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# SOLUTIONS: INTRODUCTION TO EUCLID'S GEOMETRY

Mathematics | Class IX (2026/EUCLID/09/001)

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## Section A (Multiple Choice Questions)

1. (b) **length.** Euclid defined a line as length without any breadth or thickness.
2. (b) **2.** A surface (like a sheet of paper) has length and breadth, hence 2 dimensions.
3. (a) **13 chapters.** "The Elements" is composed of 13 books or chapters.
4. (a) **Universal truths in all branches of mathematics.** Axioms are general assumptions not limited to geometry.
5. (c) **Axiom.** This is Euclid's second axiom.
6. (c) **5.** Euclid listed five specific geometric postulates.
7. (d) **Fifth Postulate.** The Playfair's Axiom is an equivalent version of this postulate.
8. (a) **Surfaces.** Moving from a 3D solid to its boundary leads to a 2D surface.

## Section B (Very Short Answer Questions)

1. (i) **Point:** A point is that which has no part.  
(ii) **Plane Surface:** A plane surface is a surface which lies evenly with the straight lines on itself.
2. **First Axiom:** Things which are equal to the same thing are equal to one another.  
**Example:** If line segment  $AB = 5$  cm and line segment  $CD = 5$  cm, then  $AB = CD$ .
3. **Axioms** are general assumptions used throughout mathematics (e.g., The whole is greater than the part).  
**Postulates** are assumptions specific to geometry (e.g., All right angles are equal to one another).
4. **Steps of Construction:**
  - (i) Let  $AB$  be the given line segment.
  - (ii) Draw a circle with center  $A$  and radius  $AB$  (Postulate 3).
  - (iii) Draw another circle with center  $B$  and radius  $BA$ .
  - (iv) Let the circles intersect at point  $C$ . Join  $AC$  and  $BC$ .
  - (v) Since  $AB = AC$  and  $AB = BC$  (radii of same circles), by Axiom 1,  $AC = BC$ . Thus,  $\triangle ABC$  is equilateral.

## Section C (Short Answer Questions)

1. **Terms needing definition:**
  - **Polygon:** A closed figure made of three or more line segments.
  - **Line Segment:** A part of a line with two endpoints.
  - **Angle:** The inclination between two lines meeting at a point.

2. **Proof:** Given:  $AC = BD$ .

From the figure,  $AC = AB + BC$  and  $BD = BC + CD$ .

So,  $AB + BC = BC + CD$ .

Subtracting  $BC$  from both sides (Using **Euclid's Axiom 3**: "If equals are subtracted from equals, the remainders are equal"), we get:

$AB = CD$ . **Hence Proved.**

3. **Undefined terms:** Points, line, in between.

**Consistency:** These postulates are **consistent** because they do not contradict each other. However, they do not follow from Euclid's postulates (they are independent). (i) describes points on a line, and (ii) describes points not on a line.

## Section D (Long Answer Questions)

1. **Euclid's Fifth Postulate:** If a straight line falling on two straight lines makes the interior angles on the same side of it taken together less than two right angles, then the two straight lines, if produced indefinitely, meet on that side on which the sum of angles is less than two right angles.

**Conclusion:** If  $\angle 1 + \angle 2 < 180^\circ$ , the lines will eventually **intersect** on that side.

2. **Proof by Contradiction:**

- Suppose two distinct lines  $l$  and  $m$  have **two** points in common,  $P$  and  $Q$ .
- This means two different lines are passing through the same two points  $P$  and  $Q$ .
- But this contradicts Euclid's Postulate 1 (and the subsequent axiom) which states that **through two distinct points, there is a unique line**.
- Thus, our assumption is wrong. Two distinct lines cannot have more than one point in common.

## Section E (Case Study Based Question)

1. (b) **Lines.** Euclid stated that the edges of a surface are lines.

2. (b) **Things which are equal to the same thing are equal to one another.**

3. (c) **3.** Solids have length, breadth, and depth (thickness).

4. (c) **A Line.**

5. (a) **Exactly one.** This is the fundamental assumption of Euclidean geometry regarding two points.