Introduction to Euclid's Geometry

Chapter Flowchart

The Chapter Flowcharts give you the gist of the chapter flow in a single glance.

Geometry
It is a pure mathematics of points and lines and curves and surfaces.

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Euclid was the first Greek mathematician who initiated a new way of thinking the study of **geometry**.

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Axioms or postulates are assumptions which are obvious universal truths. They are not proved. Theorems are statements which are proved, using definitions , axioms, previously proved statements and deductive reasoning.

Euclid's Axioms

- Things which are equal to the same thing are equal to one another.
- If equals are added to equals, the wholes are equal.
- If equals are subtracted from equals, the remainders are equal.
- Things which coincide with one another are equal to one another.
- The whole is greater than the part.
- Things which are double of the same things are equal to one another.
- Things which are halves of the same things are equal to one another.

Two equivalent versions of Euclid's fifth postulate are :
(a) "For every line l and for every point P not lying on l, there exists a unique line m passing through P are parallel to I."
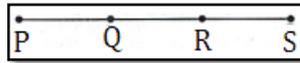(b) Two distinct intersecting lines cannot be parallel to the same line.

Euclid's Postulates

- **Postulate 1:** A straight line may be drawn from any one point to any other point.
- **Postulate 2:** A terminated line can be produced indefinitely.
- **Postulate 3:** A circle can be drawn with any centre and any radius.
- **Postulate 4:** All right angles are equal to one another.
- **Postulate 5:** 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.

All the attempts to prove Euclid's fifth postulate using the first 4 postulates failed. But they led to the discovery of several other geometries called non-euclidean geometries.

Revision Question Bank

1. Euclid divided his book 'Elements' into how many chapters? Write the difference between 'postulate' and 'axiom'.

2. If B lies between A and C, AC=15 cm and BC=9 cm. Then, what is AB^2?

3. If a line PQ, PR, PS and PT are parallel to a line l, what can be said about the points P, Q, R, S and T?

4. Solve the equation u – 5 = 15 and state the axiom that you use here.

5. If a point C lies between two points A and B such that AC = BC, then

   prove that $AC = \dfrac{1}{2}AB$. Explain by drawing figure.

6. In the given figure, if PR =QS, then prove that PQ = RS.

7. If P and Q are the centres of two intersecting circles, then prove that PQ = QR = PR.
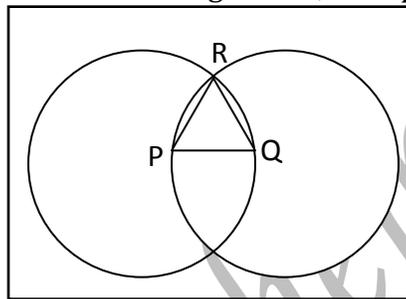

8. Prove that two distinct lines cannot have more than one point in common.

9. Sanjeev is of the same age as Rajeev. Kamal is also of the same age as Rajeev. State the Euclid's axiom that illustrates the relative ages of Sanjeev and Kamal.

10. Match the following columns.

|	Column I		Column II
A.	How many lines can be drawn to pass through one given point?	**P.**	Only one
B.	How many lines can be drawn to pass through two given points ?	**Q.**	Infinitely many
C.	How many end points does a line AB have ?	**R**.	None

Answers

1. 13 chapters,' Postulates' are the assumptions used specially for geometry and 'axioms' are the assumptions used throughout mathematics.
2. 36 cm
3. Collinear
4. Euclid's second axiom, which state that when equals are added to equals, the wholes are equal. Euclid's first axiom.   **10**. (A) – (Q), (B)- (P), (C) – (R)

Previous Years Question Bank

1. State any two Euclid's axioms.   **[CBSE Schools 2016-17]**

2. It is known that a – c = 25 and that a = b. Show that b – c = 25. Write the Euclid's axiom that best illustrates this statement. Also give two more axioms other than the axiom used in the above situation.

    [CBSE Schools 2016-17]

3. Sunil and Shyam have the same weight. If they each gain weight by 5 kg, how will their new weights be compared using the axioms? Write the Euclid's axiom that best supports your answer. Also give two more axioms other than the axiom used in the above situation.   **[CBSE Schools 2016-17]**

4. In the figure, if AC = BD, then prove that AB = CD.   **[CBSE Schools 2016-17]**
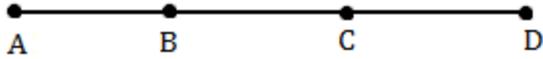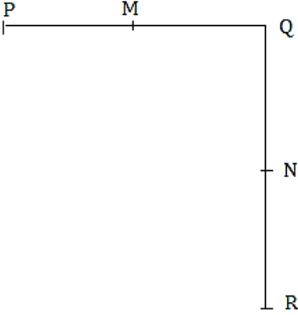
5. In the given figure, QM = QN, M is the mid-point of PQ and N is the mid-point of QR. Show that PQ = QR. State which axiom you use here. Also give two more axioms other than the axiom used in the above situation.   **[CBSE Schools 2016-17]**

6. If a point C lies between two points A and B such that AC = BC, then using Euclid's Axiom(s) prove that $AC = \frac{1}{2} AB$.   **[CBSE Schools 2016-17]**

7. For her records, a teacher asked the students about their heights. Mayank said his height is same as of Anav. Rahul said that his height is same as that of Anav. She then asked the students to relate the height of Mayank and Rahul. Anav answered, they both have same height. Is Anav correct? If yes, state Euclid's Axiom which support your answer. What are the characteristics of Anav nature?**[CBSE Schools 2016-17]**

8. Solve the equation x + 25 =40 and state which axiom you use here. Also give two more axioms other than the axiom used in the above situation.   **[CBSE Schools 2016-17]**

9. In a triangle PQR, X and Y are the mid-point of points on PR and QR respectively, such that PX = RY. Show that PR = QR.   **[CBSE Schools 2015–16]**

10. In a triangle ABC, X and Y are the points on AB and BC respectively. If BX = $\frac{1}{2}$ AB and BY = $\frac{1}{2}$ BC and AB = BC. Show that BX = BY.   **[CBSE Schools 2015–16]**

11. Solve the equation a – 35 = 75 and state which axiom you use here. Also give two more axioms other than the axiom used in the above situation.   **[CBSE Schools 2015–16]**

12. Prove that two distinct lines cannot have more than one point in common.   **[CBSE Schools 2014–15]**

13. Does Euclid's fifth postulate imply the existence of parallel lines? Explain   **[CBSE Schools 2014–15]**

14. Two line segments AB and CD intersect each other at O such that AO = OB and CO = OD. Prove that AC = BD.   **[CBSE Schools 2014–15]**

15. In the given fig. C is the mid-point of AB and D is the mid-point of AC.

    Prove that AD= $\frac{1}{4}$ AB.   **[CBSE Schools 2014–15]**
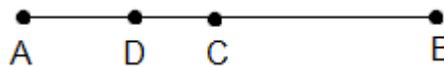
Chapter Test

Maximum Marks: 30   **Maximum Time: 1 hour**

1. Prove that the two lines which are both parallel to the same line, are parallel to each other.   **[2]**

2. If C is the mid-point of the line segment AB, L and M are mid-points of the line segment AC and BC, respectively. Prove that
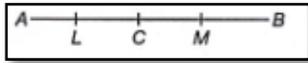

Fig. 2   **Fig. 3**   **Fig. 6**

   $AL = LC = CM = MB = \dfrac{1}{4} AB$.

   Also, state which Euclid's axiom is applied for proving result.   **(**see fig. **2)**   **[2]**
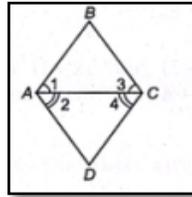
3. In figure **3**, $\angle 1 = \angle 3$ and $\angle 2 = \angle 4$. Using Euclid's axiom, show that $\angle A = \angle C$.   **[2]**

4. It is known that, if x + y = 10, then x+y+ z = 10 + z. In which Euclid's axiom illustrates this statement? **[2]**

5. Mukesh asked the teacher whether the two lines are perpendicular to the same line are perpendicular to each other or not.

   His teacher replied that yes, they will be perpendicular to each other giving the reason that two lines parallel to the same line are parallel to each other. His classmate Seema told him that he is wrong and explain him the correct statement. Mukesh thanked Seema for this.

   (i) Write the solution of Seema.   (ii) Identify the value depicted from this action.   **[3]**

6. The line PQ falls on the lines AB and CD such that the sum of the interior angles 1 and 2 is less than 180° on the left side of PQ.

   Therefore, the lines AB and CD will eventually intersect on which side of PQ?   **(**see fig. **6)**   **[3]**

7. Write down Euclid's five postulates.   **[3]**

8. A point C lies between two points A and B such that AC = BC. Using Euclid's axiom, show that AC = $\dfrac{1}{2}$ AB.

   [3]

Answers

2. Euclid's first and seventh axioms are used for proving result.

4. Euclid's second axiom illustrates that, if equals are asdded to equals, then wholes are equal.

5. (ii) The value has been shown in this question is cooperative learning among students.

6. On left side of PQ

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