36
YEARS
1988 - 2023

1892 MCQs

PREVIOUS SOLVED PAPER

Chapter-wise & Subtopic-wise

NEET PHYSICS

Updated as per latest syllabus prescribed by

NMC on 06^{th} October, 2023

Salient Features

- A compilation of 36 years of AIPMT/NEET questions (1988-2023)
- Includes solved questions from **NEET (UG) 2023**
- Includes '1892' AIPMT/NEET MCQs
- Chapter-wise and Subtopic-wise segregation of questions
- Year-wise flow of content concluded with the latest questions
- Solutions provided wherever required
- Graphical analysis of questions: Chapter-wise and Subtopic-wise
- Separate list of questions excluded from the NEET (UG) 2024 syllabus

Scan the adjacent QR code in *Quill - The Padhai App* to view **NEET (UG) 2023 (Manipur)** question paper along with answers and solutions in PDF format.

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PREFACE

Target's **'NEET Physics: PSP (Previous Solved Papers)'** is a compilation of questions asked in the past 36 years (1988-2023) in the National Eligibility cum Entrance Test (NEET), formerly known as the All India Pre-Medical Test (AIPMT).

The book consists of chapter-wise categorization of questions. Each chapter is further segregated into subtopics and thereafter all the questions pertaining to a subtopic are arranged year-wise concluding with the latest year. To aid students, we have also provided detailed solutions for questions wherever deemed necessary.

Considering the latest modifications in the syllabus of NEET (UG) examination, a list of questions based on the concepts excluded from the latest NEET (UG) 2024 syllabus is provided.

A graphical (% wise) analysis of the subtopics for the past 36 years as well as 11 years (2013 onwards) has been provided at the onset of every chapter. Both the graphs will help the students to understand and analyse each subtopic's distribution for NEET/AIPMT (36 years) and NEET (UG) (11 Years).

We are confident that this book will comprehensively cater to needs of students and effectively assist them to achieve their goal.

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.
Please write to us on: mail@targetpublications.org

A book affects eternity; one can never tell where its influence stops.

Best of luck to all the aspirants!

Publisher

Edition: Fourth

Frequently Asked Questions

Why this book?	• This book acts as a go-to tool to find all the AIPMT/NEET questions since the past 36 years at one place. • The subtopic wise arrangement of questions provides the break-down of a chapter into its important components which will enable students to design an effective learning plan. • The graphical analysis guides students in ascertaining their own preparation of a particular topic.
Why the need for two graphs?	Admission for undergraduate and post graduate medical courses underwent a critical change with the introduction of NEET in 2013. Although it received a huge backlash and was criticised for the following two years, NEET went on to replace AIPMT in 2016. The introduction of NEET brought in a few structural differences in terms of how the exam was conducted. Although the syllabus has majorly remained the same, the chances of asking a question from a particular subtopic are seen to vary slightly with the inception of NEET. The two graphs will fundamentally help the students to understand that the (weightage) distribution of a particular chapter can vary i.e., a particular subtopic having the most weightage for AIPMT may not necessarily be the subtopic with the most weightage for NEET.
How are the two graphs beneficial to the students?	• The two graphs provide a subtopic's weightage distribution over the past 36 years (for NEET/AIPMT) and over the past 11 years (for NEET-UG). • The students can use these graphs as a self-evaluation tool by analyzing and comparing a particular subtopic's weightage with their preparation of the subtopic. This exercise would help the students to get a clear picture about their strength and weakness based on the subtopics. • Students can also use the graphs as a source to know the most important as well as least important subtopics as per weightage of a particular chapter which will further help them in planning the study structure of a particular chapter. *(Note: The percentage-wise weightage analysis of subtopics is solely for the knowledge of students and does not guarantee questions from subtopics having the most weightage, in the future exams. Question classification of a subtopic is done as per the authors' discretion and may vary with respect to another individual.)*

Index

Usage of symbols:

◑ – *Part of the chapter excluded from the NEET (UG) 2024 syllabus (in index)*

D – *Sub-topics or questions that are not part of the NCERT Rationalised (2023-24) textbooks (in book)*

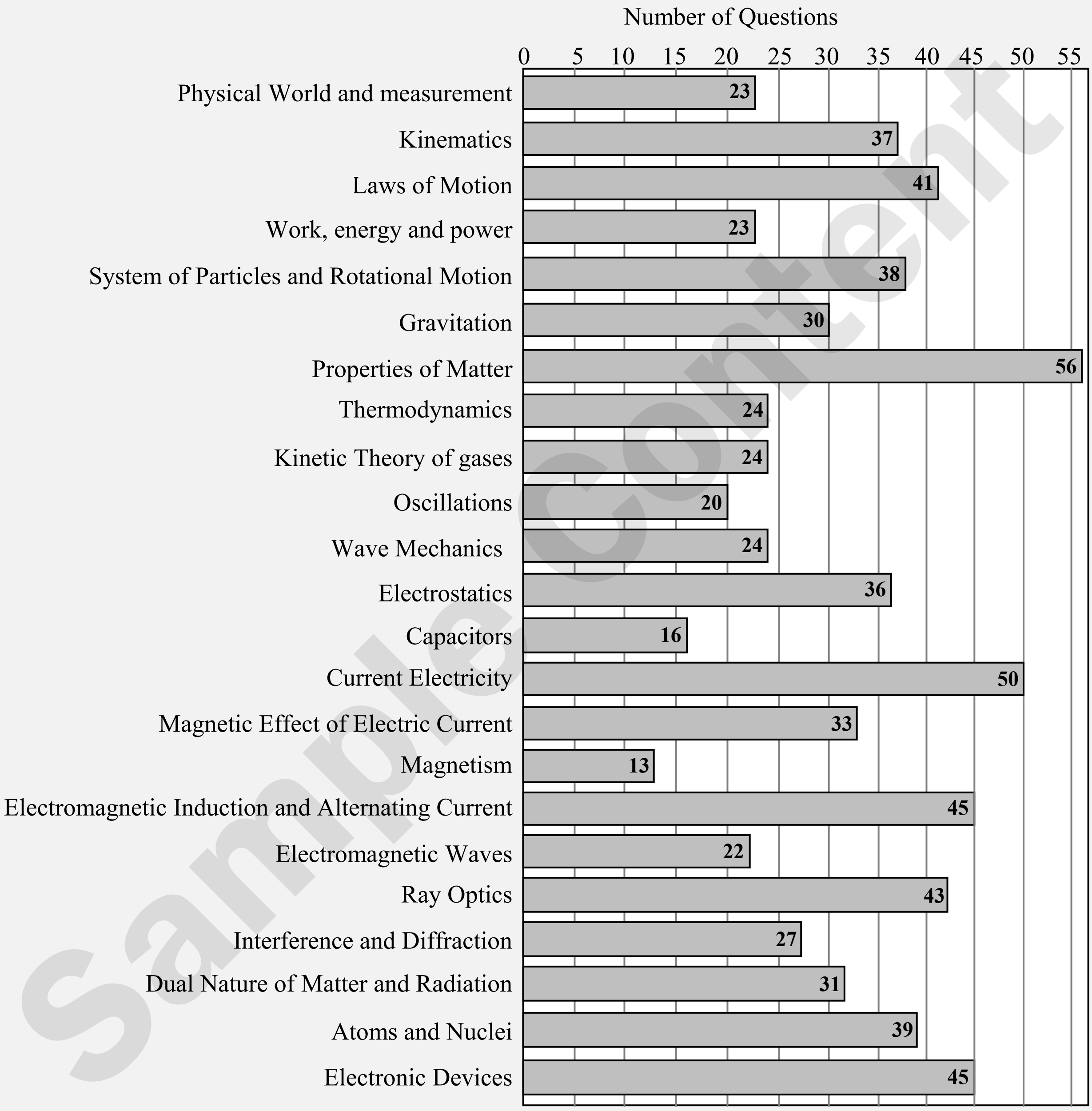
Questions based on the concepts excluded from the NEET (UG) 2024 Syllabus

Chapter Name	Sub-topic Name	Questions that are excluded from NEET (UG) 2024 Syllabus	Page no.
5. System of Particles and Rotational Motion	5.1 Centre of mass, Centre of gravity	3, 5, 6	60
		10	61
7. Properties of Matter	7.4 Elastic energy	All Questions	92
	7.18 Qualitative ideas of black body radiation		97
	7.19 Wien's displacement law		97
	7.20 Newton's law of cooling and Stefan's law		97-98
8. Thermodynamics	8.3 Heat Engine, Refrigerator (heat pump)	All Questions	110-111
10. Oscillations	10.5 Damped Simple Harmonic Motion, forced oscillations and resonance	All Questions	128
11. Wave Mechanics	11.5 Doppler effect	All Questions	139-140
14. Current Electricity	14.3 Carbon Resistors and Electrical resistivity and conductivity of a substance	15, 17	172
		21	173
	14.11 Potentiometer	All Questions	181
15. Magnetic Effect of Electric Current	15.2 Motion of a charged particle in combined electric and magnetic field	22	197
16. Magnetism	16.2 Current loop as a magnetic dipole and its magnetic dipole moment	All Questions	214
	16.4 Earth's Magnetism		215
	16.6 Electromagnet and Permanent magnet		216
17. Electromagnetic Induction and Alternating Current	17.9 LC Oscillations	All Questions	226
19. Ray Optics	19.7 Some natural phenomenon due to Sunlight	1	250
	19.8 Human Eye and its defects	All Questions	250

20. Interference and diffraction	20.4 Resolving power of microscope and astronomical telescope (Rayleigh's criteria)	All Questions	264
21. Dual Nature of matter and radiation	21.6 Davisson and Germer Experiment	All Questions	276
22. Atoms and Nuclei	22.5 Composition and size of nucleus, atomic mass, isotopes, isobars, isotones	3, 14	288
	22.8 Radioactivity: α, β and γ - rays and their properties	All Questions	290
	22.9 Radioactive Decay Law		290-292
	22.10 Types of α, β and γ decay		292-293
23. Electronic Devices	23.7 Junction Transistor	All Questions	310
	23.8 Transistor as a switch		310
	23.9 Transistor as an amplifier		310-312
	23.10 Transistor as an oscillator		312

Note: *The above table contains the list of chapters/subtopics/question numbers that are excluded from the latest syllabus of NEET (UG) 2024. However, these questions are covered to give an idea about the variety and difficulty levels of questions asked in the examination over the years.*

Chapter-wise Weightage Analysis of past 11 Years (2013 Onwards)

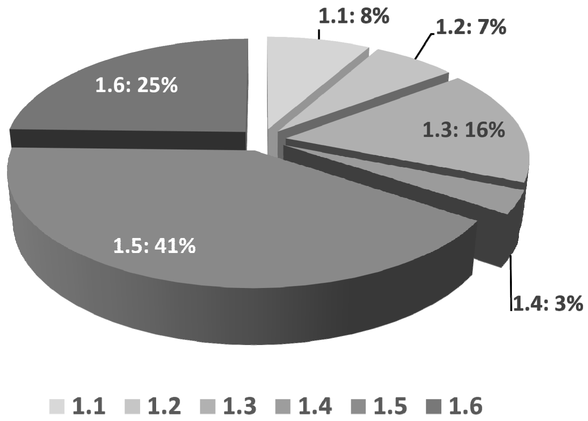


Total No. of Questions: 740

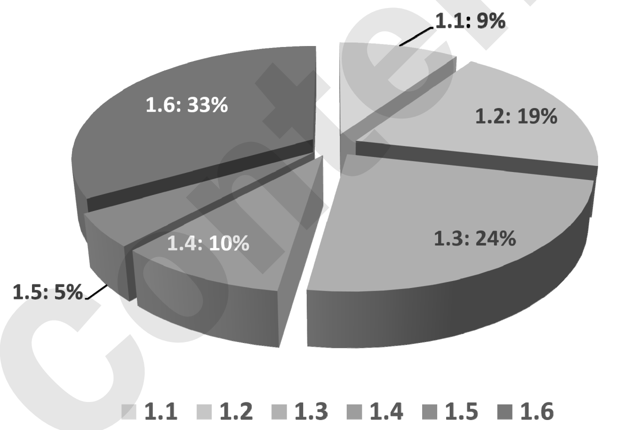
1 Physical World and Measurement

- 1.1 Fundamental and derived units
- 1.2 Accuracy, precision and least count of measuring instruments
- 1.3 Errors in measurement
- 1.4 Significant figures
- 1.5 Dimensions of physical quantities
- 1.6 Dimensional analysis and its applications

36 Years NEET/AIPMT Analysis
(Percentage-wise weightage of sub-topics)



11 Years NEET Analysis (2013 Onwards)
(Percentage-wise weightage of sub-topics)



1.1 Fundamental and derived units

1. 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 is **[1989]**
   (A) km/s (B) km s
   (C) km/s^2 (D) km s^2

2. The unit of permittivity of free space ε_0 is **[2004]**
   (A) coulomb/(newton metre)
   (B) newton metre^2/coulomb^2
   (C) coulomb^2/ newton metre^2
   (D) coulomb^2/(newton metre)^2

3. The damping force on an oscillator is directly proportional to the velocity. The units of the constant of proportionality are **[2012]**
   (A) kg m s^{-1} (B) kg m s^{-2}
   (C) kg s^{-1} (D) kg s

4. The angle of 1′ (minute of arc) in radian is nearly equal to **[Phase-II 2020]**
   (A) 1.75×10^{-2} rad
   (B) 2.91×10^{-4} rad
   (C) 4.85×10^{-4} rad
   (D) 4.80×10^{-6} rad

5. Plane angle and solid angle have: **[2022]**
   (A) No units and no dimensions
   (B) Both units and dimensions
   (C) Units but no dimensions
   (D) Dimensions but no units

D 1.2 Accuracy, precision and least count of measuring instruments

1. A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm. The main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of –0.004 cm, the correct diameter of the ball is **[2018]**
   (A) 0.521 cm (B) 0.525 cm
   (C) 0.053 cm (D) 0.529 cm

2. The main scale of a vernier callipers has n divisions/cm. n divisions of the vernier scale coincide with (n – 1) divisions of main scale. The least count of the vernier callipers is, **[Odisha 2019]**
   (A) $\frac{1}{n(n+1)}$ cm (B) $\frac{1}{(n+1)(n-1)}$ cm
   (C) $\frac{1}{n}$ cm (D) $\frac{1}{n^2}$ cm

3. A screw gauge has least count of 0.01 mm and there are 50 divisions in its circular scale. The pitch of the screw gauge is: **[Phase-I 2020]**
(A) 0.25 mm (B) 0.5 mm
(C) 1.0 mm (D) 0.01 mm

4. A screw gauge gives the following readings when used to measure the diameter of a wire
Main scale reading: 0 mm
Circular scale reading: 52 divisions
Given that 1 mm on main scale corresponds to 100 divisions on the circular scale. The diameter of the wire from the above data is: **[2021]**
(A) 0.026 cm (B) 0.26 cm
(C) 0.052 cm (D) 0.52 cm

D 1.3 Errors in measurement

1. A certain body weighs 22.42 g and has a measured volume of 4.7cc. The possible error in the measurement of mass and volume are 0.01 g and 0.1 cc. Then maximum error in the density will be **[1991]**
(A) 22% (B) 2%
(C) 0.2% (D) 0.02%

2. Percentage errors in the measurement of mass and speed are 2% and 3% respectively. The error in the estimate of kinetic energy obtained by measuring mass and speed will be **[1995]**
(A) 8% (B) 2%
(C) 12% (D) 10%

3. The density of a cube is measured by measuring its mass and length of its sides. If the maximum error in the measurement of mass and length are 3% and 2% respectively, the maximum error in the measurement of density would be **[1996]**
(A) 12% (B) 14% (C) 7% (D) 9%

4. If the error in the measurement of radius of a sphere is 2%, then error in the determination of volume of the sphere will be **[2008]**
(A) 8% (B) 2% (C) 4% (D) 6%

5. A student measures the distance traversed in free fall of a body, initially at rest, in a given time. He uses this data to estimate g, the acceleration due to gravity. If the maximum percentage errors in measurement of the distance and the time are e_1 and e_2 respectively, the percentage error in the estimation of g is **[2010]**
(A) $e_2 - e_1$ (B) $e_1 + 2e_2$
(C) $e_1 + e_2$ (D) $e_1 - 2e_2$

6. 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:
$P = \frac{a^3b^2}{cd}$ % error in P is **[2013]**
(A) 14% (B) 10%
(C) 7% (D) 4%

7. In an experiment, the percentage of error occurred in the measurement of physical quantities A, B, C and D are 1%, 2%, 3% and 4% respectively. Then the maximum percentage of error in the measurement X, where $X = \frac{A^2 B^{\frac{1}{2}}}{C^{\frac{1}{3}} D^3}$, will be: **[2019]**
(A) –10 % (B) 10 %
(C) $\left(\frac{3}{13}\right)$ % (D) 16 %

8. Time intervals measured by a clock give the following readings:
1.25 s, 1.24 s, 1.27 s, 1.21 s and 1.28 s
What is the percentage relative error of the observations? **[Phase-II 2020]**
(A) 1.6 % (B) 2 %
(C) 4 % (D) 16 %

9. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are: **[2023]**
(A) Personal errors
(B) Least count errors
(C) Random errors
(D) Instrumental errors

10. A metal wire has mass (0.4 ± 0.002) g, radius (0.3 ± 0.001) mm and length (5 ± 0.02) cm. The maximum possible percentage error in the measurement of density will nearly be: **[2023]**
(A) 1.3 % (B) 1.6 %
(C) 1.4 % (D) 1.2 %

1.4 Significant figures

1. Taking into account of the significant figures, what is the value of 9.99 m – 0.0099 m? **[Phase-I 2020]**
(A) 9.98 m (B) 9.980 m
(C) 9.9 m (D) 9.9801 m

2. The area of a rectangular field (in m^2) of length 55.3 m and breadth 25 m after rounding off the value for correct significant digits is: **[2022]**
(A) 1382.5 (B) 14×10^2
(C) 138×10^1 (D) 1382

1.5 Dimensions of physical quantities

1. The dimensional formula of angular momentum is **[1988]**
(A) $[ML^2 T^{-2}]$ (B) $[ML^{-2} T^{-1}]$
(C) $[MLT^{-1}]$ (D) $[ML^2 T^{-1}]$

2. If C and R denote capacitance and resistance, the dimensional formula of CR is **[1988]**
(A) $[M^0 L^0 T^1]$
(B) $[M^0 L^0 T^0]$
(C) $[M^0 L^0 T^{-1}]$
(D) not expressible in terms of MLT

3. The dimensional formula of torque is **[1989]**
(A) $[ML^2 T^{-2}]$ (B) $[MLT^{-2}]$
(C) $[ML^{-1} T^{-2}]$ (D) $[ML^{-2} T^{-2}]$

4. Dimensional formula of self inductance is **[1989]**
(A) $[MLT^{-2} A^{-2}]$ (B) $[ML^2 T^{-1} A^{-2}]$
(C) $[ML^2 T^{-2} A^{-2}]$ (D) $[ML^2 T^{-2} A^{-1}]$

5. Of the following quantities, which one has dimensions different from the remaining three? **[1989]**
(A) Energy per unit volume
(B) Force per unit area
(C) Product of voltage and charge per unit volume
(D) Angular momentum.

6. The dimensional formula of permeability of free space μ_0 is **[1991]**
(A) $[MLT^{-2} A^{-2}]$ (B) $[M^0 L^1 T]$
(C) $[M^0 L^2 T^{-1} A^2]$ (D) none of these

7. Which of the following has the dimensions of pressure? **[1994, 1990]**
(A) $[MLT^{-2}]$ (B) $[ML^{-1}T^{-2}]$
(C) $[ML^{-2}T^{-2}]$ (D) $[M^{-1}L^{-1}]$

8. The dimensions of RC is **[1995]**
(A) square of time
(B) square of inverse time.
(C) time
(D) inverse time.

9. Which of the following is a dimensional constant? **[1995]**
(A) Relative density
(B) Gravitational constant
(C) Refractive index
(D) Poisson ratio

10. Which of the following dimensions will be the same as that of time? **[1996]**
(A) $\frac{L}{R}$ (B) $\frac{C}{L}$ (C) LC (D) $\frac{R}{L}$

11. The dimensions of impulse are equal to that of **[1996]**
(A) pressure
(B) linear momentum
(C) force
(D) angular momentum

12. The dimensional formula of magnetic flux is **[1999]**
(A) $[M^0L^{-2}T^{-2}A^{-2}]$ (B) $[ML^0T^{-2}A^{-2}]$
(C) $[ML^2T^{-2}A^{-1}]$ (D) $[ML^2T^{-1}A^3]$

13. Which pair do not have equal dimensions? **[2000]**
(A) Energy and torque
(B) Force and impulse
(C) Angular momentum and Planck constant
(D) Elastic modulus and pressure.

14. The dimensions of Planck's constant equals to that of **[2001]**
(A) energy
(B) momentum
(C) angular momentum
(D) power

15. The dimensions of universal gravitational constant are **[2004, 1992]**
(A) $[M^{-1}L^3T^{-2}]$ (B) $[ML^2T^{-1}]$
(C) $[M^{-2}L^3T^{-2}]$ (D) $[M^{-2}L^2T^{-1}]$

16. The ratio of the dimensions of Planck's constant and that of moment of inertia has the dimensions of **[2005]**
(A) time
(B) frequency
(C) angular momentum
(D) velocity

17. Dimensions of resistance in an electrical circuit, in terms of dimension of mass M, of length L, of time T and of current I, would be **[2007]**
(A) $[ML^2T^{-2}]$ (B) $[ML^2T^{-1}I^{-1}]$
(C) $[ML^2T^{-3}I^{-2}]$ (D) $[ML^2T^{-3}I^{-1}]$

18. Which two of the following five physical parameters have the same dimensions? **[2008]**
i. energy density
ii. refractive index
iii. dielectric constant
iv. Young's modulus
v. magnetic field
(A) 1 and 4 (B) 1 and 5
(C) 2 and 4 (D) 3 and 5

19. If the dimensions of a physical quantity are given by $M^aL^bT^c$, then the physical quantity will be **[2009]**
(A) velocity if a = 1, b = 0, c = –1
(B) acceleration if a = 1, b = 1, c = –2
(C) force if a = 0, b = –1, c = –2
(D) pressure if a = 1, b = –1, c = –2

20. The dimensions of $\frac{1}{2}\varepsilon_0E^2$, where ε_0 is permittivity of free space and E is electric field, is **[2010]**
(A) $[ML^2T^{-2}]$ (B) $[ML^{-1}T^{-2}]$
(C) $[ML^2T^{-1}]$ (D) $[MLT^{-1}]$

21. The dimensions of $(\mu_0\varepsilon_0)^{-1/2}$ are **[2012, 2011]**
(A) $[L^{1/2}T^{-1/2}]$ (B) $[L^{-1}T]$
(C) $[LT^{-1}]$ (D) $[L^{1/2}T^{1/2}]$

22. Dimensions of stress are: **[Phase-I 2020]**
(A) $[ML^2T^{-2}]$ (B) $[ML^0T^{-2}]$
(C) $[ML^{-1}T^{-2}]$ (D) $[MLT^{-2}]$

1.6 Dimensional analysis and its applications

1. According to Newton, the viscous force acting between liquid layers of area A and velocity gradient $\Delta v/\Delta Z$ is given by $F = -\eta A \frac{\Delta v}{\Delta Z}$, where η is constant called coefficient of viscosity. The dimensional formula of η is **[1990]**
(A) $[ML^{-2}T^{-2}]$ (B) $[M^0L^0T^0]$
(C) $[ML^2T^{-2}]$ (D) $[ML^{-1}T^{-1}]$

2. The frequency of vibration f of a mass m suspended from a spring of spring constant k is given by a relation $f = am^xk^y$, where a is a dimensionless constant. The values of x and y are **[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) $x = -\frac{1}{2}, y = \frac{1}{2}$

3. P represents radiation pressure, c represents speed of light and S represents radiation energy striking per unit area per sec. The non zero integers x, y, z such that $P^x\ S^y\ c^z$ is dimensionless are **[1992]**
(A) x = 1, y = 1, z = 1
(B) x = –1, y = 1, z = 1
(C) x = 1, y = –1, z = 1
(D) x = 1, y = 1, z = –1

4. Turpentine oil is flowing through a tube of length l and radius r. The pressure difference between the two ends of the tube is P. The viscosity of oil is given by $\eta = \frac{P(r^2 - x^2)}{4vl}$ where v is the velocity of oil at a distance x from the axis of the tube. The dimensions of η are **[1993]**
(A) $[M^0L^0T^0]$ (B) $[MLT^{-1}]$
(C) $[ML^2T^{-2}]$ (D) $[ML^{-1}T^{-1}]$

5. The time dependence of a physical quantity p is given by $p = p_0 \exp(-\alpha t^2)$, where α is a constant and t is the time. The constant α **[1993]**
(A) is dimensionless
(B) has dimensions $[T^{-2}]$
(C) has dimensions $[T^2]$
(D) has dimensions of p

6. An equation is given here $\left(P + \frac{a}{V^2}\right) = b\frac{\theta}{V}$ where P = Pressure, V = Volume and θ = Absolute temperature. If a and b are constants, the dimensions of a will be **[1996]**
(A) $[ML^{-5}T^{-1}]$ (B) $[ML^5T^1]$
(C) $[ML^5T^{-2}]$ (D) $[M^{-1}L^5T^2]$

7. 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 **[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 $[T]$

8. The density of a material in CGS system of units is 4 g cm^{-3}. In a system of units in which unit of length is 10 cm and unit of mass is 100 g, the value of density of material will be **[2011]**
(A) 0.04 (B) 0.4
(C) 40 (D) 400

9. If force (F), velocity (V) and time (T) are taken as fundamental units, then the dimensions of mass are **[2014]**
(A) $[FVT^{-1}]$ (B) $[FVT^{-2}]$
(C) $[FV^{-1}T^{-1}]$ (D) $[FV^{-1}T]$

10. If energy (E), velocity (V) and time (T) are chosen as the fundamental quantities, the dimensional formula of surface tension will be **[2015]**
(A) $[E\,V^{-2}T^{-1}]$ (B) $[E\,V^{-1}T^{-2}]$
(C) $[E\,V^{-2}T^{-2}]$ (D) $[E^{-2}V^{-1}T^{-3}]$

11. In dimension of critical velocity v_c, of liquid following through a tube are expressed as $(\eta^x\rho^yr^z)$, where η, ρ and r are the coefficient of viscosity of liquid, density of liquid and radius of the tube respectively, then the values of x, y and z are given by **[Re-Test 2015]**
(A) 1, 1, 1 (B) 1, –1, –1
(C) –1, –1, 1 (D) –1, –1, –1

12. 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? **[Phase-II 2016]**
(A) $\sqrt{\frac{Gc}{h^{3/2}}}$ (B) $\frac{\sqrt{hG}}{c^{3/2}}$
(C) $\frac{\sqrt{hG}}{c^{5/2}}$ (D) $\sqrt{\frac{hc}{G}}$

13. A physical quantity of the dimensions of length that can be formed out of c, G and $\frac{e^2}{4\pi\varepsilon_0}$ is
[c is velocity of light, G is universal constant of gravitation and e is charge]: **[2017]**
(A) $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$ (B) $c^2\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$
(C) $\frac{1}{c^2}\left[\frac{e^2}{G4\pi\varepsilon_0}\right]^{1/2}$ (D) $\frac{1}{c}G\frac{e^2}{4\pi\varepsilon_0}$

14. If E and G respectively denote energy and gravitational constant, then $\frac{E}{G}$ has the dimensions of: **[2021]**
(A) $[M][L^{-1}][T^{-1}]$ (B) $[M][L^0][T^0]$
(C) $[M^2][L^{-2}][T^{-1}]$ (D) $[M^2][L^{-1}][T^0]$

15. If force [F], acceleration [A] and time [T] are chosen as the fundamental physical quantities. Find the dimensions of energy. **[2021]**
(A) $[F][A][T^2]$ (B) $[F][A][T^{-1}]$
(C) $[F][A^{-1}][T]$ (D) $[F][A][T]$

Answers to MCQs

1.1	:	1.	(C)	2.	(C)	3.	(C)	4.	(B)	5.	(C)										
1.2	:	1.	(D)	2.	(D)	3.	(B)	4.	(C)												
1.3	:	1.	(B)	2.	(A)	3.	(D)	4.	(D)	5.	(B)	6.	(A)	7.	(D)	8.	(A)	9.	(C)	10.	(B)
1.4	:	1.	(A)	2.	(B)																
1.5	:	1.	(D)	2.	(A)	3.	(A)	4.	(C)	5.	(D)	6.	(A)	7.	(B)	8.	(C)	9.	(B)	10.	(A)
		11.	(B)	12.	(C)	13.	(B)	14.	(C)	15.	(A)	16.	(B)	17.	(C)	18.	(A)	19.	(D)	20.	(B)
		21.	(C)	22.	(C)																
1.6	:	1.	(D)	2.	(D)	3.	(C)	4.	(D)	5.	(B)	6.	(C)	7.	(D)	8.	(C)	9.	(D)	10.	(C)
		11.	(B)	12.	(B)	13.	(A)	14.	(D)	15.	(A)										

Solutions to MCQs

1.1 Fundamental and derived units

1. $[x] = [bt^2] \Rightarrow [b] = [x/t^2] = km/s^2$

2. $F = \frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{r^2}$
$\therefore$ $\varepsilon_0 \propto \frac{Q^2}{F \times r^2}$
So ε_0 has units of coulomb^2/ newton m^2

3. $F \propto v$ or $F = kv$
where k is the constant of proportionality
$\therefore$ $k = \frac{F}{v} = \frac{N}{ms^{-1}} = \frac{kg\ ms^{-2}}{ms^{-1}} = kgs^{-1}$

4. $\theta = 1' = \left(\frac{1}{60}\right)^\circ = \left(\frac{1}{60}\right) \times \left(\frac{\pi}{180}\right)$ radian
$= 2.91 \times 10^{-4}$ radian

1.2 Accuracy, precision and least count of measuring instruments

1. Least count of screw gauge = 0.001 cm
= 0.01 mm
Main scale reading = 5 mm,
Zero error = – 0.004 cm
= – 0.04 mm
Zero correction = +0.04 mm
Observed reading = Main scale reading + (Division × least count)
Observed reading = 5 + (25 × 0.01) = 5.25 mm
Corrected reading = Observed reading + zero correction
Corrected reading = 5.25 + 0.04
= 5.29 mm
= 0.529 cm

2. 1 V.S.D. = $\frac{(n-1)}{n}$ M.S.D.
L.C. = 1 M.S.D. – 1 V.S.D.
$= 1$ M.S.D. – $\frac{(n-1)}{n}$ M.S.D.
$= \frac{1}{n}$ M.S.D.
$= \frac{1}{n} \times \frac{1}{n}$ cm
$\therefore$ L.C. $= \frac{1}{n^2}$ cm

3. L.C. $= \frac{\text{Pitch of screw}}{\text{Total number of division on circular scale}}$
$\therefore$ Pitch = 0.01 mm ×50 = 0.5 mm

4. Least count $= \frac{1\ mm}{100} = 0.01$ mm
Diameter = Main scale reading + Circular scale reading
= 0 + (52 × 0.01) mm
= 0.52 mm
= 0.052 cm

1.3 Errors in measurement

1. Density $(\rho) = \frac{\text{mass (m)}}{\text{volume (V)}}$ ….(i)
Percentage error in density is given by,
$\frac{\Delta\rho}{\rho} \times 100 = \left(\frac{\Delta m}{m} + \frac{\Delta v}{v}\right) \times 100$

$\therefore \quad \frac{\Delta\rho}{\rho} \times 100 = \left[\frac{\Delta m}{m} + \frac{\Delta v}{v}\right] \times 100\%$

$= \left[\frac{0.01}{22.42} + \frac{0.1}{4.7}\right] \times 100\%$

$= 2\%$

2. K.E. $= \frac{1}{2} mv^2$

The percentage error in measurement of kinetic energy is,

$\frac{\Delta K.E.}{K.E.} \times 100 = \left[\frac{\Delta m}{m} + 2 \times \frac{\Delta v}{v}\right] \%$

$= [2 + (2 \times 3)]\ \% = 8\%$

3. Density $(\rho) = \frac{\text{Mass}}{\text{Volume}} = \frac{m}{l^3}$ …(for cube $V = l^3$)

Percentage relative error in density will be,

$\frac{\Delta\rho}{\rho} \times 100 = \left[\frac{\Delta m}{m} + 3\ \frac{\Delta l}{l}\right] \%$

$= [3 + (3 \times 2)]\ \%$

$= (3 + 6)\ \% = 9\ \%$

4. $V = \frac{4}{3}\pi R^3$;

Taking natural logarithm on both side,

$l\text{n } V = l\text{n}\left(\frac{4}{3}\pi\right) + l\text{n } R^3$

Differentiating, $\frac{dV}{V} = 3\frac{dR}{R}$

Error in the determination of the volume

$= 3 \times 2\% = 6\%$

5. $h = ut + \frac{1}{2} gt^2$

$\therefore \quad h = \frac{1}{2} gt^2 \Rightarrow g = \frac{2h}{t^2}$

($\because$ u = 0, as body is initially at rest)

Percentage error in estimation of g will be,

$\left(\frac{\Delta g}{g} \times 100\right) = \left(\frac{\Delta h}{h} \times 100\right) + 2 \times \left(\frac{\Delta t}{t} \times 100\right)$ ….(i)

$\frac{\Delta h}{h} \times 100 = e_1$ and $\frac{\Delta t}{t} \times 100 = e_2$ ….(given)

Substituting in equation (i),

$\left(\frac{\Delta g}{g} \times 100\right) = e_1 + 2e_2$

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

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

$= 3 \times 1\% = 3\%$

error contributed by b $= 2 \times \left(\frac{\Delta b}{b} \times 100\right)$

$= 2 \times 2\% = 4\%$

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

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

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

$\frac{\Delta p}{p} \times 100 =$ (error contributed by a) + (error contributed by b) + (error contributed by c) + (error contributed by d)

$= 3\% + 4\% + 3\% + 4\%$

$= 14\%$

7. Given: $X = \frac{A^2 B^{\frac{1}{2}}}{C^{\frac{1}{3}} D^3}$

Error contributed by A $= 2 \times \left(\frac{\Delta A}{A} \times 100\right)$

$= 2 \times 1\% = 2\%$

Error contributed by B $= \frac{1}{2} \times \left(\frac{\Delta B}{B} \times 100\right)$

$= \frac{1}{2} \times 2\% = 1\%$

Error contributed by C $= \frac{1}{3} \times \left(\frac{\Delta C}{C} \times 100\right)$

$= \frac{1}{3} \times 3\% = 1\%$

Error contributed by D $= 3 \times \left(\frac{\Delta D}{D} \times 100\right)$

$= 3 \times 4 = 12\%$

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

$\frac{\Delta x}{x} \times 100 =$ (error contributed by A) + (error contributed by B) + (error contributed by C) + (error contributed by D)

$= 2\% + 1\% + 1\% + 12\%$

$= 16\%$

8. Mean value,

$t_m = \frac{t_1 + t_2 + t_3 + t_4 + t_5}{5}$

$t_m = \frac{1.25 + 1.24 + 1.27 + 1.21 + 1.28}{5}$

$t_m = 1.25$ s

Mean absolute error,

$\Delta t_m = \frac{|t_m - t_1| + |t_m - t_2| + |t_m - t_3| + |t_m - t_4| + |t_m - t_5|}{5}$

$\Delta t_m = \frac{0 + 0.01 + 0.02 + 0.04 + 0.03}{5} = 0.02$

Percentage error $= \frac{\Delta t_m}{t_m} \times 100 = \frac{0.02}{1.25} \times 100$

$= 1.6\ \%$

10. The density of a metal wire is given by,

$\rho = \frac{\text{Mass}}{\text{Volume}} = \frac{m}{\pi r^2 l}$

The relative error in density is,

$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + 2\frac{\Delta r}{r} + \frac{\Delta l}{l}$

$= \left(\frac{0.002}{0.4} + \frac{2 \times 0.001}{0.3} + \frac{0.02}{5}\right)$

$= (0.005) + (0.0067) + (0.004)$

$\therefore \quad \frac{\Delta\rho}{\rho} = 0.0157$

$\frac{\Delta\rho}{\rho} \times 100 = 0.0157 \times 100$

$\frac{\Delta\rho}{\rho}\ \% = 1.57\% \approx 1.6\%$

1.4 Significant figures

1. Performing subtraction we get,
$9.99 - 0.0099 = 9.9801$
But number of significant digits after decimal place in 9.99 is 2 and number of significant digits after decimal place in 0.0099 is also 2. Hence, subtraction carried out should be considered upto 2 significant figures after decimal, i.e., 9.98

2. Area = length × breadth = 55.3 × 25 = 1382.5 m^2
According to rules for significant figures, the final answer must have as many significant figures as that of the number with least significant figures.
The value of the area correct upto 2 significant figures is,
$A = 14 \times 10^2\ m^2$

1.5 Dimensions of physical quantities

1. Angular momentum (L)
= Moment of inertia (I) × Angular velocity (ω).
$\therefore$ $[L] = [ML^2]\ [T^{-1}] = [ML^2\ T^{-1}]$

2. $\text{Capacitance} = \dfrac{\text{charge}}{\text{Potential difference}}$
$[C] = \dfrac{[AT]}{[ML^2T^{-3}A^{-1}]} = [M^{-1}\ L^{-2}\ T^4\ A^2]$
$\text{Resistance R} = \dfrac{\text{Potential difference}}{\text{current}}$
$\therefore$ $[R] = \dfrac{[ML^2T^{-3}A^{-1}]}{[A]} = [ML^2\ T^{-3}\ A^{-2}]$
$\therefore$ $[CR] = [M^{-1}\ L^{-2}\ T^4\ A^2]\ [ML^2\ T^{-3}\ A^{-2}] = [T]$

3. Torque (τ) = Force × distance
$\therefore$ $[\tau] = [MLT^{-2}]\ [L] = [ML^2\ T^{-2}]$

4. induced emf (e) = $L\dfrac{dI}{dt}$
$\therefore$ $L = \dfrac{e}{dI/dt} = \dfrac{w/dq}{dI/dt} = \dfrac{w}{\frac{dq}{dt}\,dI} = \dfrac{w}{IdI}$
$\therefore$ $[L] = \dfrac{[W]}{[I][dI]} = \dfrac{[M^1L^2T^{-2}]}{[A^2]} = [M^1L^2T^{-2}A^{-2}]$

5. Energy per unit volume $= \dfrac{E}{V} = \dfrac{[ML^2T^{-2}]}{[L^3]}$
$= [ML^{-1}T^{-2}]$
Force per unit area $= \dfrac{F}{A} = \dfrac{[MLT^{-2}]}{[L^2]}$
$= [ML^{-1}T^{-2}]$
Product of voltage and charge per unit volume
$= \dfrac{V \times Q}{\text{Volume}} = \dfrac{VIt}{\text{Volume}} = \dfrac{\text{Power} \times \text{Time}}{\text{Volume}}$
$\therefore$ $\dfrac{[ML^2T^{-3}]\ [T]}{[L^3]} = [ML^{-1}T^{-2}]$
Angular momentum = [L]= [mvr] = $[ML^2T^{-1}]$
So angular momentum has different dimensions.

6. $\mu_0 = \dfrac{2\pi \times \text{force} \times \text{distance}}{\text{current} \times \text{current} \times \text{length}}$
$\therefore$ $[\mu_0] = \dfrac{[MLT^{-2}]\ [L]}{[A][A][L]} = [MLT^{-2}\ A^{-2}]$

7. $\text{Pressure} = \dfrac{\text{Force}}{\text{Area}}$
$\therefore$ $[\text{pressure}] = \dfrac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$

8. $[R] = [M^1L^2T^{-3}A^{-2}]$
$[C] = [M^{-1}L^{-2}T^4A^2]$
$\therefore$ $[RC] = [M^1L^2T^{-3}A^{-2}][M^{-1}L^{-2}T^4A^2] = [T]$

9. Relative density, refractive index and Poisson ratio are all ratios of similar quantities, therefore they are dimensionless constants. Gravitational constant is a dimensional constant.

10. $[L] = [M^1L^2T^{-2}A^{-2}]$
$[R] = [M^1L^2T^{-3}A^{-2}]$
$\therefore$ $[L]/[R] = \dfrac{[M^1L^2T^{-2}A^{-2}]}{[M^1L^2T^{-3}A^{-2}]} = [T]$

11. $[\text{impulse}] = [M^1L^1T^{-1}]$
$[\text{linear momentum}] = [M^1L^1T^{-1}]$
$[\text{force}] = [M^1L^1T^{-2}]$
$[\text{angular momentum}] = [M^1L^2T^{-1}]$
$\therefore$ impulse and linear momentum have same dimensions.

12. Magnetic flux, $\phi = BA = \left(\dfrac{F}{Il}\right) A$
$= \left[\dfrac{[MLT^{-2}][L^2]}{[A]\ [L]}\right]$
$= [ML^2T^{-2}A^{-1}]$

13. $[\text{force}] = [MLT^{-2}]$
$[\text{impulse}] = [MLT^{-1}]$
$[\text{energy}]$ and $[\text{Torque}] = [M^1L^2T^{-2}]$
[Angular momentum] and [Planck's Constant]
$= [M^1L^2T^{-1}]$
[elastic modulus] and [Pressure] $= [M^1L^{-1}T^{-2}]$

14. $[\text{Planck's constant}] = \dfrac{[\text{Energy}]}{[\text{Frequency}]} = \dfrac{[ML^2T^{-2}]}{[T^{-1}]}$
$= [ML^2T^{-1}]$
[angular momentum] = [Moment of inertia] × [Angular velocity]
$= [ML^2][T^{-1}]$
$= [ML^2T^{-1}]$
$[\text{momentum}] = [M^1L^1T^{-1}]$
$[\text{power}] = [M^1L^2T^{-3}]$
$\therefore$ [Planck's constant] = [angular momentum]

15. $F = G\dfrac{Mm}{R^2}$

∴ $G = \dfrac{F(R)^2}{Mm}$

∴ $[G] = \dfrac{[MLT^{-2}][L^2]}{[M][M]} = [M^{-1}L^3T^{-2}]$

16. Unit of Planck's constant (h) is J-s

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

Unit of moment of inertia is kg m^2

∴ Dimension of M.I. $= [M^1L^2]$

∴ $\dfrac{[h]}{[I]} = \dfrac{[M^1L^2T^{-1}]}{[M^1\,L^2]} = [T^{-1}] = [\text{frequency}]$

17. $R = \dfrac{V}{I}$

$[V] = \dfrac{[W]}{[q]} = \dfrac{[ML^2T^{-2}]}{[IT]}$

∴ $[R] = \dfrac{[ML^2T^{-2}/IT]}{[I]} = [ML^2T^{-3}I^{-2}]$

18. $[\text{Energy density}] = \dfrac{[\text{Work done}]}{[\text{Volume}]} = \dfrac{[MLT^{-2}L]}{[L^3]}$
$= [ML^{-1}T^{-2}]$

Refractive index and dielectric constant are dimensionless quantities

$[\text{Magnetic field}] = [M^1T^{-2}I^{-2}]$

$[\text{Young's modulus}] = [ML^{-1}T^{-2}]$

∴ Energy density and young's modulus have same dimensions.

19. $P = \dfrac{\text{force}}{\text{area}} = \dfrac{\text{mass} \times \text{acceleration}}{\text{area}}$

∴ $[P] = \dfrac{[M^1L^1T^{-2}]}{[L^2]} = [M^1L^{-1}T^{-2}]$

∴ $a = 1,\ b = -1,\ c = -2$

20. Energy density of an electric field E is

$u_E = \dfrac{1}{2}\,\varepsilon_0E^2$

where ε_0 is permittivity of free space

$u_E = \dfrac{\text{Energy}}{\text{Volume}} = \dfrac{[ML^2\,T^{-2}]}{[L^3]} = [ML^{-1}T^{-2}]$

Hence, the dimensions of $\dfrac{1}{2}\,\varepsilon_0E^2$ is $[ML^{-1}T^{-2}]$

21. $c = \dfrac{1}{\sqrt{\mu_0\varepsilon_0}} = (\mu_0\varepsilon_0)^{-1/2}$

∴ $(\mu_0\varepsilon_0)^{-1/2} = [c] = [LT^{-1}]$

22. $[\text{Stress}] = \dfrac{[F]}{[A]} = \dfrac{[M^1L^1T^{-2}]}{[L^2]} = [M^1L^{-1}T^{-2}]$

1.6 Dimensional analysis and its applications

1. $[F] = [MLT^{-2}]$

$\left[\dfrac{\Delta v}{\Delta Z}\right] = \dfrac{[LT^{-1}]}{[L]} = [T^{-1}]$

∴ Dimensional formula for coefficient of viscosity,

$\eta = \dfrac{F}{(A)\left(\frac{\Delta v}{\Delta Z}\right)} = \dfrac{[MLT^{-2}]}{[L^2][T^{-1}]} = [ML^{-1}T^{-1}]$

2. $f = am^xk^y$

Dimensions of frequency $f = [M^0L^0T^{-1}]$

Dimensions of constant $a = [M^0L^0T^0]$

Dimensions of mass $m = [M]$

Dimensions of spring constant $k = [MT^{-2}]$

Putting these values in equation (i), we get

$[M^0L^0T^{-1}] = [M]^x\,[MT^{-2}]^y$

Applying principle of homogeneity of dimensions, we get

$x + y = 0$ ….(i)

$-2y = -1$ ….(ii)

∴ $y = \dfrac{1}{2},\ x = -\dfrac{1}{2}$

3. given that, $P^x\,S^y\,c^z$ is dimensionless

∴ $[P]^x\,[S]^y\,[c]^z = [M^0\,L^0\,T^0]$

∴ $[P] = \dfrac{\text{Force}}{\text{Area}} = \dfrac{[MLT^{-2}]}{[L^2]} = [M\,L^{-1}\,T^{-2}]$

$[S] = \dfrac{\text{Energy}}{\text{Area} \times \text{time}} = \dfrac{[ML^2T^{-2}]}{[L^2][T]} = [M\,T^{-3}]$

$[c] = [LT^{-1}]$

∴ $[M^0\,L^0\,T^0] = [ML^{-1}\,T^{-2}]^x\,[MT^{-3}]^y\,[LT^{-1}]^z$ ….(i)

Applying the principle of homogeneity of dimensions, we get

$x + y = 0$ ….(ii)

$-x + z = 0$ ….(iii)

$-2x - 3y - z = 0$ ….(iv)

Solving (ii), (iii) and (iv), we get

$x = 1,\ y = -1,\ z = 1$

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

$[r] = [L]$

$[v] = [LT^{-1}]$

$[l] = [L]$

∴ $[\eta] = \dfrac{[P][r^2 - x^2]}{[4vl]} = \dfrac{[ML^0T^{-2}][L^0]}{[LT^0]\,[L]} = [ML^{-1}T^{-1}]$

5. $p = p_0e^{-\alpha t^2}$

αt^2 is dimensionless

∴ $\alpha = \dfrac{1}{t^2} = \dfrac{1}{[T^2]} = [T^{-2}]$

6. $\left(P + \dfrac{a}{V^2}\right) = b\dfrac{\theta}{V}$ Since $\dfrac{a}{V^2}$ is added to the pressure,

$[P] = \dfrac{[a]}{[V^2]}$

∴ $[a] = [P]\,[v^2]$

∴ $[a] = [ML^{-1}T^{-2}]\,[L^6]$

∴ $[a] = [ML^5T^{-2}]$

7. $v = at + \dfrac{b}{t+c}$

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

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

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

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

[T] = [c]

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

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

[b] = [L]

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

8. $n_2 = n_1 \left(\dfrac{M_1}{M_2}\right)^1 \left(\dfrac{L_1}{L_2}\right)^{-3}$

$= 4 \left(\dfrac{gm}{kg}\right)^1 \left(\dfrac{cm}{m}\right)^{-3}$

$= 4 \left(\dfrac{gm}{100gm}\right)^1 \left(\dfrac{cm}{10cm}\right)^{-3}$

∴ $n_2 = \dfrac{4}{0.1} = 40$

9. Let $m \propto F^x\ V^y\ T^z$

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

equating powers on both sides, we get,

$x = 1$ ….(i)

$x + y = 0$ ….(ii)

$-2x - y + z = 0$ ….(ii)

From equations (i),(ii) and (iii)

$x = 1$, $y = -1$, $z = 1$

∴ $[m] = [F^1V^{-1}T^1]$

10. Surface tension (T) is given as,

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

where, {F ≡ force, L ≡ length}

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

∴ $[F] = \left[\dfrac{E}{L}\right]$

∴ $[T] = \left[\dfrac{E}{L^2}\right]$

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

∴ [L] = [VT]

∴ $[T] = \left[\dfrac{E}{V^2T^2}\right]$

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

11. $[v_c] = [\eta^x \rho^y r^z]$

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

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

Comparing both sides,

$x + y = 0$, $-x - 3y + z = 1$, $-x = -1$

∴ $x = 1$, $y = -1$, $z = -1$

12. $[G] = [M^{-1}\ L^3\ T^{-2}]$

$[c] = [M^0\ L^1\ T^{-1}]$

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

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

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

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

∴ We get,

$-x + z = 0$

i.e. $z = x$ ….(i)

$3x + y + 2z = 1$ ....(ii)

$-2x - y - z = 0$ ….(iii)

∴ $y = -3x$ ….[from (i) and (iii)]

Substituting the value in eq. (ii)

∴ $3x - 3x + 2z = 1$

i.e. $z = \dfrac{1}{2}$

Substituting this value we get,

$x = \dfrac{1}{2}$ and $y = \dfrac{-3}{2}$

∴ $L = \dfrac{\sqrt{hG}}{c^{3/2}}$

13. Let the physical quantity formed of the dimensions of length be given as,

$[L] = [c]^x\ [G]^y \left[\dfrac{e^2}{4\pi\varepsilon_0}\right]^z$ ….(i)

Now,

Dimensions of velocity of light $[c]^x = [LT^{-1}]^x$

Dimensions of universal gravitational constant $[G]^y = [M^{-1}L^3T^{-2}]^y$

Dimensions of $\left[\dfrac{e^2}{4\pi\varepsilon_0}\right]^z = [ML^3T^{-2}]^z$

Substituting these in equation (i)

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

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

Solving for x, y, z

$x + 3y + 3z = 1$

$-y + z = 0$

$x + 2y + 2z = 0$

Solving the above equations,

$x = -2$, $y = \dfrac{1}{2}$, $z = \dfrac{1}{2}$

∴ $L = \dfrac{1}{c^2}\ \left[G\dfrac{e^2}{4\pi\varepsilon_0}\right]^{\frac{1}{2}}$

14. Unit of energy (E) = $\dfrac{kg\,m^2}{s^2}$

Unit of gravitational constant (G) = $\dfrac{m^3}{s^2kg}$

∴ Unit of $\left(\dfrac{E}{G}\right) = \dfrac{kg\,m^2}{s^2} \times \dfrac{s^2kg}{m^3} = \dfrac{kg^2}{m}$

∴ Dimension of $\left(\dfrac{E}{G}\right) = [M^2L^{-1}T^0]$

15. Using dimensional analysis,

$E \propto [F]^a[A]^b[T^2]^c$

$[M^1][L^2][T^{-2}] \propto [M^1L^1T^{-2}]^a\ [LT^{-2}]^b\ [T]^c$

Comparing, a = 1, a + b = 2 ⇒ b = 1,

$-2a - 2b + c = -2 \Rightarrow c = 2$

∴ a = 1 , b = 1 , c = 2

∴ $E \propto [F][A][T^2]$