

CHAPTER-2

Polynomials

Task-1

Topic	Polynomials
Nature of task	Content
Content Coverage	This task is based on the following concepts:
	Definition of a polynomial, coefficient, constant term and degree of Polynomials, classification of Polynomials according to number of terms, classification of Polynomials according to degree, value of a polynomial at a point, concept of zero of a polynomial.
Learning Objectives	<ul style="list-style-type: none">• To identify polynomials• To write different types of polynomials with specified degree.• To find coefficient, degree, no. of terms.• To find value of a polynomials at a point.
Task	Class Worksheet
Execution of task	This task may be performed in the classroom. Each student would be given the sheet. They would be then asked to write the answers to questions.
Duration	1 period
Criteria for assessment	Teacher may ask questions in groups and observe the level of understanding. It is not necessary to give marks for this assessment. It may be used for diagnostic purpose.
Follow up	–

Class Worksheet

Q1. Write 5 expressions which are not polynomials. Justify your answers.

Q2. Give examples of the polynomials

- Cubic and binomial
- Cubic and monomial
- Quadratic and trinomial
- Quadratic and monomial
- Linear and binomial
- Linear and monomial



Q3. For the polynomial $p(x) = 5x^3 - 3x^2 + 2x + \sqrt{2}$, mark the statements as true or false and justify.

- The degree of polynomial $p(x)$ is 4.
- The degree of polynomial $p(x)$ is 3.
- The coefficient of x^2 is 3.
- The coefficient of x is 2
- The constant term is 3
- The number of terms is 4

Q4. Justify the following statements with examples:

- We can have a trinomial having degree 7.
- The degree of a binomial cannot be more than two.
- There is only one term of degree one in a monomial.
- A cubic polynomial always has degree three.

Q5. Complete the entries

$$p(x) = 5x^7 - 6x^5 + 7x - 6$$

$$\text{Coefficient of } x^5 =$$

$$\text{Degree of } p(x) =$$

$$\text{Constant term} =$$

$$\text{Number of terms} =$$

Q6. If $p(x) = x^4 + 2x^3 - 10x^2 - 14x + 21$, then find $P(1)$, $P(-1)$ and $P(1/2)$.

Q7. Find the zeroes of the following polynomials:

$$\text{a) } p(x) = 3x - 5$$

$$\text{b) } p(x) = 2x + 7$$

Q8. Check whether -2 and 2 are the zeroes of the polynomial $x^4 - 16$.

Q9. Give examples to justify the following statements:

- A zero of a polynomial need not be 0.
- 0 may be a zero of a polynomial.
- Every linear polynomial has one and only one zero.
- A polynomial can have more than one zero.



Task-2

Topic	Polynomials
Nature of task	Content
Content Coverage	Algebraic identities
Learning Objectives	To verify the algebraic identity $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$ using unit cubes
Task	Hands on using Unit cubes
Execution of task	This task may be performed in the Maths laboratory. Each student would be given unit cubes. They would be then asked to perform the activity by the help of instruction sheet.
Duration	1 period
Criteria for assessment	Teacher may ask questions in groups and observe the level of understanding. Parameters for assessment: Class Ethics Performance of activity File record (Marks may be allotted by the teacher accordingly)

Note : Similarly remaining algebraic identities can be taken up in the Maths activity period.
(Refer to CBSE Maths laboratory manual)

Aim : To verify the algebraic identity $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$ using unit cubes.

Material required : Unit Cubes

Procedure

Let $a = 3$ and $b = 1$

Step 1. To represent a^3 make a cube of dimension $a \times a \times a$ i.e. $3 \times 3 \times 3$ cubic units



Step 2. To represent $a^3 - b^3$ extract a cube of dimension $b \times b \times b$ i.e. $1 \times 1 \times 1$ from the cube formed in the Step 1 of dimension $a \times a \times a$ i.e. $3 \times 3 \times 3$ cubic units.

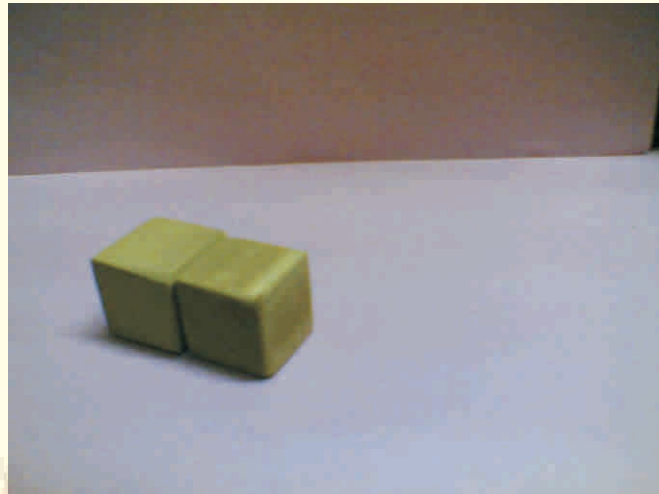


Step 3. To represent $(a - b)a^2$ make a cuboid of dimension $(a - b) \times a \times a$ i.e. $2 \times 3 \times 3$ cubic units.

Step 4. To represent $(a - b)ab$ make a cuboid of dimension $(a - b) \times a \times b$ i.e. $2 \times 3 \times 1$ cubic units.



Step 5. To represent $(a - b)b^2$ make a cuboid of dimension $(a - b) \times b \times b$ i.e. $2 \times 1 \times 1$



Step 6. To represent $(a - b)a^2 + (a - b)ab + (a - b)b^2 + (a - b)b^2 + (a - b)b^2$ i.e. $(a - b)(a^2 + ab + b^2)$ join all the cuboids formed in the Step 3, 4 and 5.

Observe the following :

The number of unit cubes in $a^3 = \dots\dots\dots$

The number of unit cubes in $b^3 = \dots\dots\dots$

The number of unit cubes in $a^3 - b^3 = \dots\dots\dots$

The number of unit cubes in $(a - b)a^2 = \dots\dots\dots$

The number of unit cubes in $(a - b)ab = \dots\dots\dots$

The number of unit cubes in $(a - b)b^2 = \dots\dots\dots$

The number of unit cubes in $(a - b)a^2 + (a - b)ab + (a - b)b^2$

Observation :

It is observed that the number of unit cubes in $a^3 - b^3$ is equal to the number of unit cubes in $(a - b)a^2 + (a - b)ab + (a - b)b^2$ i.e. $(a - b)(a^2 + ab + b^2)$.

Write the result.

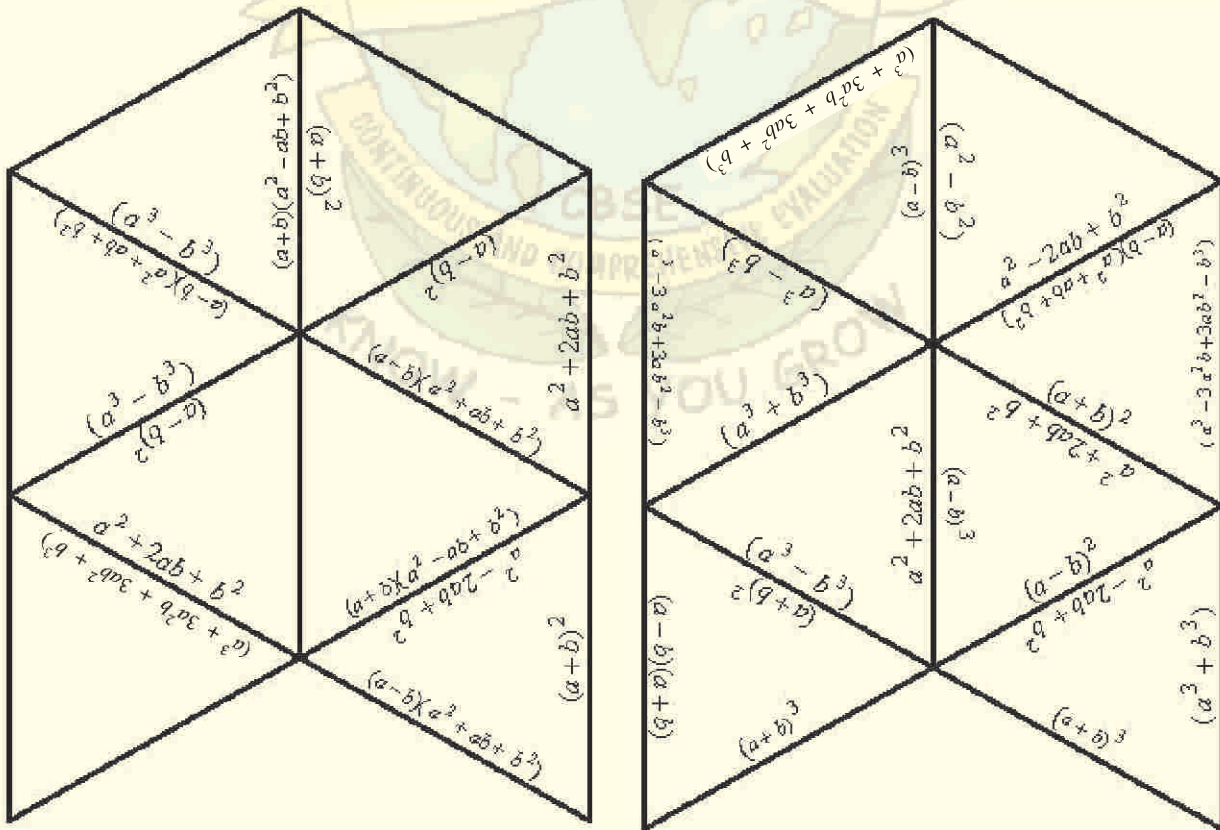


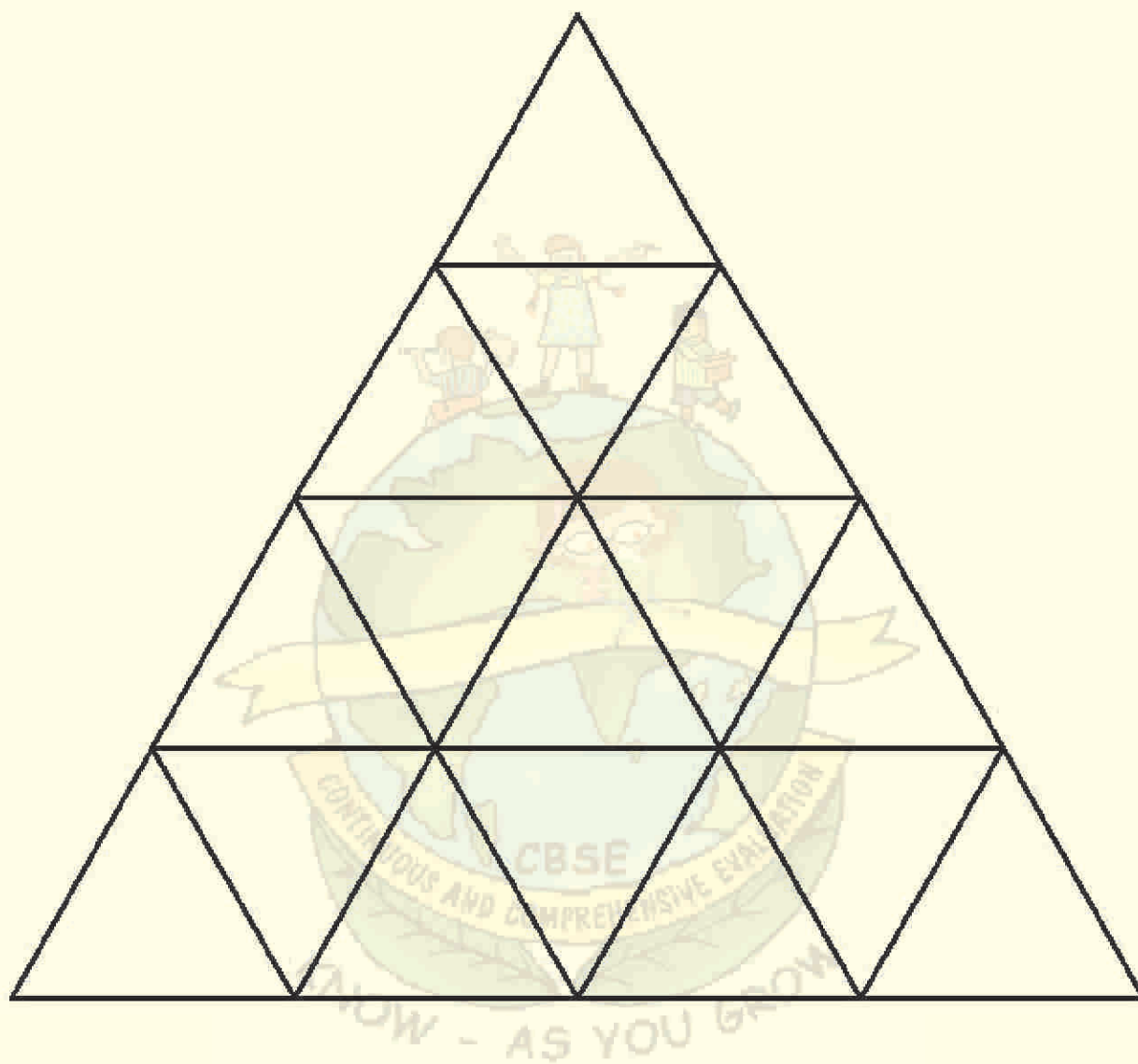
Task-3

Topic	Polynomials
Nature of task	Post content
Content Coverage	Algebraic formulae
Learning Objective	Students would test their knowledge of formulae
Task	Puzzle - fun with formulae
Execution of task	This task may be performed in groups of 4 to 5 students. Teacher would provide each group the puzzle template students. Students would be given 10 minutes to first cutout pieces and then arrange them in the desired format.
Duration	1 period
Criteria for assessment	It is a fun activity for recalling formulae. There is no need to allot marks.

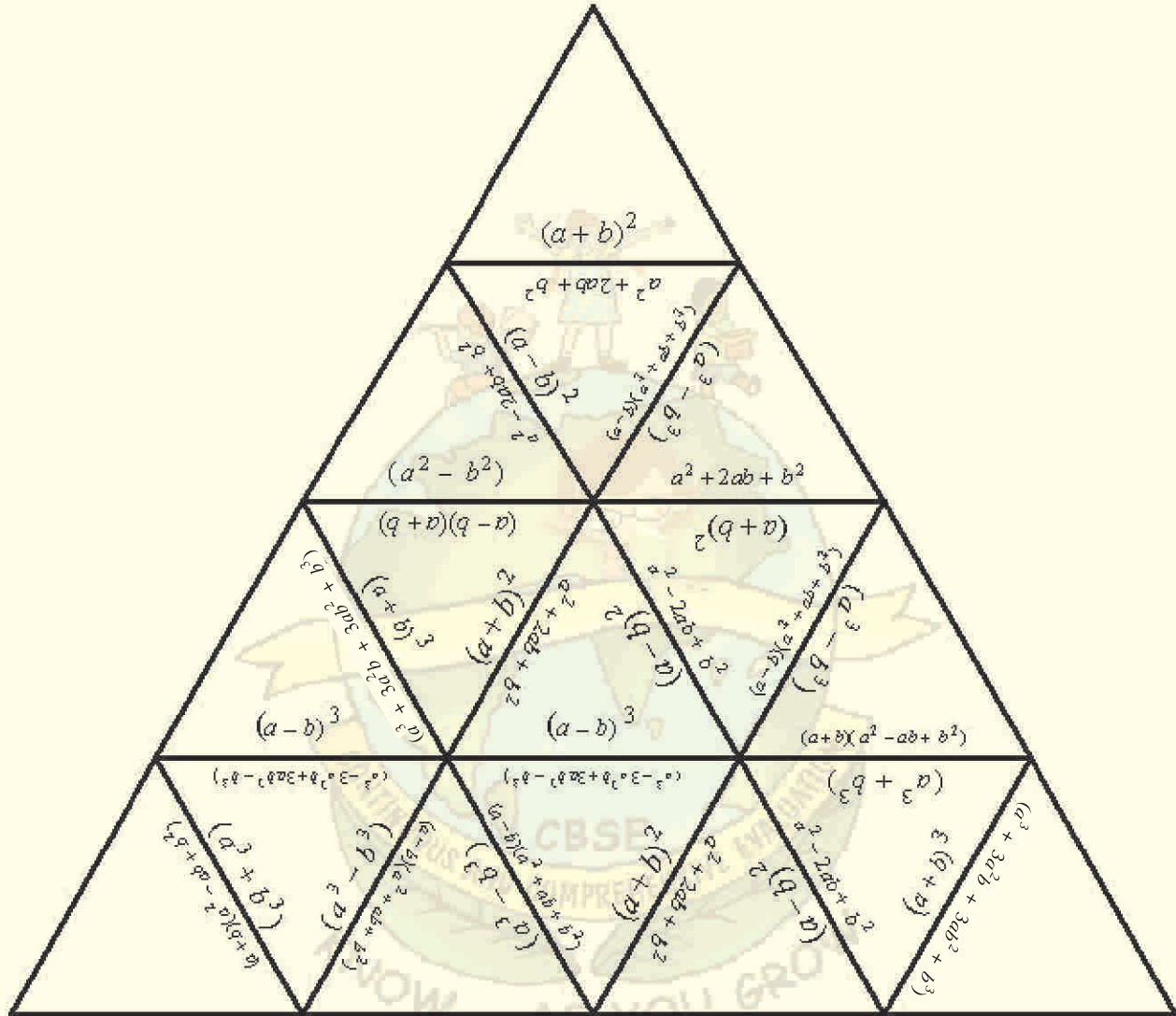
Note : This is a challenging activity. Students look to solve puzzles. It is enriching as well as motivating.

Such kinds of tasks may be used in other Chapters as formulae recapitulation activity.





Answer :



Task-4

Topic	Polynomials
Nature of task	Post content
Content Coverage	Complete Chapter
Learning Objective	<ul style="list-style-type: none"> To recognise a polynomial To find zero of polynomial To factorise given polynomial To apply remainder theorem To apply factor theorem.
Execution of task	Printed MCQ worksheet may be given to students.
Duration	1 period
Criteria for assessment	For each correct answer 1 mark can be allotted.
Follow up	<ul style="list-style-type: none"> Class room discussion Answers to the questions and common errors may be discussed in the class.

Multiple Choice Questions

- Which of the following is not a polynomial?

A. $x^2 + \sqrt{2}x + 3$	B. $x^2 - \sqrt{2}x + 6$
C. $x^3 + 3x^2 - 3$	D. $6x + 4$
- The degree of the polynomial $3x^3 - x^4 + 5x + 3$ is

A. 3	B. -4	C. 4	D. 1
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- Zero of the polynomial $p(x) = a^2x$, $a \neq 0$ is

A. $x = 0$	B. $x = 1$	C. $x = -1$	D. $a = 0$
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- Which of the following is a term of a polynomial?

A. $2x$	B. $\frac{3}{x}$	C. \sqrt{x}	D. $x^{\sqrt{x}}$
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- If $p(x) = 5x^2 - 3x + 7$, then $p(1)$ equals

A. -10	B. 9	C. -9	D. 10
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- Factorisation of $x^3 + 1$ is

A. $(x + 1)(x^2 - x + 1)$	B. $(x + 1)(x^2 + 1)$
C. $(x + 1)(x^2 + x + 1)$	D. $(x - 1)(x^2 - x - 1)$



7. If $x + y + 2 = 0$, then $x^3 + y^3 + 8$ equals
A. $(x + y + 2)^3$ B. zero C. $6xy$ D. $-6xy$
8. If $x = 2$ is a zero of the polynomial $2x^2 + 3x - p$, then the value of p is
A. -4 B. 0 C. 8 D. 14
9. $x + \frac{1}{x}$ is
A. a polynomial of degree 1 B. a polynomial of degree 2
C. a polynomial of degree 3 D. not a polynomial
10. Integral zeroes of the polynomial $(x + 3)(x - 7)$ are
A. $-3, -7$ B. $3, 7$ C. $-3, 7$ D. $3, -7$
11. The remainder when $p(x) = 2x^2 - x - 6$ is divided by $(x - 2)$ is
A. $p(-2)$ B. $p(2)$ C. $p(3)$ D. $p(-3)$
12. If $2(a^2 + b^2) = (a + b)^2$, then
A. $a + b = 0$ B. $a = b$ C. $2a = b$ D. $ab = 0$
13. If $x^3 + 3x^2 + 3x + 1$ is divided by $(x + 1)$, then the remainder is
A. 8 B. -8 C. 0 D. $\frac{1}{8}$
14. The value of $(525)^2 - (475)^2$ is
A. 100 B. 1000 C. 100000 D. -100
15. If $a + b = -1$, the value of $a^3 + b^3 - 3ab$ is
A. 26 B. 1 C. -1 D. -26
16. The value of $(2 - a)^3 + (2 - b)^3 + (2 - c)^3 - 3(2 - a)(2 - b)(2 - c)$ when $a + b + c = 6$ is
A. 3 B. -3 C. zero D. -1
17. If $\frac{a}{b} + \frac{b}{a} = 1$, ($a \neq 0, b \neq 0$), then the value of $a^3 - b^3$ is
A. 1 B. -1 C. 0 D. $\frac{1}{2}$
18. If $x = \frac{1}{2 - \sqrt{3}}$, then the value of $(x^2 - 4x + 1)$ is
A. 3 B. 1 C. zero D. -1



19. The number of zeroes of the polynomial $x^3 + x - 3 - 3x^2$ is
 A. zero B. 1 C. 2 D. 3
20. If $(x + 2)$ and $(x - 2)$ are factors of $ax^4 + 2x - 3x^2 + bx - 4$, then the value of $a + b$ is
 A. -7 B. 7 C. 14 D. -8

Task-5

Topic	Polynomials
Nature of task	Post content
Content Coverage	Complete Chapter
Learning Objective	<ul style="list-style-type: none"> To practise factorisation of polynomial To learn application of remainder theorem and factor theorem.
Execution of task	For extra practise of content taught, home assignment can be given after the completion of Chapter.
Duration	2 to 3 days
Criteria for assessment	Follow CW / HW / assignment rubric.
Follow up	Class discussion answers to the questions may be discussed in class room and individual queries may be answered.

Home Assignment

- Factorise the following : $9x^2 + 6x + 1 - 25y^2$
- Factorise the following : $a^2 + b^2 + 2ab + 2bc + 2ca$
- Show that $p(x) = x^3 - 3x^2 + 2x - 6$ has only one zero.
- Find the value of a if $x + 6$ is a factor of $x^3 + 3x^2 + 4x + a$.
- If polynomials $ax^3 + 3x^2 - 3$ and $2x^3 - 5x + a$ leaves the same remainder when each is divided by $x - 4$, find the value of a .
- Find the integral zeroes of the polynomial $2x^3 + 5x^2 - 5x - 2$.
- If $(x - 3)$ and $\left(x - \frac{1}{3}\right)$ are both factors of $ax^2 + 5x + b$, then show that $a = b$.
- Find the value of $x^3 + y^3 + 15xy - 125$ if $x + y = 5$.
- Without actually calculating, find the value of $(25)^3 - (75)^3 + (50)^3$.



Task-6: Quiz

Topic	Polynomials
Nature of task	Post Content
Content Coverage	Complete Chapter
Learning Objectives	Mentioned earlier
Task	Quiz
Execution of task	<ol style="list-style-type: none"> 1. Teacher may divide the class into 4 groups. Name them as Team A, Team B, Team C and Team D. 2. Rules for Quiz: <ul style="list-style-type: none"> • There would be 3 Rounds viz. Rapid Fire, Thinking Skills and Arithmetic Skills. • In Rapid Fire round each Team would be given 2 minutes time for answering the questions. They can answer as many questions. Each correct answer will be awarded 1 point. • In Thinking Skills round, the entire Team will work together to solve questions. There will be 3 questions to be answered by each Team. Time limit for answering one question is 2 minutes. If the answer is wrong/not answered by a team, then question will be passed to the next Team .For every correct answer Team would be awarded 2 points and in case the question is passed to next team then 1 bonus point will be given to the next Team for getting the correct answer. • In Arithmetic Skills round, each Team would be given same question. Marks 5, 4, 3, 2 would be awarded on the basis of speed and accuracy.
Duration	2 periods



Assessment: Make Score Board

Rounds	Team A	Team B	Team C	Team D
1. Rapid Fire				
2. Thinking Skills				
3. Arithmetic Skills				
Total				

Suggested questions for Rapid fire Round

- $2x$ is a monomial. (T/F)
- Constant term in $x - 2$
- There can be a binomial of degree 5. (T/F)
- The Remainder when $x^2 - 1$ is divided by $(x - 1)$
- A polynomial having three terms is called.....
- The degree of $x^5 + 3x^4 - 7x$ is.....
- A real number k is called zero of a polynomial if.....
- A quadratic polynomial can have one zero. (T/F)
- A cubic polynomial can have at most zeroes.
- Division Algorithm is....
- A polynomial of degree 4 can have three terms. (T/F)
- 4 is a zero of polynomial $P(x) = x - 4$. (T/F)
- The expanded form of $(2a + 3b + 4c)^2$
- $1 - t^3$ is equal to....



15. Am I right if I say 20 is a polynomial?
16. A zero of a polynomial is always zero. (T/F)
17. Zero of $p(x) = 5x - 3$
18. If $x^{100} + 100$ is divided by $x + 1$, then the remainder is.....

Suggested questions for Thinking Skills Round

Set 1 (3 questions for Team A)

1. What is the first term of the quotient when $81x^3 + 9x^2 - 3x - 9$ is divided by $9x - 2$?
2. What will be the remainder when $x^5 - 2x^3 + x^2 - 3$ is divided by $x - 1$?
3. If $(x - 2)$ is a factor of $kx^2 - \sqrt{2}x + 1$, then find the value of k .

Similarly questions for other teams can be prepared.

Suggested questions for Arithmetic Skills Round

1. If the polynomial $2x^3 - ax^2 + bx + 4$ has $(x + 1)$ as a factor and leaves remainder 4 when divided by $2x + 1$, find the values of a and b .

Task-7: Remedial Worksheet

1. Formula Reference Help

1. $(x + y)^2 = x^2 + 2xy + y^2$
2. $(x - y)^2 = x^2 - 2xy + y^2$
3. $x^2 - y^2 = (x - y)(x + y)$
4. $(x + a)(x + b) = x^2 + (a + b)x + ab$
5. $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$
6. $(x + y)^3 = x^3 + y^3 + 3xy(x + y)$
7. $(x - y)^3 = x^3 - y^3 - 3xy(x - y)$
8. $x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$
9. If $x + y + z = 0$
then $x^3 + y^3 + z^3 = 3xyz$

2. Reading Coefficients of terms, Degree of Polynomials

In $4x^2 + 7x - 2$
the Coefficient of x^2 is 4
the Coefficients of x is 7



Q. Check whether $x = \frac{4}{5}$ is zero of $p(x) = 5x - \pi$?

$$p(x) = 5x - \pi$$

$$p\left(\frac{4}{5}\right) =$$

Ans. _____

Q. Find the zero of $p(x) = x - 5$

Hint: Put $p(x) = 0$

Q. Find the zero of $p(x) = ax, a \neq 0$

4. Remember

Remainder theorem: Let $p(x)$ be any polynomial of degree greater than or equal to one and Let a be any real number. If $p(x)$ is divided by the linear polynomial $(x - a)$, then the remainder is $p(a)$.

Example: When $p(x) = 4x + x^3 - 2x + x + 1$ is divided by $x - 1$
then by Remainder theorem
Remainder = $p(1)$

Polynomial $p(x)$	Divided by	Remainder
$x^3 + 3x^2 + 3x + 1$	$x + 1$	$p(-1)$
$2x^3 - 3x^2 + 2x - 1$	$x - \frac{1}{2}$	
$4x^2 + 3x - 2$	$x + \frac{1}{2}$	
$3x^3 + 4x^2 - 2x + 1$	x	
$8x^3 - 3x^2 + 4x + 1$	$x + 17$	

Note : Teacher may prepare remedial worksheet as per the need of students.

