

NOTES

CLASS 7

MATHS

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Study Material

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THE TRIANGLE AND ITS PROPERTIES

I. Important Concepts/ Result

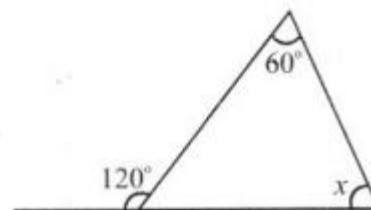
1. The six elements of a triangle are its three angles and the three sides.
2. The line segment joining a vertex of a triangle to the mid point of its opposite side is called a median of the triangle. A triangle has 3 medians.
3. The perpendicular line segment from a vertex of a triangle to its opposite side is called an altitude of the triangle. A triangle has 3 altitudes.
4. An exterior angle of a triangle is formed, when a side of a triangle is produced. At each vertex, you have two ways of forming an exterior angle.
5. A property of exterior angles: The measure of any exterior angle of a triangle is equal to the sum of the measures of its interior opposite angles.
6. The angle sum property of a triangle: The total measure of the three angles of a triangle is 180° .
7. A triangle is said to be equilateral, if each one of its sides has the same length. In an equilateral triangle, each angle has measure 60° .
8. A triangle is said to be isosceles, if atleast any two of its sides are of same length. The non-equal side of an isosceles triangle is called its base; the base angles of an isosceles triangle have equal measure.
9. Property of the lengths of sides of a triangle:
10. The sum of the lengths of any two sides of a triangle is greater than the length of the third side. The difference between the lengths of any two sides is smaller than the length of the third side.

II Some illustrations/Examples

(i) MCQs

1. How many medians can a triangle have?
(a) 2 (b) 1 (c) 3 (d) 0
Answer: (c) 3
2. Which is the longest side of a right triangle?
(a) Perpendicular (b) Base (c) Hypotenuse (d) none of these.
Answer: (c) hypotenuse

3. Find the value of x in given figure.
(a) 180° (b) 55° (c) 90° (d) 60°
Solution: Sum of interior opposite angles = Exterior angle or $60^\circ + x = 120^\circ$ or $x = 60^\circ$

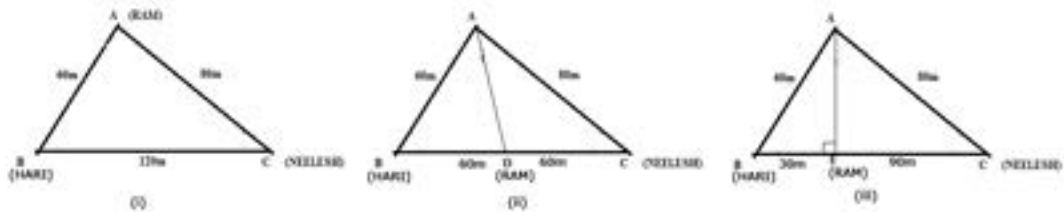


4. Which of the following are the angles of an isosceles right-angled triangle.
a) $60^\circ, 60^\circ, 60^\circ$ b) $45^\circ, 45^\circ, 90^\circ$
c) $50^\circ, 50^\circ, 80^\circ$ d) $30^\circ, 30^\circ, 120^\circ$

ii) Case study



Triangles: Three friends Ram, Hari & Neelesh are standing at position A, B & C respectively as shown in figure (i). Ram wants to join the line through Hari & Neelesh. Hari suggest Ram to move along AD & take the position at D as in figure (ii). Neelesh suggest Ram to move along AE & take the position at E as in figure (iii).



- In figure (ii) AD is _____ (median/altitude).
- In figure (iii) AE is _____ (median/altitude).
- If Ram wants to join line BC soon, then whose suggestion is fair & why?
- Following statements are true or false-

S.No.	Statement	True/False
1	$\triangle ABD$ is isosceles	
2	$BE = EC$	
3	$\triangle ABC$ is right angled	

(ii) Short answer type questions

- Find the value of x in given figure.

Solution: By angle sum property of a triangle,
 $\angle U + 30^\circ + 122^\circ = 180^\circ$
 $\angle U = 180^\circ - 152^\circ = 28^\circ$

- The lengths of two sides of a triangle are 6 cm and 8 cm. Between which two numbers can length of the third side fall?

- Solution:** We know that the sum of two sides of a triangle is always greater than the third.

Therefore, third side has to be less than the sum of the two sides. The third side is thus, less than $8 + 6 = 14$ cm. The side cannot be less than the difference of the two sides.

Thus, the third side has to be more than $8 - 6 = 2$ cm.

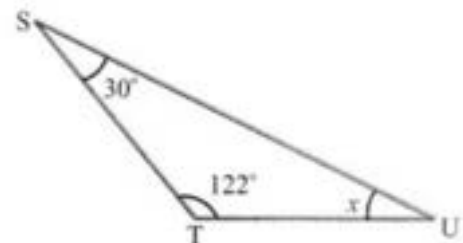
The length of the third side could be any length greater than 2 and less than 14 cm.

- State if these numbers 5, 7, 9 could possibly be the lengths of the sides of a triangle:

Solution: Yes, these numbers can be the lengths of the sides of a triangle because the sum of any two sides of a triangle is always greater than the third side.

Here, $5 + 7 > 9$, $5 + 9 > 7$, $9 + 7 > 5$

- If the sides of a triangle are 3 cm, 4 cm and 6 cm long, determine whether the triangle is right-angled triangle.



Solution: In the given triangle, the largest side is 6 cm.

We know that in a right angled triangle, the sum of the squares of the smaller sides should be equal to the square of the largest side.

$$\text{Therefore, } 3^2 + 4^2 = 9 + 16 = 25$$

$$\text{But, } 6^2 = 36$$

$$3^2 + 4^2 = 25 \text{ which is not equal to } 6^2$$

Hence, the given triangle is not a right angled triangle.

6. If the angles of a triangle are in the ratio 1: 2: 3, determine three angles.

Solution: Given angles of the triangle are in the ratio 1: 2: 3

So take first angle as x , second angle as $2x$ and third angle as $3x$

We know that sum of all the angles of a triangle = 180°

$$x + 2x + 3x = 180^\circ$$

$$6x = 180^\circ$$

$$x = 30^\circ$$

$$2x = 30^\circ \times 2 = 60^\circ \quad 3x = 30^\circ \times 3 = 90^\circ$$

Therefore the first angle is 30° , second angle is 60° and third angle is 90° .

7. In the given figure, the sides BC, CA and BA of a $\triangle ABC$ are produced to D, E and F respectively. If $\angle ACD = 105^\circ$ and $\angle EAF = 45^\circ$; find all the angles of the $\triangle ABC$.

Solution: In a $\triangle ABC$, $\angle BAC$ and $\angle EAF$ are vertically opposite angles.

$$\text{Hence, } \angle BAC = \angle EAF = 45^\circ$$

Considering the exterior angle property, we have $\angle BAC + \angle ABC = \angle ACD = 105^\circ$

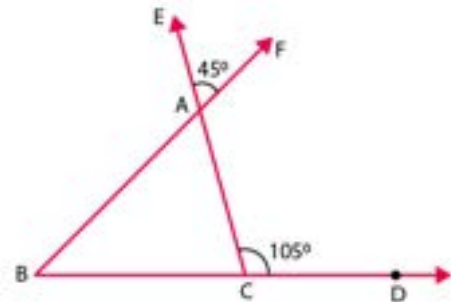
$$\text{On rearranging we get } \angle ABC = 105^\circ - 45^\circ = 60^\circ$$

We know that the sum of angles in a triangle is 180°

$$\angle ABC + \angle ACB + \angle BAC = 180^\circ$$

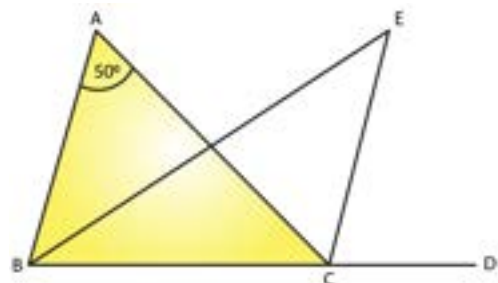
$$\angle ACB = 75^\circ$$

Therefore, the angles are 45° , 60° and 75°



8. In $\triangle ABC$, $\angle A = 50^\circ$ and BC is produced to a point D. The bisectors of $\angle ABC$ and $\angle ACD$ meet at E. Find $\angle E$.

Solution: In the given triangle,



$\angle ACD = \angle A + \angle B$. (Exterior angle is equal to the sum of two opposite interior angles.)

We know that the sum of all three angles of a triangle is 180° .

Therefore, for the given triangle, we know that the sum of the angles = 180°

$$\angle ABC + \angle BCA + \angle CAB = 180^\circ$$

$$\angle A + \angle B + \angle BCA = 180^\circ$$

$$\angle BCA = 180^\circ - (\angle A + \angle B)$$

But we know that EC bisects $\angle ACD$

$$\text{Therefore } \angle ECA = \angle ACD/2$$

$$\angle ECA = (\angle A + \angle B)/2 \quad [\angle ACD = (\angle A + \angle B)]$$

But EB bisects $\angle ABC$

$$\angle EBC = \angle ABC/2 = \angle B/2$$

$$\angle EBC = \angle ECA + \angle BCA$$

$$\angle EBC = (\angle A + \angle B)/2 + 180^\circ - (\angle A + \angle B)$$

Similarly, in $\triangle EBC$, we get,

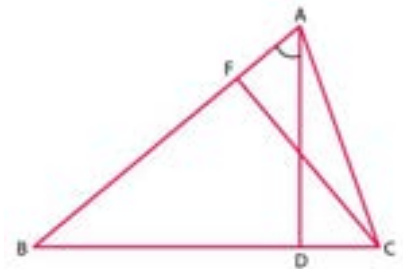
$$\angle B/2 + (\angle A + \angle B)/2 + 180^\circ - (\angle A + \angle B) + \angle BEC = 180^\circ$$

$$\angle BEC = \angle A + \angle B - (\angle A + \angle B)/2 - \angle B/2$$

$$\angle BEC = \angle A/2$$

$$\angle BEC = 50^\circ/2 = 25^\circ$$

9. In Fig.39, AD and CF are respectively perpendiculars to sides BC and AB of $\triangle ABC$. If $\angle FCD = 50^\circ$, find $\angle BAD$



Solution: We know that the sum of all angles of a triangle is 180°

Therefore, for the given $\triangle FCB$, we have

$$\angle FCB + \angle CBF + \angle BFC = 180^\circ$$

$$50^\circ + \angle CBF + 90^\circ = 180^\circ$$

$$\angle CBF = 180^\circ - 50^\circ - 90^\circ = 40^\circ$$

Using the above steps for $\triangle ABD$, we can say that:

$$\angle ABD + \angle BDA + \angle BAD = 180^\circ$$

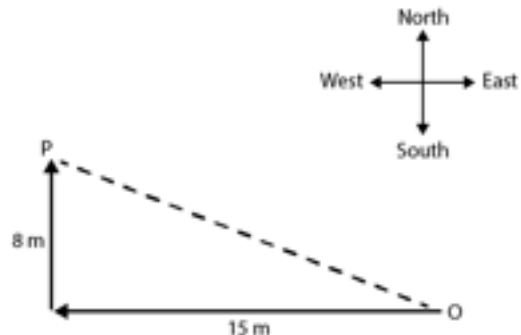
$$\angle BAD = 180^\circ - 90^\circ - 40^\circ = 50^\circ$$

10. A man goes 15 m due west and then 8 m due north. How far is he from the starting point?

Solution: Given a man goes 15 m due west and then 8 m due north. Let O be the starting point and P be the final point.

Then OP becomes the hypotenuse in the triangle.

So by using the Pythagoras theorem, we can find the distance OP.



$$OP^2 = 15^2 + 8^2$$

$$OP^2 = 225 + 64$$

$$OP^2 = 289$$

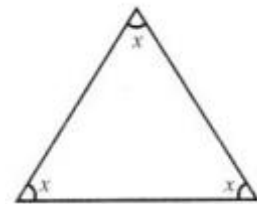
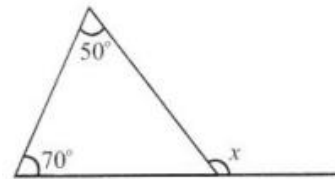
$$OP = 17$$

Hence, the required distance is 17 m.

III .Questions for Practice:

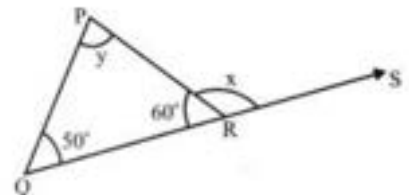
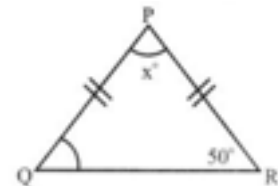
MCQs

- How many altitudes can a triangle have?
(a) 1 (b) 2 (c) 3 (d) 4
- A/an connects a vertex of a triangle to the midpoint of the opposite side.
(a) altitude (b) median (c) vertex (d) none of these
- Find the value of x in the adjoining figure.
(a) 50° (b) 70° (c) 120° (d) 180°
- In the Pythagoras property, the triangle must be
(a) acute angled (b) right angled
(c) obtuse angled (d) none of these
- Find the value of x in this figure.
(a) 40° (b) 60° (c) 35° (d) 180°
- ΔPQR is right angled at P. If $PQ = 3$ cm and $PR = 4$ cm, find QR.
(a) 7 cm (b) 5 cm (c) 2 cm (d) none of these.
- Which is the longest side in ΔPQR right angled at P?
(a) PQ (b) QR (c) PR (d) none of these.
- The hypotenuse of a right triangle is 17 cm long. If one of the remaining two sides is 8 cm in length, then the length of the other side is:
(a) 15 cm (b) 12 cm (c) 13 cm (d) none of these.
- How many acute angles can a right triangle have?
(a) 1 (b) 2 (c) 3 (d) 0
- The acute angles of right triangle are in the ratio 2 : 1. Find the measure of each of these angles.
(a) 55° and 35° (b) 60° and 30° (c) 50° and 40° (d) 45° and 45°
- One of the angles of a triangle is 100° and the other two angles are equal. Find the measure of each of these equal angles.
(a) 45° (b) 40° (c) 41° (d) 42°

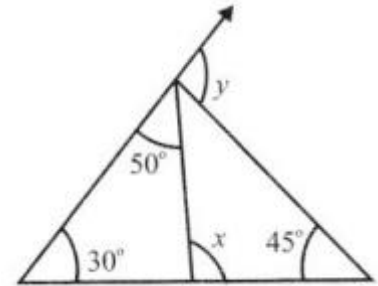
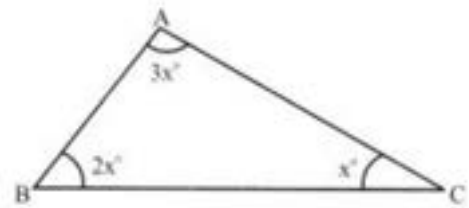


ii) Short answer type questions

- One of the exterior angles of a triangle is 120° , and the interior opposite angles are equal to each other. What is the measure of these two angles?
- Find the value of x in given figure.

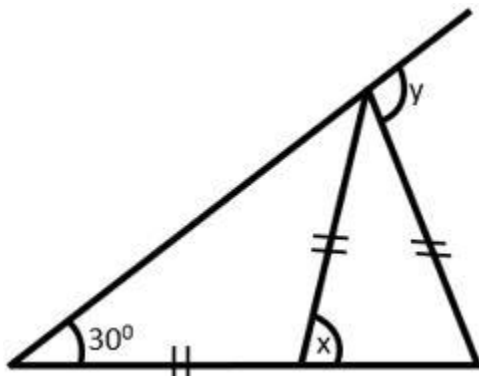


3. Determine whether the triangle whose lengths of sides are 3 cm, 4 cm, 5 cm is a right-angled triangle.
4. If the measures of the angles of a triangle are $(2p)^\circ$, $(3p - 15)^\circ$ and $(4p - 12)^\circ$. Find the value of p .
5. Find the value of x and y in the figure.
6. In the isosceles triangle, the vertical angle is 30° more than each of its base angles. Find all the angles of the triangle.
7. Find the value of x in the figure
8. If one angle of a triangle is 60° and the other two angles are in the ratio 1 : 2, then find the angles.
9. Mohini walks 1200m due East and then 500m due North. How far is she from her starting point?
10. Find the value of ' x ' and ' y ' in the given figure.
11. In a $\triangle ABC$, AD is the altitude from A such that $AD = 12$ cm. $BD = 9$ cm and $DC = 16$ cm. Examine if $\triangle ABC$ is right angled at A .
12. A student when asked to measure two exterior angles of $\triangle ABC$ observed that the exterior angles at A and B are of 103° and 74° respectively. Is this triangle possible? Why or why not?

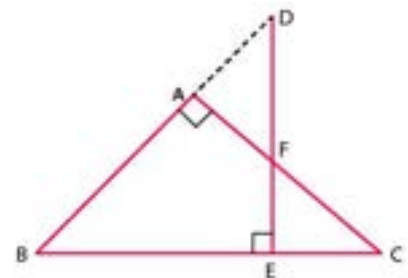


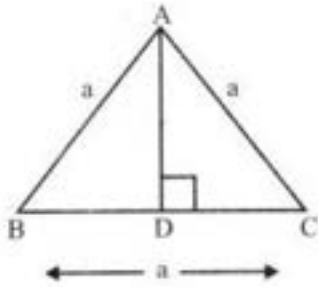
iii) Long answer type questions

1. Find the value of ' x ' and ' y ' in the below given figure.

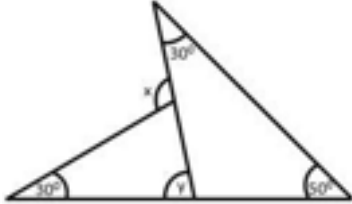


2. Two poles of heights 6 m and 11 m stand on a plane ground. If the distance between their feet is 12 m. Find the distance between their tops.
3. In the figure ABC is a right triangle right angled at A . D lies on BA produced and DE perpendicular to BC intersecting AC at F . If $\angle AFE = 130^\circ$, find
 - (i) $\angle BDE$ (ii) $\angle BCA$ (iii) $\angle ABC$
4. ABC is an equilateral triangle with side a . AD is an altitude. Find the value of AD^2 .

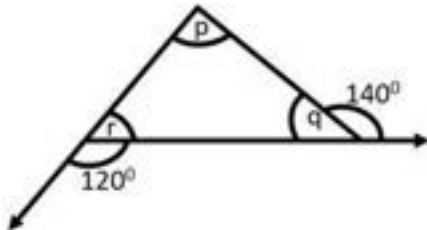




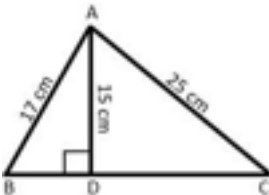
5. Find the value of 'x' and 'y' in the below given figure.



6. Find the value of 'p', 'q', and 'r' in the below given figure.



7. In the below given figure, $\angle ADB = 90^\circ$, $AB = 17$ cm, $AC = 25$ cm and $AD = 15$ cm. Find the value of BD .



8. A ladder 50 dm long when set against the wall of a house just reaches a window at a height of 48 dm. How far is the lower end of the ladder from the base of the wall?

iv) Case study:

Case study 1: BRIDGE

During an educational excursion, the Mathematics teacher observed triangles in a bridge over a river and showed them to the students. To emphasise the relatedness of math in daily life he just drew its simplified figure (side view) as shown here with following description:

$AD=AE=BE=BF=CF=CG=10$ m.

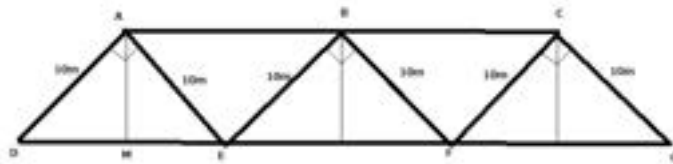


and $\angle A = \angle B = \angle C = 90^\circ$.

- (i) Count the no. of isosceles triangles in figure. A student Raman said that $\triangle ADE$, $\triangle BEF$ & $\triangle CFG$ are congruent.

Is his statement true?

- (ii) Value of $\angle D$ is
 (iii) Find the length of DE^2 .
 (iv) State following statements are true or false-



S.No.	Statement	True/False
1	Arun said : AM is altitude of $\triangle ADE$	
2	Deksha said : $DF = AC$	
3	Rakesh said : $AC = 20$ cm.	

Case study 2: GOLF HITS

A golfer David hits three balls from same point P one by one in different directions as shown in figure:

First hit towards south with range $PA = 90$ m.

Second hit towards east with range $PB = 120$ m.

Third hit towards 60° north of east with range $PC = 120$ m.

- (i) Type of $\triangle PBC$ is _____.
 (isosceles/equilateral)

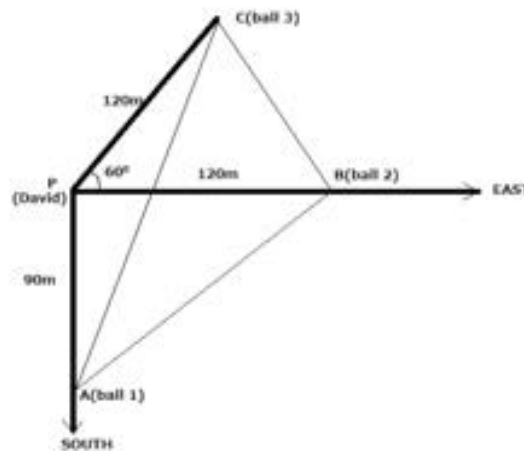
- (ii) Name the right angle in figure (if any).

- (iii) How far is ball 1 from ball 2 ?

- (iv) How far is ball 2 from ball 3 ?

- (v) Use the appropriate sign in statement
 AC ____ $AB + BC$.

(a) > (b) < (c) = (d) +



ANSWERS:

MCQs

1. (c) 3 2. (b) median 3. (c) 120° 4. (b) right angled 5. (b) 60°
 6. (b) 5 cm 7. (a) 15 cm 8. (b) 2 9. (b) 60° and 30° 10. (b) 40°

ii) Short answer type questions

1. 30° 2. 80° 3. Yes the triangle whose lengths of sides are 3 cm, 4 cm, 5 cm is a right-angled triangle.

4. $p = 23$ 5. $x = 120^\circ$, $y = 70^\circ$ 6. 50° , 50° and 80° 7. 30° , 60° and 90°

8. 40° and 80° 9. 1300 m 10. $x = 80^\circ$, $y = 75^\circ$

11. Yes $\triangle ABC$ is right angled at A.

12. No this triangle is not possible because then the two interior angles will be 77° and 106° and the sum of interior angles in a triangle is equal to 180°

iii) Long answer type questions

1. $x = 60^\circ$, $y = 90^\circ$

2. the distance between their tops is 13 m.

3. (i) $\angle BDE = 40^\circ$ (ii) $\angle BCA = 40^\circ$ (iii) $\angle ABC = 50^\circ$

4. $AD^2 = 3a^2/4$

5. $x = 110^\circ$, $y = 80^\circ$

6. $q = 40^\circ$, $r = 60^\circ$, $p = 80^\circ$

7. $BD = 8$ cm

8. Distance of the ladder from the base of the wall is 14 dm

iv) Case study:

Case study 1

(i) no. of isosceles triangles in figure is 5. Yes $\triangle ADE$, $\triangle BEF$ & $\triangle CFG$ are congruent

(ii) Value of $\angle D$ is 45°

(iii) length of $DE = 200$ m

(iv)

S.No.	Statement	True/False
1	Arun said : AM is altitude of $\triangle ADE$	True
2	Deksha said : $DF = AC$	True
3	Rakesh said : $AC = 20$ cm.	False

Case study 2

GOLF HITS

(i) $\triangle PBC$ is isosceles triangle (ii) Angle APB is the right angle

(ii) Distance of ball 1 from ball 2 = 150 m

(iii) How far Distance of ball 2 from ball 3 = 120 m (iv) $AC < AB + BC$.

Chapter Test

Time Allowed 1 hour.

Maximum Marks: 20

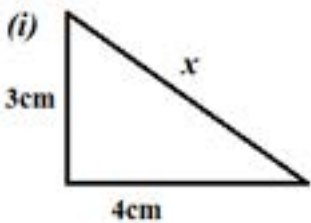
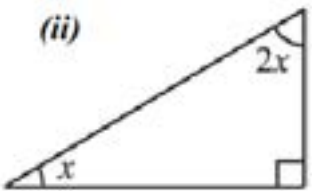
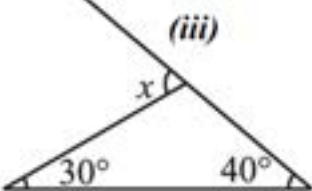
General Instructions:

1. This Question Paper has 4 Sections A - D.
2. Section A has 4 MCQs carrying 1 mark each
3. Section B has 4 questions carrying 02 marks each.
5. Section C has 1 question carrying 04 marks.
6. Section D has 1 case based integrated units of assessment (04 marks each) with sub-parts of the values of 1, 1 and 2 marks each respectively.
7. All Questions are compulsory.
8. Draw neat figures wherever required.



	SECTION A	
Q	Section A consists of 4 questions of 1 mark each.	M
1	How many altitudes can a triangle have? (a) 1 (b) 2 (c) 3 (d) 4	1
2	In right $\triangle ABC$, right angled at B, BA = 8 cm and BC = 15 cm. Find the length of the hypotenuse AC (a) 7 cm (b) 17 cm (c) 23 cm (d) 20 cm	1
3	In each of the following, there are three positive numbers. Which of these pairs could possibly be the lengths of the sides of a triangle: (a) 5, 7, 9 (b) 2, 10, 15 (c) 2, 5, 7 (d) 5, 8, 20	1
4	In each of the following, the measures of three angles are given. State in which case the angles can possibly be those of a triangle: (a) $63^\circ, 37^\circ, 80^\circ$ (b) $45^\circ, 61^\circ, 73^\circ$ (c) $59^\circ, 72^\circ, 61^\circ$ (d) $30^\circ, 20^\circ, 125^\circ$	1

	SECTION B	
5	In $\triangle ABC$, $\angle A = 100^\circ$, AD bisects $\angle A$ and $AD \perp BC$. Find $\angle B$	2
6	$\angle CBX$ is an exterior angle of $\triangle ABC$ at B. Name (i) The interior adjacent angle (ii) The interior opposite angles to exterior $\angle CBX$ Also, name the interior opposite angles to an exterior angle at A.	2
7	One of the exterior angles of a triangle is 80° , and the interior opposite angles are equal to each other. What is the measure of each of these two angles?	2
8	The angles of a triangle are arranged in ascending order of magnitude. If the difference between two consecutive angles is 10° . Find the three angles.	2

	SECTION C	
9	(a) Find the unknown length x in the following figure 1. (b) Find the values of the unknown angles x in figure 2 and figure 3:	4
	 <i>fig 1</i>  <i>fig 2</i>  <i>fig 3</i>	

	SECTION D	
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10

CASE STUDY : Golden Triangle

A golden triangle is an isosceles triangle in which the ratio of the longer side to the smaller side is 1.618(approximately)

ΔABC is a golden triangle. $AB = 4\text{cm}$. CD is a median of the triangle.

Q 1. Find the length of AD and AC approximately

Q2 What are the values of the three angles of a golden triangle?

Q3 Is ΔADC a right triangle? Give reason.

OR

AE is bisector of angle BAC . Is ΔABE a golden triangle? Give reason



CHAPTER TEST

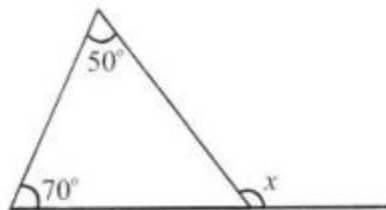
Time Allowed 1 ½ Hrs.

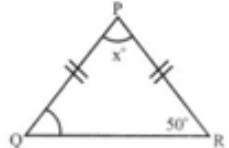
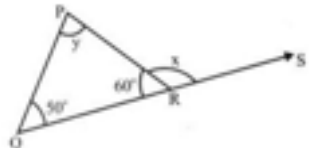
Maximum Marks: 30

General Instructions:

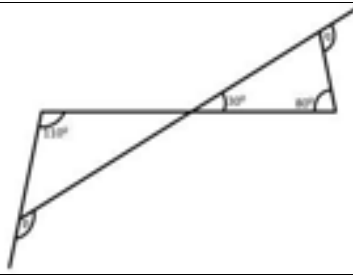
1. This Question Paper has 5 Sections A-E.
2. Section A has 5 MCQs carrying 1 mark each
3. Section B has 4 questions carrying 02 marks each.
4. Section C has 3 questions carrying 03 marks each.
5. Section D has 1 questions carrying 04 mark.
6. Section E has 1 case based integrated unit of assessment (04 marks) with sub-parts of the values of 1, 1 and 2 marks each respectively.
7. All Questions are compulsory.
8. Draw neat figures wherever required.

SECTION A		
Q No	Section A consists of 5 questions of 1 mark each.	M ks
1	Measures of each of the angles of an equilateral triangle is (a) 90° (b) 30° (c) 60° (d) 45°	1
2	The acute angles of right triangle are in the ratio 2: 1. Which of the following is the measure of each of these angles. (a) 55° and 35° (b) 60° and 30° (c) 50° and 40° (d) 45° and 45°	1
3	Find the value of x in the adjoining figure. (a) 50° (b) 70° (c) 120° (d) 180°	1
4	Which is the longest side in the triangle PQR right angled at P? (a) PQ (b) QR (c) PR (d) none of these.	1
5	PQR is a triangle right angled at P. If PQ = 3 cm and PR = 4 cm, find QR. (a) 7 cm (b) 5 cm (c) 1 cm (d) 25 cm	1

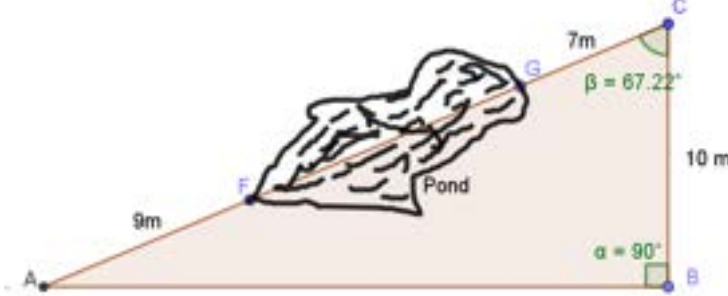


SECTION B		
	Section B consists of 4 questions of 2 marks each.	
6	Find the value of x in given figure. 	2
7	Find the value of x and y: 	2
8	The lengths of two sides of a triangle are 6 cm and 8 cm. Between which two numbers can length of the third side fall?	2
9	Determine whether the triangle whose lengths of sides are 6 cm, 8 cm, 10 cm is a right-angled triangle.	2



	SECTION C	
	Section C consists of 3 questions of 3 marks each.	
10	Find the value of 'p' and 'q' in the adjoining figure. 	3
11	In the isosceles triangle, the vertical angle is 30° more than each of its base angles. Find all the angles.	3
12	In a $\triangle ABC$, AD is the altitude from A such that $AD = 12$ cm, $BD = 9$ cm and $DC = 16$ cm. Examine if $\triangle ABC$ is right angled at A.	3

	SECTION D	
	Section D consists of 1 question of 4 mark.	
13	The foot of a ladder is 6 m away from a wall and its top reaches a window 8 m above the ground. If the ladder is shifted in such a way that its foot is 8 m away from the wall, to what height does its top reach?	4

	SECTION E	
14	CASE STUDY Length of a pond Mr. Pillai has a triangular field as shown in the picture. $AB + BC = 34$ m. On side AC there is a pond. Q1. What is the measure of angle A? Q2. What is the length of the side AC? Q3. How can he find the length of the pond without going into the water? What is the length of the pond? 	





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