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SOLUTIONS: INTRODUCTION TO EUCLID'S GEOMETRY

Mathematics | Class IX (2026/EUCLID/09/003)

Section A (Multiple Choice Questions)

1. (b) **Euclid's Postulate 1.** This postulate provides the basis for joining any two points with a straight line.
2. (b) $A > B$. This illustrates Axiom 5: "The whole is greater than the part."
3. (c) **Equivalent version of the 5th Postulate.** This is also known as Playfair's Axiom.
4. (c) **Infinite.** An infinite number of lines can radiate from a single point.
5. (c) **Points.** Definition 3 states that the extremities of a line are points.
6. (b) **It is true for all types of magnitudes.** Whether it is area, length, or volume, a part is always less than the whole.
7. (a) **Axiom 1.** Things which are equal to the same thing are equal to one another.
8. (a) **Squares and Circles.** Altars for household rituals were generally circular or square.

Section B (Very Short Answer Questions)

1. **Answer:** Only **one** unique line segment can be drawn.
Principle: Postulate 1 states that a straight line may be drawn from any one point to any other point.
2. **Proof:** Given $x + y = 15$ and $z = y$.
By substituting y with z in the first equation, we get $x + z = 15$.
Axiom used: Axiom 1 (Things which are equal to the same thing are equal).
3. **Postulate 4:** "All right angles are equal to one another."
Significance: It provides a universal standard for measurement and comparison of angles, regardless of the orientation or length of the lines forming them.
4. **Postulate 2:** "A terminated line can be produced indefinitely."

Section C (Short Answer Questions)

1. **Proof:**
Given $OA = OB$ and $OX = OY$.
To prove: $AX = BY$.
From the figure: $AX = OA - OX$ and $BY = OB - OY$.
Since $OA = OB$ and $OX = OY$, we are subtracting equals from equals.
Axiom 3: "If equals are subtracted from equals, the remainders are equal."
Therefore, $AX = BY$.

2. **Proof:**

Assume a line segment AB has two midpoints C and D .

Then $AC = \frac{1}{2}AB$ and $AD = \frac{1}{2}AB$.

By **Axiom 1**, $AC = AD$.

This is only possible if point C and D **coincide**.

By **Axiom 4**, things which coincide are equal. Hence, the midpoint is unique.

3. **Consistency:** A system of axioms is consistent if it is impossible to derive a contradiction from them. If Euclid's geometry were inconsistent, we could prove a statement and its opposite simultaneously, making the entire logical structure invalid for real-world application.

Section D (Long Answer Questions)

1. **Construction Proof:**

- (i) Let AB be the line segment.
- (ii) Draw a circle with center A and radius AB (Postulate 3).
- (iii) Draw a circle with center B and radius BA .
- (iv) Let C be the point where the circles intersect.
- (v) $AB = AC$ (radii of the same circle).
- (vi) $AB = BC$ (radii of the same circle).
- (vii) By **Axiom 1**, $AC = BC$. Thus $AB = BC = AC$.

2. **Euclid's 5th Postulate and Parallelism:**

- (i) If the sum of interior angles on one side is exactly 180° , the sum is **not** less than two right angles.
- (ii) Euclid's 5th postulate implies that the lines will **not meet** on that side. By symmetry, they will not meet on the other side either.
- (iii) This leads to the definition of parallel lines as lines that never intersect.

Section E (Case Study Based Question)

1. (a) **Axiom 1.** Things equal to the same thing are equal to each other.
2. (c) **Postulate 4.** Specifically states all right angles are equal.
3. (a) **Lies evenly with the straight lines on itself.** (Definition 7).
4. (a) **Postulate 2.** Concerns the extension of a terminated line.
5. (b) **Eventually intersect on that side.** Since $170^\circ < 180^\circ$, the sum is less than two right angles.