengths

Assuming the perimeter includes:

- The curved boundary of the main semicircle (radius R)
- The curved boundary of the smaller semicircle (radius r)
- The quarter circle (radius r), which might connect the two semicircles or form a corner

The total perimeter P would be:

$$
P = \text{Arc length of large semicircle} + \text{Arc length of small semicircle} + \text{Arc length of quarter circle}
$$

Expressed as:

$$
P = \pi R + \pi r + \frac{\pi r}{2}
$$

Simplify:

$$
P = \pi R + \pi r + \frac{\pi r}{2} = \pi R + \frac{3\pi r}{2}
$$

Clarifying the Arrangement and Validity

However, it's crucial to note that in many geometric problems, the perimeter is determined by the outer boundary which may not include internal segments or overlapping arcs. The actual perimeter could be less or more depending on how the arcs are connected.

In particular:

- If the two semicircles are attached along their diameters, the combined boundary might be only the outer arcs.
- The quarter circle might be used to connect the two semicircles smoothly, or to form a corner.

Without an explicit diagram or additional data, the most reasonable assumption is that the total perimeter is:

$$
\boxed{
P = \pi R + \frac{3\pi r}{2}
}
$$

Numerical Example and Rounding

Suppose the problem provides specific radii, for instance:

- $R = 7$ units
- $r = 5$ units

Then, the perimeter becomes:

$$
P = \pi \times 7 + \frac{3 \pi \times 5}{2} = 7\pi + \frac{15 \pi}{2}
$$

Calculating:

$$
7\pi \approx 7 \times 3.1416 \approx 21.9912
$$
$$
\frac{15 \pi}{2} \approx \frac{15 \times 3.1416}{2} \approx \frac{47.124}{2} \approx 23.562
$$

Adding:

$$
P \approx 21.9912 + 23.562 = 45.5532
$$

Rounding to the nearest whole number:

$$
\boxed{
\text{Perimeter} \approx 46 \text{ units}
}
$$

Final Remarks and Considerations

This problem underscores the importance of understanding the geometric configuration before performing calculations. The key steps involved:

- Interpreting the problem statement
- Visualizing the arrangement of arcs
- Calculating individual arc lengths
- Summing these lengths to find the total perimeter
- Applying specific radii and rounding as needed

In real-world applications, precise measurements and diagrams are essential for accuracy. When designing or analyzing such a fountain, engineers and architects must carefully consider the spatial arrangement to ensure the calculated perimeter matches the actual boundary, especially when materials like fencing or decorative edging are involved.

Conclusion

The perimeter of a fountain composed of two semicircles and a quarter circle can be effectively determined using fundamental principles of circle geometry. Assuming the arcs are arranged to form a continuous boundary, the total perimeter is the sum of the individual arc lengths, expressed as:

$$
P = \pi R + \frac{3 \pi r}{2}
$$

By substituting known radii values, performing calculations, and rounding appropriately, one can obtain a practical and accurate estimate suitable for design, review, or educational purposes. This problem exemplifies how geometric reasoning and algebraic manipulation come together to solve real-world shape measurement challenges, reinforcing the timeless relevance of mathematical principles in architecture and engineering.

Note: For an exact solution tailored to a specific scenario, please refer to the provided dimensions or a diagram illustrating the arrangement of the

semicircles and quarter circle.

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