UNITS AND MEASUREMENTS

Learning Objectives :

- ♦ Physical quantities and their types
- ♦ How to express the fundamental physical quantities.
- ♦ The unit,physicists use to measure a physical quantity and characteristics of it
- ♦ Rules for writing symbols of units.
- ♦ Measurement of length,mass,time

Applications of measurements in real life :

Φ Science and engineering are based on measurements and comparisons.Thus, we need rules about how things are measured and compared and we need experiments to establish the units for those measurements and comparisons. One purpose of physics (and engineering) is to design and conduct experiments.For example, physicists strive to develop clocks of extreme accuracy so that any time or time interval can be precisely determined and compared. You may wonder whether such accuracy is actually needed or worth the effort. Here is one example of the worth: Without clocks of extreme accuracy,the Global Positioning System (GPS) that is now vital to worldwide navigation would be useless.

Φ Measuring the composition energy values and quantity of gas piped to our homes

Φ Measurement helps in filling the fuel in our vehicles in a proper manner.

§§ Important formulae :

1) $\boxed{n \propto \frac{1}{U}}$ **2)** $N_1U_1 = N_2U$

3) $Thickness\ of\ each\ coin = \frac{\text{Thickness of all coins}}{\text{Total no. of coins}}$

4) $\text{Frequency} = \frac{1}{\text{Timeperiod}}$

§§ *MEASUREMENTS*

§§ Physical quantities :

All the quantities which are used to describe the laws of physics are known as physical quantities. OR

The quantities which are measurable are called physical quantities

Ex: length, mass, time, speed etc.

Physical quantities can be classified on the following bases

I. *Based on their directional properties*

i) **Scalars:** The physical quantities which have only magnitude but not direction are called scalar quantities.

Ex: mass, density, volume, time, etc.

ii) **Vectors :** The physical quantities which have both magnitude and direction and obey laws of vector algebra

are called vector quantities.

Ex: Displacement,velocity,force etc

II.*Based on their dependency*

i) Fundamental or base quantities : The quantities which do not depend on other physical quantities for their complete definition are known as fundamental or base quantities.

Ex: length, mass, time, etc

There are seven fundamental quantities in SI system-

i) Mass

ii) Length

iii) Time

iv) Temperature

v) Electric current

vi) Luminous intensity

vii)Amount of substance

ii)Derived Physical quantities : The quantities which can be expressed in terms of the fundamental quantities are known as derived quantities.

Eg:Speed (=distance/time), volume, acceleration, force, pressure, etc.

Note:Physical quantities can also be classified as dimensional and dimensionless quantities or constants and variables.

§§ **Solved problems :**

√ **Example-1:**

Classify the following quantities into vectors and scalars displacement, mass, force, time, speed, velocity, acceleration,pressure and work

Solution :

i)Fundamental:displacement, force,velocity, acceleration

ii)Derived:mass, time, speed,pressure and work

§§ **UNIT :**

That fixed and definite quantity which we take as our standard of reference and by which we measure other quantities of same kind, is defined as unit.

§§ **Fundamental Units :** The units which are independent and which are not be derived from other units, are defined as fundamental units.

Ex : Meter, Kilogram, Second, etc.

§§ **Derived unit :**The units which depend on fundamental units is called derivd units.

Ex : Area (m^2), Volume(m^3), Speed(m/s) etc.

¶¶ **Selection Criteria Of a Unit OR Characteristics of a unit :**

1. It's value must not vary with place and time.

2. It should be capable of being reproduced easily.

3. It must be well defined.

4. It should be of proper size i.e neither too large nor too small when compared to the quantities to be measured.

§§ **Measurement of physical quantity :**

The unit of a physical quantity is inversely proportional to its numerical value $\boxed{n \ \alpha \ \frac{1}{U}}$

where u and n are the units of physical quantity and its numerical value respectively.

Relation between unit and its numerical value

$n_1u_1 = n_2u_2$

Ex : Mass of the stone is 40 times mass of kilogram stone.

Mass of stone = 40 X kilogram = 40 kg

§§ **Measuring system of units :**

The following are some system of units that we use to measure any physical quantity.

S.No	Measuring system	Length	Mass	Time
1	CGS (Gaussian System)	centi meter	gram	second
2	MKS (Metric System	meter	kilo gram	second
3	FPS (British System)	foot	pound	second

At present M.K.S System is accepted world wide as international system of units called as S.I units.

§§ **SI system of units :**

The general conference of weights and measurements held in 1960 decided a new system of units called " System International" (SI).

This system is an improved and extended version of M.K.S system.

This system defines seven fundamental and two supplementary quantities in it.

Units of the International System (SI)		
Quantity	***Name of Unit***	***Unit Symbol***
length	metre	m
mass	kilogram	kg
time	second	s
temperature	kelvin	K
amount of substance	mole	mol
electric current	ampere	A
luminous intensity	candela	cd
Supplementary quantities		
Plane angle	radian	rad
Solid angle	steradian	sr

♣ ***Rules for writing units and symbols :***

i) The full names of the units do not begin with a capital letter.

For example,The unit of force is newton but not Newton

ii) The symbols of units named after scientists have initial capital letters.

For example,J for joule,N for newton.

iii) Symbols do not have plural forms.

For example,10kg but not 10kgs, 7m but not 7ms.

iv) No full stop, or coma (or) colon is put after the symbol.

For example,16N for sixteen newton, without any fullstop (or) coma at the end.

v) Multiplication of units is shown by leaving a spate or a raised dot.

For example, Nm and not N-m (or) N x m.

vi) Division of units is indicated by solidus (/) sign (or) negative powers.

For example, m/s (or) ms^{-1}.

vii) In front of a decimal number, zero should be placed.For example,0.7kg but not .7kg.

viii) Compound pre fixes should be avoided. For example, pf for pico farad but not $\mu\mu F$

ix) A space must be left between a number and unit. For example, 7 kg but not 7kg.

§§ *Prefixed used in S.I units :*

Multiple	Prefix	Symbol	Common Name
10^{18}	exa	E	quintillion
10^{15}	peta	P	quadrillion
10^{12}	tera	T	trillion
10^{9}	giga	G	billion
10^{6}	mega	M	million
10^{3}	kilo	k	thousand
10^{2}	hecto	h	hundred
10^{1}	deca	da	ten

Multiple	Prefix	Symbol	Common Name
10^{-1}	deci	d	Tenth
10^{-2}	centi	c	Hundredth
10^{-3}	milli	m	Thousandth
10^{-6}	micro	*u* (Greek mu)	Millionth
10^{-9}	nano	n	Billionth
10^{-12}	pico	p	Trillionth
10^{-15}	femto	f	quadrillionth
10^{-18}	atto	a	Quintillionth

§§ *Measurement of length :*

Length is the measure of distance between two points.

Measurement of length of an object is done by various measuring devices like scale,measuring tape etc.

Units : C.G.S - cm ; S.I - m

Thickness of a wire = $\frac{\text{Total thickness of wire}}{\text{No.of turns in it}}$

¶¶ *Multiples and sub multiples of Basic units:-*

The above mentioned International System of Units (SI) is now extensively used in scientific measurements.However, the following practical units of length are also conveniently used and are expressed in terms of SI system of units.

i) Astronomical unit (A.U):It is the average distance of the earth from sun.

1 A.U = 1.496 X 10^{11} m

ii) Light year:It is the distance travelled by light through vacuum in one year.

1 light year = 9.46 x 10^{15}m

1 light year = speed of light × 1 year

= 300000 × 1 year km

= 300000 × 365 × 24 × 60 × 60 km

= 9.46 × 10^{12} km = 9.46 × 10^{15} m

iii) Micron is a small unit for measurement of length.

1 micron =1μm =10^{-6} m

iv) Angstrom is a unit of length in which the size of an atom is measured and is used in atomic physics.

1 Angstrom=1A^0=10^{-10} m.

v) Fermi is a unit of distance in which the size of a nucleus is measured.

1 Fermi = 10^{-15} m

Some other practical units of length:

1 parasec = 3.26 light year

1 inch = 2.54 cm

1 mile = 1.62 km

1 foot (ft) = 12 inch = 30 cm

decimetre (dm) : One decimetre is one tenth part of a metre

$$1 \text{ dm} = \frac{1}{10} \text{ m} = 10^{-1} \text{ m} = 10 \text{ cm}$$

centimetre (cm) : One centimetre is one hundredth part of a metre.

$$1 \text{ cm} = \frac{1}{100} \text{ m} = 10^{-2} \text{ m} = 1 \text{ cm}$$

EXAMPLES

√ **Example-2 :**

Height of a boy is measured as AB in one system and as CD in another system A,C are numerical values and B,D are units. If A/C = 100 then B/D = ?

solution:

Given A,C are numericals

B,D are units

$N_1U_1 = N_2U_2$

since AB = CD and A/C =100

A/C = D/B

B/D = 1/ 100

√ **Example-3 :**

A boy height is 1.5m in SI system then numerical value of height in CGS system is

solution:

Given Boy height = 1.5m in SI system

$N_1U_1 = N_2U_2$

$1.5m = N_2$ cm

$1.5(100)cm = N_2$ cm

$N_2 = 150$

√ **Example-4 :**

The height of tree is 300cm in CGS system then unit of the height of the tree in SI system.

Solution:

Given the height of the tree in CGS = 300 cm

N1 = 300

U1 = cm

the same height of the tree in SI system = 3m

the unit in SI system is meter.

√ **Example-5 :**

A pole height is 2.5m in SI system then the numerical value of pole height in CGS system.

Solution:

Given Pole height in SI system = 2.5 m

$N_1U_1 = N_2U_2$

$2.5m=N_2$ cm

$2.5(100)cm=N_2$ cm

$N_2=250$

√ **Example-6 :**

The mass of a body is 4000 g in CGS system the numerical value of body in SI system is

Solution:

Given the mass of the body in CGS system is 4000 g

$N_1U_1 = N_2U_2$

$4000\ kg=N_2 g$

$4000(1/1000)g=N_2 g$

$N_2=4$

√ **Example-7 :**

The thickness of dozen coins on a meter scale was found to be 20 cm then the thickness of each coin is

Solution:

Given the thickness of dozen coins is = 20 cm

no of coins = 12

$$Thickness\ of\ each\ coin = \frac{\text{Thickness of all coins}}{\text{Total no. of coins}} = 20/12 = 1.66cm$$

√ **Example-8 :**

The thickness of 100 turns of wire on the scale was found to be 38 cm calculate the thickness of wire

Solution:

Given the total thickness of 100 turns of wire = 38 cm

no of turns = 100

$$Thick\ ness\ of\ a\ wire = \frac{Total\ thickness}{no\ of\ turns} = 38/100 = 0.38\ cm$$

√ **Example-9 :**

The whole length of a meter scale is divided into 300 equal parts then the smallest measurement that can be measured by using the scale in mm

solution:

Given the total length of meter scale = 1 m

no of equal parts = 300

the length of each division is = 1/300 =0.003

√ **Example-10 :**

Thickness of 50 turns of wire on the scale was found to be 40 cm. calculate thickness of wire?

solution:

Given the total thickness of 100 turns of wire = 40 cm

no of turns = 50

=40/50 =0.8 cm

$$\text{Thickness of wire} = \frac{\text{Total thickness of wire}}{\text{No.of turns in it}}$$

√ **Example-11 :**

The whole length of a meter scale is devided in to 200 equal parts then the smallest measurement that can be measured by using the scale in meter?

solution :

Given the total length of meter scale = 1 m

number of equal parts = 200

The length of each division is = 1/200 =0.002

√ **Example-12 :**

convert 20cm into m

Solution :

$20cm = 20x10^{-2}m$ (centi=10^{-2})

√ **Example-13 :**

convert 20km into cm

Solution :

20km=$20x10^3$m(kilo=10^3 , m=10^2cm)

20km=$20x10^3x10^2$cm

20km=$20x10^5$cm

TEACHING TASK

I) Choose the correct answer :

1. $\frac{1}{100}^{th}$ of meter is called

A) millimetre B) centimetre C) decametre D) kilometre

2. The distance between kothagudem and warangal is 200km. Express this distance in meters.

A) 200m B) 2000m C) 2,00,000m D) 2000000m

3. 660 kilometers = ...

A) 660 X 10^4 m B) 660 X 10^3 m C) 660 X 10^{-4} m D) 660 X 10^{-3} m

4. While measuring the length of a rectangular block the reading at one end is 1.0 cm and other end is 8.2 cm Then the length of the block is

A) 5 cm B) 8.2 cm C) 7.2 cm D) 6.2 cm

5. For measuring the diameter of a molecule,the most commonly used unit is

A) centimeter B) micron C) metre D) kilometer

6. The thickness of dozen coins on a metre scale was found to be 40 cm. Then the thickness of one coin is

A) 4 cm B) 3.33 cm C) 3.33 mm D) 3.33 m

7. Thickness of 50 turns of wire on the scale was found to be 64 cm. Calculate the thickness of wire

A) 1.28 mm B) 1.82 cm C) 1.82 mm D) 1.28 cm

8. While measuring the diameter of a ball, a student noted that the inner edges of the wooden blocks at 3.4 cm and 4.7 cm on a scale,Calculate the diameter of a ball

A) 4.7 cm B) 1.3 cm C) 1.3 mm D) 1.3 m

9. If 'n' number of coins are placed one upon another and their total thickness is 6.8 cm and the thickness of each coin is 4 mm Then number of coins n is .....

A) 17 B) 170 C) 117 D) 80

10. 24 coins are placed one upon another and their total thickness is recorded by a half metre scale. The thickness is found to be 4.8 cm Then the thickness of each coin in milli meters

A) 2 mm B) 0.2 mm C) 20 mm D) 200 mm

11. Which of the following is the biggest unit of distance?

A) kilo metre B) nano metre C) light year D) parasec

12. In 24 hour clock time, 3 pm can be written as _____

A) 00:15 hours B) 15:00 hours C) 03:00 hours D) 00:03 hours

II) Multi correct answer questions :

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D) out of which **ONE or MORE** is correct. Choose the correct options.*

13. The units of length are

a) metre b) hectare c) millimetre d) litre

14. The length of the curved object can be measured with

a) scale rod b) thread c) ruler d) rod

15. 1 micro metre is equal to

a) 10^{-6} m b) 10^{6} m c) 10^{-3} mm d) 10^{3} mm

16. Length can be measured with the help of

a) measuring tape b) metre scale c) thermometre d) clock

III) Fill in the blanks :

17. One millimetre is equal to..... part of a metre.

18. 10m plus 20cm = ...cm

19. For measurement, our senses are not always.....

20. The length of a room is 6.70 m. This is same as .....cm.

IV) Match the following :

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

21.

Column A	**Column B**
1) 1 fermi	a) 9.46×10^{15} m
2) 1AU	b) 10^{-15} m
3) par sec	c) 1.496×10^{11} m
4) 1 light year	d) 3.26 light year

A) 1-b, 2-c, 3-d,4-a B) 1-c, 2-d, 3-a, 4-b

C) 1-d, 2-c, 3-a, 4-b D) 1-c, 2-a, 3-d,4-b

22.

Column-I	**Column-II**
1) 1 μm	a) 10^{-1} m
2) 1 pm	b) 10^{-6} m
3) 1 nm	c) 10^{-9} m
4) 1 dm	d) 10^{-12} m

A) 1-b, 2-d, 3-c,4-a B) 1-c, 2-d, 3-a, 4-b

C) 1-d, 2-c, 3-a, 4-b D) 1-c, 2-a, 3-d,4-b

V) Comprehension Type :

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

23. Aditya measured his school hall as 20 m in length and 12 m in breadth with the help of measuring tape.

i) Convert given length into km?

A) 0.02 km B) 0.002 km C) 0.2 km D) 20 km

ii) Convert breadth into mm?

A) 120 mm B) 1200 mm C) 12 mm D) 12000 mm

24. Multiples and submultiples are introduced to change the size of the units to fulfill the needs of various branches in physics.

i) Convert 100 par sec into light year

A) 326 B) 3.26 C) 32.6 D) 3.56

ii) Convert AU into km

A)1.496×10^{11} km B)1.496×10^{8} km C)1.496×10^{14} m D)1.496×10^{13} km

VI) Solve the following :

25. The velocity of a car in SI units is $5ms^{-1}$ .The same in CGS units is .....

26. If Ramu to ride on a bicycle for a distance of 2.3 km from school to home then convert the same in to meter and centimeter.

VII) Higher order thinking skills (HOTS) :

27. $\frac{1 \text{ pico meter}}{1 \text{ micro meter}} =$ _____.

A) 10^{6} B) 10^{-6} C) 10^{12} D) 10^{-12}

28. If 1 nano meter = 10^{x} millimeter, then x =

A) 6 B) –6 C) 9 D) –9

KEY

Φ Φ TEACHING TASK :

I) 1) B 2) C 3) B 4) C 5) B 6) B 7) D 8) B 9)A 10)A 11) D 12) B **II)** 13) A,B,C 14) B,C 15) A,C 16) A,B **III)** 17)1/1000 18)1020 19)accurate 20)670 **IV)** 21) A 22) A **V)** 23) i) A ii) D 24) i) A ii) B **VI)** 25) $500cms^{-2}$, 26) 2300m,230000cm **VII)** 27) B 28) B

LEARNER'S TASK

BEGINNERS (Level - I)

I) *Choose the correct option :*

1. Standard unit of length is

A) kilogram B) second C) metre D) quintal

2. 1 light year =

A) 9.46×10^{15}m B) 9.46×10^{10}km C) 9.45×10^{16}km D) 9.46×10^{17}m

3. If the length of park is 200 m then 200 is .....

A) unit B) magnitude C) both A and B D) none

4. If the mass of a foot ball is 4 kg then kg is .....

A) magnitude B) standard unit C) both A and B D) none

5. 470 kilometer = ... meter

A) 470000 meter B) 470 meter C) 47000 meters D) 47 m

6. 1000 kilometers = ... m

A) 10^6 m B) 10^3 m C) 10^{-4} m D) 10^{-3} m

7. The distance travelled by light in one year is called

A) leap year B) astronomical year C) light year D) cosmic year

8. 1000 millimeters = ... meters

A) 10 B) 1 C) 100 D) 1/100

9. The multiple of metre is

A) kilometer B) centimeter C) millimeter D) decimeter.

10. The symbol used to represent 'angstrom' is

A) μ B) A^0 C) m D) Ag

11. 1 milli meter= ..... kilometer

A) 10^3 B) 10^6 C) 10^2 D) 10^4.

12. The appropriate unit for measuring thickness of a table is

A) centimeter B) kilometer C) millimeter D) micrometer

13. The unit of luminous intensity is.....

A) candela B) mole C) Kelvin D)ampere

14. 60 kilogram in short form is written as

A) 60 kgs B) 60 kg C) both (1) and (2) D) None

15. The unit of which physical quantity is same in all system of units

A) length B) mass C) time D) temperature

16. The mean distance of the earth from the sun is called .....

a) Mean solar day b) Astronomical unit c) Light year d) Parsec

ACHIEVERS (Level - II)

Solve the following problems :

1. Manju measures the length of a black board as 6.4 m while her friend Asha measures the length of a table as 280 cm. Identify whether the length of table or length of the black board is greater?

2. The length of a body is 4 cm in CGS system then the numerical value of body in SI system is

3. $20ms^{-2}$ is same in i)cms^{-2} ii)$mmin^{-2}$ (Ans;2000,72000)

4. 7coins of thickness 0.5 mm each are placed on another 5 coins of thickness 1 mm each then find the total height of coins in cm(0.85cm)

EXPLORERS (Level - III)

I) Multi correct answer questions :

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D),out of which **ONE or MORE** is correct. Choose the correct options.*

1. Which of the following are the examples for fundamental physical quantity

a) length b) area c) mass d) energy

2. Unit used in the measurement of extremely small distances.

a) Fermi b) Angstrom c) Meter d) km

3. Choose the correct statement

a) Number of fundamental quantities are limited

b) In M.K.S System there are 7 fundamental quantities

c) Number of fundamental quantities are unlimited

d) Units of fundamental quantities in M.K.S is same as in SI

4. Which of the following are the fundamental basic units

a) metre b) kilogram c) seconds d) metre/second

II) Fill in the blanks :

1. Mounika needed 4.6 m of cloth so she bought .....cm of cloth.

2. The distance between two houses is 8km It is same as .....m.

3. The thickness of each sheet of cardboard is 2cm. 100 such sheets will have thickness of .....cm.

III) Match the following :

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

1.

Column-I	**Column-II**
a) unit of length in F.P.S	1) metre
b) unit of mass in C.G.S	2) foot
c) unit of time	3) gram
d) unit of length in S.I	4) second

A) a-2, b-3, c-4, d-1 B) a-2, b-3, c-1, d-4

C) a-3, b-2, c-4, d-1 D) a-1, b-2, c-3, d-4

2.

Column-I	**Column-II**
a) Derived unit	1) Height
b) Fundamental unit	2) Area
c) Derived quantity	3) newton
d) Fundamental quantity	4) Kilogram

A) a-2, b-3, c-4, d-1 B) a-2, b-3, c-1, d-4

C) a-3, b-2, c-4, d-1 D)a-3, b-4, c-2, d-1

3.

Prefix	**Power**
a) mega	1) 10^{6}
b) peta	2) 10^{-9}
c) milli	3) 10^{15}
d) nano	4) 10^{-3}

A) a-2, b-3, c-4, d-1 B) a-2, b-3, c-1, d-4

C) a-1, b-3, c-4, d-2 D) a - 1, b-2, c-3, d-4

IV) ***Comprehension type questions :***

1. Sahiti, Neha Reddy and Sai kiran of 6th class want to mesure the length and breadth of class room.They used to measure with the help of mesuring tape.First they found the length of the class room as 7 m and breadth of the class room as 5 m.

i) What is the length of the class room in mm?

A) 7 X 10^{3} mm B) 700 mm C) 7 X 10^{4} m D) 70 mm

ii) How they mesured the length and breadth of class room?

A) mesuring tape B) pippet C) mesuring jar D) insufficient data

iii) What is the breadth of the class room in C.G.S units?

A) 5 cm B) 500 cm C) 50 cm D) 5 X 10^{3}cm

KEY

Φ Φ **LEARNER'S TASK :**

☐ **BEGINNERS :** 1) C 2) A 3) B 4) B 5) A 6) A 7) C 8) B 9) A 10) B 11) B 12) A 13) A 14) B 15) C 16) B

☐ **ACHIEVERS :** 1)length of black board is greater 2)0.04 3) i)2000 ii) 72000 4)0.85cm

☐ **EXPLORERS :** **I)** 1) A,C 2) A,B 3) A,B,D 4) A,C **II)** 1) 460 2) 8000 3) 200 **III)** 1) A 2) D 3)C **IV)** 1) i) A ii) A iii) B

§§ ***Measurement of Mass :***

Mass is the amount of matter contained in a substance is called mass.

S.I unit of mass is kilogram (kg), C.G.S unit of mass is gram (g)

Common balance, Spring balance, Table balance and Beam balance are used to find the mass of a substance.

1 gram = 1000 milligrams
1 kilogram = 1000 grams
1 quintal = 100 kilograms
1 metric tonne = 1000 kilograms

Mass of the sun=1.99×10^{30}kg
Mass of the earth=5.98×10^{24}kg

§§ **Measurement of time :**

Time is defined as a gap between two events.

The gap between two successive noons is called solar day.

The average of all solar days in which earth completes one revolution around the sun is called mean solar day.

1 mean solar day = 86,400 seconds.

The S.I unit of time is second (s).

¶¶ ***Rules for converting 24 - hour time to 12 - hour time :-***

1) 00 hours means, it is 12 0' clock at night i.e midnight.

2) 12 hours means, it is 12 0' clock at noon.

3) The time between 00 hours to 12 0' clock at noon is taken as AM.

4) In order to convert time between 12 hours to 24 hours into PM on 12 hour clock, 12 is subtracted from the given time.

§§ ***Simple Pendulum :***

1. A small weight (bob)suspended freely by a light thread such that it can swing freely about it's mean position is called a simple pendulum.

2. The length between the point of suspension and the centre of the bob is called length of pendulum.

3. 1 To and Fro motion of the pendulum about its mean position is called one oscillation.

4. The time taken by the pendulum to completed one oscillation is called time period or period time(T) .

5. The number of oscillations made by the pendulum in one second is called frequency (n) of oscillation

S.I unit of frequency is hertz (or) sec^{-1}.

$\therefore$ frequency = $\frac{1}{\text{Timeperiod}}$ $\quad \therefore n=\frac{1}{T}$

6. The time period of second's pendulum is 2 seconds.

EXAMPLE

√ **Example-12 :**

convert 300g into kilogram

Solution :

$300g=300x10^{-3}kg=0.3kg$ $\quad (gram=10^{-3}kg)$

√ **Example-13 :**

convert 32s into millisecond

Solution :

$32s=32x10^{3}\ x\ 10^{-3}s$ $\quad (1=10^{3}\ x\ 10^{-3})$

$32s=32x10^{3}millisecond$ $\quad (milli=10^{-3})$

32s=32000millisecond

√ **Example-14 :**

convert $15mm^2$ into cm^2

Solution :

$15mm^2=15\ mmxmm$ $\quad (1mm=10^{-1}cm)$

$15mm^2=15\ x10^{-1}cmx10^{-1}cm$

$15mm^2=15\ x10^{-2}cm^2$

√ **Example-15 :**

convert $\frac{1g}{cc}$ into $\frac{kg}{m^3}$

Solution :

$$\frac{1g}{cc}=\frac{10^{-3}kg}{cmxcmxcm}=\frac{10^{-3}kg}{10^{-2}mx10^{-2}mx10^{-2}m}=\frac{10^{-3}kg}{10^{-6}m^3}=10^{3}\frac{kg}{m^3}$$

√ **Example-16 :**

The time period of a simple pendulam is 50 sec then its frequencies?

Solution :

t = 50 s

f = ?

f= 1/t =1/50=0.02 Hz

√ **Example-17 :**

The frequency of tunning fork is 250Hz then its time period is?

Solution :

f = 250Hz

t = ?

t = 1/f = 1/250 = 0.004s

√ **Example-18 :**

The time period of a simple pendulem is 2 sec then its frequency is ?

Solution :

t = 2s

f = ?

f= 1/t =1/2=0.5Hz

√ **Example-19 :**

Find the frequency a simple pendulem whose time perod is 360 sec.

Solution :

t = 360 s

f = ?

f= 1/t =1/360=0.002 8Hz

√ **Example-20 :**

Find the time period of a simple pendulem whose frequency is 60 Hz .

Solution :

t = ?

f = 60Hz

t= 1/f =1/60=0.017s

TEACHING TASK

I) Choose the correct answer :

1. 1 millennium = ... decades

A) 100 B) 10 C) 9 D) 1000

2. If an aeroplane is scheduled to take off at 18 hours - 57 minutes then time in PM on 12 hour clock is

A) 6 hours PM B) 6 hour - 57 min PM C) 6 hour - 57 min AM D) 6 hours Am

3. The time period of the pendulum whose frequency is $\frac{1}{2}Hz$

A) 2 sec B) 0.5 sec C) 0.05 sec D) 0.2 sec

4. Quantity of matter present in a body is called its

A) mass B) force C) weight D) none

II) Multi correct answer questions :

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options.*

5. The terms related to simple pendulum

a) oscillations b) mass c) time period d) frequency

6. Units of time is

a) hourb) second c) light year d) solar day

7. Choose the wrong options

a) The gap or duration between two events is called time.

b) The standard unit of time is minute.

c) The time gap between two successive noons is called solar day.

d) $\frac{1}{1440}\text{th}$ part of the mean solar day is called hour.

III) Fill in the blanks :

8. One milligram is equal to .....kilogram.

9. ..... quintals is equal to one tonne.

10. 1 metric tonne = ...

11. ..... watch is used to measure time in a race.

IV) Match the following :

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

12.

	Column A		Column B
1.	Measurement of mass of Gold	a)	Clock
2.	Time	b)	Physical balance

3. Measurement of mass c) Stop watch
4. Measurement of time in race d) Beam balance

A) 1-b, 2-a, 3-d, 4-c B) 1-b, 2-c, 3-d, 4-a
C) 1-b, 2-c, 3-a, 4-b D) 1-d, 2-c, 3-a, 4-b

V) Comprehension type :

◆ *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which* ***ONLY ONE i****s correct. Choose the correct option.*

13. Neha want to go to market at 5 pm to buy 2 kg apples and 1 kg grapes. She bought and came back to home at 6:30pm.

i) Convert 5 pm into 24 hour clock?

A) 17 hB) 18 h C) 16 h D) 5 h

ii) Calculate mass of apples in grams?

A) $3x10^3$g B) $2x10^3$g C) $2x10^4$g D) $2x10^{-3}$g

iii) When she came to her home according to 24 hour clock?

A) 17 h 30 min B) 19 h 30 min C) 18 h 30 min D) 16 h 30 min

14. Multiples and submultiples are introduced to change the size of the units to fulfill the needs of various branches in physics.

i) Convert 100 quintal into nano grams (ng)

A) 10^5 ng B) 10^{16} ng C) 10^{17} ng D) 10^{18} ng

ii) Convert 1 second into day

A) $\frac{1}{86,400}$ Day B) 24 day C) $\frac{1}{24}$ day D) $\frac{1}{3600}$ day

15. A brass bob is suspended by a thin strong thread and allowed to oscillate, such that length of the pendulum is 1m.

i) In how many seconds will this pendulum complete one oscillation?

A) 20 sec B) 22 sec C) 2 sec D) 2.2 sec

ii) If a boy finishes a race when this pendulum makes 11 oscillations, how much time does the boy take in finishing the race?

A) 20 sec B) 22 sec C) 2 sec D) 2.2 sec

16. To convert a unit from one system to another, the steps to be followed are:

☞ First convert the given unit into SI unit.

☞ Then, convert it into the desired system of units.

. i) The velocity of a body is 10^2 mm/nano second, it is also equivalent to

A) 3.6×10^3 km h^{-1} B) 3.6×10^5 km h^{-1}
C) 36×10^7 km h^{-1} D) 3.6 km h^{-1}

. ii) 1 kg m/s^2 = _____g-mm/s^2

A) 10^5 B) 10^6 C) 10^4 D) 10^3

VI) Solve the following problems :

17. If the density of a body is measured as 10 kg m^{-3} ,then write the same in g cm^{-3}

18. Covert 15 mm^2 into m^2,cm^2

19. $\frac{1 \text{ pico second}}{1 \text{ micro second}} =$ _____.

20. If 1 nano gram = 10^x milligram then x =

21. The time period of a simple pendulam is 4 sec then its freaquency is ?

22. The frquency of tunning fork is 312Hz then its time period is?

VII) Higher order thinking skills (HOTS) :

23. 0.4 sq. km is _____ sq. cm

24. A body of mass 3kg is moving with 36 kmph. Then the momentum of the body is(momentum of a body is mass times the velocity)

25. A body of mass 2kg is moving with 6 m/s. Then the kinetic energy of the body is(kinetic energy of a body is given by $\frac{1}{2}mv^2$)

KEY

ΦΦ TEACHING TASK :

I) 1) A 2) B 3) A 4) A **II)** 5) A,C,D 6) A,B,D 7) B,D **III)** 8) 10^{-6} 9) 10 10) 1000kg, 11) stopwatch, **IV)** 12) A **V)** 13) i) A ii) B 14) i) C ii) A 15) i) C ii) B 16) i) C ii) B **VI)** 17) 0.01 18) 0.000015m^2,0.15cm^2 19) 10^{-6} 20) 6 21) 0.25Hz 22)0.003s **VII)** 23) $4x10^9$ 24) 30kgm/s 25) 36J

LEARNER'S TASK

BEGINNERS (Level - I)

I) Choose the correct answer :

1. S.I unit of mass is a

A) gram B) kilogram C) quintol D) metric ton

2. Which of the following is not unit of mass

A) kilogram B) milligram C) gram D) kilometer

3. The sub multiple of gram is

A) kilogram B) milligram C) quintal D) pound

4. The C.G.S unit of mass is

A) gram B) milligram C) kilogram D) quintal

5. The balance used measure the mass of gold, silver is

A) common balance B) physical balance C) beam balance D) spring balance

6. The F.P.S unit of mass is

A) gram B) milligram C) foot D) pound

7. 1 quintal = ... kilograms

A) 10 B) 100 C) 1000 D) 1

8. Kilogram in short form can be written as

A) kg B) KG C) ki D) KI

9. 1 metric tonne = ... quintals

A) 100 B) 1000 C) 10,000 D) 10

10. 1 kilogram = ... milligrams

A) 10^5 B) 10^6 C) 10^4 D) 10^3.

11. C.G.S unit of time

A) second B) hour C) metre D) minute

12. 1 hour = ... seconds

A) 3600 B) 36 C) 360 D) 36000

13. The S.I unit of time is

A) metre B) hour C) second D) minute

14. 1 mean solar day = ... minutes

A) 24 B) 1440 C) 1418 D) 1520

15. The time on the 24 hour clock is 08 h - 37 min. Then the time of 12 hour clock

A) 08 h - 37 min AM B) 11 h - 48 min PM

C) 08 h - 37 min PM D) 11 h - 48 min AM

16. The time on 12 hour clock is 2 hours - 45 min PM then the time on 24 hour clock is

A) 15 hours - 45 min B) 14 hours - 45 min C) 10 hours -15 min D) 10 hours - 45 min

17. $\frac{1}{86400}$ th Part of mean solar day = ...

A) 1 second B) 1 minute C) 1 hour D) 1 day

18. The time taken by the pendulum to complete one oscillation is called .....

A) time period B) frequency C) oscillation D) none

19. The time period of seconds pendulum is

A) 2 sec B) 20 sec C) 10 sec D) 1 sec.

20. The frequency of the pendulum whose time period 4 seconds is

A) 0.25 Hz B) 5 Hz C) 50 Hz D) 500 Hz

21. Prefix used for the multiple 1,000,000 is

A) mega B) giga C) kilo D) nano

22. The prefix 'milli' is used for the submultiple

A) 1/10 B) 1/100 C) 1/1000 D) 1000

23. The prefix "micro" is used for the submultiple

A) $\frac{1}{10}$ B) $\frac{1}{100}$ C) $\frac{1}{1000}$ D) $\frac{1}{10,000,00}$

24. The abbreviation used to represent the prefix "mega" is

A) m B) M C) μ D) A

25. 60 kilogram in short form is written as

A) 60 kgs B) 60 kg C) both (A) and (B) D) None

ACHIEVERS (Level - II)

Solve the following :

1. Pranya kept 1 kg sugar ,1.5 kg dal , 2kg flour in a basket .what is the total mass and convert in to grams.

2. 3 ton is equal to how many grams?

3. A pendulum completes 20 oscillations in 38 seconds. What is its time period?

4. 1 kilogram is equal to how many micrograms?

EXPLORERS (Level - III)

I) Multi correct answer questions :

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D),out of which* ***ONE or MORE*** *is correct. Choose the correct options*

1. Which of the following are units of length

a) foot b) mile c) metre d) yard

2. 1 Angstrom =

a) 10^{-8}cm b) 10^{-10}m c) 10^{-7}mm d) 10^{-13}km

3. Select the correct relaions\relations

a) 1km/h = (5/18) m/s b) 1 quintal = 100000 grams

c) 1mm = 10^{-3}m d) kg = 10^{-6}mg

4. The multiple of 'gram' is

a) kilogram b) kilometre c) quintal d) milligram

5. The unit of time

a) second b) kilogram c) hour d) decade

II) Fill in the blanks :

1. 1kg = ... mg

2. 18kmph = ... ms^{-1}

III) Match the following :

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

1.

	Column A	Column B
1.	S.I unit of mass	a. Oscillation
2.	Simple pendulum	b. Second
3.	S.I unit of time	c. Mass
4.	Metric tonne	d. Kilogram

A) 1-d, 2-c, 3-a, 4-b B) 1-d, 2-a, 3-b, 4-c

C) 1-a, 2-d, 3-b, 4-c D) 1-c, 2-d, 3-b, 4-a

IV) Comprehension type questions :

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

1. An aeroplane of mass of 50 metric tonne take off at 8'0 clock and land at 14'0 clock.

i) What is the mass of an aeroplane in kg?

A) 500 kg B) 1500 kg C) 5 X 10^3 kg D) 5 X 10^4 kg

ii) In 12 hour format at what time flight will land?

A) 02:00 am B) 03:00 am C) 03:00 pm D) 02:00 pm

iii) The mass of an aeroplane is 50 metric tonne.Here 50 stands for?

A) unit B) magnitude

C) mass D)none

RESEARCHERS (Level - IV)

I) Choose the correct answer :

1. The length of metre is divided into 100 equal parts what will be the value of each part ?

(VI / nstse - 2010)

(A) 1 decimetre (B) 1 millimetre (C) 1 centimetre (D) 1 kilometre

2. Th thickness of dozen of coins on a metre scale was found to be 18cm. What is the thickness of one coin? **(VI / nstse - 2010)**

(A) 15cm (B) 1.2cm (C) 1.8mm (D) 15mm

3. Which of these is longer? **(VI / nstse - 2010)**

(A) kilometre (B) mile (C) yard (D) metre

4. Length of the tube is 5643mm.What would be its length when experss in metres. **(VI / nstse - 2010)**

(A) 5m (B) 56cm (C) 5.3 m (D) 5.643m

5. Convert 4 m 2604 cm into centimeters **(JNV-2011)**

A) 3040 B) 3400 C)3004 D) 6604

6. Three of the fundamental physical quantities in physics are **(VII / kwest - olympaid 2009)**

(A) distance,time & weight (B) distance, time & speed

(C)distance,time & mass (D) density,time & volume

7. Which of the following measuremnts has NOT been expressed in correct SI units? **(VI / nstse - 2009)**

(A) 5m of cloth (B) 20seconds (C) 2 kg petrol (D) surface area of $25m^2$

8. Which one of the following is not derived unit? **(VII / kwest - olympaid 2009)**

(A) density (B) area (C)mass (D)volume

II) <u>Additional Questions for practice :</u>

1. 1 km = ... cm

A) 100 B) 100000 C) 10000 D) 10

2. The unit used to measure the distance of stars from the earth is

A) kilometer B) micron C) light year D) angstrom

3. 1 Billion meters = ... meters

A) 10^7 B) 10^6 C) 10^9 D) 10^{10}.

4. Every measurement consists of a

A) constant and a unit B) unit and a variable

C) number and a unit D) number and a variable

5. Atomic radii are measured in

A) angstrom unit B) light year C) kilometer D) metre

6. 1dm = ...

A) 10m B) 10cm C) 10mm D) 10km

7. We use standard units

A) to measure things accurately B) to convey measurements to other people

C) for the sake of uniformity D) all the above

8. Symbol for metre is

A) M B) m C) mt D) metre

9. 900 nanometers = ...

A) 900 X 10^{-9} m B) 900 X 10^{3} m C) 90X 10^{-4} m D) 9 X 10^{-3} m

10. 1000 micro meters = ...

A) 10^{4} m B) 10^{3} m C) 10^{-3} m D) 10 X 10^{-3} m

11. 10000 fermi meters = ...

A) 10^{-10} m B) 10^{13} m C) 10^{-11} m D) 10^{-3} m

12. Fundamental units

A) can be resolved into other units B) can't be resolved into other units

C) sometimes can be resolved sometimes cannot D) none of these

13. Unit of area is a

A) Derived unit B) Fundamental unit C) Both 1 and 2 D) None of these

14. To measure any physical quantity _____ should be required

A) Time B) Mass C) Unit D) Length

15. Amount of work done is 10 Joule, here 10 stands for

A) Unit B) Numerical value

C) Both (1) and (2) D) None of these

16. Among the following, the odd one is

A) pound B) quintal C) ton D) angstrom

17. Which among the following is the international system of units ?

A) S.I. B) F.P.S C) C.G.S D) M.K.S

18. Which one of the following is the 10^{-10th} part of a metre?

A) Micrometre B) Nanometre C) Angstrom D) Fermi

KEY

Φ Φ LEARNER'S TASK :

☐ **BEGINNERS : I)** 1) B 2) D 3) B 4) A 5) B 6) D 7) B 8) A 9) D
10) B 11) A 12) A 13) C 14) B 15) A 16) B 17) A 18) A
19) A 20) A 21) A 22) C 23) D 24) B 25) B

☐ **EXPLORERS : I)** 1) A,B,C,D 2)A,B,C,D 3) A,B,C 4) A,C 5) A,C,D

II) 1) 10^{6} 2) 5 **III)** 1) B **IV)** 1) i)D ii) D iii) B

☐ **RESEARCHERS : I)** 1) C 2) D 3) B 4) D 5) C 6) C 7) C 8) C **II)** 1) B
2) C 3) C 4) C 5) A 6) B 7) D 8) B 9) A 10) C
11) C 12) A 13) A 14) C 15) B 16) D 17) A 18) C