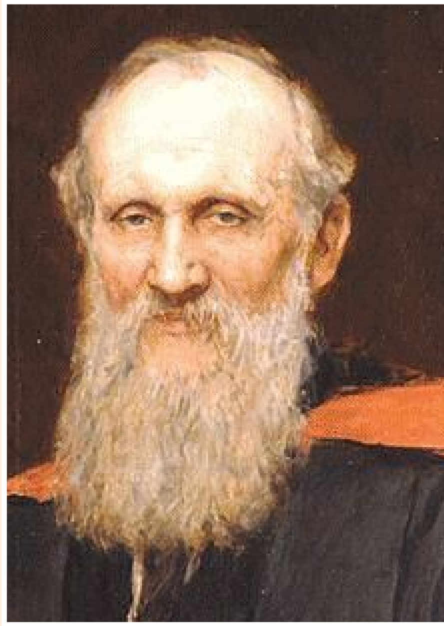
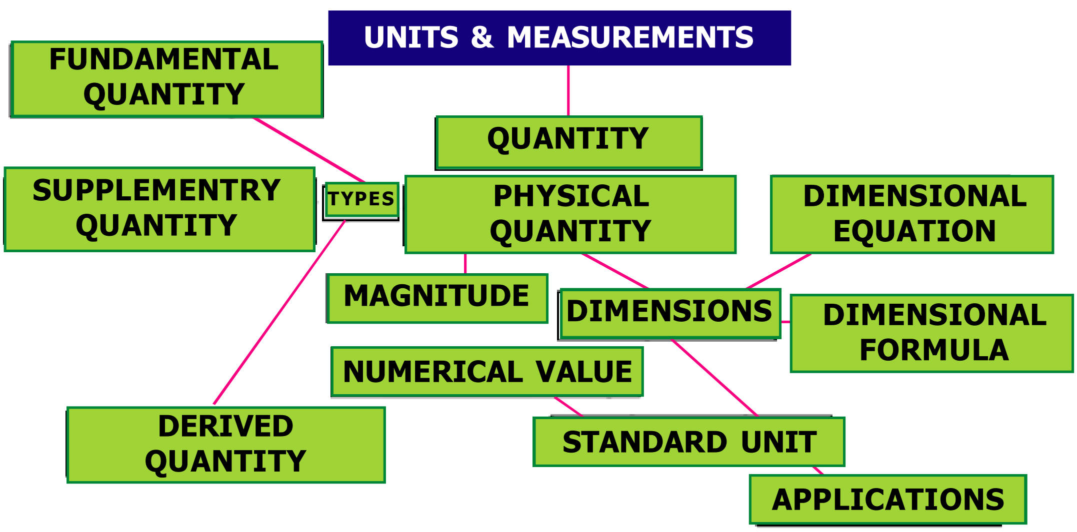
1 MEASUREMENT

Kelvin was a Scottish mathematician and physicist who developed the Kelvin scale of temperature measurement. William Thomson (Lord Kelvin) established one of the first physics laboratories in Britain. Together with Faraday, he was responsible for the introduction of the concept of an electromagnetic field. One of the most important results of his work was his idea of an absolute zero of temperature - the scale based on this is named after him.



CONCEPT MAP



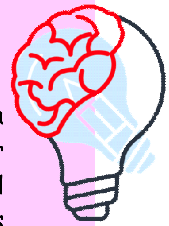
Concept 1

Quantity:

The size, amount magnitude or simply the answer for 'How much?' Or How many?' is called "Quantity" of the given object.

Knowledge Box

A physical quantity is a property of a material or system that can be quantified by measurement. Examples include length, mass, time, temperature, and electric current.



Physical Quantity:

1. Any quantity which can be 'measured' and expressed in terms of a number is called physical quantity.
2. Length, Area, Volume, Speed, Force, Energy etc... are considered as physical quantities.
3. Physical quantities are measured in various systems like

Quantity	Name of system			
	C.G.S.	F.P.S.	M.K.S.	S.I
Length	centimetre	foot	metre	metre (m)
Mass	gram	pounds	kilogram	kilogram (kg)
Time	second	second	second	second(s)
Temperature			kelvin	kelvin (K)
Electric current			ampere	ampere (A)
Luminous Intensity				candela (Cd)
Amount. of Substance				mole (mol)

4. Now the scientists of all the countries are following SI system for their research work.
5. In SI system, physical quantities are organised into three groups. They are,
   i) Fundamental Physical Quantities.
   ii) Supplementary Physical Quantities.
   iii) Derived Physical Quantities.

Unit:

1. A standard value which is used to measure a physical quantity is called "Unit".
2. The desirable features of a standard unit are
   i) Consistent - Not varying with the time.
   ii) Reproducible - To be produced again.
   iii) Invariable - Constant.
   iv) Easily available for usage.

3. Kilogram (kg), Metre (m), Second (s) are the examples of units.
4. Unit is not a name, it is a value. Hence all algebraic operations are possible with units.

Example: i) $cm \times cm = cm^2$ ii) $\frac{m^2}{m} = m$

Characteristics of a Standard Unit:

1. It should be of convenient size.
2. It should not change with respect to space and time.
3. It should be easy to define, without any doubt or ambiguity.
4. It should not be perishable.
5. It can be easily reproduced.

Measurement of a Physical Quantity:

1. Measurement of a physical quantity involves two steps. They are,
   i) Choose a standard value as a unit for measurement.
   ii) Find how many times that unit is contained in the given physical quantity.
2. Every physical quantity is expressed as number (N) followed by its unit (U)

   $P = NU$

   Where

   P – Magnitude of the physical quantity
   N – Numerical value (Number of times of the unit)
   U – Standard unit of the quantity
3. Magnitude of a physical quantity (P) does not change with the choice of the unit.

   Hence, P is a constant.

   $\Rightarrow$ NU = Constant $\Rightarrow N_1U_1 = N_2U_2$

   Example:

   Height of an object = 5 m = 500 cm
   In 5 m, the numerical value is 5 and unit is 'm'. (N_1=5, U_1=m)
   In 500 cm, the numerical value is 500 and unit is 'cm'. (N_2=500, U_2=cm)
   In both cases the numerical values and units are different, but the magnitude is same.
   Hence we can conclude that magnitude of a physical quantity is independent of choice of unit that we have taken.
4. We also have P = NU $\Rightarrow N = \frac{P}{U}$

   $\Rightarrow N \alpha \frac{1}{U}$

   $\therefore$ The numerical value of a physical quantity is inversely proportional to the unit chosen.

CLASSROOM DISCUSSION QUESTIONS — CDQ 01

1. Which of the following is NOT considered a physical quantity?

(A) Length
(B) Volume
(C) Temperature
(D) Colour

2. In which system are physical quantities measured using units like Foot, Pound, and Second?

(A) MKS system
(B) CGS system
(C) FPS system
(D) SI system

3. What are the desirable features of a standard unit?

(A) Consistent, Reproducible, Variable
(B) Consistent, Reproducible, Invariable
(C) Inconsistent, Reproducible, Variable
(D) Inconsistent, Irreproducible, Invariable

4. Which of the following is an example of a unit?

(A) Weight (B) Length
(C) Second (D) Speed

5. What is the relationship between the magnitude (P) and the numerical value (N) of a physical quantity?

(A) P = N + U (B) P = N - U
(C) P = U ÷ N (D) P = NU

6. Which statement accurately describes the relationship between the numerical value and the unit of a physical quantity?

(A) The numerical value is directly proportional to the unit
(B) The numerical value is inversely proportional to the unit
(C) The numerical value is equal to the unit
(D) The numerical value is not related to the unit

7. According to the example provided, what conclusion can be drawn about the magnitude of a physical quantity?

(A) The magnitude changes depending on the chosen unit
(B) The magnitude is directly proportional to the unit
(C) The magnitude is independent of the chosen unit
(D) The magnitude is inversely proportional to the unit

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ____ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

Concept 2

Fundamental Quantity:

1. The physical quantities which are independent and can't be derived from other physical quantities are called "Fundamental quantities".
2. They are also called as "Base quantities".

   Examples: Length, Mass and Time...etc

Fundamental Units:

1. The units of fundamental quantities are called "Fundamental units" or "Base units".
2. Fundamental units in some of the old systems are the following:

System	Fundamental Physical Quantities		
	Length	Mass	Time
FPS	Foot	Pound	Second (s)
CGS	Centimetre (cm)	Gram (g)	Second (s)
MKS	Metre (m)	Kilogram (kg)	Second (s)

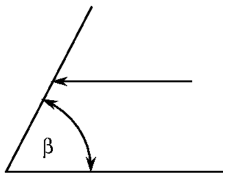
3. In SI system there are seven fundamental quantities as mentioned in the below table.

Fundamental Quantity	SI units	Symbols
Length	Metre	m
Mass	Kilogram	kg
Time	Second	s
Strength of electric current	Ampere	A
Thermodynamic temperature	Kelvin	K
Amount of substance	Mole	mol
Luminous intensity	Candela	cd

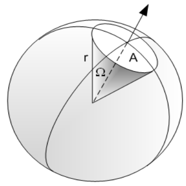
Supplementary Quantity:

1. In the SI system, plane angle and solid angle are considered as "Supplementary quantities".
2. They are also called considered as "Angular quantities".
3. The units of supplementary quantities are called "Supplementary units" or "Angular units".
4. The symbols and units of supplementary quantities are mentioned below.

Supplementary quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr



Plane Angle



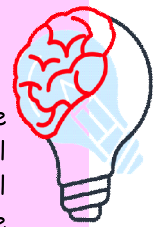
Solid Angle

Derived Physical Quantity:

Physical quantities derived from fundamental or supplementary physical quantities are called "Derived physical quantities".

Knowledge Box

Derived quantities are obtained from fundamental quantities using mathematical relationships. Examples include speed, volume, and density



Derived Units:

1. The units of derived quantities are called "Derived units".
2. Some of the derived quantities and their units are mentioned below.

Derived Physical Quantity	How it is derived from base units	Symbol
Area	Length × width	m^2
Volume	Length × width × height	m^3
Density	mass ÷ volume	$kg\ m^{-3}$
Speed	distance ÷ time	m/s
Acceleration	change in velocity ÷ time	ms^{-2}

3. Some derived units named after scientists are mentioned below.

Name	Symbol	Quantity	SI base unit Equivalents
joule	J	energy, work, heat	$kg\ m^2\ s^{-2}$
newton	N	force, weight	$kg\ m\ s^{-2}$
pascal	Pa	pressure, stress	$kg\ m^{-1}\ s^{-2}$
watt	W	power, radiant flux	$kg\ m^2\ s^{-3}$

Note:

Until 1995, the SI system classified the radian and the steradian as supplementary units, but this designation was abandoned and the two units now were grouped as derived units.

CLASSROOM DISCUSSION QUESTIONS — CDQ 02

1. What are fundamental quantities also known as?

(A) Supplementary quantities
(B) Derived quantities
(C) Base quantities
(D) Supplementary units

2. In the FPS system, what is the fundamental unit for time?

(A) Second (s)
(B) Foot (ft)
(C) Pound (lb)
(D) Kelvin (K)

3. How many fundamental quantities are there in the SI system?

(A) Five
(B) Six
(C) Seven
(D) Eight

4. Which quantity is not considered a fundamental quantity in the SI system?

(A) Length
(B) Mass
(C) Energy
(D) Time

5. What are plane angle and solid angle considered as in the SI system?

(A) Supplementary quantities
(B) Derived quantities
(C) Base quantities
(D) Supplementary units

6. What is the unit of plane angle in the SI system?

(A) Radian (rad)
(B) Steradian (sr)
(C) Metre (m)
(D) Second (s)

7. Which of the following is not a derived physical quantity?

(A) Area
(B) Force
(C) Mass
(D) Energy

8. What is the derived unit for velocity?

(A) m/s^2
(B) m^2/s
(C) m/s
(D) kgm/s^2

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ____ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

Concept 3

Rules for Writing Units in SI System:

1. All the symbols of the fundamental units should be written as they appear in the table of SI units.

5 M	**(×)**
5 m	**(✓)**

2. In compound units all the symbols of the fundamental units should be written as they appear in the table of SI units.

kg sec^{-1}	**(×)**
kg s^{-1}	**(✓)**

3. Some of the units are represented by the names of the scientists as an honour for their research in the respective fields. The full name of such units should be written with a lower initial letter.

7 Newton	**(×)**
7 newton	**(✓)**

4. Actually unit of force is kgms^{-2}, it is named as newton (N).

   The symbol of the unit named after a scientist should always be written with the capital letter.

5 n	**(×)**
5 N	**(✓)**

5. Punctuations like full stop (.), comma (,) etc., should not be used after the symbol of unit.

5 s.	**(×)**
5 s	**(✓)**

6. A unit should always be represented in a singular form.

5 kgs	**(×)**
5 kg	**(✓)**

Multiples of Metre:

1. Decametre (dam) = 10^1m = 10m.
2. Hectometre (hm) = 10^2m = 100m.
3. Kilometre (km) = 10^3m = 1000m.

Sub-Multiples of Metre:

1. Decimetre (dm) = 10^{-1}m
2. Centimetre (cm) = 10^{-2}m
3. Millimetre (mm)=10^{-3}m
4. Micrometre (μm)=10^{-6}m
5. Nanometre (nm) = 10^{-9}m
6. Pico-metre (pm) = 10^{-12}m

Sub-Multiples of Metre in Centimetres:

1. Decimetre (dm) = 10cm
2. Centimetre (cm) = 1cm
3. Millimetre (mm) = 0.1cm or 10^{-1}cm
4. Micrometre (μm)= 10^{-4}cm
5. Nanometre (nm) = 10^{-7}cm
6. Pico-metre (pm) = 10^{-10}cm

Some Practical Units of Length in Various Branches of Physics: (These are not SI units)

1. Micron (μ) = 10^{-6}m = 10^{-4}cm (diametre of human hair)
2. Angstrom (A^O) = 10^{-10}m = 10^{-8}cm (Wavelength of light)
3. Fermi = 10^{-15}m = 10^{-13}cm (Radius of nucleus)
4. Light year = 9.46×10^{15}m = 9.46×10^{12}km. (The distance travelled by light in vacuum in 1 year)
5. 1 par-sec= 3.26 light year (The largest unit of length is par-sec) (Parallactic second)
6. 1 A.U (Astronomical unit) = 1.5×10^{11}m. (The avg distance between the surface of the earth and the Sun).

Multiples of Kilogram:

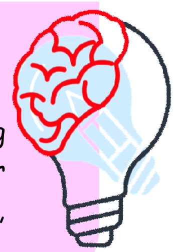
1. Quintal = 10^2kg =100kg.
2. Tonne (t) = 10^3kg = 1000kg.

Sub-Multiples of Kilogram:

1. Hectogram (hg) = 10^{-1}kg = 100g.
2. Decagram (dag) = 10^{-2}kg = 10g.
3. Gram (g) = 10^{-3}kg =1g.
4. Milligram (mg) = 10^{-6}kg = 10^{-3}g.
5. Microgram (g) = 10^{-9} kg = 10^{-6} g.

Knowledge Box

Converting units involves using a conversion factor. For example, to convert cm to m, divide by 100.



Some Practical Units of Mass in Various Branches of Physics: (These are not SI units)

1. 1 tonne = 1000kg
2. 1 quintal = 100kg
3. 1 pound = 0.456kg
4. Atomic mass unit = 1.67×10^{-27}kg
5. Astronomical Unit of mass (solar mass) = 2×10^{30}kg

Multiples of Time:

1. 1 Minute (min) = 60s
2. 1 Hour (h) = 60min = 3600s
3. 1 Day (d) = 24(h) = 24×60min
   = 24 × 60 × 60s = 86400s

Sub-Multiples of Time:

1. Decisecond = 10^{-1}s =0.1s
2. Centisecond = 10^{-2}s = 0.01s
3. Millisecond = 10^{-3}s = 0.001s
4. Microsecond = 10^{-6}s = 0.000001s

Misconception :

Misconception : Mass and weight are the same.
Correction : Mass is the amount of matter in an object (measured in kg), while weight is the gravitational force acting on that mass (measured in N).

Some Practical Units of Time in Various Branches of Physics: (These are not SI units)

1. 1 shake = 10^{-8}s
2. Decade = 10 years
3. Century = 100 years
4. Millennium = 1000 years
5. 1 mean solar day = 1×24 hour
   = 1×24 ×60 minutes
   = 1×24×60×60s
   = 86400s

Fun Facts

Time is the only quantity that always moves forward—it never takes a U-turn!

CLASSROOM DISCUSSION QUESTIONS

CDQ 03

1. Which of the following is the correct way to represent 5 metres?

(A) 5 M
(B) 5 m
(C) 5 mts
(D) 5 ms

2. How should the compound unit "kg sec" be written according to SI rules?

(A) kg sec
(B) kg s
(C) kg s^{-1}
(D) kg/sec

3. What is the correct representation for 7 Newton?

(A) 7 Newton
(B) 7 ne
(C) 7 N
(D) 7 n

4. What is the symbol for the unit named after a scientist, such as the newton?

(A) n
(B) N
(C) new
(D) nt

5. How should a unit always be represented?

(A) In a plural form
(B) In a singular form
(C) In a dual form
(D) In a collective form

6. What does the prefix "micro" represent?

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

7. What is the largest unit of length?

(A) Micron
(B) Angstrom
(C) Fermi
(D) Par-sec

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ____ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

Concept 4

Standard Prefixes:

To express the physical quantities in SI units having very large or very small numerical values some standard prefixes are used. We use these prefixes together with units to make the numerical values of quantities more “manageable”.

Example:

i) Radius of earth 64, 00, 000 m = 6400 km.

Here the prefix ‘k’ stands for 10^3.

ii) Mass of an ant 22/1000g = 22 mg.

Here the prefix “m” stands for 10^{-3}.

Prefixes used here are just numbers.

Commonly used prefixes with SI units are given below.

Multiples and Submultiples:

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

S.No.	Multiplication factor	Prefix	Symbol
1	10	deca	da
2	10^2	hecto	h
3	10^3	kilo	k
4	10^6	mega	M
5	10^9	Giga	G
6	10^{12}	tera	T
7	10^{15}	peta	P
8	10^{18}	exa	E
9	10^{21}	zetta	Z
10	10^{24}	yotta	Y

S.No.	Multiplication factor	Prefix	Symbol
11	10^{-1}	deci	d
12	10^{-2}	centi	c
13	10^{-3}	milli	m
14	10^{-6}	micro	μ
15	10^{-9}	nano	n
16	10^{-12}	pico	p
17	10^{-15}	femto	f
18	10^{-18}	atto	a
19	10^{-21}	zepto	z
20	10^{-24}	yetto	y

Note: The multiplication factors with ‘*’ are not SI prefix but are commonly in use.

Conversion of Units:

METRIC CONVERSIONS					
1 centimeter	=	10 millimeters	1 cm	=	10 mm
1 meter	=	100 centimeters	1 m	=	100 cm
1 kilometer	=	1000 meters	1 km	=	1000 m

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

   i) First convert the given unit into SI unit.

   ii) Then, convert it into the desired system of units.

Example Problems:

Convert the Following Units of 'Length' into Desired Units:

a) Convert 30 cm into metres.

Step 1: $30\ cm = 30 \times 10^{-2}\ m \quad = 0.3\ m$

b) Convert 30 cm into μm

Step 1: $30\ cm = 30 \times 10^{-2}\ m \quad = 0.3\ m$

Step 2: $0.3\ m = 0.3 \times 10^{6}\ m \times 10^{-6} = 0.3 \times 10^{6}\ \mu m$

c) Convert 30 cm into km.

Step 1: $30\ cm = 30 \times 10^{-2}\ m = 0.3\ m$

Step 2: $0.3\ m \quad = 0.3 \times 10^{-3} \times 10^{3}\ m = 0.3 \times 10^{-3}\ km$

d) Convert 30 cm into nm.

Step 1: $30\ cm = 30 \times 10^{-2}\ m \quad = 0.3\ m$

Step 2: $0.3\ m \quad = 0.3 \times 10^{9}\ m \times 10^{-9} = 0.3 \times 10^{9}\ nm$

e) Convert 30 km into cm.

Step 1: $30\ km \quad = 30 \times 10^{3}\ m$

Step 2: $30 \times 10^{3}\ m \quad = 30 \times 10^{3} \times 10^{2}\ cm \quad = 3 \times 10^{6}\ cm$

Convert the Following Units of 'Mass' into Desired Units:

Name	Symbol	Equivalence
Kilogram	kg	1000 g
Hectogram	hg	100 g
Decagram	dag	10 g
Gram	g	1 g
Decigram	dg	0.1 g
Centigram	cg	0.01 g
Milligram	mg	0.001 g

a) Convert 300 g into kg

Step 1: $300\ g \ = 300 \times 10^{-3}\ kg \ = 0.3\ kg$

b) Convert 5 mg into kg

Step 1: $5\ mg \ = 5 \times 10^{-3}\ g$

Step 2: $5 \times 10^{-3} \times 10^{-3} \times 10^{3}\ g \quad = 5 \times 10^{-6}\ kg$

c) Convert 500 kg into mg

Step 1: $500\text{kg} = 500 \times 10^3\text{g}$

Step 2: $500 \times 10^3\text{g} = 500 \times 10^3 \times 10^3 \times 10^{-3}\text{g}$

$= 500 \times 10^6\text{mg}$

d) Convert 10 quintal into ng

Step 1: $10 \text{ quintal} = 10 \times 10^2\text{kg}$

Step 2: $10 \times 10^2\text{kg} = 10 \times 10^2 \times 10^3\text{g}$

$= 10 \times 10^2 \times 10^3 \times 10^9 \times 10^{-9}\text{g}$

$= 10^{15}\text{ng}$

e) Convert 10μg into ton

Step 1: $10\mu\text{g} = 10 \times 10^{-6}\text{g}$

Step 2: $10 \times 10^{-6}\text{g} = 10 \times 10^{-6} \times 10^{-3} \times 10^3\text{g}$

$= 10 \times 10^{-9}\text{kg}$

$= 10 \times 10^{-9} \times 10^{-3} \times 10^3\text{kg}$

$= 10 \times 10^{-12}\text{ton} = 10^{-11}\text{ton}$

Convert the Following Units of 'Time' into Desired Units:

SECONDS, MINUTES, HOURS, DAYS		
What I have	**What I want**	**What I do**
Seconds	**Minutes**	**Divide by 60**
Minutes	**Seconds**	**Multiple by 60**
Minutes	**Hours**	**Divide by 60**
Hours	**Minutes**	**Multiple by 60**
Hours	**Days**	**Divide by 24**
Days	**Hours**	**Multiple by 24**

a) Convert 32s into milliseconds

Step 1: $32\text{s} = 32\times10^3\times10^{-3}\text{s} = 32\times10^3\text{milliseconds}$

b) Convert 1 day into seconds

1 day = 24 hours = 24×60 min

= 24×60×60s = 86,400s

c) Convert 64 s into nanoseconds

Step 1: $64\text{s} = 64\times10^9\times10^{-9}\text{s}$

$= 64\times10^9\text{nanoseconds}$

Task to the Students

Convert the following units of length: 250 cm to m, 5 km to m.

CLASSROOM DISCUSSION QUESTIONS

CDQ 04

1. What is 30 centimetres converted to metres?

(A) 0.03m

(B) 0.3m

(C) 3m

(D) 30m

2. Convert 30 centimetres to micrometres.

(A) 300µm

(B) 3,000µm

(C) 30,000µm

(D) 300,000µm

3. If 30 centimetres is converted to kilometres, what is the result?

(A) 0.0003km

(B) 0.03km

(C) 3km

(D) 30km

4. How many centimetres are there in 30 kilometres?

(A) 3,000cm

(B) 30,000cm

(C) 300,000cm

(D) 3,000,000cm

5. Convert 300 grams to kilograms.

(A) 0.3kg

(B) 3kg

(C) 30kg

(D) 300kg

6. Convert 500 kilograms to milligrams.

(A) 5,000,000mg

(B) 50,000,000mg

(C) 500,000,000mg

(D) 5,000,000,000mg

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

Concept 5

Conversion of Units of Derived Quantities:

Convert the Following Units of 'Volume' into Desired Units:

a) Convert 20 cm^3 into m^3

$20\ cm^3 = 20 \times (10^{-2}\ m)^3 = 20 \times 10^{-6}\ m^3$

b) Convert 0.2 m^3 into km^3

$0.2\ m^3 = 0.2 \times (10^{-3}\ km)^3 = 0.2 \times 10^{-9}\ km^3$

c) Convert cubic metre into cubic millimetre

$1\ m^3 = 1\times(10^3 mm)^3 = 1\times10^9\ mm^3 = 10^9\ mm^3$

Convert the Following Units of 'Density' into Desired Units:

a) Convert g cm^{-3} into kg m^{-3}

$$1 g\,cm^{-3} = \frac{g}{cm^3} = \frac{10^{-3}kg}{(10^{-2}m)^3} = \frac{10^{-3}kg}{10^{-6}m^3} = 10^{-3}kg \times 10^6 m^{-3} = 10^3 kgm^{-3} = 1000 kg\,m^{-3}$$

b) Converting kg m^{-3} to g cm^{-3}

$$1\frac{kg}{m^3} = \frac{1000g}{(10^2 cm)^3} = \frac{1000g}{10^6 cm^3} = 10^3 \times 10^{-6} gcm^{-3} = 10^{-3} gcm^{-3}$$

c) Convert 50 kg m^{-3} into g cm^{-3}

$$50 kg\,m^{-3} = \frac{50 kg}{1 m^3} = \frac{50\times10^3 g}{(10^2 cm)^3} = \frac{50\times10^3 g}{10^6 cm^3} = 5\times10\times10^3\times10^{-6} g\,cm^{-3} = 5\times10^{-2} g\,cm^{-3}$$

Convert the Following Units of 'Speed' into Desired Units:

a) Convert $1ms^{-1}$ into kmph

$$1ms^{-1} = \frac{10^{-3}km}{\frac{1}{60}min}$$

$$= \frac{10^{-3}km}{\frac{1}{60}\times\frac{1}{60}hr} = \frac{\frac{1}{1000}km}{\frac{1}{3600}hr} = \frac{3600}{1000}\frac{km}{hr} = \frac{18}{5}\frac{km}{hr}$$

b) Converting 1 kmph to ms^{-1}

$$1\frac{km}{h} = \frac{1000m}{60\,min} = \frac{1000m}{60 \times 60s} = \frac{1000}{3600} m/s = \frac{5}{18} m/s$$

c) Convert 54 kmph into ms^{-1}

$$54 \text{ kmph} = 54 \times \frac{5}{18} ms^{-1} = 15\ ms^{-1}$$

d) Convert 36 kmph into cms^{-1}

$$36 \text{ kmph} = 36 \times \frac{5}{18} ms^{-1} = 10ms^{-1} = 10 \times 10^2 cms^{-1} = 10^3 cms^{-1}$$

e) Convert $50ms^{-1}$ into kmph = $50ms^{-1}$ = $50 \times \frac{18}{5} \text{kmph} = 180 \text{ kmph}$

Convert the Following Units of 'Force' into the Required Units. [Newton = kg ms^{-2}]

a) Convert one newton into dyne.

$1N = 1kgms^{-2} = 10^3 g \times 10^2 cms^{-2} = 10^5 gcms^{-2} = 10^5 dyne$

$1N = 10^5 dyne$

b) Converting dyne to newtons.

$$1 dyne = 1\, gcms^{-2}$$

$$= \frac{1}{1000} kg. \frac{1}{100} ms^{-2} = 10^{-3} kg \times 10^{-2} ms^{-2} = 10^{-5} kgms^{-2}$$

c) Convert 5 kilo newton into dyne

$5\ kN = 5 \times 10^3 N = 5 \times 10^3 \times 10^5\ dyne = 5 \times 10^8\ dyne$

d) Convert 20 Mdyne into newton

$20\ Mdyne = 20 \times 10^6 dyne = 20 \times 10^6 \times 10^{-5} N = 200\ N$

Convert the Following Units of 'Energy' into the Required Units [Joule = kgm^2s^{-2}]

a) Convert joule into erg

$1J = 1Nm = 10^5 dyne \times 10^2 cm = 10^7 dynecm = 10^7 erg$

$1J = 10^7 erg$

b) Convert 25MJ into μerg

$25MJ = 25 \times 10^6 J = 25 \times 10^6 \times 10^7 erg = 25 \times 10^6 \times 10^7 \times 10^6 \mu erg$

$= 25 \times 10^{19} \mu erg$

CLASSROOM DISCUSSION QUESTIONS — CDQ 05

1. **What is 20 cubic centimetres converted to cubic metres?**
   (A) $2\times10^{-5}m^3$
   (B) $2\times10^{-6}m^3$
   (C) $2\times10^{-7}m^3$
   (D) $2\times10^{-8}m^3$

2. **Convert 0.2 cubic metres to cubic kilometres.**
   (A) $2\times10^{-10}km^3$
   (B) $2\times10^{-9}km^3$
   (C) $2\times10^{-8}km^3$
   (D) $2\times10^{-7}km^3$

3. **How many cubic millimetres are there in a cubic metre?**
   (A) 10^6mm^3
   (B) 10^7mm^3
   (C) 10^8mm^3
   (D) 10^9mm^3

4. **Convert 1 gram per cubic centimetre to kilograms per cubic metre.**
   (A) $10kg/m^3$
   (B) $100kg/m^3$
   (C) $1000kg/m^3$
   (D) $10,000kg/m^3$

5. **Convert 1 metre per second to kilometres per hour.**
   (A) 3.6km/h
   (B) 18km/h
   (C) 36km/h
   (D) 360km/h

6. **If the speed is 54 km/h, what is it in metres per second?**
   (A) 5m/s
   (B) 15m/s
   (C) 50m/s
   (D) 54m/s

7. **Convert 36 km/h to centimetres per second.**
   (A) 3cm/s
   (B) 10cm/s
   (C) 100cm/s
   (D) 1000cm/s

8. **What is 50 metres per second converted to kilometres per hour?**
   (A) 180km/h
   (B) 500km/h
   (C) 1800km/h
   (D) 5000km/h

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

Concept 6

Dimensions:

1. The nature of a physical quantity is described by its dimensions.
2. The dimensions of a physical quantity are the powers to which the base quantities are raised to represent the quantity.
3. The physical quantity that is expressed in terms of the base quantities is enclosed in square brackets '[ ]'.
4. ***Example***:

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{\text{mass}}{(\text{length})^3} = (\text{mass})(\text{length})^{-3} = [M^1\ L^{-3}]$$

5. Thus, the dimensions of density are '1' in mass and '-3' in length.
6. The dimensions of all other quantities will be zero in this case.

Dimensional Formula:

1. The expression which shows how and which of the base quantities represent the dimensions of a physical quantity is called the "Dimensional formula of the physical quantity".
2. Dimensional formulae of fundamental quantities in SI are as follows.
   i) Mass – [M]
   ii) Length – [L]
   iii) Time – [T]
   iv) Temperature – [K] or [q]
   v) Electric current – [A] or [I]
   vi) Luminous intensity – [Cd]
   vii) Amount of the substance – [mol]
3. Supplementary physical quantities have no dimensions.

Example problems:

Example 1: The dimensional formula of area is $[M^0L^2T^0]$. What does it represents?

Solution: $[M^0L^2T^0] = [M^0]\times[L^2]\times[T^0]$

Here the dimension of area is '0' in mass.

The dimension of area is '2' in length.

The dimension of area is '0' in time.

Example 2: The dimensional formula of volume is $[M^0L^3T^0]$. What does it represents?

Solution: $[M^0L^3T^0] = [M^0]\times[L^3]\times[T^0]$

Here the dimension of volume is '0' in mass.

The dimension of volume is '3' in length.

The dimension of volume is '0' in time.

Example 3: The dimensional formula of speed is $[M^0L^1T^{-1}]$. What does it represents?

Solution: $[M^0L^1T^{-1}] = [M^0]\times[L^1]\times[T^{-1}]$

Here the dimension of speed is '0' in mass.

The dimension of speed is '1' in length.

The dimension of speed is '-1' in time.

Dimensional Equation:

An equation obtained by equating a physical quantity with its dimensional formula is called "Dimensional equation of the physical quantity".

Ex: $[F] = [M^1L^1T^{-2}]$

The Dimensional Formulae of Some Quantities

S.No	Physical Quantity	General formula	Dimensional formula	SI unit
1	Area	Length × breadth	$[M^0L^2T^0]$	m^2
2	Volume	Length × breadth × height	$[M^0L^3T^0]$	m^3
3	Density	Mass/volume	$[M^1L^{-3}T^0]$	$kg\ m^{-3}$
4	Speed, velocity	Distance/time	$[M^0L^1T^{-1}]$	ms^{-1}
5	Acceleration	Change in velocity / time	$[M^0LT^{-2}]$	ms^{-2}
6	Momentum	Mass × velocity	$[M^1L^1T^{-1}]$	$kg\ ms^{-1}$
7	Force	Mass × Acceleration	$[M^1L^1T^{-2}]$	Newton (N)
8	Impulse	Force × time	$[M^1L^1T^{-1}]$	$kg\ ms^{-1}$
9	Work, Energy	Force × distance	$[M^1L^2T^{-2}]$	Joule (J) or $kgm^2\ s^{-2}$
10	Power	Work/time	$[M^1L^2T^{-3}]$	Watt (W)
11	Pressure	Force/area	$[M^1L^{-1}T^{-2}]$	Nm^{-2} (Pa)

CLASSROOM DISCUSSION QUESTIONS

CDQ 06

1. The dimensional formula of force is:

(A) $[M^1L^1T^{-2}]$

(B) $[M^1L^2T^{-2}]$

(C) $[M^0L^1T^{-2}]$

(D) $[M^1L^1T^{-1}]$

2. The SI unit of power is watt (W). What is its dimensional formula?

(A) $[M^1L^2T^{-2}]$

(B) $[M^1L^2T^{-3}]$

(C) $[M^0L^2T^{-3}]$

(D) $[M^1L^1T^{-3}]$

3. Which of the following quantities has the same dimensional formula as work?

(A) Power

(B) Energy

(C) Force

(D) Pressure

4. The dimensional formula of acceleration is:

(A) $[M^0L^1T^{-2}]$

(B) $[M^1L^1T^{-2}]$

(C) $[M^1L^2T^{-2}]$

(D) $[M^0L^2T^{-1}]$

5. Which physical quantity has the dimensional formula $[M^0L^3T^0]$?

(A) Volume

(B) Density

(C) Speed

(D) Force

6. The dimensional formula of impulse is:

(A) $[M^1L^1T^{-1}]$

(B) $[M^1L^1T^{-2}]$

(C) $[M^1L^2T^{-2}]$

(D) $[M^0L^1T^{-1}]$

7. The dimensional formula of heat or energy is same as that of:

(A) Work

(B) Momentum

(C) Power

(D) Pressure

8. What is the dimensional formula of pressure?

(A) $[M^1L^{-1}T^{-2}]$

(B) $[M^0L^1T^{-2}]$

(C) $[M^1L^1T^{-1}]$

(D) $[M^0L^0T^{-2}]$

MARK YOUR ANSWERS WITH PEN ONLY. Time Taken ☐ Minutes

1 Ⓐ Ⓑ Ⓒ Ⓓ	2 Ⓐ Ⓑ Ⓒ Ⓓ	3 Ⓐ Ⓑ Ⓒ Ⓓ	4 Ⓐ Ⓑ Ⓒ Ⓓ	5 Ⓐ Ⓑ Ⓒ Ⓓ
6 Ⓐ Ⓑ Ⓒ Ⓓ	7 Ⓐ Ⓑ Ⓒ Ⓓ	8 Ⓐ Ⓑ Ⓒ Ⓓ	9 Ⓐ Ⓑ Ⓒ Ⓓ	10 Ⓐ Ⓑ Ⓒ Ⓓ

C.D.F. (Concepts, Definitions and Formulae)

1. Any quantity which can be measured is called a physical quantity.
2. There are three types of physical quantities.
   a) Fundamental quantities ;
   b) Derived quantities;
   c) Supplementary quantities.
3. The physical quantity which does not depend upon other quantities is known as fundamental quantity. e.g: Length, mass, time, temperature etc.,
4. The physical quantity that can be derived from the fundamental quantities is known as derived quantity. e.g: Area, density, force etc.
5. To measure a physical quantity, we need a standard of the same quantity. It is called unit.
6. Every measurement has two parts.
   a) Number or numerical value
   b) Unit
7. $N \propto \frac{1}{U}$ or NU = constant or $N_1U_1 = N_2U_2$
8. The unit used to measure the fundamental quantity is called fundamental unit.
9. The unit used to measure the derived quantity is called derived unit.
10. **Principal systems of units:** There are four systems of units namely
    a) C.G.S. system or metric system b) F.P.S system or British system
    c) M.K.S system
    d) SI (international system)
11. Angstrom (A°) = 10^{-10}m = 10^{-8}cm (for wavelength)
12. Nanometre (nm) = 10^{-9}m = 10A°
13. Fermi = 10^{-15}m (size of the nucleus)
14. Micron (mm)=10^{-6} (for size of bacteria)
15. 1 light year = 9.46×10^{15}m (distances of stars)
16. 1 Parsec = 3.26 light year = 3.08×10^{16}m
17. 1 astronomical unit (A.U) = 1.496×10^{11}m
18. 1 mile = 1.61km
19. When the dimensional formula of a physical quantity is expressed in the form of an equation, then such equation is known as dimensional equation. eg: Work = $[ML^2T^{-2}]$
20. In the dimensional formula the symbols like M, L, T... etc., indicate the nature of fundamental units but not their magnitudes.
21. Dimensions of physical quantity can be positive, negative or zero.
22. Dimensional formula of any physical quantity can be obtained (a) from definition (b) from the unit (c) from the formula.

Advanced Worksheet

LEVEL 1

Single Correct Answer Type (S.C.A.T.):

1. The SI unit named after a scientist must have:

(A) Full name in capital letters

(B) Symbol in capital letters

(C) Symbol in small letters

(D) Full name in capital letters and symbol in small letters

2. 1 micrometre (μm) is equal to:

(A) 10^{-2}m (B) 10^{-3}m

(C) 10^{-6}m (D) 10^{-9}m

3. Which of the following unit is not a base unit in S.I. system?

(A) Metre (B) Candela

(C) Ampere (D) Pascal

4. Which of the following units is used to measure the wavelength of light?

(A) Micron (B) Angstrom

(C) Fermi (D) Light year

5. Which of the following system of units is not based on only units of mass, length and time?

(A) SI (B) CGS

(C) MKS (D) FPS

6. Which of the following is not the name of a physical quantity?

(A) Time (B) Speed

(C) Force (D) Kilogram

7. $1\ m^2$ = _____.

(A) $10^4 m^2$

(B) $10^3 m^2$

(C) $10^2 m^2$

(D) $100^2 cm^2$

8. The dimensions of a physical quantity are:

(A) The mean of the exponents of base quantities

(B) The sum of the exponents of base quantities

(C) The powers to which the base quantities are raised to represent that quantity

(D) The sum of all the number of base quantities

9. According to the principle of homogeneity of dimensions:

(A) We can subtract similar physical quantities

(B) We can add or subtract any physical quantities

(C) We can add or subtract similar physical quantities

(D) We can add similar physical quantities

10. $1cm^2$ = ______.

(A) 10^4m^2 (B) 10^3m^2

(C) 10^2m^2 (D) 10^2mm^2

11. The dimensions of a physical quantity are the powers of _____.

(A) Derived quantity

(B) Fundamental quantity

(C) Supplementary quantity

(D) All of these

12. The physical quantity which have the same dimensional formula:

(A) Work

(B) Energy

(C) Torque

(D) All of these

13. Which of the following is an example of dimensional equation?

(A) $M^0L^1T^{-1}$

(B) $[M^0L^1T^{-1}]$

(C) $[V] = [M^0L^1T^{-1}]$

(D) None of these

14. Convert "1" second into hour.

(A) 3600 hour

(B) $\frac{1}{3600}$ hour

(C) 60 hour

(D) $\frac{1}{60}$ hour

15. The fundamental quantities in M.K.S. system:

(A) Length (B) Mass

(C) Time (D) All of these

16. S.I. system consists of:

(A) Seven fundamental units and three supplementary units

(B) Two fundamental units and seven supplementary units

(C) Three fundamental units and three supplementary units

(D) Seven fundamental units and two supplementary units

17. The symbol of unit of temperature:

(A) K (B) C

(C) t (D) T

18. The symbol of unit of plane angle:

(A) q (B) 1

(C) rad (D) No units

19. Light year is the unit of:

(A) Time (B) Speed

(C) Distance (D) Force

20. Among the following, the odd one is:

(A) Pound (B) Quintal

(C) Tonne (D) Angstrom

21. Convert 1 second into day.

(A) $\frac{1}{86,400}$ Day

(B) 24 Day

(C) $\frac{1}{24}$ Day

(D) $\frac{1}{3600}$ Day

22. Among the following, the smallest unit of time is:

(A) Milli second

(B) Micro second

(C) Nano second

(D) Shake

23. 1 newton is equal to _____ dyne.

(A) 10^{-5} (B) 10^{3}

(C) 10^{5} (D) 10^{6}

24. Among the following, which is not the unit of time?

(A) Leap year

(B) Lunar month

(C) Light year

(D) All the above

25. One metric tonne = ____ quintal.

(A) 10,000 (B) 1000

(C) 100 (D) 10

26. We have a unit called 'fermi' in the honour of Italian physicist "Enrico Fermi". The value of one fermi is equal to:

(A) 10^{-15}cm

(B) 10^{-13}cm

(C) 10^{-12}cm

(D) 10^{-10}cm

27. 1 par sec = _____.

(A) 3.26 light year

(B) 9.46 light year

(C) 3.26×10^{16}m

(D) 9.08×10^{18}m

28. One milligram = ______.

(A) 10^{-6}kg (B) 10^{-6}g

(C) 10^{6}kg (D) 10^{3}g

29. 36 kmph = _____ ms^{-1}.

(A) $10ms^{-1}$ (B) $15ms^{-1}$

(C) $20ms^{-1}$ (D) $25ms^{-1}$

30. 4 kilo newton = _____ dynes.

(A) 4×10^{6}dyne

(B) 4×10^{8}dyne

(C) 4×10^{-6}dyne

(D) 4×10^{-8}dyne

31. While writing the dimensional formulae, the physical quantities are expressed in terms of ______.

(A) Base quantities

(B) Derived quantities

(C) Both (A) & (B)

(D) None of these

32. To find the number of ergs on one joule ____ should be known.

(A) Dimensional formula of energy

(B) Dimensional formula of relative density

(C) Dimensional formula of impulse

(D) Dimensional formula of momentum

33. The dimensional formula of force is _____.

(A) $[M^0LT^2]$

(B) $[M^0L^1T^{-1}]$

(C) $[M^1L^1T^{-3}]$

(D) $[M^1L^1T^{-2}]$

34. Dimensions of time in power is:

(A) –1 (B) –2

(C) –3 (D) –4

35. The distance travelled by a body in n^{th} second is given by $s_n = u + \frac{a}{2}(2n-1)$ where u is initial velocity and a is acceleration. The dimensional formula of s_n is:

(A) [L] (B) $[LT^{-1}]$

(C) $[LT^{-2}]$ (D) $[L^{-1}T]$

36. Two quantities A and B have different dimensions. Which mathematical operations given below is physically correct?

(A) A/B (B) A + B

(C) A – B (D) None

37. The unit of force is 1 kilo newton, the length is 1km and time is 100 second, what will be the unit of mass?

(A) 1kg

(B) 100kg

(C) 1000kg

(D) 10000kg

38. If 1 g cms^{-1} = x newton – second, then the number x is equal to:

(A) 1×10^{-1}

(B) 3.1×10^{-3}

(C) 1×10^{-5}

(D) 6×10^{-4}

39. Find the mass if force is 2N, that of length is 4m and the velocity is $6 m s^{-1}$.

(A) $\frac{2}{9}$kg

(B) $\frac{4}{3}$kg

(C) $\frac{9}{2}$kg

(D) $\frac{2}{5}$kg

40. In the formula $V^2 = Ag\lambda$, V is the velocity. A is the amplitude and g is acceleration due to gravity and λ is the wavelength. Then the formula is dimensionally:

(A) Incorrect

(B) Correct

(C) May be correct

(D) None of these

41. One joule = _______ ergs.

(A) 10^4

(B) 10^5

(C) 10^6

(D) 10^7

42. Dimensions of length in pressure is:

(A) –1

(B) –2

(C) –3

(D) –4

43. In a physical relation A = B + C each term on LHS as well as on RHS of the relation:

(A) Should project same dimensions

(B) Should not project same dimensions

(C) Should have same physical formula

(D) All of these

LEVEL 2

Multi Correct Answer Type (M.C.A.T.):

44. 1 meter per second is equal to

(A) 3.6 km/h

(B) 0.06 km/min

(C) 3600 m/h

(D) 60 m/min

45. Which of the following are fundamental quantities?

(A) Length (B) Mass

(C) Time (D) Area

46. Which of the following are derived quantities?

(A) Area (B) Velocity

(C) Force (D) Mass

47. Which of the following quantities are considered as supplementary quantities?

(A) Ampere

(B) Plane angle

(C) Solid angle

(D) Luminous intensity

48. Choose the false statements.

(A) CGS System is also considered as British system

(B) FPS System is also considered as Metric system

(C) FPS System is also considered as British system

(D) CGS System is also considered as Metric system

49. In the formula $F = \frac{a}{t} + bt^2$. Where 'F' is force, 't' is time, 'a' and 'b' are constants then the:

(A) Dimensional formula for 'a' is $[M\ L\ T^{-1}]$

(B) Dimensional formula for 'b' is $[M\ L\ T^{-4}]$

(C) Dimensional formula for 'a' is $[M\ L\ T^{-4}]$

(D) Dimensional formula for 'b' is $[M\ L\ T^{-1}]$

50. Choose the correct statements:

(A) By using the dimensional formula, we can check the correctness of a physical relation

(B) By using the dimensional formula, we can convert the S.I units into C.G.S

(C) By using the dimensional formula, we cannot check the correctness of a physical relation

(D) By using the dimensional formula, we cannot convert the S.I units into C.G.S

51. Which of the following quantities are not based on the dimensions of length, mass & time.

(A) Temperature

(B) Current

(C) Pressure

(D) Velocity

52. A dimensionless quantity:

(A) Never has a unit

(B) Always has a unit

(C) May have a unit

(D) May not have a unit

Comprehension Passage Type (C.P.T.):

PASSAGE - I

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

53. Convert 100 tonne into nano gram (ng):

(A) 10^{15}ng

(B) 10^{16}ng

(C) 10^{17}ng

(D) 10^{18}ng

54. Convert 1 second into hours:

(A) $\frac{1}{86,400}$hr (B) $\frac{1}{24}$hr

(C) $\frac{1}{3600}$hr (D) $\frac{1}{60}$hr

55. Convert 10 cm into nm:

(A) 10^{8}nm

(B) 10^{9}nm

(C) 10^{11}nm

(D) 10^{10}nm

PASSAGE - II

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.

56. The dimensional formula of density is:

(A) $[M^0 L T]$

(B) $[M^0 L T^{-1}]$

(C) $[M L^{-3} T^0]$

(D) $[M^0 L T^{-2}]$

57. 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) $[M^0 L T^{-2}]$

58. 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) $[M^1 L^1 T^{-2}]$

LEVEL 3

Matrix Matching Type (M.M.T.):

SET I

COLUMN-I

59. Micron

60. Angstrom

61. Light year

62. Fermi

COLUMN-II

(A) Distance between earth and stars

(B) Inter atomic distance in a solid

(C) Size of nucleus

(D) Diameter of human hair

(E) Distance between two cities

SET II

COLUMN-I

63. Dimensional formula of 'acceleration' is

64. Dimensional formula of 'velocity' is

65. Dimensional formula of 'volume' is

66. Dimensional formula of 'force' is

COLUMN-II

(A) $[M^1\ L^1\ T^{-2}]$

(B) $[M^0\ L^3\ T^0]$

(C) $[M^0\ L^1\ T^{-1}]$

(D) $[M^1\ L^1\ T^{-2}]$

(E) $[M^0L^1T^{-2}]$

Assertion Reason Type (A.R.T.):

(A) Both assertion & Reason are true, Reason is the correct explanation of assertion

(B) Both assertion & Reason are true, Reason is not the correct explanation of assertion

(C) Assertion is true but reason is false

(D) Assertion is false but reason is true

67. Assertion (A): The SI unit of length is the meter (m).

Reason (R): All physical quantity are vector quantities.

68. Assertion(A): Measurement is a process of comparison.

Reason(R): Comparison process is not a part of measurement.

69. Assertion(A): The magnitude of 1 micrometre is less than 1 meter

Reason(R): Submultiples are positive powers of standard units.

70. Assertion(A): The SI unit of length is the meter (m).

Reason(R): The meter is defined as the distance traveled by light in a vacuum in $\frac{1}{299,792,458}$ seconds.

71. Assertion(A): A physical quantity which has both magnitude and direction is called vector.

Reason(R): All physical quantities are scalar quantities.

72. Assertion(A): A standard unit of measurement is necessary for accuracy in scientific studies.

Reason(R): Different people using different units can lead to incorrect or inconsistent results.

Statement Type (S.T.):

(A) Both statements are correct

(B) Both statements are incorrect

(C) Statement I is correct statement II is incorrect

(D) Statement I is incorrect Statement II is correct

73. Statement-I: The size (u) of the unit of physical quantity and its numercial magnitude (n) are related to each other by the relation nu= constant

Statement-II: The choice of mass, length and time as fundamental quantities is not unique.

74. Statement-I: The product of the numerical value and unit of physical quantity remains same in every system of unit.

Statement-II: magnitude of a physical quantity remains same in every system of units.

75. Statement-I: The MKS system is coherent system of units.

Statement-II: In SI, joule is the unit for all forms of energy.

76. Statement-I: The SI unit of length is the centimeter (cm).

Statement-II: A meter is the standard unit of length in the SI system.

77. Statement-I: A Vernier caliper can measure length with greater precision than a meter scale.

Statement-II: A Vernier caliper has a least count of 0.1 mm or 0.01 cm, which allows more precise measurements.

78. Statement-I: A measuring tape is ideal for measuring the thickness of a small wire.

Statement-II: A micrometer screw gauge is used for measuring very small thicknesses with high precision.

Integer Type Questions (I.T.Q.):

79. If a watermelon weighs 3.6 kilograms, what is its weight in grams?

80. The total weight of 3 objects weighing 250 g, 1.5 kg, and 500 g is ________ kg.

81. Convert 250 centimeters into meters.

82. If a movie is 150 minutes long, how many hours and minutes is it?

Previous Contest Type (A.R.T.):

83. A physical quantity is measured and its value is found to be *nu* where *n* = numerical value and *u* = unit. Then which of the following relations is true?

[RPET 2003]

(A) $n \propto u^2$ (B) $n \propto u$

(C) $n \propto \sqrt{u}$ (D) $n \propto 1/u$

84. The temperature of a body on Kelvin scale is found to be X K. When it is measured by a Fahrenheit thermometer, it is found to be X F. Then X is:

[UPSEAT 2000]

(A) 301.25 (B) 574.25

(C) 313 (D) 40

85. The dimensions of physical quantity X in the equation $\text{Force} = \frac{X}{\text{Density}}$ is given by:

[CPMT 1979]

(A) $[M^1L^4T^{-2}]$ (B) $[M^2L^{-2}T^{-1}]$

(C) $[M^2L^{-2}T^{-2}]$ (D) $[M^1L^{-2}T^{-1}]$

86. Light year is a unit of:

[MP PMT 1989; CPMT 1991; AFMC 1991,2005]

(A) Time (B) Mass

(C) Distance (D)Energy

87. One nanometre is equal to:

[SCRA 1986; MNR 1986]

(A) 10^9mm (B) 10^{-6}cm

(C) 10^{-7}cm (D) 10^{-9}cm

88. Temperature can be expressed as a derived quantity in terms of any of the following:
[MP PET 1993; UPSEAT 2001]

(A) Length and mass

(B) Mass and time

(C) Length, mass and time

(D) None of these

89. Universal time is based on:

[SCRA 1989]

(A) Rotation of the earth on its axis

(B) Earth's orbital motion around the earth

(C) Vibrations of cesium atom

(D) Oscillations of quartz crystal

90. Which of the following is smallest unit? [AFMC 1996]

(A) Millimetre

(B) Angstrom

(C) Fermi

(D) Metre

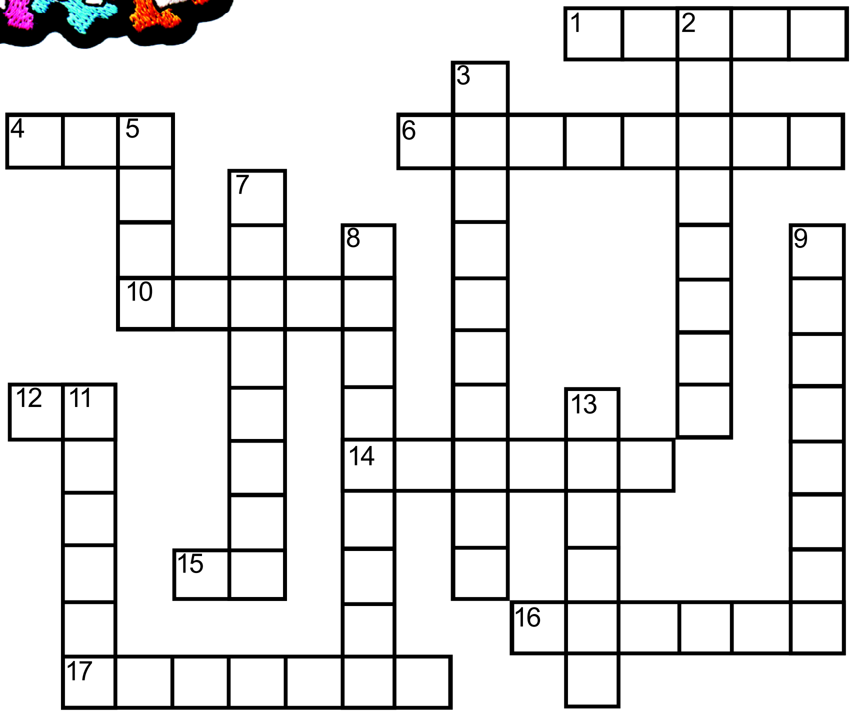
91. Which of the following is a derived unit? [BHU 2000]

(A) Unit of mass

(B) Unit of length

(C) Unit of time

(D) Unit of volume



ACROSS (→)

1. Petrol is priced by the
4. A liquid is measured in a measuring ______
6. 5 ml is a typical measurement for which:

   Teaspoon/Drinks can/Milk carton
10. A prefix meaning one thousandth
12. Millimetre is abbreviated to
14. Four ______ is the typical length of a small car
15. Which is the shortest length: mm/cm/km
16. A 12-inch ruler length is _____ cm
17. An olympic sprinter runs a ______ metres

DOWN (↓)

2. One kg is equal to ______ g.
3. Ten millilitres equals one _______
5. 'g' is an abbreviation of _______
7. Weight of a bag of sugar
8. One thousand metres
9. '1.6' litres refers to car engine's ______
11. Feet is the measurement of ____
13. The unit ounce is used to measure which of the following: weight/length?