

FOUNDATION MATHEMATICS

SAMPLE CHAPTER



NUMBER SYSTEM

Chapter Out Line

- Introduction to Number System
- N,W,I Properties and Absolute Value
- Hindu Arabic & International System
- Roman Numerals
- Factors & Multiples
- LCM & HCF and Test of Divisibility (2, 3, 4, 5, 6, 8, 9, 10, 11)
- BODMAS Rule
- Fractions & Decimals
- Standard form of a Number
- Number of divisors and Product of Divisors



NUMBER SYSTEM

LECTURE - 1

Learning Objectives

When you have completed this lecture you should be able to :

- ◆ Get an idea about fractions
- ◆ Know about Like fractions and unlike fractions
- ◆ Know about Comparison of like fractions

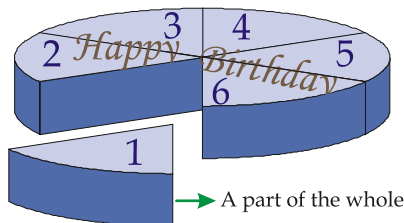


Introduction:

Tej is celebrating his birthday party at home with his family consisting of 5 persons. The birthday cake for the party is also ready.



He blew the candles and cut the cake into 6 pieces.



Each of the family members got a piece of cake which is '**a part of the whole**'.

In Mathematical terminology we say that each of the family members got a '**fraction**' of the cake.

Numerator and Denominator:

Let us consider the above illustrations once again.

One cake was divided into 6 equal parts. Therefore each of the equal parts is denoted as $\frac{1}{6}$.

Likewise for the illustration 2 one card-board was divided into two equal parts.

Therefore each equal part is denoted as $\frac{1}{2}$.

Here in the representation of each of the fractions we see two numbers. One above and the other below. Let us now learn their names. Let us consider a fraction $\frac{3}{5}$.

In the fraction $\frac{3}{5}$, 3 is called the numerator and 5 is called the denominator.

$$\begin{array}{l} \frac{3}{5} \rightarrow \text{Numerator} \\ \quad \quad \quad \rightarrow \text{Denominator} \end{array}$$

Types of fractions:

i) **Proper Fraction** : A Fraction in which numerator is less than the denominator is called a Proper fraction

Eg: $\frac{1}{2}, \frac{3}{4}, \frac{7}{9}$

ii) **Improper Fraction** : A Fraction in which numerator is greater than the denominator is called an Improper fraction.

Eg: $\frac{5}{2}, \frac{9}{4}, \frac{10}{10}$

iii) **Mixed Fraction (Compound Fraction)** : The combination of a whole number with a proper fraction is called Mixed fraction.

Eg: $1\frac{1}{2}, 7\frac{3}{4}$

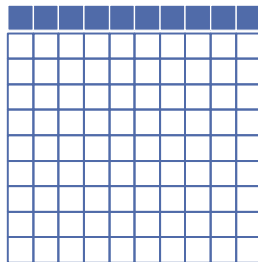
Equivalent Fractions:

Fractions that represent the same part are called equivalent Fractions.

Eg :- $\frac{1}{4}$ and $\frac{2}{8}$; $\frac{1}{3}$ and $\frac{4}{12}$; $\frac{6}{10}$ and $\frac{3}{5}$; $\frac{10}{100}$ and $\frac{1}{10}$

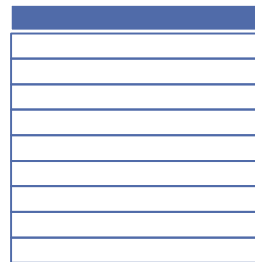
Illustration:

Consider the fractions $\frac{10}{100}$ and $\frac{1}{10}$. Also look at the figures, same area is shaded.



The square has been divided into 100 equal parts and 10 parts are

$$\text{shaded} = \frac{10}{100} = \frac{1}{10}$$



The square is divided into 10 equal parts and 1 part is shaded

$$\text{That is } \frac{1}{10}$$

We say $\frac{10}{100}$ and $\frac{1}{10}$ are equivalent fractions. Likewise quarter and two-eighths are equivalent fractions.

Like Fractions:

Fractions that have the same denominators are called like fractions.

Eg: i) $\frac{4}{5}$ and $\frac{2}{5}$ are like Fractions, they have the same denominator 5.

ii) $\frac{2}{7}, \frac{3}{7}, \frac{5}{7}$ are like Fractions, they have the same denominator 7.

Unlike Fractions : Fractions that have different denominators are called unlike Fractions.

Eg: $\frac{1}{4}$ and $\frac{2}{3}$ are Unlike Fractions;

Unit Fractions : Fractions which have one as numerator are called as unit fractions.

Eg: $\frac{1}{4}, \frac{1}{13}$ etc.

Operations of Fractions :

i) Addition of Fractions:

To add two like fractions, add their numerators and write the sum over the same denominator.

Eg:- $\frac{2}{9} + \frac{5}{9} = \frac{2+5}{9} = \frac{7}{9}$, $\frac{3}{4} + \frac{1}{4} = \frac{3+1}{4} = \frac{4}{4} = 1$

Note: To add unlike fractions: Convert the given fractions into like fractions and add them.

ii) Subtraction of Fractions:

To subtract two like fractions, subtract the numerators and write the difference over the same denominator.

Eg: i) $\frac{5}{8} - \frac{3}{8} = \frac{5-3}{8} = \frac{2}{8}$ or $\frac{1}{4}$ ii) $\frac{7}{9} - \frac{3}{9} = \frac{7-3}{9} = \frac{4}{9}$

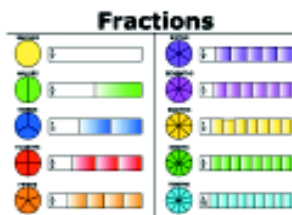
Note: To subtract unlike fractions: Convert the given fractions into like fractions and subtract them.

Comparing like Fractions:

To Compare like fractions, compare the numerators. The fraction with the greatest numerator is the greater fraction.

Eg: $\frac{3}{4} > \frac{1}{4}$ $\frac{7}{8} > \frac{5}{8}$

Note: We can compare unlike fractions by changing the given fractions into like fractions.



Rational numbers

Definition : A number which can be expressed in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$ is called a rational number.

Ex: $0, 1, \frac{3}{4}, -\frac{5}{6}$

Note: All natural numbers, whole numbers and Integers are rational numbers.

Ex. 3, -2, -1, 0, 1, 2, 3,

Note: All fractions are rational numbers, but every rational number need not be fraction.

Ex: $\frac{1}{2}, \frac{3}{4}, \frac{1}{6}, \dots$ are fractions as well as rational numbers.

Ex: 2, 3, $\frac{-5}{2}$ are rational numbers but not fractions.

Difference between Fraction and Rational number:

Fraction	Rational Numbers
A number of the form $\frac{p}{q}$ where p and q are whole numbers and $q \neq 0$ is called fraction	A number of the form $\frac{p}{q}$ where p and q are Integers and $q \neq 0$ is called a rational numbers

Positive Rational Numbers :

If $\frac{p}{q}$ is a rational number and $\frac{p}{q} > 0$, then $\frac{p}{q}$ is called a positive rational number.

(OR)

A rational number is said to be positive if its numerator and denominator are either both positive or both negative.

Ex: 1) Set of positive integers 2) Set of Natural numbers
3) Set of Non - zero whole numbers 4) Set of Fractions.

Negative Rational Numbers

If $\frac{p}{q}$ is a rational number and $\frac{p}{q} < 0$, then $\frac{p}{q}$ is called a negative rational number.

(OR)

A rational number is said to be negative if its either the numerator or denominator is negative.

Ex: 1) Set of negative integers 2) Set of negative of the Fractions.

Equivalent Rational Numbers:

The equality of two rational numbers can be checked by any one of the following ways.

1) If the numerator and denominator of a given rational number are multiplied (or divided) by the same non - zero integer, then the new rational number thus formed is said to be equivalent to the given rational number.

i.e., Rational numbers $\frac{p}{q}$ and $\frac{r}{s}$ are equivalent to each other if

$$\frac{p \times k}{q \times k} = \frac{r}{s} \text{ or } \frac{p \div k}{q \div k} = \frac{r}{s} \text{ [k is non - zero integer]}$$

Ex: $\frac{48}{52} = \frac{12}{13}$ and $\frac{12 \times 4}{13 \times 4} = \frac{48}{52}$

- 2) If the product of the numerator of the 1st rational number and the denominator of the 2nd rational number is equal to the product of the numerator of the 2nd rational number and the denominator of the 1st rational number then they are known as equivalent rational numbers.

i.e., Rational numbers $\frac{p}{q}$ and $\frac{r}{s}$ are said to be equivalent to each other if $p \times s = r \times q$

Ex: $\frac{2}{3}$ and $\frac{6}{9}$ are equivalent to each other because $2 \times 9 = 6 \times 3$

Properties of Rational Numbers:

- 1) If $\frac{p}{q}$ is a rational number and k is a non - zero integer, then $\frac{p}{q} = \frac{p \times k}{q \times k}$

Ex: $\frac{-3}{5} = \frac{-3 \times 4}{5 \times 4} = \frac{-12}{20}$

- 2) If $\frac{p}{q}$ is a rational number and k is a non - zero integer and a common factor of p and q , then

$$\frac{p}{q} = \frac{p \div k}{q \div k}$$

Ex: $\frac{18}{15} = \frac{18 \div 3}{15 \div 3} = \frac{6}{5}$

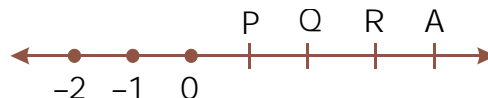
- 3) If $\frac{p}{q}$ and $\frac{r}{s}$ are two equivalent rational numbers then $p \times s = r \times q$.

Ex: $\frac{3}{4} = \frac{15}{20}$ are equivalent rational numbers $3 \times 20 = 15 \times 4 \Rightarrow 60 = 60$

Representation of Rational Numbers on the Number Line:

To represent $\frac{3}{4}$ on the number line first we draw a number line .

Let O represent 0(zero) and A represent 1. So divide OA into 4 equal periods label each point as P,Q and R. Point R represents $\frac{3}{4}$





Conceptual Practice Sheet



Single Response Type:

- Fractions whose denominators are 10, 100, 1000 etc are called
A) Vulgar fractions B) Improper fractions C) Proper fractions D) Decimal fractions
- An equivalent fraction for $\frac{4}{12}$ is
A) $\frac{2}{6}$ B) $\frac{3}{8}$ C) $\frac{3}{4}$ D) $\frac{2}{3}$
- $\frac{6}{25}$ and $\frac{7}{25}$ are examples of
A) Unlike fractions B) Like fractions
C) Irreducible fractions D) Both B and C
- If the numerator of a fraction is less than its denominator, then the fraction is
A) Proper fraction B) Improper fraction C) Vulgar fraction D) Decimal fraction
- The fraction $\frac{3}{8}$ is an example of
A) Vulgar fraction B) Decimal fraction C) Irreducible form D) Both A and C



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

- Write 500m as fraction of a kilometer
A) $\frac{1}{3}$ B) $\frac{1}{2}$ C) $\frac{1}{4}$ D) $\frac{1}{5}$
- State which of the following are true
A) $\frac{5}{8} = \frac{25}{40}$ B) $\frac{6}{7} = \frac{12}{27}$ C) $\frac{-2}{7} = \frac{4}{14}$ D) $\frac{-8}{7} = \frac{-72}{56}$
- If a student scored 15 marks in a mathematics test for 25 marks, then the fraction of marks secured is
A) $\frac{5}{12}$ B) $\frac{1}{3}$ C) $\frac{3}{8}$ D) $\frac{3}{5}$
- Which of the following is true.
A) Every fraction is a rational number
B) All integers are rational numbers
C) Quotient of two integers is always a rational number where the denominator is a non-Zero in tager
D) All of the these

5. Express $-5/19$ as a rational number with numerator as -30

A) $\frac{-30}{38}$

B) $\frac{-30}{57}$

C) $\frac{-30}{114}$

D) $\frac{-30}{76}$

LEVEL - II

6. The fraction equal to $\frac{2 \times m + 3}{19}$, for $m = 9$ is

A) $2\frac{1}{19}$

B) $1\frac{2}{19}$

C) $1\frac{3}{19}$

D) $2\frac{3}{19}$

7. Express $\frac{-40}{56}$ as a rational number with numerator = -5

A) $\frac{-5}{8}$

B) $\frac{-5}{7}$

C) $\frac{-5}{18}$

D) $\frac{-5}{6}$

8. Express $\frac{84}{-147}$ as a rational number with denominator = -7

A) $\frac{4}{-7}$

B) $\frac{12}{-21}$

C) $\frac{14}{-7}$

D) $\frac{3}{-7}$

9. 10 paise as fraction of Rs. 1 is

A) $\frac{1}{5}$

B) $\frac{2}{5}$

C) $\frac{3}{10}$

D) $\frac{1}{10}$

10. If 72 ares is expressed as a fraction of 24 hectares then the fraction is

A) $3/10$

B) $3/100$

C) $3/1000$

D) $3/10000$

LEVEL - III

11. If $\frac{3 \times x}{2 \times y} = \frac{48}{72}$, then $\frac{x}{y}$ in its lowest terms is

A) $3/9$

B) $2/9$

C) $4/9$

D) $5/9$

12. The smallest fraction among the following is

A) $\frac{5}{12}$

B) $\frac{7}{12}$

C) $\frac{8}{12}$

D) $\frac{11}{12}$

13. A person's monthly salary is Rs 19,200. If he spends Rs 2,500 on rent, Rs.3,800 on food, Rs.4,000 on travelling and Rs4,100 on medicines, then the fraction of savings is

A) $1/3$

B) $2/3$

C) $1/4$

D) $1/5$

14. If 3rd multiple of 4 is divided by 8th multiple of 2, then its equivalent fraction is

A) $72/96$

B) $72/48$

C) $72/120$

D) $72/36$

15. Equivalent fraction of $\frac{36}{45}$ with numerator 12 is

A) $\frac{12}{45}$

B) $\frac{12}{36}$

C) $\frac{12}{144}$

D) $\frac{12}{15}$



IIT - JEE Advanced Practice Sheet



Reasoning Type:

1. Statement I : $\frac{347}{-79}$ is a rational number

Statement II: Rational numbers are in the form of $\frac{a}{b}$, where a, b are integers and $b \neq 0$

- A) Both Statements are true, Statement II is the correct explanation of Statement I.
 B) Both Statements are true, Statement II is not correct explanation of Statement I.
 C) Statement I is true, Statement II is false.
 D) Statement I is false, Statement II is true.

Comprehension Type:

1. $\frac{5}{10}, \frac{m-2}{30}$ are two fractions

2. If $\frac{5}{10} = \frac{m-2}{30}$, then the value of m is

- A) 15 B) 17 C) 20 D) 7

3. The mixed fraction of $\frac{2 \times m + 3}{19}$ is

- A) $1\frac{17}{19}$ B) $1\frac{16}{14}$ C) $1\frac{18}{14}$ D) $1\frac{18}{19}$

4. If $\frac{m-10}{21}$ is simplified, then the proper fraction is

- A) $\frac{1}{3}$ B) $\frac{1}{7}$ C) $\frac{1}{5}$ D) $\frac{1}{4}$

Multi Correct Choice Type:

5. Which of the following rational number is positive, if p, q, $m \in \mathbb{Q}^+$

- A) $\frac{p \times m}{q \times m}$ B) $\frac{p+m}{q+m}$ C) $\frac{p-m}{q-m}$ D) $\frac{p \div m}{q \div m}$

6. Which of the following fractions are less than $\frac{5}{9}$?

- A) $\frac{11}{18}$ B) $\frac{13}{24}$ C) $\frac{17}{36}$ D) $\frac{5}{8}$

Matrix Match Type:

- | 7. Column-I | Column-II |
|---|-------------------|
| a) $\frac{3 \times 17}{17 \times 7} =$ | p) $\frac{7}{17}$ |
| b) $\frac{(-17) \times 19}{(-17) \times 3} =$ | q) $\frac{3}{7}$ |
| c) $\frac{19 \times 7}{17 \times 19}$ | r) $\frac{7}{3}$ |
| d) $\frac{(-17) \times 19}{(-19) \times 7}$ | s) $\frac{19}{3}$ |
| | t) $17/7$ |

Integer Answer Type:

8. $\frac{9 \times 18 \times 14 \times R}{3 \times 5 \times 6 \times (-7)} = \frac{(-18) \times 6 \times 3 \times 21}{7(-15) \times 2 \times 3}$ then R = _____

Subjective Type :

9. Of the 10 books on fairy tales, Gilly borrowed 3. What fraction of the books on fairy tales did she borrow?
10. Luke saw 9 books about the Solar System and its 9 planets. These were thick books and so he thought that 2 of these would be enough. What fraction of the solar system books did he borrow?

**NUMBER SYSTEM****LECTURE - 2***Learning Objectives*

When you have completed this lecture you should be able to :

- ◆ Know about Comparison of fractions
- ◆ Know about fraction lying between two given fractions
- ◆ Know about ascending and descending order of fractions

**Comparison of Rational Number:**

Let us understand two cases in comparison of Rational numbers. For that process, let us keep the following points in mind.

- 1) A positive rational number is always greater than a negative rational number
- 2) Zero is greater than each one of the negative rational numbers and less than each one of the positive rational numbers.
- 3) Rational Numbers can be divided into two types.
 - i) Rational Numbers having the same denominator.
 - ii) Rational Numbers having the different denominators.

Comparison of Rational Numbers when the denominators are equal:

If the denominators of two given rational numbers are equal then by comparing the numerators we can compare those rational numbers.

Ex: $\frac{-5}{7}$ and $\frac{-2}{7}$

Here, denominators are 7, 7 which are equal and numerators are -5, -2.

Since denominators are equal, let us compare the numerators. We know that $-5 < -2$.

Hence $\frac{-5}{7} < \frac{-2}{7}$

Comparison of Rational Numbers when the denominators are not equal :

If the denominators of two rational numbers are not equal, then we should change them into fractions having the same denominators.

We can achieve in two steps

Step – 1: Multiplying numerator and denominator of first rational number by the denominator of second rational number and

Step – 2: Multiplying numerator and denominator of second rational number by the denominator of first rational number.

Step – 3: Once the fractions have equal denominators, compare their numerators.

Ex: $\frac{3}{5}$ and $\frac{4}{7}$

Here, denominators are 5, 7 which are not equal and numerators are 3, 4. Since denominators are not equal, we have to change the given fractions into fractions having the same

denominators. $\frac{3 \times 7}{5 \times 7} = \frac{21}{35}$ and $\frac{4 \times 5}{7 \times 5} = \frac{20}{35}$

Now denominators of $\frac{21}{35}$ and $\frac{20}{35}$ are equal and $21 > 20$ $\therefore \frac{21}{35} > \frac{20}{35}$ i.e., $\frac{3}{5} > \frac{4}{7}$

Comparison of fractions

A) Method for Comparing two fractions only

The fractions $\frac{a}{b}$ and $\frac{c}{d}$ are compared as follows:

(i) $\frac{a}{b} > \frac{c}{d}$ if $ad > bc$ (ii) $\frac{a}{b} < \frac{c}{d}$ if $ad < bc$ (iii) $\frac{a}{b} = \frac{c}{d}$ if $ad = bc$.

Ex: Compare the following fractions in pairs:

(i) $\frac{4}{5}, \frac{7}{11}$

(ii) $\frac{9}{10}, \frac{10}{11}$

(iii) $\frac{2}{3}, \frac{10}{15}$

Sol. (i) Here, $\frac{4}{5} > \frac{7}{11}$ because $\frac{4 \times 11}{44} > \frac{5 \times 7}{35}$

(ii) Here, $\frac{9}{10} < \frac{10}{11}$ because $\frac{9 \times 11}{99} < \frac{10 \times 10}{100}$

(iii) Here, $\frac{2}{3} = \frac{10}{15}$ because $\frac{2 \times 15}{30} = \frac{3 \times 10}{30}$

By taking the L.C.M:

Taking the L.C.M of the denominator of the given fraction.

Convert each of the fraction into an equivalent fraction with denominator equal to the L.C.M. Compare their numerators . The higher the value of the numerator, the greater is the fraction

Ex: Arrange $\frac{2}{3}, \frac{3}{4}, \frac{5}{12}, \frac{9}{16}$ in ascending order.

Sol. Here, the LCM of 3, 4, 12 and 16 is 48.

$$\frac{2}{3} = \frac{2 \times 16}{3 \times 16} = \frac{32}{48} \Rightarrow \frac{3}{4} = \frac{3 \times 12}{4 \times 12} = \frac{36}{48} \Rightarrow \frac{5}{12} = \frac{5 \times 4}{12 \times 4} = \frac{20}{48} \Rightarrow \frac{9}{16} = \frac{9 \times 3}{16 \times 3} = \frac{27}{48}$$

Clearly, $\frac{20}{48} < \frac{27}{48} < \frac{32}{48} < \frac{36}{48}$

∴ The fractions in ascending order are $\frac{5}{12}, \frac{9}{16}, \frac{2}{3}, \frac{3}{4}$.

Fraction lying between two given fractions

If $\frac{a}{b}$ and $\frac{c}{d}$ are two given fractions and $\frac{a}{b} < \frac{c}{d}$, then the fraction $\frac{a+c}{b+d}$ lies between $\frac{a}{b}$ and

$\frac{c}{d}$. Thus, $\frac{a}{b} < \frac{a+c}{b+d} < \frac{c}{d}$.

Ex: Insert a fraction between $\frac{14}{23}$ and $\frac{33}{41}$

Sol. A fraction between $\frac{14}{23}$ and $\frac{33}{41}$ is $\frac{14+33}{23+41} = \frac{47}{64}$.

Thus, $\frac{14}{23} < \frac{47}{64} < \frac{33}{41}$.

NUMBER SYSTEM**PRACTICE SHEET -2****Conceptual Practice Sheet****Single Response Type:**

1. Compare $\frac{2}{3}$ and $\frac{3}{4}$ is

A) $\frac{2}{3} < \frac{3}{4}$

B) $\frac{2}{3} > \frac{3}{4}$

C) $\frac{2}{3} = \frac{3}{4}$

D) Both A & C

2. Descending order of $\frac{2}{5}, \frac{1}{3}$ and $\frac{3}{7}$ is

A) $\frac{2}{5}, \frac{1}{3}, \frac{3}{7}$

B) $\frac{1}{3}, \frac{2}{5}, \frac{3}{7}$

C) $\frac{3}{7}, \frac{2}{5}, \frac{1}{3}$

D) $\frac{3}{7}, \frac{1}{3}, \frac{2}{5}$

3. Which of the following is correct?
 A) $\frac{2}{5} > \frac{3}{7}$ B) $\frac{4}{7} < \frac{5}{6}$ C) $\frac{7}{12} > \frac{9}{14}$ D) $\frac{1}{2} < \frac{2}{5}$
4. Two fractions between $\frac{1}{2}$ and $\frac{3}{4}$ are
 A) $\frac{3}{5}, \frac{4}{3}$ B) $\frac{2}{3}, \frac{3}{5}$ C) $\frac{1}{3}, \frac{2}{3}$ D) $\frac{1}{5}, \frac{3}{5}$
5. $\frac{-8}{9} \circ \frac{-5}{9}$ (Fill in the circle)
 A) $>$ B) $<$ C) $=$ D) None of these



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

1. Compare $\frac{9}{15}$ and $\frac{11}{6}$
 A) $\frac{9}{15} > \frac{11}{6}$ B) $\frac{9}{15} < \frac{11}{6}$ C) $\frac{9}{15} = \frac{11}{6}$ D) None
2. Compare $\frac{3}{-14}$ and $\frac{5}{21}$
 A) $\frac{3}{-14} < \frac{5}{21}$ B) $\frac{3}{-14} > \frac{5}{21}$ C) $\frac{3}{-14} = \frac{5}{21}$ D) Both 1 & 3
3. $-\frac{1}{2} \square -\frac{3}{5}$ which of the symbols '=', '<' or '>' should replace the blank box?
 A) = B) < C) > D) Both 1 & 2
4. One fraction between $\frac{2}{3}$ and $\frac{3}{4}$ is
 A) $\frac{2}{7}$ B) $\frac{5}{6}$ C) $\frac{5}{7}$ D) $\frac{1}{7}$
5. Arrange in descending order $\frac{-9}{6}, \frac{-4}{3}, \frac{-17}{12}$
 A) $\frac{-4}{3}, \frac{-17}{12}, \frac{-9}{6}$ B) $\frac{-17}{12}, \frac{-9}{6}, \frac{-4}{3}$ C) $\frac{-9}{6}, \frac{-17}{12}, \frac{-4}{3}$ D) $\frac{-4}{3}, \frac{-9}{6}, \frac{-17}{12}$

LEVEL - II

6. The ascending order of $\frac{3}{2}, \frac{5}{2}, \frac{9}{2}$ is
 A) $\frac{3}{2} < \frac{5}{2} < \frac{9}{2}$ B) $\frac{5}{2} < \frac{9}{2} < \frac{3}{2}$ C) $\frac{9}{2} < \frac{3}{2} < \frac{5}{2}$ D) $\frac{7}{2} < \frac{3}{2} < \frac{5}{2}$

7. A fraction that is greater than $\frac{1}{3}$ and less than $\frac{1}{2}$ is
- A) $\frac{1}{4}$ B) $\frac{2}{3}$ C) $\frac{2}{5}$ D) $\frac{3}{5}$
8. Replace $\left(\frac{3}{15}\right)$ with $\left(\frac{-3}{5}\right)$
- A) $\frac{6}{5}, \frac{-7}{10}, \frac{3}{-5}, \frac{12}{7}$ B) $\frac{12}{7}, \frac{6}{5}, \frac{3}{-5}, \frac{-7}{10}$ C) $\frac{12}{7}, \frac{6}{5}, \frac{-7}{10}, \frac{3}{-5}$ D) $\frac{-7}{10}, \frac{3}{-5}, \frac{6}{5}, \frac{12}{7}$
9. If $\frac{3}{7}$ of a number is 27, then the number is
- A) 60 B) 61 C) 62 D) 63
10. If $\frac{2}{3}, \frac{3}{4}, \frac{1}{3}, \frac{5}{6}$ are rational numbers, then their ascending order is
- A) $\frac{1}{3}, \frac{3}{4}, \frac{2}{3}, \frac{5}{6}$ B) $\frac{1}{3}, \frac{2}{3}, \frac{3}{4}, \frac{5}{6}$ C) $\frac{1}{3}, \frac{3}{4}, \frac{2}{3}, \frac{5}{7}$ D) $\frac{1}{3}, \frac{5}{6}, \frac{3}{4}, \frac{2}{3}$

LEVEL - III

11. Arrange $\frac{3}{-5}, \frac{-7}{10}, \frac{8}{-10}, \frac{-17}{15}$ in ascending order
- A) $\frac{-17}{15}, \frac{8}{-10}, \frac{-7}{10}, \frac{3}{-5}$ B) $\frac{-7}{10}, \frac{3}{-5}, \frac{8}{-10}, \frac{-17}{15}$ C) $\frac{-17}{15}, \frac{3}{-5}, \frac{-7}{10}, \frac{8}{-10}$ D) $\frac{8}{-10}, \frac{-7}{10}, \frac{3}{-5}, \frac{-17}{15}$
12. Which of the following is correct ?
- A) $\frac{3}{5} > \frac{5}{7}$ B) $\frac{2}{9} < \frac{5}{15}$ C) $\frac{16}{11} < \frac{9}{15}$ D) $\frac{8}{9} > \frac{10}{3}$
13. Compare $\frac{-11}{1111}$ and $\frac{1}{-103}$
- A) $\frac{-11}{1111} > \frac{1}{-103}$ B) $\frac{-11}{1111} < \frac{1}{-103}$ C) $\frac{-11}{1111} = \frac{1}{-103}$ D) None
14. Compare $\frac{85}{105}$ and $\frac{90}{108}$
- A) $\frac{85}{105} = \frac{90}{108}$ B) $\frac{85}{105} > \frac{90}{108}$ C) $\frac{85}{105} < \frac{90}{108}$ D) Both 1 & 2
15. Arrange the fractions $\frac{5}{8}, \frac{7}{12}, \frac{13}{16}, \frac{16}{29}$ and $\frac{3}{4}$ in ascending order of magnitude
- A) $\frac{3}{4} < \frac{16}{29} < \frac{7}{12} < \frac{5}{8} < \frac{13}{16}$ B) $\frac{5}{8} < \frac{16}{29} < \frac{7}{12} < \frac{3}{4} < \frac{13}{16}$ C) $\frac{7}{12} < \frac{16}{29} < \frac{5}{8} < \frac{13}{16} < \frac{3}{4}$ D) $\frac{16}{29} < \frac{7}{12} < \frac{5}{8} < \frac{3}{4} < \frac{13}{16}$



IIT - JEE Advanced Practice Sheet



Reasoning Type:

1. Statement I : $\frac{-5}{7} > \frac{-6}{7}$

Statement II : In two rational numbers, if the denominators are same, then the rational number which is having greatest number in numerator is greater.

A) Both Statements are true, Statement II is the correct explanation of Statement I.

B) Both Statements are true, Statement II is not correct explanation of Statement I.

C) Statement I is true, Statement II is false. D) Statement I is false, Statement II is true.

Comprehension Type:

If $P = \frac{5}{6}$; $Q = \frac{1}{6}$; $R = \frac{7}{6}$ and $S = \frac{3}{6}$ then

2. Greatest rational number is

A) P B) Q C) R D) S

3. Smallest rational number is

A) P B) Q C) R D) S

4. Descending order for P, Q, R and S is

A) R, P, Q, S B) P, R, Q, S C) P, S, Q, R D) R, P, S, Q

Multi Correct Choice Type:

5. Which of the following fractions are less than $\frac{5}{9}$ is

A) $\frac{11}{18}$ B) $\frac{13}{24}$ C) $\frac{17}{36}$ D) $\frac{5}{8}$

6. Which of the following sum are not in simplest form?

A) $\frac{4}{9} + \frac{-5}{9}$ B) $\frac{-5}{12} + \frac{11}{-12}$ C) $\frac{-2}{5} + \frac{13}{20}$ D) $\frac{-7}{8} + \frac{1}{12} + \frac{2}{3}$

Matrix Match Type:

7. **Column-I**

a) $\frac{-1}{14}, \frac{-3}{28}, \frac{-5}{28}$

b) $\frac{1}{3}, \frac{2}{5}, \frac{1}{2}$

c) $\frac{5}{6}, \frac{3}{4}, \frac{1}{2}$

d) $\frac{2}{3}, \frac{3}{5}, \frac{5}{9}$

Column-II

p) Are in ascending order

q) Are in descending order

r) Are compared by > sign

s) Are compared by < sign

t) Can not be compared

Integer Answer Type:

8. The greater rational number among 0 and $\frac{-7}{9}$ is _____

Subjective Type :

9. If we write $\frac{7}{20}$ as a fraction whose numerator is 21 and its denominator is $53 + x$, then $x =$.
10. Compare $\frac{3}{-14}$ and $-\frac{5}{21}$

**NUMBER SYSTEM****LECTURE - 3***Learning Objectives*

When you have completed this lecture you should be able to :

- ◆ Get an idea of Addition of Rational numbers
- ◆ Get an idea of Subtraction of Rational numbers
- ◆ Get an idea of Properties of Rational numbers

**Operations on rational numbers:****Addition of rational numbers:**

In order to add two rational numbers.

- i) First express each rational number with positive denominator.
- ii) If the denominators of both the rational numbers are the same, then add their numerators and divide by the common denominator.
- iii) If the denominators of both the rational numbers are different, then we express them of equivalent rational numbers with the same denominator then add them

Addition: While adding like terms, add the numerators and retain the common denominator.

In, general $\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$

Ex: Add $\frac{3}{5} + \frac{4}{5} = \frac{3+4}{5} = \frac{7}{5}$

Ex: 1) Add $\frac{-3}{7}$ and $\frac{2}{7}$ **Sol:** $\frac{-3}{7} + \frac{2}{7} = \frac{-3+2}{7} = \frac{-1}{7}$

Ex: 2) Add $\frac{4}{-11}$ and $\frac{7}{11}$ **Sol:** $\frac{4}{-11} + \frac{7}{11} = \frac{-4}{11} + \frac{7}{11} = \frac{-4+7}{11} = \frac{3}{11}$

Ex: 3) Find the sum of the rational numbers $\frac{-4}{9}$, $\frac{15}{12}$ and $\frac{-7}{18}$

Sol: $\frac{-4}{9} + \frac{15}{12} + \frac{-7}{18} = \frac{-16+45-14}{36} = \frac{15}{36} = \frac{5}{12}$

Negative of a Rational Numbers:

Negative or additive inverse of a rational number is a rational number which when added to the given rational number gives '0'

If $\frac{p}{q}$ and $\frac{r}{s}$ are two rational numbers and $\frac{p}{q} + \frac{r}{s} = 0$, then $\frac{p}{q}$ is called the additive inverse or negative of $\frac{r}{s}$ and vice - versa.

Ex: Additive inverse of $\frac{3}{4}$ is $\frac{-3}{4}$ and $\frac{-3}{4}$ is $\frac{3}{4}$

Subtraction of Rational Numbers: Subtraction is the inverse process of addition. If $\frac{p}{q}$ and $\frac{r}{s}$

be two rational numbers it follows $\frac{r}{s} - \frac{p}{q} = \frac{r}{s} + \left(-\frac{p}{q}\right)$

Ex: 1) Subtract $\frac{-2}{7}$ from $\frac{3}{4}$ **Sol:** $\frac{3}{4} - \left(\frac{-2}{7}\right) = \frac{3}{4} + \frac{2}{7} = \frac{29}{28}$

Ex: 2) Simplify $\frac{3}{8} - \frac{-2}{9} + \frac{-1}{36}$ **Sol:** $\frac{3}{8} - \left(\frac{-2}{9}\right) + \left(\frac{-1}{36}\right) = \frac{27 - (-16) + (-2)}{72} = \frac{41}{72}$

Properties of Rational numbers:**1. Closure property :**

Observe the following :

$$(1) \frac{2}{3} + \frac{3}{4} = \frac{8+9}{12} = \frac{17}{12}$$

$$(2) \frac{-2}{3} + \frac{3}{4} = \frac{-8+9}{12} = \frac{1}{12}$$

We observe that the sum of two rational numbers is always a rational number. In such a case we say that rational numbers are closed under addition. Hence, we say

For any two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, $\left(\frac{a}{b} + \frac{c}{d}\right)$ is also rational number.

This property is called closure property for rational number over addition.

2. Commutative Property:

Observe the following :

$$(1) \quad (i) \frac{2}{3} + \frac{3}{4} = \frac{8+9}{12} = \frac{17}{12}$$

$$(ii) \frac{3}{4} + \frac{2}{3} = \frac{9+8}{12} = \frac{17}{12}$$

$$(2) \quad (i) \frac{-2}{3} + \frac{3}{4} = \frac{-8+9}{12} = \frac{1}{12}$$

$$(ii) \frac{3}{4} + \left(\frac{-2}{3}\right) = \frac{9+(-8)}{12} = \frac{1}{12}$$

We observe that the order of adding the rational numbers does not change the sum, then in such a case we say that commutative property holds good under addition.

For any two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, $\left(\frac{a}{b} + \frac{c}{d}\right) = \left(\frac{c}{d} + \frac{a}{b}\right)$

This property is called commutative property for rational number over addition

3. Associative Property :

Observe the following:

$$(1) \quad (i) \quad \frac{1}{2} + \left(\frac{2}{3} + \frac{3}{4}\right) = \frac{1}{2} + \left(\frac{8+9}{12}\right) = \frac{1}{2} + \frac{17}{12} = \frac{6+17}{12} = \frac{23}{12}$$

$$(ii) \quad \left(\frac{1}{2} + \frac{2}{3}\right) + \frac{3}{4} = \left(\frac{3+4}{6}\right) + \frac{3}{4} = \frac{7}{6} + \frac{3}{4} = \frac{14+9}{12} = \frac{23}{12}$$

$$(2) \quad (i) \quad \frac{1}{2} + \left(\frac{-2}{3} + \frac{3}{4}\right) = \frac{1}{2} + \left(\frac{-8+9}{12}\right) = \frac{1}{2} + \frac{1}{12} = \frac{6+1}{12} = \frac{7}{12}$$

$$(ii) \quad \left(\frac{1}{2} + \frac{-2}{3}\right) + \frac{3}{4} = \left(\frac{3-4}{6}\right) + \frac{3}{4} = \frac{-1}{6} + \frac{3}{4} = \frac{-2+9}{12} = \frac{7}{12}$$

1st Rational number + (2nd Rational number + 3rd Rational number) = (1st Rational number + 2nd Rational number) + 3rd Rational number.

In such a case, we say that the associative law holds good under addition.

For any three rational numbers $\frac{a}{b}$, $\frac{c}{d}$, and $\frac{e}{f}$,
 $\left(\frac{a}{b} + \frac{c}{d}\right) + \frac{e}{f} = \frac{a}{b} + \left(\frac{c}{d} + \frac{e}{f}\right)$. This property is called associative property for rational number over addition

4. Existence of additive identity (property of zero)

Observe the following:

$$(1) \quad (i) \quad \frac{2}{3} + (0) = \frac{2}{3}$$

$$(ii) \quad (0) + \frac{2}{3} = \frac{2}{3}$$

$$(2) \quad (i) \quad \left(\frac{-3}{4}\right) + 0 = \frac{-3}{4}$$

$$(ii) \quad 0 + \left(\frac{-3}{4}\right) = \frac{-3}{4}$$

For any rational numbers $\frac{p}{q}$; $\frac{p}{q} + 0 = 0 + \frac{p}{q} = \frac{p}{q}$,
 where zero is called addition identity.

5. Existence of additive inverse : [Negative of a rational number]

Observe the following :

$$(1) \quad (i) \quad \frac{2}{3} + \left(\frac{-2}{3}\right) = \frac{2+(-2)}{3} = \frac{0}{3} = 0$$

$$(ii) \quad \left(\frac{-2}{3}\right) + \frac{2}{3} = \frac{(-2)+2}{3} = \frac{0}{3} = 0$$

$$(2) \quad (i) \quad \frac{3}{4} + \left(\frac{-3}{4}\right) = \frac{3+(-3)}{4} = \frac{0}{4} = 0$$

$$(ii) \quad \left(\frac{-3}{4}\right) + \frac{3}{4} = \frac{-3+3}{4} = \frac{0}{4} = 0$$

From the above cases, we see that the sum of two rational numbers in each case is '0'.

$$\text{That is } \frac{2}{3} + \left(\frac{-2}{3}\right) = 0 ; \frac{3}{4} + \left(\frac{-3}{4}\right) = 0$$

Here we say that $\frac{2}{3}$ is the **additive inverse** of $\frac{-2}{3}$ as we are getting '0' when both are **added**.

Similarly, $\frac{-2}{3}$ is the additive inverse of $\frac{2}{3}$.

For any non-zero rational number $\frac{p}{q}$ there exists a unique rational number $\left(\frac{-p}{q}\right)$ such that $\frac{p}{q} + \left(\frac{-p}{q}\right) = 0$. Here we say that $\frac{p}{q}$ and $\left(\frac{-p}{q}\right)$ are additive inverse of each other.

Note: Additive inverse of the rational number '0' is 0 itself.

NUMBER SYSTEM

PRACTICE SHEET -3



Conceptual Practice Sheet



Single Response Type:

- Two fraction between $\frac{1}{2}$ and $\frac{4}{5}$ among the following are

A) $\frac{2}{3}$ and $\frac{5}{7}$	B) $\frac{2}{3}$ and $\frac{9}{5}$	C) $\frac{3}{7}$ and $\frac{7}{3}$	D) $\frac{5}{3}$ and $\frac{9}{7}$
------------------------------------	------------------------------------	------------------------------------	------------------------------------
- What number must be added to $\frac{-5}{8}$ so as to get $\frac{5}{9}$?

A) $\frac{77}{72}$	B) $\frac{83}{72}$	C) $\frac{85}{72}$	D) $\frac{87}{72}$
--------------------	--------------------	--------------------	--------------------
- Mohit needs to work 45 hours per week. He has work $38\frac{7}{9}$ hours so far this week. How many hours does he need to work on Friday to meet the 45 hours requirement?

A) 7 hours	B) $6\frac{2}{9}$ hours	C) $6\frac{1}{9}$ hours	D) $6\frac{7}{9}$ hours
------------	-------------------------	-------------------------	-------------------------

4. $2\frac{1}{3} + 3\frac{1}{2} =$

A) $\frac{7}{6}$

B) $\frac{5}{12}$

C) $\frac{35}{6}$

D) $\frac{35}{12}$

5. The value of $\frac{3}{7} + \frac{1}{21} - \frac{1}{14}$

A) $\frac{7}{42}$

B) $-\frac{7}{42}$

C) $\frac{17}{42}$

D) $-\frac{17}{42}$



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

1. $-\frac{1}{2} + \frac{2}{3} + \frac{4}{5} =$

A) $\frac{28}{30}$

B) $-\frac{7}{30}$

C) $\frac{29}{30}$

D) $-\frac{29}{30}$

2. $\frac{4}{9} - \frac{1}{9} + 3\frac{1}{3} =$

A) $3\frac{2}{3}$

B) $2\frac{2}{3}$

C) $1\frac{2}{3}$

D) $\frac{2}{3}$

3. One fraction between $\frac{2}{3}$ and $\frac{3}{4}$ is

A) $\frac{1}{7}$

B) $\frac{5}{6}$

C) $\frac{5}{7}$

D) $\frac{1}{7}$

4. If $a = \frac{56}{1000}$, $b = \frac{28}{100}$, $c = \frac{16}{10}$ then $a + c + b$ is

A) $\frac{1936}{100}$

B) $\frac{1936}{1000}$

C) $\frac{1936}{10000}$

D) $\frac{1936}{10}$

5. The sum of three sides of a triangle is $16\frac{3}{5}$ cm. If two of its sides measure $5\frac{7}{10}$ cm and $6\frac{3}{4}$ cm respectively, then the length of the third side is

A) $4\frac{3}{20}$ cm

B) $2\frac{5}{17}$ cm

C) $3\frac{7}{20}$ cm

D) $4\frac{3}{5}$ cm

LEVEL - II

6. The result obtained after subtracting the sum of $9\frac{3}{4}$ and $5\frac{5}{6}$ from the sum of $11\frac{2}{5}$ and $7\frac{1}{3}$ is

A) $4\frac{3}{20}$

B) $3\frac{3}{20}$

C) $3\frac{5}{20}$

D) $3\frac{7}{20}$

7. The sum of two rational numbers is -8, If one of the rational numbers is $-\frac{17}{9}$, find the other.
- A) $-\frac{50}{9}$ B) $-\frac{60}{9}$ C) $-\frac{55}{9}$ D) $-\frac{65}{9}$
8. If $\frac{4}{7} + \frac{2}{7} = \frac{y}{21}$, then the value of y is
- A) 18 B) 6 C) 20 D) 2
9. In a class of 50 students, $\frac{2}{5}$ travel to school by bus, 10 travel by car and the rest walk. What is the fraction of students who walk to school?
- A) $\frac{1}{5}$ B) $\frac{2}{5}$ C) $\frac{3}{5}$ D) $\frac{4}{5}$
10. What should be added to $\left(\frac{3}{4} + \frac{2}{5}\right)$ to get $\frac{-8}{15}$?
- A) $-\frac{101}{60}$ B) $-\frac{100}{60}$ C) $-\frac{110}{60}$ D) $-\frac{120}{60}$

LEVEL - III

11. The sum of $-\frac{1}{8}$ and $-\frac{1}{8}$ is _____.
- A) $\frac{1}{4}$ B) $-\frac{1}{4}$ C) 0 D) 1
12. If 3-times of $\frac{5}{8}$ is added to 4 times $\frac{5}{6}$ then the result is
- A) $5\frac{6}{24}$ B) $\frac{125}{24}$ C) $\frac{120}{20}$ D) $\frac{125}{20}$
13. If $P = \frac{7}{8} + \left(\frac{-9}{2}\right)$, $Q = \frac{2}{3} + \frac{3}{4}$ where $(P + Q) + R = 0$, then the value of R is
- A) 1 B) $-\frac{53}{24}$ C) $\frac{53}{24}$ D) 0
14. If $P = A \times B$ and $Q = C \times D$ where $2A = 3B = 4C = 6D = 24$, then $\frac{P}{Q \times 5}$ is
- A) $\frac{2}{5}$ B) $\frac{3}{5}$ C) $\frac{4}{5}$ D) $\frac{1}{5}$
15. If $A = \frac{-2}{15}$, $B = \frac{3}{5}$, $C = \frac{-15}{16}$ and $D = \frac{3}{4}$ are rational numbers then the value of $(B - A) + (D - C)$ is
- A) $581/240$ B) $591/240$ C) $571/280$ D) $-581/240$

**Reasoning Type :**

1. Statement I : $\left(\frac{-5}{8} + \frac{2}{5}\right) + \frac{12}{3} = \frac{-5}{8} + \left(\frac{2}{5} + \frac{12}{3}\right)$

Statement II: If a, b, and c are any three rational numbers then $(a + b) + c = a + (b + c)$

A) Both Statements are true, Statement II is the correct explanation of Statement I.

B) Both Statements are true, Statement II is not correct explanation of Statement I.

C) Statement I is true, Statement II is false. D) Statement I is false, Statement II is true.

Comprehension Type:

$\frac{10}{x}, \frac{6}{x}, \frac{8}{x}$ are fractions

2. If $\frac{10}{x} + \frac{6}{x} + \frac{8}{x} = 2$, then the value of x is

A) 16

B) 12

C) 6

D) 3

3. If $\frac{10}{x} + \frac{16}{x}$ is simplified, then the answer is

A) $2\frac{2}{6}$

B) $2\frac{1}{6}$

C) $2\frac{3}{6}$

D) $2\frac{4}{6}$

4. If $\left(\frac{10}{x} - \frac{8}{x}\right) + \frac{1}{6}$ simplified, then the answer is

A) $\frac{1}{2}$

B) $\frac{1}{4}$

C) $\frac{1}{3}$

D) $\frac{1}{8}$

Multi Correct Choice Type:

5. If $a = 1000$, $b = 5$, $c = 25$, $d = 125$, then $\frac{a}{b} + \frac{a}{c} + \frac{a}{d}$ is

A) 0.248

B) 248

C) less than 250

D) less than 24.8

6. The value of $\frac{1}{2} - \frac{1}{4} + \frac{5}{8}$

A) $\frac{7}{8}$

B) $-\frac{7}{8}$

C) $\frac{14}{16}$

D) $-\frac{14}{16}$

Matrix Match Type:

7. **Column - I**

a) Additive inverse of $\frac{-15}{-11}$

b) Additive identity of $\frac{-8}{9}$

c) If $x = \frac{-8}{9}$ then $-(-x) =$

d) If $x = \frac{-3}{4}$ and $y = \frac{-6}{7}$ then $(x + y)$

Column - II

p) $\frac{-8}{9}$

q) $\frac{15}{11}$

r) $\frac{-45}{28}$

s) 0

t) $\frac{-15}{11}$

Integer Answer Type:

8. If you add additive inverse of $\frac{-10}{34}$ to additive inverse $\frac{-131}{17}$ then the value obtained is

Subjective Type :

9. Sameera purchased $3\frac{1}{2}$ kg apples and $4\frac{3}{4}$ kg oranges. What is the total weight of fruits purchased by her?
10. What must be added to $5\frac{3}{7}$ to get 12.

**NUMBER SYSTEM****LECTURE - 4****Learning Objectives**

When you have completed this lecture you should be able to :

- ◆ Get an idea Multiplication & Division of fractions

**Multiplications of fractions :**

$$\text{Product of Fractions} = \frac{\text{Product of their numerators}}{\text{Product of their denominators}} \Rightarrow \frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$$

Ex: Find the products.

(i) $\frac{3}{5} \times \frac{2}{7}$

(ii) $\frac{7}{9} \times \frac{3}{14}$

(iii) $\frac{2}{3} \times \frac{4}{5} \times \frac{5}{8}$

Sol. We have, (i) $\frac{3}{5} \times \frac{2}{7} = \frac{3 \times 2}{5 \times 7} = \frac{6}{35}$ (ii) $\frac{7}{9} \times \frac{3}{14} = \frac{7 \times 3}{9 \times 14} = \frac{1}{6}$ (iii) $\frac{2}{3} \times \frac{4}{5} \times \frac{5}{8} = \frac{\overset{1}{2} \times \overset{1}{4} \times \overset{1}{5}}{3 \times \underset{1}{5} \times \underset{2}{8}} = \frac{1}{3}$

Properties of Multiplication of Fractions

(i) Multiplication of fractions is commutative i.e., $\frac{a}{b} \times \frac{c}{d} = \frac{c}{d} \times \frac{a}{b}$.

Ex. $\frac{3}{4} \times \frac{5}{6} = \frac{\overset{1}{3} \times \overset{1}{5}}{4 \times \underset{2}{6}} = \frac{5}{8}$. And, $\frac{5}{6} \times \frac{3}{4} = \frac{5 \times \overset{1}{3}}{\underset{2}{6} \times 4} = \frac{5}{8}$ $\therefore \frac{3}{4} \times \frac{5}{6} = \frac{5}{6} \times \frac{3}{4}$.

(ii) Multiplication of fractions is associative i.e., $\frac{a}{b} \times \left(\frac{c}{d} \times \frac{e}{f}\right) = \left(\frac{a}{b} \times \frac{c}{d}\right) \times \frac{e}{f}$.

Ex. $\frac{3}{5} \times \left(\frac{4}{7} \times \frac{2}{3}\right) = \frac{3}{5} \times \left(\frac{4 \times 2}{7 \times 3}\right) = \frac{3}{5} \times \frac{8}{21} = \frac{\overset{1}{3} \times 8}{5 \times \underset{7}{21}} = \frac{8}{35}$.

And, $\left(\frac{3}{5} \times \frac{4}{7}\right) \times \frac{2}{3} = \left(\frac{3 \times 4}{5 \times 7}\right) \times \frac{2}{3} = \frac{12}{35} \times \frac{2}{3} = \frac{\overset{4}{12} \times 2}{35 \times \underset{1}{3}} = \frac{8}{35}$ $\therefore \frac{3}{5} \times \left(\frac{4}{7} \times \frac{2}{3}\right) = \left(\frac{3}{5} \times \frac{4}{7}\right) \times \frac{2}{3}$.

Reciprocal of a Fraction : The reciprocal of a non-zero fraction $\frac{a}{b}$ is $\frac{b}{a}$.

Ex: (i) Reciprocal of $\frac{3}{5}$ is $\frac{5}{3}$ (ii) Reciprocal of 6 is $\frac{1}{6}$ (iii) Reciprocal of $\frac{1}{4}$ is $\frac{4}{1} = 4$.

Division of fractions : To divide a fraction $\frac{a}{b}$ by a non-zero fraction $\frac{c}{d}$ is the same as to multiply $\frac{a}{b}$ with the reciprocal of $\frac{c}{d}$. Thus, $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$.

Ex: Divide: (i) $\frac{3}{4} \div \frac{2}{3}$ (ii) $6 \div \frac{3}{5}$ (iii) $\frac{5}{9} \div 15$

Sol. We have, (i) $\frac{3}{4} \div \frac{2}{3} = \frac{3}{4} \times \frac{3}{2} = \frac{9}{8} = 1\frac{1}{8}$ (ii) $6 \div \frac{3}{5} = 6 \times \frac{5}{3} = 10$ (iii) $\frac{5}{9} \div 15 = \frac{5}{9} \times \frac{1}{15} = \frac{1}{27}$

NUMBER SYSTEM

PRACTICE SHEET -4



Conceptual Practice Sheet



Single Response Type:

1. $7\frac{2}{9} \div \left(\frac{1}{3} + \frac{5}{9}\right) =$

A) $22\frac{2}{9}$

B) $9\frac{34}{81}$

C) $8\frac{1}{8}$

D) $5\frac{1}{8}$

2. $10\frac{2}{7} \times \left(\frac{3}{4} + \frac{5}{8}\right) =$

A) $10\frac{1}{7}$

B) $12\frac{1}{7}$

C) $14\frac{1}{7}$

D) $16\frac{1}{7}$

3. $\left(7\frac{1}{2} - 3\frac{2}{3}\right) \times \frac{12}{69} =$

A) $\frac{1}{3}$

B) $\frac{2}{3}$

C) $1\frac{1}{3}$

D) $2\frac{2}{3}$

4. $\left(\frac{3}{4} + \frac{5}{8}\right) \div \frac{1}{16} =$

A) 22

B) 20

C) $\frac{1}{20}$

D) $\frac{1}{22}$

5. Find $\frac{2}{5} \div 1\frac{1}{2}$

A) $\frac{23}{16}$

B) $\frac{17}{16}$

C) $\frac{21}{16}$

D) $\frac{19}{16}$



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

- Divide $\frac{15}{38}$ by $\frac{-3}{19}$
A) $\frac{-2}{5}$ B) $\frac{-5}{2}$ C) $\frac{2}{5}$ D) $\frac{5}{2}$
- If $\frac{3}{7}$ of a number is 27, then the number is
A) 60 B) 61 C) 62 D) 63
- The product of $\frac{2}{7}, \frac{14}{10}, \frac{5}{9}$ is
A) 9 B) $\frac{1}{9}$ C) $\frac{2}{9}$ D) $\frac{4}{9}$
- Simplify $\left(\frac{25}{8} \times \frac{2}{5}\right) - \left(\frac{3}{5} \times \frac{-10}{9}\right)$
A) 20/11 B) 13/12 C) 23/12 D) 11/21
- Asri completed $\frac{1}{5}$ of his assessment on Monday and $\frac{3}{4}$ of it on Tuesday. How much of his assessment did Asri complete in the two days?
A) 1 B) $\frac{4}{9}$ C) $\frac{3}{20}$ D) $\frac{19}{20}$

LEVEL - II

- Name of property of multiplication of $\frac{5}{23} \times \frac{-6}{29} = \frac{-6}{29} \times \frac{5}{23}$
A) Closure B) Associative C) Commutative D) Distribute
- The product of two rational numbers is $\frac{-35}{18}$. If one of the numbers is $\frac{5}{12}$, find the other number
A) $\frac{-3}{14}$ B) $\frac{-7}{12}$ C) $\frac{-3}{14}$ D) $\frac{-14}{3}$
- Saili plants 4 saplings, in a row, in her garden. The distance between two adjacent saplings is $\frac{3}{4}$ m. Find the distance between the first and the last sapling.
A) 2 m B) 3 m C) 4 m D) 6 m

9. If $1+1 \div \left\{ 1+1 \div \left(1+\frac{1}{3} \right) \right\}$ is simplified, then the answer is
- A) $1\frac{2}{7}$ B) $1\frac{3}{4}$ C) $1\frac{4}{7}$ D) $1\frac{5}{7}$
10. If $\frac{29}{10} + \left(\frac{367}{100} + \frac{468}{1000} \right) = a + (b+c)$ then $a \times (b+c)$ is
- A) $\frac{120002}{100000}$ B) $\frac{120002}{10000}$ C) $\frac{12002}{1000000}$ D) $\frac{12002}{1000}$

LEVEL - III

11. A car runs 16km using 1 litre of petrol. How much distance will it cover using $2\frac{3}{4}$ litres of petrol.
- A) 36 km B) 42 km C) 34 km D) 44 km
12. If $\frac{c}{d} = 1 \div \frac{3}{4}$, then $\frac{5}{6} + \frac{c}{d}$ is
- A) $\frac{13}{3}$ B) $\frac{13}{2}$ C) $\frac{13}{6}$ D) $\frac{13}{4}$
13. $\left[\left(15 \div \frac{5}{3} \right) + \left(\frac{16}{15} \div 4 \right) \right] \times \frac{45}{139}$ is added to 47. Then the value obtained is
- A) 100 B) 101 C) 102 D) 50
14. If $x = \frac{2}{3}$ of $\frac{3}{4}$, $y = \frac{3}{4}$ of $\frac{8}{12}$, then $(x+y) + (x-y)$ is
- A) 0 B) 1 C) -1 D) Can't be determined
15. If $\frac{3}{x} \times \frac{8}{6} \times \frac{12}{9} = \frac{4}{3}$ and $\frac{2}{7} \times \frac{y}{9} \times \frac{27}{4} = 3$, then $\frac{x}{y}$ is a reciprocal of
- A) $\frac{7}{2}$ B) $\frac{2}{7}$ C) $\frac{14}{8}$ D) $\frac{8}{14}$



IIT - JEE Advanced Practice Sheet



Reasoning Type:

1. Statement I : $\left(\frac{-4}{5} \times \frac{3}{7} \right) \times \frac{-8}{11} = \frac{-4}{5} \times \left(\frac{3}{7} \times \frac{-8}{11} \right)$

Statement II: If a, b and c are three rational numbers, then $(a \times b) \times c = a \times (b \times c)$

- A) Both Statements are true, Statement II is the correct explanation of Statement I.
 B) Both Statements are true, Statement II is not correct explanation of Statement I.
 C) Statement I is true, Statement II is false.
 D) Statement I is false, Statement II is true.

Comprehension Type:

If x is an element of whole numbers which is not present in set of natural numbers and

$$y = \frac{3}{4} + \left(\frac{-5}{6}\right) \text{ then}$$

2. Find the value of x
 A) 2 B) 1 C) 0 D) 10
3. Find the value of y
 A) $\frac{-1}{10}$ B) $\frac{-1}{24}$ C) $\frac{-1}{28}$ D) $\frac{-1}{12}$
4. Find the value of $(x - y) + (x \div y)$
 A) $2y$ B) $-y$ C) $\frac{-1}{y}$ D) y

Multi Correct Choice Type:

5. If $a = \frac{5}{6}$, $b = \frac{3}{4}$ and $c = \frac{2}{3}$, then $ab+ac$ is equal to
 A) $1\frac{13}{72}$ B) $\frac{170}{144}$ C) $\frac{255}{216}$ D) $\frac{150}{57}$
6. What fraction of a 1275 is 816.
 A) $\frac{16}{25}$ B) $\frac{16}{24}$ C) $\frac{48}{75}$ D) $\frac{48}{72}$

Matrix Match Type:7. **Column-I**

a) The value of $6\frac{1}{4} \div 2\frac{1}{3} =$

b) If $\frac{5}{6}$ of a number is 45, then the number is

c) How many $\frac{1}{4}$ hour periods can be there in $3\frac{3}{4}$ hours?

d) The value of $\frac{7}{4}$ of $2\frac{1}{2}$

Column-II

p) $\frac{75}{28}$

q) 54

r) 15

s) $4\frac{3}{8}$

Integer Answer Type:

8. Multiplicative inverse of a rational number $\frac{-362}{1086}$ is _____

Subjective Type :

9. Simplify : $\left(\frac{16}{5} \div \frac{8}{20}\right) + \left(\frac{15}{5} \div \frac{3}{35}\right)$
10. Divide the sum $\frac{-8}{7}$ and $\frac{5}{14}$ by their product.



NUMBER SYSTEM

LECTURE - 5

Learning Objectives

When you have completed this lecture you should be able to :

- ◆ Get an idea Rational Numbers
- ◆ Get an idea Zero is rational number
- ◆ Get an idea Positive Rational numbers



RATIONAL NUMBERS

In this section, we shall define rational numbers. We shall also show that every integer is a rational number but a rational number need not be an integer.

A number of the form $\frac{p}{q}$ or a number which can be expressed in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$, is called a rational number.

In other words, a rational number is any number that can be expressed as the quotient of two integers with the condition that the divisor is not zero.

Each of the numbers $\frac{2}{3}, \frac{-5}{7}, \frac{-11}{-5}, \frac{7}{-9}$ is a rational number.

Every natural number is a rational number but a rational number need not be a natural number.

Thus we can write $1 = \frac{1}{1}, 2 = \frac{2}{1}, 3 = \frac{3}{1}$ and so on.

This shows that every natural number n can be written as $\frac{n}{1}$ which is a rational number.

Now, we see that none of the rational numbers like $\frac{5}{6}, \frac{3}{8}, \frac{1}{3}$ etc. , is a natural number. Therefore a rational number need not be a natural number.

Zero is a rational number

Since we can write 0 in any one of the forms $\frac{0}{1}, \frac{0}{-1}, \frac{0}{2}, \frac{0}{-2}, \frac{0}{3}, \frac{0}{-3}$ and so on. ie. $0 = \frac{0}{q}$ where q

is any non-zero integer. Thus, 0 can be expressed as $\frac{p}{q}$, where $p = 0$ and q is any non-zero integer. Hence, 0 is a rational number.

Every integer is a rational number but a rational number need not be an integer.

We know that $1 = \frac{1}{1}, 2 = \frac{2}{1}, 3 = \frac{3}{1}, -1 = \frac{-1}{1}, -2 = \frac{-2}{1}, -3 = \frac{-3}{1}$ and so on.

In general, any integer n can be written as $n = \frac{n}{1}$, which is a rational number. Hence, every integer is a rational number.

Also, numbers like $\frac{5}{7}, \frac{-7}{8}, \frac{11}{-6}$ are rational numbers but they are not integers. Hence, every integer is a rational number but a rational number need not be an integer.

Every fraction is a rational number but a rational number need not be a fraction.

Let $\frac{p}{q}$ be any fraction. Then, p and q are natural numbers. Since every natural number is an integer, therefore, p and q are integers. Thus, the fraction $\frac{p}{q}$ is the quotient of two integers such that $q \neq 0$. Hence, $\frac{p}{q}$ is a rational number.

A number like $\frac{7}{-8}$ is a rational number but it is not a fraction since its denominator -8 is not a natural number.

Positive Rational Numbers

A rational number is said to be positive if its numerator and denominator are either both positive integers or both negative integers.

In other words, a rational number is positive, if its numerator and denominator are of the same sign.

Each of the rational numbers $\frac{2}{3}, \frac{5}{9}, \frac{-7}{-12}, \frac{-3}{-11}$ is a positive rational number, but $\frac{3}{-7}, \frac{-4}{5}$ are not positive rational numbers.

Ex: Every natural number is a positive rational number.

Sol. We know that

$$1 = \frac{1}{1}, 2 = \frac{2}{1}, 3 = \frac{3}{1} \text{ and so on.}$$

In other words, any natural number n can be written as

$$n = \frac{n}{1}, \text{ where } n \text{ and } 1 \text{ are positive integers.}$$

Hence, every natural number is a positive rational number.

Negative Rational Number

A rational number is said to be negative if its numerator and denominator are such that one of them is positive integer and another one is a negative integer.

In other words, a rational number is negative, if its numerator and denominator are of the opposite signs.

Each of the rational numbers $\frac{-3}{7}, \frac{5}{-9}, \frac{-15}{26}$ is a negative rational number.

Ex: Every negative integer is a negative rational number

Sol: We know that $-1 = \frac{-1}{1}, -2 = \frac{-2}{1}, -3 = \frac{-3}{1}$ and so on.

In other words, any negative integer n can be written as $n = \frac{n}{1}$, here n is negative and 1 is positive.

Hence, every negative integer is a negative rational number.

Remark: The rational number 0 is neither positive nor negative.

Standard form of a rational number:

(Simplest form of rational number)

A rational number $\frac{p}{q}$ is said to be in standard form, if p and q are integers having no common divisor other than one, where $q \neq 0$.

Ex: $\frac{3}{4}, \frac{-5}{6}, \frac{8}{11}$ etc

Density property: 'Between two Rational numbers there are infinitely many rational numbers'

Insertion of Rational Numbers between any two Rational numbers:

Method 1 : If 'a' and 'b' are any two rational numbers, then the rational number exactly between

a and b is $\frac{1}{2}(a + b)$

Ex: The rational number between $\frac{1}{2}$ and $\frac{1}{3}$ is _____

Sol: $= \frac{\frac{1}{2} + \frac{1}{3}}{2} = \frac{\frac{3+2}{6}}{2} = \frac{5}{6 \times 2} = \frac{5}{12}$

The rational number between $\frac{1}{2}$ and $\frac{1}{3}$ is $\frac{5}{12}$

Method 2 : If $\frac{a}{b}$ and $\frac{c}{d}$ are any two rational numbers, then $\frac{a+c}{b+d}$ is the rational number between

$\frac{a}{b}$ and $\frac{c}{d}$ i.e. $\frac{a}{b} < \frac{a+c}{b+d} < \frac{c}{d}$

Ex: Insert a rational number between $\frac{3}{7}$ and $\frac{9}{13} \therefore \frac{3}{7} < \frac{3+9}{7+13} < \frac{9}{13}$

Method 3 : Let 'a', 'b' are any two rational numbers such that $a < b$. Suppose we want to insert 'n'

rational numbers between 'a' and 'b', now there exist 'd' in such a way that $d = \frac{b-a}{n+1}$. Then

the rational numbers between 'a' and 'b' are

$(a + d), (a + 2d), (a + 3d), \dots \dots (a + nd)$

Ex: Find 5 rational numbers between 7 and 9.

Sol: Here $a=7$, $b=9$ and $n=5$. Now $d = \frac{b-a}{n+1} \Rightarrow d = \frac{9-7}{5+1} \Rightarrow d = \frac{2}{6} \Rightarrow d = \frac{1}{3}$

Thus 5 rational numbers between 7 and 9 are

$$(i) 7 + \frac{1}{3} = \frac{22}{3} \quad (ii) 7 + 2 \times \frac{1}{3} = \frac{23}{3} \quad (iii) 7 + 3 \times \frac{1}{3} = 8$$

$$(iv) 7 + 4 \times \frac{1}{3} = \frac{25}{3} \quad (v) 7 + 5 \times \frac{1}{3} = \frac{26}{3}$$

\therefore 5 rational numbers between 7 and 9 are $\frac{22}{3}, \frac{23}{3}, 8, \frac{25}{3}, \frac{26}{3}$.

Ex: Find 9 rational numbers between 2 and 4.

Sol: $d = \frac{b-a}{n+1} \quad d = \frac{4-2}{10} \quad d = \frac{2}{10} = 0.2$

Then rational numbers are $2 + 0.2, 2+0.4, 2+0.6, 2+0.8, 2+1.0, 2+1.2, 2+1.4, 2+1.6, 2+1.8$
 $= 2.2, 2.4, 2.6, 2.8, 3.0, 3.2, 3.4, 3.6, 3.8$

NUMBER SYSTEM

PRACTICE SHEET -5



Conceptual Practice Sheet



Single Response Type:

- In the Rational number $\frac{p}{q}$ (where $q \neq 0$) p is called
 A) Numerator B) Denominator C) Fraction D) Integer
- A number which is in the form of $\frac{a}{b}$ (where $b \neq 0$ a, b are integers) is called
 A) Fraction B) Rational number C) Irrational number D) Complex number
- Name the opposite of two-thirds rational numbers in the form $\frac{p}{q}$ where p and q are integers
 A) $-\frac{3}{2}$ B) $-\frac{2}{3}$ C) $\frac{3}{2}$ D) $\frac{2}{3}$
- Which of the following rational numbers is not positive?
 A) $\frac{-28}{-41}$ B) $\frac{13}{19}$ C) $\frac{-39}{58}$ D) $\frac{0}{-5}$
- When $\frac{-3}{6}$ is written as a rational number with numerator 12, then the denominator is
 A) 18 B) -18 C) -24 D) 24



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

- Insert a one fraction between $\frac{2}{3}$ and $\frac{3}{4}$
 A) $\frac{5}{7}$ B) $\frac{2}{7}$ C) $\frac{10}{12}$ D) $\frac{15}{2}$
- Insert two fraction between $\frac{3}{5}$ and $\frac{4}{7}$
 A) $\frac{10}{12}, \frac{5}{9}$ B) $\frac{11}{15}, \frac{8}{9}$ C) $\frac{10}{17}, \frac{7}{12}$ D) $\frac{18}{10}, \frac{6}{5}$
- Replace $\frac{11}{2}$ with $\frac{11}{12}$
 A) $\frac{21}{26}, \frac{16}{19}, \frac{27}{31}$ B) $\frac{18}{26}, \frac{3}{5}, \frac{12}{11}$ C) $\frac{6}{5}, \frac{4}{11}, \frac{15}{16}$ D) $\frac{17}{5}, \frac{11}{6}, \frac{13}{4}$
- Find four rational numbers between $\frac{1}{6}$ and $\frac{1}{3}$
 A) $\frac{1}{2}, \frac{1}{4}, \frac{13}{16}, \frac{4}{11}$ B) $\frac{1}{4}, \frac{7}{24}, \frac{5}{16}, \frac{31}{96}$ C) Replace $\frac{3}{17}$ with $\frac{2}{17}$ D) $\frac{1}{8}, \frac{7}{12}, \frac{6}{17}, \frac{31}{96}$
- Express the $\frac{21}{-35}$ rational numbers in standard form.
 A) $\frac{3}{5}$ B) $\frac{3}{-5}$ C) $\frac{-5}{3}$ D) None

LEVEL - II

- Which of the following is a positive rational number
 A) $\frac{-2}{3}$ B) $\frac{3}{-4}$ C) $\frac{-7}{-9}$ D) None
- Find four rational number between -1 and $-\frac{1}{2}$
 A) $-2, \frac{-1}{4}, \frac{1}{3}, \frac{2}{5}$ B) $\frac{5}{3}, \frac{-6}{7}, \frac{-11}{6}, \frac{-2}{3}$ C) $\frac{-1}{4}, \frac{-2}{7}, \frac{-6}{13}, \frac{-4}{7}$ D) $\frac{-3}{4}, \frac{-7}{8}, \frac{-5}{8}, \frac{-9}{16}$
- Find two rational numbers between -2 and 2
 A) $\frac{15}{2}, \frac{19}{3}$ B) 0 and 1 C) -1 and 0 D) Both 2 & 3
- Express the $\frac{-36}{84}$ rational numbers in standard form.
 A) $\frac{-3}{7}$ B) $\frac{3}{7}$ C) $\frac{7}{3}$ D) None
- Find the four rational numbers between $\frac{1}{3}$ and $\frac{1}{2}$
 A) $\frac{17}{48}, \frac{18}{48}, \frac{19}{48}, \frac{20}{48}$ B) $\frac{12}{8}, \frac{6}{5}, \frac{3}{2}, \frac{17}{5}$ C) $\frac{5}{3}, \frac{6}{3}, \frac{22}{3}, \frac{18}{3}$ D) $\frac{7}{5}, \frac{8}{5}, \frac{9}{5}, \frac{11}{5}$

LEVEL - III

11. If $\frac{17}{30}$ is a rational number between
- A) $\frac{1}{3}$ and $\frac{3}{5}$ B) $\frac{6}{5}$ and $\frac{4}{5}$ C) $\frac{11}{3}$ and $\frac{14}{3}$ D) $\frac{7}{5}$ and $\frac{12}{5}$
12. The rational number $\frac{1}{16}$ and -1 are
- A) Same sides of zero on the number line B) Opposite sides of zero on the number line
C) Represents the same number D) At middle of number line
13. If $\frac{37}{50}$ is a rational number between $\frac{a}{25}$ and $\frac{19}{25}$ then the value of **a** is
- A) $\frac{2}{3} \times 34$ B) $27 \times \frac{2}{3}$ C) $2 \times \frac{18}{4}$ D) $3 \times \left(\frac{2}{3}\right)^2$
14. Which of the following cannot be written as a rational number with denominator 4?
- A) $\frac{7}{8}$ B) $\frac{20}{16}$ C) $\frac{28}{-32}$ D) $\frac{1}{-4}$
15. Which of the following are not false?
- A) $\frac{0}{3}$ is a Natural number
B) $\frac{-7}{8}, \frac{2}{-3}$ are Fractions but not Rational number
C) $\frac{2}{3}, \frac{4}{5}, \frac{7}{8}, \frac{9}{11}$ are Fractions as well as Rational number
D) Zero is a smallest Rational number



IIT - JEE Advanced Practice Sheet



Reasoning Type:

1. Statement I : 5 is rational number between $\frac{9}{2}$ and $\frac{11}{2}$
- Statement II: $a = \frac{5}{2}, b = \frac{7}{2}$ then rational number between a and b is $\frac{4}{11}$
- A) Both Statements are true, Statement II is the correct explanation of Statement I.
B) Both Statements are true, Statement II is not correct explanation of Statement I.
C) Statement I is true, Statement II is false.
D) Statement I is false, Statement II is true.

Comprehension Type:

If $\frac{a}{b}$ and $\frac{c}{d}$ are two fractions, then the fraction $\frac{a+c}{b+d}$ lies between $\frac{a}{b}$ and $\frac{c}{d}$ i.e.

$$\frac{a}{b} < \frac{a+c}{b+d} < \frac{c}{d}$$

2. Insert a fraction between $\frac{3}{4}$ and $\frac{6}{7}$ is

- A) $\frac{11}{9}$ B) $\frac{7}{9}$ C) $\frac{9}{11}$ D) 1

3. Insert two fractions in between $\frac{5}{7}$ and $\frac{3}{4}$ is /are

- A) $\frac{2}{3}, \frac{5}{6}$ B) $\frac{8}{11}, \frac{11}{15}$ C) $\frac{1}{2}, \frac{2}{5}$ D) $\frac{7}{9}, \frac{8}{9}$

4. Insert three fractions in between $\frac{7}{12}$ and $\frac{9}{11}$ are

- A) $\frac{12}{15}, \frac{11}{13}, \frac{17}{19}$ B) $\frac{4}{9}, \frac{23}{25}, \frac{7}{24}$ C) $\frac{11}{18}, \frac{5}{12}, \frac{17}{19}$ D) $\frac{23}{35}, \frac{16}{23}, \frac{25}{34}$

Multi Correct Choice Type:

5. A fraction with 48 as denominator and equivalent to the fraction is

- A) $\frac{2}{3}$ B) $\frac{4}{5}$ C) $\frac{5}{6}$ D) $\frac{3}{7}$

6. Which of the following are not false?

- A) Every positive Rational number is greater than zero
B) Every negative Rational number is less than zero
C) Every Rational number can be represented on a number line
D) For each rational number x , exactly one of the following true i) $x > 0$ ii) $x = 0$ iii) $x < 0$

Matrix Match Type:

7. **Column-I**

a) $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}$ are

b) $\frac{-7}{6}, \frac{-2}{3}$ are

c) $\frac{0}{1}, \frac{0}{2}, \frac{0}{3}$ are

d) 3, 15, 27 are

Column-II

p) Rational numbers

q) Negative Rational numbers

r) Integers

s) Natural numbers

t) Fractions

Integer Answer Type:

8. If $d = \frac{b-a}{n+1}$ and $a = 2$, $b = 10$, $n = 1$ then $d =$ _____

Subjective Type :

9. Insert three rational numbers between $\frac{1}{3}$ and $\frac{4}{5}$.

10. Find four rational numbers equivalent to each of the rational numbers.

(i) $\frac{-2}{3}$

(ii) $\frac{7}{-9}$

**Number System****LECTURE - 6****Learning Objectives**

When you have completed this lecture you should be able to :

- ◆ Know about the operations on rational numbers.
- ◆ Understand the properties of rational numbers.

**Operations on rational numbers:**

Addition of rational numbers: In order to add two rational numbers.

- i) First express each rational number with positive denominator.
- ii) If the denominators of both the rational numbers are the same, then add their numerators and divide by the common denominator.
- iii) If the denominators of both the rational numbers are different, then we express them of equivalent rational numbers with the same denominator then add them

Ex: 1) Add $\frac{-3}{7}$ and $\frac{2}{7}$ **Sol:** $\frac{-3}{7} + \frac{2}{7} = \frac{-3+2}{7} = \frac{-1}{7}$

Ex: 2) Find the sum of the rational numbers $\frac{-4}{9}$, $\frac{15}{12}$ and $\frac{-7}{18}$

Sol: $\frac{-4}{9} + \frac{15}{12} + \frac{-7}{18} = \frac{-16+45-14}{36} = \frac{15}{36} = \frac{5}{12}$

Negative of a Rational Numbers:

Negative or additive inverse of a rational number is a rational number which when added to the given rational number gives '0'

If $\frac{p}{q}$ and $\frac{r}{s}$ are two rational numbers and $\frac{p}{q} + \frac{r}{s} = 0$, then $\frac{p}{q}$ is called the additive inverse or

negative of $\frac{r}{s}$ and vice - versa.

Ex: Additive inverse of $\frac{3}{4}$ is $\frac{-3}{4}$ and $\frac{-3}{4}$ is $\frac{3}{4}$

Subtraction of Rational Numbers: Subtraction is the inverse process of addition. If $\frac{p}{q}$ and

$\frac{r}{s}$ be two rational numbers it follows $\frac{r}{s} - \frac{p}{q} = \frac{r}{s} + \left(-\frac{p}{q}\right)$

Ex: 1) Subtract $\frac{-2}{7}$ from $\frac{3}{4}$ **Sol:** $\frac{3}{4} - \left(\frac{-2}{7}\right) = \frac{3}{4} + \frac{2}{7} = \frac{29}{28}$

Ex: 2) Simplify $\frac{3}{8} - \frac{-2}{9} + \frac{-1}{36}$ **Sol:** $\frac{3}{8} - \left(\frac{-2}{9}\right) + \left(\frac{-1}{36}\right) = \frac{27 - (-16) + (-2)}{72} = \frac{41}{72}$

Properties of Rational numbers:

1. **Closure property :** Observe the following : $\frac{2}{3} + \frac{3}{4} = \frac{8+9}{12} = \frac{17}{12}$

We observe that the sum of two rational numbers is always a rational number. In such a case we say that rational numbers are closed under addition. Hence, we say

For any two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, $\left(\frac{a}{b} + \frac{c}{d}\right)$ is also rational number.
This property is called closure property for rational number over addition.

2. **Commutative Property:** Observe the following :

$$(i) \frac{2}{3} + \frac{3}{4} = \frac{8+9}{12} = \frac{17}{12} \qquad (ii) \frac{3}{4} + \frac{2}{3} = \frac{9+8}{12} = \frac{17}{12}$$

We observe that the order of adding the rational numbers does not change the sum, then in such a case we say that commutative property holds good under addition.

For any two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, $\left(\frac{a}{b} + \frac{c}{d}\right) = \left(\frac{c}{d} + \frac{a}{b}\right)$
This property is called commutative property for rational number over addition

3. **Associative Property :** Observe the following:

$$(i) \frac{1}{2} + \left(\frac{-2}{3} + \frac{3}{4}\right) = \frac{1}{2} + \left(\frac{-8+9}{12}\right) = \frac{1}{2} + \frac{1}{12} = \frac{6+1}{12} = \frac{7}{12}$$

$$(ii) \left(\frac{1}{2} + \frac{-2}{3}\right) + \frac{3}{4} = \left(\frac{3-4}{6}\right) + \frac{3}{4} = \frac{-1}{6} + \frac{3}{4} = \frac{-2+9}{12} = \frac{7}{12}$$

For any three rational numbers $\frac{a}{b}$, $\frac{c}{d}$, and $\frac{e}{f}$,
 $\left(\frac{a}{b} + \frac{c}{d}\right) + \frac{e}{f} = \frac{a}{b} + \left(\frac{c}{d} + \frac{e}{f}\right)$. This property is called associative property for rational number over addition

4. **Existence of additive identity (property of zero)** : Observe the following:

$$(i) \left(\frac{-3}{4}\right) + 0 = \frac{-3}{4}$$

$$(ii) 0 + \left(\frac{-3}{4}\right) = \frac{-3}{4}$$

For any rational numbers $\frac{p}{q}$; $\frac{p}{q} + 0 = 0 + \frac{p}{q} = \frac{p}{q}$,
where zero is called addition identity.

5. **Existence of additive inverse : [Negative of a rational number]** .Observe the following :

$$(i) \frac{2}{3} + \left(\frac{-2}{3}\right) = \frac{2+(-2)}{3} = \frac{0}{3} = 0$$

$$(ii) \left(\frac{-2}{3}\right) + \frac{2}{3} = \frac{(-2)+2}{3} = \frac{0}{3} = 0$$

Here we say that $\frac{2}{3}$ is the **additive inverse** of $\frac{-2}{3}$ as we are getting '0' when both are **added**.

Similarly, $\frac{-2}{3}$ is the additive inverse of $\frac{2}{3}$.

For any non-zero rational number $\frac{p}{q}$ there exists a unique rational number $\left(\frac{-p}{q}\right)$ such that $\frac{p}{q} + \left(\frac{-p}{q}\right) = 0$. Here we say that $\frac{p}{q}$ and $\left(\frac{-p}{q}\right)$ are additive inverse of each other.

Note :Additive inverse of the rational number '0' is 0 it self.

MULTIPLICATION OF RATIONAL NUMBERS:

The product of two rational numbers = $\frac{\text{Product of the numerators}}{\text{Product of the denominators}}$

If $\frac{a}{b}$ and $\frac{c}{d}$ are two rational numbers, then $\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$

Ex: Multiply $\frac{-7}{15}$ by $\frac{-5}{14}$ **Sol:** $\frac{-7}{15} \times \frac{-5}{14} = \frac{-7 \times -5}{15 \times 14} = \frac{1}{6}$

Properties of Multiplication of Rational Numbers:

1. **Closure property:** Observe the following:

$$(1) \frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$$

$$(2) \frac{-2}{3} \times \frac{3}{4} = \frac{-6}{12} = \frac{-1}{2}$$

For any two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, $\left(\frac{a}{b} \times \frac{c}{d}\right)$ is also rational number. This property is called closure property for rational number over multiplication.

2. **Commutative property:** Observe the following:

$$(i) \frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$$

$$(ii) \frac{3}{4} \times \frac{2}{3} = \frac{6}{12} = \frac{1}{2}$$

For any two rational numbers $\frac{a}{b}$ and $\frac{c}{d}$, $\left(\frac{a}{b} \times \frac{c}{d}\right) = \left(\frac{c}{d} \times \frac{a}{b}\right)$

This property is called commutative property for rational number over multiplication.

3. **Associative property:** Observe the following:

$$(i) \frac{1}{2} \times \left(\frac{2}{3} \times \frac{3}{4}\right) = \frac{1}{2} \times \frac{6}{12} = \frac{6}{24} = \frac{1}{4}$$

$$(ii) \left(\frac{1}{2} \times \frac{2}{3}\right) \times \frac{3}{4} = \frac{2}{6} \times \frac{3}{4} = \frac{6}{24} = \frac{1}{4}$$

For any three rational numbers $\frac{a}{b}$, $\frac{c}{d}$, and $\frac{e}{f}$,

$\left(\frac{a}{b} \times \frac{c}{d}\right) \times \frac{e}{f} = \frac{a}{b} \times \left(\frac{c}{d} \times \frac{e}{f}\right)$. Therefore the associative

property hold good for rational number over multiplication.

4. **Existency of Multiplicative Identity:** Observe the following:

$$(i) \frac{2}{3} \times 1 = \frac{2}{3}$$

$$(ii) 1 \times \frac{2}{3} = \frac{2}{3}$$

For any rational number $\frac{p}{q}$; $\frac{p}{q} \times 1 = 1 \times \frac{p}{q} = \frac{p}{q}$,
where one is called multiplicative identity.

5. **Existency of Multiplicative Inverse:** Observe the following:

$$(i) \frac{2}{3} \times \frac{3}{2} = \frac{6}{6} = 1$$

$$(ii) \frac{3}{2} \times \frac{2}{3} = \frac{6}{6} = 1$$

From the above cases, we see that product of 2 rational numbers in each case is '1' i.e., $\frac{2}{3} \times \frac{3}{2} = 1$

Here we say that $\frac{3}{2}$ is the multiplicative inverse of $\frac{2}{3}$ as we are getting the product '1' when both are **multiplied**.

Similarly, $\frac{2}{3}$ is the multiplicative inverse of $\frac{3}{2}$.

For any non-zero rational number $\frac{p}{q}$ there exists a unique

rational number $\frac{q}{p}$ such that $\frac{p}{q} \times \left(\frac{q}{p}\right) = 1$. Here we say that

$\frac{p}{q}$, $\frac{q}{p}$ are multiplicative inverse of each other.

6. **Distributive of Multiplication over Addition:** Observe the following:

$$(i) \frac{1}{2} \times \left(\frac{2}{3} + \frac{3}{4} \right) = \frac{1}{2} \times \left(\frac{8+9}{12} \right) = \frac{1}{2} \times \frac{17}{12} = \frac{17}{24} \quad (ii) \left(\frac{1}{2} \times \frac{2}{3} \right) + \left(\frac{1}{2} \times \frac{3}{4} \right) = \frac{2}{6} + \frac{3}{8} = \frac{8+9}{24} = \frac{17}{24}$$

For any three rational numbers $\frac{a}{b}$, $\frac{c}{d}$, and $\frac{e}{f}$,
 $\frac{a}{b} \times \left(\frac{c}{d} + \frac{e}{f} \right) = \left(\frac{a}{b} \times \frac{c}{d} \right) + \left(\frac{a}{b} \times \frac{e}{f} \right)$. This property is called
 distributive property for multiplication over addition.

Important Points

- The rational number '0' has no reciprocal.
- The reciprocal of a rational number is also called its multiplicative inverse.
- In general the reciprocal of a non - zero rational number $\frac{p}{q}$ is $\frac{q}{p}$ and vice - versa.
- The reciprocal of a non - zero rational number $\frac{p}{q}$ is also denoted by $\left(\frac{p}{q} \right)^{-1}$. We say $\left(\frac{p}{q} \right)^{-1} = \frac{q}{p}$.

NUMBER SYSTEM

PRACTICE SHEET -6



Conceptual Practice Sheet



Single Response Type:

1. Subtract $\frac{3}{4}$ from $\frac{5}{6}$ is _____
 A) $\frac{19}{12}$ B) $\frac{-19}{12}$ C) $\frac{1}{12}$ D) $\frac{-1}{12}$
2. The reciprocal of -5 is _____
 A) 1 B) 0 C) -5 D) $\frac{-1}{5}$
3. The reciprocal of $\frac{3}{4} \div 3$ will be
 A) 4 B) $\frac{1}{4}$ C) $\frac{9}{4}$ D) $\frac{4}{9}$
4. Which of the following pairs of rational numbers are not equal ?
 A) $\frac{3}{5}$ and $\frac{-3}{-5}$ B) $\frac{-15}{35}$ and $\frac{-21}{49}$ C) $\frac{-15}{20}$ and $\frac{25}{-30}$ D) $\frac{-8}{24}$ and $\frac{7}{-21}$

5. Narendra painted $\frac{2}{3}$ area of the wall in his room. His brother Naresh helped and painted $\frac{1}{3}$ area of the wall. How much did they paint together.
- A) $\frac{5}{3}$ B) Total wall C) Half of the wall D) $\frac{2}{3}$



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

1. $\frac{a}{b} \times \frac{c}{d} = \frac{c}{d} \times \frac{a}{b}$ is _____ property
- A) Closure B) Associative C) Commutative D) Distributive
2. Simplify $\frac{8}{-15} + \frac{4}{-3}$ is _____
- A) $\frac{-28}{15}$ B) $\frac{13}{15}$ C) $\frac{-8}{15}$ D) $\frac{-4}{3}$
3. The sum of $\frac{8}{15} + \frac{7}{15}$ is
- A) 1 B) $\frac{3}{15}$ C) $\frac{1}{30}$ D) $\frac{1}{15}$
4. Name the property under multiplication used in $\left(\frac{-1}{5} \times \frac{1}{2}\right) \times \frac{1}{3} = \frac{-1}{5} \times \left(\frac{1}{2} \times \frac{1}{3}\right)$
- A) Associative property B) Multiplicative identity
C) Commutative property D) none of these
5. Additive identity of $\frac{2010}{2009}$ is
- A) $-\frac{2009}{2010}$ B) $-\frac{2010}{2009}$ C) -1 D) 0

LEVEL - II

6. A rational number between 2 and 3 is
- A) $\frac{2}{5}$ B) $\frac{4}{3}$ C) $\frac{7}{8}$ D) $\frac{5}{2}$
7. What is the additive inverse of the rational number $\frac{-3}{7}$?
- A) $\frac{3}{7}$ B) $\frac{-3}{7}$ C) $\frac{7}{3}$ D) $\frac{-7}{3}$

8. If 3 times ' $\frac{5}{8}$ ' is added to 4 times ' $\frac{5}{6}$ ', then the result is
- A) $5\frac{5}{24}$ B) $\frac{125}{24}$ C) $\frac{25 \times 5}{3 \times 8}$ D) All
9. If $\frac{3}{4} \times \frac{5}{3} \times \frac{9}{5} \times \frac{a}{b} = \frac{9}{4}$, then the additive inverse of $\frac{a}{b}$ is
- A) $-\frac{1}{4}$ B) $-\frac{1}{9}$ C) -1 D) $-\frac{4}{9}$
10. A rational number between 2 and 3 is
- A) $\frac{2}{5}$ B) $\frac{4}{3}$ C) $\frac{7}{8}$ D) $\frac{5}{2}$

LEVEL - III

11. If $\frac{3}{x} \times \frac{8}{6} \times \frac{12}{9} = \frac{4}{3}$ and $\frac{2}{7} \times \frac{y}{9} \times \frac{27}{4} = 3$, then $\frac{x+2}{y+3}$ is
- A) $\frac{7}{2}$ B) $\frac{2}{7}$ C) $\frac{2}{5}$ D) $\frac{5}{2}$
12. $\frac{1}{15} \div \left(\frac{4}{15} + \frac{1}{3} - \frac{3}{45} \right)$ is equal to
- A) $\frac{45}{4}$ B) $\frac{1}{8}$ C) $\frac{8}{3}$ D) $\frac{4}{45}$
13. What is the product of the multiplicative inverse and the additive inverse of the number $-\frac{3}{2}$?
- A) 1 B) -1 C) $-\frac{2}{3}$ D) $\frac{2}{3}$
14. What is the multiplicative inverse of -0.015?
- A) $-66\frac{2}{3}$ B) -1 C) 0.015 D) $66\frac{2}{3}$
15. The product of two rational numbers is $-\frac{35}{18}$. If one of the numbers is $\frac{5}{12}$, find the other number
- A) $-\frac{3}{14}$ B) $-\frac{7}{12}$ C) $-\frac{3}{14}$ D) $-\frac{14}{3}$



IIT - JEE Advanced Practice Sheet



Reasoning Type:

1. Statement I : $\frac{3}{5}$ and $\frac{9}{15}$ are equivalent rational numbers.

Statement II : $\frac{p}{q}$ and $\frac{p+a}{q+a}$ are equivalent rational numbers.

- A) Both Statement-I and Statement-II are true.
 B) Both Statement-I and Statement-II are false.
 C) Statement I is true, Statement II is false.
 D) Statement I is false, Statement II is true.

Comprehension Type:

If x and y are two rational number then $\frac{x+y}{2}$ is mean of x and y additive inverse of $\frac{a}{b}$ is $\frac{-a}{b}$ and reciprocal of $\frac{a}{b}$ is $\frac{b}{a}$.

2. The mean of $\frac{5}{7}$ and $\frac{7}{5}$ is

- A) $\frac{35}{74}$ B) $\frac{37}{35}$ C) $\frac{65}{30}$ D) $\frac{30}{65}$

3. The additive inverse of $\frac{1004}{2008}$ is

- A) $\frac{2008}{1004}$ B) $-\frac{2008}{1004}$ C) $-\frac{1004}{2008}$ D) 0

4. The reciprocal of $\frac{12345}{6789}$ is

- A) $\frac{23451}{7896}$ B) $\frac{9876}{54321}$ C) $\frac{6789}{12345}$ D) 1

Multi Correct Choice Type:

5. The Rational numbers between $\frac{2}{3}$ and $\frac{3}{4}$ is

- A) $\frac{33}{24}$ B) $\frac{17}{24}$ C) $\frac{17}{48}$ D) $\frac{33}{48}$

6. If $a = 1\frac{3}{4}$ and $b = 1\frac{2}{3}$ then the false statement is

- A) $\frac{a}{b} = \frac{b}{a}$ B) $a \div b \neq b \div a$ C) $a \times b = b \times a$ D) $a \div b \neq ab$

Matrix Match Type:7. **Column-I**

a) $\frac{a}{b} + \frac{c}{d} = \frac{c}{d} + \frac{a}{b}$ is

b) $\frac{a}{b} + 0 = 0 + \frac{a}{b} = \frac{a}{b}$ is

c) $\left[\frac{a}{b} + \frac{c}{d}\right] + \frac{e}{f} = \frac{a}{b} + \left[\frac{c}{d} + \frac{e}{f}\right]$ is

d) $\frac{a}{b} + \left(\frac{-a}{b}\right) = 0$ is

Column-II

p) Closer property over addition

q) Identity property

r) Associative property

s) Existence of additive inverse

t) Commutative property over addition

Integer Answer Type:8. If you add additive inverse of $\frac{-10}{34}$ to additive inverse $\frac{-131}{17}$, then the value obtained is**Subjective Type :**9. The product of two numbers is $\frac{16}{3}$. If one of the numbers is $\frac{-26}{3}$, find the other number.10. By taking $x = \frac{3}{5}$ and $y = \frac{4}{9}$, find out whether $(x + y)^{-1} = x^{-1} + y^{-1}$ is true or false.**NUMBER SYSTEM****LECTURE - 7***Learning Objectives***When you have completed this lecture you should be able to :**

- ◆ Get an idea Decimal Representation of a rational number

**Decimal representation of a rational number**

We can represent a rational number as a decimal number by the long division process

Observe the examples : $\frac{75}{100} = 0.75$, $\frac{1}{2} = 0.5$, $\frac{-2}{5} = -0.4$, $\frac{4}{5} = 0.8$ but $\frac{10}{3} = 3.333\dots$, $\frac{2}{3} = 0.6666\dots$, $\frac{4}{11} = 0.3636\dots$

we have three types of decimals. They are

- Terminating decimals
- Non-terminating and repeating decimals
- Non-terminating and non-repeating decimals

1. In the above examples, $\frac{75}{100}, \frac{1}{2}, \frac{-2}{5}, \frac{4}{5}$ are terminating decimals, i.e., first type.
2. $\frac{10}{3}, \frac{2}{3}, \frac{4}{11}$ are non-terminating and repeating decimals, i.e., second type.
3. Non-terminating and non-repeating decimals are known as irrational numbers. We will study about them later. Repeating decimals are also called recurring decimals.

Criterion for rational numbers to be terminating decimals:

If a rational number (\neq integer) can be expressed in the form $\frac{p}{2^n \times 5^m}$, where $p \in \mathbb{Z}, n \in \mathbb{W}$ and $m \in \mathbb{W}$ the rational number will be terminating decimal. Otherwise, rational number will be non terminating recurring decimal.

Ex: (i) $\frac{3}{8} = \frac{3}{2^3 \times 5^0}$ So, $\frac{3}{8}$ is a terminating decimal.

(ii) $\frac{7}{250} = \frac{7}{2^1 \times 5^3}$ So, $\frac{7}{250}$ is a terminating decimal.

(iii) $\frac{8}{75} = \frac{8}{5^2 \times 3}$ is a non terminating, recurring decimal.

Method of expressing recurring decimals as rational numbers:

The recurring part of the non-terminating recurring decimal is called period and the number of digits in the recurring part is called periodicity.

Ex: $\frac{1}{3} = 0.\overline{3}$ period = 3, periodicity = 1, $\frac{7}{15} = 0.4\overline{6}$ period = 6, periodicity = 1

$\frac{3}{11} = 0.\overline{27}$ period = 27, periodicity = 2,

$\frac{5}{13} = 0.\overline{384615}$, period = 384615, periodicity = 6

We can express non-terminating recurring decimals in the form of rational numbers:

Example : Let us write $0.\overline{125}$ in the form of rational numbers

In $0.\overline{125}$ periodicity = 2, period = 25

So multiply by 10^2 and subtract the number from the product.

Let $0.\overline{125} = x$

$10^2x = 100x = 12.52525.....$

$(-)x = 0.12525.....$

 $99x = 12.4$

$\therefore x = \frac{12.4}{99} = \frac{124}{990} = \frac{62}{495}$

Ex: Let us find the rational form of $0.\overline{428571}$.

The periodicity of the recurring decimal is 6.

So multiply the decimal fraction by 10^6 and subtract the number from the product
 $0.\overline{428571} = x(\text{say})$

$$10^6 x = 1000000x = 428571.\overline{428571}$$

$$(- x) = \quad 0.\overline{428571}$$

$$999999x = 428571$$

$$\therefore x = \frac{428571}{999999} = \frac{3}{7}$$

Method of expressing recurring decimals as rational numbers:

The method of expressing recurring decimals in the form $\frac{p}{q}$ is as follows.

Recurring decimal = (The whole number obtained by writing the digits in their order)-(The whole number made by the non recurring digits in order) (The number of digits after the decimal point)-(The number of digits after the decimal point that do not recur)

Ex: Express $15.0\overline{2}$ as a rational number ?

Sol: Here, the whole number obtained by writing digits in their order = 1502

The whole number made by the non recurring digits in order = 150

The number of digits after the decimal point = 2 (two)

The number of digits after the decimal point do not recur = (one)

$$\therefore 15.0\overline{2} = \frac{1502 - 150}{10^2 - 10^1} = \frac{1352}{100 - 10} = \frac{1352}{90} = \frac{676}{45}$$

Note: Thus, Every rational number can be expressed either as a terminating decimal or Non-terminating repeating decimal. Conversely we can express terminating and non-terminating

but repeating decimals in the rational number form, that is in the form of $\frac{p}{q}$, where $p, q \in \mathbb{Z}$ and $q \neq 0$.

Ordering of Decimals:

First compare the whole number part. If they are the same, compare the tenths digit . If they are also the same, compare the hundredths digits, and so on.

Ex: Compare 3.23 and 3.21.

$$3.23 = 3 \text{ ones} \quad 2 \text{ tenths} \quad 3 \text{ hundredths}$$

$$3.21 = 3 \text{ ones} \quad 2 \text{ tenths} \quad 1 \text{ hundredths.}$$

Compare the whole number part 3 ones = 3 ones.

Compare the tenths digits 2 tenths = 2 tenths.

Compare the hundredths digits 3 hundredths > 1 hundredths.

Therefore $3.23 > 3.21$.

Comparison of Fractions:

Suppose some fractions are to be arranged in ascending or descending order of magnitude. Then, convert each one of the given fractions in the decimal form, and arrange them accordingly.

Suppose, we have to arrange the fractions $\frac{3}{5}$, $\frac{6}{7}$ and $\frac{7}{9}$ in descending order.

Now, $\frac{3}{5} = 0.6$, $\frac{6}{7} = 0.857\dots$, $\frac{7}{9} = 0.777\dots$ Since $0.857\dots > 0.777\dots > 0.6$, so $\frac{6}{7} > \frac{7}{9} > \frac{3}{5}$.

NUMBER SYSTEM

PRACTICE SHEET - 7



Conceptual Practice Sheet



Single Response Type:

- The periodicity of the decimal form of $\frac{1}{17}$ is
 A) 15 B) 16 C) 10 D) 4
- Which of the following is false?
 A) $4.06 > 4.006$ B) $6.87 < 6.807$ C) $0.98 < 1$ D) $7.805 < 7.85$
- If $400 + 60 + 5 + 0.1 + 0.06 + 0.009$ is simplified, then the answer is
 A) 465.619 B) 456.619 C) 465.169 D) 465.961
- $0.47, 0.047, 0.0047, 0.00047$ are in _____ order
 A) descending B) ascending C) irregular D) none
- Express the $0.\overline{053}$ as fractions.
 A) $\frac{53}{990}$ B) $\frac{53}{999}$ C) $\frac{53}{900}$ D) $\frac{53}{1000}$



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

- $0.23, 6.27, 5.63, 9.01$ are called _____ decimals.
 A) complex B) unlike C) like D) Vulgar
- Annexing zeros to the extreme right of the decimals point of a decimal ___ its value.
 A) changes B) does not change C) decreases D) increases

3. The decimal form of $\frac{87}{32}$ is
 A) 2.7125 B) 2.18725 C) 2.71875 D) 2.77815
4. If $40 + 1 + \frac{6}{10} + \frac{3}{1000} + \frac{9}{10000}$ is expressed in decimal form, then the answer is
 A) 41.639 B) 41.66309 C) 41.6039 D) 41.006039
5. 0.00063, 0.0063, 0.063, 0.63 are in _____ order
 A) descending B) ascending C) irregular D) none

LEVEL - II

6. In the division process if the Rational number represent nonterminating repeating decimal then the remainder is
 A) 0 B) 1 C) 2 D) Con't be determined
7. The decimals 2.2, 2.02, 0.22, 0.02, 0.202, 2.002 in ascending order is
 A) $0.02 < 0.202 < 0.22 < 2.02 < 2.002 < 2.2$ B) $0.02 < 0.202 < 2.02 < 0.22 < 2.002 < 2.2$
 C) $0.02 < 0.202 < 0.22 < 2.002 < 2.02 < 2.2$ D) $0.02 < 2.02 < 0.22 < 2.002 < 0.202 < 2.2$
8. If $A = 14 + \frac{9}{100} + \frac{8}{1000}$, $B = 14 + \frac{9}{10} + \frac{8}{100} + \frac{6}{1000}$, $C = 14 + \frac{9}{100} + \frac{8}{1000} + \frac{2}{10000}$, then the larger one is
 A) A B) B C) C D) None
9. The value of $0.\overline{23} \times 1000 =$
 A) $23.\overline{23}$ B) $232.\overline{32}$ C) $2.\overline{32}$ D) 232.32
10. The fractions $\frac{3}{5}$, $\frac{4}{7}$, $\frac{8}{9}$ and $\frac{9}{11}$ in their descending order is
 A) $\frac{8}{9} > \frac{9}{11} > \frac{3}{5} > \frac{4}{7}$ B) $\frac{9}{11} > \frac{3}{5} > \frac{4}{7} > \frac{8}{9}$ C) $\frac{3}{5} > \frac{9}{11} > \frac{8}{9} > \frac{4}{7}$ D) $\frac{8}{9} > \frac{4}{7} > \frac{9}{11} > \frac{3}{5}$

LEVEL - III

11. If $4 \times 10^3 + 5 \times 10^2 + 6 \times 10 + 8 \times \frac{1}{10} + 9 \times \frac{1}{100} + \frac{8}{1000}$ is simplified, then the answer is
 A) 4560.898 B) 456.898 C) 45600.898 D) 4560.8098
12. Express $2.5\overline{36}$ as fractions
 A) $\frac{2283}{999}$ B) $\frac{2283}{990}$ C) $\frac{2283}{900}$ D) $\frac{2283}{9000}$
13. Express the $0.3\overline{75}$ rational number as ratio of two integers, whose decimal expansions
 A) $\frac{167}{450}$ B) $\frac{153}{450}$ C) $\frac{159}{450}$ D) $\frac{169}{450}$

14. If $\frac{15277}{2000}$ is expressed as decimal, then the answer is
 A) 7.6285 B) 7.6485 C) 7.6385 D) 7.6185
15. The fractions $\frac{5}{8}, \frac{7}{12}, \frac{13}{16}, \frac{16}{29}$ and $\frac{3}{4}$ in ascending order is
 A) $\frac{16}{28} < \frac{7}{10} < \frac{5}{8} < \frac{3}{4} < \frac{13}{16}$ B) $\frac{16}{29} < \frac{7}{12} < \frac{5}{8} < \frac{3}{4} < \frac{13}{16}$
 C) $\frac{16}{29} < \frac{5}{8} < \frac{7}{12} < \frac{13}{16} < \frac{3}{4}$ D) $\frac{7}{12} < \frac{5}{12} < \frac{16}{29} < \frac{3}{4} < \frac{13}{16}$



IIT - JEE Advanced Practice Sheet



Reasoning Type:

1. Statement I : If $A = 3 \times 10^3 + 7 \times 10^2 + 5 \times 10^1 + \frac{8}{100} + \frac{9}{1000} + \frac{3}{10000}$ and
 $B = 3 \times 10^3 + 7 \times 10^2 + 5 \times 10^0 + \frac{8}{10} + \frac{9}{100} + \frac{3}{1000} + \frac{5}{10000}$, then $A = B$

Statement II : A decimal has two parts- whole number part and decimal part.

- A) Both Statements are true, Statement II is the correct explanation of Statement I.
 B) Both Statements are true, Statement II is not correct explanation of Statement I.
 C) Statement I is true, Statement II is false.
 D) Statement I is false, Statement II is true.

Comprehension Type:

1. If $A = \frac{14}{70}$, $B = \frac{28}{70}$, $C = \frac{1}{25}$ and $D = \frac{3}{20}$
2. The ascending order of given is
 A) A, B, C, D B) C, D, A, B C) D, A, B, C D) C, A, D, B
3. The greatest of all the given is
 A) D B) C C) B D) A
4. The smallest of all the given is
 A) D B) C C) B D) A

Multi Correct Choice Type:

5. 5.307 is greater than
 A) 5.703 B) 5.370 C) 5.073 D) 5.037
6. Which of the following fractions has a terminating decimal representation.
 A) $\frac{62}{125}$ B) $\frac{63}{90}$ C) $\frac{326}{400}$ D) $\frac{39}{60}$

Matrix Match Type:

- | 7. Column - I | Column - II |
|--|-------------|
| a) Number of decimal places of 12.38 | p) 2 |
| b) Number of decimal places of 1321.28 | q) 1 |
| c) Number of decimal places of 281.238 | r) 3 |
| d) Number of decimal places of 8.231 | s) 4 |
| | t) 5 |

Integer Answer Type:

8. The digits in decimal part of 286 is _____

Subjective Type :

9. Express $15.\overline{712}$ in the form of $\frac{a}{b}$.
10. Write the decimal $6.\overline{28}$ as a rational number.

EXTRA EDGE**Single Response Type:**

1. Which of the following statements is correct?
- A) $\frac{2}{5}$ is the additive inverse of $-\frac{5}{2}$ B) The multiplicative inverse of $-\frac{3}{7}$ is $\frac{7}{3}$
- C) Integers are commutative for subtraction
- D) Rational numbers are commutative for multiplication
2. What is the product of the additive inverse of 0.8 and the multiplicative inverse of 0.2?
- A) -4 B) 5 C) $\frac{1}{4}$ D) $-\frac{1}{5}$
3. The reciprocal of $\frac{-3}{8} \times \frac{-7}{13}$ is _____
- A) $\frac{104}{21}$ B) $\frac{-21}{104}$ C) $\frac{104}{24}$ D) $\frac{39}{56}$
4. If $P = -\sqrt{\frac{7}{3}}$, $Q = \sqrt{\frac{6}{2}}$, $R = \sqrt{5}$ and $S = \sqrt{\frac{25}{4}}$, then the rational number among the following is
- A) P B) Q C) R D) $\sqrt{\frac{25}{4}}$
5. $N \cup (W - N) \cup I = X$, then X is
- A) Q B) I⁻ C) I⁺ D) I

6. A vehicle uses $2\frac{2}{5}$ litres of petrol in 1 hour. How many litres of petrol will be required to run the vehicle for $3\frac{1}{2}$ hours ?
- A) $\frac{42}{6}$ litres B) $8\frac{2}{5}$ litres C) $3\frac{1}{2}$ litres D) $\frac{12}{5}$ litres
7. What is the multiplicative inverse of the number $-\left[\frac{a+b}{a-b}\right]$?
- A) $\frac{b-a}{a+b}$ B) $\frac{a-b}{a+b}$ C) $\frac{a+b}{a-b}$ D) $\frac{a+b}{b-a}$
8. What is the additive inverse of the value of the expression $\left[\frac{2}{5} + \left(\frac{-9}{7}\right) + \left(\frac{-4}{11}\right) + \frac{6}{5}\right]$?
- A) $\frac{616}{385}$ B) $\frac{19}{385}$ C) $-\frac{61}{55}$ D) $-\frac{8}{5}$
9. The value of $3.\overline{87} - 2.\overline{59}$ is
- A) 1.20 B) $1.\overline{2}$ C) $1.\overline{27}$ D) $1.\overline{28}$
10. The rational number between $\frac{a}{b}$ and $\frac{c}{d}$ where $a = 4 + 2 \times 3$, $b = 25 \div 5$, $c = 8 \times (4 \div 2)$, and $d = \frac{3}{5} \times 15$ is
- A) $\frac{13}{7}$ B) $\frac{14}{7}$ C) $\frac{19}{7}$ D) $\frac{17}{7}$
11. $2.3\overline{134}$ is simplified into $\frac{p}{q}$ form, then the fraction obtained is
- A) $\frac{22902}{9900}$ B) $\frac{22903}{9900}$ C) $\frac{22904}{9900}$ D) $\frac{22905}{9900}$
12. The true statement in the following is
- A) $\frac{5}{7} < \frac{7}{9} < \frac{9}{11} < \frac{11}{13}$ B) $\frac{11}{13} < \frac{9}{11} < \frac{7}{9} < \frac{5}{7}$ C) $\frac{5}{7} < \frac{11}{13} < \frac{7}{9} < \frac{9}{11}$ D) $\frac{5}{7} < \frac{9}{11} < \frac{11}{13} < \frac{7}{9}$
13. The equivalent fractions of $\frac{p}{q}$ are $\frac{50}{75}, \frac{80}{120}, \frac{56}{84}$, then $\frac{p}{q}$ is
- A) $\frac{2}{5}$ B) $\frac{2}{3}$ C) $\frac{2}{7}$ D) $\frac{2}{9}$
14. If non zero whole numbers are represented by y then y is
- A) N B) I C) Q D) R
15. If 'p' has an inverse in addition, then it is not present in
- A) W, Z B) N, Z C) N, W D) Z, Q

FOUNDATION PHYSICS

SAMPLE CHAPTER



MEASUREMENT

Chapter Out Line

- Introduction to Measurement
- Quantity and Physical Quantity
- Unit and Standard Unit
- Fundamental Physical quantities
- Derived Physical quantities
- Multiples and Submultiples of units
- Practical units of length, mass and time
- Measurement of Length Vernier callipers
- Screw gauge
- Simple Pendulum
- Dimensions and Dimensional Formula
- Trigonometrical Ratios
- Trigonometric Identities



MEASUREMENT

LECTURE - 1

Learning Objectives

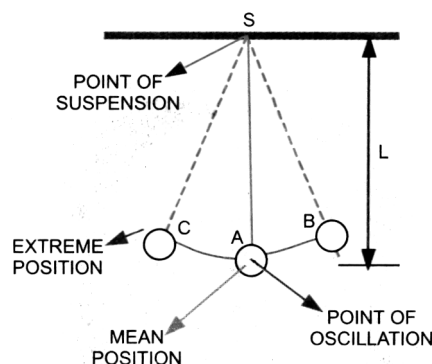
When you have completed this lecture you should be able to :

- ◆ Know about the concept of time.
- ◆ Understand the terms connected with a simple pendulum.
- ◆ Grasp the concept behind the Second's pendulum.



Simple pendulum is a device used for measuring time period.

Simple pendulum : A simple pendulum consists of a small metal ball (called bob) suspended by a long thread from a rigid support, such that the bob is free to swing back and forth.



A simple pendulum.

Terms connected with a simple pendulum :

- a) **Oscillation :** The complete to and fro motion of the pendulum constitutes one complete oscillation. The pendulum is said to have completed one oscillation if it moves from one extreme position to the other and back.
- b) **Time Period :** The time taken by the pendulum to make one complete oscillation.
- c) **Frequency of Oscillation :** The number of oscillations made by pendulum in one second is called the frequency of oscillation.

Mathematically, Time period is equal to the reciprocal of time period.

- d) **Amplitude :** The maximum displacement of a pendulum from its mean position is called amplitude.
- e) **Effective Length :** The length between point of suspension and centre of gravity of bob of a pendulum is called effective length.
- f) **Mean position of the pendulum :** It is the position of the pendulum when it is at rest.
- g) **Extreme position :** It is maximum distance, on both sides of the mean position, upto which the pendulum can vibrate.

Factors on which time period depends :

- a) **Length of pendulum :** The time period varies directly with the square root of the effective length. If the effective length of the pendulum is l and the time period T , then at a given place,

$$T \propto \sqrt{l}$$

If l_1 and l_2 are the lengths of two pendulums at a given place, such that T_1 and T_2 are the time periods, then : $T_1 \propto \sqrt{l_1}$; $T_2 \propto \sqrt{l_2}$ $\therefore \frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}}$

- b) Acceleration due to gravity :** The time period varies inversely with the square root of the acceleration due to gravity provided length of the pendulum is constant.

If the time period be T and the acceleration due to gravity at a place be g , then $T \propto \sqrt{\frac{1}{g}}$

If T_1 is the time period of pendulum, where acceleration due to gravity is g_1 , and T_2 is the time period, where acceleration due to gravity is g_2 , then

$$T_1 \propto \sqrt{\frac{1}{g_1}} ; T_2 \propto \sqrt{\frac{1}{g_2}} \therefore \frac{T_1}{T_2} = \sqrt{\frac{g_2}{g_1}}$$

Combining (1) and (2), we get

$$T \propto \sqrt{\frac{l}{g}} \quad \text{or} \quad T = 2\pi \sqrt{\frac{l}{g}}, \text{ where } 2\pi \text{ is the constant of proportionality.}$$

Note :

It should be noted here that the time period of a simple pendulum is independent of the material and mass of the bob. It is also independent of the amplitude, provided this is not too great. As a matter of fact amplitude should not exceed 5° .

Second's pendulum : A pendulum which has a time period (T) of two seconds, is called a second's pendulum. It is used in a pendulum clock.

$$\text{We know, } T = 2\pi \sqrt{\frac{l}{g}} \quad \text{or} \quad T^2 = 4\pi^2 \frac{l}{g} \quad \text{or} \quad l = \frac{gT^2}{4\pi^2} \quad (g = 9.8 \text{ m s}^{-2})$$

$$T = 2.0 \text{ s (Second's pendulum)} \quad l = \frac{9.8 \text{ m s}^{-2} \times (2\text{s})^2}{4 \times \left(\frac{22}{7}\right)^2} = 0.992 \text{ m} = 99.2 \text{ cm} \approx 100 \text{ cm} = 1 \text{ m}$$

Thus, on the surface of the earth, a simple pendulum having a length of 99.2 cm will have a time period of 2 seconds.

Important Points

- Simple pendulum is a device used for measuring time.
- The complete to and fro motion of the pendulum constitutes one complete oscillation.
- The number of oscillations made by pendulum in one second is called the frequency of oscillation
- $T = 2\pi \sqrt{\frac{l}{g}}$
- **Time :** The interval between two events is called time.
- **Time Period :** The time taken by the pendulum to make one complete oscillation.

- **Amplitude** : The maximum displacement of a pendulum from its mean position.
- **Second's pendulum** : A pendulum which has a time period (T) of two seconds.

MEASUREMENT

PRACTICE SHEET - 1



Conceptual Practice Sheet



Fill in the blanks Type:

1. _____ is a device used for measuring time.
2. The number of oscillations made by pendulum in one second is called the _____.
3. Mathematically, Time period is equal to the _____.
4. The length between point of suspension and centre of gravity of bob of a pendulum is called _____.
5. Length of seconds pendulum is approximately _____
6. One complete oscillation means _____



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

1. The time taken by the pendulum to make one complete oscillation is ____
A) Oscillation B) frequency C) time period D) none
2. The maximum displacement of a vibrating body from its mean position is called its
A) Time period B) Extreme position C) Amplitude D) Frequency
3. The time period of seconds pendulum is
A) 1 s B) 2 s C) 3 s D) 4 s
4. The time period of the simple pendulum at a given place is proportional to
A) \sqrt{l} B) l C) $\frac{1}{l}$ D) $\frac{1}{\sqrt{l}}$
5. The time period of the simple pendulum at a given place is proportional to
A) \sqrt{g} B) g C) $\frac{1}{g}$ D) $\frac{1}{\sqrt{g}}$

LEVEL - II

6. If the amplitude of a pendulum (which is very small initially) is doubled, its periodic time
A) does not change B) is doubled C) is halved D) increases four times
7. A person sitting on a swing stands up, then the time period of swing
A) increases B) decreases C) does not change D) becomes zero
8. Time period of a pendulum doesnot depend on
A) mass B) amplitude C) size D) all the above

9. The amplitude of a pendulum is 2m. the distance covers in one complete oscillation is ____
A) zero B) 4 m C) 6 m D) 8 m
10. The period of pendulum whose length is 1m is
A) about 2 seconds B) about 1 second C) about 9.8 seconds D) about 4.9 seconds

LEVEL - III

11. If the length of the pendulum is made four times at a given place, the period of pendulum
A) is halved B) is doubled C) becomes four times D) become one fourth
12. The amplitude of a pendulum is A. The distance covered in one complete oscillation is
A) 0 B) A C) 2A D) 4A
13. The length of a second's pendulum is 80 cm. What should be the length, if the time period is 1.6 sec ?
A) 52.1 cm B) 51.2 cm C) 12.5 cm D) 21.5 cm
14. When a pendulum is taken from earth to moon surface, its time period will
A) increases B) decreases C) remain same D) be infinite
15. The bob of an oscillating pendulum passes through the mean position 100 times in 100 s. The time period of the pendulum is
A) 4.0 s B) 2.0 s C) 1.0 s D) 0.5 s
16. What will be the time period of a simple pendulum of length 1.12 m, when acceleration due to gravity is 9.8m/s^2 ?
A) 22.1 s B) 1.12 s C) 12.2 s D) 2.12 s
17. The time periods of two pendulums is 2 s and 3 s respectively at a given place, then what will be the ratio of their lengths ?
A) 4 : 9 B) 9 : 4 C) 2 : 3 D) 3 : 2
18. A pendulum 100 cm and another pendulum 4 cm long are oscillating at the same time, the ratio of their time periods is
A) 1 : 5 B) 1 : 1 C) 1 : 5 D) 5 : 1

**IIT - JEE Advanced Practice Sheet****Statement Type:**

1. Statement I : The time period varies directly with the square root of the effective length
Statement II : The time period varies inversely with the square root of the effective length
A) Both statements I and II are correct.
B) Both statements I and II are incorrect.
C) Statement I is correct and statement II is incorrect.
D) Statement I is incorrect and statement II is correct.

Linked Comprehensive Type:

The time period of the simple pendulum at a given place is proportional to \sqrt{l}

2. What will be the ratio of time periods of two pendulums at a given place of lengths 1m and 9m ?
 A) 1 : 2 B) 2 : 1 C) 1 : 3 D) 3 : 1
3. If the length of the simple pendulum at a given place is made one fourth, its time period becomes
 A) four times B) one fourth C) double D) half
4. If the time periods of two simple pendulums at a given place are in ratio 2 : 1 what will be the corresponding ratio of their lengths ?
 A) 4 : 1 B) 1 : 4 C) 2 : 1 D) 1 : 2

Multi Response Type:

5. Choose the correct statements:
 A) The length between point of suspension and centre of gravity of bob of a pendulum is called effective length
 B) The number of oscillations made by pendulum in one second is called the frequency of oscillation.
 C) The length between point of suspension and centre of gravity of bob of a pendulum is called frequency oscillation
 D) The number of oscillations made by pendulum in one second is called the effective length.;
6. Choose the correct statements :
 A) The period of oscillation does not depend on the mass or material of the body suspended.
 B) The period of oscillation does not depend on amplitude.
 C) At a given place, since g is constant, the period of a particular pendulum is constant.
 D) A pendulum with a period of oscillation equal to two second, is known as a seconds pendulum.

Match the following/ Matrix Matching:

7. **Column-I**
 a) Second's pendulum
 b) Time period of a simple pendulum
 c) Amplitude
 d) Acceleration due to gravity on surface of earth
- Column-II**
 p) Directly proportional to $l^{1/2}$
 q) Inversely proportional to g
 r) 9.8 m/s^2
 s) Maximum displacement of the pendulum
 t) Time period = 2 sec.



MEASUREMENT

LECTURE - 2

Learning Objectives

When you have completed this lecture you should be able to :

- ◆ Understand the concept of dimensional formula and dimensions.
- ◆ Understand the dimensional formula of some physical quantities.



The dimension of physical quantities indicates the nature of the constitution of quantities. In other words, dimension of a physical quantity indicates how it relates to one of the seven basic/ fundamental quantities. Basic quantities are the seven dimensions of the physical quantities.

Dimensions:

Dimensions of a physical quantity are the powers with which basic quantities are raised to represent it. The dimension of a physical quantity in an individual basic quantity is the power with which that basic quantity is raised in the dimensional representation of physical quantity. We should be clear here that the dimension is not merely a power, but a combination of basic quantity and its power. Both are taken together and hence represented together. We may keep in mind that units follow dimensional constitution. Speed, for example, has dimension of 1 in length and dimension of -1 in time and hence its unit is m/s.

A pair of square bracket is used to represent the dimension of individual basic quantity with its symbol enclosed within the bracket. There is a convention in using symbol of basic quantities. The dimensions of seven basic quantities are represented as Mass $\rightarrow [M]$; Length $\rightarrow [L]$; Time $\rightarrow [T]$; Electric current $\rightarrow [I]$; Thermodynamic temperature $\rightarrow [K]$; Intensity of light $\rightarrow [cd]$; Quantity of matter $\rightarrow [mol]$.

Dimensional formula: Dimensional formula of a derived physical quantity is the “expression showing powers to which different fundamental units are raised”.

To understand the concept of dimensions

Momentum = mass \times velocity = mass $\times \frac{\text{displacement}}{\text{time}}$ or

$$P = M \times \frac{L}{T} \quad (\text{where } M - \text{mass, } L - \text{length and } T - \text{time}). \quad \text{So, we write } P = [M L T^{-1}]$$

In physics, this representation is called the dimensional way of representation or simply dimensional formula of momentum and the indices (1,1,-1) are the dimensions of momentum.

In other words, any physical quantity can be expressed in terms of fundamental physical quantities like length, mass, time....

In doing so, the fundamental quantities have to be raised to certain power. And the number showing the power to which the fundamental quantity has to be raised is called the ‘dimension’ of that physical quantity.

In the above example, the dimension of mass is 1, the dimension of length is 1 and the dimension of time is -1. Therefore $P = [M L T^{-1}]$

$P = [M L T^{-1}]$ is called Dimensional formula of momentum.

Q: How can you derive Dimensional formula of a derived physical quantity?

Ans: We can derive dimensional formula of any derived physical quantity in two ways

i) Using the formula of the physical quantity:

Ex: let us derive dimensional formula of Force .

Force $F = ma$; substitute the dimensional formula of mass $m \rightarrow [M]$; acceleration $\rightarrow [L^1T^{-2}]$
we get $F \rightarrow [M^1][L^1T^{-2}]$ $F \rightarrow [M^1L^1T^{-2}]$

ii) Using the units of the derived physical quantity:

Ex: let us derive the dimensional formula of momentum.

Unit of Momentum (p) $\rightarrow [kg \text{ ms}^{-1}]$;

kg is unit of mass $\rightarrow [M]$; m is unit of length $\rightarrow [L]$; sec is the unit of time $\rightarrow [T]$

Substitute these dimensional formulas in above equation we get $p \rightarrow [M^1L^1T^{-1}]$.

Quantities having no units, can not possess dimensions: Trigonometric ratios, logarithmic functions, exponential functions, coefficient of friction, strain, poisson's ratio, specific gravity, refractive index, Relative permittivity, Relative permeability. All these quantities neither possess units nor dimensional formulas.

Quantities having units, but no dimensions: Plane angle, angular displacement, solid angle. These physical quantities possess units but they does not possess dimensional formulas.

Quantities having both units & dimensions: The following quantities are examples of such quantities. Area, Volume, Density, Speed, Velocity, Acceleration, Force, Energy etc.

Physical Constants: These are two types

- i) Dimension less constants (value of these constants will be same in all systems of units): Numbers, pi, exponential functions are dimension less constants.
- ii) Dimensional constants (value of these constants will be different in different systems of units): Universal gravitational constant (G), plank's constant (h), Boltzmann's constant (k), Universal gas constant (R), Permittivity of free space (ϵ_0) , Permeability of free space (μ_0), Velocity of light (c).

Method for finding dimensional formulae:

Step I : Write the formula of physical quantity.

Step II : Convert the formula in fundamental physical quantity.

Step III : Write the corresponding symbol for fundamental quantities.

Step IV : Make proper algebraic combination and get the result.

Ex : The product of length and breadth of a surface gives its area.

Sol: Area = length \times breadth = $L \times L = L^2$ (or) $[M^0 L^2 T^0]$

Thus dimensional formula of area is $[M^0 L^2 T^0]$ (or) $[L^2]$, dimensions of area are : zero each in mass and time and 2 in length . Unit of area is obtained by raising the unit of length to 2nd power.

Ex : The product of length, breadth and height of a body gives its volume.

Sol: \therefore Volume = length \times breadth \times height = length \times length \times length = $L \times L \times L = L^3$ (or) $[M^0 L^3 T^0]$

Thus dimensional formula of volume is $[M^0 L^3 T^0]$ (or) $[L^3]$.

Dimensions of volume are 3 in length and zero each in mass and time. Unit of volume is obtained by raising the unit of length to third power.

Ex : The quotient of mass and volume of a body gives its density.

Sol: \therefore Density = Mass /volume = Mass/ (length)³ = M¹L⁻³

Thus dimensional formula of density is [M¹ L⁻³ T⁰]

Dimensions of density are 1 in mass, -3 in length and zero in time. Unit of density is obtained by raising the unit of mass to 1st power and unit of length to - 3 power.

In general dimensional formula of a quantity can be written as [M^a L^b T^c].

Thus the quantity has ath dimension in mass, bth dimension in length, and cth dimension in time.

Note: The dimension of fundamental quantities other than mass, length, time (i.e., Electric Current, Temperature, Amount of substance and Luminous intensity) is 0.

Ex : Write down the basic dimensions of pressure p.

Sol: Pressure is defined as P = Force/ Area

The S.I unit of pressure is the Pascal which is the name for 1 N/m².

Since force is MLT⁻² and area is L² then the basic dimensions of pressure are ML⁻¹T⁻².

When solving problems it is useful to use a notation to indicate the MLT dimensions of a quantity and in this case we would write. [P] = [ML⁻¹T⁻²]

Ex: If velocity (V), time (T) and force (F) were chosen as basic quantities, find the dimensions of mass.

Sol: Dimensionally : Force = mass × acceleration

Force = mass × velocity / time \Rightarrow Mass = Force × time/ velocity \Rightarrow mass = FTV⁻¹

Dimensional formula of some physical quantities:

S.no	Physical Quantity	General formula	Dimensional formula	S.I unit
1	area	length×breadth	[M ⁰ L ² T ⁰]	m ²
2	volume	length×breadth×height	[M ⁰ L ³ T ⁰]	m ³
3	density	mass/volume	[M L ⁻³ T ⁰]	kg m ⁻³
4	speed, velocity	distance/time	[M ⁰ L T ⁻¹]	ms ⁻¹
5	acceleration	change in velocity/time	[M ⁰ L T ⁻²]	ms ⁻²
6	momentum	mass×velocity	[M L T ⁻¹]	kg ms ⁻¹
7	force		[M L T ⁻²]	newton (N)
8	impulse	force×time	[M L T ⁻¹]	kg ms ⁻¹
9	work, energy	force×distance	[M L ² T ⁻²]	joule(J) or kgm ² s ⁻²
10	power	work/time	[M L ² T ⁻³]	watt (W)
11	pressure	force/area	[M L ⁻¹ T ⁻²]	Nm ⁻² (Pa)
12	Weight	w=mg	[M L ¹ T ⁻²]	newton (N)
13	Specific Gravity	density of substance / density of water	[M ⁰ L ⁰ T ⁰]	No units
14	Moment of force	force×arm	[M L ² T ⁻²]	joule(J) or kgm ² s ⁻²
15	Frequency	no of vibrations/time	[M ⁰ L ⁰ T ⁻¹]	hertz
16	Angle	Arc/radius	[M ⁰ L ⁰ T ⁰]	N0 units

Important Points

- **Dimensional formula** : The expression showing the powers to which the fundamental units are to be raised to obtain one unit of a derived quantity is called dimensional formula of that derived quantity.
- **Dimensions** : The dimensions of a physical quantity are the powers to which the fundamental units are to be raised to obtain one unit of that quantity.
- The dimensional formula of volume is L^3 (or) $[M^0 L^3 T^0]$
- The dimensional formula of area is L^2 (or) $[M^0 L^2 T^0]$
- The dimensional formula of density is $[M^1 L^{-3} T^0]$

MEASUREMENT

PRACTICE SHEET -2



Conceptual Practice Sheet



Fill in the blanks Type:

- Dimension of length in spring constant (Hint: Spring constant $k=F/x$)=_____.
- The dimensions of force are _____.
- Power has _____ dimensions in length.

True/ False Type:

- Physical quantity which is a ratio of two quantities of same dimension will be dimensionless.
- Planck's Constant is a dimensional constant.
- A quantity has different dimensions in different systems of units.



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

- The dimension of electric current is represented as ____
 A) [E] B) [C] C) [I] D) [D]
- The dimension of thermodynamic temperature is represented as ____
 A) [T] B) [cd] C) [I] D) [K]
- The dimension of quantity of matter is represented as ____
 A) [T] B) [cd] C) [mol] D) [K]
- Which of the following quantities having units, but no dimensions ?
 A) angular displacement B) refractive index
 C) Density D) logarithmic functions
- Which of the following quantities having no units, can not possess dimensions ?
 A) strain B) refractive index C) logarithmic functions D) all of these

LEVEL - II

6. Which of the following quantities is/are dimension less constants ?
 A) Force B) exponential functions C) pi D) Both B and C
7. Which of the following quantities is/are Dimensional constants ?
 A) specific gravity B) plank's constant (h)C) strain D) Both B and C
8. The dimensional formula of weight is
 A) $[M^0 L T^2]$ B) $[M^0 L T^{-1}]$ C) $[M^1 L^1 T^{-3}]$ D) $[M^1 L^1 T^{-2}]$
9. The dimensional formula of frequency is
 A) $[M^0 L T^2]$ B) $[M^0 L^0 T^{-1}]$ C) $[M^1 L^0 T^{-3}]$ D) $[M^1 L^0 T^{-2}]$
10. The dimensional formula of heat is
 A) $[M^0 L T]$ B) $[M^1 L^2 T^{-2}]$ C) $[M L^{-3} T^0]$ D) $[M^0 L T^{-2}]$

LEVEL - III

11. The dimensional formula of density is
 A) $[M^0 L T]$ B) $[M^0 L T^{-1}]$ C) $[M L^{-3} T^0]$ D) $[M^0 L T^{-2}]$
12. The dimensional formula of velocity is
 A) $[M^0 L T]$ B) $[M^0 L T^{-1}]$ C) $[M L T^{-1}]$ D) $[M^0 L T^{-2}]$
13. The dimensional formula of pressure is
 A) $[M L^2 T^2]$ B) $[M^0 L T^{-1}]$ C) $[M L^{-1} T^{-2}]$ D) $[M^1 L^1 T^{-2}]$
14. A unit less quantity
 A) Never has a non zero dimension B) Always has a non zero dimension
 C) May have a non zero dimension D) Does not exist
15. Among the following which pairs has same dimensions?
 A) Angle and specific gravity B) Force and pressure
 C) Work and force D) Energy and momentum
16. Which of the following quantities have zero dimensions in length ?
 A) speed B) volume C) Force D) Specific Gravity



IIT - JEE Advanced Practice Sheet

**Assertion and Reasoning Type:**

1. **Assertion** : The expression showing the powers to which the fundamental units are to be raised to obtain one unit of a derived quantity is called dimensional formula of that derived quantity.
Reason : The dimensions of a physical quantity are the powers to which the fundamental units are to be raised to obtain one unit of that quantity.
- A) Both Assertion and Reason are true, Reason is the correct explanation of Assertion
 B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion
 C) Assertion is true and reason is false.
 D) Assertion is false and reason is true.

2. Statement I : The dimensional formula for the angle is the same as that for strain and relative density
Statement II: The dimensional formula for the refractive index is the same as that for volume.
- A) Both statements I and II are correct.
B) Both statements I and II are incorrect.
C) Statement I is correct and statement II is incorrect.
D) Statement I is incorrect and statement II is correct.

Linked Comprehensive Type:

The expression showing the powers to which the fundamental units are to be raised to obtain one unit of a derived quantity is called dimensional formula of that derived quantity.

3. The dimensional formula of area is
A) $[M^0 L^0 T^{-1}]$ B) $[M^0 L T^{-1}]$ C) $[M^0 L^2 T^0]$ D) $[M L^2 T^0]$
4. The dimensional formula of force is
A) $[M^0 L T^2]$ B) $[M^0 L T^{-1}]$ C) $[M^1 L^1 T^{-3}]$ D) $[M^1 L^1 T^{-2}]$
5. The dimensional formula of acceleration due to gravity is
A) $[M^0 L T]$ B) $[M^0 L T^{-1}]$ C) $[M L T^{-1}]$ D) $[M^0 L T^{-2}]$

Multi Response Answer (s) Type:

6. Which of the following quantities have zero dimensions in mass.
A) area B) volume C) density D) speed
7. Choose the correct statement (s).
A) All quantities may be represented dimensionally in terms of the base quantities
B) All base quantity cannot be represented dimensionally in terms of the rest of the base quantities
C) The dimension of a base quantity in other base quantities is always zero.
D) The dimension of a derived quantity is never zero in any base quantity.

Match the following/ Matrix Matching:

- | 8. Column - I | Column - II |
|--|--------------------|
| a) Dimensional formula of Distance | p) $[M^0 L^0 T]$ |
| b) Dimensional formula of angle | q) $[M L^0 T^0]$ |
| c) Dimensional formula of mass | r) $[M^0 L T^0]$ |
| d) Dimensional formula of specific gravity | s) $[M^0 L^0 T^0]$ |



MEASUREMENT

LECTURE - 3

Learning Objectives

When you have completed this lecture you should be able to know :

- ◆ Measurement of length
- ◆ Vernier callipers



The meter scale enables us to measure the length to the nearest millimeter only. Engineers and scientists need to measure much smaller distances accurately. For this a special type of scale called Vernier scale is used.

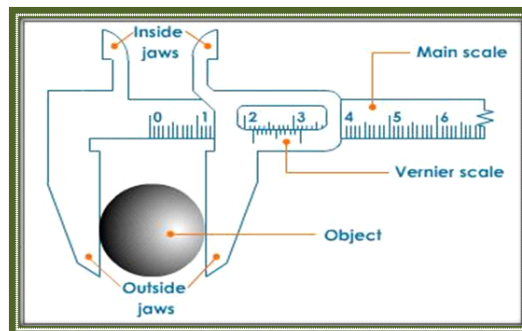
Vernier callipers: A vernier callipers is also called slide callipers. Vernier callipers was invented by Pierre vernier.

Vernier callipers is an instrument by which we can measure the smallest length upto $\frac{1}{10}$ th of a mm = 0.1 mm = 0.01 cm

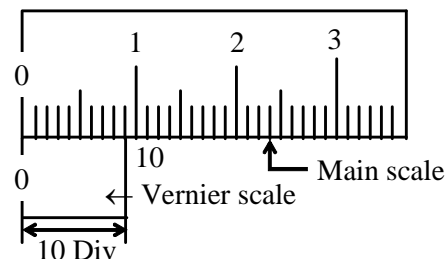
Description of Vernier Callipers:

Following are the essential parts of vernier callipers :

- a) **Main Scale:** It is a thin long strip of steel on which a scale is engraved in mm. The main scale is generally 15 cm long.



- b) **Vernier Scale:** It is small movable scale of steel, which can slide along the main scale. It has 10 divisions marked on it, such that total length of 10 divisions is equal to 9mm. In other words, 10 vernier scale divisions coincide with nine main scale divisions. The vernier scale can be fixed in any desired position along the main scale by tightening the screw .



- c) **External Jaws:** The jaws used for measuring outer dimensions such as external length, external diameter of a cylinder, a sphere, etc. are called the external jaws. One of the external jaws is fixed to main scale and is commonly called fixed jaw. The other external jaw is fixed to vernier scale and is commonly called movable jaw. The object whose outer dimensions are to be measured is held tightly between the external jaws.

- d) **Internal Jaws** : The jaws for measuring the inner dimensions of an object, such as the internal diameter of a hollow cylinder etc., are called internal jaws. One of the internal jaws is fixed to main scale and is commonly called fixed internal jaw. The other internal jaw is fixed to vernier scale and is commonly called movable internal jaw.
- e) **Tail**: It is connected to vernier scale from behind and can slide back and forth along with the vernier scale. It is used to measure internal depth of cylinders or hollow tubes

Principle of vernier : The principle of a vernier to make N vernier scale division equal to (N-1) main scale divisions.

Note: Generally $10 \text{ V.S.D} = 9 \text{ M.S.D}$.

$$1 \text{ V.S.D} = \frac{9}{10} \text{ M.S.D} = \frac{9}{10} \text{ mm} [1 \text{ M.S.D} = 1 \text{ mm}] = 0.9 \text{ mm}.$$

Thus, the difference between one main scale division and one vernier scale division is $(1 \text{ mm} - 0.9 \text{ mm}) = 0.1 \text{ mm}$. Thus we can measure length accurately upto 0.1 mm.

Pitch: The smallest value of the length or any other unit which can be read directly from a main scale accurately is called pitch.

$$\text{Thus pitch} = \frac{1 \text{ unit (length)}}{\text{Number of divisions in the unit}}$$

Least Count of vernier callipers:

The difference between one M.S.D and one V.S.D is called Least Count (L.C.)

$$\text{L.C} = 1 \text{ M.S.D} - 1 \text{ V.S.D} = 1 \text{ mm} - \frac{9}{10} \text{ mm} = \left(1 - \frac{9}{10}\right) \text{ mm} = \left(\frac{10 - 9}{10}\right) \text{ mm} = \frac{1}{10} \text{ mm} = 0.1 \text{ mm} = 0.01 \text{ cm}.$$

The least count of vernier callipers can also be defined as smallest division on the main scale to the no. of divisions on the vernier scale.

$$\text{L.C} = \frac{\text{Smallest value of one M.S.D}}{\text{No. of vernier scale division (V.S.D)}} = \frac{\text{Pitch}}{\text{No. of V.S.D}} = \frac{1}{10} \text{ mm} = 0.1 \text{ mm} = 0.01 \text{ cm}.$$

Procedure for taking a measurement using vernier callipers:

1. Determine the least count of vernier callipers.
2. To measure the external dimension of an object it should be held tightly between the external jaws and to measure the inner dimensions it should be held with internal jaws.
3. Note the main scale reading. The main scale reading is always the smaller of the two values between which the zero of vernier scale lies.
4. Note the vernier scale reading. Which coincide with any main scale division.
5. Length of the object is found by the formula.

$$\text{Length} = \text{Reading on M.S} + \text{L.C} \times \text{V.S.D. or}$$

$$\text{Length} = \text{Pitch} \times \text{M.S.D} + \text{L.C} \times \text{V.S.D.}$$

Zero error of vernier callipers:

When the two jaws of a vernier callipers are brought in contact with each other, then the zero of the vernier should coincide with the zero of the main scale. Sometimes they may not coincide. In such case, we say that the instrument has a zero error.

These zero errors are of two types - positive and negative.

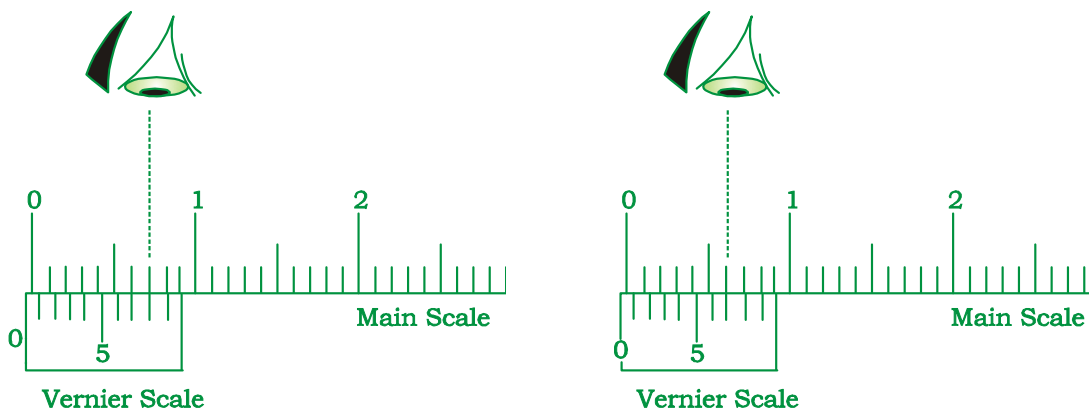
Positive zero error : If the zero of vernier scale is on the right hand side of zero of the main scale, the error is positive and the correction is said to be negative.

In the below left figure the 8th vernier division coincides with any of the main scale division. The correction is then calculated by the formula.

$$\text{Correction} = - \text{coinciding division of vernier scale} \times \text{Least count} = - 8 \times 0.01\text{cm} = - 0.08\text{cm}.$$

If the observed reading is 2.05cm ,then

$$\text{Corrected reading} = \text{Observed reading} + \text{correction} = 2.05\text{cm} + (-0.08)\text{cm} = 1.97\text{cm}.$$



Negative Zero Error: If the zero of vernier scale is to the left of the zero of the main scale, the error is negative and the zero correction is said to be positive.

In the above right figure given 7th vernier scale division coincides with the main scale division. The correction is then calculated by the formula:

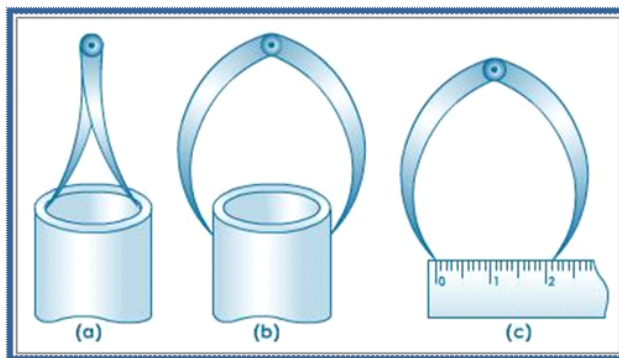
$$\text{Correction} = + (n - \text{coinciding division of vernier scale}) \times \text{Least count}$$

Where 'n' is the total number of vernier scale divisions.

$$\text{Correction} = +(10 - 8) \times 0.01\text{cm} = +0.02\text{cm}.$$


$$\begin{aligned} \text{If the observed reading is } 2.03\text{cm}, \text{Corrected reading} &= \text{Observed reading} + \text{correction} \\ &= 2.03 \text{ cm} + 0.02 \text{ cm} = 2.05 \text{ cm}. \end{aligned}$$

To measure the inner and outer diameter of a hollow cylinder or ring, inner and outer callipers are used. Take measurements by the two methods as shown in figure below.




Important Points

- **Vernier callipers** : A vernier callipers is also called slide callipers. Vernier callipers was invented by Pierre vernier.
- **Pitch** : The smallest value of the length or any other unit which can be read directly from a main scale accurately is called pitch.
- **Least count** : The magnitude of the smallest measurement which can be measured by an instrument accurately is called its least count. (L.C)
- External jaws of Vernier Callipers are used to measure external dimension of an object, such as external length, external diameter of a cylinder, a sphere etc.
- If the zero of vernier scale is on the right hand side of zero of the main scale, the error is said to be positive and the correction is said to be negative.
- If the zero of vernier scale is on the left hand side of the zero of the main scale, the error is said to be negative and the correction is said to be positive.

 **Source of inspiration**

Pierre Vernier (19 August 1580)



Pierre Vernier (19 August 1580 at Ornans, Franche-comte, Spanish Habsburgs (Now France) - 14 September 1637 same location) was a French Mathematician and instrument inventor. He was inventor and eponym of the vernier scale used in measuring devices.

He was born in Ornans, France in 1580, he was taught science by his father. He later became captain and castellan of the castle of Ornans, for the king of Spain. He was also later councillor and director general of moneys in the country of Burgundy.

MEASUREMENT

PRACTICE SHEET -3



Conceptual Practice Sheet



Fill in the blanks Type:

1. Vernier callipers consist of two scales they are _____.
2. The metallic strip of the vernier callipers is used to measure _____.
3. Internal jaws are used to measure _____.
4. The smallest value of length which can read be directly from a main scale accurately is called _____.
5. If the zero of the vernier is on the right side of the zero of the main scale then the error is said to be _____.

True/ False Type:

6. Least count (L.C) = 1 V.S.D - 1 M.S.D
7. The principle of a vernier to make (N-1) vernier scale division equal to N main scale divisions.
8. In a standard vernier callipers, when the jaws are in contact with each other if the 5th division on the main scale coincides with 4th division on the vernier scale, then the zero error is negative.
9. The zeroeth of division of a vernier cale lies between the 40th and 41st main cale division. Then the M.S.R = 4 cm, if 1 M.S.D = 1mm.



IIT - JEE Mains Practice Sheet



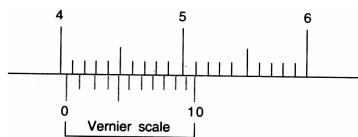
Single Response Type:

LEVEL - I

- $\frac{1 \text{ unit (length)}}{\text{no. of divisions in the unit}}$ is
 A) Least count B) Pitch C) V.S.D D) M.S.D
- The principle of vernier is
 A) $n \text{ M.S.D} = (n+1) \text{ V.S.D}$ B) $n \text{ M.S.D} = (n-1) \text{ V.S.D}$
 C) $n \text{ V.S.D} = (n-1) \text{ M.S.D}$ D) $n \text{ V.S.D} = (n+1) \text{ M.S.D}$
- In a vernier calipers 9 M.S.D is equal to how many V.S.D ?
 A) 11 B) 9 C) 10 D) 12
- 19 M.S.D coincide with 20 vernier scale division on a vernier calipers. If 1 M.S.D = 1 mm , then 1 V.S.D = _____
 A) $19/20 \text{ mm}$ B) $20/19 \text{ mm}$ C) $19/20 \text{ cm}$ D) $20/19 \text{ cm}$
- Length of the object from vernier callipers is equal to
 A) $\text{M.S.R} - (\text{Vernier coincidence} \times \text{L.C})$ B) $\text{M.S.R} + (\text{Vernier coincidence} \times \text{L.C})$
 C) $\text{Vernier scale reading} + (\text{M.S.R} \times \text{L.C})$ D) $\text{Vernier scale reading} - (\text{M.S.R} \times \text{L.C})$

LEVEL - II

- n divisions of vernier scale of a vernier callipers coincide with $(n - 1)$ divisions of main scale. What is the L.C of the instrument if the length of one main scale division is 1mm?
 A) $10n \text{ cm}$ B) $1/10n \text{ cm}$ C) $n \text{ cm}$ D) $1/100n \text{ cm}$
- Study the figure carefully and calculate the reading, (L.C. = 0.1mm)



- A) 4.31cm B) 4.31mm C) 4.13mm D) 4.13cm
- Principle of Vernier is
 A) The given unit should be increased
 B) Distance between two ends of a unit of the scale is divided into number of parts.
 C) Two scales are used in combination to get a smaller L.C.
 D) None of these
- N divisions of the main scale of a vernier callipers coincide with $N+1$ divisions of the vernier scale. If each division on the main scale is of 'a' units, determine the least count of the instrument.
 A) $(N+1) a$ B) $(N-1) a$ C) $\left(\frac{1}{N-1}\right) a$ D) $\left(\frac{1}{N+1}\right) a$

10. A cylindrical rod is fixed between the two jaws, J_1 and J_2 , of vernier callipers. Then the main scale reading is 4 cm and vernier coincidence is '6'. Find the length of the rod (Least count of Vernier callipers = 0.1 mm)
- A) 4.06 cm B) 5.06 cm C) 6.06 cm D) 3.06 cm

LEVEL - III

11. In vernier callipers, if L.C = l and pitch is P then $\frac{l}{P}$ is
- A) Always less than 1 B) Always greater than 1
C) Equal to 1 D) None of these
12. The zero error of a vernier is +2. Its zero correction is (take L.C = 0.01cm)
- A) 0.2cm B) -0.2cm C) -0.02cm D) +0.02cm
13. If the pitch of the main scale of a vernier is P and for another vernier scale is Q and both have the same no.of vernier scale division. Then their least counts l and m have the ratio
- A) 1 B) $\frac{P}{Q}$ C) $\frac{Q}{P}$ D) PQ
14. In a vernier callipers 19 main scale divisions coincides with 20 vernier scale divisions. If the main scale has 20 division in a centimetre. The least count is
- A) 0.0025 mm B) 0.025 mm C) 0.25 mm D) 2.5 mm
15. Suppose the value of 1 main scale division is equal to 1 cm and the least count is 0.01 cm, then the value of one vernier scale division is
- A) 9 mm B) 9.9 mm C) 0.09 mm D) 0.009 mm



IIT - JEE Advanced Practice Sheet

**Assertion and Reasoning Type:**

1. **Assertion** : If the zero of vernier scale is on right hand side of zero of main scale, the error is said to be positive and the correction is said to be negative.

Reason : If the zero of vernier scale is on the left hand side of the main scale, the error is said to be positive and the correction is said to be negative.

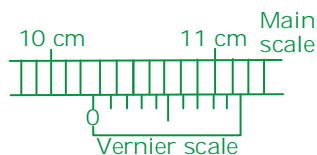
- A) Both Assertion and Reason are true, Reason is the correct explanation of Assertion
B) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion
C) Assertion is true and reason is false.
D) Assertion is false and reason is true.

Linked Comprehensive Type:

Vernier callipers was invented by Paul vernier which can be used to measure the smallest length.

2. The main scale of vernier callipers has 10 divisions in a centimetre and 10 vernier scale divisions coincide with 9 main scale divisions. The Least count of vernier callipers is
- A) 0.1cm B) 0.01cm C) 0.05cm D) 0.001cm

3. In a vernier callipers 19 main scale divisions coincide with 20 vernier scale divisions. If the main scale has 20 divisions in a centimetre. The pitch of vernier callipers is
 A) 0.05mm B) 0.1cm C) 0.01cm D) 0.05cm
4. In figure for vernier callipers, calculate the length recorded.



- A) 10.27 cm B) 10.24 cm C) 10.28 cm D) 10.23 cm

Multi Response Answer (s) Type:

5. If smallest value of main scale division is 1 mm and number of V.S.D are 10 then L.C. is
 A) 0.1 mm B) 0.01 cm C) 0.0001 mm D) 0.000001 μm

Match the following/ Matrix Matching:

6. **Column-I**

- a) Positive zero error
 b) Negative zero error
 c) correction for Positive Zero error
 d) correction for negative zero error

Column-II

- p) If the zero of V.S is on right side of zero of main scale
 q) positive
 r) negative
 s) If the zero of V.S is on left side of zero of main scale



MEASUREMENT

LECTURE - 4

Learning Objectives

When you have completed this lecture you should be able to know :

- ◆ Construction of screw gauge.
- ◆ To measure of diameter of a wire by screw gauge.
- ◆ Uses of screw gauge.



Screw gauge (micrometer screw gauge): Micrometer screw-gauge is another instrument used for measuring accurately the diameter of a thin wire or the thickness of a sheet of metal.

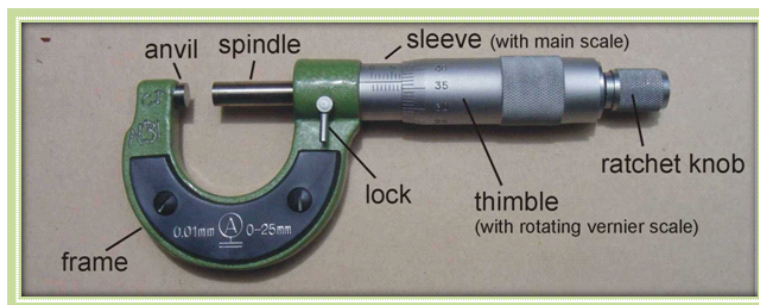
It is an instrument by which we can measured the length about

$$\frac{1}{100}^{\text{th}} \text{ of a mm} = 0.01\text{mm} = 0.001\text{cm} = 0.00001\text{m} = 10^{-5}\text{m} = 10\mu\text{m}$$

Principle of screw gauge: The principle of screw is used for working the screw gauge. When a screw working inside a fixed nut is rotated over an axis its tip advances through a distance proportional to the number of rotations of the screw.

(or) Screw gauge works on the principle of screw in a nut.

Construction of screw gauge: Screw gauge consists of the following parts.



The screw gauge is in the shape of a U which is in metal frame. A hollow cylinder with fixed thread cut inside is attached to one end of the metal frame. A fine screw can work inside the cylinder. The screw gauge also has a pitch scale. A pitch scale is a millimeter scale, marked on the cylinder which is parallel to the axis of the screw.

A sleeve with a beveled edge is attached to the head of the screw and the edge is divided into 100 equal divisions which is called as head scale. The tip of the screw has a plane surface. A stud with a plane parallel surface is fixed to the other end of the U-shaped frame. A ratchet attached to the head of the screw prevents excessive tightening of the screw.



It's a fact

A light year is 5,865,696,000,000 miles or about 9,460,800,000,000 kilometers. A "jiffy" is an actual unit of time for 1/100th of a second.

Parts

Anvil: The shiny part that the spindle moves toward, and that the thing to be measured rests against.

Sleeve: The stationary round part with the linear scale on it.

Frame: The C-shaped body that holds the anvil and barrel in constant relation to each other. It is thick because it needs to minimize flexion, expansion, and contraction, which would distort the measurement.

Locknut: The knurled part that one can tighten to hold the spindle stationary, such as when momentarily holding a measurement.

Screw (not seen): The heart of the micrometer, as explained under "Operating principles". It is inside the thimble. (No wonder that the usual name for the device in German is Messschraube, literally "measuring screw".)

Spindle: The shiny cylindrical part that the thimble causes to move toward the anvil.

Thimble: The part that one's thumb turns.

Pitch of screw: Put the zero of the head scale coincide with any division of the pitch scale and now write down the reading of pitch scale. Now produce 10 full rotations to the head scale and now write the change in the pitch scale reading.

or

It is the distance advanced by the screw for one complete rotations of the screw head.(or)
It is the distance between two consecutive threads of a screw.

Therefore the pitch is written as

$$\text{Pitch} = \text{Distance moved on the pitch scale} / \text{Number of rotations}$$

Distance moved by the screw gauge for 10 rotations = 10 mm

Distance moved by the screw gauge for one rotation = $\frac{10}{10} = 1$ mm

Then the pitch = 1 mm

Let x be the distance travelled by the tip of the screw through a nut when n complete revolutions of the head are made. Then,

$$\text{Pitch of the screw (P)} = \frac{x}{n}$$

Ex : If 5mm is the distance moved by the screw on the main scale for 5 rotations then

$$\text{Pitch} = \frac{5\text{mm}}{5} = 1\text{mm}$$

Least count: When the screw is turned through 1 division of the head scale the distance moved by the tip of the screw is called least count of the screw.

That is, the least count = Pitch of the screw / Number of head scale divisions.

Ex : Let us assume that the number of divisions on the head scale is 100 and pitch of the screw 1mm. Then, the

$$\text{L.C} = \frac{1\text{mm}}{100} = 0.01\text{mm} = 0.001\text{cm}$$

Note:

1. L.C of ordinary scale is = 1mm = 0.1cm
2. L.C of vernier callipers = 0.1mm = 0.01cm
3. L.C of screw gauge = 0.01mm = 0.001cm = 0.00001m = 10⁻⁵m Since least count of a screw gauge of the order of 10⁻⁵m. So the screw gauge is called a micrometre screw.

To measure of diameter of a wire by screw gauge :

To use a micrometer follow the instructions given below:

1. Ratchet the head until the anvil and the spindle faces are in contact. Note down the zero error.
2. The object to be measured is gripped between anvil and spindle.
3. To read a micrometer you first note the highest number along the datum line.
4. Note the reading on the thimble and multiply this number with 0.01 mm. This reading in the example is 16. Therefore, we need to multiply this number by 0.01, i.e., $0.01 \times 16 = 0.16$ mm
5. Add the readings taken in steps 3 and 4. This will give uncorrected reading, which in present case is 10.16 mm.
6. Obtain a correct reading by either adding or subtracting the zero error from the uncorrected reading obtained in step 5.

Observed diameter = Main scale reading + [Circular scale reading \times L.C.]

If the main scale reading is 5mm and 57th the circular scale reading coincides with base line, then

$$\begin{aligned} \therefore \text{Observed diameter} &= 5 \text{ mm} + 57 \times 0.001 \text{ cm} = 0.5 \text{ cm} + 0.057 \text{ cm} = 0.557 \text{ cm} \\ &= 0.557 \text{ cm} - 0.005 \text{ cm} = 0.552 \text{ cm}. \end{aligned}$$

Zero error :

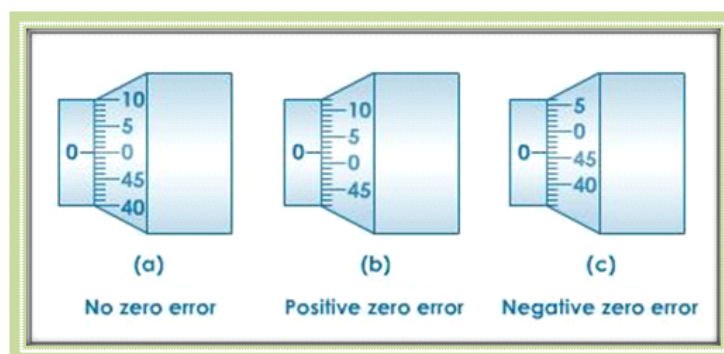
If the zero of the main scale does not coincide with zero of circular scale on bringing the screw end in contact with stud, the micrometre is said to have zero error.

Positive zero error :

If the zero line, marked on circular scale is below the reference line of the main scale, then there is a positive zero error and the correction is negative.

Negative zero error :

If the zero line marked on circular scale is above the reference line of the main scale, then there is negative error and the correction is positive.



Corrected diameter = Observed diameter \pm correction.

Correction = + [n – coinciding division of C.S.] \times L.C., where n is the total number of circular scale divisions.

Uses of screw gauge :

It is used to

1. Measure the thickness of the glass plate.
2. Measure the diameter of the thin wire.
3. Measure the diameter of small lead spheres.

Important Points

- **Anvil:** The shiny part that the spindle moves toward, and that the thing to be measured rests against.
- **Sleeve:** The stationary round part with the linear scale on it.
- **Spindle:** The shiny cylindrical part that the thimble causes to move toward the anvil.
- The least count = Pitch of the screw / Number of head scale divisions.
- L.C of screw gauge = 0.01mm = 0.001cm = 0.00001m = 10 μ m
- If the zero line, marked on circular scale is below the reference line of the main scale, then there is a positive zero error and the correction is negative.
- If the zero line marked on circular scale is above the reference line of the main scale, then there is negative error and the correction is positive.
- Observed diameter = Main scale reading + [Circular scale reading \times L.C.]



Conceptual Practice Sheet



Fill in the blank Type:

- _____ is the distance advanced by the screw for one complete rotations of the screw head
- The least count = _____ / Number of head scale divisions.
- Observed diameter of a screw gauge = Main scale reading + [Circular scale reading \times _____.]
- If the zero line, marked on circular scale is below the reference line of the main scale, then there is a _____ zero error and the correction is _____.
- If the zero line marked on circular scale is above the reference line of the main scale, then there is _____ error and the correction is _____.



IIT - JEE Mains Practice Sheet



Single Response Type:

LEVEL - I

- The pitch of a screw means

A) Area of its head	B) Thickness of the screw
C) The length of threading on it	D) The distance moved head by it in one rotation
- For a screw gauge L.C. = (Pitch of the screw) \div (_____)

A) Number of circular cylinders	B) Number of circular scale divisions
C) Number of vernier scale divisions	D) Number of main scale divisions
- To measure of diameter of a wire by screw gauge place the given wire, in between stud and movable screw and turn the ratchet in _____ direction, till the ratchet becomes free.

A) Clockwise	B) Anti clockwise	C) Either A or B	D) Neither A or B
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- A screw gauge has a negative zero error. Which is correct among these ? [Hint : n is the total number of circular scale divisions]

A) Correction = - coinciding division of C.S \times L.C
B) Correction = + coinciding division of C.S \times L.C
C) Correction = + [n - coinciding division of C.S] \times L.C]
D) Correction = + [n + coinciding division of C.S] \times L.C]

LEVEL - II

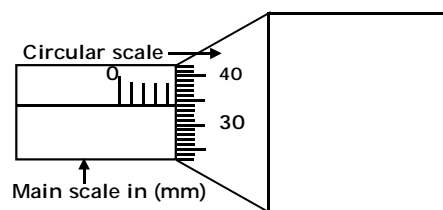
- If the screw of a micrometre screw gauge moves through a distance of 2mm when it is turned through 4 rotations, the pitch is

A) 0.5cm	B) 0.4mm	C) 0.4cm	D) 0.5mm
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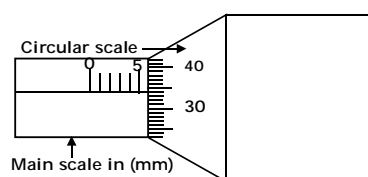
7. In a screw gauge the pitch of the screw is x and the number of circular scale divisions are n then the least count of screw gauge is _____
- A) xn B) xn^{-1} C) nx^{-1} D) $(xn)^{-1}$
8. A screw has a pitch equal to 0.5 mm. What should be the number of divisions on its head so as to read correct up to 0.001 mm with its help ?
- A) 500 B) 400 C) 300 D) 100
9. Which of the following is the most accurate instrument for measuring length
- A) Vernier callipers having 20 divisions on the sliding scale which coincide with 19 division on the main millimetre scale.
- B) A screw gauge having pitch 1mm and 50 divisions on the circular scale.
- C) A vernier scale of least count 0.01mm.
- D) A screw gauge of least count 0.001mm.
10. When the studs of a screw gauge are brought in contact, the 15th circular scale division coincides with the reference line. The zero error is
- A) +15 B) -15 C) +85 D) -85

LEVEL - III

11. What is the ratio of the least count of an ordinary vernier callipers to that of an ordinary screw gauge?
- A) 8 B) 10 C) 9 D) 7
12. If the pitch of the screw is 0.1mm and there are 100 divisions on the circular scale, the least count of the given screw gauge is
- A) 0.001mm B) 0.001cm C) 0.05cm D) 0.05mm
13. The observed diameter of a screw gauge is 0.557 cm and correction is -0.005 cm. Then the corrected diameters of a screw gauge is _____
- A) + 0.005 cm B) 0.552 cm C) 0.0552 cm D) 0.525 cm
14. Figure shows a screw gauge in which head scale has 100 divisions. The diameter of a wire is (Take the reading from the figure)



- A) 0.434 cm B) 0.434 mm C) 0.434 m D) 4.34 cm
15. Figure shows a screw gauge in which head scale has 200 divisions. The radius of a wire is (Take the reading from the figure)



- A) 0.2585 mm B) 0.2585 cm C) 2.585 cm D) 2585 mm



IIT - JEE Advanced Practice Sheet



Assertion and Reasoning Type:

1. **Assertion** : Screw gauge with a pitch of 0.5 mm is more accurate than a pitch 1mm for same number of circular scale divisions.

Reason : Higher pitch can make an accurate device.

- A) Both Assertion and Reason are true, Reason is the correct explanation of Assertion
 A) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion
 C) Assertion is true and reason is false.
 D) Assertion is false and reason is true.

Linked Comprehensive Type:

When the jaws of micrometre screw gauge are fully closed, the 94th circular scale division coincide with the base line. The circular scale of this instrument has 100 divisions and main scale has 10 divisions to a centimetre. While measuring the diameter of a wire the reading on main scale is 5 mm and 35th circular scale division coincides the main scale, base line.

2. Error is
 A) -5 divisions B) -6 divisions C) -4 divisions D) -7 divisions
3. Observed diameter is
 A) 0.053 cm B) 0.535 cm C) 0.355 cm D) 0.325 cm
4. Corrected diameter is
 A) 0.053 cm B) 0.541 cm C) 0.355 cm D) 0.325 cm

Multi Response Type:

5. If the thimble of a screw gauge has 50 divisions. The screw advances 3 mm when it is turned through 4 rotations then.
 A) pitch of the screw gauge is 0.5 mm B) least count of the screw gauge is 0.01 mm
 C) pitch of the screw gauge is 0.01 mm D) least count of the screw gauge is 0.5 mm

Match the following/ Matrix Matching:

6. A micrometre screw gauge has a negative error of 8 divisions. While measuring the diameter of a wire the reading on main scale is 3 divisions and 24th circular scale division coincide with base line. If the number of divisions on the main scale are 20 to a centimetre and circular scale has 50 divisions then

Column - I

- a) pitch of the screw
 b) observed diameter
 c) least count of the screw
 d) corrected diameter

Column - II

- p) 0.182 cm
 q) 0.174 cm
 r) 0.001 cm
 s) 0.05 cm

FOUNDATION CHEMISTRY
SAMPLE CHAPTER

1

**CHEMICAL REACTIONS
AND EQUATIONS**

Chapter Out Line

- Chemical equation
- Balancing Chemical equation
- Types of chemical reactions
- Conditions necessary to write chemical equation



CHEMICAL EQUATIONS AND REACTIONS LECTURE - 1

Learning Objectives

When you have completed this lecture you should be able to :

- ◆ Understand the concept of chemical equations
- ◆ Understand the concept of balancing chemical reactions.



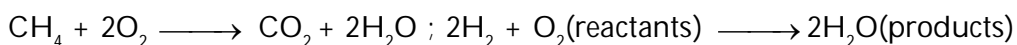
Chemical equation:

Introduction : All chemical reactions are represented by a chemical equation consists of the chemical formulas of the reactants (the starting substances) and the chemical formula of the products (substances formed in the chemical reaction). The two are separated by an arrow symbol (rightarrow, usually read as "yields") and each individual substance's chemical formula is separated from others by a plus sign.

Definition : A chemical equation is a short hand representation of a chemical reaction using symbols and formulae of the substances involved in the chemical reaction.

The symbols and formulae of the substances are arranged to show the reactants and products of a chemical reaction.

As an example, the formula for the burning of methane can be denoted:



I. Information conveyed by equation:

- i) It show the reactants which enter into a reaction and the products which are formed by the reaction.
- ii) It tells about the amounts of each substance used and each substance produced.

II. Two important principles to remember:

- i) Every chemical compound has a formula which cannot be altered.
- ii) A chemical reaction must account for every atom that is used. This is an application of the Law of conservation of Matter which states that in a chemical reaction atoms are neither created nor destroyed.

III. Some things to remember about writing equations:

- i) The diatomic elements when they stand alone are always written $\text{H}_2, \text{N}_2, \text{O}_2, \text{F}_2, \text{Cl}_2, \text{Br}_2, \text{I}_2$
- ii) The sign \longrightarrow means "yields" and shows the direction of the reaction.
- iii) A small delta, (Δ), above the arrow shows that heat has been added.
- iv) A double arrow, \rightleftharpoons , shows that the reaction is reversible and can go in both directions.

Examples:

- i) $\text{H}_2\text{CO}_3(\text{aq}) \longrightarrow \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
Carbonic acid, as in soft drinks, decomposes when it is formed.
- ii) $\text{H}_2\text{SO}_3(\text{aq}) \longrightarrow \text{H}_2\text{O}(\text{l}) + \text{SO}_2(\text{g})$
Sulphurous acid also decomposes as it is formed.
- iii) $\text{NH}_4\text{OH}(\text{aq}) \longrightarrow \text{NH}_3(\text{g}) + \text{H}_2\text{O}(\text{l})$

Rules for writing equations:

- Write down the formula(s) for any substance entering into the reaction. Place a plus (+) sign between the formulas as needed and put the yield arrow after the last one.
- Examine the formulas carefully and decide which of the four types of equations applies to the reaction you are considering. On the basis of your decision, write down the correct formulas for all products formed, placing them to the right of the arrow.

Reactants : The substances that undergo chemical change in the reaction are called reactants.

Products : The new substance(s) formed during the reaction are called product(s).

The above word-equation can be written as $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

In the above reaction magnesium and oxygen are the reactants.

In the above reaction Mg , O_2 are the reactants and MgO is the product.

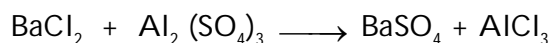
The reactants are written on the left-hand side (LHS) with a plus sign (+) between them.

The products are written on the right-hand side (RHS) with a plus sign (+) between them.

Balancing chemical equation: There are essentially three steps to write the balanced chemical equation:(Hit and trial method)

In the reaction of barium chloride and aluminium sulphate, barium sulphate and aluminium chloride are produced.

Step I: Write the unbalanced chemical equation for the given reaction.



Step II: List the number of atoms of the various elements present in the unbalanced equation in the form of a table.

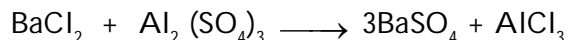
Element	Number of atoms on the reactant side (L.H.S)	Number of atoms on the product side (R.H.S)
Ba	1	1
Cl	2	3
Al	2	1
S	3	1
O	12 (4×3)	4

Here, we can see that only barium has an equal number of atoms on both sides of the equation.

Step III: In the next step, select a compound, which contains the maximum number of atoms. In this case, the compound will be aluminium sulphate (it has 2 atoms of Al, 3 atoms of S, and 12 atoms of O). From this compound, select the element, which has the maximum number of atoms and which is present in only one compound on both sides i.e., oxygen in this case. To balance the number of oxygen atoms, we can multiply barium sulphate present on the right hand side by 3 (as shown below). It should be kept in mind that coefficient '3' will be written as 3BaSO_4 and not as $(\text{BaSO}_4)_3$.

Oxygen atoms	Number of atoms on L.H.S	Number of atoms on R.H.S
Before balancing	12 in $\text{Al}_2(\text{SO}_4)_3$	4 in BaSO_4
To balance	12	3×4

Now, the equation becomes:



Again, compare the number of atoms of the various elements present in the chemical equation (as shown in the table below).

Element	Number of atoms on L.H.S	Number of atoms on R.H.S
Ba	1	3
Cl	2	3
Al	2	1
S	3	3
O	12	12

Step IV: As the atoms of both oxygen and sulphur are balanced, we will now balance the atoms of aluminium.

Aluminium atoms	Number of atoms on L.H.S	Number of atoms on R.H.S
Before balancing	2 in $\text{Al}_2(\text{SO}_4)_3$	1 in AlCl_3
To balance	2	2×1

Now, the equation becomes:



Make the table again to compare the number of atoms of the elements on both sides of the equation.

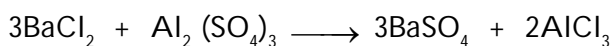
Element	Number of atoms on L.H.S	Number of atoms on R.H.S
Ba	1	3
Cl	2	6
Al	2	2
S	3	3
O	12	12

We can see that the atoms of aluminium, sulphur, and oxygen are balanced.

Step V: Now, only the atoms of barium and chlorine are unbalanced. We will first balance the atoms of barium.

Barium atoms	Number of atoms on L.H.S	Number of atoms on R.H.S
Before balancing	1 in BaCl ₂	3 in (3 BaSO ₄)
To balance	3 × 1	3

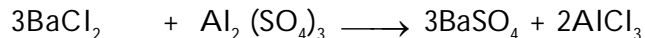
Now, the equation becomes:



Let us again prepare a table to compare the number of atoms of the elements on both sides of the equation.

Element	Number of atoms on L.H.S	Number of atoms on R.H.S
Ba	3	3
Cl	6	6
Al	2	2
S	3	3
O	12	12

It can be observed that the chemical equation is balanced now.



This method of balancing a chemical equation is called the hit-and-trial method.

To make a chemical equation more informative, the physical state of the reactants and the products is mentioned along with their chemical formulae. They are written in common brackets.

Solids are denoted by writing **(s)**.

Liquids are denoted by writing **(l)**.

Gases are denoted by writing **(g)**.

Solutions in water are denoted by writing **(aq)**.

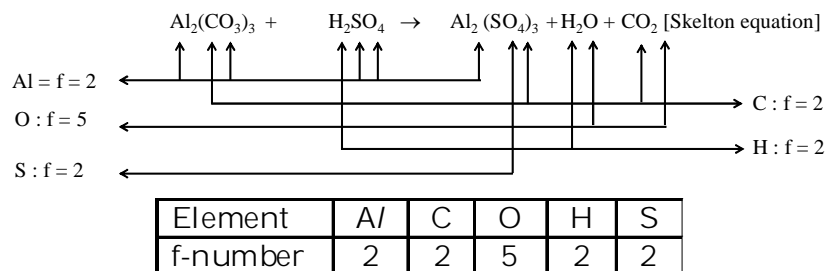
For example, the reaction of limewater with carbon dioxide that results in the formation of a precipitate of calcium carbonate and water is represented as:

Indicate the physical states of the reactants and products.

To do this, you need to be familiar with the properties of various compounds or you need to be told what the phases are for the chemicals in the reaction. Oxides are solids, hydrogen forms a diatomic gas, tin is a solid, and the term 'water vapor' indicates that water is in the gas phase :

$$\text{SnO}_2(\text{s}) + 2\text{H}_2(\text{g}) \longrightarrow \text{Sn}(\text{s}) + 2\text{H}_2\text{O}(\text{g})$$

This is the balanced equation for the reaction.

F-number method of balancing chemical equation:**Important Points**

- **Chemical equation** : "A chemical equation is a short hand representation of a chemical reaction in terms of symbols and formulae".
- **Information conveyed by equation** : It show the reactants which enter into a reaction and the products which are formed by the reaction.
The amounts of each substance used and each substance produced.
- **Unbalanced equation**: Number of elements on the left hand side of the equation is not equal to number on right hand side.
- **Balanced equation**: Number of elements on the left hand side of the equation = number on right hand side.

New Words

- ❖ **Reactants** : The substances that undergo chemical change in the reaction are called reactants.
- ❖ **Products** : The new substance(s) formed during the reaction are called product(s).
- ❖ **Atomic Equation**: A balanced equation in which the elementary substances are expressed in the atomic form is atomic equation.

CHEMICAL EQUATIONS AND REACTIONS**PRACTICE SHEET - 1****Conceptual Practice Sheet****Single Response Type:**

1. Chalk, limestone, marble, eggshells and seashells are made from
A) Calcium hydroxide B) Calcium oxide C) Calcium carbonate D) Calcium chloride
2. Conservation of mass is obtained when total mass of reactants is equal to total mass of
A) Products B) Molecules C) Protons D) Atoms
3. If both water and carbon dioxide is given to plant still it will not prepare its own food if there is lack of
A) Sugar B) Soil C) Sunlight D) Fertilizers
4. Chemical change involves formation of
A) Products B) New substances C) Salts D) Water
5. Process in which reactants react together to form product is called
A) Chemical reaction B) Chemical change C) Chemical properties D) Chemical formula

True or false type:

- The substances which undergo chemical changes are known as reactants
- An equation in which number of each atom of an element on the reactants side is equal to the number of each tom of the element on the products side, is called balanced equation.
- Sodium nitrate decomposes on heating and forms sodium nitrite and oxygen.
- Two molecules of hydrogen react with one molecule of oxygen to form one molecule of water is a balanced equation.

**IIT - JEE Mains Practice Sheet****Single Response Type:****LEVEL - I**

- Which is the correct symbol for manganese?
A) M B) Ma C) Mn D) Mg
- What is the colour and formula of Sodium Sulphate?
A) Colourless Na_2SO_4 B) White Na_2SO_4 C) Colourless NaSO_4 D) White $\text{Na}(\text{SO}_4)_2$
- Which of the following information is conveyed by a chemical reaction?
A) The colour changes taking place
B) The structure of the reactants and products
C) The absorption of energy only
D) The masses of the reactants and products involved in the reaction

LEVEL - II

- What will be the balanced product(s) of the following reaction? $\text{CH}_4 + 2\text{O}_2 \longrightarrow$
A) CH_4O_4 B) $\text{CO}_2 + 2\text{H}_2\text{O}$ C) $\text{C} + \text{H}_4\text{O}_4$ D) $\text{C} + \text{H}_2 + \text{O}_2$
- Which of the following symbols is not a correct indication of the phase of a substance in a reaction?
A) (s) = solid B) (g) = grams
C) (aq) = aqueous or dissolved in water D) All the above are correct
- In one molecule of ammonium sulphide there are _____.
A) 2 atoms of N, 8 atoms of H, and 1 atom of S
B) 1 atom of N, 4 atoms of H, and 1 atom of S
C) 1 atom of N, 4 atoms of H, and 2 atoms of S
D) 2 atoms of N, 8 atoms of H, and 2 atoms of S

LEVEL - III

- In writing chemical equations, inclusion of state symbols shall be done while
A) Correct chemical formulae of reactants and products are written
B) Equation is being balanced to fulfill law of conservation of mass
C) Equation has been balanced
D) Chemical formulae of products and reactants have been changed to bring about quick balancing

8. Consider Calcium Carbonate (CaCO_3) and Hydrochloric Acid (HCl) as reactants, Molecules of Hydrochloric Acid (HCl) required to balance equation will be
 A) 1 B) 2 C) 3 D) 4
9. Which four quantities a, b, c and d are required to balance the equation?
 $a\text{Ca}(\text{OH})_2(\text{aq}) + b\text{HCl}(\text{aq}) \longrightarrow c\text{CaCl}_2(\text{aq}) + d\text{H}_2\text{O}(\text{l})$
 A) 2 2 2 1 B) 1 2 1 2 C) 1 2 1 1 D) 2 1 1 2
10. Which four quantities a, b, c and d are required to balance the equation ...
 $a\text{Al}(\text{s}) + b\text{HCl}(\text{aq}) \longrightarrow c\text{AlCl}_3(\text{aq}) + d\text{H}_2(\text{g}) ?$
 A) 1 6 3 2 B) 2 3 2 3 C) 1 3 3 2 D) 2 6 2 3



IIT - JEE Advanced Practice Sheet



Assertion and reasoning type:

1. **Assertion:** $\text{SnCl}_2 + \text{Ni} \longrightarrow \text{NiCl}_2 + \text{Sn}$ reaction is possible.
Reason : According to metal activity series, Nickel is more reactive than tin.
 A) Both Assertion and reason are correct and reason is the correct explanation of assertion.
 B) Both Assertion and reason are correct but reason is not the correct explanation of assertion.
 C) Assertion is correct, reason is incorrect.
 D) Assertion is incorrect, reason is correct.
2. **Assertion:** The completion and speed of a reaction can be known from a balanced chemical equation.
Reason : Formulae and number of atoms of all reacting substances in a reaction can be known by a balanced chemical equation.
 A) Both Assertion and reason are correct and reason is the correct explanation of assertion.
 B) Both Assertion and reason are correct but reason is not the correct explanation of assertion.
 C) Assertion is correct, reason is incorrect.
 D) Assertion is incorrect, reason is correct.

Linked comprehensive type:

To write a balanced equation we need to know whether or not the reaction takes place between two or more reactants. 2. One must know all the products formed during the chemical reaction and must know the correct symbols and formulae of the reactants and products.

3. What is the sum of the coefficients of the reactants and products in the following equation?
 $2\text{SO}_2 + \text{O}_2 \xrightarrow{\Delta} 2\text{SO}_3$
 A) 10 B) 12 C) 5 D) 8
4. On strong heating, Potassium chlorate (KClO_3) gives Potassium chloride and oxygen. Which of the following is a balanced chemical equation for the reaction?
 A) $3\text{KClO}_3 \longrightarrow 2\text{KCl} + 3\text{O}_2$ B) $\text{KClO}_3 \longrightarrow \text{KCl} + \text{O}_2$
 C) $2\text{KClO}_3 \longrightarrow 2\text{KCl} + 3\text{O}_2$ D) $2\text{KClO}_3 \longrightarrow \text{KCl} + 3\text{O}_2$

5. Calcium hydride + Water \longrightarrow Calcium hydroxide + Hydrogen.

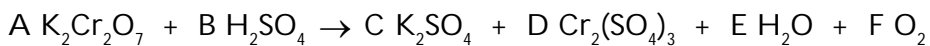
What is the correct balanced equation for the above representation.

- A) $2\text{CaH}_2 + \text{H}_2\text{O} \longrightarrow \text{Ca}(\text{OH})_2 + 4\text{H}_2$ B) $4\text{CaH}_2 + \text{H}_2\text{O} \longrightarrow 5\text{Ca}(\text{OH})_2 + 6\text{H}_2$
 C) $\text{CaH}_3 \longrightarrow \text{H}_2\text{O} \longrightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$ D) $\text{CaH}_2 + 2\text{H}_2\text{O} \longrightarrow \text{Ca}(\text{OH})_2 + 2\text{H}_2$

Linked comprehensive type:

To write a balanced equation we need to know whether or not the reaction takes place between two or more reactants. One must know all the products formed during the chemical reaction and must know the correct symbols and formulae of the reactants and products.

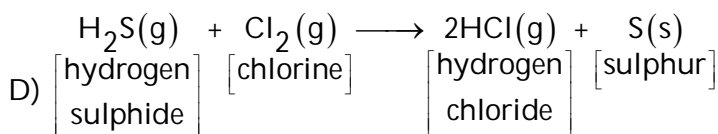
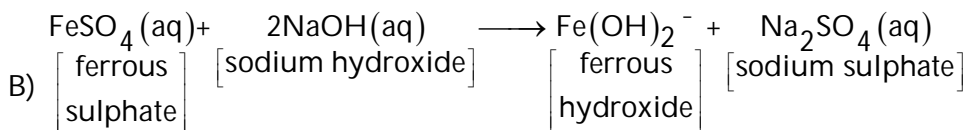
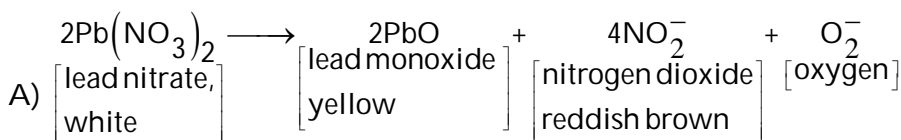
6. The no. of places at which an element appears in a chemical equation is called:
 A) Repetition B) Periodicity C) Frequency D) Regularity
7. When a metal and a non-metal have same frequency, then the element that is balanced first is:
 A) Metal B) Non-metal
 C) Metal if its atomic no. is more D) Non-metal if its atomic no. is more.
8. Balance the following equation:



- | | A | B | C | D | E | F |
|----|---|---|---|---|---|---|
| A) | 2 | 2 | 8 | 2 | 8 | 3 |
| B) | 2 | 8 | 2 | 2 | 8 | 3 |
| C) | 8 | 2 | 8 | 2 | 8 | 3 |
| D) | 2 | 8 | 2 | 2 | 2 | 3 |

Multi response type:

9. Which of the following are balanced equations?



Match the following:10. **Column I**

- a) $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$
 b) $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2$
 c) $\text{Fe}(\text{OH})_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$
 d) $\text{HOCl} \rightarrow \text{HCl} + \text{O}_2$

Column II

- p) $2\text{Fe}(\text{OH})_3 + 3\text{H}_2\text{SO}_4 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$
 q) $2\text{HOCl} \rightarrow 2\text{HCl} + \text{O}_2$
 r) $2\text{KClO}_3 \rightarrow 2\text{KCl} + 3\text{O}_2$
 s) $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

11. **Column I**

Elements

- a) H
 b) C
 c) N
 d) F
 e) O

Column II

Atomic number


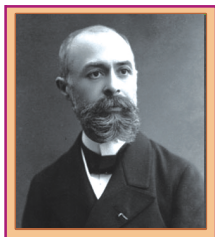
- p) 9
 q) 1
 r) 6
 s) 8
 t) 7

Subjective type:

12. Why should a chemical equation be balanced?
 13. Which law is applicable in writing chemical reaction and how it is applicable?
 14. Define chemical equation and write the conditions required for writing chemical equation.
 15. Give the necessary chemical equations and balance them.
 a) Reaction of red hot iron with steam to give Fe_3O_4 .
 b) Burning magnesium ribbon in an atmosphere of nitrogen.
 16. Balance the following chemical equations.
 i) $\text{NH}_3 + \text{Br}_2 \longrightarrow \text{N}_2 + \text{NH}_4\text{Br}$ ii) $\text{FeS}_2 + \text{O}_2 \longrightarrow \text{Fe}_2\text{O}_3 + \text{SO}_2$
 17. Define balanced chemical equation and write the conditions necessary to write balanced chemical equation.
 18. Balance the following equations:
 i) $\text{Mg} + \text{HCl} \longrightarrow \text{MgCl}_2 + \text{H}_2$ ii) $\text{Zn} + \text{O}_2 \longrightarrow \text{ZnO}$
 iii) $\text{NaOH} + \text{H}_2\text{SO}_4 \longrightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$ iv) $\text{NaHCO}_3 \longrightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$

Integer type:

19. Two molecules of hydrogen reacts with one molecule of oxygen to form _____ molecules of water.


Source of inspiration
**MENDELEEV**

Mendeleev is best known for his work on the periodic table; arranging the 63 known elements into a Periodic Table based on atomic mass, which he published in Principles of Chemistry in 1869. His first periodic Table was compiled on the basis of arranging the elements in ascending order of atomic weight and grouping them by similarity of properties. He predicted the existence and properties of new elements and pointed out accepted atomic weights that were in error. This organization surpassed attempts at classification by Beguyer de Chancourtois and New lands and was published a year before the work of Luther Meyer. Mendeleev anticipated Andrews' concept (1869) of the critical temperature of gases. He also investigated the thermal expansion of liquids, and studied the nature and origin of petroleum. He was considered one of the greatest teachers of his time.

Balance the following skeleton equations.

- $C_2H_4 + O_2 \rightarrow CO_2 + H_2O$
- $C_2H_2 + O_2 \rightarrow CO_2 + H_2O$
- $CH_4 + O_2 \rightarrow CO_2 + H_2O$
- $NH_3 + Na \rightarrow NaNH_2 + H_2$
- $Mn(OH)_2 + Na_2O_2 \rightarrow Na_2MnO_4 + NaOH$
- $Al_2(SO_4)_3 + NaOH \rightarrow Al(OH)_3 + Na_2SO_4$
- $KI + H_2SO_4 \rightarrow KHSO_4 + H_2O + SO_2 + I_2$
- $CuFeS_2 + O_2 \rightarrow Cu_2S + FeS + SO_2$
- $FeS + O_2 \rightarrow FeO + SO_2$
- $Cu_2S + CuSO_4 \rightarrow Cu + SO_2$
- $Cu_2O + Cu_2S \rightarrow Cu + SO_2$
- $CuSO_4 + KI \rightarrow CuI + I_2 + K_2SO_4$
- $Fe + N_2O \longrightarrow N_2 + Fe_3O_4$
- $CuCl + SO_2 + HCl \longrightarrow CuCl_2 + H_2O + S$
- $NaAg(CN)_2 + Zn \longrightarrow NaCN + Zn(CN)_2 + Ag$
- $FeCl_3 + NH_4CNS \longrightarrow Fe(CNS)_3 + NH_4Cl$
- $Ca_3(PO_4)_2 + H_2SO_4 \longrightarrow Ca(H_2PO_4)_2 + CaSO_4$
- $CaCN_2 + H_2O \longrightarrow CaCO_3 + NH_3$
- $Mg + HNO_3 \longrightarrow Mg(NO_3)_2 + NH_4NO_3 + H_2O$
- $Cu_2S + O_2 \rightarrow Cu_2O + SO_2$



CHEMICAL EQUATIONS AND REACTIONS LECTURE - 2

Learning Objectives

When you have completed this lecture you should be able to :

- ◆ Know about types of chemical reactions like combination, decomposition, displacement, double displacement, neutralisation etc., reactions



Introduction: When one or more substances (elements or compounds) undergo a chemical change, with the absorption or release of energy, so as to form one or more new products, then the change taking place collectively is called chemical reaction.

Thus, for a chemical reaction to take place following conditions are necessary :

- (i) There must be one or more substances to take part in a chemical reaction.
- (ii) There must be release or absorption of energy during a chemical reaction.
- (iii) There must be formed one or more new substances during a chemical reaction.

Following are the various types of chemical reactions

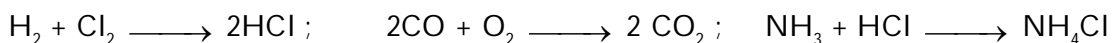
1. Chemical composition or chemical combination.
2. Chemical decomposition or chemical decomposition.
3. Chemical displacement or chemical replacement.
4. Chemical double decomposition.
5. Redox reactions

TYPES OF CHEMICAL REACTIONS:

- i) Chemical combination:** When two or more elements or compounds react chemically to form only one new compound, then the chemical reaction which takes place is called chemical combination.

Basic form: $A + X \longrightarrow AX$

Examples:



- ii) Synthesis (composition) :** In this two or more elements may combine to form a more complex compound.

Examples of synthesis reactions:

- i) Metal + oxygen \longrightarrow metal oxide: $2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$
- ii) Nonmetal + oxygen \longrightarrow nonmetallic oxide: $C(s) + O_2(g) \longrightarrow CO_2(g)$
- iii) Metal + nonmetal \longrightarrow salt: $2Na(s) + Cl_2(g) \longrightarrow 2NaCl(s)$

Example of combination of compound and a compound

- iv) Metal oxide + water \longrightarrow metallic hydroxide : $MgO(s) + H_2O(l) \longrightarrow Mg(OH)_2(s)$
- v) Nonmetallic oxide + water \longrightarrow acid : $CO_2(g) + H_2O(l) \longrightarrow H_2CO_3(aq)$

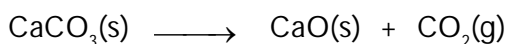
Example of combination of compound and an element $2\text{CO} + \text{O}_2 \longrightarrow 2\text{CO}_2$

Chemical decomposition: When a chemical compound decomposes on heating or absorbing some other kind of energy, so as to form two or more substances (elements or compounds), then the chemical reaction which takes place is called chemical decomposition. or A single compound breaks down into its component parts or simpler compounds.

Basic form : $\text{AX} \longrightarrow \text{A} + \text{X}$

Examples of decomposition reactions:

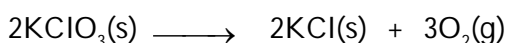
- i) Metallic carbonates, when heated, form metallic oxides and $\text{CO}_2(\text{g})$.



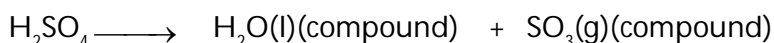
- ii) Most metallic hydroxides, when heated, decompose into metallic oxides and water:



- iii) Metallic chlorates, when heated, decompose into metallic chlorides(compound) and oxygen (an element).

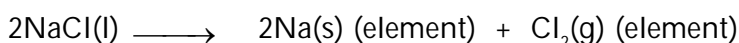
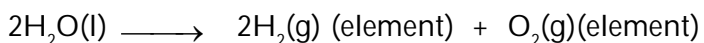


- iv) Some acids, when heated, decompose into nonmetallic oxides and water.



- v) Some oxides, when heated, decompose: $2\text{HgO}(\text{s}) \longrightarrow 2\text{Hg}(\text{l})$ (element) + $\text{O}_2(\text{g})$ (element)

- vi) Some decomposition reactions are produced by electricity.

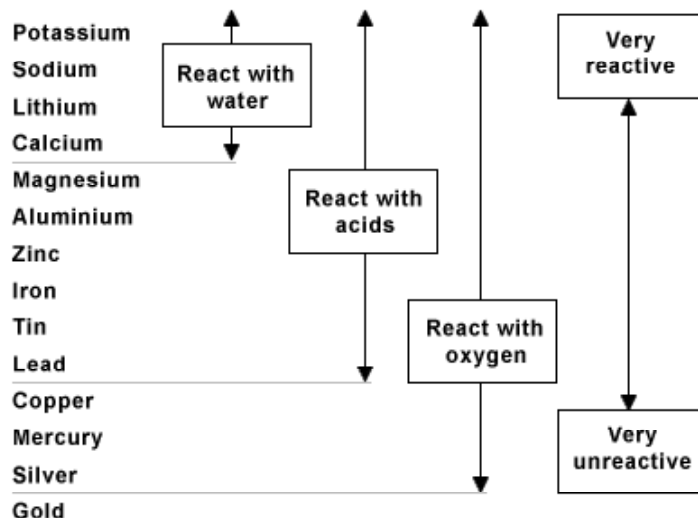


3. Chemical displacement or Replacement:

When more reactive metal displaces less reactive metal from its aqueous salt solution, the chemical reaction is called chemical displacement. **or** a more active element takes the place of another element in a compound and sets the less active one free. (According to metal activity series)

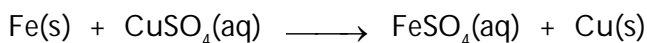
Basic form: $\text{A} + \text{BX} \longrightarrow \text{AX} + \text{B}$ or $\text{AX} + \text{Y} \longrightarrow \text{AY} + \text{X}$

Metal activity series: In the reactivity series, less reactive metal is placed below the series and more reactive metal is placed above it. Thus, as we move down, the metal in the reactivity series becomes less reactive. Therefore, in a metal displacement reaction, it is seen that a more reactive metal displaces a less reactive metal from its solution. From potassium to lead in the reactivity series present above the hydrogen and copper to gold are below the hydrogen. The elements above the hydrogen are more reactive than hydrogen and hence they can easily replace hydrogen or the elements present below the hydrogen in reactivity series. The elements present below hydrogen in the reactivity series are less reactive than hydrogen and can not replace hydrogen.

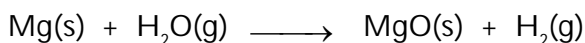
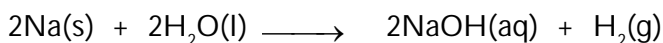


Examples of replacement reactions:

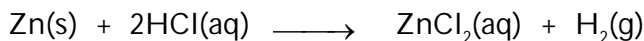
- i) Replacement of a metal in a compound by a more active metal.



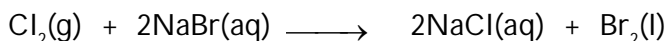
- ii) Replacement of hydrogen in water by an active metal.



- iii) Replacement of hydrogen in acids by active metals.



- iv) Replacement of nonmetals by more active nonmetals.



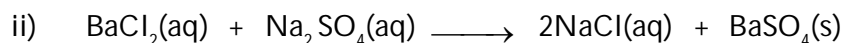
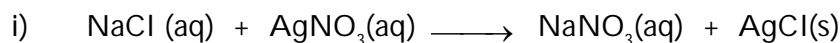
Ionic or double decomposition reaction: It occurs between ions in aqueous solution. A reaction will occur when a pair of ions come together to produce at least one of the following:

- a precipitate
- a gas
- water or some other non-ionized substance.

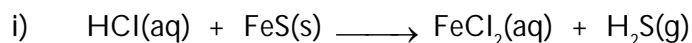


Examples of ionic reactions:

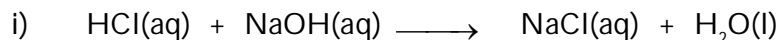
Formation of precipitate:



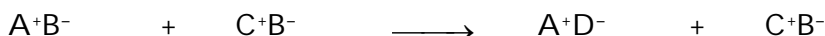
Formation of a gas.



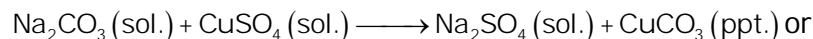
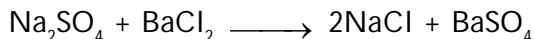
(Formation of water) Neutralisation reaction: If the reaction is between an acid and a base it is called a neutralization reaction.



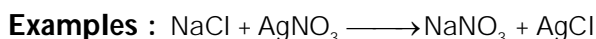
A chemical reaction, in which two compounds in their aqueous solution react by exchanging their radicals is called chemical double decomposition.



The chemical double composition reaction is of two types as discussed below :



Precipitation reaction : A chemical double decomposition reaction in which one of the products is insoluble in water is called precipitation reaction.



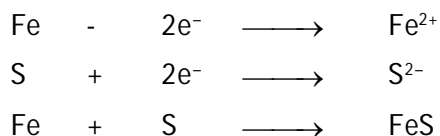
Neutralisation reaction: If the reaction is between an acid and a base it is called a neutralization reaction. $\text{HCl(aq)} + \text{NaOH(aq)} \longrightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}$

Redox reactions:(Reduction and oxidation reactions): A chemical reaction in which one substance is oxidised, and at the same time another substance is reduced is called redox reaction.

As a matter of fact all chemical reactions involving actual donation or acceptance of electrons are redox reactions. The reactions described above are redox reactions.

Oxidation : When an atom or group of atoms lose electron/electrons, it is called oxidation.

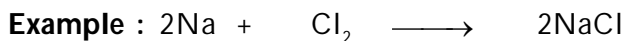
For example : The given equation: $\text{Fe} + \text{S} \longrightarrow \text{FeS}$



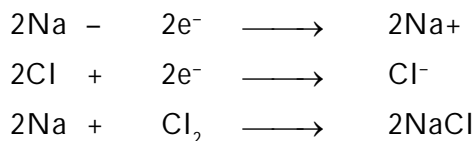
In the above equation, as atom of iron loses 2 electrons, it is oxidised. Sulphur gain two electrons, therefore sulphur is an oxidising agent.

In the above equation as aluminium atoms lose electrons, therefore, aluminium is oxidised.

Reduction : When an atom or group of atoms gains electron, it is called reduction



The above equation can be represented as under:



In the above equation, the chlorine atoms gain electrons. Therefore, chlorine is reduced.

As the sodium atoms lose electrons , therefore, sodium is a reducing agent.

Assigning Oxidation Numbers Based on Chemical Rules

Determine whether the substance in question is elemental: Free, uncombined elemental atoms always have an oxidation number of 0. This is true both for atoms whose elemental form is composed of a lone atom, as well as atoms whose elemental form is diatomic or polyatomic.

For example, Al(s) and Cl₂ both have oxidation numbers of 0 because they are in their uncombined elemental forms.

Note that Sulphur's elemental form, S₈, or octasulfur, though irregular, also has an oxidation number of 0.

Determine whether the substance in question is an ion: Ions have oxidation numbers equal to their charge. This is true both for ions that are not bound to any other elements as well as for ions that form part of an ionic compound.

For instance, the ion Cl⁻ has an oxidation number of -1.

The Cl ion still has an oxidation number of -1 when it's part of the compound NaCl. Because the Na ion, by definition, has a charge of +1, we know that the Cl ion has a charge of -1, so its oxidation number is still -1.

For metallic ions, know that multiple oxidation numbers are possible: Many metallic elements can have more than one charge. For instance, the metal Iron (Fe) can be an ion with a charge of either +2 or +3.

For example, let's examine a compound containing the metallic aluminum ion. The compound AlCl₃ has an overall charge of 0. Because we know that Cl⁻ ions have a charge of -1 and there are 3 Cl⁻ ions in the compound, the Al ion must have a charge of +3 so that the overall charge of all the ions adds to 0. Thus, Al's oxidation number is +3.

Assign an oxidation number of +1 to hydrogen (with exceptions): Like oxygen, hydrogen's oxidation number is subject to exceptional cases. Generally, Hydrogen has an oxidation number of +1 (unless, as above, it's in its elemental form, H₂). However, in the case of special compounds called hydrides, hydrogen has an oxidation number of -1.

For instance, in H₂O, we know that hydrogen has an oxidation number of +1 because oxygen has a charge of -2 and we need 2 +1 charges to make the compound's charges add up to zero. However, in sodium hydride, NaH, hydrogen has an oxidation number of -1 because the Na ion has a charge of +1 and, for the compound's total charge to equal zero, hydrogen's charge (and thus oxidation number) must equal -1.

Fluorine always has an oxidation number of -1

Ex: Calculation of oxidation number of Fe in Fe₂O₃: Charge of oxygen is -2

Let Oxidation number of Fe is x.

$$x \times 2 + (-2) \times 3 = 0; \quad 2x + (-6) = 0; \quad 2x = 0 + 6; \quad x = \frac{6}{2} = 3$$

Catalytic reaction: A chemical reaction in which the rate of reaction is altered in the presence of a catalyst is called catalytic reaction.

Important Points

- Chemical combination : When two or more elements or compounds react chemically to form only one new compound, then the chemical reaction which takes place is called chemical combination.
- **Synthesis (composition)** : In this two or more elements may combine to form a more complex compound
- **Chemical decomposition** : When a chemical compound decomposes on heating or absorbing some other kind of energy, so as to form two or more substances.

- **Chemical displacement** : When more reactive metal displaces less reactive metal from its aqueous salt solution, the chemical reaction is called chemical displacement reaction.
- **Precipitation reaction**: A chemical double decomposition reaction in which one of the products is insoluble in water is called precipitation reaction.
- **Oxidation** : When an atom or group of atoms lose electron/electrons, it is called oxidation
- **Reduction**: When an atom or group of atoms gains electron, it is called reduction.

New Words

- ❖ **Catalyst**: It is a substance which increases the rate of a reaction but it does not participate in a reaction.

CHEMICAL EQUATIONS AND REACTIONS

PRACTICE SHEET -2



Conceptual Practice Sheet



Single Response Type:

1. If two or more substances combine to form a new substance chemical reaction is termed as

A) Thermal decomposition	B) Combination
C) Addition	D) Combustion
2. When substance combines with oxygen while burning reaction is termed as

A) combustion	B) burning	C) both A and B	D) evaporation
---------------	------------	-----------------	----------------
3. Heating of limestone a ____ reaction.

A) Combination	B) Decompositon	C) Displacement	D) Double displacement
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4. The product formed other than water when acid and base are mixed is _____.

A) Salt	B) Gas	C) Both A and B	D) Pecipiate
---------	--------	-----------------	--------------
5. Combination reaction always :

A) use only one reactant	B) form one product
C) involves an ionic compound and element	D) requires oxygen gas
6. Burning of fossils fuels results in production of gas

A) bio gas	B) oxygen	C) carbon dioxide	D) nitrogen
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7. If baking soda or fruit salt is mixed with vinegar there takes place a

A) chemical reaction	B) physical reaction	C) Both A and B	D) transference
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True or false type:

8. On decomposition of CaCO_3 , two types of new compounds are formed.
9. CaCO_3 on heating gives CaO and CO_2 . It is an example for decomposition type of reaction.
10. Generally all hydroxides and oxides of metals are bases.
11. Zinc is less electropositive than hydrogen.
12. The chemical reaction, in which two compounds in their aqueous solution react by exchanging their radicals is called combination reaction.

$[AlCl_3 + 3NaOH \longrightarrow Al(OH)_3 + 3NaCl]$ is an example of

- A) double decomposition reaction B) synthesis or direct combination reaction
C) simple displacement reaction D) decomposition reaction

LEVEL - III

11. The heating of ferrous sulphate is an example of _____ reaction and the reaction between iron and copper sulphate is an example of _____ reaction.
A) displacement, decomposition B) decomposition, displacement
C) combination, displacement D) combination, decomposition
12. Sodium oxide + Water \longrightarrow Sodium hydroxide $[Na_2O + H_2O \longrightarrow 2NaOH]$ is an example of
A) decomposition reaction B) double decomposition reaction
C) synthesis or direct combination reaction D) simple displacement reaction
13. Iron + Sulfur \longrightarrow Iron sulfide $[Fe + S \longrightarrow FeS]$ is an example of
A) simple displacement reaction B) synthesis or direct combination reaction
C) double decomposition reaction D) decomposition reaction
14. Copper carbonate (+ heat) \longrightarrow Copper oxide + Carbon dioxide $[CuCO_3 \longrightarrow CuO + CO_2]$ is an example of
A) double decomposition reaction B) simple displacement reaction
C) decomposition reaction D) synthesis or direct combination reaction
15. Magnesium + Copper sulfate \longrightarrow Magnesium sulfate + Copper $[Mg + CuSO_4 \longrightarrow MgSO_4 + Cu]$ is an example of
A) simple displacement reaction B) decomposition reaction
C) synthesis or direct combination reaction D) double decomposition reaction

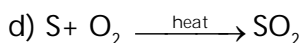
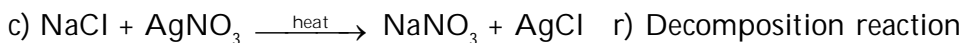
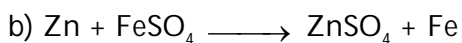
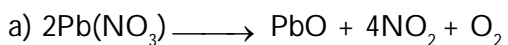


IIT - JEE Advanced Practice Sheet



Assertion and reasoning type:

1. **Assertion:** When an atom or group of atoms gains electron, it is called reduction
Reason : $2Cl + 2e^- \longrightarrow Cl^-$. In this chlorine undergoes reduction
A) Both Assertion and reason are correct and reason is the correct explanation of assertion.
B) Both Assertion and reason are correct but reason is not the correct explanation of assertion.
C) Assertion is correct, reason is incorrect.
D) Assertion is incorrect, reason is correct.
2. **Assertion:** Acid + Base \rightarrow Salt + Water, it is an example of neutralisation
Reason : Reaction between the lead monoxide and oxygen is an example of neutralisation.
A) Both Assertion and reason are correct and reason is the correct explanation of assertion.
B) Both Assertion and reason are correct but reason is not the correct explanation of assertion.
C) Assertion is correct, reason is incorrect.
D) Assertion is incorrect, reason is correct.

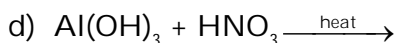
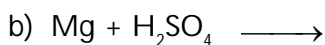
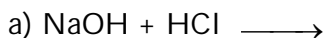
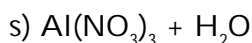
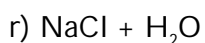
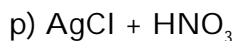
Match the following12. **Column-I****Column-II**

p) Combination

q) Double decomposition

r) Decomposition reaction

s) Displacement

13. **Column-I****Column-II****Subjective type:**

- Write the types of chemical reactions with one example each.
- Write about metal activity series in detail and write their application in displacement reactions.
- Define chemical decomposition reaction. Give one example.
- What is a chemical decomposition reaction and mention the conditions required for it.

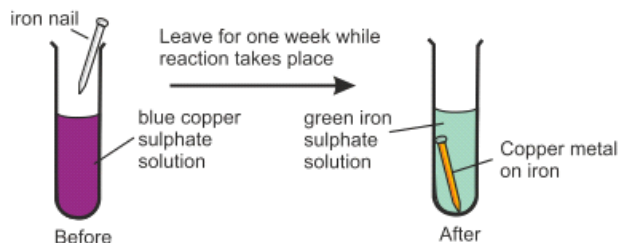
Integer type:

- On decomposition of CaCO_3 the number of new compounds formed is ____

REVISION MAP

Displacement Reaction: A reaction in which part of a reactant is replaced by another reactant.

In case of metals, a more reactive metal displaces a less reactive metal from its salt.



Examples:



Electro-positivity decreases

Activity series

K
Na
Ca

Reacts with cold water

Mg
Al
Zn
Fe
Pb
(H)

Reacts with steam

Cu
Hg
Ag
Pt
Au

No Reaction

FOUNDATION BIOLOGY

SAMPLE CHAPTER



NUTRITION IN PLANTS & ANIMALS

Chapter Out Line

- Introduction
- Autotrophic & Heterotrophic Nutrition
- Nutrition in plants
- Insectivorous plants
- Photosynthesis
- Stomata
- Nutrition in Animals
- Different ways of taking food
- Human digestive system
- Digestive system in amoeba
- Ruminant digestive system

**NUTRITION IN PLANTS & ANIMALS****LECTURE - 1***Learning Objectives*

When you have completed this lecture you should be able to :

- ◆ Study about nutrition and its importance.
- ◆ Study autotrophic and heterotrophic nutrition.

**NUTRITION IN PLANTS**

INTRODUCTION: You feel hungry in the morning and you will have a good breakfast. You go to school, come back feeling hungry again. Why do you feel hungry again? What has happened to the breakfast you ate?

Well Your breakfast has been used by your body to give you energy. This energy helped you to do all the studying, playing, talking, and drawing in school.

Any substance that can be broken down through chemical process in the body of an organism to give energy is called food.

The entire process of taking in food and water by living organisms and using it for the purpose of growth and daily activities is called nutrition.

Most plants are green, they synthesise food for themselves. Plants are the only organisms that can prepare food for themselves by using water, carbon dioxide and minerals.

The nutrients enable living organisms to build their bodies, to grow, to repair damaged parts of their bodies and provide the energy to carry out life processes.

TYPES OF NUTRITION

There are basically two modes of nutrition:

(a) Autotrophic

(b) Heterotrophic

Autotrophic Nutrition

Nutrition in which organisms can prepare their own food from simple inorganic substances is called **autotrophic nutrition**. The organisms that show autotrophic nutrition are called autotrophs. Green plants and some bacteria are autotrophs. Autotrophs prepare their food through a process called **photosynthesis**.

Heterotrophic Nutrition

All animals including humans and non-green plants (fungi and some bacteria) show heterotrophic mode of nutrition. The **heterotrophic organisms or heterotrophs** cannot prepare their own food. They derive their food from other organisms — directly or indirectly from plants.

Heterotrophs may follow any of the following three types of nutrition :

(a) Holozoic Nutrition

(b) Saprophytic Nutrition

(c) Parasitic Nutrition

Holozoic Nutrition : Holozoic nutrition is typical of most animals — all vertebrates and most invertebrates. The organisms consume the whole food (animal or plant or their parts) into their body, and then digest it into simple substances.

Saprophytic Nutrition : The organisms feed on dead and decaying plants or animals (organic matter).

Examples - Mushrooms, yeast, bread mould, many types of bacteria.

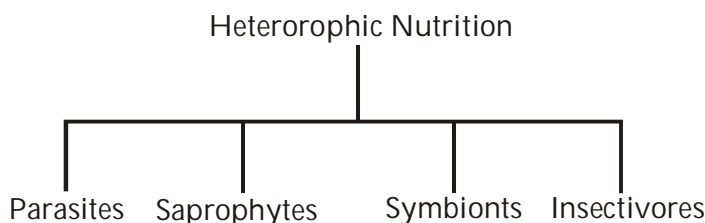
Parasitic Nutrition : The organisms live on other organisms called the **host**, and derive nourishment from the **host**. The organism deriving nourishment from the host is called the **parasite**.

Examples - Malarial parasite, tapeworm.

OTHER MODES OF NUTRITION IN PLANTS: The organisms which do not make their own food and depend for their food on other sources are called **heterotrophs**.

Plants which do not make their own food and obtain their food from others are called the **heterotrophic plants**.

Heterotrophic plants are unable to make their food by themselves. They obtain their food from other sources either completely or partially, depending upon the deficiency in their body. Depending upon the mode of nutrition, the heterotrophic plants are grouped as



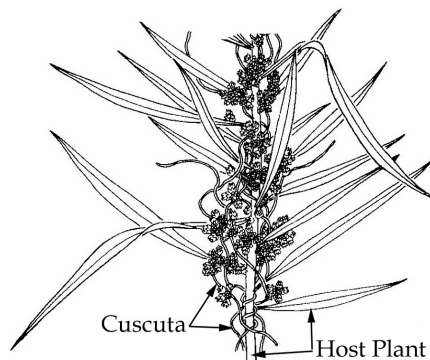
PARASITES: The living organism which obtains their food from other living organism may be plants or animals called parasite.

The organisms from which the parasites obtain food is called host. E.g., Cuscuta (Amarbel) Cuscuta (Dodder) has a short root and a long, thread - like stem.

It twines around the host stem and sends branches around neighbouring stems giving the appearance of a mass of noodles or spaghetti.

Amarbel is a total parasite that sucks food from a plant by producing special root - like structures called haustoria.

Plants such as mistletoe bear green leaves, they synthesise, their own food, but receive water and minerals from the host plant, they are partial parasite.



Dodder and mistletoe are serious problems for plants. Dodder can cover woody plants and caused heavy damage to certain economically important crops. Mistletoe can become so abundant on a tree that most of the foliage is of the parasite and not of the host.

Does this mean that the host plant is slowly killed off by the parasite?

Scientists believe that parasitic plants rarely, perhaps never, kill the host plant, so that the parasite can continue to live off the host.

A parasitic plant, *Rafflesia*, bears the world's largest flower. The flowers have five petals and may have a diameter of up to 106 cm, and weigh up to 10 kg.

SAPROPHYTES: Saprophytes are plants which obtain their food from dead and decaying plant and animal bodies. E.g., Fungi and bacteria.

Moulds growing on stale bread and mushrooms growing on moist humus or rotting wood are the source of fungus plants which are saprophytes.

Plants which use saprotrophic mode of nutrition are called saprotrophs.

In our homes, we find that sweets or any other moist food kept in a warm place for a few days get spoil, this is due to the growth of moulds (saprophytes) on the food

Fungus plants may spoil our food, leather goods, moist - wood and wet clothes.

How do saprophytic plants manage their nutrition?

Saprophytic plants are plants that live off rotting material (sapro-rotting; phytic-plant). They grow in places with lots of rotting dead leaves, often in deep shade in tropical forests. Some examples are Indian pipe and coral root.

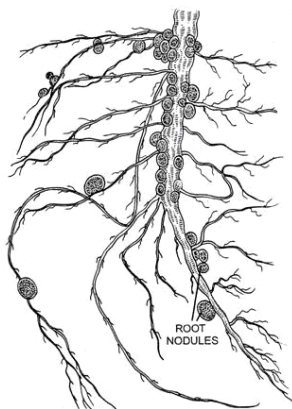
Indian pipe is found commonly in Asia and throughout north America. Coral roots are four in forest environments around the world. The roots of saprophytes contain living organisms called fungi. Fungi are capable of digesting dead and decaying matter. The fungi produce digestive juices which converts the dead and decaying matter into sugar which can be used as food by these plants.



Fungi

SYMBIONTS : Symbionts are two organisms living together for the benefit of one another. The relationship between the two organisms living together for mutual benefit is known as symbiosis.

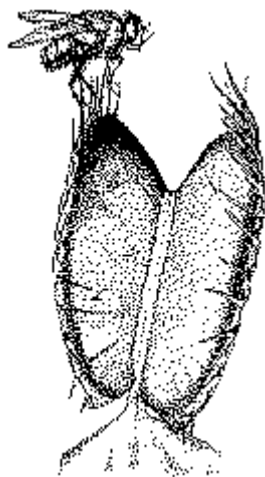
Rhizobium has the ability of fixing nitrogen from air into oxides of nitrogen. Oxide of nitrogen is the nutrition for green plants, these oxides also make the soil fertile. Thus, rhizobium which is a nitrogen fixing non - green bacterium supplies mineral nutrition to the host plant and in exchange obtains water and carbohydrate food from the nodules



Root nodules with Rhizobium bacteria

Lichens : lichens are symbionts, they are white bluish - green crust like plants growing on rocks or bark of trees. The fungus absorbs water from moist air and supplies it to the alga. In turn, alga synthesizes carbohydrate food and supplies it to the fungus.

INSECTIVOROUS PLANTS - Like animals, some plants also feed on small insects, and have developed special methods to capture their food. Insectivorous plants grow in marshy places with their roots in mud which is deficient in nitrogenous nutrition. To overcome this deficiency, their leaves are modified to trap insects, which are killed and consumed. They are autotrophs that is they are able to synthesise their own food. Common examples of insectivorous plants are *Nepenthes* (Pitcher plant), *Drosera* (sundew), *Dionaea* (Venus flytrap).

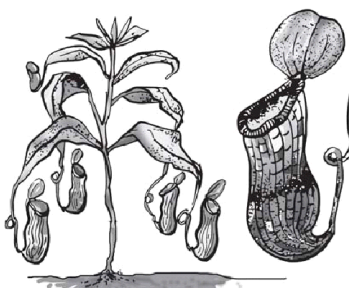


Dionaea - Insectivorous plant

Nepenthes ; In the pitcher plant, the leaf is modified to form a tubular pitcher - like structure. The inside of the pitcher is lined with downward pointed hairs. These hairs do not allow any insect climbed up and escape. The fluid at the bottom of the pitcher contains digestive juices that digest the insect.

Among the carnivorous plants the biggest, and the most amazing, are the vines known as the tropical pitcher plants. They have been known to capture and eat not only insects but also frogs and rarely even rodents. They are mainly found in southeast Asia, the majority of them in the island of Borneo.

The leaves of sundew have tentacles with drops of a sticky substance called mucilage at the ends ; insects get stuck in this substance and become entangled. The helpless insect then gets digested.

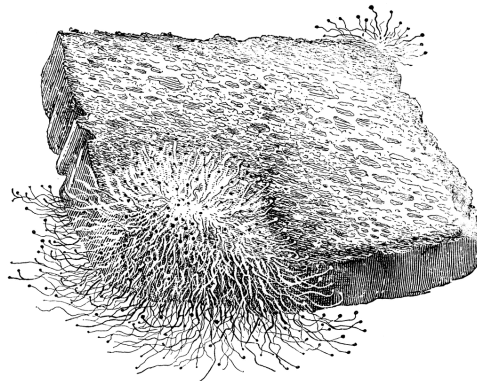


Nepenthes

The slender leaves of bladderworts bear a large number of very small, pear-shaped bladders. This opens a trapdoor and the prey is sucked in within one - thousandth of a second. The trap of the venus flytrap is a highly modified leaf. On the inner surface (reddish here is to attract insects) there are short, stiff hairs. When anything touches these hairs, the two lobes of the leaves snap shut in less than a second.

Activity

Take a piece of bread and moisten it with water. Leave it in a moist warm place for 2-3 days or until fluffy patches appear on them. These patches may be white, green, brown or of any other colour. Observe the patches under a microscope or a magnifying glass. Explanation: When we observe the patches under a microscope or a magnifying glass, you will notice cotton - like threads spread on the piece of bread. These organisms are called fungi. They have a different mode of nutrition. They secrete digestive juices on the dead and decaying matter and convert it into a solution. Then they absorb the nutrients from it. This mode of nutrition in which organisms take in nutrients in solution form from dead and decaying matter is called saprotrophic nutrition.



Rhizopus - Bread mould

HOW NUTRIENTS ARE REPLENISHED IN THE SOIL :

Have you ever wonder why we add manure and fertilizers to the soil?

We add manure and fertilizers to the soil to make up the deficiency of soil nutrients created by constant use by plants.

As plants absorb nutrients from the soil, the amount of nutrients there in decreases gradually. Thus, in order to grow healthy plants, the soil has to be enriched (i.e., fertilized from time to time).

The nutrients provided by manure and fertilizers are nitrogen, phosphorus and potassium, which are also contained in the soil. Some nutrients are obtained from nature. E.g., carbon is obtained in the form of carbon dioxide. Hydrogen and oxygen are available in water.

Although nitrogen is also present in plenty in the atmosphere, it cannot be used by plants directly, it has to be first converted into its soluble form. The roots of leguminous plants such pea plant, corn plant, gram, beans, etc., (most pulses are leguminous) bear nodules in which live bacteria known as Rhizobium.

The bacteria are located inside the nodules, this type of bacteria can directly convert atmospheric nitrogen into nitrate, a soluble form. At the same time, the bacteria also depend on the plant for its food and shelter. Such a type of mutually dependent relationship between the bacteria and the leguminous plant is an example of symbiotic relationship.

This association is of great significance for the farmers, they do not need to add nitrogen fertilizer to the soil in which leguminous plants are grown.

New Words

- ❖ **Nutrition** : the process of obtaining and utilising food.
- ❖ **Autotrophs** : organisms which can prepare their own food from simple organic substances.
- ❖ **Heterotrophs** : organisms which depend directly or indirectly on plants for food. They cannot manufacture their own food.

Important Points

- Living organisms obtain energy from the food they eat.
- Food contains nutrients which provide nutrition to the organisms.
- Organisms can be autotrophs or heterotrophs, based on their mode of obtaining food.
- Autotrophs are capable of manufacturing their food, while heterotrophs depend on other living organisms.

NUTRITION IN PLANTS & ANIMALS

PRACTICE SHEET -1



Conceptual Practice Sheet



Fill in the blanks Type:

1. Green plants are called _____ since they synthesize their own food.
2. A parasitic plant with yellow, slender, tubular stem is _____
3. Primarily animals depend for their food on _____.
4. Mushroom shows _____ mode of nutrition.
5. The modified part of pitcher is _____

True/ False Type:

6. Heterotrophs cannot make their own food.
7. Decomposers are bacteria and Fungi.
8. Carbohydrates, vitamins and fats are the components of food.
9. Nutrients help to provide energy to carry out life processes.
10. Digestive juices are secreted by the pitcher plant to digest an insect.

Subjective Type:

11. What is a nutrient?
12. Why are algae green in colour?
13. What are the main components present in carbohydrates?
14. What is parasitic nutrition?
15. How do pitcher plants get their nutrition?



Competitive Practice Sheet



Single Response Type:

LEVEL - I

- The components that are necessary for our body are called
A) Vitamins B) Pulses C) Nutrients D) Minerals
- The mode of nutrition in which organisms make food themselves from simple substances is called
A) Autotrophic nutrition B) Heterotrophic nutrition
C) Saprotrophic nutrition D) All of the above
- Some organisms live together and share shelter and nutrients. This is called
A) Predation B) Symbiotic relationship
C) Autotrophs D) Heterotrophs
- The bacterium which provides nitrogen to the leguminous plants is
A) Rhizobium B) Yeast C) Fungi D) Lichens
- Pitcher is an example of
A) Insectivorous plant B) Leguminous plant
C) Algae D) Fungi
- Select the appropriate one
A) Food in for growth and development B) Food for protection against diseases
C) No role in life processes D) Both A & B
- _____ are called protective food
A) Carbohydrates B) Proteins C) Water D) Fats
- What entangles the insect as it gets trapped by the pitcher plant?
A) Cilia B) Branches C) Flagella D) Hair
- Green plants are
A) Autotrophic B) Saprotrophic C) Symbiotic D) Parasitic
- Which of the following does not show symbiotic relationship?
A) Sponge - Alga B) Alga - Fungus C) Mosquito - Man D) Legume - Rhizobium

LEVEL - II

- Insectivorous plants like the pitcher plant feed on insects to obtain nitrogen compounds. Which of the following food components need to be digested in order to produce these nitrogenous compounds?
A) Carbohydrates B) Fats C) Vitamins D) Proteins
- Which of the following is not a heterotroph?
A) Algae B) Deer C) Yeast D) Cow

13. The mineral required by the plants to make proteins is
A) Calcium B) Potassium C) Iodine D) Nitrogen
14. Which of the following is not a role of nutrients in the body?
A) Provide energy to carry out life processes
B) Growth and repair of the damaged parts of the body
C) Provide excess fats to the body
D) Build the body structure
15. Fungi are mostly
A) Parasitic B) Symbiotic C) Autotrophic D) Saprotrophic
16. What attracts the insects towards Venus fly-trap plant?
A) Soft petals of flowers B) Bright colour of petals
C) Sugary juice in leaf lobes D) Hairy leaves
17. Which of the following statements is not true with respect to fungi?
A) Mostly fungi follow saprotrophic mode of nutrition.
B) Some fungi are useful while some are harmful in nature.
C) All fungi are useful in nature.
D) Growth of fungi may result in spoilage of food and other articles.
18. Which of the following statements is not true with respect to autotrophic nutrition?
A) Chlorophyll is required for the synthesis of food.
B) Raw materials like carbon dioxide and water are used.
C) Food is prepared from simple substances.
D) Autotrophic nutrition does not occur in green plants.
19. Plants are called autotrophs as they
A) Cannot obtain raw materials to prepare food
B) Do not have the capacity to prepare food
C) Can prepare their own food
D) Depend on other organisms for food
20. Herbivorous animals consume
A) Only plants B) Only animals
C) Only microorganisms D) Both plants and animals

LEVEL - III

21. The cotton-like structure seen on the bread is due to the growth of
A) Lichens B) Bacteria C) Fungi D) Algae
22. Saliva contains an enzyme called
A) Amylase B) Trypsin C) Pepsin D) None of the above
23. The plant which traps and feeds on insects is
A) Cascutta B) China Rose C) Pitcher Plant D) Rose

24. Mushroom is
A) An Autotroph B) Heterotroph C) Saprotrophic D) Fungus
25. Which one of the following is a parasite?
A) Lichen B) Cuscuta C) Pitcher plant D) Rhizobium

Assertion and Reasoning Type :

26. Assertion : Submerged plants get carbon dioxide in the form of carbonates and bicarbonates
Reason : Stomata are not present in submerged
- A) If both assertion and reason are true and reason is the correct explanation of assertion.
B) If both assertion and reason are true but reason is not the correct explanation of assertion.
C) If assertion is true but reason is false.
D) If assertion is false but reason is true.

Match the following/ Matrix Matching :

27. **Column - I**
- a) Autotrophs
 - b) Heterotroph
 - c) Parasite
 - d) Saprophyte
 - e) Symbiont
 - f) Insectivorous
- Column - II**
- p) Fungi
 - q) Lichen
 - r) Pitcher Plant
 - s) Algae
 - t) Man
 - u) Cuscuta



NUTRITION IN PLANTS & ANIMALS

LECTURE - 2

Learning Objectives

When you have completed this lecture you should be able to :

- ◆ Know the process of photosynthesis and its requirements.



PHOTOSYNTHESIS

The green plants prepare their own food through a process known as **photosynthesis**.

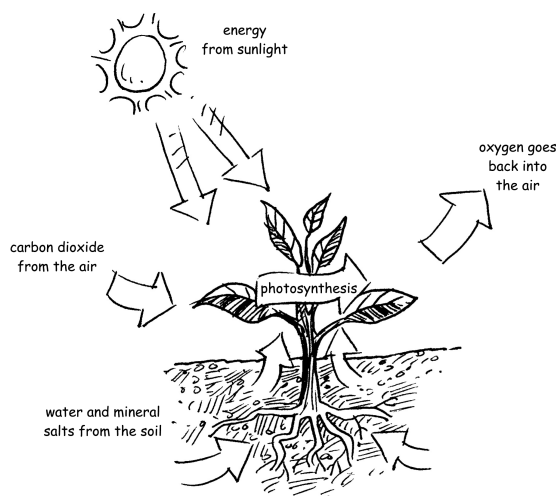


Fig : Photosynthesis

Photosynthesis, literally, means synthesis in the presence of light.

Let us see :

- Where does this process take place in the plant body?
- What are the raw materials required for this process?
- What is synthesized during the process ?

Where does photosynthesis occur?

1. Mostly in leaves.
2. In some cases in stems which are green.

Leaves contain the green coloured material, or pigment, called **chlorophyll** inside their cells.

The chlorophyll is present inside certain structures called **chloroplasts** (Fig.ii).



Fig (ii): leaf cells showing chloroplasts

Role of a leaf in photosynthesis : A leaf shows two important structures :

- (i) Presence of small pores, generally on the lower surface. Through these pores carbon dioxide enters the leaf. These pores are called **stomata**
- (ii) Presence of chlorophyll-containing cells.

Chlorophyll is necessary as it traps energy from sunlight. Without chlorophyll, photosynthesis does not take place.



It's a fact



Do you remember some plants like cacti where the leaves are modified to spines and stem is green. Photosynthesis takes place in the stem in such plants.

Raw materials required

Green plants require four things to prepare their own food. These are

1. Carbon dioxide, absorbed from the atmosphere through stomata *present* on the leaf surface.
2. Water, absorbed from the soil, through the root system.
3. Chlorophyll, present in the leaf, and
4. Light, from sun.

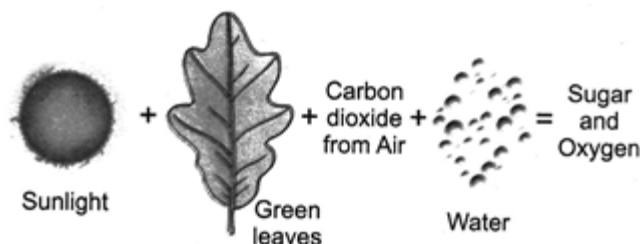


Fig : Photosynthesis

The process of preparing food using carbon dioxide and water in the presence of chlorophyll and light is known as **photosynthesis**.

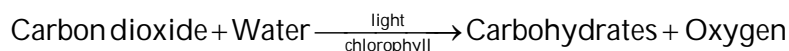
What is synthesized during photosynthesis?

During photosynthesis, food is synthesized. Oxygen is released in the process.

What this food means?

As a matter of fact, carbohydrates are prepared in this process, first simple sugars and then more complex ones. Presence of starch, a carbohydrate, in the leaves is regarded as an evidence of photosynthesis

Photosynthesis summarized :



Leaves of green plants are, thus, chemical factories producing food. They convert the energy from sunlight to chemical energy by making carbohydrates.

Activity

Aim: To find out if light is necessary for photosynthesis.

Materials required: Green plant, black paper, scissors, and clip.

Procedure: Cover a part of a leaf using strips of black paper. Destarch the plant by placing it in a dark corner for 3 days.

Pick a leaf from the destarched plant and test it for starch to confirm whether it is fully starch-free.

Now place the plant in strong sunlight for at least 6 hours.

Pick the leaf covered by the strip of black paper, remove the strip and test the leaf for starch.

Observation: The covered portion of the leaf does not turn blue-black.

Conclusion: There was no starch formation in the covered part so this part did not turn blue-black. This shows that light is necessary for photosynthesis.

Stomata : Stomata are minute openings present on the surface of leaves. These are more common on the lower leaf surface.

Structure : A stomata consists of an opening (**stomatal opening**) surrounded by two kidney-shaped cells called **guard cells**. The guard cells contain chloroplasts and carry out photosynthesis. Guard cells are surrounded by **subsidiary cells**. The whole structure consisting of the opening, guard cells and the subsidiary cells is called stomatal **apparatus**. The term stomata refers to the two guard cells along with the opening which they surround (Fig.).

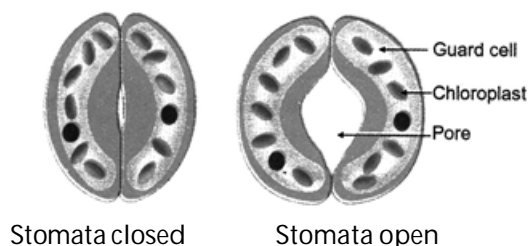


Fig: Structure of stomata

Role/Working : Exchange of gases (carbon dioxide and oxygen) takes place through stomata. The opening and closing of stomata is related to the photosynthetic activity in the leaves. Stomata are wide open during the day as photosynthesis occurs during that period. In dark or at night when there is no photosynthesis, stomata are closed.

New Words

- ❖ **Photosynthesis :** The process of making food by green plants from carbon dioxide and water in the presence of sunlight.
- ❖ **Host :** An organism which nourishes a parasite totally or partially.
- ❖ **Stomata :** Minute opening present on the undersurface of the leaf for gaseous exchange.
- ❖ **Chlorophyll :** A green pigment present in the leaves which trap solar energy for photosynthesis.
- ❖ **Insectivorous plants :** Those plants which feed on insects to get their supply of nitrogenous compounds.
- ❖ **Lichens** are symbionts, they are white bluish - green crust like plants growing on rocks or bark of trees. The fungus absorbs water from moist air and supplies it to the alga. In turn, alga synthesizes carbohydrate food and supplies it to the fungus.

- ❖ **SYMBIONTS** : Symbionts are two organisms living together for the benefit of one another. The relationship between the two organisms living together for mutual benefit is known as symbiosis.

Important Points

- Green plants manufacture their food in the presence of sunlight by the process of photosynthesis.
- Photosynthesis requires certain inorganic raw materials, *i.e.*, carbon dioxide, water, minerals, and sunlight along with an organic pigment called chlorophyll.
- Plants synthesise food in the form of glucose and store it in the form of starch in their leaves, stems, roots and fruits.
- Photosynthesis is the only biological process which supports whole life on earth.
- Leaves are the food factories of plant, the synthesis of food in plants occur in leaves.
- Carbon dioxide + Water $\xrightarrow[\text{Chlorophyll}]{\text{Sunlight}}$ Carbohydrate + Oxygen.
- Sun is the ultimate source of energy for all living organisms.

NUTRITION IN PLANTS & ANIMALS

PRACTICE SHEET -2



Conceptual Practice Sheet



Fill in the blanks Type:

1. The foods synthesized by the plants are stored as_____.
2. In photosynthesis solar energy is captured by the pigment called_____
3. During photosynthesis plants take in_____and release_____
4. _____cells surrounds the stomata
5. The process of photosynthesis produces a simple carbohydrate called_____

True/ False Type :

6. Leaves are the food factories of plant.
7. The sun is the ultimate source of energy for all living organisms.
8. Without the process of respiration there would be no plants.
9. Cuscuta do not contain chlorophyll.
10. The word "Phyte" meansPlant

Subjective Type:

11. How do plants obtain the raw materials from the surroundings?
12. How do the raw materials transport them to the food factories of the plants?
13. How would you test the presence of starch on leaves?
14. Why are leaves called the food factories of plants? Explain.



Competitive Practice Sheet



Single Response Type:

LEVEL - I

- Which of the following energy conversions takes place during photosynthesis?
A) Light energy → Mechanical energy
B) Light energy → Chemical energy
C) Chemical energy → Light energy
D) Mechanical energy → Chemical energy
- Photosynthesis in cactus is carried out by
A) Stems B) Roots C) Spines D) Leaves
- The opening and closing of stomata is controlled by
A) Guard cells B) Epidermis C) Stroma D) Mesophyll cells
- What is the ultimate source of energy for all living organisms?
A) Sun B) Soil C) Wind D) Water
- Which gas is taken in by the stomatal pores of the leaves to initiate photosynthesis?
A) Carbon dioxide B) Sulphur dioxide C) Nitrogen D) Oxygen
- Which of the following would be a direct consequence in the absence of photosynthesis?
A) There would be no oxygen produced.
B) There will be a decrease in the amount of sunlight.
C) There would not be enough carbon dioxide produced.
D) There will be depletion of water resources.
- Photosynthesis in cactus is carried out by
A) Roots B) Stems C) Spines D) Leaves
- The opening and closing of stomata is controlled by
A) Stroma B) Guard cells C) Mesophyll cells D) Epidermis
- Which of the following is not true with respect to photosynthesis in plants?
A) Photosynthesis occurs only in plants with green leaves.
B) Oxygen is released as a by-product during photosynthesis.
C) Water and carbon dioxide are essential raw materials for photosynthesis.
D) Photosynthesis in desert plants occurs through stem and branches
- The pores present on the surface of the leaves are called
A) Stomata B) Hydathodes C) Grana D) Vein

LEVEL - II

- Which of the following is considered as the food factory of a plant?
A) Root B) Leaf C) Flower D) Stem

12. Which of the following would be a direct consequence in the absence of photosynthesis?
- A) There will be depletion of water resources.
 - B) There would be no oxygen produced.
 - C) There would not be enough carbon dioxide produced.
 - D) There will be a decrease in the amount of sunlight.
13. Which of the following correctly represents the word equation for photosynthesis?
- A) Carbon dioxide + Water → Starch + Oxygen
 - B) Oxygen + Water → Starch + Carbon dioxide
 - C) Carbon dioxide + Water → Glucose + Energy
 - D) Carbon dioxide + Water → Glucose + Oxygen
14. Starch stored in the leaves after photosynthesis is a
- A) Protein
 - B) Mineral
 - C) Carbohydrate
 - D) Vitamin
15. Which colour of the leaves confirms the presence of starch on adding iodine?
- A) Yellow-brown
 - B) Red-orange
 - C) Blue-black
 - D) Cream-white
16. The tiny pores present on the surface of leaves are surrounded by
- A) Mesophyll cells
 - B) Cork cells
 - C) Guard cells
 - D) Parenchyma cells
17. The process by which energy is obtained directly from sunlight and stored as organic compounds in plants is called
- A) Respiration
 - B) Assimilation
 - C) Transpiration
 - D) Photosynthesis
18. What kind of leaves are found in desert plants?
- A) Conical
 - B) Flat
 - C) Spiny
 - D) Oval
19. Which gas is taken in by the stomatal pores of the leaves to initiate photosynthesis?
- A) Oxygen
 - B) Nitrogen
 - C) Carbon dioxide
 - D) Sulphur dioxide
20. In "Photosynthesis" the word 'photo' stands for
- A) Water
 - B) Air
 - C) Light
 - D) Leaves

LEVEL - III

21. CO₂ is utilized in this
- A) Respiration
 - B) Photosynthesis
 - C) Digestion
 - D) None of these
22. The process by which a plant prepares its food "Photosynthesis" takes place in the presence of
- A) Moon Light
 - B) Sunlight
 - C) Candle light
 - D) Bulb
23. _____ gas is released by the plants in the process of Photosynthesis
- A) Oxygen
 - B) Carbon dioxide
 - C) Nitrogen
 - D) Hydrogen
24. The Green coloured pigment in the leaves is
- A) Chlorophyll
 - B) Anthocyanin
 - C) Protoplast
 - D) Chloroplast
25. The process of photosynthesis produces
- A) Carbondioxide
 - B) Nitrogen
 - C) Oxygen
 - D) Trace gases.

26. Tiny pores found on the lower side of the leaves are called
A) Stomata B) Guard cell C) Both D) None
27. Green colour of the plant is due to the presence of
A) Oxygen B) Carbon dioxide C) Nitrogen D) Chlorophyll
28. Tiny pores present on the surface of leaves through which gaseous exchange occurs are called
A) Stomata B) Guard cells C) Food holes D) Gas holes
29. Correct equation for photosynthesis is
A) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ B) $6CO_2 + 6H_2O \rightarrow C_6 + H_{12}O_6 + 6O_2$
C) $6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$ D) $6CO_2 + 10H_2O \rightarrow C_6H_{12}O_6 + O_2 + 4H_2O$
30. Maximum Phototsynthesis occurs in
A) Blue light B) Red light C) Green light D) White light
31. Green plants do not given out CO_2 during day time because they
A) Store the same B) Respire very slowly
C) Donot respire D) Consume it in photosynthesis
32. During photosynthesis plants
A) Take oxygen and release carbon dioxide
B) Take carbon dioxide and release oxygen
C) Take carbon dioxide but do not release oxygen
D) Take oxygen but do not release carbon dioxide
33. During photosynthesis
A) Solar energy is converted into chemical energy
B) Solar energy is converted into mechanical energy
C) Chemical energy is converted into mechanical energy
D) Bio energy is converted into chemical energy

**NUTRITION IN PLANTS & ANIMALS****LECTURE - 3***Learning Objectives*

When you have completed this lecture you should be able to :

- ◆ To study human digestive system and the associated digestive glands.
- ◆ To know about human teeth and their types.

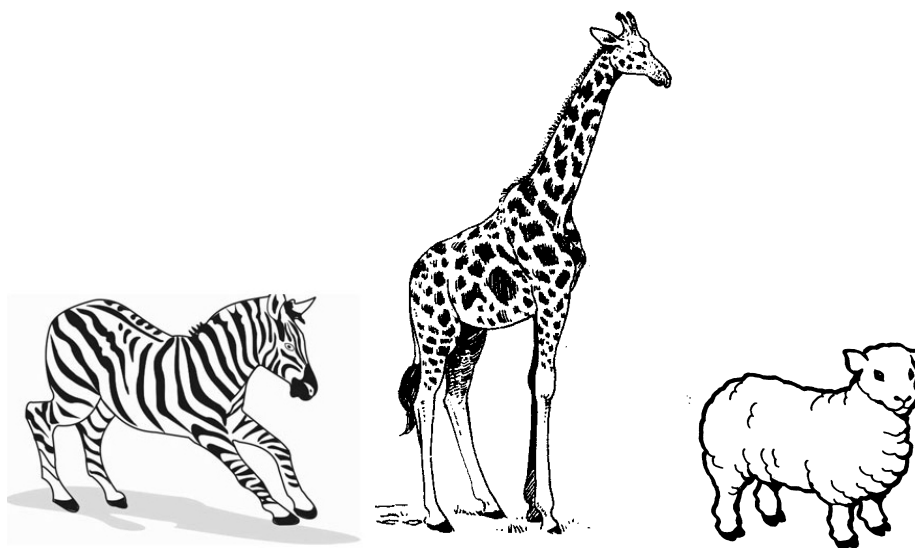
**NUTRITION IN ANIMALS****Introduction**

Nutrition in animals is mostly heterotrophic. They depend either on plants or other animals for their food. However, some animals feed on both plants and animals. Animals either eat, swallow, suck or ingest food. This method of intake of food is described as holozoic.

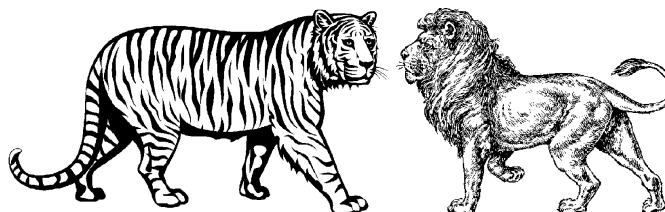
DIFFERENT WAYS OF TAKING FOOD

The mode of taking food into the body varies in different organisms, like bees and humming-birds suck the nectar of plants, infants of human and many other animals feed on mother's milk. They can be divided into following categories on the basis of their eating habits.

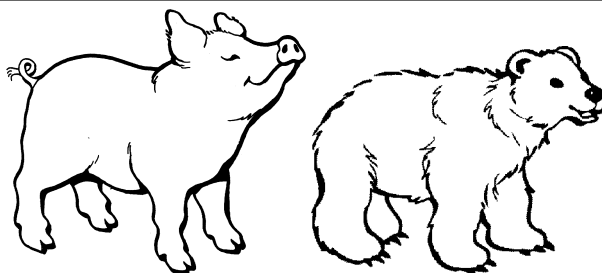
Herbivores - They feed only on plants and plant products. Herbivores include grass eating animals, grazers, leaf eaters, fruit eaters (and seed eaters).



Carnivores - They eat flesh of animals. e.g. are lion, tiger, frog, snake, lizard, hawk and eagle (birds).

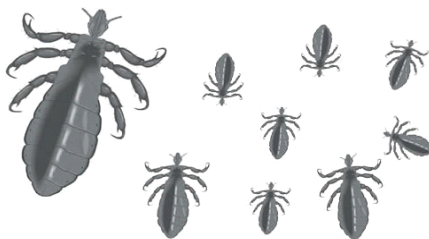


Omnivores - They both on plants and flesh. Man is omnivore. Other e.g., are pigs, bears birds like crow, sparrow and others.



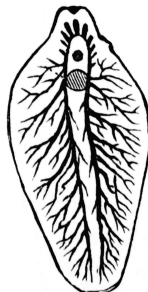
Parasites-A parasite lives in or on the body of its host. Parasite secures shelter, protection and food from its host gives nothing in return. Parasite is always smaller than the host.

- (a) **Ectoparasites** - They live on the surface of the body of the host. E.g., are lice, leeches, bedbugs, ticks. These are blood sucking parasites.



Lice

- (b) **Endoparasites** - They live within the body of the host. Examples are ascaris, hookworm, tapeworm, liver fluke, malarial parasite. It is a unicellular organisms which completes life cycle within the blood cells of man.



Saprotrophs - Most common e.g., is earthworm. As the earthworm moves, it swallows the soil along with any digestible decaying plant matter which forms its food.



Scavengers - They feed on the flesh of dead and decaying animals. E.g., - vulture.



NUTRITION IN AMOEBIA

Amoeba is an organism made up of a single cell. It is usually found in ponds and ditches. Amoeba has a cell membrane, a rounded, dense nucleus and many small bubble - like vacuoles in its cytoplasm.

It constantly changes its shape and position. Its food consists of the diatoms microscopic plants and animals floating in these waters.

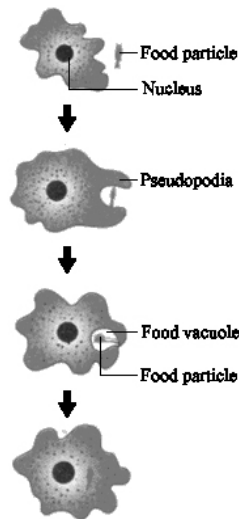
When Amoeba comes in contact with its food, it throws out finger - like projections from its body. These projections are called pseudopodia (pseudo - false; podium - feet)

Amoeba feeds on some microscopic organisms, when it senses food, it pushes out pseudopodia around the food particle and engulfs it. The food becomes trapped in a food vacuole.

Digestion and Utilization of food in animals like amoeba is intracellular.

The food is digested in the food vacuole with the help of digestive juices which are secreted into the food vacuole. This digested food is now ready to be absorbed and assimilated.

The absorbed substances are used for growth, maintenance and multiplication. The undigested residue of the food is expelled outside by the vacuole.



HUMAN DIGESTIVE SYSTEM

Digestion is the breakdown of large complex food molecules into smaller, simple molecules or monomers which can be easily absorbed in the blood.

Digestion involves two stages - physical digestion and chemical digestion. Physical digestion includes biting, chewing and grinding in which the large food molecules are broken down into smaller molecules physically with the help of teeth.

Chemical digestion involves addition of saliva, water and enzymes with the food molecules which can then be easily absorbed by the body.

Digestive system in animals includes the mouth cavity and the alimentary canal.

Mouth cavity - The mouth cavity has teeth, tongue, salivary glands and pharynx.

1. **Teeth** - Teeth are hard, bony structures found in the mouth of animals and humans. They are primarily

Used to chew food but in some animals it is also used for gnawing, catching and killing their prey. A tooth has 3 parts - crown, neck and root.

- i. The crown is the strongest part of the body called enamel which is made of salts of calcium that protect the inner layers from bacteria and changes in temperature.
- ii. The neck is embedded in the gums and is attached with a cementing substance which is rich in vitamin C.

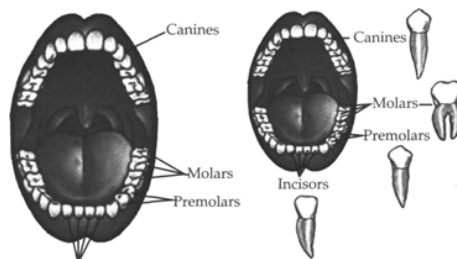
- iii. The root is situated in the bony socket of the gums and this condition is called thecodont. From the base of the root the teeth obtains nourishment and grows in size, but after a certain age the aperture at the base of the root closes and further growth of the teeth stops.

Types of teeth - There are mainly two types of teeth.

- A. Homodont type** - These are mainly found in animals. The teeth are of the same size and shape, and perform the same function.
- B. Heterodont type** - These are found in humans where the teeth are of different sizes and shapes, and perform different functions.

An adult human has 32 teeth -16 in the upper jaw and 16 in the lower jaw. The teeth are of 4 types -

- i. **Incisors** - These are located at the front of the mouth, four in the upper jaw and four in the lower jaw. They have sharp edges which help in biting and cutting the food.



Different types of teeth and arrangement in mouth cavity

- ii. **Canines** - There are 2 canines situated on either side of incisors in each jaw. These are pointed and used for tearing of food.
- iii. **Premolars** - Behind the canines are flat-shaped teeth which are used for grinding and chewing food. There are 4 premolars (2 sets) in each jaw.
- iv. **Molars** - Behind the premolars there are 12 molars (3 sets) in each jaw. The last set of molars are also called wisdom teeth. These are used for grinding and chewing the food.

Teeth pattern in different animals:

Herbivores - These have incisors and molars but no canine.

Carnivores - These have well developed canine for tearing of flesh, along with other teeth.

Omnivore - These animals have all the teeth, but the canines are not much developed as in the case of carnivores.

Dental formula - The number of teeth of each type is written as a dental formula for one side of the mouth, with the upper and lower teeth shown on separate rows. The number of teeth in a mouth is twice that listed as there are two sides. In each set, incisors are indicated first, canines second, premolars third, and finally molars. For example, the formula 2.1.2.3 for upper teeth indicates 2 incisors, 1 canine, 2 premolars, and 3 molars on one side of the upper mouth. The dentition can be expressed as a dental formula. Teeth are numbered, starting at 1 in each group, except the premolars which end at 4. This means that the carnassials (premolar and molar of carnivores) are always the fourth upper premolar and the first lower molar. Thus the human teeth are I1, I2, C1, P3, P4, M1, M2, and M3. The human dental formula is:

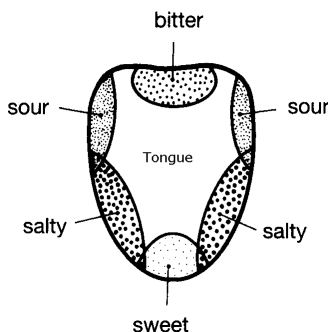
Adult	Child
I.C.P.M	I.C.P.M
2.1.2.3	2.1.0.2
I.C.P.M	I.C.P.M
2.1.2.3	2.1.0.2

Activity

Wash your hands. Look into the mirror and count your teeth. Use your index finger to feel the teeth. How many kinds of teeth could you find? Take a piece of an apple or bread and eat it. Which teeth do you use for biting and cutting, and which one for piercing and tearing? Also find out the ones that are used for chewing and grinding? Record your observations in Table.

Type of Teeth	Number of teeth		Total
	Lower Jaw	Upper Jaw	
Cutting and biting teeth			
Piercing and tearing teeth			
Chewing and grinding teeth			

Tongue - The tongue is the flexible muscular organ found attached to the bottom of the mouth. It helps in eating, swallowing of food and talking. Tiny projections on the upper surface of the tongue help in the sense of taste. There are four types of taste-buds found on the tongue which help in identifying the sweet, salty, sour and bitter flavours.

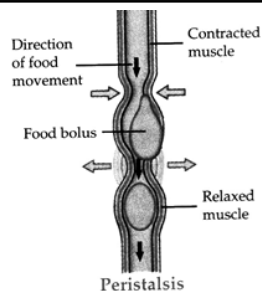


Salivary glands - There are 3 pairs of salivary glands found in the mouth. These glands secrete saliva, a watery fluid which mixes with the food and helps in digestion.

Activity

Aim: To study the effect of saliva on food.
Materials required: Bread, 1 watch glass, 1 petri dish, iodine solution & saliva from your mouth.
Procedure:
 Take out some saliva from your mouth and put it in a watch glass.
 Break off a little portion of bread and test it for starch using iodine solution.
 If it turns blue - black, starch is present.
 Now take a piece of bread in the petri dish.
 Pour a little saliva on the bread and watch.
 After some time, test for starch again on the portion where saliva was put.
Observation: The portion where saliva was put does not turn blue - black.
Conclusion: Since starch has been converted to sugar by the digestive juices in saliva, there is a negative test for starch.

The PHARYNX is the broad posterior end of mouth cavity and forms a common passage for food and air. It opens downwards in two apertures - Gullet and Glottis. Food from the pharynx opens in the gullet that is the opening of the oesophagus, and the glottis opens in the larynx that is the sound box.



The movement of muscles in the alimentary canal is called peristalsis, maximum peristalsis occurs in the stomach and minimum in the oesophagus and rectum.

New Words

- ❖ **Canines** : Sharp teeth for tearing the food.
- ❖ **Incisors** : Front teeth for biting and cutting the food.
- ❖ **Tongue** : A fleshy, muscular organ attached to the floor of the mouth cavity at the back and free at the front.

Important Points

- Intake of nutrients is called nutrition, for the continuation of vital activities.
- Human beings have a well-developed digestive system for their nutrition.
- The mouth has teeth, tongue, salivary glands, etc. to assist chewing.
- Tongue, present in the mouth cavity, helps in mixing the food with saliva, and also in tasting and swallowing the food.

NUTRITION IN PLANTS & ANIMALS

PRACTICE SHEET -3



Conceptual Practice Sheet



Fill in the blanks Type:

1. Two main energy giving foods are _____ and _____
2. The digestive glands associated with the alimentary canal in humans are _____ , _____ and _____
3. Incisor teeth help in _____ the food
4. _____ is the hardest known substance in our body.
5. Cellulose is a type of _____

True/ False Type:

6. Based on their food habits, heterotrophs can be herbivores, carnivores 'or' omnivores
7. Salivary glands secrete saliva that breaksdown the proteins in food into Aminoacids
8. Heterotrophes cannot make their own food
9. Amoeba is star shaped

Subjective Type:

10. What are the different modes of feeding in animals

11. What are Milk teeth and permanent teeth
12. What is peristalsis?



Competitive Practice Sheet



Single Response Type:

LEVEL - I

1. How many teeth are present in the lower jaw of human beings?
A) 20 B) 16 C) 19 D) 14
2. Which of the following is a function of pseudopodia in Amoeba? (A) Capture food (B) Digest food (C) Enable movement (D) Absorb food
A) Only B B) Both A and C C) Only A D) Only D
3. The part of the teeth which contains nerves and blood vessels is called
A) Gum B) Pulp cavity C) Dentine D) Enamel
4. Which of the following is not a function of the tongue?
A) Tasting of food B) Swallowing of food
C) Mixing of saliva with food D) Digestion of starch in food
5. Salivary glands secrete
A) Renin B) Pepsin C) Mucus D) Saliva
6. Finger-like projections on the body of Amoeba are called
A) Pseudopodia B) Parapodia C) Villi D) Cilia
7. Excessive intake of foods containing sugar is a major cause of
A) Headache B) Stomach pain C) Tooth decay D) Indigestion
8. The breakdown of complex components of food into simpler substances is called
A) Digestion B) Nutrition C) Breathing D) Respiration
9. The set of teeth that exists in the mouth during the period from six to eight years of a human being are called
A) Permanent teeth B) Premolar teeth C) Molar teeth D) Milk teeth
10. Plenty of boiled water mixed with a pinch of salt and sugar dissolved in it is called
A) An Acid B) A base
C) An indicator D) Oral Rehydration solution

LEVEL - II

11. Movement of food through the oesophagus is due to
A) Lubrication by saliva B) Peristalsis
C) Gravitational pull D) All of these
12. The main function of the lacteals of intestine is the absorption of
A) Amino acids B) Glucose and vitamins
C) Lactic acid D) Fatty acids and glycerol



NUTRITION IN PLANTS & ANIMALS

LECTURE - 4

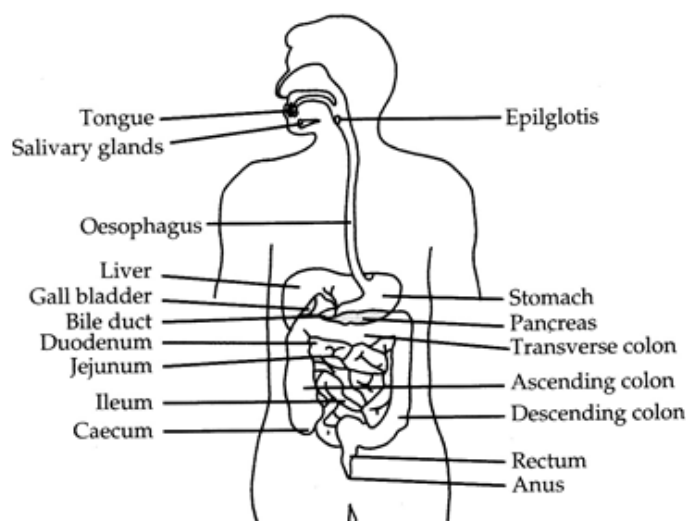
Learning Objectives

When you have completed this lecture you should be able to :

- ◆ Understand various digestive disorders like gall stones and diarrhoea. etc.
- ◆ Understand about Alimentary canal



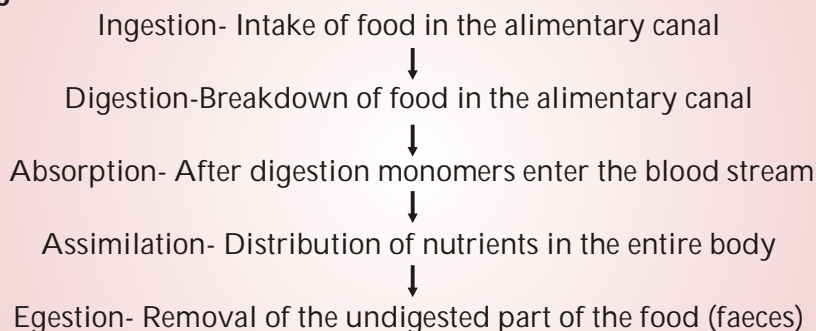
Alimentary canal - It is the main part of the digestive system, which begins from the mouth through which food is taken in and extends to the anus through which digestive wastes are excreted out.



Alimentary Canal

The different parts of the alimentary canal are-

- i. Mouth cavity
- ii. Oesophagus
- iii. Stomach -It has three parts-
 - a. Cardiac
 - b. Fundus
 - c. Pylorus
- iv. Small intestine-It has three parts-
 - a. Duodenum
 - b. Jejunum
 - c. Ileum
- v. Large intestine-It has three parts-
 - a. Caecum
 - b. Colon
 - c. Rectum

Steps in digestion**Digestion of food in different parts of the alimentary canal**

Food in the mouth cavity - Mastication of food occurs in the mouth cavity which is mixed with saliva; this food mixed with saliva is called bolus.

Saliva has ptyalin enzyme, which digests carbohydrates partially, and this is why when we chew food for a longer duration it tastes sweet.

Food in the oesophagus - Digestion does not occur here. However, a smooth downward conduction of bolus takes place.

Food in the stomach - In the stomach food is digested in acidic medium. Propepsin and prorennin are activated in the form of enzymes by hydrochloric acid (HCl), which digests protein partially in the stomach. HCl in the stomach has three main functions

- i. It makes food acidic.
- ii. It activates the inactive protein digestive enzymes, propepsin and prorennin.
- iii. It kills microbes in the food.

Complex protein Pepsin → Derived proteins (peptones and proteose)

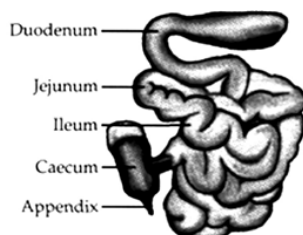
Milk protein Rennin → Calcium paracaseinate (curd)

Calcium paracaseinate Pepsin → Derived proteins (peptones and proteose)

Bolus mixed with gastric juice is called chyme. (A pulp-like thick paste made up of digestive juices and bolus is called chyme.)

Food in the small intestine

Small intestine - It has three parts-



Small intestine

- (a) Duodenum - It is approximately 15 cm long and receives bile juice and pancreatic juice. It joins the stomach and the small intestine.
- (b) Jejunum - It is about 80 cm long and it is here that a minor digestion takes place.

- (c) Ileum - It is about 4.5 metres long and here major digestion takes place along with the absorption of food. Here, addition of pancreatic juice, bile juice and intestinal juice occurs and the digestion takes place in an alkaline medium. Bile juice is produced in the liver and stored in the gall bladder. Pancreatic juice is produced in the pancreas.

Bile juice does not have any digestive enzyme, therefore it helps in the emulsification of fats only. Pancreatic juice digests 80% of the total fat by its lipase enzyme, and the remaining fat is digested by intestinal lipase called steapsin. The chemical reactions are as follows:



The protein is digested into its derivatives by trypsin and chymotrypsin enzyme of the pancreatic juice. The complete digestion into amino acids takes place by the erepsin enzyme of the intestinal juice.

Protein in an alkaline medium $\xrightarrow{\text{Trypsin and chymotrypsin}}$ Derived proteins

Derived proteins $\xrightarrow{\text{Erepsin}}$ Amino acids

The carbohydrate is digested by disaccharide enzymes, like sucrase, maltase, lactase, etc.

Sucrose $\xrightarrow{\text{Sucrase}}$ Glucose + fructose

Maltose $\xrightarrow{\text{Maltase}}$ Glucose

Lactose $\xrightarrow{\text{Lactase}}$ Glucose + galactose

Food in the large intestine - In the large intestine the digestion process does not take place, instead water and salts are absorbed.

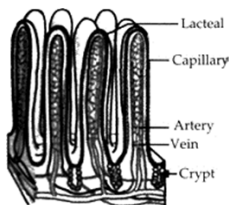
Absorption - The monomers of different food components are mostly absorbed in the ileum part of the small intestine, where blood capillaries and lymph vessels are found. The monomers of proteins and carbohydrates are absorbed through the blood capillaries whereas fat monomers are absorbed through the lymph vessels which are called lacteals.

Thus:

Carbohydrates \rightarrow Glucose, fructose and galactose (monomers) by blood vessels.

Protein \rightarrow Amino acids (monomers) by blood vessels.

Fat \rightarrow Fatty acids and glycerol (monomers) by lymph vessels.



The Gut Wall's Villi

To increase the absorptive surface area the intestine has guts, villi and microvilli, which increase the absorptive surface area by almost 600 times. (Villi are small finger-like projections on the intestinal surface to increase the absorptive surface area)

Assimilation:

Assimilation is the process in which extra and additional food monomers are converted into other molecules and in turn reconverted into required molecules. Fatty adds and glycerol are converted into simple fat molecules, which are stored under the skin in the farm of adipose tissues.

Additional glucose is converted to glycogen and stored in the liver and muscles.

Excess amino acids are converted into ammonia which forms urea, which is the excretory waste of mammals.

Egestion- The undigested part of food is called faeces, which is stored temporarily in the rectum and is removed periodically. This removal is known as defecation.

Excretion is the removal of metabolic wastes only and not the removal of faecal matter, since faeces consists only of undigested part of the food and not the metabolic wastes; therefore the removal of faecal matter is defecation and not excretion.

RUMINANT DIGESTIVE SYSTEM

Actually, cows and some other plant-eating animals swallow large amount of food at a time. Later, they bring back the swallowed food into the mouth to chew on it again. This process is called **rumination** and such animals are called **ruminants**.

- Humans cannot digest the **cellulose** present in the food as the human system lacks the cellulose enzyme required to digest it.

Ingestion - The food is taken into the mouth with the help of the tongue. As the food is being chewed, it is also mixed with saliva. Since grass is difficult to digest, ruminants have big chewing teeth with powerful jaw muscles.

Digestion - After the initial chewing, the food passes down the 2 to 3 feet long oesophagus. The oesophagus leads into the stomach, which in ruminants is four chambered **Rumen, Reticulum, Omasum** and **Abomasum**.

Rumen - The rumen helps in storing the large quantities of food that has been quickly consumed. The food is partially digested here and is called the **cud**.

- The cud is then brought back into the mouth, re-chewed, and re-swallowed in a process called **cud-chewing**. The rumen also has billions of bacteria and protozoa which breakdown the fibre called **cellulose** found in hay and grass.

Reticulum - The reticulum helps in moving the swallowed food back into the mouth for through chewing. The reticulum opens into the omasum.

Omasum - Its main function is to absorb excess water reduce the particle size further.

Abomasum - The walls of the abomasums secrete digestive juices that help in digestion

Absorption - Absorption begins in the four-chambered stomach itself but the main absorptive organs are the intestines.

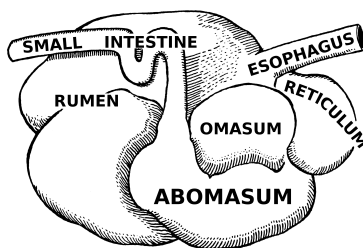
The food from the abomasum passes into the small intestine, where it mixes with secretions from the pancreas and liver.

Most of the digestion of carbohydrates, proteins, and fats takes place. Several villi are present, which help in increasing the surface area for absorption.

Assimilation - After digestion and absorption, the nutrients absorbed from food are taken to the cells in all parts of the body through the circulating blood.

In this way the digested food is transported to all the body parts. Body cells oxidize the food to release energy.

Egestion - The small intestine leads into the large intestine. The main function of the large intestine is to absorb water from the digested food that is flowing down, make it more solid, and excrete it out as faeces.



New Words

- ❖ **Digestion** : Breaking down of the complex food components into simple and soluble food substances.
- ❖ **Egestion** : Elimination of undigested and unabsorbed food residues.
- ❖ **Ingestion** : Process of taking food inside the body.

Important Points

- Digestion is the breakdown of complex food molecules into simple monomer forms.
- Absorption is the distribution of digested monomers in the body through blood circulation.
- Egestion is removal of faecal matter.
- In the mouth cavity partial digestion of carbohydrate takes place in the presence of ptyalin enzyme.
- In the stomach partial digestion of protein occurs in an acidic medium into derived proteins.
- In the small intestine complete digestion of food takes place in an alkaline medium.
- The stored food is further utilised by the process of respiration.

NUTRITION IN PLANTS & ANIMALS

PRACTICE SHEET -4



Conceptual Practice Sheet



Fill in the blanks Type :

1. The inner lining of the stomach secretes mucous, _____ and .
2. Swallowing of grass and storing it in a part of the stomach, called .
3. Piercing and tearing the food is the function of teeth
4. Grass eaten by ruminants are stored in .
5. _____ cannot digest cellulose.

True/ False Type:

6. Gastric juice is secreted by the small intestine
7. Egestion is removal of Faecal matter
8. The part of the digestive system that ends at the rectum is called large intestine.
9. The continuous canal through which the food passes from buccal cavity to stomach is called larynx.
10. Fat is completely digested in the mouth

Subjective Type:

11. What do you understand by animal nutrition?
12. What are the main steps of digestion in humans?
13. What is digestion?
14. Name the process of taking in food?
15. What are the main organs of digestive system

**Competitive Practice Sheet****Single Response Type:****LEVEL - I**

1. Swallowed food passes into the stomach through the
A) Stomach B) Oesophagus C) Large intestine D) Small intestine
2. Faeces is excreted out of the body through the
A) Large intestine B) Villi C) Stomach D) Anus
3. Carbohydrate cellulose is digested by the action of
A) Worms B) Bacteria C) Protozoa D) Virus
4. During digestion, the starch carbohydrate is completely broken down into simplest sugar called
A) Fatty acids B) Amino acids C) Glucose D) Glycerol
5. The stomach is a thick -walled bag of shape
A) V- shape B) U-shape C) X- shape D) Z- shape
6. Saliva helps in digestion which is secreted by
A) Gastric glands B) Intestinal glands C) Salivary glands D) Both B & C
7. Intake of food into alimentary canal is known as
A) Digestion B) Ingestion C) Absorption D) Egestion
8. After digestion proteins are converted into
A) Fatty acids B) Glucose C) Amino acids D) Glycerol
9. Which enzyme helps in digestion of sucrose
A) Protease B) Lipase C) Sucrose D) Maltose
10. The function of the digestive juices present in the stomach is to breakdown
A) The proteins into simpler substances B) Starch into sugars
C) Fats into juices D) Food into gases

LEVEL - II

11. The largest gland in the human body is
A) Oesophagus B) Salivary gland C) Liver D) Villi
12. The process of digestion taking place in grass- eating animals is called
A) Egestion B) Rumination C) Assimilation D) Absorption

13. Pepsin is released from the
A) Mouth cavity B) Stomach C) Small intestine D) Liver
14. Most digestion and absorption takes place in
A) Stomach B) Caecum C) Small Intestine D) Large intestine
15. Carbohydrate digestion begins in
A) Stomach B) Mouth C) Intestine D) All the above
16. Which one is false ?
A) Bile is secreted by gall bladder B) Bile is secreted by liver
C) Fudic stomach is the site of digestion D) Parietal cells occur in wall of stomach
17. Length of small intestine is
A) 10.5m long B) 40m long C) 23.4m long D) 7.5m long.
18. Diarrhoea is caused due to
A) Infection B) Indigestion C) Poisoning D) All of the above
19. Where is bile produced?
A) Gall bladder B) Blood C) Liver D) Spleen
20. The main function of the lacteals of intestine is the absorption of
A) Amtno acids B) Glucose and vitamins
C) Lactic acid D) Fatty acids and glycerol

LEVEL - III

21. Gastric digestion takes place efficiently in
A) Acidic medium B) Alkaline medium
C) Neutral medium D) Highly alkaline medium
22. The pointed teeth in the buccal cavity are called
A) Incisors B) Canines C) Premolars D) Molars
23. Bile juice is stored in
A) liver B) Pancreas C) Gall bladder D) Stomach
24. The inner walls of the small intestine have millions of small finger like projections called
A) Villi B) Trachae C) Appendix D) oesophagus
25. Which of the following is not a part of nutrition?
A) Digestion B) Absorption C) Assimilation D) Excretion
26. An amoeba ingests food with the help of
A) Cilia B) Tentacles C) Pseudopodia D) Buccal Cavity
27. Grass is rich in _____ a special kind of carbohydrate which can only be digested by ruminants.
A) Glucose B) Cellulose C) Sucrose D) Fructose
28. Amylase enzyme is present in
A) Bile juice B) Saliva C) Gastric juice D) Pancreatic juice

29. The walls of large intestine absorb
- A) Water B) Proteins C) Cellulose D) Roughage
30. Which is not digested by human?
- A) Protein B) Fats C) Glucose D) Cellulose