Competency Focused Practice Questions

Mathematics | Grade 10

Co-created by
Centre for Excellence in Assessment
CBSE
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 working closely with Educational Initiatives (Ei) in the area of assessment and capacity of the board. Through resources like the Essential Concepts document and A-Question-A-Day (AQAD), high quality assessment 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 five subjects of Grade 10. 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 subjective questions 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 a detailed scoring rubric to guide evaluation of students' responses.

Each item has been reviewed twice by the experts, to check for appropriateness of the item, validity of the item, conceptual correctness, language accuracy and other nuances. The process is designed to increase the quality of each question.

How can these item booklets be used?

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
- to get inspiration to create more such competency-based items

Students can also use this document to understand different kinds of ques ons and prac ce specific concepts and competencies.

Please write back to us if there is any feedback.

Team CBSE

Table of Contents

Chapter - 1
Real Numbers

Q: 1 **Let *p* be a prime number and *k* be a positive integer.**

If *p* divides k^2, then which of these is DEFINITELY divisible by *p* ?

$\frac{k}{2}$	k	$7k$	k^3

1 only k
2 only k and 7 k
3 only k, 7 k and k^3
4 all - $\frac{k}{2}$, k, 7 k and k^3

Q: 2 **√n is a natural number such that n > 1.**

Which of these can DEFINITELY be expressed as a product of primes?

i) √n
ii) n
iii) $\frac{\sqrt{n}}{2}$

1 only ii)
2 only i) and ii)
3 all - i), ii) and iii)
4 (cannot be determined without knowing n)

Q: 3 **The HCF of *k* and 93 is 31, where *k* is a natural number.**

Which of these CAN be true for SOME VALUES of *k* ?

i) *k* is a multiple of 31.
ii) *k* is a multiple of 93.
iii) *k* is an even number.
iv) *k* is an odd number.

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

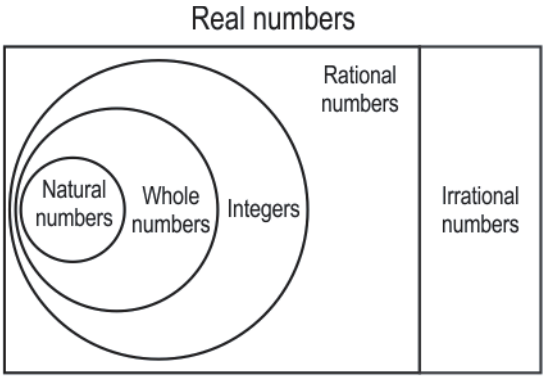
Q: 4 **Let *p* and *q* be two natural numbes such that *p* > *q*. When *p* is divided by *q*, the remainder is *r*.**

i) *r* CANNOT be (*p* - *q*).
ii) *r* CAN either be *q* or (*p* - *q*).
iii) *r* is DEFINITELY less than *q*.

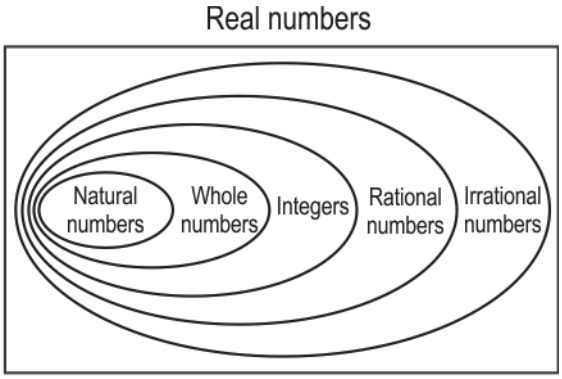
Which of the above statements is/are true?

1 only ii)
2 only iii)
3 only i) and iii)
4 (cannot be determined without knowing the values of p , q and r)

Q: 5 **Two representations of real numbers are shown below.** **[1]**



Representation 1



Representation 2

Which one is correct?

Q: 6 **β and δ are positive integers. HCF of β and 630 is 210. HCF of δ and 110 is 55.** **[2]**

Find the HCF of β, 630, δ and 110 using Euclid's division algorithm. Show your steps.

Q: 7 **A dining hall has a length of 8.25 m, breadth of 6.75 m, and height of 4.50 m. What is the length of the longest unmarked ruler that can exactly measure the three dimensions of the hall? Show your steps and give valid reasons.** **[2]**

Q: 8 **GrowMore Plantations have two rectangular fields of the same width but different lengths. They are required to plant 84 trees in the smaller field and 231 trees in the larger field. In both fields, the trees will be planted in the same number of rows but in different numbers of columns.** **[2]**

i) What is the most number of rows that can be planted in this arrangement? Show your work.
ii) If the trees are planted in the number of rows obtained in part (i), how many columns will each field have?

Q: 9 **M and N are positive integers such that M = $p^2 q^3 r$ and N = $p^3 q^2$, where p, q, r are prime numbers.** **[2]**

Find LCM(M, N) and HCF(M, N).

Q: 10 **Find all pairs of positive integers whose sum is 91 and HCF is 13. Show your work.** **[3]**

Q: 11 **The number 58732045 is divided by a number between 3256 and 3701.** **[3]**

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

i) The remainder is always less than 3701.
ii) The remainder is always more than 3256.
iii) The remainder can be any number less than 58732045.

Q: 12 **Hemant claimed that any positive integer can be expressed either as 3 n, (3 n - 2) or (3 n - 1).** **[3]**

Prove or disprove Hemant's claim.

Q: 13 **(n^2 + 3 n - 4) can be expressed as a product of only 2 prime factors where n is a natural number.** **[1]**

Find the value(s) of n for which the given expression is an even composite number. Show your work and give valid reasons.

Q: 14 **The prime factorisation of a prime number is the number itself.** **[1]**

How many factors and prime factors does the square of a prime number have?

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	3
2	2
3	3
4	2

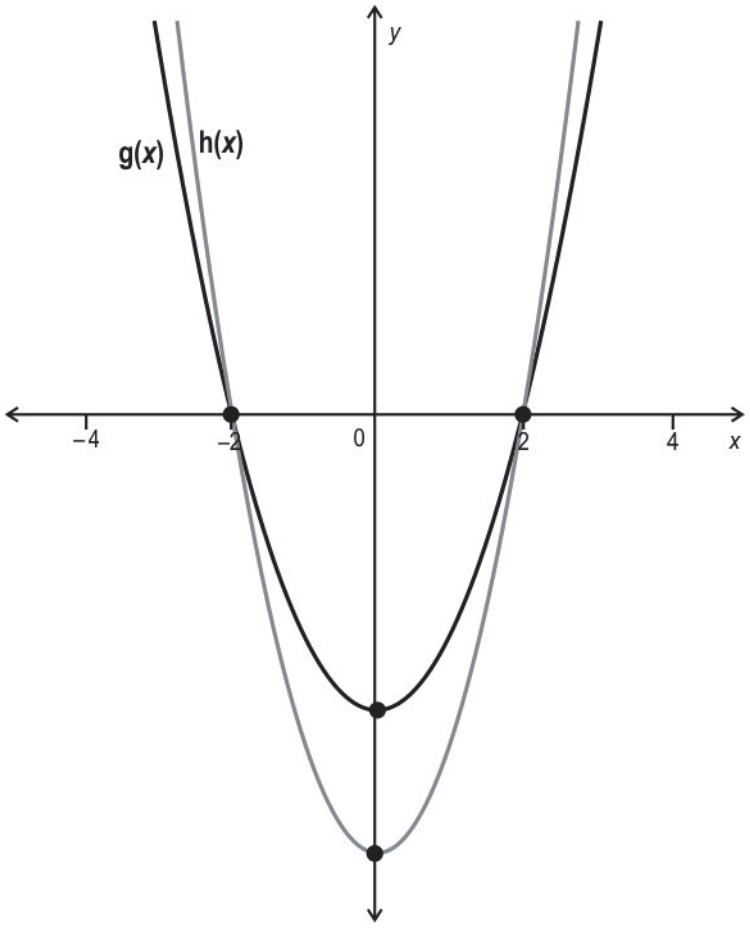
Q.No	Teacher should award marks if students have done the following:	Marks
5	Writes that Representation 1 is correct.	1
6	Finds the HCF of 210 and 55 using Euclid's division algorithm as: $210 = (55 \times 3) + 45$ $55 = (45 \times 1) + 10$ $45 = (10 \times 4) + 5$ $10 = (5 \times 2) + 0$	1
	Concludes that HCF of β, 630, δ and 110 is 5.	1
7	Identifies and reasons that the length of the longest ruler should be equal to the HCF of the three lengths.	1
	Finds the HCF of the three numbers as Prime factorization of $825 = 3 \times 5^2 \times 11$ Prime factorization of $675 = 3^3 \times 5^2$ Prime factorization of $450 = 2 \times 3^2 \times 5^2$ Highest Common factor, HCF $= 3 \times 5^2 = 75$ Mentions the length of the longest ruler as 75 cm or 0.75 m. (Award 0.5 marks if the length is correct but the unit is incorrect).	1
8	i) Identifies that the number of rows for the two fields must be HCF of 84 & 231, and applies an appropriate method to find the HCF as 21.	1
	ii) Finds the number of columns in the smaller field as $\frac{84}{21} = 4$.	0.5
	Finds the number of columns in the larger field as $\frac{231}{21} = 11$.	0.5
9	Finds LCM(M, N) as $p^3 q^3 r$.	1
	Finds HCF(M, N) as $p^2 q^2$.	1

Q.No	Teacher should award marks if students have done the following:	Marks
10	Assumes the pair of numbers to be x and y. Writes that, since HCF(x, y) = 13, x and y will be of the form, $x = 13p$ $y = 13q$ where, p and q are co-primes.	0.5
	Uses the given information and writes, $x + y = 91$ $\Rightarrow 13p + 13q = 91$ $\Rightarrow p + q = 7$	0.5
	Finds all possible values of p and q as: 1 and 6 2 and 5 3 and 4	1
	Finds all possible values of x and y as: 13 and 78 26 and 65 39 and 52	1
11	i) Writes true 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 3701.	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 is always less than the divisor but cannot be any number less than the dividend.	1
12	Assumes the positive integer to be m and uses Euclid's division lemma with divisor as 3 to write the equation: $m = 3k + r$ where k is the quotient and r is the remainder.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Writes that, since the positive integer m is being divided by 3, the possible values of the remainder are 0, 1 or 2.	1
	Uses steps 1 and 2 to write that any positive integer m can be represented as: 3 k, 3 k + 1 or 3 k + 2	0.5
	Replaces 3 k with 3 t + 3 since these are equivalent by Euclid's division lemma to get: 3 t + 3, 3 t + 3 - 2 or 3 t + 3 - 1	0.5
	Rewrites the above expressions by using n = (t + 1) where n is an integer as: 3 n, 3 n - 2 or 3 n - 1 Hence, proves that Hemant's claim is correct.	0.5
13	Factorises the given expression as: (n - 1)(n + 4)	0.5
	Writes that, for the above to be an even composite number, one of the factors has to be 2 and hence: (n - 1) = 2 => n = 3	0.5
14	For the square of a prime number: number of factors = 3 number of prime factors = 1 (Award 0.5 marks for each correct number)	1

Chapter - 2
Polynomials

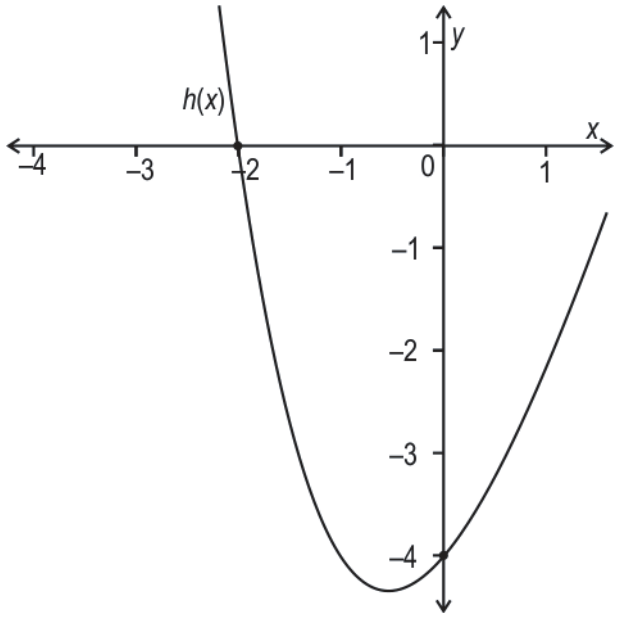
Q: 1 **Shown below are the parts of graphs of two polynomials, $g(x)$ and $h(x)$. When $h(x)$ is divided by $(x - 3)$, the remainder is k.**



Which of these is true for the remainder when $g(x)$ is divided by $(x - 3)$?

1 It is less than k.
2 It is equal to k.
3 It is more than k.
4 (cannot conclude without knowing the polynomials)

Q: 2 **Shown below is a part of the graph of a polynomial *h* (*x*).**

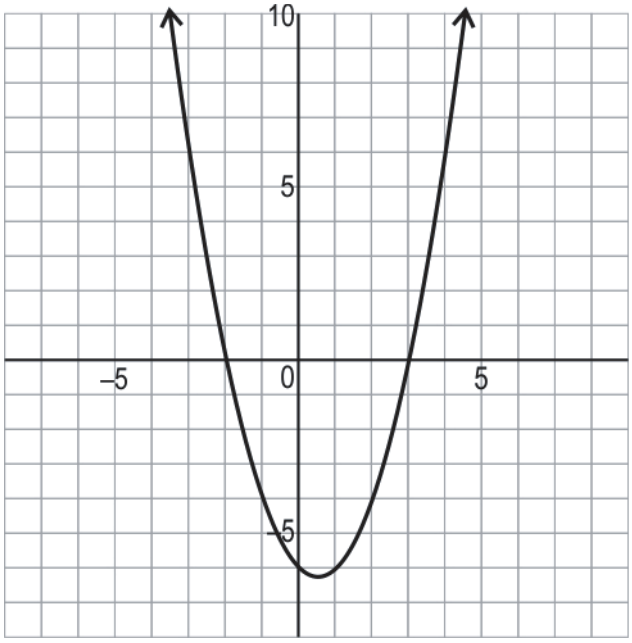


On dividing *h* (*x*) by which of the following will the remainder be zero?

i) (*x* - 2)
ii) (*x* + 2)
iii) (x - 4)
iv) (x + 4)

1 only ii)
2 only i) and iii)
3 only ii) and iv)
4 (cannot be determined without knowing the polynomial *h* (*x*))

Q: 3 **[2]**



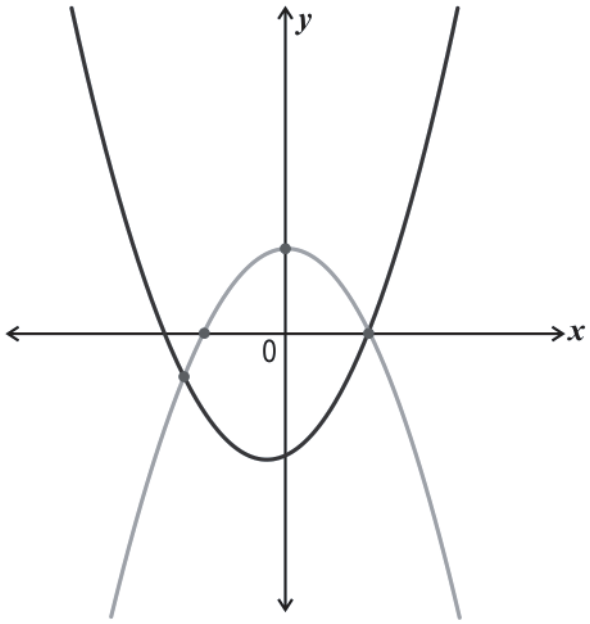
Write a quadratic polynomial whose sum of zeros is less than that of the polynomial shown in the graph above.

Q: 4 **[2]**

$$\frac{x^2 - 3\sqrt{2}x + 4}{x - \sqrt{2}} \; ; x \neq \sqrt{2}$$

At how many points does the graph of the above expression intersect the *x* -axis? Show your work.

Q: 5 **Two polynomials are shown in the graph below.** **[1]**



Find the number of zeroes that are common to both the polynomials. Explain your answer.

Q: 6 **p and q are zeroes of the polynomial $2x^2 + 5x - 4$.** **[2]**

Without finding the actual values of p and q, evaluate $(1 - p)(1 - q)$. Show your steps.

Q: 7 **A polynomial is given by $q(x) = x^3 - 2x^2 - 9x + k$, where k is a constant.** **[3]**

The sum of two zeroes of $q(x)$ is zero.

Using the relationship between the zeroes and coefficients of a polynomial, find the:

i) zeroes of $q(x)$.
ii) value of k.

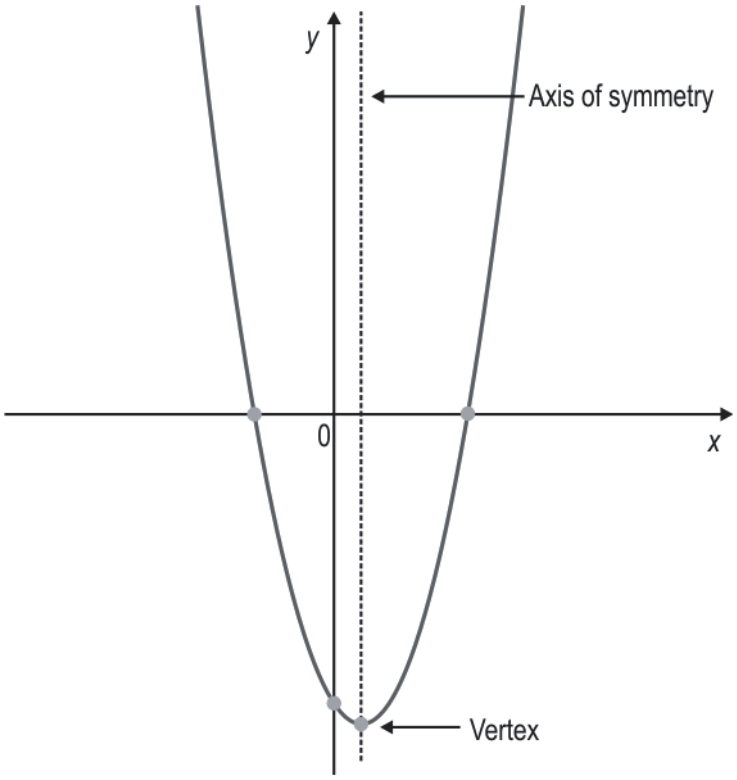
Show your steps.

Q: 8 **$p(x) = ax^2 - 8x + 3$, where a is a non-zero real number. One zero of $p(x)$ is 3 times the other zero.** **[3]**

i) Find the value of a. Show your work.
ii) What is the shape of the graph of $p(x)$? Give a reason for your answer.

Q: 9 $f(x) = 2x^2 - 4x + k$, where k is a non-zero real number. When $f(x)$ is divided by $(x + 2)$, it leaves a remainder of (-14). **[5]**

i) Find the zeroes of $f(x)$.
ii) Shown below is the graph of $f(x)$. The vertex is the minimum value of $f(x)$ and the dotted line drawn through the vertex is the axis of symmetry of the graph.



At what point does the axis of symmetry intersect the x-axis? Find the minimum value of $f(x)$.

Show your steps.

Q: 10 $p(x) = 2x^2 - 6x - 3$. The two zeroes are of the form: **[2]**

$$\frac{3 \pm \sqrt{k}}{2}$$; Where k is a real number

Use the relationship between the zeroes and coefficients of a polynomial to find the value of k. Show your steps.

Q: 11 Find the distance between the zeroes of the polynomial $f(x) = 2x^2 - x - 6$. Show your steps. **[2]**

Q: 12 $x^4 + ax^3 + bx^2 + 2x + 3 = (x^2 - 2)\,q(x) - 2x - 3$ where a, b are non-zero real constants and $q(x)$ is a non-zero polynomial. **[5]**

i) Find the values of a and b.
ii) Find the zeroes of $q(x)$.

Show your steps.

Q: 13 **[3]**

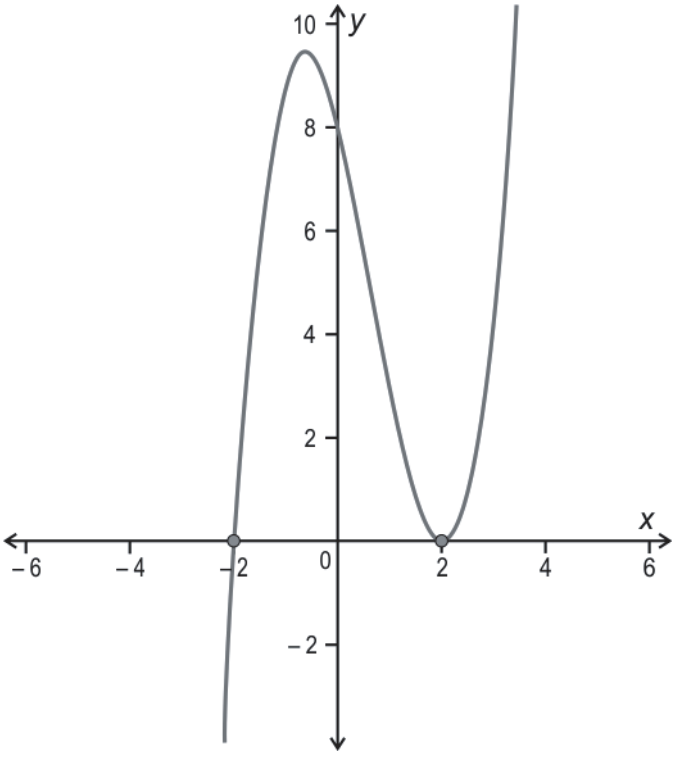
$f(x) = x^3 - ax^2 + (a - 3)x + 6$, where a is a non-zero real number. When $f(x)$ is divided by $(x + 1)$, there is no remainder.

If $f(x)$ is completely factorisable, find the zeroes of $f(x)$. Show your steps.

Q: 14 One zero of $f(x) = x^3 - 3x^2 + 4$ is 2. **[2]**

At how many points will the graph of $f(x)$ intersect the x-axis? Show your steps.

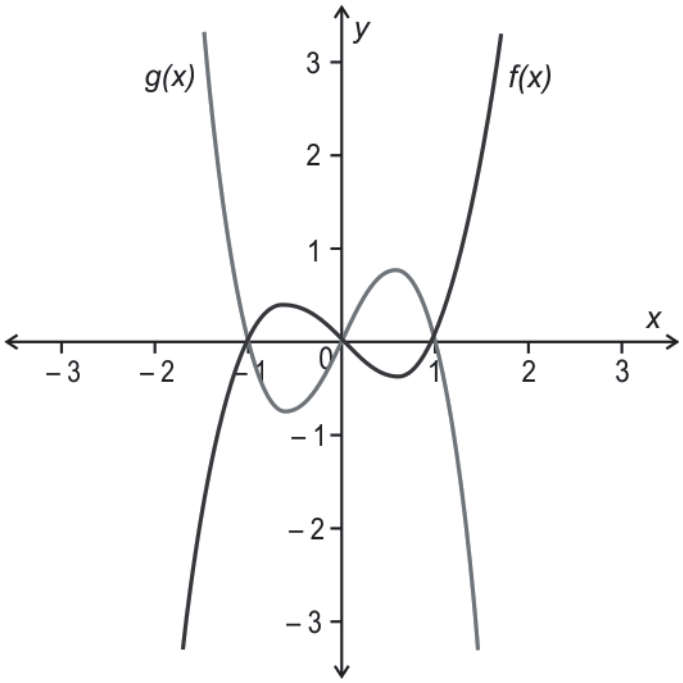
Q: 15 Students of a class were shown the graph below. **[1]**



Based on their answers, they were divided into two groups. Group 1 said the graph represented a quadratic polynomial whereas group 2 said the graph represented a cubic polynomial.

i) Which group was correct?
ii) Write the polynomial represented by the graph.

Q: 16 **Shown below are the graphs of two cubic polynomials, $f(x)$ and $g(x)$. Both polynomials have the zeroes (-1), 0 and 1.** **[1]**



Anya said, "Both the graphs represent the same polynomial, $f(x) = g(x) = (x + 1)(x - 0)(x - 1)$ as they have the same zeroes."

Pranit said, "Both the graphs represent two different polynomials, $f(x) = (x + 1)(x - 0)(x - 1)$ and $g(x) = -(x + 1)(x - 0)(x - 1)$ and only two such polynomials exist that can have the zeroes (-1), 0 and 1."

Aadar said, "Both the graphs represent two different polynomials and infinitely many such polynomials exist that have the zeroes (-1), 0 and 1."

Who is right? Justify your answer.

Q: 17 **$p(x) = (x + 3)^2 - 2(x - c)$; where c is a constant.** **[2]**

If $p(x)$ is divisible by x, find the value of c. Show your steps.

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	1
2	1

Q.No	Teacher should award marks if students have done the following:	Marks
3	Identifies the sum of the zeroes of the given polynomial as 3 - 2 = 1.	1
	Writes a quadratic polynomial whose sum of zeroes is less than 1. For example, $x^2 + 3x - 5 = 0$.	1
4	Factorises the numerator to write the given expression as: $\frac{(x-\sqrt{2})(x-2\sqrt{2})}{x-\sqrt{2}}$	1
	Writes that the graph of the above expression, $x - 2\sqrt{2}$, intersects the x -axis at exactly one point.	1
5	Finds the number of zeroes that are common to both the polynomials as 1.	0.5
	Explains the answer. For example, the two polynomials intersect at 2 points but only 1 of them lie on the x -axis.	0.5
6	Expands $(1 - p)(1 - q)$ to get $1 - (p + q) + pq$.	0.5
	Finds the sum of the zeroes as $\frac{-5}{2}$.	0.5
	Finds the product of the zeroes as $\frac{-4}{2} = -2$.	0.5
	Uses the above steps to find the value of $(1 - p)(1 - q)$ as $1 - (-\frac{5}{2}) - 2 = \frac{3}{2}$.	0.5
7	i) Assumes the values of zeroes of $q(x)$ as $(-\alpha)$, α and β.	0.5
	Writes the sum of zeroes as: $-\alpha + \alpha + \beta = 2$ Finds β as 2.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Writes the equation for the sum of the products of zeroes taken two at a time as: $-\alpha^2 - \alpha\beta + \beta\alpha = -9$ Finds α^2 as 9.	1
	Finds the 3 zeroes of $q(x)$ as (-3), 3 and 2.	0.5
	ii) Writes the equation for the product of zeroes as $(-\alpha^2\beta) = (-k)$ and finds the value of k as 18.	0.5
8	i) Assumes the roots of $p(x)$ to be α and β to write the relation $\alpha = 3\beta$.	0.5
	Writes the sum of the roots as $4\beta = \frac{8}{a}$ to get β as $\frac{2}{a}$.	0.5
	Writes the product of the roots as $3\beta^2 = \frac{3}{a}$ to get a as 4.	1
	ii) Writes that, since a is positive, the graph of $p(x)$ is an open upward parabola or open upwards like U.	1
9	i) Writes that, since remainder of $\frac{f(x)}{(x+2)}$ is -14, therefore, $f(-2) = -14$.	0.5
	Uses the above step to write the equation as: $2(-2)^2 - 4(-2) + k = -14$ Finds the value of k as -30.	1
	Factorises $f(x)$ as $(2x + 6)(x - 5)$ and finds the zeroes as -3 and 5.	1.5
	ii) Finds the point at which the axis of symmetry intersects the x-axis as the average of the two zeroes: $\frac{(-3+5)}{2} = 1$.	1
	Finds the minimum value of $f(x)$ as: $f(1) = 2(1)^2 - 4(1) - 30 = -32$.	1

Q.No	Teacher should award marks if students have done the following:	Marks
10	Writes the equation for the product of zeroes as: $\left(\frac{3+\sqrt{k}}{2}\right)\left(\frac{3-\sqrt{k}}{2}\right)=\frac{-3}{2}$	1
	Simplifies the above equation and writes: $\frac{9-k}{4}=\frac{-3}{2}$	0.5
	Solves the above equation and finds the value of k as 15.	0.5
11	Factorises $f(x)$ as $(x-2)(2x+3)$.	1
	Writes $f(x)=0$ and finds the coordinates of the zeroes as (2, 0) and $(\frac{-3}{2}, 0)$. (Award full marks if only the zeroes of $f(x)$ are written.)	0.5
	Finds the distance between the zeroes as $\frac{7}{2}$ units.	0.5
12	i) Writes the given equation as $x^4+ax^3+bx^2+4x+6=(x^2-2)q(x)$.	0.5

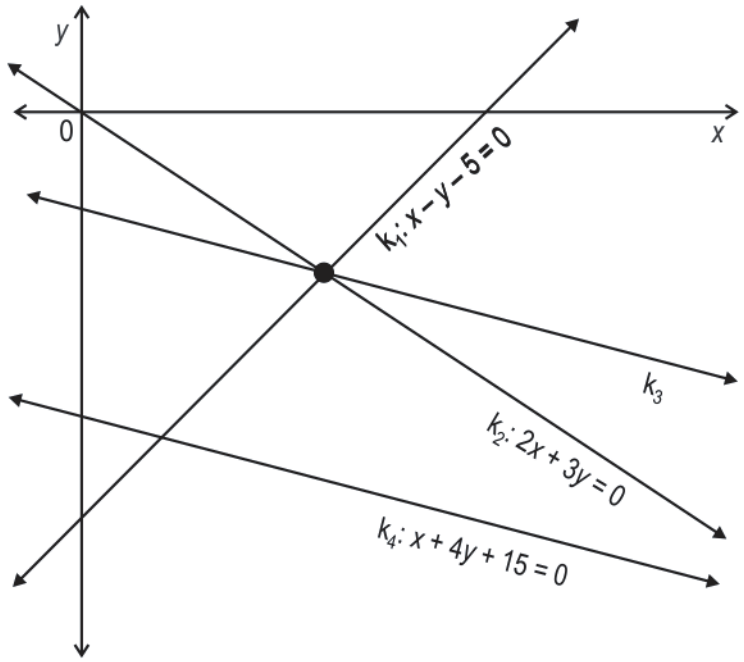
Q.No	Teacher should award marks if students have done the following:	Marks
	Divides $x^4 + ax^3 + bx^2 + 4x + 6$ by $(x^2 - 2)$ to get $q(x)$ as $x^2 + ax + b + 2$. For example: $x^2 - 2 \overline{)\, x^4 + ax^3 + bx^2 + 4x + 6}$ $\quad x^2 + ax + b + 2$ $-\ (x^4 \quad - 2x^2)$ $ax^3 + x^2(b + 2) + 4x + 6$ $-\ (ax^3 \quad - 2ax)$ $x^2(b + 2) + x(2a + 4) + 6$ $-\ (x^2(b + 2) \quad - 2b - 4)$ $x(2a + 4) + 2b + 10$	2
	Equates the coefficient of x in the remainder to 0 and finds the value of a as -2.	0.5
	Equates the constant term in the remainder to 0 and finds the value of b as -5.	0.5
	ii) Uses step 3 and writes $q(x)$ as $x^2 - 2x - 3$.	0.5
	Factorises $q(x)$ as $(x + 1)(x - 3)$ and finds its zeroes as -1 and 3.	1
13	Writes that, since $f(x)$ is divisible by $(x + 1)$, $f(-1) = 0$ and finds the value of a as 4.	0.5
	Uses the above step and writes $f(x)$ as $x^3 - 4x^2 + x + 6$.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Divides $f(x)$ by $(x + 1)$ and finds the quotient as $x^2 - 5x + 6$. For example: $x+1 \overline{)\, x^3 - 4x^2 + x + 6}$; $x^2 - 5x + 6$ $-(x^3 + x^2)$ $-5x^2 + x + 6$ $-(-5x^2 - 5x)$ $6x + 6$ $-(6x + 6)$ 0	1
	Factorises the quotient as $(x - 2)(x - 3)$.	0.5
	Finds the zeroes of $f(x)$ as (-1), 2 and 3.	0.5
14	Divides $f(x)$ by $(x - 2)$ and finds the quotient as $x^2 - x - 2$. For example: $x-2 \overline{)\, x^3 - 3x^2 + 4}$; $x^2 - x - 2$ $-(x^3 - 2x^2)$ $-x^2 + 4$ $-(-x^2 + 2x)$ $-2x + 4$ $-(-2x + 4)$ 0	1
	Factorises the quotient as $(x - 2)(x + 1)$.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Concludes from the above step that the graph of $f(x)$ intersects the x-axis at two points.	0.5
15	i) Writes that group 2 was correct.	0.5
	ii) Writes the polynomial represented by the graph as $(x - 2)^2 (x + 2)$.	0.5
16	Writes that Aadar is right and gives a justification. For example, the factored form of a cubic polynomial with the zeroes (-1), 0 and 1 can be written as $k(x + 1)(x - 0)(x - 1)$ where k is an integer.	1
17	Writes the given polynomial as: $p(x) = x^2 + 9 + 4x + 2c$	0.5
	Writes that, if $p(x)$ is divisible by x, $p(0) = 0$. OR Writes that the remainder of $\frac{p(x)}{x}$, which is $9 + 2c$, should be 0.	1
	Finds the value of c as $\frac{-9}{2}$.	0.5

Chapter - 3
Pair of Linear Equations in Two Variables

Q: 1 **Shown below is a graph with four straight lines. It is given that lines k_1, k_2 and k_3 intersect at exactly one point and line $k_3 \parallel k_4$.**



Which of the following is the equation of line k_3?

1 $x + y - 1 = 0$
2 $x + 4y + 5 = 0$
3 $x - 4y - 11 = 0$
4 $2x + 8y + 35 = 0$

Q: 2 **Harsh correctly solved a pair of linear equations in two variables and found their only point of intersection as (3, -2). One of the lines was $x - y = 5$.**

Which of the following could have been the other line?

I: $3x - 3y = 15$
II: $2x - 3y = 12$
III: $2x - 3y = 14$

1 only I
2 only II
3 only I and II
4 only II and III

Q: 3 **Two linear equations in variables *x* and *y* are given below.**

$a_1 x + b_1 y + c = 0$
$a_2 x + b_2 y + c = 0$

Which of the following pieces of information is independently sufficient to determine if a solution exists or not for this pair of linear equations?

I: $\frac{a_1}{b_1} = \frac{a_2}{b_2} = 1$

II: $\frac{a_1}{a_2} = \frac{b_1}{b_2}$

III: $\frac{a_1}{a_2} = \frac{a_1}{b_1} \neq 1$

IV: $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

1 IV **2** I and IV **3** II and IV **4** I and III

Q: 4 **The ratio of a two-digit number and the sum of its digits is 7:1. How many such two-digit numbers are possible?**

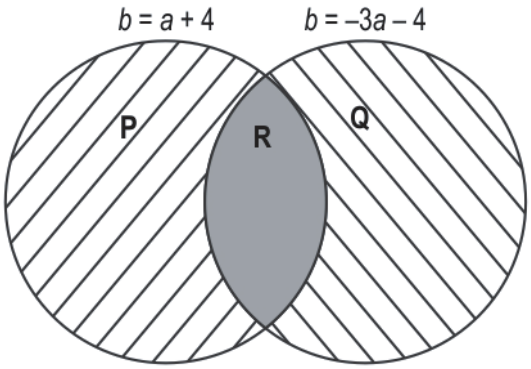
1 1 **2** 4 **3** 9 **4** (infinitely many)

Q: 5 **If a pair of linear equations given by $a_1 x + b_1 y + c_1 = 0$ and $a_2 x + b_2 y + c_2 = 0$ has a unique solution, then which of the following is true?**

1 $a_1 a_2 = b_1 b_2$ **2** $a_1 b_2 \neq a_2 b_1$ **3** $\frac{a_1}{a_2} = \frac{b_1}{b_2}$ **4** $\frac{a_1}{b_2} \neq \frac{b_1}{a_2}$

Q: 6 **Write a pair of linear equations in 2 variables which have infinite solutions.** **[1]**

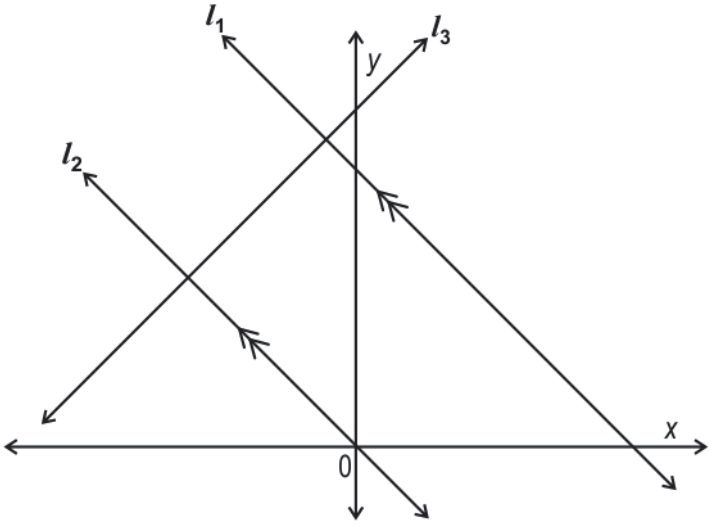
Q: 7 **The two circles represent the ordered pairs, (a, b), which are solutions of the respective equations. The circles are divided into 3 regions P, Q and R as shown.** **[3]**



Write one ordered pair each belonging to P, Q and R. Show your work.

Q: 8 **Shown below is a graph representing straight lines l_1, l_2 and l_3 such that:** **[3]**

- **l_2 is parallel to l_1 and l_3 intersects l_1 at exactly one point.**
- **The equation of l_1 is $x + y = k$, where k is a real number.**



Based on the above information, identify if the statements below are true or false. Justify your answer.

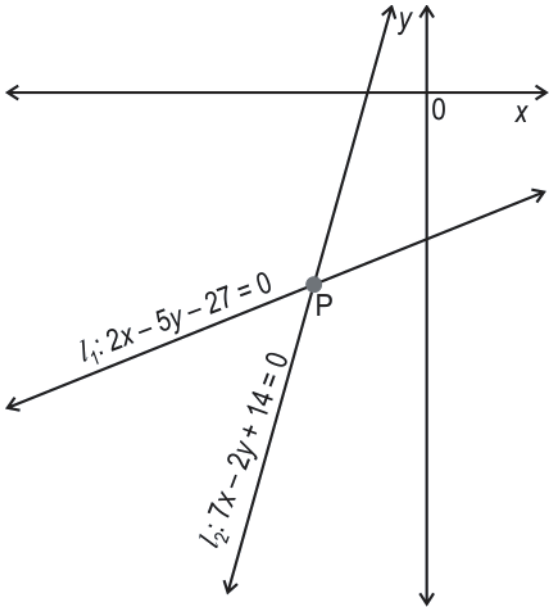
i) $2x + 2y = 2k$ can be the equation of l_2.
ii) $(-x) + y = k$ can be the equation of l_3.

Q: 9 **Shown below is a pair of linear equations.** **[3]**

$x + 0.999\,y = 2.999$
$0.999\,x + y = 2.998$

i) Without finding the values of x and y, prove that $x - y = 1$.
ii) Find the values of x and y. Show your work.

Q: 10 **Shown below are lines $l_1 : 2x - 5y - 27 = 0$ and $l_2 : 7x - 2y + 14 = 0$.** **[2]**



Write the equation of a line l_3, in two variables, such that it intersects l_1 and l_2 exactly at one point, P. Show your work.

Q: 11 **Given below are two lines such that $l_1 \parallel l_2$.** **[3]**

$l_1 : 2x + 2y + 2 = 0$
$l_2 : 3x - 3y + 3 = 0$

i) Using comparison of ratios of coefficients, write the equation of a line l_3, in two variables, such that it intersects l_1 at exactly one point.
ii) Find the point of intersection of l_2 and l_3.

Show your steps.

Q: 12 **A company has a locker in which valuable documents are kept. The passcode is a four digit number of the form *xyyx*. The Chief Executive Officer (CEO) and the Vice President (VP) of the company have each been given one clue. On solving BOTH clues, the passcode that opens the locker can be found.** **[3]**

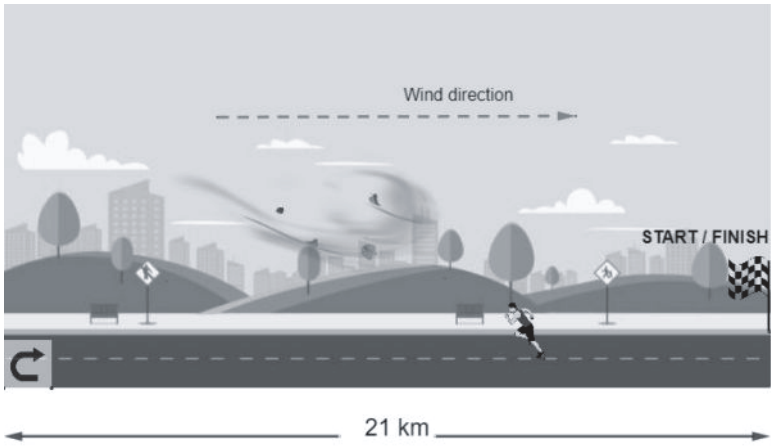
CEO's clue: When twice the ones digit is subtracted from the tens digit, the result is 1.

VP's clue: Three more than the tens digit is thrice the ones digit.

Find the passcode that opens the locker. Show your work.

Q: 13 **At the Bengaluru marathon, the 42 km route is designed such that marathoners run in a straight line for 21 km, and return back along the same path in the opposite direction.** **[3]**

A marathoner, running against the wind, covered the first half of the marathon in 2 hours. Then, he covered the second half, running with the wind, in 1.5 hours. Assume that the marathoner ran at a constant speed and that the wind speed and direction did not change throughout the marathon.



(Note: The figure is not to scale.)

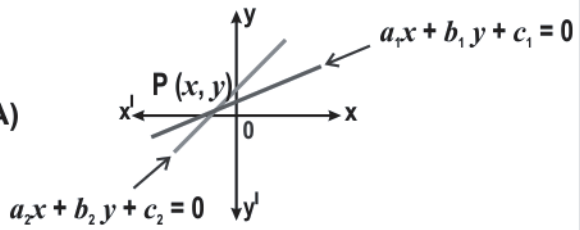
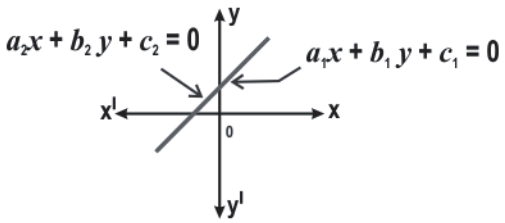
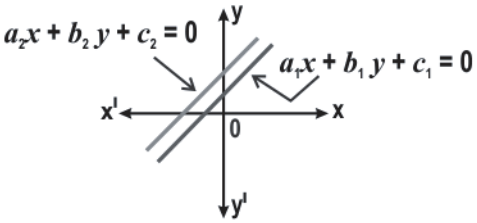
Calculate the speed (in km/h) of the marathoner and the wind. Show your steps.

Q: 14 **A new intra-city transportation startup has employed both taxis and auto rickshaws. The night fare for a taxi is Rs 9 for the first half kilometre and Rs 15 per kilometre thereafter, while the night fare for an auto rickshaw is Rs 20 for the first one kilometre and Rs 13 per kilometre thereafter.** **[3]**

i) Express the night fare structure for taxis and auto rickshaws in the form of linear equations. Use *f* as the fare (in Rs) and *d* as the distance travelled (in km).

ii) At what distance is the night fare for a taxi and an auto rickshaw equal? Show your steps.

Q: 15 **Match the graphical representation in column I with their corresponding criteria in column II and consequences in column III.** **[3]**

COLUMN I	COLUMN II	COLUMN III
A) 	1) $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$	i) Infinitely many solutions
B) 	2) $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	ii) No solution
C) 	3) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$	iii) Exactly one solution

(Note: Match the alphabets A), B), C) in column I with the corresponding numbers 1), 2), 3) in column II and i), ii), iii) in column III respectively.)

Q: 16 **Arvind owns a dry-fruits store. He sells cashew nuts at Rs 600/kg and pistachio nuts at Rs 750/kg.** **[3]**

A customer asks for a mixture of cashew nuts and pistachio nuts with the following conditions:
- **both the items should together weigh 500 g.**
- **both the items should together cost Rs 360.**

i) If Arvind packs *x* kg of cashew nuts and *y* kg of pistachio nuts for the customer, frame the equations that represent the given context.

ii) Find the weights of cashew nuts and pistachio nuts that Arvind packed for the customer.

Show your work.

Q: 17 **Is the pair of linear equations x = p and y = q consistent? Justify your answer.** **[1]**

(Note: p and q are constants)

Q: 18 **The four-wheeler parking fees at a metro station is charged in two parts - a fixed charge of Rs x up to 2 hours and Rs y for every subsequent hour.** **[5]**

i) Murli parked his car for 6 hours and paid Rs 110. Aparna parked her car for 13 hours and paid Rs 250. Frame a pair of linear equations representing the context and find the fixed charge and the subsequent charge per hour.

ii) Amish parked his car at the station from 8 AM to 3 PM. Find the amount Amish must pay as the parking charges.

Show your work.

Q: 19 **Ananya had red, blue and yellow marbles in the ratio 4:5:3. She gave all her red marbles and some blue marbles to Neha. The ratio of the number of blue marbles and yellow marbles left with Ananya was 7:9.** **[5]**
If Ananya gave 20 marbles to Neha, how many of them are red marbles? Show your work.

Q: 20 **Given below is a non-linear equation.** **[1]**

$$\frac{3(x+y)+7(x-y)}{x^2-y^2}=12$$

Garima has reduced it to a linear equation in two variables. Shown below are her steps.

Step 1: $\frac{3(x+y)+7(x-y)}{(x+y)(x-y)}=12$

Step 2: $\frac{3}{(x+y)}+\frac{7}{(x-y)}=12$

Step 3: Takes $\frac{1}{(x+y)}=a$ **and** $\frac{1}{(x-y)}=b$

Step 4: $3a+7b=12$

However, she has made a mistake in one step. Identify the erroneous step and complete the solution.

Answer the questions based on the given information.

The total cost of snowden ice cream parlour is divided into fixed cost (x) and variable cost (y). Fixed cost is the cost that the ice cream parlour has to incur even at zero level of production and variable cost is the cost that will be directly proportional to each unit of ice cream sold.

The parlour launched a new flavour of ice cream and wanted to find the fixed and variable cost associated with it. They found that their total cost for that flavour was Rs 27500 after selling 150 units and Rs 32500 after selling 250 units.

Q: 21 **Frame the equations that represent the total cost incurred by snowden ice cream parlour for the new flavour in terms of fixed and variable costs.** **[1]**

Q: 22 **Find the fixed cost incurred by the ice cream parlour for the new flavour. Show your work.** **[1]**

Q: 23 **Find the variable cost per unit incurred by the ice cream parlour for the new flavour. Show your work.** **[1]**

Q: 24 **The break-even point of a new flavour ice cream is the number of units sold at which the total cost price of the ice cream is the same as the total selling price. The parlour launches another new flavour whose fixed cost is Rs 10000, variable cost is Rs 40 and the selling price of each unit Rs 60.** **[2]**

Find the number of units at the break-even point of the other new flavour. Show your work.

The table below gives the correct answer for each multiple-choice question in this test.

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

Q.No	Teacher should award marks if students have done the following:	Marks
6	**Writes 2 equations in the form, a *x* +b *y* = c and ka *x* + kb *y* = kc. For example, 2 *x* + 3 *y* = 1, 6 *x* + 9 *y* = 3.**	**1**
7	**Writes a coordinate for the region P and Q as (0, 4) and (0, -4) respectively.**	**1**
	Solves the pair of equations as *a* + 4 = -3 *a* - 4 to get the value of *a* as $\frac{-8}{4}$ = -2.	**1**
	Uses the above step to find the value of *b* as -2 + 4 = 2.	**0.5**
	Writes the coordinate for region R as (-2, 2).	**0.5**
8	i) For two lines to be parallel, $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ and compares l_1 and l_2 as $\frac{1}{2} = \frac{1}{2} = \frac{1}{2}$.	**1**
	Uses the above step to write that as 2 *x* + 2 *y* = 2 *k* is not parallel to l_1, it cannot be the equation of l_2.	**0.5**
	ii) For two lines to intersect at exactly one point, $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ and compares l_1 and l_3 as $\frac{1}{-1} \neq \frac{1}{1}$.	**1**
	Uses the above step to write that as (- *x*) + *y* = *k* intersects l_1 at exactly one point, it can be the equation of l_3.	**0.5**
9	**i) Subtracts the given equations and finds that *x* - *y* = 1.**	**1.5**
	ii) Solves any two equations and finds the values of *x* and *y* as 2 and 1 respectively.	**1.5**
10	**Solves the equations of l_1 and l_2 to get the point of intersection as (-4, -7).**	**1**
	Writes an equation for l_3 such that it passes through (-4, -7). For example, *x* + *y* + 11 = 0.	**1**

Q.No	Teacher should award marks if students have done the following:	Marks
11	i) Assumes the equation of line l_3 as $ax + by = c$ where a, b and c are non-zero real numbers and writes the condition for l_1 and l_3 to have a unique solution as $\frac{2}{a} \neq \frac{2}{b}$.	1
	Writes an equation of l_3 that satisfies the above condition. For example, $2x + y - 1 = 0$ since $\frac{2}{2} \neq \frac{2}{1}$.	0.5
	ii) Solves the equations of lines l_2 and l_3 correctly to find the point of intersection. For example, if l_3 is $2x + y - 1 = 0$, then the point of intersection of l_2 and l_3 is (0, 1).	1.5
12	Translates the given clues to frame a pair of linear equations in two variables as: $y - 2x = 1$ $y + 3 = 3x$	1
	Solves the pair of equations obtained in the above step to find the values of x and y as 4 and 9 respectively.	1.5
	Concludes that the passcode of the locker is 4994.	0.5
13	Assumes the marathoner's speed as m km/h and the wind's speed as w km/h. Takes the marathoner's effective speeds as ($m - w$) km/h for the first half and ($m + w$) km/h for the second half.	0.5
	Formulates the pair of linear equations as: $m - w = \frac{21}{2}$ $m + w = \frac{21}{1.5}$	0.5
	Solves the pair of linear equations to find the value of m as $\frac{49}{4}$ km/hr or 12.25 km/hr. (Award full marks if the answer is provided in the form of an equivalent fraction.)	1
	Finds the value of w by substituting the value of m in either of the two equations from step (2) as $\frac{7}{4}$ km/hr or 1.75 km/hr. (Award full marks if the answer is provided in the form of an equivalent fraction.)	1

Q.No	Teacher should award marks if students have done the following:	Marks
14	i) Expresses the taxi's night fare structure in the form of an equation as $f = 9 + 15(d - 0.5)$ $\Rightarrow f = 15d + 1.5$ (Award full marks if any other correct variation of the equation is written.)	1
	Expresses the auto rickshaw's night fare structure in the form of an equation as $f = 20 + 13(d - 1)$ $\Rightarrow f = 13d + 7$ (Award full marks if any other correct variation of the equation is written.)	1
	ii) Solves the pair of linear equations obtained in steps (1) and (2) by using an appropriate method to get d as 2.75 km.	1
15	Matches A - 2 - iii. or Matches A) in column I with 2) in column II and iii) in column III.	1
	Matches B - 3 - i. or Matches B) in column I with 3) in column II and i) in column III.	1
	Matches C - 1 - ii. or Matches C) in column I with 1) in column II and ii) in column III.	1
16	i) Frames the pair of linear equations in two variables representing the given context as: $x + y = \frac{1}{2}$ $600x + 750y = 360$	1

Q.No	Teacher should award marks if students have done the following:	Marks
	ii) Solves the above pair of linear equations to find the values of x and y as $\frac{1}{10}$ and $\frac{2}{5}$ respectively and concludes that Arvind packed $\frac{1}{10}$ kg of cashew nuts and $\frac{2}{5}$ kg of pistachio nuts for the customer. (Award full marks if the answer is obtained in terms of grams instead of kilograms.)	2
17	Writes that the pair of linear equations $x = p$ and $y = q$, where p and q are constants, is consistent.	0.5
	Justifies the answer. For example, writes that the solution of the given pair of linear equations is $x = p$ and $y = q$ or $(x, y) = (p, q)$ and hence it is consistent.	0.5
18	i) Frames the first equation as: $x + (6 - 2)y = 110$ or $x + 4y = 110$	1
	Frames the second equation as: $x + (13 - 2)y = 250$ or $x + 11y = 250$	1
	Solves the pair of linear equations by any suitable method and finds the values of x and y as 30 and 20 respectively.	1.5
	Concludes that the fixed charge up to 2 hours is Rs 30 and the subsequent charge is Rs 20 per hour.	0.5
	ii) Calculates Amish's parking duration as 7 hours.	0.5
	Uses the values obtained in part (i) and finds Amish's parking charge as 30 + (7 - 2)20 = Rs 130.	0.5
19	Assumes the total number of marbles Ananya had as 12 x (4 x red marbles, 5 x blue marbles and 3 x yellow marbles) and the number of blue marbles Ananya gave to Neha as y.	0.5
	Frames the first linear equation as: $4x + y = 20$ ----- 1	1

Q.No	Teacher should award marks if students have done the following:	Marks
	Frames the second linear equation as: $\frac{5x-y}{3x} = \frac{7}{9}$ ----- 2	**1**
	Solves the pair of linear equations by any suitable method correctly and finds the values of *x* and *y* as 3 and 8 respectively.	**2**
	Finds the number of red marbles Ananya gave to Neha as 20 - 8 = 12.	**0.5**
20	**Writes that Garima has made a mistake in step 2.**	**0.5**
	Writes the correct equation as 3b + 7a = 12.	**0.5**
21	**Frames the pair of linear equations that represents the given context as:** ***x* + 150 *y* = 27500** ***x* + 250 *y* = 32500** **(Award 0.5 marks for each correct linear equation.)**	**1**
22	**Solves the given pair of linear equations by any suitable method:** **x + 150 *y* = 27500** ***x* + 250 *y* = 32500** **Finds the values of *x* as 20000 and concludes that the fixed cost incurred by the ice cream parlour is Rs 20,000.** **(Note: The pair of linear equations is given for reference only and the marks are to be awarded only for finding the solution of the pair of linear equations.)**	**1**
23	**Solves the given pair of linear equations by any suitable method:** **x + 150 *y* = 27500** ***x* + 250 *y* = 32500** **Finds the values of *y* as 50 and concludes that the variable cost per unit incurred by the ice cream parlour is Rs 50.** **(Note: The pair of linear equations is given for reference only and the marks are to be awarded only for finding the solution of the pair of linear equations.)**	**1**

Q.No	Teacher should award marks if students have done the following:	Marks
24	**Assuming *n* as the number of units and *m* as revenue at break-even point, frames the pair of linear equations that represents the given context as:** ***m* = 60 *n*** ***m* = 10000 + 40 *n***	**1**
	Solves the given pair of linear equations by any suitable method to find the values of *n* as 500 and concludes that the number of units at the break-even point is 500.	**1**

Chapter - 4
Quadratic Equations

Q: 1 **Which of these is a QUADRATIC equation having one of its roots as zero?**

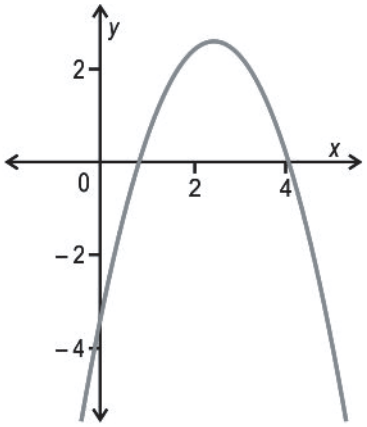
i) $x^3 + x^2 = 0$
ii) $x^2 - 2x = 0$
iii) $x^2 - 9 = 0$

1 only i) **2** only ii) **3** only i) and ii) **4** only ii) and iii)

Q: 2 **Aman solved a quadratic equation and found its roots to be real.**

Which of these could represent the graph of the equation Aman solved?

i



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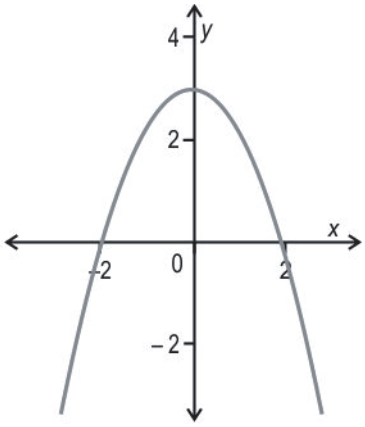
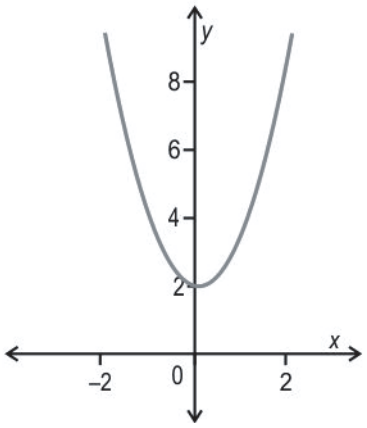


iii



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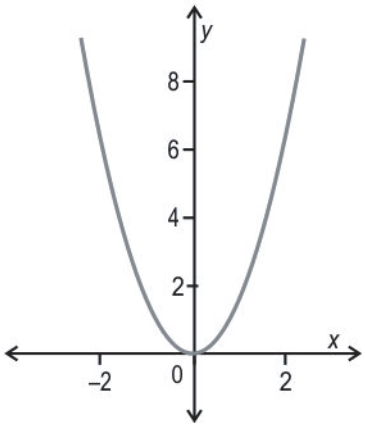


1 only iii) **2** only i) and ii)
3 only iii) and iv) **4** only i), ii) and iv)

Q: 3 **Three students were asked how they would verify their solution of a quadratic equation, (x - 2)(x - 5) = 0. Shown below are their responses.**

Student 1 said, "In the first bracket, x must equal 2, and in the second bracket, x must equal 5. So, (2 - 2)(5 - 5) = 0."

Student 2 said, "In the first bracket, x must equal 2, but in the second bracket, x can have any real number value. For example, (2 - 2)(3 - 5) = 0 or (2 - 2)(10 - 5) = 0."

Student 3 said, "Both brackets should always have the same x value. So, x is either 2 or 5 in both brackets. For example, (2 - 2)(2 - 5) = 0 and (5 - 2)(5 - 5) = 0."

Whose response is correct?

1 only student 1
2 only student 3
3 only students 1 and 2
4 all students - 1, 2 and 3

Q: 4 **[3]**

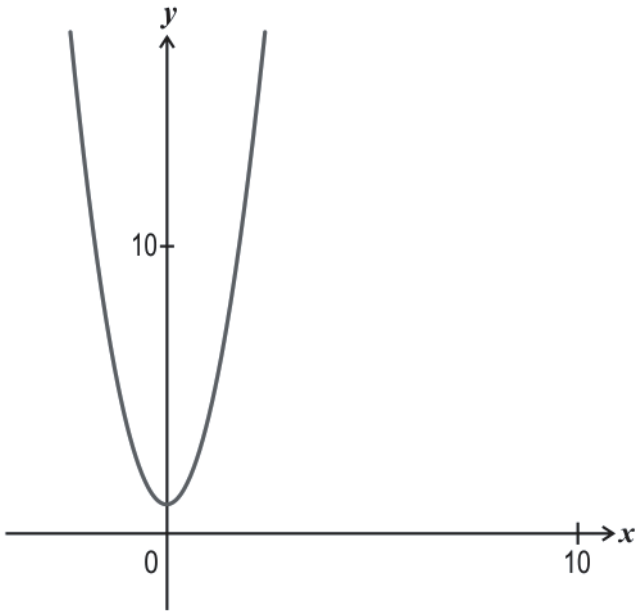
$$3(3)^{2m} + 11(3)^{m} = 4$$

Use the substitution $3^{m} = x$ to solve for m. Show your steps.

Q: 5 $(2x + 1)^3 = 8x(x^2 + 1) + 3$ **[3]**

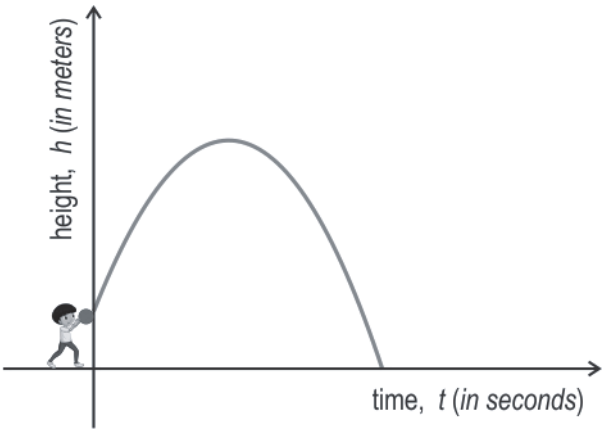
Write the zeroes of the above equation in the form (x , y). Show your steps.

Q: 6 **Shown below is the graph of a quadratic polynomial, $y(x) = px^2 + qx + r$.** **[1]**



Find the nature of the roots of the quadratic equation, $px^2 + qx + r = 0$. Give a reason for your answer.

Q: 7 **The graph below represents the path of a ball thrown by Ankush. The maximum height, h, the ball reaches with respect to time, t, is represented by the polynomial $h(t) = -t^2 + \frac{19}{4}t + \frac{5}{4}$.** **[2]**



(Note: The figure is not to scale.)

How long will it take for the ball to reach the ground? Show your steps.

Q: 8 **Check whether the following equation is quadratic.** **[1]**

i) $(x - 4)^3 + 20 = x^3 + 2x$

ii) $\frac{2}{x^2} + 4x + 3 = 0$

Justify your answer in each case.

Q: 9 **Arpit was asked to represent the following statements in the form of a quadratic equation:** **[1]**

"The sum of the squares of two positive integers is 225. The square of the larger number is 16 times the smaller number."

If Arpit wrote the equation correctly, what could he have written?

Q: 10 **Find the solution(s) of the following equation.** **[2]**

$$(y-1)(y-3)\left(\frac{1}{y-3}+\frac{2y}{y-1}\right) = 2 \; ; \; y \neq 1, 3$$

Show your steps and give valid reasons.

Q: 11 **One of the solutions of the following equation is -7 where k is a constant.** **[2]**

$z^2 - kz - 28 = 0$

i) Find the value of k.
ii) Find the other solution.

Show your steps.

Q: 12 **When a marble is dropped from an initial height, d metres, with an initial speed, v m/s, the height of the marble at time t is represented by $h(t) = vt - 2t^2 + d$.** **[2]**

A marble is dropped from a height of 48 m with an initial speed, 10 m/s. How long does it take for the marble to hit the ground? Show your steps and give valid reasons.

Q: 13 **The roots of the equation below are real numbers.** **[1]**

$2x^2 - 20x + c = 0$

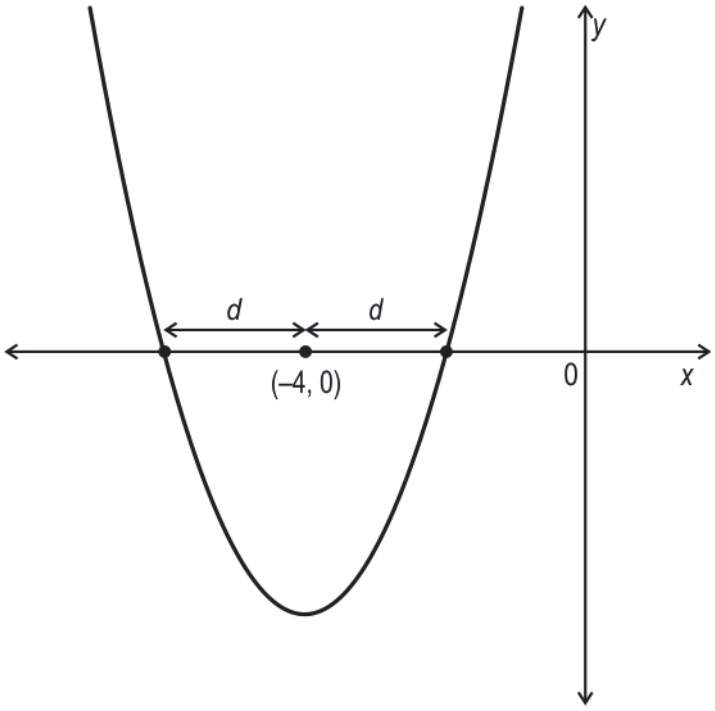
For what value of c, the roots will be equal? Show your steps and give valid reasons.

Q: 14 **Find all the possible value(s) of *x* for the following equation to be true.** **[3]**

$$\sqrt{(15-2x)} - x = 0$$

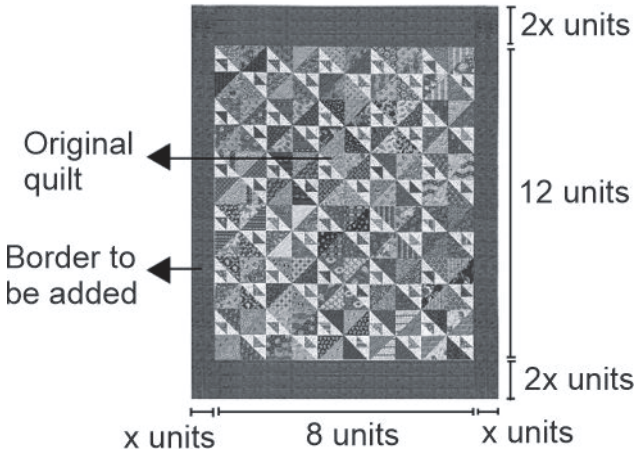
Show your steps and give valid reasons.

Q: 15 **Shown below is the graph of a quadratic equation $y = (x^2 + kx + 12)$.** **[2]**



Without finding the value of *k*, find the two roots of the given quadratic equation. Show your steps.

Q: 16 **A quilt maker has a rectangular quilt measuring 12 units by 8 units. He wants to add a border to it as shown in the figure below. He has 64 sq units of fabric for the border.** **[3]**



(Note: The figure is not to scale.)

i) If *x* and 2 *x* are the widths of the border as shown, frame a quadratic equation using the total area enclosed by the new quilt (with the border).
ii) Find the measures of the new quilt (with the border).

Show your work along with valid reasons.

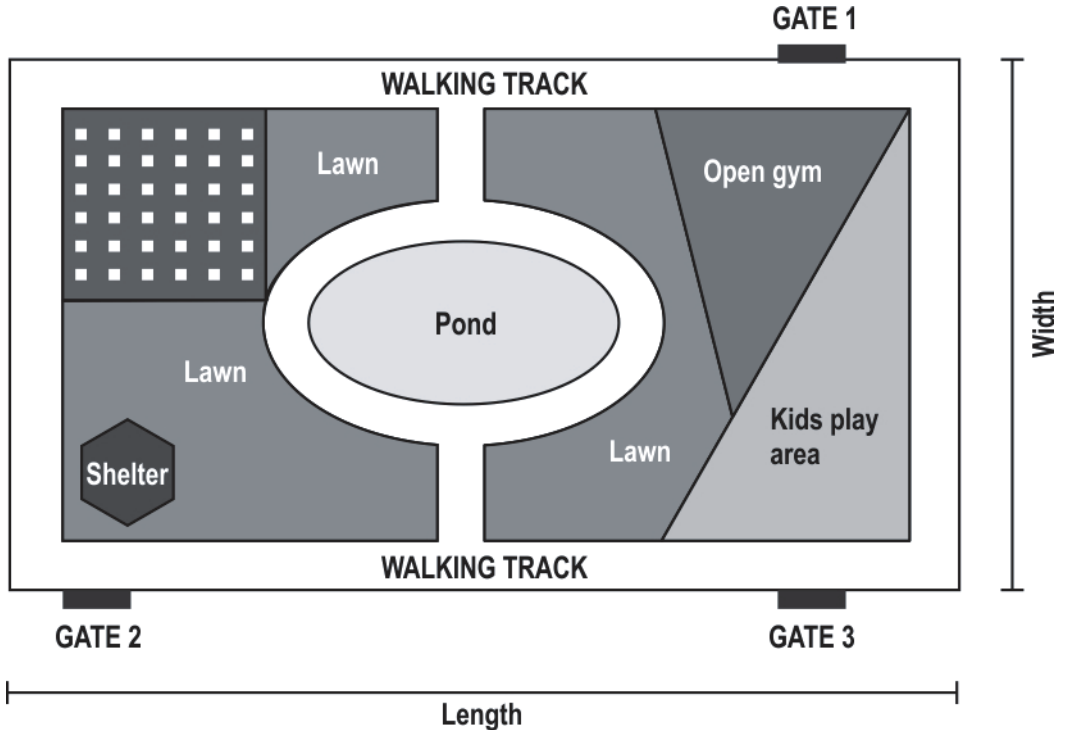
Q: 17 **Ayush used the quadratic formula to solve a quadratic equation in *y* to get:** **[1]**

$$y = \frac{7 \pm \sqrt{169}}{10}$$

Write a quadratic equation Ayush could have been solving. Show your steps.

Study the given information and answer the questions that follow.

Bangalore city corporation is building parks in residential areas across the city. Shown below is one such park. The rectangular park consists of various components like walking track, kids play area, open gym, pond etc.



(Note: The image is not to scale.)

Q: 18 **Gate 3 has been placed exactly opposite to gate 1 on the boundary of the park. The distance between gate 3 and gate 2 is 1 m more than the distance between gate 3 and gate 2.** **[2]**

The shortest distance between gates 1 and 2 is 29 m, find the width of the park. Show your work.

Q: 19 **The caretaker of the park is attempting to plant saplings in the form of a square. That is, number of rows of saplings is the same as the number of columns of saplings. On arranging the saplings, he found that 24 saplings were still left with him. When he increased the number of rows and columns by 1, he found that he was short of 25 saplings.** **[2]**

Find the number of saplings available with him. Show your work.

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	2
2	4
3	2

Q.No	Teacher should award marks if students have done the following:	Marks
4	Substitutes 3 $m = x$ and writes the given equation as: $3x^2 + 11x - 4 = 0$	0.5
	Simplifies the above equation as: $(3x - 1)(x + 4) = 0$	0.5
	Finds the roots of the above equation as $\frac{1}{3}$ and -4.	0.5
	Equates 3 m to $\frac{1}{3}$ and finds the value of m as -1.	0.75
	Equates 3 m to -4 and writes that it is not possible as 3 to any variable power cannot result in a negative number.	0.75
5	Simplifies the given equation as: $8x^3 + 12x^2 + 6x + 1 = 8x^3 + 8x + 3$	1
	Simplifies the above equation by combining like terms and taking out common factors as: $6x^2 - x - 1 = 0$	0.5
	Factorises the above equation as: $(3x + 1)(2x - 1) = 0$	1
	Writes the zeroes of the above equation in the form (x, y) as: $(-\frac{1}{3}, 0)$ and $(\frac{1}{2}, 0)$	0.5
6	Writes that the quadratic equation, $px^2 + qx + r = 0$, has no real roots since the given graph does not intersect the x -axis.	1
7	Writes the equation for the height when it reaches the ground as: $-4t^2 + 19t + 5 = 0$	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Re-writes the above equation as: $(4t + 1)(-t + 5) = 0$	1
	Finds the roots of the above equation as $-\frac{1}{4}$, 5 and writes that the ball reaches the ground after 5 seconds.	0.5
8	i) Writes that the equation is of degree 2 or writes that the simplified form is $-12x^2 + 46x - 44 = 0$, and hence it is quadratic.	0.5
	ii) Writes that the equation is not of degree 2 and hence it is not quadratic.	0.5
9	Writes $x^2 + 16x - 225 = 0$, where x is the smaller number. (Award full marks for any equivalent equation.)	1
10	Simplifies the given equation as $2y^2 - 5y - 3 = 0$.	0.5
	Factorises the above equation as: $(y - 3)(2y + 1) = 0$	1
	Concludes that the solution of the original equation is $y = \frac{-1}{2}$ as $y \neq 3$.	0.5
11	i) Substitutes $z = (-7)$ in the given equation and finds the value of k as -3.	1
	ii) Substitutes $k = -3$ in the given equation and factorises the LHS as $(z + 7)(z - 4)$.	0.5
	Concludes that the other solution is $z = 4$. (Award the full 2 marks if the relationship between the roots and the coefficients of the quadratic polynomial is used to find the other solution and the value of k .)	0.5
12	Identifies d as 48 m, v as 10 m/s and writes that when the marble hits the ground, $h(t) = 0$.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Substitutes the above values in the given equation, factorises it and finds the roots as $t = 8$ and $t = -3$.	1
	Mentions that $t \neq -3$ as time cannot be negative. Concludes that it takes 8 seconds for the marble to hit the ground.	0.5
13	Writes that the roots will be equal when the value of the discriminant is zero. i.e., $(-20)^2 - 4(2)\,c = 0$.	0.5
	Finds the value of c as $\frac{400}{8} = 50$.	0.5
14	Brings down the given equation to the standard form as: $x^2 + 2x - 15 = 0$	1
	Factorises the above equation as: $(x + 5)(x - 3) = 0$	0.5
	Solves the above equation to get $x = (-5)$ and $x = 3$.	0.5
	Substitutes $x = (-5)$ in the original equation and writes that LHS ≠ RHS.	0.5
	Substitutes $x = 3$ in the original equation and writes that LHS = RHS. Concludes that $x = 3$.	0.5
15	Writes the equation for the product of the roots as $(-4 - d)(-4 + d) = 12$.	1
	Solves the above equation and finds the value of d as (-2) or 2.	0.5
	Uses d as 2 since it is the distance and finds the two roots of the given quadratic equation as (-2) and (-6).	0.5
16	i) Finds the area of the original quilt as $12 \times 8 = 96$ sq units. Finds the area of the quilt with the border as $96 + 64 = 160$ sq units.	0.5

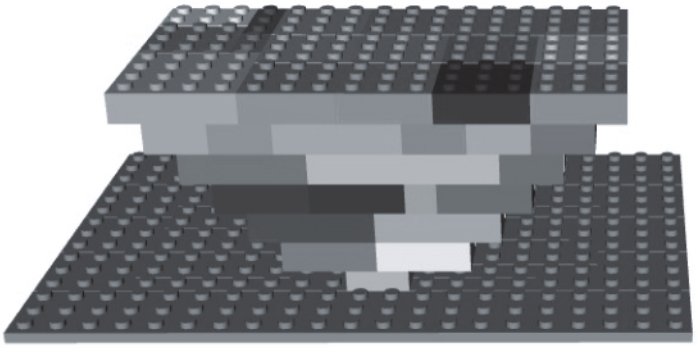
Q.No	Teacher should award marks if students have done the following:	Marks
	Frames a quadratic equation using the total area of the quilt as: $(4x + 12)(2x + 8) = 160$ $\Rightarrow 8x^2 + 56x - 64 = 0$	0.5
	ii) Solves the quadratic equation obtained in the previous step and finds the roots as (-8) and 1.	1
	Mentions that $x \neq (-8)$ as length cannot be negative. Concludes that the value of x is 1 unit.	0.5
	Finds the length and breadth of the new quilt as 16 units and 10 units respectively.	0.5
17	Finds the value of c as $\frac{169-49}{-4\times5} = -6$.	0.5
	Writes a quadratic equation Ayush could have been solving. For example, $5y^2 - 7y - 6 = 0$.	0.5
18	Takes the distance between gates 1 and 3 as 'x' m. Writes that the distance between gates 2 and 3 is $(x + 1)$ m. Applies Pythagoras theorem to the triangle formed by gates 1, 2 and 3 and frames a quadratic equation as: $x^2 + (x + 1)^2 = 29^2$ or $x^2 + x - 420 = 0$	1
	Solves the above quadratic equation and finds the value of x as 20m. Concludes that the width of the park is 20m.	1
19	Takes the former number of rows and columns of saplings as x and finds the number of saplings available as $x^2 + 24$.	0.5
	Takes the latter number of rows and columns of saplings as $(x + 1)$ and finds the number of saplings available as $(x + 1)^2 - 25$.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Equates the above two quadratic expressions and solves for x as: $x^2 + 24 = x^2 + 1 + 2x - 25$ $\Rightarrow x = 24$	0.5
	Finds the number of saplings available with the caretaker as $24^2 + 24 = 600$.	0.5

Chapter - 5
Arithmetic Progressions

Q: 1 **The cylindrical bumps on top of lego blocks are called studs.**

Pragun has built a solid inverted lego pyramid as shown below. The number of studs in successive floors forms an arithmetic progression. Pragun figures out that the sum of the number of studs used in the first p floors is given by $(6p^2 - 2p)$.



(Note: The figure is only for visual representation.)

How many studs are there in the 5th floor?

1 140 **2** 88 **3** 64 **4** 52

Q: 2 **4 groups in a class were asked to come up with an arithmetic progression (AP). Shown below are their responses:**

Group	Arithmetic progression
M	4, 2, 0, -2, ...
N	41, 38.5, 36, 33.5, ...
O	-19, -21, -23, -25, ...
P	-3, -3, -3, -3, ...

Which of these groups correctly came up with an AP?

1 only groups M and O
2 only groups N and O
3 only groups M, N and O
4 all groups - M, N, O and P

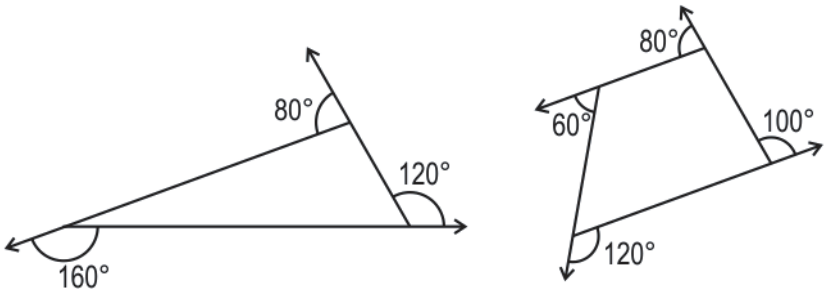
Q: 3 **Priya is preparing for the Bicycle Marathon. Her racing bicycle has a device to calculate the number of kilometres she cycled. She decides to increase the distance she cycles everyday by a fixed number of kilometres.** **[5]**
(i) On the first day Priya cycled 8 km. In 10 days she cycled a total of 170 km. How many kilometres did she cycle on the 3rd day?

(ii) Priya plans to go on a cycle tour from Bangalore to Mangalore covering 425 Km. She travels 20 km on day 1 and increases the distance covered each day by 5km. In how many days will she reach her destination?

Q: 4 **√2, √18, √50, √98 ...** **[1]**

Is the above pattern in AP? Justify your answer.

Q: 5 **The exterior angles marked in each of the polygons below are in arithmetic progression.** **[3]**



Minal drew one such polygon with *n* sides. The smallest exterior angle is 8° and each subsequent angle is 4° more than the previous angle.

Find the number of sides of the polygon that Minal had drawn. Show your steps.

Q: 6 **Consider the list of numbers below.** **[1]**

$\frac{1}{2} + k, \frac{2}{3} + k, \frac{3}{4} + k, \frac{4}{5} + k$, ... **where *k* is an integer.**

Is the above list of numbers an arithmetic progression? Justify your answer.

Q: 7 **Sana decided to start practicing for an upcoming marathon. She decided to gradually increase the duration. She ran for 10 mins on day 1 and increased the duration by 5 minutes every day.** **[3]**

From which day onwards will she be running for 2.5 hours or more? Show your work.

Q: 8 **Two arithmetic progressions have the same first term. The common difference of one progression is 4 more than the other progression. 124th term of the first arithmetic progression is the same as 42nd term of the second.** **[3]**

Find one set of possible values of the common differences. Show your work.

Q: 9 **The sum of the first two terms of an arithmetic progression is the same as the sum of the first seven terms of the same arithmetic progression.** **[2]**

Can such an arithmetic progression exist? Justify your answer.

Q: 10 **Animation is a method in which a sequence of images are manipulated to appear as moving objects. An animation specialist wants to show the growth of a sapling into a tree through animation. She follows the steps below:** **[2]**

♦ She develops the first image by designing a sapling containing a certain number of leaves.
♦ She develops the second image by adding 15 leaves to the first image.
♦ She develops the third image by adding 22 leaves to the second image.
♦ Then the fourth image by adding 29 leaves to the third image and so on.

If she continues the process in the same manner, how many leaves will she be adding to the 25th image to develop the 26th image? Show your work.

Q: 11 **14, 21, 28, 35,... and 26, 39, 52, 65,... are two arithmetic progressions such that the p th term of the first arithmetic progression is the same as the q th term of the second arithmetic progression.** **[2]**

Derive a relationship between p and q. Show your work.

Q: 12 **A stone is thrown into still water and the figure below represents the concentric circular phenomenon known as ripple effect. The radius of the first circle is 3 cm.** **[2]**

(Note: The figure is not to scale.)

If the radius of each subsequent circle is 4 cm more than the previous, which circle has a radius of 43 cm? Show your steps.

Q: 13 **Ramit is moving towards a stationary source of sound at a constant speed. At his initial position, he hears a pitch of 5 hertz.** **[3]**

If the pitch from the source increases by 4 hertz for every 5 m Ramit travels, find the distance he would have travelled towards the source when the pitch is exactly 149 hertz. Show your steps.

Q: 14 **Given below are the details of an experiment using a bucket and a mug to understand water consumption.** **[3]**

The bucket's volume is 30 litres and the mug's volume is $\frac{1}{20}$ of the bucket. The bucket has 1 litre of water before the tap is turned on. The tap is filling the bucket at a constant rate of 0.1 litres per second. Every 30 seconds, he takes a mug full of water from the bucket.

i) Write an arithmetic progression for the volume of water in the bucket every 30 seconds.
ii) Find the volume of water in the bucket after exactly 7.5 minutes. Show your work.

(Note: Assume no spillage of water.)

Q: 15 **Kevin is baking a tall layered wedding cake as shown below. The customer has ordered a 111 kg cake and 12 layers.** **[2]**

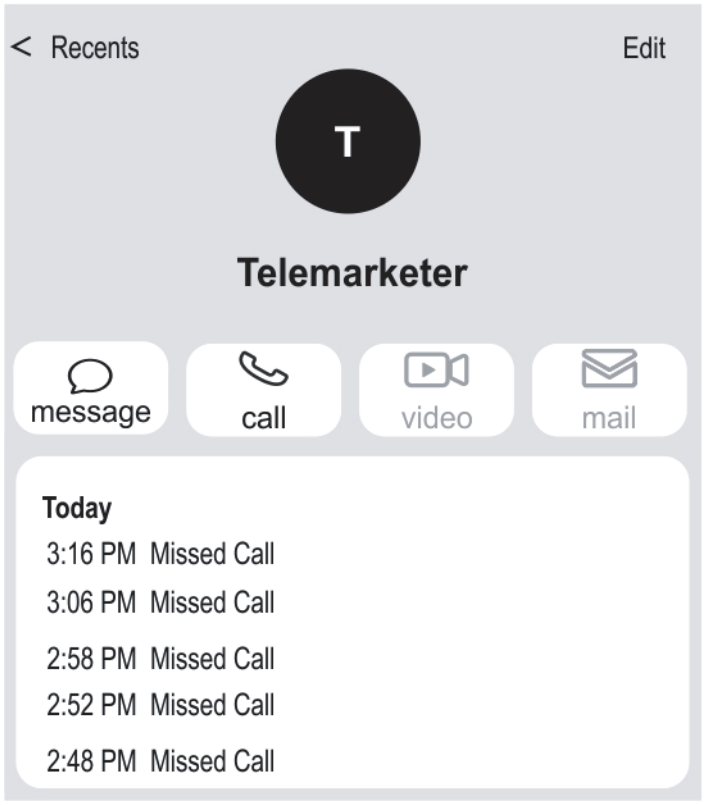
(Note: The image is for visual representation only.)

For the cake to stand properly, he makes the bottom-most cake of 17.5 kg and reduced the weight of each layer such that the difference in the weights of the consecutive layers is the SAME.

i) By what weight does he reduce each subsequent layer?
ii) What is the weight of the lightest cake layer?

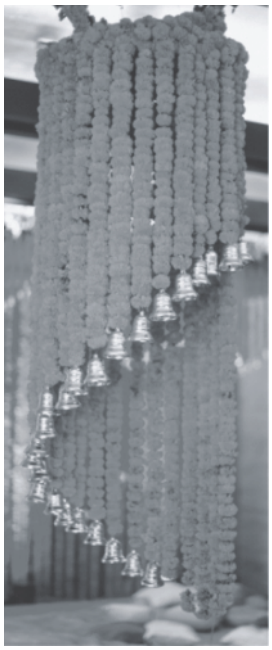
Show your work.

Q: 16 **Parth was receiving spam calls from a telemarketing centre. He got the first call at 2:48 pm as shown below.** **[3]**



If the telemarketer continues to call using the same pattern, at what time will Parth receive the 13th call? Show your work.

Q: 17 **Shivam bought a large quantity of marigold flowers to decorate his house for a family function. He used 630 flowers to recreate the pattern shown below. He used 7 flowers in the shortest garland and 35 flowers in the longest garland.** **[1]**



(Note: The figure is for visual representation only.)

If he kept the difference between two consecutive garlands the same, how many garlands did he make? Show your steps.

Q: 18 **Huner said, "The value of the 20th term of ANY arithmetic progression is double that of the 10th term."** **[2]**

Is Huner's statement correct? Justify your answer.

Q: 19 **The average of an Arithmetic Progression with 151 terms is zero. One of its terms is zero.** **[3]**

Which term of the Arithmetic Progression is zero? Show your steps.

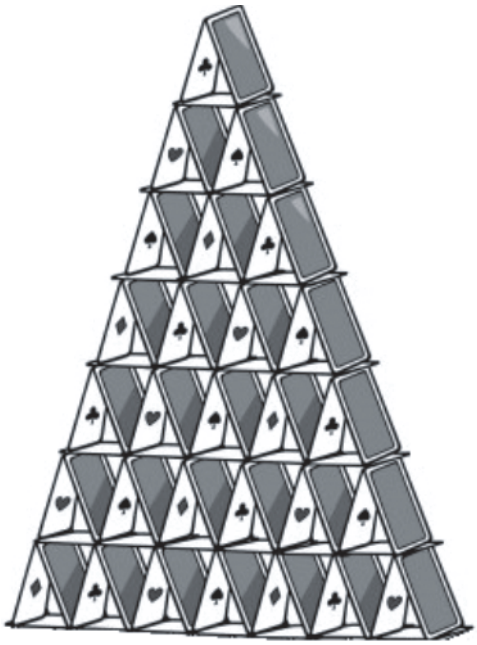
Q: 20 **The ratio of the sum of the first 11 terms of an arithmetic progression to the sum of its first 21 terms is given by 1:4.** **[3]**

i) Show that 23 a + 10 d = 0, where a is the first term and d is the common difference of the arithmetic progression.
ii) Write an expression for the n th term of the above arithmetic progression only in terms of a and n.

Show your work.

Answer the questions based on the given information.

Shown below is a house of cards, a structure created by stacking playing cards on top of each other in the shape of a pyramid. Each small triangle is made using 3 cards and each layer has 1 less triangle than the layer below it.



Ankit and his friends were having a sleepover and wanted to do something fun. One of the friends suggested that they could make a house of cards.

Q: 21 **Ankit and his friends want to use 3 cards in the top layer and 18 in the bottom layer.** **[1]**

Form an AP showing the number of cards in each layer starting from the top layer.

Q: 22 **Ankit is planning to make a pyramid with the top and bottom layer containing 15 and 138 cards respectively.** **[2]**

How many layers will such a pyramid have? Show your work.

Q: 23 **They have a total of 360 cards with them.** **[2]**

Find the maximum number of layers that Ankit and his friends can make using the cards they have, if they want to have 1 triangle (3 cards) at the top layer. Show your work.

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	4
2	4

Q.No	Teacher should award marks if students have done the following:	Marks
3	(i) Applies the formula for the sum of n terms correctly and finds the value of the common difference d as 2.	1
	Either applies the formula for the nth term or generates the pattern with a=8 and d=2 to find the distance cycled on the 3rd day as 12 km.	1
	(ii) Applies the formula for the sum of n terms of AP and represents the given scenario mathematically as $n^2 + 7n - 170 = 0$.	2
	Solves the above quadratic equation correctly and finds n as 10 days.	1
4	Answers that the pattern is in AP.	0.5
	Mentions that the series is in AP because the common difference is the same which is $2\sqrt{2}$.	0.5
5	Writes the equation for the sum of the arithmetic progression as: $\frac{n}{2}[16 + 4(n - 1)] = 360$	1
	Simplifies the above equation as: $n^2 + 3n - 180 = 0$	0.5
	Finds the roots of the above equation as 12, -15.	1
	Finds the number of sides of the polygon that Minal had drawn as 12.	0.5
6	Finds the difference between the consecutive terms of the given list of numbers as $\frac{1}{6}, \frac{1}{12}, \frac{1}{20}$, etc and writes that the difference between the consecutive terms is not a constant.	0.5
	Concludes that the given list of numbers is not an arithmetic progression.	0.5
7	Converts 2.5 hours to minutes as 2.5 × 60 = 150 minutes.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Identifies that the increase in the running duration follows an arithmetic progression given by 10, 15, 20, 25,... and assumes the day corresponding to 150 mins as *n*. **Finds the value of *n* as follows:** **$10 + (n - 1) \times 5 = 150$** **$\Rightarrow n = 29$** **(Award 0.5 marks if just the formula for nth term is written.)**	**2**
	Concludes that Sana will be running for 2.5 hours or more from 29th day onwards.	**0.5**
8	**Considers $d_1 = d_2 + 4$ or $d_2 = d_1 + 4$ where d_1 & d_2 are the common differences of the two arithmetic progressions.**	**0.5**
	Writes $a_{124} = b_{42}$ **$\Rightarrow a_1 + 123\, d_1 = b_1 + 41\, d_2$** **where a_1, a_{124}, b_1 & b_{42} are the 1st, 124th, 1st and 42nd terms of the two arithmetic progressions respectively.**	**1**
	Solves the above two equations and finds the value of d_1 as -2 and d_2 as -6 OR d_1 as 2 and d_2 as 6. **$a_{124} = b_{42}$** **$\Rightarrow a_1 + 123(4 + d_2) = b_1 + 41\, d_2$** **$\Rightarrow 492 + 123\, d_2 = 41\, d_2$** **$\Rightarrow d_2 = -6$** **(One way of simplification is shown here. Award full marks for any other appropriate method used.)**	**1.5**
9	**Writes that an arithmetic progression having the sum of the first two terms same as the sum of the first seven terms can exist.**	**0.5**
	Justifies by writing that such an arithmetic progression exists if the sum of the first term and four times the common difference is zero. **That is, $a + 4d = 0$, where *a* is the first term and *d* is the common difference.** **(Award full marks if an example like -4, -3, -2, -1, 0, 1, 2, ... is written instead of an algebraic justification.)**	**1.5**

Q.No	Teacher should award marks if students have done the following:	Marks
10	Identifies that the number of leaves being added at each step follows an arithmetic progression and writes the AP as: 15, 22, 29, ...	0.5
	Identifies the first term of the AP, a as 15 and the common difference, d as 7.	0.5
	Finds the 25th term of the above AP as: $15 + (25 - 1) \times 7 = 183$ and concludes that the animation specialist will be adding 183 leaves to the 25th image to develop the 26th image.	1
11	Equates the p th term of the first arithmetic progression, a_p, to the q th term of the second arithmetic progression, b_q, as $a_p = b_q$.	0.5
	Uses the expression for the general term of an arithmetic progression and rewrites the above equation as: $a + (p - 1) \times d_1 = b + (q - 1) \times d_2$ $14 + (p - 1) \times 7 = 26 + (q - 1) \times 13$ where a, b are the first terms and d_1, d_2 are the common differences of the given arithmetic progressions respectively. (Award 0.5 marks if only the formula for the general term of an arithmetic progression is written.)	1
	Simplifies the above equation to obtain the relationship between p and q as $7p - 13q = 6$.	0.5
12	Writes the equation for the n th term of an arithmetic progression as: $3 + 4(n - 1) = 43$ (Award 0.5 marks if only the formula for the n th term of an AP is written correctly.)	1
	Solves the above equation for n and finds the circle which has a radius of 43 cm as the 11th circle.	1
13	Writes an arithmetic progressions (AP) for the increase in pitch every 5 m as: 5 hertz, 9 hertz, 13 hertz, 17 hertz, ...	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Identifies the first term of the AP, a as 5 and the common difference, d as 4.	0.5
	Finds the n th term of the AP when the pitch is exactly 149 hertz as: $5 + 4(n - 1) = 149$ $\Rightarrow n = 37$ (Award 0.5 marks if only the formula for the n th term of an AP is written correctly.)	1
	Finds the distance travelled by Ramit as $36 \times 5 = 180$ m.	1
14	i) Finds the volume of water from the tap in 30 seconds as $0.1 \times 30 = 3$ litres.	0.5
	Writes an arithmetic progression (AP) for the volume of water in the bucket every 30 seconds as: 1, 2.5, 4, 5.5, ...	0.5
	ii) Identifies the first term of the AP, a as 1 and the common difference, d as 1.5.	0.5
	Finds the term corresponding to 7.5 minutes in the AP as $\frac{7.5}{0.5} + 1 = 16$.	0.5
	Finds the volume of water in the bucket exactly after 7.5 minutes as: $1 + 1.5(16 - 1) = 23.5$ litres. (Award 0.5 marks if only the formula for the n th term of an AP is written correctly.)	1
15	i) Writes the equation for the common difference, d, of the given arithmetic progression (AP) as: $111 = \frac{12}{2}[(2 \times 17.5) + (12 - 1)d]$	0.5
	Solves the above equation and finds the value of d as (-1.5) and writes that Kevin reduces the weight of each subsequent layer by 1.5 kg.	0.5
	ii) Writes the equation for the weight of the lightest layer of cake, l, as: $111 = \frac{12}{2}(17.5 + l)$	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Solves the above equation and finds the weight of the lightest layer of cake as 1 kg.	0.5
16	Identifies that the interval between the calls follows an arithmetic progression (AP) and writes the AP as: 4 minutes, 6 minutes, 8 minutes, 10 minutes, ...	1
	Identifies the first term of the AP, a as 4 and the common difference, d as 2.	0.5
	Finds the sum of 12 terms of the above AP as: $\frac{12}{2}$ [(2 × 4) + 2(12 - 1)] = 180 minutes or 3 hours. (Award 0.5 marks if only the formula for the sum of n terms of an AP is written correctly.)	1
	Uses the above step to conclude that Parth will receive the 13th call at 2:48 pm + 3 hours = 5:48 pm.	0.5
17	Assumes the total number of garlands made by Shivam as n and writes: $630 = \frac{n}{2}(35 + 7)$	0.5
	Solves the above equation to find the value of n as 30.	0.5
18	Writes that Huner statement is not correct.	0.5
	Writes that Huner's statement is correct only when the first term of an arithmetic progression (AP), a and common difference, d are equal but not for any AP.	1.5
19	Writes $\frac{S_n}{151} = 0$ to find the sum of the given Arithmetic Progression as $S_n = 0$.	0.5
	Writes the equation for the sum of an Arithmetic Progression as: $\frac{n}{2}[2a + (n - 1)d] = 0$	0.5
	Simplifies the above equation as: $a + 75d = 0$.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Assumes the x th term to be zero and writes the equation for the term as: $a + (x - 1)d = 0$	0.5
	Uses $a = -75d$ in the above equation to write: $-75d + xd - d = 0$	0.5
	Solves the above equation and finds the value of x as 76.	0.5
20	i) Uses the given information and writes the following equation: $4 \times \frac{11}{2}[2a + 10d] = 1 \times \frac{21}{2}[2a + 20d]$ (Award 0.5 marks if just the formula for the sum of the first n terms of an arithmetic progression is written correctly.)	1
	Solves the above equation to show that $23a + 10d = 0$.	1
	ii) Uses the above relation and expresses d in terms of a as: $d = \frac{-23a}{10}$ Uses the formula to find the n th term of an arithmetic progression and arrives at an expression for the general term of the given arithmetic progression only in terms of a and n as: $a_n = \frac{a(33-23n)}{10}$ (Award full marks for any equivalent version of the above expression.) (Award 0.5 marks if just the formula for the n th term of an arithmetic progression is written correctly.)	1
21	Identifies the first term of the arithmetic progression (AP) as 3, the common difference as 3 and writes the AP as: 3, 6, 9, 12, 15, 18.	1

Q.No	Teacher should award marks if students have done the following:	Marks
22	**Assumes the total number of layers as *n* and writes:** **$15 + (n - 1) \times 3 = 138$** **(Award 0.5 marks if only the formula for the *n* th term of an AP is written correctly.)**	**1**
	Solves the above equation for *n* and finds the number of layers that such a pyramid will have as 42.	**1**
23	**Assumes the total number of layers that can be made as *n* and writes:** **$\frac{n}{2}[2 \times 3 + (n - 1) \times 3] = 360$**	**0.5**
	Simplifies the above equation as: **$n^2 + n - 240 = 0$**	**0.5**
	Finds the roots of the above equation as 15, -16.	**0.5**
	Concludes that the maximum number of layers that Ankit and his friends can make is 15.	**0.5**

Chapter - 6
Triangles

Q: 1 **Which of the following are DEFINITELY similar to each other?**

1 any two rhombuses
2 any two right triangles
3 any two regular pentagons
4 any two isosceles triangles

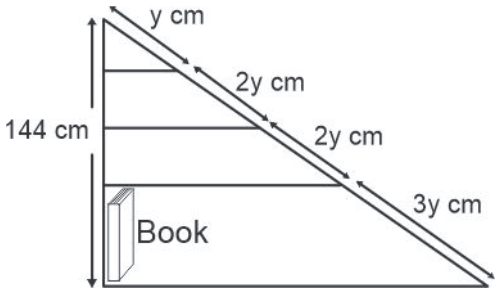
Q: 2 **ΔABC and ΔPQR are similar triangles. A_1 and A_2 are the areas, P_1 and P_2 are the perimeters of ΔABC and ΔPQR respectively.**

Which of these is the same as the ratio of the height of ΔABC to that of ΔPQR?

$\frac{A_1}{A_2}$ (i) $\frac{P_1}{P_2}$ (ii) $\sqrt{\frac{A_1}{A_2}}$ (iii) $\sqrt{\frac{P_1}{P_2}}$ (iv)

1 only (i) and (ii)
2 only (ii) and (iii)
3 only (iii) and (iv)
4 (Cannot be concluded from the given information.)

Q: 3 **Leela has a triangular cabinet that fits under his staircase. There are four parallel shelves as shown below.**

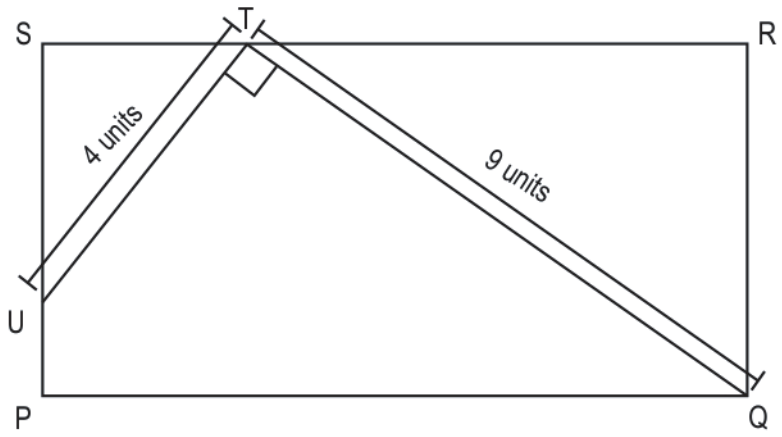


(Note: The figure is not to scale.)

The total height of the cabinet is 144 cm. What is the maximum height of a book that can stand upright on the bottom-most shelf?

1 18 cm **2** 36 cm **3** 54 cm **4** 86.4 cm

Q: 4 **Shown below is a rectangle PQRS. ∠UTQ is a right angle.**



(Note: The figure is not to scale.)

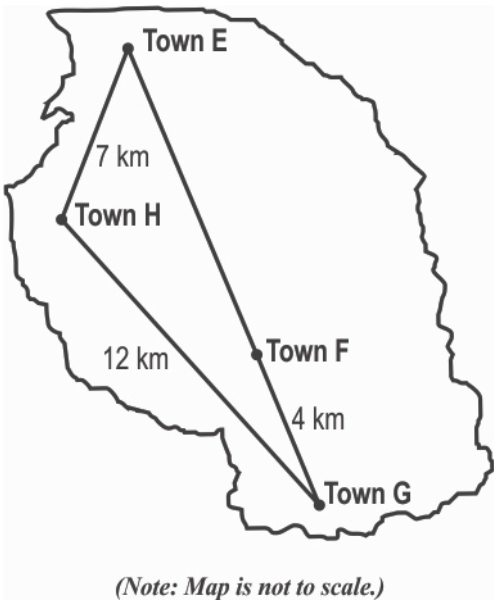
Which of these is TRUE about ΔUST and ΔTRQ?

1 The perimeters are in the ratio 16:81.
2 The ratio of ∠SUT:∠RTQ is 4:9.
3 The ratio of US:TR is 4:9.
4 The ratio of US:QR is 4:9.

Q: 5 **The areas of two similar triangles are 64 cm^2 and 121 cm^2.** **[2]**

If the length of a side of the larger triangle is 55 cm, find the length of the corresponding side of the smaller triangle. Show your work.

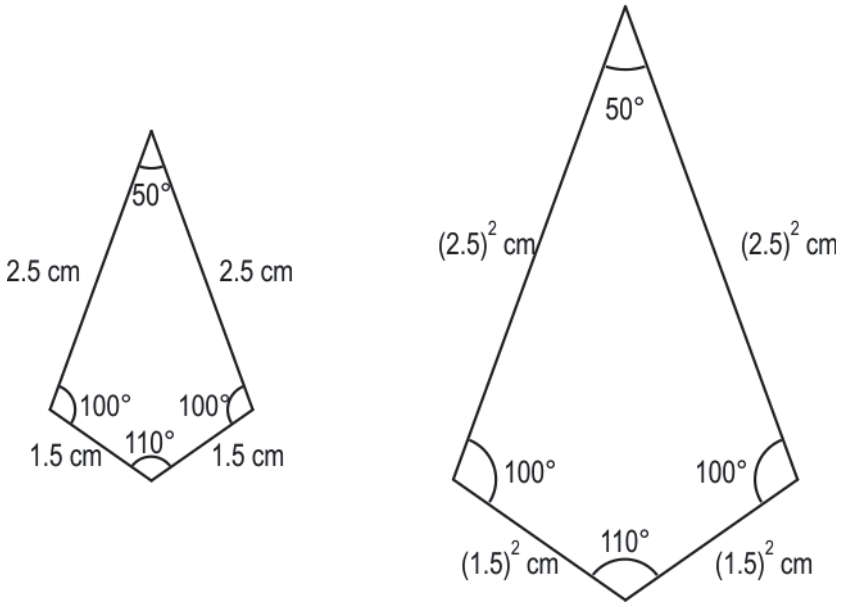
Q: 6 **[1]**



Looking at the above figure, Hari said that the shortest distance between Town E and Town F is 15 km.

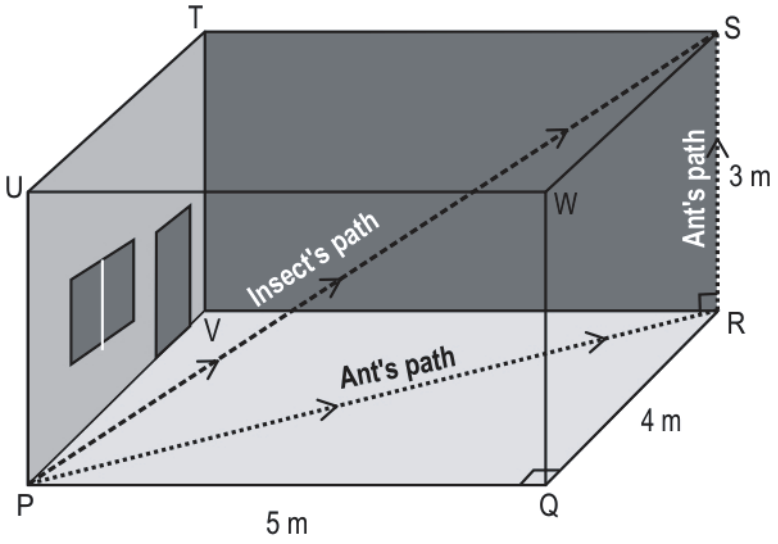
Is the statement true or false? Justify your answer using the relevant properties.

Q: 7 **Are the two quadrilaterals shown below similar? Give a reason for your answer.** **[1]**



(Note: The figure is not to scale.)

Q: 8 **An insect sitting at corner P of a room flies along the dotted line PS and reaches corner S. Whereas, an ant sitting at corner P, reaches corner S by crawling along the path PR, followed by RS. Both the paths are shown below.** **[3]**



(Note: The figure is not to scale.)

i) Find the length of the path taken by the ant.
ii) Find the length of the path of the insect's flight.

Show your steps.

Q: 9 **Panchami is standing on the ground and flying a kite at a vertical height of 22 m from the ground. The length of the taut string to which the kite is connected, is 29 m. Panchami is holding the string roller 1 m above the ground.** **[2]**

i) Draw a figure representing the above scenario.
ii) Find the horizontal distance between the kite and Panchami. Show your work.

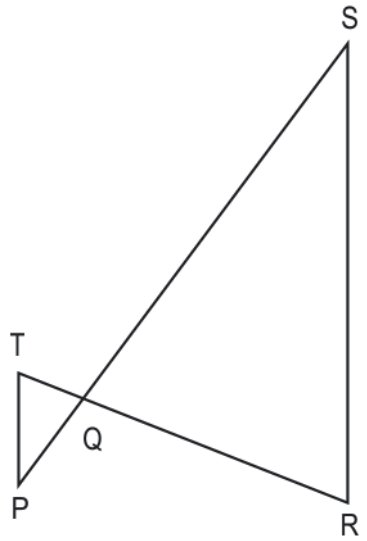
Q: 10 **During a mathematics class, a teacher wrote the following three algebraic expressions on the board:** **[3]**

($m^2 - n^2$), ($2mn$) and ($m^2 + n^2$), where m and n are positive integers with $n < m$

One of the students, Kaivalya, claimed that the above set of expressions ALWAYS represent the sides of a right-angled triangle.

Is Kaivalya's claim correct? Justify your answer.

Q: 11 **In a mathematics class, a teacher drew the following figure where $\frac{TQ}{QR} = \frac{1}{3}$. She then asked, "What is the sufficient condition required to prove that ΔTQP ~ ΔRQS?"** **[5]**



(Note: The figure is not to scale.)

- **Darsh said that it is sufficient if it is given that $\frac{TP}{SR} = \frac{1}{3}$.**
- **Bhargav said that it is sufficient if it is given that ∠P = ∠S.**
- **Tanvi said that it is sufficient if it is given that $\frac{PQ}{QS} = \frac{1}{3}$.**

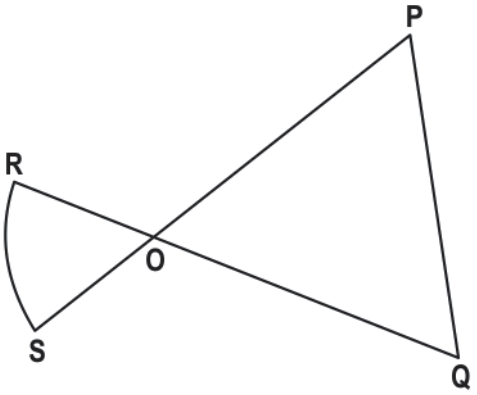
Examine whether each of their responses is correct or incorrect. Give reasons.

Q: 12 **Is it possible to have an isosceles right-angled triangle, such that the length of each of its sides is an integer? Give a reason to support your answer.** **[2]**

Q: 13 **ΔABC is similar to ΔPQR. The ratio of the perimeter of ΔABC to the perimeter of ΔPQR is 4:9.** **[3]**

i) Sara said $\frac{AB}{PQ} = \frac{4}{9}$. Is it true? Justify your answer.
ii) Find the ratio of the area of ΔABC to the area of ΔPQR.

Q: 14 **In the figure below, OPQ is a triangle with OP = OQ. RS is an arc of a circle with centre O.** **[2]**

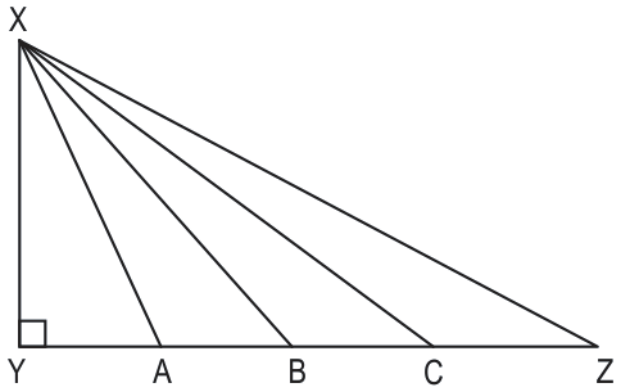


(Note: The figure is not to scale.)

Triangle OSR is similar to triangle OPQ.

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

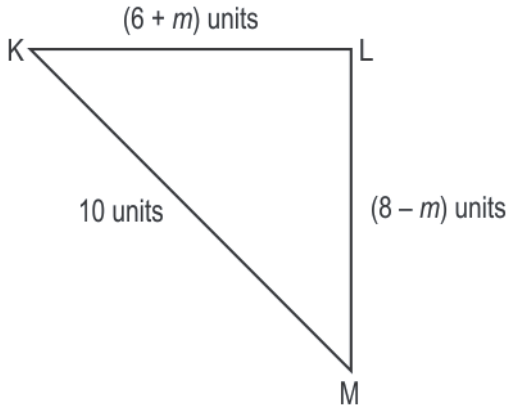
Q: 15 **In the figure below, XYZ is a right-angled triangle. A, B and C are the three points on YZ such that they divide YZ into 4 equal parts.** **[2]**



(Note: The figure is not to scale.)

Prove that $3XA^2 + XB^2 + XC^2 - XZ^2 = 4XY^2$.

Q: 16 **A teacher drew the below figure on the board and asked her students, "Is there any value of *m* such that ΔKLM becomes a right triangle?".** **[2]**



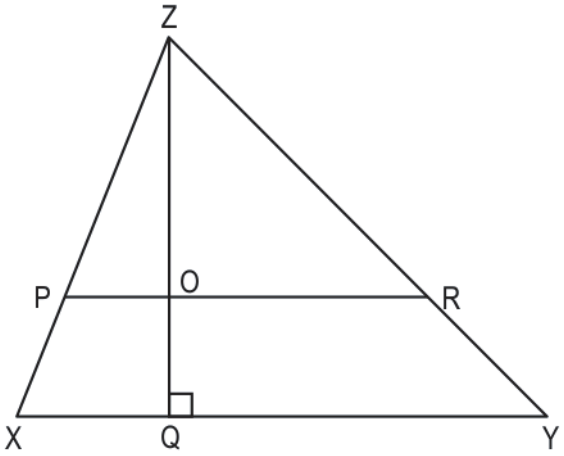
(Note: The figure is not to scale.)

Lata said, "The value of *m* can be 0".

Hina said, "The value of *m* can be 1".

Write if the above statements are true or false and justify your answer.

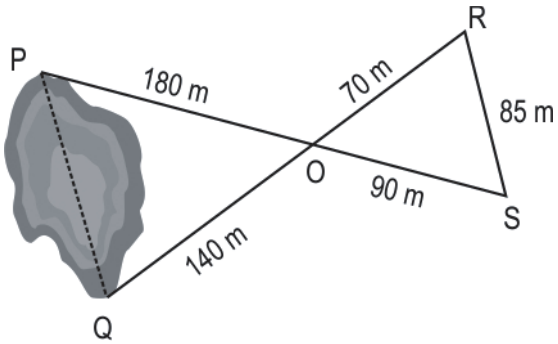
Q: 17 **In the figure below, P and R are points on the sides XZ and YZ respectively. PR || XY and PR bisects the area of ΔXYZ.** **[3]**



(Note: The figure is not to scale.)

If ZQ = 10 cm, find the length of OQ. Show your steps and give valid reasons.

Q: 18 **A geologist asked his assistant Annie, if the length of the lake, PQ, can be found from the information shown below.** **[3]**

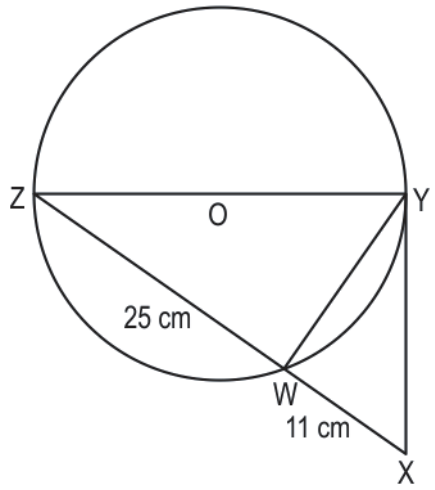


(Note: The figure is not to scale.)

Annie said, "it is possible to find the length of the lake, PQ."

Is Annie's statement correct? Justify your answer with valid reasons.

Q: 19 **Shown below is a circle with centre O. YX is the tangent to the circle at Y.** **[3]**

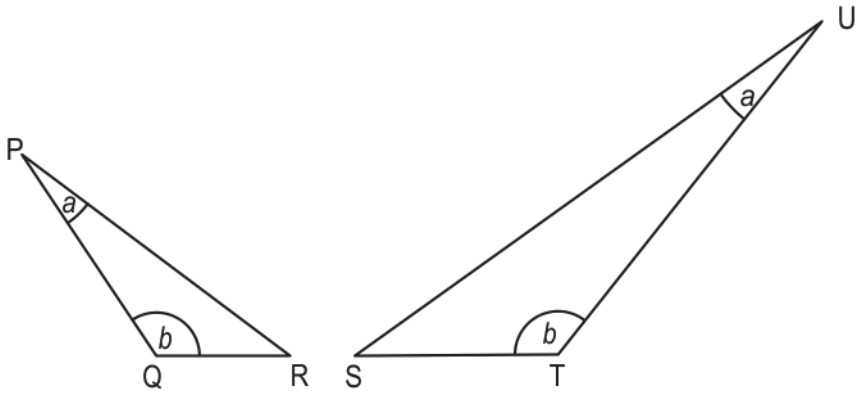


(Note: The figure is not to scale.)

i) Prove that ΔZWY ~ ΔZYX.
ii) Using part i), find the length of ZY.

Show your steps and give valid reasons.

Q: 20 **In the below figure, QR = 4 cm, RP = 8 cm and ST = 6 cm.** **[2]**



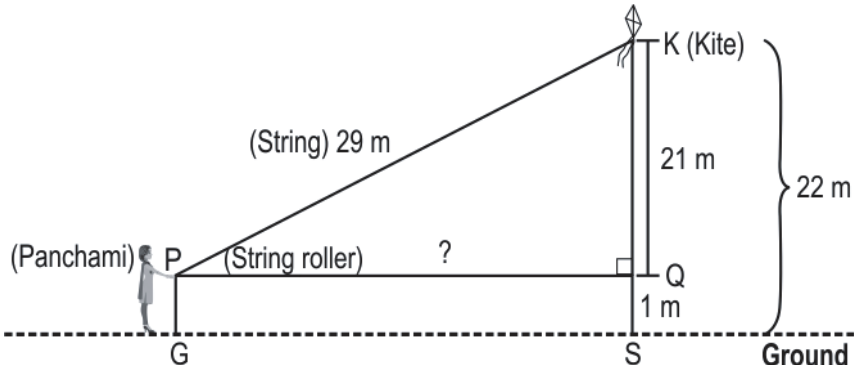
(Note: The figure is not to scale.)

If the perimeter of ΔSTU is 27 cm, find the length of PQ. Show your steps.

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	3
2	2
3	3
4	3

Q.No	Teacher should award marks if students have done the following:	Marks
5	Assumes the length of the corresponding side of the smaller triangle as x and uses the theorem, "the ratio of the areas of two similar triangles is equal to the square of the ratio of their corresponding sides" to write, $\frac{64}{121} = \left(\frac{x}{55}\right)^2$	1
	Solves the equation in the above step and finds the length of the corresponding side of the smaller triangle as 40 cm.	1
6	Mentions that the statement is false.	0.5
	Explains that it can't be 15 using triangular inequality theorem.	0.5
7	Writes that the two quadrilaterals are not similar.	0.5
	Writes the reason that the corresponding sides of the quadrilateral are not in the same ratio.	0.5
8	i) Finds the length of PR using the Pythagoras theorem in ΔPQR as: $PR^2 = PQ^2 + QR^2$ $\Rightarrow PR^2 = 5^2 + 4^2$ $\Rightarrow PR^2 = 25 + 16$ $\Rightarrow PR = \sqrt{41}$	1
	Finds the length of the path taken by the ant as $(\sqrt{41} + 3)$ m.	1
	ii) Finds the length of PS using the value of PR obtained in step 1 and the Pythagoras theorem in ΔPRS as: $PS^2 = PR^2 + RS^2$ $\Rightarrow PS^2 = 41 + 3^2$ $\Rightarrow PS^2 = 41 + 9$ $\Rightarrow PS = \sqrt{50}$ Concludes that the length of the path of the insect's flight is $\sqrt{50}$ m or $5\sqrt{2}$ m. (Award full marks if the correct answer is obtained using the formula for the diagonal of a cuboid instead of the Pythagoras theorem.)	1

Q.No	Teacher should award marks if students have done the following:	Marks
9	**i) Draws a figure representing the given scenario. The figure may look as follows:** 	1
	ii) Applies Pythagoras' theorem and finds the horizontal distance between the kite and Panchami, PQ, as $\sqrt{(29^2 - 21^2)}$ m = 20 m. **(Award 0.5 marks if only the expression to find the the horizontal distance using Pythagoras' theorem is written correctly.)**	1
10	**Expands $(m^2 - n^2)^2$ as $m^4 + n^4 - 2m^2n^2$.**	0.5
	Expands $(2mn)^2$ as $4m^2n^2$.	0.5
	Expands $(m^2 + n^2)^2$ as $m^4 + n^4 + 2m^2n^2$.	0.5
	Uses the above steps and writes: **$(m^4 + n^4 - 2m^2n^2) + (4m^2n^2) = (m^4 + n^4 + 2m^2n^2)$** **$\Rightarrow (m^2 - n^2)^2 + (2mn)^2 = (m^2 + n^2)^2$**	1
	Concludes that, by the converse of Pythagoras' theorem, Kaivalya's claim is correct.	0.5
11	**Writes that Darsh's answer is incorrect.**	0.5
	Writes that in order to apply any of the similarity criterion, atleast one more piece of information is necessary.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Writes that Bhargav's answer is correct.	0.5
	Gives the following reason: ∠TQP = ∠RQS [Vertically opposite angles] ∠P = ∠S [Given] ∠T = ∠R [Angle sum property] Hence, concludes that by AAA criterion of similarity of triangles, ΔTQP ~ ΔRQS.	1.5
	Writes that Tanvi's answer is correct.	0.5
	Gives the following reason: $\frac{TQ}{QR} = \frac{1}{3}$ [Given] ∠TQP = ∠RQS [Vertically opposite angles] $\frac{PQ}{QS} = \frac{1}{3}$ [Given] Hence, concludes that by SAS criterion of similarity of triangles, ΔTQP ~ ΔRQS.	1.5
12	Assumes that such a triangle exists. Takes the length of the equal sides to be k units, where k is an integer.	0.5
	Uses Pythagoras's theorem and finds the length of the third side (hypotenuse) as: $\sqrt{(k^2 + k^2)} = \sqrt{2}\,k$ units. Writes that the length of the third side (hypotenuse) is not an integer.	1
	Concludes that there cannot exist an isosceles right-angled triangle, such that the length of each of its sides is an integer.	0.5
13	i) Writes that Sara's claim is true.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Uses the given information, ΔABC is similar to ΔPQR to write: AB = *k* PQ, BC = *k* QR, CA = *k* RP, where *k* is a constant.	0.5
	Uses the ratio of the perimeters to write: $\frac{AB+BC+CA}{PQ+QR+RP} = \frac{4}{9}$	0.5
	Uses steps 1 and 2 to solve for *k* and finds the ratio $\frac{AB}{PQ}$ as $\frac{4}{9}$.	0.5
	ii) Finds the ratio of the areas of the two triangles as: $\frac{Area\text{-}of\text{-}\Delta ABC}{Area\text{-}of\text{-}\Delta PQR} = (\frac{4}{9})^2 = \frac{16}{81}$	1
14	Writes True(T).	0.5
	Writes that in ΔOSR and ΔOPQ: ∠ROS = ∠POQ = *x* ° (vertically opposite angles) ∠ORS = ∠OSR= ∠OPQ = ∠OQP = $\frac{180°-x°}{2}$ (angle sum property of isoceles triangles)	1
	Uses the above step to justify that ΔOSR ~ ΔOPQ by using the AAA similarity criterion.	0.5
15	Assumes YA = AB = BC = CZ = *d* and writes YB = 2 *d*, YC = 3d and YZ = 4 *d*.	0.5
	Uses the Pythagoras theorems for ΔXYA, ΔXYB, ΔXYC and ΔXYZ and writes: $XA^2 = XY^2 + d^2$ $XB^2 = XY^2 + 4\,d^2$ $XC^2 = XY^2 + 9\,d^2$ $XZ^2 = XY^2 + 16\,d^2$	1

Q.No	Teacher should award marks if students have done the following:	Marks
	Substitutes the above relations in $3XA^2 + XB^2 + XC^2 - XZ^2$ as: $3(XY^2 + d^2) + (XY^2 + 4d^2) + (XY^2 + 9d^2) - (XY^2 + 16d^2) = 4XY^2 + 16d^2 - 16d^2 = 4XY^2$	0.5
16	Writes that Lata's statement is true.	0.5
	Justifies the above answer. For example: When $m = 0$, $10^2 = 100$ and $6^2 + 8^2 = 100$, which satisfies the Pythagoras theorem. Hence, one of the angles should be 90°.	0.5
	Writes that Hina's statement is false.	0.5
	Justifies the above answer. For example: When $m = 1$, $10^2 = 100$ and $7^2 + 7^2 = 98 \neq 100$, which does not satisfy the Pythagoras theorem. Hence, ΔKLM is not a right triangle at $m = 1$. (Award full 2 marks if the quadratic equation is framed using the Pythagoras theorem to find the value of m and if right conclusions are made.)	0.5
17	Proves ΔPRZ ~ ΔXYZ by giving appropriate reasons. For example: In ΔPRZ and ΔXYZ: ∠ZPR = ∠ZXY (corresponding angles) ∠ZRP = ∠ZYX (corresponding angles) Hence, ΔPRZ ~ ΔXYZ using the AA similarity criterion.	1.5
	Applies the similarity and writes: $\frac{ZO}{ZQ} = \frac{\sqrt{\text{Area-of-}\Delta ZPR}}{\sqrt{\text{Area-of-}\Delta ZXY}} = \frac{1}{\sqrt{2}}$. Finds that $ZO = \frac{10}{\sqrt{2}}$ cm and $OQ = ZQ - ZO = 10 - \frac{10}{\sqrt{2}}$ or $10 - 5\sqrt{2}$ cm.	1.5
18	Writes that Annie is right.	0.5

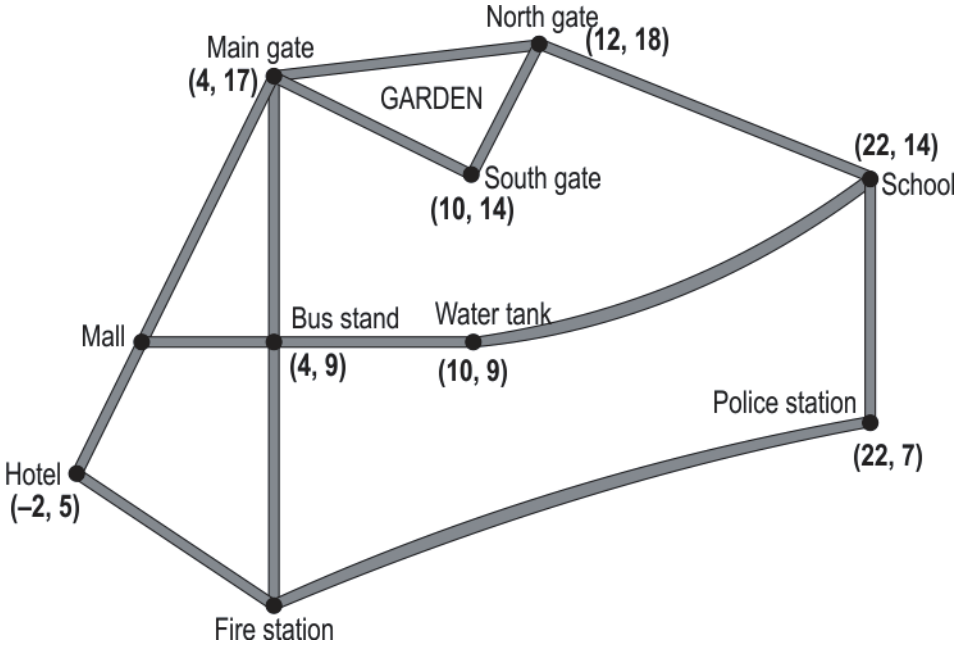
Q.No	Teacher should award marks if students have done the following:	Marks
	Writes that in ΔPOQ and ΔSOR: $\frac{PO}{SO} = \frac{QO}{OR} = 2$ (given) ∠POQ = ∠SOR (vertically opposite angles) Concludes that ΔPOQ ~ ΔSOR using SAS similarity criterion.	1.5
	Uses the above step and finds PQ = 2 × RS = 2 × 85 = 170 m. Hence, justifies that it is possible to find the length of the lake, PQ.	1
19	i) Writes that ∠ZYX = 90° and gives the reason that radius is always perpendicular to the tangent at the point of contact.	0.5
	Writes that ∠ZWY = 90° and gives the reason that angle in a semicircle is always 90°.	0.5
	Writes that, in ΔZWY and ΔZYX: ∠Z is common. ∠ZWY = ∠ZYX = 90° (using step 1 and 2) Concludes that ΔZWY ~ ΔZYX by using the AA similarity criterion.	1
	ii) Uses above step and writes the relation as: $\frac{ZY}{ZX} = \frac{ZW}{ZY}$ $\Rightarrow \frac{ZY}{25+11} = \frac{25}{ZY}$	0.5
	Finds the length of ZY as 30 cm.	0.5
20	Writes that ΔRQP and ΔSTU are similar by the AA similarity criterion.	0.5
	Finds the length of SU as: $\frac{QR}{ST} = \frac{RP}{SU}$ $\Rightarrow \frac{4}{6} = \frac{8}{SU}$ => SU = 12 cm	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Uses the given value of the perimeter of triangle STU to find the length of UT as 9 cm.	0.5
	Finds the length of PQ as: $\frac{QR}{ST} = \frac{PQ}{UT}$ $=> \frac{4}{6} = \frac{PQ}{9}$ => PQ = 6 cm	0.5

Chapter - 7
Coordinate Geometry

Answer the questions based on the information given.

Shown below is a map of Giri's neighbourhood.



Giri did a survey of his neighbourhood and collected the following information.
* The hotel, mall and the main gate of the garden lie in a straight line.
* The distance between the hotel and the mall is half the distance between the mall and the main gate of the garden.
* The bus stand is exactly midway between the main gate of the garden and the fire station.
* The mall, bus stand and the water tank lie in a straight line.

Q: 1 **What is the *x* -coordinate of the mall's location?**

1 -8 **2** 0 **3** 1 **4** 2

Q: 2 **Giri proposed a plan to make a triangular pathway by joining the midpoints of the sides of the triangular garden.**

What will be the area, in square units, enclosed by the triangular pathway?

1 3.75 **2** 7.5 **3** 15 **4** 30

Q: 3 **What are the coordinates of the fire station?**

1 (0, 8) **2** (4, -17) **3** (4, 1) **4** (4, 13)

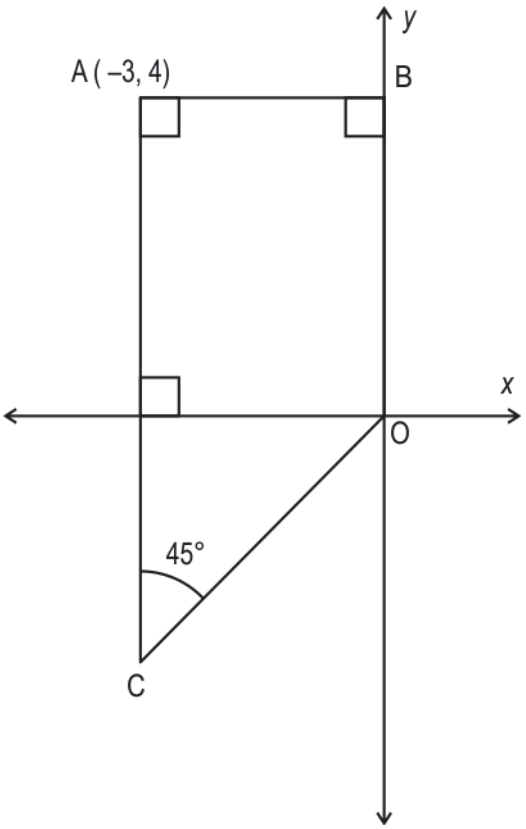
Q: 4 **What is the shortest distance between the water tank and the school?**

1 √13 units **2** √65 units **3** 13 units **4** 169 units

Q: 5 **How much more is the shortest distance of the school from the water tank than the distance of the school from the police station?**

1 6 units **2** 7 units **3** 13 units **4** 20 units

Q: 6 **A quadrilateral ABOC is drawn on a coordinate grid as shown below. O is the origin and the coordinates of A are (-3, 4). ∠OCA = 45°.**



(Note: The figure is not to scale.)

What is the perimeter of ABOC?

1 14 + 3√2 units
2 17 + 3√2 units
3 14 + 4√2 units
4 (cannot be found using the given information)

Q: 7 **ΔABC is a triangle such that AB:BC = 1:2. Point A lies on the *y* -axis and the coordinates of B and C are known.**

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

i) Section formula
ii) Distance formula

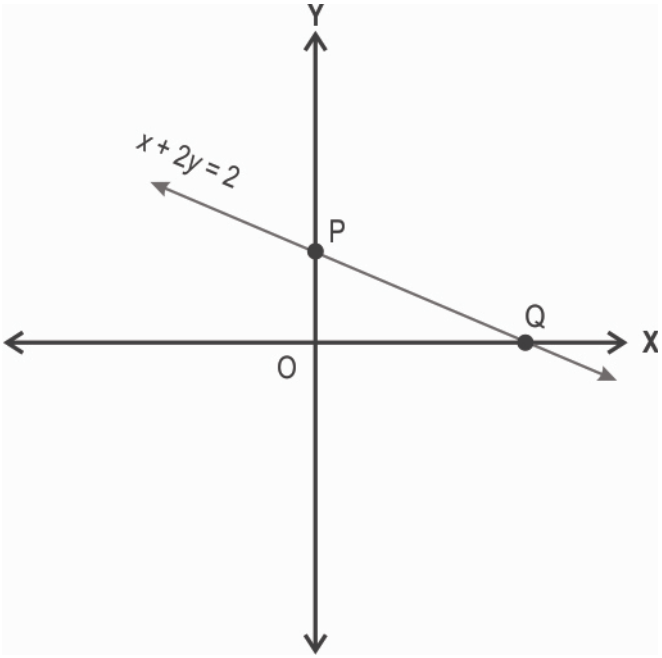
1 only i) **2** only ii) **3** both i) and ii) **4** neither i) or ii)

Q: 8 **A(5, 1), B(1, 4) and C(8, 5) are the coordinates of the vertices of a triangle.**

Which of the following types of triangle will ΔABC be?

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

Q: 9 **The line $x + 2y = 2$ forms a triangle OPQ, with the coordinate axes.** **[2]**



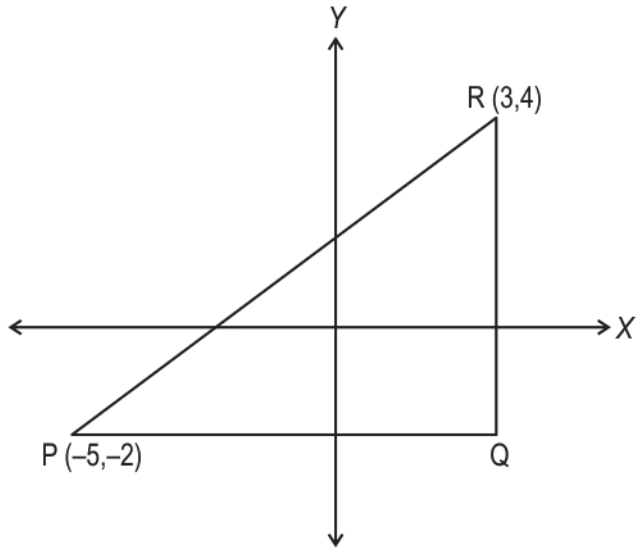
(i) What are the coordinates of points P and Q?

(ii) What is the area of the triangle formed? Show your steps.

Q: 10 **The radius of a circle with centre at the origin is $\frac{1}{2}$ units.** **[2]**

Find all the points on the circle which are of the form $(-y, y)$. Show your steps.

Q: 11 **Shown below is a right triangle PQR.** **[2]**



Find the value of cos P. Show your work.

Q: 12 **The three vertices of a rhombus PQRS are P(2, -3), Q(6, 5) and R(-2, 1).** **[3]**

a) Find the coordinates of the point where both the diagonals PR and QS intersect.
b) Find the coordinates of the fourth vertex S.

Show your steps and give valid reasons.

Q: 13 **Preeti and Arun are both driving to their respective offices from the same home. Preeti drives towards the east at an average speed of 30 km per hour for 12 minutes and then towards the south at an average speed of 60 km per hour for 3 minutes. Arun drives towards the west at an average speed of 30 km per hour for 4 minutes and then towards the north at an average speed of 45 km per hour for 4 minutes.** **[5]**

What is the straight-line distance between Preeti's office and Arun's office? Show your steps and represent the given scenario on the coordinate plane.

Q: 14 **On a playground, Parth, Qasim and Ragini are standing at the points P(2, 4), Q(8, 6) and R(8, 9) respectively. Sameer is standing exactly halfway between Parth and Qasim on the line joining Parth and Qasim.** **[2]**

What is the shortest distance, in units, between Sameer and Ragini? Show your steps.

Q: 15 For a triangle, the coordinates of the orthocentre and the circumcentre are (-4, 8) and ($\frac{1}{2}$, 1) respectively. [2]

Find the coordinates of the centroid of the triangle if the centroid divides the distance from the orthocentre to the circumcentre in the ratio 2:1. Show your steps.

Q: 16 Raaji and Gagan are finding a treasure that is exactly on the straight line joining them. Raaji's location is at (-6, -5) and Gagan's location is at (10, 11). The distance from the treasure to Raaji's location is three times that of the distance to Gagan's location. [2]

Find the coordinates of the location of the treasure. Show your steps.

Q: 17 The area of ΔPQR is 4 square units. The coordinates of P and Q are (-2, 2) and (-3, 1) respectively. The point R lies on the line $y + 3x = 4$. [3]

Find the coordinates of R. Show your steps.

Q: 18 Three players are standing on the circle at points A(-5, 0), B(1, 0) and C(3, 4). A ball is placed at a point that is equidistant from all 3 players. [5]

i) What are the coordinates of the ball?
ii) The fourth player is standing at the point D(-5, 4). Is he/she standing on the circle?

Show your steps and give valid reasons.

Q: 19 On a golf course, three holes A(-6, -1), B and C(9, -4) lie on a straight line in that order. The distance between B and C is two times that between B and A. [3]

Rahul strikes the ball, which is at point P(2, 3), such that it goes in the hole B.
i) Find the coordinates of hole B.
ii) Find the shortest distance covered by the ball.

Show your steps.

Q: 20 PQ is a line segment such that the y-coordinate of P is -1 and Q lies on the y-axis. The mid-point of PQ is O(-3, -6). [1]

Find the coordinates of Q. Show your work.

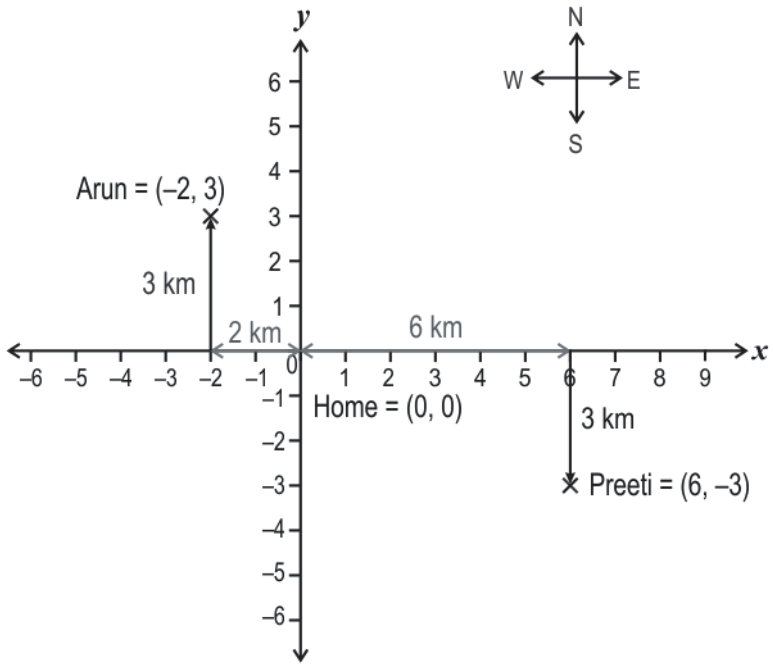
Q: 21 A circle with centre O(2, -5) has a chord with end-points A(1, 2) and B. M(5, -2) is the point where the perpendicular to the chord from the centre touches AB. [1]

Find the coordinates of point B. Show your steps with valid reasons.

The table below gives the correct answer for each multiple-choice question in this test.

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

Q.No	Teacher should award marks if students have done the following:	Marks
9	(i) Finds the coordinates correctly as P (0, 1) and Q(2, 0).	1
	(ii) Uses any suitable method to find the area of the triangle as 1 sq unit.	1
10	Identifies the distance between the origin and the point $(-y, y)$ as $\frac{1}{2}$ units and uses the distance formula to write the equation as: $(-y)^2 + y^2 = (\frac{1}{2})^2$	0.5
	Simplifies the above equation as $2y^2 = \frac{1}{4}$.	0.5
	Solves the above equation to get y as $\frac{1}{\sqrt{8}}$ and $\frac{-1}{\sqrt{8}}$.	0.5
	Finds the points as $(\frac{1}{\sqrt{8}}, \frac{-1}{\sqrt{8}})$ and $(\frac{-1}{\sqrt{8}}, \frac{1}{\sqrt{8}})$.	0.5
11	Finds the coordinates of Q as (3, -2).	0.5
	Uses the distance formula and finds PR as $\sqrt{(8^2 + 6^2)} = 10$ units and PQ as $\sqrt{8^2} = 8$ units.	1
	Mentions that cos P = $\frac{PQ}{PR}$ and finds its value as $\frac{8}{10} = \frac{4}{5}$.	0.5
12	a) 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 P(2, -3) and R(-2, 1) as (0, -1) .	0.5
	b) Finds the mid-point of Q(6, 5) and S(x, y) as $(\frac{6+x}{2}, \frac{5+y}{2})$, where x and y are the coordinates of the fourth vertex S.	0.5
	Uses the above steps and equates the respective coordinates of the mid-points to get the following relationships: i) $0 = \frac{6+x}{2}$ ii) $-1 = \frac{5+y}{2}$	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Solves the above two equations to find the values of *x* and *y* as -6 and -7 respectively. **Concludes that the coordinates of the fourth vertex S are (-6, -7).**	**1**
13	**Finds the distance travelled by Preeti towards the east as $\frac{30\times12}{60}$ = 6 km.**	**0.5**
	Finds the distance travelled by Preeti towards the south as $\frac{60\times3}{60}$ = 3 km.	**0.5**
	Finds the distance travelled by Arun towards the west as $\frac{30\times4}{60}$ = 2 km.	**0.5**
	Finds the distance travelled by Arun towards the north as $\frac{45\times4}{60}$ = 3 km.	**0.5**
	Represents the above scenario on a coordinate plane. The figure may look as follows:  **Locates the coordinates of Preeti's office as (6, -3) and the coordinates of Arun's office as (-2, 3).**	**2**

Q.No	Teacher should award marks if students have done the following:	Marks
	Finds the distance between the two offices as $\sqrt{\{(6 + 2)^2 + (-3 - 3)^2\}} = 10$ km. (Award 0.5 marks if the distance formula is correctly written.)	1
14	Uses the mid-point formula and finds the coordinates of Sameer's location as: $(\frac{2+8}{2}, \frac{4+6}{2}) = (5, 5)$. (Award 0.5 marks if only the mid-point formula is written.)	1
	Uses the distance formula and finds the shortest distance between Sameer and Ragini as $\sqrt{\{(8 - 5)^2 + (9 - 5)^2\}} = 5$ units. (Award 0.5 marks if only the distance formula is written.)	1
15	Uses the section formula to find the coordinates of the centroid as follows: $\left(\frac{2\left(\frac{1}{2}\right) + (-4)}{2 + 1}, \frac{2(1) + 1(8)}{2 + 1}\right)$ (Award 0.5 marks if only the section formula is written correctly.)	1
	Simplifies the above expressions and finds the coordinates of the centroid as $(-1, \frac{10}{3})$.	1
16	Writes that (x, y) are the coordinates of the location of the treasure that divide (-6, -5) and (10, 11) in the ratio $m : n = 3:1$.	0.5
	Uses the section formula to find (x, y) as follows: $(\frac{3(10)+1(-6)}{3+1}, \frac{3(11)+1(-5)}{3+1})$ $= (6, 7)$ (Award 0.5 marks if only the section formula is correctly written.)	1.5

Q.No	Teacher should award marks if students have done the following:	Marks
17	Applies the formula of area of the triangle and writes the relation as follows: $4 = \frac{1}{2} \times [(-2)(1 - y) + (-3)(y - 2) + x(2 - 1)]$ where, (x, y) are the coordinates of the third vertex, R. (Award 0.5 marks if only the formula to find the area of a triangle is correctly written.)	1
	Simplifies the above equation as: $x - y = 4$	1
	Solves $y + 3x = 4$ and $x - y = 4$ to find the values of x and y as 2 and -2 respectively. Concludes that (2, -2) are the coordinates of R.	1
18	i) Considers the coordinates of the ball as O(x, y) and considering OA = OB = OC, applies distance formula and writes the equations: $OA = OB \Rightarrow (x + 5)^2 + (y)^2 = (x - 1)^2 + (y)^2$ and $OB = OC \Rightarrow (x - 1)^2 + (y)^2 = (x - 3)^2 + (y - 4)^2$	1
	Simplifies the above equations to find the coordinates of the ball as O(-2, 4). (Award 1 mark if only one of the coordinates is correctly written.)	2
	ii) Considers O as the centre and finds the radius of the circle by finding either OA or OB or OC. $OA = \sqrt{\{(-2+5)^2 + (4 - 0)\}^2} = \sqrt{25} = 5$ units	1
	Finds the distance between O and D as 3 units and explains that the fourth player is not standing on the circle as the distance between the player and the centre of the circle is not equal to the radius of the circle.	1
19	i) Writes that point B internally divides the line joining A and C in the ratio 1:2.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Uses the section formula to find the coordinates of hole B as: $\left(\frac{2(-6)+1(9)}{1+2}, \frac{2(-1)+1(-4)}{1+2}\right)$ (Award 0.5 marks if only the section formula is correctly written.)	1
	Evaluates the above expressions to find the coordinates of hole B as (-1, -2).	0.5
	ii) Finds the shortest distance covered by the ball as $\sqrt{[(2 - (-1))^2 + (3 - (-2))^2]} = \sqrt{34}$ units.	1
20	Writes that the coordinates of Q is of the form (0, *y*) and uses the mid-point formula to find the value of *y* as $\left(\frac{-1+y}{2}\right) = -6$.	0.5
	Solves the above equation to find the value of *y* as -11 and writes the coordinates of Q as (0, -11).	0.5
21	Writes that the point M, where the perpendicular to the chord from the centre touches AB, is the mid-point of AB and writes the expressions to find the coordinates of point B as $\left(\frac{1+x}{2}, \frac{2+y}{2}\right) = (5, -2)$.	0.5
	Solves the above expressions to find the coordinates of point B as (9, -6).	0.5

Chapter - 8
Introduction to Trigonometry

Q: 1 **If cos y = 0, then what is the value of $\frac{1}{2}\cos\frac{y}{2}$?**

1 0 **2** $\frac{1}{2}$ **3** $\frac{1}{\sqrt{2}}$ **4** $\frac{1}{2\sqrt{2}}$

Q: 2 **P and Q are acute angles such that P > Q.**

Which of the following is DEFINITELY true?

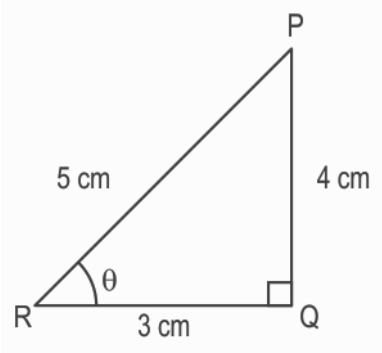
1 sin P < sin Q **2** tan P > tan Q **3** cos P > cos Q **4** cos P > sin Q

Q: 3 **In a right-angled triangle PQR, ∠Q = 90°.**

Which of these is ALWAYS 0?

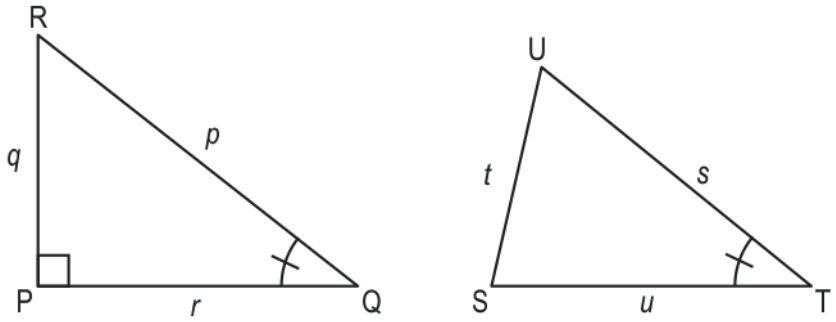
1 cos P - sec R
2 tan P - cot R
3 sin P - cosec R
4 (cannot be known without knowing the value of P)

Q: 4 **[1]**



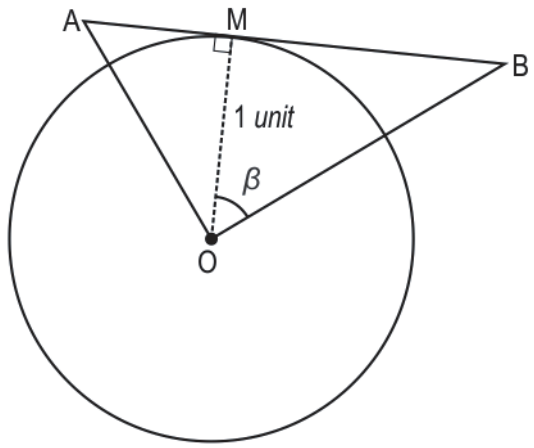
Show that sin θ = cos (90 - θ) is true using the definition of trigonometric ratios.

Q: 5 **In the triangles shown below, ∠Q = ∠T.** **[1]**



Write an expression each for cos Q and sin T.

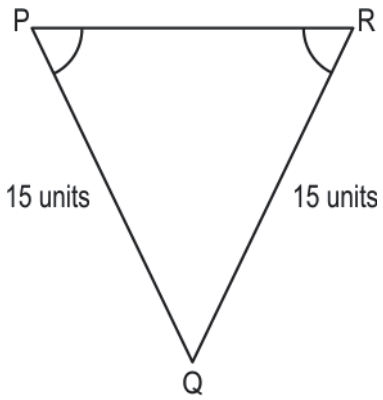
Q: 6 **A unit circle is shown below with centre O. A tangent AB is drawn to the circle at point M such that ∠MOB = β.** **[2]**



(Note: The figure is not to scale.)

If OA ⊥ OB, write the expressions that represent the lengths of
i) OB
ii) OA
iii) AB

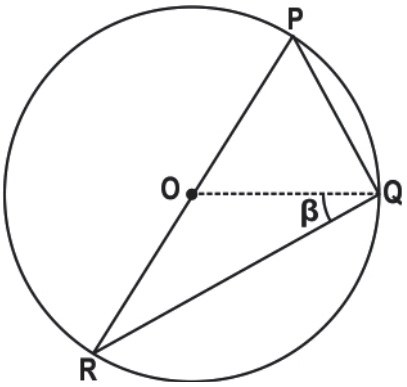
Q: 7 **In the figure below, 5sin P = 4.** **[2]**



(Note: The figure is not to scale.)

What is the length of PR? Draw a diagram and show your steps.

Q: 8 **▲PQR is inscribed in a circle with a centre O and radius *r* units.** **[3]**



If PR is the diameter of the circle and ∠RQO = β,

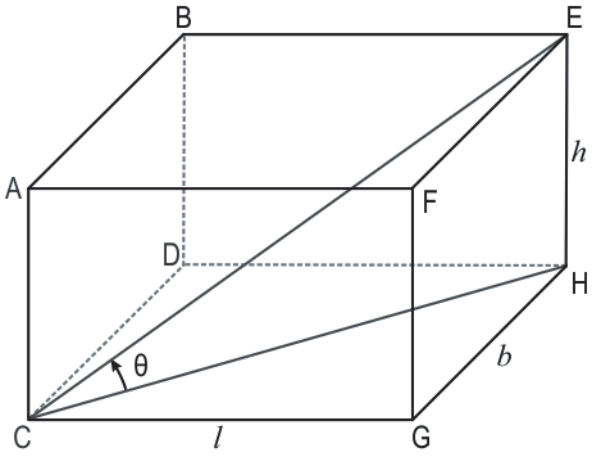
Express (QR^4 - PQ^4), in terms of *r* and β, to the simplest form.
Show your steps and give valid reasons.

Q: 9 **Prove the following.** **[3]**

i) $\frac{1}{cosec\,\theta - cot\,\theta} - \frac{cot\,\theta}{cos\,\theta} = cot\,\theta$

ii) $\frac{tan\,18°}{cos\,72°} - \frac{1}{cosec\,72° + tan\,18°} = cot\,72°$

Q: 10 **Shown below is a cuboid. Its length is *l* units, breadth *b* units and height *h* units.** **[3]**



i) Express cos θ in terms of *l*, *b,* and *h.*

ii) If the figure was a cube, what would be the value of cos θ *?*

Show your work.

Q: 11 **Prove that:** **[2]**

$$\frac{\text{cosec}^2 x - \sin^2 x \cot^2 x - \cot^2 x}{\sin^2 x} = 1$$

Q: 12 **[5]**

$$\text{If } \frac{1}{\sin\theta - \cos\theta} = \frac{\text{cosec}\,\theta}{\sqrt{2}}, \text{ prove that } \left(\frac{1}{\sin\theta + \cos\theta}\right)^2 = \frac{\sec^2\theta}{2}.$$

Q: 13 **Solve:** **[3]**

$$\left(\frac{4\tan 53°}{\cot 37°}\right)^2 - \frac{\sec 34° \sin 56° \cos 17°}{\sec 6° \sin 73° \sin 84°}$$

Show your steps.

Q: 14 **During a math lesson, Mr. Kumar wrote the expression given below on the board and asked the students to simplify it.** **[2]**

$$\frac{\cos A}{1-\sin A}+\frac{1-\sin A}{\cos A}$$

Salma solved it in her notebook as follows:

$$\frac{\cos A}{1-\sin A}+\frac{1-\sin A}{\cos A}$$

$$=\frac{\cos^2 A+(1-\sin A)^2}{(1-\sin A)\times\cos A} \quad \text{...(step 1)}$$

$$=\frac{\cos^2 A+\cos^2 A}{(1-\sin A)\times\cos A} \quad \text{...(step 2)}$$

$$=\frac{2\cos^2 A}{(1-\sin A)\times\cos A} \quad \text{...(step 3)}$$

$$=\frac{2\cos A}{1-\sin A} \quad \text{...(step 4)}$$

Examine if Salma has made any error(s) and rectify them to find the correct answer.

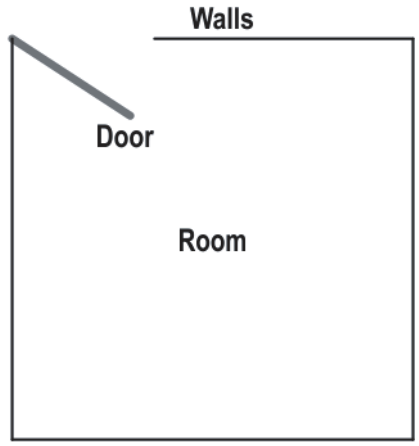
Q: 15 **The teacher asked the students to correctly complete the following sentence about the rhombus.** **[3]**

"A rhombus has a side length of *l* units and one of its angles is equal to θ. The ratio of the lengths of the two diagonals is dependent on _____."

Ashima: only *l*.
Bilal: only θ.
Chris: both *l* and θ.
Duleep: neither *l* nor θ.

Who answered the question correctly? Show your work and give valid reasons.

Q: 16 **A 90 cm wide door opens on one side of the room at a maximum angle of 90°. Due to shortage of space, a 40 cm by 80 cm table is kept behind the door along the wall such that it obstructs its path.** **[1]**



(Note: The figure is not to scale.)

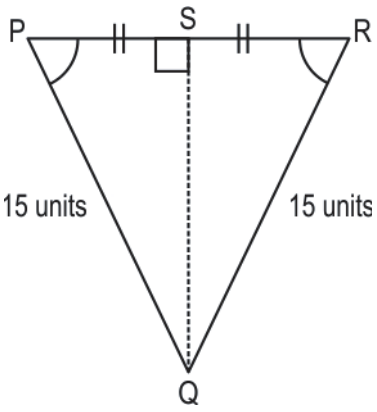
At what distance from the hinge should the table be kept such that the door opens for a maximum angle of 60°. Show your work.

(Note: Use √2 = 1.41, √3 = 1.73)

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	4
2	2
3	2

Q.No	Teacher should award marks if students have done the following:	Marks
4	Marks the 3rd angle as 90 - θ and verifies the given statement using the ratio definition.	1
5	Writes $\cos Q = \frac{r}{p}$.	0.5
	Writes $\sin T = \sin Q = \frac{q}{p}$.	0.5
6	i) Applies trigonometric ratios in ΔOMB to write: $\cos(\beta) = \frac{OM}{OB} = \frac{1}{OB}$ $\Rightarrow OB = \sec \beta$	0.5
	ii) Applies trigonometric ratio in ΔOMA to write: $\cos(90° - \beta) = \frac{OM}{OA} = \frac{1}{OA}$ $\Rightarrow OA = \operatorname{cosec} \beta$	0.5
	iii) Uses above steps along with Pythagoras' theorem to write: $AB^2 = OA^2 + OB^2$ $\Rightarrow AB^2 = \operatorname{cosec}^2\beta + \sec^2\beta$ $\Rightarrow AB^2 = \frac{\cos^2\beta + \sin^2\beta}{\sin^2\beta \cos^2\beta}$ $\Rightarrow AB = \sqrt{\frac{1}{\sin^2\beta \cos^2\beta}}$ $\Rightarrow AB = \frac{1}{\sin\beta \cos\beta}$ (Award full marks for any other variation of the correct answer.)	1

Q.No	Teacher should award marks if students have done the following:	Marks
7	**Writes that, in an isosceles triangle, the perpendicular bisects the base and draws a diagram. The diagram may look as follows:**  ***(Note: The figure is not to scale.)***	**0.5**
	Uses the value of sin P to find the length of SQ as 15sin P = 15 × $\frac{4}{5}$ = 12 units.	**0.5**
	Uses the Pythagoras theorem to find the length of PS as $\sqrt{(15^2 - 12^2)}$ = 9 units.	**0.5**
	Finds the length of PR as 2 × 9 = 18 units.	**0.5**
8	**Identifies that ΔRQO is isosceles since OQ = OR = *r* and finds the measure of ∠ORQ = ∠OQR = β.**	**0.5**
	Identifies that ΔPQR is right-angled at Q and finds the length of QR as PR × cos β = 2 *r* (cos β).	**0.5**
	Identifies that ΔPQR is right-angled at Q and finds the length of PQ as PR × sin β = 2 *r* (sin β).	**0.5**
	Uses steps 2 and 3 to express $(QR^4 - PQ^4)$ as 16 $r^4 (\cos^4 \beta - \sin^4 \beta)$.	**0.5**
	Factorises the above expression for $(QR^4 - PQ^4)$ as 16 $r^4 (\cos^2 \beta - \sin^2 \beta) (\cos^2 \beta + \sin^2 \beta)$.	**0.5**

Q.No	Teacher should award marks if students have done the following:	Marks
	Simplifies and factorises the above expression for ($QR^4 - PQ^4$) as 16 r^4 (cos β - sin β) (cos β + sin β). **(Award full marks if the student simplifies to any other variation of this equation.)**	**0.5**
9	**i) Simplifies the given LHS by rationalizing the first term as:** $\frac{cosec\,\theta + cot\,\theta}{cosec^2\theta - cot^2\theta} - \frac{cot\,\theta}{cos\,\theta}$	**0.5**
	Simplifies the above expression as: **cosec θ + cot θ - cosec θ = cot θ** **Concludes that LHS = RHS.**	**1**
	ii) Simplifies the given LHS as: $\frac{sin\,18°}{cos\,18°} \times \frac{1}{sin\,18°} - \frac{1}{cosec\,72° + cot\,72°}$	**0.5**
	Simplifies the above expression by rationalizing the second term as: $sec\,18° - \frac{cosec\,72° - cot\,72°}{cosec^2 72° - cot^2 72°}$	**0.5**
	Simplifies the above expression as: **sec 18° - sec 18° + cot 72° = cot 72°** **Concludes that LHS = RHS.**	**0.5**
10	**i) Finds the length of CH using the Pythagoras' theorem in ΔCGH as:** **CH = √($CG^2 + GH^2$) = √($l^2 + b^2$) units**	**0.5**

Q.No	Teacher should award marks if students have done the following:	Marks
	Finds the length of CE using the Pythagoras' theorem in ΔCHE as: **CE = $\sqrt{(CH^2 + EH^2)} = \sqrt{(l^2 + b^2 + h^2)}$ units**	**0.5**
	Finds cos θ as: $\cos\theta = \frac{CH}{CE} = \frac{\sqrt{l^2+b^2}}{\sqrt{l^2+b^2+h^2}}$ $\Rightarrow \cos\theta = \sqrt{\frac{l^2+b^2}{l^2+b^2+h^2}}$ **(Award 0.5 marks if only the ratio for cos θ is correctly written.)**	**1**
	ii) Applies $l = b = h$ for a cube and solves for cos θ as: $\cos\theta = \sqrt{\frac{l^2+b^2}{l^2+b^2+h^2}} = \sqrt{\frac{2}{3}}$	**1**
11	**Simplifies the given LHS as:** $\frac{1 - \sin^2 x \cot^2 x}{\sin^2 x}$	**1**
	Simplifies the above expression as: **$\text{cosec}^2 x - \cot^2 x$**	**0.5**
	Simplifies the above expression as 1 and concludes that LHS = RHS.	**0.5**

Q.No	Teacher should award marks if students have done the following:	Marks
12	**Squares both sides of the given equation as:** $\frac{1}{\sin^2\theta + \cos^2\theta - 2\sin\theta\cos\theta} = \frac{\text{cosec}^2\theta}{2}$	0.5
	Simplifies the above equation as: $\frac{2}{\text{cosec}^2\theta} = 1 - 2\sin\theta\cos\theta$	1
	Simplifies the above equation as: **$2\sin\theta\cos\theta = 1 - 2\sin^2\theta$**	1
	Squares the LHS of the equation to be proved as: $\frac{1}{\sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta}$	0.5
	Uses step 3 and simplifies the above expression as: $\frac{1}{2 - 2\sin^2\theta}$	1
	Simplifies the above expression as: $\frac{1}{2\cos^2\theta} = \frac{\sec^2\theta}{2}$ **Concludes that LHS = RHS.**	1

Q.No	Teacher should award marks if students have done the following:	Marks
13	**Simplifies the given expression as:** $\left(\frac{4\cot(90°-53°)}{\cot 37°}\right)^2 - \frac{\operatorname{cosec}(90°-34°) \times \frac{1}{\operatorname{cosec} 56°} \times \sin(90°-17°)}{\operatorname{cosec}(90°-6°) \times \sin 73° \times \frac{1}{\operatorname{cosec} 84°}}$	1.5
	Simplifies the given expression as: $\left(\frac{4\cot 37°}{\cot 37°}\right)^2 - \frac{\operatorname{cosec} 56° \times \frac{1}{\operatorname{cosec} 56°} \times \sin 73°}{\operatorname{cosec} 84° \times \sin 73° \times \frac{1}{\operatorname{cosec} 84°}}$	1
	Simplifies the above expression as: $4^2 - 1 = 15$	0.5
14	**Identifies that step (2) has an error.**	0.5
	For step (2), identifies that incorrect identity is used and writes the correct identity as: $(1 - \sin A)^2 = 1 + \sin^2 A - 2 \sin A$	0.5
	Writes the step by step solution to get the correct simplified form as 2sec A or $\frac{2}{\cos A}$.	1
15	**Draws a rhombus, say ABCD, and connects diagonals AC and BD bisecting at a point, say E.**	0.5
	In ΔEAD, applies the properties of the rhombus to get **i) ∠AED = 90°** **ii) AE = $\frac{AC}{2}$** **iii) DE = $\frac{BD}{2}$** **iv) ∠EAD = $\frac{\theta}{2}$**	1

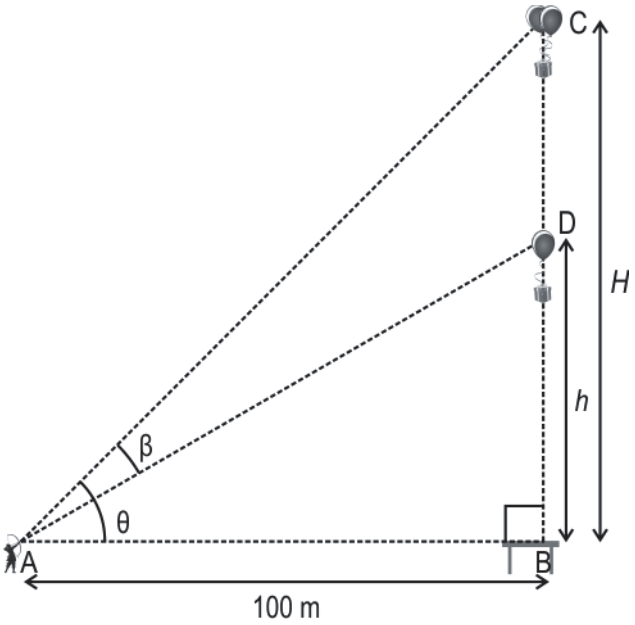
Q.No	Teacher should award marks if students have done the following:	Marks
	Applies trigonometric ratio to get $\tan \frac{\theta}{2} = \frac{AE}{DE} = \frac{AC}{BD}$	0.5
	Writes that the ratio of the diagonals $\frac{AC}{BD}$ is only dependent on θ and not *l*. Writes that Bilal answered it correctly.	1
16	Assumes the required distance as *x* cm and writes the ratio as: $\tan 30° = \frac{40}{x}$	0.5
	Solves the above equation to find the value of *x* as 40 × 1.73 = 69.2 cm.	0.5

Chapter - 9
Some Applications of Trigonometry

Answer the questions based on the information given below.

At an archery academy, Guru Drona had floated a gift box with two balloons at a height of H metres from the table. As part of his practice, Arjuna was given the task to bring the gift box to the table placed below. Arjuna was standing on the ground at a horizontal distance of 100 metres from the table at point B. He aimed at the balloons with an elevation angle of θ and shot the arrow to burst one of the balloons.

When Arjuna burst the first balloon, the box came down to the height of *h* metres from the table. He now reduced his angle of elevation by β and shot his arrow at the second balloon. The second balloon burst and the gift box landed safely on the table. Assume that Arjuna's arrows travelled in straight lines and did not curve down.



(Note: The figure is not to scale.)

(Use √3 = 1.73, √2 = 1.41)

Q: 1 **If θ = 45° and β = 15°, what is the difference between the box's initial height and its height after the first shot?**

1 100 - $\frac{100}{\sqrt{3}}$ m
2 $\frac{100}{\sqrt{3}}$ m
3 100√3 - 100 m
4 (cannot be calculated without knowing H.)

Q: 2 **If θ = 45° and β = 15°, what is the distance that the arrow has to travel to burst the second balloon?**

1 $\frac{100\sqrt{3}}{2}$ m
2 $\frac{200}{\sqrt{3}}$ m
3 100√2 m
4 100√3 m

Q: 3 **For Ashwatthama, Guru Drona raised the gift box further higher such that the angles θ and β were 60° and 30° respectively. What is the value of the ratio $\frac{H}{h}$ now?**

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

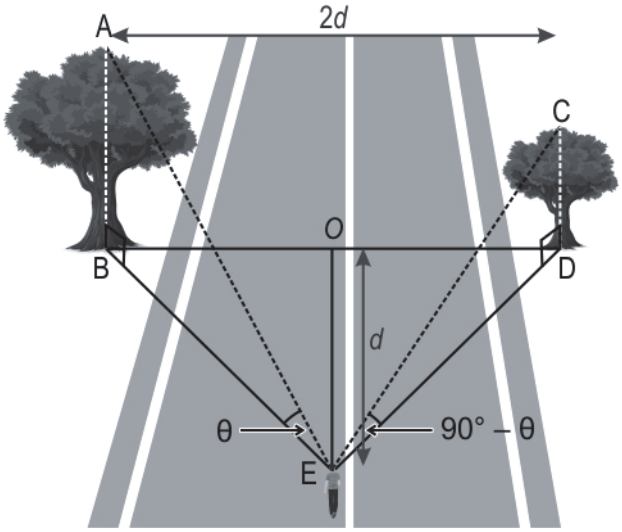
Q: 4 **When the initial angle of elevation, θ, was 45°, Arjuna felt uncomfortable as it strained his neck. From his original spot, approximately how much should he retreat away from the balloons, so that the new angle of elevation, θ, becomes 30°?**

1 73 m
2 100 m
3 173 m
4 (cannot be calculated without knowing H.)

Q: 5 **Arjuna measured that θ = 45°. Right before he could shoot the first arrow, a gust of wind pushed the balloons 15 m higher. What should Arjuna do to ensure that he doesn't miss?**

1 Move towards the table by 15 m but keep the arrow at the same angle of elevation.
2 Move away from the table by 15 m but keep the arrow at the same angle of elevation.
3 Increase the arrow's angle of elevation by 15° but stay at the same place.
4 Move away from the table by 15 m and increase the arrow's angle of elevation by 15°.

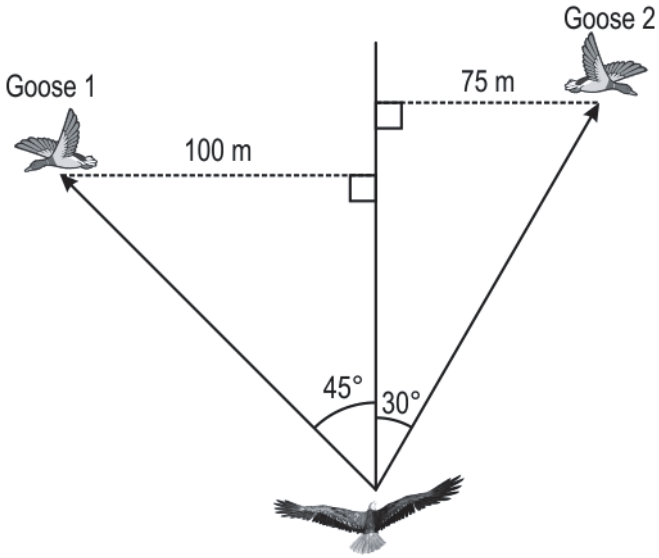
Q: 6 **Two trees are 2 *d* meters apart. Ajay stood at a point midway between them and started walking in a direction perpendicular to the line connecting the two trees. After walking *d* metres, he observed the angle of elevations to the tops of the two trees and found them to be complementary.** **[3]**



(Note: The figure is not to scale.)

If one of the trees is thrice as tall as the other, find the height of the shorter tree, in terms of *d*. Show your work.

Q: 7 **The position of an eagle and two identical geese are shown in the figure below. All the birds are at the same height from the ground. Assume that the Eagle can fly at the same speed in all directions and that the geese are unaware of the Eagle's intention and will not move from their positions.** **[2]**

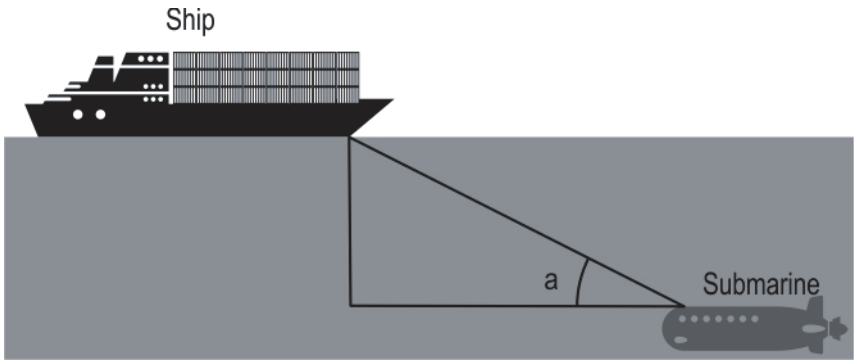


(Note: The figure is not to scale.)

If the eagle wants to attack the goose that is nearer to it, which one should it attack? Show your steps.

(Note: Use √2 = 1.41, √3 = 1.73)

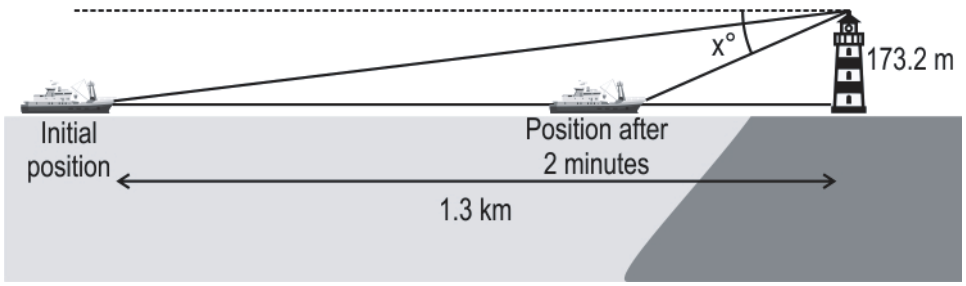
Q: 8 **Shown below is a submarine scouting an enemy ship in the ocean using a sonar device. Sonar devices send out a sound pulse from a transducer, and then precisely measure the time it takes for the sound pulses to be reflected back to the transducer.** **[2]**



A sonar wave sent by the submarine hits the ship and returns back in 2 seconds. The speed of a sonar wave underwater is 1500 m/s and the submarine is diving at a depth of 750 m below sea level.

Find the angle of elevation '*a*' of the ship from the submarine. Show your steps.

Q: 9 **A ship was moving towards the shore at a uniform speed of 36 km/h. Initially, the ship was 1.3 km away from the foot of a lighthouse which is 173.2 m in height.** **[3]**



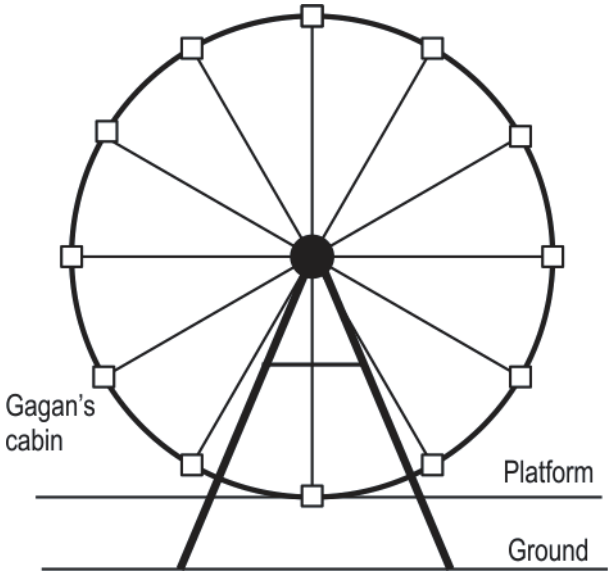
(Note: The figure is not to scale.)

Find the angle of depression, *x*, of the top of the lighthouse from the ship after the ship had been moving for 2 minutes.

Show your steps and give reasons.

(Note: Take √3 as 1.732 and √2 as 1.414.)

Q: 10 **In the giant wheel shown below, Gagan is sitting in one of the cabins which is 12 m high from the platform. Jyoti and Karan are sitting in the lowest and the highest cabins from the platform respectively.** **[5]**



(Note: The figure is not to scale.)

From Gagan, the angle of depression of Jothi and the angle of elevation of Kiran is 30° and 60° respectively.

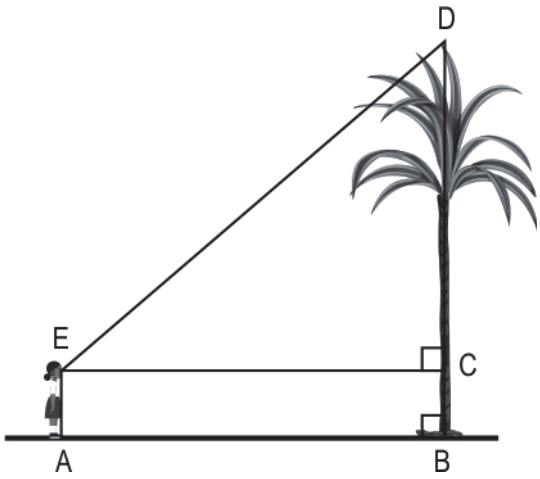
i) What will be the angle of elevation of Gagan from Jothi?

ii) What will be the angle of depression of Gagan from Kiran?

iii) Find the diameter of the giant wheel.

Show your steps with a diagram.

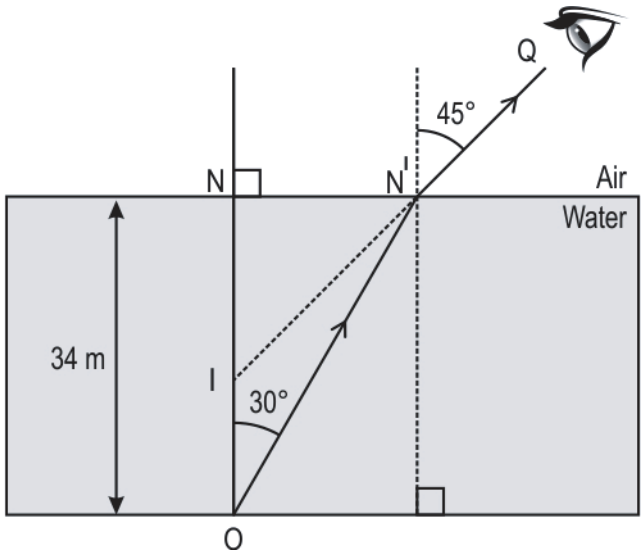
Q: 11 **In the figure below, the height of the girl is 1.5 m and the height of the tree is 13.5 m.** **[1]**



(Note: The figure is not to scale.)

If AB = 12√3 m, what is the angle of elevation of the top of the tree from her eyes? Show your steps.

Q: 12 **Shown below is a rectangular tub of water of depth 34 cm. An object O is at the bottom of the tub. The image of the object is formed at I for an observer at Q.** **[2]**



(Note: The figure is not to scale.)

Find the distance by which the object seem to be moved for the observer. Show your work and give valid reasons.

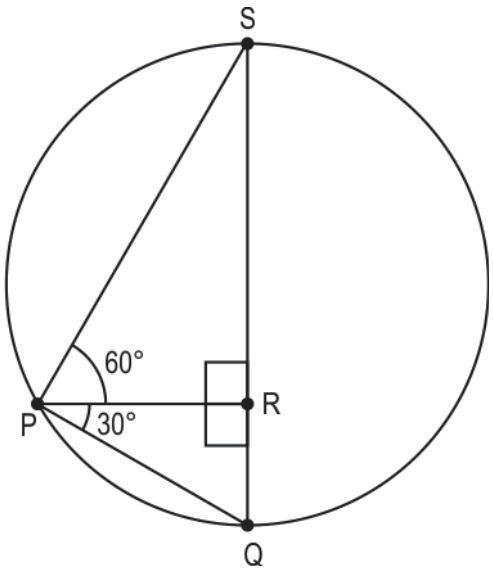
(Note: Take √2 = 1.4, √3 = 1.7)

The table below gives the correct answer for each multiple-choice question in this test.

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

Q.No	Teacher should award marks if students have done the following:	Marks
6	**Applies Pythagoras' theorem in either of the two triangles ΔEOB or ΔEOD and finds Ajay's distance from each tree as $\sqrt{(d^2 + d^2)} = \sqrt{2}\,d$.**	**0.5**
	Assumes the height of shorter tree as *h* metres and taller tree as 3 *h* metres. **Takes the angle of elevation of shorter tree as θ and the taller tree as (90° - θ).** **(Award full marks if h and $\frac{h}{3}$ are used instead of h and 3h.)**	**0.5**
	Uses trigonometric ratios in the two triangles ΔEDC and ΔEBA respectively and writes: $\frac{h}{d\sqrt{2}} = \tan\theta$ $\frac{3h}{d\sqrt{2}} = \tan(90° - \theta) = \cot\theta$	**1**
	Solves the equations in step 3 for *h* and finds the height, *h*, of the shorter tree, in metres, as: $\frac{h}{d\sqrt{2}} \times \frac{3h}{d\sqrt{2}} = \tan\theta \times \cot\theta$ $\Rightarrow \frac{3h^2}{2d^2} = 1$ $\Rightarrow h = d \times \sqrt{\frac{2}{3}}$	**1**
7	**i) Applies trigonometric ratio to determine the distance of the first goose from Eagle as 100√2 m or 141 m**	**1**
	Applies trigonometric ratio to determine the distance of the second goose from Eagle as 150 m. **Argues that since goose 1 is closer, the Eagle would attack it.**	**1**

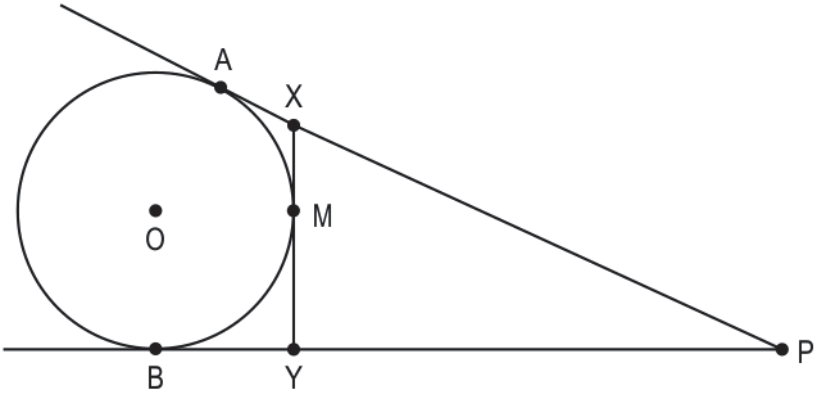
Q.No	Teacher should award marks if students have done the following:	Marks
8	Writes that the distance traveled by the sonar wave is 1500 × 2 = 3000 m.	0.5
	Writes that since 3000 m is the distance traveled by the sonar wave to the ship and back, the distance between the ship and the sonar = $\frac{3000}{2}$ or 1500 m.	0.5
	Writes that sin *a* = $\frac{750}{1500}$ or $\frac{1}{2}$.	0.5
	Writes *a* as 30° since sin 30° = $\frac{1}{2}$.	0.5
9	Finds the distance covered by the ship in 2 minutes as 36 × $\frac{1}{30}$ = 1.2 km (2 min = $\frac{1}{30}$ h).	0.5
	Calculates the distance of the ship from the foot of the lighthouse as 1.3 - 1.2 = 0.1 km or 100 m.	0.5
	Assumes that the angle of elevation from the ship to the top of the lighthouse as *a* and writes tan *a* = $\frac{173.2}{100}$ or 1.732.	1
	Calculates *a* as 60° since tan 60° = √3 or 1.732.	0.5
	Writes that alternate interior are equal and hence finds the angle of depression as *x* = *a* = 60°.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
10	**Draws a rough diagram. The figure may look as follows:**  ***(Note: The figure is not to scale.)***	**1**
	i) Writes that the angle of elevation of Gagan from Jothi is 30°.	**0.5**
	ii) Writes that the angle of depression of Gagan from Kiran is 60°.	**0.5**
	iii) Writes the length of RQ as 12 m.	**0.5**
	Uses tan ratio for ΔPQR and finds the length of PR as: **tan 30° = $\frac{12}{PR}$** **=> PR = 12√3 m.**	**1**
	Uses tan ratio for ΔPSR and finds the length of SR as: **tan 60° = $\frac{SR}{12\sqrt{3}}$** **=> SR = 36 m.**	**1**
	Finds the diameter of the giant wheel as SR + RQ = 12 + 36 = 48 m.	**0.5**

Q.No	Teacher should award marks if students have done the following:	Marks
11	Writes that tan DEC = $\frac{13.5-1.5}{12\sqrt{3}} = \frac{1}{\sqrt{3}}$.	0.5
	Finds the angle of elevation of the top of the tree from her eyes as ∠DEC = 30°.	0.5
12	Finds the length NN' in ΔNON' as 34tan 30° = $\frac{34}{\sqrt{3}}$ cm.	0.5
	Writes that corresponding angles are equal and finds the measure of ∠NIN' as 45°.	0.5
	Finds the depth NI in ΔNIN' as $\frac{34}{\sqrt{3}}$ ÷ tan 45° = $\frac{34}{\sqrt{3}}$ cm.	0.5
	Finds the distance by which the object seemed to be moved for the observer as 34 - $\frac{34}{\sqrt{3}}$ = 34 × $\frac{0.7}{1.7}$ = 14 cm.	0.5

Chapter - 10
Circles

Q: 1 **In the figure below, ΔPXY is formed using three tangents to a circle centred at O.**

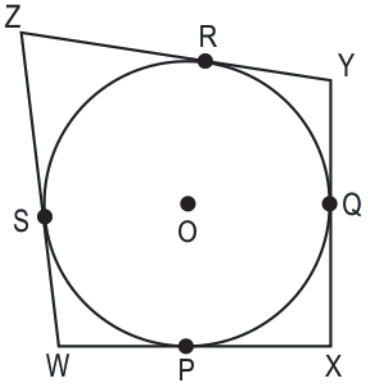


(Note: The figure is not to scale.)

Based on the construction, the sum of the tangents PA and PB is _____ the perimeter of ΔPXY.

1 lesser than
2 greater than
3 equal to
4 (cannot be answered without knowing the tangent lengths)

Q: 2 **Raghav drew the following figure on a board where a circle is inscribed in a quadrilateral.**



(Note: The figure is not to scale.)

Then he wrote the following relationships.

i) ZW + WX = XY + YZ
ii) ZY + WX = ZW + YX

Which of the above relationships is/are DEFINITELY true?

1 only i **2** only ii **3** both i and ii **4** neither i nor ii

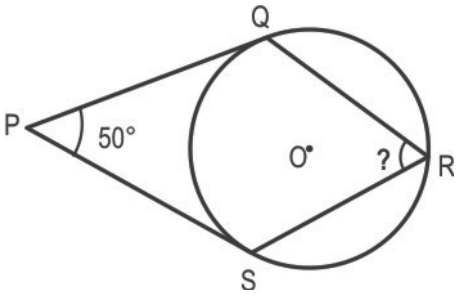
Q: 3 **A circle has a centre O and radii OQ and OR. Two tangents, PQ and PR, are drawn from an external point, P.**

In addition to the above information, which of these must also be known to conclude that the quadrilateral PQOR is a square?

i) OQ and OR are at an angle of 90°.
ii) The tangents meet at an angle of 90°.

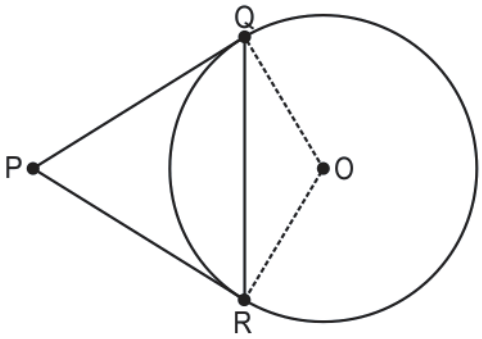
1 only i) **2** only ii) **3** either i) or ii) **4** both i) and ii)

Q: 4 **In the following figure, O is the centre of the circle and PQ and PS are tangents to the circle at points Q and S respectively.** **[1]**



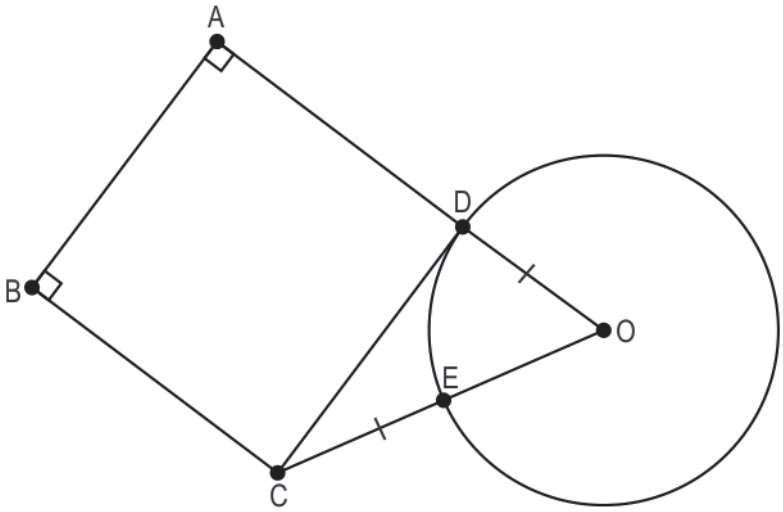
What is the measure of ∠QRS? Show your work.

Q: 5 **Shown below is a circle with centre O and tangents PQ and PR.** **[3]**



Using triangles QOR and PQR, and without doing any extra constructions, prove that the tangents PQ and PR are equal in length.

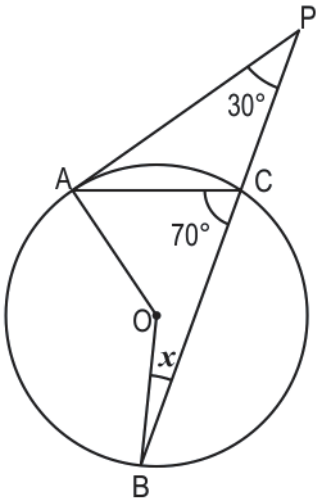
Q: 6 **ABCD is a square. CD is a tangent to the circle with centre O as shown in the figure below.** **[3]**



(Note: The figure is not to scale.)

If OD = CE, what is the ratio of the area of the circle and the area of the square? Show your steps and give valid reasons.

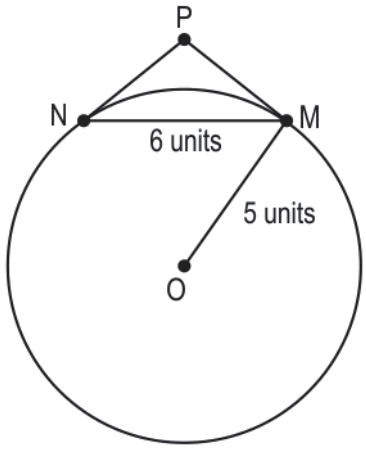
Q: 7 **In the figure given below, PA is a tangent to the circle with centre O and PCB is a straight line.** **[3]**



(Note: The figure is not to scale.)

Find the measure of∠OBC. Show your steps and give valid reasons.

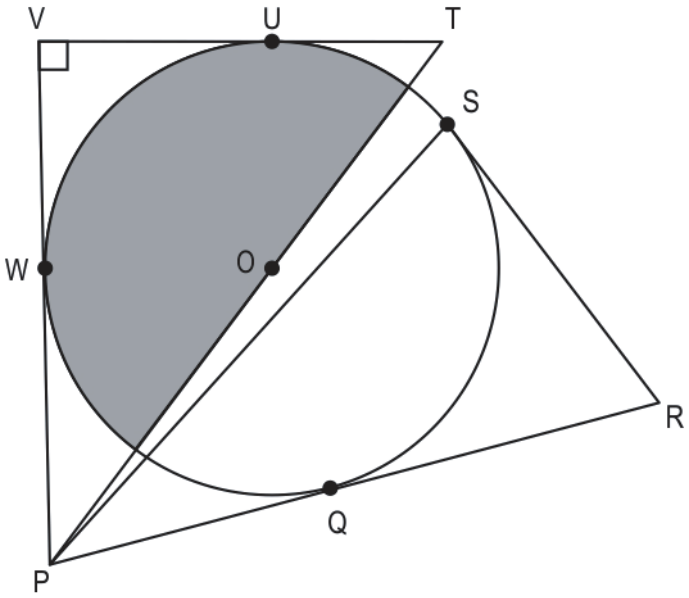
Q: 8 **Shown below is a circle with centre O and radius 5 units. PM and PN are tangents and the length of chord MN is 6 units.** **[5]**



(Note: The figure is not to scale.)

Find the length of (PM + PN). Show your work.

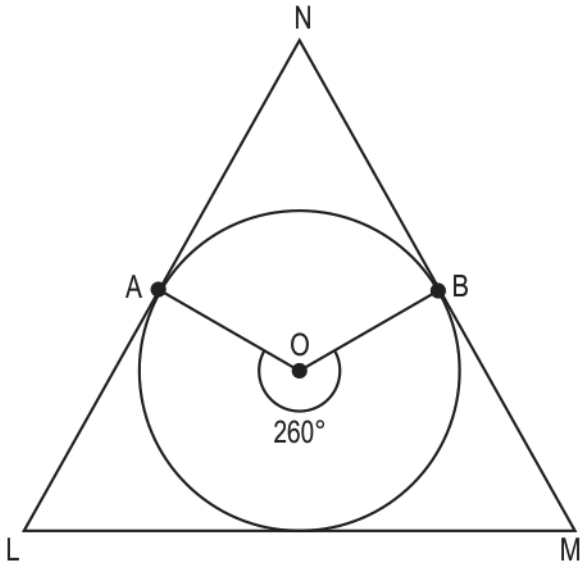
Q: 9 **Shown below is a circle with centre O. VP = 34 cm, PR = 36 cm and RS = 17 cm. U, W, Q and S are the points of tangency.** **[5]**



(Note: The figure is not to scale.)

Find the area of the shaded region in terms of π. Show your steps and give valid reasons.

Q: 10 **In the figure below, a circle with centre O is inscribed inside ΔLMN. A and B are the points of tangency.** **[1]**



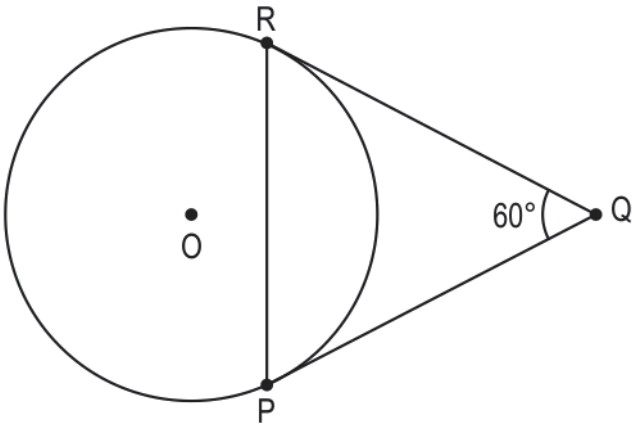
(Note: The figure is not to scale.)

Find ∠ANB. Show your steps.

Q: 11 **A point is 25 cm from the centre of a circle of radius 15 cm.** **[1]**

Find the length of the tangent from the point to the circle. Show your steps.

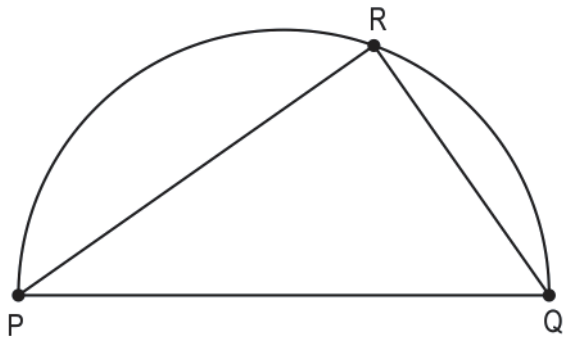
Q: 12 **In the figure below, PQ and RQ are tangents to the circle with centre O and radius 6√3 cm.** **[5]**



(Note: The figure is not to scale.)

i) Prove that ΔPQR is an equilateral triangle.
ii) Find the length of RP. Show your steps along with a diagram and give valid reasons.

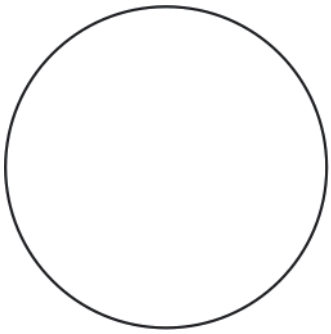
Q: 13 **Shown below is a ΔPQR inscribed in a semicircle.** **[2]**



A circle is drawn such that QR is a tangent to it at the point R.

How many such circles can be drawn? Justify your answer.

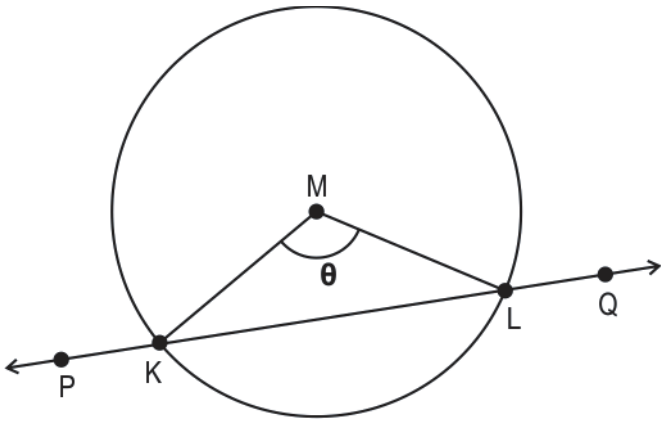
Q: 14 **Shown below is a circle whose centre is unknown.** **[3]**



State true or false for the statements below and give valid reasons.

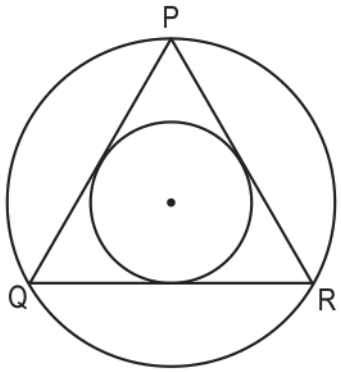
i) The centre of the circle can be found using any 2 tangents.
ii) The centre of the circle can be found using any 2 chords.

Q: 15 **Shown below is a circle with centre M. PQ is a secant and ∠KML = θ.** **[2]**



i) Show that, when θ = 0°, PQ becomes a tangent to the circle.
ii) What is the point of contact of the tangent in part i) with the circle?

Q: 16 **In the figure below, O is the centre of two concentric circles. ΔPQR is an equilateral triangle such that its vertices and sides touch the bigger and smaller circles respectively. The difference between the area of the bigger circle and the smaller circle is 616 cm^2.** **[5]**



(Note: The figure is not to scale.)

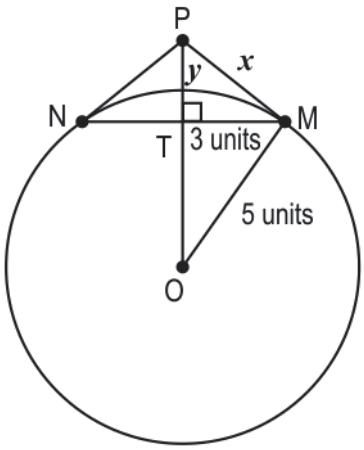
Find the perimeter of ΔPQR. Draw a rough diagram, show your work and give reasons.

(Note: Take π as $\frac{22}{7}$.)

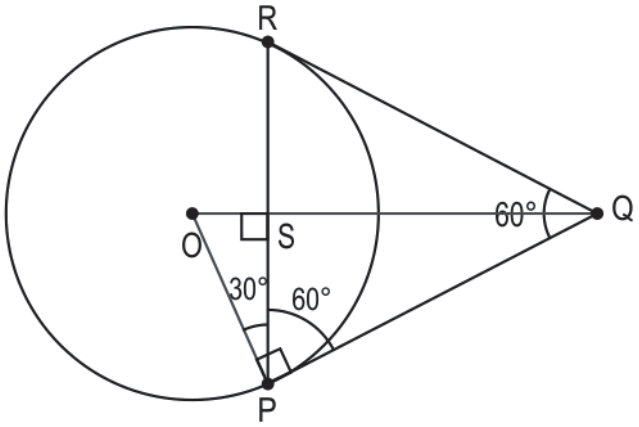
The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	3
2	2
3	3

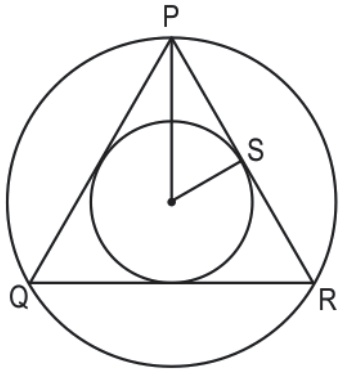
Q.No	Teacher should award marks if students have done the following:	Marks
4	Finds the angle as 65°.	0.5
	Explains that ∠QOS is 130° and ∠QRS=130/2 = 65°.	0.5
5	Assumes the base angles of ΔQOR as θ each as angles opposite equal sides are equal.	1
	Writes that ∠PRQ and ∠PQR are (90 - θ)° each as radius of a circle is perpendicular to the tangents.	1
	Writes that in ΔQPR, PQ and PR are equal as sides opposite to equal angles in a triangle are equal.	1
6	Writes that OE = OD (radii of the same circle) and CE = OD (given). Finds the length of OC as 2OD.	0.5
	Writes that as CD is tangent to the circle, OD ⊥ CD and applies Pythagoras' theorem in ΔODC to find the length of CD as: $OC^2 = CD^2 + OD^2$ $\Rightarrow CD^2 = OC^2 - OD^2 = 4\times OD^2 - OD^2$ $\Rightarrow CD^2 = 3 \times OD^2$	1
	Finds the area of the circle as $\pi\times OD^2$ sq units.	0.5
	Finds the area of the square as $3\times OD^2$ sq units, using step 2. (Award 1.5 marks if the student has combined steps 2 and 4 together).	0.5
	Finds the ratio of the areas as Area(circle):Area(square) = π:3	0.5
7	Writes that sum of angles on a straight line is 180° and finds the measure of ∠ACP as 110°.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Writes that sum of angles in a triangle is 180° and finds the measure of ∠CAP as 40°.	0.5
	Writes that ∠OAP = 90° since PA is tangent to the circle and finds the measure of ∠OAC as 50°.	0.5
	Joins OC. Writes that ΔOAC is isosceles and finds the measure of ∠OCA as 50°.	0.5
	Finds the measure of ∠OCB as 20°.	0.5
	Writes that ΔOCB is isosceles and finds the measure of ∠OBC as 20°.	0.5
8	Connects P to O intersecting MN at T. Applies chord properties to conclude that i) PO ⊥ MN ii) MT = NT = 3 units.  	0.5
	Applies Pythagoras' theorem in ΔOTM to find OT as 4 units.	1
	Assumes PM = x units and PT = y units and applies Pythagoras' theorem to find two equations in x and y as From ΔPTM, $x^2 = y^2 + 3^2$ .... (1) From ΔPMO, $(y + 4)^2 = x^2 + 5^2$ .... (2)	1

Q.No	Teacher should award marks if students have done the following:	Marks
	Solves the pair of equations in the previous step to get *y* (PT) as $\frac{9}{4}$ or 2.25 units.	1
	Inputs the value of *y* in one of the equations from step 3 to find the value of *x* (PM) as $\frac{15}{4}$ or 3.75 units.	1
	Applies tangent property from external point to conclude that PM = PN and finds PM + PN as $\frac{30}{4}$ or 7.5 units.	0.5
9	Writes that RQ = RS = 17 cm and gives the reason that the lengths of tangents drawn from an external point to a circle are equal.	0.5
	Finds the length of PQ = 36 - 17 = 19 cm.	0.5
	Writes that PQ = PW = 19 cm and gives the reason that the lengths of tangents drawn from an external point to a circle are equal.	0.5
	Finds the length of VW = 34 - 19 = 15 cm.	0.5
	Writes that ∠VWO = ∠VUO = 90° and gives the reason that the tangent at any point of a circle is perpendicular to the radius through the point of contact.	1
	Uses above step and ∠WVO = 90° (given), to conclude that, VWOU is a square.	0.5
	Concludes that the radius of the circle, UO = VW = 15 cm.	0.5
	Finds the area of the shaded region, the semi circle as $\frac{1}{2} \times \pi \times 15 \times 15 = 112.5\pi$ cm^2 .	1
10	Finds minor ∠AOB as 360° - 260° = 100°.	0.5
	Finds ∠ANB as 360° - (90° + 90° + 100°) = 80°.	0.5
11	Finds the length of the tangent as $\sqrt{(25^2 - 15^2)}$ = 20 cm.	1
12	i) Writes that PQ = RQ and gives the reason that the lengths of tangents drawn from an external point to a circle are equal.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Uses the above step and the angle sum property in ΔPQR to find ∠RPQ = ∠PRQ = 60°. **Concludes that ΔPQR is an equilateral triangle as all the angles are equal to 60°.**	**0.5**
	ii) Joins OP and OQ and writes that ∠OPQ = 90°. The figure may look as follows:  ***(Note: The figure is not to scale.)***	**1**
	Finds ∠OPS as ∠OPQ - ∠SPQ = 90° - 60° = 30°.	**0.5**
	Writes that ∠OQP = 30° and gives the reason that the centre of a circle lies on the bisector of the angle between the two tangents.	**0.5**
	Uses the angle sum property in ΔOPQ to find ∠POQ as 60°. **Uses the angle sum property in ΔOPS to find ∠OSP as 90°.**	**1**
	Uses the sine ratio in ΔOPS to find the length of PS as: **sin 60° = $\frac{PS}{PO}$** **⇒ PS = 9 cm** **Writes that RS = PS = 9 cm and gives the reason that the perpendicular from the centre of a circle to a chord bisects the chord.**	**0.5**

Q.No	Teacher should award marks if students have done the following:	Marks
	Finds the length of RP as RS + PS = 9 + 9 = 18 cm.	0.5
13	Writes that infinite such circles can be drawn.	0.5
	Justifies the answer. For example, writes that ∠PRQ = 90° because it is the angle in a semicircle. Also, writes that the radius is perpendicular to the tangent at the point of contact. Concludes that infinite circles with their radii lying on extended PR and R being a point on the circumference of the circle can be drawn.	1.5
14	i) Writes true.	0.5
	Gives a reason. For example, drawing 90° angles at the points of contact of the 2 tangents and extending perpendicular lines to meet at a point gives the centre of the circle.	1
	ii) Writes true.	0.5
	Gives a reason. For example, drawing the perpendicular bisectors of the 2 chords and extending them to meet at a point gives the centre of the circle.	1
15	i) Writes that ΔKLM is an isosceles triangle and finds the measures of ∠KLM = ∠LKM = $\frac{180°-\theta}{2}$ = 90° - $\frac{\theta}{2}$.	0.5
	Writes that angles on a straight line are supplementary and finds the measures of ∠PKM = ∠QLM = 180° - (90° - $\frac{\theta}{2}$) = 90° + $\frac{\theta}{2}$.	0.5
	Writes that, when θ = 0°, KM and LM coincide and ∠PKM = ∠QLM = 90°. Hence, concludes that PQ becomes a tangent to the circle.	0.5
	ii) Writes the point of contact of the tangent in part i) with the circle as K or L.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
16	Joins OP and OS to make ΔOPS. The figure may look as follows:  *(Note: The figure is not to scale.)*	1
	Writes that, since OP and OS are the radii of the bigger and smaller circles respectively, $\pi OP^2 - \pi OS^2 = 616\ cm^2$.	0.5
	Finds the value of $(OP^2 - OS^2)$ as $196\ cm^2$.	0.5
	Writes that ΔOPS is a right-angled triangle because the tangent at any point on a circle is perpendicular to the radius at the point of contact.	0.5
	Writes that, in right-angled ΔOPS, $PS^2 = OP^2 - OS^2 = 196\ cm^2$	0.5
	Finds the length of PS as 14 cm.	0.5
	Writes that, since PR is the chord of the bigger circle and OS ⊥ PR, PR = 2× PS because the perpendicular from the centre of a circle to a chord bisects the chord and finds the measure of PR as 2 × 14 = 28 cm.	1
	Finds the perimeter of ΔPQR as 3 × 28 = 84 cm.	0.5

Chapter - 11
Constructions

Q: 1 **Sirisha is posed with the following four construction problems.**

Problem 1: Construct an equilateral ΔABC with AB = 3 cm.
Problem 2: Construct a parallelogram MNOP with MN = 2 cm, ∠M = 60° and MP = 4 cm.
Problem 3: Construct a right-angle triangle ΔXYZ with ∠Y = 90° and XY = 3 cm.
Problem 4: Construct a square PQRS with diagonal PR = 4 cm.

Which of these have sufficient information for Sirisha to construct a UNIQUE geometrical figure?

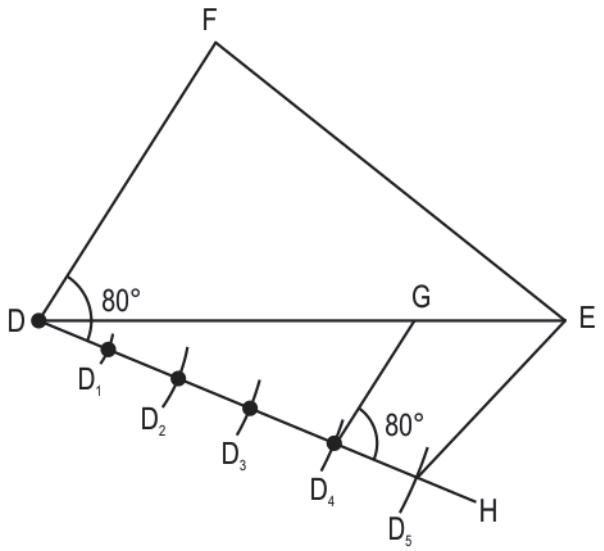
1 only 1 and 4
2 only 2 and 3
3 only 1, 2 and 4
4 all - 1, 2, 3 and 4

Q: 2 **Construct a ΔABC, right-angled at C and AC = 3.5 cm, that can be inscribed in a circle of radius 4 cm. Show your steps and give valid reasons.** **[3]**

(Note: The construction of a circle is not needed.)

Q: 3 **Usha was asked to construct a triangle, ΔDGF', similar to ΔDEF with sides equal to $\frac{4}{5}$ of the corresponding sides of ΔDEF.** **[1]**

Shown below are the first four steps she followed during construction.



Step 1: Draws a line DH which makes an acute angle with the side DE.

Step 2: Locates 5 points D_1, D_2, D_3, D_4, and D_5 on DH such that $DD_1 = D_1D_2 = D_2D_3 = D_3D_4 = D_4D_5$.

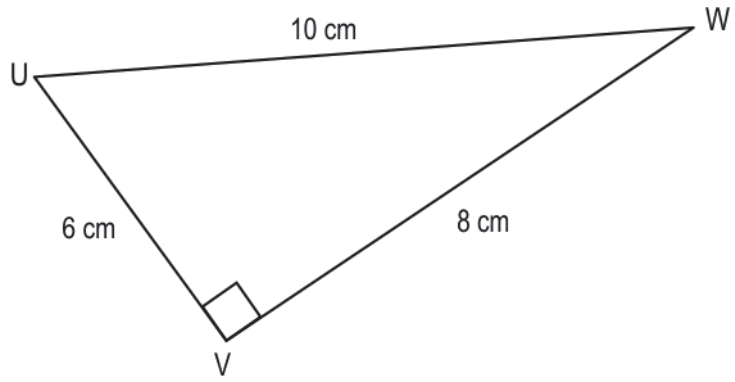
Step 3: Joins ED_5.

Step 4: Draws GD_4 parallel to FD.

(Note: The figure is not to scale.)

Is Usha's approach correct? If yes, what should be her next step? If no, what is her mistake?

Q: 4 **In one of the geometry classes, the teacher drew the following triangle on the board.** **[1]**



(Note: The figure is not to scale.)

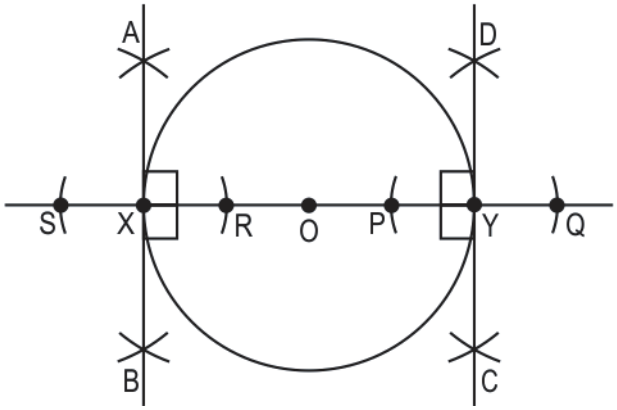
She then asked the students to draw the LARGEST circle such that:
i) the centre of the circle coincides with one of the vertices of ΔUVW and
ii) one of the sides of ΔUVW is a tangent to the circle.

What should be the centre and radius of the circle?

Q: 5 **A circle has a diameter XY.** **[2]**

Construct a tangent at point Y. Use a ruler and compass.

Q: 6 **Prasoon wanted to construct a square that is circumscribing a circle with centre O. He draws two tangents at the end of diameter, XY using perpendicular bisectors as shown below.** **[1]**

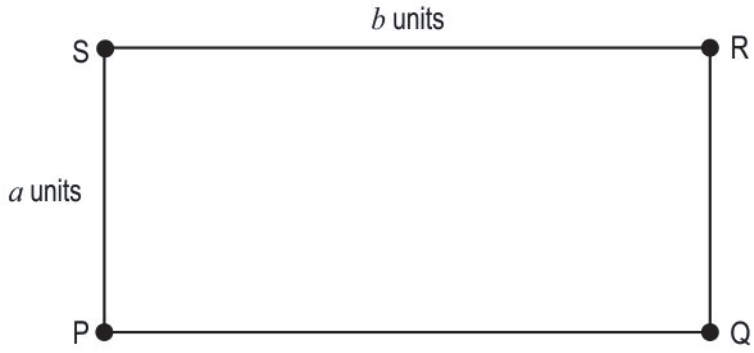


What are the next steps Prasoon needs to take to complete the square?

Q: 7 **Two circles are such that the centre of each lies on the circumference of the other circle.** **[2]**

Construct two tangents to these circles such that the perpendicular distance between the two tangents is equal to the distance between the two centres. Use only a ruler and compass.

Q: 8 **Shown below is a rectangle PQRS with *a* units as the breadth and *b* units as the length.** **[3]**



Construct a rectangle PXYZ such that PZ = $\frac{a}{2}$ units and PX = $\frac{3b}{5}$ units where X is on PQ and Z is on PS. Use a ruler and compass only.

Q: 9 **Two friends, Ketaki and Priyam, were discussing about the common tangents to circles.** **[3]**

Ketaki said, "Only 2 circles can have a common tangent."
Priyam said, "Any number of circles can have a common tangent."

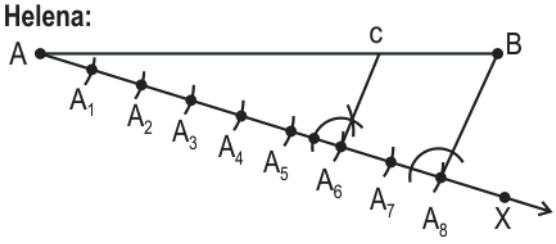
Who is right? Justify your answer with a construction.

Q: 10 **Two tangents drawn from an external point to a circle are 5 cm in length and at an angle of 105°.** **[3]**

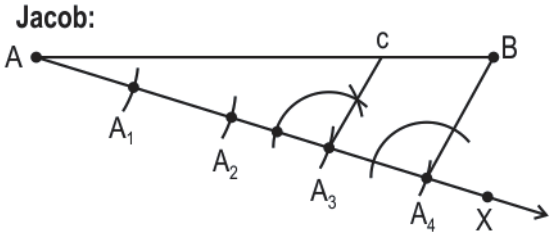
Find the radius of the circle. Use a ruler and compass only.

Q: 11 **A teacher asked her students to divide a straight line, AB, in the ratio 6:2 using a compass and ruler. Two students' solutions are shown below.** **[1]**

Helena:



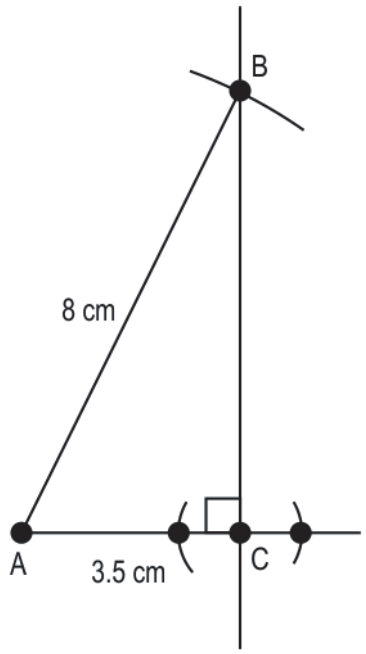
Jacob:

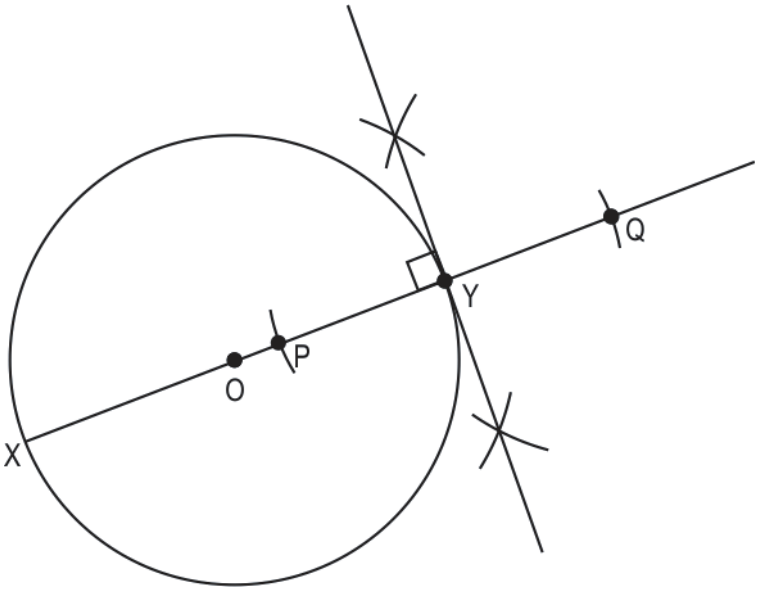


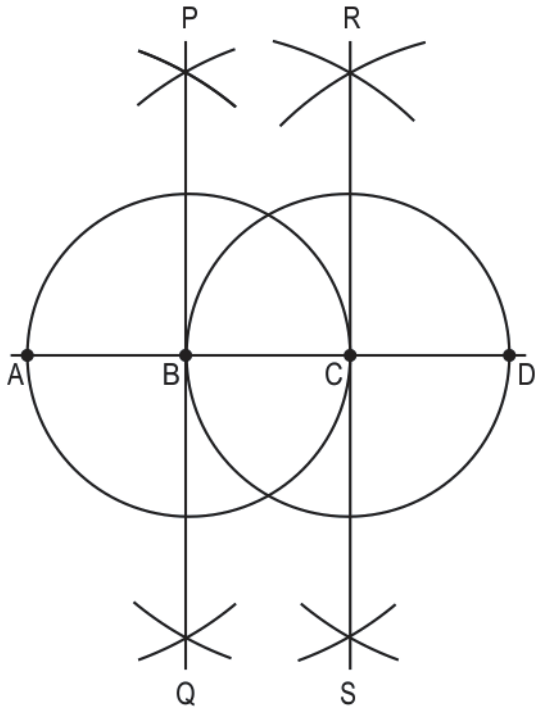
Whose solution is correct? Give a valid reason for your answer.

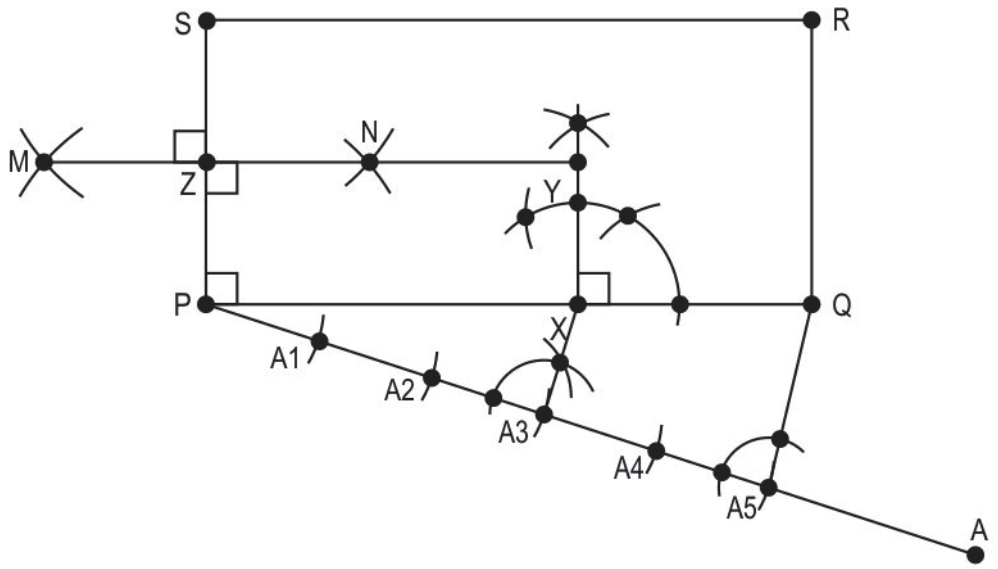
The table below gives the correct answer for each multiple-choice question in this test.

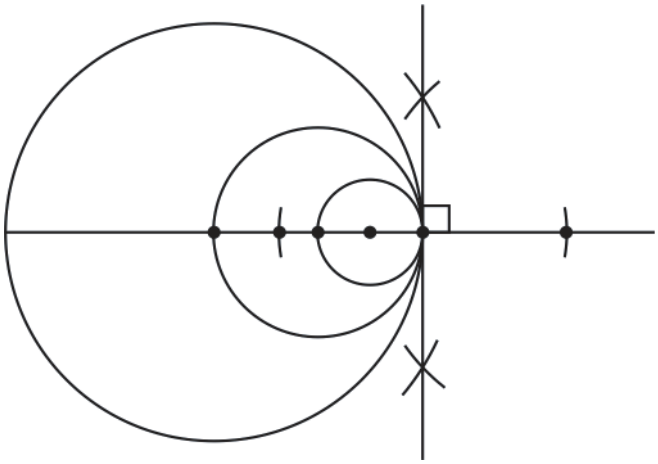
Q.No	Correct Answers
1	3

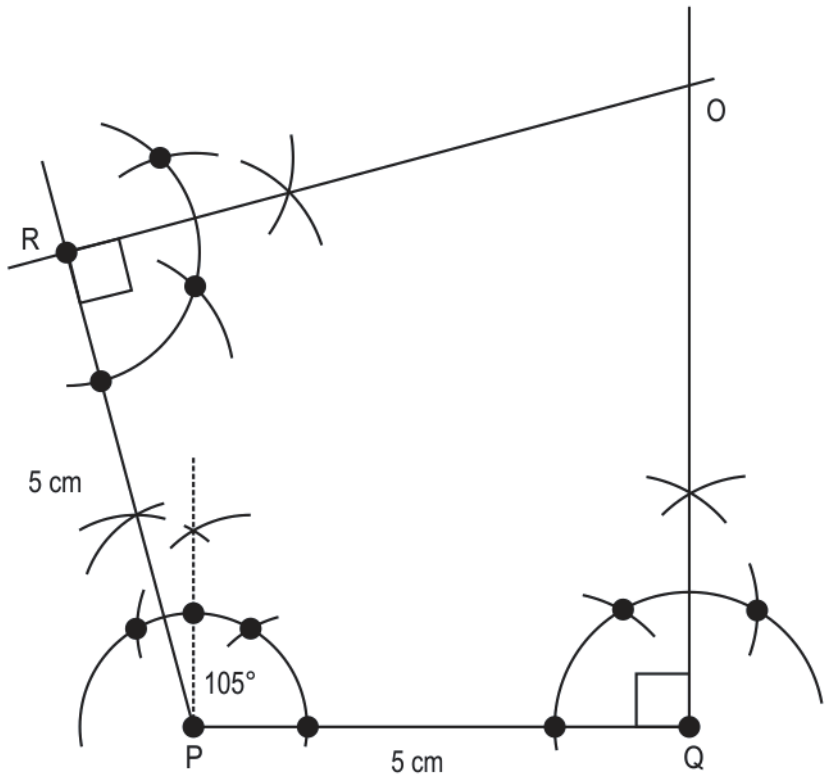
Q.No	Teacher should award marks if students have done the following:	Marks
2	Constructs AC = 3.5 cm.	0.5
	Constructs a perpendicular at point C.	0.5
	Writes that hypotenuse AB = 8 cm because, for every right-angled triangle in a circle, the hypotenuse is equal to the diameter.	1
	With A as the centre, construct an arc with a length of 8 cm intersecting the perpendicular from step 3 at B.	0.5
	Connects AB to complete the triangle.	0.5
	The construction may look as follows:  (Award full marks for the question if the method is correct but measurements are off by +/- 0.1 cm.)	0
3	Writes that Usha's approach is not correct.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Writes that Usha has drawn D_4G parallel to DF instead of drawing it parallel to D_5E. This has resulted in DG not being $\frac{4}{5}$ of DE. (Award full marks for any equivalent explanation.)	0.5
4	Writes that the centre of the circle should be the vertex W.	0.5
	Writes that the radius of the circle should be 8 cm.	0.5
5	Draws a circle with centre O, diameter XY and cuts two equal arcs, say P and Q, from point Y.	1
	Constructs the perpendicular bisector of PQ that passes through point Y.	1
	The construction may look as follows:  	0
6	Writes that Prasoon needs to draw another diameter that is perpendicular to XY, say EF.	0.5
	Writes that the next step to be followed by Prasoon is to construct tangents at E and F respectively using perpendicular bisectors.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
7	Constructs two circles with centres, say B and C, such that the centre of each lies on the circumference of the other circle, where both circles have the same radii.	0.5
	Uses perpendicular bisectors to: ♦ construct a tangent at B for the circle with centre C. ♦ constructs a tangent at C for the circle with centre B.	1.5
	The construction may look as follows:  	0
8	Draws the given rectangle PQRS. Draws a line PA making an acute angle with PQ. Marks 5 arcs having an equal radius on PA. Joins A_5 to Q and draws a line parallel to A_5 Q from A_3. Marks the point dividing PQ as X to get PX:PQ = 3:5.	1.5
	Constructs the perpendicular bisector of PS, say MN, and marks the mid-point as Z.	0.5

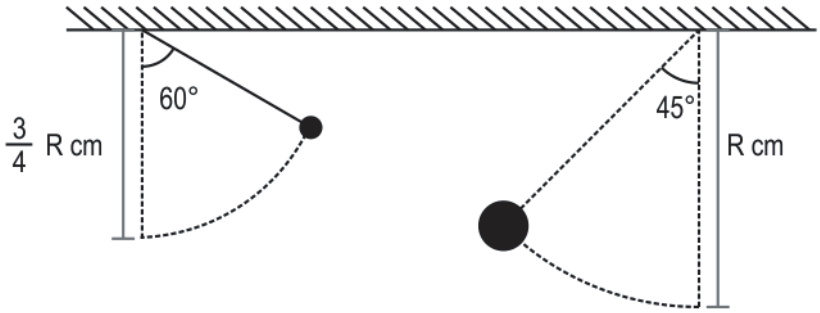
Q.No	Teacher should award marks if students have done the following:	Marks
	Draws a 90° angle at X and extends MN to mark the point of intersection as Y.	1
	The final construction may look as follows: 	0
9	Writes that Priyam is right.	0.5
	Draws 3 circles such that they have one common point of contact.	1
	Draws a tangent at the common point of contact.	1

Q.No	Teacher should award marks if students have done the following:	Marks
	The construction may look as follows: 	0
	Writes that, similarly, any number of such circles can be drawn with a common tangent.	0.5
10	Draws a tangent PQ of length 5 cm.	0.5
	Draws an angle of 105° at P and draws the other tangent PR of length 5 cm.	1
	Draws an angle of 90° at Q and R and extends the lines to meet at O.	1
	Measures OQ and OR to find the radius of the circle as 5.9 cm. (Award full marks if radius is 5.9 ± 0.1 cm.)	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	The construction may look as follows:  	**0**
11	**Writes that both students' solution is correct and gives a valid reason. For example, 6:2 is equivalent to 3:1 and hence, the line can either be divided into 8 equal parts or 4 equal parts.**	**1**

Chapter - 12
Areas Related to Circle

Q: 1 **Shown below are two pendulums of different lengths attached to a bar.**



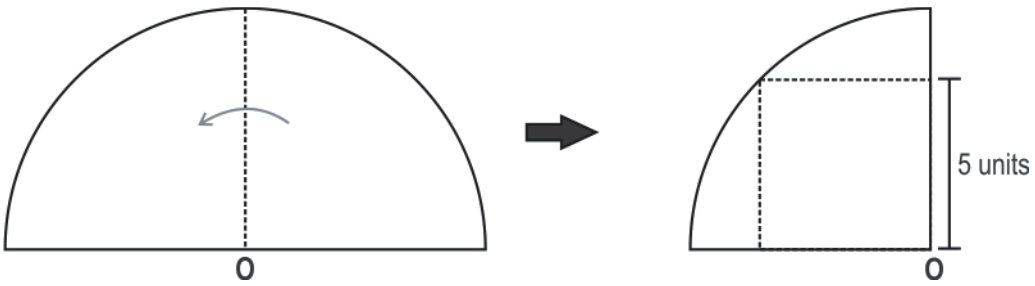
Pendulum 1 Pendulum 2

(Note: The figure is not to scale.)

Based on the figure shown above, the arc length of pendulum 1 is _____ the arc length of pendulum 2.

1 greater than
2 lesser than
3 equal to
4 (cannot be answered without knowing the value of R.)

Q: 2 **Shown below is a semicircular sheet of paper with centre O which is folded in half. A square of length 5 units is cut from it.**

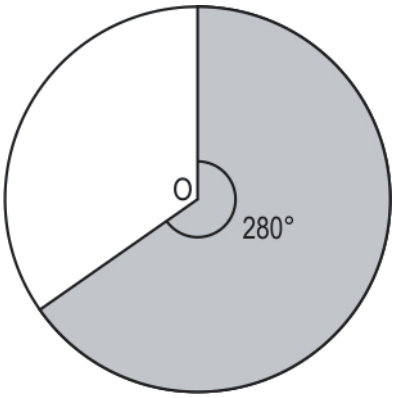


(Note: The figures are not to scale.)

What is the area of paper left?

1 25(π - 1) sq units
2 25(π - 2) sq units
3 25(2π - 2) sq units
4 25($\frac{1}{2}$ π - 1) sq units

Q: 3 **Shown below is a circle with centre O. The shaded sector has an angle of 280° and area A cm^2.**



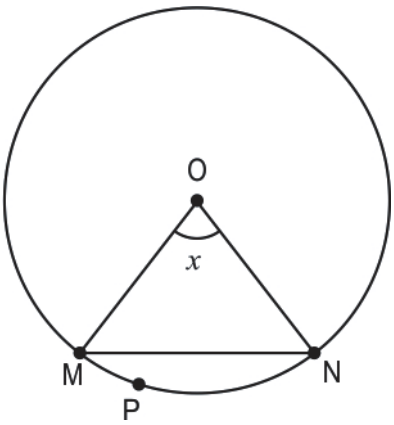
(Note: The figure is not to scale.)

Which of these is the area of the UNSHADED sector?

1 $\frac{2}{7}$ A cm^2 **2** $\frac{1}{3}$ A cm^2

3 $\frac{2}{3}$ A cm^2 **4** $\frac{7}{9}$ A cm^2

Q: 4 **Shown below is a circle with centre O. Chord MN subtends an angle at O.**



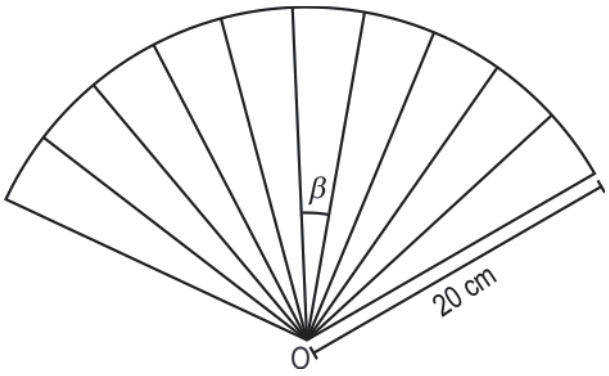
Which of these is true for the above circle?

I. $\frac{x}{360°} = \frac{\text{length of arc MPN}}{\text{circumference of the circle}}$

II. $\frac{x}{360°} = \frac{\text{minor sector area}}{\text{area of the circle}}$

1 only I **2** only II **3** both I and II **4** neither I nor II

Q: 5 **The figure below is a part of a circle with centre O. Its area is $\frac{1250\pi}{9}$ cm^2 and the 10 sectors are identical.** **[2]**



(Note: The figure is not to scale.)

Find the value of β, in degrees. Show your steps.

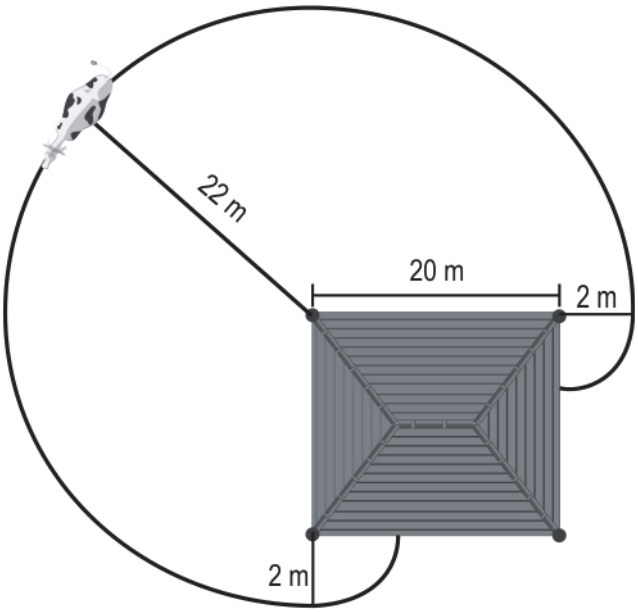
Q: 6 **Avikant bought a pair of glasses with wiper blades. He was curious to know the area being cleaned by each of the wiper blades. With the help of a ruler and a protractor, he found the length of each blade as 3 cm and the angle swept as 60°.** **[2]**

(Note: The figure is for visual representation only.)

i) Find the area that each wiper cleans in one swipe, in terms of π.
ii) If the diameter of each circular glass is 5 cm, what percent of the area of the glass will be cleaned by the blade in one swipe?

Show your work.

Q: 7 **A cow is tied at one of the corners of a square shed. The length of the rope is 22 m. The cow can only eat the grass outside the shed as shown below.** **[3]**



(Note: The figure is not to scale.)

What is the area that the cow can graze on? Show your steps.

(Note: Give the answer in terms of π.)

Q: 8 **A circle has radius 5 cm. Three chords of lengths 6 cm, 8 cm and 10 cm are drawn.** **[1]**

Which chord subtends the largest angle on its minor arc?

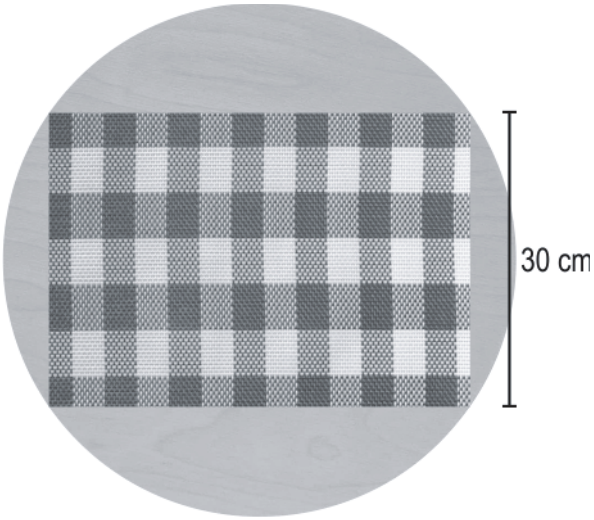
Q: 9 **Ramit drew two circles of different radii. Each of them had an arc that subtended an equal angle at the centre.** **[2]**

He said, "Both arcs are of the same length".

i) Is Ramit right?
ii) If both radii and angles subtended by the two arcs are different, can the arc lengths be the same?

Give valid reasons.

Q: 10 **Sneha had a rectangular tablecloth with one side measuring 30 cm which she wanted to keep on her circular table of radius 25 cm. After keeping it on the table, she realised that the corners of the tablecloth just touched the edge of the circular table as shown in the figure.** **[3]**

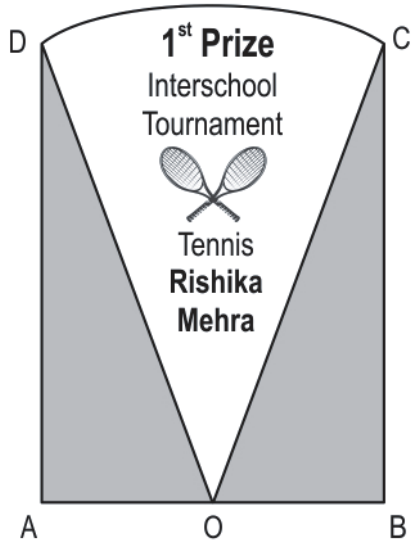


(Note: The figure is not to scale.)

Find the area of the table not covered by the tablecloth. Show your steps with valid reasons.

(Note: Use π = 3.14.)

Q: 11 **Shown below is the trophy shield Rishika received on winning an interschool tennis tournament.** **[5]**



(Note: The figure is not to scale.)

The trophy is made of a glass sector DOC supported by identical wooden right triangles, ΔDAO and ΔCOB. AO = 7 cm and AO:DA = 1:√3.

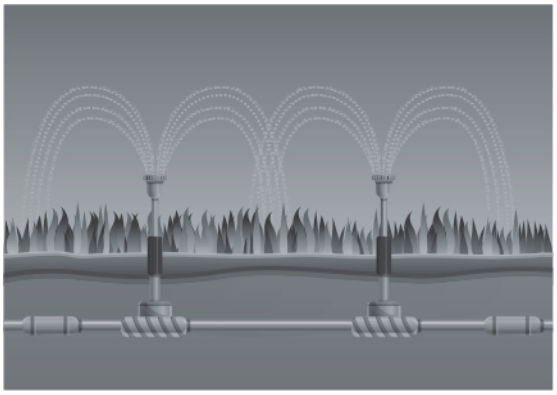
Find the area of:
i) the glass sector correct to 2 decimal places.
ii) the wooden triangles correct to 2 decimal places.

Show your steps.

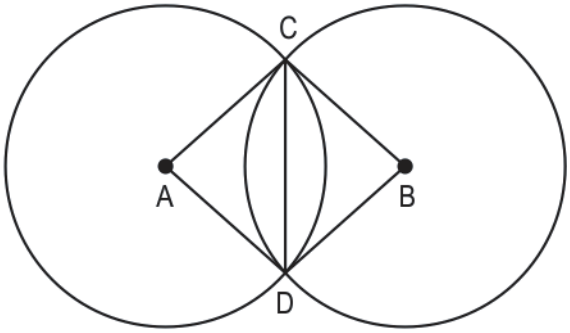
(Note: Take π as $\frac{22}{7}$ and √3 as 1.73.)

Q: 12 **Sprinklers are crop irrigation equipment which rotate around a center and spay water on the crops in the circular region.** **[3]**

Two such high power sprinklers, occupying negligible area are installed in a straight line in a field such that they spray water on an common area. Shown below are the side and top views where points A and B are the sprinklers.



Side view of the sprinklers



Top view of the region sprayed

(Note: The figures are not to scale.)

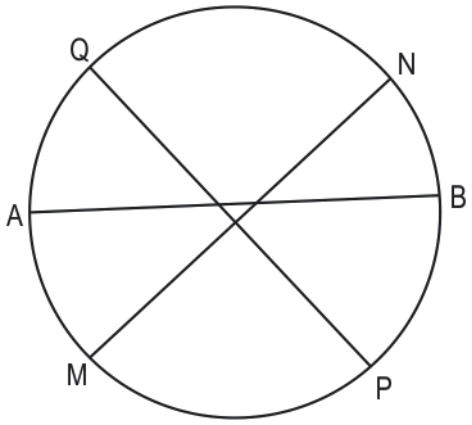
Both the sprinklers spray over an equal area. It is given that, CD = 400 m and ∠CAD = ∠CBD = 90°.

i) Find the radius of the circular region sprayed by the sprinkler.
ii) Find the area of the overlapping region.

Show your work.

(Note: Use π = 3.14.)

Q: 13 **Shown below is a circle with multiple chords. One of the chords is the diameter of the circle.** **[3]**

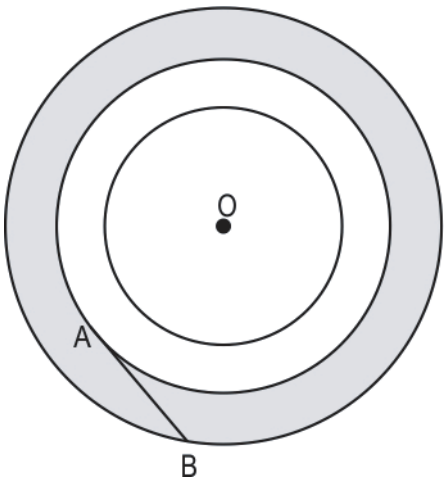


AB = 13.9 cm
MN = 14 cm
PQ = 14.1 cm

(Note: The figure is not to scale.)

Find the measure of the angle subtended by a 4.7π cm arc at the circumference of the circle. Show your work and give valid reasons.

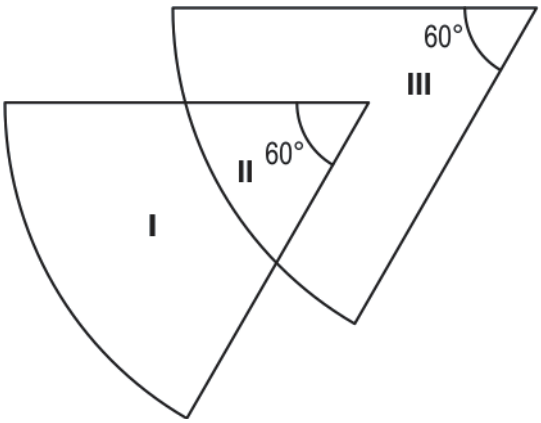
Q: 14 **Shown below are 3 concentric circles with centre O. The tangent to the second circle, AB, has a length of 5 cm.** **[2]**



(Note: The figure is not to scale.)

Find the area of the shaded region in terms of π. Draw a rough figure and show your work.

Q: 15 **Shown below are two overlapping sectors of a circle. The radii of the sectors are 6 cm and 8 cm. The figure is divided into three regions - I, II and III.** **[2]**



(Note: The figure is not to scale.)

Find the difference in the areas of regions I and III. Show your work.

(Note: Take π = $\frac{22}{7}$.)

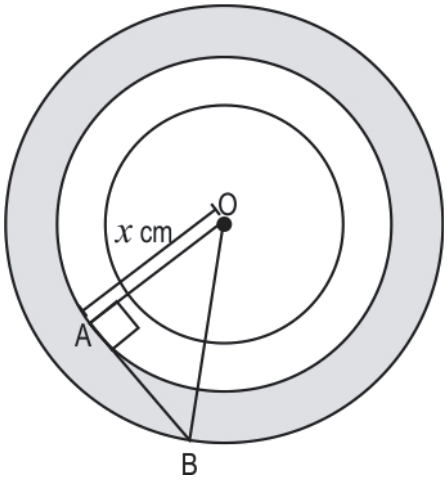
The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	3
2	2
3	1
4	3

Q.No	Teacher should award marks if students have done the following:	Marks
5	Equates the area occupied by the figure to the area of a sector as: $\frac{1250\pi}{9} = \frac{\theta}{360} \times \pi \times 20^2$ where, θ is the angle of the entire sector in degrees.	0.5
	Solves the above equation to find the value of θ as 125°.	1
	Finds the value of β as $\frac{125}{10} = 12.5°$.	0.5
6	i) Finds the area that each wiper cleans in one swipe as $\frac{60°}{360°} \times \pi \times (3)^2 = \frac{3}{2}\pi$ or 1.5π cm^2. (Award 0.5 marks if only the formula for area of a sector is correctly written.)	1
	ii) Finds the area of the glass as $\pi \times \frac{5}{2} \times \frac{5}{2} = \frac{25\pi}{4}$ cm^2.	0.5
	Finds the percentage of the area cleaned by the wiper blade in one swipe as $\frac{1.5\pi \times 4}{25\pi} \times 100 = 24\%$.	0.5
7	Writes the total area as: Total area = (3 quarters sector with radius 22 m) + (2 × one-quarter sector with radius 2 m)	1
	Finds the total area as: Total area = $(\frac{3}{4} \times \pi \times 22^2) + (2 \times \frac{1}{4} \times \pi \times 2^2)$ => Total area = $363\pi + 2\pi = 365\pi$ m^2	2
8	Writes that the chord of length 6 cm subtends the largest angle on its minor arc.	1
9	i) Writes that Ramit is not right and gives a reason. For example, two arcs are not of the same length as arc length is directly proportional to the radius of the circle which is different.	1

Q.No	Teacher should award marks if students have done the following:	Marks
	ii) Writes that the arc lengths can be the same and gives a reason. For example, if the product of the measure of the angle and the radius is the same for both circles, then arc lengths will be the same.	1
10	Writes that since ABCD is a rectangle, the diagonal of the tablecloth will be equal to the diameter of the circular table, which is 50 cm.	0.5
	Uses Pythagoras theorem to find the measure of the other side of the tablecloth as $\sqrt{(50^2 - 30^2)} = 40$ cm.	1
	Finds the area of the table as $3.14 \times (25)^2 = 1962.5$ cm^2.	0.5
	Finds the area of the tablecloth as $30 \times 40 = 1200$ cm^2.	0.5
	Finds the area not covered by the tablecloth as area of the table - area of the tablecloth = $1962.5 - 1200 = 762.5$ cm^2.	0.5
11	In ΔDOA, assumes ∠DOA as θ and writes that $\tan\theta = \frac{DA}{AO} = \frac{\sqrt{3}}{1}$.	0.5
	Finds the value of θ as 60°.	0.5
	Writes that ∠DOA = ∠COB = 60° and finds the measure of ∠DOC as 180 - (60 + 60) = 60°.	1
	Writes that $\frac{AO}{DO} = \cos 60°$ and finds the length of DO as 14 cm. (Award full marks if Pythagoras' theorem is used to correctly find the length of DO.)	1
	i) Finds the area of the sector as $\frac{60}{360} \times \frac{22}{7} \times 14^2 = 102.67$ cm^2.	1
	ii) Finds the area of the wooden triangles as $\frac{1}{2} \times 7 \times 7\sqrt{3} \times 2 = 84.77$ cm^2.	1
12	i) Uses Pythagoras Theorem in ΔACD to find the length of the AC as: $CD^2 = AC^2 + AD^2$ $\Rightarrow 160000 = 2AC^2$ $\Rightarrow 200\sqrt{2} = AC$	1

Q.No	Teacher should award marks if students have done the following:	Marks
	ii) Finds area of sector CAD = area of sector CBD = $\frac{90}{360} \times 3.14 \times (200\sqrt{2})^2 = 62800$ m^2.	1
	Finds the area of ΔCAD = area of ΔCBD = $\frac{1}{2} \times 200\sqrt{2} \times 200\sqrt{2} = 40000$ m^2.	0.5
	Writes that area of the overlapping region = 62800 + 62800 - 40000 - 40000 = 45600 m^2.	0.5
13	Writes that, since the diameter of a circle is the longest chord, the diameter of the given circle is 14.1 cm	0.5
	Assumes the measure of the angle subtended by a 4.7π cm arc at the centre as θ and writes the equation as: $\frac{\theta}{360} \times 2 \times \pi \times \frac{14.1}{2} = 4.7\pi$	1
	Solves the above equation to find the measure of θ as 120°.	0.5
	Writes that, the angle subtended by an arc at the centre is double the angle subtended by it at any point on the remaining part of the circle, and finds the measure of the angle subtended by the arc at the circumference of the circle as $\frac{1}{2} \times 120° = 60°$.	1

Q.No	Teacher should award marks if students have done the following:	Marks
14	Joins OA and OB to make ΔOAB and assumes the radius of the second circle as x cm. The figure may look as follows:  *(Note: The figure is not to scale.)*	0.5
	Uses Pythagoras' theorem to find the length of OB as $\sqrt{(x^2 + 25)}$ cm.	0.5
	Finds the area of the second circle as πx^2 cm^2 and the area of the largest circle as $\pi(x^2 + 25)$ cm^2.	0.5
	Finds the area of the shaded region as $\pi(x^2 + 25) - \pi x^2 = 25\pi$ cm^2.	0.5
15	Finds the area of the 8 cm sector as $\frac{60}{360} \times \pi \times 8^2 = \frac{64\pi}{6}$ cm^2.	0.5
	Finds the area of the 6 cm sector as $\frac{60}{360} \times \pi \times 6^2 = \frac{36\pi}{6}$ cm^2.	0.5
	Finds the difference in the areas of regions I and III as area of (I + II) - area of (II + III) = $\frac{28}{6} \times \frac{22}{7} = \frac{44}{3}$ cm^2.	1

Chapter - 13
Surface Areas and Volumes

Q: 1 **Figure 1 below is a solid cuboid made of unit cubes. Figure 2 is obtained after removing some unit cubes from figure 1.**

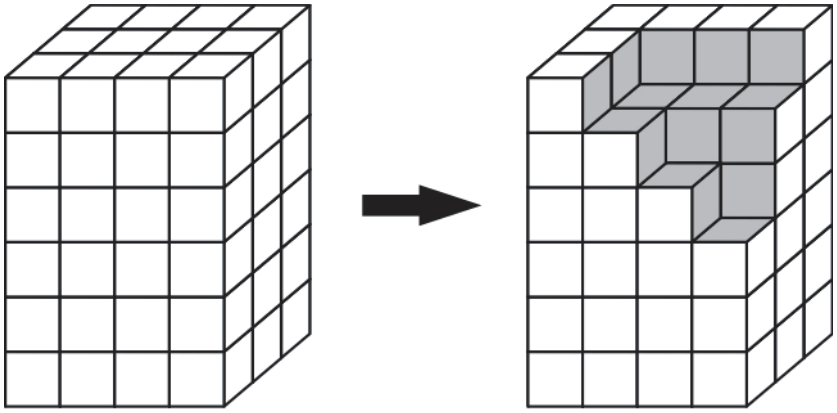


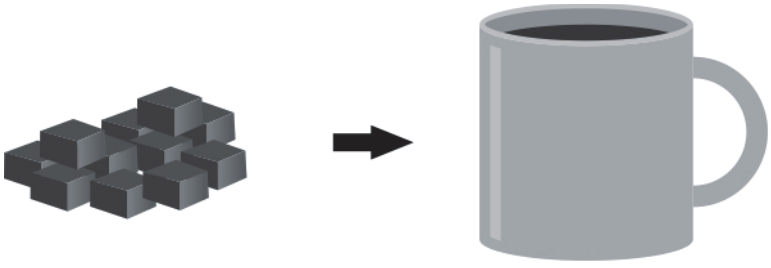
Figure 1 Figure 2

(Note: The figures are not to scale.)

Based on the figures shown above, the surface area of the cuboid in Figure 1 is _____ the surface area of the solid in Figure 2.

1. less than
2. more than
3. equal to
4. (cannot be concluded with the given information)

Q: 2 **Anishka melted 11 chocolate cubes in a cylindrical cup as shown.**



(Note: The figures are not to scale.)

If the length of the side of each cube is *k* cm and the radius of the cup is *r* cm, which of these represents the height of the melted chocolate in the cup?

(Note: Take π = $\frac{22}{7}$.)

1. $\frac{7k^3}{4r}$ cm
2. $\frac{7k^3}{2r^2}$ cm
3. $\frac{7k^2}{4r}$ cm
4. $\frac{7k^2}{2r^2}$ cm

Q: 3 **A container with a grey hemispherical lid has radius R cm. In figure 1, it contains water upto a height of R cm. It is then inverted as shown in figure 2.**

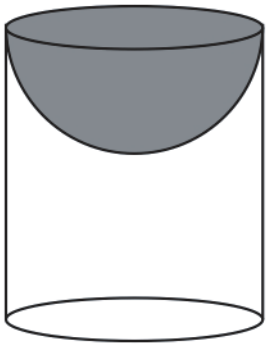


Figure 1

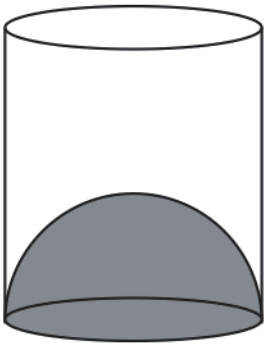


Figure 2

What is the height of water in figure 2?

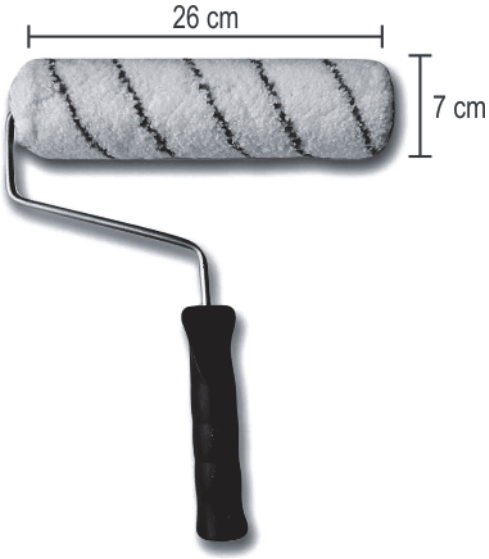
1 R cm

2 $\frac{5R}{3}$ cm

3 2R cm

4 $\frac{7R}{3}$ cm

Q: 4 **A paint roller is a paint application tool used for painting large flat surfaces rapidly and efficiently. One such roller is shown below, which is 26 cm long with an outer diameter of 7 cm.** **[2]**

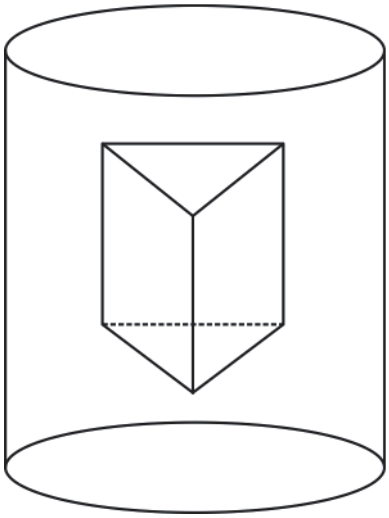


(Note: The figure is not to scale.)

Find the maximum area of the surface that gets painted when the roller makes 6 complete rotations vertically. Show your work.

(Note: Take $\pi = \frac{22}{7}$.)

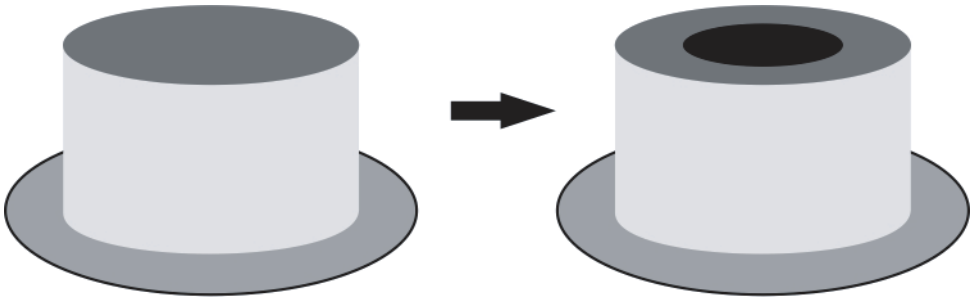
Q: 5 **Shown below is a triangular prism and a cylinder.** **[1]**



On filling the cylinder with water and completely submerging the prism inside the filled cylinder, some water was forced to overflow out of the cylinder. When the prism was removed again, it was noticed that the cylinder had exactly $\frac{3}{5}$ of its water remaining.

If the volume of the cylinder is K litres, what is the volume of the prism? Show your steps and give valid reason.

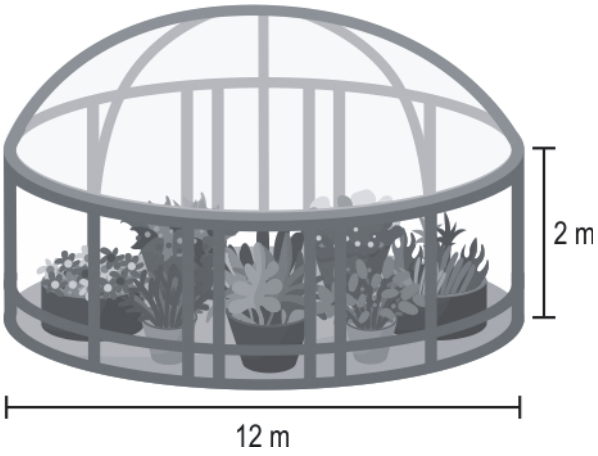
Q: 6 **Shown below is a cake that Subodh is baking for his brother's birthday. The cake is 21 cm tall and has a radius of 15 cm. He wants to surprise his brother by filling gems inside the cake. In order to do that, he removes a cylindrical portion of cake out of the centre as shown. The piece that is removed is 21 cm tall.** **[3]**



If the cake weighs 0.5 g per cubic cm and the weight of the cake that is left after removing the central portion is 6600 g, find the radius of the central portion that is cut. Show your steps.

(Note: Take $\pi = \frac{22}{7}$.)

Q: 7 **Dinesh is building a greenhouse in his farm as shown below. The base of the greenhouse is circular having a diameter of 12 m and it has a hemispherical dome on top.** **[2]**

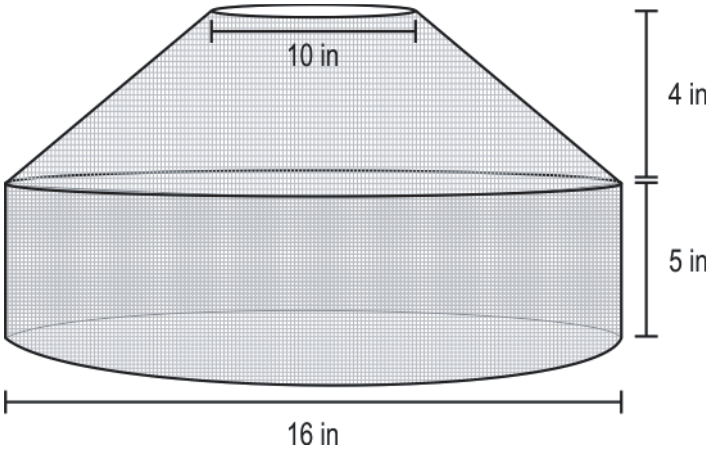


(Note: The image is not to scale.)

How much will it cost him to cover the walls and top of the greenhouse with transparent plastic, if the plastic sheet costs Rs 77 per sq m? Show your steps.

(Note: Take $\pi = \frac{22}{7}$.)

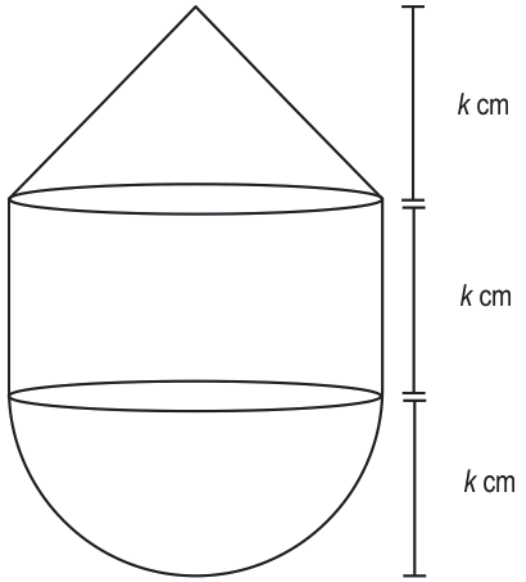
Q: 8 **Shifali made a lampshade using cane web as shown below.** **[3]**



Find the minimum number of sheets of cane web required to make this lamp if each sheet has an area of 44 square inches.

(Note: Take $\pi = \frac{22}{7}$.)

Q: 9 **Shown below is a solid made of a cone, a cylinder and a hemisphere.** **[3]**



(Note: The figure is not to scale.)

Prove that the total volume of the solid is twice the volume of the cylinder.

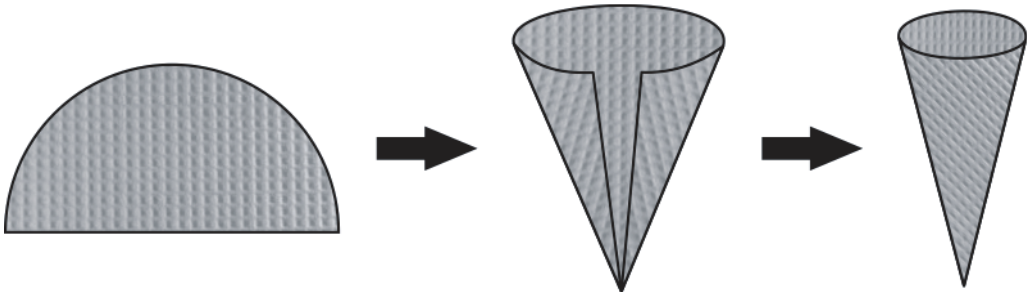
Q: 10 **A cloche is used to cover dishes before serving. Shown below is a hemispherical glass cloche of radius 13 cm. Kanan wants to use it to cover a cylindrical cake of volume 3168 cm^3.** **[2]**

(Note: The figure is not to scale.)

Find one set of values of radius and height of the cake, such that the cloche does not touch the cake when covered. Show your steps.

(Note: Take $\pi = \frac{22}{7}$.)

Q: 11 **A semi-circular waffle sheet of radius 5 cm is folded into an ice-cream cone as shown below.** **[3]**



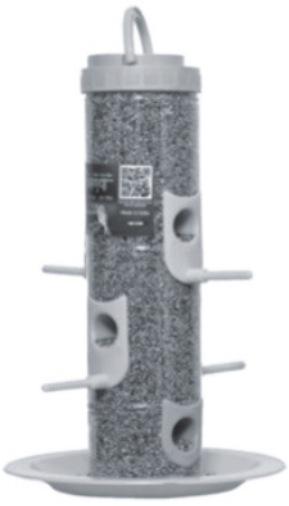
(Note: The figures are not to scale.)

Due to overlap while folding, the radius of the base of the cone is 80% of what it would be without overlap.

Find the approximate volume of the cone. Show your work.

(Note: Take $\pi = \frac{22}{7}$.)

Q: 12 **A bird feeder tube has a diameter of 8 cm and height of 28 cm. The tube has 7 circular openings of 2 cm diameter each for the birds to eat from. The tube can hold a maximum of 3 kg of bird food.** **[5]**



(Note: The image is for visual representation only.)

If the birds eat an average of 75 g of food per hour, what will be the height of the food in the tube after 5 hours? Show your work.

(Note: Take $\pi = \frac{22}{7}$.)

Q: 13 **Two people have an equal amount of moulding clay. They make different solids of the same circular radius out of it - cylinder and hemisphere.** **[2]**

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

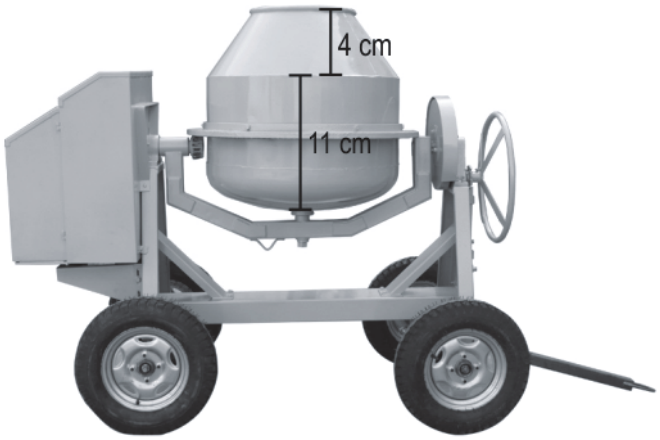
i) Simran said, "The curved surface area of the cylinder is larger."
ii) Manoj said, "Both the solids have the same curved surface area."

Q: 14 **A 5.54 litre watering can sprinkles water at the rate of 500 mL/min. The can has a diameter of 14 cm and is initially filled to its full capacity.** **[2]**

What is the height of water in the can after it is used for 8 minutes? Show your work.

(Note: Take $\pi = \frac{22}{7}$.)

Q: 15 **Shown below is a small model of a cement mixer. The radius of the bottom of the drum is 5 cm and that of the top of the drum is 2 cm.** **[3]**

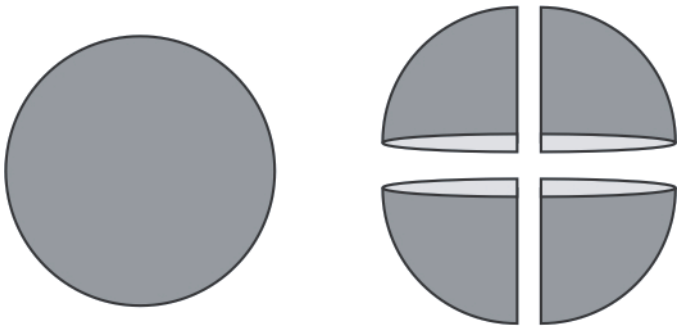


(Note: The figure is not to scale.)

Find the maximum quantity of cement, rounded to the nearest whole number, that the drum can hold. Show your steps.

(Note: Take $\pi = \frac{22}{7}$.)

Q: 16 **The surface area of a solid spherical ball is S cm^2. It is cut into 4 identical pieces as shown below.** **[1]**



Find the total surface area of 4 identical pieces of the solid spherical ball in terms of S. Show your work.

The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	3
2	2
3	2

Q.No	Teacher should award marks if students have done the following:	Marks
4	Identifies that the area that gets painted is the curved surface area of the roller and writes the formula to find the curved surface area of the roller as $2 \times \pi \times \frac{7}{2} \times 26$.	1
	Finds the maximum area of the surface that gets painted when the roller makes 6 complete rotations vertically as $6 \times 2 \times \pi \times \frac{7}{2} \times 26 = 3432\ cm^2$.	1
5	Writes that the volume of the prism is equal to the volume of water overflowed which is $\frac{2}{5}$ of the volume of the cylinder.	0.5
	Find the volume of the prism as $\frac{2}{5}$ K litres.	0.5
6	Finds the volume of the cake without the hole as $(\pi \times 15^2 \times 21)\ cm^3$.	0.5
	Finds the weight of the cake without hole as $(\pi \times 15^2 \times 21 \times 0.5)$ gm.	0.5
	Uses the above step and the given information to find the weight of the central portion that is removed as $(\pi \times 15^2 \times 21 \times 0.5) - 6600 = 825$ g	0.5
	Finds the volume of the central portion that is removed as $825 \div 0.5 = 1650\ cm^3$.	0.5
	Finds the radius of the central portion that is removed as $\sqrt{(1650 \div 21\pi)} = 5$ cm. (Award full marks if the correct answer is obtained using an alternate method.)	1
7	Finds the CSA of the hemispherical roof as $(2 \times \pi \times 6^2)\ m^2$.	0.5
	Finds the CSA of the cylindrical wall as $(2 \times \pi \times 6 \times 2)\ m^2$.	0.5
	Finds the total surface area of the greenhouse to be covered as $(72\pi + 24\pi) = 96\pi\ m^2$.	0.5
	Finds the cost of the plastic sheet required to cover the entire greenhouse as $(96\pi \times 77) =$ Rs 23232.	0.5
8	Finds the CSA of the top portion of the lampshade as $\pi(5 + 8)5$ sq in. (Award 0.5 marks if just the formula to find the surface area of frustum of cone is correctly written.)	1

Q.No	Teacher should award marks if students have done the following:	Marks
	Finds the CSA of the bottom portion of the lampshade as (2 × π × 8 × 5) sq in. (Award 0.5 marks if just the formula to find the surface area of cylinder is correctly written.)	1
	Finds the total area of the cane web used to make the lampshade as 145π sq in and the minimum number of sheets of cane web required to make this lamp as $\frac{145\times22}{44\times7} \approx 11$ sheets.	1
9	Finds the volume of the cone as $\frac{\pi}{3} k^3$ cm^3.	0.5
	Finds the volume of the cylinder as πk^3 cm^3.	0.5
	Finds the volume of the hemisphere as $\frac{2}{3} \pi k^3$ cm^3.	0.5
	Finds the total volume of the solid as $\frac{\pi}{3} k^3 + \pi k^3 + \frac{2}{3} \pi k^3 = 2\pi k^3$ cm^3.	1
	Uses steps 2 and 4 and concludes that the total volume of the solid is twice the volume of the cylinder.	0.5
10	Assumes the radius of the cylindrical cake as r cm and height as h cm writes: $\pi r^2 h = 3168$ $\Rightarrow r^2 h = 1008$	0.5
	Writes the prime factorisation of 1008 as 2 × 2 × 2 × 2 × 3 × 3 × 7.	0.5
	Finds a set of values of radius and height of the cake as 12 cm and 7 cm. (Award 1.5 marks if another method is used to find a correct set of values.)	1
11	Equates the circumference of the base to the curved surface area of the waffle sheet as $2\pi r = \pi r$ and find the base radius of the cone without overlap as $\frac{5}{2}$ cm.	1
	Finds the radius of the cone with overlap as $\frac{80}{100} \times \frac{5}{2} = 2$ cm.	1

Q.No	Teacher should award marks if students have done the following:	Marks
	Finds the volume of the cone by considering the approximate height of the cone as 5 cm as $\frac{1}{3} \times \frac{22}{7} \times 2 \times 2 \times 5 = \frac{440}{21}$ cm^3 ~ 20 cm^3. (Award 0.5 marks if only the formula for the volume of a cone is correctly written.)	1
12	Finds the volume of the tube as $\frac{22}{7} \times 4 \times 4 \times 28 = 1408$ cm^3. (Award 0.5 marks if only the formula for the volume of a cylinder is correctly written.)	1
	Finds the quantity of bird food eaten in 5 hours as $75 \times 5 = 375$ g.	0.5
	Writes that 3000 g is equivalent to 1408 cm^3, hence 375 g is equivalent 176 cm^3.	1.5
	Finds the volume of the tube that is filled after 5 hours as 1408 - 176 = 1232 cm^3.	0.5
	Finds the height of the food in the tube as $\frac{1232 \times 7}{22 \times 4 \times 4} = 24.5$ cm.	1.5
13	Writes the ratio of curved surface area to volume of a: cylinder as $\frac{2}{r}$ hemisphere as $\frac{3}{r}$ where *r* is the circular radius.	1.5
	Uses the above step to conclude that both Simran's and Manoj's statements are false.	0.5
14	Finds the volume of water left after 8 minutes as 5.54 - $(8 \times \frac{1}{2})$ = 1.54 litres or 1540 cm^3.	1
	Writes the equation for the height of the can, *h* as $\frac{22}{7} \times (7)^2 \times h = 1540$.	0.5
	Solves the above equation for *h* as 10 cm.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
15	Finds the volume of the cylindrical portion as $\frac{22}{7} \times 5 \times 5 \times 11 = \frac{6050}{7}$ cm^3. (Award 0.5 marks if only the formula for the volume of a cylinder is correctly written.)	1
	Finds the volume of the frustum portion as $\frac{1}{3} \times \frac{22}{7} \times 4 \times (5^2 + 2^2 + 10) = \frac{1144}{7}$ cm^3. (Award 0.5 marks if only the formula for the volume of a frustum is correctly written.)	1
	Finds the maximum quantity of cement that the drum can hold as $\frac{6050}{7} + \frac{1144}{7} = \frac{7194}{7}$ cm^3.	0.5
	Writes $\frac{7194}{7}$ in decimal form as 1027.71 and rounds it off to the nearest whole number as 1028 cm^3.	0.5
16	Assumes the radius of the solid spherical ball as r cm and writes that the total surface area of 4 identical pieces of solid spherical ball = $4\pi r^2 + 2\pi r^2 + 2\pi r^2 = 8\pi r^2 = (2 \times 4\pi r^2)$ cm^2	0.5
	Finds the total surface area of the 4 identical pieces of solid spherical ball as 2 × S cm^2.	0.5

Chapter - 14
Statistics

Q: 1 **In statistics, an outlier is a data point that differs significantly from other observations of a data set.**

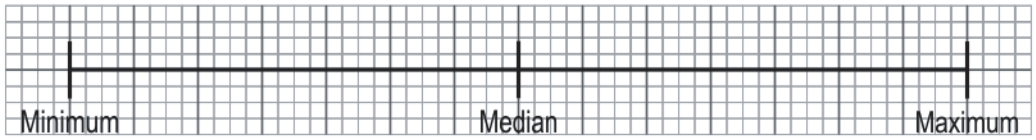
If an outlier is included in the following data set, which measure(s) of central tendency would change?

12, 15, 22, 44, 44, 48, 50, 51

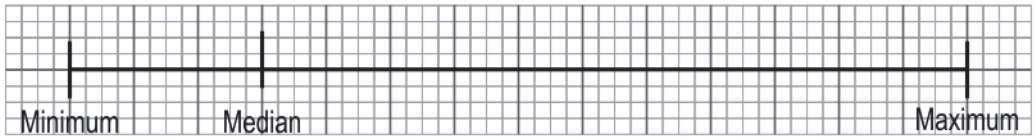
1. only mean
2. only mean and median
3. all - mean, median, mode
4. (cannot be said without knowing the outlier.)

Q: 2 **Shown below are number line representations of the medians of two different data sets.**

i) Data set 1:



ii) Data set 2:



Minimum - Smallest data point

Maximum - Largest data point

Which of the two representations of median could be correct?

1. only i)
2. only ii)
3. both i) and ii)
4. (cannot say without knowing the elements of the data sets)

Q: 3 **A survey was conducted on 80 gamers on how many games did they play in a day. The data is given below.**

Number of games	Number of gamers
1 - 2	20
2 - 3	24
3 - 4	10
4 - 5	12
5 - 6	8
6 - 7	4
7 - 8	2

Which of the following is the modal class?

1 1 - 2 **2** 2 - 3 **3** 4 - 5 **4** 7 - 8

Q: 4 **A ketchup manufacturing company sells ketchup in three different bottle sizes. Now, it wants to sell only one size in the market. It has data on how the three sizes perform in the market.** **[1]**

Based on which measure of central tendency, should the company fix the size of the ketchup bottle? Justify your answer.

Q: 5 **The mean temperature of a certain city for 31 consecutive days was found to be 35.7°C. Further, the mean temperature of the first 8 days was 28.4°C. The mean temperature of the next 12 days was 36.4°C.** **[3]**

Find the mean temperature of the rest of the days. Show your work.

(Note: Round the numbers to one decimal point.)

Q: 6 **Bowling strike rate for a bowler is defined as the average number of balls bowled per wicket taken. A Bowler has taken 148 wickets so far with a strike rate of 27. In his next match, he bowls 48 balls and takes 2 wickets.** **[3]**

What is his new strike rate? Show your work.

Q: 7 **In a class test, the mean score of the class is 60. Half the students of the class scored 80 marks or above in the test.** **[2]**

Dipti said, "Each of the remaining half of the students would have definitely got 40 marks or below in the test for the mean to be 60 marks".

Prove or disprove Dipti's statement with a valid example.

Answer the questions based on the given information.

TRP stand for Television Rating Point. It is a tool that indicates the popularity of a television channel/program. It is used to judge which TV channel/program is viewed the most. A channel with higher TRP indicates that the channel is viewed by a large number of viewers.

Shown below is a data taken from 25000 televisions in a city. The table shows the details of 2 channels, their screen times and the number of viewers. Screen time refers to the duration for which the channel was viewed.

	Screen time (in hours)	0 – 2	2 – 4	4 – 6	6 – 8	8 – 10	10 – 12
Number of Viewers	Channel 1	5500	10000	6000	2000	1000	500
	Channel 2	9000	6000	6500	1500	1700	300

Q: 8 **On an average, how long does a viewer watch channel 1? Show your steps.** **[2]**

(Note: Round your answer to two decimal places.)

Q: 9 **Construct a less than type ogive for channel 2. Show your work.** **[3]**

Q: 10 **The frequency distribution of daily rainfall in a town during a certain period is shown below.** **[3]**

Rainfall (in mm)	Number of days
0 - 20	7
20 - 40	*x*
40 - 60	10
60 - 80	4

Unfortunately, due to manual errors, the information on the 20-40 mm range got deleted from the data.

If the mean daily rainfall for the period was 35 mm, find the number of days when the rainfall ranged between 20-40 mm. Show your work.

Q: 11 **Shown below is an ogive for the average wages of 35 countries for the period 2017-2020.** **[1]**

(Source of data: https://data.oecd.org/earnwage/average-wages.htm)

Raghav interpreted, "Since it is an increasing graph, a higher number of countries have an average wage of 60-70 thousand dollars than 30-40 thousand dollars in the given period."

Is Raghav right or wrong? Justify your answer.

(Note: Average wage of a country refers to the average wage of the working adult population of a country.)

Q: 12 **Shown below is a table representing the percentage distribution of mental health disorders of Asian countries in 2019.** **[1]**

Percentage of citizens with mental health disorders	Number of Asian countries
7.5 - 10	1
10 - 12.5	25
12.5 - 15	11
15 - 17.5	4
17.5 - 20	1

(Source of data: https://ourworldindata.org/mental-health.)

Can the median of the above data be greater than 12.5%? Give a valid reason.

Teacher should award marks if students have done the following:

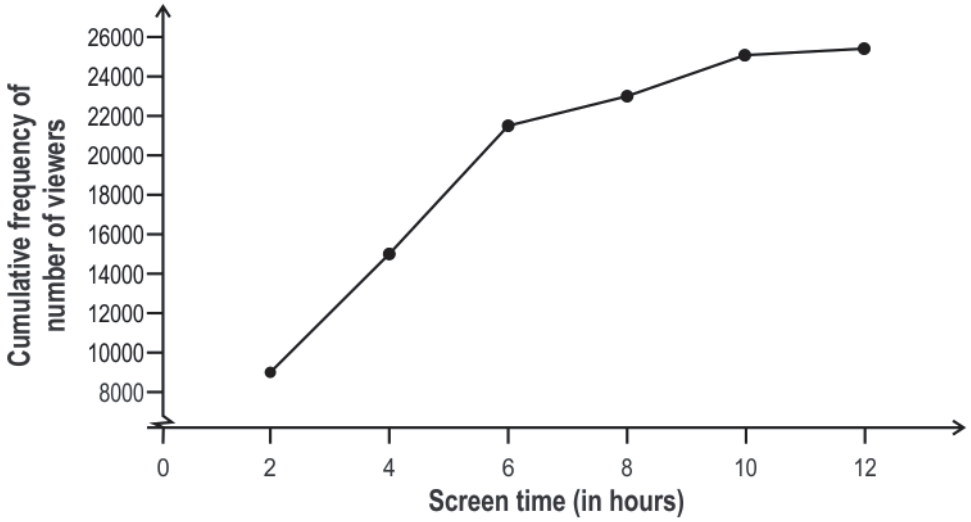
Q.No	Correct Answers
1	1
2	3
3	2

Q.No	Teacher should award marks if students have done the following:	Marks
4	Writes that the company should fix the size of the ketchup bottle based on the mode.	0.5
	Writes that the mode gives the information about the size that is sold most often.	0.5
5	Finds the number of days remaining as 31 - 8 - 12 = 11.	0.5
	Finds the sum of the temperatures of all the 31 days as 35.7°C × 31 = 1106.7°C.	0.5
	Finds the sum of the temperatures of first 8 days as 28.4°C × 8 = 227.2°C.	0.5
	Finds the sum of the temperatures of next 12 days as 36.4°C × 12 = 436.8°C.	0.5
	Finds the sum of the temperatures of last 11 days as 1106.7°C - 227.2°C - 436.8°C = 442.7°C.	0.5
	Finds the mean temperature of the last 11 days as $\frac{442.7}{11}$ = 40.2°C.	0.5
6	Finds the total number of balls bowled by the bowler so far as 148 × 27 = 3996.	1
	Finds the total number of balls bowled after the latest match as 3996 + 48 = 4044 and total number of wickets taken after the latest match as 148 + 2 = 150.	1
	Finds the new strike rate of the bowler as (total number of balls bowled)/(total number of wickets taken) = $\frac{4044}{150}$ = 26.96.	1
7	Writes that Dipti's claim is not correct.	0.5
	Writes a valid example by showing scores of some students where the mean is 60 marks, half of the students scored 80 marks or above, but the rest have scored both above and below 40 marks. For example, Consider there are 4 students in the class with scores, 80, 90, 20 and 50. The mean is 60 marks, half of them got 80 or above, but one score in the remaining half is above 40.	1.5

<table>
<tr><th>Q.No</th><th>Teacher should award marks if students have done the following:</th><th>Marks</th></tr>
<tr><td>8</td><td>Rewrites the data of channel 1 as:

<table>
<tr><th>Class Interval</th><th>f_i</th><th>x_i</th><th>$f_i x_i$</th></tr>
<tr><td>0 - 2</td><td>5500</td><td>1</td><td>5500</td></tr>
<tr><td>2 - 4</td><td>10000</td><td>3</td><td>30000</td></tr>
<tr><td>4 -6</td><td>6000</td><td>5</td><td>30000</td></tr>
<tr><td>6 - 8</td><td>2000</td><td>7</td><td>14000</td></tr>
<tr><td>8 - 10</td><td>1000</td><td>9</td><td>9000</td></tr>
<tr><td>10- 12</td><td>500</td><td>11</td><td>5500</td></tr>
<tr><td></td><td>$n = 25000$</td><td></td><td>$\Sigma f_i x_i = 94000$</td></tr>
</table></td><td>1.5</td></tr>
<tr><td></td><td>Writes that, on an average, a viewer watches channel 1 for $\frac{94000}{25000}$ = 3.76 hours.</td><td>0.5</td></tr>
<tr><td>9</td><td>Writes the cumulative frequency of the data corresponding to channel 2 as:

<table>
<tr><th>Class Interval</th><th>f_i</th><th>Cumulative frequency</th></tr>
<tr><td>0 - 2</td><td>9000</td><td>9000</td></tr>
<tr><td>2 - 4</td><td>6000</td><td>15000</td></tr>
<tr><td>4 -6</td><td>6500</td><td>21500</td></tr>
<tr><td>6 - 8</td><td>1500</td><td>23000</td></tr>
<tr><td>8 - 10</td><td>1700</td><td>24700</td></tr>
<tr><td>10- 12</td><td>300</td><td>25000</td></tr>
</table></td><td>1</td></tr>
</table>

Q.No	Teacher should award marks if students have done the following:	Marks
	The ogive may look as follows:  **(Award full marks if the ogive is drawn directly without writing the table in the first step.)**	**2**
10	**Completes the frequency distribution table as:** | Rainfall (in mm) | Number of days / Frequency (f_i) | Class-mark (x_i) | ($f_i x_i$) | |---|---|---|---| | 0 - 20 mm | 7 | 10 | 70 | | 20 - 40 mm | x | 30 | $30x$ | | 40 - 60 mm | 10 | 50 | 500 | | 60 - 80 mm | 4 | 70 | 280 | | Total | $21 + x$ | | $850 + 30x$ |	**1.5**
	Writes the equation for mean as: $\frac{850+30x}{21+x} = 35$	**0.5**
	Solves the equation in step 2 to find the value of x as 23.	**1**

Q.No	Teacher should award marks if students have done the following:	Marks
11	Writes that Raghav is wrong and justifies the answer. For example, 4 countries have an average wage of 60-70 thousand dollars and 7 countries have an average wage of 30-40 thousand dollars in the given period.	1
12	Writes that the median of the given data cannot be greater than 12.5% as 10 - 12.5 is the median class.	1

Chapter - 15
Probability

Answer the questions based on the information given.

HOOK-A-DUCK is a traditional stall game. A number of identical rubber ducks are floated in a water trough. The ducks have metal rings fastened to their heads. The player captures the ducks using a pole with a hook at one end. Although the ducks appear identical, the letters S, M or L appears on the bottom of some ducks, signifying that the player who captures them receives a Small, Medium or Large prize respectively. A duck with no letter signifies no prize.

In order to play the game, a player needs to buy a token and is given three attempts per token. In each attempt, he needs to capture a duck. The captured ducks are examined to reveal whether they have any letter and the player gets the prizes accordingly. The ducks are returned to the trough only after the player finishes all the three attempts. If a player buys more than one token, the ducks are returned to the trough after every 3 attempts.

Sam is playing one such game where there are 120 ducks in the trough. The ratio of the number of ducks without any letter to the number of ducks with letters S, M and L is 10:6:3:1 respectively.

Q: 1 **Sam is playing his first attempt of the game. What is the probability that he wins a medium prize?**

1 $\frac{3}{120}$ **2** $\frac{3}{60}$ **3** $\frac{3}{20}$ **4** $\frac{3}{17}$

Q: 2 **A player captures empty ducks in his first two attempts. What is the probability that he will win a small prize in his third attempt?**

1 $\frac{36}{120}$ **2** $\frac{36}{118}$ **3** $\frac{6}{18}$ **4** $\frac{6}{14}$

Q: 3 **Meera is playing the game and she got a duck marked S in her first attempt. Which duck will be most likely captured by her in the second attempt?**

1 A duck with letter S
2 A duck with letter M
3 A duck with letter L
4 A duck with no letter

Q: 4 **A certain number of new ducks, when added to the trough, doubles the probability of winning a large prize in the first attempt.**

Which of the following could be true about the number of new ducks getting added?

(i) 20 new ducks out of which 8 marked L.
(ii) 240 new ducks out of which 2 marked L.
(iii) 120 new ducks out of which 18 marked L.

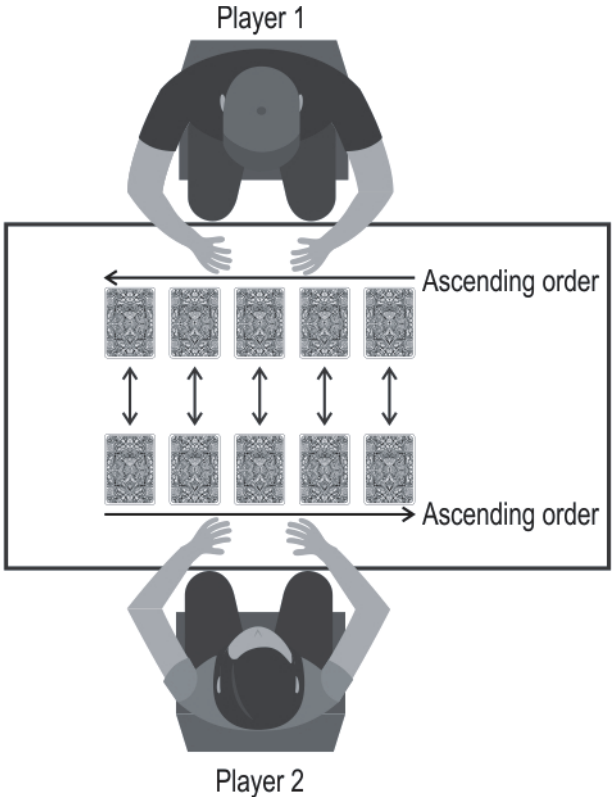
1 only (ii) **2** only (iii) **3** only (i) and (ii) **4** only (i) and (iii)

Q: 5 **Let *k* be the probability that a player wins a medium prize in his first attempt.**

If a player wins a small and a large prize in his first two attempts, then the probability that he wins a medium prize in his third attempt is _____.

1 equal to *k*
2 less than *k*
3 more than *k*
4 (cannot be determined using the given information)

Q: 6 **In a cards game, there are ten cards, 1 to 10. Two players, seated facing each other, randomly choose 5 cards each. They arrange their cards in ascending order of the number on the card as shown below.**



The difference between the corresponding cards is calculated such that the lower value is subtracted from the higher value.

In a random game, what is the probability that the sum of the differences is 24?

1 0
2 $\frac{1}{5}$
3 $\frac{1}{2}$
4 (cannot be calculated without knowing the cards chosen by each player.)

Q: 7 **At a party, there is one last pizza slice and two people who want it. To decide who gets the last slice, two fair six-sided dice are rolled. If the largest number in the roll is:**

- **1, 3 or 6, Ananya would get the last slice, and**
- **2, 4 or 5, Pranit would get it.**

In a random roll of dice, who has a higher chance of getting the last pizza slice?

(Note: If the number on both the dice is the same, then consider that number as the larger number.)

1 Ananya
2 Pranit
3 Both have an equal chance
4 (cannot be answered without knowing the exact numbers in a roll.)

Q: 8 **A number was selected at random from 1 to 100 (inclusive of both numbers) and it was found to be a multiple of 10.**

What is the probability that the selected number is a multiple of 5?

1 $\frac{1}{10}$ **2** $\frac{1}{5}$ **3** $\frac{1}{2}$ **4** 1

Answer the questions based on the information given below.
Four friends - Ayush, Minal, Rohan and Shreya - are playing a board game called Food Master. Shown below are their current positions on the board during the first round.

The rules of the game are:
- In each chance, two 6-sided fair dice numbered 1-6 are rolled by the player.
- The number of steps a player moves forward by is the sum of the numbers on the two dice.
- Each player gets a restaurant card for their first visit to any of the 16 restaurants.
- After 10 rounds, the player with the most number of restaurant cards wins.

Q: 9 **What are the chances that Rohan lands on 'FREE PARKING' in his next turn?**

1 $\frac{7}{36}$ **2** $\frac{1}{6}$ **3** $\frac{1}{12}$ **4** $\frac{1}{36}$

Q: 10 **What is the probability of Minal landing on 'ROLL AGAIN' in her next turn?**

1 0 **2** $\frac{1}{36}$ **3** $\frac{1}{6}$ **4** 1

Q: 11 **Among Minal and Shreya, who has a higher chance of landing on the Goan restaurant in their next turn? Show your steps.** **[2]**

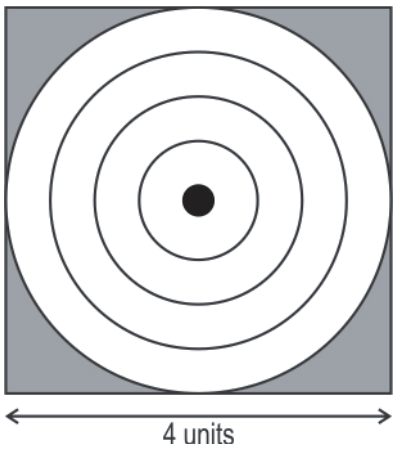
Q: 12 **In a medical centre, 780 randomly selected people were observed to find if there is a relationship between age and the likelihood of getting a heart attack. The following results were observed.** **[2]**

	Younger than or equal to 55	Older than 55	Total
Number of persons who have had a heart attack	29	75	104
Number of persons who have never had a heart attack	401	275	676
Total	430	350	780

(i) Based on this table, what is the probability that a randomly chosen person from the same sample is younger than or equal to 55 years and has had a heart attack?

(ii) Looking at the data in the table, Giri says "*if a person is randomly chosen, then the probability that the person have had a heart attack is about 12.5%*".
Is the statement true or false? Justify your reason.

Q: 13 **Shown below is a square dart board with circular rings inside.** **[2]**



(Note: The figure is not to scale.)

Find the probability that a dart thrown at random lands on the shaded area. Show your steps.

Q: 14 **A 4-sided fair die is numbered 1 - 4. Nikhil and Pratik are playing with such a die each. They roll their dice once at the same time. A player wins only if they get a number larger than the other player.** **[2]**

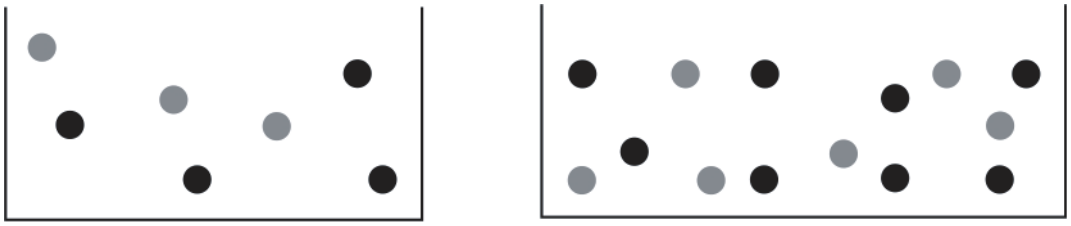
What is the probability of Pratik winning the game? Show your work.

Q: 15 **On a particular day, Vidhi and Unnati couldn't decide on who would get to drive the car. They had one coin each and flipped their coins exactly three times. The following was agreed upon:** **[3]**

- **If Vidhi gets two heads in a row, she would drive the car.**
- **If Unnati gets a head immediately followed by a tail, she would drive the car.**

Who has more probability to drive the car that day? List all outcomes and show your steps.

Q: 16 **Shown below are two baskets with grey and black balls.** **[2]**



Basket 1 Basket 2

Abhishek is playing a game with his friend where he has to close his eyes and pick a black ball from one of the baskets in one trial.

He said "I will try with basket 2 as it has a higher number of black balls than basket 1 and hence the probability of picking a black ball from basket 2 is higher."
Is Abhishek's statement correct? Justify your answer.

Q: 17 **Rohan has a bag of multiple balls either pink, green or yellow in colour. He randomly picks up one ball.** **[1]**

His friend, Farid predicted, "The probability of Rohan picking a pink ball is definitely $\frac{1}{3}$ as there are 3 colours".

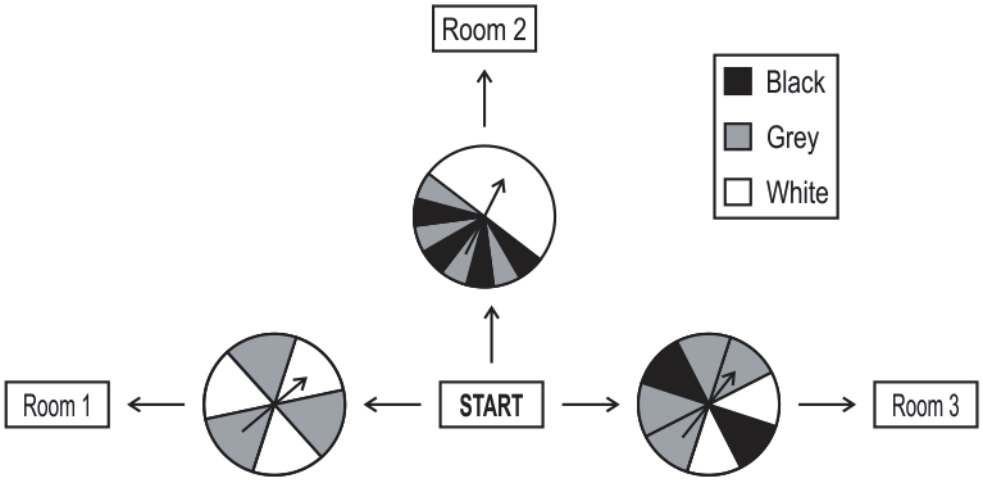
Is Farid's statement true or false. Give a valid reason or a counter example.

Q: 18 **Shivesh was tossing a fair coin. Shown below are the outcomes of his first 5 tosses.** **[1]**

Tail Tail Tail Tail Tail

Is the probability of Shivesh getting a head in his sixth toss higher than the probability of getting a tail? Give a valid reason.

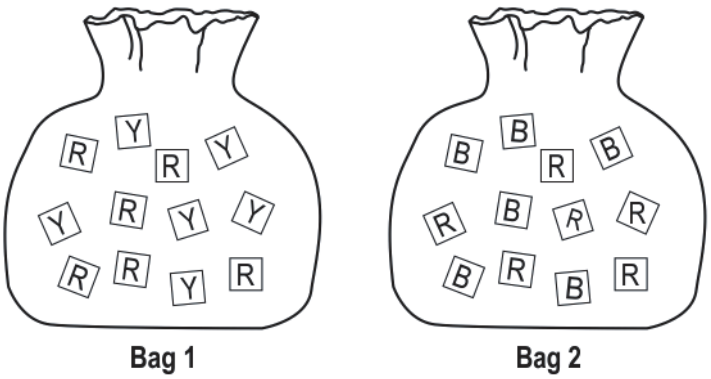
Q: 19 **Shown below is a game with 3 spinners attached to 3 rooms. Each player is given a treasure which has to be kept in one of the rooms. All the spinners are rotated and if any spinner lands on the grey region, that room is opened. If the player kept his treasure in that room, he loses the treasure. If he kept it in any other room, he wins the treasure.** **[3]**



Zaira kept her treasure in the room which is least likely to be opened.

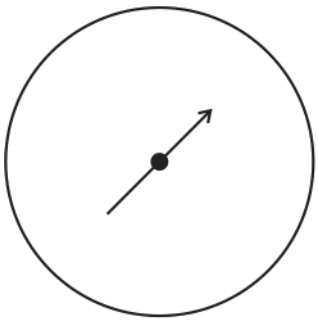
In which room did she keep her treasure? Show your work.

Q: 20 **At a fair, there is a game such that it has two bags. Bag 1 has an equal number of red(R) and yellow(Y) cubes and bag 2 has an equal number of red(R) and blue(B) cubes. Rohit has to pick a cube from each of the bags. If he picks up at least 1 red cube, he gets a prize.** **[1]**

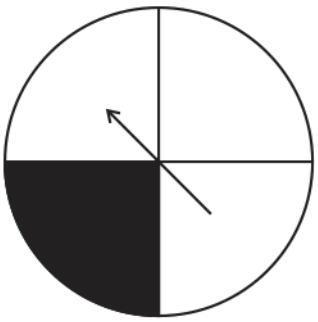


Find the probability of Rohit getting a prize. List all outcomes and show your work.

Q: 21 **Shown below are two spinners.** **[1]**



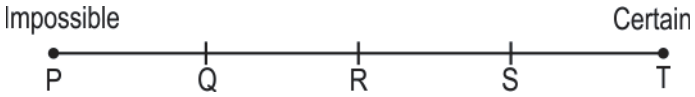
Spinner 1



Spinner 2

Select the points on the probability scale below that represents:
i) the probability of spinner 1 landing on a black region.

ii) the probability of spinner 2 landing on white region.



Q: 22 **On a given day, an airplane is carrying 78 meals, of which 39 are vegetarian and the rest are non-vegetarian.** **[1]**

If the air hostess started distributing the meals and picked the first meal from the lot, what is the probability that it has a surprise gift?

Q: 23 **Jenin has four 50-rupee notes, seven 100-rupee notes and two 2000-rupee notes in her purse. She doesn't have any other denomination of currency with her. She goes for shopping and buys a skirt for Rs 799. She takes out a note from her purse at random.** **[2]**

i) Find the probability that the note will be sufficient to pay for the dress.
ii) Find the probability that she will be able to give exactly Rs 799 to the shopkeeper.

Show your work.

Q: 24 **Farah and Sheena are playing a game with number tokens. Each of them has four number tokens, 2, 3, 4 and 5. A token is randomly picked by each of them from their stack simultaneously. If the sum of the numbers picked by each of them is a prime number, Farah wins the game and if it is a composite number, then Sheena wins the game.** **[3]**

Find the probability of each of them winning the game and state who has a higher probability of winning the game. Show your work.

Teacher should award marks if students have done the following:

Q.No	Correct Answers
1	3
2	2
3	4
4	4
5	3
6	1
7	2
8	4
9	2
10	1

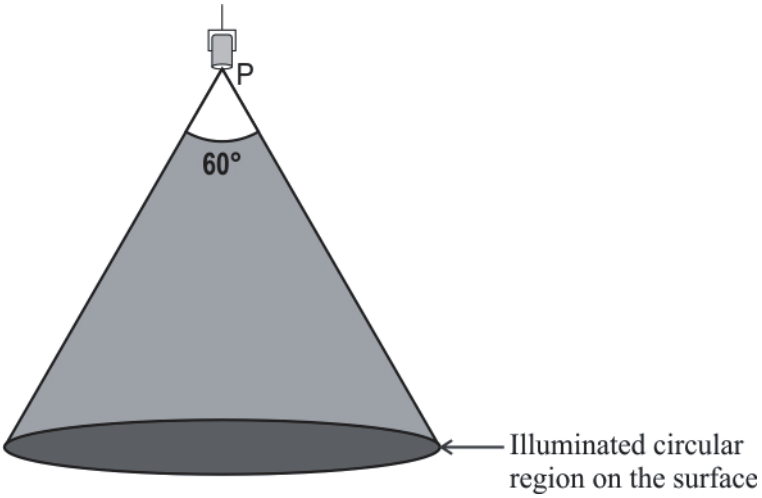
Q.No	Teacher should award marks if students have done the following:	Marks
11	Finds the probability of Minal landing on the Goan restaurant as $\frac{5}{36}$.	1
	Finds the probability of Shreya landing on the Goan restaurant as $\frac{4}{36}$. Hence, concludes that Minal has a higher chance of landing on the Goan restaurant.	1
12	(i) Calculates the probability as $\frac{29}{780}$ or any equivalent number.	1
	(ii) Explains that the statement is true and gives the justification that the probability that a random person have had a heart attack is $\frac{104}{780}$ which is approximately $\frac{1}{8}$ or 12.5%.	1
13	Finds the area of the square dartboard as $4^2 = 16$ sq units.	0.5
	Finds the area of the outer circular ring with radius 2 units as $\pi(2)^2 = 4\pi$ sq units.	0.5
	Finds the probability that a dart thrown at random lands on the shaded area as $\frac{16-4\pi}{16} = \frac{4-\pi}{4}$.	1
14	Identifies the total number of outcomes as 16 and the probable outcomes to win the game as 6.	1
	Finds the probability of Pratik winning the game as $\frac{6}{16}$ or $\frac{3}{8}$.	1
15	Writes all the outcomes as {(HHH), (HHT), (HTH), (THH), (TTH), (THT), (HTT), (TTT)} and identifies the total number of outcomes as 8.	0.5
	Writes the favourable outcomes for Vidhi as {(HHH), (HHT), (THH)} and identifies the favourable outcomes for Vidhi to win as 3.	0.5
	Finds the probability of Vidhi flipping two heads in a row as $\frac{3}{8}$.	0.5
	Writes the favourable outcomes for Unnati as {(HHT), (HTH), (THT), (HTT)} and identifies the favourable outcomes for Unnati to win as 4.	0.5
	Finds the probability of Unnati flipping a head immediately followed by a tail as $\frac{4}{8}$.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	Uses steps 3 and 5 to conclude that if they flipped their coins exactly three times, Unnati is more likely to drive the car that day.	0.5
16	Writes that Abhishek's statement is not correct.	0.5
	Justifies the answer. For example, writes that the probability of randomly picking a black ball from basket 1 is $\frac{4}{7}$ and the probability of randomly picking a black ball from basket 2 is $\frac{8}{14}$. Hence, the probability of picking a black ball from basket 1 is same as basket 2.	1.5
17	Writes that Farid's statement is false.	0.5
	Gives a counterexample. For example, if a bag has 1 pink ball, 2 green balls and 2 yellow balls, the probability of randomly picking a pink ball is $\frac{1}{5}$.	0.5
18	Writes no and gives a reason. For example, when tossing a fair coin, the probability of getting a head is equal to the probability of getting a tail.	1
19	Finds the probability of opening room 1 as $\frac{3}{6}$ or $\frac{1}{2}$.	0.5
	Finds the probability of opening room 2 as $\frac{4}{16}$ or $\frac{1}{4}$.	1
	Finds the probability of opening room 3 as $\frac{4}{8}$ or $\frac{1}{2}$.	0.5
	Compares the above probabilities and concludes that Zaira kept her treasure in room 2.	1
20	Writes all the outcomes as {(RR), (RB), (YR), (YB)} and the probable outcome to get a prize as {(RR), (RB), (YR)} .	0.5
	Uses the above step to find the probability of Rohit getting a prize as $\frac{3}{4}$.	0.5
21	i) Selects the point representing the probability of spinner 1 landing on a black region as point P.	0.5

Q.No	Teacher should award marks if students have done the following:	Marks
	ii) Selects the point representing the probability of spinner 2 landing on a white region as point S.	0.5
22	Finds the number of favourable outcomes as 1 and the number of total outcomes as 78.	0.5
	Finds the probability that the picked meal has a surprise gift as $\frac{1}{78}$.	0.5
23	i) Identifies total number of outcomes as 4 + 7 + 2 = 13 and favourable number of outcomes as 2.	0.5
	Finds the probability that the note will be sufficient to pay for the dress as $\frac{2}{13}$. (Award full marks if the probability is found directly without mentioning the above step.)	0.5
	ii) Writes that the probability that Jenin will be able to give exactly Rs 799 to the shopkeeper is 0.	1
24	Writes that the total number of outcomes is 16.	0.5
	Writes that the number of favourable outcomes for Farah to win the game is 6.	0.5
	Finds the probability that Farah wins the game as $\frac{6}{16} = \frac{3}{8}$.	0.5
	Finds the probability that Sheena wins the game as $1 - \frac{3}{8} = \frac{5}{8}$.	1
	Uses steps 3 and 4 to conclude that Sheena has a higher probability of winning the game.	0.5

Chapter - 16
Multiple Concepts

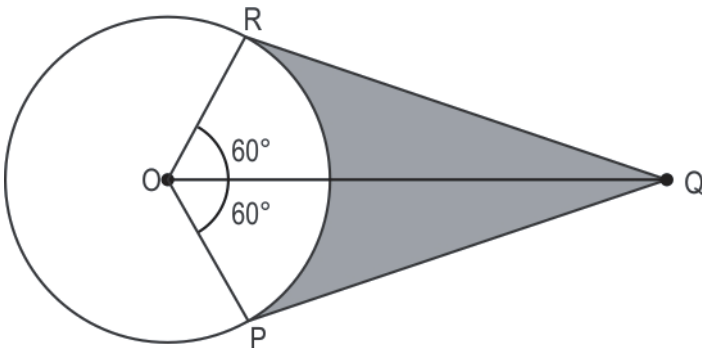
Q: 1 **A spotlight, P, is at a height of 12 m from the surface. The light from P, forms a right circular cone and illuminates a circular region on the surface as shown below.** **[3]**



(Note: The figure is not to scale.)

Find the area of the illuminated circular region on the surface, in terms of π. Show your steps along with a rough diagram with all the relevant measures marked.

Q: 2 **Shown below is a circle with centre O and radius 10 cm. Two tangents QR and QP are drawn to it from an external point Q and OQ = 20 cm.** **[3]**



(Note: The figure is not to scale.)

Find the area, in terms of π, occupied by the shaded region. Show your work.

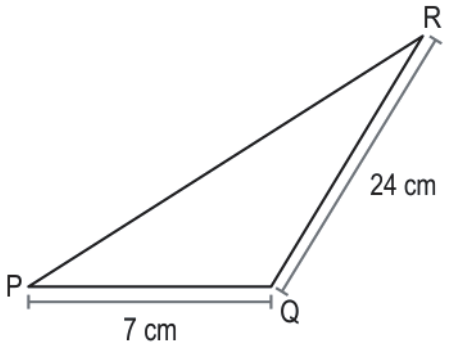
Q: 3 **The line *m* is a tangent to the circle C at the point (9, 12). The circle is centred at the origin.** **[2]**

Check if the line *m* passes through the point (15, 0). Show your work.

Q: 4 **If $3\cot\theta + \tan\theta = 5\sec\theta$; $0° \leq \theta \leq 90°$, find the value of θ.** **[3]**

Show your steps and give valid reasons.

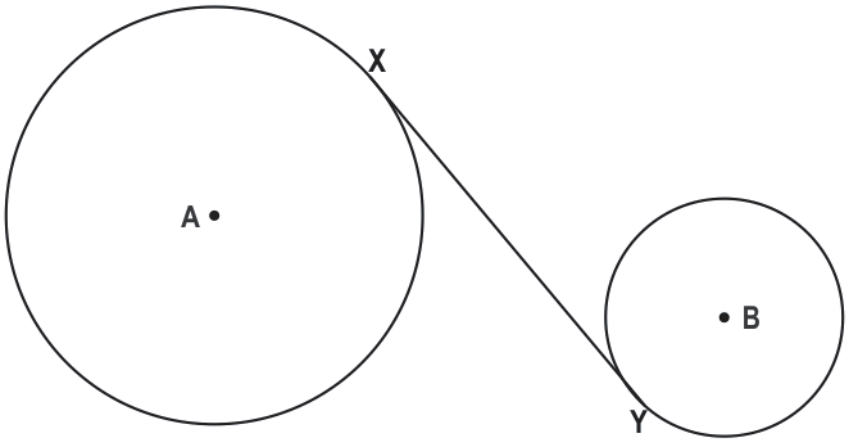
Q: 5 **Rehan has a set of 40 cards numbered 1 - 40 without repeating any number. Rehan wants to construct ▲PQR shown below by choosing the length of PR, in cm, from the set of the cards.** **[3]**



(Note: The figure is not to scale.)

What is the probability that a card chosen at random makes ▲PQR an OBTUSE angled triangle with Q as obtuse angle? Show your work.

Q: 6 **Kiran is making a toy by using two circular disks of radii 12 cm and 6 cm respectively, connected by a taut wire. The wire, XY, is the internal tangent to both disks as shown below.** **[5]**



(Note: The figure is not to scale.)

If the centres of the circular disks, A and B are 30 cm apart, what is the length of the wire XY? Show your steps with a figure and give valid reasons.

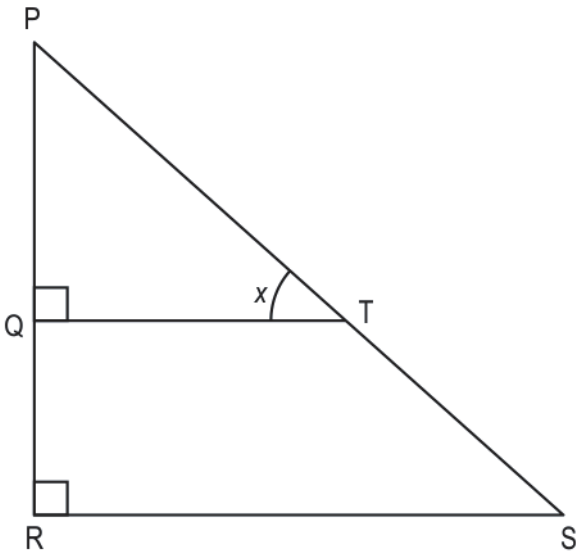
Q: 7 **Shown below are two paths from Madrid to New York. The dotted line is the shortest distance, approximately 6000 km, on a 2D map. The other solid circular arc is the shortest distance on a 3D globe and the actual path taken by a flight. The arc subtends an angle of 60° at the centre of the circular arc.** **[3]**

(Note: The figure is not to scale.)

What is the actual distance covered by the fight? Draw a rough diagram and show your work.

(Note: Take π = 3.14, if needed.)

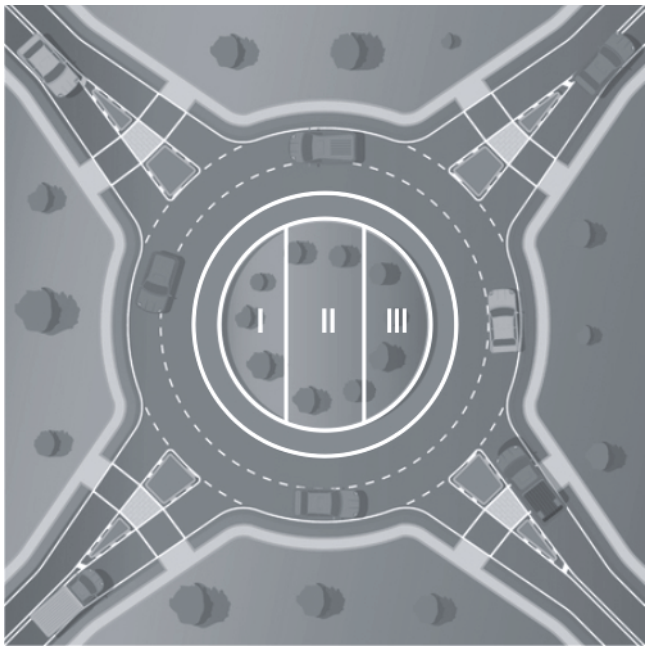
Q: 8 **In the figure below, tan $x = \frac{3}{4}$, PT = 10 cm and QR = 3 cm.** **[3]**



(Note: The figure is not to scale.)

Find the area of quadrilateral RSTQ. Show your steps and give valid reasons.

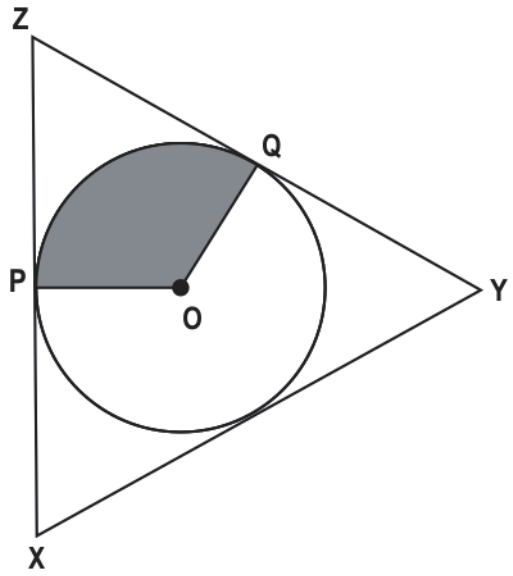
Q: 9 **At a certain roundabout, the radius of the circular region is 50 ft. The circular region includes a 2 ft wide circular concrete footpath and a flowering bed. The flowering bed is divided into three parts using two dividers of length 48√3 ft each as shown below.** **[5]**



(Note: The figure is not to scale.)

Find the area of regions (I + III), in terms of π. Draw a rough diagram and show your steps.

Q: 10 **In the figure below, a circle with centre O is inscribed in an equilateral triangle ΔXYZ. The area of the shaded region of the circle is 2π cm^2.** **[2]**



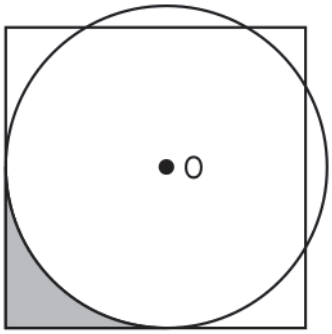
(Note: The figure is not to scale.)

What is the radius of the circle? Show your steps and give valid reasons.

Q: 11 **A point P lies on a circle. Two friends, Priya and Sumedha, drew tangents to the circle at point P.** **[1]**

What is the probability that their tangents coincide? Give a valid reason for your answer.

Q: 12 **Shown below is a circle and a square. The circle with centre O has a radius of 4 cm.** **[3]**



(Note: The figure is not to scale.)

Find the area of the shaded region. Show your work and give valid reasons.

(Note: If needed, take π as 3.14.)

Q: 13 **Given below are two equations.** **[2]**

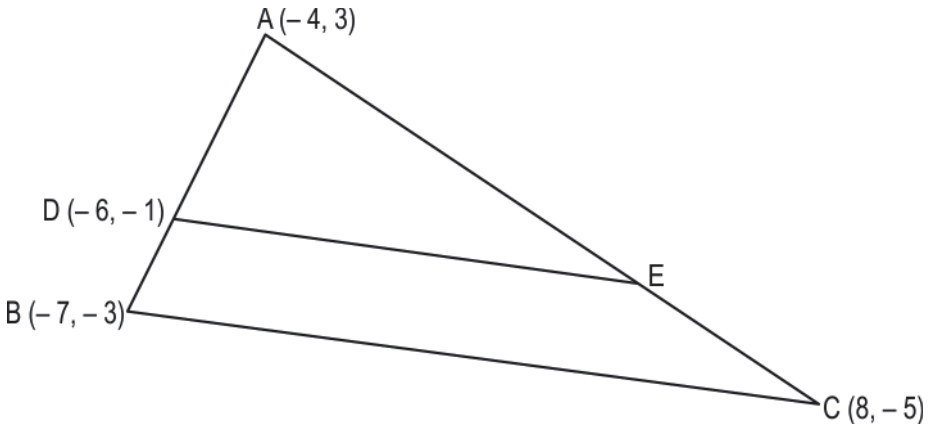
$$49^{(x+3y)} = 7$$
$$7^{(4x+12y)} = 49^4$$

i) Frame a pair of linear equations in two variables by simplifying the given equations.
ii) Do these linear equations form a pair of coincident lines? Justify your answer.

Q: 14 **A rhombus PQRS has a side length of 5.8 cm and a diagonal QR of length 8.4 cm.** **[2]**

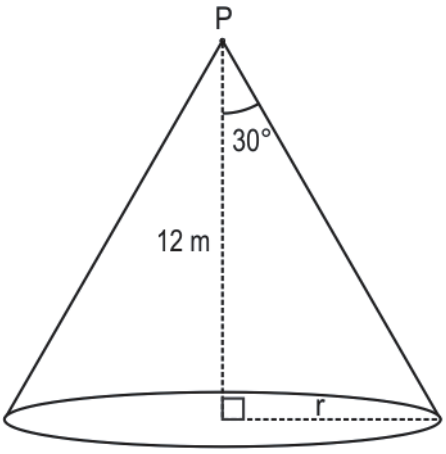
Use a ruler and compass to draw the rhombus PQRS.

Q: 15 **In the figure shown below, DE || BC.** **[3]**

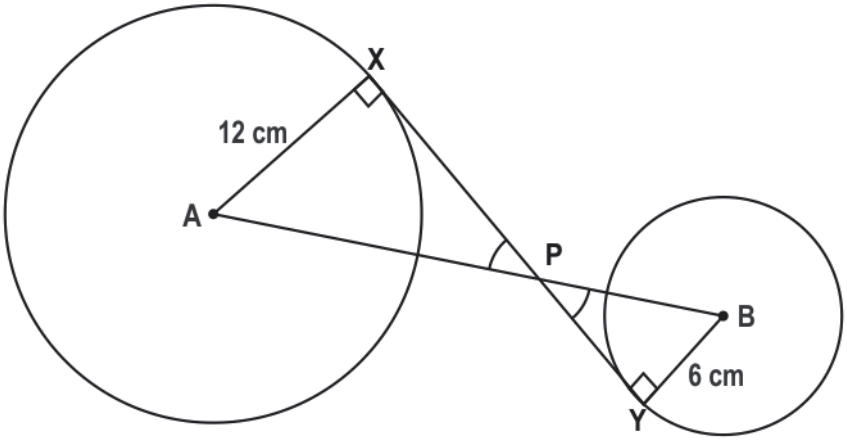


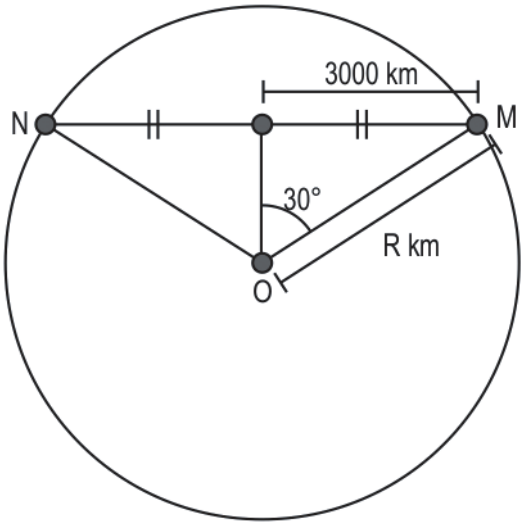
(Note: The figure is not to scale.)

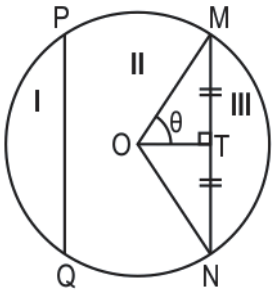
Find the coordinates of point E. Show your work and give valid reasons.

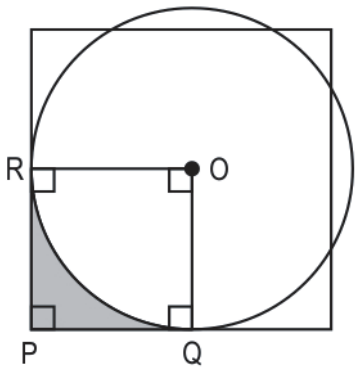
Q.No	**Teacher should award marks if students have done the following:**	Marks
1	**Draws a rough figure representing the given information. It may look as follows:**  	**0.5**
	Assumes the radius of the circular region to be *r* and finds the value of *r* as 12(tan30°) = 4√3 m.	**1.5**
	Finds the area of the illuminated circular region as π × $(4\sqrt{3})^2$ = 48π m^2.	**1**
2	**Finds the lengths of the tangents RQ and PQ as 10√3 cm each, either by applying the Pythagoras theorem as √(20^2 - 10^2) or by considering RQ and PQ as 10tan60°.**	**0.5**
	Finds the area of ΔORQ as $\frac{1}{2}$ × 10 × 10√3 = 50√3 cm^2. **Similarly, finds the area of ΔOPQ as 50√3 cm^2.**	**0.5**
	Finds the area of the quadrilateral PQRO as 2 × 50√3 = 100√3 cm^2.	**0.5**
	Finds the area of the minor sector OPR as: $\frac{120°}{360°} \times \pi \times (10)^2$ $= \frac{100\pi}{3}\ cm^2$ **(Award 0.5 marks if only the formula for area of a sector is correctly written.)**	**1**

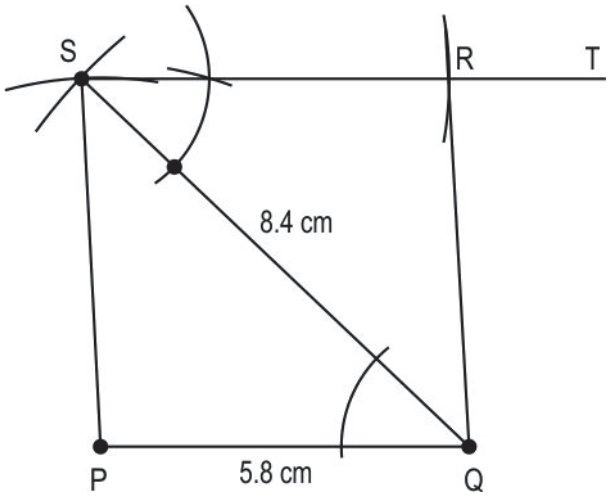
Q.No	**Teacher should award marks if students have done the following:**	Marks
	Finds the area occupied by the shaded region as: **(Area of the quadrilateral PQRO) - (Area of the minor sector OPR)** **= $100\sqrt{3}$ cm^2 - $\frac{100\pi}{3}$ cm^2** **(Award full marks if the correct answer is obtained by an alternate method.)**	**0.5**
3	**Finds the radius of the circle using the distance formula between (0, 0) and (9, 12) as 15 units.**	**1**
	Concludes that (15, 0) is a point on the circle and the line *m* being a tangent touches the circle at only one point, the line cannot pass through the point (15, 0). **(Award full marks if graphical representation is used to conclude the answer.)**	**1**
4	**Simplifies the given equation as:** **$3\frac{\cos\theta}{\sin\theta} + \frac{\sin\theta}{\cos\theta} = 5\frac{1}{\cos\theta}$** **$\Rightarrow 3\cos^2\theta + \sin^2\theta - 5\sin\theta = 0$**	**0.5**
	Simplifies the above equation as: **$2\sin^2\theta + 5\sin\theta - 3 = 0$**	**0.5**
	Factorises the above equation to get $\sin\theta = \frac{1}{2}$ or (-3).	**1**
	Writes that $\sin\theta$ cannot be equal to (-3) as $0 \leq \sin\theta \leq 1$ and hence concludes that $\sin\theta = \frac{1}{2}$.	**0.5**
	Uses the above step to find the value of θ as 30° since $\sin 30° = \frac{1}{2}$.	**0.5**
5	**Identifies that at PR = 25 cm, ΔPQR is a right-angled triangle. Hence, for obtuse-angled triangle, PR > 25 cm.**	**1**
	Writes that PR < (24 + 7) cm or PR < 31 cm for PQR to be a triangle.	**1**

Q.No	**Teacher should award marks if students have done the following:**	Marks
	Uses the above steps and finds the probability that a card chosen at random makes ΔPQR an OBTUSE angled triangle at Q as $\frac{5}{40}$.	**1**
6	**Draws the figure by joining AB, AX and YB. The figure may look as follows:**  ***(Note: The figure is not to scale.)***	**0.5**
	Writes that in ΔAXP and ΔBYP: **∠AXY = ∠XYB = 90° (as tangent is ⊥ to radius)** **∠APX = ∠BPY (vertically opposite angles)** **Conclude that ΔAXP ~ ΔBYP by using the AA similarity criterion.**	**1.5**
	Uses the above step and writes: $\frac{AP}{PB} = \frac{XP}{PY} = \frac{AX}{BY} = \frac{12}{6} = 2$ **=> AP = 2PB.** **Uses AP + PB = 30 (given) and AP = 2PB to get PB as 10 cm and AP as 20 cm.**	**1.5**
	Uses the Pythagoras theorem for ΔBYP and finds PY as 8 cm. **Finds XP as 16 cm by using the ratio XP = 2PY.** **(Award full marks if the Pythagoras theorem is used for ΔAXP and ΔBYP to find the lengths of XP and PY respectively.)**	**1**

Q.No	**Teacher should award marks if students have done the following:**	Marks
	Finds the length of the wire, XY as 16 + 8 = 24 cm.	**0.5**
7	**Draws a rough diagram representing the given situation. The diagram may look as follows:**  ***(Note: The figure is not drawn to scale.)***	**1**
	Finds the radius of the circle, R as $\frac{3000}{\sin 30°}$ = 6000 km.	**1**
	Finds the actual distance covered by the flight as $\frac{60°}{360°} \times 2 \times 3.14 \times 6000 = 6280$ km. **(Award 0.5 marks if only the formula for the arc length is correctly written.)**	**1**
8	**Uses tan $x = \frac{3}{4}$ for ΔPQT and PT = 10 cm to find the length of PQ and QT as 6 cm and 8 cm respectively.**	**1**
	Writes that in ΔPQT and ΔPRS: **∠PQT = ∠PRS = 90°** **∠QPT = ∠RPS (common angle)** **Concludes that ΔPQT ~ ΔPRS by using the AA similarity criterion.**	**0.5**

Q.No	**Teacher should award marks if students have done the following:**	Marks
	Uses the above two steps and writes the relation as: $\frac{PQ}{PR} = \frac{QT}{RS}$ $\Rightarrow \frac{6}{9} = \frac{8}{RS}$ $\Rightarrow RS = 12$ cm	**1**
	Finds the area of quadrilateral RSTQ as $\frac{1}{2} \times (8 + 12) \times 3 = 30$ sq cm.	**0.5**
9	**Draws a rough diagram. The diagram may look as follows:**  	**1**
	Writes that $\sin\theta = \frac{24\sqrt{3}}{48} = \frac{\sqrt{3}}{2}$ and finds the angle subtended by the chord at the centre as $2 \times 60° = 120°$.	**1**
	Finds the area of the sector with central angle of 120° as $\frac{120°}{360°} \times \pi \times (48)^2 = 768\pi$ ft^2 . **(Award 0.5 marks if only the formula for the area of a sector is correctly written.)**	**1**
	Finds the height OT of ΔMON as: $\cos 60° = \frac{OT}{48}$ $\Rightarrow OT = 24$ ft **(Award full marks if Pythagoras' theorem is correctly used to find the height.)**	**1**
	Finds the area of ΔMON as $\frac{1}{2} \times 48\sqrt{3} \times 24 = 576\sqrt{3}$ ft^2.	**0.5**

Q.No	**Teacher should award marks if students have done the following:**	Marks
	Finds the area of the segments (I + III) as $2(768\pi - 576\sqrt{3})$ or $384(4\pi - 3\sqrt{3})$ ft^2.	**0.5**
10	**Writes that ∠PZQ = 60° and gives the reason that ΔXYZ is an equilateral triangle.** **Writes that ∠ZPO = ∠ZQO = 90° and gives the reason that the tangent at any point of a circle is perpendicular to the radius through the point of contact.** **Finds ∠POQ as 360° - 90° - 90° - 60° = 120° and gives the reason that the sum of internal angles of a quadrilateral is 360°.**	**1**
	Uses the area of the shaded region of the circle and finds the radius of the circle, *r*, as: **$2\pi = \frac{120°}{360°} \times \pi r^2$** **$\Rightarrow r = \sqrt{6}$ cm**	**1**
11	**Writes that the probability of their tangents coinciding is 1 and gives a reason. For example, writes that there is only one tangent at any point on the circumference of the circle.**	**1**
12	**Writes that radius of a circle is perpendicular to the tangent at the point of contact and draws two radii. The figure may look as follows:**  **(Award 1 mark if an equivalent explanation is written without a figure.)**	**1**
	Writes that PQOR is a square and finds its area as $4 \times 4 = 16$ cm^2.	**0.5**

Q.No	**Teacher should award marks if students have done the following:**	Marks
	Writes that QOR is a quadrant and finds its area as $\frac{90}{360} \times 3.14 \times 4 \times 4 = 12.56\ cm^2$.	**1**
	Finds the area of the shaded region as $16 - 12.56 = 3.44\ cm^2$.	**0.5**
13	**i) Frames the pair of linear equations in two variables using the given information as:** **$2x + 6y = 1$** **$4x + 12y = 8$** **(Award 0.5 marks for each correct linear equation in two variables.)**	**1**
	ii) Writes that these linear equations do not form a pair of coincident lines.	**0.5**
	Justifies the answer. For example, writes that $\frac{2}{4} = \frac{6}{12} \neq \frac{1}{8}$.	**0.5**
14	**Draws the base PQ of length 5.8 cm, diagonal QS of length 8.4 cm and PS of length 5.8 cm.**	**0.5**
	Draws a ray ST parallel to PQ by making ∠PQS equal to ∠TSQ.	**1**
	Cuts a length of 5.8 cm from S and joins SR and QR to get the rhombus PQRS.	**0.5**
	The construction may look as follows:  	**0**

Q.No	**Teacher should award marks if students have done the following:**	Marks
15	**Assumes that D divides AB in ratio *m* : *n* and uses section formula to write:** **$(-6, -1) = \left(\frac{-7m-4n}{m+n}, \frac{-3m+3n}{m+m}\right)$**	**0.5**
	Finds *m* : *n* as 2:1.	**1**
	Writes that in ΔABC, according to the Basic Proportionality Theorem (BPT) point E will divide AC in ratio 2:1 since DE || BC and D divides AB in ratio 2:1.	**0.5**
	Uses the section formula to find the coordinates of point E as: **$\left(\frac{8(2)+(-4)(1)}{2+1}, \frac{(-5)(2)+3(1)}{2+1}\right)$**	**0.5**
	Evaluates the above expressions to find the coordinates of point E as $(4, \frac{-7}{3})$.	**0.5**

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Academic Unit, 17 Rouse Avenue, New Delhi -110002