UNIT 7
ALGEBRA

(A) Main Concepts and Results

- The word '**variable**' means something that can vary, i.e., change. The value of a variable is not fixed. We use a variable to represent a number and denote it by any letter such as l, m, n, p, x, y, z etc.
- A variable allows us to express relation in any practical situation and to express many common rules and properties of geometry, algebra etc.
- An expression with a variable, constants and the sign of equality (=) is called an **equation**.
- The value of the variable which satisfies the equation is called a **solution** of the equation.

(B) Solved Examples

In examples 1 to 3, write the correct answer from the given four options:

Example 1: $4a$ equals

(A) $4 + a$ (B) $4 \times a$

(C) $a \times a \times a \times a$ (D) $4 \div a$

Solution: Correct answer is (B).

Example 2: 8 more than three times the number x can be represented as

(A) $8 + x + 3$ (B) $3x - 8$ (C) $3x + 8$ (D) $8x + 3$

Solution: Correct answer is (C).

Example 3: Which of the following is an equation?

(A) $x + 7$ (B) $2y + 3 = 7$

(C) $2p < 10$ (D) $12x$

Solution: Correct answer is (B)

Example 4: Fill in the blanks to make it a true statement:

7 times of y subtracted from 50 can be expressed as _____

Solution: $50 - 7y$

Example 5: State true or false:

$x = 5$ is a solution of the equation $3 - x = 8$

Solution: False

Give an expression for each of the examples 6 to 8:

Example 6: 13 subtracted from thrice of a number.

Solution: Let the number be x.

Thrice of the number is $3x$.

13 subtracted from it is the expression $3x - 13$.

Example 7: Megha's age (in years) is 2 more than 5 times her daughter's age.

Solution: Let the daughter's age be m years.

5 times of m is $5m$.

2 more than $5m$ is the expression $5m + 2$.

The age of Megha (in years) is $(5m + 2)$.

Example 8: Anagha, Sushant and Faizal are climbing the steps to a hill top. Anagha is at the step p. Sushant is 10 steps ahead and Faizal is 6 steps behind Anagha. Where are Sushant and Faizal? The total number of steps to the hill top is 3 steps less than 8 times what Anagha has reached. Express the total number of steps using p.

Solution: Anagha is at step p.

Sushant is 10 steps ahead of Anagha. That is, he is at the step $p + 10$.

Faizal is 6 steps behind Anagha. That is, he is at step $p - 6$.

8 times of $p = 8p$

3 less than $8p = 8p - 3$

So, the total number of steps = $8p - 3$

In examples 9 and 10, change the statements, converting expressions into statements in ordinary language.

Example 9: Cost of a pencil is Rs x. A pen costs Rs $6x$.

Solution: Cost of a pen is 6 times the cost of a pencil.

Example 10: Manisha is z years old. Her uncle is $5z$ years old and her aunt is $(5z - 4)$ years old.

Solution: Manisha's uncle is five times of Manisha's age. Her aunt is 4 years younger than her uncle.

(C) Exercise

In questions 1 to 23, out of the four given options, only one is correct. Write the correct answer.

1. If each match box contains 50 matchsticks, the number of matchsticks required to fill n such boxes is

(A) $50 + n$ (B) $50n$ (C) $50 \div n$ (D) $50 - n$

2. Amulya is x years of age now. 5 years ago her age was

(A) $(5 - x)$ years (B) $(5 + x)$ years
(C) $(x - 5)$ years (D) $(5 \div x)$ years

3. Which of the following represents $6 \times x$

(A) $6x$ (B) $\frac{x}{6}$ (C) $6 + x$ (D) $6 - x$

4. Which of the following is an equation?

(A) $x + 1$ (B) $x - 1$ (C) $x - 1 = 0$ (D) $x + 1 > 0$

5. If x takes the value 2, then the value of $x + 10$ is

(A) 20 (B) 12 (C) 5 (D) 8

6. If the perimeter of a regular hexagon is x metres, then the length of each of its sides is

(A) $(x + 6)$ metres (B) $(x \div 6)$ metres
(C) $(x - 6)$ metres (D) $(6 \div x)$ metres

7. Which of the following equations has $x = 2$ as a solution?

(A) $x + 2 = 5$ (B) $x - 2 = 0$ (C) $2x + 1 = 0$ (D) $x + 3 = 6$

8. For any two integers x and y, which of the following suggests that operation of addition is commutative ?

(A) $x + y = y + x$ (B) $x + y > x$ (C) $x - y = y - x$ (D) $x \times y = y \times x$

9. Which of the following equations does not have a solution in integers?

(A) $x + 1 = 1$ (B) $x - 1 = 3$ (C) $2x + 1 = 6$ (D) $1 - x = 5$

10. In algebra, $a \times b$ means ab, but in arithmetic 3×5 is

(A) 35 (B) 53 (C) 15 (D) 8

11. In algebra, letters may stand for

(A) known quantities (B) unknown quantities
(C) fixed numbers (D) none of these

12. "Variable" means that it

(A) can take different values (B) has a fixed value
(C) can take only 2 values (D) can take only three values

13. $10 - x$ means

(A) 10 is subtracted x times (B) x is subtracted 10 times
(C) x is subtracted from 10 (D) 10 is subtracted from x

14. Savitri has a sum of Rs x. She spent Rs 1000 on grocery, Rs 500 on clothes and Rs 400 on education, and received Rs 200 as a gift. How much money (in Rs) is left with her?

(A) $x - 1700$ (B) $x - 1900$ (C) $x + 200$ (D) $x - 2100$

15. The perimeter of the triangle shown in Fig. 7.1 is

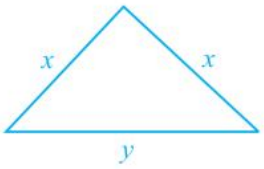


Fig. 7.1

(A) $2x + y$ (B) $x + 2y$ (C) $x + y$ (D) $2x - y$

16. The area of a square having each side x is

(A) $x \times x$ (B) $4x$ (C) $x + x$ (D) $4 + x$

17. The expression obtained when x is multipled by 2 and then subtracted from 3 is

(A) $2x - 3$ (B) $2x + 3$ (C) $3 - 2x$ (D) $3x - 2$

18. $\frac{q}{2} = 3$ has a solution

(A) 6 (B) 8 (C) 3 (D) 2

19. $x - 4 = -2$ has a solution

(A) 6 (B) 2 (C) -6 (D) -2

20. $\frac{4}{2} = 2$ denotes a

(A) numerical equation (B) algebraic expression

(C) equation with a variable (D) false statement

21. Kanta has p pencils in her box. She puts q more pencils in the box. The total number of pencils with her are

(A) $p + q$ (B) pq (C) $p - q$ (D) $\frac{p}{q}$

22. The equation $4x = 16$ is satisfied by the following value of x

(A) 4 (B) 2 (C) 12 (D) -12

23. I think of a number and on adding 13 to it, I get 27. The equation for this is

(A) $x - 27 = 13$ (B) $x - 13 = 27$

(C) $x + 27 = 13$ (D) $x + 13 = 27$

In question 24 to 40, fill in the blanks to make the statements true:

24. The distance (in km) travelled in h hours at a constant speed of 40km per hour is _____.

25. p kg of potatoes are bought for Rs 70. Cost of 1kg of potatoes (in Rs) is _____.

26. An auto rickshaw charges Rs 10 for the first kilometre then Rs 8 for each such subsequent kilometre. The total charge (in Rs) for d kilometres is _____.

27. If $7x + 4 = 25$, then the value of x is _____.

28. The solution of the equation $3x + 7 = -20$ is _____.

29. 'x exceeds y by 7' can be expressed as _____.

30. '8 more than three times the number x' can be written as _____.

31. Number of pencils bought for Rs x at the rate of Rs 2 per pencil is _____.

32. The number of days in w weeks is _____.

33. Annual salary at r rupees per month alongwith a festival bonus of Rs 2000 is _____.

34. The two digit number whose ten's digit is 't' and units's digit is 'u' is _____.

35. The variable used in the equation $2p + 8 = 18$ is _____.

36. x metres = _____ centimetres

37. p litres = _____ millilitres

38. r rupees = _____ paise

39. If the present age of Ramandeep is n years, then her age after 7 years will be _____.

40. If I spend f rupees from 100 rupees, the money left with me is _____ rupees.

In question 41 to 45, state whether the statements are true or false.

41. 0 is a solution of the equation $x + 1 = 0$

42. The equations $x + 1 = 0$ and $2x + 2 = 0$ have the same solution.

43. If m is a whole number, then $2m$ denotes a multiple of 2.

44. The additive inverse of an integer x is $2x$.

45. If x is a negative integer, $-x$ is a positive integer.

46. $2x - 5 > 11$ is an equation.

47. In an equation, the LHS is equal to the RHS.

48. In the equation $7k - 7 = 7$, the variable is 7.

49. $a = 3$ is a solution of the equation $2a - 1 = 5$

50. The distance between New Delhi and Bhopal is not a variable.

51. t minutes are equal to $60t$ seconds.

52. $x = 5$ is the solution of the equation $3x + 2 = 20$

53. 'One third of a number added to itself gives 8', can be expressed as

$$\frac{x}{3} + 8 = x$$

54. The difference between the ages of two sisters Leela and Yamini is a variable.

55. The number of lines that can be drawn through a point is a variable.

In questions 56 to 74, choose a letter *x*, *y*, *z*, *p* etc...., wherever necessary, for the unknown (variable) and write the corresponding expressions:

56. One more than twice the number.

57. 20°C less than the present temperature.

58. The successor of an integer.

59. The perimeter of an equilateral triangle, if side of the triangle is m.

60. Area of the rectangle with length k units and breadth n units.

61. Omar helps his mother 1 hour more than his sister does.

62. Two consecutive odd integers.

63. Two consecutive even integers.

64. Multiple of 5.

65. The denominator of a fraction is 1 more than its numerator.

66. The height of Mount Everest is 20 times the height of Empire State building.

67. If a note book costs Rs p and a pencil costs Rs 3, then the total cost (in Rs) of two note books and one pencil.

68. z is multiplied by –3 and the result is subtracted from 13.

69. p is divided by 11 and the result is added to 10.

70. x times of 3 is added to the smallest natural number.

71. 6 times q is subtracted from the smallest two digit number.

72. Write two equations for which 2 is the solution.

73. Write an equation for which 0 is a solution.

74. Write an equation whose solution is not a whole number.

In questions 75 to 84, change the statements, converting expressions into statements in ordinary language:

75. A pencil costs Rs p and a pen costs Rs $5p$.

76. Leela contributed Rs y towards the Prime Minister's Relief Fund. Leela is now left with Rs $(y + 10000)$.

77. Kartik is n years old. His father is $7n$ years old.

78. The maximum temperature on a day in Delhi was p°C. The minimum temperature was $(p - 10)^{\circ}$C.

79. John planted t plants last year. His friend Jay planted $2t + 10$ plants that year.

80. Sharad used to take p cups tea a day. After having some health problem, he takes $p - 5$ cups of tea a day.

81. The number of students dropping out of school last year was m. Number of students dropping out of school this year is $m - 30$.

82. Price of petrol was Rs p per litre last month. Price of petrol now is Rs $(p - 5)$ per litre.

83. Khader's monthly salary was Rs P in the year 2005. His salary in 2006 was Rs (P + 1000).

84. The number of girls enrolled in a school last year was g. The number of girls enrolled this year in the school is $3g - 10$.

85. Translate each of the following statements into an equation, using x as the variable:

(a) 13 subtracted from twice a number gives 3.

(b) One fifth of a number is 5 less than that number.

(c) Two-third of number is 12.

(d) 9 added to twice a number gives 13.

(e) 1 subtracted from one-third of a number gives 1.

86. Translate each of the following statements into an equation:

(a) The perimeter (p) of an equilateral triangle is three times of its side (a).

(b) The diameter (d) of a circle is twice its radius (r).

(c) The selling price (s) of an item is equal to the sum of the cost price (c) of an item and the profit (p) earned.

(d) Amount (a) is equal to the sum of principal (p) and interest (i).

87. Let Kanika's present age be x years. Complete the following table, showing ages of her relatives:

	Situation (described in ordinary language)	Expressions
(i)	Her brother is 2 years younger.	_____
(ii)	Her father's age exceeds her age by 35 years.	_____
(iii)	Mother's age is 3 years less than that of her father.	_____
(iv)	Her grand father's age is 8 times of her age.	_____

88. If m is a whole number less than 5, complete the table and by inspection of the table, find the solution of the equation $2m - 5 = -1$:

m					
$2m - 5$					

89. A class with p students has planned a picnic. Rs 50 per student is collected, out of which Rs 1800 is paid in advance for transport. How much money is left with them to spend on other items?

90. In a village, there are 8 water tanks to collect rain water. On a particular day, x litres of rain water is collected per tank. If 100 litres of water was already there in one of the tanks, what is the total amount of water in the tanks on that day?

91. What is the area of a square whose side is m cm?

92. Perimeter of a triangle is found by using the formula $P = a + b + c$, where a, b and c are the sides of the triangle. Write the rule that is expressed by this formula in words.

93. Perimeter of a rectangle is found by using the formula $P = 2 (l + w)$, where l and w are respectively the length and breadth of the rectangle. Write the rule that is expressed by this formula in words.

94. On my last birthday, I weighed 40kg. If I put on m kg of weight after a year, what is my present weight?

95. Length and breadth of a bulletin board are r cm and t cm, respectively.

(i) What will be the length (in cm) of the aluminium strip required to frame the board, if 10cm extra strip is required to fix it properly.

(ii) If x nails are used to repair one board, how many nails will be required to repair 15 such boards?

(iii) If 500sqcm extra cloth per board is required to cover the edges, what will be the total area of the cloth required to cover 8 such boards?

(iv) What will be the expenditure for making 23 boards, if the carpenter charges Rs x per board.

96. Sunita is half the age of her mother Geeta. Find their ages

(i) after 4 years?

(ii) before 3 years?

97. Match the items of Column I with that of Column II:

	Column I		**Column II**
(i)	The number of corners of a quadrilateral	(A)	=
(ii)	The variable in the equation $2p + 3 = 5$	(B)	constant
(iii)	The solution of the equation $x + 2 = 3$	(C)	+1
(iv)	solution of the equation $2p + 3 = 5$	(D)	–1
(v)	A sign used in an equation	(E)	p
		(F)	x

(D) Activities

Activity 1: Observe the following patterns and find a rule:

(i)

	Perimeter	Number of unit shapes
	3	1
	4	2
	5	3
	6	4

Rule : Perimeter = Number of unit shapes + 2 = $k + 2$, where k is the number of unit shapes (triangles).

(ii)



4 1



..... 2



....

Rule :

(iii)



5 1



....



....

Rule :

(iv)



5 1



....



....

Rule :