🟦 Chapter 5: Introduction to Euclid’s Geometry

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🔷 Geometry in Ancient Civilisations

🕉️ **Ancient India:**

- Geometry (called "Shulba Sutra") came from altar (vedi) construction for Vedic rituals.
- Household rituals used square/circular altars 🔲⚪
- Public rituals used complex shapes — rectangle, triangle, trapezium 🔺

🧱 **Egypt & Babylonia:**

- Used geometry practically for building pyramids, irrigation, etc.
- No proofs — only measurements.

🧠 **Greece:**

- Geometry became a science of reasoning.
- Thales & Pythagoras introduced logic & deduction 🔍

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🔶 Euclid and the Elements

🟦 Euclid: Greek mathematician, ~300 BCE

📚 Famous book: Elements — collection of all geometry known then (13 chapters, 465 propositions)

He defined:

- ✍️ **Axioms**: Basic truths accepted universally
- 📐 **Postulates:** Geometry-specific assumptions
- 🧾 **Theorems:** Statements proven using axioms/postulates

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🧠 Euclid’s Axioms (General Truths)

1️⃣ Things equal to the same thing are equal to one another.
2️⃣ If equals are added to equals, the wholes are equal.
3️⃣ If equals are subtracted from equals, the remainders are equal.
4️⃣ Things which coincide are equal.
5️⃣ Whole is greater than part.
6️⃣ Things double of same thing are equal.
7️⃣ Things halves of same thing are equal.

✅ Example:
If Ram = Ravi in weight and both gain 2 kg → they are still equal (Axiom 2)

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📏 Euclid’s Postulates (Geometry-Specific)

1️⃣ A straight line can be drawn from any point to another.
2️⃣ A line segment can be extended indefinitely.
3️⃣ A circle can be drawn with any center and radius.
4️⃣ All right angles are equal.
5️⃣ (Most famous) If a line falling on two others makes interior angles less than 180°, the two lines will meet on that side.
→ Rewritten later as Playfair's Axiom.

🧠 Postulate ≠ Theorem → Postulates are accepted without proof.

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🟨 Important Terms in Geometry

📌 **Undefined Terms:**

- Point 🔹: Location without size or dimension
- Line ➖: Infinite straight path
- Plane 📄: Flat surface with no thickness

🟦 **Defined Terms:**

- Line segment: Part of line with 2 endpoints
- Ray: Line with one endpoint
- Angle: Two rays with a common start

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🧪 Euclid’s Geometry Today

🟦 **Modern Geometry:**

- Based on undefined terms + axioms + definitions
- Logical system built step by step
- A system is consistent if no contradiction exists

Examples:

- “Given 2 points, one and only one line can be drawn”
- “Two lines intersect at most at one point”

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🔍 Multiple Choice Practice

❓ Euclid’s 2nd axiom: If equals are added to equals → wholes are equal ✅
❓ 5th Postulate describes line meeting → sum of interior angles < 180° ✅
❓ Postulates are accepted without proof ❌
❓ Theorems are proven ✨
❓ Greeks used deductive reasoning ✓

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📐 Examples Using Axioms

💡 If AB = BC, and BX = BY, show that AX = CY
→ Use: Things equal to same thing are equal

💡 If C is midpoint of AB, and D is midpoint of XY
→ AB = 2AC, XY = 2XD, and AC = XD
→ So, AB = XY ✅ (double of equal things)

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🧠 True/False Reasoning

✔️ True: Pyramid's side faces are triangles
❌ False: Not all are equilateral
✔️ True: In Vedic altars, public ones were complex shaped
✔️ True: Point, Line, Plane = undefined
✔️ True: Area of triangle = area of square → equal areas
✔️ False: Euclid's fourth axiom is not "everything equals itself" — it's about right angles

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🧮 Long Answer Explanation

🟦 Example: "Square is a polygon with 4 equal sides and all right angles"

➡ **Define:**

- **Polygon:** Closed figure with 3+ line segments
- **Right angle:** 90°
- **Line, Point** → Undefined

✅ Use Euclid's First Axiom (sides)
✅ Use Fourth Postulate (angles)
➡ Hence, square has all equal sides and angles

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💬 Real-World Application

💡 Two salesmen sell same in August
→ In Sept., both double their sales
→ By Euclid's 6th axiom: Double of equals = equal again

💡 x + y = 10 and x = z
→ z + y = 10 (From Axiom 1)

💡 Show AB = DE if AC = DC and CB = CE
→ Use equal parts + Axiom 1

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📚 Summary Table

Concept	Explanation / Axiom Used
Equal to same ⇒ Equal	Axiom 1
Add equal to equal ⇒ Whole	Axiom 2
Double of same ⇒ Equal	Axiom 6
Right angles equal	Postulate 4
Parallel line unique	Playfair’s Axiom (5th Postulate equivalent)
Theorem	Statement that needs proof
Postulate	Geometry-specific truth accepted without proof