Competency Focused Practice Questions

Mathematics (Volume 3) | Grade 10

Co-created by

CBSE Centre for Excellence in Assessment

and

Educational Initiatives

Preface

Assessments are an important tool that help gauge learning. They provide valuable feedback about the effectiveness of instructional methods; about what students have actually understood and also provide actionable insights. The National Education Policy, 2020 has outlined the importance of competency-based assessments in classrooms as a means to reform curriculum and pedagogical methodologies. The policy emphasizes on the development of higher order skills such as analysis, critical thinking and problem solving through classroom instructions and aligned assessments.

Central Board of Secondary Education (CBSE) has been collaborating with Educational Initiatives (Ei) in the area of assessment. Through resources like the Essential Concepts document and A- Question-A-Day (AQAD), high quality questions and concepts critical to learning have been shared with schools and teachers.

Continuing with the vision to ensure that every student is learning with understanding, Question Booklets have been created for subjects for Grade 10th and 12th. These booklets contain competency-based items, designed specifically to test conceptual understanding and application of concepts.

Process of creating competency-based items

All items in these booklets are aligned to the NCERT curriculum and have been created keeping in mind the learning outcomes that are important for students to understand and master. Items are a mix of Free Response Questions (FRQs) and Multiple-Choice Questions (MCQs). In case of MCQs, the options (correct answer and distractors) are specifically created to test for understanding and capturing specific errors/misconceptions that students may harbour. Each incorrect option can thereby inform teachers on specific gaps that may exist in student learning. In case of subjective questions, each question also has a detailed scoring rubric to guide evaluation of students' responses.

Each item has been reviewed by experts, to check for appropriateness of the item, validity of the item, conceptual correctness, language accuracy and other nuances.

How can these item booklets be used?

There are 195 questions in this booklet.

The purpose of these item booklets is to provide samples of high-quality competency-based items to teachers. The items can be used to–

- get an understanding of what good competency-based questions could look like
- give exposure to students to competency-based items
- assist in classroom teaching and learning
- get inspiration to create more such competency-based items

Students can also use this document to understand different kinds of questions and practice specific concepts and competencies. There will be further additions in the future to provide competency focused questions on all chapters.

The item booklets are aligned with the 2022-23 curriculum. However, a few questions from topic which got rationalized in 2023-24 syllabus are also there in the booklet which may be used as a reference for teachers and students.

Please write back to us to give your feedback.

Team CBSE

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Chapter - 1
Real Numbers

Multiple Choice Questions

Q: 1 **Which of the following is an irrational number?**

1 $\sqrt{5}$ **2** 3.14159265359 **3** $\frac{\sqrt{4}}{3}$ **4** $0.\overline{23517}$

Q: 2 **Which of the following is an irrational number?**

1 5√4 **2** $\frac{\sqrt{2}}{\sqrt{8}}$ **3** 6 + √5 **4** √64 - √4

Q: 3 $\frac{63}{p}$ **has a terminating decimal expansion.**

Which of these CANNOT be a factor of *p* ?

1 2 **2** 5 **3** 13 **4** 20

Q: 4 **Which of the following have a terminating decimal expansion?**

(Note: You need not evaluate the decimals.)

1 $\frac{1}{3}$ **2** $\frac{1}{60}$ **3** $\frac{1}{90}$ **4** $\frac{1}{625}$

Q: 5 **Which of these is the HCF of 1260 and 1680?**

1 210 **2** 420 **3** 630 **4** 5040

Q: 6 **Which of these is the LCM of 720 and 900?**

1 180 **2** 1800 **3** 3600 **4** 648000

Q: 7 Which of the following is the rationalised form of $\frac{\sqrt{5}}{\sqrt{3}+\sqrt{2}}$?

1 5 **2** $\frac{\sqrt{3}+\sqrt{2}}{\sqrt{5}}$ **3** $\sqrt{15}-\sqrt{2}$ **4** $\sqrt{15}-\sqrt{10}$

Q: 8 **Which of the following fractions has a terminating decimal expansion?**

1 $\frac{33}{343}$ **2** $\frac{19}{49}$
3 $\frac{71}{99}$ **4** $\frac{237}{625}$

Q: 9 **Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Read the statements carefully and choose the option that correctly describes statements (A) and (R).**

Assertion (A): Product of HCF and LCM of THREE numbers is equal to the product of those numbers.

Reason (R): Product of HCF and LCM of TWO numbers is equal to the product of those numbers.

1 Both (A) and (R) are true and (R) is the correct explanation for (A).
2 Both (A) and (R) are true and (R) is not the correct explanation for (A).
3 (A) is false but (R) is true.
4 Both (A) and (R) are false.

Free Response Questions

Q: 10 **The prime factorisation of a natural number p is $(5 \times 7 \times t)$ where $t \neq 2, 3$.** **[1]**

What is the prime factorisation of $42p^2$?

Q: 11 **$\sqrt{4} + \sqrt{5}$ is a rational number.** **[1]**

Write true or false and justify your answer.

Q: 12 **Ramesh has two rectangular fields of the same length but different widths. He wants to plant 76 trees in the smaller field and 190 trees in the larger field. In both fields, the trees will be planted in the same number of columns but in different numbers of rows.** **[1]**

What is the most number of columns that can be planted in this arrangement? Show your work.

Q: 13 **Use Euclid's Division Algorithm to find the HCF of 175, 225 and 465. Show your work.** **[2]**

Q: 14 **Given that $\sqrt{3}$ is irrational, show by contradiction that the sum of $\sqrt{3}$ and 2 is irrational. Show your steps.** **[2]**

Q: 15 **M and N are positive integers such that $M = p^5 q^3 r^2$ and $N = p^7 q^5 r$, where p, q, r are prime numbers.** **[2]**
Find LCM(M, N) and HCF(M, N).

Q: 16 **√5 is an irrational number. Meera was asked to prove that (3 + √5) is an irrational number.** **[2]**

Shown below are the steps of Meera's proof:

Step 1	Let (3 + √5) be a rational number. Then (3 + √5) can be written as $\frac{p}{q}$, where p and q ($q \neq 0$) are co-primes.
Step 2	Hence, √5 = ($\frac{p}{q}$ - 3).
Step 3	Since p and q are integers, ($\frac{p}{q}$ - 3) is also an integer.
Step 4	Since ($\frac{p}{q}$ - 3) is an integer and every integer is a rational number, ($\frac{p}{q}$ - 3) is a rational number. It implies that √5 is a rational number.
Step 5	But this contradicts the fact that √5 is an irrational number. Hence, (3 + √5) is an irrational number.

She made an error in one step due to which her subsequent steps were incorrect too.

In which step did she make that error? Justify your answer.

Q: 17 **Ajay has a box of length 3.2 m, breadth 2.4 m, and height 1.6 m.** **[2]**
What is the length of the longest ruler that can exactly measure the three dimensions of the box? Show your steps and give valid reasons.

Q: 18 ***m* is a positive integer. HCF of *m* and 450 is 25. HCF of *m* and 490 is 35.** **[2]**

Find the HCF of *m*, 450 and 490. Show your steps.

Q: 19 **Prove that √7 is irrational.** **[3]**

Q: 20 **Prove that $\frac{1}{\sqrt{2}}$ is irrational.** **[3]**

Q: 21 **Show that any positive even integer is of the form (8 *m*), (8 *m* + 2), (8 *m* + 4) or (8 *m* + 6), for some positive integer *m*. Show your work.** **[3]**

Q: 22 **Write two rational numbers each between the following pair:** **[3]**

i) √3 and √10
ii) 7 and √64
iii) √15 and 6

Q: 23 **The number 3837425721 is divided by a number between 5621 and 5912.** **[3]**

State true or false for the below statements about the remainder and justify your answer.

i) The remainder can be more than 5912.
ii) The remainder cannot be less than 5621.
iii) The remainder is always between 5621 and 5912.

Q: 24 **On the two real numbers $a = 2 + \sqrt{5}$ and $b = 3 - \sqrt{7}$, perform the following operations:** **[5]**

i) Calculate the sum ($a + b$).
ii) Calculate the product (ab).
iii) Find the additive inverse of a.
iv) Rationalise $\frac{1}{b}$.
v) Verify whether the numbers a and b are rational or irrational. Provide a valid reason for your answer.

Q: 25 **i) Find the LCM and HCF of 78, 91, and 195.** **[5]**
ii) Check whether LCM(a, b, c) × HCF(a, b, c) = $a \times b \times c$ where a, b and c are natural numbers.

Show your work.

Case Study

Answer the questions based on the given information.

For the screening of an informational documentary, three schools were selected by the district administration.

Name of the school	No. of students
C.A.V. Public School	78
Bal Vidya Bhawan	117
Bombay Public School	130

♦ During the screening, multiple rooms are used simultaneously, and each room can accommodate an equal number of students.
♦ All students in a particular room belong to the same school.
♦ As a token of appreciation, the district administration has provided an equal number of chocolates to each school.
♦ When distributing these chocolates, each school distributes chocolates equally among its students, ensuring fairness and consistency.

Q: 26 **Find the maximum number of students that can be seated in one room. Show your work.** **[2]**

Q: 27 **What is the minimum number of rooms required? Show your work.** **[2]**

Q: 28 **What is the minimum number of chocolates provided to each school? Show your work.** **[1]**

Q.No	Correct Answers
1	1
2	3
3	3
4	4
5	2
6	3
7	4
8	4
9	3

Q.No	What to look for	Marks
10	Writes the prime factorisation of 42 p^2 as ($2 \times 3 \times 5^2 \times 7^3 \times t^2$).	1
11	Writes False.	0.5
	Justifies the answer. For example, states that √5 is irrational as it is the square root of a prime number and sum of a rational and irrational is irrational.	0.5
12	Identifies that the number of columns for the two fields must be HCF of 76 & 190, and applies an appropriate method to find the HCF as 38.	1
13	Finds the HCF of 175, 225 and 465 using Euclid's Division Algorithm as follows: 225 = 175 × 1 + 50 175 = 50 × 3 + 25 50 = 25 × 2 + 0 Finds the HCF of 175 and 225 as 25.	1
	465 = 25 × 18 + 15 25 = 15 × 1 + 10 15 = 10 × 1 + 5 10 = 5 × 2 + 0 Finds the HCF of 465 and 25 as 5. Concludes that the HCF of 175, 225 and 465 is 5.	1
14	Assumes that (2 + √3) is rational and writes $2 + \sqrt{3} = \frac{p}{q}$, where p and q are co-prime integers and $q \neq 0$.	0.5
	Simplifies the above as $\frac{p}{q} - 2 = \sqrt{3}$.	0.5
	Writes that since p and q ($q \neq 0$) are integers and 2 is a rational, ($\frac{p}{q} - 2$) is also rational.	0.5
	Writes that since √3 is irrational, hence proves by contradiction that the sum of √3 and 2 is irrational.	0.5

Q.No	What to look for	Marks
15	Finds LCM(M, N) as $p^7 q^5 r^2$.	1
	Finds HCF(M, N) as $p^5 q^3 r$.	1
16	Identifies that Meera makes an error in step 3.	1
	Writes that if p and q are integers, $(\frac{p}{q} - 3)$ cannot be an integer since p and q are co-primes.	1
17	Identifies and reasons that the length of the longest ruler should be equal to the HCF of the three lengths.	0.5
	Finds the HCF of the three numbers as Prime factorization of 32 = 2^5 Prime factorization of 24 = 3×2^3 Prime factorization of 16 = 2^4 Highest Common factor, HCF = 2^3 Mentions the length of the longest ruler as 80 cm or 0.8 m. (Award 0.5 marks if the length is correct but the unit is incorrect).	1.5
18	Writes that the HCF of m, 450 and 490 is nothing but the HCF of 25 and 35 and finds the same as: 35 = (25 × 1) + 10 25 = (10 × 2) + 5 10 = (5 × 2) + 0.	1
	Concludes that HCF of m, 450 and 490 is 5.	1
19	Assumes $\sqrt{7} = \frac{a}{b}$ where $b \neq 0$, a and b are co-primes.	0.5
	Writes $b\sqrt{7} = a$ and squares both the sides to get $7b^2 = a^2$.	0.25
	Concludes that a is divisible by 7 as a^2 is divisible by 7 because 7 is a prime number.	0.5

Q.No	What to look for	Marks
	Writes $a = 7c$ and squares both the sides to get $a^2 = 49c^2$.	0.25
	Replaces a^2 with $7b^2$ from step 2 to get $7b^2 = 49c^2$ and solves it to get $b^2 = 7c^2$.	0.5
	Concludes that b is divisible by 7 as b^2 is divisible by 7 because 7 is a prime number.	0.5
	Mentions that 7 divides both a and b which contradicts the assumption that a and b are both co-prime and hence $\sqrt{7}$ is irrational.	0.5
20	Assumes $\frac{1}{\sqrt{2}} = \frac{a}{b}$ where $b \neq 0$, a and b are co-primes.	0.5
	Writes $b = a\sqrt{2}$ and squares both the sides to get $b^2 = 2a^2$.	0.25
	Concludes that b is divisible by 2 as b^2 is divisible by 2 because 2 is a prime number.	0.5
	Writes $b = 2c$ and squares to get $b^2 = 4c^2$.	0.25
	Replaces b^2 with $2a^2$ from step 2 to get $2a^2 = 4c^2$ and solves it to get $a^2 = 2c^2$.	0.5
	Concludes that a is divisible by 2 as a^2 is divisible by 2 because 2 is a prime number.	0.5
	Mentions that 2 divides both a and b which contradicts the assumption that a and b are both co-primes and hence $\frac{1}{\sqrt{2}}$ is irrational.	0.5
21	Writes Euclid's Division Lemma for $a = bm + n$, $0 \leq n < b$, where a is a positive integer and substitutes $b = 8$ to get $a = 8m + n$, $0 \leq n < 8$.	0.5
	Mentions that the possible values of n for $a = 8m + n$ are 0, 1, 2, 3, 4, 5, 6, 7.	1
	Writes that a can be $(8m)$, $(8m + 1)$, $(8m + 2)$, $(8m + 3)$, $(8m + 4)$, $(8m + 5)$, $(8m + 6)$ or $(8m + 7)$ where m is the quotient.	0.5

Q.No	What to look for	Marks
	Writes that out of the above expressions only (8 *m*), (8 *m* + 2), (8 *m* + 4) and (8 *m* + 6) are even and concludes that any positive even integer is of the form (8 *m*), (8 *m* + 2), (8 *m* + 4) or (8 *m* + 6).	1
22	i) Writes any 2 rational numbers between √3 and √10. For example, 2 and 2.1.	1
	ii) Writes any 2 rational numbers between 7 and √64. For example, 7.22 and 7.5.	1
	iii) Writes any 2 rational numbers between √15 and 6. For example, 4 and 5.	1
23	i) Writes false and justifies the answer. For example, writes that Euclid's Division Lemma states that the remainder is always less than the divisor and all the divisors are less than 5912.	1
	ii) Writes false and justifies the answer. For example, the remainder is always less than the divisor and the numbers from 0 to the divisor are all possible remainders.	1
	iii) Writes false and justifies the answer. For example, writes that Euclid's Division Lemma states that the remainder always lies between 0 and the divisor.	1
24	i) Calculates the sum correctly as 5 + √5 - √7.	1
	ii) Calculates the product correctly as 6 - 2√7 + 3√5 - √35.	1
	iii) Calculates the additive inverse of *a* correctly as (-2 - √5).	1
	iv) Calculates the rationalised form of $\frac{1}{b}$ correctly as $\frac{(3+\sqrt{7})}{2}$.	1
	v) Verifies both *a* and *b* are irrational because they are the sum of rational and irrational numbers.	1

Q.No	What to look for	Marks
25	**i) Finds the LCM and HCF of 78, 91, and 195 as 2730 and 13 respectively. The working may look as follows:** **Prime factorization of:** **$78 = 2^1 \times 3^1 \times 13^1$** **$91 = 7^1 \times 13^1$** **$195 = 3^1 \times 5^1 \times 13^1$** **LCM = 2 x 3 x 5 x 7 x 13 = 2730** **HCF = 13**	**3**
	ii) Considers a, b and c as 78, 91 and 195 respectively. **Finds LCM(a, b, c) × HCF(a, b, c) as 2730 × 13 = 35,490.**	**1**
	Finds the product of a, b, and c as 78 × 91 × 195 = 13,84,110. **Concludes that LCM(a, b, c) × HCF(a, b, c) ≠ $a \times b \times c$.**	**1**
26	**Identifies that to find the required number, HCF of 78, 117, and 130 is needed and finds the HCF of 78, 117, and 130 as:** **Prime factorization of 78, 117, and 130-** **$78 = 2^1 \times 3^1 \times 13^1$** **$117 = 3^2 \times 13^1$** **$130 = 2^1 \times 5^1 \times 13^1$** **Concludes that the maximum number of students to be seated in a room = HCF(78, 117, 130) = 13.**	**2**
27	**Finds the total number of students as 78 + 117 + 130 = 325.**	**1**
	Divides the total number of students by 13 to obtain the minimum number of rooms required as 25.	**1**
28	**Identifies that LCM of 78, 117, and 130 is the minimum number of chocolates received by each school and uses the prime factorization used earlier to find the LCM of 78, 117, and 130 as:** **LCM = 2 × 3 × 3 × 5 × 13 = 1170.** ***(Note: Award full marks if the student performs prime factorization.)***	**1**

Chapter - 2
Arithmetic Progressions

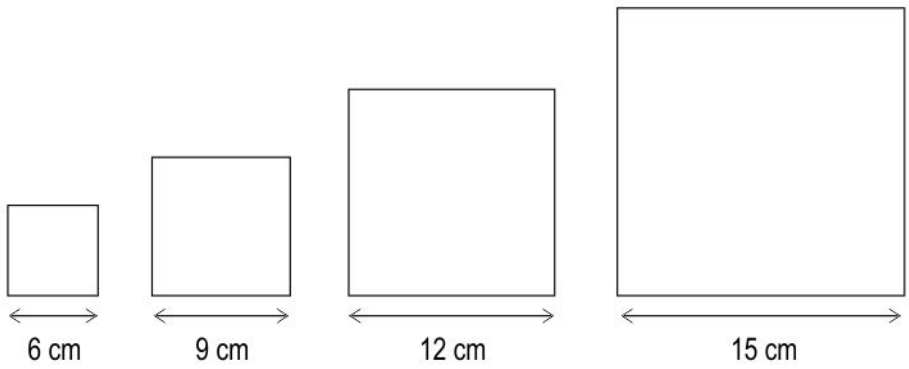
Multiple Choice Questions

Q: 1 **In a game, a player must gather 20 flags positioned 5 meters apart in a straight line. The starting point is 10 meters away from the first flag. The player starts from the starting point, collects the 20 flags and comes back to the starting point to complete one round.**

What will be the total distance covered by a player upon completing one round?

1 105 m **2** 210 m **3** 220 m **4** 1150 m

Q: 2 **Shown below are some squares whose sides form an arithmetic progression (AP).**



(Note: The figures are not to scale.)

Which of these are also in AP?

i) The areas of these squares.

ii) The perimeters of these squares.

iii) The length of the diagonals of these squares.

1 only ii)
2 only i) and ii)
3 only ii) and iii)
4 all - i), ii) and iii)

Q: 3 **Given below is an arithmetic progression. X and Y are unknown.**

$4\frac{1}{4}$, $6\frac{3}{4}$, X, $11\frac{3}{4}$, Y, $16\frac{3}{4}$

Which of these are X and Y?

1 X = $8\frac{3}{4}$, Y = $13\frac{3}{4}$
2 X = $8\frac{3}{4}$, Y = $14\frac{1}{4}$
3 X = $9\frac{1}{4}$, Y = $14\frac{1}{4}$
4 X = $9\frac{1}{4}$, Y = $13\frac{3}{4}$

Q: 4 **Which of the following are in Arithmetic progression?**

i) 2, 12, 22, 32, 42, ...
ii) 1, 2, 4, 7, 11, 16, ...
iii) 7, 6.5, 6, 5.5, 5, ...

1 only i)
2 only i) and ii)
3 only i) and iii)
4 all - i), ii) and iii)

Q: 5 **Given below is a pattern.**

$-\frac{3}{4}, -\frac{5}{8}, -\frac{1}{2}, -\frac{3}{8}, -\frac{1}{4}, \ldots$

If the pattern is extended, what would be the 41st term?

1 $\frac{-223}{4}$ **2** $\frac{23}{4}$ **3** $\frac{17}{4}$ **4** $\frac{35}{8}$

Q: 6 **Vanshika decided to plant a certain number of seeds every month as a part of a gardening project. In the first month, she planted 5 flower seeds, and in the final month, she planted 50 flower seeds. Every month, she planted 3 more seeds than the previous month.**

How many flower seeds did Vanshika plant in total?

1 50 **2** 103 **3** 390 **4** 440

Q: 7 **A construction company is working on construction of new floors in an old building which already had 6 floors. During the first week, they completed 5 floors. Each subsequent week, they completed 3 more floors.**

If this progression continues for 12 weeks, how many floors will the building have in total?

1 38 **2** 44 **3** 47 **4** 258

Q: 8 **Which term of the arithmetic progression (AP) 21, 18, 15, ... is 0?**

1 6th term
2 7th term
3 8th term
4 (the AP does not have 0 as any term)

Free Response Questions

Q: 9 **Write the first four terms of an Arithmetic Progression, whose first term is 3.75, and the common difference is (-1.5).** **[1]**

Q: 10 **If the first term of an arithmetic progression (AP) is 5 and the common difference is (-3), then the *n* th term of the progression is given by $T_n = 5n - 3$.** **[1]**

Is the above statement true or false? Justify your answer.

Q: 11 **In a library, the arrangement of bookshelves follows a pattern where the number of books on each successive shelf increases by 10 books. The first shelf has 30 books, and the last shelf has 160 books.** **[2]**

i) How many shelves are there in the library?
ii) How many total books are there in the library?

Show your work.

Q: 12 **The common difference of an arithmetic progression is $\frac{5}{2}$. The 9th term is 17.** **[2]**

i) Find the first term.
ii) Find the 101th term.

Show your work.

Q: 13 **Sameer is saving up to buy a bike, which costs Rs 46,000. He plans to save money each month. In the first month, he saves Rs 1,000 and every subsequent month, he saves Rs 250 more than the previous month.** **[2]**

After how many months will he be able to buy the bike? Show your work.

Q: 14 **The n th term of an arithmetic progression (AP) is $T_n = (2n + 1)^2 - 3$.** **[2]**

Determine the sum of the first 10 terms of the AP. Show your work.

Q: 15 **John is renovating his house. He began by painting one wall, which took him 2 hours on the first day. Each subsequent day, he spends an additional 30 min on the renovation project.** **[2]**

On which day will he spend 12 hours of his day on the renovation? Show your work.

Q: 16 **How many terms of the arithmetic progression 5, 7 $\frac{1}{2}$, ... add up to 50? Show your work.** **[2]**

Q: 17 **Given below are 2 arithmetic progressions (AP):** **[2]**

AP_1 : 5, 9, 13, 17,...
AP_2 : 30, 40, 50, 60,...

The x th term of AP_1 is the same as the y th term of AP_2.

Find the relationship between x and y. Show your work.

Q: 18 **A theatre charges Rs 350 for the first ticket and Rs 20 less for every subsequent ticket. The offer is valid for 12 tickets only.** **[3]**

i) Find the discounted price for the first four tickets.

ii) How much would someone pay for 8 tickets?

iii) What would be the discounted price of the 12th ticket?

Show your work.

Q: 19 **How many three-digit numbers are smaller than 200 and divisible by 8? Find sum of these numbers. Show your work.** **[3]**

Q: 20 **In an arithmetic progression, the sum of the first n terms is given by $S_n = 2n^2 - 5n$.** **[3]**

Determine the first term and the common difference of this arithmetic progression. Show your work.

Q: 21 **In a new school, student enrolments occured over a period of 30 days, with 5 students joining each day than the previous day. The first day started with an enrolment of 12 students.** **[3]**

i) After how many days did the school have a total of 110 students?
ii) How many students were enrolled in the 30 days?

Show your work.

Q: 22 **In a construction project of making chairs, the team adds 3 chairs every day. On the first day, they added 4 chairs.** **[3]**

i) After how many days will the office have a total of 40 chairs?
ii) Calculate the total number of chairs after 30 days.
iii) If they added 5 chairs instead of 3 chairs each day, find the minimum number of days after which there will be more than 150 chairs.

Show your work.

Q: 23 **A librarian wanted to add more books to a library that had a current collection of 150 books. He added 5 books every week.** **[3]**

i) How many books were there in the library after 11 weeks?

ii) Determine the total number of new books added in the 11 weeks.

iii) If the library has a maximum capacity of 300 books, after how many weeks would the library reach its limit?

Show your work.

Q: 24 **The difference between the 5th and 10th terms of an arithmetic progression (AP) is 15.** **[3]**

If the first term is 4, find the common difference and the 15th term of the AP. Show your work.

Q: 25 **The difference between the 2^{nd} and 4^{th} term of an arithmetic progression (AP) is 6.** **[3]**

Find the common difference of the AP. Show your work.

Q: 26 **[5]**

The cannon fires every 2 minutes, with the first shot occurring 10 minutes after the start of the fight. Additionally, the weight of each cannonball increases by 0.5 kg with each successive shot, starting with the first ball weighing 0.5 kg.

i) How many balls are fired after the first 30 minutes of fight?
ii) What is the ball's weight when the 12th ball is fired?
iii) After how much time will the ball of 10 kg be fired?

Show your work.

Q: 27 **A car covers 55 km in the first hour and increases its speed by 10 km/hr every hour.** **[5]**

i) Find the total distance covered in 6 hours.
ii) How long will the car take to cover 1000 km?
iii) Find the speed of the car in the 9th hour.

Show your work.

Case Study

Answer the questions based on the given information.

Isha is planning to grow her orchard. She wants to plant rows of fruit trees in a way that each row has more trees than the one before, following a specific pattern. Given below are the details of her plan:

i) The first row will have 5 trees.

ii) Each new row will have 3 more trees than the one before.

iii) There will be a total of 10 rows of trees.

Q: 28 **Calculate the number of trees in the 10th row of the orchard. Show your work.** **[1]**

Q: 29 **What will be the total number of trees in the orchard after all 10 rows are planted? Show your work.** **[2]**

Q: 30 **Isha changed her plan by not planting in rows 5 and 6 to create a pathway for walking, without altering the pattern for the rows. All rows will have the same number of trees as before.** **[3]**

Calculate the number of trees now. Show your work.

Q.No	Correct Answers
1	2
2	3
3	3
4	3
5	3
6	4
7	2
8	3

Q.No	What to look for	Marks
9	Writes the first four terms as: 3.75, 2.25, 0.75, -0.75	1
10	Writes false and justifies the answer. For example, writes that: The n th term of an AP is: $T_n = 5 + (-3)(n - 1) = 8 - 3n$	1
11	i) Assumes the the total number of shelves in the bookshelf as n and writes the equation as: $160 = 30 + 10(n - 1)$	0.5
	Solves the above equation to find the value of n as 14.	0.5
	ii) Finds the total number of books in the shelf as: $\frac{14}{2} \times (30 + 160) = 1330$	1
12	i) Assumes the first term of the arithmetic progression to be a and forms the equation: $17 = a + (9 - 1) \times \frac{5}{2}$ Solves the above equation to find the value of a as (-3).	1
	ii) Finds the 101th term as: $(-3) + (101 - 1) \times \frac{5}{2} = 247$	1
13	Assumes the number of months to be n and writes the equation: $46000 = \frac{n}{2})\} [(2 \times 1000) + (n - 1) \times 250]$	1
	Solves the above equation to get n as 16 or -23. Writes that the number of months cannot be negative and hence after 16 months, he will be able to buy the bike.	1

Q.No	What to look for	Marks
14	Finds the 1st term of the AP as: $(2 \times 1 + 1)^2 - 3 = 6$	0.5
	Finds the 10th term of the AP as: $(2 \times 10 + 1)^2 - 3 = 438$	0.5
	Finds the sum of first 10 terms of the AP as: $\frac{10}{2}(6 + 438) = 2220$	1
15	Finds the first term of the progression as $2 \times 60 = 120$ min and writes the common difference as 30 min.	0.5
	Finds the time spent on the n th day as $12 \times 60 = 720$ min.	0.5
	Writes the equation for the n th day as: $720 = 120 + (n - 1) \times 30$ Solves the above equation to find that John will spend 12 hours of his day on the 21st day.	1
16	Writes the equation for the sum of n terms of an arithmetic progression as: $50 = \frac{n}{2}[2 \times 5 + (n - 1) \times 2\frac{1}{2}]$	0.5
	Solves the above equation to get the values of n as 5 or (-8). Writes that the number of terms cannot be negative and hence $n = 5$.	1.5
17	Writes the equation for the x th term of AP_1 as: $5 + (x - 1) \times 4$	0.5
	Writes the equation for the x th term of AP_2 as: $30 + (y - 1) \times 10$	0.5

Q.No	What to look for	Marks
	Equates the above two equations and writes: $5 + (x - 1) \times 4 = 30 + (y - 1) \times 10$ $\Rightarrow 4x - 10y = 19$	1
18	i) Finds the price for first ticket as Rs 350 and the subsequent 3 tickets as Rs 330, Rs 310, and Rs 290.	1
	ii) Writes the equation for the price of 8 tickets as: $\frac{8}{2} \times [(2 \times 350) + (7 \times (-20))]$	0.5
	Solves the above equation to get total price of 8 tickets as Rs 2240.	0.5
	iii) Finds the discounted price of 12th ticket as: $350 + 11 \times (-20) =$ Rs 130	1
19	Writes the sequence of 3-digit numbers less than 200 divisible by 8 as 104, 112, 120, ..., 192 and mentions that it forms an arithmetic progression (AP).	0.5
	Assumes that the AP has n terms and writes the equation for the last term as: $192 = 104 + (n - 1)8$	0.5
	Solves the above equation to find the total number of terms in the AP as 12.	1
	Finds the sum of all terms of the AP as: $\frac{12}{2}(104 + 192) = 1776$	1
20	Finds the first term (T_1) of the arithmetic progression as: $S_1 = 2(1)^2 - 5(1) = (-3)$	1
	Finds the second term (T_2) of the arithmetic progression as: $T_1 + T_2 = S_2 = 2(2)^2 - 5(2) = (-2)$ $\Rightarrow T_2 = (-2) - (-3) = 1$	1.5

Q.No	What to look for	Marks
	Finds the common difference as: **$T_2 - T_1 = 1 - (-3) = 4$**	**0.5**
21	**i) Writes that the first term of the arithmetic progression (AP) is 12, common difference is 5. Assumes the required number of days as *n* and writes the equation for 110 students as:** **$110 = \frac{n}{2} \times (24 + (n - 1) \times 5)$**	**0.5**
	Solves the above equation to find the values of *n* as 5 or (-8.8). **Writes that after 5 days, the school had a total of 110 students.**	**1**
	ii) Finds the total number of students enrolled in 30 days as: **$\frac{30}{2} \times (24 + (30 - 1) \times 5) = 2535$**	**1.5**
22	**i) Finds the first term (*a*) as 4 and common difference (*d*) as 3. Using the formula to determine the number of days (*n*),** **$40 = 4 + (n - 1) \times 3$** **$\Rightarrow n = 13$** **Concludes that after 13 days, there would be total of 40 chairs in office.**	**1**
	ii) Finds the total number of chairs after 30 days as: **$4 + (30 - 1) \times 3 = 91$**	**1**
	iii) Finds the new common difference to be 5. **Assumes the minimum number of days as *n* and writes the equation for the number of days after which there will be more than 150 chairs as:** **$4 + (n - 1) \times 5 > 150$** **$\Rightarrow n > 30.2 \cong 31$** **After 31 days there will be more than 150 chairs.**	**1**

Q.No	What to look for	Marks
23	i) Writes that the number of books added forms an arithmetic progression with first term 150 and common difference 5. Finds the number of books in the library after 11 weeks as: $150 + (11 - 1) \times 5 = 200$	1
	ii) Finds the total number of new books added in the 11 weeks as 200 - 150 = 50.	0.5
	iii) Assumes that after n weeks, there were 300 books. Writes the equation as: $300 = 150 + (n - 1) \times 5$	1
	Solves the above equation for n and finds the required number of weeks as 31.	0.5
24	Writes the 5th and 10th term of the arithmetic progression as ($a + 4d$) and ($a + 9d$), where a is the first term and d is the common difference of the AP.	0.5
	Writes the difference of both the terms as 5 d or (-5 d) and equates it with 15 to get the common difference as (3) or (-3).	0.5
	Finds the 15th term of the AP as 46 or (-38). The working may look as follows: case i) when $a = 4$, $n = 15$ and $d = 3$: $T_{15} = 4 + (15 - 1) \times 3 = 46$ case ii) when $a = 4$, $n = 15$ and $d = -3$: $T_{15} = 4 - (15 - 1) \times 3 = -38$	2
25	Represents the 2 nd and 4 th term of the AP as ($a + d$) and ($a + 3d$) with the first term as a and common difference as d.	1
	Finds the difference of 2 nd and 4 th term as ($a + 3d$) - ($a + d$) = 2 d or ($a + d$) - ($a + 3d$) = (-2 d).	1
	Concludes that the common difference can either be 3 or (-3).	1

Q.No	What to look for	Marks
26	**i) Finds the first term (a) = 10 and common difference (d) = 2.** **Assumes *n* as the number of balls fired.** **$30 = 10 + (n - 1) \times 2$** **Finds the value of *n* as 11 and hence 11 balls have been fired after the first 30 minutes of fight.**	**1**
	ii) Finds the first term (a) = 0.5 and common difference (d) = 0.5. **Required weight = $0.5 + (12 - 1) \times 0.5$** **Thus concludes weight of the 12th ball fired is 6 kg.**	**1.5**
	iii) Assumes that after *n* th ball, the 10 kg ball is fired and writes the equation as: **$10 = 0.5 + (n - 1) \times 0.5$** **Solves the equation to find *n* as 20 and hence after the 20th ball, the ball would weigh 10 kg.**	**1**
	Uses the above *n* to evaluate the time as: **$10 + (20 - 1) \times 2$** **Concludes that after 48 mins of the fight starting, 10 kg ball will be fired.**	**1.5**
27	**i) States that speed of car forms an arithmetic progression with common difference, *d* = 10 and first term, *a* = 55.**	**1**
	Finds the total distance covered after 6 hours as 480 km. The working may look as follows: **$\frac{6}{2}\{2 \times 55 + (6 - 1) \times 10\} = 480$ km**	**1**

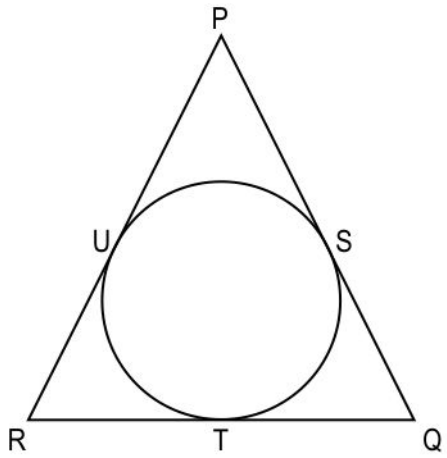
Q.No	What to look for	Marks
	ii) Uses the equation of sum of first *n* terms of an arithmetic progression and finds that the car will cover the distance of 1000 km in 11 hours. The working may look as follows: $1000 = \frac{n}{2}\{2 \times 55 + (n - 1) \times 10\}$ $\Rightarrow n^2 + 10n - 200 = 0$ $\Rightarrow n = 10$ or (-20) **Concludes that $n = 10$ since negative value of time is not possible.**	**2**
	iii) Uses the equation of *n* th terms of an AP to find the 9th term and states that the speed will be 135 km/h. The working may look as follows: $T_9 = 55 + (9 - 1) \times 10 = 135$ km/h	**1**
28	**Writes that the first row contains 5 trees, and each subsequent row has 3 more trees than the previous row.** **Concludes that the given pattern is in AP, and identifies *a* as 5 and *d* as 3.**	**0.5**
	Finds the number of trees in the 10th row as: $5 + (10 - 1) \times 3 = 32$	**0.5**
29	**Uses the sum of an arithmetic series formula and writes:** $\frac{10}{2} \times (2 \times 5 + (10 - 1) \times 3)$ **Solves the above equation to get the total number of trees in the orchard after all 10 rows are planted as 185.**	**2**
30	**Forms two APs such as :** AP_1 : 1 st, 2 nd, 3 rd, 4 th row. AP_2 : 7 th, 8 th, 9 th, 10 th row.	**0.5**
	Finds the total number of trees in AP_1 as: $\frac{4}{2} \times (2 \times 5 + (4 - 1) \times 3) = 38$	**0.5**

Q.No	What to look for	Marks
	Calculates the number of trees in the 7 th row as: **$5 + (7 - 1) \times 3 = 23$**	**0.5**
	Finds total number of trees in AP_2 as : **$\frac{4}{2} \times (2 \times 23 + (4 - 1) \times 3) = 110$**	**1**
	Finds the total number of trees as 38 + 110 = 148 trees. **(Award full marks if students calculate total number of trees and subtract number of trees in Row 5 and 6.)**	**0.5**

Chapter - 3
Circles

Multiple Choice Questions

Q: 1 **In the figure below, ▲PQR is an isosceles triangle with PQ = PR, and the lengths of PU and UR are 5 units and 3 units respectively.**

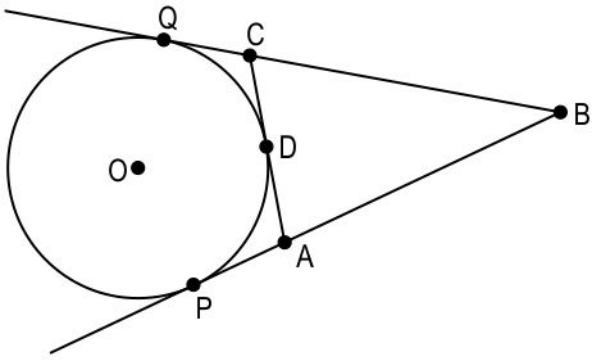


(Note: The figure is not to scale.)

Which of the following is TRUE?

1 PS = 3 units **2** SQ = 5 units **3** QT = 3 units **4** QR = 8 units

Q: 2 **In the figure below, ▲ABC is formed using three tangents to a circle centred at O.**



(Note: The figure is not to scale.)

Based on the construction, which of the following statements is true?

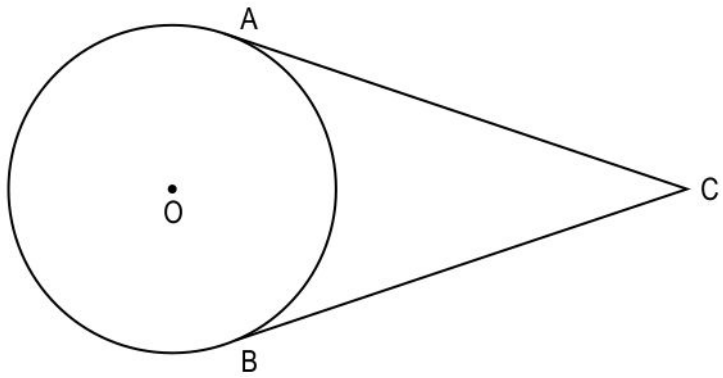
1 The sum of the length of BP and BQ less than the perimeter of ΔABC.
2 The sum of the length of BP and BQ is same as the perimeter of ΔABC.
3 The sum of the length of BP and BQ is greater than the perimeter of ΔABC.
4 Length of the tangents should be known to compare it to the perimeter of ΔABC.

Q: 3 **Four tangents of a circle are extended from both the sides to intersect each other until a quadrilateral is formed.**

Which of these quadrilateral is NOT possible to be formed?

1 Square **2** Rhombus **3** Rectangle **4** Trapezium

Q: 4 **A circle with center O is shown below, where CA and CB are tangents to the circle.**

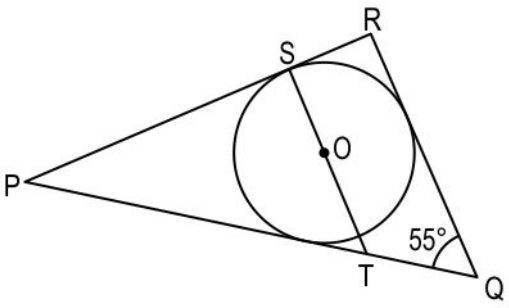


(Note: Figure is not to scale)

If measure of ∠ACB = 50°, find the measure of ∠AOB.

1 40° **2** 50° **3** 130° **4** 140°

Q: 5 **In the following figure, O is the center of the circle. PQ, QR and RP are tangents of the circle. TS is parallel to QR.**



(Note: The figure is not to scale.) **Which of these is the measure of ∠RPQ?**

1 35° **2** 55° **3** 62.5° **4** 70°

Q: 6 **How many tangents can be drawn from an external point to a circle?**

1 Only 1 **2** Only 2 **3** Only 3 **4** Infinitely many

Q: 7 **Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Read the statements carefully and choose the option that correctly describes statements (A) and (R).**

Assertion (A): All angles formed by a chord on the same side of the circumference of a circle are equal to each other.

Reason (R): The sum of any two angles formed by a chord on the opposite sides of the circumference of a circle is 180°.

1 Both (A) and (R) are true and (R) is the correct explanation for (A).
2 Both (A) and (R) are true and (R) is not the correct explanation for (A).
3 (A) is false but (R) is true.
4 Both (A) and (R) are false.

Q: 8 **Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Read the statements carefully and choose the option that correctly describes statements (A) and (R).**

Assertion (A): At the point of contact, a tangent to a circle is always perpendicular to the radius.

Reason (R): The point where a tangent touches a circle is the only point of contact between the tangent and the circle.

1 Both (A) and (R) are true and (R) is the correct explanation for (A).
2 Both (A) and (R) are true and (R) is not the correct explanation for (A).
3 (A) is false but (R) is true.
4 (A) is true but (R) is false.

Q: 9 **Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Read the statements carefully and choose the option that correctly describes statements (A) and (R).**

Assertion (A): Area of minor sector formed by an arc is always half the area of the major sector formed by it.

Reason (R): The angle subtended by an arc at the center is double the angle subtended by it at any point on the circumference of the circle.

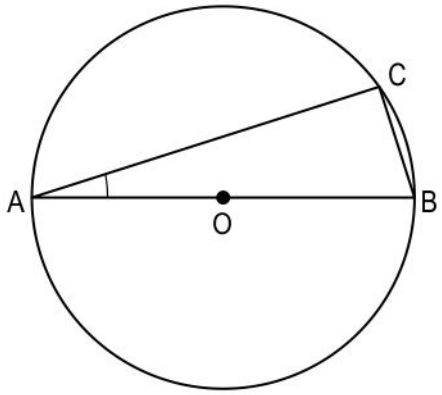
1 Both (A) and (R) are true and (R) is the correct explanation for (A).
2 Both (A) and (R) are true and (R) is not the correct explanation for (A).
3 (A) is true but (R) is false.
4 (A) is false but (R) is true.

Free Response Questions

Q: 10 **AC is a chord to a circle, the length of which is double the radius of the circle.** **[1]**

If B is a point on the circumference of the circle, what is the measure of ∠ABC? Give reason.

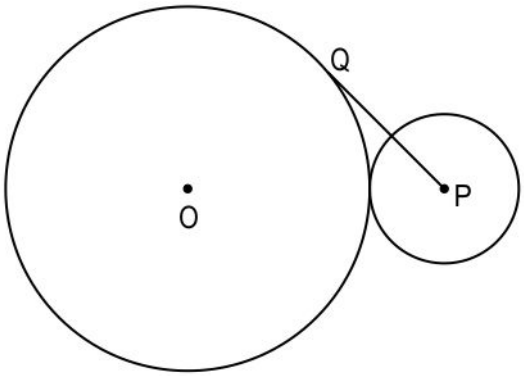
Q: 11 **In the figure below, AB is the diameter of the circle and C is a point on the circumference of the circle with centre O.** **[1]**



(Note: The figure is not to scale.)

If ∠ABC = 50°, what is the measure of ∠BAC? Justify your answer.

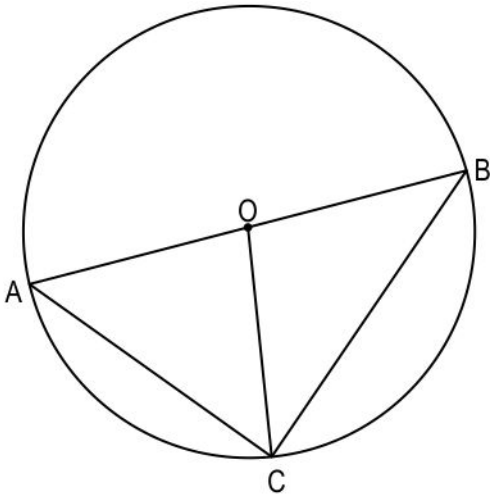
Q: 12 **In the figure below, circles with centres O and P touch each other and their radii are 12 units and 3 units respectively. PQ is a tangent to the circle with centre O.** **[1]**



(Note: The figure is not to scale.)

What is the length of the tangent PQ?

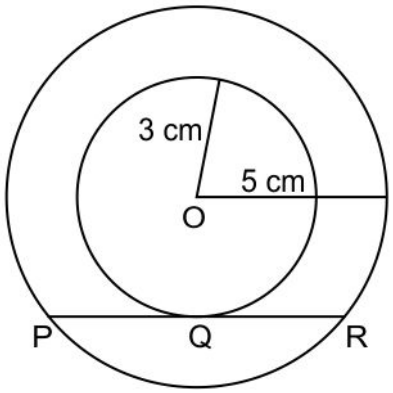
Q: 13 **In the figure below, AB is the diameter of the circle and ∠ABC is 33° where C is the point on circle.** **[1]**



(*Note: The figure is not to scale.*)

If OC is the bisector of ∠ACB, find the measure of ∠BOC. Show your work with valid reasons.

Q: 14 **Shown below are two concentric circles having center O. The radius of the smaller circle is 3 cm and that of the larger circle is 5 cm.** **[2]**



(Note: The figure is not to scale.)

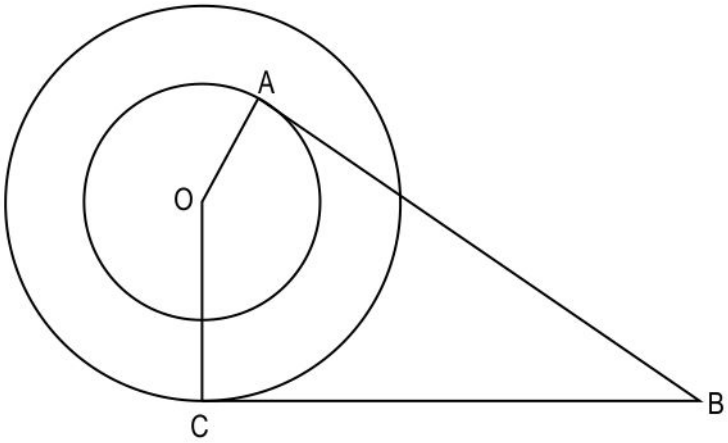
PR is a chord of the larger circle which is also a tangent to the smaller circle at point Q. What is the length of PR?

Show your work and give valid reason.

Q: 15 **i) Construct two tangents to a circle of your choice from an external point. Draw the radii at the points of tangency of both the tangents to form a quadrilateral.** **[2]**
ii) Prove that the line segment joining the external point and the center of the circle divides the quadrilateral into two triangles with equal area.

Show your work.

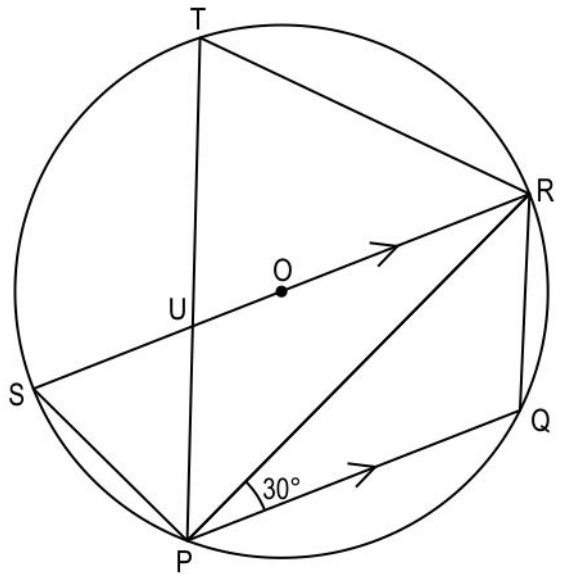
Q: 16 **In the figure below, O is the centre of two concentric circles of radii OA and OC. From point B, tangent BC is drawn to outer circle and tangent BA is drawn to inner circle.** **[2]**



(*Note: The figure is not to scale.*)

If ∠ABC = 43°, find the measure of ∠AOC. Show your work.

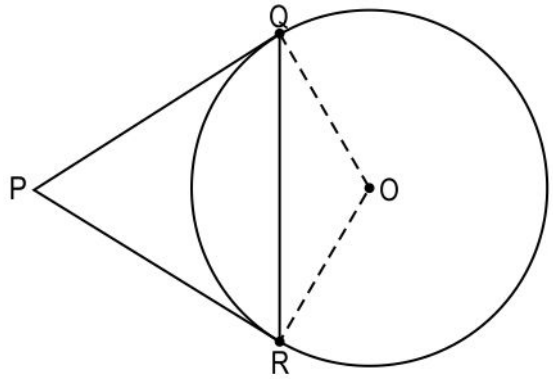
Q: 17 **Shown below is a circle with centre O, ∠RPQ = 30° and RS || PQ.** **[2]**



(Note: The figure is not to scale.)

What is the measure of ∠PTR?

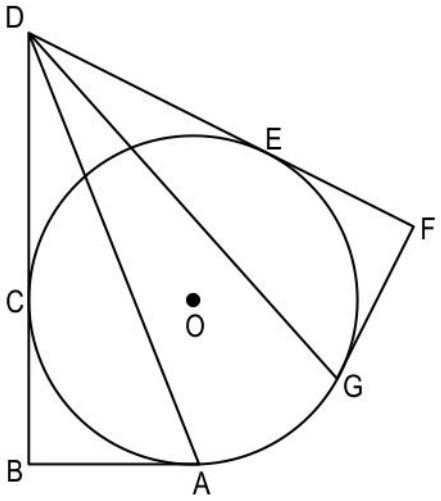
Q: 18 **Shown below is a circle with centre O having radius of 3 units and PQ and PR are the tangents from external points P. The length of PQ is 4 units.** **[3]**



(*Note: The figure is not to scale.*)

Find area of quadrilateral PQOR. Show your steps.

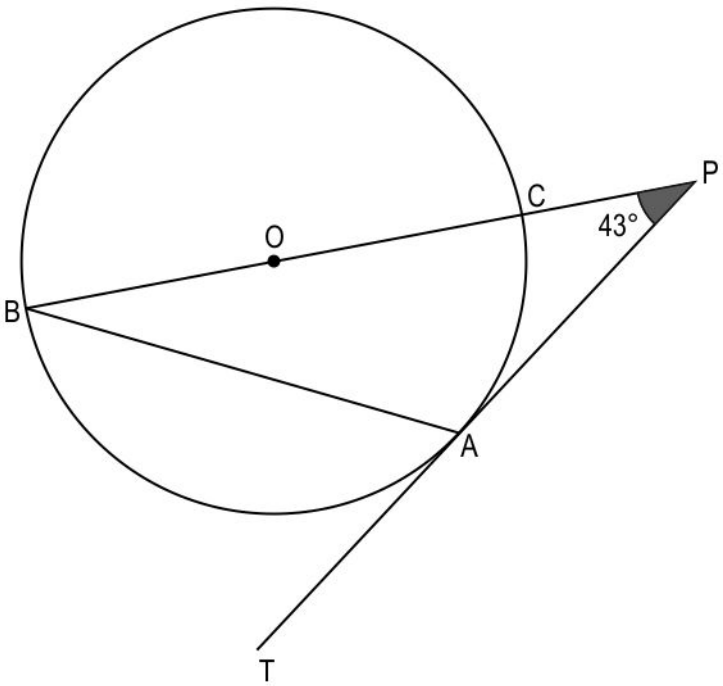
Q: 19 **Shown below is a circle with centre O. AB = GF = 5 cm, DC = 7 cm. A, C, E, and G are the points of tangency with ∠ABC = ∠EFG = 90°.** **[3]**



(Note: The figure is not to scale)

Find the length of (AD + DG). Show your work with valid reasons.

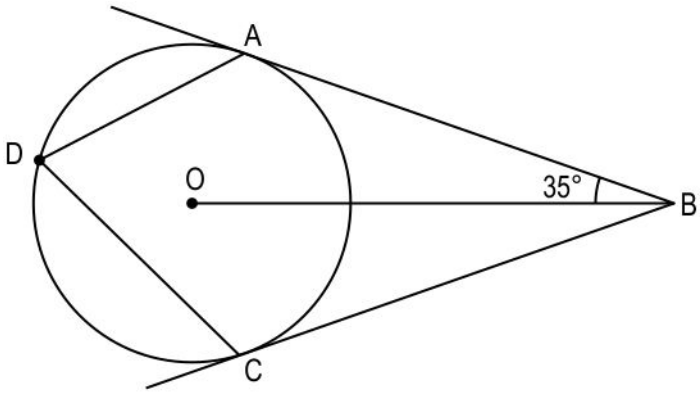
Q: 20 **In the figure given below, BC is a diameter of the circle with center O. PT is tangent to the circle at point A and ∠BPA = 43°.** **[3]**



(Note: The figure is not to scale.)

Find the measure of ∠PAB. Show your work with a rough figure and give valid reasons.

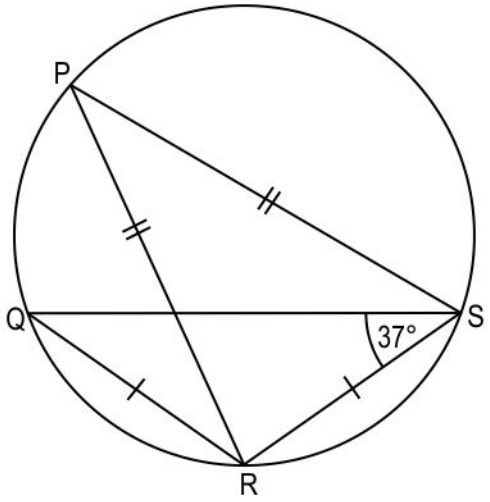
Q: 21 **Given below is a circle with centre O. AB and BC are tangents to the circle from an external point B such that ∠OBA = 35°. D is a point on the circle such that it is NOT on the same line as OB.** **[3]**



(Note: The figure is not to scale.)

Find the measure of ∠ADC. Show your work.

Q: 22 **The points P, Q, R and S lie on the circumference of the circle. SR = RQ , PR = PQ and ∠SQR = 37°.** **[3]**



(Note: The figure is not to scale.)

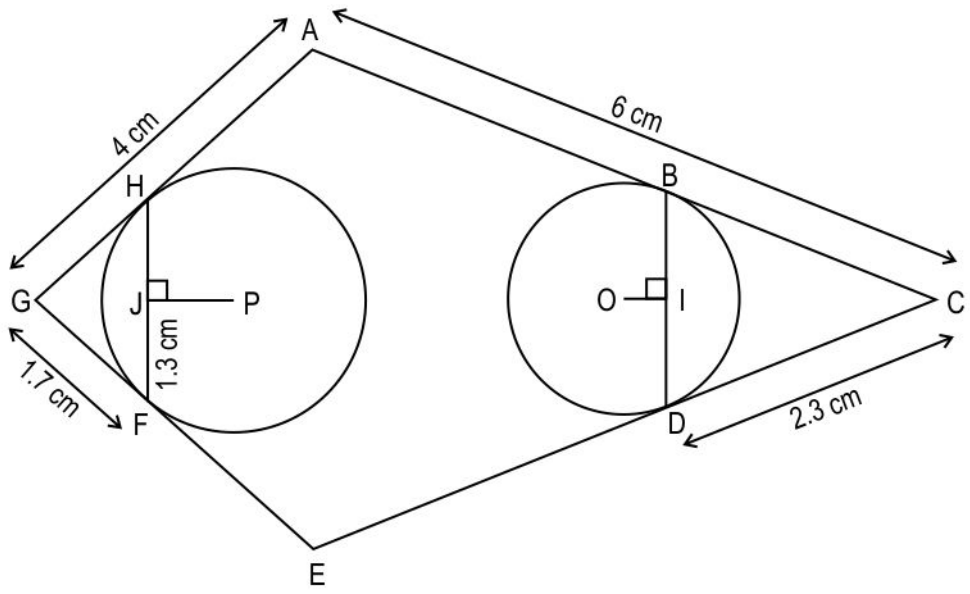
Find ∠PRS. Show your work with valid reasons.

Q: 23 **A circle with centre O and radius 13 units has PM and PN as its two tangents from an external point P. The length of chord MN is 24 units.** **[5]**

Use the properties of tangent to a circle to find the length of (PM + PN). Draw a rough figure and show your work.

Q: 24 **Sahid is learning thread embroidery and draws following pattern with two circles inscribed inside a kite on a piece of cloth. A kite is a quadrilateral with two distinct pairs of adjacent sides that are of equal length. Here, AG = EG and AC = EC.** **[5]**

Chord BD and HF are of equal length.



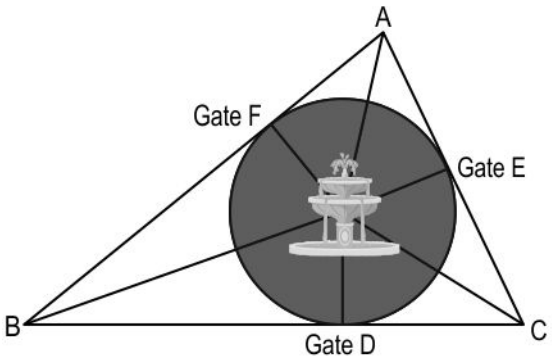
(*Note: The figure is not to scale.*)

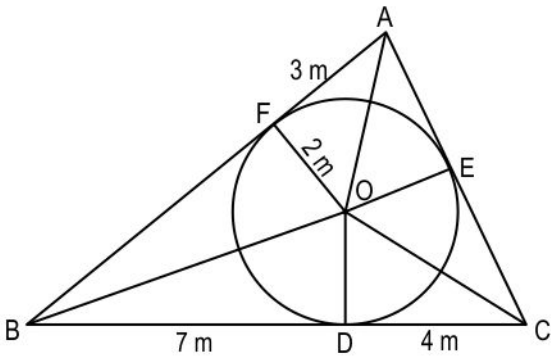
If he wants to enclose hexagon ABDEFH with a red coloured thread, what length of red coloured thread will he need? Show your steps with valid reasons.

Case Study

Answer the questions based on the given information.

A Municipal Corporation wants to build an old-age home on a triangular piece of land. The plan is to build a circular building along the triangular boundary with a water fountain at the centre and utilize the remaining space for gardening. Also, there are six paths that radiate from the fountain towards the boundary of the triangular land. The blueprint along with the dimensions is shown below.





(Note: The figures are not to scale.)

The distance between Gate F and point A is 3 metres. The distance of Gate D from points B and C is 7 metres and 4 metres, respectively. The water fountain is at a distance of 2 meters from gate F.

Q: 25 **The Municipal Corporation needs to pass an underground electric wire from point A to D along the paths AO and OD.** **[2]**

If the cost of laying wire is Rs. 500 per meter, then find the total cost of laying the main electric wire.

Show your work and give your answer correct to nearest hundreds.

Q: 26 **A compound wall along with three solid gates, both of height 2 m is to be built for fencing the entire triangular area.** **[2]**

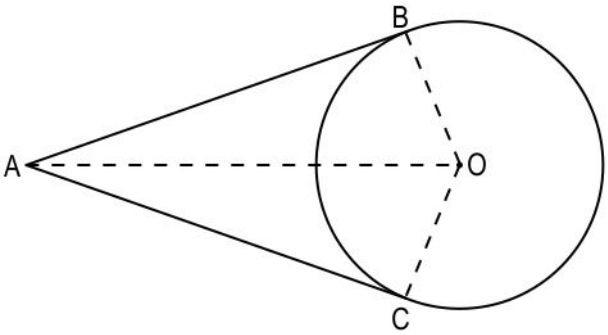
If 1 liter of paint is required to paint 4 m^2 of the internal surface area of the wall and the gates, find the quantity of paint required to paint the entire internal surface of the boundary. Show your work.

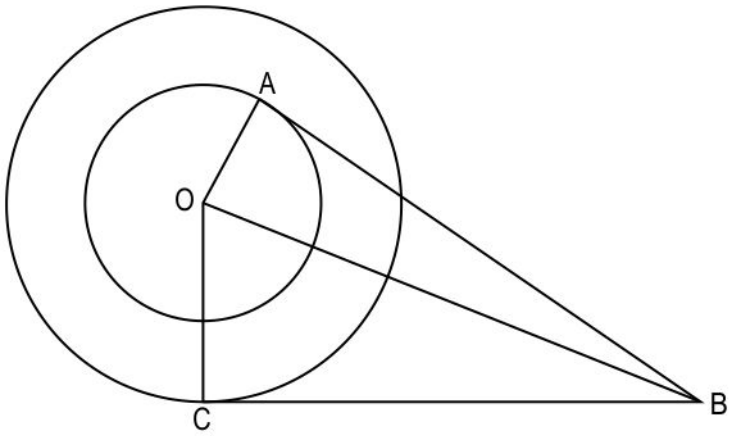
Q: 27 **A person standing somewhere in between point B and gate D wants to go to the fountain at the center. She starts walking towards gate D and takes a turn at gate D.** **[1]**

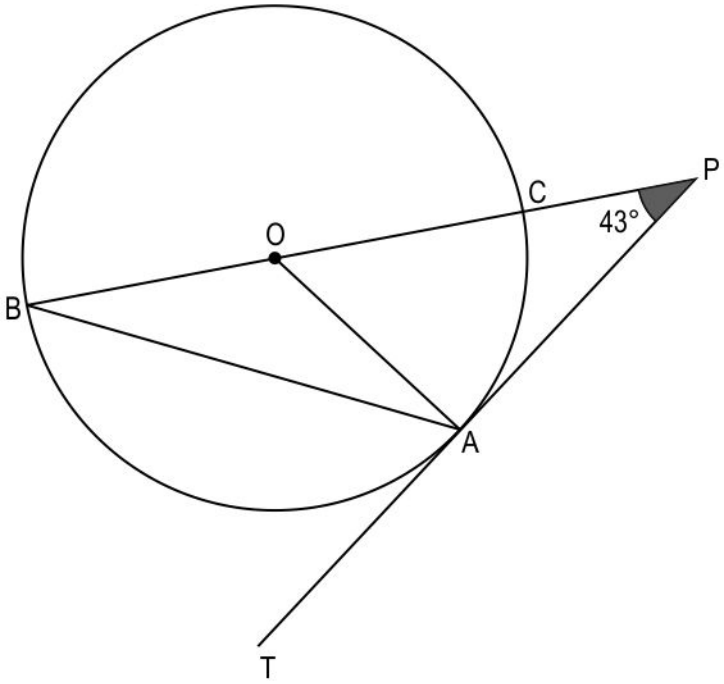
At what angle should she turn at gate D to reach fountain at the center? Support your answer with suitable reason.

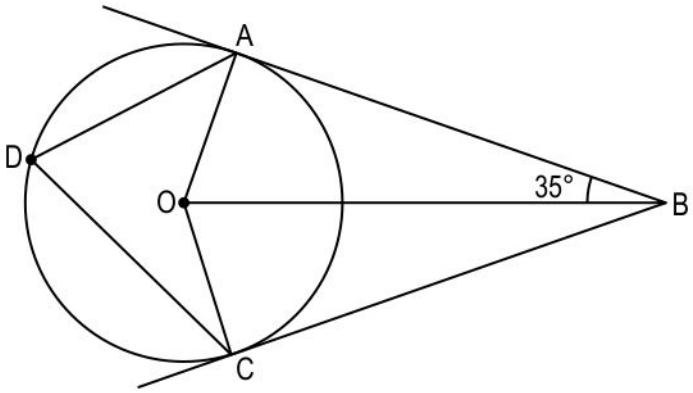
Q.No	Correct Answers
1	3
2	2
3	3
4	1
5	2
6	2
7	2
8	4

Q.No	What to look for	Marks
10	**Writes that the measure of ∠ABC is 90°.**	**0.5**
	States that AC is the diameter of the circle and the angle subtended by diameter on the circumference of the circle is 90°.	**0.5**
11	**States that since diameter subtends right angle on the circumference of circle, ΔABC is a right angled triangle with right angle at point C.**	**0.5**
	States that ∠ABC + ∠CAB = 90°. Therefore, ∠CAB = 40°.	**0.5**
12	Finds the length of PQ as, $\sqrt{OP^2 - OQ^2} = \sqrt{(12+3)^2 - 9^2}$ $= \sqrt{15^2 - 9^2} = \sqrt{225 - 81} = \sqrt{144} = 12$ units.	**1**
13	**States that the angle subtended by a diameter of a circle on it's circumference is 90°. Hence, measure of ∠OCB is 45°.**	**0.5**
	Uses angle sum property of triangle in ΔBCO to find the measure of ∠BOC = 180° - 45° - 33° = 102°.	**0.5**
14	**States that tangent of a circle is perpendicular to its radius.**	**1**
	Uses pythagoras theorem to find the length of QR as, $QR = \sqrt{OR^2 - OQ^2} = \sqrt{5^2 - 3^2} = 4$ cm.	**0.5**
	Finds PR = 2 x QR = 2 x 4 = 8 cm	**0.5**

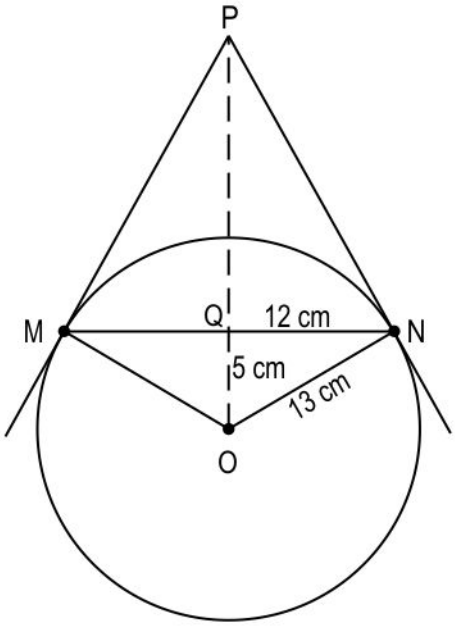
Q.No	What to look for	Marks
15	**i) Draws a circle with centre O and two tangents AB and AC. Joins OA, OB and OC. The figure may look as follows:**  	**0.5**
	ii) Writes that, in ▲OAB and ▲OAC, **OA is common,** **OB = OC (radii of the same circle)** **∠OBA = ∠OCA = 90°** **Concludes that, ▲OAB is congruent to ▲OAC by RHS congruence criteria. Hence, writes that line segment AO joining the external point and the center of the circle, divides the quadrilateral made by both the tangents and the radius of the circle into two equal parts.** **(Award full marks if any other correct method is used. For example, this can also be proved by showing that the heights of two triangles are the same.)**	**1.5**
16	**States that in a circle angle made between radius and tangent at the point of contact of tangent is 90°.**	**0.5**

Q.No	What to look for	Marks
	Joins line segment OB as shown in image below.  **Finds measure of ∠AOB = 180° - 90° - ∠ABO = 90° - ∠ABO.** **Similarly, ∠COB = 180° - 90° - ∠CBO = 90° - ∠CBO.**	**0.5**
	Finds ∠AOC = ∠AOB + ∠COB = 180° - ∠ABO - ∠CBO = 180° - ∠ABC = 180° - 43° = 137° **(Award full marks if any other correct method is used.)**	**1**
17	**Writes that in ▲RPS:** **∠PRS = 30° (alternate interior ∠'s since RS||PQ)** **∠SPR = 90° (Angle subtended in semi-circle is of 90°)** **∠PSR = (180° - 90° - 30°) = 60° (Angle sum property of triangle.)**	**1.5**
	Writes that ∠PSR = ∠PTR (angles in the same segment on chord PR) **Hence, measure of ∠PTR = 60°**	**0.5**
18	**Writes that tangents from external points are equal in length.** **Hence, PQ = PR = 4 units.**	**1**
	States that since PQ and PR are tangents to the circle, ∠PRO and ∠PQO are right angles. **Hence, ▲PQO and ▲PRO are right angled triangle.**	**0.5**

Q.No	What to look for	Marks
	Finds area of $\triangle PQO = \frac{1}{2} \times OQ \times PQ = \frac{1}{2} \times 3 \times 4 = 6$ sq units. Similarly, area of $\triangle PRO = 6$ sq units.	1
	Finds the area of quadrilateral PQOR = area of $\triangle PQO$ + area of $\triangle PRO$ = 12 sq units.	0.5
19	Uses the property that length of tangents drawn from an external point to a circle are equal and writes that AB = BC = GF = EF = 5 cm and CD = DE = 7 cm.	1
	Finds the length of BD = CD + BC = 7 + 5 = 12 cm and BD = DF = 12 cm.	1
	Using pythagoras theorem, in $\triangle ABD$, $AD^2 = BD^2 + AB^2$, we have AD = 13 cm.	0.5
	Finds AD + DG = 13 + 13 = 26 cm.	0.5
20	Draws OA. The figure may look as follow: 	0.5

Q.No	What to look for	Marks
	Writes that the tangent to a circle is perpendicular to the radius of the circle at the point of contact and hence ∠OAP = 90°.	**0.5**
	Uses the exterior angle property of triangles in ▲OAP as: **∠AOB = ∠OAP + ∠APO** **=> ∠AOB = 90° + 43° = 133°.**	**0.5**
	Writes that ▲OAB is an isoceles triangle as OA = OB and hence ∠OAB = ∠OBA.	**0.5**
	Uses the angle sum property of a triangle in ▲OAB and gets: **$\angle OAB = \angle OBA = \frac{180-133}{2} = 23.5°$.**	**0.5**
	Finds the measure of ∠PAB as 90° + 23.5° = 113.5°. **(Award full marks if any other correct method is used.)**	**0.5**
21	**Joins OA and OC as follows:**  **Mentions that in ▲OBA and ▲OBC:** **i) OA = OC (radii of the circle)** **ii) AB = CB (tangents from an external point)** **iii) ∠OAB = ∠OCB = 90° (AB and BC are tangents)**	**1**

Q.No	What to look for	Marks
	Uses the above step to conclude that ▲OBA ≅ ▲OBC by RHS congruency.	0.5
	Writes that ∠OBA = ∠OBC since the corresponding angles of congruent triangles are equal.	0.5
	In ABCO, finds ∠AOC as 360° - (90° + 90° + 70°) = 110°.	0.5
	Writes that angle made by the chord AC at the circumference is half of the angle made at the centre and hence finds the measure of ∠CDA as $\frac{110^\circ}{2}$ = 55°.	0.5
22	States that in ▲QRS, ∠RQS = ∠RSQ = 37° giving reason that angles on the equal sides of a triangle are equal in measure.	1
	States that angles in the same segment of a circle are equal. Hence, ∠RQS = ∠RPS = 37°.	1
	Finds that in ▲PRS, ∠PRS = $\frac{180-37}{2}$ = 71.5° since ∠PRS = ∠RSP as they are angles on the equal sides of the triangle.	1

Q.No	What to look for	Marks
23	**Joins OP so that it intersects MN at point Q. Then, ▲MPN is isosceles and PO is the angle bisector of ∠MPN.** **So, OP ⊥ MN and therefore, OP bisects MN which gives NQ = QM = 12 cm.** **Also, OQ = √ (ON^2 - NQ^2) = √ (13^2 - 12^2) cm = 5 cm.** **Draws a rough image similar to the image given below -** 	**2**
	States that since, OP ⊥ MN, ▲PQN is right angled triangle with ∠PQN = 90°. **Now, ∠PNQ + ∠QNO = 90° = ∠PNQ + ∠NPQ** **So, ∠QNO = ∠NPQ**	**1**
	Therefore, By AA similarity, ▲PQN ~ ▲NQO. **Hence, $\frac{PN}{NO} = \frac{QN}{QO}$** **Substitutes the value of NO, QN and QO, and finds $\frac{PN}{13} = \frac{12}{5}$** **=> PN = $\frac{156}{5}$ cm**	**1**

Q.No	What to look for	Marks
	States that, since, PM amd PN are tangents to the circle from an external point, PM = PN. Hence, PM + PN = $2\times \frac{156}{5}$ cm = $\frac{312}{5}$ cm (Provide full marks for any other correct methods used.)	1
24	Writes that tangents from an external point to a circle are equal in length. Hence finds GF = GH = 1.7 cm and CD = BC = 2.3 cm.	1
	Finds AH as 4 - 1.7 = 2.3 cm and AB as 6 - 2.3 = 3.7 cm.	1
	Writes that the perpendicular from the centre to a chord bisects the chord. Thus finds BD = HF = 2 × 1.3 = 2.6 cm.	1
	Writes that distinct pair of adjacent sides in a kite are equal and states with reference from question that AG = EG and AC = EC. Finds AG = EG = 4 cm and AC = EC = 6 cm. Thus finds FE = 4 - 1.7 = 2.3 cm and ED = 6 - 2.3 = 3.7 cm.	1
	Finds the perimeter of the hexagon ABDEFH as: 3.7+ 2.6 + 3.7+ 2.3 + 2.6 + 2.3 = 17.2 cm Concludes that Sahid will need 17.2 cm of red coloured thread.	1
25	States that the tangent to a circle is perpendicular to the radius of the circle, therefore, ▲AOF is right angled triangle.	0.5
	By using Pythagoras theorem, $AO^2 = OF^2 + AF^2$, Finds AO as √13 m. Finds AD as: AD = AO + OD = (√13 + 2) m	1

Q.No	What to look for	Marks
	Finds the total cost of laying wire correct to nearest hundreds as (√13 + 2) × 500 = 500√13 + 1000 = Rs 2800.	0.5
26	States that the length of tangents drawn from an external point to the circle are same and concludes BF = BD = 7 m, AE = AF = 3 m and CD = CE = 4 m.	1
	Finds perimeter of △ABC as 28 m. Calculates area to be painted as $2 \times 28\ m^2 = 56\ m^2$. Concludes that $56 \times \frac{1}{4} = 14$ liters of paint is required to cover the entire internal surface area of the wall and gates.	1
27	States the reason that angle between tangent and radius to the circle at the point of contact of tangent to the circle is 90°. Hence, concludes that the person must turn by a measure of 90°.	1

Chapter - 4
Coordinate Geometry

Multiple Choice Questions

Q: 1 **What is the distance between the points (-1, 3) and (2, -5)?**

1 √5 **2** √55 **3** √65 **4** √73

Q: 2 **A circle of radius 5 units has its centre at (-2, 2). The point (-6, *y*) lies on the circle.**

Which of these could be the value of *y* ?

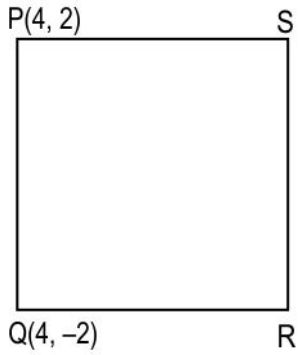
1 -3 **2** 1 **3** 5 **4** 6

Q: 3 **P(1, 7), Q(-3, 2) and R(6, 1) are the coordinates of the vertices of a triangle.**

Which of the following types of triangle is △PQR?

1 Scalene triangle
2 Equilateral triangle
3 Isosceles right-angled triangle
4 Isosceles acute-angled triangle

Q: 4 **In the SQUARE given below, the coordinates of two adjacent vertices P and Q are given.**



What are the coordinates of vertex R?

1 (-4, -2) **2** (8, 2) **3** (8, -2) **4** (-4, 2)

Q: 5 **△PQR is a triangle such that PQ:PR = 1:2. Point P lies on the *x* -axis and the coordinates of Q and R are known.**

Which of the following formula can DEFINITELY be used to find the coordinates of P?

i) Section formula
ii) Distance formula

1 only i) **2** only ii) **3** both i) and ii) **4** neither i) or ii)

Q: 6 **Which one of these is the relation between *x* and *y* if (*x, y*) is equidistant from (-1, 4) and (2, 5)?**

1 $3x - y = 6$ **2** $6x + 2y = -9$
3 $3x + y = 6$ **4** $3x - y = 3$

Q: 7 **What is the distance of (7, -3) from the origin?**

1 7 units **2** √40 units **3** √21 units **4** √58 units

Q: 8 **Which of the following points is the mid-point of the line segment joining P(5, 2) and Q(7, 6)?**

1 (1, 2) **2** (6, 4) **3** (2, 4) **4** (4, 4)

Free Response Questions

Q: 9 **The point (*x, y*) is equidistant from (-4, 0) and (5, 3).** **[1]**

Write an equation relating *x* and *y*. Show your steps.

Q: 10 **In what ratio does the origin divides line segment joining A(-5, 0) and B(3, 0)? Show your work.** **[1]**

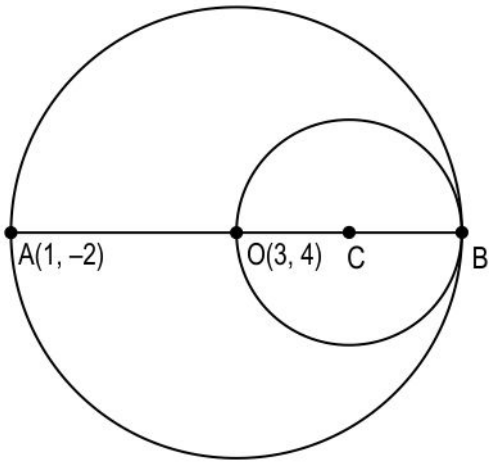
Q: 11 **A(6, 8), B(3, 7) and C(4, 4) are the vertices of a right-angled triangle, where ∠B = 90°.** **[2]**

Find the area of the triangle. Show your work.

Q: 12 **F lies on the line segment joining E(-3, 2) and G(4, 5). F divides EG in the ratio 2:1.** **[2]**

Find the coordinates of F. Show your work.

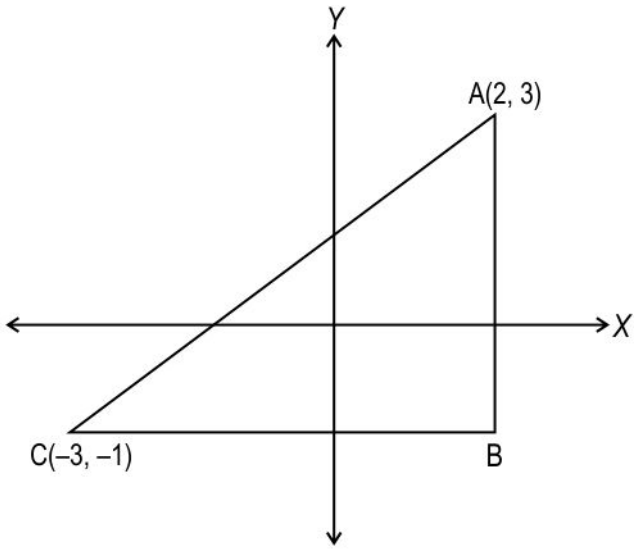
Q: 13 **In the figure given below, AB is the diameter of the circle with centre O and OB is the diameter of the circle with centre C.** **[2]**



(Note: The figure is not to scale)

Find the coordinates of point C. Show your steps.

Q: 14 **Shown below is a right triangle ABC.** **[2]**



Find the value of cos C. Show your work.

Q: 15 **Find the ratio in which O(4, 3) divides the line segment joining A(2, 1) and B(7, 6). Show your work.** **[2]**

Q: 16 **Find the length of the longest side of the triangle formed by the points of intersection of line 8 x + 6 y = 48 with the coordinate axes. Show your work.** **[2]**

Q: 17 **A square is inscribed in a circle of radius 2 cm with center O at the origin. All 4 vertices of the square lie on the coordinate axes.** **[2]**

Use the distance formula to find the length of the side of the square. Show your work.

Q: 18 **Check whether the points A(0, 5), B(2, 3), C(4, 5) and D(2, 7) are the vertices of a square. Show your work.** **[3]**

Q: 19 **Atul plotted the seating plan of his classroom on a cartesian plane such that, Abdul is seated at (3, 7), and Vaibhav is seated at (-2, -1). Prashant is seated somewhere on the line that connects Abdul and Vaibhav. It is given that the distance between Prashant and Vaibhav is half of the distance between Abdul and Prashant.** **[3]**

What are the coordinates of Prashant's seat? Show your work.

Q: 20 **P(-6, 4) and Q(2, 10) are the two end-points of the diameter of the circle with centre O(x, y).** **[3]**

i) Find the radius.
ii) Prove that $4x + 3y - 13 = 0$.

Show your steps.

Q: 21 **Find the ratio in which the x-axis divides the line segment joining the points A(4, 9) and B(3, -5). Show your work.** **[3]**

Q: 22 **The three vertices of a rhombus ABCD are A(-3, 2), B(-5, -5) and C(2, -3).** **[3]**

i) Find the coordinates of the point where both the diagonals AC and BD intersect.
ii) Find the coordinates of the fourth vertex D.

Show your steps and give valid reasons.

Q: 23 **Prove that A(-1, 1), B(1, 2) and C(3, 3) are collinear.** **[3]**

Q: 24 **Points C and D divide the line segment AB into 3 equal parts where the coordinates of points A and D are (4,2) and (8,10) respectively.** **[3]**

What are the coordinates of point B? Show your work.

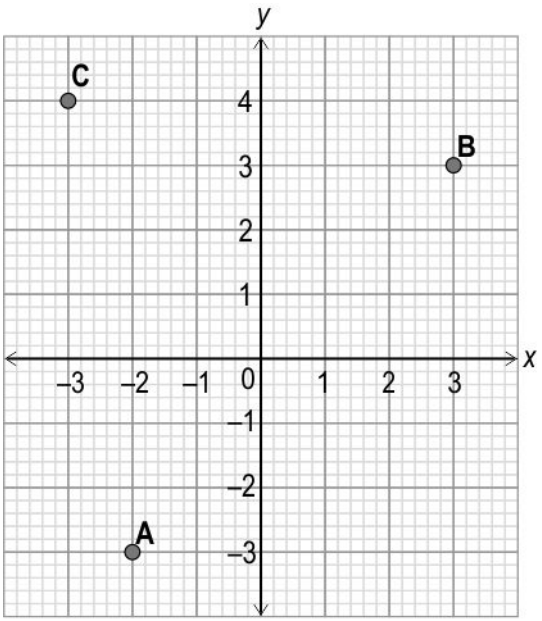
Q: 25 **A circle passes through the following points:** **[5]**

P(-1, 5), Q(-4, 6) and R(-2, 2)

i) Find the coordinates of the centre of the circle.
ii) Find the radius of the circle.

Show your work.

Q: 26 **Shown below is a coordinate grid with points A, B, and C plotted on it.** **[5]**



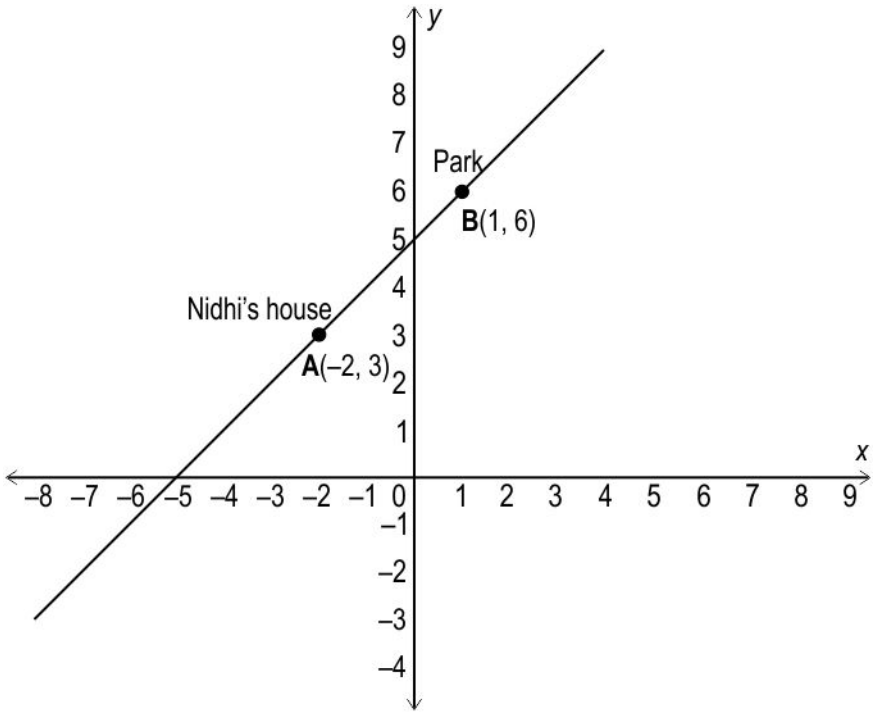
(i) Find the length of all the sides of the triangle formed by A, B, and C.
(ii) Find the area of triangle ABC.

Show your work.

Case Study

Answer the questions based on the given information.

Nidhi and Shikha have planned to meet at a park. Nidhi's house is at point A, and the park is at point B as shown in the below figure. Shikha's house is at point C, the coordinates of which are unknown.



Points A, B, and C lie on a straight line. The park divides the line connecting their houses such that AB:BC = 3:2.

Q: 27 **Find the coordinates of Shikha's house.** **[3]**

Q: 28 **Find the distance between Nidhi's house and the Park.** **[1]**

Q: 29 **Find the distance between Nidhi's house and Shikha's house.** **[1]**

Q.No	Correct Answers
1	4
2	3
3	1
4	3
5	2
6	3
7	4
8	2

Q.No	What to look for	Marks
9	Applies the distance formula correctly to write $\sqrt{\{(x+4)^2 + y^2\}} = \sqrt{\{(x-5)^2 + (y-3)^2\}}$	0.5
	Writes the relation as $3x + y = 3$.	0.5
10	Writes the distance of A from the origin is 5 units and that of B from the origin is 3 units. Hence, the ratio in which the origin divides the line segment AB is 5:3 (Award full marks if student uses any other method using calculation.)	1
11	Identifies height of triangle = AB and base of triangle = BC.	0.5
	Finds height = AB = $\sqrt{\{(-3)^2 + (-1)^2\}} = \sqrt{10}$ units and base = BC = $\sqrt{\{(1^2 + (-3)^2)\}} = \sqrt{10}$ units.	1
	Finds area of triangle = $\frac{1}{2}$ × base × height = $\frac{1}{2} \times \sqrt{10} \times \sqrt{10} = 5$ square units.	0.5
12	Uses the section formula to find the coordinates of the point F as follows: $\left(\frac{2(4)+1(-3)}{2+1}, \frac{2(5)+1(2)}{2+1}\right)$	1
	Simplifies the above expression and finds the coordinates of point F as $(\frac{5}{3}, 4)$.	1
13	Finds the coordinates of B using the mid-point formula as B(5, 10). Working may look like: Let co-ordinates of B be (x, y) O(3, 4) = $(\frac{(x+1)}{2}, \frac{(y-2)}{2})$ => $x = 5$, $y = 10$	1.5
	Finds the coordinates of C using the mid-point formula as C(4, 7). Working may look like: Let co-ordinates of C be (m, n) C(m, n) = $(\frac{(3+5)}{2}, \frac{(4+10)}{2})$ => $m = 4$, $n = 7$	0.5

Q.No	What to look for	Marks
14	Finds the coordinates of B as (2, -1).	0.5
	Uses the distance formula and finds AC = $\sqrt{(5^2 + 4^2)} = \sqrt{41}$ units and BC = $\sqrt{(5)^2}$ = 5 units.	1
	Mentions cos C = $\frac{BC}{AC}$ and finds the value as $\frac{5}{\sqrt{41}}$.	0.5
15	Finds the distances using the distance formula: AO = $\sqrt{8} = 2\sqrt{2}$ units BO = $\sqrt{18} = 3\sqrt{2}$ units	1
	Finds the ratio $\frac{AO}{BO} = \frac{2}{3}$. Hence, the ratio in which O(4, 3) divides the line segment AB is 2:3. (Award full marks if the student correctly solves the same using the Section Formula.)	1
16	Substitutes x and y as 0 in the given equation $8x + 6y = 48$ to find the coordinates of the points of intersection as (0, 8) and (6, 0) respectively.	1
	Uses the distance formula to find the length of the longest side of the triangle as $\sqrt{\{(0 - 6)^2 + (8 - 0)^2\}} = 10$ units.	1
17	Writes that the coordinates of the vertices of the circle would be (2, 0), (0, -2), (-2, 0), (0, 2).	1
	Uses the distance formula and any 2 adjacent coordinates of the vertices of the square to find the length of the side of the square as $2\sqrt{2}$ cm.	1
18	Finds the measure of AB as $\sqrt{\{(2)^2 + (-2)^2\}} = \sqrt{8} = 2\sqrt{2}$ units. Finds the measure of BC as $\sqrt{\{2^2 + 2^2\}} = \sqrt{8} = 2\sqrt{2}$ units.	1
	Finds the measure of CD as $\sqrt{\{(-2)^2 + 2^2\}} = \sqrt{8} = 2\sqrt{2}$ units. Finds the measure of DA as $\sqrt{\{(-2)^2 + (-2)^2\}} = \sqrt{8} = 2\sqrt{2}$ units.	1

Q.No	What to look for	Marks
	Finds the diagonals of ABCD as: **AC = √{(4 - 0)^2 + (5 - 5)^2 } = √16 = 4 units.** **BD = √{(2 - 2)^2 + (7 - 3)^2 } = √16 = 4 units.**	**0.5**
	Concludes AB = BC = CD = DA and, AC = BD. Hence, A, B, C, and D are vertices of a square. **(Award full marks if the student uses any other method to prove this).**	**0.5**
19	**Represents the given situation mathematically as:** **Let the positions of Abdul, Prashant and Vaibhav be as points A, P and V on the seating plan.** **Here, PV = $\frac{1}{2}$ AP** **=> $\frac{AP}{PV} = \frac{2}{1}$** **=> AP:PV = 2:1**	**1**
	Uses section formula for the coordinates of P such that it divides AV in the ratio of 2:1 as: $\left(\frac{1(3)+2(-2)}{2+1}, \frac{1(7)+2(-1)}{2+1}\right)$	**1**
	Simplifies the above expression to find the coordinates of Prashant's seat as ($\frac{-1}{3}$, $\frac{5}{3}$).	**1**
20	**i) Finds the diameter, PQ as √{(2 + 6)^2 + (10 - 4)^2 } = 10 units.**	**1**
	Finds the radius as $\frac{10}{2}$ = 5 units.	**0.5**
	ii) Uses the distance formula and writes the following relation: **(x + 6)^2 + (y - 4)^2 = (x - 2)^2 + (y - 10)^2**	**0.5**
	Simplifies the above equation and concludes that 4 x + 3 y - 13 = 0.	**1**

Q.No	What to look for	Marks
21	Assumes that the ratio as $p:q$ and mentions that the coordinates of the point at which the line intersects the x -axis can be taken as (x, 0).	1
	Uses the section formula to write the equation as: $(x, 0) = \left(\frac{3p+4q}{p+q}, \frac{-5p+9q}{p+q}\right)$	1
	Equates $\frac{-5p+9q}{p+q}$ to 0 as: $\frac{-5p+9q}{p+q} = 0$ $\Rightarrow 5p = 9q$ $\Rightarrow p : q = 9:5$	1
22	i) Writes that the diagonals of a rhombus bisect each other.	0.5
	Finds the point of intersection of both the diagonals by finding the mid-point of A(-3, 2) and C(2, -3) as $\left(\frac{-1}{2}, \frac{-1}{2}\right)$.	0.5
	ii) Finds the mid-point of B(-5, -5) and D(x, y) as $\left(\frac{x-5}{2}, \frac{y-5}{2}\right)$, where x and y are the coordinates of the fourth vertex D.	0.5
	Uses the above steps and equates the respective coordinates of the mid-points to get the following relationships: $\frac{-1}{2} = \frac{x-5}{2}$ $\frac{-1}{2} = \frac{y-5}{2}$	0.5
	Solves the above two equations to find the values of x and y as 4 and 4 respectively. Concludes that the coordinates of the fourth vertex D are (4, 4).	1
23	Assumes that A, B and C are collinear and hence AB + BC = AC. Finds the distance AB, BC and AC as: $AB = \sqrt{(2^2 + 1^2)} = \sqrt{5}$ units $BC = \sqrt{(2^2 + 1^2)} = \sqrt{5}$ units $AC = \sqrt{(4^2 + 2^2)} = \sqrt{20} = 2\sqrt{5}$ units	2

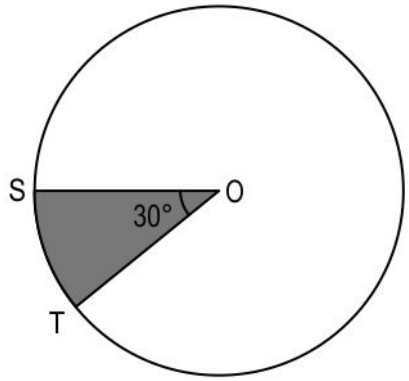
Q.No	What to look for	Marks
	Writes that since AB + BC = AC, A, B and C are collinear. (Award full marks if the student proves the same using the area of the triangle method.)	1
24	Assumes the coordinate of point B as (x, y). States that since points C and D divide line segment AB into 3 equal parts, point D will divide AB in the ratio of 1:2 or 2:1.	1
	Uses section formula to find the values of (x, y) as (16,26) when D divides AB in ratio 1:2. The working may look as follows: $(8,10) = \left(\frac{x+8}{3}, \frac{y+4}{3}\right)$	1
	Uses section formula to find the values of (x, y) as (10,14) when D divides AB in ratio 2:1. The working may look as follows: $(8,10) = \left(\frac{2x+4}{3}, \frac{2y+2}{3}\right)$	1
25	i) Assumes the centre of the circle as any point, say O(x, y) and uses the distance formula to find OP, OQ and OR. $OP = \sqrt{[(x+1)^2 + (y-5)^2]} = \sqrt{(x^2 + 2x + y^2 - 10y + 26)}$ $OQ = \sqrt{[(x+4)^2 + (y-6)^2]} = \sqrt{(x^2 + 8x + y^2 - 12y + 52)}$ $OR = \sqrt{[(x+2)^2 + (y-2)^2]} = \sqrt{(x^2 + 4x + y^2 - 4y + 8)}$	1.5
	Uses OP = OQ to get $3x - y + 13 = 0$. Uses OP = OR to get $x + 3y - 9 = 0$. Uses OQ = OR to get $x - 2y + 11 = 0$. (Award full marks if any 2 of the 3 equations are formed.)	1
	Solves any 2 of the 3 equations mentioned in step 2 to get $x = -3$ and $y = 4$. Concludes that the centre of the circle is O(-3, 4).	1.5
	ii) Substitutes the value of x and y in any one of the equations in step 1 to find the radius of the circle as: $OP = \sqrt{(9 - 6 + 16 - 40 + 26)} = \sqrt{5}$ units	1
26	(i) Identifies points as A(-2, -3), B(3, 3) and C(-3, 4).	1

Q.No	What to look for	Marks
	Finds the distance AB = $\sqrt{(5^2 + 6^2)} = \sqrt{61}$ units.	**1**
	Finds the distance BC = $\sqrt{(6^2 + 1^2)} = \sqrt{37}$ units.	**1**
	Finds the distance AC = $\sqrt{((-1)^2 + 7^2)} = \sqrt{50}$ units.	**1**
	(ii) Finds the area of ΔABC as: Area of $\Delta ABC = \frac{1}{2}\|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)\|$ Area of $\Delta ABC = \frac{1}{2}\|(-2)(3-4) + 3(4+3) + (-3)(-3-3)\|$ Area of $\Delta ABC = \frac{41}{2}$ sq units	**1**
27	**Uses the section formula by considering C(*m*, *n*) and dividing line AC such that AB:BC = 3:2 to write:** $B(1, 6) = (\frac{3\times m+2\times(-2)}{3+2}, \frac{3\times n+2\times 3}{3+2})$	**1**
	Simplifies the expressions obtained above to form pairs of equations as $\frac{3m}{}$ - 4/5)} = 1 and $\frac{3n}{}$ + 6/5)} = 6.	**1**
	Solves the above system of equations to obtain 3 *m* = 9 and 3 *n* = 24 to find *m* = 3 and *n* = 8. **Hence obtains the coordinates of Shikha's house as C(3, 8).**	**1**
28	**Uses the distance formula to find the distance between Nidhi's house and the park as:** **$\sqrt{(1 - (-2))^2 + (6 - 3)^2} = \sqrt{18} = 3\sqrt{2}$ units**	**1**
29	**Writes coordinates of Nidhi's house as A(-2, 3) and Shikha's house as C(3, 8).** **Uses the distance formula to find the distance between their houses as $\sqrt{(3 - (-2))^2 + (8 - 3)^2} = \sqrt{50}$ units = $5\sqrt{2}$ units.**	**1**

Chapter - 5
Areas related to circles

Multiple Choice Questions

Q: 1 **Shown below is a circle with centre O. The area of the minor sector SOT is 7 cm^2.**



(Note: The figure is not to scale.)

What is the area of the circle?

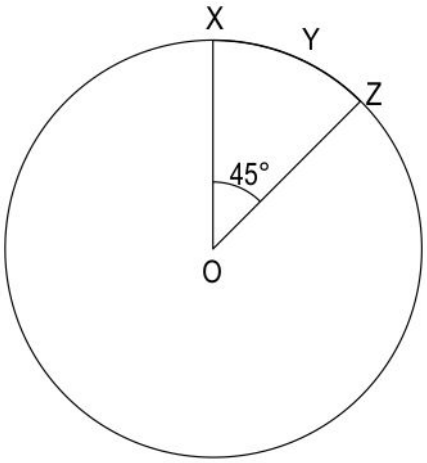
1 $84\pi\ cm^2$

2 $\frac{84}{11}\ cm^2$

3 $84\ cm^2$

4 $\frac{\sqrt{84}}{\sqrt{\pi}}\ cm^2$

Q: 2 **In the figure given below, O is the centre of the circle. XYZ is an arc on the circle subtending an angle of 45° at the centre.**

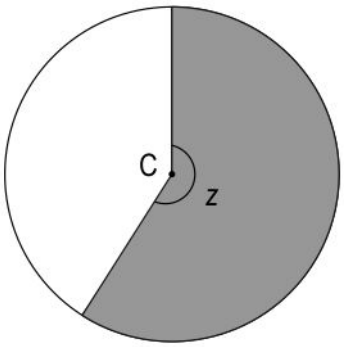


(Note: The figure is not to scale.)

If the radius of the circle is 32 cm, then what is the length of the arc XYZ?

1 4π cm **2** 8π cm **3** 64π cm **4** 128π cm

Q: 3 **In the figure shown below, C is the centre of the circle. The area of the shaded sector is $\frac{5}{8}$ of the area of the circle.**

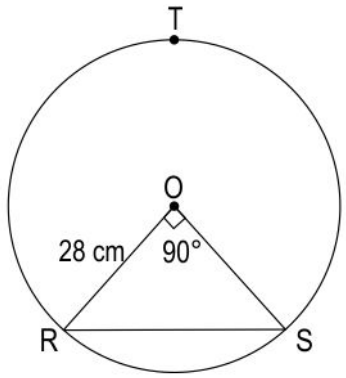


(Note: The figure is not to scale.)

What is the measure of angle *z* ?

1 135°
2 200°
3 225°
4 (cannot be determined as the radius of circle is not given)

Q: 4 **Shown below is a circle with centre O and radius 28 cm. Chord RS subtends an angle of 90° at O.**



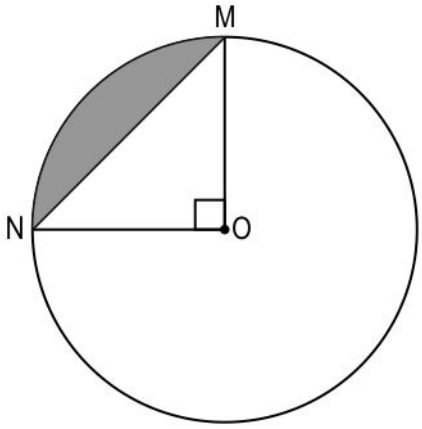
(Note: The figure is not to scale.)

What is the area of the segment RTS?

(Note: Take π as $\frac{22}{7}$.)

1 224 cm^2 **2** 616 cm^2
3 1848 cm^2 **4** 2240 cm^2

Q: 5 **In the circle shown below, O is the centre. MN is a chord which subtends an angle of 90° at the centre. The area of the shaded region is 72 cm^2.**



What is the radius of the circle?

(Note: Take π as $\frac{22}{7}$.)

1 6√7 cm **2** 6√28 cm **3** 84 cm **4** 252 cm

Q: 6 **A circular pond needs to be fenced along its circumference. One-fourth of the fencing is already done, which cost Rs 750 at the rate of Rs 50 per metre.**

How many metres of the pond still need to be fenced?

1 15 **2** 20 **3** 45 **4** 60

Q: 7 **Which of the following information is NOT sufficient to differentiate between minor and major sector of a circle?**

1 the angle subtended at the centre
2 the radius of the circle
3 the area of the sector
4 the length of the arc

Free Response Questions

Q: 8 **In a circular agricultural field, a sector subtending an angle of 120° at the centre is dedicated to growing sugarcane.** **[1]**

If the radius of the circular field is 30 meters, what is the area of the land used for growing sugarcane? Show your work.

(Note: Take π as 3.14.)

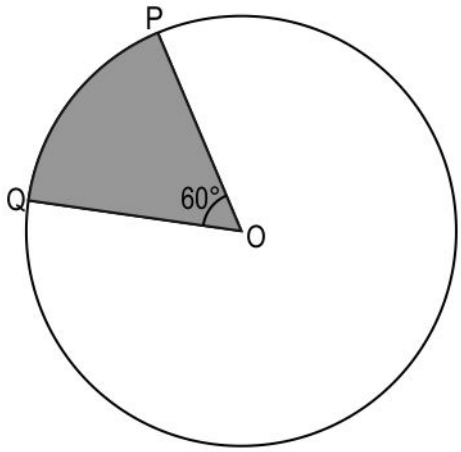
Q: 9 **Anjali got the following question in her class test.** **[1]**

"*A 13 cm chord of a circle subtends an angle of 60° at the centre. Find the area of the minor segment.*"

After the test, she went to the teacher and said, "The question cannot be answered as it doesn't mention the radius of the circle".

Is Anjali right or wrong? Give a valid reason for your answer.

Q: 10 **Shown below is a circle with centre O. The area of the shaded region is 294π cm^2.** **[1]**



(Note: The figure is not to scale.)

What is the area of the circle? Show your work.

Q: 11 **Find the length of an arc which subtends an angle of 80° at the centre of a circle with radius 63 cm. Show your work.** **[1]**

(Note: Take π as $\frac{22}{7}$.)

Q: 12 **The length of an arc of a circle is 22 cm and its radius is 21 cm.** **[2]**

What is the area of the sector formed by the arc? Show your work.

(Note: Use π as $\frac{22}{7}$.)

Q: 13 **Find the perimeter of a sector with a radius of 18 cm subtending an angle of 70° at the centre. Show your work.** **[2]**

(Note: Use π as $\frac{22}{7}$.)

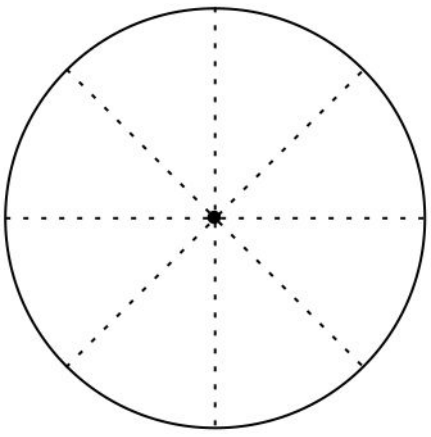
Q: 14 **A sector of a circle with radius 6 cm subtends an angle of 30° at the centre.** **[2]**

Find:
i) the length of the arc.
ii) the area of the corresponding major sector.

Show your work.

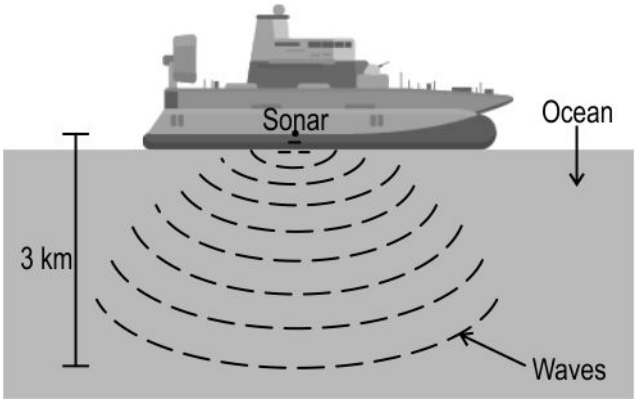
(Note: Take π as $\frac{22}{7}$.)

Q: 15 **A circular sheet of paper with a diameter of 16 inches is divided into 8 equal pieces as shown below.** **[2]**



What is the area of each piece of the paper in terms of π? Show your work.

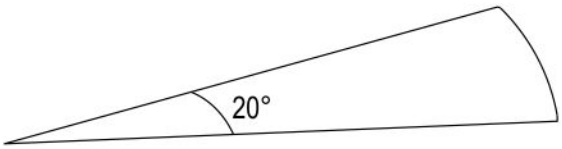
Q: 16 **A SONAR system is deployed in a maritime environment to detect and alert submarines about potential underwater obstacles. The SONAR covers a sector with a central angle of 120° and has a maximum detection range of 3 kilometres under water.** **[2]**



Approximately, how much area is covered by the SONAR during the monitoring period? Show your work.

(Note: Take π as 3.14 if required.)

Q: 17 **The arc length of the sector below is 11 cm.** **[3]**

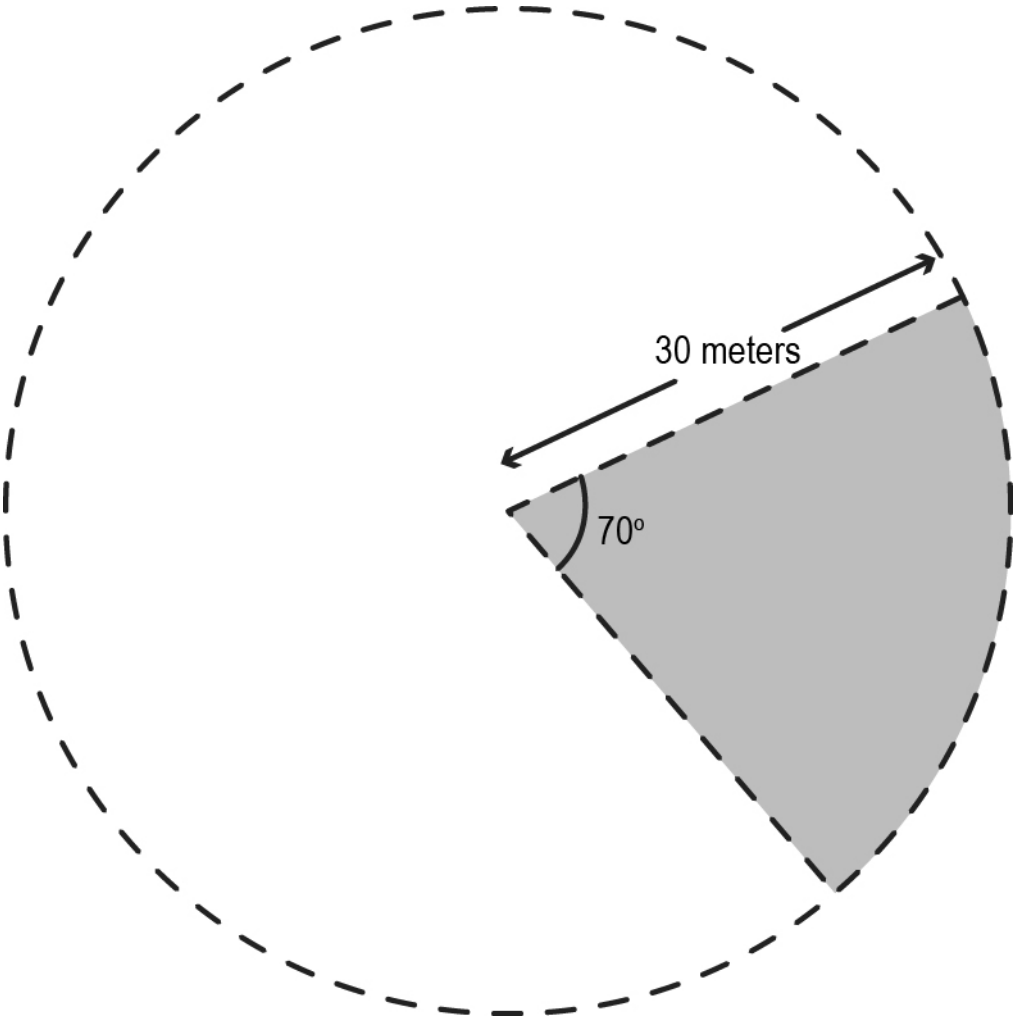


(Note: The figure is not to scale.)

Find the area of the sector. Show your work.

(Note: Take π as $\frac{22}{7}$.)

Q: 18 **Raju is a farmer who owns a portion of land in the shape of a sector. He wishes to install a new irrigation system on his land. The radius of his sector of land is 30 metres, it subtends an angle of 70° at the centre as shown below.** **[3]**



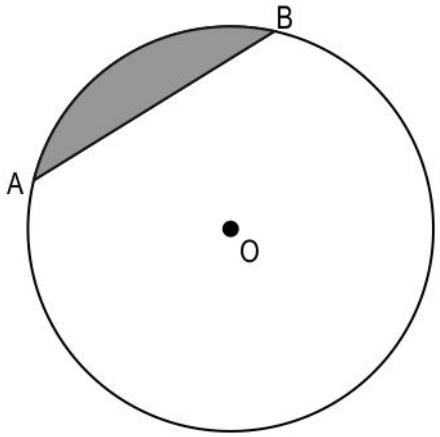
(Note: The figure is not to scale.)

The cost of installing the new irrigation system is Rs 250 per m^2. Raju has kept aside a budget of Rs 1,20,000 for it.

Will Raju be able to install the new irrigation system with his budget? Explain your answer with proper working.

(Note: Take π as $\frac{22}{7}$.)

Q: 19 **Shown below is a circle with centre O. The area of the circle is 154 cm^2. The length of chord AB is $7\sqrt{2}$ cm and it subtends an angle of 90° at the centre.** **[3]**

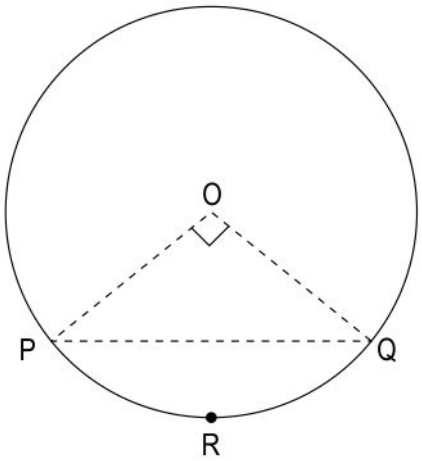


(Note: The figure is not to scale.)

Find the area of the shaded segment. Show your work.

(Note: Take π as $\frac{22}{7}$.)

Q: 20 **Given below is a circle with centre O. The length of arc PRQ is 22 cm and it subtends an angle of 90° at the centre. A triangle POQ is cut along the dotted lines as shown below.** **[3]**



(Note: The figure is not to scale.)

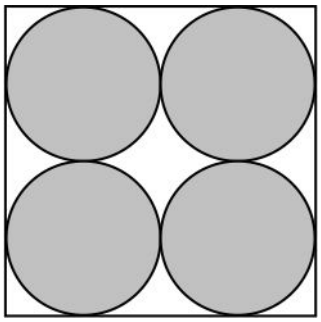
Find the area of the remaining circle after the triangle is cut. Show your work.

(Note: Take π as $\frac{22}{7}$.)

Q: 21 **A chord of length 18 cm subtends an angle of 60° at the centre of a circle.** **[3]**

Find the area of the corresponding major segment in terms of π and roots. Show your work.

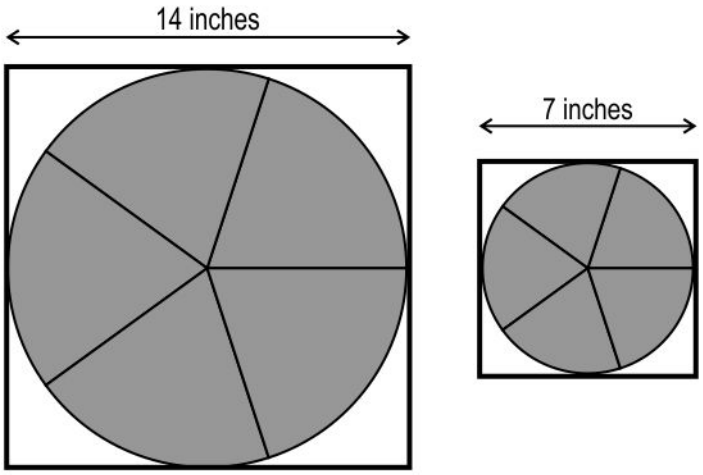
Q: 22 **On a white sheet of square paper, 4 identical yellow circles are drawn such that the circles inside the square touch the boundaries of two other circles and the two sides of the square as shown below:** **[3]**



If the area of the square sheet is 576 cm^2, what is the area that is NOT covered by the circles? Show your work.

(Note: Take π as 3.14.)

Q: 23 **Sameer and Madhur drew two circles circumscribed by squares of side 14 and 7 inches respectively. Both the circles are divided into 5 equal sectors as shown below.** **[5]**



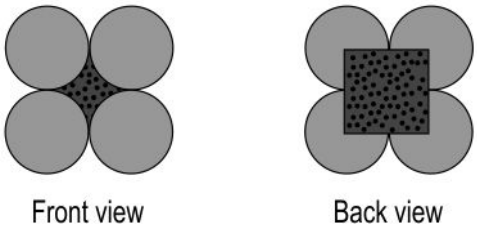
i) Determine the area occupied by one sector of the larger circle.

ii) Sameer says, "The area occupied by 2 sectors of the larger circle is equal to the area occupied by 4 sectors of the smaller circle, as the side of the larger square is twice of the smaller square."

Do you agree with the statement? Justify your answer.

(Note: Take π as $\frac{22}{7}$ if required.)

Q: 24 **Pragati made a flower using 4 identical circles and a dotted square. The front view and back view of the flower is as shown below.** **[5]**



The diameter of each circle is the same as the length of the side of the square, 42 mm.

i) Find the perimeter of the flower. Show your work.

ii) Find the area of the dotted region from the front view. Show your work.

iii) Is the area of the flower the same from the front and back views? Justify your answer with proper working.

(Note: Take π as $\frac{22}{7}$.)

Case Study

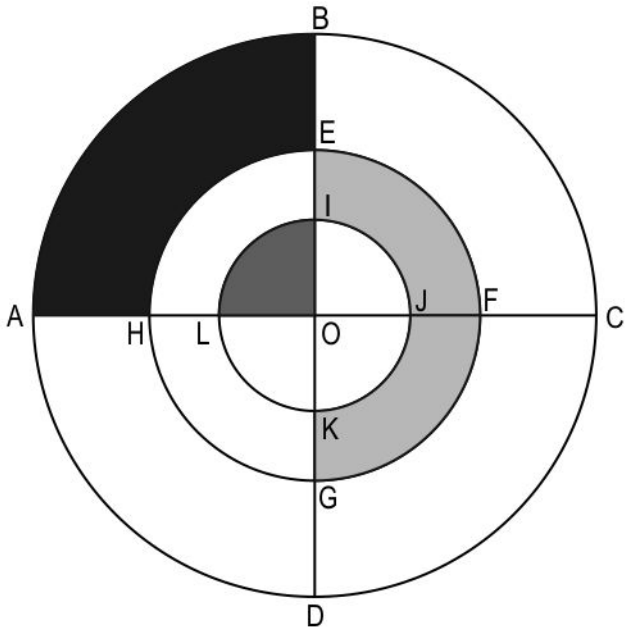
Answer the questions based on the given information.

An archery target board consists of three concentric circles with centre O as shown below. The innermost circle has a radius of 7 cm, the middle circle has a radius of 14 cm, and the outer circle has a radius of 28 cm. The target board is divided into four equal parts by AC and BD, which are the diameters of the outermost circles. The scoring system for the game is as follows:

Area LIO: 10 points

Area KJIEFG: 7 points

Area ABEH: 4 points



(Note: Take π as $\frac{22}{7}$ if required.)

Q: 25 **Find the area of the sector in which 10 points can be scored. Show your work.** **[1]**

Q: 26 **If the target lands on the boundary of the 4 points scoring area, a deduction of 1 point occurs, resulting in a score of 3 points.** **[2]**

Find the length of the boundary in which 3 points can be scored. Show your work.

Q: 27 **Find the area KJIEFG. Show your work.** **[2]**

Q.No	Correct Answers
1	3
2	2
3	3
4	4
5	1
6	3
7	2

Q.No	What to look for	Marks
8	Finds the area of the sector used for growing sugarcane as: $\frac{120°}{360°} \times 3.14 \times 30 \times 30 = 942\ m^2$	1
9	Writes that Anjali is wrong and gives a reason. For example, since the chord extends an angle of 60° at the centre, it forms an equilateral triangle with the radii and hence, the radius is 13 cm.	1
10	Identifies that the shaded sector occupies $\frac{1}{6}$ th of the area of circle. Hence, finds the area of the circle as: $294\pi \times 6 = 1764\pi\ cm^2$ (Award full marks if radius is calculated first and then the area of the circle.)	1
11	Finds the length of the arc as $\frac{80°}{360°} \times 2 \times \frac{22}{7} \times 63 = 88$ cm.	1
12	Assumes the angle of the sector as θ and writes the equation as: $22 = \frac{\theta}{360} \times 2 \times \frac{22}{7} \times 21$ $\Rightarrow \theta = 60°$	1
	Finds the area of the sector as: $\frac{60}{360} \times \frac{22}{7} \times 21 \times 21 = 231\ cm^2$	1
13	Finds the length of the arc of the sector as: $\frac{70°}{360°} \times 2 \times \frac{22}{7} \times 18 = 22$ cm	1
	Finds the perimeter of the sector as 22 + 18 + 18 = 58 cm.	1
14	i) Finds the length of the arc as: $\frac{30°}{360°} \times 2 \times \frac{22}{7} \times 6 = \frac{22}{7}$ cm	1

Q.No	What to look for	Marks
	ii) Finds the area of the major sector as: $\frac{330°}{360°} \times \frac{22}{7} \times (6)^2 = \frac{726}{7}\ cm^2$ **(Award full marks if the area of major sector is found by subtracting the area of minor sector from the area of circle.)**	**1**
15	**Identifies that 8 equal pieces mean each sector will have a central angle of** $\frac{360°}{8} = 45°$	**1**
	Uses the above to find the area of each sector as: $\frac{45°}{360°} \times \pi \times 8 \times 8 = 8\pi\ in^2$	**1**
16	**Expresses the underwater sector's area covered by SONAR as:** $\frac{120°}{360°} \times 3.14 \times 3 \times 3$	**1**
	Solves the above expression and finds the area covered as 9.42 km^2**.**	**1**
17	**Assumes the radius of the sector as** r **cm and writes the equation for the arc length as:** $\frac{20°}{360°} \times 2 \times \frac{22}{7} \times r = 11$	**1**
	Solves the above equation to find the value of r **as** $\frac{63}{2}$ **cm.**	**0.5**
	Writes the expression for the area of the sector as: $\frac{20°}{360°} \times \frac{22}{7} \times (\frac{63}{2})^2$	**1**
	Evaluates the above expression to find the area of the sector as $\frac{693}{4}\ cm^2$**.**	**0.5**
18	**Writes the expression to find the area of the sector as:** $\frac{70°}{360°} \times \frac{22}{7} \times 30 \times 30$	**1**

Q.No	What to look for	Marks
	Solves and finds the area of the sector as 550 m^2.	1
	Finds the cost of installing the irrigation system as 550 × 250 = Rs 1,37,500.	0.5
	Concludes that Raju will not be able to install the new irrigation system as the cost which is Rs 1,37,500 exceeds his budget of Rs 1,20,000.	0.5
19	Finds the area of the minor sector AOB as $\frac{1}{4} \times 154 = 38.5\ cm^2$.	0.5
	Finds radius (r) of the circle by applying pythagoras theorem in △AOB as: $r^2 + r^2 = (7\sqrt{2})^2$ $\Rightarrow r = 7$ cm (Award full marks if the radius is found correctly using area of the circle.)	1
	Identifies that △AOB has base = 7 cm and height = 7 cm. Finds the area of △AOB as $\frac{1}{2} \times 7 \times 7 = 24.5\ cm^2$.	1
	Finds the area of the shaded segment as 38.5 - 24.5 = 14 cm^2.	0.5
20	Finds the radius of the circle by using the equation for arc length as: $\frac{90°}{360°} \times 2 \times \frac{22}{7} \times r = 22$ $\Rightarrow r = 14$ cm	1
	Finds the area of △POQ as: $\frac{1}{2} \times 14 \times 14 = 98\ cm^2$	1
	Finds the area of circle as $\frac{22}{7} \times 14^2 = 616\ cm^2$.	0.5
	Subtracts area of triangle from area of circle to get the remaining area as: 616 - 98 = 518 cm^2	0.5

Q.No	What to look for	Marks
21	Identifies that the triangle formed will be an equilateral triangle. Finds the area of triangle as $\frac{\sqrt{3}}{4} \times 18^2 = 81\sqrt{3}$ cm^2.	1
	Finds the area of the minor sector as $\frac{60°}{360°} \times \pi \times 18 \times 18 = 54\pi$ cm^2.	1
	Finds the area of the circle as $\pi \times 18^2 = 324\pi$ cm^2.	0.5
	Finds the area of the corresponding major segment as $324\pi - (54\pi - 81\sqrt{3}) = 270\pi + 81\sqrt{3}$ cm^2.	0.5
22	Writes that if the area of square sheet is 576 cm^2, then the side of square is $\sqrt{576} = 24$ cm.	1
	Finds the radius of each circle as $\frac{24}{4} = 6$ cm.	0.5
	Finds the area of the circles as $= 3.14 \times 6 \times 6 = 113.04$ cm^2.	0.5
	Finds the area of the square sheet not covered by the circles as: $576 - (4 \times 113.04) = 123.84$ cm^2	1
23	i) Identifies that the radius of the larger circle will be $\frac{14}{2} = 7$ inches as the circle is circumscribed in the square of 14 inches.	0.5
	Writes the following or an equivalent expression to get the area of a sector of the larger circle: $\frac{1}{5} \times \frac{22}{7} \times 7 \times 7 = \frac{154}{5}$ or 30.8 sq inches	1.5
	ii) Calculates the area of 2 sectors of the larger circle as: $2 \times 30.8 = 61.6$ sq inches	1
	Identifies that radius of the smaller circle is $\frac{7}{2}$ inches. Writes the following expression to get the area of 4 sectors: $\frac{4}{5} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} = \frac{154}{5}$ or 30.8 sq inches	1.5

Q.No	What to look for	Marks
	Concludes that Sameer's statement is wrong, as area of 2 sectors of larger circle (61.6 sq inches) is more than 4 sectors of smaller circle (30.8 sq inches). **(Award full marks only if areas of both are calculated and given as justification for the statement being wrong.)**	**0.5**
24	**i) Finds the perimeter of flower as:** $(4 \times 2\pi r) - (4 \times \frac{1}{4} \times 2\pi r) = 6\pi r$ $6 \times \frac{22}{7} \times 21 = 396$ mm	**1**
	ii) Finds the area of the dotted region from the front as: $(42)^2 - (\frac{22}{7} \times (21)^2) = 378$ mm^2	**1**
	iii) Finds the area of the flower from the front view as: $378 + (4 \times \frac{22}{7} \times 21^2) = 5922$ mm^2	**1**
	Finds the area of the flower from the back view as: $(42)^2 + (4 \times \frac{3}{4} \times \frac{22}{7} \times 21^2) = 5922$ mm^2	**1**
	Compares the area of the front and back views and concludes that the area remains the same.	**1**
25	**Uses the expression for the area of a sector to find the area of the part LIO as:** $\frac{1}{4} \times \frac{22}{7} \times 7 \times 7 = \frac{77}{2}$ **or** 38.5 cm^2	**1**
26	**Finds the length of arc of middle circle as:** $\frac{1}{4} \times 2 \times \frac{22}{7} \times 14 = 22$ cm	**0.5**
	Finds the length of arc of outer circle as: $\frac{1}{4} \times 2 \times \frac{22}{7} \times 28 = 44$ cm	**0.5**

Q.No	What to look for	Marks
	Finds the length of boundary in which 3 points can be scored as: **44 + 22 + 2(28 - 14) = 94 cm**	**1**
27	**Finds the area of the semicircle in the middle region as:** $\frac{1}{2} \times \frac{22}{7} \times 14 \times 14 = 308\ cm^2$	**0.5**
	Finds the area of the innermost semicircle as: $\frac{1}{2} \times \frac{22}{7} \times 7 \times 7 = 77\ cm^2$	**0.5**
	Finds the area KJIEFG as (308 - 77) = 231 cm^2.	**1**

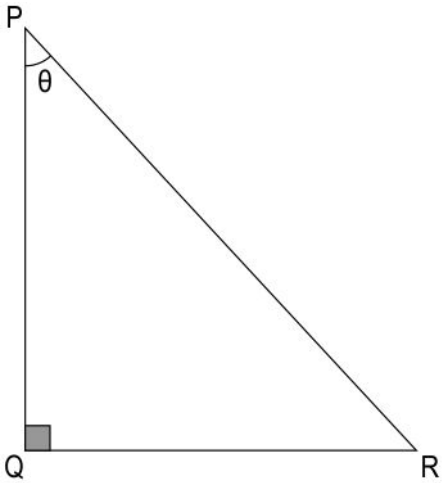
Chapter - 6
Introduction to Trigonometry

Multiple Choice Questions

Q: 1 **Given, cot θ = 3, what is the value of cos θ?**

1 $\frac{1}{3}$
2 $\frac{1}{\sqrt{10}}$
3 $\frac{3}{\sqrt{10}}$
4 (cannot be determined using given information)

Q: 2 **Given below is △PQR, right-angled at Q.**



(Note: The figure is not to scale.)

What is the value of tan θ?

1 $\frac{PQ}{QR}$ **2** $\frac{QR}{PQ}$ **3** $\frac{PQ}{RP}$ **4** $\frac{QR}{RP}$

Q: 3 **Given that $\cos^2\theta - \sin^2\theta = \frac{3}{4}$, what is the value of cos θ?**

1 $\frac{7}{8}$ **2** $\frac{\sqrt{7}}{2\sqrt{2}}$ **3** 1 **4** $\frac{\sqrt{7}}{2}$

Q: 4 **If cot 81° = tan θ, what is the value of sec 5θ?**

(Note: 0 ° ≤ 5θ ≤ 90 °)

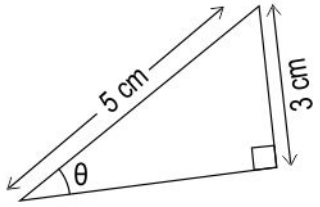
1 $\frac{1}{\sqrt{2}}$
2 1
3 √2
4 (5θ will always be greater than 90°)

Q: 5 **Any relation which is ALWAYS true is an identity. Which of the following is a trigonometric identity?**

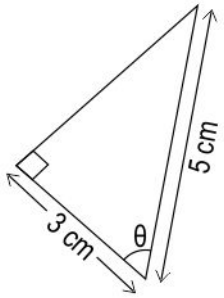
i) $\cot\theta = \frac{\cos\theta}{\sin\theta}$
ii) $\sec^2\theta + \text{cosec}^2\theta = 1$
iii) $\frac{1-\cos^2\theta}{\cos^2\theta} = \tan^2\theta$
iv) $\frac{\sin^2\theta}{1-\sin^2\theta} = \cot^2\theta$

1 only i) and ii)
2 only i) and iii)
3 only i), ii) and iii)
4 only i), iii) and iv)

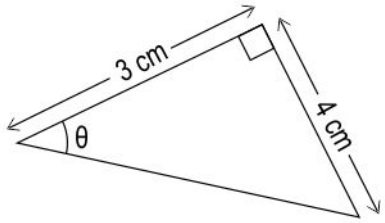
Q: 6 **Which of these triangles have sin θ = $\frac{4}{5}$?**



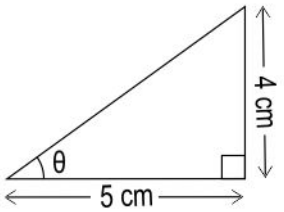
P



Q



R



S

(Note: The figures are not to scale.)

1 only Q and R
2 only Q and S
3 only Q, R and S
4 all - P, Q, R and S

Q: 7 Which of these is equal to $\sqrt{\frac{1+\sin\theta}{1-\sin\theta}}$?

1 sec θ + tan θ
2 sec θ - tan θ
3 $\sec^2\theta + \tan^2\theta$
4 $(\sec\theta + \tan\theta)^2$

Q: 8 **If cos θ = $\frac{12}{13}$, what is the value of 5cosec θ - 4tan θ?**

1 $\frac{10}{39}$
2 $\frac{131}{60}$
3 $\frac{31}{3}$
4 $\frac{34}{3}$

Answer the questions based on the given information.

A TRIG-QUIZ is organized in a school, which consists of 3 rounds in order to get a winner. 4 Teams participated in the quiz - Team 1, Team 2, Team 3 and Team 4.
In each round, the same question was asked to all the teams and one team was eliminated after every round.

Following three questions were asked in 3 rounds to the teams.

Round 1	Round 2	Round 3
Give a correct statement related to trigonometric ratio of an angle Θ.	If $\cos^2\Theta - \sin^2\Theta = 3/4$, $0° < \Theta < 90°$, use appropriate identities to find the values of $\cos\Theta$ and $\tan\Theta$.	In a right angled triangle ABC, B is at right angle and $\sin A = 1/4$. Find the value of: $\cos^2A + 2\sin^2A + 2\sin^2C + 2\cos^2C$

Q: 9 **Which team gets eliminated in Round 1 if the following are the statements made by the teams:**

Team 1: $\cos\theta = -1$, for some angle θ.
Team 2: $\tan\theta = 2$, for some angle θ.
Team 3: $\sin\theta = 2$, for some angle θ.
Team 4: $\tan\theta = 10$, for some angle θ.

1 Team 1 **2** Team 2 **3** Team 3 **4** Team 4

Q: 10 **What answers should the teams give to enter Round 3. Show your work.** **[2]**

Q: 11 **The remaining teams were asked the Round 3 question.** **[2]**

What answer should a team give to win the Quiz? Show your work.

Free Response Questions

Q: 12 **If $\tan x - \cot y = 0$, find the value of $x + y$.** **[1]**

Show your steps.

(Note: $0° \le x, y \le 90°$.)

Q: 13 **Prove that:** **[1]**

$\sin^2 70° - \sin^2 10° = \cos^2 10° - \cos^2 70°$

Q: 14 **Write true or false for the given statement and give a valid reason.** **[1]**
In $\triangle ABC$, right-angled at B, cosec A can be less than 1.

Q: 15 **What is the value of $\sin^2\theta + \sec^2\theta + \cos^2\theta - \tan^2\theta$ where θ is an acute angle? Show your work.** **[1]**

Q: 16 **Find the value of θ for which the below statement is true. θ is acute angle.** **[2]**
$\sqrt{3}\tan\theta - \cot 45° = 0$

Show your work.

Q: 17 **In $\triangle ABC$, AC = 25 cm and $\sin C = \frac{4}{5}$.** **[2]**

Find the length of BC. Show your work.

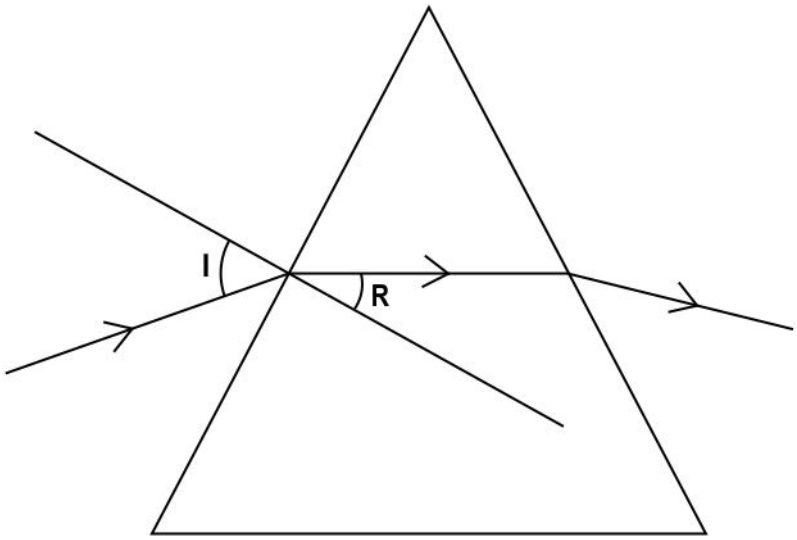
Q: 18 **$\sin(A + B) = \frac{\sqrt{3}}{2}$ and $\sin(A - B) = \frac{1}{2}$ where A and B are acute angles.** **[2]**

Find the values of A and B. Show your steps.

Q: 19 **$2\sin 3A = \sqrt{3}$ where 3A is an acute angle.** **[2]**

Find the value of A. Show your steps.

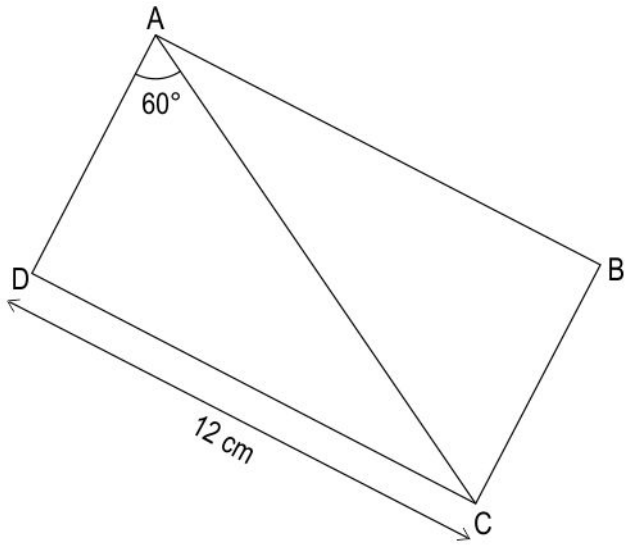
Q: 20 **Shown below is a glass prism. When a ray of light enters the prism, it refracts inside the prism as shown.** **[2]**



If the refractive index (RI) of the above prism is sec 45° and the angle of refraction (R) is 30°, find the angle of incidence (I). Show your work.

(*Note* : *Refractive Index* = $\frac{\sin I}{\sin R}$.)

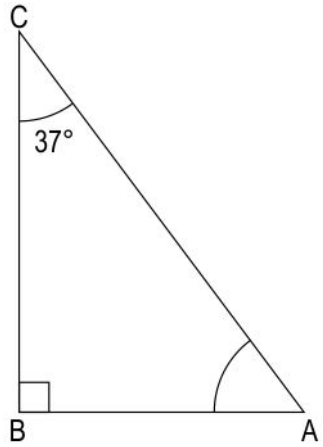
Q: 21 **In the figure below, ABCD is a rectangle.** **[2]**



(Note: The figure is not to scale.)

Find the length of BC and AC. Show your work.

Q: 22 **In a △ABC, ∠C is 37° and CB = 20 cm as shown below.** **[3]**



(Note: The figure is not to scale.)

Find
i) Length of AB.
ii) sin 37°

Show your work.

(Note: Take cos 37° as 0.8.)

Q: 23 **Prove that:** **[3]**

$$\sqrt{\frac{sec\ \theta\ -\ 1}{sec\ \theta\ +\ 1}} = cosec\ \theta - cot\ \theta$$

Q: 24 **A △PQR is right angled at Q. If tan *P* = √5 - 2, show that sin *P* × cos *P* = $\frac{1}{2\sqrt{5}}$. Show your work.** **[3]**

Q: 25 **Prove:** **[3]**

$$\frac{tan\ \theta}{1\ -\ cot\ \theta} + \frac{cot\ \theta}{1\ -\ tan\ \theta} = 1\ +\ sec\ \theta\ cosec\ \theta$$

Show your work.

Q: 26 **Prove that:** **[5]**

$$\frac{tan\ \theta\ +\ sec\ \theta\ -\ 1}{tan\ \theta\ -\ sec\ \theta\ +\ 1} = \frac{1\ +\ sin\ \theta}{cos\ \theta}$$

Q: 27 **Solve the following:** **[5]**

i) Given tan A = $\frac{5}{12}$, find sin A, cos A, cot A, sec A, cosec A.

ii) Given 4 $\cos^2$ A + 8 $\sin^2$ A = 5, show that cot A = √3.

Show your work.

Q.No	Correct Answers
1	3
2	2
3	2
4	3
5	2
6	1
7	1
8	4
9	3

Q.No	What to look for	Marks
10	Uses identity $\cos^2\theta + \sin^2\theta = 1$ and writes: $2\cos^2\theta - 1 = \frac{3}{4}$	1
	Simplifies the above and finds the values as: $\cos\theta = \frac{\sqrt{7}}{\sqrt{8}}$ $\tan\theta = \frac{1}{\sqrt{7}}$	1
11	Uses the given equation $\sin A = \frac{1}{4}$ to find other ratios as: $\cos A = \frac{\sqrt{15}}{4}$ $\sin C = \frac{\sqrt{15}}{4}$ $\cos C = \frac{1}{4}$	1
	Substitutes the above values in the given expression, $\cos^2A + 2\sin^2A + 2\sin^2C + 2\cos^2C$ and simplifies it to get $\frac{49}{16}$.	1
12	Rewrites that the given equation as $\tan x = \cot y$.	0.5
	Concludes that this is only possible for a pair of complementary angles. Hence, $x + y = 90°$	0.5
13	Proceeds with LHS as, $= \sin^2 70° - \sin^2 10°$ Uses identity $\sin^2\theta = 1 - \cos^2\theta$ to get $= (1 - \cos^2 70°) - (1 - \cos^2 10°)$ $= 1 - \cos^2 70° - 1 + \cos^2 10°$ $= \cos^2 10° - \cos^2 70° = RHS$	1
14	Writes False.	0.5

Q.No	What to look for	Marks
	Gives a reason. For example, writes that as, in a right-angled triangle, cosec A is always greater than or equal to 1, as it represents the reciprocal of the sine function, and the sine of an acute angle is always less than or equal to 1.	0.5
15	Rearranges the given expression and uses identities to evaluate as: $(\sin^2\theta + \cos^2\theta) + (\sec^2\theta - \tan^2\theta)$ $= 1 + 1 = 2$	1
16	Simplifies the given equation as $\tan\theta = \frac{1}{\sqrt{3}}$.	1
	Finds the value of θ for which $\tan\theta$ is $\frac{1}{\sqrt{3}}$ as 30°.	1
17	Writes: $\sin C = \frac{AB}{AC} = \frac{4}{5}$.	0.5
	Substitutes the value of AC as 25 in the above equation and simplifies it to find the value of AB as 20 cm.	0.5
	Uses Pythagoras theorem to find the length of BC as: $\sqrt{(25)^2 - (20)^2} = 15$ cm.	1
18	Writes that, since $\sin(A + B) = \frac{\sqrt{3}}{2}$, $A + B = 60°$.	0.5
	Writes that, since $\sin(A - B) = \frac{1}{2}$, $A - B = 30°$.	0.5
	Solves the equations in steps 1 and 2 to find A as 45° and B as 15°.	1
19	Rewrites the above equation as: $\sin 3A = \frac{\sqrt{3}}{2}$	0.5
	From the above step finds 3A as: $\sin 3A = \frac{\sqrt{3}}{2}$ $\Rightarrow \sin 3A = \sin 60°$ $\Rightarrow 3A = 60°$	1

Q.No	What to look for	Marks
	Thus finds the value of A as $\frac{60}{3}$ = 20°.	**0.5**
20	**Writes the equation for the refractive index as:** $\text{Refractive Index} = \frac{\sin I}{\sin R}$ $\Rightarrow \sec 45^\circ = \frac{\sin I}{\sin 30^\circ}$ $\Rightarrow \sqrt{2} = \frac{\sin I}{0.5}$ $\Rightarrow \sin I = \frac{1}{\sqrt{2}}$	**1**
	Finds the value of I for which sin I is $\frac{1}{\sqrt{2}}$, that is 45°.	**1**
21	**Writes that in ΔADC,** **tan 60° = $\frac{12}{AD}$** **=> AD = 4√3 cm** **Finds BC = AD = 4√3 cm.**	**1**
	Uses Pythagoras theorem in ΔADC to find AC as $\sqrt{[12^2 + (4\sqrt{3})^2]}$ = 8√3 cm. **(Award full marks if the AC is found using other trigonometric ratios.)**	**1**
22	**i) Writes, in the ΔABC:** **cos C = $\frac{CB}{CA}$** **=> cos 37° = $\frac{20}{CA}$** **=> CA = $\frac{20}{0.8}$ = 25 cm**	**1**
	Uses Pythogorus theorem to find AB as: **AB = $\sqrt{(25^2 - 20^2)}$ = 15 cm**	**1**
	ii) Finds sin 37° as: **=> sin C = $\frac{AB}{AC}$** **=> sin 37° = $\frac{15}{25}$ = 0.6** **(Award equal marks if a student uses an alternative method.)**	**1**

Q.No	What to look for	Marks
23	**Multiplies both numerator and denominator with √(sec *θ* - 1) as:** $\sqrt{\frac{(sec\ \theta\ -\ 1)\times(sec\ \theta\ -\ 1)}{(sec\ \theta\ +\ 1)\times(sec\ \theta\ -\ 1)}}$	**1**
	Uses the identity sec^2 *θ* - 1 = tan^2 *θ* in the above expression as: $= \sqrt{\frac{(sec\ \theta\ -\ 1)^2}{(sec^2\ \theta\ -\ 1)}}$ $= \sqrt{\frac{(sec\ \theta\ -\ 1)^2}{tan^2\ \theta}}$ $= \frac{(sec\ \theta\ -\ 1)}{tan\theta}$	**1.5**
	Further simplifies the above expression as: $= \frac{sec\ \theta}{tan\ \theta} - \frac{1}{tan\ \theta}$ $= cosec\ \theta - \cot\ \theta$ **Hence, proves the given statement.**	**0.5**
24	**Finds the hypotenuse as:** $\sqrt{(\sqrt{5}-2)^2 + 1^2} = \sqrt{10-4\sqrt{5}}$ units	**1**
	Finds the value of sin *P* and cos *P* as $\frac{\sqrt{5}-2}{\sqrt{(10-4\sqrt{5})}}$ and $\frac{1}{\sqrt{(10-4\sqrt{5})}}$ respectively.	**1**
	Calculates the value of sin *P* × cos *P* as $\frac{\sqrt{5}-2}{10-4\sqrt{5}}$ and simplifies it further as $\frac{1}{2\sqrt{5}}$.	**1**

Q.No	What to look for	Marks
25	**Rewrites the LHS of the above equation as:** $\frac{\frac{\sin\theta}{\cos\theta}}{1-\frac{\cos\theta}{\sin\theta}} + \frac{\frac{\cos\theta}{\sin\theta}}{1-\frac{\sin\theta}{\cos\theta}}$ **Simplifies the above expression as:** $\frac{1}{\sin\theta - \cos\theta}\left[\frac{\sin^3\theta - \cos^3\theta}{\sin\theta\cos\theta}\right]$	1
	Uses the formula ($a^3 - b^3$) = ($a - b$)($a^2 + ab + b^2$) in the above expression and simplifies it as: $\frac{\sin^2\theta + \cos^2\theta + \sin\theta\cos\theta}{\sin\theta\cos\theta}$	1
	Further simplifies the above expression as: $\frac{1 + \sin\theta\cos\theta}{\sin\theta\cos\theta}$ **Replaces $\frac{1}{\sin\theta}$ with cosec θ and $\frac{1}{\cos\theta}$ with sec θ in the above expression and simplifies it as:** $1 + \sec\theta\,\mathrm{cosec}\,\theta$ **Hence, proves the given statement.**	1
26	**Uses identity $\sec^2\theta - \tan^2\theta = 1$ in LHS of the above equation and rewrites it as:** $\frac{(\tan\theta + \sec\theta) - (\sec^2\theta - \tan^2\theta)}{\tan\theta - \sec\theta + 1}$	1
	Rewrites the above equation as: $\frac{(\tan\theta + \sec\theta) - (\sec\theta + \tan\theta)\times(\sec\theta - \tan\theta)}{\tan\theta - \sec\theta + 1}$	1

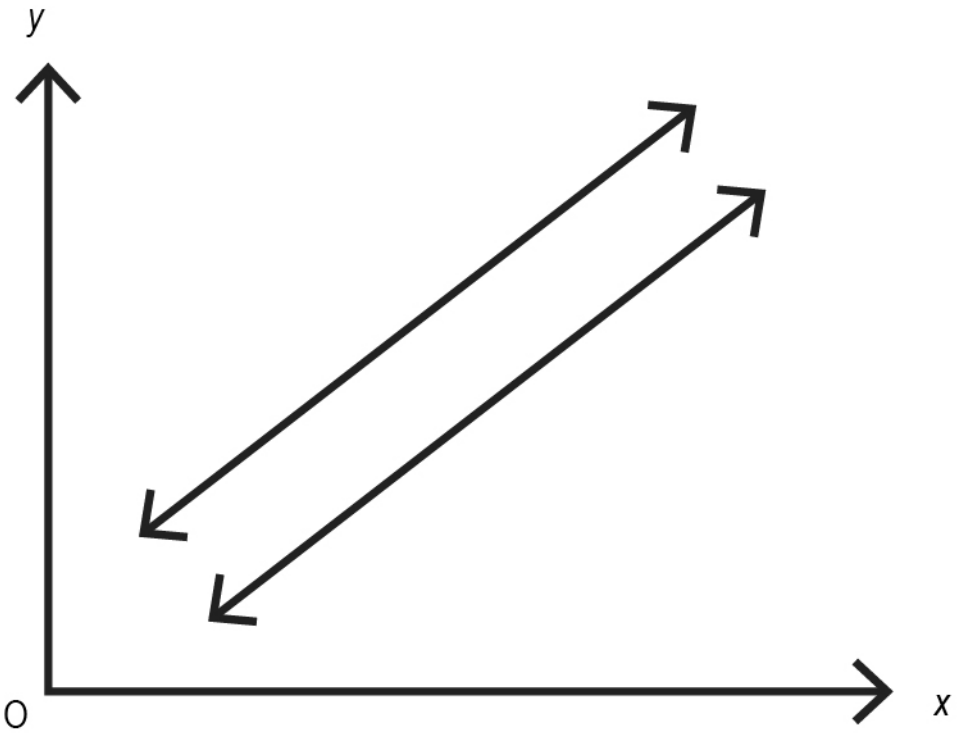
Q.No	What to look for	Marks
	Takes (tan θ + sec θ) common in the numerator as: $\frac{(tan\ \theta + sec\ \theta) \times (1 - sec\ \theta + tan\ \theta)}{tan\ \theta - sec\ \theta + 1}$	**1**
	Rearrange the numerator and simplifies the above expression as: $\frac{(tan\ \theta + sec\ \theta)\times(tan\ \theta - sec\ \theta + 1)}{(tan\ \theta - sec\ \theta + 1)}$ $= tan\ \theta + sec\ \theta$ $= \frac{sin\ \theta}{cos\ \theta} + \frac{1}{cos\ \theta}$	**1**
	Further simplifies the above expression and proves: $\frac{1+sin\ \theta}{cos\ \theta}$ = RHS	**1**
27	**i) Uses the pythagoras theorem and finds the hypotenuse as √(144 + 25) = 13 units.**	**1**
	Determines the other ratios as: **sin A = $\frac{5}{13}$** **cos A = $\frac{12}{13}$** **cot A = $\frac{12}{5}$** **sec A = $\frac{13}{12}$** **cosec A = $\frac{13}{5}$**	**2**
	ii) Divides the given equation with $\sin^2 A$ to get: **$4\cot^2 A + 8 = 5\ \text{cosec}^2 A$.**	**1**

Q.No	What to look for	Marks
	Uses identity, $\text{cosec}^2\theta = 1 + \cot^2\theta$ in RHS to get: **$4\cot^2 A + 8 = 5(1 + \cot^2 A)$** **Simplifies the above to get $\cot A = \sqrt{3}$** **Thus shows that, $\cot A = \sqrt{3}$.**	**1**

Chapter - 7
Pair of linear equations in two variables

Multiple Choice Questions

Q: 1 **Given below is a graph showing two lines that never intersect. These are represented by two linear equations.**



Which of these can be said about the number of solution(s) of the above pair of linear equations?

1 They have infinitely many solutions.
2 They have a unique solution.
3 They do not have a solution.
4 Nothing can be said about the number of solutions unless the algebraic form of these equations are known.

Q: 2 **Given below is a pair of linear equations in two variables.**

$4x + 2y = 18$
$3x - 6y = 6$

Which of the following pairs of equations have the same number of solution(s) as the given pair?

1 $3a + 3b = 18$; $a + b = 6$
2 $a - b = 4$; $b - a = 4$
3 $6a - 2b = 10$; $3a + b = 5$
4 $7a + 9b = 27$; $28a + 36b = 76$

Q: 3 **If a pair of linear equations given by $l_1 x + m_1 y + n_1 = 0$ and $l_2 x + m_2 y + n_2 = 0$ has infinitely many solutions, then which of the following is DEFINITELY true?**

1 $\frac{l_1}{l_2} = \frac{n_2}{n_1}$ **2** $l_1 l_2 \neq m_1 m_2$ **3** $\frac{l_1}{l_2} \neq \frac{m_1}{m_2}$ **4** $l_1 m_2 = l_2 m_1$

Q: 4 **A gardener bought a mix of 100 flower and vegetable seeds for a total of Rs 1350. Each flower seed costs Rs 12, and each vegetable seed costs Rs 11.**

Which of the following pairs of linear equations can be used to determine *f*, the number of flower seeds purchased, and *v*, the number of vegetable seeds purchased?

1 $f + v = 100$; $11 f + 12 v = 1350$
2 $f + v = 1350$; $12 f + 11 v = 1350$
3 $f + v = 100$; $12 f + 11 v = 1350$
4 $f + v = 23$; $12 f + 11 v = 1350$

Q: 5 **Sara collected a total of Rs 1800 in a fundraising event. She knew that the event had a mix of Rs 10 and Rs 50 notes, but not sure how many of each. She counted the total number of notes as 60.**

Which of the following pairs of linear equations can be used to find the number of 10-rupee and 50-rupee notes?

***(Note: x represents the number of 10-rupee note and y represents the number of* 50-rupee note.)**

1 $x + y = 60$; $x - y = 40$
2 $x + y = 1800$; $10 x + 50 y = 60$
3 $x + y = 60$; $10 y + 50 x = 1800$
4 $x + y = 60$; $10 x + 50 y = 1800$

Q: 6 **Tanisha and Aditya have some chocolates with them such that:**

♦ if Tanisha were to give 6 chocolates to Aditya, the new quantity of chocolates with each of them would be equal.

♦ instead, if Aditya were to give 3 chocolates to Tanisha, then Tanisha would have four times as many chocolates as Aditya initially had.

Which of these pairs of equations would help us find the number of chocolates that they have?

(Note: Assume the initial number of chocolates with Tanisha as 'x' and that with Aditya as 'y'.)

1 $x - 6 = y + 6$; $x + 3 = 4(y - 3)$
2 $x - 6 = y + 6$; $x + 3 = 4 y$
3 $x + 6 = y - 6$; $x - 3 = 4 y$
4 $x - y = 6$; $x = y$

Q: 7 **For the given pair of linear equations, two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Read the statements carefully and choose the option that correctly describes statements (A) and (R).**

$x - 2y + 3 = 0$
$3x + 4y - 11 = 0$

Assertion (A) **: The pair of linear equations has a unique solution.**

Reason (R) **: The pair of linear equations represents a pair of coincident lines.**

1 Both (A) and (R) are true and (R) is the correct explanation of the (A).
2 Both (A) and (R) are true but (R) is not the correct explanation of the (A).
3 (A) is true but (B) is false.
4 (A) is false but (B) is true.

Free Response Questions

Q: 8 **Given below is a pair of linear equations in two variables:** **[1]**

$6y + 7z = 12$; $12y - 12z = 24$

Which variable's coefficient can be changed such that the given pair has infinitely many solutions? What should it be changed to? Show your work.

Q: 9 **On a specific day, a budget-friendly restaurant managed to sell 1000 vegetarian meals. These vegetarian meals were priced at Rs 85 per adult and Rs 45 per child. A total of Rs 73000 was collected from these sales.** **[1]**

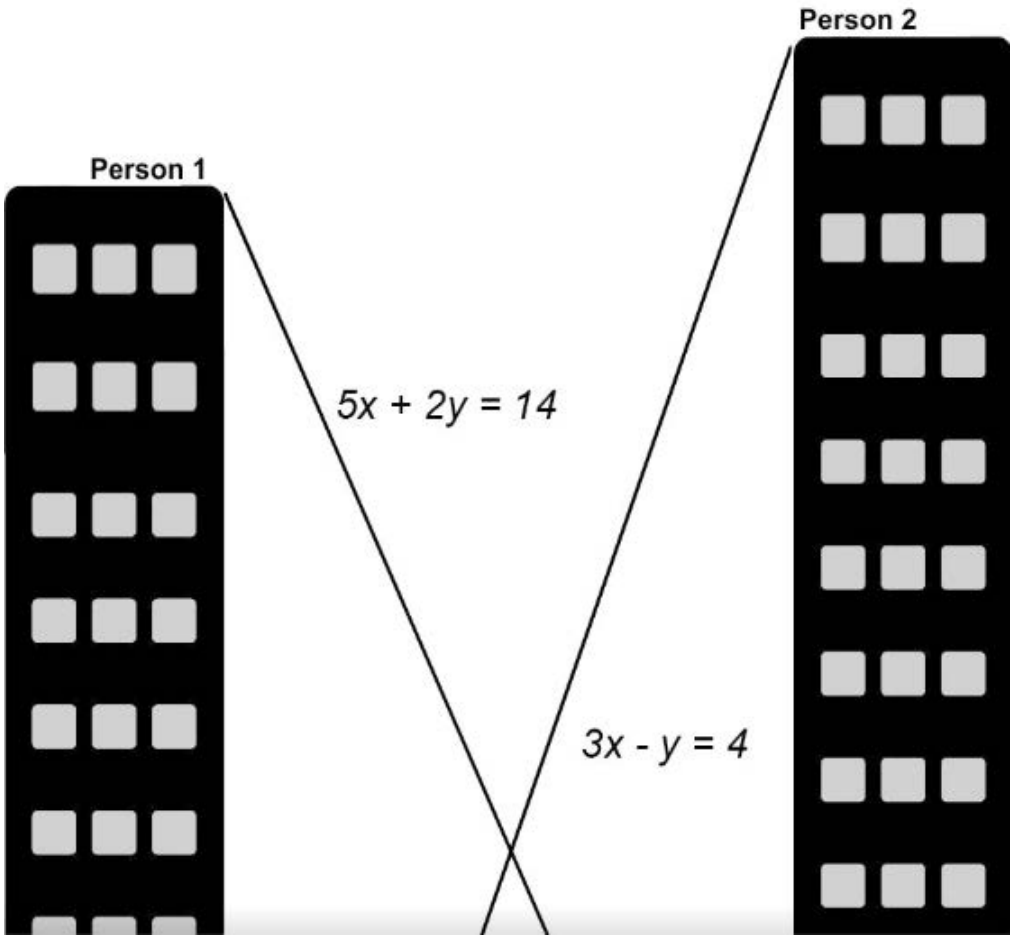
If p represents the number of adult veg meals sold and q represents the number of child veg meals sold, write a pair of equations to find out how many meals of each kind were sold.

Q: 10 **A pair of linear equations is shown below, where b is an integer.** **[1]**

$2x - y = b + 1$
$x + (b - 1)y = 3b$

For any given value of b, how many solution(s) does this pair of equations have? Justify your answer.

Q: 11 **Shown below is an image where the lines represent the paths of sight of two people standing at different heights and looking at the bottom level of the buildings. Both lines of sight can be represented by the corresponding linear equations.** **[2]**



(Note: The figure is not to scale.)

Find the ordered pair that will represent the intersecting point of their lines of sight. Show your work.

Q: 12 **Nisha and Samarth are preparing a cup of coffee each by mixing two ingredients, milk and brewed coffee in different quantities satisfying the following conditions:** **[2]**

♦ The quantity of milk in Nisha's cup is twice the quantity of brewed coffee in her cup.
♦ The quantity of milk in Samarth's cup is four times the quantity of brewed coffee in his cup.
♦ The quantity of milk in Nisha's cup is 40 ml less than what is found in Samarth's cup.
♦ The quantity of brewed coffee in Nisha's cup exceeds Samarth's by 30 ml.

Represent the above situation in the form of a pair of linear equations in two variables. Show your work.

Q: 13 **The delivery fees of a delivery service company consists of a fixed fee in addition to a fee based on the distance travelled. For a delivery covering 20 kms, the total fee (fixed + variable fee) is Rs 300, and for a delivery spanning 25 kms, the total fee is Rs 350.** **[2]**

How much total amount would a customer need to pay for a delivery that covers a distance of 49 kms? Show your work.

Q: 14 **Different shades of purple are obtained by mixing different quantities of red and blue colours.** **[2]**

An artist combined 5 litres of red paint with 7 litres of blue paint to achieve a shade of purple, incurring a cost of Rs 5000. To achieve a different shade of purple, she mixed 7 litres of red paint and 5 litres of blue paint, incurring a cost of Rs 4600.

Calculate the price of red and blue paint per litre. Show your work.

Q: 15 **In a chemistry lab, scientists are studying a chemical reaction between two substances, Substance A and Substance B. The following was known:** **[2]**

♦ The total mass of the substances before the reaction was 9 grams.
♦ The difference in mass between Substance A and Substance B before the reaction was 6 grams. Determine the mass of Substances A and B before the reaction. Show your work.

Q: 16 **Tanvi and her friend Vanshika both made purchases from a local fruit seller on a specific day. Tanvi bought 3 kgs of grapes and 4 kgs of oranges, spending a total of Rs 680. Meanwhile, Vanshika bought 4 kgs of grapes and 2 kgs of oranges from the same fruit seller, spending a total of Rs 640.** **[2]**

What is the price of grapes and oranges per kg? Show your work.

Q: 17 **A two-digit number is such that the sum of its digits is 11. When the digits are reversed, the resulting number increases by 27.** **[3]**

Determine the original two-digit number. Show your work.

Q: 18 **Two real numbers *c* and *d* satisfy the following equations:** **[3]**

$2c - 3d = 7$
$4c + d = 1$

Find the product of *c* and *d*. Show your work.

Q: 19 **Solve the following pair of linear equations in two variables graphically.** **[3]**

$x + 3y = 6$
$2x - 3y = 12$

Identify the shape resulting from the intersection of the pair of equations with the *y*-axis and write its vertex coordinates.

Q: 20 **The length of a rectangle is 3 cm less than five times the width. The sum of six times the length and two times the width is equal to 46 cm.** **[3]**

What is the width of the rectangle? Show your work.

Q: 21 **In the competitive world of smartphone data plans, two leading telecom companies, TechConnect and SwiftLink offer distinct pricing structures. TechConnect charges a base monthly fee of Rs 300, along with an additional Rs 15 for each gigabyte (GB) of data used beyond the initial 5 GB included in the plan. In contrast, SwiftLink offers a different pricing model with a flat monthly fee of Rs 600 for unlimited data usage.** **[3]**

i) Express the data plan structure for TechConnect in the form of linear equation. Use *c* as the total cost (in Rs) and *d* as the data usage (in GB).

ii) At what point of data usage the cost of a data plan with TechConnect becomes equal to the cost of the data plan with SwiftLink?

Show your steps.

Q: 22 **Rahul rode his bike initially at an average speed of 40 km/h. Upon noticing a road sign indicating a speed limit of 35 km/h, he slowed down and rode at an average speed of 35 km/h for the remainder of his journey. He covered a total of 190 km in 5 hours.** **[3]**

For how long did Rahul maintain an average speed of 40 km/h? Show your work.

Q: 23 **A geometric shape is formed by the equation $2y + x = 8$ and the coordinate axes. For the resulting shape,** **[5]**

i) Identify the shape and find its vertices.
ii) Find the perimeter and area of the shape.

Solve graphically.

Q: 24 **Muskan lives 12 km away from her college. She walks to the metro station and takes a metro to college everyday. If she goes to the nearest metro station, she needs to walk for 2 km and cover the rest by metro. This takes her 1 hour. If she walks to a metro station farther away, she needs to walk for 4 km and cover the rest by metro. This takes her 1.5 hours.** **[5]**

Find the average speeds of Muskan's walking and the metro. Show your work.

Case Study

Answer the questions based on the given information.

Reena and Sonia went to a mall on 14th November 2022. On the occasion of Children's Day, the mall was offering movie tickets and bowling alley tickets at discounted prices. The cost of a movie ticket was Rs 70 more than twice the cost of a bowling alley ticket. Sonia purchased five bowling alley tickets and three movie tickets for a total of Rs 870.

Q: 25 **Represent the given situation with a pair of linear equations.** **[1]**

Q: 26 **Find the price of a movie ticket and a bowling alley ticket. Show your work.** **[2]**

Q: 27 **On the next day, Reena took her siblings to the mall. She observed that prices of the movie ticket and the bowling alley ticket had come back to their standard rates of Rs 220 and Rs 90, respectively. She bought a total of 10 tickets, costing her Rs 1420.** **[2]**

Find the number of movie tickets and bowling alley tickets she bought. Show your work.

Q.No	Correct Answers
1	3
2	3
3	4
4	3
5	4
6	2
7	3

Q.No	What to look for	Marks
8	Identifies that either of the coefficients of z can be changed.	0.5
	Changes either 7 to (-6) in first equation or (-12) to 14 in second equation so that all ratios are equal to $\frac{1}{2}$, making it a pair with infinitely many solutions.	0.5
9	Expresses equations in this or any equivalent form: $p + q = 1000$ $85p + 45q = 73000$	1
10	Identifies that for any integer b : $\frac{2}{1} \neq \frac{-1}{b-1}$ This satisfies the condition for intersecting lines, hence there is a unique solution.	1
11	Solves the following pair of linear equations to get $x = 2$ and $y = 2$: $5x + 2y = 14$ $3x - y = 4$	1.5
	Writes that (2, 2) represents the intersecting point of both lines of sight.	0.5
12	Writes that if quantity of brewed coffee = x ml for Nisha, then quantity of milk = $2x$ ml for Nisha. Writes that if quantity of brewed coffee = y ml for Samarth, then quantity of milk = $4y$ ml for Samarth.	1
	Represents both the equations in this or an equivalent form: $4y - 2x = 40$ $x - y = 30$	1
13	Assumes the fixed fee as Rs x and the variable fee as Rs y, then formulates the following pair of linear equations: $x + 20y = 300$ $x + 25y = 350$	1

Q.No	What to look for	Marks
	Solves the pair of linear equations to find the value of x as Rs 100 and y as Rs 10.	**0.5**
	Finds the final total amount as: **100 + (10 × 49) = Rs 590**	**0.5**
14	**Translates the given information to frame a pair of linear equations in two variables as:** $5x + 7y = 5000$ $7x + 5y = 4600$ **where x = price of red paint per litre; y = price of blue paint per litre**	**1**
	Solves the pair of equations obtained in the above step to find the price of red and blue paints per litre as Rs 300 and Rs 500 respectively.	**1**
15	**Assumes the mass of Substance A as x grams and that of Substance B as y grams. Represents the given situation in linear equations as:** $x + y = 9$ $x - y = 6$	**1**
	Solves the above pair of equations and finds the mass of Substance A as $\frac{15}{2}$ grams and that of Substance B as $\frac{3}{2}$ grams. **(Award full marks if the mass of Substance A is $\frac{3}{2}$ grams and that of Substance B is $\frac{15}{2}$ grams.)**	**1**
16	**Assumes the price of grapes per kg as Rs x and that of oranges as Rs y. Formulates the following pair of linear equations:** $3x + 4y = 680$ $4x + 2y = 640$	**1**
	Solves the above pair of linear equations to find the price of grapes and oranges per kg as Rs 120 and Rs 80 respectively.	**1**

<table>
<tr><th>Q.No</th><th>What to look for</th><th>Marks</th></tr>
<tr><td rowspan="3">17</td><td>Assumes the digit at the tens place and ones place as x and y respectively.

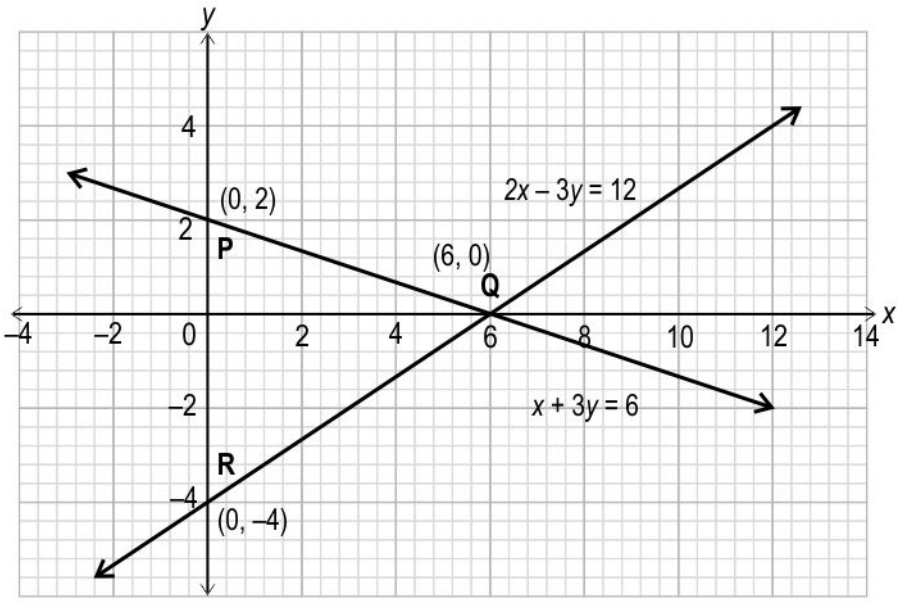
Writes the equation as:

$x + y = 11$
$10y + x = 10x + y + 27$</td><td>1</td></tr>
<tr><td>Solves the above equations correctly to find the values of x and y as 4 and 7 respectively.</td><td>1</td></tr>
<tr><td>Finds the original two-digit number as 47.</td><td>1</td></tr>
<tr><td rowspan="2">18</td><td>Solves the given pair of linear equation to find the values of c and d as $\frac{5}{7}$ and $\frac{-13}{7}$ respectively.</td><td>2</td></tr>
<tr><td>Finds the product of c and d as:

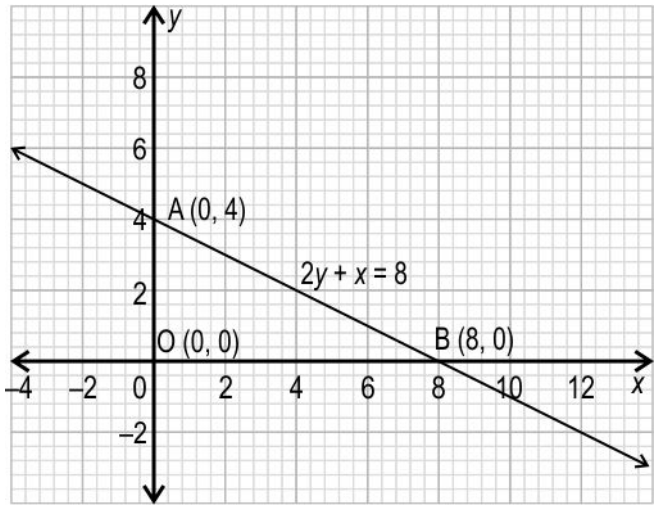
$\frac{5}{7} \times \frac{-13}{7} = \frac{-65}{49}$</td><td>1</td></tr>
<tr><td>19</td><td>Finds at least two points that satisfy the linear equation, $x + 3y = 6$. For example,

<table><tr><td>x</td><td>0</td><td>6</td></tr><tr><td>y</td><td>2</td><td>0</td></tr></table>
Finds at least two points that satisfy the linear equation, $2x - 3y = 12$. For example,

<table><tr><td>x</td><td>0</td><td>6</td></tr><tr><td>y</td><td>-4</td><td>0</td></tr></table></td><td>1.5</td></tr>
</table>

Q.No	What to look for	Marks
	Draws the graph for each equation using the coordinates found in the above two steps and thus finds the solution as $x = 6$ and $y = 0$. The graph may look as follows: 	**1**
	Identifies the shape as a triangle and write its vertices as (0, 2), (6, 0) and (0, -4).	**0.5**
20	**Assumes the width and length of the rectangle as w and x respectively. Expresses the above statement as a pair of linear equations:** **$x = 5w - 3$** **$6x + 2w = 46$**	**1**
	Solves the above pair of linear equations to find the width of the rectangle as 2 cm.	**2**
21	**i) Expresses the data plan structure for TechConnect in the form of an equation as:** **$c = 300 + 15(d - 5)$** **$\Rightarrow c = 15d + 225$** **(Award full marks if any other correct variation of the equation is written.)**	**1**

Q.No	What to look for	Marks
	ii) Identifies that the cost of both plans will become equal when *c* becomes 600: **600 = 15 *d* + 225**	**1**
	Solves the above equation and concludes that at data usage of 25 GB, the cost for both the plans will become equal.	**1**
22	**Assumes the time duration for which Rahul rode his bike at an average speed of 40 km/h to be *x* and at 35 km/h to be *y*.** **Frames the pair of linear equations in two variables as:** ***x* + *y* = 5** **40 *x* + 35 *y* = 190**	**1**
	Solves the above pair of linear equations to find *x* = 3 and *y* = 2.	**1.5**
	Writes that Rahul rode his bike at an average speed of 40 km/h for 3 hours.	**0.5**

Q.No	What to look for	Marks
23	**Finds at least two points that satisfy the linear equation, 2 y + x = 8. For example,** x 0 8 y 4 0 **Draws the graph for the equation using the coordinates found above. The graph may look as follows:**  	2
	i) Identifies the shape as a triangle and writes the vertices as (0, 4), (0, 0) and (8, 0).	1
	ii) Finds the perimeter of triangle using pythagoras theorem as 4 + 8 + $\sqrt{(4^2 + 8^2)}$ = 12 + 4$\sqrt{5}$ units.	1
	Finds the area of the triangle as $\frac{1}{2}$ × 4 × 8 = 16 sq units.	1
24	**Takes average speed while walking and average speed of the metro as x km/h and y km/h respectively.**	0.5
	Uses speed = $\frac{\text{distance}}{\text{time}}$ to frame equations $\frac{2}{x} + \frac{10}{y} = 1$ and $\frac{4}{x} + \frac{8}{y} = 1.5$ respectively.	1.5

Q.No	What to look for	Marks
	Substitutes $\frac{1}{x} = m$ and $\frac{1}{y} = n$, where m and n are also variables. Rewrites the equations as: **$2m + 10n = 1$** **$4m + 8n = 1.5$**	**1**
	Solves the above equations to find the values of m and n as $\frac{7}{24}$ and $\frac{1}{24}$ respectively. **Expresses the average speed of Muskan as $x = \frac{24}{7}$ km/h and average speed of the metro as $y = 24$ km/h.**	**2**
25	**Assumes the price of one bowling alley ticket as Rs x and price of one movie ticket as Rs y.** **Frames the pair of linear equations as:** **$y - 2x = 70$** **$5x + 3y = 870$**	**1**
26	**Solves the equations simultaneously to find the price of a movie ticket as Rs 190 and a bowling alley ticket as Rs 60.**	**2**
27	**Assumes the number of movie tickets and bowling alley tickets to be m and b respectively.** **Frames the pair of linear equations as:** **$m + b = 10$** **$220m + 90b = 1420$**	**1**
	Solves the equations to find the number of movie tickets (m) and bowling alley tickets (b) to be 4 and 6 respectively.	**1**

8. Annexure
Correct Answer Explanation

Chapter Name	Q. No	Correct Answer	Correct Answer Explanation
Real numbers	1	A	The square root of numbers which are not a perfect square of any number is an irrational number. All the other three options are either terminated decimal or square root of perfect squares, or non-terminating non-repeating decimal expansion. Hence only option A here is an irrational number.
	3	C	In the fraction 63/p, p can only be of the form $2^m \times 5^n$ to make the fraction a terminating decimal expansion. All the other 3 options are of the form $2^m \times 5^n$, so p cannot be equal to 13.
Arithmetic Progressions	4	C	In i), the common difference is 10, hence it is in AP. In iii), the common difference is (-0.5), hence it is in AP. In ii), there is no common difference and it's a random pattern, with random intervals between the numbers. So, it is not in AP. Hence, only i) and iii) are in Arithmetic progression.
	7	B	The construction progress follows an AP where the first term (a) is 5 (floors completed in the first week), and the common difference (d) is 3 (floors completed each subsequent week). The formula to find the nth term = a + (n−1) × d, where n = 12 => 5 + (12 − 1) × 3 = 38. Given, 6 floors were already there. So total number of floors = 38 + 6 = 44. Hence, option B is the correct answer.
Circles	2	B	Tangents drawn to the circle from an external point is of the same length. So, PA=DA and QC=DC (tangents to the circle from the external point A and C) Thus, AP + AB = AD + AB and CQ + BC = CD + BC Thus, BP = AD + AB and BQ = CD + BC Thus, BP + BQ = AD + AB + CD + BC Thus, BP + BQ = perimeter of ΔABC

			Hence, option B is the correct answer.
	3	C	If rectangle is drawn, the measure of length and breadth of rectangle will be same as the length of the diameter of the circle. Which will in turn make the rectangle into square.
	5	A	A right angle is formed between the radius and the tangent to the circle. Given that TS is parallel to QR. Thus, ∠PRQ = ∠PSO = 90° (corresponding angles) By angle sum property of triangle in ΔPQR, ∠RPQ = 180° - (90° + 55°) = 180° - 145° = 35°. Hence, option A is the right answer.
Coordinate Geometry	4	C	In a square all sides are of the same length and it must be noticed in the figure that P and Q has same x-coordinate and different y co-ordinate with a difference of 4 units.
	6	C	To find the relation, the distance formula is to be used and the two sides are to be equated as: $(x + 1)^2 + (y - 4)^2 = (x - 2)^2 + (y - 5)^2$ $\Rightarrow x^2 + 2x + 1 + y^2 - 8y + 16 = x^2 - 4x + 4 + y^2 - 10y + 25$ $\Rightarrow 6x + 2y = 12$ $\Rightarrow 3x + y = 6.$
Areas related to circles	7	B	The radius will remain same for both minor and major sectors of a circle. But the angle subtended at the centre, the area of the sector and the length of the arc, all three will be larger for the major sector and smaller for the minor sector. Hence, option B is the answer.
	3	C	Angle z can be found by framing and solving for this equation: $(5/8)\pi(r)^2 = (z/360)\pi(r)^2$ $\Rightarrow z = 225°.$ Hence, option C is the correct answer.
Introduction to Trigonometry	3	B	$\cos^2 \text{theta} - \sin^2 \text{theta} = 3/4$ $\Rightarrow 2\cos^2 \text{theta} - 1 = 3/4$

			=> $\cos^2$ theta = 7/8 => cos theta = sqrt(7/8)
	7	A	Multiplying and dividing the equation by sqrt (1 + sin theta) We get, sqrt [(1 + sin theta)^2/ (1 - $\sin^2$ theta)] sqrt [(1 + sin theta)^2/ ($\cos^2$ theta)] (1 + sin theta) / cos theta (1 / cos theta) + (sin theta/cos theta) sec theta + tan theta Hence, option A is the correct answer.
Pair of Linear Equations in Two Variables	6	B	If Tanisha gives 6 chocolates to Aditya, that means 6 should be subtracted from Tanisha's and added to Aditya's chocolates, which turns out to be equal: x - 6 = y + 6. If Aditya gives 3 chocolates to Tanisha, then 3 should be added to Tanisha's; Aditya's initial chocolates should be multiplied by 4 to make them equal: x + 3 = 4y. Hence, option B is the correct answer.
	7	C	As (1/3) ≠ (-1/2) => (a1/a2) ≠ (b1/b2), the pair of equations has a unique solution and it represents a pair of intersecting lines. That means the assertion is correct but the reasoning is not. Hence, option C is the correct answer.

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