SAMPLE CONTENT

IQB IMPORTANT QUESTION BANK

Based on Latest Paper Pattern of Maharashtra State Board

Mathematics Part - II

"IQB KE SAATH SSC EKDUM TENSION FREE"

STD. X
(Eng. Med.)

Target Publications® Pvt. Ltd.

Based on the **Latest Syllabus** prescribed by the Maharashtra State Board of Secondary and Higher Secondary Education, Pune - 04

IQB Important Question Bank

STD. X

Mathematics Part - II

Salient Features

- A compilation of Most Important Questions
- A great resource for expeditious and exhaustive board exam preparation
- Written as per Latest Board Paper Pattern
- Includes selective questions from 2019 - 2022 Board Papers
- Important inclusion: 'Smart Check' and 'Time Management' to solve the Question Paper
- Includes Model Question Paper for self evaluation
- Inclusion of **QR Code** for students to access 'Solution' for the Model Question Paper.

Scan the adjacent QR Code to access Board Question Papers and Solutions of March 2020, December 2020 and March 2022.

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PREFACE

IQB Mathematics Part – II : Std. X is a treasure house of the most important questions that would help students to face the Board Examination confidently. This book is created in accordance with the Latest Board paper Pattern.

IQB (Important Question Bank) consists of chapters in which questions are arranged as per the board paper pattern so that students can easily prepare for the examination.

Smart Check is a technique to verify the answers. This is our attempt to cross-check the accuracy of the answer. **Time Management** is provided with Paper Pattern (on the adjacent page) to aid students to solve the activity sheet within the allotted time.

We have provided One **Model Question Paper** at the end of the book that enables students to assess their level of preparation for the Board examination.

We have provided **QR Code** for students to access the 'Solution' given for the Model Question Paper.

Selected questions from the Board Papers of March 2019, July 2019, March 2020, December 2020 and March 2022 with solutions have been included to give the student an idea about the kind of questions asked in the previous examinations.

Armed with an arsenal of carefully crafted questions and relevant answers, we are confident that this book will cater to the needs of students and effectively assist them to achieve their goal.

Publisher

Edition: Third

PAPER PATTERN

- There will be separate question papers for Part I and Part II of 40 marks each.
- Duration of each paper will be 2 hours.

Question No.	Type of Questions	Total Marks	Marks with option	Time Management
1.	(A) Solve 4 out of 4 MCQ (1 mark each)	04	04	08 mins
	(B) Solve 4 out of 4 subquestions (1 mark each)	04	04	08 mins
2.	(A) Solve 2 activity based subquestions out of 3 (2 marks each)	04	06	10 mins
	(B) Solve any 4 out of 5 subquestions (2 marks each)	08	10	20 mins
3.	(A) Solve 1 activity based subquestion out of 2 (3 marks each)	03	06	08 mins
	(B) Solve any 2 out of 4 subquestions (3 marks each)	06	12	16 mins
4.	Solve any 2 out of 3 subquestions (4 marks each) [Out of textbook]	08	12	30 mins
5.	Solve any 1 out of 2 subquestions (3 marks each)	03	06	10 mins
	To Review and Re-checking	-	-	**10 mins**
	Total Marks	**40**	**60**	**120 mins**

Distribution of Marks	
Easy Questions	40%
Medium Questions	40%
Difficult Questions	20%

Objectives	Maths – II
Knowledge	20%
Understanding	30%
Application	30%
Skill	20%

[Maharashtra State Board of Secondary and Higher Secondary Education, Pune – 04]

TOPIC-WISE WEIGHTAGE OF MARKS

Sr. No.	Topic Name	Marks with option
1	Similarity	10
2	Pythagoras Theorem	07
3	Circle	12
4	Geometric Constructions	07
5	Co-ordinate Geometry	07
6	Trigonometry	07
7	Mensuration	10
	Total	**60**

Note: In the topic-wise weightage of marks given in the above table, flexibility of maximum 2 marks is permissible.

INDEX

Note:

- ***Smart check is indicated by ✓ symbol.***
- ***Steps of construction are provided in Chapter 4 : Geometric constructions for the students' understanding.***

Detailed Analysis of Question Paper

Mathematics Part - II

Time: 2 Hours **Total Marks: 40**

Note:

i. All questions are compulsory.
ii. Use of calculator is not allowed.
iii. The numbers to the right of the questions indicate full marks.
iv. In case of MCQs [Q. No. 1(A)] only the first attempt will be evaluated and will be given credit.
v. For every MCQ, the correct alternative (A), (B), (C) or (D) with sub-question number is to be written as an answer.
vi. Draw proper figures for answers wherever necessary.
vii. The marks of construction should be clear. Do not erase them.
viii. Diagram is essential for writing the proof of the theorem.

Q.1. (A) Four alternative answers are given for every sub-question. Choose the *correct* alternative and write its alphabet with sub-question number. [4]

- This question carries 4 marks. It contains 4 sub-questions of 1 mark each. All sub-questions are compulsory.
- These are Multiple Choice Questions which either require short solutions or direct application of mathematical concepts.
- For this question, students should write the correct option along with its contents.
  Example: 1. (B) 16 cm

Q.1. (B) Solve the following sub-questions: [4]

- This question carries 4 marks. It contains 4 sub-questions of 1 mark each.
  All sub-questions are compulsory.

Q.2. (A) Complete the following activities and rewrite it (Any *two*): [4]

- This question carries 4 marks. It contains 3 sub-questions of which any 2 are to be attempted. Each sub-question carries 2 marks.
- These questions are activity based and generally include proofs and solutions to be completed by filling the blanks.

Q.2. (B) Solve the following sub-questions (Any *four*): [8]

- This question carries 8 marks. It contains 5 sub-questions of which any 4 are to be attempted. Each sub-question carries 2 marks.
- These questions are from textbook and have short solutions with application of one or two mathematical concepts.

Q.3. (A) Complete the following activities and rewrite it (Any *one*): [3]

- This question carries 3 marks. It contains 2 sub-questions of which any 1 is to be attempted. Each sub-question carries 3 marks.
- These questions are activity based and generally include proofs and solutions to be completed by filling the blanks.

Q.3. (B) Solve the following sub-questions (Any *two*): [6]

- This question carries 6 marks. It contains 4 sub-questions of which any 2 are to be attempted. Each sub-question carries 3 marks.
- These questions are from textbook with long solutions and may require application of two or more mathematical concepts.

Q.4. Solve the following sub-questions (Any *two*): [8]

- This question carries 4 marks. It contains 3 sub-questions of which any 2 are to be attempted. Each sub-question carries 4 marks.
- These are challenging questions based on the prescribed syllabus, but are out of the textbook. They require application of more than one mathematical competencies.

Q.5. Solve the following sub-questions (Any *one*): [3]

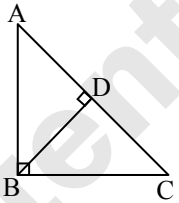
- This question carries 3 marks. It contains 2 sub-questions of which any 1 is to be attempted. Each sub-question carries 3 marks.
- These are open ended questions for which students have to think independently and will require an application oriented vision for mathematics. They are based on the textbook.
  For example:
  - Expecting the student to express his own views
  - To draw a figure from given information
  - To complete an incomplete construction
  - To complete the given flow chart
  - To construct a problem from given information or situation
  - Open ended questions
  - Estimation and Approximation
  - Comprehension of a mathematical passage

2 Pythagoras Theorem

Important Theorems

1. Similarity of right angled triangles:

Theorem: In a right angled triangle, if an altitude is drawn to the hypotenuse, then the two triangles formed will be similar to the original triangle and to each other.



Given: In ΔABC, ∠ABC = 90°,
seg BD ⊥ hypotenuse AC, A–D–C.

To prove: ΔABC ~ ΔADB
ΔABC ~ ΔBDC
ΔADB ~ ΔBDC

Proof: In ΔABC and ΔADB,

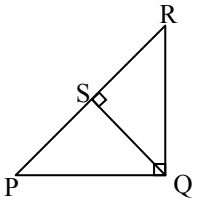
∠ABC ≅ ∠ADB ...[Each angle is of measure 90°]
∠BAC ≅ ∠DAB ...[Common angle]
∴ $\Delta ABC \sim \Delta ADB$ …(i)[AA test of similarity]

In ΔABC and ΔBDC,
∠ABC ≅ ∠BDC ...[Each angle is of measure 90°]
∠ACB ≅ ∠BCD ...[Common angle]
∴ $\Delta ABC \sim \Delta BDC$ ...(ii) [AA test of similarity]
∴ ΔADB ~ ΔBDC ...[From (i) and (ii)]

2. Theorem of geometric mean:

Theorem: In a right angled triangle, the perpendicular segment to the hypotenuse from the opposite vertex is the geometric mean of the segments into which the hypotenuse is divided.

In the adjoining figure, in ΔPQR, ∠θ = 90° and seg QS ⊥ hypotenuse PR, then $QS^2 = PS \times SR$



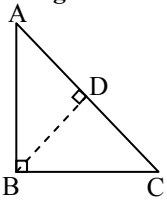
3. Pythagoras Theorem:

Theorem: In a right angled triangle, the square of the hypotenuse is equal to the sum of the squares of the remaining two sides.

Given: In ΔABC, ∠ABC = 90°.

To prove: $AC^2 = AB^2 + BC^2$

Construction: Draw seg BD ⊥ hypotenuse AC, A–D–C.



Proof: In ΔABC, $\angle ABC = 90°$ …[Given]

seg BD $\perp$ hypotenuse AC …[Construction]

$\therefore$ $\Delta ABC \sim \Delta ADB$ …[Similarity of right angled triangles]

$\therefore$ $\frac{AB}{AD} = \frac{AC}{AB}$ …[Corresponding sides of similar triangles]

$\therefore$ $AB^2 = AD \times AC$ …(i)

Also, $\Delta ABC \sim \Delta BDC$ …[Similarity of right angled triangles]

$\therefore$ $\frac{BC}{DC} = \frac{AC}{BC}$ …[Corresponding sides of similar triangles]

$\therefore$ $BC^2 = DC \times AC$ ...(ii)

$AB^2 + BC^2 = AD \times AC + DC \times AC$ …[Adding (i) and (ii)]

$= AC\,(AD + DC)$

$= AC \times AC$ …[A–D–C]

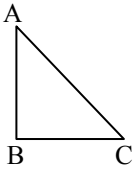
$\therefore$ $AB^2 + BC^2 = AC^2$

i.e. $AC^2 = AB^2 + BC^2$

4. Converse of Pythagoras Theorem:

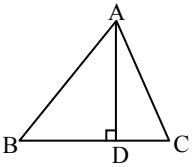
Theorem: In a triangle, if the square of one side is equal to the sum of the squares of the remaining two sides, then the triangle is a right angled triangle.

In the adjoining figure, if in ΔABC, $AC^2 = AB^2 + BC^2$, then $\angle ABC = 90°$

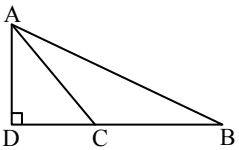


5. Application of Pythagoras Theorem :

i. In ΔABC, if $\angle C$ is an acute angle, and seg AD $\perp$ seg BC, then $AB^2 = BC^2 + AC^2 - 2\,BC \times DC$.

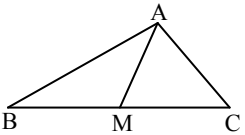


ii. In ΔABC, if $\angle ACB$ is an obtuse angle, and seg AD $\perp$ seg BC, then $AB^2 = BC^2 + AC^2 + 2\,BC \times CD$.



6. Apollonius Theorem:

In ΔABC, if M is the midpoint of side BC, then $AB^2 + AC^2 = 2\,AM^2 + 2\,BM^2$.



Q.1. (A) 1 Mark Questions

1. Out of the following which is the Pythagorean triplet? **[Mar 2020]**
   (A) (1, 5, 10) (B) (3, 4, 5)
   (C) (2, 2, 2) (D) (5, 5, 2)

2. Out of the dates given below which date constitutes a Pythagorean triplet?
   (A) 15/08/17 (B) 16/08/16
   (C) 3/5/17 (D) 4/9/15

3. Find perimeter of a square if its diagonal is $10\sqrt{2}$ cm.
   (A) 10 cm (B) $40\sqrt{2}$ cm
   (C) 20 cm (D) 40 cm

4. Height and base of a right angled triangle are 24 cm and 18 cm find the length of its hypotenuse.
   (A) 24 cm (B) 30 cm
   (C) 15 cm (D) 18 cm

5. In right-angled triangle PQR, if hypotenuse PR = 12 and PQ = 6, then what is the measure of ∠P? **[July 2019]**
   (A) 30° (B) 60° (C) 90° (D) 45°

6. Altitude on the hypotenuse of a right angled triangle divides it in two parts of lengths 4 cm and 9 cm. Find the length of the altitude.
   (A) 9 cm (B) 4 cm
   (C) 6 cm (D) $2\sqrt{6}$ cm

Answers

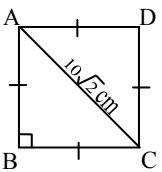
1. (B) 2. (A) 3. (D) 4. (B) 5. (B) 6. (C)

Hints:

1. Consider Option B.
   Here, $5^2 = 25$
   $3^2 + 4^2 = 9 + 16 = 25$
   $\therefore$ $5^2 = 3^2 + 4^2$
   $\therefore$ (3, 4, 5) is the Pythagorean triplet.

2. Consider Option A.
   Here, $15^2 + 8^2 = 225 + 64 = 289$, and $17^2 = 289$
   $\therefore$ $15^2 + 8^2 = 17^2$

3. In ΔABC, $\angle B = 90°$, and $\angle BAC = \angle BCA = 45°$
   $\therefore$ $AB = \frac{1}{\sqrt{2}}$ AC …[Theorem of 45° – 45° – 90° triangle]
   $= \frac{1}{\sqrt{2}} \times 10\sqrt{2}$



$\therefore$ AB = 10 cm

$\therefore$ Perimeter of square = 4 (AB)

$= 4 \times 10 = 40$ cm

4. In ΔPQR, $\angle Q = 90°$

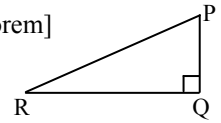
$\therefore$ $PR^2 = PQ^2 + QR^2$ …[Pythagoras theorem]

$= 24^2 + 18^2$

$= 576 + 324$

$= 900$

$\therefore$ $PR = \sqrt{900} = 30$ cm

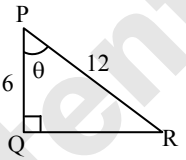


5. $\cos\theta = \frac{PQ}{PR}$

$\therefore$ $\cos\theta = \frac{6}{12}$

$\therefore$ $\cos\theta = \frac{1}{2}$

$\therefore$ $\theta = 60°$ $\ldots\left[\because \cos 60° = \frac{1}{2}\right]$



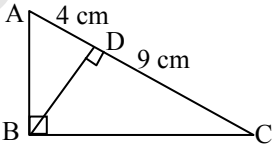
6. In ΔABC,

$BD^2 = AD \times DC$

…[Theorem of geometric mean]

$\therefore$ $BD^2 = 4 \times 9$

$\therefore$ $BD = \sqrt{36} = 6$ cm



Practice Set

1. If a, b, c are sides of a triangle and $a^2 + b^2 = c^2$, name the type of the triangle.

(A) Obtuse angled triangle (B) Acute angled triangle

(C) Right angled triangle (D) Equilateral triangle

2. If in ΔABC, AB = 15 cm, BC = 17 cm and AC = 8 cm, then which of the following will be a right angle?

(A) $\angle A$ (B) $\angle B$

(C) $\angle C$ (D) none of these

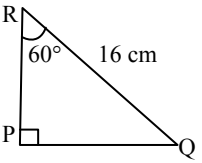
3. From the figure given below, the lengths of PQ and PR are _____ and _____ respectively.

(A) 8 cm, $8\sqrt{2}$ cm

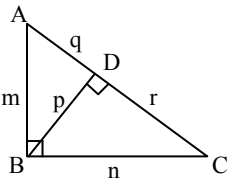
(B) $8\sqrt{2}$ cm, 8 cm

(C) 8 cm, $8\sqrt{3}$ cm

(D) $8\sqrt{3}$ cm, 8 cm



4. For the given figure, which of the following relations is correct?



(A) $p^2 = qr$
(B) $m^2 + n^2 = q^2 + r^2$
(C) $p^2 = q^2 + r^2$
(D) $p^2 = mn$

5. If the lengths of the diagonals of a rhombus are 12 cm and 16 cm, then what is the length of its side?

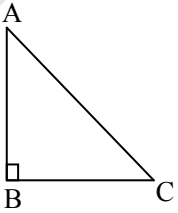
(A) 10 cm (B) 20 cm
(C) $10\sqrt{2}$ cm (D) $20\sqrt{2}$ cm

Answers

1. (C) 2. (A) 3. (D) 4. (A) 5. (A)

Q.1. (B) 1 Mark Questions

1. In Δ ABC, ∠ABC = 90°, ∠BAC = ∠BCA = 45°. If AC = $9\sqrt{2}$, then find the value of AB. [Mar 2022]



Sol: In ΔABC,
∠ABC = 90°, ∠BAC = ∠BCA = 45° …[Given]

∴ AB = $\frac{1}{\sqrt{2}}$ AC …[Theorem of 45° – 45° – 90° triangle]

∴ AB = $\frac{1}{\sqrt{2}} \times 9\sqrt{2}$

∴ **AB = 9 units**

2. Find the diagonal of a square whose side is 10 cm. [Mar 2020]

Sol: Diagonal of a square = $\sqrt{2} \times$ side
$= \sqrt{2} \times 10$
$= 10\sqrt{2}$ cm

3. Sides of the triangle are 5 cm, 4 cm and 3 cm. Determine whether the triangle is right angled or not.

Sol: $(5)^2 = 25$ ...(i)
$(4)^2 + (3)^2 = 16 + 9 = 25$ ...(ii)
Since $(5)^2 = (4)^2 + (3)^2$ ...[From (i) and (ii)]

∴ By converse of Pythagoras theorem, **the given sides form a right angled triangle.**

4. In a right angled triangle, if sum of the squares of the sides making right angle is 225, then what is the length of the hypotenuse?

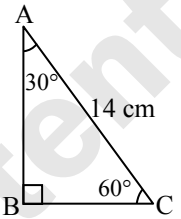
Sol: Since, square of the hypotenuse is equal to the sum of the squares of the remaining two sides.

$\therefore$ (Length of hypotenuse)^2 = 225

$\therefore$ Length of hypotenuse = $\sqrt{225}$ = **15**

Practice Set

1. In the given figure, in ΔABC, $\angle B = 90°$, $\angle C = 60°$, $\angle A = 30°$, AC = 14 cm, find BC.



2. Find the length of diagonal of the square whose side is 8 cm.

3. If the sides of a triangle are 6 cm, 8 cm and 10 cm respectively, determine whether the triangle is right angled triangle or not.

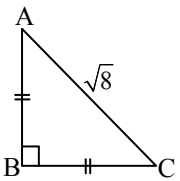
4. In a right angled triangle, if sum of the squares of the sides making right angle is 169, then what is the length of the hypotenuse?

Answers

1.	7 cm	2.	$8\sqrt{2}$ cm
3.	Right angled triangle.	4.	13

Q.2. (A) 2 Marks Questions

1. For finding AB and BC with the help of information given in the given figure, complete the following activity.



AB = BC …[Given]

$\therefore$ $\angle BAC = \angle BCA$ …[Isosceles triangle theorem]

$\therefore$ $\angle BAC =$ $\square$

$\therefore$ AB = BC = $\square$ × AC …[Side opposite to 45°]

= $\square$ × $\sqrt{8}$

$\therefore$ AB = BC = $\square$

Page no. 39 to 40 are purposely left blank.

Similarly, in ΔPNQ,

R is the midpoint of [ ].

∴ $PN^2 + PQ^2 = 2\,PR^2 +$ [ ] …[Apollonius theorem]

∴ $PN^2 + a^2 = 2a^2 +$ [ ]

∴ $PN^2 = 3a^2$

∴ $PN = \sqrt{3}\,a$ …(ii)[Taking square root of both sides]

∴ $PM = PN = \sqrt{3}a$ …[From (i) and (ii)]

Answers

1.	i.	Angle of an equilateral triangle	ii.	Side opposite to 60°
	iii.	8 cm	iv.	24 cm
2.	i.	Apollonius theorem	ii.	side QN
	iii.	$2RN^2$	iv.	$2a^2$

Q.2. (B) 2 Marks Questions

1. In ΔPQR, ∠P = 60°, ∠Q = 90° and QR = $6\sqrt{3}$ cm, then find the values of PR and PQ. [Dec 2020]

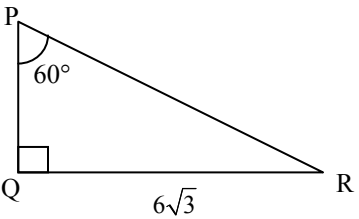
Sol: In ΔPQR, ∠P = 60°, ∠Q = 90° …[Given]

∴ ∠R = 30° …[Remaining angle of a triangle]

∴ ΔPQR is a 30° – 60° – 90° triangle.

∴ $QR = \frac{\sqrt{3}}{2}\,PR$ …[Side opposite to 60°]

∴ $6\sqrt{3} = \frac{\sqrt{3}}{2}\,PR$ …[Given]



∴ $PR = \frac{6\sqrt{3} \times 2}{\sqrt{3}}$

∴ PR = 12 cm …(i)

Also, $PQ = \frac{1}{2}\,PR$ …[Side opposite to 30°]

∴ $PQ = \frac{1}{2} \times 12$ …[From (i)]

∴ PQ = 6cm

∴ PR = 12 cm and PQ = 6 cm

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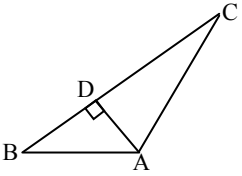
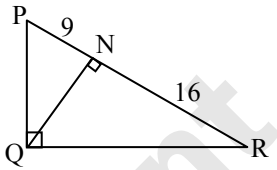
3. Find the perimeter of a square whose diagonal is $16\sqrt{2}$ cm long.

4. See the given figure.
In ΔABC, seg AD $\perp$ seg BC.
Prove that:
$AB^2 + CD^2 = BD^2 + AC^2$



5. In the given figure, $\angle PQR = 90°$,
seg QN $\perp$ seg PR, PN = 9, NR = 16.
Find QN.

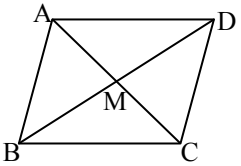


Answers

1.	AD = 8 units, BC = 13 units	2.	6 cm
3.	64 cm	5.	12 units

Q.3. (A) 3 Marks Questions

1. Sum of the squares of adjacent sides of a parallelogram is 130 cm and length of one of its diagonals is 14 cm. Find the length of the other diagonal by filling the boxes.



Let □ABCD be the given parallelogram and its diagonals AC and BD intersect at point M.

$\therefore$ $AB^2 + AD^2 =$ [ ], BD = 14 cm

MD = $\frac{1}{2}$ BD …(i) [ ]

$= \frac{1}{2} \times 14 = 7$ cm

In ΔABD, seg AM is the median. …[From (i)]

$AB^2 + AD^2 = 2AM^2 + 2MD^2$ …[Apollonius theorem]

$\therefore$ [ ] $= 2\ AM^2 + 2\ (7)^2$

$\therefore$ AM = [ ] cm

Now, AC = [ ] …[Diagonals of a parallelogram bisect each other]

= [ ]

Page no. 45 to 47 are purposely left blank.

In ΔABD, seg AO is the median. …[From (i)]

∴ $AB^2 + AD^2 = 2OA^2 + 2OB^2$ …[Apollonius theorem]

∴ $\square = 2OA^2 + 2(13)^2$

∴ OA = $\square$ cm

Now, OA = $\square$ …[Diagonals of a parallelogram bisect each other]

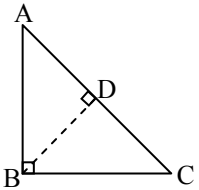
∴ AC = $\square$ cm

Answers

1. i. GD ii. 18 units iii. Pythagoras theorem
   iv. $4\sqrt{13}$ units v. $EG^2 + FG^2$ vi. $6\sqrt{13}$ units
2. i. 410
   ii. Diagonals of a parallelogram bisect each other
   iii. 410 iv. 6 v. $\frac{1}{2}$ AC vi. 12

Q.3. (B) 3 Marks Questions

1. Prove that in a right angled triangle, the square of the hypotenuse is equal to the sum of the squares of remaining two sides.



Given: In Δ ABC, ∠ ABC = 90°

To prove: $AC^2 = AB^2 + BC^2$

Construction: Draw seg BD ⊥ AC, A-D-C.

Proof: In ΔABC, ∠ABC = 90° …[Given]

seg BD ⊥ hypotenuse AC …[Construction]

∴ ΔABC ~ ΔADB …[Similarity of right angled triangles]

∴ $\frac{AB}{AD} = \frac{AC}{AB}$ …[Corresponding sides of similar triangles]

∴ $AB^2 = AD \times AC$ …(i)

Also, ΔABC ~ ΔBDC …[Similarity of right angled triangles]

∴ $\frac{BC}{DC} = \frac{AC}{BC}$ …[Corresponding sides of similar triangles]

∴ $BC^2 = DC \times AC$ …(ii)

$AB^2 + BC^2 = AD \times AC + DC \times AC$ …[Adding (i) and (ii)]

$= AC (AD + DC)$

$= AC \times AC$ …[A–D–C]

∴ $AB^2 + BC^2 = AC^2$

i.e. $AC^2 = AB^2 + BC^2$

2. In ΔPQR, point S is the mid-point of side QR. If PQ = 11, PR = 17, PS = 13, find QR. [Mar 2020]

Sol: In ΔPQR, point S is the midpoint of side QR. …[Given]

∴ seg PS is the median.

∴ $PQ^2 + PR^2 = 2\,PS^2 + 2\,SR^2$ …[Apollonius theorem]

∴ $11^2 + 17^2 = 2\,(13)^2 + 2\,SR^2$

∴ $121 + 289 = 2\,(169) + 2\,SR^2$

∴ $410 = 338 + 2\,SR^2$

∴ $2\,SR^2 = 410 - 338$

∴ $2\,SR^2 = 72$

∴ $SR^2 = \frac{72}{2} = 36$

∴ $SR = \sqrt{36}$ …[Taking square root of both sides]

$= 6$ units

Now, $QR = 2\,SR$ …[S is the midpoint of QR]

$= 2 \times 6$

∴ **QR = 12 units**

3. Walls of two buildings on either side of a street are parallel to each other. A ladder 5.8 m long is placed on the street such that its top just reaches the window of a building at the height of 4 m. On turning the ladder over to the other side of the street, its top touches the window of the other building at a height 4.2 m. Find the width of the street.

Sol: Here, AC and CE represent the ladder of length 5.8 m, and A and E represent windows of the buildings on the opposite sides of the street. BD is the width of the street.

AB = 4 m and ED = 4.2 m

In ΔABC, ∠B = 90°

∴ $AC^2 = AB^2 + BC^2$ …[Pythagoras theorem]

∴ $5.8^2 = 4^2 + BC^2$

∴ $BC^2 = 33.64 - 16 = 17.64$

∴ BC = 4.2 m …[Taking square root of both sides]

In ΔCDE, ∠CDE = 90°

∴ $CE^2 = CD^2 + DE^2$ …[Pythagoras theorem]

∴ $5.8^2 = CD^2 + 4.2^2$

∴ $CD^2 = 33.64 - 17.64 = 16$

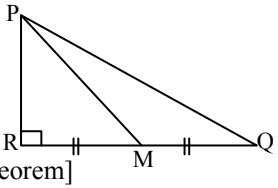
∴ CD = 4 m …[Taking square root of both sides]

Now, BD = BC + CD …[B–C–D]

$= 4.2 + 4 = 8.2$ m

∴ **The width of the street is 8.2 metres.**

4. In the adjoining figure, M is the midpoint of QR. ∠PRQ = 90°.
Prove that, $PQ^2 = 4\,PM^2 - 3\,PR^2$.



***Proof*:** In ΔPQR,

$\angle PRQ = 90°$ …[Given]

$\therefore\ PQ^2 = PR^2 + RQ^2$ …[Pythagoras theorem]

$= PR^2 + (RM + MQ)^2$ …[R–M–Q]

$= PR^2 + (RM + RM)^2$ …[M is the midpoint of QR]

$= PR^2 + (2\,RM)^2$

$\therefore\ PQ^2 = PR^2 + 4\,RM^2$ …(i)

Now, in ΔPRM, $\angle PRM = 90°$

$\therefore\ PM^2 = PR^2 + RM^2$ …[Pythagoras theorem]

$\therefore\ RM^2 = PM^2 - PR^2$ …(ii)

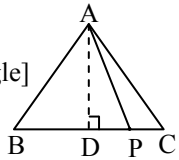
$\therefore\ PQ^2 = PR^2 + 4\,(PM^2 - PR^2)$ …[From (i) and (ii)]

$\therefore\ PQ^2 = PR^2 + 4\,PM^2 - 4\,PR^2$

$\therefore\ \mathbf{PQ^2 = 4\,PM^2 - 3\,PR^2}$

5. ΔABC is an equilateral triangle. Point P is on base BC such that $PC = \frac{1}{3}$ BC, if AB = 6 cm find AP.

Construction: Draw seg AD ⊥ seg BC, B–D–C.



Sol: ΔABC is an equilateral triangle. …[Given]

$\therefore$ AB = BC = AC = 6 cm …[Sides of an equilateral triangle]

$PC = \frac{1}{3}\,BC = \frac{1}{3} \times 6 = 2$ cm

In ΔADC, $\angle C = 60°$, … [Angle of an equilateral triangle]

$\angle ADC = 90°$ … [Construction]

$\therefore\ \angle DAC = 30°$ … [Remaining angle of a triangle]

$\therefore\ DC = \frac{1}{2}\,AC$ …[Theorem of 30° – 60° – 90° triangle]

$= \frac{1}{2} \times 6 = 3$ cm

But, DC = DP + PC …[D–P–C]

$\therefore\ 3 = DP + 2$

$\therefore\ DP = 3 - 2 = 1$ cm

Now, in ΔAPC, ∠APC is an obtuse angle,

and seg AD ⊥ seg BC …[Construction]

$\therefore\ AC^2 = PC^2 + AP^2 + 2\,PC \times DP$ …[Application of Pythagoras theorem]

$\therefore\ 6^2 = 2^2 + AP^2 + 2\,(2)\,(1)$

$\therefore\ 36 = AP^2 + 4 + 4$

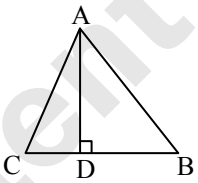
$\therefore\ AP^2 = 36 - 8 = 28$

$\therefore\ AP = \sqrt{28}$ …[Taking square root of both sides]

$\therefore\ \mathbf{AP = 2\sqrt{7}\ cm}$

Practice Set

1. Seg PM is a median of ΔPQR. If PQ = 40, PR = 42 and PM = 29, find QR.
2. Pranali and Prasad started walking to the East and to the North respectively, from the same point and at the same speed. After 2 hours distance between them was $15\sqrt{2}$ km. Find their speed per hour.
3. ΔDEF is an equilateral triangle. seg DP ⊥ side EF, and E–P–F. Prove that: $DP^2 = 3\,EP^2$.
4. In ΔABC, seg AD ⊥ seg BC and DB = 3 CD.
   Prove that: $2\,AB^2 = 2\,AC^2 + BC^2$.

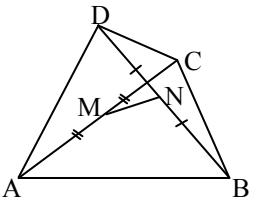


Answers

1. 58 units 2. 7.5 km/hour

Q.4. 4 Marks Questions

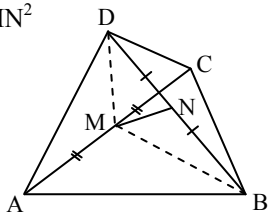
1. □ABCD is a quadrilateral. M is the midpoint of diagonal AC and N is the midpoint of diagonal BD.
Prove that :
$AB^2 + BC^2 + CD^2 + DA^2 = AC^2 + BD^2 + 4MN^2$.



Given: □ABCD is a quadrilateral.
M and N are the midpoints of diagonal AC and BD respectively.

To prove: $AB^2 + BC^2 + CD^2 + DA^2 = AC^2 + BD^2 + 4MN^2$

Construction: Join seg DM and seg BM



Proof: In ΔADC,
seg DM is the median.

$\therefore\ AD^2 + CD^2 = 2\,DM^2 + 2\,CM^2$ ...[Apollonius theorem]

$\therefore\ AD^2 + CD^2 = 2\,DM^2 + 2\left(\frac{1}{2}AC\right)^2$ …[M is the midpoint of AC]

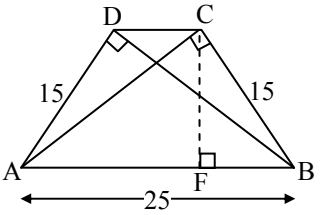
$\therefore\ AD^2 + CD^2 = 2DM^2 + 2 \times \frac{1}{4}AC^2$

$\therefore\ AD^2 + CD^2 = 2DM^2 + \frac{1}{2}\,AC^2$ … (i)

Page no. 52 to 54 are purposely left blank.

Now, $A(\Delta ABC) = \frac{1}{2} \times BC \times AC$

Also, $A(\Delta ABC) = \frac{1}{2} \times AB \times CF$



$\therefore \quad \frac{1}{2} \times BC \times AC = \frac{1}{2} \times AB \times CF$

$\therefore \quad BC \times AC = AB \times CF$

$\therefore \quad 15 \times 20 = 25 \times CF$

$\therefore \quad CF = \frac{15 \times 20}{25} = 12$ units

$A(\square ABCD) = \frac{1}{2} \times CF \times (AB + CD)$

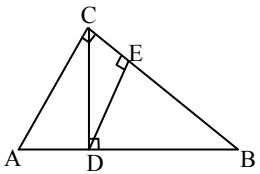
$= \frac{1}{2} \times 12 \times (25 + 7)$

$= \frac{1}{2} \times 12 \times 32$

$\therefore$ **$A(\square ABCD) = 192$ sq. units**

Practice Set

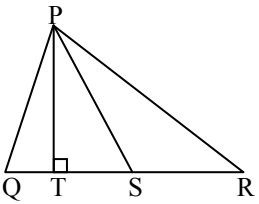
1. In ΔABC, $\angle ACB = 90°$, seg CD $\perp$ seg AB, seg DE $\perp$ seg CB. Show that: $CD^2 \times AC = AD \times AB \times DE$



2. ABC is a triangle in which AB = AC and D is a point on BC. Prove that $AB^2 - AD^2 = BD.CD$.

3. Prove that the sum of the squares of the sides of a rhombus is equal to the sum of the squares of diagonals.

4. In the given figure, seg PS is the median of ΔPQR and PT $\perp$ QR. Prove that,



i. $PR^2 = PS^2 + QR \times ST + \left(\frac{QR}{2}\right)^2$

ii. $PQ^2 = PS^2 - QR \times ST + \left(\frac{QR}{2}\right)^2$

Q.5. 3 Marks Questions

1. If a and b are natural numbers and a > b. If $(a^2 + b^2)$, $(a^2 - b^2)$ and 2ab are the sides of the triangle, then prove that the triangle is right angled. Find out two Pythagorean triplets by taking suitable values of a and b. [Mar 2022]

Sol: $(a^2 + b^2)^2 = a^4 + 2a^2b^2 + b^4$ …(i)

$(a^2 - b^2)^2 = a^4 - 2a^2b^2 + b^4$ …(ii)

$(2ab)^2 = 4a^2b^2$ …(iii)

Now, $(a^4 + 2a^2b^2 + b^4) = (a^4 - 2a^2b^2 + b^4) + 4a^2b^2$

$\therefore$ $(a^2 + b^2)^2 = (a^2 - b^2)^2 + (2ab)^2$ … [From (i), (ii) and (iii)]

$\therefore$ **The triangle with sides $(a^2 + b^2)$, $(a^2 - b^2)$ and (2ab) is a right angled triangle.** …[Converse of Pythagoras theorem]

i. Let a = 2, b = 1

$a^2 + b^2 = 2^2 + 1^2 = 4 + 1 = 5$

$a^2 - b^2 = 2^2 - 1^2 = 4 - 1 = 3$

$2ab = 2 \times 2 \times 1 = 4$

$\therefore$ **(5, 3, 4) is a Pythagorean triplet.**

ii. Let a = 4, b = 3

$a^2 + b^2 = 4^2 + 3^2 = 16 + 9 = 25$

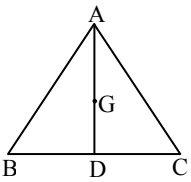
$a^2 - b^2 = 4^2 - 3^2 = 16 - 9 = 7$

$2ab = 2 \times 4 \times 3 = 24$

$\therefore$ **(25, 7, 24) is a Pythagorean triplet.**

2. In an isosceles triangle, length of the congruent sides is 13 cm and its base is 10 cm. Find the distance between the vertex opposite to the base and the centroid.

Sol: Suppose ΔABC is an isosceles triangle.



$\therefore$ AB = AC = 13 cm, BC = 10 cm

AD is the median and G is the centroid.

$\therefore$ D is the midpoint of side BC.

$\therefore$ $DC = \frac{1}{2} BC = \frac{1}{2} \times 10 = 5$ cm

Now, $AB^2 + AC^2 = 2\,AD^2 + 2\,DC^2$ ...[Apollonius theorem]

$\therefore$ $13^2 + 13^2 = 2\,AD^2 + 2\,(5)^2$

$\therefore$ $2 \times 13^2 = 2\,AD^2 + 2 \times 25$

$\therefore$ $169 = AD^2 + 25$ ...[Dividing both sides by 2]

$\therefore$ $AD^2 = 169 - 25$

$\therefore$ $AD^2 = 144$

$\therefore$ $AD = \sqrt{144} = 12$ cm

We know that, the centroid divides the median in the ratio 2 : 1.

$\therefore \quad \frac{AG}{GD} = \frac{2}{1}$

$\therefore \quad \frac{GD}{AG} = \frac{1}{2}$ ...[By invertendo]

$\therefore \quad \frac{GD + AG}{AG} = \frac{1+2}{2}$ ...[By componendo]

$\therefore \quad \frac{AD}{AG} = \frac{3}{2}$ ...[A–G–D]

$\therefore \quad \frac{12}{AG} = \frac{3}{2}$

$\therefore \quad AG = \frac{12 \times 2}{3} = 8$ cm

$\therefore$ **The distance between the vertex opposite to the base and the centroid is 8 cm.**

Practice Set

1. In ΔPQR, $PD \perp QR$ such that D lies on QR. If PQ = a, PR = b, QD = c and DR = d, then prove that $(a + b)(a - b) = (c + d)(c - d)$.

2. In a quadrilateral ABCD, $\angle A + \angle D = 90°$.
Prove that $AC^2 + BD^2 = AD^2 + BC^2$.
[**Hint:** Produce AB and DC to meet at E]

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