🟦 Chapter 11: Constructions

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🧠 Introduction

"Construction" in geometry means creating exact shapes using only a compass and straightedge (scale).
In this chapter, we focus on constructing triangles based on given conditions without measuring angles using a protractor.

Goal: Accurate geometric drawing using basic tools and logical steps.

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🔹 Basic Tools Required

1. Compass 🧭
2. Ruler/scale 📏
3. Sharp pencil ✏️
4. Eraser (for neatness)
5. Optional: Divider (for measuring lengths easily)

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🔸 Standard Angle Constructions

Certain angles can be constructed exactly using a compass and ruler by repeatedly bisecting known angles like 60° and 90°.

✅ Constructible Angles:

- 60°: By drawing equilateral triangle
- 30°: Bisecting 60°
- 90°: Using perpendicular construction
- 45°: Bisecting 90°
- 15°, 22.5°, 67.5°: Further bisections
- 120°: Extend 60° in opposite direction

Note: Some angles like 35°, 40° cannot be constructed with compass and straightedge alone.

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🔹 Key Constructions for Triangles

This chapter focuses on constructing triangles when specific measurements are given. Let's break them down 👇

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1️⃣ Constructing Triangle when Base, Base Angle, and Sum of Other Two Sides is Given

🧠 Given:

- Base BC
- ∠B (base angle)
- AB + AC = a fixed value

🧰 Steps:

1. Draw base BC
2. Construct ∠B using compass
3. Extend the ray in direction of angle
4. Mark a point D such that BD = AB + AC
5. Join D to C
6. Draw perpendicular bisector of DC
7. Mark intersection of bisector and angle line as point A
8. Join AB and AC to complete triangle ABC

📝 Logic:

You're converting the "sum of sides" into a straight line and using bisector to balance the distances.

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2️⃣ Constructing Triangle when Base, Base Angle, and Difference of Other Two Sides is Given

🧠 Given:

- Base BC
- ∠B
- AB − AC = a fixed value (say AB > AC)

🧰 Steps:

1. Draw base BC
2. Construct ∠B
3. Extend the ray in angle direction
4. Mark point D on ray such that BD = AB − AC
5. Join D to C
6. Draw perpendicular bisector of DC
7. Mark intersection of bisector and ray as point A
8. Join AB and AC to complete triangle

📝 Logic:

Instead of balance, you now shift the distance to adjust for the difference.

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3️⃣ Constructing Triangle When Perimeter and Two Angles are Given

🧠 Given:

- Angles ∠A and ∠B
- Perimeter = AB + BC + CA

🧰 Steps:

1. Draw a line segment PQ = perimeter

2. Construct ∠X = ∠A at P and ∠Y = ∠B at Q
3. From rays of these angles, draw lines to meet at point R
4. Draw triangle ABC similar to triangle PQR, scaled down using compass to required lengths

📝 Logic:

You first create a triangle with required angles and scale, then use compass arcs to recreate actual triangle.

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4️⃣ Constructing Triangle Given Altitude and Equilateral Triangle

🧠 Given:

- Altitude (height) of equilateral triangle

🧰 Steps:

1. Draw a line and mark midpoint
2. At midpoint, erect a perpendicular of given altitude
3. Use that point to draw two 60° angles using compass
4. Use arcs to mark equal sides
5. Complete triangle using those points

📝 Note:

In equilateral triangle, altitude also bisects the opposite side and angle.

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📏 Other Key Concepts

🔸 **Perpendicular Bisector:**

- Used in constructions to find the center point between two given points

🔸 **Angle Bisector:**

- Used to find the line that splits a given angle into two equal parts

🔸 **Geometric Justification:**

- After drawing, always write the reason why construction is correct (like: “triangle formed because sides and angles satisfy conditions”)

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🔚 Final Tips for Constructions

✅ Always draw lightly with pencil, use compass cleanly
✅ Label all key points clearly (A, B, C, etc.)
✅ Use arc marks clearly so construction is traceable
✅ Justify your construction with steps and logic