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CHAPTER NOTES

Introduction to Polynomials Class 9 Notes | CBSE Maths Chapter 2

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Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Explain Introduction to Polynomials simply

What can the board exam ask?

Most important formulas

Quiz me on this chapter

Ask Ira anything...



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Introduction to Polynomials Class 9 Notes | CBSE Maths Chapter 2

Introduction to Polynomials is Chapter 2 of CBSE Class 9 Maths. In the new 2026-27 NCERT book (Ganita Manjari, Grade 9, Part I) the chapter is titled "Introduction to Linear Polynomials". It starts with algebraic expressions built from everyday situations, defines a polynomial in one variable and its degree, and then focuses on linear polynomials: evaluating them, turning them into linear equations, spotting linear patterns, modelling linear growth and decay, finding a relationship $y = ax + b$ from two readings, and drawing that relationship as a straight line.

The chapter sits in Unit II, Algebra, which carries 20 of the 80 theory marks in the CBSE Class IX course structure for 2026-27, shared with three other algebra chapters. School exams test it through degree and coefficient questions, word problems that become linear equations, nth-term rules for patterns, growth and decay models, and graphs with slope and y-intercept. These ideas lead straight into the chapters on sequences and variables.

Quick Answer - Introduction to Polynomials

A **polynomial in one variable** (univariate) has one variable and its powers. Its **degree** is the highest power of the variable. Degree 0 is constant, 1 is linear, 2 is quadratic, 3 is cubic, and so on. A sequence that increases by a fixed amount for every step of 1 in the variable is called an **arithmetic sequence**. A fixed increase is **linear growth**. The relationship $y = ax + b$ is a straight line where a is the slope and b is the y-intercept. Different y-intercepts are parallel lines.



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All Key Formulas at a Glance

Idea	Rule or Formula	Remember
Degree of a polynomial	Highest power of the variable	$5y^3 + y^2 + 2y - 1$ has degree 3
Names by degree	0 constant, 1 linear, 2 quadratic, 3 cubic	$8 = 8x^0$, so degree 0
Linear polynomial	$ax + b, a \neq 0$	Degree exactly 1
Linear equation	Linear polynomial = constant	$2x + 10 = 64$ gives $x = 27$
Linear pattern	Consecutive terms differ by a constant	1, 3, 5, 7, ... has nth term $2n - 1$
Linear growth	Value = start + (increase) $\times t$	
Linear decay	Value = start - (decrease) $\times t$	
Linear relationship	$y = ax + b$	
Slope and y-intercept	Slope = a, line crosses y-axis at (0, b)	
Line through the origin	$y = ax$ (b = 0)	
Parallel lines	Same a, different b	



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Key Concepts

1. Algebraic Expressions: Terms, Variables, Coefficients and Constants

Raju at the shop. Red boxes hold 4 pens each and blue boxes hold 5 pencils each. Raju buys x red boxes and y blue boxes, and gets 3 extra pens free. The x red boxes hold $4x$ pens and the y blue boxes hold $5y$ pencils, so the total number of pens and pencils is

$$4x + 5y + 3$$

- **Terms:** $4x$, $5y$ and 3 (the parts joined by $+$ or $-$ signs).
- **Variables:** x and y . Earlier books called these letter-numbers; from now on the word used is **variable**.
- **Coefficients:** 4 is the coefficient of x and 5 is the coefficient of y .
- **Constant:** 3 , a term with no variable.

Fencing a garden. A rectangular garden is $2l$ m long and w m wide. The length costs ₹100 per metre, a wooden fence costs ₹50 per square metre of the garden.

Wire fence: $2l \times 100 = 200l$. Wooden fence: $50 \times 2lw = 100lw$. Total cost = ₹($200l + 160w + 50lw$).

Here the terms are $200l$, $160w$ and $50lw$, the coefficients are 200 , 160 and 50 . The difference from Raju's expression is that the variables are multiplied together, and it has two variables.

Bending a wire. A wire 20 cm long is bent into the shape of a rectangle. The perimeter is always 20 cm, the width is $(10 - x)$ cm, and the area is

$$x(10 - x) = 10x - x^2$$

This expression has only **one variable**, x , the constant term is 10 and the coefficient of x^2 is -1 . The whole expression is a quadratic expression in one variable.



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2. Polynomials in One Variable and Their Degree

Expressions such as $4x$, $x^2 + 1$, $2y - 5$, $5y^3 + y^2 + 2y - 1$ and $3z + 7$ each use only one variable (x , y or z) together with its powers. Such expressions are called **one-variable polynomials**, **univariate polynomials** ("univariate" means having one variable), or simply **polynomials** when the context is clear.

Degree. The highest power of the variable in a polynomial is its **degree**. In $x^2 + 5x + 1$ the highest power of x is 2. In $5y^3 + y^2 - 8$ the highest power of y is 3.

Reading coefficients. In $5y^3 + y^2 + 2y - 1$ the coefficient of y^3 is 5, that of y^2 is 1 (no number written means 1), that of y is 2, and the constant term is -1.

Names by degree.

Degree	Name	Example from the chapter
0	Constant polynomial	Ira Your teacher for Introduction to Poly...  Hi, I am Ira. I teach this syllabus all day, so Introduction to Polynomials is very much my home ground. Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:
1	Linear polynomial	
2	Quadratic polynomial	
3	Cubic polynomial	

Missing terms. A power that does not appear in a polynomial, so the coefficient of z is 0. In $x^4 - 3x^2 + 6$ the coefficient of z is 0.

A polynomial of degree 1 is a **linear polynomial**.

3. Evaluating a Polynomial and For

A chess club charges a joining fee of ₹200 and a fee of ₹50 for each match played.

Matches played	1	2
Amount paid (₹)	250	300

The amount $200 + 50m$ is a linear polynomial in m , and it rises by the constant ₹50 for every extra match. If a player paid ₹750, then $200 + 50m = 750$, so $50m = 550$ and $m = 11$ matches.

This is the **characteristic feature of linear polynomials**: the difference between successive values at integers is constant. Patterns with this property are called **linear patterns**.

From polynomial to equation. When a linear polynomial in one variable is set equal to a constant, the result is a **linear equation**. Example: two numbers add up to 64 and one is 10 more than the other. Let the smaller be x , so the larger is $x + 10$. Then $x + (x + 10) = 64$, which gives $2x + 10 = 64$. The left side, $2x + 10$, is a linear polynomial; equating it to 64 gives the equation $2x = 54$, so $x = 27$. The numbers are 27 and 37.

Polynomials as input-output processes. For every value of x , the polynomial $2x + 3$ gives one output: $x = 4$ gives $2 \times 4 + 3 = 11$ and $x = -6$ gives $2 \times (-6) + 3 = -9$. Think of a machine: a value of x goes in, the value of $2x + 3$ comes out. This process is called a **function**, and $2x + 3$ is a function of the variable x . Functions are studied in detail in later classes.

The rectangle made from the 20 cm wire and x cm is a linear function. At $x = 6$ cm, the area is $10 \times 6 - 6^2 = 6$ cm², whereas $10x - x^2$ is a **quadratic function**.

4. Linear Patterns and the nth Term

A growing pattern of square tiles. The chessboard pattern at each stage is made by adding two more tiles to the previous stage. Stage 1 has 3 tiles, Stage 2 has 5 tiles, Stage 3 has 7 tiles, Stage 4 has 9 tiles, Stage 5 has 11 tiles, and so on. The number of tiles at each stage is one less than twice the stage number. So, Stage 1 has $2 \times 1 - 1 = 1$ tile, Stage 2 has $2 \times 2 - 1 = 3$ tiles, Stage 3 has $2 \times 3 - 1 = 5$ tiles, Stage 4 has $2 \times 4 - 1 = 7$ tiles, Stage 5 has $2 \times 5 - 1 = 9$ tiles. So, the number of tiles at stage n is $2n - 1$.

Stage	Number of square tiles
1	1
2	3
3	5
4	7
5	9

The number of tiles at each stage is one less than twice the stage number. So, Stage 1 has $2 \times 1 - 1 = 1$ tile, Stage 2 has $2 \times 2 - 1 = 3$ tiles, Stage 3 has $2 \times 3 - 1 = 5$ tiles, Stage 4 has $2 \times 4 - 1 = 7$ tiles, Stage 5 has $2 \times 5 - 1 = 9$ tiles. So, the number of tiles at stage n is $2n - 1$.

$2n - 1$ has degree 1, so it is a linear polynomial. The relation between stage number and number of tiles is a linear relation.

Using the rule: Stage 15 has $2 \times 15 - 1 = 29$ tiles. To find which stage has 21 tiles, solve $2n - 1 = 21$, so $2n = 22$ and $n = 11$. So, Stage 11 has 21 tiles.



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Spending pocket money. Bela has ₹100 and spends ₹5 every day, so she has 95, 90, 85, 80, ... rupees left after days 1, 2, 3, 4, and **100 - 5n** after n days. She has ₹40 left when $100 - 5n = 40$, that is on day 12. On day 15 she has $100 - 75 = ₹25$. The money runs out when $100 - 5n = 0$, that is after 20 days.

A fare with a starting charge. An auto-rickshaw fare is ₹25 for the first 2 km, then rises by ₹15 for every further km.

The fares for 1 to 6 km are ₹25, 25, 40, 55, 70 and 85.

For n km with $n \geq 2$ the fare is $25 + 15 \times (n - 2) = \mathbf{15n - 5}$. A 10 km ride costs $25 + 15 \times 8 = ₹145$. A fare of ₹130 means $15n - 5 = 130$, so $15n = 135$ and $n = 9$ km.

Definition. A **linear pattern** is a sequence of numbers where the difference between two consecutive terms is constant. In every example above, the nth term is a linear expression in n. Such sequences are studied again in the chapter on Sequences and Progressions.

How to find the nth-term rule quickly. If t (positive when they go up, negative when they go down), the rule has ... the difference is 2, so the rule is $2n + 5$, ... the difference is 2, so the rule is $2n + 5$.

5. Linear Growth and Linear Decay

Linear growth: cost of a journey. The cost in rupees and d the distance in km.

Distance d (km)	0
Cost C (₹)	100

Each extra km adds a fixed ₹60. For 15 km when $100 + 60d = 700$, so $60d = 600$ and

Linear decay: water in a tank. The water i After t months its height is $h(t) = 3 - 0.5t$ m



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Month t	0	1	2	3	4
Height h (m)	3	2.5	2	1.5	1

Each month the height falls by the same 0.5 m. After 5 months, $h = 3 - 2.5 = 0.5$ m.

Telling them apart. Growth has the form $\text{start} + (\text{fixed amount}) \times t$, decay has the form $\text{start} - (\text{fixed amount}) \times t$. Check the sign of the coefficient of the time variable: positive for growth, negative for decay.

Building a model from words. Pick the starting value (the value when time is 0) and the fixed change per interval, then write $\text{start} \pm \text{change} \times t$.

6. Finding a Linear Relationship $y = ax + b$

A **linear relationship** between two variables is one that follows a constant rate of change. For the tile pattern, with x the stage number and y the number of tiles.

The data bill. A telecom company charges for using data. With 10 GB the bill was ₹350; with 20 GB it was ₹550. Find a linear relationship between the data used and the bill.

1. Substitute $x = 10$, $y = 350$: $350 = 10a + b$
2. Substitute $x = 20$, $y = 550$: $550 = 20a + b$
3. From the first equation, $b = 350 - 10a$.
4. Put this into the second: $550 = 20a + (350 - 10a)$
5. Then $b = 350 - 10 \times 20 = 150$.

So **$y = 20x + 150$** . The number 20 is the charge per GB (₹20), the bill when no data is used.

A shortcut check. Going from 10 GB to 20 GB, the data used doubles. The bill increases by ₹200, which is $200 \div 10 = ₹20$. This matches a . The change in x .

Temperature scales. Celsius and Fahrenheit are two different scales for measuring temperature. Water freezes at 0°C and 32°F , and water boils at 100°C and 212°F . The relationship between the two scales is linear. Find a linear relationship between the temperature in Celsius and Fahrenheit. $180a = 100$, so $a = 5/9$. Then $b = -32 \times 5/9$. So $^\circ\text{C} = (5/9)(^\circ\text{F} - 32)$.



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7. Plotting a Linear Relationship as a Straight Line

Every linear relationship $y = ax + b$ can be drawn as a straight line on the coordinate plane. Two points are enough to fix a line.

Plotting $y = 2x + 1$.

1. Choose $x = 0$: $y = 1$. Call this point A (0, 1). Its x-coordinate is 0 and its y-coordinate is 1.
2. Choose $x = 3$: $y = 7$. Call this point B (3, 7).
3. Plot A and B on graph paper, join them with a ruler and extend the line in both directions.

More points on the same line: (1, 3), (2, 5), (5, 11), (7, 15), (9, 19), (12, 25) and (20, 41).

Point on a line test. A point lies on a line exactly when its coordinates satisfy the equation. (7, 15) lies on $y = 2x + 1$ because $2 \times 7 + 1 = 15$. The point (4, 10) does not, because $2 \times 4 + 1 = 9$, not 10.

Guessing the equation from points. The graph shows three straight lines. In each, the y-coordinate is

Tip: plot a third point as a check. If the third point is wrong.

8. Slope, y-intercept and Parallel Lines

Lines of the form $y = ax$. The chapter draws three lines: $y = x$, $y = \frac{1}{2}x$, the points (0, 0) and (4, 2) lie on the line $y = \frac{1}{2}x$.

- Every line $y = ax$ passes through the origin (0, 0).
- The line $y = x$ is equally inclined to both axes.
- For $a > 1$ the line is **steeper** than $y = x$ (for example, $y = 2x$).
- For $a < 1$ (with a positive) the line is **less steep** than $y = x$ (for example, $y = \frac{1}{2}x$).

The number a is called the **slope** of the line. For $y = 3x$ and $y = -3x$, the lines still pass through the origin, but the slope increases or decreases.

Growth, decay and the sign of the slope.

Linear growth by a line with **positive slope**; **linear decay** by a line with **negative slope**. The slope of a line $y = ax + b$ equals the constant difference between consecutive y-values.



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Comparing $y = 3x + 1$ and $y = -3x + 1$. Both cut the y-axis at (0, 1). The first rises (slope 3) and the second falls (slope -3), and they are equally steep.

Changing b with a fixed. The lines $y = 2x - 1$, $y = 2x + 1$ and $y = 2x + 5$ all have slope 2. Drawn on the same axes, they are **parallel**; changing b only shifts the line up or down.

The y-intercept. Any line $y = ax + b$ cuts the y-axis at the point **(0, b)**, because $x = 0$ gives $y = b$. The number b is the **y-intercept**.

So $y = 2x + 5$ cuts the y-axis at A (0, 5), $y = x + 3$ at B (0, 3), and $y = 3x - 2$ at C (0, -2).

A y-intercept of 3 means the line cuts the y-axis 3 units from the origin in the positive direction. A y-intercept of -2 means it cuts 2 units from the origin in the negative direction.

Rearrange first. Read a and b only after y is alone on one side. For $2y = 4x + 7$, divide by 2: $y = 2x + 7/2$, so the slope is 2 and the y-intercept is $7/2$.



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Formula and Theorem Sheet

Topic	Result	Example
Univariate polynomial	Expression in one variable and its powers	$5y^3 + y^2 + 2y - 1$
Degree	Highest power of the variable	$x^2 + 5x + 1$ has degree 2
Constant, linear, quadratic, cubic	Degree 0, 1, 2, 3	8, $3z + 7$, $x^2 + 5x + 1$, $5y^3 + 1$
Linear equation	Linear polynomial equated to a constant	$2x + 10 = 64$
Linear pattern	Constant difference	
Linear growth	Fixed increase	
Linear decay	Fixed decrease	
Linear relationship	$y = ax + b$	
Finding a from two readings	$a = (\text{change in } y) / (\text{change in } x)$	
Slope and y-intercept	$y = ax + b$: (0, b)	
Sign of slope	Positive: growth Negative: decay (linear)	
Parallel lines	Same a, different b	



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Important Definitions

- **Coefficient:** the number multiplying the variable part of a term. In $2x^2 + 5xy - 3y^2$ the coefficients are 2, 5 and -3.
- **Constant term:** the term with no variable, such as -1 in $5y^3 + y^2 + 2y - 1$.
- **Univariate polynomial (polynomial in one variable):** an algebraic expression in one variable and its powers, such as $x^2 + 5x + 3$.
- **Degree of a polynomial:** the highest power of the variable in it.
- **Constant, quadratic and cubic polynomials:** polynomials of degree 0, 2 and 3, such as 8, $x^2 + 5x + 1$ and $5y^3 + y^2 + 2y - 1$.
- **Linear polynomial:** a polynomial of degree 1, such as $2x + 3$ or $5 - 4y$.
- **Linear pattern:** a sequence of numbers in which the difference between consecutive terms is constant.
- **Linear growth:** a pattern in which a quantity increases at a constant rate.
- **Linear decay:** a pattern in which a quantity decreases at a constant rate.
- **Linear relationship:** a relationship between two quantities represented by a straight line.
- **Slope:** the number a in $y = ax + b$; it measures the steepness of the line.
- **y-intercept:** the number b in $y = ax + b$; it is the value of y when $x = 0$.



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Solved Examples (NCERT)

Example 1: Degrees of polynomial

Question: Find the degrees of the following polynomials.
 $4z - 3$

Solution:

1. (i) Powers of x present: 2, 1, 0. Highest power is 2. Degree is 2.
2. (ii) Powers of y present: 3, 1, 0. Degree is 3.
3. (iii) $-9 = -9x^0$. Degree **0** (constant polynomial).

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4. (iv) $4z - 3$ has highest power 1. Degree **1** (linear).

Example 2: Coefficients and constant terms (Exercise Set 2.1)

Question: (a) What are the coefficients of x^2 and x^3 in the polynomial $x^4 - 3x^3 + 6x^2 - 2x + 7$? (b) What is the coefficient of z in the polynomial $4z^3 + 5z^2 - 11$? (c) What is the constant term of the polynomial $9x^3 + 5x^2 - 8x - 10$?

Solution:

1. (a) The x^2 term is $+6x^2$, so its coefficient is **6**. The x^3 term is $-3x^3$, so its coefficient is **-3**.
2. (b) There is no term in z (power 1). The coefficient of z is **0**.
3. (c) The term with no variable is -10 . The constant term is **-10**.

Example 3: Values of polynomials (Exercise Set 2.2)

Question: (a) Find the value of the linear polynomial $2x - 3$ at $x = 0$ and $x = -1$. (b) Find the value of the quadratic polynomial $7s^2 - 4s + 3$ at $s = 0$ and $s = -3$.

Solution:

1. (a) $x = 0$: $0 - 3 = -3$. $x = -1$: $2 \times (-1) - 3 = -5$.
2. (b) $s = 0$: 6 . $s = -3$: $7 \times (-3)^2 - 4 \times (-3) + 3 = 66$.

Example 4: Ages of Salil and his mother

Question: The present age of Salil's mother is 5 years more than three times the age of Salil. In 5 years, their ages will add up to 70 years. Find their present ages.

Solution: Let Salil's present age be x years. Then his mother's age is $x + 5$ and $3x + 5$.

$$(x + 5) + (3x + 5) = 70, \text{ so } 4x + 10 = 70, 4x = 60, x = 15$$

Salil is **15 years** old and his mother is **45 years** old.

Example 5: Ruby's coins (Exercise Set 2.3)

Question: Ruby has 3 times as many two-rupee coins as one-rupee coins. If the total value of the coins is ₹88, how many coins does she have in all?



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Solution: Let the number of five-rupee coins be n . Then she has $3n$ two-rupee coins.

Value: $5 \times n + 2 \times 3n = 5n + 6n = 11n$. So $11n = 88$ and $n = 8$.

She has **8 five-rupee coins** and **24 two-rupee coins**. Check: $40 + 48 = 88$.

Example 6: Dimensions of a rectangle (Exercise Set 2.2)

Question: If the length of a rectangle is three more than twice its width and its perimeter is 24 cm, what are the dimensions of the rectangle?

Solution: Let the width be w cm. The length is $(2w + 3)$ cm.

Perimeter = $2(\text{length} + \text{width}) = 2(2w + 3 + w) = 2(3w + 3) = 6w + 6$.

$6w + 6 = 24$, so $6w = 18$ and $w = 3$. Length = $2 \times 3 + 3 = 9$.

The rectangle is **9 cm by 3 cm**. Check: $2(9 + 3) = 24$.

Example 7: A growing plant (Exercise Set 2.2)

Question: Suppose a plant has height 1.75 feet after 0 months. (i) Make a table of the height, h , increases every month. (iii) For which values of t does it represent linear growth.

Solution:

Start with the expression from part (iii): the height increases by 0.5 feet every month, so $h = 1.75 + 0.5t$.

(i) After 7 months: $h = 1.75 + 3.5 = \mathbf{5.25}$ feet.

(ii) Table: at $t = 0, 1, 2, 3, \dots, 10$ the height increases by 0.5 feet every month.

The height increases by the same 0.5 feet every month. This is a linear polynomial in t with positive coefficient.



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Example 8: Finding a and b from two bills (Exercise Set 2.5)

Question: A gym charges a fixed monthly fee and an additional cost per hour for using the badminton court. A student using the gym observed that when she used the badminton court for 10 hours, her bill was ₹800. When she used it for 15 hours, her bill was ₹1100. If the monthly bill y depends on the hours of the use of the badminton court, x, according to the relation $y = ax + b$, find the values of a and b.

Solution:

- 1. $x = 10, y = 800$: $800 = 10a + b$, so $b = 800 - 10a$.
- 2. $x = 15, y = 1100$: $1100 = 15a + b = 15a + 800 - 10a = 5a + 800$.
- 3. $5a = 300$, so **a = 60**.
- 4. $b = 800 - 600 = \mathbf{200}$.

The relationship is $y = 60x + 200$: ₹60 per hour of court use and a fixed fee of ₹200

Example 9: Slopes, intercepts and

Question: Draw the graph of the following Also, find the coordinates of the points wh
 $4x + 7$ (iii) $5y = 6x - 10$ (iv) $3y = 6x - 11$. Ar

Solution: First make y the subject of each one more point from the equation (for (i), > line.

Line	In the form $y = ax + b$
(i)	$y = -3x + 4$
(ii)	$y = 2x + 7/2$
(iii)	$y = (6/5)x - 2$
(iv)	$y = 2x - 11/3$

Lines (ii) and (iv) have the same slope 2 and



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Example 10: Two linear polynomials from conditions (End-of-Chapter Exercises)

Question: Let $p(x) = ax + b$ and $q(x) = cx + d$ be two linear polynomials such that: (i) $p(0) = 5$. (ii) The polynomial $p(x) - q(x)$ cuts the x -axis at $(3, 0)$. (iii) The sum $p(x) + q(x)$ is equal to $6x + 4$ for all real x . Find the polynomials $p(x)$ and $q(x)$.

Solution:

1. $p(0) = a \times 0 + b = b$, so **$b = 5$** .
2. $p(x) + q(x) = (a + c)x + (b + d) = 6x + 4$ for all x . So $a + c = 6$ and $b + d = 4$, giving $d = -1$.
3. $p(x) - q(x) = (a - c)x + (b - d) = (a - c)x + 6$. It cuts the x -axis at $(3, 0)$, so its value at $x = 3$ is 0:
 $3(a - c) + 6 = 0$, giving $a - c = -2$.
4. Adding $a + c = 6$ and $a - c = -2$: $2a = 4$, so $a = 2$ and $c = 4$.

$p(x) = 2x + 5$ and $q(x) = 4x - 1$. Check: sum = $6x + 4$; difference = $-2x + 6$ which is 0 at $x = 3$.

Competency-Based Questions

1. Case-based: The cab company

A cab company charges a fixed booking fee of ₹20 and for a 10 km ride costs ₹250. The fare y (in ₹) for a ride of x km is given by $y = 20x + 50$.

(a) Find a and b . $170 = 6a + b$ and $250 = 10a + b$. Subtracting, $80 = 4a$, so $a = 20$. Substituting $a = 20$ in $170 = 6a + b$, we get $170 = 120 + b$. The fare is **$y = 20x + 50$** .

(b) What do a and b mean here? $a = ₹20$ is the fixed booking fee (fare for 0 km).

(c) How far can a rider travel for ₹390? $390 = 20x + 50$, so $340 = 20x$, giving $x = 17$. The rider can travel 17 km.

2. Case-based: Draining a pond

A school pond holds 900 litres of water. For every 10 minutes, 100 litres of water is drained. The amount of water W left after t minutes is given by $W = 900 - 10t$.

(a) Write the amount of water W left after t minutes. $W = 900 - 10t$.



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(b) How much water is left after 12 minutes? $900 - 540 = 360$ litres.

(c) When will the pond be empty? $900 - 45t = 0$ gives $t = 20$ minutes.

3. Case-based: A row of squares made of matchsticks

Stage 1 is one square made of 4 matchsticks. At every new stage one more square is added to the end of the row, sharing one side with the last square, so each new square needs 3 more matchsticks.

(a) Write the number of matchsticks for Stages 1 to 5. 4, 7, 10, 13, 16.

(b) Find the rule for Stage n . Constant difference 3, so the rule is $3n + c$. At $n = 1$: $3 + c = 4$, so $c = 1$. Rule: $3n + 1$.

(c) Can a stage use exactly 100 matchsticks? $3n + 1 = 100$ gives $3n = 99$, $n = 33$. Yes, Stage 33.

4. Assertion-Reason

Assertion (A): The number 7 is a polynomial.

Reason (R): 7 can be written as $7x^0$, in which the power is a whole number.

Options: (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.

Answer: (a). The chapter shows that a constant is a polynomial of degree 0. R gives exactly the same explanation.

5. Assertion-Reason

Assertion (A): The lines $y = 4x + 3$ and $y = 4x + 5$ are parallel.

Reason (R): Two lines of the form $y = ax + b$ are parallel if a is the same.

Answer: (c). A is true: both lines have slope 4. R is false: lines with the same slope and same y-intercept meet at that point on the line.

6. Assertion-Reason

Assertion (A): The sequence 2, 5, 9, 14, ... is an arithmetic progression.



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Reason (R): In a linear pattern, the difference between consecutive terms is constant.

Answer: (d). R is the definition of a linear pattern, so it is true. The differences in A are 3, 4, 5, which are not constant, so A is false.

7. Data reasoning: Is it linear?

Two tables are recorded.

t	0	1	2	3	4
Table P	18	15	12	9	6
Table Q	1	2	4	8	16

(a) Which table shows a linear relationship? Justify. Table P: the differences are all -3, so it is linear. Table Q: the differences are not constant, so it is not linear.

(b) Write the rule for the linear table and its slope. Table P: decreases by a fixed 3 each step, so it is linear decay.

8. Source-based: The cost of a garden

Read: "A rectangular garden of length l m is to be decorated. A wire fence is to be laid along the length and the width. The cost of the fence is to be built along the width costing ₹50 per meter. The cost of the fence throughout the garden which will cost ₹5000."

(a) Write the total cost as an algebraic expression.

(b) Is this a univariate polynomial? Explain. A polynomial has only one variable.

(c) The owner fixes the width at 10 m. Write the total cost. $200l + 1600 + 500l = 700l + 1600$. It is a linear expression.



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Important Questions for Exams

1-Mark Questions

Q1. Write the degree of the polynomial $7 - 2x + 5x^3$.

Answer: The highest power of x is 3, so the degree is 3.

Q2. Write the coefficient of x in $3x^2 - 9$.

Answer: There is no x term, so the coefficient of x is 0.

Q3. Classify $5 - 4y$ by degree.

Answer: Degree 1, so it is a linear polynomial.

Q4. Write the y -intercept of the line $y = 3x - 2$.

Answer: -2. The line cuts the y -axis at $(0, -2)$.

2-Mark Questions

Q5. Write a polynomial of degree 3 in the form $ax^3 + bx^2 + cx + d$ such that the sum of coefficients is -7.

Answer: $x^3 - 7x^2 + 2x + 1$ (any cubic with -7 as constant term and its x^2 coefficient is -7).

Q6. Find the values of the following polynomials: (i) $5x^2 - 3x + 7$ if $x = 1$ (ii) $4t^3 - t^2 + 6$ if $t = a$.

Answer: (i) $5 - 3 + 7 = 9$. (ii) $4a^3 - a^2 + 6$.

Q7. A farmer cuts a 300 feet fence into two pieces, one of which is 4 times as long as the shorter piece. How long is the shorter piece?

Answer: Shorter = x , longer = $4x$. $x + 4x = 300$. $5x = 300$. $x = 60$. So the shorter piece is 60 feet.

3-Mark Questions

Q8. A learning platform charges a fixed fee of ₹10 per module accessed. A student observes that when she accessed 14 modules, her bill was ₹400. Find the fixed fee and the charge per module accessed, x , according to the number of modules accessed, x , according to the following table.

Answer: $400 = 10a + b$ and $500 = 14a + b$. Subtracting, $100 = 4a$. $a = 25$. So $y = 25x + 150$: ₹25 per module and ₹150 fixed fee.



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Q9. A mobile phone is bought for ₹10,000. Its value decreases by ₹800 every year. (i) Find the value of the phone after 3 years. (ii) Make a table of values for t varying from 0 to 8 years and show how the value of the phone, v , depreciates with time. (iii) Find an expression that relates v and t , and explain why it represents linear decay.

Answer: (iii) $v = 10000 - 800t$. (i) After 3 years, $v = 10000 - 2400 = ₹7,600$. (ii) For $t = 0$ to 8: 10000, 9200, 8400, 7600, 6800, 6000, 5200, 4400, 3600. The value falls by the same ₹800 over each equal interval of one year, and the coefficient of t is negative, so this is linear decay.

Q10. The digits of a two-digit number differ by 3. If the digits are interchanged, and the resulting number is added to the original number, we get 143. Find both the numbers.

Answer: Let the tens digit be a and the units digit b . The number is $10a + b$ and the reversed number is $10b + a$. Their sum is $11a + 11b = 143$, so $a + b = 13$. The digits differ by 3, so taking $a > b$, $a - b = 3$. Adding, $2a = 16$, so $a = 8$ and $b = 5$. The numbers are **85 and 58**. Check: $85 + 58 = 143$.

5-Mark Questions

Q11. The graph of a linear polynomial $p(x)$ passes through the points (1, 5) and (0, 2). Find the polynomial $p(x)$. (ii) Find the coordinates of the point where the graph of $p(x)$ intersects the x-axis.

Answer: Let $p(x) = ax + b$. From (1, 5): $a + b = 5$. From (0, 2): $b = 2$. So $a = 3$ and $b = 2$. So $p(x) = 3x + 2$. It cuts the x-axis at $p(x) = 0$: $3x + 2 = 0$, $x = -2/3$, so $(-2/3, 0)$.

Q12. Let $p(x) = ax + b$ and $q(x) = cx + d$ be two linear polynomials. The graph of $p(x)$ passes through the points (2, 3) and (4, -1). (iii) The graph of $q(x)$ is parallel to the graph of $p(x)$. Also, find the coordinates of the point where the graph of $q(x)$ intersects the x-axis.

Answer: From (2, 3) and (4, -1): $2a + b = 3$ and $4a + b = -1$. Subtracting, $-2a = 4$, so $a = -2$. Then $b = 7$. So $p(x) = -2x + 7$. Parallel lines have the same slope, so $q(x) = -2x + d$. From (2, 3): $-4 + d = 3$, so $d = 7$. So $q(x) = -2x + 7$. $q(x) = 0$ at $x = 3.5$, so $(3.5, 0)$.

Q13. If the temperature of a liquid can be measured in two different units as y °F, the relation between the two units is given by the linear equation $y = (9/5)(x - 273) + 32$, where x is the temperature in Kelvin. Find the temperature in Kelvin when the temperature in Fahrenheit is 32.

Answer: (i) $x = 313$: $x - 273 = 40$, $(9/5) \times 40 = 72$, $72 + 32 = 104$. (ii) $y = 32$: $32 = (9/5)(x - 273) + 32$. Multiply by $5/9$: $x - 273 = 0$, so $x = 273$.



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Common Mistakes and Examiner Tips

1. **Taking the number of terms as the degree.** $2x^2 - 5x + 3$ has three terms but degree 2. Fix: look only at the highest power of the variable.
2. **Dropping the sign of a coefficient.** In $x^4 - 3x^3 + \dots$ the coefficient of x^3 is -3, not 3. Fix: the sign in front of a term belongs to its coefficient.
3. **Saying a missing term has "no coefficient".** The coefficient of z in $4z^3 + 5z^2 - 11$ is 0. Fix: write the answer as 0.
4. **Calling a constant "not a polynomial" or giving it degree 1.** -9 is a constant polynomial of degree 0. Fix: remember $-9 = -9x^0$.
5. **Substituting a negative value without brackets.** $7s^2$ at $s = -3$ is $7 \times 9 = 63$, not -63. Fix: write $7 \times (-3)^2$ with brackets every time.
6. **Wrong nth-term rule from a table.** For 1, 3, 5, 7, ... writing $2n + 1$ gives 3 at $n = 1$. Fix: after writing a rule, test it at $n = 1$ and $n = 2$.
7. **Forgetting the part already paid for.** In a charge is $15(n - 2)$, not $15n$. Fix: count o
8. **Mixing up growth and decay.** $h(t) = 3 -$ Fix: check the sign of the coefficient of
9. **Reading slope and intercept before ma** 4) and the y-intercept is $7/2$ (not 7). Fix
10. **Thinking equal y-intercepts make lines** parallel lines have equal slopes and diff



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Quick Revision Points

- A univariate polynomial has one variable
- Degree = highest power of the variable
- Degree 0 constant, 1 linear, 2 quadratic
- To evaluate a polynomial, substitute the
- A linear polynomial equated to a constant
- A linear pattern has a constant difference
- The tile pattern 1, 3, 5, 7, ... has nth term
- Linear growth: fixed increase over equal intervals, such as $C(d) = 100 + 60d$.

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- Linear decay: fixed decrease over equal intervals, such as $h(t) = 3 - 0.5t$.
- A linear relationship is $y = ax + b$; two readings give a and b .
- $a = \text{change in } y \div \text{change in } x$.
- $y = ax$ passes through the origin; $a > 1$ is steeper than $y = x$, $0 < a < 1$ is less steep.
- Positive slope: line rises, growth. Negative slope: line falls, decay.
- $y = ax + b$ cuts the y -axis at $(0, b)$; b is the y -intercept.
- Same slope, different y -intercepts: parallel lines.

Weightage and Exam Pattern

Class 9 has no board exam. This chapter is assessed in school exams: periodic tests, the half-yearly exam and the annual exam. In the CBSE Class IX Mathematics course structure for 2026-27, **Unit II, Algebra, carries 20 marks** out of 100 marks over 12 teaching periods. That 20 marks is shared between Sequences and Progressions, Exploring Algebraic Identities, and Variables. The course structure does not include the remaining 20 marks of the subject are internal assessment 10, portfolio 5, lab practical 5)

Unit
I. Number System
II. Algebra
III. Coordinate Geometry
IV. Geometry
V. Mensuration
VI. Statistics and Probability

The question paper design in the course is based on remembering and understanding, 24% ap



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The course structure lists the key concepts as algebraic expressions, the definition and degree of a polynomial, linear polynomials and applications, linear patterns, linear growth and decay, linear relationships and their graphs, and the slope and y-intercept of $y = ax + b$. The chapter prepares you for sequences and progressions, linear equations in two variables and Class 10 algebra.



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