Name : _____

Grade : VIII

Subject : Mathematics

Chapter : 3. Understanding Quadrilaterals

Objective Type Questions

1 Marks.

I. Multiple choice questions

1. What is the sum of all the angels of a pentagon? **[NCERT Exemplar]**

a. 180^0 b. 360^0 c. 540^0 d. 720^0

2. The number of sides of a regular polygon where each exterior angle has a measure of 45° is : **[NCERT Exemplar]**

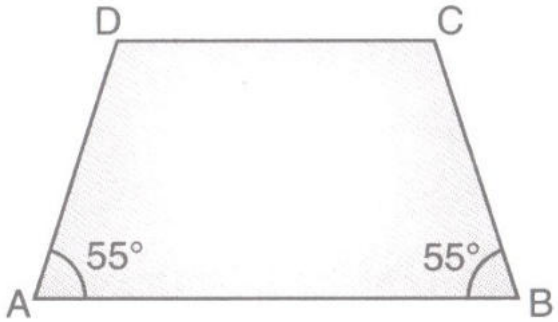
a. 8 b. 10 c. 4 d. 6

3. Sum of the interior angles of a regular polygon of n sides is : **[NCERT Exemplar]**

a. n x 90° b. (n - 2) x 90° c. n x 180° d. (n - 2) x 180°

4. In the trapezium ABCD, the measure of ZD is **[NCERT Exemplar]**

a. 55° b. 115° c. 135° d. 125°



5. PQRS is a square. PR and SQ intersect at 0. Then $\angle POQ$ is a [NCERT Exemplar]

a. Right angle b. Straight angle c. Reflex angle d. Complete angle

6. Which of the following is not true for an exterior angle of a regular polygon with n sides ? **[NCERT Exemplar]**

a. Each exterior angle = $\frac{360^0}{n}$ b. Exterior angle = 180° - interior angle

c. $n = \frac{360^0}{exterior\ angles}$ d. Each exterior angle = $\frac{(n-2) \times 180^0}{n}$

1. c	2. a	3. d	4. d	5. a	6. d

II. Multiple choice questions

1. Which of the following is a property of a parallelogram?

   a. Opposite sides are parallel

   b. The diagonals bisect each other at right angles

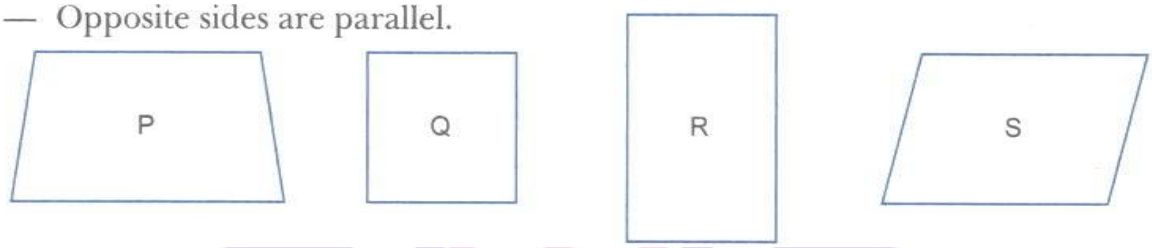
   c. The diagonals are perpendicular to each other

   d. All angles are equal

2. Which of the following figures satisfy the following properties?[NCERT Exemplar]

— All sides are congruent.
— Opposite sides are parallel.

— All angles are right angles.



   a. P b. Q c. R d. S

3. A quadrilateral whose all sides, diagonals and angles are equal is **[NCERT Exemplar]**

   a. square b. trapezium c. rectangles d. rhombus

4. The sum of all exterior angles of a triangle is

   a. 180^0 b. 360^0 c. 540^0 d. 720^0

5. If the diagonals of a quadrilateral are equal and bisect each other, then the quadrilateral is a **[NCERT Exemplar]**

   (a) rhombus (b) rectangle (c) square (d) parallelogram

6. How many diagonals does a hexagon have? [NCERT Exemplar]

   (a) 9 (b) 8 (c) 2 (d) 6

7. What is the maximum number of obtuse angles that a quadrilateral can have? **[NCERT Exemplar]**

   (a) 1 (b) 2 (c) 3 (d) 4

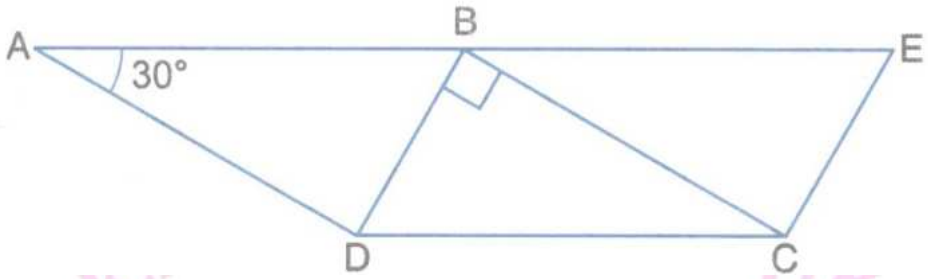
8. How many non-overlapping triangles can we make in a n-gon (polygon having n sides), by joining the vertices? **[NCERT Exemplar]**

   (a) n - 1 (b) n - 2 (c) n - 3 (d) n - 4

9. If two adjacent angles of a parallelogram are (5x - 5)° and (10x + 35)° then the ratio of these angles is **[NCERT Exemplar]**

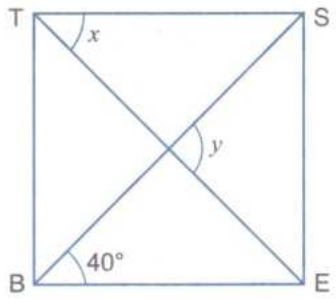
   (a) 1 : 3 (b) 2 : 3 (c) 1 : 4 (d) 1 : 2

10. In Fig., ABCD and BDCE are parallelograms with common base DC. If BC ⊥ BD then ∠BEC = **[NCERT Exemplar]**



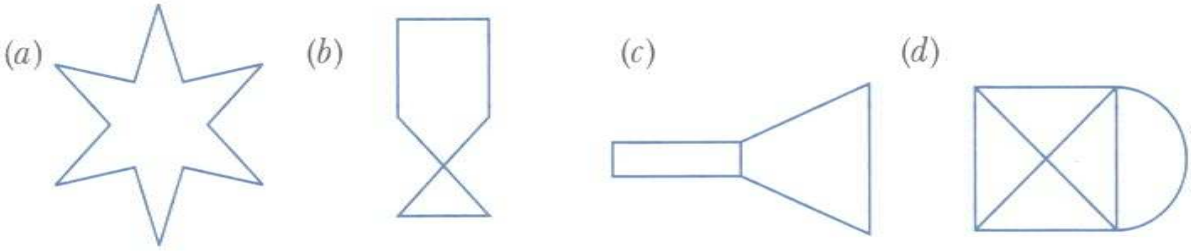
(a) 60° (b) 30° (c) 150° (d) 120°

11. In Fig., BEST is a rhombus. Then the value of y - x is **[NCERT Exemplar]**



(a) 40° (b) 50° (c) 20° (d) 10°

12. The closed curve which is also a polygon is **[NCERT Exemplar]**



13. The sum of angles of a concave quadrilateral is **[NCERT Exemplar]**

(a) more than 360° (b) less than 360°

(c) equal to 360° (d) twice of 360°

14. Which of the following can never be the measure of exterior angle of a regular polygon?

(Hint: Measure of exterior angle of a regular polygon should be a multiple of 360)

[NCERT Exemplar]

(a) 22° (b) 36° (c) 45° (d) 30°

15. PQRS is a trapezium in which PQ || SR and ∠P = 130°, ∠Q = 110°. Then ∠R is equal to

[NCERT Exemplar]

(a) 70° (b) 50° (c) 65° (d) 55°

16. The number of sides of a regular polygon whose each interior angle of 135° is

[NCERT Exemplar]

(a) 6 (b) 7 (e) 8 (d) 9

17. What is the sum of all angles of a hexagon? [NCERT Exemplar]

(a) 180° (b) 360° (c) 540° (d) 720°

18. The angle between the two altitudes of a parallelogram through the same vertex of an obtuse angle of the parallelogram is 30°. The measure of the obtuse angle is

[NCERT Exemplar]

(a) 100° (b) 150° (c) 105° (d) 120°

1. (a)	2. (b)	3. (a)	4. (b)	5. (b)	6. (a)	7. (c)	8. (b)	9. (a)
10. (a)	11 (a)	12. (a)	13. (c)	14. (a)	15. (a)	16. (c)	17. (d)	18. (b)

I. Fill in the blanks

1. The diagonals of a rhombus bisect each other at _____. [NCERT Exemplar]
2. The sum of interior angles of a polygon of n sides is _____ right angles. [NCERT Exemplar]
3. All sides of a _____ are equal and all angles are right angles. [NCERT Exemplar]
4. If all sides of a quadrilateral are equal, it is a _____. [NCERT Exemplar
5. A square has sides of equal length and angles of equal measure, so it is _____ a polygon. [NCERT Exemplar]

1. Right angles	2. 2n - 4	3. Square	4. Rhombus	5. Regular

I. True or False

1. All rectangles are parallelograms. [NCERT Exemplar]
2. All squares are rectangles. [NCERT Exemplar]
3. All angles of a trapezium are equal. [NCERT Exemplar]
4. All kites are square. [NCERT Exemplar]
5. Slim of all the angle& of a quadrilateral is 180°. [NCERT Exemplar]
6. If diagonals of a quadrilateral are equal, it must be a rectangle. [NCERT Exemplar]

1. True	2. True	3. False	4. False	5. False	6. False

I. Very Short Answer Type Questions

1. Find the number of sides of a regular polygon, whose each exterior angle has a measure of 40°. **[NCERT Exemplar]**

Sol. Since, the given polygon is a regular polygon.

$\therefore$ Its each exterior angle is equal.

$\therefore$ Sum of all the exterior angles = 360°

$\therefore$ Number of exterior angles = $\frac{360^0}{40^0}$

$\Rightarrow$Number of sides = 9

2. Each interior angle of a polygon is 108°. Find the number of sides of the polygon. **[NCERT Exemplar]**

Sol. Since each interior angle = 108°

So, exterior angle = 180° − 108° = 72°

Number of sides = $\frac{360^0}{esterior\ angle} = \frac{360^0}{72^0} = 5$

3. The four angles of a quadrilateral are in the ratio 3 : 4 : 5 : 6. Find the angles. **[NCERT Exemplar]**

Sol. Let angles be 3x, 4x, 5x, 6x.

Thus, 3x + 4x + 5x + 6x = 360°, Since, sum of the angles of a quadrilateral is 360°.

So, $18x = 360°$

or, $x = 20°$

Thus, angles are 60°, 80°, 100°, 120°.

4. Two adjacent angles of a parallelogram are in the ratio 4 : 5. Find their measures. **[NCERT Exemplar]**

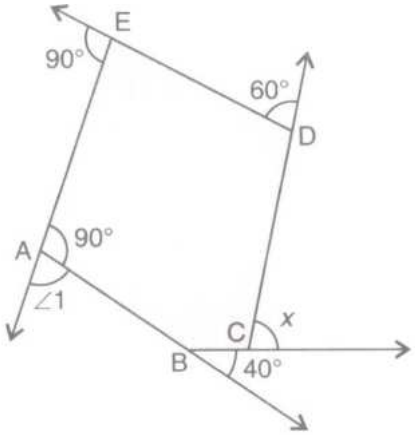
Sol. Let the angles be 4x and 5x.

Then, $4x + 5x = 180° \; 9x = 180°$

$x = 20°$

So, angles are $4x\ 20° = 80°\ and\ 5x\ 20° = 100°$.

5. Find x and $\angle 1$ in the following figure. **[NCERT Exemplar]**



Sol. In the given figure $\angle 1 + 90° = 180°$ (linear pair)

$$\angle 1 = 90°$$

Now, sum of exterior angles of a polygon is 360°.

Therefore, $x + 60° + 90° + 90° + 40° = 360°$

$$x + 280° = 360°$$

$$x = 80°$$

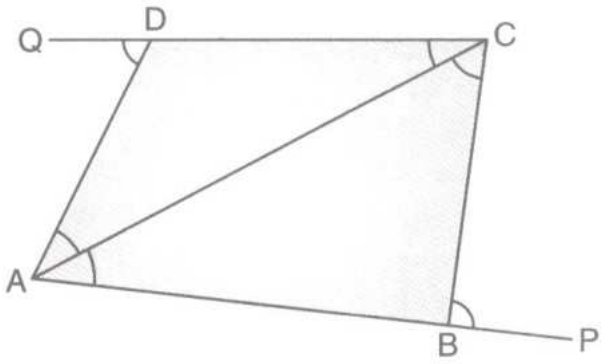
6. The sides AB and CD of a quadrilateral ABCD are extended to points P and Q respectively. Is LADQ + LCBP = LA + LC ? Give reason. **[NCERT Exemplar]**

Sol. Join AC, then

$$\angle CBP = \angle BCA + \angle BAC \text{ and}$$

$$\angle ADQ = \angle ACD + \angle DAC$$

(Exterior angles of triangles)



Therefore,

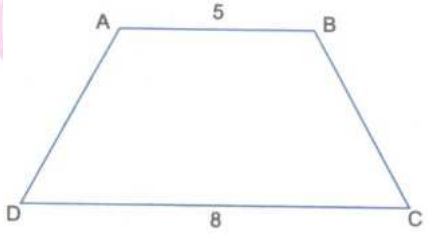
$$\angle CBP + \angle ADQ = \angle BCA + \angle BAC + \angle ACD + \angle DAC$$

$$= (\angle BCA + \angle ACD) + (\angle BAC + \angle DAC)$$

$$= \angle C + \angle A$$

II. Very Short Answer Type Questions

1. ABCD is a quadrilateral in which AB = 5 cm, CD = 8 cm and the sum of angle A and angle D is 180^0. What is the name of this quadrilateral?



Sol. Since = $\angle A + \angle D = 180^0$

These are interior angles on the same side of transversal (AD).

Therefore AB||DC

Hence, ABCD is a trapezium.

2. Two adjacent angles of a parallelogram are in the ratio 1 : 3. Find its angles.

[NCERT Exemplar]

Sol. Let the angles be x and 3x.

Then, $x + 3x = 180°$

$4x = 180° \implies x = 45°$

So, angles are 45° and (3 x 45°) i.e., 135°.

3. A photo frame is in the shape of a quadrilateral with one diagonal longer than the other. Is it a rectangle? Why or why not? **[NCERT Exemplar]**

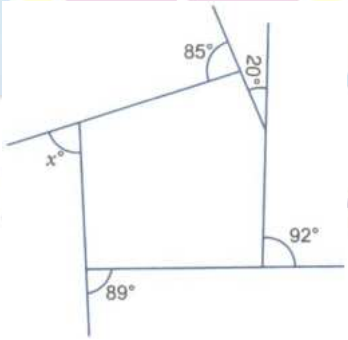
Sol. No, it is not a rectangle. In a rectangle diagonals are equal.

4. In Fig. 3.24, find the value of x. **[NCERT Exemplar]**

Sol. Sum of all exterior angles = 360°

$x + 89° + 92° + 20° + 85° = 360°$

$x + 286° = 360° \implies x = 360° - 286° = 74°.$



5. The point of intersection of diagonals of a quadrilateral divides one diagonal in the ratio 1 : 2. Can it be a parallelogram? Why or why not? [NCERT Exemplar]

Sol. No, it cannot be a parallelogram. Diagonals of parallelogram bisect each other i.e., in the ratio 1 : 1.

6. A playground in the town is in the form of a kite. The perimeter is 106 metres. If one of its sides is 23 metres, what are the lengths of other three sides?

Sol. A kite has two pairs of equal consecutive sides.

$\therefore$ One side = 23 m

Other side = 23 m

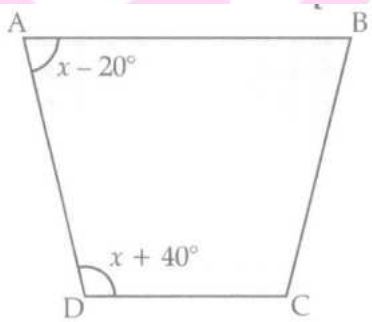
Sum of rest two sides = 106 — (23 + 23) = 60 m

Length of other two sides are 30 m and 30 m.

Hence, the length of other three sides are 23 m, 30 m and 30 m.

I. Short Answer Type Questions

1. Find the value of x in the trapezium ABCD given below. [NCERT Exemplar]



Sol. In the given trapezium ABCD, we have AB || CD

Also, sum of interior angles A and D is 180°.

$\therefore \quad \angle A + \angle D = 180°$

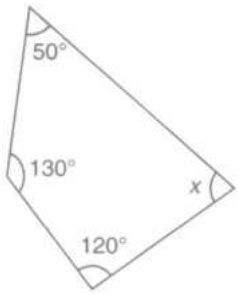
$(x - 20°) + (x + 40°) = 180°$

$2x° + 20° = 180°$

$2x° = 160°$

$x° = 80°$

2. Find the measure of angle x in the following figure : **[NCERT Exemplar]**



Sol. The sum of interior angles of a quadrilateral = 360°

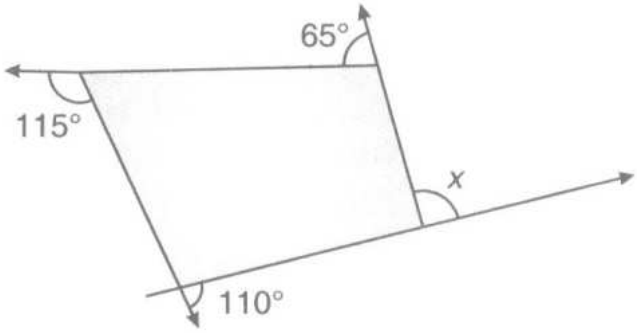
$\therefore \quad x + 120° + 130° + 50° = 360°$

$\therefore \quad x + 300° = 360°$

$\therefore \quad x = 360° - 300°$

$x = 60°$

3. Find the measure of x in the figure. **[NCERT Exemplar]**



Sol. Sum of all the exterior angles of a quadrilateral = 360°

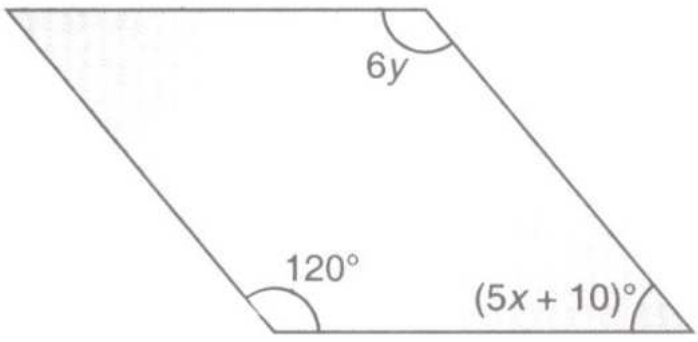
$\therefore \quad x + 65° + 115° + 110 = 360°$

$\therefore \quad x + 290° = 360°$

or $\quad x = 360° - 290°$

$\therefore \quad x = 70°$

4. Find the values of x and y in the following parallelogram. **[NCERT Exemplar]**



Sol. $\therefore$ Opposite angles of 11 gm are equal

$\therefore \quad 6y = 120° \; y = 20°$

Now, $5x + 10° + 6y = 180°$

$5x + 10° + 6 \times 20° = 180°$

$5x = 180° - 130°$

$5x = 50°$

$x = \frac{50^0}{5}$

$x = 10^0$

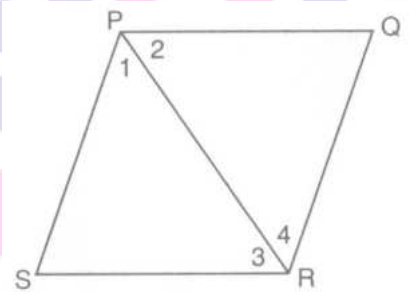
5. Find the measure of exterior angle of a regular pentagon and an exterior angle of a regular decagon. What is the ratio between these two angles. [NCERT Exemplar]

Sol. Exterior angle of a regular pentagon $= \frac{360^0}{5^0} = 72°$

Exterior angle of a regular decagon $= \frac{360^0}{5^0} = 36°$

Ratio between these two $= \frac{72^0}{36^0} = 2:1$

6. One of the diagonals of a rhombus and its sides are equal. Find the angles of the rhombus. [NCERT Exemplar]



Sol. Let PQRS be a rhombus such that its diagonal PR is equal to its side, that is, PQ = QR = RS = PS = PR So, △PRS and APQR are equilateral.

$\angle S = \angle Q = 60°$ [Each angle of an equilateral triangle is 60°.]

and

$$\angle P = \angle 1 + \angle 2 = 60° + 60° = 120° = \angle R$$

Hence, $\angle S = \angle Q = 60° \; and \; \angle P = \angle R = 120°$

7. The ratio of exterior angle to interior angle of a regular polygon is 1 : 4. Find the number of sides of the polygon. [NCERT Exemplar]

Sol. Let the exterior angle of the polygon be x Then, the interior angle of polygon $= 180° - x$ According to question,

$$\frac{x}{180^0 - x} = \frac{1}{4}$$

or, $4x = 180° - x$

or $5x = 180^0$

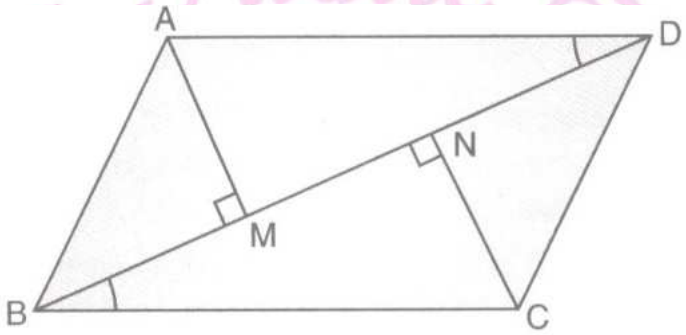
or, $x = \frac{180^5}{5}$

so, $x = 36^0$

Number of sides of polygon $\frac{360^0}{exterior\ angle}$

$= \frac{360^0}{36^0} = 10^0$

8. If AM and CN are perpendiculars on the diagonal BD of a parallelogram ABCD, Is △AMD △CNB ? Give reason. **[NCERT Exemplar]**



Sol. In $\triangle AMD$ and $\triangle CNB$

$AD = BC$

(opposite side of parallelogram)

$\angle DMB = \angle CNB = 90°$

$\angle ADM = \angle NBC$

$(AD \parallel BC$ and BD is transversal$)$

So, $\triangle AMD = CNB$ (AAS)

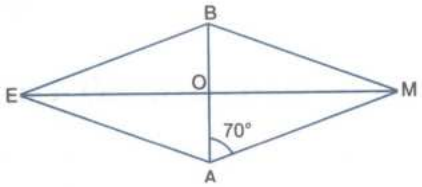
II. Short Answer Type Questions

1. In rhombus BEAM, find ∠AME and ∠AEM. **[NCERT Exemplar]**

Sol. Since diagonals of rhombus bisect each other at right angles (Fig. 3.25)

∴ ∠AOM = 90°

In ∠AOM,



∠AOM + ∠OAM + ∠AMO = 180°

90° + 70° + ∠AMO = 180°

160° + ∠AMO = 180°

∠AMO = 180° - 160° = 20°

∠AME = ∠AMO = 20°

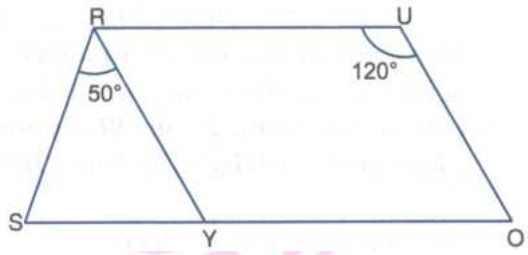
In ∠AEM,

AE = AM (Sides of rhombus are equal)

∠AME = ∠AEM (Angles opposite to equal sides)

∴ ∠AEM = 20°

2. In the given parallelogram YOUR (Fig.), ∠RUO = 120° and OY is extended to point S such that ∠SRY = 50° Find ∠YSR. [NCERT Exemplar]



Sol. ∠RYO = ∠RUO = 120°

(Opposite angles of parallelogram are equal)

∠RYS + ∠RYO = 180° (Linear pair)

∠RYS + 120° = 180°

⇒ ∠RYS = 180° — 120° = 60°

In ΔRSY,

$\angle YSR + \angle RYS + \angle SRY = 180^0$

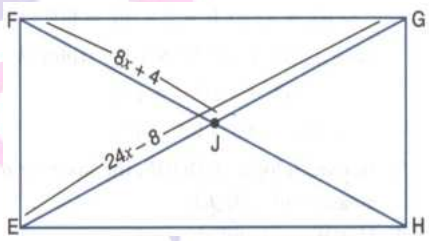
$\angle YSR + 60° + 50° = 180^0$

$\angle YSR + 110° = 180^0$

$\angle YSR = 180^0 - 110^0 = 70^0$

3. Quadrilateral EFGH is a rectangle in which J is the point of intersection of the diagonals. Find the value of x if JF = 8x + 4 and EG = 24x - 8. [NCERT Exemplar]

Sol. EG = 24x - 8



HF = 2(8x + 4) = 16x + 8

Since diagonals of rectangle are equal,

∴ EG = HF

or 24x — 8 = 16x + 8 or 24x — 16x = 8 + 8

or 8x = 16 or x = 2

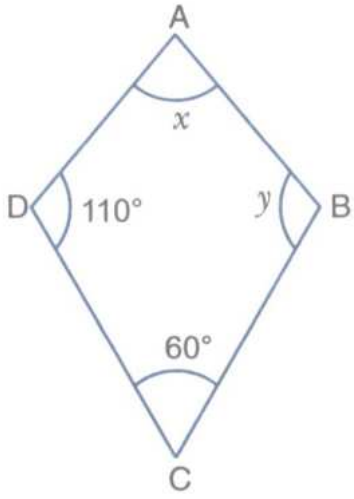
4. Find the values of x and y in the adjoining kite. [NCERT Exemplar]

Sol. In the Fig.,

m (A) m(C)

But m(B) = m(D) (Property of a quadrilateral i.e., kite)

∴ y = 110°



In ΔABCD,

x + y + 60° + 110° = 360°

x + 110° + 60° + 110° = 360°

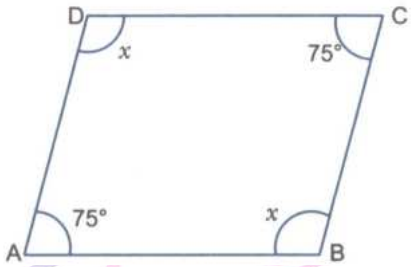
x + 280° = 360°

x = 360° — 280° = 80°

5. Two angles of a quadrilateral are each of measure 75° and the other two angles are equal. What is the measure of these two angles? Name the possible figure so formed.

[NCERT Exemplar]

Sol. Let equal angles be x



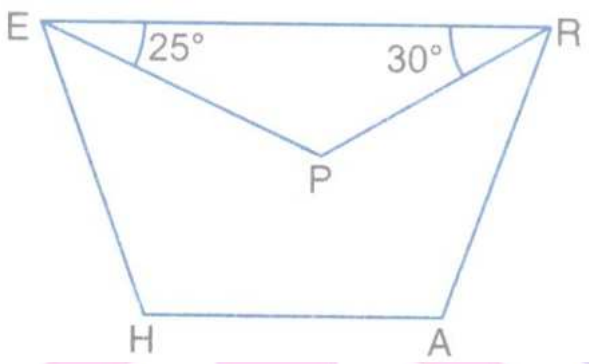
$\therefore \quad x + x + 75° + 75° = 360°$

$2x + 150° = 360°$

$2x = 210° \; x = 105°$

Each equal angle is 105°. The possible figure so formed is parallelogram.

6. In trapezium HARE, EP and RP are bisectors of ∠E and ∠R respectively. Find ∠HAR and ∠EHA. **[NCERT Exemplar]**



Sol. Since EP is bisector of ∠HER

$\therefore \quad \angle HEP = \angle PER = 25°$

$\angle HER = \angle HEP + \angle PER = 25° + 25° = 50°$

Now, ER || HA and EH is transversal

$\angle HER + \angle EHA = 180°$ (Interior angles on the same side of transversal)

$50° + \angle EHA = 180°$

$\angle EHA = 180° - 50° = 130°$

Since PR is bisector of ∠ERA

$\angle ERA = 2\angle ERP = 2 \times 30° = 60°$

Also, $\angle ERA + \angle HAR = 180°$ (Interior angles on the same side of transversal)

$60° + LHAR = 180°$

$\angle HAR = 180° - 60° = 120°$

7. In parallelogram MODE, the bisector of ∠M and ∠O meet at Q (Fig.), find the measure of ∠MQO.

Sol. MODE is a parallelogram.

$\angle EMO + \angle DOM = 180°$ (Interior angles on the same side of transversal)

$\frac{1}{2} \angle EMO + \angle DOM = \frac{1}{2} \times 180°$

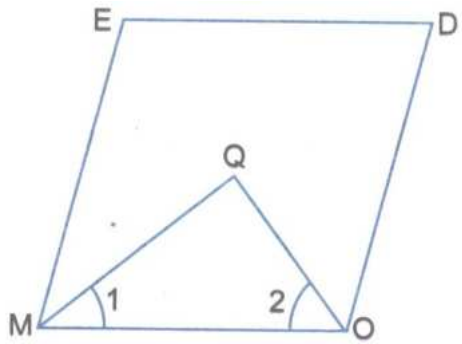
$\angle 1 + \angle 2 = 90°$

In ΔMOQ,

$\angle 1 + \angle 2 + \angle MQO = 180°$

$90° + \angle MQO = 180°$

$\angle MQO = 180° - 90° = 90°$



8. A Rangoli has been drawn on a floor of a house. ABCD and PQRS both are in the shape of a rhombus. Find the radius of semicircle drawn on each side of rhombus ABCD. Measurements are in cm. [NCERT Exemplar]

Sol. Diagonals of rhombus bisects each other at right angle.

$OA = 2 + 2 = 4$ cm and $OB = 2 + 1 = 3$ cm

In ΔAOB, $\Delta AOB = 90°$

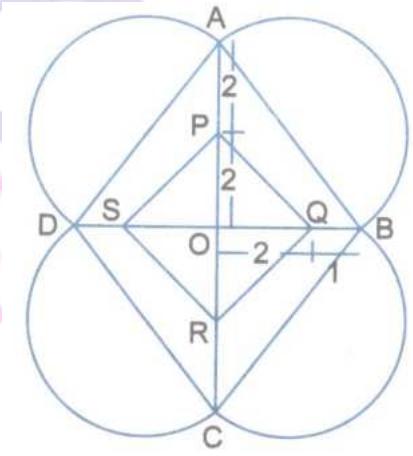
$\therefore AB^2 = 0A^2 + OB^2$ (Using Pythagoras theorem)

$= 4^2 + 3^2 = 16 + 9 = 16 + 9$

$AB = \sqrt{25} = 5$ cm.

This is the diameter of semicircle.

Radius $= \frac{5}{2} = 2.5$ cm.



9. The angle between the two altitudes of a parallelogram through the vertex of an obtuse angle of the parallelogram is 45°. Find the angles of the parallelogram.

[NCERT Exemplar]

Sol. Let ABCD is a parallelogram in which $AE \perp BC$ and $AF \perp DC$

In ❑AECF,

$\angle AEC + \angle ECF + \angle CFA + \angle EAF = 360°$

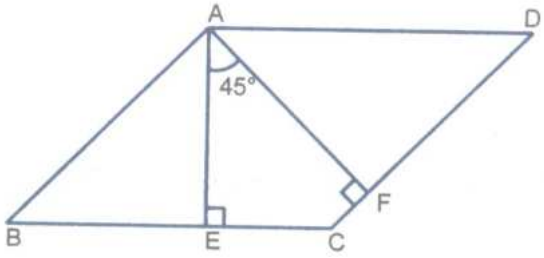
$90° + \angle ECF + 90° + 45° = 360°$

$225° + LECF = 360°$

$\angle ECF = 360° - 225°$

$\angle ECF = 135° \Rightarrow \angle C = 135°$

$\angle A = \angle C = 135°$ (Opposite angles of parallelogram)



$\angle B + \angle C = 180°$ (Adjacent angles of parallelogram)

$\angle B + 135° = 180°$

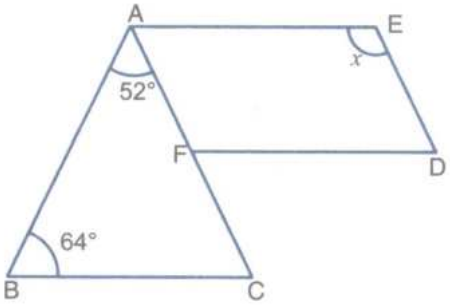
$\angle B = 180° - 135° = 45°$

$\angle D = \angle B = 45°$ (Opposite angles of parallelogram)

10. In Fig., FD || BCH AE and AC || ED. Find the value of x. [NCERT Exemplar]

Sol. In ΔABC,

$\angle BAC + \angle ABC + \angle ACB = 180°$ (Angle sum property)



$52° + 64° + \angle ACB = 180°$

$116° + \angle ACB = 180°$

$\angle ACB = 180° - 116° = 64°$

Since AE || BC and AC is transversal,

$\angle CAE = \angle ACB = 64°$ (Alternate angles)

Now, AE || FD and AF || ED

$\therefore$ AEDF is a parallelogram.

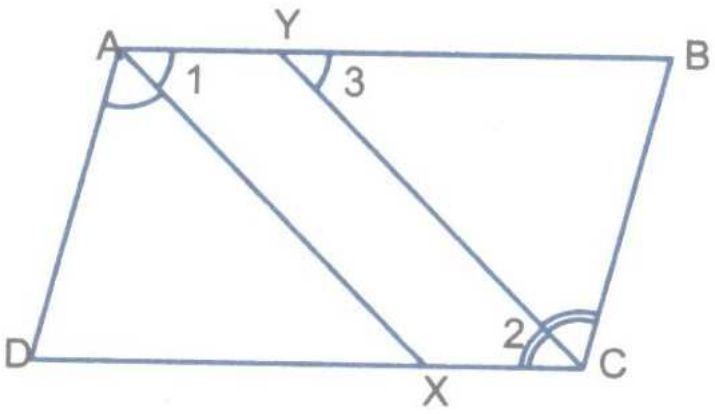
$\angle CAE + \angle E = 180°$ (Adjacent angles of parallelogram are supplementary)

$64° + x = 180°$

$\Rightarrow$ $x = 180° - 64° = 116°$

11. ABCD is a parallelogram. The bisector of angle A intersects CD at X and bisector of angle C intersects AB at Y. Is AXCY a parallelogram? Give reason.

[NCERT Exemplar]



Sol. $\angle A = \angle C$

(Opposite angles of a parallelogram)

or $\frac{\angle A}{2} = \frac{\angle C}{2} \Rightarrow \angle 1 = \angle 2$

But $\angle 2 = \angle 3$ (Alternate angles)

$\therefore$ $\angle 1 = \angle 3$

But they are a pair of corresponding angles

$\therefore$ AX || YC ...(i)

AY || XC ...(ii) ($\therefore$ AB || DC)

From (i) and (ii)

Δ AXCY is a parallelogram.

I. Long Answer Type Questions

1. Two given angles of a parallelogram have equal measure. Find the measure of each of the angles of the parallelogram. [NCERT Exemplar]

Sol. Let ABCD be a parallelogram such that adjacent angles $\angle A = \angle B$

Since, $\angle A + \angle B = 180°$

$\Rightarrow$ $2\angle A = 180°$

$\therefore$ $\angle A = \angle B = \frac{180^2}{2} = 90°$

Since, opposite angles of a parallelogram are equal.

$\therefore$ $\angle A = \angle C = 90°$

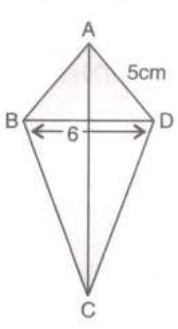
and $\angle B = \angle D = 90°$

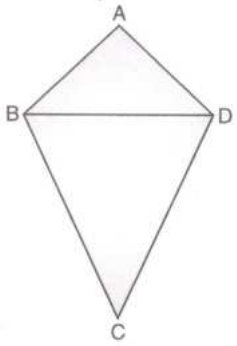
Thus, $\angle A = 90°$, $\angle B = 90°$,

$\angle C = 90°$ and $\angle D = 90°$

2. Construct a quadrilateral ABCD in which AB = AD = 5 cm, BC = CD = 7 cm and BD = 6 cm. What type of quadrilateral is this ? [NCERT Exemplar]

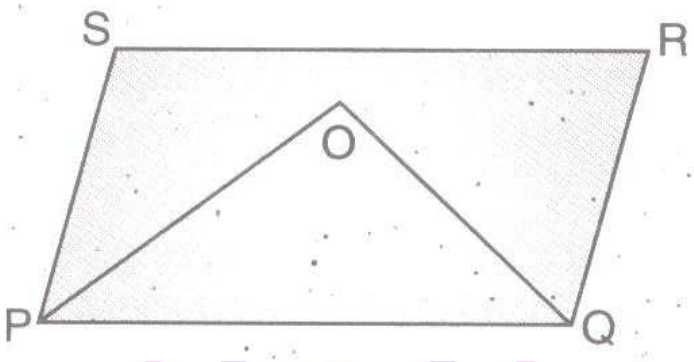
Sol. Looking at the rough figure, draw a line segment BD = 6 cm. Taking B and D as centres and 5 cm radius, draw arcs to intersect at the point A, then taking B and D as centres and 7 cm radius, draw arcs in the opposite side of A to intersect at the point C. Join AB, AD and BC, DC. Then ABCD is the required quadrilateral. It is a kite.





3. In a parallelogram PQRS, the bisectors of LP and LQ meet at 0. Find LPOQ.

[NCERT Exemplar]



Sol. Since, OP and OQ are the bisectors of ∠P and ∠Q respectively.

So, ∠OPQ = ½ ∠P and ∠OQP = ½ ∠2

In ∠POQ,

∠OPQ + ∠PQO + ∠POQ = 180° (Angle sum property)

i.e., —2 LP + LPOQ + —1 LQ =180° 2

i.e., ∠POQ = 180° - ½ (∠P + ∠Q)

=180°- ½x 180°

= 90°

4. In a quadrilateral ABCD, DO and CO are the bisectors of ∠D and ∠C respectively.

Prove that LCOD = ½ [∠A + ∠B]. **[NCERT Exemplar]**

Sol. In Δ∠COD, we have

∠COD + ∠1 + ∠2 = 180°

⇒ ∠COD = 180° — [∠1 + ∠2]

⇒ $\angle COD = 180° - \left[\frac{1}{2}\angle D + \frac{1}{2}\angle C\right]$

⇒ ∠COD = 180^0 — ½[∠D + ∠**C]**

But ∠A + ∠B + ∠C + ∠D = 360°

⇒ ∠C + ∠D = 360° — (∠A + ∠B)

⇒ ∠COD = 180° — ½[360° — (∠A + ∠B)]

= 180° — ½ [360°] + ½ [∠A + ∠B]

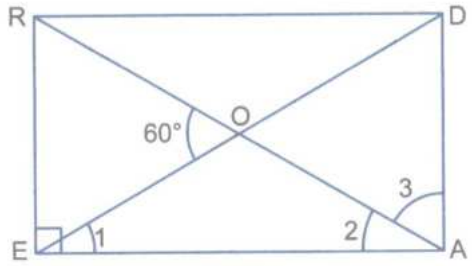
= 180° —180° + ½ [∠A + ∠B]

= ½(∠A + ∠B)

Thus, ∠COD = ½[∠A + ∠B]

II. Long Answer Type Questions

1. In rectangle READ (Fig.), find ∠EAR, ∠RAD and ∠ROD. [NCERT Exemplar]



Sol. We have,

$\angle EOR + \angle EOA = 180°$ (Linear pair)

$60° + \angle EOA = 180°$

$\angle EOA = 180° - 60° = 120°$

Since diagonals of a rectangle are equal and they bisect each other, therefore, in ΔEOA we have

$OE=O \Rightarrow S \angle 1= \angle 2$

(Angles opposite to equal sides)

In ΔEOA

$\angle 1 + \angle 2 + \angle EOA = 180°$ (Angle sum property)

$2\angle 2 + 120° = 180° \Rightarrow 2\angle 2 = 60° \angle EAR = 30°$

$2\angle 2 = 60° \Rightarrow \angle 2 = 30°$

$\angle EAR + 120°$

Since each angle of a rectangle is a right angle,

$\angle EAD = 90°$

$\angle 2 + \angle 3 = 90°$

$\Rightarrow 30° + \angle 3 = 90°$

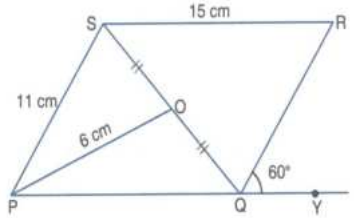
$\angle 3 = 90° - 30° = 60°$

$\angle RAD = 160°$

Now, $\angle ROD = \angle EOA = 120°$ (Vertically opposite angles)

2. In parallelogram PQRS, 0 is the midpoint of SQ (Fig.). Find LS, LR, PQ, QR and diagonal PR. [NCERT Exemplar]

Sol. $\angle PQR + \angle RQY = 180°$(Linear pair)



$\angle PQR + 60° = 180°$

$\angle PQR = 180° - 60° = 120°$

Now, $\angle S = \angle PSR = \angle PQR = 120°$

(Opposite angles of parallelogram are equal)

Again, $\angle PQR + \angle R = 180°$ (Adjacent angles of parallelogram)

$120° + \angle R = 180°$

$\angle R = 180° - 120° = 60°$

PQ = SR = 15 cm (Opposite sides of parallelogram are equal)

QR = PS = 11 cm

Diagonal PR = 2(PO) (Diagonals of a parallelogram bisect each other)

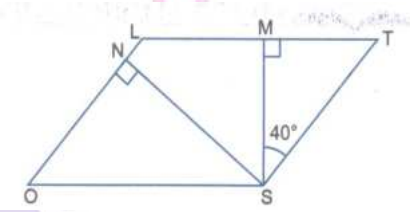
$= 2 \times 6 = 12$ cm

3. In parallelogram LOST, (Fig.) SNIOL and SM⊥LT . Find LSTM, LSON and LNSM

[NCERT Exemplar]

Sol. $\angle SMT = 90°$

$\angle MST = 40°$ (Given)



In ΔSTM,

$\angle SMT + \angle MST + \angle STM = 180°$

(Angle sum property) $90° + 40° + \angle STM = 180°$

$130° + \angle STM = 180°$

$\angle STM = 180° - 130° = 50°$

$\angle SON = \angle STM = 50°$ (Opposite angles of parallelogram)

In ΔOSN,

$\angle OSN + \angle ONS + \angle SON = 180°$ (Angle sum property)

$\angle OSN + 90° + 50° = 180°$

$\angle OSN + 140° = 180°$

$\angle OSN = 180° - 140° = 40°$

Now, $\angle SOL + \angle OST = 180°$ (Adjacent angles of parallelogram)

$50° + 40° + \angle NSM + 40° = 180°$ ($\because \angle OST = \angle OSN + \angle NSM + \angle MST$)

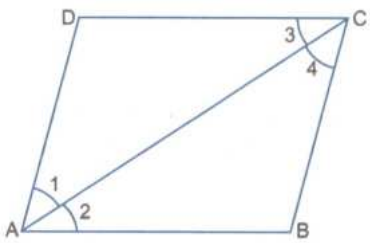
$130° + \angle NSM = 180°$

$\angle NSM = 180° - 130° = 50°$

4. A diagonal of a parallelogram bisects an angle. **[NCERT Exemplar]**

(i) Will it also bisect the other angle?

(ii) Is it a rhombus? Give reason.



Sol. Let ABCD be a parallelogram (Fig. 3.39) in which

$\angle 1 = \angle 2$

(i) $\angle 1 = \angle 4$ (Alternate angles)

and $\angle 2 = \angle 3$ (Alternate angles)

But $\angle 1 = \angle 2$

$\therefore \angle 3 = \angle 4$

So, the diagonal will bisect the other angle.

(ii) $\angle 1 = \angle 2$ (Given)

$\angle 2 = \angle 3$ (Alternate angles)

$\angle 1 = \angle 3$

Hence, CD = DA (Sides opposite to equal angles are equal)

$\therefore$ ABCD is a rhombus.

I. High Order Thinking Skills [HOTS] Questions.

1. (a) Prove that the interior angle of a regular pentagon is three times the exterior angle of a regular decagon.

(b) Is rectangle a regular polygon ? Why ?

Sol. (a) We know that,

A pentagon has five sides, then $n = 5$

But each interior angle of a regular polygon $= \left(\frac{n-2}{n}\right) \times 180^0$

$\therefore$ Each interior angle of a regular pentagon $= \left(\frac{3}{5}\right) \times 180^0$

$= 3 \times 36 = 108°$

and a decagon has 10 sides, then

Exterior angle of a regular decagon $= \left(\frac{360°}{180°}\right) = 36°$

Therefore, interior angle of regular pentagon

= 3 x The exterior angle of a regular decagon

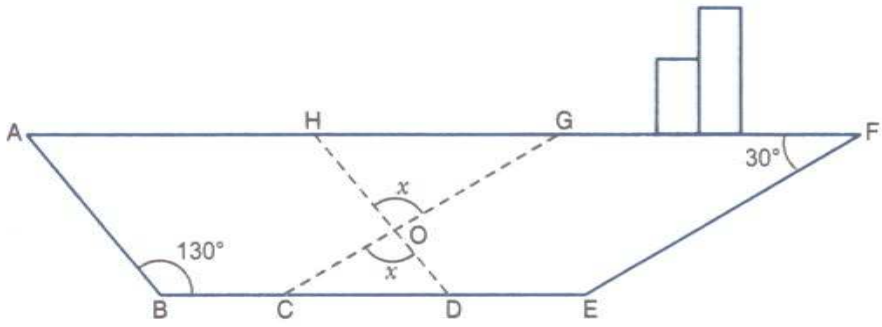
= 3 x 36° = 108°

(b) Yes, a rectangle is not a regular polygon because it is equiangular but not all sides are equal.

II. High Order Thinking Skills [HOTS] Questions.

1. In Fig. a ship, ABDH and CEFG are two parallelograms. Find the value of x.

[NCERT Exemplar]



Sol. Since ABDH is a parallelogram,

$\angle B + \angle BDH = 180°$

(Adjacent angles of parallelogram are supplementary)

$130° + \angle BDH = 180°$

$\angle BDH = 180° - 130° = 50°$

Similarly, CEFG is a parallelogram.

$\angle GCE = \angle F = 30°$

In ΔCOD,

$\angle OCD + \angle ODC + \angle COD = 180°$ (Angle sum property)

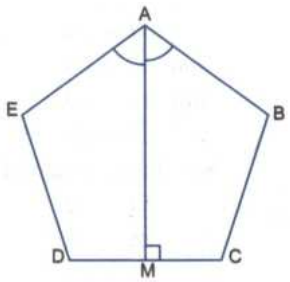
$\angle GCE + \angle BDH + x = 180°$

$30° + 50° + x = 180°$

$80° + x = 180°$

$x = 180° - 80° = 100°$

2. ABCDE is a regular pentagon. The bisector of angle A meets the side CD at M (Fig.). Find $\angle AMC$ [NCERT Exemplar]



Sol. The measure of each interior angle of regular pentagon = 108°

$\therefore \angle MAB = \frac{1}{2} \times 108° = 54°$

In $\blacksquare ABCM$,

$\angle MAB + \angle ABC + \angle BCM + \angle AMC = 360°$

(Sum of angles of a quadrilateral is 360°)

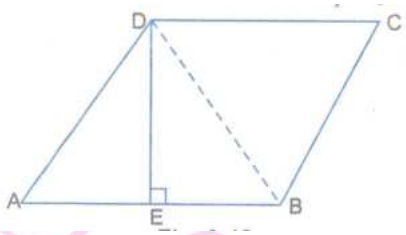
$54° + 108° + 108° + \angle AMC = 360°$

$270° + \angle AMC = 360°$

$\angle AMC = 360° - 270° = 90°$

3. ABCD is a rhombus such that the perpendicular bisector of AB passes through D (Fig.). Find the angles of the rhombus. **[NCERT Exemplar]**

[Hint : Join BD. Then AABD is equilateral.]



Sol. Let ABCD be a rhombus in which DE is perpendicular bisector of AB. Join BD. (Fig.) In ΔADE and ΔBDE

$AE = EB$

(DE is perpendicular bisector of AB)

$DE = DE$ (Common)

$\angle AED = \angle BED$ (Each 90°)

$\Delta ADE = \Delta BDE$ (SAS)

$AD = BD$ (CPCT)

So, AABD and ABCD are equilateral.

$\angle A = \angle C = 60°$ (All angles of equilateral triangle are 60°)

Now, $\angle A + \angle D = 180°$ (Adjacent angles are supplementary)

$60° + \angle D = 180°$

$\angle D = 180° - 60° = 120°$

Hence, $\angle A = \angle C = 60°$ and $\angle B = \angle D = 120°$.

4. A regular pentagon ABCDE and a square ABFG are formed on opposite sides of AB. (Fig.) Find ∠BCF. **[NCERT Exemplar]**

Sol. Each interior angle of regular pentagon $= \frac{(2 \times 5-4)}{5} \times 90$

$= \frac{(10-4) \times 90}{5} \times 108^0$

Since ABFG is a square,

So, $\angle ABF = 90°$

Therefore, $\angle CBF = 360° - (108° + 90°)$

$\angle CBF = 360° - 198° = 162°$

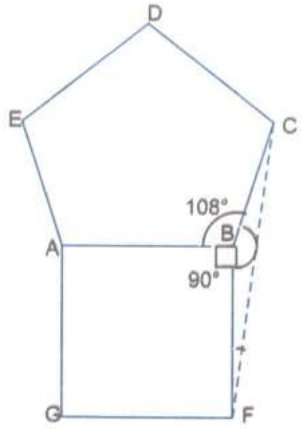
$AB = BF$

(All sides of square are equal)

$AB = BC$

(All sides of regular pentagon are equal)

$\therefore$ $BF = BC$ ...(i)



In ΔCBF,

$FB = BC$ (From (i))

$\angle CFB = \angle BCF = x$

(Angles opposite to equal sides)

$\therefore \quad x + x + 162° = 180°$

$2x = 180° - 162°$

$2x = 18° \Rightarrow x = 9^o$

$\therefore \quad \angle BCF = 9°$

I. Value Based Questions.

1. (a) The four angles of a quadrilateral are as 3 : 5 : 7 : 9. Find the angles.

(b) Is an equilateral triangle a regular polygon ? Why ?

Sol. (a) Let $\angle A = 3x$, $\angle B = 5x$, $\angle C = 7x$ and $\angle D = 9x$

We know that, in a quadrilateral

$\angle A + \angle B + \angle C + \angle D = 360°$

Then, $3x + 5x + 7x + 9x = 360°$

or $24x = 360°$

or $x = \frac{360°}{24} = 15°$

Therefore,

$\angle A = 3x = 3 \times 15° = 45°$

$\angle B = 5x = 5 \times 15° = 75°$

$\angle C = 7x = 7 \times 15° = 105°$

and $\angle D = 9x = 9 \times 15° = 135°$

(b) Yes, an equilateral triangle is a regular polygon because it is both equiangular and equilateral.
