UNIT 2

GEOMETRY

(A) Main Concepts and Results

- A **line segment** corresponds to the shortest distance between two points. The line segment joining points A and B is denoted as $\overline{AB}$ or as $\overline{BA}$. A ray with initial point A and a point B on it is denoted as AB. Line AB is denoted as AB.
- Two distinct lines in a plane that cross at a point are called **intersecting lines,** otherwise they are called **parallel lines**.
- Two rays with a common initial point form an **angle**.
- A simple closed curve made of line segments only is called a **polygon**.
- A polygon of three sides is called a **triangle** and that of four sides is called a **quadrilateral**.
- A polygon with all its sides equal and all its angles equal is called a **regular polygon**.
- A figure, every point of which is equidistant from a fixed point is called a **circle**. The fixed point is called its **centre** and the equal distance is called its **radius**.

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(B) Solved Examples

In examples 1 and 2, write the correct answer from the given four options.

Example 1: The number of diagonals of a pentagon is

(A) 3 (B) 4 (C) 5 (D) 10

Solution: Correct answer is (C).

Example 2: The number of diagonals of a triangle is

(A) 0 (B) 1 (C) 2 (D) 3

Solution: Correct answer is (A).

In examples 3 and 4, fill in the blanks to make the statements true:

Example 3: A polygon of six sides is called a ______.

Solution: Hexagon

Example 4: A triangle with all its sides of unequal lengths is called a ______ triangle.

Solution: Scalene

In examples 5 to 7, state whether the statements are true or false.

Example 5: Two non-parallel line segments will always intersect.

Solution: False (Hint: They will intersect, when they are produced)

Example 6: All equilateral triangles are isosceles also.

Solution: True

Example 7: Angle of 0° is an acute angle.

Solution: False [Hint: Measure of acute angle is between 0° and 90°]

Example 8: In Fig. 2.1, $PQ \perp AB$ and PO = OQ. Is PQ the perpendicular bisector of line segment AB? Why or why not?

Solution: PQ is not the perpendicular bisector of line segment AB, because AO ≠ BO. [Note: AB is the perpendicular bisector of line segment PQ].

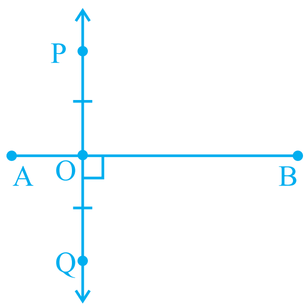

Fig. 2.1

Example 9: In Fig. 2.2, if $AC \perp BD$, then name all the right angles.

Solution: There are four right angles. They are: $\angle APD$, $\angle APB$, $\angle BPC$ and $\angle CPD$.

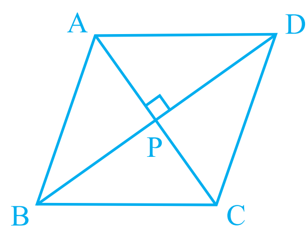

Fig. 2.2

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Example 10: Is ABCD of Fig. 2.3 a polygon? If yes, what is the special name for it?

Solution: Yes, it is a polygon, because it is a simple closed figure made of line segments only. It is a quadrilateral.

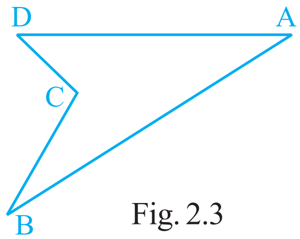

Fig. 2.3

Example 11: In Fig. 2.4, BCDE is a square and a 3D shape has been formed by joining the point A in space with the vertices B, C, D and E. Name the 3D shape and also its (i) vertices, (ii) edges and (iii) faces.

Solution: The 3D shape formed is a square pyramid.

(i) Vertices are A, B, C, D and E.

(ii) Edges are AB, AC, AD, AE, BC, CD, DE and EB.

(iii) Faces are: square BCDE and triangles ABC, ACD, ADE and ABE.

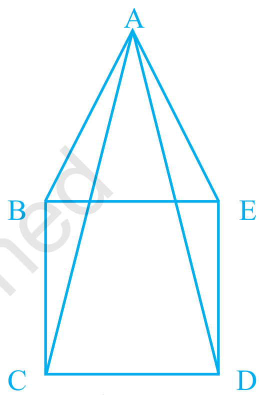

Fig. 2.4

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Example 12 : Write the measure of smaller angle formed by the hour and the minute hands of a clock at 7 O' clock. Also, write the measure of the other angle and also state what types of angles these are.

Solution : Measure of the required angle = $30° + 30° + 30° + 30° + 30° = 150°$

Measure of the other angle = $360° - 150° = 210°$

Angle of measure 150° is an obtuse angle and that of 210° is a reflex angle.

(C) Exercise

In each of the questions 1 to 16, out of four options only one is correct. Write the correct answer.

1. Number of lines passing through five points such that no three of them are collinear is

(A) 10 (B) 5 (C) 20 (D) 8

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2. The number of diagonals in a septagon is

(A) 21 (B) 42 (C) 7 (D) 14

3. Number of line segments in Fig. 2.5 is

(A) 5 (B) 10 (C) 15 (D) 20

Fig. 2.5

4. Measures of the two angles between hour and minute hands of a clock at 9 O' clock are

(A) 60°, 300° (B) 270°, 90° (C) 75°, 285° (D) 30°, 330°

5. If a bicycle wheel has 48 spokes, then the angle between a pair of two consecutive spokes is

(A) $\left(5\frac{1}{2}\right)$ (B) $\left(7\frac{1}{2}\right)$ (C) $\left(\frac{2}{11}\right)$ (D) $\left(\frac{2}{15}\right)$

6. In Fig. 2.6, ∠XYZ cannot be written as

(A) ∠Y (B) ∠ZXY

(C) ∠ZYX (D) ∠XYP

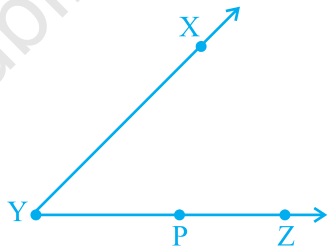

Fig. 2.6

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7. In Fig 2.7, if point A is shifted to point B along the ray PX such that PB = 2PA, then the measure of ∠BPY is

(A) greater than 45° (B) 45°

(C) less than 45° (D) 90°

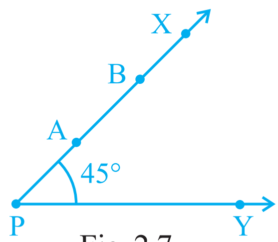

Fig. 2.7

8. The number of angles in Fig. 2.8 is

(A) 3 (B) 4

(C) 5 (D) 6

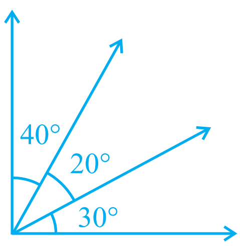

Fig. 2.8

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9. The number of obtuse angles in Fig. 2.9 is

(A) 2 (B) 3

(C) 4 (D) 5

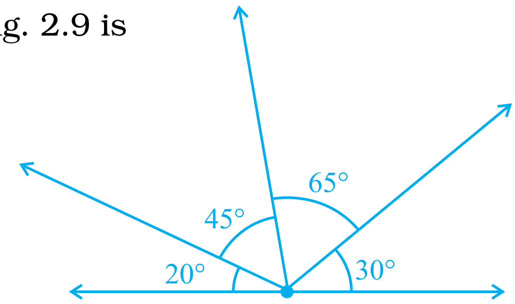

Fig. 2.9

10. The number of triangles in Fig. 2.10 is

(A) 10 (B) 12

(C) 13 (D) 14

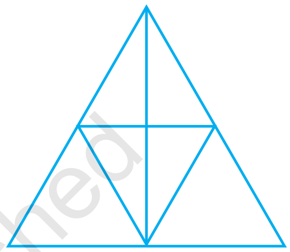

Fig. 2.10

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11. If the sum of two angles is greater than 180°, then which of the following is not possible for the two angles?

(A) One obtuse angle and one acute angle

(B) One reflex angle and one acute angle

(C) Two obtuse angles

(D) Two right angles.

12. If the sum of two angles is equal to an obtuse angle, then which of the following is not possible?

(A) One obtuse angle and one acute angle.

(B) One right angle and one acute angle.

(C) Two acute angles.

(D) Two right angles.

13. A polygon has prime number of sides. Its number of sides is equal to the sum of the two least consecutive primes. The number of diagonals of the polygon is

(A) 4 (B) 5 (C) 7 (D) 10

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14. In Fig. 2.11, AB = BC and AD = BD = DC.

The number of isosceles triangles in the figure is

(A) 1 (B) 2

(C) 3 (D) 4

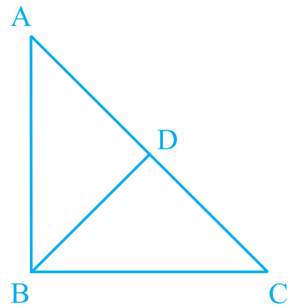

Fig. 2.11

15. In Fig. 2.12,

$\angle BAC = 90°$ and $AD \perp BC$.

The number of right triangles in the figure is

(A) 1 (B) 2

(C) 3 (D) 4

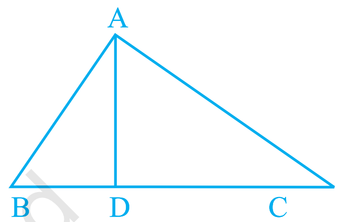

Fig. 2.12

16. In Fig. 2.13, $PQ \perp RQ$, PQ = 5 cm and QR = 5 cm. Then Δ PQR is

(A) a right triangle but not isosceles

(B) an isosceles right triangle

(C) isosceles but not a right triangle

(D) neither isosceles nor right triangle

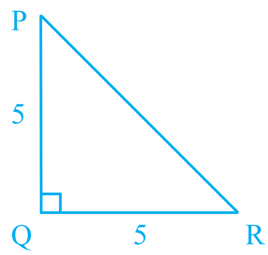

Fig. 2.13

In questions 17 to 31, fill in the blanks to make the statements true:

17. An angle greater than 180° and less than a complete angle is called _______.

18. The number of diagonals in a hexagon is ________.

19. A pair of opposite sides of a trapezium are ________.

20. In Fig. 2.14, points lying in the interior of the triangle PQR are ______, that in the exterior are ______ and that on the triangle itself are ______.

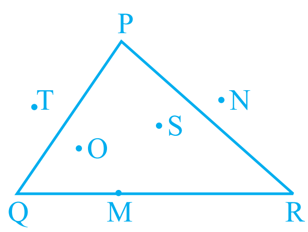

Fig. 2.14

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21. In Fig. 2.15, points A, B, C, D and E are collinear such that AB = BC = CD = DE. Then

(a) AD = AB + ______

(b) AD = AC + ______

(c) mid point of AE is ______

(d) mid point of CE is ______

(e) AE = ______ AB.

Fig. 2.15

22. In Fig. 2.16,

(a) ∠AOD is a/an ______ angle

(b) ∠COA is a/an ______ angle

(c) ∠AOE is a/an ______ angle

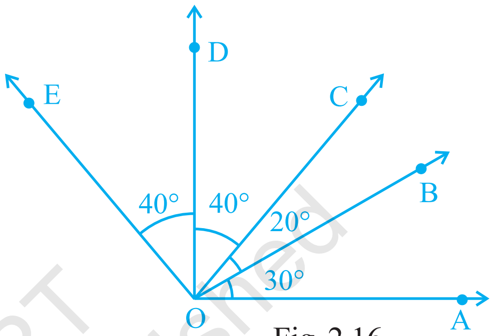

Fig. 2.16

23. The number of triangles in Fig. 2.17 is ______.

Their names are ______________________.

24. Number of angles less than 180° in Fig. 2.17 is ______and their names are ______.

25. The number of straight angles in Fig. 2.17 is ______.

26. The number of right angles in a straight angle is ______ and that in a complete angle is ______.

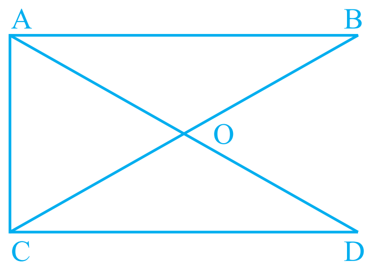

Fig. 2.17

27. The number of common points in the two angles marked in Fig. 2.18 is ______.

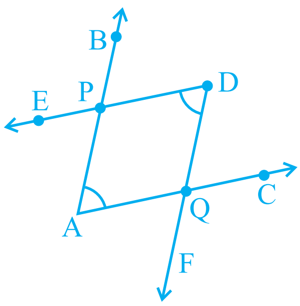

Fig. 2.18

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28. The number of common points in the two angles marked in Fig. 2.19 is ______.

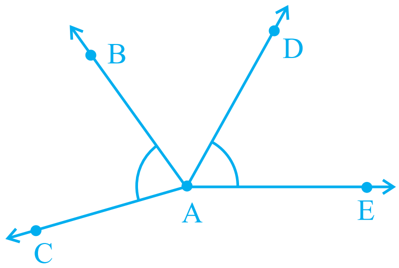

Fig. 2.19

29. The number of common points in the two angles marked in Fig. 2.20 ______ .

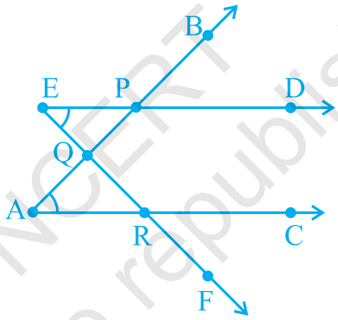

Fig. 2.20

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30. The number of common points in the two angles marked in Fig. 2.21 is ______.

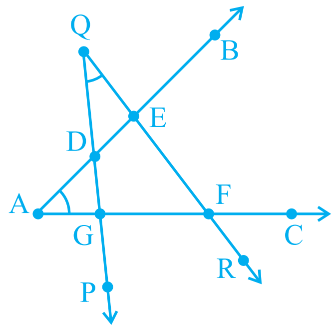

Fig. 2.21

31. The common part between the two angles BAC and DAB in Fig. 2.22 is ______.

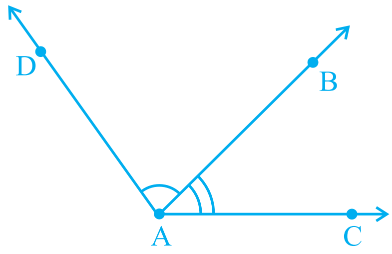

Fig. 2.22

State whether the statements given in questions 32 to 41 are true (T) or false (F):

32. A horizontal line and a vertical line always intersect at right angles.

33. If the arms of an angle on the paper are increased, the angle increases.

34. If the arms of an angle on the paper are decreased, the angle decreases.

35. If line PQ || line m, then line segment PQ || m

36. Two parallel lines meet each other at some point.

37. Measures of ∠ABC and ∠CBA in Fig. 2.23 are the same.

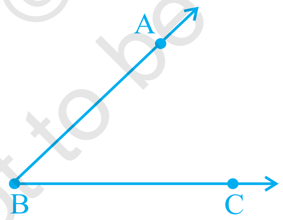

Fig. 2.23

38. Two line segments may intersect at two points.

39. Many lines can pass through two given points.

40. Only one line can pass through a given point.

41. Two angles can have exactly five points in common.

42. Name all the line segments in Fig. 2.24.

Fig. 2.24

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43. Name the line segments shown in Fig. 2.25.

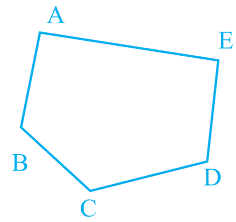

Fig. 2.25

44. State the mid points of all the sides of Fig. 2.26.

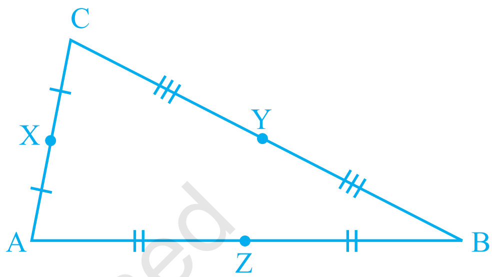

Fig. 2.26

45. Name the vertices and the line segments in Fig. 2.27.

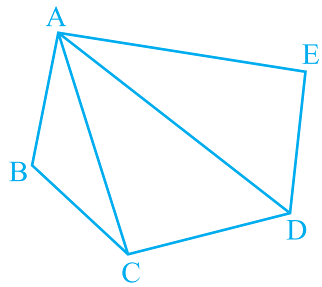

Fig. 2.27

46. Write down fifteen angles (less than 180°) involved in Fig. 2.28.

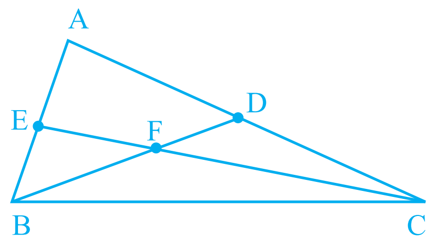

Fig. 2.28

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47. Name the following angles of Fig. 2.29, using three letters:

(a) $\angle 1$

(b) $\angle 2$

(c) $\angle 3$

(d) $\angle 1 + \angle 2$

(e) $\angle 2 + \angle 3$

(f) $\angle 1 + \angle 2 + \angle 3$ (g) $\angle CBA - \angle 1$

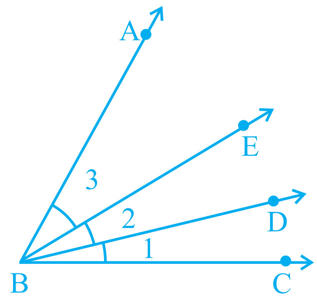
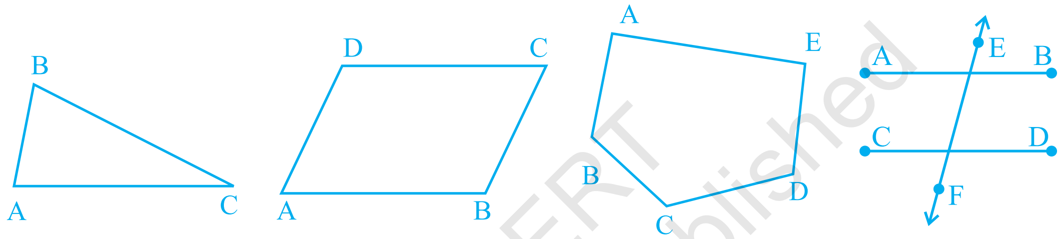


Fig. 2.29

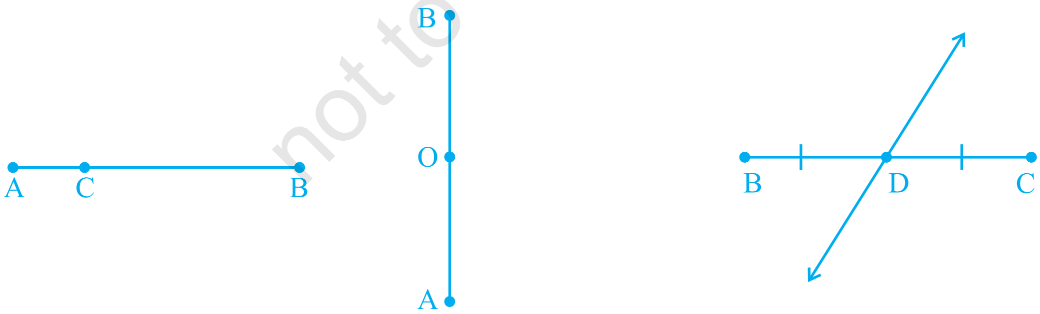
48. Name the points and then the line segments in each of the following figures (Fig. 2.30):



(i) (ii) (iii) (iv)

Fig. 2.30

49. Which points in Fig. 2.31, appear to be mid-points of the line segments? When you locate a mid-point, name the two equal line segments formed by it.



(i) (ii) (iii)

Fig. 2.31

50. Is it possible for the same

(a) line segment to have two different lengths?

(b) angle to have two different measures?

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51. Will the measure of ∠ABC and of ∠CBD make measure of ∠ABD in Fig. 2.32?

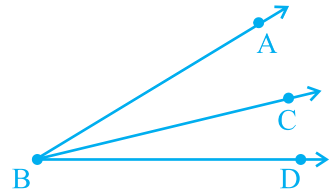

Fig. 2.32

52. Will the lengths of line segment AB and line segment BC make the length of line segment AC in Fig. 2.33?

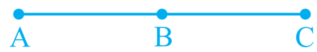

Fig. 2.33

53. Draw two acute angles and one obtuse angle without using a protractor. Estimate the measures of the angles. Measure them with the help of a protractor and see how much accurate is your estimate.

54. Look at Fig. 2.34. Mark a point

(a) A which is in the interior of both ∠1 and ∠2.

(b) B which is in the interior of only ∠1.

(c) Point C in the interior of ∠1.

Now, state whether points B and C lie in the interior of ∠2 also.

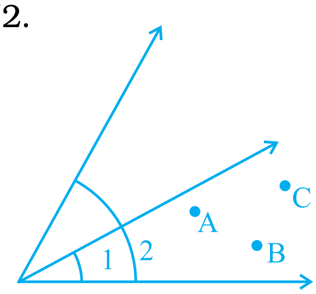

Fig. 2.34

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55. Find out the incorrect statement, if any, in the following:

An angle is formed when we have

(a) two rays with a common end-point

(b) two line segments with a common end-point

(c) a ray and a line segment with a common end-point

56. In which of the following figures (Fig. 2.35),

(a) perpendicular bisector is shown?

(b) bisector is shown?

(c) only bisector is shown?

(d) only perpendicular is shown?

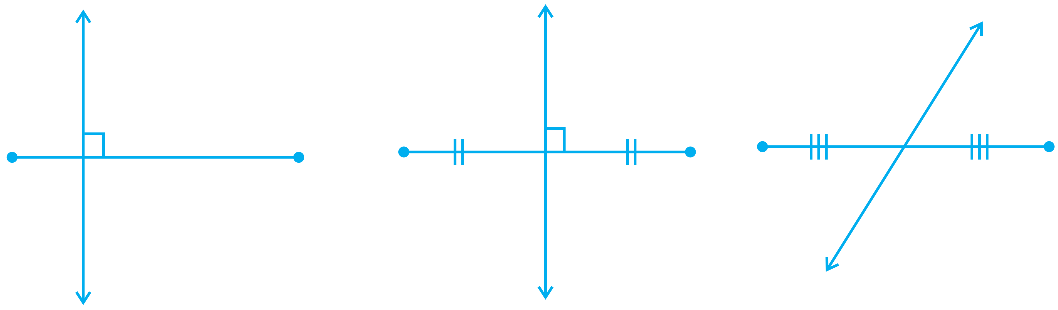

Fig. 2.35

57. What is common in the following figures (i) and (ii) (Fig. 2.36.)?

Fig. 2.36

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Is Fig. 2.36 (i) that of triangle? if not, why?

58. If two rays intersect, will their point of intersection be the vertex of an angle of which the rays are the two sides?

59. In Fig. 2.37,

(a) name any four angles that appear to be acute angles.

(b) name any two angles that appear to be obtuse angles.

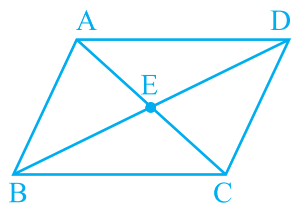


Fig. 2.37

60. In Fig. 2.38,

(a) is AC + CB = AB?

(b) is AB + AC = CB?

(c) is AB + BC = CA?

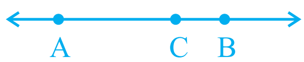


Fig. 2.38

61. In Fig. 2.39,

(a) What is AE + EC?

(b) What is AC – EC?

(c) What is BD – BE?

(d) What is BD – DE?

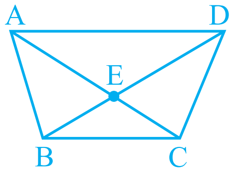
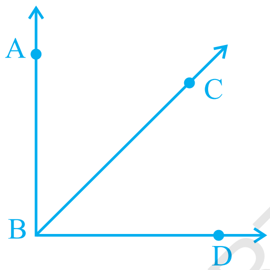


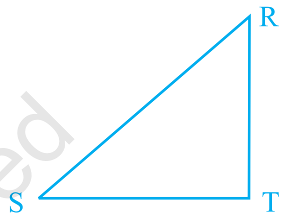
Fig. 2.39

62. Using the information given, name the right angles in each part of Fig. 2.40:

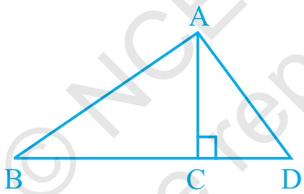
(a) BA⊥BD



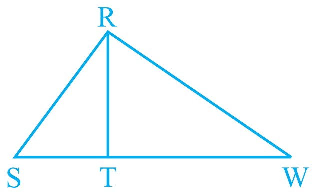
(b) RT⊥ST



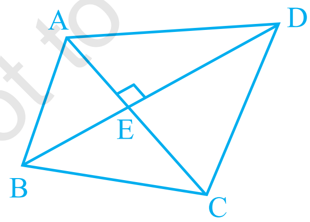
(c) AC⊥BD



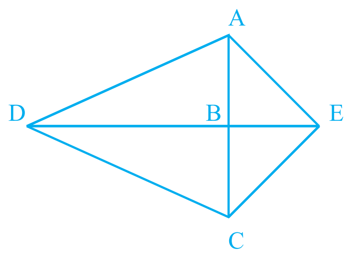
(d) RS⊥RW



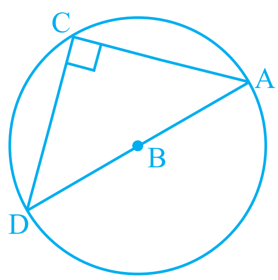
(e) AC⊥BD



(f) AE⊥CE



(g) AC⊥CD



(h) OP⊥AB

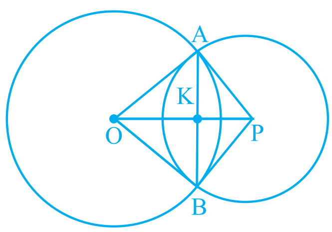


Fig. 2.40

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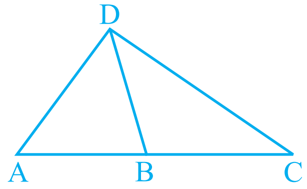
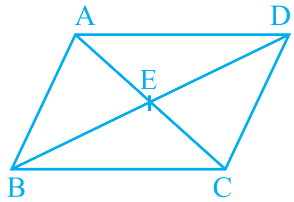
63. What conclusion can be drawn from each part of Fig. 2.41, if

(a) $\overline{DB}$ is the bisector of ∠ADC?



(b) $\overline{BD}$ bisects ∠ABC?



(c) $\overline{DC}$ is the bisector of ∠ADB, CA ⊥ DA and CB ⊥ DB?

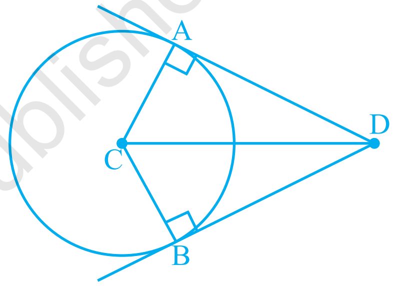


Fig. 2.41

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64. An angle is said to be trisected, if it is divided into three equal parts. If in Fig. 2.42, ∠BAC = ∠CAD = ∠DAE, how many trisectors are there for ∠BAE ?

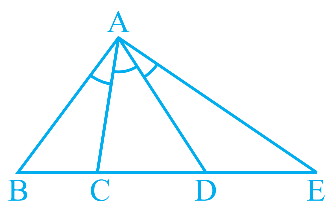

Fig. 2.42

65. How many points are marked in Fig. 2.43?

Fig. 2.43

66. How many line segments are there in Fig. 2.43?

67. In Fig. 2.44, how many points are marked? Name them.

68. How many line segments are there in Fig. 2.44? Name them.

Fig. 2.44

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69. In Fig. 2.45 how many points are marked? Name them.

70. In Fig. 2.45 how many line segments are there? Name them.

Fig. 2.45

71. In Fig. 2.46, how many points are marked? Name them.

72. In Fig. 2.46 how many line segments are there? Name them.

Fig. 2.46

73. In Fig. 2.47, O is the centre of the circle.

(a) Name all chords of the circle.

(b) Name all radii of the circle.

(c) Name a chord, which is not the diameter of the circle.

(d) Shade sectors OAC and OPB.

(e) Shade the smaller segment of the circle formed by CP.

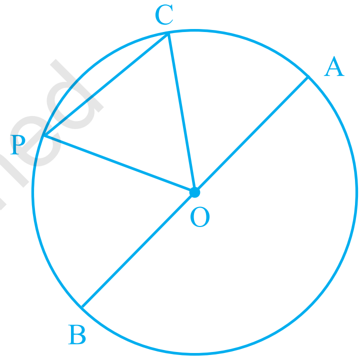

Fig. 2.47

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74. Can we have two acute angles whose sum is

(a) an acute angle? Why or why not?

(b) a right angle? Why or why not?

(c) an obtuse angle? Why or why not?

(d) a straight angle? Why or why not?

(e) a reflex angle? Why or why not?

75. Can we have two obtuse angles whose sum is

(a) a reflex angle? Why or why not?

(b) a complete angle? Why or why not?

76. Write the name of

(a) vertices (b) edges, and

(c) faces of the prism shown in Fig. 2.48.

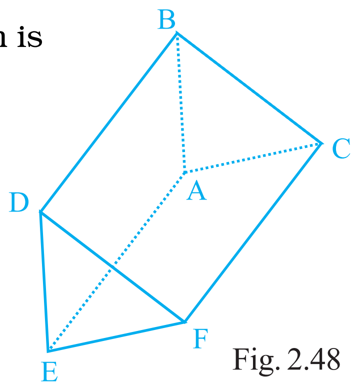

Fig. 2.48

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77. How many edges, faces and vertices are there in a sphere?

78. Draw all the diagonals of a pentagon ABCDE and name them.

(D) Activities

Activity 1: Observe questions 65 to 72. Can you find out the number of line segments, when the number of points marked on line segment is 7?, 9?, 10?.

Activity 2: Copy the equilateral ΔABC shown in Fig. 2.49 on your notebook.

(a) Take a point P as shown in the figure.

(b) Draw $PD \perp BC$, $PE \perp CA$ and $PF \perp AB$

(c) Also, draw $AK \perp BC$

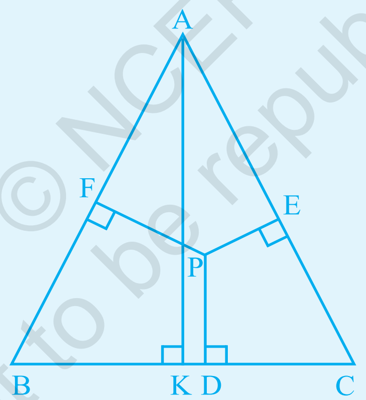

Fig. 2.49

Now, draw a line l, measure PD using a divider and ruler and mark it on line l as shown Fig. 2. 50.

Fig. 2.50

Again measure PE with divider and mark it on the line l as DE (say). Again measure PF with divider and mark it on line l next to E as EF.

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Now check whether the length of AK and the length (PD + DE + EF) are the same!

Activity 3: Copy the isosceles triangle ABC shown in Fig. 2.51 on your notebook. Take a point E on BC and draw EF $\perp$ CA and EG $\perp$ AB. Measure EF and EG and add them.

Draw $AD \perp BC$.

Check whether the sum of EF and EG is equal to AD with the help of ruler or with the help of divider.

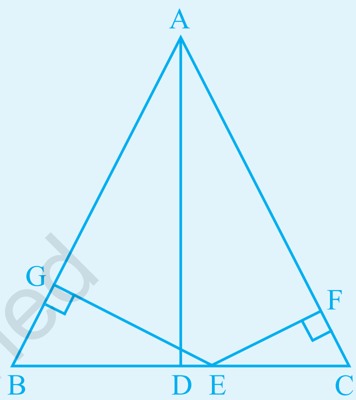

Fig. 2.51

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