UNIT 10

ALGEBRAIC EXPRESSIONS

(A) Main Concepts and Results

- Algebraic expression is formed from variables and constants using different operations.
- Expressions are made up of terms.
- A term is the product of factors. Factors may be numerical as well as algebraic (literal).
- Coefficient is the numerical factor in a term. Sometimes, any factor in a term is called the coefficient of the remaining part of the term.
- The terms having the same algebraic factors are called like terms.
- The terms having different algebraic factors are called unlike terms.
- Expression with one term is called a 'Monomial'.
- Expression with two unlike terms is called a 'Binomial'.
- Expression with three unlike terms is called a 'Trinomial'.
- In general, an expression with one or more than one term (with non-negative integral exponents of the variables) is called a 'Polynomial'.
- The sum (or difference) of two like terms is a like term with coefficient equal to the sum (or difference) of coefficients of the two like terms.

- When we add (or subtract) two algebraic expressions, the like terms are added (or subtracted) and the unlike terms are written as they are.
- To find the value of an expression, we substitute the values of the variables in the expression and then simplify.
- Rules and formulas in mathematics are written in a concise and general form using algebraic expressions.

(B) Solved Examples

In Examples 1 to 3, there are four options, out of which one is correct. Write the correct answer.

Example 1: The like terms in $3x(3 - 2y)$ and $2(xy + x^2)$ are

(a) $9x$ and $2x^2$ (b) $-6xy$ and $2xy$

(c) $9x$ and $2xy$ (d) $-6xy$ and $2x^2$

Solution : The correct answer is (b).

Expressions are used to write word problems in math terms.

Expressions are like **instructions** that tell you what you have to do to a number or variable.

In words	Expression
A number x is increased by 7	$x + 7$
A number y is decreased by 7	$y - 7$
A number a is multiplied by 7	$a \times 7$
A number k is divided by 7	$k \div 7$

Sometimes you might have to describe a **real-life situation** using a mathematical expression.

You need to imagine what would happen to a quantity, and write that down using variables, and +, –, × and ÷ .

When you change a **variable expression** to a **word expression** you, can say the **same thing** in several **different ways.**

+ : Instead of "2 **added to** x", you could say "x **increased by** 2," or "2 **more than** x," or "**the sum of** x and 2."

– : "2 **subtracted from** x" means the same as "2 **less than** x," or "x decreased by 2."

× : "x **multiplied by** 2" means the same as "**the product of** x and 2," "x **times** 2," or "**twice** x."

÷ : you could say: either "x **divided by** 3" or "**one third of** x."

Example 2: The coefficient of xy in $3x^2zy + 7xyz - 2z^2x$ is

(a) $3z$ (b) -2 (c) $7yz$ (d) $7z$

Solution: Correct answer is (d).

Example 3: The factors of the term $-xy^2$ are

(a) $x \times y \times y$ (b) $-1 \times y \times y$

(c) $-1 \times x \times y$ (d) $-1 \times x \times y \times y$

Solution: Correct answer is (d).

In Examples 4 to 7, fill in the blanks to make the statements true.

Example 4: An algebraic expression having one or more terms with non-negative integral exponents of the variables is called _____.

Solution: Polynomials

Example 5: Numerical factor in any term of a polynomial is called _____ of the term.

Solution: Numerical coefficient or coefficient.

Example 6: The terms with different algebraic factors are called _____.

Solution: Unlike terms

Example 7: The terms with same algebraic factors are called _____.

Solution: Like terms

In Examples 8 to 10, state whether the statements are True or False.

Example 8: An expression with two terms is called a binomial.

Solution: True

Example 9: Every polynomial is a monomial.

Solution: False

Example 10: The value of a variable is fixed.

Solution: False

Example 11: Twice the sum of length x and breadth y of a rectangle is the perimeter of a rectangle. Write the expression for perimeter.

Solution: Perimeter of rectangle = 2 (Length + Breadth)

$= 2\,(x + y) = 2x + 2y$

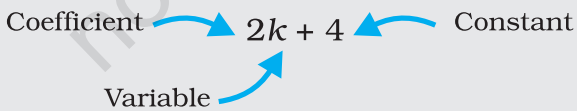
Example 12: Identify the term containing u^2 in the expression $u^3 + 3u^2v + 3uv^2 + v^3$ and write its coefficient.

Solution: Term containing $u^2 = 3u^2v$

Coefficient of $u^2 = 3v$

A Variable Represents an Unknown Number

In algebra you'll often have to work with numbers whose values you don't know. When you solve math problems, you can use a **letter** or a **symbol** to stand in for the number. The letter or symbol is called a **variable**.



The number that the variable is being multiplied by is called the **coefficient** – like the 2 above.

Any number not joined to a variable is called a **constant** – like the 4 above. It's called that because its value doesn't **change**, even if the value of the variable changes.

A term is a group of numbers and variables. One or more terms added together make an expression. For example, in the expression above, $2k$ is one term and 4 is another term. In the expression $3 + 4x - 5wyz$, the terms are 3, $4x$ and $-5wyz$.

An Expression is a Mathematical Phrase

Expressions are **mathematical phrases** that may contain **numbers**, **operations** and **variables**. The operations act like a set of instructions that tell you what to do with the numbers and variables. For example, 2k + 4 tells you to double *k*, then add four to it.

There are two types of expressions – **numeric** and **variable.**

• **Numeric expressions** have numbers in them, and often operations – but they don't include any variables:

→ 5 + 13

→ 2 × 5 – 6

→ 8 + 7 ÷ 6

• **Variable expressions** have variables in them, and may also include numbers and operations :

→ 5 h

→ 5 x

→ 5 k + 4

Example 13: Simplify the expression by combining the like terms:

$7x^3 - 3x^2y + xy^2 + x^2y - y^3$

Solution: Rearranging the terms in the given expression, we get

$7x^3 - 3x^2y + x^2y + xy^2 - y^3$

$= 7x^3 + (-3x^2y) + x^2y + xy^2 - y^3$

$= 7x^3 + (-3 + 1)\, x^2y + xy^2 - y^3$ [Using distributive property]

$= 7x^3 + (-2)\, x^2y + xy^2 - y^3$

$= 7x^3 - 2x^2y + xy^2 - y^3$

Example 14: Subtract the sum of $-3x^3y^2 + 2x^2y^3$ and $-3x^2y^3 - 5y^4$ from $x^4 + x^3y^2 + x^2y^3 + y^4$.

Solution:

$$\begin{array}{rr} & -3x^3y^2 + 2x^2y^3 \\ + & -3x^2y^3 - 5y^4 \\ \hline & -3x^3y^2 - x^2y^3 - 5y^4 \end{array}$$

Sum $= -3x^3y^2 - x^2y^3 - 5y^4$

Now, $x^4 + x^3y^2 + x^2y^3 + y^4$

$-3x^3y^2 - x^2y^3 - 5y^4$

(+) (+) (+)

difference $= x^4 + 4x^3y^2 + 2x^2y^3 + 6y^4$

Build Understanding

The parts of a variable expression that are separated by addition or subtraction signs are called **terms**. The variable expression $x + 3y + 2x - 4y^2$ contains four terms : x, $3y$, $2x$ and $-4y^2$. The terms x and $2x$ are like terms because they have the same variable raised to the same power. The terms $3y$ and $4y^2$ are unlike terms because they have different variable parts.

Variables are all well and good, but they're only useful when you use them to solve math problems. You can use variables and numbers to describe a problem in math terms — it's called an expression.

Example 15: Find the value of the following expressions at $a = 1$ and $b = -2$:

(i) $a^2 + b^2 + 3ab$ (ii) $a^3 + a^2b + ab^2 + b^3$

Solution: (i) Value of $a^2 + b^2 + 3ab$ at $a = 1$ and $b = -2$

$= (1)^2 + (-2)^2 + 3(1)(-2)$

$= 1 + 4 - 6$

$= 5 - 6$

$= -1$

(ii) Value of $a^3 + a^2b + ab^2 + b^3$ at $a = 1$ and $b = -2$

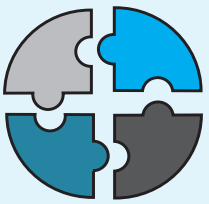
$= (1)^3 + (1)^2(-2)+(1)(-2)^2 + (-2)^3$

$= 1 - 2 + 4 - 8$

$= 5 - 10$

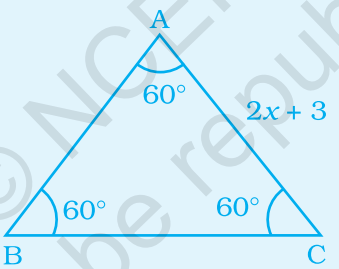
$= -5$

Application on Problem Solving Strategy



Example 16

Find each side of an equilateral triangle given below, if it's perimeter is 240 cm.



Solution: 

Understand and Explore the Problem

- What information is given in the question?
  ΔABC is an equilateral triangle. Hence AB = BC = CA.
- What are we trying to find?
  The value of one of the sides of the equilateral triangle.
- Is there any information that is not needed?
  The measure of each angle of ΔABC.

Plan a Strategy

- In an equilateral triangle, all sides are equal. Therefore, three times each side is same as perimeter.

Solve

- $3 \times$ length of one side = perimeter

  Therefore, $3 \times (2x + 3) = 240$

  Thus, $2x + 3 = \frac{\cancel{240}}{\cancel{3}} = 80$

  $\Rightarrow 2x + 3 = 80$

  $\Rightarrow 2x = 80 - 3$

  $\Rightarrow 2x = 77$

  $\Rightarrow x = \frac{77}{2}$

  Therefore, $x = 38.5$

  Hence, Side $= 2x + 3 = (2 \times 38.5) + 3 = 80$ cm.

Revise

- The above answer is verified by multiplying side with 3 and comparing the result with given perimeter.

  $3 \times 80 = 240$ = Perimeter given in question.

Think and Discuss

Draw this triangle on your copy and measure the angles of the triangle. What do you observe?

(C) Exercise

In each of the questions 1 to 16, out of the four options, only one is correct. Write the correct answer.

1. An algebraic expression containing three terms is called a

(a) monomial (b) binomial (c) trinomial (d) All of these

2. Number of terms in the expression $3x^2y - 2y^2z - z^2x + 5$ is

(a) 2 (b) 3 (c) 4 (d) 5

Check Understanding

Identify the following terms as like or unlike.

(a) $3x$, $3y$ (b) $7k$, $-3k$ (c) $2p$, $2pt$

3. The terms of expression $4x^2 - 3xy$ are:

(a) $4x^2$ and $-3xy$ (b) $4x^2$ and $3xy$

(c) $4x^2$ and $-xy$ (d) x^2 and xy

4. Factors of $-5x^2y^2z$ are

(a) $-5 \times x \times y \times z$ (b) $-5 \times x^2 \times y \times z$

(c) $-5 \times x \times x \times y \times y \times z$ (d) $-5 \times x \times y \times z^2$

5. Coefficient of x in $-9xy^2z$ is

(a) $9yz$ (b) $-9yz$ (c) $9y^2z$ (d) $-9y^2z$

6. Which of the following is a pair of like terms?

(a) $-7xy^2z$, $-7x^2yz$ (b) $-10xyz^2$, $3xyz^2$

(c) $3xyz$, $3x^2y^2z^2$ (d) $4xyz^2$, $4x^2yz$

7. Identify the binomial out of the following:

(a) $3xy^2 + 5y - x^2y$ (b) $x^2y - 5y - x^2y$

(c) $xy + yz + zx$ (d) $3xy^2 + 5y - xy^2$

8. The sum of $x^4 - xy + 2y^2$ and $-x^4 + xy + 2y^2$ is

(a) Monomial and polynomial in y (b) Binomial and Polynomial

(c) Trinomial and polynomial (d) Monomial and polynomial in x

9. The subtraction of 5 times of y from x is

(a) $5x - y$ (b) $y - 5x$ (c) $x - 5y$ (d) $5y - x$

10. $-b - 0$ is equal to

(a) $-1 \times b$ (b) $1 - b - 0$ (c) $0 - (-1) \times b$ (d) $-b - 0 - 1$

11. The side length of the top of square table is x. The expression for perimeter is:

(a) $4 + x$ (b) $2x$ (c) $4x$ (d) $8x$

12. The number of scarfs of length half metre that can be made from y metres of cloth is :

(a) $2y$ (b) $\frac{y}{2}$ (c) $y + 2$ (d) $y + \frac{1}{2}$

13. $123x^2y - 138x^2y$ is a like term of :

(a) $10xy$ (b) $-15xy$ (c) $-15xy^2$ (d) $10x^2y$

14. The value of $3x^2 - 5x + 3$ when $x = 1$ is

(a) 1 (b) 0 (c) –1 (d) 11

15. The expression for the number of diagonals that we can make from one vertex of a n sided polygon is:

(a) $2n + 1$ (b) $n - 2$ (c) $5n + 2$ (d) $n - 3$

Evaluating Variable Expressions

A variable is a letter that is used to represent one or more numbers. The numbers are the values of the variable. A variable expression is a collection of numbers, variables and operations. Here are some examples.

VARIABLE EXPRESSION	MEANING	OPERATION
$8y = 8 \times y = 8(y)$	8 times y	Multiplication
$\frac{16}{b} = 16 \div b$	16 divided by b	Division
$4 + s$	4 plus s	Addition
$9 - x$	9 minus x	Subtraction

The expression 8y is usually not written as $8 \times y$ because of possible confusion of symbol ' × ' with the variable x. Replacing each variable in an expression by a number is called **evaluating the expression.** The resulting number is the value of the expression.

Write the variable expression → **Substitute values for variables** → **Simplify the numerical expression**

16. The length of a side of square is given as $2x + 3$. Which expression represents the perimeter of the square?

(a) $2x + 16$ (b) $6x + 9$ (c) $8x + 3$ (d) $8x + 12$

In questions 17 to 32, fill in the blanks to make the statements true.

17. Sum or difference of two like terms is _____.

18. In the formula, area of circle = πr^2, the numerical constant of the expression πr^2 is _____.

19. $3a^2b$ and $-7ba^2$ are _____ terms.

20. $-5a^2b$ and $-5b^2a$ are _____ terms.

21. In the expression $2\pi r$, the algebraic variable is _____.

22. Number of terms in a monomial is _____.

23. Like terms in the expression $n(n + 1) + 6(n - 1)$ are _____and _____.

24. The expression $13 + 90$ is a _____.

25. The speed of car is 55 km/hrs. The distance covered in y hours is _____.

26. $x + y + z$ is an expression which is neither monomial nor _____.

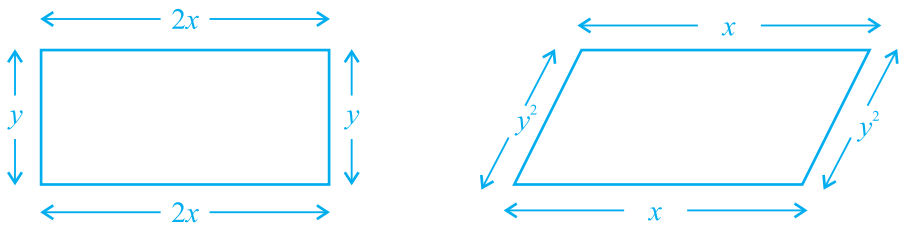
Expressions can be Described in Words

To show you understand an expression, you need to be able to explain **what it means** in words. You can write a **word expression** to represent the numeric or variable expression.

27. If $(x^2y + y^2 + 3)$ is subtracted from $(3x^2y + 2y^2 + 5)$, then coefficient of y in the result is _____.

28. $-a - b - c$ is same as $-a -$ (_____).

29. The unlike terms in perimeters of following figures are_____ and _____.



30. On adding a monomial _____ to $-2x + 4y^2 + z$, the resulting expression becomes a binomial.

31. $3x + 23x^2 + 6y^2 + 2x + y^2 +$ _____ $= 5x + 7y^2$.

32. If Rohit has $5xy$ toffees and Shantanu has $20yx$ toffees, then Shantanu has _____ more toffees.

In questions 33 to 52, state whether the statements given are True or False.

33. $1+\frac{x}{2}+x^3$ is a polynomial.

34. $(3a - b + 3) - (a + b)$ is a binomial.

35. A trinomial can be a polynomial.

36. A polynomial with more than two terms is a trinomial.

37. Sum of x and y is $x + y$.

38. Sum of 2 and p is $2p$.

39. A binomial has more than two terms.

40. A trinomial has exactly three terms.

41. In like terms, variables and their powers are the same.

42. The expression $x + y + 5x$ is a trinomial.

43. $4p$ is the numerical coefficient of q^2 in $-4pq^2$.

44. $5a$ and $5b$ are unlike terms.

45. Sum of $x^2 + x$ and $y + y^2$ is $2x^2 + 2y^2$.

46. Subtracting a term from a given expression is the same as adding its additive inverse to the given expression.

47. The total number of planets of Sun can be denoted by the variable n.

48. In like terms, the numerical coefficients should also be the same.

49. If we add a monomial and binomial, then answer can never be a monomial.

50. If we subtract a monomial from a binomial, then answer is atleast a binomial.

51. When we subtract a monomial from a trinomial, then answer can be a polynomial.

52. When we add a monomial and a trinomial, then answer can be a monomial.

Using Tables to Identify and Extend Patterns

Make a table that shows the number of triangles in each figure. Then tell how many triangles are in the fifth figure of the pattern. Use drawings to justify your answer.

Figure 1 **Figure 2** **Figure 3**

The table shows the number of triangles in each figure.

Figure	1	2	3	4	5
Number of Triangles	2	4	6	8	10
		+2	+2	+2	+2

The pattern is to add 2 triangles each time.

Figure 4 has 6 + 2 = 8 triangles. Figure 5 has 8 + 2 = 10 triangles.

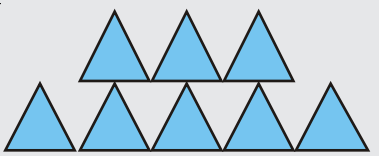


Figure 4

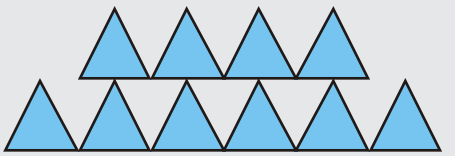


Figure 5

53. Write the following statements in the form of algebraic expressions and write whether it is monomial, binomial or trinomial.

(a) x is multiplied by itself and then added to the product of x and y.

(b) Three times of p and two times of q are multiplied and then subtracted from r.

(c) Product of p, twice of q and thrice of r.

(d) Sum of the products of a and b, b and c and c and a.

(e) Perimeter of an equilateral triangle of side x.

(f) Perimeter of a rectangle with length p and breadth q.

(g) Area of a triangle with base m and height n.

(h) Area of a square with side x.

(i) Cube of s subtracted from cube of t.

(j) Quotient of x and 15 multiplied by x.

(k) The sum of square of x and cube of z.

(l) Two times q subtracted from cube of q.

54. Write the coefficient of x^2 in the following:

(i) $x^2 - x + 4$ (ii) $x^3 - 2x^2 + 3x + 1$

(iii) $1 + 2x + 3x^2 + 4x^3$ (iv) $y + y^2x + y^3x^2 + y^4x^3$

55. Find the numerical coefficient of each of the terms :

(i) x^3y^2z, xy^2z^3, $-3xy^2z^3$, $5x^3y^2z$, $-7x^2y^2z^2$

(ii) $10xyz$, $-7xy^2z$, $-9xyz$, $2xy^2z$, $2x^2y^2z^2$

56. Simplify the following by combining the like terms and then write whether the expression is a monomial, a binomial or a trinomial.

(a) $3x^2yz^2 - 3xy^2z + x^2yz^2 + 7xy^2z$

(b) $x^4 + 3x^3y + 3x^2y^2 - 3x^3y - 3xy^3 + y^4 - 3x^2y^2$

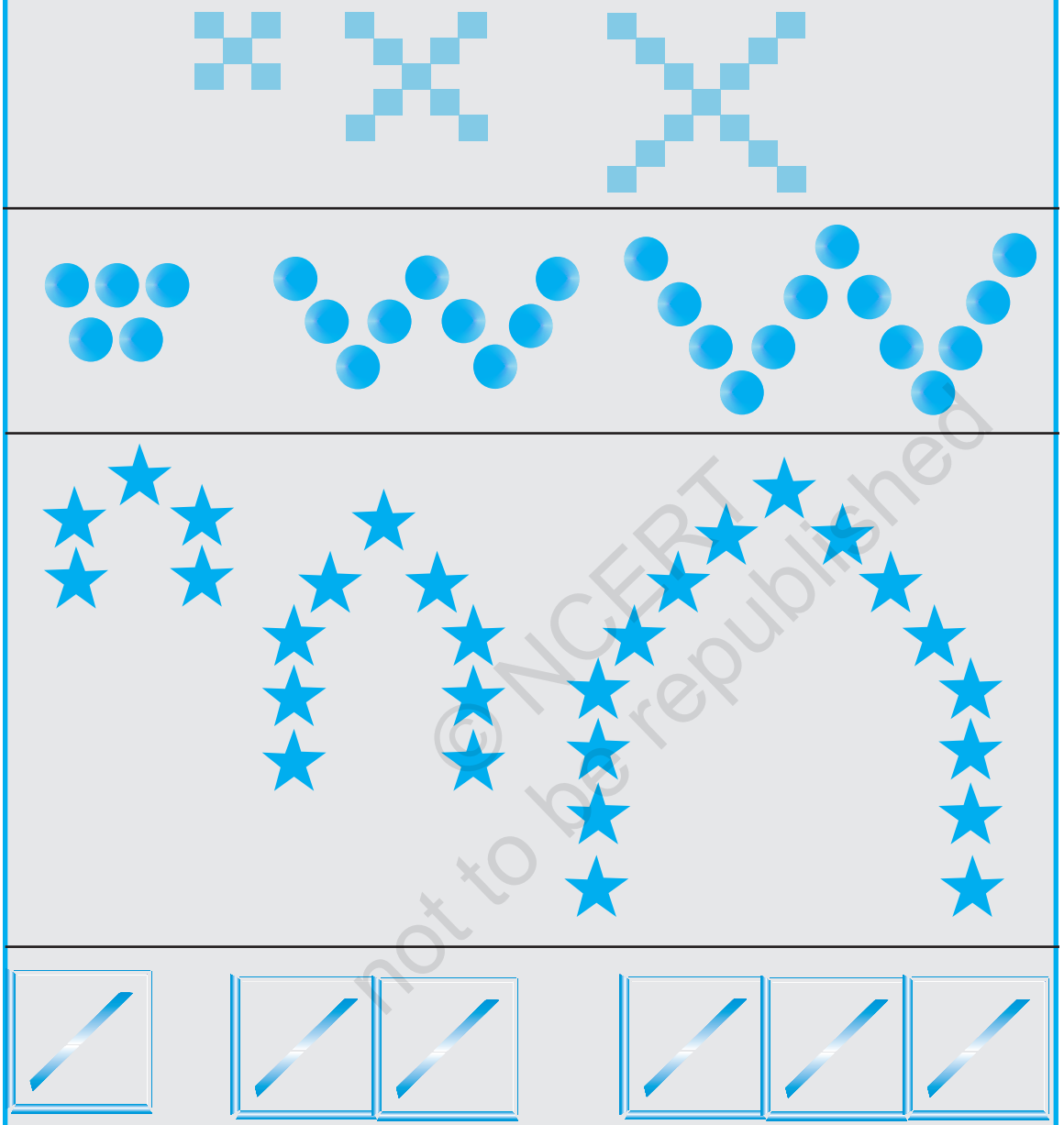
(c) $p^3q^2r + pq^2r^3 + 3p^2qr^2 - 9p^2qr^2$

(d) $2a + 2b + 2c - 2a - 2b - 2c - 2b + 2c + 2a$

(e) $50x^3 - 21x + 107 + 41x^3 - x + 1 - 93 + 71x - 31x^3$

Number Strips and Expressions

Four sequences of patterns start as shown below:



The four patterns are different.

1. What do the four patterns have in common?

You may continue the sequence of each pattern as far as you want.

2. How many squares, dots, stars or bars will the 10th figure of each sequence have?

57. Add the following expressions:

(a) $p^2 - 7pq - q^2$ and $-3p^2 - 2pq + 7q^2$

(b) $x^3 - x^2y - xy^2 - y^3$ and $x^3 - 2x^2y + 3xy^2 + 4y$

(c) $ab + bc + ca$ and $-bc - ca - ab$

(d) $p^2 - q + r$, $q^2 - r + p$ and $r^2 - p + q$

(e) $x^3y^2 + x^2y^3 + 3y^4$ and $x^4 + 3x^2y^3 + 4y^4$

(f) $p^2qr + pq^2r + pqr^2$ and $-3pq^2r - 2pqr^2$

(g) $uv - vw$, $vw - wu$ and $wu - uv$

(h) $a^2 + 3ab - bc$, $b^2 + 3bc - ca$ and $c^2 + 3ca - ab$

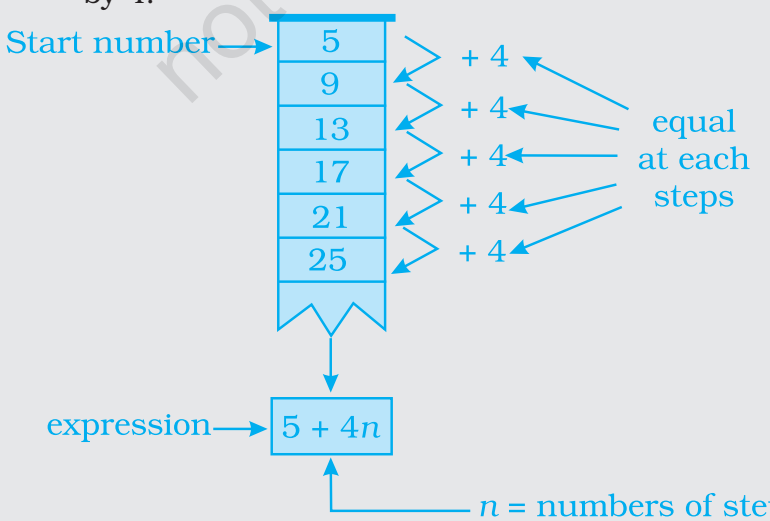
(i) $\frac{5}{8}p^4 + 2p^2 + \frac{5}{8}$; $\frac{1}{8} - 17p + \frac{9}{8}p^2$ and $p^5 - p^3 + 7$

(j) $t - t^2 - t^3 - 14$; $15t^3 + 13 + 9t - 8t^2$; $12t^2 - 19 - 24t$ and $4t - 9t^2 + 19t^3$

Arithmetic Sequence

The common properties of the four sequences of patterns on previous page are:

- the first figure has 5 elements (squares, dots, stars or bars);
- with each step in the row of figures, the number of elements grows by 4.



So, the four sequences of patterns correspond to the same number sequence.

Remark: To reach the 50th number in the strip, you need 49 steps.

So take $n = 49$ and you find the 50th number:

$5 + 4 \times 49 = 201$.

58. Subtract

(a) $-7p^2qr$ from $-3p^2qr$.

(b) $-a^2 - ab$ from $b^2 + ab$.

(c) $-4x^2y - y^3$ from $x^3 + 3xy^2 - x^2y$.

(d) $x^4 + 3x^3y^3 + 5y^4$ from $2x^4 - x^3y^3 + 7y^4$.

(e) $ab - bc - ca$ from $-ab + bc + ca$.

(f) $-2a^2 - 2b^2$ from $-a^2 - b^2 + 2ab$.

(g) $x^3y^2 + 3x^2y^2 - 7xy^3$ from $x^4 + y^4 + 3x^2y^2 - xy^3$.

(h) $2(ab + bc + ca)$ from $-ab - bc - ca$.

(i) $4.5x^5 - 3.4x^2 + 5.7$ from $5x^4 - 3.2x^2 - 7.3x$.

(j) $11 - 15y^2$ from $y^3 - 15y^2 - y - 11$.

59. (a) What should be added to $x^3 + 3x^2y + 3xy^2 + y^3$ to get $x^3 + y^3$?

(b) What should be added to $3pq + 5p^2q^2 + p^3$ to get $p^3 + 2p^2q^2 + 4pq$?

60. (a) What should be subtracted from $2x^3 - 3x^2y + 2xy^2 + 3y^3$ to get $x^3 - 2x^2y + 3xy^2 + 4y^3$?

(b) What should be subtracted from $-7mn + 2m^2 + 3n^2$ to get $m^2 + 2mn + n^2$?

61. How much is $21a^3 - 17a^2$ less than $89a^3 - 64a^2 + 6a + 16$?

62. How much is $y^4 - 12y^2 + y + 14$ greater than $17y^3 + 34y^2 - 51y + 68$?

63. How much does $93p^2 - 55p + 4$ exceed $13p^3 - 5p^2 + 17p - 90$?

64. To what expression must $99x^3 - 33x^2 - 13x - 41$ be added to make the sum zero?

Think and Discuss

1. **Describe** two different number patterns that begin with 3, 6, ...
2. **Tell** when it would be useful to make a table to help you identify and extend a pattern.

65. Subtract $9a^2 - 15a + 3$ from unity.

66. Find the values of the following polynomials at $a = -2$ and $b = 3$:

(a) $a^2 + 2ab + b^2$ (b) $a^2 - 2ab + b^2$

(c) $a^3 + 3a^2b + 3ab^2 + b^3$ (d) $a^3 - 3a^2b + 3ab^2 - b^3$

(e) $\frac{a^2+b^2}{3}$ (f) $\frac{a^2-b^2}{3}$

(g) $\frac{a}{b}+\frac{b}{a}$ (h) $a^2 + b^2 - ab - b^2 - a^2$

67. Find the values of following polynomials at $m = 1$, $n = -1$ and $p = 2$:

(a) $m + n + p$ (b) $m^2 + n^2 + p^2$

(c) $m^3 + n^3 + p^3$ (d) $mn + np + pm$

(e) $m^3 + n^3 + p^3 - 3mnp$ (f) $m^2n^2 + n^2p^2 + p^2m^2$

68. If $A = 3x^2 - 4x + 1$, $B = 5x^2 + 3x - 8$ and $C = 4x^2 - 7x + 3$, then find:

(i) (A + B) – C

(ii) B + C – A

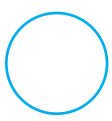
(iii) A + B + C

69. If $P = -(x - 2)$, $Q = -2(y + 1)$ and $R = -x + 2y$, find a, when $P + Q + R = ax$.

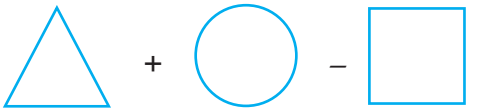
70. From the sum of $x^2 - y^2 - 1$, $y^2 - x^2 - 1$ and $1 - x^2 - y^2$ subtract $-(1 + y^2)$.

71. Subtract the sum of $12ab - 10b^2 - 18a^2$ and $9ab + 12b^2 + 14a^2$ from the sum of $ab + 2b^2$ and $3b^2 - a^2$.

72. Each symbol given below represents an algebraic expression:

 $= 2x^2 + 3y$,  $= 5x^2 + 3x$,  $= 8y^2 - 3x^2 + 2x + 3y$

The symbols are then represented in the expression:



Find the expression which is represented by the above symbols.

73. Observe the following nutritional chart carefully:

Food Item (Per Unit = 100g)	**Carbohydrates**
Rajma	60g
Cabbage	5g
Potato	22g
Carrot	11g
Tomato	4g
Apples	14g

Write an algebraic expression for the amount of carbohydrates in 'g' for

(a) y units of potatoes and 2 units of rajma (b) $2x$ units tomatoes and y units apples.

74. Arjun bought a rectangular plot with length x and breadth y and then sold a triangular part of it whose base is y and height is z. Find the area of the remaining part of the plot.

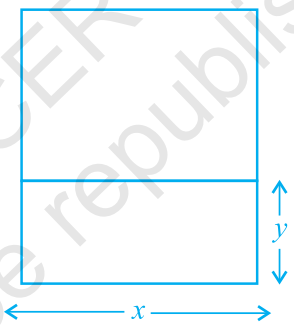
75. Amisha has a square plot of side m and another triangular plot with base and height each equal to m. What is the total area of both plots?

76. A taxi service charges ₹ 8 per km and levies a fixed charge of ₹ 50. Write an algebraic expression for the above situation, if the taxi is hired for x km.

77. Shiv works in a mall and gets paid ₹ 50 per hour. Last week he worked for 7 hours and this week he will work for x hours. Write an algebraic expression for the money paid to him for both the weeks.

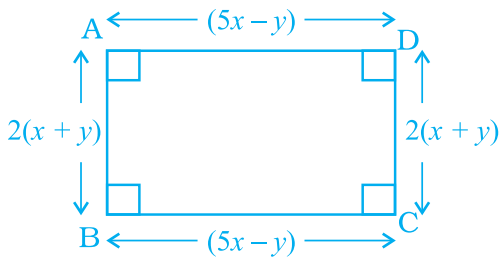
78. Sonu and Raj have to collect different kinds of leaves for science project. They go to a park where Sonu collects 12 leaves and Raj collects x leaves. After some time Sonu loses 3 leaves and Raj collects $2x$ leaves. Write an algebraic expression to find the total number of leaves collected by both of them.

79. A school has a rectangular play ground with length x and breadth y and a square lawn with side x as shown in the figure given below. What is the total perimeter of both of them combined together?

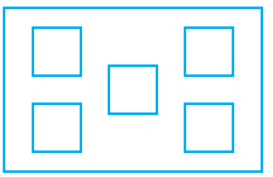


80. The rate of planting the grass is ₹ x per square metre. Find the cost of planting the grass on a triangular lawn whose base is y metres and height is z metres.

81. Find the perimeter of the figure given below:



82. In a rectangular plot, 5 square flower beds of side $(x+2)$ metres each have been laid (see figure given below). Find the total cost of fencing the flower beds at the cost of ₹ 50 per 100 metres:



83. A wire is $(7x - 3)$ metres long. A length of $(3x - 4)$ metres is cut for use. Now, answer the following questions:

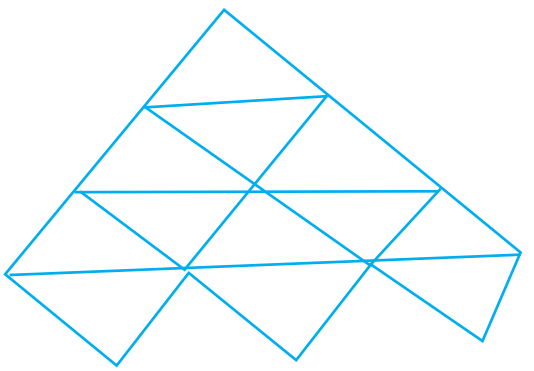
(a) How much wire is left?

(b) If this left out wire is used for making an equilateral triangle. What is the length of each side of the triangle so formed?

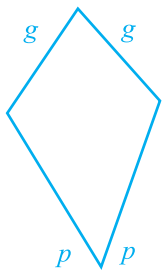
84. Rohan's mother gave him ₹ $3xy^2$ and his father gave him ₹ $5(xy^2+2)$. Out of this total money he spent ₹ $(10-3xy^2)$ on his birthday party. How much money is left with him?

85. (i) A triangle is made up of 2 red sticks and 1 blue sticks 

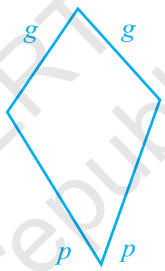
. The length of a red stick is given by r and that of a blue stick is given by b. Using this information, write an expression for the total length of sticks in the pattern given below:

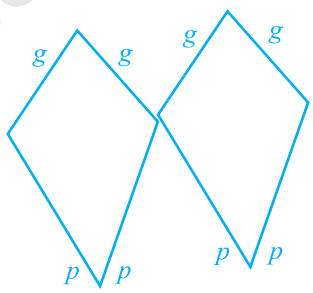


(ii) In the given figure, the length of a green side is given by g and that of the red side is given by p.



Write an expression for the following pattern. Also write an expression if 100 such shapes are joined together.





86. The sum of first n natural numbers is given by $\frac{1}{2}n^2 + \frac{1}{2}n$. Find

(i) The sum of first 5 natural numbers.

(ii) The sum of first 11 natural numbers.

(iii) The sum of natural numbers from 11 to 30.

87. The sum of squares of first n natural numbers is given by $\frac{1}{6}n(n+1)(2n+1)$ or $\frac{1}{6}(2n^3 + 3n^2 + n)$. Find the sum of squares of the first 10 natural numbers.

88. The sum of the multiplication table of natural number 'n' is given by $55 \times n$. Find the sum of

(a) Table of 7

(b) Table of 10

(c) Table of 19

89. If $\triangle(x) = 2x + 3$, $\square(x) = \frac{3}{2}x + 7$ and $\bigcirc(x) = x - 3$,

then find the value of :

(i) $2\triangle(6) + \square(3) - \bigcirc(1)$

(ii) $\frac{1}{2}\square(2) + \bigcirc(8) - 3\triangle(0)$

90. If $\triangle(x) = \frac{3}{4}x - 2$ and $\diamond(x) = x + 6$, then find the value of:

(i) $\triangle(10) - \diamond(4)$

(ii) $2\diamond(12) - \frac{3}{2}\triangle(1)$

Translate each of the following algebraic expressions Question 91 to 94 into words.

91. $4b - 3$

92. $8\,(m + 5)$

93. $\frac{7}{8-x}$

94. $17\left(\frac{16}{w}\right)$

95. (i) **Critical Thinking** Write two different algebraic expressions for the word phrase "$\left(\frac{1}{4}\right)$ of the sum of x and 7."

(ii) **What's the Error?** A student wrote an algebraic expression for "5 less than a number n divided by 3" as $\frac{n}{3}-5$. What error did the student make?

(iii) **Write About it** Shashi used addition to solve a word problem about the weekly cost of commuting by toll tax for ₹ 15 each day. Ravi solved the same problem by multiplying. They both got the correct answer. How is this possible?

96. **Challenge** Write an expression for the sum of 1 and twice a number n. If you let n be any odd number, will the result always be an odd number?

97. **Critical Thinking** Will the value of $11x$ for $x = -5$ be greater than 11 or less than 11? Explain.

98. Match Column I with Column II in the following:

	Column I	Column II
1.	The difference of 3 and a number squared	(a) $4 - 2x$
2.	5 less than twice a number squared	(b) $n^2 - 3$
3.	Five minus twice the square of a number	(c) $2n^2 - 5$
4.	Four minus a number multiplied by 2	(d) $5 - 2n^2$
5.	Seven times the sum of a number and 1	(e) $3 - n^2$
6.	A number squared plus 6	(f) $2(n + 6)$

7. 2 times the sum of a number and 6 (g) 7 (n + 1)

8. Three less than the square of a number (h) $n^2 + 6$

99. At age of 2 years, a cat or a dog is considered 24 "human" years old. Each year, after age 2 is equivalent to 4 "human" years. Fill in the expression [24 + ☐ $(a - 2)$] so that it represents the age of a cat or dog in human years. Also, you need to determine for what 'a' stands for. Copy the chart and use your expression to complete it.

Age	[24 + ☐ $(a - 2)$]	Age (Human Years)
2		
3		
4		
5		
6		

100. Express the following properties with variables x, y and z.

(i) Commutative property of addition

(ii) Commutative property of multiplication

(iii) Associative property of addition

(iv) Associative property of multiplication

(v) Distributive property of multiplication over addition

(D) Application

1. Game

Think of a number, multiply the number by 8, divide by 2, add 5, and then subtract 4 times the original number.

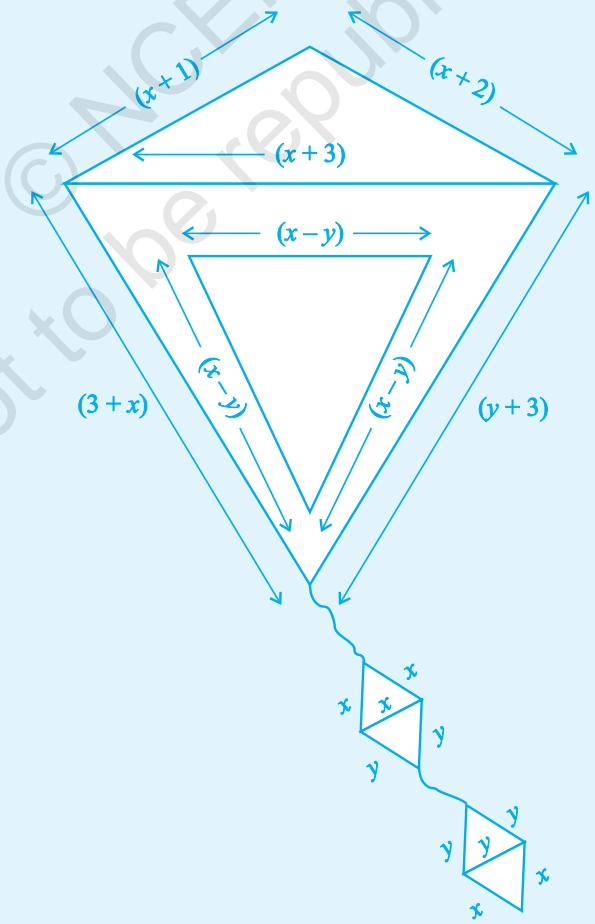
No matter what number you choose the answer will always be 5.

Here's how

	What you say	What the person think	Role of Mathematics
(i)	Pick any number	6 (for example)	n
(ii)	Multiply by 8	8 (6) = 48	$8n$
(iii)	Divide by 2	48 ÷ 2 = 24	$8n \div 2 = 4n$
(iv)	Add 5	24 + 5 = 29	$4n + 5$
(v)	Subtract 4 times the original number	29 – 4 (6) = 29 – 24 = 5	$4n + 5 - 4n = 5$

Invent your own Math magic thinking that has atleast five steps. Try it with your friend!

2. Colour the scalene triangle with Yellow, Isosceles with Green and equilateral with Red in the given adjoining figure.



3. Cross Number Puzzle

Rohit has to solve the given cross number puzzle to qualify for the next round of Mathematics quiz competition. Help him by evaluating the values of given expression at $x = 0$, $y = 1$, $z = 2$. Also help him to fill the cross number along Across and Downward with the help of given clues, (Numbers to be written in words)

Across

(a) $xy + yz + zx$

(b) $x^2y^2 + z^2 - 2xyz$

(c) $8 - (x+y)$

(d) $x^2y^3 + y^2z^3 + z^2x^3$

Down

(e) $x^2 - 2xy\,(y-z)$

(f) $\dfrac{x^3 + y^3 + z^3}{3}$

(g) $x^3 + y^3 + z^3 - 2yz^2$

(h) $2x + 2y + 2z$