

KENDRIYA VIDYALAYA SANGATHAN

Zonal Institute of Education and Training, Gwalior



तत् त्वं पूषन् अपावृणु
केन्द्रीय विद्यालय संगठन

Graded Worksheet

Class -09

Mathematics (Ganit Manjari -1)

Session 2026-27

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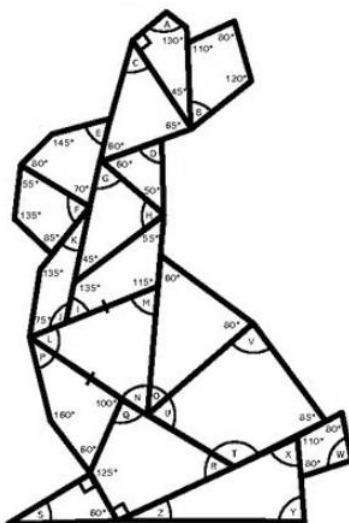
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CLASS 9 – MATHEMATICS (Ganita Manjari-01)

Chapter 1: Orienting Yourself – The Use of Coordinates

Time Allowed: 20 minutes	Maximum Marks: 25
Name: _____	Roll No. / Section: _____

Section A – Multiple Choice Questions ($1 \times 9 = 9$ Marks)

Q.No	Question	Marks
1	The point (0, 0) in a Cartesian plane is called the: (a) Abscissa (b) Origin (c) Ordinate (d) Quadrant	1
2	In which quadrant does the point $(-3, 4)$ lie? (a) I (b) II (c) III (d) IV	1
3	The x-coordinate of a point is also known as its: (a) Ordinate (b) Abscissa (c) Origin (d) None of these	1
4	The perpendicular distance of the point (a, b) from the x-axis is: (a) a (b) b (c) $a + b$ (d) $\sqrt{a^2 + b^2}$	1
5	A point lying on the y-axis has its x-coordinate equal to: (a) 0 (b) 1 (c) equal to its y-coordinate (d) always negative	1
6	In the third quadrant, the signs of the coordinates (x, y) are: (a) (+, +) (b) (–, +) (c) (–, –) (d) (+, –)	1
7	The distance between the points (0, 0) and (3, 4) is: (a) 5 units (b) 7 units (c) 3 units (d) 4 units	1
8	The two axes of a Cartesian plane intersect each other at the: (a) Quadrant (b) Origin (c) Abscissa (d) Ordinate	1
9	The mid-point of the line segment joining (2, 3) and (4, 7) is: (a) (3, 5) (b) (6, 10) (c) (1, 2) (d) (2, 4)	1

Section B – Assertion-Reason Questions ($1 \times 2 = 2$ Marks)

Each question below consists of an Assertion (A) and a Reason (R). Choose the correct option: (a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is NOT the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.

Q.No	Question	Marks
1	Assertion (A): The point $(-2, -5)$ lies in the third quadrant. Reason (R): In the third quadrant, both the x-coordinate and the y-coordinate of a point are negative.	1
2	Assertion (A): The distance between two points (x_1, y_1) and (x_2, y_2) is given by $\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$. Reason (R): This distance formula is based on the Pythagoras theorem, known in ancient India as the Baudhāyana theorem.	1

Section C – Short Answer Questions ($2 \times 2 = 4$ Marks)

Q.No	Question	Marks
1	Write the coordinates of the origin. Also state into how many quadrants the two coordinate axes divide a plane.	2
2	Find the distance between the points $A(3, 4)$ and $B(0, 0)$.	2

Section D – Short Answer Questions ($3 \times 2 = 6$ Marks)

Q.No	Question	Marks
1	Plot the points $A(2, 3)$, $B(-2, 3)$, $C(-2, -3)$ and $D(2, -3)$ on graph paper. Name the figure formed by joining these points in order and find its dimensions.	3
2	Find the coordinates of the mid-point of the line segment joining $P(-3, 5)$ and $Q(7, -1)$. Also state the quadrant in which P and Q respectively lie.	3

Section E – Case Study Based Question (4 Marks)

Reiaan wants to arrange the furniture in his rectangular room. He marks the origin O at one corner of the room, drawing the x-axis along one wall and the y-axis along the adjacent wall. All distances are measured in metres. On this plan, the study table T is located at $(5, 2)$, the bed B is located at $(5, 8)$, and the door D lies on the x-axis at $(9, 0)$.

Q.No	Question	Marks
1	Write the coordinates of the origin O.	1
2	On which axis does the door D lie? Give a reason.	1
3	Find the distance between the study table T and the bed B.	2

CLASS 9 – MATHEMATICS (Ganita Manjari-01)

Chapter 1: Orienting Yourself – The Use of Coordinates

ANSWER KEY

Section A – MCQ Answers

1. (b) Origin
2. (b) II
3. (b) Abscissa
4. (b) b
5. (a) 0
6. (c) $(-, -)$
7. (a) 5 units
8. (b) Origin
9. (a) (3, 5)

Section B – Assertion-Reason Answers

1. (a) Both A and R are true, and R is the correct explanation of A.
2. (a) Both A and R are true, and R is the correct explanation of A.

Section C – Short Answer (2 Marks) Answers

1. Origin = (0, 0). The two axes divide the plane into 4 quadrants.
2. $AB = \sqrt{(3-0)^2 + (4-0)^2} = \sqrt{9+16} = \sqrt{25} = 5$ units.

Section D – Short Answer (3 Marks) Answers

1. $AB = 4$ units, $BC = 6$ units, $CD = 4$ units, $DA = 6$ units $\rightarrow$ opposite sides equal and all angles 90° , so ABCD is a rectangle of dimensions 4 units $\times$ 6 units.
2. Mid-point = $((-3+7)/2, (5+(-1))/2) = (2, 2)$. P(-3, 5) lies in the II quadrant; Q(7, -1) lies in the IV quadrant.

Section E – Case Study Answers

- (i) O = (0, 0) [1 mark]
- (ii) D lies on the x-axis, because its y-coordinate is 0. [1 mark]
- (iii) $TB = \sqrt{(5-5)^2 + (8-2)^2} = \sqrt{0+36} = 6$ metres. [2 marks]

CLASS 9 – MATHEMATICS (Ganita Manjari-01)

Chapter 2: Introduction to Linear Polynomials

Time Allowed: 20 minutes	Maximum Marks: 25
Name: _____	Roll No. / Section: _____

Section A

11 Questions × 1 Mark = 11 Marks (Q1–Q9: MCQs, Q10–Q11: Assertion–Reason)

Q.No	Question	Marks
Q1	What is the degree of the polynomial $p(x) = 7x - 5$? (a) 0 (b) 1 (c) 2 (d) -5	1
Q2	Identify the coefficient of x in the algebraic expression $4 - 3x + x^2$: (a) 4 (b) -3 (c) 1 (d) 3	1
Q3	If the height of a growing plant after t days is given by $h(t) = 5 + 0.4t$ cm, what was the initial height of the plant? (a) 0.4 cm (b) 5 cm (c) 5.4 cm (d) 0 cm	1
Q4	What is the zero of the linear polynomial $p(x) = 2x + 8$? (a) 4 (b) -4 (c) 8 (d) -8	1
Q5	Which of the following represents a linear polynomial in one variable? (a) $x^2 + 3x + 1$ (b) $3/x + 2$ (c) $5y - 7$ (d) $x + y = 4$	1
Q6	The cost $C(n)$ in rupees for renting a bicycle for n hours is $C(n) = 50 + 20n$. What does the constant term 50 represent? (a) Hourly charge (b) Fixed base charge (c) Total charge for 1 hour (d) Discount amount	1
Q7	If a line representing a linear polynomial pass through the origin $(0, 0)$, its y -intercept is: (a) 1 (b) 0 (c) -1 (d) Undefined	1
Q8	Evaluating the polynomial $p(x) = -3x + 12$ at $x = 4$ gives: (a) 0 (b) 24 (c) 12 (d) -4	1
Q9	If the n th term of a linear sequence is given by $T_n = 3n + 2$, what is the 5th term? (a) 15 (b) 12 (c) 17 (d) 10	1

Directions for Q10 & Q11: Each question below consists of an Assertion (A) and a Reason (R). Choose the correct option: (a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is NOT the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.

Q.No	Question	Marks
Q10	Assertion (A): The expression $p(x) = 5x^0$ is a constant polynomial with degree 0. Reason (R): Every non-zero real number is a constant polynomial of degree 0.	1

Q11	Assertion (A): The graph of $y = -2x + 5$ goes downward from left to right as x increases. Reason (R): A linear polynomial $y = mx + c$ slopes downward when its coefficient of x (slope m) is negative.	1
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Section B

1 Question $\times$ 2 Marks + 1 Question $\times$ 3 Marks = 5 Marks

Q.No	Question	Marks
Q12	A student starts with ₹1,200 in a savings account and deposits ₹300 every month. Write a linear expression for the total amount in the account after m months. Calculate the balance after 6 months.	2
Q13	The sum of the ages of a mother and her daughter is 48 years. The mother is 26 years older than the daughter. Write a linear equation to represent this situation and find their present ages.	3

Section C

1 Question $\times$ 5 Marks = 5 Marks

Q.No	Question	Marks
Q14	Consider the linear equation $y = 2x - 4$. (i) Rewrite the equation and identify its slope (m) and y -intercept (c). [1 mark] (ii) Find the x -intercept (the point where $y = 0$). [1 mark] (iii) Find the value of y when $x = -2$ and $x = 3$. [2 marks] (iv) State whether the graph of this line moves "upward" or "downward" from left to right as x increases, and justify your answer. [1 mark]	5

Section D: Case-Based Question

1 Question $\times$ 4 Marks = 4 Marks

Q.No	Question	Marks
Q15	Q15. Pattern Analysis using Matchsticks A student forms a growing pattern of squares using matchsticks. One square takes 4 matchsticks. Each subsequent square is added side-by-side, sharing one inner boundary wall with the previous square. Stage 1 (1 Square): 4 matchsticks Stage 2 (2 Squares): 7 matchsticks Stage 3 (3 Squares): 10 matchsticks Based on the information above, answer the following questions: (i) How many matchsticks will be required to build Stage 4 (4 squares)? [1 mark] (ii) Write the general linear rule/formula for the number of matchsticks required for the nth stage. [1 mark] (iii) How many matchsticks are needed for Stage 15? [2 marks] OR (iii) If a student has 49 matchsticks, what is the maximum number of squares (stage number) they can construct in this pattern? [2 marks]	4

Answer Key

Periodic Test: Mathematics (Class 9) — Chapter 2: Introduction to Linear Polynomials

Section A (MCQs & Assertion-Reason)

Q.No	Answer	Solution / Explanation
Q1	(b) 1	$p(x) = 7x - 5$ has highest power of x equal to 1, so degree = 1.
Q2	(c) -3	In $4 - 3x + x^2$, the term with x is $-3x$, so coefficient of $x = -3$.
Q3	(b) 5 cm	Initial height is at $t = 0$: $h(0) = 5 + 0.4(0) = 5$ cm.
Q4	(b) -4	Set $2x + 8 = 0 \Rightarrow x = -4$.
Q5	(c) $5y - 7$	It is degree 1 in a single variable y ; others have degree 2, two variables, or aren't a polynomial expression.
Q6	(b) Fixed base charge	The constant term (50) is the charge when $n = 0$, i.e., the fixed base charge.
Q7	(b) 0	A line through the origin passes through (0,0), so its y -intercept is 0.
Q8	(a) 0	$p(4) = -3(4) + 12 = -12 + 12 = 0$.
Q9	(c) 17	$T_5 = 3(5) + 2 = 15 + 2 = 17$.
Q10	(a)	$x^0 = 1$, so $p(x) = 5(1) = 5$, a non-zero constant — a degree-0 polynomial. R correctly explains A.
Q11	(a)	Slope $m = -2$ (negative), so the line falls left to right. R correctly explains A.

Section B

Q.No	Answer	Solution / Explanation
Q12	₹3,000	Linear expression: $A(m) = 1200 + 300m$ Balance after 6 months: $A(6) = 1200 + 300(6) = 1200 + 1800 = ₹3,000$
Q13	Daughter: 11 yrs; Mother: 37 yrs	Let daughter's age = x years, mother's age = $x + 26$ years. $x + (x + 26) = 48 \Rightarrow 2x + 26 = 48 \Rightarrow 2x = 22 \Rightarrow x = 11$ Daughter's age = 11 years; Mother's age = $11 + 26 = 37$ years.

Section C

Q.No	Answer	Solution / Explanation
Q14	See solution	(i) $y = 2x - 4 \Rightarrow$ slope $m = 2$, y -intercept $c = -4$ (ii) x -intercept: set $y = 0 \Rightarrow 0 = 2x - 4 \Rightarrow x = 2$, so x -intercept is (2, 0) (iii) At $x = -2$: $y = 2(-2) - 4 = -8$. At $x = 3$: $y = 2(3) - 4 = 2$ (iv) Upward — because the slope $m = 2$ is positive, so y increases as x increases.

Section D: Case-Based Question

Q.No	Answer	Solution / Explanation
Q15	See solution	(i) Stage 4: 13 matchsticks (add 3 for each new square: 4, 7, 10, 13...) (ii) General rule: $T_n = 3n + 1$ (iii) Stage 15: $T_{15} = 3(15) + 1 = 46$ matchsticks OR (iii) $3n + 1 = 49 \Rightarrow 3n = 48 \Rightarrow n = 16$, so 16 squares can be built.

CLASS 9 – MATHEMATICS (Ganita Manjari-01)

Chapter 3: The World of Numbers

Time Allowed: 20 minutes	Maximum Marks: 25
Name: _____	Roll No. / Section: _____

SECTION A — Multiple Choice Questions ($9 \times 1 = 9$ marks)

Q.No	Question	Marks
1	The set of Natural Numbers is denoted by: (a) $\mathbb{Z}$ (b) $\mathbb{N}$ (c) $\mathbb{Q}$ (d) $\mathbb{R}$	1
2	Which mathematician gave explicit rules of arithmetic that transformed zero into a fully operational number? (a) Āryabhaṭa (b) Hippasus (c) Brahmagupta (d) Mādhava of Sangamagrama	1
3	The Ishango bone contains a column of notches grouped as 11, 13, 17 and 19. These numbers are all: (a) even numbers (b) prime numbers (c) perfect squares (d) multiples of 3	1
4	According to Brahmagupta's rules, the product of two debts, $(-3) \times (-4)$, is: (a) -12 (a debt) (b) 12 (a fortune) (c) 0 (d) cannot be determined	1
5	Which of the following numbers is irrational? (a) 0.375 (b) $22/7$ (as a fraction) (c) $\sqrt{2}$ (d) 0.6 ($0.666\dots$)	1
6	A rational number p/q (in lowest terms) has a terminating decimal expansion when the prime factors of q are: (a) only 3 and 7 (b) only 2 and/or 5 (c) any prime number (d) only 11 and 13	1
7	The decimal expansion of $1/7$ is: (a) terminating (b) purely repeating (non-terminating) (c) non-terminating and non-repeating (d) none of these	1
8	The exact infinite series for π , $\pi = 4 \times (1 - 1/3 + 1/5 - 1/7 + \dots)$, was discovered by: (a) Brahmagupta (b) Āryabhaṭa (c) Mādhava of Sangamagrama (d) Johann Lambert	1
9	$0.9999\dots$ (recurring) is: (a) slightly less than 1 (b) exactly equal to 1 (c) an irrational number (d) undefined	1

SECTION B — Assertion-Reason Questions ($2 \times 1 = 2$ marks)

Directions: Each question below consists of an Assertion (A) and a Reason (R). Choose the correct option:

- (a) Both A and R are true, and R is the correct explanation of A.
- (b) Both A and R are true, but R is NOT the correct explanation of A.
- (c) A is true, but R is false.
- (d) A is false, but R is true.

Q.No	Assertion (A) / Reason (R)	Marks
10	Assertion (A): $\sqrt{2}$ is an irrational number. Reason (R): $\sqrt{2}$ cannot be expressed in the form p/q , where p and q are integers and $q \neq 0$.	1

Q.No	Assertion (A) / Reason (R)	Marks
11	Assertion (A): Every rational number can be represented by a unique point on the number line. Reason (R): Rational numbers are dense — between any two rational numbers, there exists another rational number.	1

SECTION C — Case-Based Question (4 marks)

12. Read the following passage carefully and answer the questions that follow.

Not every length can be measured using a rational number. To construct and visualise irrational lengths such as $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, ... geometrically, mathematicians use a classic construction called the Square Root Spiral. Starting from a point O, a line segment OA_1 of length 1 unit is drawn. At A_1 , a perpendicular of length 1 unit is drawn to reach A_2 ; by the Baudhāyana–Pythagoras Theorem, $OA_2 = \sqrt{2}$. At A_2 , another perpendicular of length 1 unit is drawn to reach A_3 , giving $OA_3 = \sqrt{3}$. This process repeats, with each new triangle using the previous hypotenuse as one leg, and a fixed unit length as the other leg, spiralling outward as shown below.

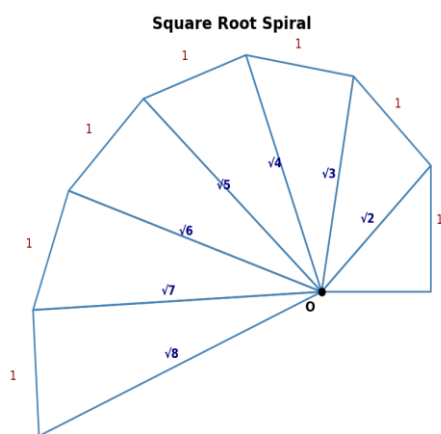


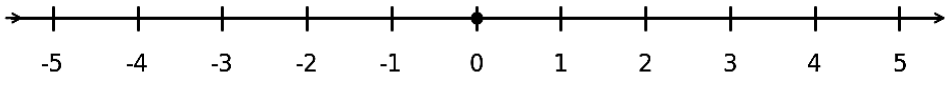
Fig: The Square Root Spiral

Part	Question	Marks
(i)	In the first right triangle, both legs are 1 unit long. Find the length of the hypotenuse OA_1 using the Pythagoras theorem.	1
(ii)	The second right triangle has legs of length OA_1 (found above) and 1 unit. Find the length of the hypotenuse OA_2 .	1
(iii)	The fifth hypotenuse OA_5 has legs $OA_4 = \sqrt{5}$ and 1 unit. Find OA_5 and state, with a reason, whether it is rational or irrational.	2

SECTION D — Short Answer Questions ($2 \times 2 = 4$ marks)

Q.No	Question	Marks
13	Convert the pure repeating decimal 0.6 (that is, 0.6666...) into the form p/q , showing all steps.	2
14	State Brahmagupta's rule for the product of two debts. Verify this rule by evaluating $(-7) \times (-3)$.	2

SECTION E — Long Answer Questions (2 ×3 = 6 marks)

Q.No	Question	Marks
15	Prove, using the method of Proof by Contradiction, that $\sqrt{3}$ is an irrational number.	3
16	Represent the integers -4, 0 and 3 on a number line (a labelled reference figure is given below). Using this figure, briefly explain Brahmagupta's concepts of Fortunes (Dhana) and Debts (Ṛiṇa). Negative Integers ← Debt (Ṛiṇa) Fortunes (Dhana) → Positive Integers  Zero (Śhūnya) 	3

ANSWER KEY

Chapter 3: The World of Numbers — Ganita Manjari, Grade 9

Maximum Marks: 25

SECTION A — Multiple Choice Questions ($9 \times 1 = 9$ marks)

Q.No	Correct Answer	Marks
1	(b) $\mathbb{N}$	1
2	(c) Brahmagupta	1
3	(b) prime numbers	1
4	(b) 12 (a fortune)	1
5	(c) $\sqrt{2}$	1
6	(b) only 2 and/or 5	1
7	(b) purely repeating (non-terminating)	1
8	(c) Mādhava of Sangamagrama	1
9	(b) exactly equal to 1	1

SECTION B — Assertion-Reason Questions ($2 \times 1 = 2$ marks)

Q.No	Correct Answer & Brief Justification	Marks
10	(a) Both A and R are true, and R is the correct explanation of A. $\sqrt{2}$ being irrational is defined precisely by the fact that it cannot be written as p/q with p, q integers and $q \neq 0$. So R correctly explains A.	1
11	(b) Both A and R are true, but R is NOT the correct explanation of A. Every rational number does correspond to a unique point on the number line (A is true), and rational numbers are indeed dense (R is true). However, density explains why infinitely many rationals lie between two points — it does not explain why a single rational number has a unique position on the line. Hence R is not the correct explanation of A.	1

SECTION C — Case-Based Question (4 marks)

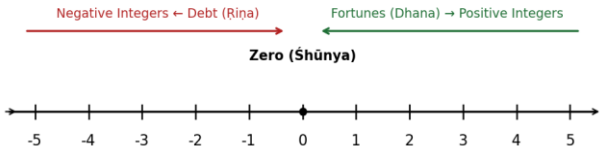
Fig: The Square Root Spiral

Part	Solution	Marks
(i)	By the Pythagoras theorem: $OA_1^2 = 1^2 + 1^2 = 2$. So $OA_1 = \sqrt{2}$ units.	1
(ii)	$OA_2^2 = (OA_1)^2 + 1^2 = (\sqrt{2})^2 + 1^2 = 2 + 1 = 3$. So $OA_2 = \sqrt{3}$ units.	1
(iii)	$OA_5^2 = (OA_4)^2 + 1^2 = (\sqrt{5})^2 + 1^2 = 5 + 1 = 6$. So $OA_5 = \sqrt{6}$ units. $\sqrt{6}$ is an irrational number, because 6 is not a perfect square and cannot be expressed in the form p/q where p, q are integers and $q \neq 0$ (its decimal expansion is non-terminating and non-repeating).	2

SECTION D — Short Answer Questions ($2 \times 2 = 4$ marks)

Q.No	Solution	Marks
13	Let $x = 0.6 = 0.6666\dots$ Multiply both sides by $10^1 = 10$ (one digit repeats): $10x = 6.6$ Subtract: $10x - x = 6.6 - 0.6 \Rightarrow 9x = 6$ So $x = 6/9 = 2/3$.	2
14	Brahmagupta's rule: The product of two debts is a fortune, i.e. $(-a) \times (-b) = +ab$. Verification: $(-7) \times (-3) = 21$, which is positive (a fortune), confirming the rule.	2

SECTION E — Long Answer Questions ($2 \times 3 = 6$ marks)

Q.No	Solution	Marks
15	Proof by contradiction: Assume $\sqrt{3}$ is rational. Then $\sqrt{3} = p/q$, $q \neq 0$, where p, q are co-prime integers. Squaring: $3 = p^2/q^2 \Rightarrow p^2 = 3q^2$. So p^2 is divisible by 3, which means p is divisible by 3 (since 3 is prime). Let $p = 3k$. Substituting: $(3k)^2 = 3q^2 \Rightarrow 9k^2 = 3q^2 \Rightarrow q^2 = 3k^2$. So q^2 is divisible by 3, meaning q is also divisible by 3. This means p and q share a common factor of 3, contradicting our assumption that p and q are co-prime. Hence, our assumption is wrong, and $\sqrt{3}$ is irrational.	3
16	On the number line, -4 lies 4 units to the left of 0, and 3 lies 3 units to the right of 0 (see figure). Fortunes (Dhana): Positive integers such as 3 represent wealth or assets — amounts a person owns. Debts (Riṇa): Negative integers such as -4 represent amounts owed — a deficit or liability. Zero (Śhūnya) is the reference point, representing neither profit nor loss. 	3

CLASS 9 – MATHEMATICS (Ganita Manjari-01)

Chapter 4: Exploring Algebraic Identities

Time Allowed: 20 minutes	Maximum Marks: 25
Name: _____	Roll No. / Section: _____

Section A — Multiple Choice & Assertion-Reason Questions (1 mark each)

Q.No	Question	Marks
1	An algebraic identity is an equation that is true for: (a) only one value of the variable (b) only two values of the variable (c) all values of the variable (d) no value of the variable	1
2	The expansion of $(a + b)^2$ is: (a) $a^2 + b^2$ (b) $a^2 - 2ab + b^2$ (c) $a^2 + 2ab + b^2$ (d) $a^2 + ab + b^2$	1
3	$(5x + 2y)^2$ is equal to: (a) $25x^2 + 20xy + 4y^2$ (b) $25x^2 + 10xy + 4y^2$ (c) $25x^2 + 4y^2$ (d) $25x^2 + 20xy + 2y^2$	1
4	Using a suitable identity, the value of 43^2 is: (a) 1849 (b) 1936 (c) 1764 (d) 1600	1
5	The value of $(525)^2 - (475)^2$ is a. 500 b. 1000 c. 50000 d. -100	1
6	If $a = 10$ and $b = 2$, then which relation is correct? (a) $(a + b)^2 < a^2 + b^2$ (b) $(a + b)^2 = a^2 + b^2$ (c) $(a + b)^2 > a^2 + b^2$ (d) cannot be determined	1
7	The factors of $x^2 + 4x + 4$ are: (a) $(x + 2)(x + 2)$ (b) $(x + 4)(x + 4)$ (c) $(x - 2)(x - 2)$ (d) $(x + 1)(x + 4)$	1
8	The factorization of $6x^2 + 11x + 3$ is a. $(3x + 1)(2x + 3)$ b. $(x + 3)(2x + 1)$ c. $(x + 1)(2x + 3)$ d. $(3x + 3)(x + 1)$	1

9	The expansion of $(a + b + c)^2$ is: (a) $a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$ (b) $a^2 + b^2 + c^2 + ab + bc + ca$ (c) $a^2 + b^2 + c^2$ (d) $a^2 + b^2 + c^2 + 2ab$	1
10	Assertion (A): $(a + b)^2 = a^2 + 2ab + b^2$ is true for all real numbers a and b. Reason (R): An algebraic identity is an equation that is true only for some specific values of the variables occurring in it. (a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.	1
11	Assertion (A): $(x - y)$ is a factor of $(x^4 - y^4)$. Reason (R): $x^4 - y^4 = (x^2 - y^2)(x^2 + y^2)$, and $x^2 - y^2 = (x - y)(x + y)$. (a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.	1
Section B — Short Answer Questions (2 marks each)		
12	Using a suitable identity, expand $(2x - 3y)^3$	2
13	Factorise $9x^2 + 24xy + 16y^2$ using a suitable identity.	2
Section C — Short Answer Questions (3 marks each)		
14	Factorise: $4x^2 + 9y^2 + 16z^2 + 12xy - 24yz - 16xz$	3
15	Without finding the cubes, factorise $(x - 2y)^3 + (2y - 3z)^3 + (3z - x)^3$	3
Section D — Case-Based Question (4 marks)		
16	Simran is an engineer. She has a beautiful house. She made a beautiful rectangular garden and a swimming pool in her house. Area of the garden is $x^2 - 3x - 4$. (i) What are the dimensions of the garden? (ii) Find the perimeter of the garden. (iii) If length is increased by x units then, what will be the total area of the garden? (OR) What will be the total cost of preparing the garden, if the cost per sq unit is Rs.50	1+ 1+ 2= 4

ANSWERS

Chapter 4: Exploring Algebraic Identities

Q.No	Answer
1	(c) all values of the variable
2	(c) $a^2 + 2ab + b^2$
3	(a) $25x^2 + 20xy + 4y^2$
4	(a) 1849
5	© 50000
6	(c) $(a + b)^2 > a^2 + b^2$
7	(a) $(x + 2)(x + 2)$
8	a. $(3x + 1)(2x + 3)$
9	(a) $a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
10	(c) A is true, but R is false (an identity is true for ALL values, not specific ones).
11	(a) Both A and R are true, and R is the correct explanation of A.
12	$8x^3 - 36x^2 + 54x - 27$
13	$(3x + 4y)^2$
14	$(2x + 3y - 4z)^2$
15	$3(x - 2y)(2y - 3z)(3z - x)$
16	(i) $(x-4)(x-1)$ (ii) $4x - 6$ (iii) $2x^2 - 2x - 4$ OR $50x^2 - 150x - 200$

CLASS 9 – MATHEMATICS (Ganita Manjari-01)

Chapter 5: I'm Up and Down, and Round and Round (Circles)

Time Allowed: 20 minutes	Maximum Marks: 25
Name: _____	Roll No. / Section: _____

Section A — Multiple Choice & Assertion-Reasoning Questions (10 × 1 = 10 Marks)

Q.No.	Question	Mark
1	The angle subtended by an arc at the centre of a circle is: (a) equal to the angle subtended by it at a point on the remaining part of the circle (b) half the angle subtended by it at a point on the remaining part of the circle (c) twice the angle subtended by it at a point on the remaining part of the circle (d) thrice the angle subtended by it at a point on the remaining part of the circle	1
2	Equal chords of a circle subtend equal angles at the: (a) minor arc (b) centre (c) major arc (d) circumference	1
3	The perpendicular drawn from the centre of a circle to a chord: (a) is parallel to the chord (b) bisects the chord (c) does not meet the chord (d) trisects the chord	1
4	If two chords of a circle are equidistant from the centre, then they are: (a) parallel to each other (b) equal in length (c) perpendicular to each other (d) unequal in length	1
5	The angle in a semicircle is: (a) 45° (b) 60° (c) 90° (d) 180°	1
6	The sum of either pair of opposite angles of a cyclic quadrilateral is: (a) 90° (b) 180° (c) 270° (d) 360°	1
7	Angles in the same segment of a circle are: (a) equal (b) supplementary (c) complementary (d) unrelated	1
8	A unique circle can be drawn through: (a) any two points (b) any three collinear points (c) any three non-collinear points (d) any four points	1
9	The longest chord of a circle is its: (a) radius (b) diameter (c) secant (d) tangent	1
10	Assertion (A): The exterior angle of a cyclic quadrilateral is equal to its interior opposite angle. Reason (R): Opposite angles of a cyclic quadrilateral are supplementary, and a linear pair of angles also adds up to 180° . (a) Both A and R are true, and R is the correct explanation of A (b) Both A and R are true, but R is not the correct explanation of A (c) A is true, but R is false	1

Q.No.	Question	Mark
	(d) A is false, but R is true	

Section B — Very Short Answer Type Questions (2 × 2 = 4 Marks)

Q.No.	Question	Marks
11	State whether the following statement is true or false. Give a reason for your answer: "A circle can pass through three collinear points."	2
12	A chord of a circle of radius 5 cm is at a distance of 3 cm from the centre. Find the length of the chord.	2

Section C — Short Answer Type Questions (2 × 3 = 6 Marks)

Q.No.	Question	Marks
13	Prove that equal chords of a circle subtend equal angles at the centre.	3
14	Two chords AB and CD of a circle are each at a distance of 4 cm from the centre O. Prove that AB = CD, stating the theorem used.	3

Section D — Case-Based Question (1 × 5 = 5 Marks)

Q.No.	Question	Marks
15	A circular park has centre O and radius 20 m. Three friends — Aman (A), Bina (B) and Chetan (C) — stand at three points on the boundary of the park such that chord AB = chord BC. The angle subtended by chord AB at the centre O is 70°. (i) What is the angle subtended by chord BC at the centre O? (1) (ii) Name the type of triangle formed by OAB (in terms of its sides). (1) (iii) A fourth friend Deepa (D) stands on the major arc AC (not containing B) such that ABCD is a cyclic quadrilateral. If $\angle ABC = 150^\circ$, find $\angle ADC$, showing your steps. (2) (iv) State the theorem/property used to find $\angle ADC$ in part (iii). (1)	5

Answer Key

Ganit Manjari — Class 9 — Chapter 5: Circles

Section A — Multiple Choice & Assertion-Reasoning Questions

Q.No.	Question	Marks
1	(c) twice the angle subtended by it at a point on the remaining part of the circle	1
2	(b) centre	1
3	(b) bisects the chord	1
4	(b) equal in length	1
5	(c) 90°	1
6	(b) 180°	1
7	(a) equal	1
8	(c) any three non-collinear points	1
9	(b) diameter	1
10	(a) Both A and R are true, and R is the correct explanation of A	1

Section B — Very Short Answer Type Questions

Q.No.	Question	Marks
11	False. A unique circle cannot pass through three collinear points. If the points were collinear, the perpendicular bisectors of the segments joining them would be parallel and never meet, so no single centre equidistant from all three points can exist.	2
12	Length of chord = 8 cm. Half-chord = $\sqrt{r^2 - d^2} = \sqrt{5^2 - 3^2} = \sqrt{25 - 9} = \sqrt{16} = 4$ cm. So the full chord = $2 \times 4 = 8$ cm.	2

Section C — Short Answer Type Questions

Q.No.	Question	Marks
13	Given: A circle with centre O, and chords $AB = CD$. To prove: $\angle AOB = \angle COD$. Proof: In $\triangle AOB$ and $\triangle COD$, $OA = OC$ (radii), $OB = OD$ (radii), $AB = CD$ (given). By SSS congruence, $\triangle AOB \cong \triangle COD$, so $\angle AOB = \angle COD$ (by CPCT). Hence, equal chords of a circle subtend equal angles at the centre.	3

14	Draw $OM \perp AB$ and $ON \perp CD$, so $OM = ON = 4$ cm (given, equidistant from centre). In right triangles OMA and OND: $OA = OD$ (radii), $OM = ON$ (given), $\angle OMA = \angle OND = 90^\circ$. By RHS congruence, $\triangle OMA \cong \triangle OND$, so $AM = DN$ (CPCT). Since the perpendicular from the centre bisects the chord, $AB = 2 \cdot AM$ and $CD = 2 \cdot DN$. As $AM = DN$, it follows that $AB = CD$. Theorem used: Equal chords of a circle are equidistant from the centre (and its converse).	3
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Section D — Case-Based Question

Q.No.	Question	Marks
15	(i) 70° — equal chords ($AB = BC$) subtend equal angles at the centre. (ii) Isosceles triangle, since $OA = OB$ (both are radii of the same circle). (iii) ABCD is a cyclic quadrilateral, so its opposite angles are supplementary: $\angle ABC + \angle ADC = 180^\circ$. Given $\angle ABC = 150^\circ$, so $\angle ADC = 180^\circ - 150^\circ = 30^\circ$. (iv) Theorem used: The sum of either pair of opposite angles of a cyclic quadrilateral is 180° (opposite angles of a cyclic quadrilateral are supplementary).	5

CLASS 9 – MATHEMATICS (Ganita Manjari-01)

CHAPTER 6: MEASURING SPACE — PERIMETER AND AREA

Time Allowed: 20 minutes	Maximum Marks: 25
Name: _____	Roll No. / Section: _____

Section A — Multiple Choice Questions (1 Mark each = 11 Marks)

Q.No.	Question	Marks
Q1	The ratio of the circumference of a circle to its diameter is called: (a) the radius (b) π (c) the area (d) the sector angle	1
Q2	The circumference of a circle of radius r is given by: (a) πr (b) $2\pi r$ (c) πr^2 (d) $2\pi r^2$	1
Q3	The area of a circle of radius r is given by: (a) $2\pi r$ (b) πr^2 (c) πr (d) $2\pi r^2$	1
Q4	If an arc of a circle of radius r subtends an angle θ° at the centre, its length is: (a) $2\pi r \times \theta/360^\circ$ (b) $\pi r^2 \times \theta/360^\circ$ (c) $\pi r \times \theta/180^\circ$ (d) $2\pi r \times \theta/180^\circ$	1
Q5	For a triangle with sides a, b, c and semi-perimeter s , Heron's formula gives the area as: (a) $\sqrt{s(s-a)(s-b)(s-c)}$ (b) $s(s-a)(s-b)(s-c)$ (c) $\sqrt{[(s-a)(s-b)(s-c)]}$ (d) $(1/2)abc$	1
Q6	The formula for the area of a cyclic 4-gon in terms of its four sides was discovered by: (a) Heron (b) Brahmagupta (c) Āryabhaṭa (d) Archimedes	1
Q7	Which of the following is the best approximation of π used for most practical calculations? (a) $\pi = 22/7$ exactly (b) $\pi \approx 22/7$ (c) $\pi = 3$ exactly (d) $\pi = 10$ exactly	1
Q8	The area of a sector of a circle of radius r , subtending an angle θ° at the centre, is: (a) $\pi r^2 \times \theta/360^\circ$ (b) $2\pi r \times \theta/360^\circ$ (c) $\pi r \times \theta/360^\circ$ (d) $\pi r^2 \times \theta/180^\circ$	1
Q9	A segment of a circle is the region bounded by: (a) two radii (b) an arc and the chord joining its endpoints (c) two chords (d) two arcs	1
	For Q10 and Q11, two statements are given — Assertion (A) and Reason (R). Choose the correct option: (a) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true.	

Q10	Assertion (A): π is an irrational number. Reason (R): A number is irrational if it cannot be written as a ratio of two integers, and its decimal expansion does not terminate or repeat.	1
Q11	Assertion (A): A median of a triangle divides it into two triangles of equal area. Reason (R): Two triangles with equal bases and equal heights (between the same parallels) always have equal areas.	1
Section B — Short Answer Type Questions		
Q12	Find the area of a triangle whose sides are 5 cm, 12 cm and 13 cm, using Heron's formula.	2
Q13	The circumference of a circle is 88 cm. Find (i) its radius, and (ii) its area. (Use $\pi = 22/7$.)	2
Section C — Short Answer Type Questions		
Q14	A sector of a circle has radius 21 cm and the angle at the centre is 60° . Find (i) the length of the arc of the sector, and (ii) the area of the sector. (Use $\pi = 22/7$.)	3
Q15	The sides of a triangular field are in the ratio 3 : 4 : 5, and its perimeter is 144 m. Find the area of the field. Hence find the cost of levelling the field at ₹5 per m^2 .	3
Section D -Case-Based Question (4 Marks)		
Q16	A school is designing a circular running track for its sports day. The track has two straight sections, each 80 m long, and two semicircular curved ends with a common centre. The radius of the innermost semicircular curve is 21 m. An athlete runs at a constant distance of 0.5 m from the inner border throughout the race. (Use $\pi = 22/7$.) (i) Find the radius of the circle on which the athlete actually runs. [1] (ii) Find the total length of the curved (circular) part of the track that the athlete covers in one complete lap. [1] (iii) Find the total distance covered by the athlete in one complete lap of the track (straight sections + curved sections). [2]	4

ANSWER KEY

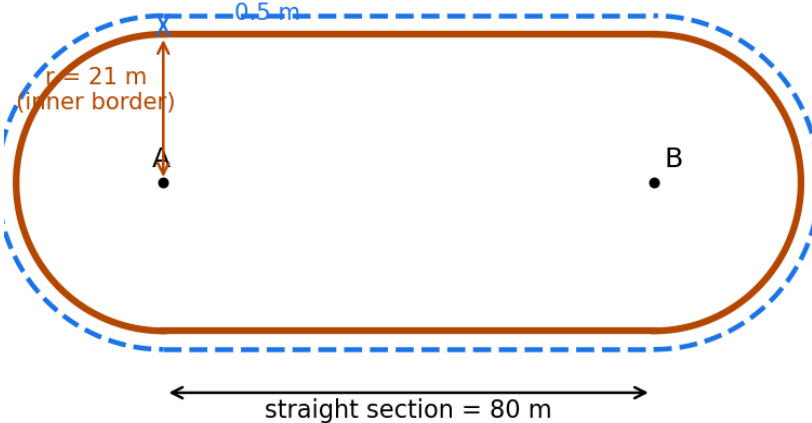
Chapter 6: Measuring Space — Perimeter and Area

Q.No.	Question	Marks
Q1	B	1
Q2	B	1
Q3	B	1
Q4	A	1
Q5	A	1
Q6	B	1
Q7	B	1
Q8	A	1
Q9	B	1
Q10	A	1
Q11	A	1
Section B — Short Answer Type Questions		
Q12	Semi-perimeter, $s = \frac{1}{2}(5 + 12 + 13) = \frac{1}{2}(30) = 15$ cm Area = $\sqrt{[s(s-a)(s-b)(s-c)]} = \sqrt{[15 \times (15-5) \times (15-12) \times (15-13)]}$ $= \sqrt{[15 \times 10 \times 3 \times 2]} = \sqrt{900} = 30$ cm² <i>Check: since $5^2 + 12^2 = 25 + 144 = 169 = 13^2$, this is a right triangle with legs 5 cm and 12 cm. Area = $\frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 5 \times 12 = 30$ cm² — matching Heron's formula. Answer: Area = 30 cm²</i>	2
Q13	(i) Circumference $C = 2\pi r$, so $88 = 2 \times \frac{22}{7} \times r$ $r = (88 \times 7) / (2 \times 22) = 616 / 44 = 14$ cm (ii) Area = $\pi r^2 = \frac{22}{7} \times 14 \times 14 = \frac{22}{7} \times 196 = 22 \times 28 = 616$ cm²	2

Section C — Short Answer Type Questions

Q14	(i) Arc length = $2\pi r \times \theta/360^\circ = 2 \times 22/7 \times 21 \times 60/360$ $= (2 \times 22 \times 21)/7 \times 1/6 = 132 \times 1/6 = 22 \text{ cm}$ (ii) Sector area = $\pi r^2 \times \theta/360^\circ = 22/7 \times 21 \times 21 \times 60/360$ $= 22/7 \times 441 \times 1/6 = 1386 \times 1/6 = 231 \text{ cm}^2$	3
Q15	Let the sides be $3x, 4x, 5x$. Then $3x + 4x + 5x = 144 \rightarrow 12x = 144 \rightarrow x = 12$ So the sides are: $3x = 36 \text{ m}, 4x = 48 \text{ m}, 5x = 60 \text{ m}$ Semi-perimeter, $s = 144/2 = 72 \text{ m}$ Area = $\sqrt{[s(s-a)(s-b)(s-c)]} = \sqrt{[72 \times (72-36) \times (72-48) \times (72-60)]}$ $= \sqrt{[72 \times 36 \times 24 \times 12]} = \sqrt{746496} = 864 \text{ m}^2$ <i>Check: 3:4:5 is a Pythagorean triple, so this is a right triangle with legs 36 m and 48 m. Area = $\frac{1}{2} \times 36 \times 48 = 864 \text{ m}^2$ — matches. ✓</i> Cost of levelling = Area $\times$ rate = $864 \times ₹5 = ₹4320$ Answer: Area = 864 m^2; Cost of levelling = ₹4320	3

Section D -Case-Based Question (4 Marks)

Q16	 (i) Radius of the circle on which the athlete runs [1 mark] Radius = inner radius + distance from inner border = $21 + 0.5 = 21.5 \text{ m}$ Answer: Radius = 21.5 m (ii) Length of the curved part covered in one lap [1 mark] The two semicircular ends together form one full circle of radius 21.5 m, so: Length of curved part = Circumference = $2\pi r = 2 \times 22/7 \times 21.5$ $= (44 \times 21.5) / 7 = 946 / 7 = 135.14 \text{ m (approx.)}$ Answer: Curved part $\approx 135.14 \text{ m}$ (iii) Total distance covered in one complete lap [2 marks] Total distance = length of the two straight sections + length of the curved part Straight sections = $2 \times 80 = 160 \text{ m}$ Total distance = $160 + 135.14 = 295.14 \text{ m}$ Answer: Total distance $\approx 295.14 \text{ m}$	4
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CLASS 9 – MATHEMATICS (Ganita Manjari-01)

Chapter 7: The Mathematics of Maybe — Introduction to Probability

Time Allowed: 20 minutes	Maximum Marks: 25
Name: _____	Roll No. / Section: _____

Section A — Multiple Choice Questions (1 Mark each = 11 Marks)

Q.No.	Question	Marks
Q1	The probability of an event that is certain to happen is: (a) 0 (b) $\frac{1}{2}$ (c) 1 (d) -1	1
Q2	A coin is tossed 500 times and head appears 285 times. The empirical probability of getting a tail is: (a) 0.285 (b) 0.430 (c) 0.500 (d) 0.570	1
Q3	The sum of the probabilities of all the elementary events of an experiment is: (a) 0 (b) 1 (c) between 0 and 1 (d) greater than 1	1
Q4	Which of the following cannot be the probability of an event? (a) 0.7 (b) $\frac{2}{3}$ (c) $\frac{5}{4}$ (d) 0	1
Q5	. In a survey of 200 families, it was found that 120 families own a car. The probability that a family chosen at random does NOT own a car is: (a) 0.6 (b) 0.4 (c) 0.2 (d) 0.8	1
Q6	A die is thrown 300 times and the number 4 comes up 42 times. The empirical probability of getting a 4 is: (a) $\frac{7}{50}$ (b) $\frac{1}{6}$ (c) $\frac{42}{100}$ (d) $\frac{4}{300}$	1
Q7	Two coins are tossed together 400 times and “two heads” appears 96 times. The probability of not getting two heads is: (a) 0.24 (b) 0.76 (c) 0.48 (d) 0.96	1
Q8	The empirical probability of an event is always: (a) less than 0 (b) equal to 1 (c) between 0 and 1 (both inclusive) (d) more than 1	1
Q9	In a cricket match, a batswoman hits a boundary 6 times out of 30 balls she plays. The probability that she did not hit a boundary is: (a) $\frac{1}{5}$ (b) $\frac{4}{5}$ (c) $\frac{1}{6}$ (d) $\frac{5}{6}$	1

	For Q10 and Q11, two statements are given — Assertion (A) and Reason (R). Choose the correct option: (a) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true.											
Q10	Assertion (A): If a coin is tossed 1000 times and head appears 480 times, then the empirical probability of getting a head is 0.48. Reason (R): Empirical probability of an event = (Number of trials in which the event happened) ÷ (Total number of trials).	1										
Q11	Assertion (A): The probability of an impossible event is 1. Reason (R): The probability of any event always lies between 0 and 1, both inclusive.	1										
Section B — Short Answer Type Questions												
Q12	A bag contains slips numbered from 1 to 50. One slip is drawn at random 200 times (with replacement) and a slip bearing an even number was drawn 96 times. Find the empirical probability of drawing (i) an even number, and (ii) an odd number.	2										
Q13	In a class of 40 students, the blood groups were recorded as follows: A – 12 students, B – 10 students, O – 14 students and AB – 4 students. If one student is selected at random, find the probability that the student has (i) blood group O, (ii) blood group AB.	2										
Section C — Short Answer Type Questions												
Q14	Three coins are tossed together 250 times and the number of heads obtained was recorded as shown below: <table><tr><th>Number of heads</th><th>0</th><th>1</th><th>2</th><th>3</th></tr><tr><th>Frequency</th><td>30</td><td>95</td><td>85</td><td>40</td></tr></table> Find the probability of getting (i) exactly two heads, (ii) at least one head, (iii) no head. Also verify that the sum of all these probabilities, together with the probability of exactly one head, is 1.	Number of heads	0	1	2	3	Frequency	30	95	85	40	3
Number of heads	0	1	2	3								
Frequency	30	95	85	40								

Q15	The following table shows the number of students in a school who were absent on different days of a week (total 300 attendance records were studied): <table><tr><th>Day</th><th>Mon</th><th>Tue</th><th>Wed</th><th>Thu</th><th>Fri</th></tr><tr><td>No. of absentees</td><td>75</td><td>45</td><td>60</td><td>54</td><td>66</td></tr></table> If one absentee record is picked at random, find the probability that it belongs to (i) Monday, (ii) Wednesday or Friday, (iii) a day other than Tuesday.	Day	Mon	Tue	Wed	Thu	Fri	No. of absentees	75	45	60	54	66	3
Day	Mon	Tue	Wed	Thu	Fri									
No. of absentees	75	45	60	54	66									
Section D -Case-Based Question (4 Marks)														
Q16	The Traffic Police Department of a city carried out a survey at a busy crossing to study the use of helmets by two-wheeler riders. Over one full day, 800 two-wheeler riders were observed. Out of these, 560 riders were wearing a helmet and the rest were riding without one. Among the 560 helmet users, 336 were men and the remaining were women. The department wants to use this data to plan a road safety awareness campaign in nearby schools. Based on the above information, answer the following questions: (i) Find the probability that a rider chosen at random was wearing a helmet. (ii) Find the probability that a rider chosen at random was not wearing a helmet. (iii) Find the probability that a rider chosen at random was a woman wearing a helmet. Also state what the two probabilities in parts (i) and (ii) add up to, and why. ?	1 +1 +2 =4												

SOLUTIONS WITH EXPLANATION

CLASS 9 — MATHEMATICS

Chapter 7: The Mathematics of Maybe — Introduction to Probability

SECTION A — Multiple Choice Questions

Q1. The probability of an event that is certain to happen is:

Answer: (c) 1

A certain (sure) event always happens, so its probability is 1. An impossible event has probability 0. Probability can never be negative, so (d) is ruled out.

Q2. A coin is tossed 500 times; head appears 285 times. Empirical probability of a tail:

Answer: (b) 0.430

Number of tails = $500 - 285 = 215$.

$P(\text{tail}) = 215 / 500 = 0.43$.

Q3. The sum of the probabilities of all the elementary events of an experiment is:

Answer: (b) 1

All possible outcomes together cover every trial, so their probabilities always add up to 1.

Q4. Which of the following cannot be the probability of an event?

Answer: (c) $5/4$

A probability must lie between 0 and 1. Since $5/4 = 1.25$ is greater than 1, it cannot be a probability. The values 0.7, $2/3$ and 0 are all valid.

Q5. Of 200 families, 120 own a car. Probability a family does NOT own a car:

Answer: (b) 0.4

Families without a car = $200 - 120 = 80$.

$P(\text{no car}) = 80 / 200 = 0.4$.

Q6. A die is thrown 300 times; the number 4 comes up 42 times. Empirical probability of a 4:

Answer: (a) $7/50$

$P(4) = 42 / 300 = 7/50$ (dividing numerator and denominator by 6). As a decimal this is 0.14.

Q7. Two coins tossed 400 times; “two heads” appears 96 times. Probability of NOT getting two heads:

Answer: (b) 0.76

Trials without two heads = $400 - 96 = 304$.

$P(\text{not two heads}) = 304 / 400 = 0.76$.

Q8. The empirical probability of an event is always:

Answer: (c) between 0 and 1 (both inclusive)

The favourable trials can range from 0 (never happens) up to the total number of trials (always happens), so the ratio always lies from 0 to 1.

Q9. A batswoman hits a boundary 6 times out of 30 balls. Probability she did NOT hit a boundary:

Answer: (b) $4/5$

Balls without a boundary = $30 - 6 = 24$.

$P(\text{no boundary}) = 24 / 30 = 4/5$.

SECTION B — Assertion–Reason Questions

Q10.

Answer: (a) Both A and R are true and R is the correct explanation of A.

Assertion: $P(\text{head}) = 480 / 1000 = 0.48$ — true.

Reason correctly states the empirical probability formula, and it is exactly the rule used to get 0.48. So R properly explains A.

Q11.

Answer: (d) A is false but R is true.

Assertion is false: the probability of an impossible event is 0, not 1.

Reason is true: every probability lies between 0 and 1 (both inclusive). Since A is wrong and R is right, the answer is (d).

SECTION C — Very Short Answer Questions

Q12. Slips 1–50 drawn 200 times; an even number appeared 96 times. Find $P(\text{even})$ and $P(\text{odd})$.

Answer: (i) $P(\text{even}) = 12/25$ (ii) $P(\text{odd}) = 13/25$ (i) $P(\text{even}) = 96 / 200 = 12/25 = 0.48$.

(ii) Odd draws = $200 - 96 = 104$, so $P(\text{odd}) = 104 / 200 = 13/25 = 0.52$.

Check: $12/25 + 13/25 = 25/25 = 1$. ✓

Q13. Class of 40: A = 12, B = 10, O = 14, AB = 4. Find $P(O)$ and $P(AB)$.

Answer: (i) $P(O) = 7/20$ (ii) $P(AB) = 1/10$ Total students = 40.

(i) $P(O) = 14 / 40 = 7/20 = 0.35$.

(ii) $P(AB) = 4 / 40 = 1/10 = 0.10$.

SECTION D — Short Answer Questions

Q14. Three coins tossed 250 times; the frequency of heads is given below.

Number of heads	0	1	2	3
Frequency	30	95	85	40

Answer: (i) $P(\text{exactly two heads}) = 17/50$ (ii) $P(\text{at least one head}) = 22/25$ (iii) $P(\text{no head}) = 3/25$ Total trials = $30 + 95 + 85 + 40 = 250$.

(i) $P(\text{exactly two heads}) = 85 / 250 = 17/50 = 0.34$.

(ii) At least one head means 1, 2 or 3 heads = $95 + 85 + 40 = 220$ trials. $P(\text{at least one head}) = 220 / 250 = 22/25 = 0.88$. (Shortcut: $1 - P(\text{no head}) = 1 - 30/250 = 220/250$.) (iii) $P(\text{no head}) = 30 / 250 = 3/25 = 0.12$.

Verification: the probabilities of getting 0, 1, 2 and 3 heads are $30/250 + 95/250 + 85/250 + 40/250 = 250/250 = 1$. ✓ This shows all the elementary probabilities add up to 1.

Q15. Absentee records over a week (total 300 records).

Day	Mon	Tue	Wed	Thu	Fri
No. of absentees	75	45	60	54	66

Answer: (i) $P(\text{Monday}) = 1/4$ (ii) $P(\text{Wed or Fri}) = 21/50$ (iii) $P(\text{not Tuesday}) = 17/20$ Total records = $75 + 45 + 60 + 54 + 66 = 300$.

(i) $P(\text{Monday}) = 75 / 300 = 1/4 = 0.25$.

(ii) Wednesday or Friday = $60 + 66 = 126$. $P = 126 / 300 = 21/50 = 0.42$.

(iii) A day other than Tuesday = $300 - 45 = 255$. $P(\text{not Tuesday}) = 255 / 300 = 17/20 = 0.85$.

SECTION E — Case Study Based Question

Q16. Helmet survey of 800 two-wheeler riders: 560 wore a helmet (of whom 336 were men), and the rest rode without one.

Given: total riders = 800; helmet users = 560; non-users = $800 - 560 = 240$; women helmet users = $560 - 336 = 224$. **Answer: (i) $7/10$ (ii) $3/10$ (iii) $7/25$**

(i) $P(\text{wearing a helmet}) = 560 / 800 = 7/10 = 0.70$.

(ii) $P(\text{not wearing a helmet}) = 240 / 800 = 3/10 = 0.30$.

(iii) $P(\text{a woman wearing a helmet}) = 224 / 800 = 7/25 = 0.28$.

The probabilities in (i) and (ii) add up to $7/10 + 3/10 = 1$. This is because “wearing a helmet” and “not wearing a helmet” are complementary events — every rider falls into exactly one of the two groups, so together they cover all the outcomes and their probabilities must total 1.

CLASS 9 – MATHEMATICS (Ganita Manjari-01)

Chapter 8: Predicting What Comes Next — Exploring Sequences and Progressions

Time Allowed: 20 minutes	Maximum Marks: 25
Name: _____	Roll No. / Section: _____

Section A — Multiple Choice Questions ($1 \times 9 = 9$ marks)

Q1.	The next term of the sequence 1, 4, 9, 16, 25, ... is: (a) 30 (b) 36 (c) 35 (d) 49	1
Q2.	The explicit formula for the n th term of an arithmetic progression with first term 'a' and common difference 'd' is: (a) $t_n = a + nd$ (b) $t_n = a \times (n - 1)d$ (c) $t_n = a + (n - 1)d$ (d) $t_n = a - (n - 1)d$	1
Q3.	The common difference of the AP: 5, 2, -1, -4, ... is: (a) 3 (b) -3 (c) 2 (d) -2	1
Q4.	The common ratio of the GP: 2, 6, 18, 54, ... is: (a) 2 (b) 3 (c) 4 (d) 6	1
Q5.	The explicit rule for the sequence of odd numbers 1, 3, 5, 7, ... is: (a) $t_n = n + 1$ (b) $t_n = 2n - 1$ (c) $t_n = 2n + 1$ (d) $t_n = n^2$	1
Q6.	Which of the following sequences is a geometric progression? (a) 2, 4, 6, 8, ... (b) 1, 3, 6, 10, ... (c) 3, 6, 12, 24, ... (d) 5, 8, 11, 14, ...	1
Q7.	The sum of the first n natural numbers, S_n , is given by: (a) $S_n = n(n + 1)$ (b) $S_n = n(n + 1)/2$ (c) $S_n = n^2/2$ (d) $S_n = (n - 1)/2$	1
Q8.	The recursive rule $t_1 = 1$, $t_n = t_{n-1} + 3$ for $n \geq 2$ generates the sequence: (a) 1, 3, 6, 10, ... (b) 1, 4, 7, 10, ... (c) 1, 3, 9, 27, ... (d) 3, 6, 9, 12, ...	1
Q9.	The n th term of the triangular number sequence 1, 3, 6, 10, 15, ... is: (a) $t_n = n^2$ (b) $t_n = n(n + 1)/2$ (c) $t_n = 2n - 1$ (d) $t_n = n(n - 1)/2$	1

Assertion–Reasoning Questions ($1 \times 2 = 2$ marks)

For Q10 and Q11, two statements are given — Assertion (A) and Reason (R). Choose the correct option:

- (a) Both A and R are true, and R is the correct explanation of A.
- (b) Both A and R are true, but R is not the correct explanation of A.
- (c) A is true, but R is false.
- (d) A is false, but R is true.

Q10.	Assertion (A): The sequence 4, 9, 16, 25, ... is an arithmetic progression. Reason (R): In an arithmetic progression, the difference between any two consecutive terms is constant.	1
Q11.	Assertion (A): In a GP, if the first term is 'a' and the common ratio is 'r', the nth term is $ar^{(n-1)}$. Reason (R): Each term of a GP is obtained by adding a fixed number to the previous term.	1
Section B — Short Answer Type Questions ($2 \times 2 = 4$ marks)		
Q12.	Find the nth term of the arithmetic progression 7, 3, -1, -5, Hence find its 15th term.	2
Q13.	Check whether the sequence 4, 8, 16, 32, ... is a geometric progression. If so, state the common ratio and write its nth term.	2
Section C — Long Answer Type Questions ($3 \times 2 = 6$ marks)		
Q14.	Which term of the AP: 21, 18, 15, ... is -81? Also, verify whether 0 is a term of this AP. Give reasons for your answer.	3
Q15.	Find the 12th term of a GP whose common ratio is 2 and whose 8th term is 192.	3
Section D — Case-Based Question (4 marks)		
Q16.	Read the following passage and answer the questions that follow: The Sierpiński triangle is formed in stages. Stage 0 is a single black equilateral triangle. At every next stage, each black triangle is replaced by 3 smaller black triangles (the central one is removed). The number of black triangles at Stage 0, 1, 2, 3 is 1, 3, 9, 27 respectively, forming a GP. (i) Write the first term and common ratio of this GP. [1] (ii) Write the explicit formula for the number of black triangles, t_n, at Stage n. [1] (iii) How many black triangles will be present at Stage 6? [1] (iv) If the area of the black region at Stage 0 is 1 square unit, write the explicit formula for the area of the black region, s_n, at Stage n, and state what happens to this area as n increases. [1]	4

ANSWER KEY

Chapter 8: Predicting What Comes Next — Exploring Sequences and Progressions

Section A — MCQs

1. (b) 36 — differences 3,5,7,9,11; next term $25+11=36$.
2. (c) $t_n = a + (n - 1)d$
3. (b) -3 — each term decreases by 3.
4. (b) 3 — $6/2=3$, $18/6=3$, $54/18=3$.
5. (b) $t_n = 2n - 1$
6. (c) 3, 6, 12, 24, ... — common ratio 2 throughout.
7. (b) $S_n = n(n + 1)/2$
8. (b) 1, 4, 7, 10, ... — each term is 3 more than the previous.
9. (b) $t_n = n(n + 1)/2$

Assertion–Reasoning

10. (d) A is false, but R is true — the sequence 4, 9, 16, 25, ... has differences 5, 7, 9, ... which are not constant, so it is NOT an AP; however, the definition of an AP given in R is correct.
11. (c) A is true, but R is false — the n th term formula is correct, but a GP is formed by multiplying (not adding) a fixed number (the common ratio) to the previous term.

Section B — Short Answer

12. First term $a = 7$, common difference $d = 3 - 7 = -4$. So $t_n = 7 + (n - 1)(-4) = 11 - 4n$. 15th term: $t_{15} = 11 - 4(15) = -49$.
13. Ratios: $8/4 = 2$, $16/8 = 2$, $32/16 = 2$. Since the ratio is constant ($= 2$), the sequence is a GP with common ratio $r = 2$. n th term: $t_n = 4 \times 2^{(n-1)}$.

Section C — Long Answer

14. First term $a = 21$, common difference $d = 18 - 21 = -3$. $t_n = 21 + (n - 1)(-3) = 24 - 3n$. Setting $t_n = -81$: $n = 35$. So -81 is the 35th term. For 0 to be a term: $n = 8$, a natural number, so 0 IS the 8th term of this AP.
15. $t_n = a \times r^{(n-1)}$, $r = 2$. Given $t_8 = a \times 2^7 = 192 \Rightarrow a = 1.5$. $t_{12} = a \times 2^{11} = 1.5 \times 2048 = 3072$.

Section D — Case-Based

- (i) First term $a = 1$, common ratio $r = 3$.
- (ii) $t_n = 3^n$ (using stage numbering starting at $n = 0$).
- (iii) At Stage 6: $t_6 = 3^6 = 729$ black triangles.
- (iv) $s_n = (3/4)^n$. As n increases, s_n keeps getting multiplied by $3/4$ (< 1), so the area of the black region keeps decreasing and gets closer and closer to 0.

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SAMPLE QUESTION PAPER

Class : IX

Subject : MATHEMATICS

Max. Marks : 80

Time : 3 Hours

General Instructions:

1. This question paper contains 38 questions. All questions are compulsory.
2. This question paper is divided into five Sections – A, B, C, D and E.
3. Section A: Question Nos. 1 to 20 are Multiple Choice Questions (MCQs) of 1 mark each.
4. Section B: Question Nos. 21 to 25 are Very Short Answer (VSA) type questions of 2 marks each.
5. Section C: Question Nos. 26 to 31 are Short Answer (SA) type questions of 3 marks each.
6. Section D: Question Nos. 32 to 35 are Long Answer (LA) type questions of 5 marks each.
7. Section E: Question Nos. 36 to 38 are Case Study/Source Based questions carrying 4 marks each, with sub-parts.
8. An internal choice has been provided in one question each in Sections B, C, D, and in the 2-mark sub-part of the Case Study questions in Section E, as indicated against the respective question.
9. Use of calculators is not permitted.
10. Questions for Visually Impaired candidates will be provided wherever required, in lieu of questions involving figures/graphs.

SECTION A — Multiple Choice Questions

Question Nos. 1 to 20 carry 1 mark each.

Q.No.	Question	Marks
1.	The point P(–4, 7) lies in the: (a) I quadrant (b) II quadrant (c) III quadrant (d) IV quadrant	1
2.	The distance between the points A(0, 0) and B(6, 8) is: (a) 6 units (b) 8 units (c) 10 units (d) 14 units	1
3.	Which of the following is a linear polynomial in x? (a) $x^2 + 3$ (b) $5x - 2$ (c) $3/x + 1$ (d) $x^3 - x$	1
4.	If $p(x) = 4x - 9$, then the value of $p(3)$ is: (a) 3 (b) –3 (c) 12 (d) 21	1
5.	Which of the following is an irrational number? (a) $4/9$ (b) $\sqrt{16}$ (c) $\sqrt{7}$ (d) 0.75	1
6.	The decimal expansion of $22/7$ is: (a) terminating (b) non-terminating repeating (c) non-terminating non-repeating (d) none of these	1

Q.No.	Question	Marks
7.	On simplifying, $(x + 7)(x - 7)$ equals: (a) $x^2 + 49$ (b) $x^2 - 49$ (c) $x^2 + 14x - 49$ (d) $x^2 - 14x + 49$	1
8.	The factorised form of $4x^2 - 25$ is: (a) $(2x - 5)(2x + 5)$ (b) $(4x - 5)(x + 5)$ (c) $(2x - 5)^2$ (d) $(2x + 5)^2$	1
9.	The perpendicular drawn from the centre of a circle to a chord: (a) is parallel to the chord (b) bisects the chord (c) doubles the length of the chord (d) trisects the chord	1
10.	Equal chords of a circle subtend equal angles at the: (a) circumference (b) centre (c) diameter (d) tangent point	1
11.	The angle in a semicircle is: (a) 45° (b) 60° (c) 90° (d) 180°	1
12.	The area of a triangle with base 12 cm and height 5 cm is: (a) 60 cm^2 (b) 30 cm^2 (c) 17 cm^2 (d) 120 cm^2	1
13.	The circumference of a circle of radius 14 cm (use $\pi = 22/7$) is: (a) 44 cm (b) 88 cm (c) 22 cm (d) 154 cm	1
14.	The area of a parallelogram with base 8 cm and corresponding height 6 cm is: (a) 24 cm^2 (b) 48 cm^2 (c) 14 cm^2 (d) 96 cm^2	1
15.	A coin is tossed once. The probability of getting a tail is: (a) 0 (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) 1	1
16.	A die is thrown once. The total number of possible outcomes is: (a) 3 (b) 4 (c) 5 (d) 6	1
17.	The probability of an event always lies between: (a) -1 and 1 (b) 0 and 1 (c) 0 and 2 (d) 1 and 2	1
18.	The n th term of an AP with first term a and common difference d is given by: (a) $a + nd$ (b) $a + (n - 1)d$ (c) $a - (n - 1)d$ (d) $na + d$	1
19.	The common difference of the AP 5, 9, 13, 17, ... is: (a) 3 (b) 4 (c) 5 (d) 9	1
20.	The next term of the geometric progression 3, 6, 12, 24, ... is: (a) 30 (b) 36 (c) 48 (d) 42	1

SECTION B — Very Short Answer Type Questions

Question Nos. 21 to 25 carry 2 marks each.

Q.No.	Question	Marks
21.	If $p(x) = 3x - 6$, find the zero of the polynomial.	2

Q.No.	Question	Marks
22.	Draw the graph of the linear equation $y = x + 2$ by plotting any three of its solutions on a Cartesian plane. <i>For Visually Impaired candidates, in lieu of the above: Verify whether each of the points $(-2, 0)$, $(0, 2)$ and $(1, 3)$ satisfies the linear equation $y = x + 2$. State, with reason, whether each point is a solution of the equation.</i>	2
23.	Represent $\sqrt{5}$ on the number line. OR Find two irrational numbers between 3 and 4. <i>For Visually Impaired candidates, in lieu of the above: Find the value of $\sqrt{5}$ correct to two decimal places using the long division method, and state the two consecutive integers between which $\sqrt{5}$ lies.</i>	2
24.	A chord of length 8 cm is drawn in a circle of radius 5 cm. Find the distance of the chord from the centre of the circle.	2
25.	Find the 15th term of the Arithmetic Progression 7, 11, 15, 19, ...	2

SECTION C — Short Answer Type Questions

Question Nos. 26 to 31 carry 3 marks each.

Q.No.	Question	Marks
26.	Plot the points A(1, 1), B(4, 1) and C(4, 5) on a Cartesian plane. Using the distance formula, find the lengths of AB, BC and CA, and state the type of triangle formed. <i>For Visually Impaired candidates, in lieu of the above: Using the distance formula, find the lengths of AB, BC and CA for the points A(1, 1), B(4, 1) and C(4, 5), and state the type of triangle formed. (Plotting on graph paper is not required.)</i>	3
27.	Express $0.4777\ldots$ (i.e., 0.47, where 7 recurs) in the form p/q , where p and q are integers and $q \neq 0$.	3
28.	Simplify the following and state whether each result is rational or irrational: (i) $(\sqrt{5} + \sqrt{3})(\sqrt{5} - \sqrt{3})$ (ii) $(3 + \sqrt{2})^2$	3
29.	Using a suitable identity, evaluate 998^2 without direct multiplication. Show all steps.	3
30.	Find the area of a triangular park whose sides measure 30 m, 40 m and 50 m, using Heron's formula.	3
	OR	
	A circular flower bed has a circumference of 44 m. Find its area. (Use $\pi = 22/7$)	
31.	A bag contains 5 red, 4 blue and 3 green balls, all identical in size. One ball is drawn at random from the bag. Find the probability that the ball drawn is (i) red (ii) not blue.	3

Q.No.	Question	Marks
	OR Two coins are tossed together once. Write the sample space and find the probability of getting at least one head.	

SECTION D — Long Answer Type Questions

Question Nos. 32 to 35 carry 5 marks each.

Q.No.	Question	Marks
32.	The coordinates of the vertices of a triangle ABC are A(0, 0), B(6, 0) and C(6, 8). Using the distance formula, find the lengths of all three sides of the triangle, verify that $\triangle ABC$ is right-angled, and find its area. OR Points A(-1, y) and B(5, 7) are such that the distance AB = 10 units. Find the possible value(s) of y.	5
33.	Prove the identity $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$ using algebra tiles or otherwise. Hence, if $a + b + c = 12$ and $ab + bc + ca = 22$, find the value of $a^2 + b^2 + c^2$.	5
34.	Prove that the perpendicular drawn from the centre of a circle to a chord bisects the chord. Using this result, AB and CD are two equal chords, each of length 24 cm, of a circle of radius 13 cm. Find the distance of each chord from the centre.	5
35.	Pipes are stacked in a pile with 20 pipes in the bottom row, 19 in the next row, 18 in the row above that, and so on, forming an Arithmetic Progression, with 1 pipe in the topmost row. Find (i) the number of rows in the pile, and (ii) the total number of pipes in the pile.	5

SECTION E — Case Study Based Questions

Question Nos. 36 to 38 carry 4 marks each.

Q.No.	Question	Marks
36.	 A mobile-repair shop charges a fixed inspection fee of ₹50, plus ₹30 for every additional part used in a repair. If x represents the number of parts used, the total charge $C(x)$, in rupees, forms a linear polynomial in x. (i) Write the total charge $C(x)$ as a linear polynomial in x. [1] (ii) Find the amount charged for a repair that uses 4 parts. [1] (iii) A customer was charged ₹230 for a repair. Find the number of parts used.	4

Q.No.	Question	Marks
	OR Find the zero of the polynomial $p(x) = C(x) - 50$. [2]	
37.	 A school playground is in the shape of a rectangle 50 m long and 30 m wide. A circular fountain of radius 7 m is to be constructed at one corner of the playground. (Use $\pi = 22/7$) (i) Find the perimeter of the rectangular playground. [1] (ii) Find the area of the rectangular playground. [1] (iii) Find the area of the circular fountain. OR Find the circumference of the circular fountain. [2]	4
38.	 Spin the wheel works by offering entrants the opportunity to win prizes determined by spinning a virtual wheel that will land on a random segment. Each segment offers a different prize or offer. This means there is always a chance to win something, regardless of where the segment lands At a school fair, a spinning wheel is divided into 10 equal sectors, numbered 1 to 10. A visitor spins the wheel once, and the number on which the pointer stops is noted. (i) Write the total number of possible outcomes. [1] (ii) Find the probability that the pointer stops at a number greater than 7. [1] (iii) Find the probability that the pointer stops at an even number. OR Find the probability that the pointer stops at a multiple of 3. [2]	4

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MARKING SCHEME / ANSWER KEY

Class : IX Subject : Mathematics Max. Marks : 80

SECTION A

Q1 – Q20 (1 mark each — correct option)

Q.No.	Correct Option	Q.No.	Correct Option
1	(b) II quadrant	11	(c) 90°
2	(c) 10 units	12	(b) 30 cm^2
3	(b) $5x - 2$	13	(b) 88 cm
4	(a) 3	14	(b) 48 cm^2
5	(c) $\sqrt{7}$	15	(c) $1/2$
6	(b) non-terminating repeating	16	(d) 6
7	(b) $x^2 - 49$	17	(b) 0 and 1
8	(a) $(2x - 5)(2x + 5)$	18	(b) $a + (n - 1)d$
9	(b) bisects the chord	19	(b) 4
10	(b) centre	20	(c) 48

SECTION B

Q21 – Q25 (2 marks each)

A21. $p(x) = 3x - 6 = 0 \Rightarrow 3x = 6 \Rightarrow x = 2$. Zero of the polynomial = 2. [2]

A22. Any three solutions of $y = x + 2$, e.g.:

$x = -2 \Rightarrow y = 0 \rightarrow (-2, 0)$; $x = 0 \Rightarrow y = 2 \rightarrow (0, 2)$; $x = 1 \Rightarrow y = 3 \rightarrow (1, 3)$.

Plotting these points and joining them gives a straight line with slope 1 and y-intercept 2. [2]

(1 mark for correct solutions/table, 1 mark for correctly drawn line)

VI alternative: all three points $(-2, 0)$, $(0, 2)$, $(1, 3)$ satisfy $y = x + 2$ (verified by substitution), so each is a solution of the equation.

A23. Mark points O and A on a number line such that $OA = 2$ units. At A, draw $AB \perp OA$ with $AB = 1$ unit. By Pythagoras theorem, $OB = \sqrt{(2^2 + 1^2)} = \sqrt{5}$. With O as centre and radius OB, draw an arc cutting the number line at P. Then $OP = \sqrt{5}$.

OR: Two irrational numbers between 3 and 4 (any valid answer), e.g. 3.1010010001... and 3.2020020002... [2]

VI alternative: $\sqrt{5}$ lies between the integers 2 and 3; by long division, $\sqrt{5} \approx 2.24$ (correct to two decimal places).

A24. Half the chord = 4 cm (perpendicular from centre bisects the chord). Distance =

$$\sqrt{(\text{radius}^2 - (\text{half-chord})^2)} = \sqrt{(5^2 - 4^2)} = \sqrt{(25 - 16)} = \sqrt{9} = 3 \text{ cm. } [2]$$

A25. AP: $a = 7$, $d = 4$. $T_{15} = a + 14d = 7 + 14(4) = 7 + 56 = 63$. [2]

SECTION C

Q26 – Q31 (3 marks each)

A26. Using the distance formula:

$$AB = \sqrt{[(4-1)^2 + (1-1)^2]} = \sqrt{9} = 3 \text{ units}$$

$$BC = \sqrt{[(4-4)^2 + (5-1)^2]} = \sqrt{16} = 4 \text{ units}$$

$$CA = \sqrt{[(4-1)^2 + (5-1)^2]} = \sqrt{(9+16)} = \sqrt{25} = 5 \text{ units}$$

Since $3^2 + 4^2 = 5^2$, triangle ABC is a right-angled triangle (right angle at B). [3]

A27. Let $x = 0.4777\ldots$

$$10x = 4.777\ldots \quad \dots(i) \quad 100x = 47.777\ldots \quad \dots(ii)$$

$$(ii) - (i): 90x = 43 \Rightarrow x = 43/90. [3]$$

A28. (i) $(\sqrt{5} + \sqrt{3})(\sqrt{5} - \sqrt{3}) = 5 - 3 = 2$ (rational)

(ii) $(3 + \sqrt{2})^2 = 9 + 6\sqrt{2} + 2 = 11 + 6\sqrt{2}$ (irrational). [3]

A29. $998^2 = (1000 - 2)^2 = 1000^2 - 2 \times 1000 \times 2 + 2^2 = 1,000,000 - 4000 + 4 = 9,96,004$. [3]

A30. $s = (30+40+50)/2 = 60$ m. Area = $\sqrt{[s(s-a)(s-b)(s-c)]} = \sqrt{(60 \times 30 \times 20 \times 10)} = \sqrt{3,60,000} = 600 \text{ m}^2$.

OR: Circumference = $2\pi r = 44 \Rightarrow r = 44 \times 7/(2 \times 22) = 7$ m. Area = $\pi r^2 = (22/7) \times 7^2 = 154 \text{ m}^2$. [3]

A31. Total balls = $5 + 4 + 3 = 12$. (i) $P(\text{red}) = 5/12$. (ii) $P(\text{not blue}) = 1 - 4/12 = 8/12 = 2/3$.

OR: Sample space = {HH, HT, TH, TT}. $P(\text{at least one head}) = 3/4$. [3]

SECTION D

Q32 – Q35 (5 marks each)

A32. $AB = \sqrt{[(6-0)^2 + (0-0)^2]} = 6$ units; $BC = \sqrt{[(6-6)^2 + (8-0)^2]} = 8$ units; $CA = \sqrt{[(6-0)^2 + (8-0)^2]} = 10$ units.

Since $6^2 + 8^2 = 10^2$, $\triangle ABC$ is right-angled at B. Area = $\frac{1}{2} \times 6 \times 8 = 24$ sq. units.

OR: $\sqrt{[(5-(-1))^2 + (7-y)^2]} = 10 \Rightarrow 36 + (7-y)^2 = 100 \Rightarrow (7-y)^2 = 64 \Rightarrow 7-y = \pm 8 \Rightarrow y = -1$ or $y = 15$. [5]

A33. $(a+b+c)^2 = (a+b+c)(a+b+c) = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$ (expand and collect like terms — full proof/derivation expected).

Given $a+b+c = 12$, $ab+bc+ca = 22$: $144 = a^2+b^2+c^2 + 2(22) = a^2+b^2+c^2 + 44 \Rightarrow a^2+b^2+c^2 = 100$. [5]

A34. Proof: Let O be the centre and $OM \perp$ chord AB. In $\triangle OMA$ and $\triangle OMB$: $OA = OB$ (radii), $OM = OM$ (common), $\angle OMA = \angle OMB = 90^\circ$. By RHS congruence, $\triangle OMA \cong \triangle OMB$, so $AM = MB$, i.e., OM bisects AB.

Application: half-chord = 12 cm, radius = 13 cm. Distance = $\sqrt{(13^2 - 12^2)} = \sqrt{(169-144)} = \sqrt{25} = 5$ cm. Since $AB = CD$, both chords are equidistant (5 cm) from the centre. [5]

A35. AP: $a = 20$, $d = -1$, last term $l = 1$. $l = a + (n-1)d \Rightarrow 1 = 20 - (n-1) \Rightarrow n = 20$ rows.
Sum = $n/2 (a + l) = 20/2 \times (20 + 1) = 10 \times 21 = 210$ pipes. [5]

SECTION E

Q36 – Q38 (4 marks each)

A36. (i) $C(x) = 30x + 50$. [1]

(ii) $C(4) = 30(4) + 50 = 120 + 50 = ₹170$. [1]

(iii) $230 = 30x + 50 \Rightarrow 30x = 180 \Rightarrow x = 6$ parts. OR: Zero of $p(x) = 30x \Rightarrow x = 0$. [2]

A37. (i) Perimeter = $2(50 + 30) = 160$ m. [1]

(ii) Area = $50 \times 30 = 1500$ m². [1]

(iii) Area of fountain = $\pi r^2 = (22/7) \times 7^2 = 154$ m². OR: Circumference = $2\pi r = 2 \times (22/7) \times 7 = 44$ m. [2]

A38. (i) Total outcomes = 10. [1]

(ii) Numbers greater than 7: $\{8, 9, 10\} \Rightarrow P = 3/10$. [1]

(iii) Even numbers: $\{2, 4, 6, 8, 10\} \Rightarrow P = 5/10 = 1/2$. OR:

Multiples of 3: $\{3, 6, 9\} \Rightarrow P = 3/10$. [2]

