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# 11 Algebra

## IMPORTANT DEFINITIONS

### 1. Algebra

**Algebra** is about finding the unknown or it is about connecting real life problems into equations and then solving them. Unfortunately many textbooks go straight to the rules, procedures and formulas, forgetting that these are real life problems being solved.

### 2. Algebraic Expression

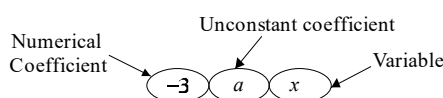
An **algebraic expression** is an expression formed from any combination of numbers and variables by using the operations of addition, subtraction, multiplication, division, exponentiation (raising to powers), or extraction of roots.

For example :  $7$ ,  $x$ ,  $2x = 3y + 1$ ,  $\frac{5x^3 - 1}{4xy + 1}$ ,  $\pi r^2$  and  $\pi r\sqrt{r^2 - h^2}$  are algebraic expressions. By an

algebraic expression in certain variables, (1) we mean an expression that contains only those variables, and by a **constant**. (2) If numbers are substituted for the variables in an algebraic expression the resulting number is called the **value** of the expression for these values of the variables.

### 3. Algebraic Terms

The basic unit of an algebraic expression is a term. In general, a *term* is either a number or a product of a number and one or more variables. Below is the term  $-3ax$ .



Different types of terms are (i) Constant term, (ii) Like term, (iii) Unlike term.

(i) **Constant term:** A term of the expression having no literal factor is called constant term.

(a) In the expression  $3x + 5$ , the constant term is  $5$ .

(b) In the expression  $x^2 + y^3 - \frac{4}{5}$ , the constant term is  $-\frac{4}{5}$ .

(ii) **Like term:** The term having same terms literal factors are called like or similar terms.

(iii) **Unlike term:** The terms not having the same literal factors are called unlike or dissimilar terms.

Example: In the expression  $6x^2y + 5xy^2 - 8xy - 7yx^2$  we have  $6x^2y$  and  $-7yx^2$  as like terms, whereas  $5xy^2$  and  $-8xy$  are unlike terms.

#### 4. How to Form Algebraic Expressions

**Example 1:** Sarita has some marbles. Ameena has 10 more. Appu says that he has 3 more marbles than the number of marbles Sarita and Ameena together have. How do you get the number of marbles that Appu has?

**Solution:** Since it is not given how many marbles Sarita has, we shall take it to be  $x$ . Ameena then has 10 more, i.e.,  $x + 10$ . Appu says that he has 3 more marbles than what Sarita and Ameena have together. So we take the sum of the numbers of Sarita's marbles and Ameena's marbles, and to this sum add 3, that is, we take the sum of  $x$ ,  $x + 10$  and 3.

**Example 2:** Ramu's father's present age is 3 times Ramu's age. Ramu's grandfather's age is 13 years more than the sum of Ramu's age and Ramu's father's age. How do you find Ramu's grandfather's age?

**Solution:** Since Ramu's age is not given, let us take it to be  $y$  years. Then his father's age is  $3y$  years. To find Ramu's grandfather's age we have to take the sum of Ramu's age ( $y$ ) and his father's age ( $3y$ ) and to the sum add 13, that is, we have to take the sum of  $y$ ,  $3y$  and 13.

**Example 3:** In a garden, roses and marigolds are planted in square plots. The length of the square plot in which marigolds are planted is 3 meters greater than the length of the square plot in which roses are planted. How much bigger in area is the marigold plot than the rose plot?

**Solution:** Let us take  $x$  meters to be length of the side of the rose plot. The length of the side of the marigold plot will be  $(x + 3)$  meters. Their respective areas will be  $l^2$  and  $(x + 3)^2$ . The difference between  $(x + 3)^2$  and  $x^2$  will decide how much bigger in area the marigold plot is. In all the three situations, we had to carry out addition or subtraction of algebraic expressions. There are a number of real life problems in which we need to use expressions and do arithmetic operations on them. In this section, we shall see how algebraic expressions are added and subtracted.

#### 5. Various types of algebraic expression are as follows:

- (i) **Monomial:** An expression which contains only one term is known as monomial. Thus,  $3x$ ,  $5xy^2$ ,  $-8$  etc. are all monomials.
- (ii) **Binomials:** An expression containing two terms is called a binomial. Thus  $6 - y$ ,  $2x + 3y$ ,  $x^2 - 5xy^2z$  are all binomials.
- (iii) **Trinomials:** An expression containing three terms is called a trinomial. Thus,  $2 + x - y$ ,  $a + b + c$ ,  $x^3 - y^3 + z^3$ ,  $6 + xyz + x^2$  are all trinomials.
- (iv) **Quadrinomials:** An expression containing four terms is called a quadrinomial. Thus,  $x^2 + y^2 + z^2 - xy^2$ ,  $x^3 + y^3 + 2^3 + 3xy^2$  etc., are quadrinomials.
- (v) **Polynomial:** An expression containing two or more terms is known as a polynomial.

Ex.  $10x^2 + 5x + 6$ ,  $7x^3 + 8x^2 + 5x + 3$ .

## 6. Addition and Subtraction of Like Terms

The simplest expressions are monomials. They consist of only one term. To begin with we shall learn how to add or subtract like terms.

**Example 4:** Add  $3x$  and  $4x$ .

**Solution:** To add  $3x$  and  $4x$ , just add the co-efficients of each like term.

$$\begin{aligned}\text{i.e., } 3x + 4x &= (3 \times x) + (4 \times x) \\ &= (3 + 4) \times x \text{ (using distributive law)} = 7 \times x = 7x \text{ or } 3x + 4x = 7x\end{aligned}$$

**Example 5:** Add  $8xy$ ,  $4xy$  and  $2xy$

**Solution:**  $8xy + 4xy + 2xy = (8 + 4 + 2) \times xy = 14 \times xy = 14xy$  or  $8xy + 4xy + 2xy = 14xy$

**Example 6 :** Subtract  $4n$  from  $7n$ .

**Solution:**  $7n - 4n = (7 \times n) - (4 \times n) = (7 - 4) \times n = 3 \times n = 3n$  or  $7n - 4n = 3n$

**Example 7:** Subtract  $5ab$  from  $11ab$ .

**Solution:**  $11ab - 5ab = (11 - 5) ab = 6ab$

Thus, the sum of two or more like terms is a like term with a numerical coefficient equal to the sum of the numerical coefficients of all the like terms. Similarly, the difference between two like terms is a like term with a numerical coefficient equal to the difference between the numerical coefficients of the two like terms.

**Note:** Unlike terms cannot be added or subtracted the way like terms are added or subtracted. We have already seen examples of this, when 5 is added to  $x$ , we write the result as  $(x + 5)$ . Observe that in  $(x + 5)$  both the terms 5 and  $x$  are retained. Similarly, if we add the unlike terms  $3xy$  and 7, the sum is  $3xy + 7$ . If we subtract 7 from  $3xy$ , the result is  $3xy - 7$ .

## 7. Adding and Subtracting General Algebraic Expressions

**Rule of Addition:** The sum of several like terms is another like term whose coefficient in the sum of the coefficient of the like terms.

Let us take some examples:

**Example 8:** Add  $3x + 11$  and  $7x - 5$

**Solution:**  $(3x + 11) + (7x - 5) = 3x + 11 + 7x - 5$   
 $= 3x + 7x + 11 - 5$  (rearranging terms)  
 $= (3x + 7x) + (11 - 5)$  (grouping like terms)  $= 10x + 6$

Hence,  $3x + 11 + 7x - 5 = 10x + 6$

**Example 9:** Add  $3x + 11 + 8z$  and  $7x - 5$ .

**Solution:**  $(3x + 11 + 8z) + (7x - 5) = 3x + 11 + 8z + 7x - 5$   
 $= (3x + 7x) + (11 - 5) + 8z$  (grouping like terms)  $= 10x + 6 + 8z$   
 Therefore, the sum  $= 10x + 6 + 8z$

**Example 10:** Subtract  $a - b$  from  $3a - b + 4$

**Solution:**  $(3a - b + 4) - (a - b) = 3a - b + 4 - a + b$   
 $= (3a - a) + (b - b) + 4$  (grouping like terms)  
 $= (3 - 1)a + (1 - 1)b + 4$  (using Distributive law)  $= 2a + (0)b + 4 = 2a + 4$   
 (or)  $3a - b + 4 - (a - b) = 2a + 4$

**Example 11:** Collect like terms and simplify the expression:

$$12m^2 - 9m + 5m - 4m^2 - 7m + 10$$

**Solution:** Rearranging terms, we have  
 $12m^2 - 4m^2 + 5m - 9m - 7m + 10 = (12 - 4)m^2 + (5 - 9 - 7)m + 10$   
 $12m^2 - 4m^2 + 5m - 9m - 7m + 10 = 8m^2 + (-4 - 7)m + 10$   
 $= 8m^2 + (-11)m + 10 = 8m^2 - 11m + 10$

**Column Method:** In this method, each expression is written in separate such that their like terms are arranged one below the other in a column. Then, addition or subtraction of the terms is done column wise.

**Example 12:** Subtract  $24ab - 10b - 18a$  from  $30ab + 12b + 14a$ .

**Solution:**  $30ab + 12b + 14a - (24ab - 10b - 18a) = 30ab + 12b + 14a - 24ab + 10b + 18a$   
 $= 30ab - 24ab + 12b + 10b + 14a + 18a$   
 $= 6ab + 22b + 32a$

Alternatively, we write the expressions one below the other with the like terms appearing exactly below like terms as:

|        |   |       |   |       |
|--------|---|-------|---|-------|
| $30ab$ | + | $12b$ | + | $14a$ |
| $24ab$ | - | $10b$ | - | $18a$ |
| (-)    |   | (+)   |   | (+)   |
|        |   |       |   |       |
| $6ab$  | + | $22b$ | + | $32a$ |
|        |   |       |   |       |

**Example 13:** From the sum of  $2y^2 + 3yz$ ,  $-y^2 - yz - z^2$  and  $yz + 2z^2$ , subtract the sum of  $3y^2 - z^2$  and  $-y^2 + yz + z^2$ .

**Solution:** We first add  $2y^2 + 3yz$ ,  $-y^2 - yz - z^2$  and  $yz + 2z^2$ .

|                   |             |
|-------------------|-------------|
| $2y^2 + 3yz$      |             |
| $-y^2 - yz - z^2$ |             |
| (+)               | $yz + 2z^2$ |
|                   |             |
| $y^2 + 3yz + z^2$ | (1)         |
|                   |             |

We then add  $3y^2 - z^2$  and  $-y^2 + yz + z^2$

$$\begin{array}{r}
 3y^2 - z^2 \\
 (+) -y^2 + yz + z^2 \\
 \hline
 2y^2 + yz
 \end{array} \quad (2)$$

Now we subtract sum (2) from the sum (1):

$$\begin{array}{r}
 y^2 + 3yz + z^2 \\
 2y^2 + yz \\
 (-) \quad (-) \\
 \hline
 -y^2 + 2yz + z^2
 \end{array}$$

## 8. Finding the Value of an Algebraic Expression

We know that the value of an algebraic expression depends on the values of the variables forming the expression. There are a number of situations in which we need to find the value of an expression, such as when we wish to check whether a particular value of a variable satisfies a given equation or not. We find values of expressions also, when we use formulas from geometry and from everyday mathematics. For example, the area of a square is  $l^2$ , where  $l$  is the length of a side of the square. If  $l = 5$  cm., the area is  $5^2$  cm<sup>2</sup> or 25 cm<sup>2</sup>; if the side is 10 cm, the area is  $10^2$  cm<sup>2</sup> or 100 cm<sup>2</sup> and so on. We shall see more such examples in the next section.

**Example 14:** Find the values of the following expressions for  $x = 2$ .

(i)  $x + 4$  (ii)  $4x - 3$  (iii)  $19 - 5x^2$  (iv)  $100 - 10x^3$

**Solution:** Putting  $x = 2$

- i) In  $x + 4$ , we get the value of  $x + 4$ , i.e.,  $x + 4 = 2 + 4 = 6$
- ii) In  $4x - 3$ , we get  $4x - 3 = (4 \times 2) - 3 = 8 - 3 = 5$
- iii) In  $19 - 5x^2$ , we get  
 $19 - 5x^2 = 19 - (5 \times 2^2) = 19 - (5 \times 4) = 19 - 20 = -1$
- iv) In  $100 - 10x^3$ , we get  
 $100 - 10x^3 = 100 - (10 \times 2^3) = 100 - (10 \times 8) \text{ (Note } 2^3 = 8)$   
 $= 100 - 80 = 20$

**Example 15:** Find the value of the following expressions when  $n = -2$ .

(i)  $5n - 2$  (ii)  $5n^2 + 5n - 2$  (iii)  $n^3 + 5n^2 + 5n - 2$

- Solution:**
- i) Putting the value of  $n = -2$ , in  $5n - 2$ , we get,  $5(-2) - 2 = -10 - 2 = -12$
  - ii) In  $5n^2 + 5n - 2$ , we have, for  $n = -2$ ,  $5n - 2 = -12$   
and  $5n^2 = 5 \times (-2)^2 = 5 \times 4 = 20$  [as  $(-2)^2 = 4$ ]  
Combining,  $5n^2 + 5n - 2 = 20 - 12 = 8$
  - iii) Now, for  $n = -2$ ,  $5n^2 + 5n - 2 = 8$  and  
 $n^3 = (-2)^3 = (-2) \times (-2) \times (-2) = -8$   
Combining,  $n^3 + 5n^2 + 5n - 2 = -8 + 8 = 0$

We shall now consider expressions of two variables, for example:  $x + y$ ,  $xy$ . To work out the numerical value of an expression of two variables, we need to give the values of both variables. For example, the value of  $(x + y)$ , for  $x = 3$  and  $y = 5$ , is  $3 + 5 = 8$ .

**Example 16:** Find the value of the following expressions for  $a = 3$ ,  $b = 2$ .

(i)  $a + b$  (ii)  $7a - 4b$  (iii)  $a^2 + 2ab + b^2$  (iv)  $a^3 - b^3$

**Solution:** Substituting  $a = 3$  and  $b = 2$  in

i)  $a + b$ , we get  $a + b = 3 + 2 = 5$

ii)  $7a - 4b$ , we get  $7a - 4b = 7 \times 3 - 4 \times 2 = 21 - 8 = 13$ .

iii)  $a^2 + 2ab + b^2$ , we get

$$a^2 + 2ab + b^2 = 3^2 + 2 \times 3 \times 2 + 4 = 9 + 2 \times 6 + 4 = 9 + 12 + 4 = 25$$

iv)  $a^3 - b^3$ , we get

$$a^3 - b^3 = 3^3 - 2^3 = 3 \times 3 \times 3 - 2 \times 2 \times 2 = 9 \times 3 - 4 \times 2 = 27 - 8 = 19$$

## TIPS FOR COMPETITIVE LEVEL

### 9. Simple Equation

**Equation:** A statement of equality which involves one or more variables is called equation.

**Note:** An equation has an **equal sign** ( $=$ ) between its two sides. The equation means that the value of the left hand side (LHS) is equal to the value of the right hand side (RHS). If the LHS is not equal to the RHS, we do not get an equation. For example, The statement  $2n$  is greater than 10, i.e.  $2n > 10$  is not an equation. Similarly, the statement  $2n$  is smaller than 10 i.e.  $2n < 10$  is not an equation.

**Solution of an Equation:** The value of the variable in an equation which satisfies the equation is called a solution to the equation. Thus,  $n = 5$  is a solution to the equation  $2n = 10$ .

### 10. Method for Solving an Equation

In this section we shall look at some simple equations and the methods used to find their solution. There are four basic rules:

**Rule 1:** An equal quantity may be added to both sides of an equation.

**Rule 2:** An equal quantity may be subtracted from both sides of an equation.

**Rule 3:** An equal quantity may multiply both sides of an equation.

**Rule 4:** An equal *non-zero* quantity may divide both sides of an equation.

The application of these rules is illustrated in the following examples:

**Example 17:** Solve the equations

a)  $3x - 8 = x + 10$       b)  $\frac{x}{2} = -6$

- Solution:**
- a) By Rule 1 we may add 8 to both sides:  
 $3x - 8 + 8 = x + 10 + 8$  i.e.  $3x = x + 18$   
 By Rule 2 we may subtract  $x$  from both sides.  
 $3x - x = x + 18 - x$  i.e.  $2x = 18$   
 Finally, by Rule 4 we may divide both sides by 2 giving  $x = 9$
- b) By Rule 3 we may multiply both sides by 2,  
 $\left(\frac{2}{1}\right) \times \left(\frac{x}{2}\right) = 2 \times (-6)$  i.e.  $x = -12$

**Example 18:** Find the solution to the equation  
 $5(x - 3) - 7(6 - x) = 24 - 3(8 - x) - 3$

**Solution:** Removing the brackets from both sides first and then simplifying:

$$\begin{aligned} 5(x - 3) - 7(6 - x) &= 24 - 3(8 - x) - 3 \\ \Rightarrow 5x - 15 - 42 + 7x &= 24 - 24 + 3x - 3 \\ \Rightarrow 5x + 7x - 15 - 42 &= 3x - 3 \\ \Rightarrow 12x - 57 &= 3x - 3 \end{aligned}$$

Adding 57 to both sides:

$$12x = 3x - 3 + 57 = 3x + 54$$

Subtracting  $3x$  from both sides:  $12x - 3x = 54$

i.e.,  $9x = 54$ , giving  $x = 6$

When fractions occur we can sometimes transform the equation to one that does not involve fractions.

**Example 19:** Find the solution to the equation  
 $(4x/5) - (7/4) = (x/5) + (x/4)$

**Solution:** The least common multiple of the denominators in the equation is  $4 \times 5 = 20$  and we proceed as follows:

$$\begin{aligned} \Rightarrow 20\left(\frac{4x}{5} - \frac{7}{4}\right) &= 20\left(\frac{x}{5} + \frac{x}{4}\right) \\ \Rightarrow \frac{20}{1} \cdot \frac{4x}{5} - \frac{20}{1} \cdot \frac{7}{4} &= \frac{20}{1} \cdot \frac{x}{5} + \frac{20}{1} \cdot \frac{x}{4} \\ \Rightarrow 16x - 35 &= 4x + 5x \\ \Rightarrow 16x - 35 &= 9x \end{aligned}$$

Adding 35 to both sides and subtracting  $9x$  from both sides leads to  $7x = 35$  so  $x = 5$  the solution to the equation.



# REVISION EXERCISE

## LEVEL - I

1. Add:
  - i)  $3mn, -5mn, 8mn, -4mn$
  - ii)  $t + 7tp, -8tp + 8t, 8t - 7tp$
  - iii)  $-7mn + 5, 12mn + 2, 9mn - 8, -2mn - 3$
  - iv)  $a + b - 3, b - a + 3, a - b + 3$
  - v)  $14x + 10y - 12xy - 13, 18 - 7x - 10y + 8xy, 4xy$
2. **Subtract:**
  - i)  $-5y^2$  from  $y^2$
  - ii)  $6xy$  from  $-12xy$
  - iii)  $(a - b)$  from  $(a + b)$
  - iv)  $a(b - 5)$  from  $b(5 - a)$
  - v)  $-m^2 + 5mn$  from  $4m^2 - 3mn + 8$
3.
  - a) What should be added to  $x^2 + xy + y^2$  to obtain  $2x^2 + 3xy$ ?
  - b) What should be subtracted from  $2a + 8b + 10$  to get  $-3a + 7b + 16$ ?
4.
  - a) From the sum of  $3x - y + 11$  and  $-y - 11$ , subtract  $3x - y - 11$ .
  - b) From the sum of  $4 + 3x$  and  $5 - 4x + 2x^2$ , subtract the sum of  $3x^2 - 5x$  and  $-x^2 + 2x + 5$ .
5. If  $m = 2$ , find the value of: (i)  $m - 2$  (ii)  $3m - 5$  (iii)  $9 - 5m$  (iv)  $3m^2 - 2m - 7$
6. If  $p = -2$ , find the value of: (i)  $4p + 7$  (ii)  $-3p^2 + 4p + 7$
7. Find the value of the following expressions, when  $x = -1$ :
  - (i)  $2x - 7$  (ii)  $-x + 2$  (iii)  $x^2 + 2x + 1$  (iv)  $2x^2 - x - 2$
8. If  $a = 2, b = -2$ , find the value of: (i)  $a^2 + b^2$  (ii)  $a^2 + ab + b^2$  (iii)  $a^2 - b^2$
9. When  $a = 0, b = -1$ , find the value of the given expressions:
  - (i)  $2a + 2b$  (ii)  $2a^2 + b^2 + 1$  (iii)  $2a^2b + 2ab^2 + ab$  (iv)  $a^2 + ab + 2$
10. Simplify the expressions and find the value if  $x = 2$ .
  - (i)  $x + 7 + 4(x - 5)$  (ii)  $3(x + 2) + 5x - 7$ ; (iii)  $6x + 5(x - 2)$  (iv)  $4(2x - 1) + 3x + 11$
11. Simplify:
  - (i)  $21b - 32 + 7b - 20b$  (ii)  $p - (p - q) - q - (q - p)$
  - (iii)  $3a - 2b - ab - (a - b + ab) + 3ab + b - a$
12. (i) If  $z = 10$ , find the value of  $z^3 - 3(z - 10)$ ; (ii) If  $p = -10$ , find the value of  $p^2 - 2p - 100$
13. What should be the value of  $a$ , if the value of  $2x^2 + x - a$  equals to 5, when  $x = 0$ ?
14. Simplify the expression and find its value when  $a = 5$  and  $b = -3$ .  $2(a^2 + ab) + 3 - ab$



**LEVEL - II**

1. Rakhi travelled  $4x$  km distance by walk,  $2y$  km by cycle and 9 km by bus. The total distance covered by Rakhi in an algebraic expression is \_\_\_\_\_.
2. I had ₹200 with me. I gave ₹ $x$  to Seema, ₹ $\frac{x}{2}$  to Vidhu and I am left with ₹ $\frac{x}{2}$ . The amount I gave to Vidhu is \_\_\_\_\_.
3. If six times of a number is 48, then the number is \_\_\_\_\_.
4. If half the number is added to 18, then sum is 46, find the number?
5. Match the items of column-I with that of column-II :

**Column-I**

- (i) The number of corners of a quadrilateral
- (ii) The variable in the equation  $2p + 3 = 5$
- (iii) The solution of the equation  $2p + 3 = 5$
- (iv) A sign used in an equations

**Column-II**

- (a) =
- (b) Constant
- (c) +1
- (d) 4
- (e) p
- (f) x

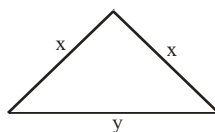
6. Find the value of  $x$  if  $\frac{x}{4} + \frac{1}{2} = 4$ ?
7. Meera bought packs of trading cards that contain 10 cards each. She gave away 7 cards.  
 $x$  = No. of packs of trading cards.  
 Which expression shows the number of cards left with meera?  
 (a)  $10x - 7$       (b)  $7x - 8$       (c)  $5 - 10x$       (d)  $8 - 5x$
8. Find the value of  $p$  if,  $\frac{2}{3}p - 2\frac{1}{2} = 3\frac{1}{2}$ ,
9. Find the value of  $x$  for which the equation is  $16(x + 7) = 144$ ?
10. The number of girls in a class is 5 times the number of boys. Which of the following can not be the total number of children in the class?  
 (a) 36      (b) 40      (c) 48      (d) 108
11. When Raju multiplies a certain number by 17 and adds 40 to the product, he gets 227 find that number?
12. Write down  $7xy^2 \times 3x^2y \times 5y^4$  in the exponential form.
13. The volume of a cuboid is given by the product of its length, breadth and height. The length of a cuboid is  $2x^2$  times its breadth and the height is  $\frac{3}{2}xy$  times of length. Find the volume of the cuboid if its breadth is  $6y^2$ .

14. In a large hall there are  $4x^2$  rows of benches. If each row has  $5x^2y^3$  benches and each bench can accommodate  $xy^2$  persons, determine the total number of persons if its is full up to its capacity.
15. The cost of painting a rectangular metal sheet is square of its area. If the length and breadth of the rectangle are  $2xy$  and  $3x^2y$ , find the cost. Given that area of a rectangle is the product of its length and breadth.
16. Ravish cover  $3x^2y$  centimeters in one step. What is the distance moved by him in  $2xy^2$  minutes, if he takes  $xy$  steps in one minute.
17. Aarushi spends  $\text{`}x$  daily and earns  $\text{`}y$  per week. How much money she saves in  $xy^2$  weeks?
18. One ball pen costs  $\text{`}x$  and one fountain pen cost  $\text{`}y$ . Find the cost of  $y^2$  ball pens and  $x^2$  fountain pens.
19. Simplify:  $(a^3 - 2a^2 + 4a - 5) - (-a^3 - 8a + 2a^2 + 5)$ .
20. Simplify:  $5x - [4x - \{(2x - 5) - 3(3x - 4)\}]$ .
21. If  $a = 3$ ,  $b = 2$ ,  $c = -1$  then  $\frac{a}{b} + \frac{b}{c} - \frac{c}{a}$  equals.
22.  $\left(\frac{1}{5}x - \frac{1}{6}y\right)(5x + 6y)$  is equal to \_\_\_\_\_.
23. If  $A = 7x^2 + 5xy - 9y^2$ ,  $B = -4x^2 + xy + 5y^2$  and  $C = 4y^2 - 3x^2 - 6xy$ . Then find  $A + B + C$ .
24. Let  $P = a^2 - b^2 - 2ab$ ,  $Q = a^2 + 4b^2 - 6ab$ ,  $R = b^2 + 6$ ,  $S = a^2 - 4ab$  and  $T = -2a^2 + b^2 - ab + a$   
Find the value of  $P + Q + R + S + T$ ?
25. Mona's father is thrice as old as Mona. After 12 years, his age will be twice as that of his daughter find their present ages?

### MULTIPLE CHOICE QUESTIONS

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)  $50 + n$  (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)  $(5 - x)$  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)  $(x - 6)$  metres  
 (c)  $(x \div 6)$  metres (d)  $(6 + x)$  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)  $x - y = y - x$
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)  $x - y = y - x$
10. In algebra, letters may stand for  
 (a) known quantities (b) unknown quantities  
 (c) fixed numbers (d) none of these
11. "Variable" means that it  
 (a) can take different values (b) unknown quantities  
 (c) can take only 2 values (d) can take only three values
12.  $10 - x$  means  
 (a) 10 is subtracted  $x$  times (b)  $x$  is subtracted 10 times  
 (c)  $x$  is subtracted from 10 (d)  $10x$  is subtracted from  $x$
13. Savitri has a sum of Rs.  $x$ . She spent Rs. 1000 on grocery, Rs. 500 on clothes and Rs. 400 on education, and received 200 as a gift. How much money (in Rs.) is left with her?  
 (a)  $x - 1700$  (b)  $x - 1900$  (c)  $x + 200$  (d)  $x - 2100$
14. The perimeter of the triangle shown in figure is



- (a)  $2x + y$  (b)  $x + 2y$  (c)  $x + y$  (d)  $2x - y$
15. The area of a square having each side  $x$  is

## Light, Shadows and Reflections

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### LIGHT — A FORM OF ENERGY

Light is a form of energy which creates the sensation of vision. Imagine the world would be if there were no light around us.

### SOURCES OF LIGHT

An object which emits light is called a source of light. The various sources of light can be grouped under two main heads, viz:

1. Natural sources of light.
2. Man-made or artificial sources of light.

#### 1. Natural Sources of Light:

Some of the natural sources of light are mentioned below:

- a) **The Sun:** The most important natural source of light for us is the Sun. It is a very bright source. Even though, it is 150 million kilometres away from the Earth, it gives sufficient amount of light to make the day bright and warm for us on the Earth.
- b) **The Moon:** The Moon has no light of its own but reflects the light of the Sun. The light from the Moon is cool and pleasant.
- c) **The Stars:** The stars are other natural sources of light. Some of them are even brighter than the Sun. But they are so far away from us that they are seen at night only, as twinkling points in the sky.
- d) **Fire Flies:** These are amazing creatures which are a natural sources of light and although they do not emit very bright light, they are very pleasing to the eyes.

#### 2. Man-made or Artificial Sources of Light:

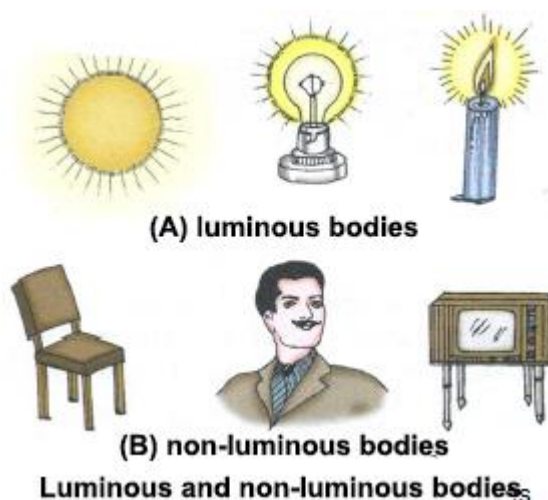
- a) **Candles, oil lamps and gas lamps** are man-made sources of light.
- b) **Electric bulbs and fluorescent tubes:** At night, the main source of light is either the electric bulb or the fluorescent tube. Sodium lamps and mercury lamps are used increasingly nowadays at important crossings at the roads.

**Point Source and Extended Source of Light:**

- a) **Point Source of Light:** A source of light which is of the size of the pin head of a common pin is called point source of light.
- b) **Extended source of light:** Any source of light which is bigger than the point source of light is called extended source of light. A burning candle, a glowing electric bulb or a fluorescent tube, etc., are the examples of extended source of light.

**LUMINOUS AND NON-LUMINOUS BODIES**

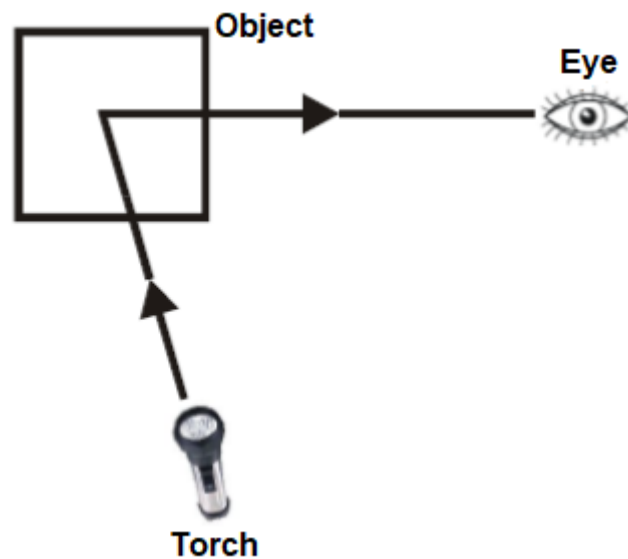
You know that the Sun, the stars, a candle, an oil lamp, etc., give us light. Such bodies, which give out light of their own are called luminous bodies.



Light is a combination of electrical and magnetic energy which can pass through transparent and translucent objects. The objects which do not have their own light is known as non-luminous objects. An interesting fact is that mirror is an example of a non-luminous object.

**How can Non-Luminous Bodies be Made Luminous?**

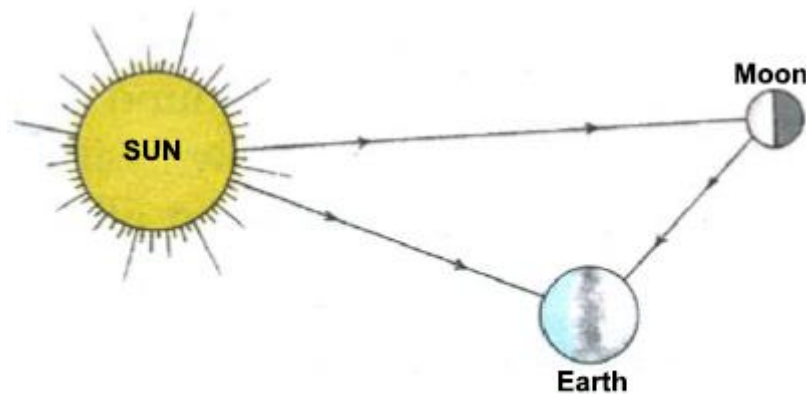
Any non-luminous body can be made luminous by heating it. Take an iron wire and heat it on a gas flame. After sometime the iron wire will become red hot and start emitting light. At this point the temperature of iron is between  $600^{\circ}\text{C}$  to  $800^{\circ}\text{C}$ . How objects become visible to us: When light from a luminous body, like sun, electric light or torch falls on an object, it bounces off and travels to our eyes, thus, making the object visible.



The box can be seen because it reflects light from the torch.

### Why are the Moon and the Planets Considered as Non-luminous Bodies?

All of you must have seen the Moon at night giving out cool milky white light. Similarly, you must have seen the planet Venus, which appears like a bright star during early evening. Why do we call them non-luminous bodies, when actually light is coming from them? Well, the simple reason is that they do not produce light of their own. Instead, they reflect the light from the Sun falling on them. Hence, they are non-luminous bodies.



*The Moon only reflects the light of the sun towards the earth*

### Transparent, Translucent and Opaque Objects

Substances which allow light to pass through them easily, and through which we can see clearly are called **transparent substances**. Glass, water, air and cellophane paper are examples of transparent substances.

Substances through which light can pass partially but we cannot see through them clearly are called **translucent substances**. Frosted glass, greased paper, butter paper and wax paper are examples of such substances.

Substances which do not allow light to pass through them at all are called **opaque substances**. Wood, metals, bricks, and stones are examples of opaque substances.

## RECTILINEAR PROPAGATION OF LIGHT

Can you see your friend on the other side of a wall? Of course not, because light can't bend. Also it can't travel through the wall.

While seeing a film in a cinema hall you may have noticed that the light from the projector appears to go in a straight line towards the screen. In a cinema hall, what you see is not light itself, but innumerable dust particles in the path of light, which become visible when light falls on them.

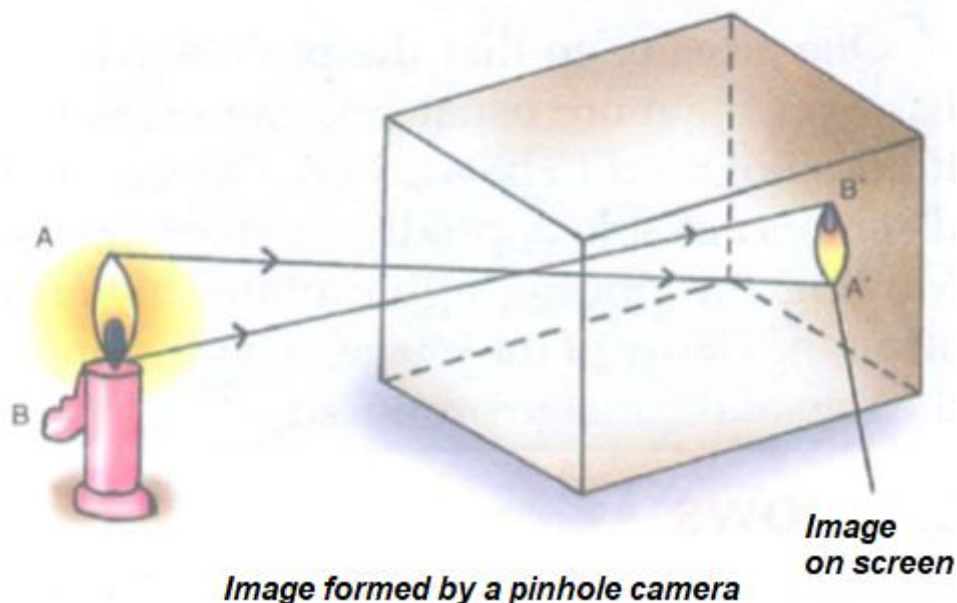
The above examples show that **light travels in straight line**. This phenomenon is called the **rectilinear propagation of light**.

## PINHOLE CAMERA

The pinhole camera is the simplest kind of camera. It does not have a lens. It just makes use of a tiny opening (a pinhole-sized opening) to focus all light rays within the smallest possible area to obtain an image, as clearly as possible. The simple image formed using a pinhole camera is always inverted.

A pinhole camera is based upon the principle of rectilinear propagation of light. It consists of a rectangular light proof box with a very small hole in the middle of one face and a shutter arrangement to open and close the hole. A photographic plate is usually placed on the opposite side of the hole. When rays of light coming from an object pass through the fine hole, they form an inverted, small and real image on the screen. The

sharpness and size of the image can be altered by adjusting the distance of the object from the hole.



Using the property of similar triangles we can write

$$\frac{\text{Height of the image (I)}}{\text{Height of the object (O)}} = \frac{\text{Distance of the image from the pinhole (V)}}{\text{Distance of the object from the pinhole (U)}}$$

OR

$$\frac{I}{O} = \frac{V}{U}$$

The image remains sharp when the distance between the screen and the pinhole is increased. If the pinhole camera is moved nearer to the object the image on the screen will become large.

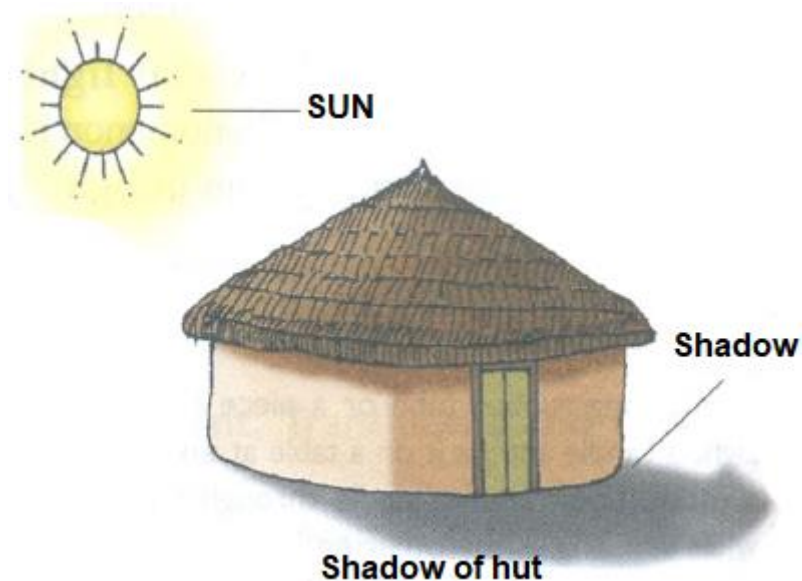
One advantage that the pinhole camera has over the more usual lens camera is that it does not need to be focused. Objects at all distances are able to produce a sharp image. Moving the photographic plate does not affect the clarity of the image, it only changes the size of the image produced.

## SHADOWS

You must have seen shadows of plants, animals and other objects. If an opaque body is placed in the path of light, the rays cannot pass through it. Thus, the rays of light are



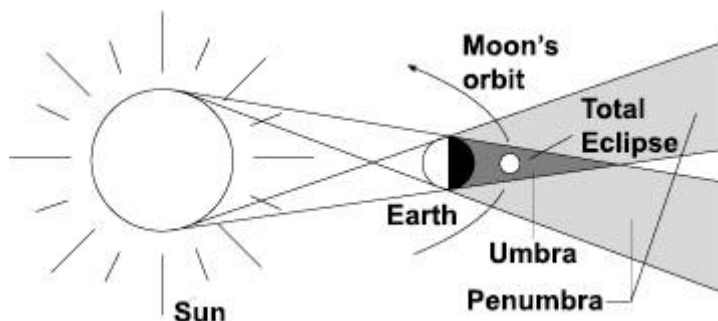
blocked from going to the other side of the opaque body and the space behind the object does not receive any light from that source.



Eclipses are examples of the formation of shadows in nature.

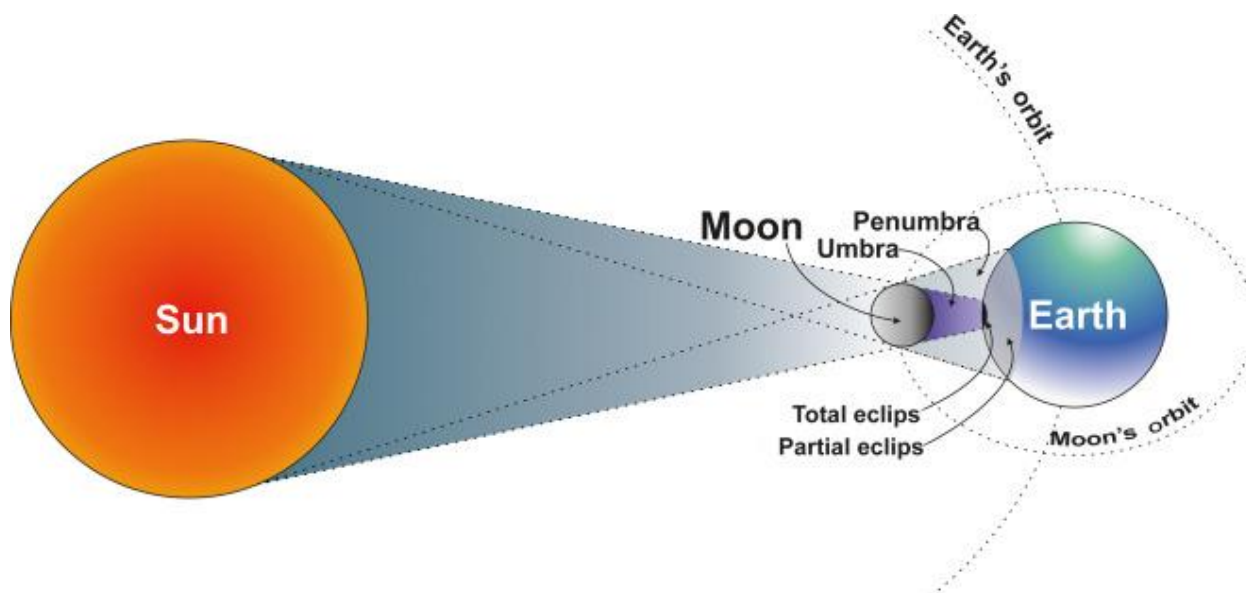
In a Lunar Eclipse, the sun, earth and the moon come in a straight line, with the earth in the middle, the shadow of the earth falls on the moon.

When the moon is in position A, no light from the sun falls on it and the moon becomes invisible and we observe a total lunar eclipse. In position B a partial lunar eclipse can be seen.



## Solar Eclipse

When the sun, the moon and the earth come in a straight line, with the moon in the middle, the shadow of the moon falls on some position of the earth. The sun is not visible from these portions of earth and people living there see a solar eclipse.



In the region of umbra, the sun will be blocked totally at these places, and a total solar eclipse can be seen. In the rest of the region between A and B and between A and C, the sun will be partially blocked by the moon and a partial solar eclipse can be seen.

During a total solar eclipse a bright ring, called the diamond ring appears in the sky for a very short period. It is a spectacular view.

It was observed in several parts of India during the total solar eclipse of 24 October 1995.

### Conditions for the Formation of a Shadow:

1. There must be a source of light.
2. There must be an opaque body to obstruct the path of light.
3. There must be an opaque screen to receive the shadow as it cannot be formed in air.

The nature and the size of the shadows depend on:

- i) The size of the source of light and the object.
- ii) The distance between the source of light and the object and that between the object and the screen.

## Regions of Shadow

A shadow consists of two regions:

- a) **Umbra:** The region of total darkness is called umbra. No ray of light enters in this region.
- b) **Penumbra:** The region of partial darkness which surrounds the umbra is called penumbra. Some rays of light always reach this region and illuminate it partially.

## MIRRORS AND REFLECTIONS

Suppose a ray of light, while travelling from one optical medium to another (say from air to glass), strikes the surface of separation of two media. If the ray of light is returned by the second optical medium into the first optical medium with a change in angle, the phenomenon is known as reflection of light.

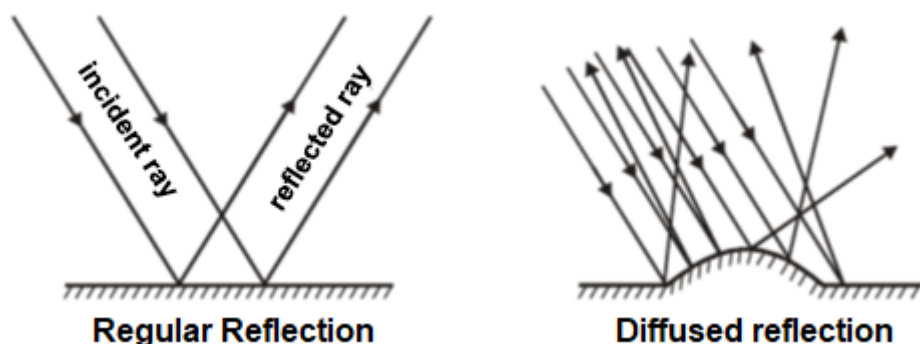
A looking glass is the best example of a mirror. A highly polished metal surface, still water or oil are examples of mirrors. It must be noted that reflection from a mirror gives us clear images. The images are different from shadows.

## REFLECTION OF LIGHT

**Types of reflection:** There are two types of reflection

**Regular Reflection:** When a parallel beam of light falls on a smooth and highly polished surface, then the reflected beam is also parallel and directed in a fixed direction. Such type of reflection is called regular reflection.

For example, light reflected from reflector of search light, automobile head lights, *etc.*

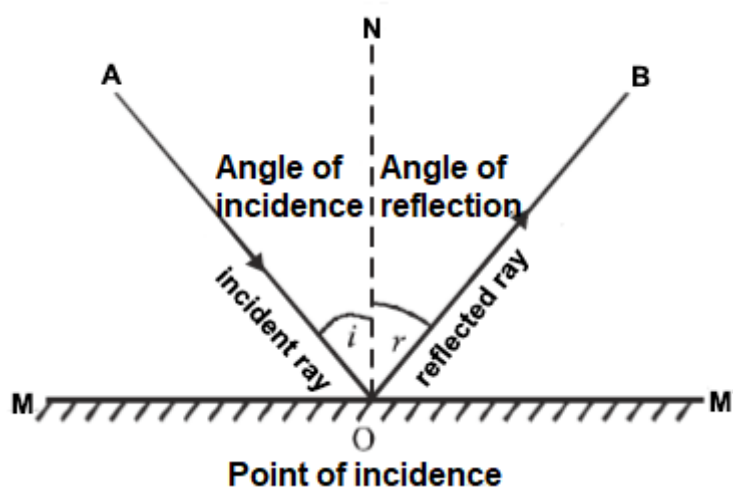


**Diffused Reflection:** When a parallel beam of light falls on a rough surface, the reflected light is not parallel but spreads in all directions, such type of reflection of light is called irregular or diffused reflection. For example, light reflected from the wooden surface. We see objects around us due to diffused reflection.

## LAWS OF REFLECTION

The reflection of light from a plane surface or from a spherical surface takes place according to two laws which are:

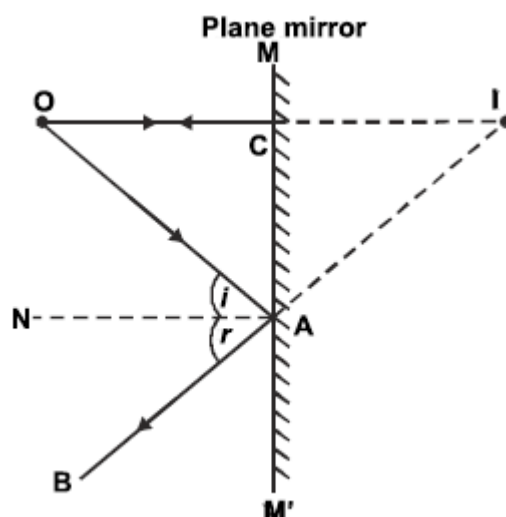
- i) The incident ray, the normal to the mirror at the point of incidence and the reflected ray, all lie in the same plane.
- ii) The angle of incidence is equal to the angle of reflection (i.e.,  $\angle i = \angle r$ ).



## FORMATION OF IMAGE BY PLANE MIRROR

When a ray of light falls on a surface, then it can undergo one of the following three phenomena reflection, refraction, or absorption. When it falls on a normal surface than most of the light gets absorbed. So mirrors are polished surfaces coated with mercury such that they reflect most of the light falling on them. Now based on the type of reflecting surface we can classify mirrors as concave, convex, or plane mirror. Here we will be talking about the plane mirror only. So to form an image we require at least two rays from the object which meet or appear to meet at a point.

Consider a point object O placed in front of a plane mirror M'. The mirror will form an image I of the object O. Here, two reflected rays AB and CO when produced backward, meet at a point behind the mirror and hence form the virtual image I at that point.



| Real image |  | Virtual image |  |
|------------|--|---------------|--|
| i)         | When light rays coming from an object actually meet at a point after reflection or refraction, meet at a point after reflection or refraction, real image is formed. | i)            | When light rays coming from an object do not actually meet at a point but appear to meet at a point when produced backwards after reflection or refraction, virtual image is formed. |
| ii)        | Real image can be obtained on a screen.  | ii)           | Virtual image cannot be obtained on a screen.  |

### Properties of Images formed by a Plane Mirror:

- The image formed by a plane mirror is virtual and erect.
- The distance of the object from the mirror is equal to the distance of the image from the mirror.
- The size of the image is equal to the size of the object.
- The linear magnification produced by a plane mirror is unity, i.e.,

$$m = \frac{v}{u} = \frac{h'}{h} = 1$$

Where u is the object distance h is height of object

v is image distance of h' is height of image.

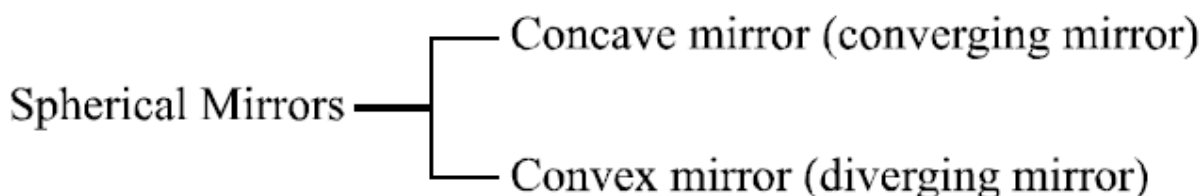
- The image formed is laterally inverted, i.e., the left side of the image appears to the right side and vice versa.

**Uses of Plane Mirror:**

- i) Plane mirror is used as a looking glass.
- ii) Plane mirror is used in solar cooker to reflect the sun light.
- iii) Plane mirrors are used in periscopes usually used in submarines.
- iv) Plane mirrors are used in barber's shop to see the back portion of the head.

**Spherical Mirrors**

A spherical mirror is that mirror whose reflecting surface is the part of a hollow sphere of glass. Spherical mirrors are of two types: Concave mirror and convex mirror. A spherical mirror, whose reflecting surface is curved inwards, that is, faces towards the centre of the sphere, is called a concave mirror. A spherical mirror whose reflecting surface is curved outwards, is called a convex mirror.

**IMPORTANT DEFINITIONS**

1. **Light – A form of Energy:** Light is a form of energy which excites the sensation of vision. Imagine how the world would be if there was no light around us.
2. **Luminous and Non-Luminous Bodies:** You know that the Sun, the stars, a candle, an oil lamp, etc., give us light. Such bodies, which give out light of their own are called luminous bodies.

You know that the moon, mirror, gold, etc., which do not have their own light are called non luminous bodies.

Substances which allow light to pass through them easily, and through which we can see clearly are called **transparent substances**. Glass, water, air and cellophane paper are examples of transparent substances.

Substances through which light can pass partially but we cannot see through them clearly are called **translucent substances**. Frosted glass, greased paper, butter paper and wax paper are examples of such substances.

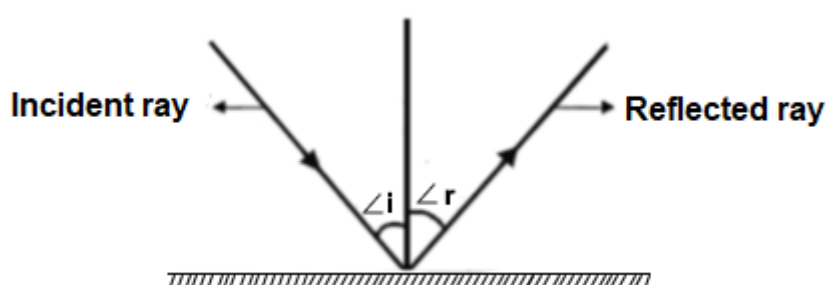
Substances which do not allow light to pass through them at all are called **opaque substances**.

Wood, metals, bricks, and stones are examples of opaque substances.

3. **Shadow:** The space behind the opaque object, where the light is wholly, or partially cut off by it is called shadow.
4. **Mirror:** Any smooth, polished surface which can turn back the rays of light into the same medium is known as **mirror**.
5. **Reflection of Light:** The process of bouncing back the light to the same medium after striking the surface of another medium is called reflection. A surface which reflects the light is called reflector. Silver metal is one of the best reflectors of light. A highly polished surface, such as a mirror, reflects most of the light falling on it.

### Keywords

1. **Luminous:** Objects that give out or emit light of their own are called luminous objects.
2. **Mirror:** A smooth shining surface, which rebounds the light back in same or in different directions is called a mirror.
3. **Opaque objects:** If an object completely stops the passage of all the light falling on it, it is an opaque object.
4. **Pinhole camera:** It is a device which forms a photograph-like image of a bright object on a screen.
5. **Reflection of light:** When a ray of light falls on a smooth and polished surface, light returns back in the same medium. It is called reflection.



6. **Shadow:** Opaque objects do not allow light to pass through them and cast dark patches behind them. These dark patches are called shadows.
7. **Translucent objects:** Some objects allow only a part of light falling on them to pass through, such objects are called translucent objects. For example, a single thin sheet of paper.

8. **Transparent objects:** Those objects which allow all the light to pass through the are called transparent objects.

9.

|                                     |
|-------------------------------------|
| <b>REVISION EXERCISE – LEVEL -1</b> |
|-------------------------------------|

**I. Write True (T) or False (F) against the following statements in the given brackets.**

1. The Sun is a natural source of light. [ ]
2. Any non-luminous body can be made luminous by heating it. [ ]
3. Any material medium through which light energy can pass partially or wholly is called an optical medium. [ ]
4. An oiled paper is an example of an opaque body. [ ]
5. A pinhole camera can take pictures of moving objects. [ ]
6. Glass is a translucent substance. [ ]
7. A polished metal surface can't act as a mirror. [ ]
8. We can see a shadow even if there is no light. [ ]
9. A shadow is always a dark patch [ ]
10. The image formed by a pin hole camera is of the same size as the object. [ ]
11. The image formed by a plane mirror is of the same colour as the object. [ ]
12. A beam of light consists of several rays. [ ]

**II. Fill in the blanks:**

1. Light is a form of .....
2. All bodies which emit light energy by themselves are called .....bodies.
3. The path along which light energy travels in a given direction is called a .....of light.
4. A glowing electric bulb is an example of .....source of light.
5. A region of total darkness is called.....
6. Any polished surface from which regular reflection takes place is called a .....
7. Reflection from a mirror gives clear .....
8. A shadow has no .....
9. Shadows are formed because light travels in .....



10. A solar eclipse occurs when the shadow of the ..... falls on the .....

**III. Match the items in Column A with the items in Column B.**

**Column A**

1. Penumbra
2. Umbra
3. Light
4. Rectilinear propagation of light
5. Eclipse

**Column B**

- (a) Form of energy.
- (b) Light travels in straight lines .
- (c) Shadow cast by heavenly bodies.
- (d) No ray of light enters here.
- (e) Region of partial darkness.

**IV. Tick (✓) the only correct choice amongst the following.**

1. Objects which do not allow light to pass through them are called  
(a) transparent                      (b) translucent                      (c) opaque
2. Which of the following is a non-luminous body?  
(a) moon                      (b) sun                      (c) burning candle
3. A number of rays from different directions assemble at a point are called  
(a) Divergent rays                      (b) Convergent rays                      (c) Parallel rays  
(d) Intersecting rays
4. The formation of eclipses is based on the principle of formation of  
(a) shadow                      (b) point source                      (c) medium
5. A looking glass is the best example of a  
(a) pinhole camera                      (b) mirror                      (c) lens
6. A highly polished furniture acts like a  
(a) pinhole camera                      (b) mirror                      (c) lens
7. The body placed in front of a mirror is called a/an  
(a) object                      (b) mirror                      (c) obstacle
8. An opaque material which obstructs the path of light is called, a/an  
(a) object                      (b) mirror                      (c) obstacle
9. A shadow has no  
(a) colour                      (b) shape                      (c) size
10. An image has  
(a) the colour of the object                      (b) black colour                      (c) no colour at all

**LEVEL - II**

1. The image formed by a plane mirror
  - (a) Is an erect image.
  - (b) is of the same size as that of object
  - (c) Shows an interchange of right and left.
  - (d) Shows all the three characteristics listed above.
2. We are able to see different objects around us through
  - (a) their shadows
  - (b) regular reflection
  - (c) both regular and diffused reflection
  - (d) diffused reflection
3. The region of shadow
  - (a) receives light from the top of the source
  - (b) does not receive any light at all
  - (c) receives light from the bottom of the source
  - (d) receives light from the source
4. A tracing paper will make a shadow with less
  - (a) dark
  - (b) size
  - (c) colour
  - (d) shape
5. Long shadows with different positions are found when sun is low in western horizon in
  - (a) afternoon
  - (b) noon
  - (c) late afternoon
  - (d) sunset
6. Shadow is short when sun is overhead at-
  - (a) noon
  - (b) night
  - (c) midnight
  - (d) sunset
7. In Wayang Kulit light falling on puppets cannot pass through them except
  - (a) boundaries
  - (b) holes
  - (c) heads
  - (d) costumes
8. A \_\_\_\_\_ eclipse occurs when earth comes between sun and moon in a straight line.
  - (a) solar
  - (b) lunar
  - (c) shadow
  - (d) none of these
9. The shape of a shadow depends on which of the following:
  - (a) shape of the opaque object
  - (b) colour of screen
  - (c) colour of the object
  - (d) all of these
10. If we are able to see anything clearly through an object, then such an object is said to be a \_\_\_\_\_ object.
  - (a) transparent
  - (b) translucent
  - (c) opaque
  - (d) none of these

**ADDITIONAL EXERCISE**

1. What are luminous and non-luminous objects?
2. Define opaque objects with example.
3. **State whether the statements given below are True or False:**
  - (i) A torch bulb is a luminous object.
  - (ii) Light travels in a straight line.
  - (iii) Image formed by a plane mirror is inverted.
  - (iv) Light gets reflected when strikes a shiny surface.
  - (v) Transparent substances reflect all the light falling on them.
  - (vi) All the shining bodies in sky have their own light.
  - (vii) Jugnu (Firefly) is a living luminous body.
  - (viii) When screen is far away from the objects, the shadow will have no penumbra.
  - (ix) A reflected image gives us more information about the object than a shadow.
4. Light travels in
  - (A) straight line      (B) curved line      (C) zig-zag line      (D) randomly
5. When an opaque object comes in the path of light it forms
  - (A) an image with colours      (B) shadow
  - (C) black and white image      (D) depends on the colour of the light
6. Which types of objects do not allow light to pass through them?
  - (A) Translucent      (B) Opaque      (C) Transparent      (D) Penumbra
7. Which is an example of a translucent object?
  - (A) A thin sheet of paper      (B) A thin glass slab
  - (C) A thin iron sheet      (D) All of these
8. Bouncing back of light from shining surfaces is called
  - (A) Reflection      (B) Refraction      (C) Bending      (D) Dispersion

9. What is lateral inversion?
- (A) Image becomes inverted
  - (B) Image bends laterally
  - (C) Right of the object appears left of the image
  - (D) All of these happen
10. Which letters of English alphabet will not show lateral inversion?
- (A) I, O, U
  - (B) N, Z, X
  - (C) I, X, E
  - (D) A, E, I
11. Which is a device to image the sun?
- (A) Plane mirror
  - (B) Pinhole camera
  - (C) A straight pipe
  - (D) Glass slab
12. Which of the following is a cold source of light?
- (A) Firefly (Jugnu)
  - (B) Tube light
  - (C) The sun
  - (D) Electric bulb
13. Out of these, which one is not a man-made luminous body?
- (A) Electric bulb
  - (B) Burning candle
  - (C) Firefly (Jugnu)
  - (D) Oil lamp
14. In case of three plane mirrors meeting at a point to form a corner of a cube, if incident light suffers one reflection on each other
- (A) The emergent ray is antiparallel to incident one
  - (B) The emergent ray is perpendicular to incident one
  - (C) The incident ray cannot emerge
  - (D) None of these
15. Which of the following statement is/are true?
- (i) Moon is a luminous body.
  - (ii) An object which does not emit light is called a non-luminous.

(iii) A ray of light is the path along which light travels

(iv) Translucent bodies do not form shadow

(A) (ii) and (iii)

(B) (i) and (iv)

(C) (ii) and (iv)

(D) (i) and (iii)

16. An image that is not produced by light rays coming from the image but is the result of your brain's interpretations of these light rays is called a/an\_\_.

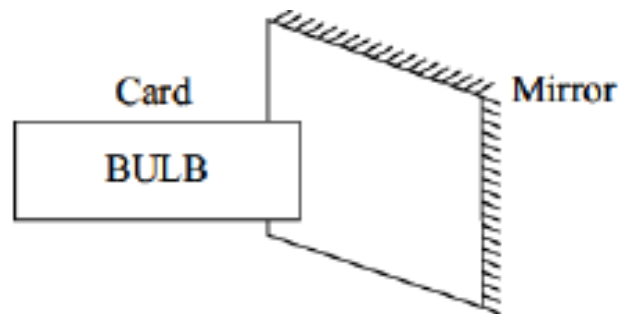
(A) Real image

(B) Virtual image

(C) Imagined image

(D) None of these

17. A card with the word BULB written on it, is placed in front of a plane mirror, as shown in the figure.



(A) BULB

(B) BULB

(C) BULB

(D) BULB

## Sorting Materials Into Groups

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### Introduction

We use variety of objects in our day to day lives. Objects are made up of different materials: An object can be made from more than one material

**Example:** Cake, Soaps

Different objects can be made from the same material Example: Table, Chair, and Door are made from wood. An object can be made from different materials Example: Bottles from glass, plastic, metal.

### Importance of grouping

Grouping materials in groups makes it convenient for study. Objects are grouped on the basis of their shapes, the materials they are made up of, and the properties of these materials. Materials can be grouped on the basis of similarities or differences in their properties.

Grouping of objects on the basis of common properties: Objects are grouped on the basis of properties like lustre, hard/softness, transparency, solubility, floatation, attraction towards magnet, conduction of heat and conduction of electricity.

### Basis of Classification of Objects

The classification of various objects into groups can be done on the basis of their similarities and dissimilarities such as: living or non-living; plant or animal; nature of material; use, colour, shape, size appearance, hardness, texture, etc. Thus, the various objects can be classified (or grouped) as follows:

- (i) All the objects can be classified into two main groups: Living objects and Non-living objects.
- (ii) Living objects can be classified further into two groups: Plants and Animals.
- (iii) Non-living objects can be classified into many groups on the basis of their nature of material, use colour, shape, size, appearance, hardness, texture, etc.

It should be noted that **the classification of objects into groups can be done only when the objects have some similarities and some dissimilarities (differences).**

The objects cannot be classified into group if all of them are similar or all of them are dissimilar (different). Thus, if we have some objects which similar in all respects, they cannot be classified into different groups.

### **Classification of Objects as Living and Non-Living**

**All the living objects need food, water and air for their survival whereas non-living objects do not require these things.** Based on this difference, all the objects around us can be classified into two group living objects and non-living objects. As an example, let us classify the following objects into living objects and non-living objects:



Table, Toy, Dog, Clothes, Rose, Algae, Pencil, Knife, Shoes, Hydrilla, Grass-hopper, Blackboard, Cactus, Wool, Earthworm, Tree, Fish, Feather, Nail, Hen

If we look at these objects carefully, we will find that out of these objects, dog, rose, algae, hydrilla, grasshopper, cactus, earthworm, tree, fish and hen are living objects. On the other hand, table, toy, clothes, knife, shoes, blackboard, wool, feather and nail are non-living objects. So, we can classify (or divide) above objects into two groups as 'living objects' and 'non-living objects' as follows:

### **Following are the important characteristics of living things:**

1. All living things breathe, eat, grow, move, reproduce and have senses.
2. Living things exhibit locomotory motion, they move. Animals are able to move as they possess specialized locomotory organs, for example – Earthworms move through the soil surface through longitudinal and circular muscles. Plants move in order to catch sunlight for photosynthesis
3. Living things respire. Respiration is a chemical reaction, which occurs inside cells to release energy from the food. Transport of gases takes place. The food that is ingested through the process of digestion is broken down to release energy that is utilized by the body to produce water and carbon dioxide as by-products.
4. Living things are sensitive to touch (and other stimuli as well) and have the capability to sense changes in their environment.

5. They grow. Living things mature and grow through different stages of development.
6. One of the striking features is that living things are capable of producing offsprings of their own kind through the process of reproduction, wherein genetic information is passed from the parents to the offsprings.
7. They acquire and fulfil their nutritional requirements to survive through the process of nutrition and digestion, which involves engulfing and digesting the food. Some living organisms are also autotrophic, which means they can harness the sun's energy to make their food (also known as autotrophs).
8. The digested food is eliminated from the body through the process of excretion.

| Living objects  | Non Living objects   |   |  |
|---|--|---|--|
| Dog<br>Rose<br>Algae<br>Hydrilla<br>Grasshopper<br>Cactus<br>Earthworm<br>Tree<br>Fish<br>Chicken | Table<br>Toy<br>Clothes<br>Pencil<br>Knife<br>Shoes<br>Blackboard<br>Wool<br>Feather<br>Nail |  |  |
|   |  | Figure Chicken is a living object   | Figure Toy is a non –living object   |



### Classification of Living Objects as Plants and Animals

All the plants can make their food by using carbon dioxide, water and sunlight whereas animals cannot make their food in this way. Based on this difference, all the living objects can be classified into two groups: plants and animals. Let us classify the following living objects into plants and animals.

Dog, Rose, Algae, Hydrilla, Grasshopper, Cactus, Earthworm, Tree, Fish, Hen

Now, out of these living objects, rose, algae, hydrilla, cactus and tree are plants whereas dog, grasshopper, earthworm, fish and hen are animals. So, we can classify these living objects into two groups, and animals, as follows:



| Plants   | Animals     |   |  |
|----------|-------------|---|--|
| Rose     | Dog         |  |  |
| Algae    | Grasshopper |   |  |
| Hydrilla | Earthworm   |   |  |
| Cactus   | Fish        |   |  |
| Tree     | Hen         |   |  |
|          |             | Figure: hydrilla is plant   | Figure : Dog is an animal  |

### Classification of Non-Living Objects

**The non-living objects can be classified on the basis of the material (of which they are made), uses, colour, shape, size, appearance, hardness and texture, etc.** We will give an example of the classification of non-living objects on the basis of the nature of their material. Consider the following non objects:

Table, Nail, Beaker, Toy, Chair, Utensils, Test-tube, Ruler, Bed, Magnet, Funnel, Mug, Door, Coin, Mirror, Polythene bag

Out of these objects, table, chair, bed and door are made of wood; nail, utensils, magnet and coin made of metals; beaker, test-tube, funnel and mirror are made of glass whereas toy, ruler, mug and polythene bag are made of plastics. So, we can classify all the above objects into four groups on the basis of material of which they are made: objects made of wood; objects made of metal; objects made of glass and objects made of plastics. This classification is shown on the next page.

### Characteristics Of Non-living Things

1. Non-living things do not eat, grow, breathe, move and reproduce. They do not have senses.
2. The important characteristics of non-living things are mentioned below:
3. Non-living things are lifeless. They do not have cells, and there is no protoplasm which forms the basis for life to exist.
4. Lack of protoplasm leads means no metabolic activities.

5. They do not have a definite and certain size of their own. They take the shape of the substance they are contained in, for example, a liquid takes the shape of its container. Stones, rocks and boulders are moulded by the changing environment and landscape. The change in the state of a non-living thing is due to an external influence.

| Objects made of wood | Objects made of plastic | Objects made of metals | Objects made of glass |
|----------------------|-------------------------|------------------------|-----------------------|
| Table                | Nail                    | Beaker                 | Toy                   |
| Chair                | Utensils                | Test-tube              | Ruler                 |
| Bed                  | Magnet                  | Funnel                 | Mug                   |
| Door                 | Coin                    | Mirror                 | Polythene bag         |

### Classification of Materials

The materials are classified on the basis of certain properties such as

- i) Appearance (Shiny or Dull)
- ii) Hardness or Softness
- iii) Solubility or Insolubility in water
- iv) Transparency, Translucency or Opaqueness

#### Property – Appearance(Shiny or Dull)

Materials can be grouped as lustrous and non-lustrous on the basis of properties like luster/shine possessed by them. Lustrous materials are those that have a shine on them. Due to this property metals are widely used for making jewellery.



**Figure: Wood has Dull appearance**



**Figure: Diamond has shiny appearance**

Example: Gold, silver and most metals are lustrous in nature. Non-lustrous materials are dull in appearance. Example: wood, plastics

**Property – Hardness/Softness**

Materials that can be compressed or scratched easily are called soft materials.

Example: Cotton, Sponge. Some materials that are difficult to compress are called hard. Example: Iron and most of the other metals.



**Figure : Iron is a hard material**



**Figure : cotton is a soft material**

**Property – Transparency**

Materials can be classified as transparent, opaque and translucent on the basis of transmittance of light by them.

**Transparent Materials**

Transparent materials allow light to pass through them completely. One can see through such materials Example: Glass, water, Air and Some plastics



**Glass is a transparent material so we can see clearly through the glass window shown in this picture**

**Opaque Materials:** Opaque materials do not allow light to pass through them. You cannot see through them. Example: Wood, Cardboard and Metals.



**Cardboard is an opaque material. We cannot see anything through a sheet of cardboard**

**Translucent Materials:** Translucent materials allow light to pass through them only partially. They are partially transparent and partially opaque. Example: Butter paper, Frosted glass.

**Translucent Objects:** There are some objects through which we can see, but not very clearly. Such objects are known as translucent. For example: Butter paper, ground glass etc.

**Translucent Examples**

Examples of translucent objects also include everyday materials.

1. frosted glass shower door
2. sunglasses
3. wax paper



**Figure** Ground glass is a translucent material so we cannot see clearly through the ground glass window of bathroom shown in this picture.

**Property - Soluble or Insoluble:** Substances that completely dissolve in water are said to be soluble in water. Example: Lemon juice, vinegar, sugar, salt are completely Soluble in water and form a single layer with water. Materials (solids or liquids) that form distinct layers with water are said to be insoluble in water.

We can group materials into insoluble and soluble. Soluble materials dissolve in liquids whereas insoluble materials don't dissolve in liquids. However, sometime we have to separate insoluble materials from some mixtures.

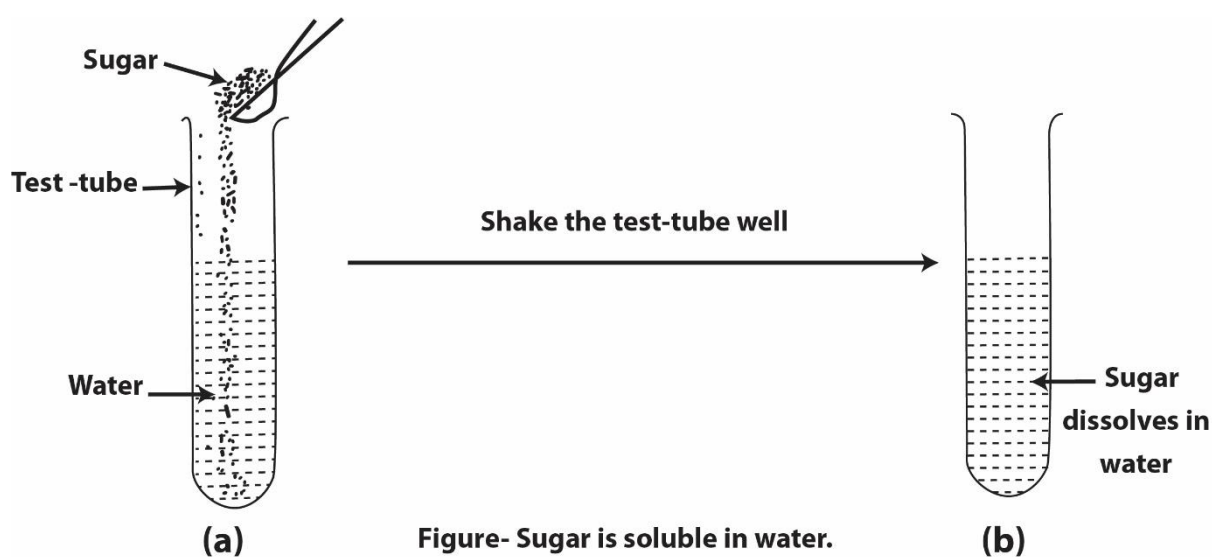
**Example:** Substances like sand and sawdust do not dissolve in water even if you stir them very well. They are said to be insoluble in water.

To strain rice or noodles to separate it from the water

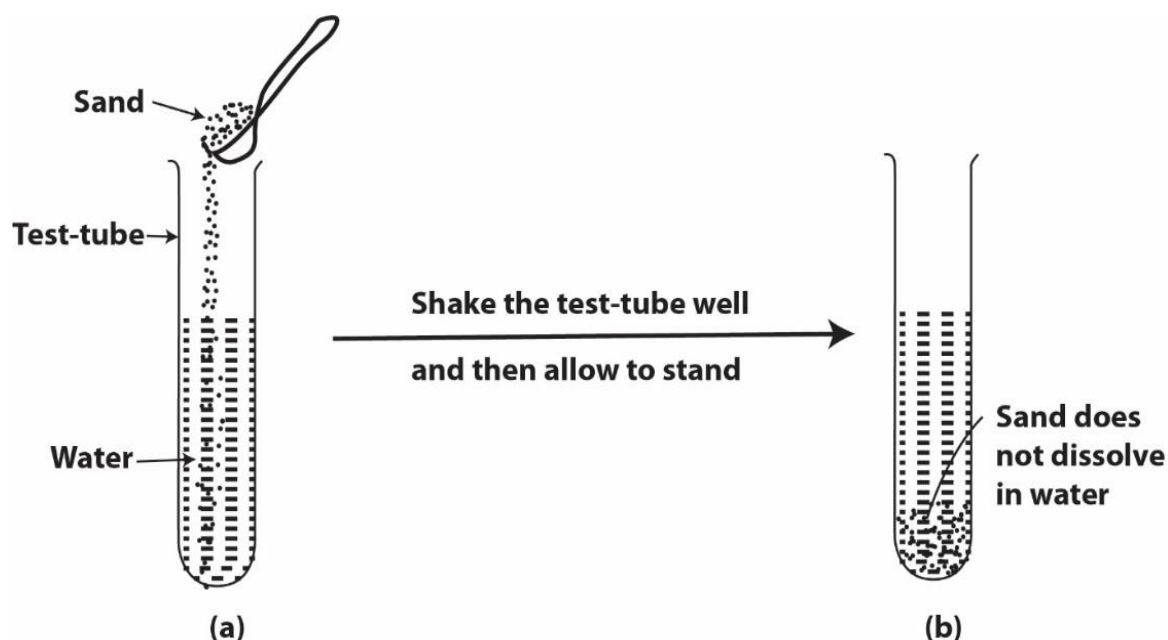
To filter a mixture of coffee made using ground coffee beans

To filter a mixture of tea made using tea leaves

The filter paper will allow the water and coffee solution to pass through into the cup, while the none dissolve coffee grounds are left in the filter paper.

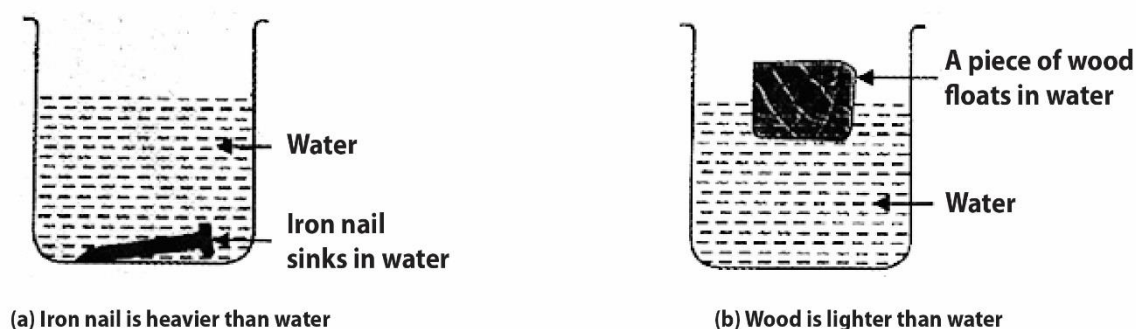


Lemon juice, vinegar are completely soluble in water and form a single layer with water whereas mustard oil and kerosene will not dissolve in water, but will form distinct layers. Liquids that are soluble in water and form single layer with water are said to be miscible in water. Whereas liquids that are insoluble in water and form distinct layers are said to be immiscible in water. Some gases can dissolve in water as well. For example, oxygen dissolved in water is useful for plants and animals that live underwater.



**Property - Float or Sink:** Materials that are insoluble in water either float on the surface or sink in water. Light materials float in water. Example: Paper, Plastic boll etc. Heavy materials sink in water. Example: Metals, stones etc.

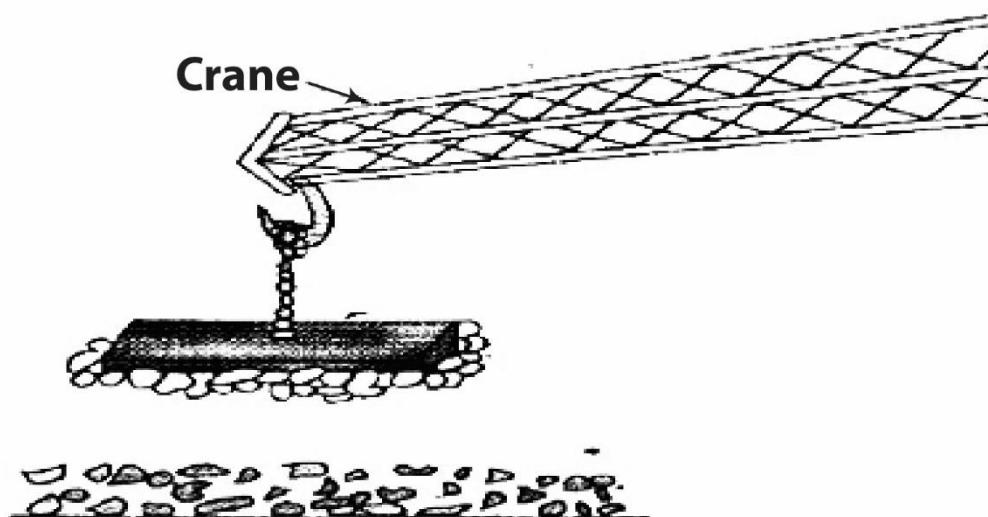




**Figure:-** Materials can be heavier than water or lighter than water.

### Property

**Attraction towards a magnet:** Substances that are attracted to a magnet are called magnetic substances. Example: Iron, Nickel.



**Conduction of heat:** Materials that allow the heat to pass through them are called good conductors of heat. Example: Ex. Iron, Copper, Gold, Silver. Materials that do not allow the heat to pass through them are called bad conductors of heat. Example: Plastic, Cotton, Wood.

**Property state:** - Everything in this universe is made up of matter. Matter exists in 3 states - Solid state, liquid state and gaseous state.

As discovered by scientists, the matter is made up of very tiny particles and these particles are so small that we cannot see them with naked eyes.

It has been observed that matter exists in nature in different forms. Some substances are rigid and have a fixed shape like wood and stone; some substances can flow and take the shape of their container like water, while there are forms of matter that do not have definite shape or size such as air.

Thus, **the matter can be classified into different categories based on the physical properties exhibited by them and the states in which they exist; these are called states of matter.**

**Following are the basic three states of matter:**

1. Solid state
2. Liquid state
3. Gas state

**Solid state:** All solid substances are said to have solid state.

**Properties of solid state:**

- Solids have definite shapes, volumes and are not compressible.
- The particles are closely packed and they cannot flow.

**Liquid state:** All liquid substances are said to have liquid state.

Based on the arrangement of constituent particles, solids are classified into two-state types:

1. Crystalline Solids
2. Amorphous Solids

**Properties of liquid state**

- Liquids do not have definite shapes; they take the shape of the container and have definite volume.
- The particles of liquids are loosely packed than the particles in solids
- They can be compressed to a small extent.
- Liquids are almost incompressible. In liquids molecules are pretty close to each other. The molecules does not have lot of space between them. The molecules cannot squeezed closer to one another.
- Liquids have fixed volume but no fixed shape. They have fixed volume but they do not have fixed or definite shape. If you take 100 ml of water, pour water in a cup, it will take the shape of the cup. Now pour the liquid from cup to a bottle, the liquid has changed its shape and now it has taken the shape of bottle.

- Liquids flow from higher to lower level.
- Liquids have their boiling points above room temperature, under normal conditions. The liquids on heating slowly changes to vapour or gaseous phase. This process is called boiling.

**Gaseous state:** All gaseous substances are said to have gaseous state.

**Properties of gaseous state**

- Gasses do not possess any definite volume or shape. They totally fill all the space accessible to them. The characteristic or properties of gases to fill the available volume within a container is the result of the freedom that gas particles have to move everywhere in the accessible space. This autonomy of movement of gaseous molecules is because of the very weak binding forces amidst molecules. In other words, their intermolecular forces are very weak.
- Particles of a gas are very loosely packed
- Gases are highly compressible.

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**KEY POINTS**

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1. Anything that occupies space and has mass is called matter.
2. Matter exists in three states-solid, liquid and gas.
3. The change in state of matter from one to another is called interconversion of state.
4. On the basis of composition, matter is classified as follows.
5. The classification of various objects into groups can be done on the basis of their similarities and dissimilarities
6. All the living objects need food, water and air for their survival whereas non-living objects do not require these things
7. Classification of Living Objects as Plants and Animals
8. Classification of Non-Living Objects



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**REVISION EXERCISE**

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**Very Short Answer Questions**

1. What are materials?
2. Define classification.
3. Define appearance.
4. Define a soluble substance.
5. Give two examples of soluble substances.
6. Give two examples of insoluble substances.
7. Name two things that are made of metals.
8. Name two things that can be made from different materials.
9. Why does a shopkeeper group various items in his shop?
10. Give examples of materials with dull appearance.
11. Give examples of materials with shining appearance.
12. Name the property on which floating and sinking of a substance depends.
13. Which material is generally used for making pens
14. What is common property in salt and sand?
15. Write two gases which are soluble in water?
16. Write two gases which are insoluble in water

**Short Answer Questions**

17. Define hard materials?
18. Give examples of hard materials.
19. What are soft materials?
20. Give two examples of soft materials.
21. Define an insoluble substance.
22. Categorize the material as soluble or insoluble
  - a) Chalk powder and water
  - b) Lime juice and water
23. Why are cutting tools made up of metals?
24. Diamond is used to cut glass. Why
25. Why metals and stones are used to make cutting tools.
26. When Chalk powder is added to water it sinks and settles down.
27. When sand is added to water it sinks and settles down.

28. When cooking oil is added to water it forms a separate layer and floats on water.
29. When kerosene oil is added to water, it forms a separate layer and floats on water.

### Medium Answer Questions

30. What is called 'transparency'?
31. What are transparent materials? Give examples of transparent materials.
32. What are translucent materials? Give examples of translucent materials.
33. What are opaque materials? Give examples of opaque objects.
34. What are the advantages of classification?
35. What happens when lime juice and salt are added to water? Why?
36. How will you decide whether a solid or a liquid will sink or float in a liquid?
37. List all the items known to you that float on water. Check and see if they will float on an oil or kerosene?

### Long Answer Questions

38. Name five things made of the following materials.  
Cotton, Leather, Paper, Plastic, Metal, Wood
39. Explain the behaviour of the following materials when added to water. Salt, Sugar, Chalk powder, Sawdust, Sand, Kerosene oil, vinegar, and lime juice, Cooking Oil, Milk.
40. Classify the following materials into transparent, translucent and opaque. Glass window, Oil paper, Wood, Plastic sheet used to cover books, Thin muslin cloth, Wall, Acrylic sheet, Frosted glass, Glass used in bathrooms, Metal sheet, Note book, Butter paper.

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### EXERCISE (Single Correct Type) LEVEL - I

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1. A substance which allows the heat to pass is  
(a) density                      (b) conductor                      (c) electricity                      (d) heat
2. All things are made up of  
(a) things                      (b) properties                      (c) materials                      (d) none of these
3. A liquid containing a dissolved material is called  
(a) solubility                      (b) solution                      (c) soluble                      (d) none of these
4. These are good conductors of heat  
(a) solids                      (b) non-metals                      (c) metals                      (d) none of these

5. All gases are\_\_\_\_\_ conductors of heat  
(a) good (b) bad (c) neutral (d) none of these
6. Glass bowl is a\_\_\_\_\_ material  
(a) opaque (b) transparent (c) translucent (d) none of these
7. All metals are..... conductors of heat  
(a) bad (b) poor (c) good (d) neutral
8. Wax and plastics are..... in water  
(a) soluble (b) insoluble (c) miscible (d) none of these
9. Copper is a material  
(a) non-Magnetic (b) magnetic (c) both(A) & (B) (d) none of these
10. Chalk powder is ..... in water:  
(a) soluble (b) insoluble (c) miscible (d) none of these
11. The smallest particle of an element is:  
(a) An atom (b) A molecule (c) Substance (d) Compound
12. What is the physical state of water at room temperature?  
(a) Solid (b) Liquid (c) Gas (d) All the above
13. The classification of matter into solid, liquid and gases is on the basis of:  
(a) Mass and weight (b) Intermolecular space  
(c) Gravitational force (d) None of the above
14. The gas in a container:  
(a) Spread out along the bottom of the container  
(b) Spread out all through the container  
(c) Will not spread out at all  
(d) Spread out only at the top of the container.
15. A small piece of stone sinks in water because, it is  
(a) Heavier (b) Lighter (c) Smaller (d) Larger
16. When kerosene oil is added to water  
(a) It dissolves in water  
(b) It does not dissolve in water and settles down  
(c) It does not dissolve in water and forms a separate layer.  
(d) None of these.
17. When vinegar is added to water  
(a) It dissolves in water

- (b) It does not dissolve in water and settles down  
(c) It does not dissolve in water and forms a separate layer.  
(d) None of these.
18. Which of the following is true  
(a) Air is transparent and pure water is translucent  
(b) Air is transparent and pure water is opaque  
(c) Both air and pure water are transparent  
(d) Both air and pure water are translucent
19. Glass can be cut using  
(a) Knife (b) Metal tools (c) Diamond (d) Scissors
20. Which of the following is less dense than water?  
(a) Oil (b) Chalk power (c) Wood (d) Sand

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**LEVEL -II**

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1. The advantage of classification are  
(a) Sorting of similar and dissimilar things  
(b) Identifying and location things conveniently  
(c) Easy and more meaningful study.  
(d) All the above.
2. The external look of an object is called  
(a) Hardness (b) Appearance (c) Solubility (d) Transparency
3. Which of the following material is shiny in appearance?  
(a) Paper (b) Cotton (c) Chalk (d) Metallic chain
4. Which of the following material is dull in appearance?  
(a) Metallic chain (b) Silk (c) Wood (d) Steel Utensils.
5. Which of the following is the hardest substance known?  
(a) Wood (b) Iron (c) Diamond (d) Stone
6. Choose the soft substance out of the following.  
(a) Cotton (b) Glass (c) Sponge (d) Both ((A) & (C))
7. Substances that are used to make cutting tools are  
(a) Metals (b) Stones (c) Diamond (d) All of them
8. Which of the following substance is usually taken as a standard to check if different materials are soluble or not?  
(a) Water (b) Milk (c) Oil (d) Sulphuric acid

9. Which of the following substances are soluble in water?  
(a) Vinegar                      (b) Lime juice                      (c) Salt                      (d) All of them
10. Which of the following is insoluble in water?  
(a) Chalk powder                      (b) Sugar                      (c) Vinegar                      (d) Salt.
11. Choose the correct statement out of the following  
(a) A less dense substance sinks and settles down  
(b) A more dense substance sinks and settles down  
(c) Both less dense and more dense substances float on water.  
(d) None of these is correct.
12. The materials through which you can see clearly are called  
(a) Opaque material                      (B) Translucent material  
(c) Transparent material                      (D) none of the above
13. Which of the following is a translucent material?  
(a) Oil paper                      (B) Butter paper                      (C) Frosted glass                      (D) All of them
14. Light does not pass at all through  
(a) Opaque materials                      (B) Translucent material  
(c) Transparent materials                      (D) All of them
15. A Substance which is shiny in appearance hard, smooth and can be transparent or translucent is  
(a) Wood                      (B) Glass                      (C) Metal                      (D) Plastic
16. Which of the following materials is used to make plates  
(a) Steel                      (B) Glass                      (C) Plastic                      (D) all the above
17. Which of the following things are made of plastic?  
(a) Saris                      (B) Jackets                      (C) Pens                      (D) Books
18. The item which is shiny in appearance is  
(a) Paper                      (B) Metallic chain                      (C) Card board                      (D) Cotton
19. The item which is dull in appearance is  
(a) Wood                      (B) Copper wire                      (C) Aluminium oil                      (D) Steel utensils
20. When sand added to water.  
(a) It dissolves in water.  
(b) It does not dissolve in water and settles down  
(c) It does not dissolve in water and floats on top  
(d) None of these.

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**MULTIPLE CORRECT ANSWER TYPE QUESTIONS**


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21. The whole universe is composed of:  
 (a) Matter (b) Energy (c) Atoms (d) Molecules
22. Generally coconut oil exists as:  
 (a) Solid (b) Liquid (c) Gas (d) All the above
23. Matter occupies\_\_\_\_\_ and has\_\_\_\_\_  
 (a) Space (b) Heat (c) Mass (d) Pressure

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**MATRIX MATCH ANSWER TYPE QUESTIONS**


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24. Match the column I with column II

**Column-I**

- (a) Water  
 (b) Solute  
 (c) Solution  
 (d) Solvent  
 (a) a—(i), b—(iv), c—(ii), d— (iii)  
 (c) a—(i), b—(iv), c—(iii), d—(ii)

**Column-II**

- (i) Sharbat  
 (ii) The liquid in which the substance gets dissolved.  
 (iii) Universal solvent  
 (iv) The substance dissolves in liquid  
 (b) a—(iv),b—(iii),c—(i), d—(ii)  
 (d) a—(iii), b—(iv),c—(i), d—(ii)

25. Match the column

**Column-I**

- (a) Solution  
 (b) Universal solvent  
 (c) Physical change  
 (d) Chemical change  
 (a) a—(ii), b—(iv), c—(i), d—(iii)  
 (c) a—(ii), b—(iv), c—(iii), d—(i)

**Column-II**

- (i) Burning of candle  
 (ii) Sugar added to water  
 (iii) Water vapour formation  
 (iv) Water  
 (b) a—(iv), b—(iii), c — (i), d—(ii)  
 (d) a—(iii), b—(iv), c—(i), d—(ii)

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**ADDITIONAL EXERCISE**


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1. Tables are made up of:  
 (A) plastic (B) wood  
 (C) leather (D) both (A) and (B)
2. Which one of the following is soft?

- |  |          |          |            |           |
|--|----------|----------|------------|-----------|
|  | (A) Iron | (B) Wood | (C) Cotton | (D) Stone |
|--|----------|----------|------------|-----------|
3. Which one of the following is hard?
- |            |            |          |                  |
|------------|------------|----------|------------------|
| (A) Cotton | (B) Sponge | (C) Iron | (D) None of them |
|------------|------------|----------|------------------|
4. Choose the substance soluble in water:
- |           |         |           |          |
|-----------|---------|-----------|----------|
| (A) Sugar | (B) Mud | (C) Chalk | (D) Sand |
|-----------|---------|-----------|----------|
5. Choose the transparent substance:
- |          |           |            |           |
|----------|-----------|------------|-----------|
| (A) Wood | (B) Stone | (C) Mirror | (D) Glass |
|----------|-----------|------------|-----------|
6. What makes the basis of sorting materials into groups
- (A) Similarities in their properties
- (B) Differences in their properties
- (C) Both similarities and differences in their properties
- (D) All of these
7. Which one will show a metallic lustre?
- (A) Any surface of a metal
- (B) Freshly cut surface of a metal
- (C) Freshly cut surface of non-metal
- (D) Surfaces of all materials
8. An oily thin paper sheet will be
- |                 |                         |
|-----------------|-------------------------|
| (A) transparent | (B) translucent         |
| (C) opaque      | (D) cannot be predicted |
9. Purpose of sorting material into groups is
- |                               |                   |
|-------------------------------|-------------------|
| (A) to study their properties | (B) convenience   |
| (C) both (A) and (B)          | (D) inconvenience |
10. Which is a set of transparent materials?
- |                   |                     |
|-------------------|---------------------|
| (A) Glass and air | (B) Water and glass |
| (C) Water and air | (D) All of these    |
11. Choose the opaque object from the following:
- |              |         |           |           |
|--------------|---------|-----------|-----------|
| (A) Charcoal | (B) Air | (C) Glass | (D) Water |
|--------------|---------|-----------|-----------|
12. Which one of the following is not soluble in water?
- |                     |                     |
|---------------------|---------------------|
| (A) Turmeric powder | (B) Common salt     |
| (C) Alum            | (D) All are soluble |
13. Which object shines
- |                 |                  |                 |                 |
|-----------------|------------------|-----------------|-----------------|
| (A) Plastic toy | (B) Cotton shirt | (C) Steel spoon | (D) Stone piece |
|-----------------|------------------|-----------------|-----------------|
14. Which of the following has reddish brown colour?
- |          |            |          |           |
|----------|------------|----------|-----------|
| (A) Gold | (B) Copper | (C) Iron | (D) Brass |
|----------|------------|----------|-----------|
15. Which one of the following is insoluble in water?
- |                 |                     |
|-----------------|---------------------|
| (A) Alcohol     | (B) Sodium chloride |
| (C) Coconut oil | (D) Sugar           |

# The Living Organisms And Their Surroundings

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## Living things around us

Any organism or a living form that possesses or shows the characteristics of life or being alive is a living thing. Living things are those that display the following characteristics:

- a) An organised structure, being made up of a cell or cells.
- b) Ability to grow
- c) Ability to metabolise
- d) Ability to adapt to the environment
- e) Ability to move
- f) Ability to respire
- g) Ability to respond to stimuli.

Let us now discuss the characteristics of living things in detail:

i) **Nutrition:** All the living things (plants and animals) need food, air and water to stay alive. Plants make their own food by the process of photosynthesis. Animals obtain their food from plants or other animals.

Plants are called producers and animals are called consumers.

ii) **Growth:** All the living things have the ability to grow. The young ones of all the plants and animals grow and become bigger in size. For example, a small plant grows to become a big tree. A small puppy grows and becomes a dog.

iii) **Response to Stimuli:** All the living things show response to the external stimuli such as light, heat, touch, sound and taste etc. in the form of some movement of their body part. For example, if we move from a dark place in to bright sunshine suddenly, our eyes shut automatically for a moment till they adjust to the changed surroundings.

Plants also respond to stimuli such as touch, sunlight, water etc. for example, *Mimosa Pudica* plant which is commonly known as “touch-me-not” plant, fold up the leaves on touching.

iv) **Respiration:** When you hear the word ‘respire’, you probably think of breathing. When you breath, you are taking in oxygen with each inhale and releasing carbon dioxide with each exhale. This gas exchange is important for respiration, but while



breathing is a physical process, respiration can be thought of as more of a chemical process. Respiration is the chemical process in which food taken by an organism combines with oxygen to release energy. All the living beings undergo respiration to obtain energy from food. The process of breathing, in animals like dogs, cows etc is similar to human beings. The Earthworm absorbs oxygen needed for respiration through its thin and moist skin. The fish has special organs of breathing called gills.

(v) **Reproduction:** It is the biological process by which living organisms produce new members of their species. All living organisms have the ability to reproduce. Some organisms reproduce their young ones through eggs, for example Birds and fish whereas some animals reproduce by giving birth to their young ones like all mammals for example Human beings.

#### **Difference between Living and Non-living things:**

| Living Things |  | Non-living Things |   |
|---------------|--|-------------------|---|
| 1.            | Living things have ability to grow                                       | 1.                | Non-living things do not grow   |
| 2.            | Living things can move on their own                                      | 2.                | Non-living things cannot move on their own  |
| 3.            | Living things have the ability to reproduce                              | 3.                | Non-living things do not have the ability to reproduce                              |
| 4.            | Living things have the ability to excrete waste material from their body | 4.                | Non-living things do not have the ability to excrete waste material from their body |
| 5.            | Living things respond to stimuli   | 5.                | Non-living things do not respond to stimuli   |

#### **Habitat**

Habitat is place where an organisms lives. A habitat must provide to the organism:

- i) Food
- ii) Shelter
- iii) Favourable climatic conditions to survive, breed and flourish

#### **Types of Habitat**

Three main habitats in biosphere are:

a) Terrestrial habitat or Land habitat: Forest, grasslands, desert and mountain

b) Aquatic habitat or Water habitat: River, pond, lake, sea

c) Aerial or Arboreal habitat (Air or Tree): Tropical forests

**a) Terrestrial Habitat:** The organisms that live, grow and propagate on land are called terrestrial organisms and their habitat is called terrestrial habitat. e.g., grassland, deserts, etc.

Man, Tiger, Tree etc. are Terrestrial organisms.

**b) Aquatic Habitat:** The organisms that live and breed in water are called as aquatic organisms and their habitat is called aquatic habitat. River, oceans, lakes are aquatic habitats.

Whales, Fishes etc. are aquatic organisms.

**Note:** The organisms which use both water and land as their habitat are known as amphibian organisms

i.e., Frog, Crocodile, Bryophyte (Amphibian of plant kingdom) etc.

**c) Arboreal habitat:** Organisms that use trees for their activities are known as arboreal organisms and their habitat is called arboreal habitat. Birds, such as eagle, pigeon, parrots etc. are arboreal organisms.

### Microhabitat

A small area within a habitat with special geographic or climatic conditions to suit organisms better than other is called microhabitat i.e., mountainous region is a microhabitat within the terrestrial habitat.

**Components of Habitat:** The two components of habitat are:

i) Biotic Component

ii) Abiotic Component

i) **Biotic Component:** Living things such as animals, plant, human beings and microorganisms are called biotic components. Biotic components are also called living components.

ii) **Abiotic Component:** All non living things such as soil, water bodies, atmosphere and meteorological factor such as sun light, temperature, rainfall, wind speed etc. are called abiotic components. Abiotic components are also called non-living components.

**Adaptation in Animals and Plants to Different Habitat**

The tendency of an organisms to develop certain specific features which improve the chances of its survival in the environment in which it lives is known as adaptation.

Examples: Camel and Desert rat are adapted to the desert habitat.

Adaptation is of two types:

**i) Permanent Adaptation:** Such adaptations are based on genetic basis and cause permanent changes in the individuals, e.g. Camel is well adapted to desert environment and not to aquatic environment.

Fish is well adapted to live in water.

**ii) Temporary Adaptation:** It is a short term adaptation, and is not inherited e.g., RBCs increase in blood while moving to high altitudes.

**Different Habitats**

**i) Terrestrial Habitat:** The plants and animals that live on land are said to live in terrestrial habitat. e.g.

Grassland, Forests, deserts, mountains etc.

**Adaptation in Desert Habitat:** The climate of deserts is dry and hot. Desert have very little vegetation.

They provide little shelter for large animals from the sun.

ii) Most animals which survive in deserts are insects, birds, reptiles, and smaller mammals.

iii) Many animals living in deserts remain inactive during the day and become active during the night. This prevents loss of water from their body.

**REVISION EXERCISE**

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1. The surrounding where organisms live is called a\_\_\_\_\_.  
(a) Habitat                      (b) Habit                      (c) Dwellings                      (d) Adaptation
2. In the sea, plants and animals are surrounded by:  
(a) Fresh water              (b) Saline water              (c) Acidic water              (d) Marshy water
3. The habitat of plants and animals that live on land is called:  
(a) Aquatic                      (b) Terrestrial                      (c) Mountain                      (d) Grassland
4. Which of the following is an abiotic component?  
(a) Dog                      (b) Trees                      (c) Rocks                      (d) Bacteria
5. In cactus plants, the spines are modified\_\_\_\_\_.  
(a) Leaf                      (b) Root                      (c) Flower                      (d) Stem
6. Which part of the earth is very hot in day time and very cold in night?  
(a) Plains                      (b) Rainforest                      (c) Desert                      (d) Mountain
7. Based upon their habitat crocodiles are:  
(a) Rainforest animal                      (b) Aquatic animal  
(c) Terrestrial animal                      (d) Amphibian animal
8. Short term adaptation is also known as  
(a) Permanent adaptation                      (b) Temporary adaptation  
(c) Aquatic adaptation                      (d) Terrestrial adaptation
9. State True or False:  
(a) Non-living things respond to stimuli.  
(b) Living things have the ability to reproduce.  
(c) Organisms that use trees for their activities are known as terrestrial organisms.  
(d) All non-living things are abiotic component of habitat.  
(e) The climate of deserts is dry and wet.
10. Fill in the blank:  
(a) \_\_\_\_\_ are also called as living components.  
(b) \_\_\_\_\_ is also known as amphibian of plant kingdom.  
(c) Fishes are \_\_\_\_\_ organisms.  
(d) The biological process by which living organisms produce new members of their species is called as\_\_\_\_\_.

**LEVEL - II**

1. The presence of specific features or certain habits, which enable a plant or an animal to live in its surroundings, is called\_\_\_\_\_.  
(a) Habitat                      (b) Adaptation                      (c) Terrestrial                      (d) Aquatic
2. Fishes have scales on their body. This helps them to \_\_\_\_\_.  
(a) Remain in the same place in water                      (b) Balance themselves in water  
(c) Change directions in water                      (d) Swim in water
3. The mountain goat has strong hooves :  
(a) For attacking other animals                      (b) For protecting it from cold  
(c) For running up the rocky slopes                      (d) For scratching its back
4. Lions have eyes in front because :  
(a) It can see the colour of the object correctly  
(b) It should look in front only  
(c) It can locate its prey exactly  
(d) It knows the presence of its prey
5. Suppose you accidentally sit on a drawing pin. You would jump up quickly. The pricking of the pin is called the \_\_\_\_\_.  
(a) Response                      (b) Paining reaction  
(c) Quick reaction                      (d) Stimulus
6. Living beings are characterized by all except \_\_\_\_\_.  
(a) Reproduction                      (b) Locomotion  
(c) Respiration                      (d) Getting crystallized
7. Two different animals have the following characteristics in common.  
(i) They are aquatic animals.  
(ii) They give birth to their young ones and suckle them.  
(iii) They have blow holes and breathe through lungs.  
The animals are likely to be:  
(a) A turtle and a frog                      (b) A sword fish and a shark  
(c) A dolphin and a whale                      (d) A turtle and a penguin
8. The process in which an individual organisms adjust to a change in its environment:  
(a) Adaptation                      (b) Adoption                      (c) Acclimatization                      (d) Habitat
9. Breathing activity is a part of which of the following bio-chemical process?

- (a) Photosynthesis (b) Respiration  
(c) Digestion (d) Excretion
10. Which of these matched pairs are correct?
- A. *Mimosa Pudica* (i) Tropical forests  
B. Arboreal Habitat (ii) Amphians of plant kingdom  
C. Bryophytes (iii) Touch-me-not  
D. Respiration (iv) Biochemical process
- (a) A-iii, B-i, C-ii, D-iv (b) A-ii, B-iii, C-i, D-iv  
(c) A-iv, B-ii, C-iii, D-i (d) A-iii, B-ii, C-i, D-iv

### **ADDITIONAL EXERCISE**

1. Which one of the following statements is correct?  
(A) Several kinds of plants and animals may share the same habitat.  
(B) All the animals and plants in a habitat are adopted to it.  
(C) Both the statements (A) and (B) are correct.  
(D) None of these is correct.
2. Animals and plants have certain features which make them to survive in a particular habitat. This is called  
(A) adaptation (B) speciation (C) specialisation (D) evolution
3. Which is a biotic component of environment?  
(A) Plants (B) Animals (C) Microorganisms (D) All of these
4. Which is not an abiotic component of environment?  
(A) Soil (B) Bacteria (C) Water (D) Air
5. Which is an example of an animal found in mountain region?  
(A) Leopard (B) Yak (C) Mountain goat (D) All of these
6. What is the characteristic of a desert plant?  
(A) No leaves or very small leaves (B) Spines  
(C) Deep roots (D) All of these
7. Respiration in aquatic animals occurs by  
(A) lungs (B) gills (C) nostrils (D) legs
8. Which is an aquatic adaptation?  
(A) Streamline body (B) Light and hollow bones  
(C) Hair on body (D) Gills
9. Bending of a stem towards sunlight is called  
(A) geotropism (B) phototropism (C) hydrotropism (D) nasticism
10. Sunken stomata are present in  
(A) hydrophytes (B) epiphytes (C) xerophytes (D) mesophytes