ANSWER KEY & MARKING SCHEME · CBSE CLASS 9

Polynomials

Mathematics · Chapter 2 · Use this with the Board Paper · Companion to Quick Drill

HOW TO USE

Attempt the Board Paper first (closed-book, full time). Then come here. For 2-mark+ questions, compare your answer to the model. For 3-4 mark questions, also consult the **Topper Templates** below — these show the exact step-by-step structure that scores full marks per CBSE marking-scheme conventions.

MODEL ANSWERS · BOARD PAPER

Section A — Very Short Answer

Q1. Find the degree of the polynomial 5x^4 - 3x^3 + 2x - 7. [1 mark]

Ans: Degree = 4 (highest power of x).

Q2. Is root 2 times x^2 + 3x + 1 a polynomial? Justify. [1 mark]

Ans: Yes; coefficients may be irrational (here root 2) but the exponents 2, 1, 0 are non-negative integers, satisfying the polynomial definition.

Q3. Find the zero of p(x) = 3x - 9. [1 mark]

Ans: 3x - 9 = 0 gives x = 3. Zero is 3.

Q4. Classify x^3 + 2x by terms and by degree. [1 mark]

Ans: Binomial (2 terms); cubic polynomial (degree 3).

Section B — Short Answer I

Q5. Use the Remainder Theorem to find the remainder when p(x) = x^3 - ax^2 + 6x - a is divided by (x - a). [2 marks]

Ans: By Remainder Theorem, remainder = p(a) = a^3 - a times a^2 + 6a - a = a^3 - a^3 + 6a - a = 5a.

Q6. Evaluate (102)^3 using a suitable identity. [2 marks]

Ans: (100 + 2)^3 = 100^3 + 3(100)^2(2) + 3(100)(2)^2 + 2^3 = 1000000 + 60000 + 1200 + 8 = 1061208.

Q7. Factorise: x^2 + 7x + 12 by splitting the middle term. [2 marks]

Ans: Need two numbers summing to 7, product 12: 3 and 4. x^2 + 3x + 4x + 12 = x(x+3) + 4(x+3) = (x+3)(x+4).

Q8. Find the value of k if (x - 2) is a factor of p(x) = 2x^3 - 6x^2 + 5x + k. [2 marks]

Ans: By Factor Theorem, p(2) = 0. p(2) = 16 - 24 + 10 + k = 2 + k = 0, so k = -2.

Section C — Short Answer II

Q9. Factorise: x^3 - 23x^2 + 142x - 120. [3 marks]

Ans: p(1) = 1 - 23 + 142 - 120 = 0, so (x - 1) is a factor. Dividing: x^3 - 23x^2 + 142x - 120 = (x - 1)(x^2 - 22x + 120). Split: 120 = 10 times 12 with 10 + 12 = 22. So x^2 - 22x + 120 = (x - 10)(x - 12). Final: (x - 1)(x - 10)(x - 12).

Q10. If x + y + z = 0, show that x^3 + y^3 + z^3 = 3xyz. [3 marks]

Ans: Identity: x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx). Given x + y + z = 0, the right-hand side becomes 0 times anything = 0. Hence x^3 + y^3 + z^3 - 3xyz = 0, that is x^3 + y^3 + z^3 = 3xyz.

Q11. Factorise: 27x^3 + y^3 + z^3 - 9xyz. [3 marks]

Ans: Rewrite as (3x)^3 + y^3 + z^3 - 3(3x)(y)(z). By identity a^3+b^3+c^3-3abc = (a+b+c)(a^2+b^2+c^2-ab-bc-ca) with a=3x, b=y, c=z: = (3x + y + z)(9x^2 + y^2 + z^2 - 3xy - yz - 3xz).

Section D — Long Answer

Q12. **(a) Use the Factor Theorem to verify that (x - 1), (x + 2), and (x - 3) are factors of p(x) = x^3 - 2x^2 - 5x + 6. (b) Hence write p(x) as a product of three linear factors.** **[5 marks]**

> **Ans:** (a) p(1) = 1 - 2 - 5 + 6 = 0; p(-2) = -8 - 8 + 10 + 6 = 0; p(3) = 27 - 18 - 15 + 6 = 0. By Factor Theorem, all three are factors. (b) Since p(x) is degree 3 and we have three distinct linear factors with leading coefficient 1, p(x) = (x - 1)(x + 2)(x - 3).

Q13. **If a + b + c = 9 and ab + bc + ca = 26, find the value of a^2 + b^2 + c^2. Hence find a^3 + b^3 + c^3 - 3abc.** **[4 marks]**

> **Ans:** (a+b+c)^2 = a^2 + b^2 + c^2 + 2(ab+bc+ca), so 81 = a^2+b^2+c^2 + 52, giving a^2+b^2+c^2 = 29. Then a^3+b^3+c^3-3abc = (a+b+c)(a^2+b^2+c^2 - ab-bc-ca) = 9 times (29 - 26) = 9 times 3 = 27.

★ TOPPER ANSWER TEMPLATES

5 TEMPLATES · MEMORISE THE FORMAT

★ TOPPER TEMPLATE — Factorise a cubic using the Factor Theorem

Appears as a 3-mark question in almost every CBSE Class 9 Polynomials set.

Step 1 [1 mark]	**Find & verify a root**	List divisors of the constant term as possible roots; test the smallest. e.g. $p(1)=1-6+11-6=0$, so $(x-1)$ is a factor by the Factor Theorem.
Step 2 [1 mark]	**Divide out the factor**	Divide the cubic by $(x-1)$: $x^3-6x^2+11x-6 = (x-1)(x^2-5x+6)$.
Step 3 [1 mark]	**Factorise the quadratic**	Split the middle term: $x^2-5x+6 = (x-2)(x-3)$. Final answer: $(x-1)(x-2)(x-3)$.

COMMON LOSS OF MARKS:

- Forgetting to write 'by Factor Theorem' as justification (-0.5)
- Not verifying the chosen root before dividing (-0.5)
- Splitting middle term incorrectly in the quadratic factor (-1)

★ TOPPER TEMPLATE — Apply the cubic identity $x^3+y^3+z^3-3xyz$

Recurs as a 3-mark identity-application question across CBSE Class 9 papers.

Step 1 [1 mark]	**State the identity**	$x^3+y^3+z^3-3xyz = (x+y+z)(x^2+y^2+z^2-xy-yz-zx)$. If $x+y+z=0$ then $x^3+y^3+z^3=3xyz$.
Step 2 [1 mark]	**Rewrite & substitute**	Rewrite each cube as a base, e.g. $27x^3+y^3+z^3-9xyz = (3x)^3+y^3+z^3-3(3x)(y)(z)$, so the substitution matches the identity.
Step 3 [1 mark]	**Simplify**	$= (3x+y+z)(9x^2+y^2+z^2-3xy-yz-3xz)$, keeping every cross-term sign correct.

COMMON LOSS OF MARKS:

- Writing identity with wrong signs in second bracket (-1)
- Forgetting to match 3xyz coefficient when rewriting (-1)
- Sign error on the cross terms -xy, -yz, -zx (-0.5)

★ TOPPER TEMPLATE — Find a remainder using the Remainder Theorem

A reliable 2-mark question in CBSE Class 9 Polynomials.

Step 1 [1 mark]	**Identify a & state theorem**	For divisor $(x-2)$, $a=2$. By the Remainder Theorem the remainder equals $p(a)=p(2)$.
Step 2 [1 mark]	**Substitute & simplify**	$p(2)=2^3+3(2^2)-5(2)+7 = 8+12-10+7 = 17$. Remainder = 17.

COMMON LOSS OF MARKS:

- Substituting x = -2 instead of x = +2 from (x - 2) (-1)
- Arithmetic error in evaluating p(a) (-0.5)
- Skipping the Theorem statement (-0.5)

★ TOPPER TEMPLATE — Factorise a quadratic by splitting the middle term

A standard 2-mark question in CBSE Class 9 Polynomials.

Step 1 [1 mark]	**Find the split pair**	For $6x^2+17x+5$: need two numbers with sum $b=17$ and product $a\cdot c=30 \rightarrow 15$ and 2.
Step 2 [1 mark]	**Split, group & factor**	$6x^2+15x+2x+5 = 3x(2x+5)+1(2x+5) = (2x+5)(3x+1)$.

COMMON LOSS OF MARKS:

- Splitting with numbers that add but don't multiply correctly (-1)
- Sign errors when c is negative (-0.5)
- Not grouping properly leading to wrong common factor (-1)

★ TOPPER TEMPLATE — Evaluate a number using an algebraic identity

A common 2-mark question in CBSE Class 9 Polynomials.

Step 1 [1 mark]	**Rewrite & state identity**	$95^2 = (100-5)^2$. Use $(a-b)^2 = a^2-2ab+b^2$ with a=100, b=5.
Step 2 [1 mark]	**Substitute & simplify**	$= 100^2-2(100)(5)+5^2 = 10000-1000+25 = 9025$.

COMMON LOSS OF MARKS:

- Using (a+b)^2 by mistake (-1)
- Missing the 2ab middle term (-1)
- Arithmetic slip in subtraction (-0.5)

MARKING SCHEME — GENERAL NOTES

- Award full marks for correct final answer with all working shown.
- Deduct half mark for missing 'by Remainder Theorem' or 'by Factor Theorem' justification when the method is the question's focus.
- In factorisation, award 1 mark for finding the first factor via Factor Theorem and 1 mark for completing the split into linear factors.
- Sign errors in the master identity (x^3+y^3+z^3-3xyz) cost 1 mark; a totally wrong identity costs 2 marks.
- Forgetting the 2xy or 3x^2 y middle terms in squared or cubed expansions costs 1 mark per missing term.
- Arithmetic slips with otherwise correct method: deduct half mark and award method marks.
- Section D long answer: marks split as stated; partial credit per sub-step.
- No marks for unsupported one-line final answer in Section C and D.