

NEET-UG / AIPMT & JEE (Main)



Physics Vol - I

For all Agricultural, Medical, Pharmacy and Engineering Entrance Examinations held across India.

3831 MCQs with Hints

Hydraulic System

The Tower Bridge in London uses Hydraulic Pressure to open and close the bridge.



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Target Publications Pvt. Ltd.

For all Agricultural, Medical, Pharmacy and Engineering Entrance Examinations held across India.

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Physics

Vol. I

Salient Features

- Exhaustive coverage of MCQs subtopic wise.
- '3831' MCQs including questions from various competitive exams.
- Includes solved MCQs from MHT CET 2016, NEET P-I and P-II 2016, JEE (Main) 2015 & 16, AIPMT 2015 & Re-Test.
- Various competitive exam questions updated till latest year.
- Concise theory for every topic.
- Neat and authentic diagrams.
- Hints provided wherever relevant.
- Topic test at the end of each chapter.
- Important inclusions: Knowledge bank and Googly questions

Solutions/hints to Topic Test available in downloadable PDF format at
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PREFACE

Target's "NEET Physics Vol-I" is compiled according to the notified syllabus for NEET-UG & JEE (Main), which in turn has been framed after reviewing various state syllabi as well as the ones prepared by CBSE, NCERT and COBSE.

The book comprises of a comprehensive coverage of **Theoretical Concepts & Multiple Choice Questions**. The flow of content & MCQ's is planned keeping in mind the weightage given to a topic as per the NEET-UG & JEE (Main) exam.

MCQ's in each chapter are a mix of questions based on theory, numerical and graphical. The level of difficulty of these questions is at par with that of various competitive examinations like CBSE, AIIMS, CPMT, JEE, AIEEE, TS EAMCET (Med. and Engg.), BCECE, Assam CEE, AP EAMCET (Med. and Engg.) & the likes. Also to keep students updated, questions from most recent examinations such as AIPMT/NEET, MHT CET, K CET, GUJ CET, WB JEEM, JEE (Main), of years 2015 and 2016 are exclusively covered.

Unique points are represented in the form of  **Notes** at the end of theory section,  **Formulae** are collectively placed after notes for quick revision and  **Shortcuts** are included to save time of students while dealing with rigorous questions.

An additional feature of **Knowledge Bank** is introduced to give students glimpse of various interesting concepts related to the subtopic.



Googly Questions are specifically prepared to develop thinking skills required to answer any tricky or higher order question in students. These will give students an edge required to score in highly competitive exams.



Topic Test has been provided at the end of each chapter to assess the level of preparation of the student on a competitive level.

We are confident that this book will cater to needs of students of all categories and effectively assist them to achieve their goal. We welcome readers' comments and suggestions which will enable us to refine and enrich this book further.

All the best to all Aspirants!

Yours faithfully
Authors

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Note: ** marked section is not for JEE (Main)

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- 1.14 Dimensional analysis and its applications

1.1 Physics

- i. Physics is the branch of science which deals with the study of nature and natural phenomena.
- ii. The word 'Physics' is derived from the greek word '*phusis*' meaning nature.
- iii. '*Phusis*' was first introduced by the ancient scientist Aristotle.
- iv. Physics is the basis of all sciences.

1.2 Scope and excitement of Physics

- i. There are two domains in the scope of Physics; macroscopic and microscopic.
- ii. The macroscopic domain deals mainly with the branch of classical mechanics which includes subjects like mechanics, electrodynamics, optics, thermodynamics etc.
- iii. The microscopic domain includes atomic, molecular and nuclear phenomena which deal with the constitution and structure of matter at the minute scales of atoms and other elementary particles.
- iv. The study of physics is exciting in many ways.
Example:
 - a. Live transmission of events thousands of kilometers away on the television.
 - b. S.T.D, I.S.D, Fax, Cellular phone etc.
 - c. The speed and memory of the fifth generation of computers.
 - d. Use of robots for many purposes.
 - e. Technological advances in health science.
 - f. Lasers and their ever-increasing applications.
 - g. Exploring the new sources of energy.

1.3 Physics related to society and technology

• Physics related to society:

Most of the developments in Physics have a direct impact on the society.

Example:

- i. The development of telephone, telegraph, telex have enabled us to transmit important messages instantly.
- ii. The development of radio, television, satellites have increased the means of communication.
- iii. Advances in electronics, computers, lasers have greatly enriched the society.
- iv. Rapid means of transport have increased the pace of transportation through air, water and land.

• Physics related to technology:

- i. Technology is the application of the principles of physics for practical purposes.
- ii. Technology and physical principles are inter-related quantities.
- iii. Technology gives rise to new principles in physics and vice-versa.
- iv. Following table shows the link between technology and basic principles of physics.

No.	Technology	Basic Principles
i.	Rocket propulsion	Newton's laws of motion.
ii.	Aeroplane	Bernoulli's principle in fluid dynamics.
iii.	Steam engine	Laws of Thermodynamics.
iv.	Sonar	Reflection of ultrasonic waves.
v.	Electric generator	Faraday's laws of electromagnetic induction.



vi.	Hydroelectric power	Conversion of gravitational potential energy into electrical energy.
vii.	Radio and Television	Generation, propagation and detection of electromagnetic waves.
viii.	Electron microscope	Wave nature of electrons.
ix.	Optical fibres	Total internal reflection of light.
x.	Lasers	Light amplification by stimulated emission of radiation.
xi.	Computers	Digital logic

v. Following table shows the contribution of physicists from different countries

Name	Major contribution / discovery
Archimedes	Principle of buoyancy; Principle of the lever
Galileo Galilei	Law of inertia
Isaac Newton	Universal law of gravitation; Laws of motion; Reflecting Telescope
Christiaan Huygens	Wave theory of light
Michael Faraday	Laws of electromagnetic induction
James Clerk Maxwell	Electromagnetic theory; Light-an electromagnetic wave
Heinrich Rudolf Hertz	Generation of electromagnetic waves
J.C. Bose	Ultra short radio waves
W.K. Roentgen	X-rays
Marie Sklodowska Curie	Discovery of radium and polonium; Studies on natural radioactivity
Albert Einstein	Explanation of photoelectric effect; Theory of relativity
Victor Francis Hess	Cosmic Radiation
R.A. Millikan	Measurement of electronic charge
J.J. Thomson	Electron
Ernest Rutherford	Nuclear Model of atom
Niels Bohr	Quantum model of hydrogen atom
James Chadwick	Neutron
C.V. Raman	Inelastic scattering of light by molecules
Louis Victor de Broglie	Wave nature of matter
M.N. Saha	Thermal ionisation
S.N. Bose	Quantum statistics
Wolfgang Pauli	Exclusion principle
Enrico Fermi	Controlled nuclear fission

Werner Heisenberg	Quantum Mechanics; Uncertainty principle
Paul Dirac	Relativistic theory of electron; Quantum statistics
Edwin Hubble	Expanding Universe
Ernest Orlando Lawrence	Cyclotron
Hideki Yukawa	Theory of nuclear forces
Homi Jehangir Bhabha	Cascade process of cosmic radiation
Lev Davidovich Landau	Theory of condensed matter; Liquid helium
S. Chandrasekhar	Chandrasekhar limit, structure and evolution of stars
John Bardeen	Transistors; Theory of super conductivity
C.H. Townes	Maser; Laser
Abdus Salam	Unification of weak and electromagnetic interactions

1.4 Fundamental force in nature

The four fundamental forces in nature are:

- Gravitational Force :** it is the force of mutual attraction between any two objects by virtue of their masses.
- Electromagnetic force:** it is the force which exists between the charged particles.
- Strong nuclear force :** it is the force which binds protons and neutrons in a nucleus
- Weak nuclear force:** it appears only in certain nuclear processes such as β -decay of a nucleus.
- The different forces occurring in nature (eg:- tension, friction, buoyancy) actually arise from the above mentioned fundamental forces.

1.5 Nature of physical laws

Conservation laws are important tools for analysis of various laws in nature.

Example:

- Law of conservation of energy:**
According to law of conservation of energy, sum of all kinds of energy in this universe remains constant.
- Law of conservation of linear momentum:**
In the absence of an external force, the linear momentum of a system remains unchanged.
- Law of conservation of angular momentum:**
If the total external torque acting on a system is zero, then the angular momentum of the system remains constant.
- Law of conservation of charge:**
Charges can neither be created nor be destroyed but can be transferred from one body to another.



1.6 Need for measurement

- Physical quantities:

- A quantity which can be measured and with the help of which, various physical happenings can be explained and expressed in the form of laws, is called a physical quantity.

Example: length, mass, time, force etc.

- There are two types of physical quantities.

- Fundamental quantities:**

The physical quantities which do not depend on any other physical quantities for their measurements are called fundamental quantities.

Example: mass, length, time etc.

- Derived quantities:**

Physical quantities other than fundamental quantities which depend on one or more fundamental quantities for their measurements are called derived quantities.

Example: speed, acceleration, force etc.

- Measurement:

- Measurement is necessary for a precise description of any natural phenomena.
- All experiments require some measurement of readings, observations, conclusions and records.
- For the experimental verification of various theories, each physical quantity should be known precisely. Hence proper measurement of physical quantities with proper instruments are necessary.
- For example:

If a person is waiting at a place for a long time, then, in this case the exact time for which he has waited cannot be predicted as the time here is not defined precisely. A numerical value for time measured on a watch is necessary.

1.7 Unit of measurement and system of units

- Unit of measurement:

- A physical quantity is represented completely by its magnitude and unit. For example, 10 metre means a length which is ten times the unit of length. Here 10 represents the numerical value of the given quantity and metre represents the unit of quantity under consideration.
- In expressing a physical quantity, we first choose a unit and then find how many times that unit is contained in the given physical quantity.

$$\text{Physical quantity}(Q) = \text{Magnitude} \times \text{Unit} \\ = n \times u$$

where, n represents the numerical value and u represents the unit.

- While expressing definite amount of physical quantity, as the unit (u) changes, the magnitude (n) will also change but product ' nu ' will remain the same.

$$n u = \text{constant},$$

$$\therefore n \propto \frac{1}{u} \text{ or } n_1 u_1 = n_2 u_2$$

where, n_1 = numerical value of a physical quantity in unit u_1 and

n_2 = numerical value of a physical quantity in unit u_2 .

- Thus, magnitude of a physical quantity and units are inversely proportional to each other. Larger the unit, smaller will be the magnitude.

- System of units:

- A complete set of units, both fundamental and derived for all kinds of physical quantities is called system of units.
- The common systems of units are given below:

- CGS system:** This system is also called Gaussian system of units. In this system, length, mass and time are chosen as the fundamental quantities and corresponding fundamental units are centimetre (cm), gram (g) and second (s) respectively.

- MKS system:** This system is also called Giorgi system. In this system, length, mass and time are taken as fundamental quantities. Their corresponding fundamental units are metre (m), kilogram (kg) and second (s).

- FPS system:** In this system, foot, pound and second are used respectively for measurements of length, mass and time. This is British engineering system of unit.

- S.I. system:** It is known as International system of units and is extended system of units applied to whole physics.

There are seven fundamental quantities in this system.

- SI Unit:

- Internationally accepted units are called SI units.
- It corresponds to M.K.S system of unit.



- iii. SI units of various fundamental quantities are given below.

Sr. No.	Quantity	Unit	Symbol
i.	Length	metre	<i>m</i>
ii.	Mass	kilogram	<i>kg</i>
iii.	Time	second	<i>s</i>
iv.	Electric Current	ampere	<i>A</i>
v.	Temperature	kelvin	<i>K</i>
vi.	Amount of substance	mole	<i>mol</i>
vii.	Luminous Intensity	candela	<i>cd</i>

Besides the above seven fundamental units, two supplementary units are also defined.

Radian (*rad*) for plane angle and Steradian (*sr*) for solid angle.

1.8 Fundamental and derived units

• Fundamental units:

- Units which can neither be derived nor be resolved into other units are called *fundamental units*. All fundamental units are different from one another.
- In mechanics, unit of mass in (kg), unit of length in (cm) and unit of time in (s) are fundamental units.

• Definitions of some fundamental units in SI system:

- Metre: One metre is defined as the distance travelled by light in vacuum during a time interval of $\frac{1}{299792458}$ seconds.
- Kilogram: One kilogram is defined as the mass of a cylinder made of platinum-iridium placed at the International Bureau of Weights and Measures in Sevres (France).
- Second: One second is defined as the time required for 9,192,631,770 periods of the light wave emitted by cesium-133 atoms making a particular atomic transition.
- Ampere: One ampere is that constant current, if maintained in two straight parallel conductors of infinite length of negligible circular cross-section and placed 1 metre apart in vacuum, produce between these conductors, a force equal to 2×10^{-7} newton per metre of length.
- Kelvin: One kelvin is the fraction $\frac{1}{273.16}$ of the thermodynamic temperature of triple point of water.
- Mole: One mole is the amount of substance of a system, which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12.

- Candela: One candela is the unit of luminous intensity in a given direction of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and has a radiant intensity of $\frac{1}{683}$ watt per steradian in that direction.
- Radian (*rad*): 1 radian is an angle that subtends an arc equal to length of radius of circle, at the centre of the circle.
- Steradian (*sr*): One steradian is the solid angle subtended at the centre of a sphere by an area equal to square of radius of the sphere.

• Derived units:

- Unit which is obtained by multiplying or dividing two or more fundamental units is called *derived unit*.
- Following steps are involved in finding derived unit of a physical quantity.
Step 1: Write the formula of the derived quantity.
Step 2: Convert the formula into fundamental physical quantities.
Step 3: Write the corresponding units in proper system.
Step 4: Make proper algebraic combination to get the result.
For example, to find unit of force:
Step 1: $F = ma$
Step 2: $F = m \frac{\Delta v}{\Delta t} = \frac{m}{\Delta t} \frac{\Delta s}{\Delta t}$
Step 3: $F = \frac{\text{kilogram} \times \text{meter}}{\text{second} \times \text{second}}$
Step 4: The unit of force = $\text{kg} \cdot \text{m/s}^2$

• Practical units:

- A large number of units are used in general life for measurement of different quantities in comfortable manner. They are neither fundamental units nor derived units. Such units are called *practical units*.
Example:
 - 1 fermi = $1 \text{ fm} = 10^{-15} \text{ m}$
 - 1 X-ray unit = $1 \text{ XU} = 10^{-13} \text{ m}$
 - 1 angstrom = $1 \text{ \AA} = 10^{-10} \text{ m} = 10^{-8} \text{ cm}$
 - Sedrial day : It is the time taken by earth to complete one rotation about its axis with respect to a distant star.
1 Solar year = 366.25 Sedrial day
= 365.25 average solar day.
Thus 1 Sedrial day is less than 1 solar day.
 - Shake: It is an obsolete and practical unit of time.
1 Shake = 10^{-8} sec



ii. Some practical units are listed below:

Sr. No.	Practical units of length	Practical units of mass	Practical units of time
1.	1 light year = 9.46×10^{15} m	1 quintal = 10^2 kg	1 year = $365 \frac{1}{4}$ solar days
2.	1 Astronomical unit or 1 AU = 1.5×10^{11} m	1 metric tonne = 10^3 kg	1 lunar month = 27.3 solar days
3.	1 parsec = 3.26 light year	1 atomic mass unit (amu) = 1.66×10^{-27} kg	1 solar day = 86400 s
4.	1 seamile = 6020 ft	1 pound = 0.4537 kg	Tropical year: It is that year in which solar eclipse occurs.
5.	1 micron = $1 \mu\text{m}$ = 10^{-6} m	1 Chandrashekhar limit = 1.4 times the mass of sun = 2.8×10^{30} kg	Leap Year: It is that year in which the month of February is of 29 days.

Knowledge Bank

The energy of various amounts of the explosive TNT is often used as a unit of explosion energy and sometimes of violent explosive volcanic eruptions.

The Hiroshima bomb yield was 15 Kiloton of TNT.

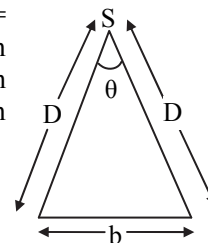
1.9 Length, mass and time measurement

• Measurement of length:

- There are two methods of measuring the length: direct method and indirect method.
- In direct method, a metre scale or vernier callipers is used for measuring short distances. Vernier callipers have a higher accuracy of 10^{-4} m while that of a meter scale is 10^{-3} m.
- To measure long distances such as distance between two planets, diameter of sun, distances of stars from earth, indirect method is used.

• Measurement of long distances:

- Parallax method is used to measure large distances such as distance between two planets, stars etc.
- In this method, diameter of earth is taken as basis (distance between two positions).
- If b = basis and θ = parallax angle, then distance between earth and nearby star is given by, $D = \frac{b}{\theta}$.



Knowledge Bank

The human vision uses parallax method to estimate distance from objects. Here baseline is shortest distance between two eyes. Parallax angle is measured by brain and gives you a guess for the distance of that object.

• Method of measuring very small distances (size of molecules):

- Dissolve 1 cm^3 of oleic acid in alcohol to make a solution of 20 cm^3 . Then take 1 cm^3 of this solution and dilute it to 20 cm^3 using alcohol such that the concentration of the solution is equal to $\left(\frac{1}{20 \times 20}\right) \text{ cm}^3$ of oleic acid/ cm^3 of solution.
- Suppose n drops of this acid are present in the water. Then determine the approximate volume of each drop ($V \text{ cm}^3$).
- Volume of n drops of solution = $nV \text{ cm}^3$
Amount of oleic acid in this solution = $nV \left(\frac{1}{20 \times 20}\right) \text{ cm}^3$
- This solution of acid spreads very fast on the surface of water and forms a very thin layer of thickness t . If this spreads over an area of $A \text{ cm}^2$, then thickness of film is given by

$$t = \frac{\text{volume of film}}{\text{area}} = \frac{nV}{(20 \times 20)A} \text{ cm}$$

• Measurement of mass:

- Mass is the particle content of an object. It does not depend on the temperature, pressure or location of the object in space.
- The prototype of mass (platinum-iridium bar of 1 kilogram) is available at National Physical Laboratory (NPL), New Delhi.



- iii. While dealing with atoms and molecules, kilogram is an inconvenient unit. There is an important standard unit of mass, called atomic mass unit (amu), which has been established for expressing mass of atoms.
- iv. $1 \text{ amu} = 1 \text{ u} = (1/12)$ of the mass of an atom of $\text{C}^{12} = 1.66 \times 10^{-27} \text{ kg}$.
- v. Mass of commonly available objects can be determined by a common balance like the one used in grocery shop. Large masses in the universe like planets, stars etc., based on Newton's law of gravitation can be measured by using gravitational method.
- vi. For measurement of small masses of atomic and sub – atomic particles, we use mass spectrograph in which radius of the trajectory is proportional to the mass of charged particle moving in uniform electric and magnetic field.

• **Measurement of time:**

- i. To measure any time interval, a clock is needed. Now-a-days atomic standard of time is used for the measurement of time.
- ii. In atomic standard of time, periodic vibrations of cesium atom is used.
- iii. One second is the time required for 9, 192, 631, 770 vibrations of cesium atomic clock. This corresponds to transition between two hyperfine energy states of cesium 133 atom.
- iv. The cesium atomic clocks are very accurate.
- v. The national standard of time interval 'second' as well as the frequency is maintained through four cesium atomic clocks.

1.10 Accuracy, precision and least count of measuring instruments

• **Accuracy of measuring instruments:**

- i. Accuracy of measuring instruments is the closeness of the measurement to the true or known value.
- ii. Accuracy of the measurement depends upon the accuracy of the instrument used for measurement.
- iii. Defect in measurement of physical quantities can lead to errors and mistakes.
- iv. Lesser the errors, more is the accuracy in the measurement of a physical quantity.
- v. For example, when we measure volume of a bar, the length is measured with a metre scale whose least count is 1 mm. The breadth is measured with a vernier calliper whose least count is 0.1 mm. Thickness of the bar can be measured with a micrometer screw gauge whose least count is 0.01 mm.

- vi. Thus smaller the magnitude of a quantity, greater is the need for measuring it accurately.

• **Precision of measuring instruments:**

- i. Precision describes the limitation of measuring instruments.
- ii. An instrument is said to have a high degree of precision if the measured value remains unchanged, how-so-ever large number of times it may have been repeated.
- iii. It gives an idea to what resolution or limit the quantity is measured by a measuring instrument.
- iv. In fact, precision is determined by the least count of the measuring instrument.
- v. Least count of a measuring instrument is defined as the smallest measurement that can be made accurately with the help of that instrument. Smaller the least count, greater is the precision.
- vi. For example, least count of a vernier callipers is often 0.01cm and least count of a screw gauge or spherometer is often 0.001cm.
- vii. Therefore, measurement of small length using a screw gauge or a spherometer will be more precise than the same measurement using a vernier callipers.
- viii. Similarly, screw gauge or spherometer with least count 0.0005 cm will be more precise than the one with least count 0.001cm.

• **Rounding-off in the measurement:**

- i. If the digit to be dropped is less than 5, then the preceding digit is left unchanged.
Example: $x = 7.82$ is rounded off to 7.8, $x = 3.94$ is rounded off to 3.9.
- ii. If the digit to be dropped is more than 5, then the preceding digit is raised by one.
Example: $x = 6.87$ is rounded off to 6.9.
- iii. If the digit to be dropped is 5 followed by digits other than zero, then the preceding digit is raised by one.
Example: $x = 16.351$ is rounded off to 16.4.
- iv. If digit to be dropped is 5 or 5 followed by zeroes then the preceding digit is left unchanged, if it is even.
Example: $x = 3.250$ becomes 3.2 on rounding off.
- v. If digit to be dropped is 5 or 5 followed by zeroes, then the preceding digit is raised by one, if it is odd.
Example: $x = 3.750$ is rounded off to 3.8.

**1.11 Errors in measurement**

The difference in the true value and measured value of a quantity is called error in measurement. Following errors are observed in measurement.

i. Absolute error:

It is the magnitude of the difference between the mean (true) value and the measured value of the quantity.

If $a_1, a_2, a_3, \dots, a_n$ are n values of a physical quantity then mean value $a_m = \frac{a_1 + a_2 + \dots + a_n}{n}$

and absolute errors in the measured values of the quantity are

$$\Delta a_1 = a_m - a_1$$

$$\Delta a_2 = a_m - a_2$$

$$\dots\dots\dots$$

$$\Delta a_n = a_m - a_n$$

The absolute errors may be positive or negative.

ii. Mean absolute error:

It is the arithmetic mean of the magnitudes of absolute errors in all the measurements of the quantity. It is given by

$$\overline{\Delta a} = \frac{|\Delta a_1| + |\Delta a_2| + \dots + |\Delta a_n|}{n}$$

Hence the final result of measurement may be written as, $a = a_m \pm \overline{\Delta a}$

This implies that any measurement of the quantity is likely to lie between $(a_m + \overline{\Delta a})$ and $(a_m - \overline{\Delta a})$.

iii. Relative error or fractional error:

The relative error or fractional error of measurement is the ratio of mean absolute error to the mean value of the quantity measured.

Relative error or Fractional error

$$= \frac{\text{Mean absolute error}}{\text{Mean value}} = \frac{|\overline{\Delta a}|}{a_m}$$

iv. Percentage error:

When the relative or fractional error is expressed in percentage, we call it as percentage error.

$$\text{Percentage error} = \frac{|\overline{\Delta a}|}{a_m} \times 100\%$$

Percentage error in different cases:

- i. If the error in measurement of 'a' is Δa , then the percentage error is $\frac{\Delta a}{a} \times 100\%$
- ii. If the error in the measurement of 'a' is Δa and the error in the measurement of 'b' is Δb then, percentage error in $a + b = \left(\frac{\Delta a + \Delta b}{a + b} \right) \times 100\%$

- iii. If the error in the measurement of 'a' is Δa and the error in the measurement of 'b' is Δb then, percentage error in $a - b = \left(\frac{\Delta a + \Delta b}{a - b} \right) \times 100\%$

- iv. If the error in measurement of 'a' is Δa and the error in measurement of 'b' is Δb then, percentage error in 'ab' $= \left(\frac{\Delta a}{a} + \frac{\Delta b}{b} \right) \times 100$

- v. If the error in measurement of 'a' is Δa and the error in measurement of 'b' is Δb then percentage error in $\frac{a}{b} = \left(\frac{\Delta a}{a} + \frac{\Delta b}{b} \right) \times 100$

- vi. If the error in measurement of 'a' is Δa , then the percentage error in $a^n = n \left(\frac{\Delta a}{a} \right) \times 100\%$

1.12 Significant figures

Significant figures in the measured value of a physical quantity is the sum of reliable digits and the first uncertain digit. Larger the number of significant figures obtained in a measurement, greater is the accuracy of the measurement. The reverse is also true.

The following rules are observed in counting the number of significant figures in a given measured quantity.

- i. All non-zero digits are significant.
Example:
42.3 has three significant figures.
24.123 has five significant figures.
- ii. A zero becomes significant figure if it appears between two non-zero digits.
Example:
5.03 has three significant figures.
4.004 has four significant figures.
- iii. Leading zeros or the zeros placed on the left hand side of the number are not significant.
Example:
0.543 has three significant figures.
0.006 has one significant figure.
- iv. Trailing zeros or the zeros on the right hand side of the number are significant.
Example:
4.330 has four significant figures.
343.000 has six significant figures.
- v. In exponential notation, the numerical portion gives the number of significant figures.
Example:
 1.32×10^{-2} has three significant figures.
 1.32×10^4 has three significant figures.



1.13 Dimensions of physical quantities

- The dimensions of a physical quantity are the powers to which the fundamental unit must be raised to represent the unit of a given physical quantity.
- The dimensional formula of a physical quantity is an expression that shows how and which of the fundamental quantities enter into the unit of that quantity.
- In mechanics, the dimensional formula is written in terms of the dimensions of mass, length and time [M, L and T].
- In heat and thermodynamics, in addition to M, L and T, the dimension of temperature in kelvin [K] is to be mentioned.
- In electricity and magnetism, in addition to M, L and T, the dimension of current or charge per unit time [I] or [A] is to be mentioned.

1.14 Dimensional analysis and its applications

• Dimensional analysis

- The analysis of the phenomenon carried out by using the method of dimensions is called dimensional analysis.*
- In dimensional analysis, dimensions of any physical quantity can be expressed in the form of dimensional equation.
- It is based on the principle of homogeneity i.e., dimensions of all the terms on either side of a physical equation are same.
Example:
Force = mass $\times$ acceleration,
Dimensionally,
 $[MLT^{-2}] = [M] [LT^{-2}]$.
- There are many uses of dimensional analysis.

• Applications of dimensional analysis:

- To check the correctness of physical equation:
A physical equation is correct only if the dimensions of all the terms on both sides of that equation are the same.
For example, consider the equation of motion,
 $v = u + at$ (1)
Writing the dimensional equation of every term, we get,
 $v = [L^1 M^0 T^{-1}]$, $u = [L^1 M^0 T^{-1}]$
 $a = [L^1 M^0 T^{-2}]$, $t = [L^0 M^0 T^1]$
 $at = [L^1 M^0 T^{-2}] \times [L^0 M^0 T^1] = [L^1 M^0 T^{-1}]$
As dimensions of both sides of equation (1) are same, physical equation is dimensionally correct.

- To find conversion factor between units of same physical quantity into different system of units:

For example:

To convert 1 N into dyne

$$n_1 = 1 \text{ N}$$

$$n_2 = 1 \left(\frac{1 \text{ kg}}{1 \text{ g}} \right)^1 \left(\frac{1 \text{ m}}{1 \text{ cm}} \right)^1 \left(\frac{1 \text{ s}}{1 \text{ s}} \right)^{-2}$$

$$= 1 \times 10^3 \times 10^2 \times 1$$

$$\therefore n_2 = 10^5$$

$$\therefore 1 \text{ N} = 10^5 \text{ dyne}$$

- To derive the relation between physical quantities:

- Time period (T) of a simple pendulum depends upon length (l) and acceleration due to gravity (g) as follows:

$$T \propto l^a g^b$$

$$\text{i.e. } T = k l^a g^b \quad \dots(1)$$

where k = proportionality constant which is dimensionless.

- The dimensions of $T = [L^0 M^0 T^1]$
The dimensions of $l = [L^1 M^0 T^0]$
The dimensions of $g = [L^1 M^0 T^{-2}]$
Taking dimensions on both sides of equation (1), we get
 $[L^0 M^0 T^1] = [L^1 M^0 T^0]^a [L^1 M^0 T^{-2}]^b$
 $[L^0 M^0 T^1] = [L^{a+b} M^0 T^{-2b}]$
- Equating corresponding powers of L, M and T on both sides, we get
 $a + b = 0$ (2)
and $-2b = 1$

$$\therefore b = -\frac{1}{2}$$

Substituting b in equation (2), we get

$$a = \frac{1}{2}$$

- Substituting values of a and b in equation (1), we have

$$T = k l^{\frac{1}{2}} g^{-\frac{1}{2}}$$

$$\therefore T = k \frac{l^{\frac{1}{2}}}{g^{\frac{1}{2}}}$$

$$= k \left(\frac{l}{g} \right)^{\frac{1}{2}} = k \sqrt{\frac{l}{g}}$$

- Experimentally it is found that
 $k = 2\pi$

$$\therefore T = 2\pi \sqrt{\frac{l}{g}}$$

This is the required expression for time period of simple pendulum.



• **Limitations of dimensional analysis:**

- i. While deriving a formula, the proportionality constant cannot be found.
- ii. The formula for a physical quantity depending on more than three other physical quantities cannot be derived. It can only be checked.
- iii. The equations of the type $v = u + at$ cannot be derived. They can only be checked.

- iv. The equations containing trigonometrical functions ($\sin\theta$, $\cos\theta$, etc), logarithmic functions ($\log x$, $\log x^3$, etc) and exponential functions (e^x , e^{x^2} , etc) can neither be derived nor be checked because they are independent of L, M and T.

• **Dimensions, units, formulae of some quantities:**

Quantity	Formula	Unit	Dimension
Speed	$\frac{\text{Distance}}{\text{Time}}$	ms^{-1}	$[\text{M}^0\text{L}^1\text{T}^{-1}]$
Acceleration	$\frac{\text{Change in velocity}}{\text{Time}}$	ms^{-2}	$[\text{M}^0\text{L}^1\text{T}^{-2}]$
Force	Mass $\times$ Acceleration	N (newton)	$[\text{M}^1\text{L}^1\text{T}^{-2}]$
Pressure	$\frac{\text{Force}}{\text{Area}}$	Nm^{-2}	$[\text{M}^1\text{L}^{-1}\text{T}^{-2}]$
Density	$\frac{\text{Mass}}{\text{Volume}}$	kg m^{-3}	$[\text{M}^1\text{L}^{-3}\text{T}^0]$
Work	Force $\times$ distance	joule	$[\text{M}^1\text{L}^1\text{T}^{-2}]$ $[\text{L}^1] = [\text{M}^1\text{L}^2\text{T}^{-2}]$
Energy	Force $\times$ distance	joule	$[\text{M}^1\text{L}^1\text{T}^{-2}]$ $[\text{L}^1] = [\text{M}^1\text{L}^2\text{T}^{-2}]$
Power	$\frac{\text{Work}}{\text{Time}}$	watt	$[\text{M}^1\text{L}^2\text{T}^{-3}]$
Momentum	Mass $\times$ Velocity	kg ms^{-1}	$[\text{M}^1\text{L}^1\text{T}^{-1}]$
Impulse	Force $\times$ Time	Ns	$[\text{M}^1\text{L}^1\text{T}^{-1}]$
Torque	$\vec{\tau} = \vec{r} \times \vec{F}$	N-m	$[\text{M}^1\text{L}^1\text{T}^{-2}]$ $[\text{L}] = [\text{M}^1\text{L}^2\text{T}^{-2}]$
Temperature (T)	--	kelvin	$[\text{M}^0\text{L}^0\text{T}^0\text{K}^1]$
Heat (Q)	Energy	joule	$[\text{M}^1\text{L}^2\text{T}^{-2}]$
Specific heat (c)	$\frac{Q}{m\theta}$	joule/kg-K	$[\text{M}^0\text{L}^2\text{T}^{-2}\text{K}^{-1}]$
Thermal capacity	--	joule/K	$[\text{M}^1\text{L}^2\text{T}^{-2}\text{K}^{-1}]$
Latent heat (L)	$\frac{\text{heat}(Q)}{\text{mass}(m)}$	joule/kg	$[\text{M}^0\text{L}^2\text{T}^{-2}]$
Gas constant (R)	$\frac{PV}{T}$	joule/mol-K	$[\text{M}^1\text{L}^2\text{T}^{-2}\text{K}^{-1}]$
Boltzmann constant (k)	$\frac{R}{N}$, N = Avogadro number	joule/K	$[\text{M}^1\text{L}^2\text{T}^{-2}\text{K}^{-1}]$
Coefficient of viscosity (η)	$\eta = \frac{F}{A} \cdot \frac{1}{\left(\frac{dv}{dx}\right)}$	$\frac{\text{newton} - \text{second}}{\text{m}^2}$	$[\text{M}^1\text{L}^{-1}\text{T}^{-1}]$
Coefficient of thermal conductivity (K)	From $\frac{\Delta Q}{\Delta t} = KA \left(\frac{\Delta T}{\Delta x} \right)$ $K = \frac{\Delta Q}{\Delta t} \left(\frac{\Delta x}{\Delta T} \right) \times \frac{1}{A}$	joule/m-s-K	$[\text{M}^1\text{L}^1\text{T}^{-3}\text{K}^{-1}]$
Stefan's constant (σ)	$\sigma = \frac{E}{T^4}$	$\text{watt/m}^2 - \text{K}^4$	$[\text{M}^1\text{L}^0\text{T}^{-3}\text{K}^{-4}]$
Wien's constant (b)	$b = N_m \times T$	metre-K	$[\text{M}^0\text{L}^1\text{T}^0\text{K}^1]$



Planck's constant (h)	$\frac{\text{Energy (E)}}{\text{Frequency (F)}}$	joule-s	$[M^1 L^2 T^{-1}]$
Coefficient of linear Expansion (α)	--	kelvin ⁻¹	$[M^0 L^0 T^0 K^{-1}]$
Mechanical equivalent of Heat(J)	--	joule/calorie	$[M^0 L^0 T^0]$
Electricity			
Electric charge (q)	Current $\times$ Time	coulomb	$[M^0 L^0 T^1 A^1]$
Electric current (I)	--	ampere	$[M^0 L^0 T^0 A^1]$
Capacitance (C)	$\frac{\text{Charge}}{\text{P.D.}}$	coulomb/ volt or farad	$[M^{-1} L^{-2} T^4 A^2]$
Electric potential (V)	$\frac{\text{Work}}{\text{Charge}}$	joule/ coulomb	$[M^1 L^2 T^{-3} A^{-1}]$
Permittivity of free space (ϵ_0)	$\epsilon_0 = \frac{q_1 q_2}{4\pi Fr^2}$	$\frac{\text{coulomb}^2}{\text{newton} - \text{metre}^2}$	$[M^{-1} L^{-3} T^4 A^2]$
Dielectric constant (K)	$\epsilon_r = \frac{\epsilon}{\epsilon_0}$	Unitless	$[M^0 L^0 T^0]$
Resistance (R)	$\frac{\text{P.D.}}{\text{Current}}$	volt/ampere or ohm	$[M^1 L^2 T^{-3} A^{-2}]$
Resistivity or Specific resistance (ρ)	$\frac{Ra}{l}$	ohm-metre	$[M^1 L^3 T^{-3} A^{-2}]$
Coefficient of Self-induction (L)	$L = \frac{(w/q)dt}{dI}$	$\frac{\text{volt} - \text{second}}{\text{ampere}}$ or henry or ohm-second	$[M^1 L^2 T^{-2} A^{-2}]$
Coefficient of mutual inductance (M)	$\frac{edt}{dI}$	henry	$[M^1 L^2 T^{-2} A^{-2}]$
Magnetic flux (ϕ)	$d\phi = \frac{wdt}{q}$	volt-second or weber	$[M^1 L^2 T^{-2} A^{-1}]$
Magnetic induction (B)	$B = \frac{F}{qv}$	$\frac{\text{newton}}{\text{ampere} - \text{metre}}$ or $\frac{\text{joule}}{\text{ampere} - \text{metre}^2}$ or $\frac{\text{volt} - \text{second}}{\text{metre}^2}$ or tesla	$[M^1 L^0 T^{-2} A^{-1}]$
Magnetic intensity (H)	$H = \frac{Id}{r^2}$	ampere/ metre	$[M^0 L^{-1} T^0 A^1]$
Magnetic dipole moment (M)	$M = IA$	ampere-metre ²	$[M^0 L^2 T^0 A^1]$
Permeability of free space (μ_0)	$\mu_0 = \frac{4\pi Fr^2}{I(dl)}$	$\frac{\text{newton}}{\text{ampere}^2}$ or $\frac{\text{joule}}{\text{ampere}^2 - \text{metre}}$ or $\frac{\text{volt} - \text{second}}{\text{ampere} - \text{metre}}$ or $\frac{\text{ohm} - \text{second}}{\text{metre}}$ or $\frac{\text{henry}}{\text{metre}}$	$[M^1 L^1 T^{-2} A^{-2}]$
Surface charge density(σ)	$\sigma = \frac{\text{charge}}{\text{area}}$	coulomb metre ⁻²	$[M^0 L^{-2} T^1 A^1]$
Electric dipole moment (p)	$q(2a)$	coulomb – metre	$[M^0 L^1 T^1 A^1]$
Conductance	$\frac{1}{R}$	ohm ⁻¹	$[M^{-1} L^{-2} T^3 A^2]$



Conductivity (σ)	$\frac{1}{\rho}$	ohm ⁻¹ metre ⁻¹	$[M^{-1}L^{-3}T^3A^2]$
Current density (J)	Current per unit area	ampere/m ²	$[M^0L^{-2}T^0A^1]$
Intensity of electric field (E)	$\frac{\text{Force}}{\text{Charge}}$	volt/metre, newton/coulomb	$[M^1L^1T^{-3}A^{-1}]$
Rydberg constant (R)	$\frac{2\pi^2mk^2e^4}{ch^3}$; $k = \frac{1}{4\pi\epsilon_0}$	m ⁻¹	$[M^0L^{-1}T^0]$

• **Quantities having same dimensions:**

Dimension	Quantity
$[M^0L^0T^{-1}]$	Frequency, angular frequency, angular velocity, velocity gradient and decay constant
$[M^1L^2T^{-2}]$	Work, internal energy, potential energy, kinetic energy, torque, moment of force
$[M^1L^{-1}T^{-2}]$	Pressure, stress, Young's modulus, bulk modulus, modulus of rigidity, energy density
$[M^1L^1T^{-1}]$	Momentum, impulse
$[M^0L^1T^{-2}]$	Acceleration due to gravity, gravitational field intensity
$[M^1L^1T^{-2}]$	Thrust, force, weight, energy gradient
$[M^1L^2T^{-1}]$	Angular momentum and Planck's constant
$[M^1L^0T^{-2}]$	Surface tension, Surface energy (energy per unit area), spring constant
$[M^0L^0T^0]$	Strain, refractive index, relative density, angle, solid angle, distance gradient, relative permittivity (dielectric constant), relative permeability etc.
$[M^0L^2T^{-2}]$	Latent heat and gravitational potential
$[ML^2T^{-2}\theta^{-1}]$	Thermal capacity, gas constant, Boltzmann constant and entropy
$[M^0L^0T^1]$	$\sqrt{l/g}$, $\sqrt{m/k}$, $\sqrt{R/g}$, where l = length g = acceleration due to gravity, m = mass, k = spring constant, R = Radius of earth
$[M^0L^0T^1]$	L/R , $\sqrt{LC}$, RC where L = inductance, R = resistance, C = capacitance
$[ML^2T^{-2}]$	I^2Rt , $\frac{V^2}{R}t$, VIt , qV , LI^2 , $\frac{q^2}{C}$, CV^2 where I = current, t = time, q = charge, L = inductance, C = capacitance, R = resistance



Notes

- There are different systems of units. Out of them, SI system is internationally accepted and the most modern system.
- Equations having logarithmic, trigonometric, exponential functions cannot be derived by dimensional formula.
- Parallax method is usually used to determine long distances like distance of moon from the earth.
- LASER beam is used to determine the distance of moon by reflection method.
- SONAR uses ultrasonic sound to determine distance of submarine objects by reflection method.
- RADAR uses radiowaves to determine distance and speed of flying objects by reflection method.

- Dimensional method does not give a complete information in cases where a physical quantity depends on more than three quantities, because by equating the powers of M, L and T, we can obtain only three equations for the exponents.
- Calculation pertaining to error determines its maximum value and practically it helps in determining limits of measurement.
- Physical relations involving addition or subtraction sign cannot be derived by the method of dimensional analysis.
- If units or dimensions of two physical quantities are same, these need not represent the same physical characteristics. For example, torque and work have the same units and dimensions but their physical characteristics are different.
- Smaller the least count, higher is the accuracy of measurement.



12. Significant figures do not change if we measure a physical quantity in different units.
13. A physical quantity that does not have any unit must be dimensionless.
14. The pure numbers are dimensionless.



Formulae

1. **Measure of physical quantity:** $M = nu$
2. **Relation between numerical value and size of unit:** $n_1 u_1 = n_2 u_2$
3. **Conversion factor of a unit in two system of units:**

$$n_2 = n_1 \left[\frac{M_1}{M_2} \right]^a \left[\frac{L_1}{L_2} \right]^b \left[\frac{T_1}{T_2} \right]^c$$

4. **Average value or mean value:**

$$\bar{a}_m = \frac{a_1 + a_2 + a_3 + \dots + a_n}{n} = \frac{1}{n} \sum_{i=1}^n a_i$$

5. **If $x = x_1 \pm x_2$ then maximum error:**

$$\Delta x = \Delta x_1 \pm \Delta x_2$$

6. **If $x = x_1^m \times x_2^n$ then error in measurement:**

$$\frac{\Delta x}{x} = \frac{m \Delta x_1}{x_1} + \frac{n \Delta x_2}{x_2}$$

7. **Absolute error:**

$$|\Delta a| = |\text{Average value} - \text{Measured value}| \\ = |a_m - a_n|$$

8. **Mean absolute error:**

$$\frac{|\Delta a|}{a_m} = \frac{|\Delta a_1| + |\Delta a_2| + \dots + |\Delta a_n|}{n} = \frac{1}{n} \sum_{i=1}^n \Delta a_i$$

9. **Relative (fractional) error** = $\frac{|\Delta a|}{a_m}$

10. **Percentage error** = $\frac{|\Delta a|}{a_m} \times 100\%$



Shortcuts

1. In mechanics, Length, Mass and Time are arbitrarily chosen as fundamental quantities. In fact, any three quantities in mechanics can be termed as fundamental as all other quantities in mechanics can be expressed in terms of these.

Example:

- i. If speed and time are taken as fundamental quantities, length will become a derived quantity because then length will be expressed as speed $\times$ time.

- ii. If force and acceleration are taken as fundamental quantities, then mass will be defined as force/acceleration and will be termed as a derived quantity.

2. Practical units may or may not belong to a system but can be expressed in any system of units.

Example: 1 mile = 1.6 km = 1.6×10^3 m.

3. Dimensional formula of critical quantities involved in a physical equation can be determined. For example,

$$\text{In the equation, } \left(P + \frac{a}{V^2} \right) (V - b) = RT$$

Dimensions of P and a/V^2 are same, similarly V and b have same dimensions.

$$\text{Dimensions of } a/b = \left[\frac{PV^2}{V} \right] = [PV] = [ML^2T^{-2}]$$

4. i. Spherometer and micrometer screwgauge work on the same principle. Hence, we determine the pitch and the least count by the same method. Pitch of a screw is the distance travelled by the screw in its one complete rotation and least count is the ratio of pitch to the number of circular scale divisions.
- ii. Spectrometer has its circular scale divided into 360 equal parts. Each degree is further divided into two equal parts. Hence, the smallest division on the circular scale is 0.5° or 30 minutes. The vernier scale has 30 equal divisions which coincide with 29 equal divisions of the main scale. Here, the vernier constant of the spectrometer is $1'$.

5. In the problems on significant figures, if a quantity is squared, then the number of significant digits is not squared.

6. Percentage errors in measuring a physical quantity can be calculated as follows:

For $X = \frac{a^2 b^3}{\sqrt{c} d^5}$, percentage errors in measurement of a, b, c and d are 2%, 3%, 4% and 1% respectively. Then percentage error in

$$X = \left(2 \frac{\Delta a}{a} + 3 \frac{\Delta b}{b} + \frac{1}{2} \frac{\Delta c}{c} + 5 \frac{\Delta d}{d} \right) \times 100\%$$

$$= 2 \times 2 + 3 \times 3 + 0.5 \times 4 + 5 \times 1 = 20\%$$

It can also be identified that maximum error is contributed by 'b' and minimum by 'c'.

7. If distance between two sources is very large (i.e. two planets), then parallax method is used to measure separation between them

$$s = \frac{\text{basis}}{\text{parallactic angle}} = \frac{b}{\theta}$$



8. In the formula, $[M^x L^y T^z]$; if $x = y = z = 0$, then the quantity is a dimensionless quantity

Examples of dimensionless quantities: Strain, specific gravity, relative density, angle, solid angle, poisson's ratio, relative permittivity, Reynold's number, all the trigonometric ratios, refractive index, dielectric constant, magnetic susceptibility etc.

A dimensionless quantity has the same numeric value in all the system of units.

- To express large or small magnitudes following prefixes are used:

Power of 10	Prefix	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^2	hecta	h
10	deca	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

- A few quick conversions:

- Pressure:
 $1 \text{ N/m}^2 = 10 \text{ dyne/cm}^2$ or
 $1 \text{ dyne/cm}^2 = 0.1 \text{ N/m}^2$.
- Density:
 $1 \text{ kg/m}^3 = 10^{-3} \text{ g/cm}^3$ or
 $1 \text{ g/cm}^3 = 10^3 \text{ kg/m}^3$.
- Coefficient of viscosity:
 SI units is decapoise (Ns/m^2) and CGS unit is poise.
 $1 \text{ poise} = 10^{-1} \text{ decapoise}$ or
 $1 \text{ decapoise} = 10 \text{ poise}$.
- Magnetic induction:
 S I unit is tesla (Wb/m^2) and CGS unit is gauss.
 $1 \text{ gauss} = 10^{-4} \text{ tesla}$ or
 $1 \text{ tesla} = 10^4 \text{ gauss}$.
- Magnetic flux:
 SI unit is weber and CGS unit is maxwell.
 $1 \text{ Wb} = 10^8 \text{ maxwell}$ or
 $1 \text{ maxwell} = 10^{-8} \text{ Wb}$.



Multiple Choice Questions

1.1 Physics

- The branch of science dealing with the nature and natural phenomena is called
 (A) Logic (B) Physics
 (C) Chemistry (D) Biotechnology
- The theory of solar system, in which the sun occupies the central position, is known as
 (A) Einstein's theory of solar system.
 (B) Copernicus theory of solar system.
 (C) Newton's theory of solar system.
 (D) Maxwell's theory of solar system.
- The theory of motion of material objects at low speeds is called
 (A) Newtonian mechanics.
 (B) Thermodynamics.
 (C) Dynamic theory.
 (D) Newton's theory of relativity.
- High speed moving particles are studied under
 (A) theory of relativity.
 (B) theory of straight line motion.
 (C) theory of first law of thermodynamics.
 (D) theory of second law of thermodynamics.
- Cascade process in cosmic rays is invented by
 (A) R. A. Millikan
 (B) H. J. Bhaba
 (C) E. O. Lawrence
 (D) Hertz

1.2 Scope and excitement of Physics

- In the scope of physics, there
 (A) is one domain
 (B) are two domains
 (C) are three domains
 (D) are four domains
- The atomic, molecular and nuclear phenomena are the parts of _____ domain.
 (A) macroscopic
 (B) microscopic
 (C) megascopic
 (D) electroscopic

1.3 Physics related to society and technology

- The application of principles of physics for practical purpose is called
 (A) law of conservation of linear momentum
 (B) law of conservation of charge
 (C) technology
 (D) guessing of phenomenon



9. Bernoulli's principle of fluid mechanics is used in
 (A) Aeroplane (B) Lasers
 (C) Rocket propulsion (D) Sonar
10. Electron microscope is based on the principle of
 (A) optical fibre
 (B) wave nature of electron
 (C) digital logic
 (D) Newton's second law
11. Reflection of ultrasonic waves is used in the technology of
 (A) Lasers (B) Optical fibre
 (C) Sonar (D) aeroplane
12. Conversion of gravitational potential energy into electrical energy is used in
 (A) steam engine
 (B) electric generator
 (C) nuclear power
 (D) hydroelectric power
13. Match the following

A		B	
a.	Michael Faraday	e.	Quantum model of Hydrogen atom
b.	Niel Bohr	f.	Laws of electromagnetic induction
c.	J.J. Thomson	g.	Discovery of Neutron
d.	Chadwick	h.	Discovery of Electron

[TS EAMCET (Med.) 2015]

- | | | | | |
|-----|-----|-----|-----|-----|
| | (a) | (b) | (c) | (d) |
| (A) | h | g | e | f |
| (B) | c | f | h | g |
| (C) | f | e | h | g |
| (D) | g | e | h | f |

1.4 Fundamental force in nature

14. If F_G , F_E and F_N represent gravitational force, electromagnetic force, strong nuclear force then which of the following is CORRECT option:
 (A) $F_E > F_N > F_G$ (B) $F_N > F_E > F_G$
 (C) $F_N > F_G > F_E$ (D) $F_G > F_E > F_N$
15. **Assertion :** Strong Nuclear force is stronger than electromagnetic force.
Reason : Strong nuclear force overcomes the electrostatic repulsion between protons and binds them together maintaining nuclear stability.
 (A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
 (B) Assertion is true, Reason is True; Reason is not a correct explanation for Assertion

- (C) Assertion is True, Reason is False.
 (D) Assertion is False, Reason is False.

1.5 Nature of physical laws

16. All the events that we observe in nature can be explained and understood in terms of
 (A) few physical laws
 (B) experimental logic
 (C) chemical changes
 (D) hypothetical thinking
17. Laws of conservation of linear momentum states that linear momentum of a system
 (A) remains unchanged provided there is external force acting on it.
 (B) changes without application of any external force on it.
 (C) changes depending upon application of zero unbalanced force.
 (D) remains unchanged provided unbalanced force is absent.
18. Charges are neither created nor destroyed but can be transferred from one body to another, is law of conservation of
 (A) charge
 (B) forces
 (C) electromagnetic induction
 (D) angular momentum

1.6 Need for measurement

19. A quantity which can be measured and by which various physical happenings can be explained and expressed in the form of laws is called
 (A) physical laws
 (B) chemical quantity
 (C) physical observation
 (D) physical quantity
20. Measurement is necessary for
 (A) a precise description of any natural phenomena.
 (B) it's physical state only.
 (C) approximate description of any natural phenomena.
 (D) approximate description of physical quantity.
21. For experimental verification of various theories, each physical quantity should be known
 (A) approximately
 (B) with proper external appearance only
 (C) with proper temperature only
 (D) precisely

**1.7 Unit of measurement and system of units**

22. A physical quantity is represented completely by
(A) its magnitude only
(B) its unit only
(C) its magnitude as well as unit
(D) neither magnitude nor unit but its direction.
23. The reference standard used for the measurement of a physical quantity is called
(A) standard quantity (B) dimension
(C) constant (D) unit
24. A physical quantity (Q) can be expressed in terms of its magnitude (n) and unit (u) as
(A) $Q = n \times u$ (B) $Q = \frac{n}{u}$
(C) $Q = \frac{2n}{u}$ (D) $Q = \frac{2u}{n}$
25. SI system contains _____ fundamental quantities.
(A) 3 (B) 4
(C) 6 (D) 7
26. The length in C.G.S. system is measured in the unit of
(A) millimetre (B) centimetre
(C) metre (D) decametre
27. Gaussian system of units is also called as
(A) SI system (B) MKS system
(C) FPS system (D) CGS system
28. Which of the following is NOT a characteristic of a good unit?
(A) It is invariable
(B) It is reproducible
(C) It is perishable
(D) It is easily available
29. In which of the following systems can scientific data be exchanged between different parts of the world?
(A) M.K.S. (B) C.G.S.
(C) F.P.S. (D) S.I.
30. F.P.S. means
(A) foot - paise - second
(B) force - pound - scale
(C) force - paise - scale
(D) foot - pound - second
31. A set of fundamental and derived units is known as
(A) supplementary units.
(B) system of units.
(C) complementary units.
(D) metric units.

1.8 Fundamental and derived units

32. Which of the following system of units is NOT based on units of mass, length and time alone? **[Kerala PMT 2004]**
(A) SI (B) MKS
(C) FPS (D) CGS
33. The physical quantities which do not depend on any other physical quantity for their measurements are called
(A) fundamental quantities
(B) derived quantities
(C) fundamental or derived quantities
(D) neither fundamental nor derived quantities
34. Which of the following is NOT a derived quantity?
(A) area
(B) time
(C) speed
(D) intensity of electric field
35. N s is the unit of **[MP PMT 1984; CPMT 1984, 85]**
(A) Velocity
(B) Angular momentum
(C) Momentum
(D) Energy
36. The unit of angular acceleration in the SI system is **[SCRA 1980; EAMCET 1981]**
(A) N kg^{-1} (B) m s^{-2}
(C) rad s^{-2} (D) rad s^{-3}
37. Out of the following units, which is NOT a fundamental unit?
(A) newton (B) second
(C) pound (D) kilogram
38. Which of the following is NOT a derived unit?
(A) joule (B) erg
(C) dyne (D) mole
39. Temperature can be expressed as a derived quantity in terms of **[MP PET 1993; UPSEAT 2001]**
(A) Length and mass
(B) Mass and time
(C) Length, mass and time
(D) Neither length, mass and time.
40. The unit of permittivity of free space ϵ_0 is **[MP PET 1993; MP PMT 2003; CBSE PMT 2004]**
(A) coulomb/(newton metre)
(B) newton metre²/coulomb²
(C) coulomb²/(newton metre)²
(D) coulomb²/(newton metre²)



41. The unit for nuclear dose given to a patient is
(A) fermi (B) rutherford
(C) curie (D) rontgen
42. volt/metre is the unit of
[C PMT 1984; AFMC 1991]
(A) Potential
(B) Work
(C) Force
(D) Electric intensity
43. $\frac{\text{Newton}}{\text{metre}^2}$ is the unit of
[C PMT 1985; ISM Dhanbad 1994; AFMC 1995]
(A) Energy (B) Momentum
(C) Force (D) Pressure
44. The unit of reduction factor of tangent galvanometer is [C PMT 1987; AFMC 2004]
(A) ampere (B) gauss
(C) radian (D) tesla
45. The unit of self inductance of a coil is
[MP PMT 1983, 92; SCRA 1986; C PMT 1984, 85, 87; CBSE PMT 1993]
(A) farad (B) henry
(C) weber (D) tesla
46. Henry/ohm can be expressed in
[C PMT 1987]
(A) second (B) coulomb
(C) mho (D) metre
47. Which of the following represents a volt?
[C PMT 1990; AFMC 1991]
(A) joule/second (B) watt/ampere
(C) watt/coulomb (D) coulomb/joule
48. Kilowatt-hour is a unit of
[NCERT 1975; AFMC 1991]
(A) Electrical charge (B) Energy
(C) Power (D) Force
49. In which of the following system of units, weber is the unit of magnetic flux?
[SCRA 1991; CBSE PMT 1993; D PMT 2005]
(A) CGS (B) MKS
(C) SI (D) FPS
50. If the unit of length and force be increased four times, then the unit of energy is
[Kerala PMT 2005]
(A) Increased 4 times
(B) Increased 8 times
(C) Increased 16 times
(D) Decreased 16 times
51. The binding energy of a nucleon in a nucleus is of the order of a few [SCRA 1979]
(A) eV (B) ergs
(C) MeV (D) volts
52. Hertz is the unit for
[MNR 1983; SCRA 1983; R PMT 1999]
(A) Frequency
(B) Force
(C) Electric charge
(D) Magnetic flux
53. In SI, henry is the unit of
[MP PET 1984; CBSE PMT 1993; DPMT 1984]
(A) Self inductance
(B) Mutual inductance
(C) Both (A) and (B)
(D) resistance
54. 'Torr' is the unit of [R PMT 1999, 2000]
(A) Pressure (B) Volume
(C) Density (D) Flux
55. dyne/cm² is NOT a unit of [R PET 2000]
(A) Pressure
(B) Stress
(C) Strain
(D) Young's modulus
56. Which of the following is different in respect of units?
[Orissa JEE 2002]
(A) Phase difference
(B) Mechanical equivalent
(C) Loudness of sound
(D) Poisson's ratio
57. Faraday is the unit of [AFMC 2003]
(A) Charge (B) EMF
(C) Mass (D) Energy
58. The SI unit of universal gas constant (R) is
[CPMT 1984, 87; MP PMT 1987, 94; AFMC 1996; UPSEAT 1999]
(A) watt K⁻¹ mol
(B) newton K⁻¹ mol⁻¹
(C) joule K⁻¹ mol⁻¹
(D) erg K⁻¹ mol⁻¹
59. Which does NOT have the same unit as others?
[Orissa PMT 2004]
(A) watt s (B) kilowatt hour
(C) eV (D) J s
60. The physical quantity having the same unit in all the systems of units is
(A) length (B) time
(C) mass (D) foot
61. The physical quantity denoted by $\frac{\text{mass} \times \text{pressure}}{\text{density}}$ is
(A) force
(B) momentum
(C) angular momentum
(D) work



62. Which of the following is a supplementary unit?
(A) steradian (B) candela
(C) kelvin (D) pascal
63. The unit of electric field is newton/coulomb. Its other equivalent term is potential gradient. What will be its unit?
(A) Vm (B) Vm^2
(C) Vm^{-2} (D) Vm^{-1}
64. weber/ m^2 is equivalent to [AFMC 1997]
(A) volt (B) henry
(C) tesla (D) all of these
65. Which of the following physical quantities and units do not match? [R PET 91]
(A) Magnetic field-weber
(B) Inductance-henry
(C) Capacitance-farad
(D) Electric flux-volt $\times$ metre
66. The unit of energy is same as the unit of
(A) power (B) momentum
(C) work (D) force
67. Which of the following quantities can be written as $\text{kg m}^2 \text{A}^{-2} \text{s}^{-3}$ in S.I. units ?
(A) resistance (B) inductance
(C) capacitance (D) magnetic flux
68. The unit of impulse is same as that of
(A) moment of force
(B) linear momentum
(C) rate of change of linear momentum
(D) force
69. Which one of the following is NOT a unit of length?
(A) angstrom (B) light year
(C) fermi (D) radian
70. The SI unit of magnetic permeability is
(A) A m^{-1} (B) A m
(C) H m^{-1} (D) Am^2
71. Which of the following is NOT equal to watt?
[CPMT 1990; SCRA 1991]
(A) joule/second
(B) ampere $\times$ volt
(C) $(\text{ampere})^2 \times \text{ohm}$
(D) ampere/volt
72. Which of the following is NOT represented in correct unit? [NCERT 1984; MNR 1995]
(A) $\frac{\text{Stress}}{\text{Strain}} = \text{N/m}^2$
(B) Surface tension = N/m
(C) Energy = $\frac{\text{kg m}}{\text{s}}$
(D) Pressure = N/m^2
73. The unit of power is [C PMT 1985]
(A) joule
(B) joule per second only
(C) both joule per second or watt
(D) watt only
74. A suitable unit for gravitational constant is [MNR 1988]
(A) kg m s^{-1} (B) $\text{N m}^{-1} \text{s}$
(C) $\text{Nm}^2 \text{kg}^{-2}$ (D) kg m s^{-2}
75. SI unit of pressure is [NCERT 1976; AFMC 1991; USSR MEE 1991]
(A) pascal
(B) dyne/cm^2
(C) cm of Hg
(D) atmosphere
76. Which of the following is NOT a unit of energy? [AIIMS 1985]
(A) Ws (B) $\frac{\text{kg m}}{\text{s}}$
(C) Nm (D) joule
77. joule second is the unit of [CPMT 1990; CBSE PMT 1993; BVP 2003]
(A) Work
(B) Momentum
(C) Pressure
(D) Angular momentum
78. Unit of power is [C PMT 1971; DCE 1999]
(A) kilowatt (B) kilowatt-hour
(C) dyne (D) joule
79. Density of wood is 0.5 g/cc in the CGS system of units. The corresponding value in MKS system is [NCERT 1973; C PMT 1983; JIPMER 1993]
(A) 500 (B) 5
(C) 0.5 (D) 5000
80. The SI unit of momentum is [SCRA 1986, 89; C PMT 1987]
(A) $\frac{\text{kg}}{\text{m}}$ (B) $\frac{\text{kg m}}{\text{s}}$
(C) $\frac{\text{kg m}^2}{\text{s}}$ (D) $\text{kg} \times \text{newton}$
81. The unit of specific resistance is [CPMT 1975; MP PET 1984; SCRA 1989]
(A) ohm/cm^2 (B) ohm/cm
(C) ohm cm (D) $(\text{ohm cm})^{-1}$
82. Parsec is a unit of [SCRA 1986; BVP 2003; AIIMS 2005]
(A) Distance (B) Velocity
(C) Time (D) Angle



83. Unit of moment of inertia in MKS system is
[MP PMT 1984]

- (A) $\text{kg} \times \text{cm}^2$ (B) $\frac{\text{kg}}{\text{cm}^2}$
(C) $\text{kg} \times \text{m}^2$ (D) $\text{joule} \times \text{m}$

84. curie is a unit of
[CBSE PMT 1992; CPMT 1992]

- (A) Energy of γ -rays
(B) Half life
(C) Radioactivity
(D) Intensity of γ -rays

85. Young's modulus of a material has the same units as
[MP PMT 1994]

- (A) Pressure (B) Strain
(C) Compressibility (D) Force

1.9 Length, mass and time measurement

86. Light year is a unit for the measurement of

- (A) distance
(B) time
(C) temperature
(D) luminous intensity

87. An atomic clock makes use of

- (A) cesium 133 atom
(B) cesium 132 atom
(C) cesium 123 atom
(D) cesium 131 atom

88. The farthest objects in our Universe discovered by modern astronomers are so distant that light emitted by them takes billions of years to reach the Earth. These objects (known as quasars) have man-puzzling features which have not yet been satisfactorily explained. What is the distance in km of a quasar from which light takes 3.0 billion years to reach us?

- (A) 2.8×10^{25} km (B) 2.8×10^{24} km
(C) 2.8×10^{26} km (D) 2.83×10^{22} km

89. One second is equal to [MNR 1986]

- (A) 1650763.73 time periods of Kr clock
(B) 652189.63 time periods of Kr clock
(C) 1650763.73 time periods of Cs clock
(D) 9192631770 time periods of Cs clock

90. Length cannot be measured in

- (A) fermi (B) debye
(C) micron (D) light year

91. The angular diameter of the sun is $1921''$. If the distance of the sun from the earth is 1.5×10^{11} m, then the linear diameter of the sun is

- (A) 2.6×10^9 m (B) 0.7×10^9 m
(C) 5.2×10^9 m (D) 1.39×10^9 m

92. To measure the distance of a planet from the earth, _____ method is used.

- (A) echo (B) direct
(C) parallax (D) paradox

93. Which of the following represents a unified atomic mass unit (1u)?

- (A) 8.333×10^{-1} of the mass of an atom of ^{12}C in kg.
(B) 0.8333×10^{-1} of the mass of an atom of ^{12}C in g.
(C) 8.333×10^{-1} of the mass of an atom of ^{12}C in g.
(D) 0.8333×10^{-1} of the mass of an atom of ^{12}C in kg.

1.10 Accuracy, precision and least count of measuring instruments

94. Accuracy of measuring instruments is the closeness of the measurement to the

- (A) approximately double value
(B) true value
(C) pitch of the instrument
(D) least count of the instrument

95. Greater accuracy is required for

- (A) greater physical quantity
(B) large size physical quantity
(C) smaller physical quantity
(D) large distances only

96. The precision is alternately determined by

- (A) least count of measuring instrument.
(B) number of observations.
(C) maximum reading that can be taken with the instrument
(D) any arbitrary observation.

97. Select the most precise instrument

- (A) a metre scale
(B) a vernier callipers
(C) a micrometer screw gauge with 0.001 cm least count.
(D) a micrometer screw gauge with 0.0005 cm least count.

98. The main scale of a vernier callipers marked upto 10 cm is equally divided into 200 equal parts. Its vernier scale of 20 divisions coincides with 8 mm on the main scale. The least count of the instrument is

- (A) 0.02 cm (B) 0.002 cm
(C) 0.01 cm (D) 0.001 cm

99. A spherometer has 100 equal divisions marked along the periphery of its disc and five full rotations of the disc advances on the main scale by 0.175 cm. The least count of the system is

- (A) 3.5×10^{-4} cm (B) 35×10^{-3} cm
(C) 3.5×10^{-2} cm (D) 35×10^{-4} cm



100. In an experiment, the angles are required to be measured using an instrument. 29 divisions of the main scale coincide with 30 divisions of the vernier scale. If the smallest division of the main scale is half a degree ($= 0.5^\circ$), then the least count of the instrument is [AIEEE 2009]
(A) half minute (B) one degree
(C) half degree (D) one minute
101. In a vernier callipers, one main scale division is x cm and n divisions of the vernier scale coincide with $(n - 1)$ divisions of the main scale. Then the least count (in cm) of the callipers is
(A) $\left(\frac{n-1}{n}\right)x$ (B) $\left(\frac{n}{n-1}\right)x$
(C) $\frac{x}{n}$ (D) $\frac{x}{n-1}$
102. A certain pendulum clock with a 12 h dial happens to gain 1.0 min/day. After setting the clock to the correct time, how long must one wait until it again indicates the correct time?
(A) 720 min (B) 720 days
(C) 60 days (D) 12 min
103. The diameter of the paper pin is measured accurately by using
(A) Vernier callipers
(B) Micrometer screw gauge
(C) Metre scale
(D) A measuring tape
104. The diameter of a cylinder is measured using a Vernier callipers with no zero error. It is found that the zero of the Vernier scale lies between 5.10 cm and 5.15 cm of the main scale. The Vernier scale has 50 divisions equivalent to 2.45 cm. The 24th division of the Vernier scale exactly coincides with one of the main scale divisions. The diameter of the cylinder is [JEE (Advanced) 2013]
(A) 5.112 cm (B) 5.124 cm
(C) 5.136 cm (D) 5.148 cm
107. The magnitude of the difference between mean value and each individual value is called
(A) absolute error
(B) error in reading
(C) most probable value
(D) true error
108. Instrumental error can be caused due to
(A) faulty construction of instrument.
(B) wrong setting of instrument.
(C) lack of concentration of observer.
(D) wrong procedure of handling the instrument.
109. While performing an experiment, minute change in experimental conditions like temperature, pressure or fluctuation in voltage is called
(A) instrumental error
(B) systematic error
(C) personal error
(D) random error
110. In an experiment, refractive index of glass was observed to be 1.45, 1.56, 1.54, 1.44, 1.54 and 1.53. The mean absolute error in the experiment is
(A) 0.04 (B) 0.02
(C) 0.03 (D) 0.01
111. A body travels a distance of (13.8 ± 0.2) m in a time (4.0 ± 0.3) s. The velocity of the body within error limits is
(A) $(3.45 \pm 8.9) \text{ ms}^{-1}$
(B) $(3.45 \pm 0.3) \text{ ms}^{-1}$
(C) $(3.45 \pm 0.4) \text{ ms}^{-1}$
(D) $(3.45 \pm 9.8) \text{ ms}^{-1}$
112. The radius of a sphere is (5.3 ± 0.1) cm. The percentage error in its volume is
(A) $\frac{0.1}{5.3} \times 100$ (B) $3 \times \frac{0.1}{5.3} \times 100$
(C) $\frac{0.1 \times 100}{3.53}$ (D) $3 + \frac{0.1}{5.3} \times 100$
113. The relative density of material of a body is found by weighing it first in air and then in water. If the weight in air is (5.00 ± 0.05) newton and weight in water is (4.00 ± 0.05) newton, then the relative density along with the maximum permissible percentage error is
(A) $5.0 \pm 11\%$ (B) $5.0 \pm 1\%$
(C) $5.0 \pm 6\%$ (D) $1.25 \pm 5\%$
114. The period of oscillation of a simple pendulum in the experiment is recorded as 2.63 s, 2.56 s, 2.42 s, 2.71 s and 2.80 s respectively. The average absolute error is
(A) 0.1 s (B) 0.11 s
(C) 0.01 s (D) 1.0 s

1.11 Errors in measurement

105. Errors and mistakes are due to
(A) defect in measurement of physical quantities.
(B) instrumental fault
(C) selection of instrument
(D) measurement at different instant
106. The difference between the true value and measured value is called
(A) mistake
(B) error
(C) significant figures
(D) fault



115. The length of a cylinder is measured with a metre rod having least count 0.1 cm. Its diameter is measured with vernier callipers having least count 0.01 cm. Given that length is 5.0 cm and radius is 2.0 cm, the percentage error in the calculated value of the volume will be

(A) 1% (B) 2%
(C) 3% (D) 4%

116. You measure two quantities as $A = 1.0 \text{ m} \pm 0.2 \text{ m}$, $B = 2.0 \text{ m} \pm 0.2 \text{ m}$. We should report correct value for $\sqrt{AB}$ as

[NCERT Exemplar]

(A) $1.4 \text{ m} \pm 0.4 \text{ m}$
(B) $1.41 \text{ m} \pm 0.15 \text{ m}$
(C) $1.4 \text{ m} \pm 0.3 \text{ m}$
(D) $1.4 \text{ m} \pm 0.2 \text{ m}$

117. If there is a positive error of 50% in the measurement of velocity of a body, then the error in the measurement of kinetic energy is

(A) 25% (B) 50%
(C) 100% (D) 125%

118. A physical quantity P is given by $P = \frac{A^3 B^{\frac{1}{2}}}{C^{-4} D^{\frac{2}{3}}}$.

The quantity which brings in the maximum percentage error in P is

(A) A (B) B
(C) C (D) D

119. If the length of rod A is $3.25 \pm 0.01 \text{ cm}$ and that of B is $4.19 \pm 0.01 \text{ cm}$, then the rod B is longer than rod A by [J & K CET 2005]

(A) $0.94 \pm 0.00 \text{ cm}$
(B) $0.94 \pm 0.01 \text{ cm}$
(C) $0.94 \pm 0.02 \text{ cm}$
(D) $0.94 \pm 0.005 \text{ cm}$

120. A physical quantity A is related to four observable a, b, c and d as follows, $A = \frac{a^2 b^3}{c \sqrt{d}}$, the percentage errors of measurement in a, b, c and d are 1%, 3%, 2% and 2% respectively. What is the percentage error in the quantity A?

[Kerala PET 2005]

(A) 5% (B) 7%
(C) 12% (D) 14%

121. Accidental error can be minimised by

(A) taking only one reading.
(B) taking small quantity.
(C) selecting instrument with greater least count.
(D) selecting instrument with small least count.

122. **Assertion:** The error in the measurement of radius of the sphere is 0.3%. The permissible error in its surface area is 0.6%.

Reason: The permissible error is calculated by the formula $\frac{\Delta A}{A} = 4 \frac{\Delta r}{r}$.

[AIIMS 2008]

(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion.
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion.
(C) Assertion is True, Reason is False.
(D) Assertion is False, Reason is False.

123. Error due to non-removal of parallax between pointer and its image in case of magnetic compass needle causes

(A) instrumental error.
(B) systematic error.
(C) personal error.
(D) random error.

124. Choose the WRONG statement for zero error and zero correction.

(A) If the zero of the vernier scale does not coincide with the zero of the main scale, then the instrument is said to be having a zero error.
(B) Zero correction has a magnitude equal to zero error but sign opposite to that of the zero error.
(C) Zero error is positive when the zero of vernier scale lies to the left of the zero of the main scale.
(D) Zero error is negative when the zero of vernier scale lies to the left of the zero of the main scale.

125. Estimate the mean absolute error from the following data:

20.17, 21.23, 20.79, 22.07, 21.78

(A) 0.85 (B) 0.58
(C) 0.03 (D) 0.01

126. The least count of a screw gauge is 0.005 cm. The diameter of a wire is 0.020 cm as measured by it. The percentage error in measurement is

(A) 25 % (B) 20 %
(C) 15 % (D) 5 %

127. Two resistances $R_1 = 50 \pm 2 \text{ ohm}$ and $R_2 = 60 \pm 3 \text{ ohm}$ are connected in series. The equivalent resistance of the series combination is

(A) $(110 \pm 2) \text{ ohm}$ (B) $(110 \pm 1) \text{ ohm}$
(C) $(110 \pm 5) \text{ ohm}$ (D) $(110 \pm 6) \text{ ohm}$



128. The density of a cube is determined by measuring its mass and length of its one side. If maximum error in measurement of mass is 4% and edge is measured with an error of 3%, then the percentage error in the measurement of density will be

[AIPV 2003; CBSE PMT 96]

- (A) 13% (B) 9%
(C) 7% (D) 1%

129. The percentage error in measurement of length and time period is 2 % and 1 % respectively. The percentage error in measurement of 'g' is

- (A) 2 % (B) 3 %
(C) 6 % (D) 4 %

130. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. Measured value of L is

20.0 cm known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 90 s using a wrist watch of 1 s resolution. The accuracy in the determination of g is

[JEE (Main) 2015]

- (A) 2 % (B) 3%
(C) 1% (D) 5%

131. A resistor of 2 k Ω with tolerance 10% is connected in parallel with a resistor of 4 k Ω with tolerance 10%. The tolerance of the parallel combination is approximately

- (A) 10% (B) 20%
(C) 30% (D) 40%

132. The fractional error $\left(\frac{\Delta x}{x}\right)$, if $x = a^n$ is

- (A) $\pm \left(\frac{\Delta a}{a}\right)^n$
(B) $\pm n \left(\frac{\Delta a}{a}\right)$
(C) $\pm n \log e \frac{\Delta a}{a}$
(D) $\pm n \log \frac{\Delta a}{a}$

133. If $x = (a - b)$, the maximum percentage error in the measurement of x will be

[BCECE 2015]

- (A) $\left[\frac{\Delta a}{a-b} - \frac{\Delta b}{a-b}\right] \times 100$
(B) $\left[\frac{\Delta a}{a-b} + \frac{\Delta b}{a-b}\right] \times 100$
(C) $\left[\frac{\Delta a}{a} + \frac{\Delta b}{b}\right] \times 100$
(D) $\left[\frac{\Delta a}{a} - \frac{\Delta b}{b}\right] \times 100$

134. A wire has a mass (0.3 ± 0.003) g, radius (0.5 ± 0.005) mm and length (6 ± 0.06) cm. The maximum percentage error in the measurement of its density is [IIT JEE 2004]

- (A) 1 (B) 2
(C) 3 (D) 4

135. In an experiment, four quantities a, b, c and d are measured with percentage errors 1%, 2%, 3% and 4% respectively. Quantity P is calculated as follows:

$$P = \frac{a^3 b^2}{cd} \cdot \% \text{ error in P is [NEET UG 2013]}$$

- (A) 14% (B) 10%
(C) 7% (D) 4%

136. A physical quantity Q is found to depend on observables x, y and z, obeying relation

$$Q = \frac{x^3 y^2}{z} \cdot \text{The percentage error in the}$$

measurements of x, y and z are 1%, 2% and 4% respectively. What is percentage error in the quantity Q? [K CET 2014]

- (A) 4 % (B) 3 %
(C) 11 % (D) 1 %

1.12 Significant figures

137. If the digit to be dropped is more than 5, then the preceding digit is _____

- (A) raised by 1
(B) unchanged
(C) lowered by 1
(D) an average of 5 and that digit

138. Figure 4.850, rounded off to two digits, becomes

- (A) 3.5 (B) 4.8
(C) 4.9 (D) 5.1

139. In the measurement of length, the length of the string is 3.750 cm. Its value when rounded off to two digit number is

- (A) 3.75 (B) 3.8
(C) 3.7 (D) 3.6

140. The radius of the earth is 6400 km, the order of magnitude is

- (A) 10^7 m (B) 10^4 m
(C) 10^3 m (D) 10^2 m

141. The order of magnitude of 4.9 and 51 are

- (A) same (B) double
(C) differ by 1 (D) four

142. A bee of mass 0.000087 kg sits on a flower of mass 0.0123 kg. What is the total mass supported by the stem of the flower upto approximate significant figures?

- (A) 0.012387 kg (B) 0.01239 kg
(C) 0.0124 kg (D) 0.012 kg



143. A man runs 100.5 m in 10.3 s. His average speed upto approximate significant figures is
 (A) 9.76 ms^{-1}
 (B) 9.708 ms^{-1}
 (C) 9.7087 ms^{-1}
 (D) 9.70874 ms^{-1}
144. What is the number of significant figures in 0.310×10^3 ?
 (A) 2 (B) 3
 (C) 4 (D) 6
145. If $L = 2.331 \text{ cm}$, $B = 2.1 \text{ cm}$, then $L + B =$
[DCE 2003]
 (A) 4.431 cm (B) 4.43 cm
 (C) 4.4 cm (D) 4 cm
146. The number of significant figures in all the given numbers 25.12, 2009, 4.156 and 1.217×10^{-4} is
[Pb PET 2003]
 (A) 1 (B) 2
 (C) 3 (D) 4
147. The number of significant figures in 0.0500 is
 (A) 4 (B) 3
 (C) 2 (D) 1
148. The value of $(9.15 + 3.8)$ with due regards to significant figure is
 (A) 13.000 (B) 13.00
 (C) 13.0 (D) 13
149. $4.338 + 4.835 \times 3.88 \div 3.0$ is equal to
 (A) 10.6 (B) 10.59
 (C) 10.81 (D) 10.23
150. 5.480×10^2 has _____ significant figures.
 (A) 6 (B) 4
 (C) 2 (D) 1
151. Three measurements are made as 18.425 cm, 7.21 cm and 5.0 cm. The addition should be written as
 (A) 30.635 cm
 (B) 30.64 cm
 (C) 30.63 cm
 (D) 30.6 cm
152. In the reading 2.614 cm of measurement, only uncertain figure is
 (A) 1 (B) 2
 (C) 4 (D) 6
153. The decimal equivalent of $\frac{1}{25}$ upto three significant figures is
 (A) 0.040 (B) 0.04000
 (C) 0.0040 (D) 4.0×10^{-2}
154. Which of the following numerical values has three significant figures?
 (A) 3.033 (B) 0.030
 (C) 30.30 (D) 0.300

1.13 Dimensions of physical quantities

155. A pair of physical quantities having the same dimensional formula is **[EAMCET 1991]**
 (A) angular momentum and torque.
 (B) torque and energy.
 (C) entropy and power.
 (D) power and angular momentum.
156. Which of the following quantity is NOT dimensionless?
 (A) Reynold's number
 (B) Strain
 (C) Angle
 (D) Radius of gyration
157. Dimensional formula for electrical field is
[GUJ CET 2014]
 (A) $[M^1 L^2 T^{-3} A^{-2}]$
 (B) $[M^1 L^2 T^{-3} A^{-1}]$
 (C) $[M^1 L^1 T^{-3} A^{-1}]$
 (D) $[M^0 L^0 T^0 A^0]$
158. **Assertion:** There is no physical quantity which has a unit but is dimensionless.
Reason: A physical quantity having dimensions cannot be unitless.
 (A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion.
 (B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion.
 (C) Assertion is True, Reason is False.
 (D) Assertion is False, Reason is True.
159. The dimensions of angular momentum/magnetic moment are
 (A) $[M^3 L T^{-2} A^2]$ (B) $[M A^{-1} T^{-1}]$
 (C) $[M L^2 A^{-2} T]$ (D) $[M^2 L^{-3} A T^2]$
160. Force F is given by the equation

$$F = \frac{X}{\text{Linear density}}$$
 . Then dimensions of X are
[EAMCET 2015]
 (A) $M^2 L^0 T^{-2}$ (B) $M^0 L^0 T^{-1}$
 (C) $L^2 T^{-2}$ (D) $M^0 L^2 T^{-2}$
161. If C and R represent capacitance and resistance respectively, then the dimensions of RC are **[C PMT 1981, Pb PMT 1999]**
 (A) $[M^0 L^0 T^2]$ (B) $[M^0 L^0 T^1]$
 (C) $[M L^{-1}]$ (D) $[M^1 L^0 T^1]$
162. Dimensional formula for latent heat is
[C PMT 1978, 86; MNR 1987; IIT 1983, 89; R PET 2002]
 (A) $[M^0 L^2 T^{-2}]$ (B) $[M L T^{-2}]$
 (C) $[M L^2 T^{-2}]$ (D) $[M L^2 T^{-1}]$



163. Dimensional formula for volume elasticity is
[MNR 1986; C PMT 1991; MP PMT 1991, 2002]
(A) $[M^1 L^{-2} T^{-2}]$ (B) $[M^1 L^{-3} T^{-2}]$
(C) $[M^1 L^2 T^{-2}]$ (D) $[M^1 L^{-1} T^{-2}]$
164. The dimensional formula for Planck's constant (h) is
[Kerala PMT 2002]
(A) $[ML^{-2} T^{-3}]$ (B) $[ML^2 T^{-2}]$
(C) $[ML^2 T^{-1}]$ (D) $[ML^{-2} T^{-2}]$
165. The dimensions of Stefan's constant are
[MH-CET 2015]
(A) $[M^0 L^1 T^{-3} K^{-4}]$
(B) $[M^1 L^1 T^{-3} K^{-3}]$
(C) $[M^1 L^2 T^{-3} K^{-4}]$
(D) $[M^1 L^0 T^{-3} K^{-4}]$
166. Out of the following, the only pair that does NOT have identical dimensions is
[BHU 1997; MP PET/PMT 1998]
(A) Angular momentum and Planck's constant.
(B) Moment of inertia and moment of a force.
(C) Work and torque.
(D) Impulse and momentum.
167. Which of the following has dimensions different from the remaining three?
[AIIMS 1987; CBSE PMT 1993]
(A) Energy per unit volume
(B) Force per unit area
(C) Product of voltage and charge per unit volume
(D) Angular momentum per unit mass
168. **Assertion:** Linear mass density has the dimensions of $[M^1 L^{-1} T^0]$.
Reason: This is so because density is mass per unit volume.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion.
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion.
(C) Assertion is True, Reason is False.
(D) Assertion is False, Reason is False.
169. The dimensions of CV^2 matches with the dimensions of
[DCE 1993]
(A) $L^2 I$ (B) $L^2 I^2$
(C) LI^2 (D) $\frac{1}{LI}$
170. In the expression for Boyle's law, the product 'PV' has dimensions of
[MH-CET 2015]
(A) Force (B) Impulse
(C) Energy (D) Momentum
171. The dimensions of $\frac{1}{\sqrt{\epsilon_0 \mu_0}}$ are that of
[SCRA 1986]
(A) Velocity (B) Time
(C) Capacitance (D) Distance
172. Dimensional formula of magnetic flux is
[IIT 1982; DCE 1993; CBSE PMT 1989, 99; D PMT 2001; Kerala PMT 2005]
(A) $[ML^2 T^{-2} A^{-1}]$ (B) $[ML^0 T^{-2} A^{-2}]$
(C) $[M^0 L^{-2} T^{-2} A^{-3}]$ (D) $[ML^2 T^{-2} A^3]$
173. Inductance L can be dimensionally represented as
[J & K CET 2005]
(A) $[ML^2 T^{-2} A^{-2}]$
(B) $[ML^2 T^{-4} A^{-3}]$
(C) $[ML^{-2} T^{-2} A^{-2}]$
(D) $[ML^2 T^4 A^3]$
174. Dimensions of kinetic energy are
[Bihar PET 1983; AFMC 1991; D PET 1993]
(A) $[ML^2 T^{-2}]$ (B) $[M^2 L T^{-1}]$
(C) $[ML^2 T^{-1}]$ (D) $[ML^3 T^{-1}]$
175. Dimensions of coefficient of viscosity are
[AIIMS 1993; D PMT 2004]
(A) $[ML^2 T^{-2}]$ (B) $[ML^2 T^{-1}]$
(C) $[ML^{-1} T^{-1}]$ (D) $[MLT]$
176. If C and L denote capacitance and inductance respectively, then the dimensions of LC are
(A) $[M^0 L^0 T^0]$ (B) $[M^0 L^0 T^2]$
(C) $[M^2 L^0 T^2]$ (D) $[MLT^2]$
177. The dimensions of surface tension are
[MP PMT 1994, 99; UPSEAT 1999]
(A) $[ML^{-1} T^{-2}]$ (B) $[MLT^{-2}]$
(C) $[ML^{-1} T^{-1}]$ (D) $[MT^{-2}]$
178. Which of the following sets of physical quantities have same dimensions?
[MP PET 1997]
(A) Work, energy, force.
(B) Velocity, momentum, impulse.
(C) Potential energy, kinetic energy, momentum.
(D) Pressure, stress, coefficient of elasticity.
179. The ratio of the dimensions of Planck constant and that of moment of inertia has the dimensions of
[K CET 2015]
(A) angular momentum
(B) time
(C) velocity
(D) frequency
180. Dimensions of CR are those of
[EAMCET (Engg.) 1995; AIIMS 1999]
(A) Frequency (B) Energy
(C) Time period (D) Current



181. $[ML^{-1}T^{-2}]$ represents the dimensions of
[EAMCET (Med.) 1995; Pb PMT 2001]
 (A) Strain. (B) Solid angle.
 (C) acceleration. (D) Pressure.
182. The physical quantity which has the dimensional formula $[M^1T^{-3}]$ is
[CET 1998]
 (A) Surface tension
 (B) Solar constant
 (C) Density
 (D) Compressibility
183. The dimensions of solar constant are
[BCECE 2015]
 (A) $[MLT^{-2}]$ (B) $[M^0L^0T^0]$
 (C) $[ML^0T^{-3}]$ (D) $[M^0LT^{-3}]$
184. $[ML^3T^{-1}Q^{-2}]$ is dimension of **[R PET 2000]**
 (A) Resistivity (B) Conductivity
 (C) Resistance (D) None of these
185. Which of the following represents the dimensions of farad? **[AMU (Med.) 2002]**
 (A) $[M^{-1}L^{-2}T^4A^2]$ (B) $[ML^2T^2A^{-2}]$
 (C) $[ML^2T^2A^{-1}]$ (D) $[MT^{-2}A^{-1}]$
186. The dimensions of pressure are equal to
[AIEEE 2002]
 (A) Force per unit volume
 (B) Energy per unit volume
 (C) Force
 (D) Energy
187. Which of the following quantities is dimensionless? **[MP PET 2002]**
 (A) Gravitational constant
 (B) Planck's constant
 (C) Power of a convex lens
 (D) Angle
188. The dimensional formula for Boltzmann's constant is **[Pb PET 2001; MP PET 2002]**
 (A) $[ML^2T^{-2}\theta^{-1}]$
 (B) $[ML^2T^{-2}]$
 (C) $[ML^0T^{-2}\theta^{-1}]$
 (D) $[ML^{-2}T^{-1}\theta^{-1}]$
189. The dimensions of k in the equation $W = \frac{1}{2} kx^2$ are **[Orissa JEE 2003]**
 (A) $[M^1L^0T^{-2}]$ (B) $[M^0L^1T^{-1}]$
 (C) $[M^1L^1T^{-2}]$ (D) $[M^1L^0T^{-1}]$
190. The dimensions of universal gas constant are **[Pb PET 2003]**
 (A) $[ML^2T^{-2}\theta^{-1}]$
 (B) $[M^2LT^{-2}\theta]$
 (C) $[ML^3T^{-1}\theta^{-1}]$
 (D) None of these
191. If the dimensional formula is $[L^2M^1T^{-2}]$ then the physical quantity will be
 (A) torque
 (B) impulse
 (C) force
 (D) force per unit area
192. What is dimensional formula of thermal conductivity? **[UP SEE 2006]**
 (A) $[MLT^{-1}\theta^{-1}]$ (B) $[MLT^{-3}\theta^{-1}]$
 (C) $[M^2LT^{-3}\theta^{-2}]$ (D) $[ML^2T^{-2}\theta]$
193. The dimensions of impulse are
[C PMT 1986; AFMC 1997; EAMT 1998; UPCPMT 1999]
 (A) $[M^1L^1T^{-3}]$
 (B) $[M^1L^1T^{-1}]$
 (C) $[M^1L^2T]$
 (D) $[M^2LT^{-1}]$
194. Which of the following pairs have same dimensions?
[IIT 88; UP PMT 97; R PMT 2001]
 (A) Work and angular momentum.
 (B) Light year and wavelength.
 (C) Stress and work.
 (D) Energy and modulus of elasticity.
195. Which of the following pairs do NOT have same dimensions?
[BHU 97; MP PMT 98; UP PMT 2000; Kerala 2001]
 (A) Angular momentum and 'h'
 (B) Moment of inertia and torque
 (C) Work and torque
 (D) Impulse and momentum
196. The power of lens is $P = 1/f$, where 'f' is focal length of the lens. The dimensions of power of lens are
 (A) $[LT^{-2}]$ (B) $[M^0L^{-1}T^0]$
 (C) $[M^0L^0T^0]$ (D) $[M^0L^1T^0]$
197. The optical path difference is defined as $\Delta x = 2\pi/\lambda$. What are the dimensions of optical path difference?
 (A) $[M^0L^{-1}T^0]$ (B) $[MLT^0]$
 (C) $[ML^0T]$ (D) $[ML^{-2}T]$
198. The dimensional formula for Reynold's number is **[MH-CET 2014]**
 (A) $[L^0M^0T^0]$
 (B) $[L^1M^1T^1]$
 (C) $[L^{-1}M^1T^1]$
 (D) $[L^1M^1T^{-1}]$
199. The dimensions of specific heat are
 (A) $[MLT^{-2}K^{-1}]$ (B) $[ML^2T^{-2}K^{-1}]$
 (C) $[M^0L^2T^{-2}K^{-1}]$ (D) $[M^0LT^{-2}K^{-1}]$



200. Which of the following units denotes the dimensions $[ML^2/Q^2]$, where Q denotes the electric charge? [AIEEE 2006]

(A) henry (B) Hm^{-2}
(C) weber (Wb) (D) Wbm^{-2}

201. Which of the following physical quantities have neither dimensions nor unit?

(A) Angle
(B) Luminous intensity
(C) Coefficient of friction
(D) Current

202. The fundamental unit which has same power in the dimensional formulae of surface tension and viscosity is

(A) mass
(B) length
(C) time
(D) both (A) and (B)

203. Let $[\epsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = time and A = electric current, then [JEE (Main) 2013]

(A) $[\epsilon_0] = [M^{-1} L^{-3} T^2 A]$
(B) $[\epsilon_0] = [M^{-1} L^{-3} T^4 A^2]$
(C) $[\epsilon_0] = [M^{-1} L^2 T^{-1} A^{-2}]$
(D) $[\epsilon_0] = [M^{-1} L^2 T^{-1} A]$

204. Match the following two columns.

	Column I		Column II
(a)	Electrical resistance	(p)	$[M^1 L^3 T^{-3} A^{-2}]$
(b)	Electrical potential	(q)	$[ML^2 T^{-3} A^{-2}]$
(c)	Specific resistance	(r)	$[ML^2 T^{-3} A^{-1}]$
(d)	Specific conductance	(s)	None of these

[GUJ CET 2015]

(A) a – q, b – s, c – r, d – p
(B) a – q, b – r, c – p, d – s
(C) a – p, b – q, c – s, d – r
(D) a – p, b – r, c – q, d – s

205. Match the list-I with list-II

	List-I		List-II
P	Boltzmann constant	(I)	$[ML^0 T^0]$
Q	Coefficient of viscosity	(II)	$[ML^{-1} T^{-1}]$
R	Water equivalent	(III)	$[MLT^{-3} K^{-1}]$
S	Coefficient of thermal conductivity	(IV)	$[ML^2 T^{-2} K^{-1}]$

[AP EAMCET (Engg.) 2016]

(A) P – III, Q – I, R – II, S – IV
(B) P – III, Q – II, R – I, S – IV
(C) P – IV, Q – II, R – I, S – III
(D) P – IV, Q – I, R – II, S – III

1.14 Dimensional analysis and its applications

206. Checking the correctness of physical equations using the method of dimensions is based on

(A) equality of inertial frame of reference.
(B) the type of system of units.
(C) the method of measurement.
(D) the principle of homogeneity of dimensions.

207. Dimensional equation cannot be used

(A) to check the correctness of a physical quantity.
(B) to derive the relation between different physical quantities.
(C) to find out constant of proportionality which may be a pure number.
(D) to change from one system of units to another.

208. If u_1 and u_2 are the units selected in two systems of measurement and n_1 and n_2 are their numerical values, then [SCRA 1986]

(A) $n_1 u_1 = n_2 u_2$
(B) $n_1 u_1 + n_2 u_2 = 0$
(C) $n_1 n_2 = u_1 u_2$
(D) $(n_1 + u_1) = (n_2 + u_2)$

209. **Assertion:** μN is not the same as nm.

Reason: $1 \mu N = 10^{-6} N$ and $1 nm = 10^{-9} m$

(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion.
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion.
(C) Assertion is True, Reason is False.
(D) Assertion is False, Reason is False.

210. In C.G.S. system, the magnitude of the force is 100 dynes. In another system where the fundamental physical quantities are kilogram, metre and minute, the magnitude of the force is [EAMCET 2001]

(A) 0.036 (B) 0.36
(C) 3.6 (D) 36

211. The frequency of vibration f of a mass m suspended from a spring of spring constant K is given by a relation $f = C m^x K^y$; where C is a dimensionless quantity. Then the value of x and y are [CBSE PMT 1990]

(A) $x = \frac{1}{2}, y = \frac{1}{2}$
(B) $x = -\frac{1}{2}, y = -\frac{1}{2}$
(C) $x = \frac{1}{2}, y = -\frac{1}{2}$
(D) $x = -\frac{1}{2}, y = \frac{1}{2}$



212. Two quantities A and B have different dimensions. Which mathematical operation given below is physically meaningful?

[CPMT 1997]

- (A) A/B
(B) $A+B$
(C) $A-B$
(D) $A+2B$

213. A force F is given by $F = at + bt^2$, where t is time. What are the dimensions of a and b?

[AFMC 2001; BHU 1998, 2005]

- (A) $[MLT^{-3}]$ and $[ML^2T^{-4}]$
(B) $[MLT^{-3}]$ and $[MLT^{-4}]$
(C) $[MLT^{-1}]$ and $[MLT^0]$
(D) $[MLT^{-4}]$ and $[MLT^{-1}]$

214. If energy (E), velocity (v) and force (F) be taken as fundamental quantity, then what are the dimensions of mass?

[AMU 2000]

- (A) $[Ev^2]$ (B) $[Ev^{-2}]$
(C) $[Fv^{-1}]$ (D) $[Fv^{-2}]$

215. If L, C and R denote the inductance, capacitance and resistance respectively, the dimensional formula for C^2LR is

[UPSEAT 2002]

- (A) $[ML^{-2}T^{-1}I^0]$
(B) $[M^0L^0T^3I^0]$
(C) $[M^{-1}L^{-2}T^6I^2]$
(D) $[M^0L^0T^2I^0]$

216. If force (F), length (L) and time (T) are assumed to be fundamental units, then the dimensional formula of the mass will be

[J & K CET 2004]

- (A) $[FL^{-1}T^2]$
(B) $[FL^1T^{-2}]$
(C) $[FL^{-1}T^{-2}]$
(D) $[FL^2T^2]$

217. In a system of units if force (F), acceleration (A) and time (T) are taken as fundamental units, then the dimensional formula of energy is

[BHU 2005]

- (A) $[FA^2T]$ (B) $[FAT^2]$
(C) $[F^2AT]$ (D) $[FAT]$

218. Density of a liquid in CGS system is 0.625 g/cm^3 . What is its magnitude in SI system?

[J & K CET 2005]

- (A) 0.625 kg/m^3
(B) 0.0625 kg/m^3
(C) 0.00625 kg/m^3
(D) 625 kg/m^3

219. If the dimensions of length are expressed as $G^x c^y h^z$, where G, c and h are the universal gravitational constant, speed of light and Planck's constant respectively, then

[IIT 1992]

- (A) $x = \frac{1}{2}, y = \frac{1}{2}, z = \frac{-1}{2}$
(B) $x = \frac{1}{2}, y = \frac{3}{2}, z = \frac{1}{2}$
(C) $x = \frac{1}{2}, y = \frac{-3}{2}, z = \frac{1}{2}$
(D) $x = \frac{1}{2}, y = \frac{3}{2}, z = \frac{-1}{2}$

220. The speed of light (c), gravitational constant (G) and Planck's constant (h) are taken as the fundamental units in a system. The dimensions of time in this new system should be

[AMU 1995]

- (A) $[G^{1/2}h^{1/2}c^{-5/2}]$ (B) $[G^{-1/2}h^{1/2}c^{1/2}]$
(C) $[G^{1/2}h^{1/2}c^{-3/2}]$ (D) $[G^{1/2}h^{1/2}c^{1/2}]$

221. The frequency of vibration of string is given by $n = \frac{p}{2l} \left[\frac{F}{m} \right]^{1/2}$. Here p is the number of segments in the string and l is the length. The dimensional formula for m will be

[BHU 2004]

- (A) $[M^0LT^{-1}]$ (B) $[ML^0T^{-1}]$
(C) $[ML^{-1}T^0]$ (D) $[M^0L^0T^0]$

222. The surface tension of a liquid is 70 dyne/cm. In MKS system, its value is

[C PMT 1973, 74; AFMC 1996; BHU 2002]

- (A) 70 N/m
(B) $7 \times 10^{-2} \text{ N/m}$
(C) $7 \times 10^3 \text{ N/m}$
(D) $7 \times 10^2 \text{ N/m}$

223. The dimensions of physical quantity X in the equation, $\text{Force} = \frac{X}{\text{Density}}$ are given by

[DCE 1993]

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

224. One nanometer is equal to

- (A) 10^9 mm (B) 10^{-6} cm
(C) 10^{-7} cm (D) 10^{-9} cm

225. Which relation is WRONG?

[R PMT 1997]

- (A) 1 calorie = 4.18 joules
(B) $1 \text{ \AA} = 10^{-10} \text{ m}$
(C) $1 \text{ MeV} = 1.6 \times 10^{-13} \text{ joules}$
(D) 1 newton = 10^{-5} dyne



226. If momentum (p), area (A) and time (T) are taken to be fundamental quantities, then energy has the dimensional formula

[NCERT Exemplar]

- (A) $[pA^{-1}T^1]$
 (B) $[p^2AT]$
 (C) $[pA^{-1/2}T]$
 (D) $[pA^{1/2}T^{-1}]$

227. If momentum (P), area (A) and time (T) are assumed to be fundamental quantities, then energy has dimensional formula

- (A) $[P^1T^{-1}A^{-1/2}]$
 (B) $[P^1T^{-1}A^{1/2}]$
 (C) $[P^2T^{-1}A^{-1}]$
 (D) $[P^1T^1A^{-1}]$

228. If pressure P, velocity V and time T are taken as fundamental physical quantities, the dimensional formula of the force is

[EAMCET (Engg.) 2000]

- (A) $[PV^2T^2]$
 (B) $[P^{-1}V^2T^{-2}]$
 (C) $[PVT^2]$
 (D) $[P^{-1}VT^2]$

229. Find the dimensions of (a/b) in the equation $P = \frac{a-t^2}{bx}$, where P is pressure, x is distance and t is time.

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

230. Which of the following physical quantities represent the dimensions of $\frac{b}{a}$ in the relation

$P = \frac{x^2 - b}{at}$, where P is power, x is distance and 't' time [AP EAMCET (Med.) 2016]

- (A) Power
 (B) Surface tension
 (C) Torsional constant
 (D) Force

231. Using the principle of homogeneity of dimensions, find which of the following relations is correct.
 [T is the time period, a is the radius of the orbit and M is the mass of the sun].

- (A) $T^2 = \frac{4\pi^2 a^3}{G}$
 (B) $T^2 = \frac{4\pi^2 a^3}{GM}$
 (C) $T^2 = 4\pi^2 a^3$
 (D) $T^2 = \frac{4\pi^2 a^3}{GM^2}$

232. A quantity X is given by $\epsilon_0 L \frac{\Delta V}{\Delta t}$ where ϵ_0 is

the permittivity of free space, L is length, ΔV is potential difference and Δt is a time interval. The dimensional formula for X is the same as that of

- (A) Resistance (B) Charge
 (C) Voltage (D) Current

233. 'h' has same dimensions as that of

[R PMT 1999; R PET 1994, 2002, 2003;
 C PMT 1993, 94; CBSE PMT 2002]

- (A) Energy
 (B) Linear momentum
 (C) Angular momentum
 (D) Torque

234. If $x = \frac{a \sin \theta + b \cos \theta}{a + b}$, then

- (A) the dimensions of x and a are same.
 (B) the dimensions of a and b are not same.
 (C) x is dimensionless.
 (D) x has dimensions of length.

235. If L, C and R represent inductance, capacitance and resistance respectively, then which of the following does not represent dimensions of frequency? [IIT 1984]

- (A) $\frac{1}{RC}$ (B) $\frac{R}{L}$
 (C) $\frac{1}{\sqrt{LC}}$ (D) $\frac{C}{L}$

236. The dimensional representation of gravitational potential is identical to that of

- (A) internal energy.
 (B) angular momentum.
 (C) latent heat.
 (D) electric potential.

237. Wavelength of ray of light is 0.00006 m. Its value in micron is

- (A) 0.6 (B) 6
 (C) 60 (D) 600

238. If $x = at + bt^2$, where x is the distance travelled by the body in kilometres while t is the time in seconds, then the units of b are

[CBSE PMT 1993]

- (A) $\frac{\text{km}}{\text{s}}$ (B) km s
 (C) $\frac{\text{km}}{\text{s}^2}$ (D) km s^2

239. If the speed of light (c), acceleration due to gravity (g) and pressure (p) are taken as the fundamental quantities, then the dimensions of gravitational constant are [AMU (Med.) 1999]

- (A) $c^2 g^0 p^{-2}$ (B) $c^0 g^2 p^{-1}$
 (C) $c g^3 p^{-2}$ (D) $c^{-1} g^0 p^{-1}$



240. Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length?

[NEET P-II 2016]

- (A) $\sqrt{\frac{Gc}{h^{3/2}}}$
 (B) $\frac{\sqrt{hG}}{c^{3/2}}$
 (C) $\frac{\sqrt{hG}}{c^{5/2}}$
 (D) $\sqrt{\frac{hc}{G}}$

241. If the acceleration due to gravity is 10 m s^{-2} and the units of length and time are changed in kilometre and hour respectively, the numerical value of the acceleration is [Kerala PET 2002]

- (A) 360000 (B) 72,000
 (C) 36,000 (D) 1,29,600

Miscellaneous

242. Which is the correct unit for measuring nuclear radii?

- (A) micron (B) millimeter
 (C) angstrom (D) Fermi

243. Which of the following is the smallest unit?

[AFMC 1996]

- (A) millimeter (B) angstrom
 (C) fermi (D) metre

244. Which is NOT the unit of length?

- (A) light year
 (B) astronomical unit
 (C) parsec
 (D) tropical year

245. 1.4 times the mass of the sun is equal to

- (A) 1 atomic mass unit
 (B) 1 metric ton
 (C) 1 chandrasekhar limit
 (D) 1 pound

246. The year in which solar eclipse occurs is called

- (A) leap year
 (B) solar year
 (C) tropical year
 (D) polar year

247. One sidereal day

- (A) is small than one solar day.
 (B) is equal to solar day
 (C) is longer than one solar day.
 (D) has no connection with solar day.

248. Match the following [TS EAMCET 2015]

A		B	
a.	Rocket propulsion	e.	Bernoulli's principle in fluid dynamics
b.	Aeroplane	f.	Total internal reflection of light
c.	Optical fibers	g.	Newton's laws of motion
d.	Fusion test reactor	h.	Magnetic confinement of plasma
		i.	Photoelectric effect

- (a) (b) (c) (d)
 (A) g f e h
 (B) g e f i
 (C) i e f g
 (D) g e f h

249. Match list I with list II and select the correct answer.

List I		List II	
i.	Einstein	a.	Wave nature of light
ii.	Yukawa	b.	Theory of relativity
iii.	Maxwell	c.	Theory of nuclear forces
iv.	de Broglie	d.	Electromagnetic theory

- i. ii. iii. iv.
 (A) b c d a
 (B) b c a d
 (C) b a c d
 (D) b d a c

250. Match List-I (Fundamental Experiment) with List-II (its conclusion) and select the correct option from the choices given below the list:

List-I		List-II	
(p)	Frank-Hertz experiment	(i)	Particle nature of light
(q)	Photo-electric experiment	(ii)	Discrete energy levels of atom
(r)	Davison-Germer experiment	(iii)	Wave nature of electron
		(iv)	Structure of atom

[JEE (Main) 2015]

- (A) (p) – (i) (q) – (iv) (r) – (iii)
 (B) (p) – (ii) (q) – (iv) (r) – (iii)
 (C) (p) – (ii) (q) – (i) (r) – (iii)
 (D) (p) – (iv) (q) – (iii) (r) – (ii)



251. From the equation $\tan \theta = \frac{rg}{v^2}$, one can obtain

the angle of banking θ for a cyclist taking a curve (the symbols have their usual meanings). Then it is

- (A) Both dimensionally and numerically correct.
- (B) Neither numerically nor dimensionally correct.
- (C) Dimensionally correct only.
- (D) Numerically correct only.

252. A highly rigid cubical block A of small mass M and side L is fixed rigidly on another cubical block B of the same dimensions and of low modulus of rigidity η such that the lower face of A completely covers the upper face of B. The lower face of B is rigidly held on a horizontal surface. A small force F is applied perpendicular to one of the side faces of A. After the force is withdrawn, block A executes small oscillations. The time period of which is given by [IIT 1992]

- (A) $2\pi\sqrt{\frac{M\eta}{L}}$
- (B) $2\pi\sqrt{\frac{L}{M\eta}}$
- (C) $2\pi\sqrt{\frac{ML}{\eta}}$
- (D) $2\pi\sqrt{\frac{M}{\eta L}}$

253. Number of particles crossing a unit area perpendicular to X-axis in unit time is given

by $n = -D \left(\frac{n_2 - n_1}{x_2 - x_1} \right)$, where n_1 and n_2 are

number of particles per unit volume for the value of n meant to x_2 and x_1 . Find dimensions of D called as diffusion constant.

[C PMT 1979]

- (A) $[M^0 L T^2]$
- (B) $[M^0 L^2 T^{-4}]$
- (C) $[M^0 L T^{-3}]$
- (D) $[M^0 L^2 T^{-1}]$

254. Crane is British unit of volume. (One crane = 170.474 litre). Convert crane into SI unit.

- (A) 0.170474 m^3
- (B) 17.0474 m^3
- (C) 0.0017474 m^3
- (D) 1704.74 m^3

255. Maxwell's equations relate to

- (A) law of gravitation
- (B) basic laws of electrodynamics
- (C) laws of electromagnetic induction
- (D) nuclear model of an atom

256. The unit of Stefan's constant σ is

[AFMC 1986; MP PET 1992;

MP PMT 1992; CBSE PMT 2002]

- (A) $\text{W m}^{-2} \text{K}^{-1}$
- (B) $\text{W m}^{+2} \text{K}^{-4}$
- (C) $\text{W m}^{-2} \text{K}^{-4}$
- (D) $\text{W m}^{-2} \text{K}^{+4}$

257. Match the following [VITEEE 2005]

List I		List II	
i.	Magnetic flux	a.	tesla
ii.	Magnetic flux density	b.	weber
iii.	Relative permeability	c.	no unit
iv.	Magnetic field intensity	d.	ampere/metre

- (A) i - b, ii - a, iii - c, iv - d
- (B) i - c, ii - d, iii - b, iv - a
- (C) i - d, ii - b, iii - a, iv - c
- (D) i - b, ii - d, iii - c, iv - a

258. The nearest star to our solar system is 4.29 light years away. How much is this distance in terms of parsec? How much parallax would this star (named Alpha Centuari) show when viewed from two locations of the Earth six months apart in its orbit around the Sun?

- (A) 1.32 parsec, 1.52"
- (B) 1.26 parsec, 3.64"
- (C) 1.32 parsec, 2.32"
- (D) 2.32 parsec, 2.64"

259. The length of a rod is $0.5 \times 10^2 \text{ m}$, the order of magnitude of the length of the rod is

- (A) 10^3 m
- (B) 10^2 m
- (C) 10^1 m
- (D) 10^{-1} m

260. **Assertion:** Out of three measurements, $t = 0.4 \text{ s}$; $t = 0.40 \text{ s}$ and $t = 0.400 \text{ s}$, the last one is most accurate.

Reason: In every measurement, only the last significant digit is not accurately known.

- (A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion.
- (B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion.
- (C) Assertion is True, Reason is False.
- (D) Assertion is False, Reason is False.

261. The number of seconds in a day and its order of magnitude are

- (A) $8.64 \times 10^4 \text{ s}$, 10^5 s
- (B) $6.84 \times 10^4 \text{ s}$, 10^4 s
- (C) $8.64 \times 10^5 \text{ s}$, 10^5 s
- (D) $6.85 \times 10^4 \text{ s}$, 10^5 s

262. Order of magnitude of $(10^6 + 10^3)$ is

- (A) 10^{18}
- (B) 10^9
- (C) 10^6
- (D) 10^3



263. The radius of a uniform wire is $r = 0.021$ cm. the value of π is given to be 3.142. What is the area of cross section of the wire upto approximate significant figures?

- (A) 0.0014 cm^2
 (B) 0.00139 cm^2
 (C) 0.001386 cm^2
 (D) 0.0013856 cm^2

264. A student measured the length of a rod and wrote it as 3.50 cm. Which instrument did he use to measure it? [JEE (Main) 2014]

- (A) A meter scale
 (B) A vernier calliper where the 10 divisions in vernier scale matches with 9 division in main scale and main scale has 10 divisions in 1 cm
 (C) A screw gauge having 100 divisions in the circular scale and pitch as 1 mm
 (D) A screw gauge having 50 divisions in the circular scale and pitch as 1 mm

265. Two full turns of the circular scale of a screw gauge cover a distance of 1 mm on its main scale. The total number of divisions on the circular scale is 50. Further, it is found that the screw gauge has a zero error of -0.03 mm. While measuring the diameter of a thin wire, a student notes the main scale reading of 3 mm and the number of circular scale divisions in line with the main scale as 35. The diameter of the wire is

- (A) 3.32 mm (B) 3.73 mm
 (C) 3.67 mm (D) 3.38 mm

266. A screw gauge with a pitch of 0.5 mm and a circular scale with 50 divisions is used to measure the thickness of a thin sheet of Aluminium. Before starting the measurement, it is found that when the two jaws of the screw gauge are brought in contact, the 45th division coincides with the main scale line and that the zero of the main scale is barely visible. What is the thickness of the sheet if the main scale reading is 0.5 mm and the 25th division coincides with the main scale line?

[JEE (Main) 2016]

- (A) 0.80 mm (B) 0.70 mm
 (C) 0.50 mm (D) 0.75 mm

267. A wire has a mass 0.3 ± 0.003 g, radius 0.5 ± 0.005 mm and length 6 ± 0.06 cm. The maximum percentage error in the measurement of its density is

[IIT (Screening) 2004]

- (A) 1 (B) 2
 (C) 3 (D) 4

268. A physical parameter 'a' can be determined by measuring the parameters b, c, d and e using the relation $a = b^{\alpha} c^{\beta} d^{\gamma} e^{\delta}$. If the maximum errors in the measurement of b, c, d and e are $b_1\%$, $c_1\%$, $d_1\%$ and $e_1\%$, then the maximum error in the value of 'a' determined by the experiment is

- (A) $(b_1 + c_1 + d_1 + e_1)\%$
 (B) $(b_1 + c_1 - d_1 - e_1)\%$
 (C) $(\alpha b_1 + \beta c_1 - \gamma d_1 - \delta e_1)\%$
 (D) $(\alpha b_1 + \beta c_1 + \gamma d_1 + \delta e_1)\%$

269. If the time period of a simple pendulum is $T = 2\pi\sqrt{l/g}$, then the fractional error in acceleration due to gravity is

[Assam CEE 2015]

- (A) $\frac{4\pi^2 \Delta l}{\Delta T^2}$ (B) $\frac{\Delta l}{l} - 2 \frac{\Delta T}{T}$
 (C) $\frac{\Delta l}{l} + 2 \frac{\Delta T}{T}$ (D) None of these

270. The density of a cube is measured by measuring its mass and length of side. If the maximum error in their measurement are 3% and 2% respectively, the maximum error in the measurement of density is

- (A) 7% (B) 5%
 (C) 9% (D) 3%

271. A student measures the value of g with the help of a simple pendulum using the formula $g = \frac{4\pi^2 L}{T^2}$. He measures length L with a metre scale having least count 1 mm and finds it 98.0 cm. The time period is measured with the help of a watch of least count 0.1 s. The time of 20 oscillations is found to be 40.0 s. The error Δg in the measurement of g is (in m/s^2).

[BCECE 2014]

- (A) $9.68 \left[\frac{0.1}{98} + 0.1 \right]$ (B) $9.68 \left[\frac{1}{98} + 0.1 \right]$
 (C) $9.68 \left[\frac{0.1}{98} + \frac{0.1}{20} \right]$ (D) $9.68 \left[\frac{1}{98} + \frac{1}{20} \right]$

272. Select the correct match.

	Column I		Column II
i.	R/L	a.	Time
ii.	CR	b.	Frequency
iii.	E/B	c.	Speed
iv.	$\sqrt{\epsilon_0 \mu_0}$	d.	None

- (A) i - a, ii - b, iii - c, iv - d
 (B) i - c, ii - a, iii - b, iv - d
 (C) i - d, ii - b, iii - a, iv - c
 (D) i - b, ii - a, iii - c, iv - d



273. An athletic coach told his team that muscle times speed equals power. What dimensions does he view for muscle?

(A) $[MLT^{-2}]$ (B) $[ML^2T^2]$
(C) $[MLT^2]$ (D) $[L]$

274. The dimensions of e.m.f. in MKS are

[C PMT 2002]

(A) $[ML^{-1}T^{-2}Q^{-2}]$ (B) $[ML^2T^{-2}Q^{-2}]$
(C) $[MLT^{-2}Q^{-1}]$ (D) $[ML^2T^{-2}Q^{-1}]$

275. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be

[AIPMT 2015]

(A) $[E V^{-2}T^{-1}]$ (B) $[E V^{-1}T^{-2}]$
(C) $[E V^{-2}T^{-2}]$ (D) $[E^{-2}V^{-1}T^{-3}]$

276. If $X = 3 YZ^2$, then the dimension of Y in MKS system, if X and Z are the dimensions of capacity and magnetic field respectively, is

[MP PMT 2003]

(A) $[M^{-3}L^{-2}T^{-4}A^{-1}]$ (B) $[ML^{-2}]$
(C) $[M^{-3}L^{-2}T^{-4}A^4]$ (D) $[M^{-3}L^{-2}T^8A^4]$

277. If E, M, J and G denote energy, mass, angular momentum and gravitational constant, then

$\frac{EJ^2}{M^5G^2}$ has the dimensions of

(A) length (B) angle
(C) mass (D) time

278. The equation of state of some gases can be expressed as $\left(P + \frac{a}{V^2}\right)(V - b) = RT$. Here P is

the pressure, V is the volume, T is the absolute temperature and a, b, R are constants. The dimensions of 'a' are [CBSE PMT 1991, 96]

(A) $[ML^5T^{-2}]$ (B) $[ML^{-1}T^{-2}]$
(C) $[M^0L^3T^0]$ (D) $[M^0L^6T^0]$

279. The dimensions of Hubble's constant are

(A) $[T^{-1}]$ (B) $[M^0L^0T^{-2}]$
(C) $[MLT^4]$ (D) $[MLT^{-1}]$

280. A physical quantity x depends on quantities y and z by the relation $x = Ay + B \tan Cz$, where A, B and C are constants. Which of the following do not have the same dimensions?

[AMU (Engg.) 2001]

(A) x and B (B) C and z^{-1}
(C) y and B/A (D) x and A

281. Match list I with list II and select the correct answer

List I		List II	
i.	spring constant	a.	$[M^1L^2T^{-2}]$
ii.	pascal	b.	$[M^0L^0T^{-1}]$
iii.	hertz	c.	$[M^1L^0T^{-2}]$
iv.	joule	d.	$[M^1L^{-1}T^{-2}]$

i. ii. iii. iv.
(A) c d b a
(B) d c a b
(C) d c b a
(D) c a d b

282. In the relation $P = \frac{\alpha}{\beta} e^{-\frac{\alpha Z}{k\theta}}$, P is pressure, Z is

the distance, k is Boltzmann constant and θ is the temperature. The dimensional formula of β will be [IIT (Screening) 2004]

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

283. If the velocity of surface wave (v) depends upon surface tension (T), coefficient of viscosity (η) and density (ρ), then the expression for v will be

[Assam CEE 2015]

(A) $\frac{T^2}{\rho\eta}$ (B) $\frac{T}{\eta}$
(C) $\frac{\eta\rho}{T^2}$ (D) $\frac{\rho}{\eta}$

284. If n denotes a positive integer, h the Planck's constant, q the charge and B the magnetic

field, then the quantity $\left(\frac{nh}{2\pi qB}\right)$ has the

dimensions of

[WB JEE 2014]

(A) area (B) length
(C) speed (D) acceleration

285. The velocity v of a particle at time t is given by $v = at + \frac{b}{t+c}$, where a, b and c are constant. The dimensions of a, b and c are respectively [C PMT 2006]

(A) $[L^2]$, [T] and $[LT^2]$
(B) $[LT^2]$, [LT] and [L]
(C) [L], [LT] and $[T^2]$
(D) $[LT^{-2}]$, [L] and [T]

286. The force F is expressed in terms of distance x and time t as $F = a\sqrt{x} + bt^2$. The dimensions of a/b are

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

287. Find the value of 20 J on the system based on 20 cm, 1 kg and $\frac{1}{2}$ minute as fundamental units.

(A) 4.5×10^5 units
(B) 4.5×10^4 units
(C) 4.5×10^7 units
(D) zero


Answers to MCQ's

- | | | | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1. (B) | 2. (B) | 3. (A) | 4. (A) | 5. (B) | 6. (B) | 7. (B) | 8. (C) | 9. (A) | 10. (B) |
| 11. (C) | 12. (D) | 13. (C) | 14. (B) | 15. (A) | 16. (A) | 17. (D) | 18. (A) | 19. (D) | 20. (A) |
| 21. (D) | 22. (C) | 23. (D) | 24. (A) | 25. (D) | 26. (B) | 27. (D) | 28. (C) | 29. (D) | 30. (D) |
| 31. (B) | 32. (A) | 33. (A) | 34. (B) | 35. (C) | 36. (C) | 37. (A) | 38. (D) | 39. (D) | 40. (D) |
| 41. (D) | 42. (D) | 43. (D) | 44. (A) | 45. (B) | 46. (A) | 47. (B) | 48. (B) | 49. (C) | 50. (C) |
| 51. (C) | 52. (A) | 53. (C) | 54. (A) | 55. (C) | 56. (D) | 57. (A) | 58. (C) | 59. (D) | 60. (B) |
| 61. (D) | 62. (A) | 63. (D) | 64. (C) | 65. (A) | 66. (C) | 67. (A) | 68. (B) | 69. (D) | 70. (C) |
| 71. (D) | 72. (C) | 73. (C) | 74. (C) | 75. (A) | 76. (B) | 77. (D) | 78. (A) | 79. (A) | 80. (B) |
| 81. (C) | 82. (A) | 83. (C) | 84. (C) | 85. (A) | 86. (A) | 87. (A) | 88. (A) | 89. (D) | 90. (B) |
| 91. (D) | 92. (C) | 93. (D) | 94. (B) | 95. (C) | 96. (A) | 97. (D) | 98. (C) | 99. (A) | 100. (D) |
| 101. (C) | 102. (B) | 103. (B) | 104. (B) | 105. (A) | 106. (B) | 107. (A) | 108. (A) | 109. (D) | 110. (A) |
| 111. (A) | 112. (B) | 113. (A) | 114. (B) | 115. (C) | 116. (D) | 117. (D) | 118. (C) | 119. (C) | 120. (D) |
| 121. (D) | 122. (C) | 123. (C) | 124. (C) | 125. (B) | 126. (A) | 127. (C) | 128. (A) | 129. (D) | 130. (B) |
| 131. (C) | 132. (B) | 133. (B) | 134. (D) | 135. (A) | 136. (C) | 137. (A) | 138. (B) | 139. (B) | 140. (A) |
| 141. (C) | 142. (C) | 143. (A) | 144. (B) | 145. (C) | 146. (D) | 147. (B) | 148. (C) | 149. (A) | 150. (B) |
| 151. (D) | 152. (C) | 153. (A) | 154. (D) | 155. (B) | 156. (D) | 157. (C) | 158. (D) | 159. (B) | 160. (A) |
| 161. (B) | 162. (A) | 163. (D) | 164. (C) | 165. (D) | 166. (B) | 167. (D) | 168. (B) | 169. (C) | 170. (C) |
| 171. (A) | 172. (A) | 173. (A) | 174. (A) | 175. (C) | 176. (B) | 177. (D) | 178. (D) | 179. (D) | 180. (C) |
| 181. (D) | 182. (B) | 183. (C) | 184. (A) | 185. (A) | 186. (B) | 187. (D) | 188. (A) | 189. (A) | 190. (A) |
| 191. (A) | 192. (B) | 193. (B) | 194. (B) | 195. (B) | 196. (B) | 197. (A) | 198. (A) | 199. (C) | 200. (A) |
| 201. (C) | 202. (A) | 203. (B) | 204. (B) | 205. (C) | 206. (D) | 207. (C) | 208. (A) | 209. (A) | 210. (C) |
| 211. (D) | 212. (A) | 213. (B) | 214. (B) | 215. (B) | 216. (A) | 217. (B) | 218. (D) | 219. (C) | 220. (A) |
| 221. (C) | 222. (B) | 223. (C) | 224. (C) | 225. (D) | 226. (D) | 227. (B) | 228. (A) | 229. (B) | 230. (C) |
| 231. (B) | 232. (D) | 233. (C) | 234. (C) | 235. (D) | 236. (C) | 237. (C) | 238. (C) | 239. (B) | 240. (B) |
| 241. (D) | 242. (D) | 243. (C) | 244. (D) | 245. (C) | 246. (C) | 247. (A) | 248. (D) | 249. (A) | 250. (C) |
| 251. (C) | 252. (D) | 253. (D) | 254. (A) | 255. (B) | 256. (C) | 257. (A) | 258. (A) | 259. (B) | 260. (A) |
| 261. (A) | 262. (C) | 263. (A) | 264. (B) | 265. (D) | 266. (A) | 267. (D) | 268. (D) | 269. (C) | 270. (C) |
| 271. (A) | 272. (D) | 273. (A) | 274. (D) | 275. (C) | 276. (D) | 277. (B) | 278. (A) | 279. (A) | 280. (D) |
| 281. (A) | 282. (A) | 283. (B) | 284. (A) | 285. (D) | 286. (C) | 287. (A) | | | |


Hints to MCQ's

- | | |
|---|---|
| <p>13. Michael - Laws of electromagnetic induction
Faraday - Quantum model of Hydrogen atom
Niel Bohr - Discovery of Electron
J.J. Thomson - Discovery of Neutron
Chadwick - Discovery of Neutron</p> <p>32. In S.I. system, there are seven fundamental quantities.</p> <p>35. Impulse = change in momentum = $F \times t$
So the unit of momentum will be equal to newton-second.</p> <p>36. Angular acceleration = $\frac{\text{Angular velocity}}{\text{Time}} = \frac{\text{rad}}{\text{s}^2}$</p> <p>39. Because temperature is a fundamental quantity.</p> | <p>40. $F = \frac{1}{4\pi\epsilon_0} \frac{Q_1 Q_2}{r^2}$
$\therefore \epsilon_0 \propto \frac{Q^2}{F \times r^2}$
So ϵ_0 has units of coulomb²/(newton m²)</p> <p>42. $E = - \frac{dV}{dx}$</p> <p>45. $L = \frac{\phi}{I} = \frac{\text{Wb}}{\text{A}} = \text{henry}.$</p> <p>46. $\frac{L}{R}$ is a time constant of L-R circuit. Hence Henry/ohm can be expressed as second.</p> <p>47. $\frac{\text{watt}}{\text{ampere}} = \frac{\text{volt.ampere}}{\text{ampere}} = \text{volt}$</p> |
|---|---|



50. Energy = force $\times$ distance, so if both are increased by 4 times, then energy will increase by 16 times.
56. Poisson's ratio is a unitless quantity.
57. 1 Faraday = 96500 coulomb
58. $PV = nRT$
 $\therefore R = \frac{PV}{nT} = \frac{\text{joule}}{\text{mole} \times \text{kelvin}} = \text{JK}^{-1} \text{mol}^{-1}$
59. joule-second is the unit of angular momentum whereas others are units of energy.
61. $\frac{\text{mass} \times \text{force} \times \text{volume}}{\text{area} \times \text{mass}} = \text{force} \times \text{length} = \text{work}$
67. Resistance = $\frac{V}{I} = \frac{W}{qI} = \frac{\text{kg m}^2/\text{s}^2 \times \text{m}}{\text{As} \times \text{A}}$
 $\therefore$ The unit of resistance = $\frac{\text{kg m}^2}{\text{s}^2 \times \text{As} \times \text{A}} = \text{kg m}^2 \text{A}^{-2} \text{s}^{-3}$
68. Impulse = force $\times$ time
 = mass $\times$ acceleration $\times$ time
 = mass $\times$ change in velocity
 = change in momentum.
69. Radian is the unit of angle.
71. watt = joule/second = ampere $\times$ volt
 = ampere² $\times$ ohm
72. Unit of energy is $\text{kg m}^2/\text{s}^2$
73. watt = joule/s.
74. $F = \frac{Gm_1m_2}{d^2}$;
 $\therefore G = \frac{Fd^2}{m_1m_2} = \text{Nm}^2/\text{kg}^2$
76. $\frac{\text{kg m}}{\text{s}}$ is the unit of linear momentum.
77. $\tau = \frac{dL}{dt}$
 $\therefore dL = \tau \times dt = r \times F \times dt$
 i.e. the unit of angular momentum is joule-second.
79. 1 C.G.S unit of density = 1000 M.K.S. unit of density
 $\therefore 0.5 \text{ g/cc} = 500 \text{ kg/m}^3$
80. $mv = \text{kg} \left(\frac{\text{m}}{\text{s}} \right)$
81. $R = \rho \frac{L}{A}$
 $\therefore \rho = \frac{RA}{L} = \text{ohm} \times \text{cm}$
82. Parsec is astronomical unit of distance.
83. As $I = MR^2 = \text{kg m}^2$
84. curie = disintegration/s
85. $Y = \frac{\text{Stress}}{\text{Strain}} = \frac{\text{Force / Area}}{\text{Dimensionless quantity}}$
 $\therefore Y = \text{Pressure}.$
88. Distance = velocity $\times$ time
 = $(3 \times 10^8) \times (3 \times 10^9 \times 365 \times 24 \times 60 \times 60)$
 = $2.8 \times 10^{25} \text{ km}$
91. Distance of sun from earth = $1.5 \times 10^{11} \text{ m}$
 Angular diameter of sun,
 $\theta = 1921'' = \left(\frac{1921}{60 \times 60} \right)^\circ = \frac{1921}{3600} \times \frac{\pi}{180} \text{ rad}$
 Diameter of sun,
 $D = s \times \theta = 1.5 \times 10^{11} \times \frac{1921}{3600} \times \frac{\pi}{180}$
 $\therefore D = 1.39 \times 10^9 \text{ m}$
98. 1 M.S.D. = $\frac{10}{200} \text{ cm} = 0.050 \text{ cm}$;
 1 V.S.D. = $\frac{0.8}{20} \text{ cm} = 0.04 \text{ cm}$
 $\therefore \text{L.C.} = 1 \text{ M.S.D.} - 1 \text{ V.S.D.}$
 = $0.05 - 0.04 = 0.01 \text{ cm}$
99. Least count = $\frac{\text{Pitch}}{\text{Total number of divisions}}$
 = $\frac{0.035}{100} = 3.5 \times 10^{-4} \text{ cm}$
100. 30 VSD = 29 MSD
 1 VSD = $\frac{29}{30} \text{ MSD}$
 Least count = 1 MSD - 1 VSD
 = $\left(1 - \frac{29}{30} \right) \times 0.5^\circ \text{ MSD}$
 = $\frac{1}{30} \times 0.5^\circ = \left(\frac{1}{60} \right)^\circ = 1 \text{ minute}$
101. Vernier constant = 1 M.S.D. - 1 V.S.D
 Since $n \text{ V.S.D.} = (n - 1) \text{ M.S.D.} = (n - 1) \times \text{cm}$
 $\therefore 1 \text{ V.S.D.} = \left(\frac{n-1}{n} \right) \times \text{cm}$
 $\therefore \text{V.C.} = \text{cm} - \left(\frac{n-1}{n} \right) \times \text{cm} = \frac{x}{n} \text{ cm}$
102. The clock will show correct time after it gains
 $12 \times 60 = 720 \text{ minutes in 720 days.}$
104. For a given Vernier callipers,
 1 MSD = $5.15 - 5.10 = 0.05 \text{ cm}$
 1 VSD = $\frac{2.45}{50} = 0.049 \text{ cm}$
 $\therefore \text{L.C.} = 1 \text{ MSD} - 1 \text{ VSD} = 0.001 \text{ cm}$
 Hence the reading = $5.10 + (0.001 \times 24)$
 = 5.124 cm
 Thus diameter of cylinder = 5.124 cm



111. Here, $s = (13.8 \pm 0.2)\text{m}$
and $t = (4.0 \pm 0.3)\text{s}$
Expressing it in percentage error, we have,
 $s = 13.8 \pm \frac{0.2}{13.8} \times 100\% = 13.8 \pm 1.4\%$
and $t = 4.0 \pm \frac{0.3}{4} \times 100\% = 4 \pm 7.5\%$
 $\therefore v = \frac{s}{t} = \frac{13.8}{4} \pm (1.4 + 7.5) = (3.45 \pm 8.9)\text{m/s}.$
112. $\therefore V = \frac{4}{3}\pi r^3$
 $\therefore$ % error in volume = $3 \times$ % error in radius.
 $= \frac{3 \times 0.1}{5.3} \times 100$
113. Weight in air = $(5.00 \pm 0.05)\text{N}$
Weight in water = $(4.00 \pm 0.05)\text{N}$
Loss of weight in water = $(1.00 \pm 0.1)\text{N}$
Now, relative density = $\frac{\text{weight in air}}{\text{weight loss in water}}$
i.e. $R.D. = \frac{5.00 \pm 0.05}{1.00 \pm 0.1}$
Now, relative density with max. permissible error
 $= \frac{5.00}{1.00} \pm \left(\frac{0.05}{5.00} + \frac{0.1}{1.00} \right) \times 100$
 $= 5.0 \pm (1 + 10)\% = 5.0 \pm 11\%$
114. Average value
 $= \frac{2.63 + 2.56 + 2.42 + 2.71 + 2.80}{5} = 2.62\text{ s}$
Now $|\Delta T_1| = 2.63 - 2.62 = 0.01$
 $|\Delta T_2| = 2.62 - 2.56 = 0.06$
 $|\Delta T_3| = 2.62 - 2.42 = 0.20$
 $|\Delta T_4| = 2.71 - 2.62 = 0.09$
 $|\Delta T_5| = 2.80 - 2.62 = 0.18$
Mean absolute error
 $\Delta T = \frac{|\Delta T_1| + |\Delta T_2| + |\Delta T_3| + |\Delta T_4| + |\Delta T_5|}{5}$
 $= \frac{0.54}{5} = 0.108 \approx 0.11\text{ s}$
115. Volume of cylinder, $V = \pi r^2 l$
Percentage error in volume
 $\frac{\Delta V}{V} \times 100 = \frac{2\Delta r}{r} \times 100 + \frac{\Delta l}{l} \times 100$
 $= \left(2 \times \frac{0.01}{2.0} \times 100 + \frac{0.1}{5.0} \times 100 \right) = (1 + 2)\% = 3\%$
116. Let $x = \sqrt{AB} = \sqrt{(1.0)(2.0)} = 1.414\text{ m}$
Rounding off to two significant digits we get,
 $x = 1.4\text{ m}$
Error in x is given by
 $\frac{\Delta x}{x} = \frac{1}{2} \left[\frac{\Delta A}{A} + \frac{\Delta B}{B} \right] = \frac{1}{2} \left[\frac{0.2}{1.0} + \frac{0.2}{2.0} \right] = \frac{0.6}{2 \times 2}$

- $\therefore \Delta x = x \left[\frac{0.6}{2 \times 2} \right] = 1.4 \times \frac{0.6}{2 \times 2}$
 $\Delta x = 0.21\text{ m}$
Rounding off to two significant figures,
 $\Delta x = 0.2\text{ m}$
 $\therefore \sqrt{AB} = x \pm \Delta x = (1.4 \pm 0.2)\text{m}$
117. Kinetic energy, $E = \frac{1}{2}mv^2$
 $\therefore \frac{\Delta E}{E} \times 100 = \frac{v'^2 - v^2}{v^2} \times 100 = \left[\left(\frac{v'}{v} \right)^2 - 1 \right] \times 100$
 $= [(1.5)^2 - 1] \times 100 = 125\%$
118. Quantity C has maximum power i.e. 4. So it brings maximum error in P.
120. Percentage error in A
 $= \left(2 \times 1 + 3 \times 3 + 1 \times 2 + \frac{1}{2} \times 2 \right) \% = 14\%$
122. The permissible error is calculated by the formula
 $\frac{\Delta A}{A} = 2 \frac{\Delta r}{r}$
125. $\bar{a}_m = \frac{20.17 + 21.23 + 20.79 + 22.07 + 21.78}{5}$
 $\bar{a}_m = 21.21$
 $|\Delta \bar{a}_1| = |21.21 - 20.17| = 1.04$
 $|\Delta \bar{a}_2| = |21.21 - 21.23| = 0.02$
 $|\Delta \bar{a}_3| = 0.42$
 $|\Delta \bar{a}_4| = 0.86$
 $|\Delta \bar{a}_5| = 0.57$
 $|\Delta \bar{a}_m| = \frac{|\Delta \bar{a}_1| + |\Delta \bar{a}_2| + |\Delta \bar{a}_3| + |\Delta \bar{a}_4| + |\Delta \bar{a}_5|}{5}$
 $= \frac{1.04 + 0.02 + 0.42 + 0.86 + 0.57}{5}$
 $= 0.58$
126. Percentage error = $\left(\frac{\Delta d}{d} \times 100 \right) \%$
 $= \left(\frac{0.005}{0.020} \times 100 \right) \%$
 $= 25 \%$
129. $T = 2\pi \sqrt{\frac{L}{g}}$
 $\therefore T^2 = 4\pi^2 \frac{L}{g}$ or $g = 4\pi^2 \frac{L}{T^2}$
 $\therefore \frac{\Delta g}{g} = \pm \left[\frac{\Delta L}{L} + 2 \left(\frac{\Delta T}{T} \right) \right]$
 $\therefore \frac{\Delta g}{g} = \pm \left[\frac{2}{100} + 2 \left(\frac{1}{100} \right) \right]$
 $\therefore \frac{\Delta g}{g} = \pm 4\%$



$$130. T = 2\pi\sqrt{\frac{L}{g}}$$

$$\therefore g = 4\pi^2 \cdot \frac{L}{T^2}$$

$$\begin{aligned}\therefore \frac{\Delta g}{g} \times 100 &= \frac{\Delta L}{L} \times 100 + 2 \frac{\Delta T}{T} \times 100 \\ &= \frac{\Delta L}{L} \times 100 + 2 \cdot \frac{\Delta T}{T} \times 100 \\ &= \frac{0.1}{20.0} \times 100 + 2 \times \frac{1}{90} \times 100 \\ &= \frac{100}{200} + \frac{200}{90} = \frac{1}{2} + \frac{20}{9} \approx 3\%\end{aligned}$$

$$\begin{aligned}131. R_p &= \frac{R_1 R_2}{R_1 + R_2} \\ \frac{\Delta R_p}{R_p} \times 100 &= \frac{\Delta R_1}{R_1} \times 100 + \frac{\Delta R_2}{R_2} \times 100 \\ &\quad + \frac{\Delta(R_1 + R_2)}{(R_1 + R_2)} \times 100\end{aligned}$$

$$\text{Now, } \Delta R_1 = \frac{10}{100} \times 2 \text{ k}\Omega = 0.2 \text{ k}\Omega,$$

$$\Delta R_2 = \frac{10}{100} \times 4 \text{ k}\Omega = 0.4 \text{ k}\Omega$$

$$\begin{aligned}\text{Again, } \frac{\Delta R_p}{R_p} \times 100 &= \frac{0.2}{2} \times 100 + \frac{0.4}{4} \times 100 \\ &\quad + \frac{0.2 + 0.4}{6} \times 100 \\ &= 10 + 10 + 10 = 30\%.\end{aligned}$$

$$134. \text{ Here, } \frac{\Delta m}{m} = \frac{0.003}{0.3}, \frac{\Delta r}{r} = \frac{0.005}{0.5}, \frac{\Delta L}{L} = \frac{0.06}{6}$$

$$\text{As } \rho = \frac{m}{(\pi r^2)L},$$

$$\begin{aligned}\therefore \left(\frac{\Delta \rho}{\rho}\right) \times 100 &= \left(\frac{\Delta m}{m} + \frac{2\Delta r}{r} + \frac{\Delta L}{L}\right) \times 100 \\ &= \left(\frac{0.003}{0.3} + \frac{2 \times 0.005}{0.5} + \frac{0.06}{6}\right) \times 100 \\ &= 1 + 2 + 1 = 4\%\end{aligned}$$

$$135. \text{ Given that: } P = \frac{a^3 b^2}{cd}$$

$$\begin{aligned}\text{error contributed by } a &= 3 \times \left(\frac{\Delta a}{a} \times 100\right) \\ &= 3 \times 1\% \\ &= 3\%\end{aligned}$$

$$\begin{aligned}\text{error contributed by } b &= 2 \times \left(\frac{\Delta b}{b} \times 100\right) \\ &= 2 \times 2\% \\ &= 4\%\end{aligned}$$

$$\text{error contributed by } c = \left(\frac{\Delta c}{c} \times 100\right) = 3\%$$

$$\text{error contributed by } d = \left(\frac{\Delta d}{d} \times 100\right) = 4\%$$

$\therefore$ Percentage error in P is given as,

$$\begin{aligned}\frac{\Delta p}{p} \times 100 &= (\text{error contributed by } a) + (\text{error contributed by } b) + (\text{error contributed by } c) \\ &\quad + (\text{error contributed by } d) \\ &= 3\% + 4\% + 3\% + 4\% \\ &= 14\%\end{aligned}$$

$$\begin{aligned}136. \frac{\Delta Q}{Q} &= 3 \frac{\Delta x}{x} + 2 \frac{\Delta y}{y} + \frac{\Delta z}{z} = 3 \times 1 + 2 \times 2 + 4 \\ &= 11\%\end{aligned}$$

$$\begin{aligned}142. \text{ Total mass} &= 0.000087 + 0.0123 \\ &= 0.012387 \text{ kg} \approx 0.0124 \text{ kg}\end{aligned}$$

The mass of the bee is accurate upto sixth decimal place in kg, whereas the mass of the flower is accurate only upto fourth decimal place. Hence the sum must be rounded off to the fourth decimal place.

$$143. \text{ Average speed} = 100.5/10.3 = 9.76 \text{ ms}^{-1}$$

The distance has four significant figures but the time has only three. Hence the result must be rounded off to three significant figures i.e., 9.76 ms^{-1} .

$$144. \text{ Number of significant figures are 3, because } 10^3 \text{ is decimal multiplier.}$$

$$\begin{aligned}145. \text{ Given, } L &= 2.331 \text{ cm} \\ &= 2.33 \text{ (correct upto two decimal places)} \\ \text{and } B &= 2.1 \text{ cm} = 2.10 \text{ cm}\end{aligned}$$

$$\therefore L + B = 2.33 + 2.10 = 4.43 \text{ cm} = 4.4 \text{ cm}$$

$$\therefore \text{ minimum significant figure is 2.}$$

$$146. \text{ The number of significant figures in all of the given numbers is 4.}$$

$$153. \frac{1}{25} = 0.04$$

$$\therefore \text{ Decimal equivalent upto 3 significant figures is 0.040.}$$

$$\begin{aligned}157. \text{ Electric Field} &= \text{Force/Charge} = [\text{MLT}^{-2}]/[\text{AT}] \\ [\text{E}] &= [\text{M}^1 \text{L}^1 \text{T}^{-3} \text{A}^{-1}]\end{aligned}$$

$$158. \text{ Physical quantity having dimensions must possess unit but there are certain quantities which have units but no dimensions. For example, angle, loudness of sound etc.}$$

$$160. F = \frac{X}{\text{Linear Density}} = \frac{X}{(\text{Mass / length})}$$

$$\text{MLT}^{-2} \times \frac{\text{M}}{\text{L}} = X$$

$$\therefore X = \text{M}^2 \text{T}^{-2}$$



$$161. \therefore [R] = [ML^2T^{-3}I^{-2}] \text{ and } [C] = [M^{-1}L^{-2}T^4I^2]$$

$$\therefore [RC] = [T^1]$$

$$162. Q = ML$$

$$\therefore L = \frac{Q}{M} = \frac{ML^2T^{-2}}{M} = [M^0L^2T^{-2}]$$

$$163. \text{ Volume elasticity} = \frac{\text{Force/Area}}{\text{Volume strain}}$$

Strain is dimensionless, so

$$\text{Volume elasticity} = \frac{\text{Force}}{\text{Area}} = \frac{MLT^{-2}}{L^2} = [ML^{-1}T^{-2}]$$

$$164. E = hv$$

$$\therefore [ML^2T^{-2}] = [h][T^{-1}]$$

$$\therefore [h] = [ML^2T^{-1}]$$

$$165. \sigma = \frac{E}{T^4}$$

Where E is energy radiated per unit area per unit time.

$$166. \text{ Moment of inertia} = mr^2 = [M][L^2]$$

Moment of Force

$$= \text{Force} \times \text{Perpendicular distance}$$

$$= [MLT^{-2}][L] = [ML^2T^{-2}]$$

$$167. \text{ Energy per unit volume} = \frac{[ML^2T^{-2}]}{[L^3]} = [ML^{-1}T^{-2}]$$

$$\text{Force per unit area} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$$

Product of voltage and charge per unit volume

$$= \frac{V \times Q}{\text{Volume}} = \frac{VIt}{\text{Volume}} = \frac{\text{Power} \times \text{Time}}{\text{Volume}}$$

$$\therefore \frac{[ML^2T^{-3}][T]}{[L^3]} = [ML^{-1}T^{-2}]$$

Angular momentum per unit mass

$$= \frac{[ML^2T^{-1}]}{[M]} = [L^2T^{-1}]$$

So angular momentum per unit mass have different dimensions.

$$168. \text{ Linear mass density is mass per unit length, though density is mass per unit volume. Hence, Reason is not a correct explanation of Assertion.}$$

$$169. \text{ Both represent the formula of energy } \left(E = \frac{1}{2}CV^2 = \frac{1}{2}LI^2 \right)$$

$$170. PV = \left(\frac{F}{A} \right) V \quad \dots \left\{ \because P = \frac{F}{A} \right\}$$

$$= \frac{[M^1L^1T^{-2}]}{[L^2]} [L^3] = [M^1L^2T^{-2}]$$

$$171. \frac{1}{\sqrt{\epsilon_0\mu_0}} = c = \text{velocity of light}$$

$$172. \phi = BA = \frac{F}{I \times L} A = \frac{[MLT^{-2}][L^2]}{[A][L]} = [ML^2T^{-2}A^{-1}]$$

$$173. E = \frac{1}{2}LI^2. \text{ Hence } L = [ML^2T^{-2}A^{-2}]$$

$$174. \text{ Kinetic energy} = \frac{1}{2}mv^2 = M[L^2T^{-1}]^2 = [ML^2T^{-2}]$$

$$175. F = -\eta.A \frac{dv}{dx} \quad \therefore \eta = [ML^{-1}T^{-1}]$$

$$176. f = \frac{1}{2\pi\sqrt{LC}} \quad \therefore LC = \frac{1}{f^2} = [M^0L^0T^2]$$

$$177. \text{ Surface tension} = \frac{\text{Force}}{\text{Length}} = \frac{[MLT^{-2}]}{L} = [MT^{-2}]$$

$$178. [\text{Pressure}] = [\text{Stress}] = [\text{coefficient of elasticity}] = [ML^{-1}T^{-2}]$$

$$179. \text{ unit of Planck constant (h) is J-s}$$

$$\therefore \text{Dimension of h} = [M^1L^2T^{-2}][T^1] = [M^1L^2T^{-1}]$$

unit of Moment of inertia is Kg m^2

$$\therefore \text{Dimension of M.I.} = [M^1L^2]$$

$$\therefore \frac{h}{I} = \frac{[M^1L^2T^{-1}]}{[M^1L^2]} = [T^{-1}]$$

This is dimension of frequency.

$$180. \text{ Capacitance} \times \text{resistance} = \frac{\text{charge}}{\text{potential}} \times \frac{\text{potential}}{\text{current}} = \frac{\text{current} \times \text{time}}{\text{current}} = \text{time}$$

$$182. \text{ Solar constant is energy received per unit area per unit time i.e. } \frac{[ML^2T^{-2}]}{[L^2][T]} = [M^1T^{-3}]$$

$$183. \text{ units of solar constant} \Rightarrow \frac{W}{m^2}$$

$$= \text{kg} \frac{m^2}{s^3} \times \frac{1}{m^2} = \frac{kg}{s^3}$$

$$\therefore \text{Dimension} \Rightarrow [ML^0T^{-3}]$$

$$184. \text{ Resistivity } [\rho] = \frac{[R].[A]}{[I]},$$

$$[R] = [ML^2T^{-1}Q^{-2}]$$

$$\therefore [\rho] = [ML^3T^{-1}Q^{-2}]$$

$$185. C = \frac{Q}{V} = \frac{[AT]}{[ML^2T^{-3}A^{-1}]} = [M^{-1}L^{-2}T^4A^2]$$



$$186. \frac{\text{Energy}}{\text{Volume}} = \frac{ML^2T^{-2}}{L^3} = [ML^{-1}T^{-2}] = \text{Pressure}$$

$$187. [G] = [M^{-1}L^3T^{-2}]; [h] = [ML^2T^{-1}]$$

$$\text{Power of lens} = \frac{1}{\text{focal length}} = [L^{-1}]$$

Angle is dimensionless.

$$188. k_B = \left[\frac{R}{N} \right] = [ML^2T^{-2}\theta^{-1}]$$

$$189. W = \frac{1}{2} kx^2$$

$$\therefore [k] = \frac{[W]}{[x^2]} = \left[\frac{ML^2T^{-2}}{L^2} \right] = [MT^{-2}]$$

$$190. \therefore R = \frac{PV}{T} = \left[\frac{ML^{-1}T^{-2} \times L^3}{\theta} \right] = [ML^2T^{-2}\theta^{-1}]$$

192. Substituting dimensions for corresponding quantities in the expression for coefficient of thermal conductivity.

Heat ΔQ transferred through a rod of length L and area A in time Δt is,

$$\Delta Q = KA \left(\frac{T_1 - T_2}{L} \right) \Delta t$$

where, K = coefficient of thermal conductivity

$T_1 - T_2$ = temperature difference.

$$[K] = \frac{[ML^2T^{-2}][L]}{[L^2][\theta][T]} = [MLT^{-3}\theta^{-1}]$$

199. The heat energy content H of a body of mass m at temperature θ is given by $H = ms\theta$, where s is the specific heat.

$$\therefore s = \frac{H}{m\theta}$$

$$\therefore \text{Dimensions of } s = \frac{\text{dimensions of heat energy}}{\text{dimensions of mass} \times \text{dimensions of temperature}}$$

$$= \frac{[ML^2T^{-2}]}{[M \times K]} = [M^0L^2T^{-2}K^{-1}]$$

$$200. \frac{ML^2}{Q^2} = \frac{[ML]^2}{[AT]^2} = [ML^2T^{-2}A^{-2}]$$

Now, Henry (H) = SI unit of inductance

$$= \frac{e}{dI/dt} = \frac{edt}{dI} = \frac{W}{q} \times \frac{dt}{dI} = \frac{[ML^2T^{-2}][T]}{[AT][A]}$$

$$= [ML^2T^{-2}A^{-2}]$$

$$201. \text{Coefficient of friction} = \frac{\text{Applied force}}{\text{Normal reaction}}$$

$$= \frac{[MLT^{-2}]}{[MLT^{-2}]} = \text{no dimensions}$$

$$\text{Unit} = \frac{N}{N} = \text{No unit}$$

$$202. \sigma = [M^1L^0T^{-2}], \eta = [M^1L^{-1}T^{-1}]$$

$$203. \epsilon_0 = \frac{q_1 q_2}{4\pi Fr^2}$$

$$\therefore [\epsilon_0] = \frac{A^2 T^2}{(M^1 L^1 T^{-2}) L^2} = [M^{-1} L^{-3} T^4 A^2]$$

$$204. [R] \equiv [M^1 L^2 T^{-3} A^{-2}] \text{ use } R = \frac{V}{I}$$

$$[V] \equiv [M^1 L^2 T^{-3} A^{-1}] \text{ use } V = \frac{U}{q}$$

$$[\rho] \equiv [M^1 L^3 T^{-3} A^{-2}] \text{ use } \rho = \frac{RA}{l}$$

$$[\sigma] \equiv [M^{-1} L^{-3} T^3 A^2] \text{ use } \sigma = \frac{1}{\rho}$$

208. Physical quantity (p)

= Numerical value (n) $\times$ Unit (u)

If physical quantity remains constant then

$$n \propto 1/u \Rightarrow n_1 u_1 = n_2 u_2.$$

209. μN represents a micro newton ($= 10^{-6} N$) and nm represents a nano metre ($= 10^{-9} m$).

$$210. n_2 = n_1 \left(\frac{M_1}{M_2} \right)^1 \left(\frac{L_1}{L_2} \right)^1 \left(\frac{T_1}{T_2} \right)^{-2}$$

$$= 100 \left(\frac{gm}{kg} \right)^1 \left(\frac{cm}{m} \right)^1 \left(\frac{s}{min} \right)^{-2}$$

$$= 100 \left(\frac{gm}{10^3 gm} \right)^1 \left(\frac{cm}{10^2 cm} \right)^1 \left(\frac{s}{60s} \right)^{-2}$$

$$\therefore n_2 = \frac{3600}{10^3} = 3.6$$

211. By putting the dimensions of each quantity on both the sides, we get

$$[T^{-1}] = [M]^x [MT^{-2}]^y$$

Now comparing the dimensions of quantities on both sides, we get $x + y = 0$ and $2y = 1$

$$\therefore x = -\frac{1}{2}, y = \frac{1}{2}$$

212. Quantities having different dimensions can only be divided or multiplied but they cannot be added or subtracted.

213. From the principle of dimensional homogeneity, $[a] = \left[\frac{F}{t} \right] = [MLT^{-3}]$ and

$$[b] = \left[\frac{F}{t^2} \right] = [MLT^{-4}]$$

214. Let $m \propto E^x v^y F^z$

$$\therefore m = KE^x v^y F^z$$

By substituting the following dimensions:

$$[E] = [ML^2T^{-2}], [v] = [LT^{-1}], [F] = [MLT^{-2}]$$

and by equating the powers of M, L, T on both sides, we get

$$x = 1, y = -2, z = 0. \text{ So } [m] = [Ev^{-2}]$$



$$\begin{aligned}
 215. \quad C^2 LR &= [C^2 L^2] \times \left[\frac{R}{L} \right] \\
 &= [T^4] \times \left[\frac{1}{T} \right] = [T^3] \\
 &\quad \left[\because \left[\frac{L}{R} \right] = T \text{ and } \sqrt{LC} = T \right]
 \end{aligned}$$

216. Let $m = KF^a L^b T^c$
 Substituting the dimensions of
 $[F] = [MLT^{-2}]$, $[L] = [L]$ and $[T] = [T]$
 and comparing powers of M, L, T on both
 sides, we get $m = [FL^{-1}T^2]$

217. $E = KF^a L^b T^c$
 $[ML^2T^{-2}] = [MLT^{-2}]^a [LT^{-2}]^b [T]^c$
 $[ML^2T^{-2}] = [M^a L^{a+b} T^{-2a-2b+c}]$
 $\therefore a = 1, a + b = 2$
 $\therefore b = 1$
 and $-2a - 2b + c = -2$
 $\therefore c = 2$
 $\therefore E = KFAT^2$

218. $n_1 u_1 = n_2 u_2$
 $n_1 [M_1 L_1^{-3}] = n_2 [M_2 L_2^{-3}]$
 $\therefore n_2 = n_1 \left[\frac{M_1}{M_2} \right] \times \left[\frac{L_1}{L_2} \right]^{-3}$
 $= 0.625 \left[\frac{1g}{1kg} \right] \times \left[\frac{1cm}{1m} \right]^{-3}$
 $= 0.625 \times 10^{-3} \times 10^6$
 $= 625 \text{ kg/m}^3$

219. Length $\propto G^x c^y h^z$
 $[L] = [M^{-1} L^3 T^{-2}]^x [LT^{-1}]^y [ML^2 T^{-1}]^z$
 By comparing the powers of M, L and T on
 both sides, we get, $-x + z = 0$, $3x + y + 2z = 1$
 and $-2x - y - z = 0$ which on solving give
 $x = \frac{1}{2}$, $y = -\frac{3}{2}$, $z = \frac{1}{2}$

220. Time $\propto c^x G^y h^z \Rightarrow T = kc^x G^y h^z$
 Substituting the dimensions in the above
 relation we get,
 $\therefore [M^0 L^0 T^1] = [LT^{-1}]^x [M^{-1} L^3 T^{-2}]^y [ML^2 T^{-1}]^z$
 $\therefore [M^0 L^0 T^1] = [M^{-y+z} L^{x+3y+2z} T^{-x-2y-z}]$
 Comparing the powers of M, L and T on both
 sides we get,
 $-y + z = 0 \quad \dots (i)$
 $x + 3y + 2z = 0 \quad \dots (ii)$
 $-x - 2y - z = 1 \quad \dots (iii)$
 On solving equations (i), (ii) and (iii),
 $x = \frac{-5}{2}$, $y = z = \frac{1}{2}$
 Hence dimensions of time are $[G^{1/2} h^{1/2} c^{-5/2}]$

$$221. \quad n = \frac{p}{2l} \left[\frac{F}{m} \right]^{1/2}$$

$$\therefore n^2 = \frac{p^2}{4l^2} \left[\frac{F}{m} \right]$$

$$\therefore m \propto \frac{F}{l^2 n^2}$$

$$\therefore [m] = \left[\frac{MLT^{-2}}{L^2 T^{-2}} \right] = [ML^{-1} T^0]$$

222. 1 dyne = 10^{-5} newton, 1 cm = 10^{-2} m

$$\therefore 70 \frac{\text{dyne}}{\text{cm}} = \frac{70 \times 10^{-5} \text{ N}}{10^{-2} \text{ m}} = 7 \times 10^{-2} \text{ N/m}$$

223. $[X] = [F] \times [\rho] = [MLT^{-2}] \times \left[\frac{M}{L^3} \right] = [M^2 L^{-2} T^{-2}]$

224. 1 nm = 10^{-9} m = 10^{-7} cm

225. 1 newton = 10^5 dyne

226. Energy, $E = \frac{1}{2} mv^2 = \frac{1}{2} (mv)v$

But $mv = p$; {p = momentum}

$v = \frac{x}{T}$ {where x = distance; T = time}

$$\therefore E = \frac{1}{2} p \left(\frac{x}{T} \right)$$

Now,

Area (A) has dimensions of (length)²

$$\therefore x \text{ has dimension of } \sqrt{A}$$

$$\therefore E = \frac{1}{2} p \frac{\sqrt{A}}{T}$$

$$\therefore [E] = [pA^{1/2} T^{-1}]$$

227. $E = \frac{1}{2} mv^2 = \frac{1}{2} mv \times v = \frac{1}{2} \times P \times \frac{s}{t} = \frac{1}{2} P \frac{\sqrt{A}}{T}$

$$\therefore \text{Dimensional formula of energy is } [P^1 A^{1/2} T^{-1}]$$

229. $[P] = [ML^{-1} T^{-2}]$

From $a - t^2$, dimensions of a are $[M^0 L^0 T^2]$

$$[b] = \frac{[T^2]}{[ML^{-1} T^{-2} L]} = [M^{-1} L^0 T^4]$$

$$\therefore \frac{a}{b} = \frac{[T^2]}{[M^{-1} L^0 T^4]} = [M^1 L^0 T^{-2}]$$

230. Given,

$$P = \frac{x^2 - b}{at}$$

From principle of homogeneity, 'b' will have
 the dimensions of x^2

$$\therefore [b] = [L^2] \quad \dots (i)$$

Also,

$$[P] = [M^1 L^2 T^{-3}]$$

$$[t] = [T^1]$$

$$\therefore [a] = \frac{[b]}{[P][t]} = \frac{[L^2]}{[M^1 L^2 T^{-3}][T^1]}$$

$$[a] = [M^{-1} T^2] \quad \dots (ii)$$



$$\therefore \frac{[b]}{[a]} = \frac{[L^2]}{[M^{-1}T^2]} = [M^1L^2T^{-2}] \quad \dots\text{(iii)}$$

$$\text{Torsional constant } K = \frac{\tau}{\theta}$$

$$\therefore [K] = [\tau] \\ [K] = [M^1L^2T^{-2}] \quad \dots\text{(iv)}$$

From (iii) and (iv) we have,

$$\frac{[b]}{[a]} = [K]$$

$$\begin{aligned} 232. \quad X &= \epsilon_0 L \times \frac{\Delta V}{\Delta t} \\ &= [M^{-1}L^{-3}T^4A^2] [L] \frac{[ML^2T^{-3}A^{-1}]}{[T]} \\ &= [M^0L^0T^0A^1] \end{aligned}$$

$$235. \quad f = \frac{1}{2\pi\sqrt{LC}}$$

$\therefore \left(\frac{C}{L}\right)$ does not represent the dimensions of frequency.

$$237. \quad 6 \times 10^{-5} = 60 \times 10^{-6} = 60 \text{ microns}$$

$$238. \quad [x] = [bt^2] \Rightarrow [b] = [x/t^2] = \text{km/s}^2$$

$$\begin{aligned} 239. \quad &\text{Let } [G] \propto c^x g^y p^z \\ &\text{By substituting the following dimensions we get,} \\ &[G] = [M^{-1}L^3T^{-2}], [c] = [LT^{-1}], [g] = [LT^{-2}] \\ &[p] = [ML^{-1}T^{-2}] \\ &\text{and by comparing the powers of M, L, T on both sides} \end{aligned}$$

$$\text{we get } x = 0, y = 2, z = -1$$

$$\therefore [G] \propto c^0 g^2 p^{-1}$$

$$\begin{aligned} 240. \quad [G] &= [M^{-1}L^3T^{-2}] \\ [c] &= [M^0L^1T^{-1}] \\ [h] &= [M^1L^2T^{-1}] \end{aligned}$$

Now, let the relation between given quantities and length be,

$$L = G^x c^y h^z$$

$$\therefore [L^1] = [M^{-1}L^3T^{-2}]^x [M^0L^1T^{-1}]^y [M^1L^2T^{-1}]^z$$

$\therefore$ We get,

$$-x + z = 0$$

$$\text{i.e. } z = x \quad \dots\text{(i)}$$

$$3x + y + 2z = 1 \quad \dots\text{(ii)}$$

$$-2x - y - z = 0 \quad \dots\text{(iii)}$$

$$\therefore y = -3x \quad \dots[\text{from (i) and (iii)}]$$

Substituting the value in eq. (ii)

$$\therefore 3x - 3x + 2z = 1$$

$$\text{i.e. } z = \frac{1}{2}$$

Substituting this value we get,

$$x = \frac{1}{2} \quad \text{and } y = \frac{-3}{2}$$

$$\therefore L = \frac{\sqrt{Gh}}{c^{3/2}}$$

$$241. \quad n_2 = n_1 \left[\frac{L_1}{L_2} \right]^1 \left[\frac{T_1}{T_2} \right]^{-2} = 10 \left[\frac{\text{metre}}{\text{km}} \right]^1 \left[\frac{\text{s}}{\text{hr}} \right]^{-2}$$

$$\therefore n_2 = 10 \left[\frac{\text{m}}{10^3 \text{ m}} \right]^1 \left[\frac{\text{s}}{3600 \text{ s}} \right]^{-2} = 129600$$

$$243. \quad 1 \text{ fermi} = 10^{-15} \text{ metre.}$$

$$244. \quad \text{tropical year is the unit of time.}$$

$$250. \quad \text{Frank-Hertz Exp. - Discrete energy level.} \\ \text{Photo-electric effect - Particle nature of light} \\ \text{Davison-Germer exp. - Diffraction of electron beam.}$$

$$251. \quad \text{Given equation is dimensionally correct because both sides are dimensionless but numerically wrong because the correct equation is } \tan \theta = \frac{v^2}{rg}.$$

$$252. \quad \text{By substituting the dimensions of mass [M], length [L] and coefficient of rigidity } [ML^{-1}T^{-2}], \\ \text{we get } T = 2\pi \sqrt{\frac{M}{\eta L}} \text{ as the right formula for time period of oscillations.}$$

$$\begin{aligned} 253. \quad [n] &= \text{Number of particles crossing a unit area in unit time} = [L^{-2}T^{-1}] \\ [n_2] &= [n_1] = \text{number of particles per unit volume} = [L^{-3}] \\ [x_2] &= [x_1] = \text{positions} \end{aligned}$$

$$\therefore D = \frac{[n][x_2 - x_1]}{[n_2 - n_1]} = \frac{[L^{-2}T^{-1}] \times [L]}{[L^{-3}]} = [L^2T^{-1}]$$

$$254. \quad 1 \text{ crane} = 170.474 \text{ litre}$$

$$1 \text{ litre} = 10^{-3} \text{ m}^3$$

$$\therefore 170.474 \text{ litre} = 170.474 \times 10^{-3} \text{ m}^3 \\ = 0.170474 \text{ m}^3$$

$$256. \quad \text{Stefan's law is } E = \sigma(T^4)$$

$$\therefore \sigma = \frac{E}{T^4}$$

$$\text{where, } E = \frac{\text{Energy}}{\text{Area} \times \text{Time}} = \frac{\text{watt}}{\text{m}^2}$$

$$\therefore \sigma = \frac{\text{watt m}^{-2}}{\text{K}^4} = \text{watt m}^{-2} \text{K}^{-4}$$

$$258. \quad \text{Here distance of the star} = 4.29 \text{ light years}$$

$$= 4.29 \times 9.46 \times 10^{15} = 4.058 \times 10^{16} \text{ m}$$

$$\text{Since } 1 \text{ parsec} = 3.08 \times 10^{16} \text{ m}$$

Therefore distance in parsec

$$= \frac{4.058 \times 10^{16}}{3.08 \times 10^{16}} = 1.318 \approx 1.32 \text{ parsec}$$

In the orbit around the sun, the distance between the two locations of the earth six months apart = 2 AU = $2 \times 1.496 \times 10^{11} \text{ m}$.



Therefore the star will show parallax

$$\theta = \frac{l}{s} = \frac{2 \times 1.496 \times 10^{11}}{4.058 \times 10^{16}} = 7.37 \times 10^{-6} \text{ radian} = 1.52''$$

260. Fractional error in the three measurements are respectively, $\pm \frac{0.1}{0.4}$; $\pm \frac{0.01}{0.40}$; $\pm \frac{0.001}{0.400}$.

The last one has the least error, i.e., it is the most accurate one.

263. Area, $A = \pi r^2 = 3.142 \times (0.021)^2$
 $= 0.00138562 \text{ cm}^2$

There are only two significant figures in 0.021 cm. Hence the result must be rounded off to two significant figures i.e., $A = 0.0014 \text{ cm}^2$.

264. As per the question, the measured value is 3.50 cm. Hence the least count must be 0.01 cm = 0.1 mm

For vernier scale, where the 10 divisions in vernier scale matches with 9 division in main scale and main scale has 10 divisions in 1 cm
 1 MSD = 1 mm and 9 MSD = 10 VSD,
 Least count = 1 MSD – 1 VSD = 0.1 mm
 Hence, correct option is (B).

265. Pitch of screw gauge = $\frac{1}{2} \text{ mm} = 0.5 \text{ mm}$

Least count of screw gauge

$$= \frac{0.5}{50} \text{ mm} = 0.01 \text{ mm}$$

Zero error = -0.03 mm

Zero correction = + 0.03 mm

Observed diameter of wire

$$= 3 \text{ mm} + 35 \times (0.01) \text{ mm} = 3.35 \text{ mm}$$

Corrected diameter of wire

$$= (3.35 + 0.03) \text{ mm} = 3.38 \text{ mm}$$

266. Main Scale Reading (MSR) = 0.5 mm
 Circular Scale Division (CSD) = 25th
 Number of divisions on circular scale = 50
 Pitch of screw = 0.5 mm

$$\therefore \text{LC of screw gauge} = \frac{0.5}{50} = 0.01 \text{ mm}$$

$$\therefore \text{zero error} = -5 \times \text{LC} = -0.05 \text{ mm}$$

$$\therefore \text{zero correction} = +0.05 \text{ mm}$$

$$\text{Observed reading} = 0.5 \text{ mm} + (25 \times 0.01) \text{ mm} = 0.75 \text{ mm}$$

$$\text{Corrected reading} = 0.75 \text{ mm} + 0.05 \text{ mm} = 0.80 \text{ mm}$$

$$267. \therefore \text{Density, } \rho = \frac{M}{V} = \frac{M}{\pi r^2 L}$$

$$\begin{aligned} \therefore \frac{\Delta \rho}{\rho} &= \frac{\Delta M}{M} + 2 \frac{\Delta r}{r} + \frac{\Delta L}{L} \\ &= \frac{0.003}{0.3} + 2 \times \frac{0.005}{0.5} + \frac{0.06}{6} \\ &= 0.01 + 0.02 + 0.01 = 0.04 \end{aligned}$$

$$\therefore \text{Percentage error} = \frac{\Delta \rho}{\rho} \times 100 = 0.04 \times 100 = 4\%$$

$$268. a = b^\alpha c^\beta / d^\gamma e^\delta$$

So maximum error in 'a' is given by

$$\begin{aligned} \left(\frac{\Delta a}{a} \times 100 \right)_{\max} &= \alpha \cdot \frac{\Delta b}{b} \times 100 + \beta \cdot \frac{\Delta c}{c} \times 100 \\ &\quad + \gamma \cdot \frac{\Delta d}{d} \times 100 + \delta \cdot \frac{\Delta e}{e} \times 100 \\ &= (\alpha b_1 + \beta c_1 + \gamma d_1 + \delta e_1)\% \end{aligned}$$

269. We have;

$$T = 2\pi \sqrt{\frac{l}{g}}$$

$$\text{Squaring } T^2 = 4\pi^2 \left(\frac{l}{g} \right)$$

$$\therefore g = 4\pi^2 \frac{l}{T^2}$$

Fractional error in g is

$$\frac{\Delta g}{g} = \frac{\Delta l}{l} + 2 \frac{\Delta T}{T}$$

$$271. \frac{\Delta g}{g} = \frac{\Delta L}{L} + 2 \left(\frac{\Delta T}{T} \right)$$

$$\therefore \Delta g = g \left[\frac{\Delta L}{L} + 2 \left(\frac{\Delta T}{T} \right) \right]$$

Time for 20 oscillations = 40 s

$$\therefore \text{Time for 1 oscillation} = \frac{40}{20}$$

$$\therefore T = 2 \text{ s}$$

$$\therefore \Delta g = 9.68 \left[\frac{0.1}{98} + 2 \left(\frac{0.1}{2} \right) \right]$$

$$\therefore \Delta g = 9.68 \left[\frac{0.1}{98} + 0.1 \right]$$

273. According to the problem, muscle $\times$ speed = power

$$\therefore \text{muscle} = \frac{\text{power}}{\text{speed}} = \frac{[ML^2T^{-3}]}{[LT^{-1}]} = [MLT^{-2}]$$

$$274. e = L \frac{di}{dt}$$

$$\therefore [e] = [ML^2T^{-2}A^{-2}] \left[\frac{A}{T} \right]$$

$$[e] = \left[\frac{ML^2T^{-2}}{AT} \right] = [ML^2T^{-2}Q^{-1}]$$

275. Surface tension (T) is given as,

$$[T] = \left[\frac{F}{L} \right]$$

where, {F $\equiv$ force, L $\equiv$ length}

But energy [E] = [F][L]

$$\therefore [F] = \left[\frac{E}{L} \right]$$

$$\therefore [T] = \left[\frac{E}{L^2} \right]$$



But velocity $[V] = \left[\frac{L}{T} \right]$

$\therefore [L] = [VT]$

$\therefore [T] = \left[\frac{E}{V^2 T^2} \right]$

$[T] = [EV^{-2}T^{-2}]$

276. $Y = \frac{X}{3Z^2} = \frac{[M^{-1}L^{-2}T^4A^2]}{[MT^{-2}A^{-1}]^2} = [M^{-3}L^{-2}T^8A^4]$

277. $\frac{[ML^2T^{-2}][ML^2T^{-1}]^2}{[M^5][M^{-1}L^3T^{-2}]^2}$
 $= [M^0L^0T^0]$ i.e. a dimensionless quantity

278. By principle of dimensional homogeneity,
 $\left[\frac{a}{V^2} \right] = [P]$

$\therefore [a] = [P] [V^2] = [ML^{-1}T^{-2}] \times [L^6] = [ML^5T^{-2}]$

279. Hubble's constant, $H = \frac{\text{velocity}}{\text{distance}} = \frac{[LT^{-1}]}{[L]}$
 $= [T^{-1}]$

280. From the dimensional homogeneity
 $[x] = [Ay] = [B] \Rightarrow \left[\frac{x}{A} \right] = [y] = \left[\frac{B}{A} \right]$
 $[Cz] = [M^0L^0T^0] = \text{Dimensionless}$
 x and B ; C and z^{-1} ; y and $\frac{B}{A}$ have the same dimensions but x and A have different dimensions.

281. spring constant $= \frac{F}{x} = \frac{[MLT^{-2}]}{[L]} = [M^1L^0T^{-2}]$

pascal = unit of pressure

$$= \frac{F}{A} = \frac{[MLT^{-2}]}{[L^2]} = [M^1L^{-1}T^{-2}]$$

hertz = unit of frequency $= [M^0L^0T^{-1}]$

joule = unit of work $= [M^1L^2T^{-2}]$.

282. In the given equation, $\frac{\alpha Z}{k\theta}$ should be dimensionless

$\therefore \alpha = \frac{k\theta}{Z}$

$\therefore [\alpha] = \frac{[ML^2T^{-2}K^{-1} \times K]}{[L]} = [MLT^{-2}]$

and $P = \frac{\alpha}{\beta}$

$\therefore [\beta] = \left[\frac{\alpha}{P} \right] = \frac{[MLT^{-2}]}{[ML^{-1}T^{-2}]} = [M^0L^2T^0]$.

283. $[T] = [M^1T^{-2}]$
 $[\eta] = [M^1L^{-1}T^{-1}]$
 $[\rho] = [M^1L^{-3}]$

From the options given, we have,

$$\frac{[T]}{[\eta]} = \frac{[M^1T^{-2}]}{[M^1L^{-1}T^{-1}]} = [L^1T^{-1}] = [v]$$

$\therefore v = \frac{T}{\eta}$

284. $\left[\frac{nh}{2\pi qB} \right] = \left[\frac{mvr}{qB} \right]$
 $= \frac{[mvr][v]}{[F]} = \left[\frac{mv^2r}{\frac{mv^2}{r}} \right] = [r^2] = [L^2]$
 $= \text{dimensions of area.}$

285. $v = at + \frac{b}{t+c}$

As c is added to time t , therefore, c must have the dimensions of time $[T]$.

From $v = at$, $a = \frac{v}{t}$

$$[a] = \frac{[LT^{-1}]}{[T]} = [LT^{-2}]$$

From $[t+c] = [T] = [c]$,
 $[T] = [c]$

From $[v] = \left[\frac{b}{t+c} \right]$,

$$[b] = [v][t] = [LT^{-1}][T]$$

$$[b] = [L]$$

$\therefore$ Dimensions of a , b , c are $[LT^{-2}]$, $[L]$ and $[T]$ respectively.

286. $[a\sqrt{x}] = [F]$

$\therefore [a] = \frac{[F]}{[\sqrt{x}]} = \frac{[L^1M^1T^{-2}]}{[L^{1/2}]} = [M^1L^{1/2}T^{-2}]$

$$[bt^2] = [F]$$

$\therefore [b] = \frac{[F]}{[t^2]} = \frac{[L^1M^1T^{-2}]}{[T^2]} = [M^1L^1T^{-4}]$

$$[a/b] = \frac{[L^{1/2}M^1T^{-2}]}{[L^1M^1T^{-4}]} = [L^{-1/2}T^2]$$

Dimensions of physical quantity are independent of the constant multiple of a unit.

287. $20 \text{ J} = 20 \frac{\text{kg m}^2}{\text{s}^2}$
 $= 20 \frac{1\text{kg} \times (100\text{cm})^2}{(1\text{s})^2} = 20 \frac{1 \times (100/20)^2}{(1/30)^2}$
 $= 4.5 \times 10^5 \text{ units.}$



Topic Test

- Who gave the quantum model of an atom?
(A) Neil Bohr
(B) E. Rutherford
(C) Paul Dirac
(D) C. Anderson
- Out of the following, which is NOT microscopic domain?
(A) optics (B) atoms
(C) molecules (D) nuclei
- Computers are based on
(A) wave nature of electron
(B) optical phenomenon
(C) digital logic
(D) electricity
- Which among the following is the unit for mass in metric or M.K.S system?
(A) gram (B) kilogram
(C) pound (D) milligram
- Which of the following is NOT a fundamental quantity?
(A) temperature
(B) electric charge
(C) mass
(D) electric current
- A spherometer has 100 equal divisions marked along the periphery of its disc and one full rotation of the disc advances on the main scale by 0.01 cm. The least count of the system is
(A) 10^{-4} cm (B) 10^{-2} cm
(C) 10^{-3} cm (D) 10^2 cm
- If the pointer of the voltmeter is not exactly at the zero of the scale, the error is called
(A) instrumental error
(B) systematic error
(C) personal error
(D) random error
- The length, breadth and height of a rectangular block of wood were measured to be $l = 13.12 \pm 0.02$ cm, $b = 7.18 \pm 0.01$ cm, $h = 4.16 \pm 0.02$ cm respectively. The percentage error in the volume of the block will be
(A) 7 % (B) 0.77 %
(C) 0.72 % (D) 0.27 %
- If the digit to be dropped is 5 or 5 followed by zeroes, then the preceding digit is
(A) raised by one if it is odd.
(B) raised by one if it is even.
(C) lowered by one if it is even.
(D) unchanged if it is odd.
- The number of significant figures in 0.0009 is
(A) 4 (B) 3
(C) 2 (D) 1
- Latent heat has the same dimensions as that of
(A) Velocity gradient
(B) Potential gradient
(C) Energy gradient
(D) Gravitational potential
- Dimensions of 'ohm' are same as that of
(A) $\frac{h}{e}$ (B) $\frac{h^2}{e}$
(C) $\frac{h}{e^2}$ (D) $\frac{h^2}{e^2}$
- Taking frequency f , velocity v and density ρ to be the fundamental quantities, the dimensional formula for momentum will be
(A) $\rho v^4 f^{-3}$ (B) $\rho v^3 f^{-1}$
(C) $\rho v f^2$ (D) $\rho^2 v^2 f^2$
- One pico Farad is equal to
(A) 10^{-24} F (B) 10^{-18} F
(C) 10^{-12} F (D) 10^{-6} F
- If total external torque acting on system is zero, then _____ is conserved.
(A) Energy
(B) Linear momentum
(C) Angular momentum
(D) Charge
- The macroscopic forces like 'tension', 'friction', 'spring force' arises from
(A) Strong Nuclear force
(B) Electromagnetic force
(C) Weak Nuclear force
(D) Gravitational force
- It takes 8.6 years for light to reach Earth from the brightest star in night sky (called Sirius). The distance between Earth and Sirius in AU is [$1 \text{ AU} = 1.5 \times 10^{11} \text{ m}$]
(A) 0.54×10^4 (B) 1.2×10^4
(C) 1.2×10^{28} (D) 5.4×10^5
- What are the units of magnetic permeability?
(A) $\text{Wb A}^{-1} \text{ m}^{-1}$ (B) $\text{Wb}^{-1} \text{ Am}$
(C) Wb A m^{-1} (D) $\text{Wb A}^{-1} \text{ m}$
- μ_0 and ϵ_0 denote the permeability and permittivity of free space, the dimensions of $\mu_0 \epsilon_0$ are
(A) $[\text{LT}^{-1}]$ (B) $[\text{L}^{-2} \text{T}^2]$
(C) $[\text{M}^{-1} \text{L}^{-3} \text{Q}^2 \text{T}^2]$ (D) $[\text{M}^{-1} \text{L}^{-3} \text{I}^2 \text{T}^2]$



20. If velocity v , acceleration a and force F are chosen as fundamental quantities, then the dimensional formula of angular momentum in terms of v , a and F would be

- (A) $[Fa^{-1}v]$ (B) $[Fv^3a^{-2}]$
(C) $[Fv^2a^{-1}]$ (D) $[F^2v^2a^{-1}]$

**Answer to Topic Test**

- | | | | |
|---------|---------|---------|---------|
| 1. (A) | 2. (A) | 3. (C) | 4. (B) |
| 5. (B) | 6. (A) | 7. (B) | 8. (B) |
| 9. (A) | 10. (D) | 11. (D) | 12. (C) |
| 13. (A) | 14. (C) | 15. (C) | 16. (B) |
| 17. (D) | 18. (A) | 19. (B) | 20. (B) |