NCERT

SMART Scan

OBJECTIVE

PHYSICS

Chapterwise Solved Papers

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INDEX

NEET Updated (Reduced) Syllabus as per National Medical Commission (Undergraduate Medical Education Board)

UNIT 1. PHYSICS AND MEASUREMENT

Units of measurements, System of Units and SI Units, Fundamental and derived units, Significant figures, Errors in measurements, Dimensions of physical quantities, Dimensional analysis and its applications.

UNIT 2. KINEMATICS

The frame of reference, Motion in a straight line, Uniform and non-uniform motion, Average speed and instantaneous velocity, Velocity-time and Position-time graph, Relations for uniformly accelerated motion, Scalars and Vectors (Addition, subtraction and products), Unit Vector and Resolution of a Vector Relative Velocity, Motion in a plane, Projectile Motion

UNIT 3. LAWS OF MOTION

Forces, Newton's First law of motion(inertia), Newton's Second Law of motion & Impulses, Newton's Third Law of motion, Law of conservation of linear momentum and its applications, Equilibrium of concurrent forces., Static and Kinetic friction, Laws of friction, Rolling friction, Centripetal force and its applications. Vehicle on level circular road, Vehicle on a banked road

UNIT 4. WORK, ENERGY, AND POWER

Work done by a constant force and a variable force, Kinetic and potential energies, Power, Work-energy theorem, The potential energy of spring conservation of mechanical energy, Dynamics of uniform circular motion (Motion in a vertical circle), Elastic and inelastic collision in one and two dimensions.

UNIT 5. ROTATIONAL MOTION

Centre of mass of a two-particle system & of a rigid body, Basic concepts of rotational motion, Moment of a force: Torque, Conservation of angular momentum and its applications, The moment of inertia and radius of gyration & their applications., Equilibrium of rigid bodies, Rigid body rotation and equations of rotational motion.

UNIT 6. GRAVITATION

The universal law of gravitation, Acceleration due to gravity and its variation with altitude and depth, Kepler's law of planetary motion, Gravitational potential energy, Orbital velocity, Escape velocity, Time period and energy of satellite

UNIT 7. PROPERTIES OF SOLIDS AND LIQUIDS

Elastic behaviour, Stress-strain relationship & Hooke's Law, Young's modulus, Bulk modulus & Modulus of rigidity, Pressure due to a fluid column, Pascal's law and its applications, Effect of gravity on fluid pressure, Viscosity. Stokes' law & Terminal velocity, Streamline flow, turbulent flow and Critical velocity, Bernoulli's principle and its applications, Surface energy, surface tension & its applications (drops, Bubbles, and capillary rise), Excess of pressure across a curved surface, Heat temperature thermal expansion, specific heat, calorimetry, change of state latent heat, Heat transfer-Conduction, Convection and Radiation

UNIT 8. THERMODYNAMICS

Thermal equilibrium, Zeroth law and Concept of temperature Heat,

work and internal energy

First law of thermodynamics

Isothermal and adiabatic processes

Second law of thermodynamics: Reversible and irreversible processes

UNIT 9. KINETIC THEORY OF GASES

Equation of state of a perfect gas, Work done on compressing a gas, Kinetic theory of gases-assumptions.

The concept of pressure, Kinetic interpretation of temperature, RMS speed of gas molecules, Law of equipartition of energy and applications to specific heat capacities of gases, Mean free path.

UNIT 10. OSCILLATIONS AND WAVES

Oscillation and periodic motion- time period, Frequency, Displacement as a function of time, Periodic functions, Simple harmonic motion and its equation, energy in S.H.M.-Kinetic and potential energies, Phase: oscillations of a spring – restoring force and force constant, Simple pendulum-derivation of expression for its time period, Wave motion, Longitudinal and transverse waves, Speed of travelling wave

Displacement relation for a progressive wave, Principle of superposition of waves and Reflection of waves, Standing waves in strings and organ pipes, Fundamental modes and harmonics (Beats).

UNIT 11. ELECTROSTATICS

Conservation of charge, Coulomb's law forces between two point charges, Forces between multiple charges, Superposition principle and continuous charge distribution, Electric field: Electric field due to a point charge, Electric field lines, Electric dipole, Electric field due to a dipole, Torque on a dipole in a uniform electric field, Electric flux, Gauss's law and its applications (straight wire, infinite plane sheet, thin spherical shell), Electric potential and its calculation for a point charge, Potential difference, Equipotential surfaces, Conductors and insulators, Capacitors and capacitances.

UNIT 12. CURRENT ELECTRICITY

Electric current, Drift velocity, Mobility and their relation with electric current, Ohm's law, Electrical resistance, V-I characteristics of Ohmic and non-ohmic conductors, Electrical energy and power, Electrical resistivity and conductivity, Series and parallel combinations of resistors, Temperature dependence of resistance, Internal resistance, Potential difference and emf of a cell, and combination of cells, Kirchhoff's laws and their applications, Wheatstone bridge, Metre Bridge.

UNIT 13. MAGNETIC EFFECTS OF CURRENT AND MAGNETISM

Biot- Savart law , Ampere's law, Force on a moving charge and current-carrying conductor in a uniform magnetic field, Torque experienced by a current loop in a uniform magnetic field(Moving coil galvanometer and, Its sensitivity) and conversion to ammeter and voltmeter, Current loop as a magnetic dipole and its magnetic dipole moment, Bar magnet, Magnetic field due to a magnetic dipole (bar magnet), Torque on a magnetic dipole, Para-dia-and ferromagnetic substances with examples, Effect of temperature on magnetic properties.

UNIT 14. ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENTS:

Electromagnetic induction, Faraday's law, Induced emf and current: Lenz's Law, Eddy currents, Self and mutual inductance, Alternating currents, Peak and RMS value of alternating current/voltage, LCR series circuit: Reactance and Impedance, Resonance: power in AC circuits, wattless current, AC generator and transformer.

UNIT 15. ELECTROMAGNETIC WAVES

Displacement current, Electromagnetic waves and their characteristics, Transverse nature of electromagnetic waves, Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, Gamma rays), Applications of e.m. waves.

UNIT 16. OPTICS

Reflection of light: Spherical mirrors, Mirror formula, Refraction of light at plane and spherical surfaces & through a prism, Thin lens formula, lens maker formula & Combination of thin lenses in contact, Total internal reflection and its applications, Magnification & Power of a Lens, Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers, Wave optics: Wavefront and Huygens' principle, Interference and diffraction of light, Polarization, Plane-polarized light, Brewster's law, Uses of plane-polarized light and Polaroid.

UNIT 17.DUAL NATURE OF MATTER AND RADIATION

Dual nature of radiation, Photoelectric effect, Hertz and Lenard's observations, Particle nature of light, De Broglie relation.

UNIT 18.ATOMS AND NUCLEI:

Rutherford's model of atom, Bohr model, Energy levels, hydrogen spectrum, Composition and size of nucleus, Atomic masses, Mass-energy relation, Mass defect; binding energy per nucleon and its variation with mass number, Nuclear fission and fusion.

UNIT 19. ELECTRONIC DEVICES

Semiconductors, Semiconductor diode: I-V characteristics in forward and reverse bias, Diode as a rectifier; I-V characteristics of LED, The photodiode & Solar cell, Zener diode: Zener diode as a voltage regulator, Logic gates (OR, AND, NOT, NAND and NOR).

UNIT 20. EXPERIMENTAL SKILLS

Familiarity with the basic approach and observation of the experiments and activities:

1. Vernier calipers-its use to measure the internal and external diameter and depth of a vessel
2. Screw gauge-its use to determine thickness /diameter of thin sheet/wire,
3. Simple Pendulum-dissipation of energy by plotting a graph between the square of amplitude and time,
4. Metre Scale- the mass of a given object by the principal of moments,
5. Young's modulus of elasticity of the material of a metallic wire.
6. Surf ace tension of water by capillary rise and effect of detergents,
7. Co-efficient of Viscosity of a given viscous liquid by measuring terminal velocity of a given spherical body,
8. Speed of sound in air at room temperature using a resonance tube,
9. Specific heat capacity of a given (i) solid and (ii) liquid by method of mixtures,
10. The resistivity of the material of a given wire using a meter bridge,
11. The resistance of a given wire using Ohm's law,
12. Resistance and figure of merit of a galvanometer by half deflection method,
13. The focal length of:

(i) Convex mirror

(ii) Concave mirror, and

(iii) Convex lens, using the parallax method

14. The plot of the angle of deviation vs angle of incidence for a triangular prism
15. Refractive index of a glass slab using a travelling microscope.
16. Characteristic curves of a p-n junction diode in forward and reverse bias.
17. Characteristic curves of a Zener diode and finding reverse break down voltage.
18. Identification of Diode. L.E.D,. Resistor. A capacitor from a mixed collection of such items.

All India Medical Entrance Exam Physics Previous Years Exam Papers Analysis Chart

S. No	Exam	Proposed Year	Question Paper	Total Question
		All India Pre Medical Test/National Eligibility Cum Entrance Test (AIPMT/NEET)		
1.	RE-NEET (UG)	23.06.2024		50
2.	NEET (UG)	05.05.2024		50
3.	RE-NEET - Manipur	06.06.2023		50
4.	NEET (UG)	07.05.2023		50
5.	NEET	17.07.2022		50
6.	NEET	12.09.2021		50
7.	NEET	13.09.2020		50
8.	NEET	05.06.2019		50
9.	NEET	06.05.2018		50
10.	NEET	07.05.2017		50
11.	NEET	01.05.2016	Phase-I	50
12.	NEET	24.06.2016	Phase-II	50
13.	NEET/AIPMT	25.07.2015		50
14.	NEET	04.05.2014		50
15.	NEET	05.05.2013		50
16.	AIPMT	2012		50
17.	AIPMT	2011		50
18.	AIPMT	2010		50
19.	AIPMT	2009		50
20.	AIPMT	2008		50
21.	AIPMT	2007		50
22.	AIPMT	2006		50
23.	AIPMT	2005		50
24.	AIPMT	2004		50
25.	AIPMT	2003		50
26.	AIPMT	2002		50
27.	AIPMT	2001		50
28.	AIPMT	2000		50
29.	AIPMT	1999, 98, 97, 96, 95, 94, 93, 92, 91, 90, 89, 88		600
		Telangana State Council Higher Education		
30.	Telangna SCHE	08.05.2024	Shift-I	40
31.	Telangana SCHE	07.05.2024	Shift I	40
32.	Telangana SCHE	07.05.2024	Shift II	40
		All India Institute of Medical Sciences (AIIMS)		
33.	AIIMS	26.05.2019	Shift-I	60
34.	AIIMS	26.05.2019	Shift-II	60
35.	AIIMS	25.05.2019	Shift-I	60
36.	AIIMS	25.05.2019	Shift-II	60
37.	AIIMS	2018		60
38.	AIIMS	2017		60
39.	AIIMS	2016		60
40.	AIIMS	2015		60
41.	AIIMS	2014		60
42.	AIIMS	2013		60
43.	AIIMS	2012		60
44.	AIIMS	2011		60
45.	AIIMS	2010		60
46.	AIIMS	2009		60
47.	AIIMS	2008		60
48.	AIIMS	2007		60
49.	AIIMS	2006		60
50.	AIIMS	2005		60

51.	AIIMS	2004		60
52.	AIIMS	2003		60
53.	AIIMS	2002		60
54.	AIIMS	2001		60
55.	AIIMS	2000		60
56.	AIIMS	1999, 98, 97, 96, 94		300
Andhra Pradesh Engineering, Agriculture and Medical Common Entrance Test (AP EAMCET)				
57.	AP EAMCET Medical	2013		50
58.	AP EAMCET Medical	2012		50
59.	AP EAMCET Medical	2010		40
60.	AP EAMCET Medical	2009		40
61.	AP EAMCET Medical	2008		40
62.	AP EAMCET Medical	2007		40
63.	AP EAMCET Medical	2006		40
64.	AP EAMCET Medical	2004		40
65.	AP EAMCET Medical	2003		50
66.	AP EAMCET Medical	2002		40
67.	AP EAMCET Medical	2001		40
68.	AP EAMCET Medical	1999		40
69.	AP EAMCET Medical	1998		50
70.	AP EAMCET Medical	1997		50
Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER)				
71.	JIPMER	2019		60
72.	JIPMER	2018		60
73.	JIPMER	2017		60
74.	JIPMER	2016		60
75.	JIPMER	2015		60
76.	JIPMER	2014		60
77.	JIPMER	2013		60
78.	JIPMER	2012		60
79.	JIPMER	2011		60
80.	JIPMER	2010		60
81.	JIPMER	2009		60
82.	JIPMER	2008		60
83.	JIPMER	2007		60
84.	JIPMER	2006		60
85.	JIPMER	2005		60
86.	JIPMER	2004		60
Uttar Pradesh Combined Pre Medical Test (UPCPMT)				
87.	UPCPMT	2014		50
88.	UPCPMT	2013		50
89.	UPCPMT	2012		50
90.	UPCPMT	2011		50
91.	UPCPMT	2010		50
92.	UPCPMT	2009		50
93.	UPCPMT	2008		50
94.	UPCPMT	2007		50
95.	UPCPMT	2006		50
96.	UPCPMT	2005		50
97.	UPCPMT	2004		50
98.	UPCPMT	2003		50
99.	UPCPMT	2002		50
100.	UPCPMT	2001		50
			Total	**6070**

Note : After detailed analysis of above mentioned papers of **NEET** and Other Medical Entrance Examination Related to **Physics** 6070 have been presented Chapterwise. Questions of repeated and similar nature have included so that the technique of asking question can benefit the competitors.

01.

Physics and Measurement

Chapter -1. Units and Measurements

Multiple Choice Question (MCQs)

1. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are :

(a) Random errors (b) Instrumental errors
(c) Personal errors (d) Least count errors

NEET (UG)-07.05.2023

Ans. (a) : The error in the measurement which arise due to unpredictable fluctuations in the temperature in temperature and voltage supply are random error.

2. The number of significant figures in quantity 0.00005041 J is

(a) 9 (b) 4 (c) 3 (d) 10

AP EAMCET-07.07.2022, Shift-I

Ans. (b) : $0.00005041 = 5041 \times 10^{-8}$
Significant digit = 5041
Only 4 significant figures

3. The number of significant figures in the quantity 5.6200 J is

(a) 3 (b) 5 (c) 2 (d) 4

AP EAMCET-11.07.2022, Shift-II

Ans. (b) : As we know zeroes only after a non-zero digit, after the decimal, and zeroes between any two non-zero digits are significant.
Therefore, the answer is 5.

4. If N_A, N_B and N_C are the number of significant figures in A = 0.001204 m, B = 43120000 m and C = 1.200 m respectively then

(a) $N_A = N_B = N_C$ (b) $N_A > N_B > N_C$
(c) $N_A < N_B < N_C$ (d) $N_A > N_B < N_C$

AP EAMCET-04.07.2022, Shift-I

Ans. (a) :
0.001204 contains 4 significant figure i.e. $N_A = 4$
43120000 contains 4 significant figure i.e. $N_B = 4$
1200 contains 4 significant figure i.e. $N_C = 4$
Hence, $N_A = N_B = N_C$

5. The S. I. unit of thermal conductivity is

(a) $J\,S\,m^{-1}\,K^{-1}$ (b) $W^{-1}\,m^{-1}\,K^{-1}$
(c) $W\,m^{-1}\,K^{-1}$ (d) $W\,m^{-2}\,K^{-1}$

NEET (National) 2019

Ans. (c): The unit of thermal conductivity $(k) = \frac{QL}{A\Delta T}$

Unit of $k = \frac{M}{M^2 \times K} \times \text{watt}$

$k = Wm^{-1}K^{-1}$

6. "Parsec" is the unit of:

(a) time (b) distance
(c) frequency (d) angular acceleration

AIIMS-2005

Ans. (b) : Parsec is an astronomical unit of length equal to the distance at which a baseline of one astronomical unit subtends an angle of one second of arc.
1 Parsec = 3.08×10^{16} m
= 3.26 light year

7. If e is the charge, V the potential difference, T the temperature, then the units of $\frac{eV}{T}$ are the same as that of

(a) Planck's constant
(b) Stefan's constant
(c) Boltzmann's constant
(d) Gravitational constant

AIIMS-2016

Ans. (c) :

$\because \frac{eV}{T} = \frac{\text{Work done(W)}}{T}$

$= \frac{PV}{T} \quad \left(\because PV = \frac{RT}{N}\right)$

$= \frac{R}{N} = K = \text{Boltzmann constant}$

8. Unit of electrical conductivity is

(a) ohm (b) siemen
(c) m/mho (d) mho/m

UP CPMT-2010

Ans. (d) : Resistivity and conductivity are interrelated Conductivity is the inverse of resistivity. According to this is easy to express one in terms of the other.

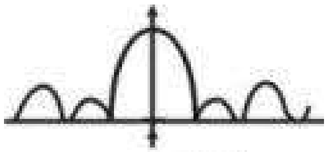
$\sigma = \frac{1}{\rho}$ unit mho/m or siemen/m

9. SI unit of intensity of wave is

(a) $J\,m^{-2}s^{-1}$ (b) $J\,m^{-1}s^{-2}$
(c) $W\,m^{-2}$ (d) $J\,m^{-2}$

UP CPMT-2012

Ans. (a, c): The intensity of waves is defined as the power delivered per Unit area.



center of pattern

Intensity of wave = $\dfrac{\text{energy}}{\text{Area}\times\text{Time}}$

$$=\frac{J}{m^2\times S}=Wm^{-2}$$

$\therefore$ The S.I Unit of intensity of wave is Wm^{-2}.

10. The unit of permittivity of free space, ε_0 is

(a) coulomb/newton-metre

(b) newton-metre^2/coulomb^2

(c) coulomb^2/newton-metre^2

(d) coulomb^2/(newton-metre)^2

AIPMT 2004

Ans. (c) : Coulomb law state that.

$$F=\frac{1}{4\pi\varepsilon_0}.\frac{q_1.q_2}{r^2}$$

$$\varepsilon_0=\frac{q_1.q_2}{4\pi F.r^2}$$

When, unit of F =N

Unit of r = m

Unit of q = Coulomb (c)

$$\varepsilon_0=\frac{\text{Coulomb}\times\text{Coulomb}}{\text{newton}-(\text{metre})^2}$$

$$\varepsilon_0=\frac{C.C}{N.m^2}=\text{Coulomb}^2/\text{newton}-\text{metre}^2$$

11. The unit of specific resistance is

(a) ohm/m^2 (b) ohm/m^3

(c) ohm m (d) ohm/m

UPCPMT-1975

Ans. (c) : We know that,

$$R=\rho\frac{l}{A}$$

ρ = specific resistance

$$\rho=\frac{RA}{l}$$

$$\rho=\frac{\text{ohm - m}^2}{\text{m}}$$

Unit of ρ = ohm − m

12. What is the SI unit of Stefan-Boltzmann's constant σ?

(a) $W\,m^{-2}\,K^{-4}$ (b) $W\,m^2\,K^4$

(c) $W\,K^{-4}$ (d) $erg\,s^{-2}\,K^{-4}$

AIPMT-2002,

Ans.(a): According to stefan's law, energy per unit time

$(E/t) = \sigma AT^4$

$$\sigma=\frac{E/t}{AT^4}$$

$$\sigma=\frac{W}{m^2K^4}$$

$= Wm^{-2}K^{-4}$

The SI unit of Stefan's constant = $W.m^{-2}.K^{-4}$ and CGS unit is = Erg.cm^2

13. Unit of Magnetic Flux is:

(a) Tesla (b) Gauss

(c) Weber (d) Weber/m^2

AIIMS-26.05.2019(E) Shift-2

Ans. (c) : The SI unit of magnetic flux is weber (Wb). Weber is commonly expressed in a multitude of other units.

$$Wb=\frac{kg.m^2}{s^2.A}=V.s=H.A=T.m^2=\frac{J}{A}=10^8\,mx$$

where,

Wb = Weber s = second

T = Tesla H = Henry

V = volt A = Ampere

J = joule Mx = Maxwell

14. The correct unit of thermal conductivity is

(a) $Jm^{-2}\sec^{-1}(°C)^{-1}$ (b) $Jm^{-1}\sec^{-1}(°C)^{-2}$

(c) J-sec (d) $Jm^{-1}\sec^{-1}(°C)^{-1}$

AIIMS-27.05.2018(E)

Ans. (d): The thermal conductivity of a material is a measure of its ability to conduct heat.

Thermal conductivity (K) = $\dfrac{QL}{A.\Delta T}$

Where,

Q = Heat transfer through the material

L = Length

A = Area

ΔT = Temperature difference

So,

The unit of thermal conductivity = $\dfrac{Js^{-1}\times m}{m^2\times °C}$

$= Js^{-1}m^{-1}°C^{-1}$

15. The unit of viscosity in the CGS system is poise (P) and that in SI Poiseuille (PI). Which of the following statement is correct?

(a) 1 P = 1PI (b) 1P = 10PI

(c) 10P =1PI (d) Non of these

UP CPMT-2013

Ans. (c) : 1P = 1 gm $cm^{-1}\,S^{-1}$

$\therefore$ 1 PI = 10 g $cm^{-1}\,S^{-1}$

$\boxed{1PI = 10\,P}$

16. What is the number of significant figures in $(3.20 + 4.80)\times10^5$

(a) 2 (b) 3

(c) 4 (d) 5

AP EAMCET-07.09.2021, Shift-I

Ans. (b): 3.20 has '3' significant figures 4. 80 has '3' significant figures. Therefore, there is 3 significant Figure's because 10^5 has no singeficant figures.

17. If the absolute errors in two physical quantities A and B are a and b respectively, then the absolute error in the value of A – B is

(a) a – b (b) b – a
(c) a = b (d) a + b

AP EAMCET(Medical)-2014

Ans. (d) : Absolute error in the given value,

$X = A - B$

$\Delta A = a$

$\Delta B = b$

$\Delta X = \Delta A + \Delta B$

$\Delta X = a + b$

Where a and b are absolute errors in the quantity A and B respectively.

18. Zero error belongs to the category of:

(a) Constant errors (b) Instrumental errors
(c) Personal errors (d) Random errors

AP EAMCET-24.08.2021, Shift-II

Ans. (b) : Instrumental errors:- It is the errors due to imperfect design or calibration of the measuring instrument. Zero error is the instrumental error.

• **Random error:–** Measurements lack precision, but cluster around accurate value.

Numerical Answer Type (NATs)

19. The pitch of an error free screw gauge is 1 mm and there are 100 divisions on the circular scale. While measuring the diameter of a thick wire, the pitch scale reads 1 mm and 63rd division on the circular scale coincides with the reference line. The diameter of the wire is :

(a) 1.63 cm (b) 0.163 cm
(c) 0.163 m (d) 1.63 m

RE-NEET (UG)-23.06.2024

Ans. (b) : Given, Pitch of screw gauge = 1mm

Number of divisions on the circular scale = 100

Main scale reading (or linear scale reading) = 1mm

63rd division on the circular scale coincides with the reference line.

∴ Circular scale reading = 63

Now, Least count of screw gauge

$$= \frac{\text{pitch}}{\text{Number of divisions on circular scale}}$$

$$= \frac{1}{100} = 0.01 \text{ mm}$$

Total reading = linear scale reading + circular scale reading × least count

$= 1 + 63 \times 0.01$

$= 1.63$ mm

$= 0.163$ cm

Hence, the diameter of the wire is 0.163 cm.

20. In a vernier calipers, (N+ 1) divisions of vernier scale coincide with N divisions of main scale. If 1 MSD represents 0.1 mm, the vernier constant (in cm) is :

(a) $\frac{1}{10N}$ (b) $\frac{1}{100(N+1)}$
(c) 100 N (d) 10 (N + 1)

NEET (UG) 05.05.2024

Ans. (b) : Given that,

(N+1) division of Vernier scale = N division of main scale

So, 1 Vernier scale division (V.S.D.) $= \frac{N}{N+1}$ main scale division (M.S.D.)

We know that,

Least count (L.C.) = 1 MSD – 1 VSD

$$= 1 \text{ MSD} - \frac{N}{N+1}\text{MSD}$$

$$= \left(\frac{N+1-N}{N+1}\right)\text{MSD} = \frac{1}{N+1}\text{MSD}$$

From question, MSD = 0.1mm

So,

$$\text{L.C.} = \frac{1}{N+1}(0.1)\text{mm} = \frac{1}{100(N+1)}\text{cm}$$

21. The energy equivalent of 3.2 μg of mass is

(a) 18×10^{26} J (b) 18×10^{20} MeV
(c) 18×10^{23} MeV (d) 32×10^{26} J

Telangana SCHE 08.05.2024 shift I

Ans. (b) : The find the energy equivalent of 3.2μg of mass in MeV.

(1) convert mass to kilograms

$3.2\mu g = 3.2\times10^{-9}$kg

(2) Use Einstein's formula

$E = mc^2$

(3) Calculate the energy in joules

$E = (3.2 \times10^{-9}\text{kg})\times(3\times10^8\text{m/s})^2$

$E = 2.88\times10^8$J

(4) Convert joules to MeV

$1J = 6.242\times10^{12}$ MeV

$E = 2.88\times10^8 J\times6.242\times10^{12}$ MeV

$E = 18\times10^{20}$ MeV

The energy equivalent of 3.2 μg of mass is 18×10^{20} MeV

22. When two resistors of resistance (123±2) Ω and (227±4) Ω are connected in series, then the value of equivalent resistance is

(a) (350±7) Ω (b) (350±1) Ω
(c) (350±12) Ω (d) (350±3) Ω

Telangana SCHE 08.05.2024 shift I

Ans. (*) : $R_1 = 123\Omega$ with an uncertainty of ±2Ω

$R_2 = 227\Omega$ with an uncertainty of ± 4Ω

The equivalent resistance R_{eq} when the resistors are connected in series is

$R_{eq} = R_1 + R_2 = 123\Omega + 227\Omega = 350\Omega$
The total uncertainty when adding the resistance is:-
$\Delta R_{eq} =$
$\sqrt{(\Delta R_1)^2 + (\Delta R_2)^2} = \sqrt{(2\Omega)^2 + (4\Omega)^2} = \sqrt{4+16} = \sqrt{20}$
$=4.47\Omega \cong 4.5\ \Omega$
If considering an alternative method of direct addition of uncertainties.
$\Delta R_{eq} = \Delta R_1 + \Delta R_2 = 2\Omega + 4\Omega = 6\Omega$
The Value should be $(350 \pm 6)\ \Omega$

23. 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:
(a) 1.4% (b) 1.2%
(c) 1.3% (d) 1.6%
NEET (UG)-07.05.2023

Ans. (d) : Given that : m = (0.4 ± 0.002) g
r = (0.3 ± 0.001) mm
l = (5 ± 0.02)cm
The volume of the wire is given by –
$V = \pi r^2 L$
The density of the wire is –
$$\rho = \frac{m}{\pi r^2 L}$$
$$\frac{\Delta\rho}{\rho}\times 100 = \frac{\Delta m}{m}\times 100 + 2\frac{\Delta r}{r}\times 100 + \frac{\Delta L}{L}\times 100$$
$$= \frac{0.002}{0.4}\times 100 + 2\times\frac{0.001}{0.3}\times 100 + \frac{0.02}{5}\times 100$$
$$= \frac{2}{4} + \frac{2}{3} + \frac{2}{5}$$
$$= \frac{30+40+24}{60}$$
$$= \frac{94}{60}$$
$$\boxed{\frac{\Delta\rho}{\rho}\times 100 = 1.56\% = 1.6\%}$$

24. The diameter of a spherical bob, when measured with vernier calipers yielded the following values :3.33 cm, 3.32 cm, 3.34cm, 3.33cm, and 3.32 cm.
The mean diameter to appropriate significant figures is:
(a) 3.33cm (b) 3.32cm
(c) 3.328 (d) 3.3cm
RE-NEET (UG)-06.06.2023 (Manipur)

Ans. (a) :
$$\text{Mean diameter} = \frac{3.33+3.32+3.34+3.33+3.32}{5}$$
= 3.328 cm
$\boxed{\text{Mean diameter} = 3.33\text{ cm}}$
(by taking appropriate significant figure)

25. Taking into account of the significant figures, what is the value of 9.99 m − 0.0099 m?
(a) 9.98 m (b) 9.980 m
(c) 9.9 m (d) 9.9801 m
[NEET (Sep.) 2020]

Ans. (a) :
  9.9900
− 0.0099
  9.9801
Since least number of significant figure persent in given numbers in 2, hence,
$9.99\text{m} - 0.0099\text{m} = 9.98\text{m}$

26. Two intervals of time are measured as Δt_1= (2.00 ± 0.02) s and Δt_2= (4.00 ± 0.02)s. The value of with $\sqrt{(\Delta t_1)(\Delta t_2)}$ with correct significant figures and error is
(a) (2.828 ± 0.01)s (b) (2.83 ± 0.02)s
(c) (2.828 ± 0.0075)s (d) (2.83 ± 0.0075)s
AP EAMCET (21.04.2019) Shift-I

Ans. (b) : Given,
$\Delta t_1 = (2.00 \pm 0.02)$ second Δt_1 = 2.00 second,
$\Delta te_1 = \pm 0.02$ second
$\Delta t_2 = (4.00 \pm 0.02)$ second Δt_2 = 4.00 second,
$\Delta te_2 = \pm 0.02$ second
$\because T = \sqrt{\Delta t_1 \times \Delta t_2}$
$T = \sqrt{2.00 \times 4.00} = 2.8284$
$T = 2.838$
$$\frac{\Delta T_e}{\Delta T} = \frac{1}{2}\left(\frac{\Delta te_1}{\Delta t_1} + \frac{\Delta te_2}{\Delta t_2}\right) = \pm\frac{1}{2}\left[\frac{0.02}{2.00} + \frac{0.02}{4.00}\right]$$
$$= \pm\frac{1}{2}[0.01 + 0.005]$$
$$\frac{\Delta T_e}{2.83} = \pm\frac{1}{2}(0.015)$$
$$\Delta T_e = 0.0212258 = 0.02$$
$$T = (2.83 \pm 0.02)\text{second}$$

27. The length, breadth and thickness of a block are given by l = 12 cm, b = 6 cm and t = 2.45cm. The volume of the block according to the idea of significant figures should be
(a) $1 \times 10^2 cm^3$ (b) $2 \times 10^2\ cm^3$
(c) $1.763 \times 10^2 cm^3$ (d) None of the above
JIPMER-2005
UPCPMT-2004

Ans. (b) : Given that,
l = 12 cm
b = 6 cm
t = 2.45 cm

Using the relation for volume

$V = l \times b \times t$

$V = 12 \times 6 \times 2.45$

$V = 176.4$

$V = 1.764 \times 10^2\ cm^3$

The minimum number of significant figures is one in thickness, hence the volume will contain only one significant figure.

Therefore,

$V = 2 \times 10^2\ cm^3$

28. In a system of units, the units of mass, length and time are 1 quintal, 1 km and 1h respectively. In this system 1 N force will be equal to

(a) 1 unit (b) 129.6 unit
(c) 125.7 unit (d) 10^3 unit

UP CPMT-2002

Ans. (b) : $1\ kg = 10^{-2}$ quintal

$1\ m = 10^{-3}$ km

$1\ s = \frac{1}{3600}$ hour

$$1\ N = \frac{kg \times m}{s^2} = \frac{10^{-2} \times 10^{-3}}{\left(\frac{1}{3600}\right)^2}$$

$1\ N = 10^{-5} \times 3600 \times 3600$

$1\ N = 129.6$ unit

Hence, unit in quintal, kilometer and hour is 129.6 unit.

29. The length and breadth of a metal sheet are 3.124 m and 3.002 m respectively. The area of this sheet upto four correct significant figure is:

(a) $9.378\ m^2$ (b) $9.37\ m^2$
(c) $9.378248\ m^2$ (d) $9.3782\ m^2$

AIIMS-2001

Ans. (a) : Given, Length = 3.124 m

Breadth = 3.002 m

Area $= L \times B$

$= 3.124 \times 3.002 = 9.378\ m^2$

30. What is the fractional error in g calculated from $T = 2\pi\sqrt{\ell/g}$? Given fraction errors in T and l are ± x and ± y respectively?

(a) x + y (b) x – y
(c) 2x + y (d) 2x – y

AIIMS-2012

Ans. (c) : $T = 2\pi\sqrt{\frac{l}{g}}$

Squaring both side

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

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

$$g \propto \frac{l}{T^2}$$

taking log and differentiating

$\log g = \log l - 2 \log T$

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

for maximum error is +ve sign

$$\%\ \text{Error},\ \frac{\Delta g}{g} = \frac{\Delta l}{l} + \frac{2\Delta T}{T}$$

$$\frac{\Delta g}{g} = y + 2x$$

31. The least count of a stop watch is 0.2 second. The time of 20 oscillations of a pendulum is measured to be 25 second. The percentage error in the measurement of time will be

(a) 8% (b) 1.8%
(c) 0.8% (d) 0.1%

AIIMS-2015

Ans. (c) : Given,

Least count of stop watch = $[\Delta T]$ = 0.2 sec

No. of Oscillation (n) = 20

Time taken = 25 sec

∴ Time Period of oscillation (T) $= \frac{25}{20}$

$= 1.25$ sec

$$\%\ \text{error} = \frac{\Delta T}{T \times n} \times 100 = \frac{0.2}{1.25 \times 20} \times 100$$

$= 0.8\%$

32. The heat generated in a circuit is given by $Q = I^2 Rt$, where I is current, R is resistance and t is time. If the percentage errors in measuring I, R and t is 2%, 1% and 1% respectively, then the maximum error in measuring heat will be

(a) 2% (b) 3%
(c) 4% (d) 6%

AIIMS-26.05.2018(M)
BITSAT-2020

Ans. (d) : Generated heat, $Q = I^2Rt$

taking log and differentiating

$\log Q = 2 \log I + \log R + \log t$

$$\frac{\Delta Q}{Q} = 2\frac{\Delta I}{I} + \frac{\Delta R}{R} + \frac{\Delta t}{t}$$

$$\frac{\Delta Q}{Q} \times 100 = \frac{2\Delta I}{I} \times 100 + \frac{\Delta R}{R} \times 100 + \frac{\Delta t}{t} \times 100$$

$$= 2 \times 2\% + 1\% + 1\% = 6\%$$

33. If the error in the measurement of momentum of a particle is (+100%), then the error in the measurement of kinetic energy is

(a) 25% (b) 200%
(c) 300% (d) 400%

UP CPMT-2014

Ans. (c): We know that

Momentum (p) = mv

Kinetic energy (KE) = $\frac{1}{2}mv^2$

Then,

$$KE = \frac{p^2}{2m}$$

Given, $p_i = p$

$$p_f = p + \frac{p \times 100}{100} = 2p$$

Error,

$$\frac{KE_f - KE_i}{KE_i} \times 100 = \frac{p_f^2 - p_i^2}{p_i^2} \times 100$$

$$\text{Error} = \frac{(2p)^2 - p^2}{p^2} \times 100$$

= 3×100

=300%

34. A public park, in the form of a square, has an area of (100 ± 0.2)m². The side of park is

(a) (10 ± 0.01)m
(b) (10 ± 0.1)m
(c) (10.0 ± 0. 1)m
(d) (10.0 ± 0.2)m

UP CPMT-2014

Ans. (a) : Area = (100± 0.2)m²

So,

$100 = l^2$

10 m = l (length)

Now,

$$\frac{\Delta A}{A} = \frac{2\Delta l}{l}$$

$$\frac{0.2}{100} = 2 \times \frac{\Delta l}{10}$$

Δl = 0.01 m

So, length = (10± 0.01)m

35. The length of a pendulum is measured as 1.01 m and time for 30 oscillations is measured as one minute 3 s. Error length is 0.01 m and error in time is 3 s. The percentage error in the measurement of acceleration due to gravity is

(a) 1
(b) 5
(c) 10
(d) 15

AP EAMCET -2012

Ans. (c) : Given data,

T = 1 min 3 sec

= 60 + 3

= 63 sec

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

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

Error analysis,

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

$$\frac{\Delta g}{g} = \frac{0.01}{1.01} + 2 \times \frac{3}{63}$$

$$\frac{\Delta g}{g} = 0.0099 + 0.095$$

$$\frac{\Delta g}{g} \times 100 = [0.0099 + 0.095] \times 100$$

$= 0.1042 \times 100$

$= 10.4\% \approx 10\%$

36. 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 4% and 3% respectively, the maximum error in the measurement of density will be

(a) 7%
(b) 9%
(c) 12%
(d) 13%

[AIPMT 1996]

Ans. (d) : Given that,

% error in mass = 4%

% error in length = 3%

$\because$ Density D = $\frac{\text{mass}}{\text{volume}} = \frac{m}{L^3}$

$$\therefore \quad \frac{\Delta D}{D} \times 100 = \left(\frac{\Delta m}{m} \times 100\right) + 3\left(\frac{\Delta L}{L} \times 100\right)$$

= 1 × 4% + 3 × 3%

= 4% + 9%

max. error in measurement of density = 13%

37. The percentage errors in the measurement of mass and speed are 2% and 3% respectively. The error in kinetic energy obtained by measuring mass and speed, will be

(a) 12%
(b) 10%
(c) 8%
(d) 2%

[AIPMT 1995]

Ans. (c) : Given that,

% error in mass (m) = 2%

% error in speed (v) = 3%

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

taking log of both side

logE = 10g m + 2 log v

Differentiating of both side

$$\frac{\Delta E}{E} = \frac{\Delta M}{M} + \frac{\Delta V}{V}$$

$$= \left(\frac{\Delta m}{m} \times 100\right) + 2\left(\frac{\Delta v}{v} \times 100\right)$$

= 1×2% + 2 × 3%

= 2% + 6%

= 8%

38. In an experiment four quantities a, b, c and d are measured with percentage error 1%, 2%. 3% and 4% respectively. A quantity 'P' is calculated as $P=\frac{a^3b^2}{cd}$. Then the percentage error in 'P' is

(a) 14% (b) 10%
(c) 7% (d) 4%

AP EAMCET-28.04.2017, Shift-II
NEET- 2013

Ans. (a) : Given that,

Percentage change in, $a\left(\frac{\Delta a}{a}\times 100\right)=1\%$

Percentage change in, $b\left(\frac{\Delta b}{b}\times 100\right)=2\%$

Percentage change in, $c\left(\frac{\Delta c}{c}\times 100\right)=3\%$

Percentage change in, $d\left(\frac{\Delta d}{d}\times 100\right)=4\%$

and $P=\frac{a^3b^2}{cd}$

Percentage change in P = ?

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

= 3 × 1% + 2 × 2% + 1 × 3% + 1 × 4%
= 3% + 4% + 3% + 4%

$$\frac{\Delta P}{P}\times 100=14\%$$

Percentage change in P = 14%

39. In an experiment of simple pendulum, the errors in the measurement of length of the pendulum (L) and time period (T) are 3% and 2% respectively. The maximum percentage error in the value of $\frac{L}{T^2}$ is

(a) 5% (b) 7% (c) 8% (d) 1%

AP EAMCET-2001

Ans. (b) : Given that,

Error in the measurement of length, $\frac{\Delta L}{L}=3\%$

Error in the measurement of time, $\frac{\Delta T}{T}=2\%$

Let $\frac{L}{T^2}=x$

So, the fractional error in the measurement of x

$$\frac{\Delta x}{x}\times 100=\frac{\Delta L}{L}\times 100+\frac{2\Delta T}{T}\times 100$$

= 3 + 2 (2) = 3 + 4 = 7%

Hence, the maximum percentage error in the value of $\frac{L}{T^2}$ is 7%.

40. A clock with an iron pendulum keeps correct time at 15^0C. If room temperature rises to 20^0C, the error in seconds per day will be : (coefficient of linear expansion of iron is $00.000012/^0C$)

(a) 2.5 s (b) 2.6 s
(c) 2.4 s (d) 2.2 s

AP EAMCET(Medical)-1997

Ans. (b) : Given that,

$t_1 = 15°C$
$t_2 = 20°C$
$\alpha = 00.000012/^0C = 12\times 10^{-6}/°C$

Loss or gain time per day

$= \frac{1}{2}\times \alpha\Delta T\times 24\times 60\times 60$

$= \frac{1}{2}\times 12\times 10^{-6}\times 5\times 24\times 60\times 60$

= 2.592
≃ 2.6 sec

41. Dimensional formula of a physical quantity X is $[M^{-1}L^3T^{-2}]$ the errors is measuring the quantities M,L and T respectively are 2%,3% and 4%, The maximum percentage of error that occurs in measuring the quantity X is:

(a) 9 (b) 10
(c) 14 (d) 19

AP EAMCET(Medical)-2002

Ans. (d) : Given that,

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

$$\frac{\Delta X}{X}\times 100=\frac{\Delta M}{M}\times 100+3\frac{\Delta L}{L}\times 100+2\frac{\Delta T}{T}\times 100$$

= 2% + 3 × 3% + 2 × 4%
= 2% + 9% + 8%
= 19%

The maximum percentage of error occur in measuring is 19%.

42. While measuring acceleration due to gravity by a simple pendulum, a student makes a positive error of 2% in the length of the pendulum and a positive error of 1% in the value of time period, this actual percentage error in the measurement of the value of g will be

(a) 5% (b) 4%
(c) 3% (d) 0%

AP EMCET(Medical)-2011

Ans. (d) : Given that

$\frac{\Delta l}{l}\times 100=+2\%$

$\frac{\Delta T}{T}\times 100=+1\%$

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

$$\frac{\Delta g}{g}\times 100 = \frac{\Delta l}{l}\times 100+(-2)\frac{\Delta T}{T}\times 100$$
$$\frac{\Delta g}{g}\times 100 = 2\% + (-2)\times(1)\%$$
$$\frac{\Delta g}{g}\times 100 = 2\% - 2\%$$
$$\frac{\Delta g}{g}\times 100 = 0\%$$

43. R = 65± 1Ω L, l = 5 ± 0.1 mm and d = 10 ± 0.5 mm. Find error I calculation of resistivity.

(a) 21% (b) 13%
(c) 16% (d) 41%

JIPMER-2018

Ans. (b) : Given that,
R = 65 ± 1 Ω, l = 5 ±0.1 mm, d = 10 ± 0.5
Since we know that

$$R = \rho\frac{l}{A}$$
$$\rho = \frac{RA}{l}$$
$$\rho = R\frac{\pi d^2}{4l}$$

So, error in resistivity, $\frac{\Delta\rho}{\rho} = \frac{\Delta R}{R} \pm \frac{2\Delta d}{d} \pm \frac{\Delta l}{l}$

$$\frac{\Delta\rho}{\rho} = \frac{1}{65}+\frac{2\times(0.5)}{10}+\frac{(0.1)}{5}$$
$$\frac{\Delta\rho}{\rho} = 0.015+0.1+0.02$$
$$\frac{\Delta\rho}{\rho} = 0.015+0.1+0.02$$
$$\frac{\Delta\rho}{\rho} = 0.135$$
$$\frac{\Delta\rho}{\rho}\times 100\% = 0.135\times 100$$
$$\boxed{\frac{\Delta\rho}{\rho}\times 100\% = 13.5\%}$$

44. The velocity of projection of a body is increased by 2%. Other factors remaining unchanged, what will be the percentage change in the maximum height attained?

(a) 1% (b) 2%
(c) 4% (d) 8%

AIIMS-25.05.2019(E) Shift-2

Ans. (c) : Height of projection

$$H = \frac{u^2\sin^2\theta}{2g} \Rightarrow H \propto u^2, \left(\frac{\sin^2\theta}{2g}\right) = \text{constant}$$

taking log and differentiating
log H = 2 log 4

$$\frac{\Delta H}{H} = 2\frac{\Delta u}{u}$$
$$\frac{\Delta H}{H} = 2\frac{\Delta u}{u} \Rightarrow \frac{\Delta H}{H}\times 100 = 2\frac{\Delta u}{u}\times 100$$
$$= 2(2\%) = 4\%$$

45. If 1% and 2% are the errors in the measurement of mass and density of a cube respectively, then the error in the measurement of length is

(a) 1% (b) 3%
(c) 2% (d) 4%

AP EAMCET (22.04.2019) Shift-I

Ans. (a) : Volume of cube, $V = a^3$
Where, a = side of cube

Density of cube is given as $\rho = \frac{m}{V}$

$$\because V = a^3$$
$$\therefore \rho = \frac{m}{a^3}$$
$$a^3 = \frac{m}{\rho}$$
$$a = \left(\frac{m}{\rho}\right)^{1/3}$$

So, percentage error in measurement of length of a cube is given as–

$$\left(\frac{\Delta a}{a}\times 100\right)\% = \frac{1}{3}\left[\left(\frac{\Delta m}{m}\times 100\right)\% + \left(\frac{\Delta\rho}{\rho}\times 100\right)\%\right]$$

$$\because \left(\frac{\Delta m}{m}\times 100\right)\% = 1\%, \quad \left(\frac{\Delta\rho}{\rho}\times 100\right)\% = 2\%$$

$$\therefore \left(\frac{\Delta a}{a}\times 100\right)\% = \frac{1}{3}[1\% + 2\%]$$
$$\left(\frac{\Delta a}{a}\times 100\right)\% = \frac{1}{3}\times 3\% = 1\%$$
$$\boxed{\left(\frac{\Delta a}{a}\times 100\right)\% = 1\%}$$

46. The sides of a rectangular plate are (9.0 ± 0.3) cm and (3.0 ± 0.1) cm. The area of the plate with error limits is

(a) $(27.0 \pm 0.1)\text{cm}^2$ (b) $(27.0 \pm 0.3)\text{cm}^2$
(c) $(27.0 \pm 1.8)\text{cm}^2$ (d) $(27.0 \pm 0.2)\text{cm}^2$

AP EAMCET-24.04.2019, Shift-II

Ans. (c) : Given that,
Length (l) = (9.0 ± 0.3)
Breadth (d) = (3.0 ± 0.1)
Area (A) = l × b = 9 × 3 = 27 cm^2

Percentage error of Area

$$\frac{\Delta A}{A}=\frac{\Delta l}{l}+\frac{\Delta b}{b}$$

$$\frac{\Delta A}{A}=\left(\frac{0.3}{9.0}+\frac{0.1}{3.0}\right)=\frac{1.8}{27.0}$$

$$\Delta A=\frac{1.8}{27.0}\times A$$

$$\Delta A=\frac{1.8}{27.0}\times A$$

$$\Delta A=\frac{1.8}{27.0}\times 27.0$$

$$\Delta A=1.8$$

So, Area = $(27.0 \pm 1.8)cm^2$

47. To estimate g from $g=4\pi^2\frac{L}{T^2}$, error in measurement of L is ±2% and error in measurement of T is ±3%. The error in estimated g will be

(a) ±8% (b) ±5% (c) ±3% (d) ±6%

AP EAMCET (18.09.2020) Shift-II

Ans. (a) : Given, $g=\frac{4\pi^2 L}{T^2}$

The percentage error in measurement of 'g' is given as–

$$\left(\frac{\Delta g}{g}\times 100\right)\%=\left(\frac{\Delta L}{L}\times 100\right)\%+2\times\left(\frac{\Delta T}{T}\times 100\right)\%$$

$$\because \left(\frac{\Delta L}{L}\times 100\right)\% = \pm 2\% \quad , \quad \left(\frac{\Delta T}{T}\times 100\right)\% = \pm 3\%$$

$$\therefore \left(\frac{\Delta g}{g}\times 100\right)\% = \pm 2\% + 2\times(\pm 3\%)$$

$$\left(\frac{\Delta g}{g}\times 100\right)\% = 2\% + 6\%$$

$$\boxed{\left(\frac{\Delta g}{g}\times 100\right)\% = \pm 8\%}$$

48. 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?

(a) 2% (b) 4% (c) 16% (d) 1.6%

[NEET (Oct.) 2020]

Ans. (d) : Error = Reading value – mean value

$$\text{Mean value} = \frac{\text{Sum of observation}}{\text{No. of observation}}$$

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

$$=\frac{6.25}{5}$$

= 1.25 sec

Error in each reading, $E_1 = 1.25 - 1.25 = 0$

$E_2 = 1.24 - 1.25 = -0.01$

$E_3 = 1.27 - 1.25 = 0.02$

$E_4 = 1.21 - 1.25 = -0.04$

$E_5 = 1.28 - 1.25 = 0.03$

$$\text{Relative error} = \frac{\text{Sum of absolute error}}{\text{Mean value}\times 5}$$

$$=\frac{|E_1|+|E_2|+|E_3|+|E_4|+|E_5|}{1.25\times 5}\times 100\%$$

$$=\frac{0+0.01+0.02+0.04+0.03}{1.25\times 5}\times 100\%$$

$$=\frac{0.1}{1.25\times 5}\times 100\%$$

= 1.6%

49. When two resistors of resistances $R_1 = (200 \pm 2)\ \Omega$ and $R_2 = (400 \pm 4)\ \Omega$ are connected in series, the equivalent resistance of the combination is ______

(a) $(800 \pm 7)\ \Omega$ (b) $(600 \pm 2)\ \Omega$
(c) $(600 \pm 6)\ \Omega$ (d) $(200 \pm 2)\ \Omega$

AP EAMCET-25.08.2021, Shift-I

Ans. (c) : Given that,

Resistances $R_1 = (200\pm2)\Omega$, $R_2=(400\pm4)\Omega$

When two resistances connected in series then equivalent resistance is-

$R = R_1 + R_2$

$\therefore R = (200 \pm 2) + (400 \pm 4)$

$R = (600 \pm 6)\Omega$

50. A physical quantity P is related to four observables a,b,c, and d as $P=\frac{\sqrt{ab}.d^{\alpha}}{\sqrt{c}}$ (α is constant). The percentage errors in a,b,c and d are 0.5% in each. If the percentage error in P is 2%, then α is–

(a) $\frac{5}{2}$ (b) $\frac{2}{5}$ (c) $\frac{3}{4}$ (d) $\frac{3}{2}$

AP EAMCET-07.07.2022, Shift-II

Ans. (a) : Given,

$$P=\frac{\sqrt{ab}\,d^{\alpha}}{\sqrt{c}}$$

$$\frac{\Delta P}{P}\times 100=\left(\frac{1}{2}\frac{\Delta a}{a}+\frac{1}{2}\frac{\Delta b}{b}+\alpha\frac{\Delta d}{d}+\frac{1}{2}\frac{\Delta c}{c}\right)\times 100$$

$$\frac{\Delta P}{P}\times 100=\frac{1}{2}\times 0.5+\frac{1}{2}\times 0.5+\alpha\times 0.5+\frac{1}{2}\times 0.5$$

$$2=\frac{1}{4}+\frac{1}{4}+\frac{\alpha}{2}+\frac{1}{4}$$

$$2=\frac{3}{4}+\frac{\alpha}{2}$$

$$\boxed{\therefore \alpha=\frac{5}{2}}$$

51. **The pressure on a square plate is measured by measuring the force on the plate and the length of the sides of the plate. If the maximum errors in the measurement of force and length are respectively 4% and 2 %, then the maximum error in the measurement of pressure is**
(a) 1 % (b) 2 %
(c) 6 % (d) 8 % **AIIMS-2017**

Ans. (d) : We know that, $P = \frac{F}{A} = \frac{F}{l^2}$
So maximum error in Pressure (P),
$$\left|\frac{\Delta P}{P}\right|_{max} = \frac{\Delta F}{F} + \frac{2\Delta l}{l}$$
$$\left(\frac{\Delta P}{P}\times 100\right)_{max} = \frac{\Delta F}{F}\times 100 + 2\left(\frac{\Delta l}{l}\times 100\right)$$
$$= 4\% + 2\times 2\%$$
$$\left(\frac{\Delta P}{P}\times 100\right)_{max} = 8\%$$

52. **A certain body weighs 22.42 g and has a measured volume of 4.7 cc. 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**
(a) 22% (b) 2%
(c) 0.2% (d) 0.02%
[NEET 2021]
AP EMCET(Medical)-2010
[AIPMT 1991]

Ans. (b) : Given that,
Weight of body (m) = 22.42 g
Volume of body (v) = 4.7 cc
Error in mass (Δm) = 0.01 g
Error in volume (Δv) = 0.1 cc
% error in mass = $\frac{\Delta m}{m} \times 100 = \frac{0.01}{22.42} \times 100$
$= \frac{1}{2242} \times 100$
% error in volume = $\frac{\Delta v}{v} \times 100$
$= \frac{0.1}{4.7} \times 100 = \frac{1}{47} \times 100$
∵ Density D = $\frac{\text{mass(m)}}{\text{volume(v)}}$
%error in density = %error in mass + %error in volume
$= \frac{1}{2242}\times 100 + \frac{1}{47}\times 100 = 2.17\%$
Maximum error in density ≃ 2%

53. **If the error in the measurement of radius of a sphere is 2%, then the error in the determination of volume of the sphere will be**
(a) 4% (b) 6% (c) 8% (d) 2%
AP EAMCET-25.09.2020, Shift-II
[AIPMT 2008]

Ans. (b) : Given that, % error in radius = 2%
$\frac{\Delta r}{r} \times 100 = 2\%$
∵ volume of sphere = $\frac{4}{3}\pi r^3$
log of both side log v = 3 logr
Differentiating both side
$\frac{dV}{V} = 3\frac{dr}{r}$
$\frac{\Delta v}{v} \times 100 = 3\left(\frac{\Delta r}{r}\times 100\right)$
$= 3 \times 2\%$
$\frac{\Delta v}{v} \times 100 = 6\%$
$\frac{\Delta v}{v} = 6\%$
% error in volume = 6%

54. **An atom bomb weighing 1 kg explodes releasing 9×10^{13}J of energy. What percentage of mass is converted into energy?**
(a) 0.1% (b) 1%
(c) 2% (d) 10%
UP CPMT-2013

Ans. (a) : Given,
$E = 9 \times 10^{13}$ J
$c = 3 \times 10^8$ ms^{-2}
We know that,
$E = mc^2$
$9 \times 10^{13} = m(3 \times 10^8)^2$
$m = \frac{9\times10^{13}}{(3\times10^8)^2} = \frac{9\times10^{13}}{9\times10^{16}}$
$m = 1 \times 10^{-3}$ kg
$\frac{\Delta m}{m}\times 100 = 10^{-3} \times 100 = 0.1\%$

Assertion and Reason

55. **Assertion (A) :** The number 0.00764 has three significant figures.
Reason (R) : If the number is less than 1, the zeros on the right of the decimal point but to the left of the first non-zero digit are not significant.
(a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true but (R) is false.
(d) (A) is false but (R) is true.
AP EAMCET (23.04.2019) Shift-I

Ans. (a): For Assertion (A):-
No. of significant figure in 0.00764
= (7, 6, 4)
There are 3 significant figure in above number
For reason (R):-
Let a number is

$0.\boxed{00}\,abc\boxed{00} \rightarrow$ significant (Right zeros)
$\downarrow$
Non – significant (Left zeros)

56. Assertion: Number of significant figures in 0.005 is one and that in 0.500 is three
Reason: This is because zeros are not significant.
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

AIIMS-25.05.2019(E) Shift-2

Ans. (c) : No. of significant in 0.005
= (digit 5)
= only 1 significant figure
No. of significant in 0.500
= (5, 0, 0)
= 3 significant figure
So, Zeroes placed to the left of the number are never significant, but zeroes places to right of the number are significant.
Hence, assertion is true but reason is false.

57. Assertion: The number of significant figures depends on the least count of measuring instrument.
Reason: Significant figures define the accuracy of measuring instrument.
(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2016

Ans. (b) : Significant figure refers to the accuracy of measurement and accuracy of measurement also depend upon the least count of measuring instrument.

58. 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 $\frac{\Delta A}{A} = \frac{4\Delta r}{r}$
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2008

Ans. (c) : We know that,
Area of sphere, $A = 4\pi r^2$
taking log and differentiating

$$\frac{\Delta A}{A} = \frac{2\Delta r}{r}$$

$$\frac{\Delta A}{A}\times 100 = 2\times 0.3\% = 0.6\%$$

The permissible error is not calculated by

$$\frac{\Delta A}{A} = \frac{4\Delta r}{r}$$

So, Reason is not correct.

59. Assertion: When percentage errors in the measurement of mass and velocity are 1% and 2% respectively, the percentage error in K.E. is 5%.
Reason: $\frac{\Delta E}{E} = \frac{\Delta m}{m} + \frac{2\Delta v}{v}$
(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2010

Ans. (a) : We know that,
Kinetic Energy, $K.E = \frac{1}{2}mv^2$
taking log and Differentiating of Both side

$$\frac{\Delta E}{E} = \frac{\Delta m}{m} + \frac{2\Delta v}{v}$$

$$\frac{\Delta E}{E}\times 100 = \frac{\Delta m}{m}\times 100 + 2\frac{\Delta V}{V}\times 100$$

= 1% + 2 × 2% = 5%

60. Assertion: In the measurement of physical quantities direct and indirect methods are used.
Reason: The accuracy and precision of measuring instruments along with errors in measurements should be taken into account, while expressing the result.
(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2017

Ans. (a) : Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

Chapter-2. Dimensional Analysis and its Application

Multiple Choice Question (MCQs)

61. A force defined by $F = \alpha t^2 + \beta t$ acts on a particle at a given time t. The factor which is dimensionless α and β are constants, is :

(a) $\beta t/\alpha$ (b) $\alpha t/\beta$
(c) $\alpha\beta t$ (d) $\alpha\beta/t$

NEET (UG) 05.05.2024

Ans. (b) : Given,

$F = \alpha t^2 + \beta t$

Dimension of F = dimension of at^2 = dimension of βt

$\frac{\text{kgm}}{\text{s}^2} = \alpha \times s^2 = \beta \times s$

$\Rightarrow$ dimension of $\alpha = \frac{\text{Kgm}}{\text{s}^4}$

dimension of $\beta = \frac{\text{Kgm}}{\text{s}^3}$

Checking for option (b)

dimension of $\frac{\alpha t}{\beta} = \frac{\text{Kgm}}{\text{s}^4} \times \frac{s \times s^3}{\text{Kgm}} = 1$

Hence $\frac{\alpha t}{\beta}$ has no dimension.

62. The quantities which have the same dimensions as those of solid angle are :

(a) strain and angle
(b) stress and angle
(c) strain and arc
(d) angular speed and stress

NEET (UG) 05.05.2024

Ans. (a) : Dimension of solid angle = [L°M°T°]

Strain = $\frac{\text{change in surface}}{\text{orginal surface}}$

Strain = [L° M° T°]

Angle = $\frac{\text{Arc}}{\text{radius}}$ = [M°T°L°]

So dimension of angle will be equal to dimension of strain.

63. The displacement of a particle in wave motion is given by y=α sin (βX +γt) where 'X' and 't' represent displacement and time respectively. Then, the dimensional formula for $\frac{\alpha\beta}{\gamma}$ is

(a) $[M^o L^o T^1]$ (b) $[M^o L^o T^0]$
(c) $[M^1 L^1 T^1]$ (d) $[M^1 L^o T^1]$

Telangana SCHE 07.05.2024 Shift-II

Ans. (a) : $y = \alpha \sin(\beta x + \gamma t)$

Every terms inside the bracket of sin should be dimensionless.

$y = \alpha$

$\alpha = [L]$

$[\beta x] = [M^0L^0T^0]$

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

$[\gamma t] = [M^0L^0T^0]$

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

So, dimension $\frac{\alpha\beta}{\gamma} = \frac{[LL^{-1}]}{[T^{-1}]}$

$= [T]$

$= [M^0L^0T^1]$

64. The mechanical quantity, which has dimensions of reciprocal of mass (M^{-1}) is

(a) Torque
(b) Gravitational constant
(c) Angular momentum
(d) Coefficient of thermal conductivity

RE-NEET (UG)-06.06.2023 (Manipur)

Ans. (b) : Dimension of torque = $[M^1L^2 T^{-2}]$

dimension of Gravitational constant = $[M^{-1} L^3T^{-2}]$

dimension of angular momentum = $[ML^2T^{-1}]$

dimension of coefficient of thermal conductivity

$= [MLT^{-3}\theta^{-1}]$

From above it is clear that the gravitational constant is mechanical quantity which has dimensions of reciprocal of mass (M^{-1}).

65. Plane angle and solid angle have

(a) No units and no dimensions
(b) Both units and dimensions
(c) Unit but no dimensions
(d) Dimensions but no units

NEET 17.07.2022

Ans. (c) : Unit but no dimensions

Plane angle	Radian
Solid angle	Steradian

66. The dimensions $[MLT^{-2}A^{-2}]$ belong to the

(a) Magnetic permeability
(b) Electric permittivity
(c) Magnetic flux
(d) Self inductance

NEET 17.07.2022

Ans. (a):

List–I	List–II
(a) Magnetic Permeability	$[M^1LT^{-2}A^{-2}]$
(b) Electric Permeability	$[M^{-1}L^{-3}T^4A^2]$
(c) Magnetic flux	$[M^1L^2T^{-2}A^{-1}]$
(d) Self Inductance	$[ML^2T^{-2}A^{-2}]$

67. The physical quantity which has dimensional formula as that of $\frac{\text{Energy}}{\text{Mass} \times \text{Length}}$ is :

(a) force (b) power
(c) pressure (d) acceleration

AP EAMCET(Medical)-2000

Ans. (d) :

$\frac{\text{Energy}}{\text{mass} \times \text{length}}$ = Acceleration

and the dimension of Acceleration is

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

68. The correct order in which the dimension of 'Length' increases in the following physical quantities is?

(A) Permittivity (B) Resistance
(C) Magnetic permeability (D) Stress

(a) (A), (B), (C), (D) (b) (D), (C), (B), (A)
(c) (A), (D), (C), (B) (d) (C), (B), (D), (A)

AP EAMCET(Medical)-2004

Ans. (c) : (A) Electrical Permittivity,

$(\varepsilon_0) = [M^{-1}L^{-3}T^4A^2] = -3$

(B) Resistance (R) $=[M^1L^2T^{-3}A^{-2}] \Rightarrow 2$

(C) Magnetic permeability (μ) $=[M^1L^1T^{-2}A^{-2}] \Rightarrow 1$

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

$\therefore$ The correct order is the (A, D, C, B) dimension of 'length' increase in the following physical quantities.

69. What is the dimensions of impedance?

(a) $[ML^2T^{-3}I^{-2}]$ (b) $[M^{-1}L^{-2}T^3I^2]$
(c) $[ML^3T^{-3}I^{-2}]$ (d) $[M^{-1}L^{-3}T^3I^2]$

AIIMS-2007

Ans. (a) : Impedance (Z) = $\frac{\text{Voltage (V)}}{\text{Current (I)}}$

$$\text{Dimension of } [Z] = \frac{[V]}{[I]} = \frac{[M^1L^2T^{-3}A^{-1}]}{[M^0L^0T^0A^1]}$$

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

$$= [ML^2T^{-3}I^{-2}] \qquad (\because A = I)$$

70. Which of the following physical quantities do not have same dimensions?

(a) pressure and stress
(b) tension and surface tension
(c) strain and angle
(d) energy and work

AIIMS-2007, 2001

Ans. (b) : Tension is a force experienced within a body to resist another force applied externally.

Dimension of tension = Dimension of force

$= [MLT^{-2}]$

Surface tension is the force per unit length perpendicular to line drawn in the surface of the liquid.

Dimension of surface tension,

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

Dimension of surface tension = $[MT^{-2}]$

71. Which of the following pair of quantities do not have the same dimensions:

(a) Potential gradient, electric field
(b) Torque, kinetic energy
(c) Light year, time period
(d) Impedance, reactance

AIIMS-2011

Ans. (c) : Light year is unit of distance.

So, dimension of light year = [L]

• Time taken for one complete oscillation to occur is called time period.

So, Dimension of time period = [T]

72. The dimensional formula of Farad is

(a) $[M^{-1}L^{-2}TQ]$ (b) $[M^{-1}L^{-2}T^2Q^2]$
(c) $[M^{-1}L^{-2}TQ^2]$ (d) $[M^{-1}L^{-2}T^2Q]$

AIIMS-2012

Ans. (b) : Dimension of Farad

$\therefore \quad C = \frac{Q}{V}$

As we know,

$W = Q.V \quad \Rightarrow V = \frac{W}{Q}$

$C = \frac{Q^2}{W} \quad [\because Q = CV]$

And $\quad W = F.d$

Thus, $\quad C = \frac{Q^2}{F.d}$

$$\text{Dimension of } C = \frac{[\text{Dimension of } Q]^2}{\text{Dimension of } F \times \text{dimension of } d}$$

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

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

73. The magnetic moment has dimensions of

(a) $[LA]$ (b) $[L^2 A]$
(c) $[LT^{-1} A]$ (d) $[L^2 T^{-1}A]$

JCECE-2007
AIIMS-2006

Ans. (b): Magnetic moment of a current carrying coil is defined as the product of current in the coil with the area of coil in vector form. That is,

$$\vec{M} = I\vec{A}$$

Thus, dimensions of M = [A] [L]^2

= [L^2 A]

74. Dimensions of relative density is

(a) $[ML^{-2}]$ (b) $[ML^{-3}]$
(c) Dimensionless (d) $[M^2L^{-6}]$

UP CPMT-2003

Ans. (c) : Relative density = $\dfrac{\text{Density of substance}}{\text{Density of water}}$

$$= \frac{[ML^{-3}]}{[ML^{-3}]}$$

Since, both have the same dimensions, thus their ratio is dimensionless.

75. The dimensional formula for emf, e in MKS system will be

(a) $[ML^2T^{-2}Q^{-1}]$ (b) $[ML^2T^{-1}]$
(c) $[ML^{-2}Q^{-1}]$ (d) $[MLT^{-2}Q^{-2}]$

UP CPMT-2002

Ans. (a) : Dimensional formula of emf electro magnetic force -

$$\text{EMF} = \frac{W}{q} \text{ or } \frac{[ML^2T^{-2}]}{[Q]} = [ML^2T^{-2}Q^{-1}]$$

or $$\text{EMF} = \frac{[ML^2T^{-2}]}{[AT]}$$

$$\text{EMF} = [ML^2T^{-3}A^{-1}]$$

76. $[ML^3T^{-3}A^{-2}]$ is the dimensional formula of

(a) resistance (b) resistivity
(c) conductance (d) conductivity

UP CPMT-2012

Ans. (b) : The formula of resistivity is given by

$$\rho = \frac{AR}{l}$$

• Here, ρ is the resistivity of the wire A is Area of cross section- of wire R is the resistance of the wire.
l is the length of the wire.

The dimension of Resistivity $\rho = [ML^3T^{-3}A^{-2}]$
The dimension of Resistance $R = [ML^2T^{-3}A^{-2}]$
The dimension of Conductance $C = [M^{-1}L^{-2}T^3A^2]$
The dimension of Conductivity $= [M^{-1}L^{-2}T^3A^1]$

77. The Physical quantity having the dimensions $[M^{-1}L^{-3}T^3A^2]$ is

(a) Resistance (b) Resistivity
(c) Electrical conductivity (d) Electromotive force

JIPMER-2011

Ans. (c) : We know that,

Resistivity $\rho = \dfrac{RA}{l}$

$$\rho = \frac{[ML^2T^{-3}A^{-2}][L^2]}{[L]}$$

$$\rho = \frac{[M]}{L^{-3}[AT][T]} = [ML^3A^{-2}T^{-3}]$$

So, Electrical conductivity $\sigma = \dfrac{1}{\rho}$

$$\rho = [ML^3A^{-2}T^{-3}]$$

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

78. The dimensions of $\frac{1}{2}\varepsilon_0E^2$, where ε_0 is permittivity of free space and E is electric field, are

(a) $[ML^2T^{-2}]$ (b) $[ML^{-1}T^{-2}]$
(c) $[ML^2T^{-1}]$ (d) $[MLT^{-1}]$

[AIPMT 2010]
AIIMS-2014

Ans. (b) : The given equation is $\frac{1}{2}\varepsilon_0E^2$

Where, ε_0 = permittivity
E = Electric field

∵ Dimension of $\varepsilon_0 = [M^{-1}L^{-3}T^4A^2]$

and

Dimension of electric field $E = \dfrac{F}{q}$

$$E = \frac{[MLT^{-2}]}{[AT]}$$

$$E = [MLT^{-3}A^{-1}]$$

∴ Dimension of $\frac{1}{2}\varepsilon_0E^2 = [M^{-1}L^{-3}T^4A^2]\,[MLT^{-3}A^{-1}]^2$

$$\frac{1}{2}\varepsilon_0E^2 = [M^{-1}L^{-3}T^4A^2]\,[M^2L^2T^{-6}A^{-2}]$$

$$\frac{1}{2}\varepsilon_0E^2 = [ML^{-1}T^{-2}]$$

79. The ratio of the dimensions of Planck's constant and that of the moment of inertia is the dimension of

(a) frequency (b) velocity
(c) angular momentum (d) time

SRM JEE-2010
[AIPMT 2005]

Ans. (a) : Dimension of Planck's constant,

$$h = \frac{E}{\nu} = \frac{[ML^2T^{-2}]}{[M^0L^0T^{-1}]} = [ML^2T^{-1}]$$

Dimension of moment of Inertia = mass × (Radius of gyration)^2

$= [M^1L^0T^0] \times [M^0L^1T^0]^2 = [ML^2]$

The ratio of the dimensions,

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

$= [T^{-1}]$

T^{-1} is the dimension of frequency.

80. A pair of physical quantities having same dimensional formula is

(a) force and torque
(b) work and energy
(c) force and impulse
(d) linear momentum and angular momentum

[AIPMT 2000]

Ans. (b) : A pair of physical quantities having same dimensional formula is –
work and energy.

The dimension of work = Fd cos θ

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

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

The dimension of energy $E = m.c^2$

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

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

81. The force F on a sphere of radius r moving in a medium with velocity v is given by F = 6πηrv. The dimensions of η are

(a) $[ML^{-3}]$ (b) $[MLT^{-2}]$
(c) $[ML^{-1}]$ (d) $[ML^{-1}T^{-1}]$

[AIPMT 1997]

Ans. (d) : Given, F = 6πηrv

$$\eta = \frac{F}{6\pi rv}$$

The dimension of F = $[MLT^{-2}]$

The dimension of r = [L]

The dimension of v = $[LT^{-1}]$

$$\therefore \quad \eta = \frac{[MLT^{-2}]}{[L][LT^{-1}]}$$

$\eta = [ML^{-1}T^{-1}]$

82. Which of the following will have the dimensions of time?

(a) [LC] (b) $\left[\frac{R}{L}\right]$
(c) $\left[\frac{L}{R}\right]$ (d) $\left[\frac{C}{L}\right]$

[AIPMT 1996]

Ans. (c) : [RC] = [T] Time constant of R – C circuit.

$\left[\frac{L}{R}\right] = [T]$ Time constant of R – L circuit

Hence, option (c) is correct.

83. The dimensional formula of torque is

(a) $[ML^2T^{-2}]$ (b) $[MLT^{-2}]$
(c) $[ML^{-1}T^{-2}]$ (d) $[ML^{-2}T^{-2}]$

UPCPMT-2014
[AIPMS 2011]
[AIPMT 1989]

Ans. (a) : Torque

τ= F.r

Where F = torque

r = distance of force form the center

Dimensions of r and F are [r] = [L] and [F] = $[MLT^{-2}]$

$[\tau] = [MLT^{-2}][L]$

$[\tau] = [ML^2T^{-2}]$

84. Which of the following is a dimensional constant ?

(a) Relative density
(b) Poisson's ratio
(c) Refractive index
(d) Gravitational constant

[AIPMT 1995]

Ans. (d) : Gravitational constant is a dimensional constant.

$$\because \quad F = G.\frac{m_1m_2}{r^2}$$

$$\because \quad G = \frac{Fr^2}{m_1m_2}$$

The dimension of (F) = $[MLT^{-2}]$

The dimension of $(r^2) = [L^2]$

The dimension of $m_1m_2 = [M^2]$

The dimension of G = $\frac{[MLT^{-2}].[L^2]}{[M^2]}$

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

85. Of the following quantities, which one has dimensions different from the remaining three?

(a) Energy per unit volume
(b) Force per unit area
(c) Product of voltage and charge per unit volume
(d) Angular momentum

[AIPMT 1989]

Ans. (d) : Energy per unit volume

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

Force per unit Area = $\frac{F}{A}$

$= \frac{[MLT^{-2}]}{[L^2]}$

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

Product of voltage and charge per unit volume

$$= \frac{vit}{V}$$

$$= \frac{P \times t}{V} = \frac{[ML^2T^{-3}][T]}{[L^3]}$$

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

Dimension of angular momentum

$$= (r)(P)$$

$$= (r)(mv)$$

$$= [L][M][LT^{-1}]$$

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

So, concluding we can say that angular momentum has different units.

86. Dimension of force is

(a) $[M^2L^1T^{-1}]$ (b) $[M^1L^1T^{-2}]$
(c) $[M^2L^{-1}T^{-2}]$ (d) $[M^1L^1T^{-1}]$

JIPMER-2018

Ans. (b) : Dimension of force

Force = mass × acceleration

$$\text{Unit} = [\text{Kg}]\left[\frac{\text{meter}}{\text{sec}^2}\right]$$

Dimension of force = $[M^1L^1T^{-2}]$

87. If force (F), work (W) and velocity (v) are taken as fundamental quantities, then the dimensional formula of time (T) is:

(a) $[WFv]$ (b) $[WFv^{-1}]$
(c) $[W^{-1}F^{-1}v]$ (d) $[WF^{-1}v^{-1}]$

AP EAMCET(Medical)-2007

Ans. (d) : Force = F

Work = W

Velocity = v

Let the distance be 'd' and the time be t Distance can be expressed as d = v ×t

Work done by an object is given by.

$$W = F \times d$$

$$= F \times v \times t$$

$$t = \frac{W}{Fv}$$

$$t = \left[W^1F^{-1}v^{-1}\right]$$

Hence, the dimensional formula of the time will be $[WF^{-1}v^{-1}]$

88. The dimensional formula of coefficient of kinematic viscosity is:

(a) $[M^0L^{-1}T^{-1}]$ (b) $[M^0L^2T^{-1}]$
(c) $[ML^2T^{-1}]$ (d) $[ML^{-1}T^{-1}]$

AP EAMCET(Medical)-2002

Ans. (b) : The dimensional formula of kinematic viscosity is $[M^0L^2T^{-1}]$.

89. The dimensional formula of magnetic induction is:

(a) $[MT^{-1}A^{-1}]$ (b) $[MT^{-2}A^{-1}]$
(c) $[MTA^{-2}]$ (d) $[MTA^{-2}]$

AP EAMCET(Medical)-2000

Ans. (b) : The dimensional formula of magnetic induction is $[MT^{-2}A^{-1}]$.

90. What is the dimension of Luminous flux?

(a) $[cd^1]$ (b) $[cd^1T^{-1}]$
(c) $[cd^1L^{-2}]$ (d) $[cd^1L^1T^{-1}]$

AIIMS-26.05.2019(M) Shift-1

Ans. (a) : The unit of luminous intensity is Candela and denoted as cd.

So, the unit of luminous flux = [cd]

91. P, Q, R and S denote energy, mass, angular momentum and gravitational constant respectively, the quantity $\left[\frac{Q^5S^2}{PR^2}\right]$ has the dimensions of

(a) Mass (b) Length
(c) Time (d) Angle

AP EAMCET (Medical)-24.04.2019, Shift-I

Ans. (d) : Given,

Let quantity is x

So, $x = \left[\frac{Q^5S^2}{PR^2}\right]$ ....(i)

Where, P → energy

Q → mass

R → angular momentum

S → Gravitational constant

Dimension of ,

Energy [P] = $[ML^2T^{-2}]$

Mass [Q] = [M]

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

Gravitational constant [S] = $[M^{-1}L^3T^{-2}]$

Substituting dimension of each quantity in equation (1)

$$[x] = \frac{[M]^5\left[M^{-1}L^3T^{-2}\right]^2}{\left[ML^2T^{-2}\right]\left[ML^2T^{-1}\right]^2}$$

$$= \frac{M^3L^6T^{-4}}{M^3L^6T^{-4}} = \left[M^0L^0T^0\right]$$

Angle is dimension less quantity

So, dimension formula of angle = $[M^0L^0T^0]$

92. If E and G respectively denote energy and gravitational constant. Then $\frac{E}{G}$ has the dimensions of

(a) $[M^2][L^{-1}][T^0]$ (b) $[M][L^{-1}][T^{-1}]$
(c) $[M][L^0][T^0]$ (d) $[M^2][L^{-2}][T^{-1}]$

[NEET 2021]

Ans. (a)

Energy (E) = $\frac{1}{2}mv^2$

Dimension of E = $[ML^2T^{-2}]$

and gravitational constant (G) = $\frac{Fr^2}{m_1m_2}$

$$G = \frac{[MLT^{-2}][L^2]}{[M^2]}$$

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

Now,

Dimension of $\frac{E}{G} = \frac{[ML^2T^{-2}]}{[M^{-1}L^3T^{-2}]}$

$$\frac{E}{G} = [M^2L^{-1}T^0]$$

93. The dimensions of Boltzmann constant are

(a) $[ML^2T^{-2}\theta^{-1}]$ (b) $[ML^2T^{-2}\theta]$

(c) $[M^2LT^{-2}\theta^{-1}]$ (d) $[ML^0T^{-2}\theta^{-1}]$

AP EAMCET-08.07.2022, Shift-I

AIIMS-26.05.2019(E) Shift-2

Ans. (a) : Dimensional formula of Boltzmann constant

$(K_b) = \frac{\text{Dimensional formula of energy}}{\text{Dimensional formula of temperature}}$

$= \frac{[ML^2T^{-2}]}{[\theta]}$

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

94. The dimension of angular momentum is

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

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

UPCPMT-1999, 1989, 1986, 1982, 1973

AIPMT-1988

AIPMT-1992, 1988

Ans. (c) : We know

Angular momentum (L) = mvr.

where = m = mass (kg)

V = velocity (m/s)

r = radius (m)

$L = [M][LT^{-1}][L]$

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

95. The correct dimensional formula for impulse is given by

(a) $[ML^2T^{-2}]$ (b) $[MLT^{-1}]$

(c) $[ML^2T^{-1}]$ (d) $[MLT^{-2}]$

AIPMT-1991

UPCPMT-1978

AP EAMCET-1981

Ans. (b) : Impulse (I) = Force × time

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

$[I] = [M^1L^1T^{-1}]$

96. Dimensional formula of Stefan's constant is

(a) $[MT^{-3}K^{-4}]$ (b) $[ML^0T^{-2}K^{-4}]$

(c) $[ML^2T^{-2}]$ (d) $[MT^{-2}L^0]$

(e) $[MT^{-4}L^0]$

AIPMT-2002

Ans. (a) : Stefan's constant $(\sigma) = \frac{E}{AtT^4}$

$$[\sigma] = \frac{[ML^2T^{-2}]}{[L^2][K^4][T]}$$

$$[\sigma] = \frac{[ML^0T^{-3}]}{[K]^4}$$

Dimension of $(\sigma) = [ML^0T^{-3}K^{-4}]$

97. The dimensions of self inductance *L* are

(a) $[ML^2T^{-2}A^{-2}]$ (b) $[ML^2T^{-1}A^{-2}]$

(c) $[ML^2T^{-1}A^{-1}]$ (d) $[ML^{-2}T^{-2}A^{-2}]$

AIPMT-1992, 1989

Ans. (a) : We know that,

$$E = L\frac{di}{dt}$$

where is 'i' is the current of circuit and L is the self inductance.

$$L = \frac{|E|}{\frac{di}{dt}} = \frac{[ML^2T^{-3}A^{-1}]}{[AT^{-1}]}$$

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

98. The dimensions of universal gravitational constant are–

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

(c) $[M^{-1}L^3T^{-2}]$ (d) $[ML^2T^{-2}]$

AP EAMCET-23.09.2020, Shift-II

JIPMER-2004

AIIMS-2000

UPCPMT-1996, DPMT-1984

AIPMT-2004, 1992

Ans. (c) : Gravitational force acting between two body is–

$$F = \frac{Gm_1m_2}{r^2}$$

$$\therefore \quad G = \frac{F.r^2}{m_1.m_2}$$

Where, G = Universal gravitational constant

F = Gravitational force

m_1 = mass of first body

m_2 = mass of second body

r = Distance between two body.

$\therefore$ Unit of Universal gravitational constant–

$\Rightarrow$ Unit of $G = \frac{\text{Newton. m}^2}{\text{kg . kg}} = \frac{\text{N.m}^2}{(\text{Kg})^2}$

$\Rightarrow$ Dimension of G = Dimension of $\frac{\text{N.m}^2}{(\text{Kg})^2}$

$\Rightarrow$ Dimension of $G = \frac{[MLT^{-2}][L^2]}{[M^2]}$

$\Rightarrow$ Dimension of $G = [M^{-1} L^3 T^{-2}]$

99. Planck's constant has the dimensions of

(a) linear momentum (b) angular momentum
(c) energy (d) power

AP EAMCET-06.09.2021, Shift-I
AIPMT-2001

Ans. (b) : We know that, E = hν
Where, E = Energy, h = Planck's constant,
ν = Frequency
Dimension of Plank's constant

$h = \frac{E}{\nu}$

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

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

Dimension of Angular momentum
= MVr
= $[M][LT^{-1}]$ [L]
= $[ML^2T^{-1}]$
Hence, option (b) is correct.

100. Dimensions of Planck's constant is :

(a) $[ML^2T^{-1}]$ (b) $[MLT^{-2}]$
(c) $[ML^{-2}T]$ (d) $[ML^{-1}T^2]$

AIIMS-1997,
UPCPMT-1999

Ans. (a) : Formula, E = hν

$\text{Planck's Constant } (h) = \frac{\text{Energy in each Photon}}{\text{Frequency of radiation}}$

$= \frac{E}{\nu} = \frac{[ML^2T^{-2}]}{[T^{-1}]}$

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

101. The dimension of magnetic flux is

(a) $[MLT^{-1}A^{-1}]$ (b) $[ML^{-1}TA^{-2}]$
(c) $[ML^{-2}T^2A^{-2}]$ (d) $[ML^2T^{-2}A^{-1}]$

AP EAMCET (Medical)-2003
AIPMT-1999, 89, AIIMS-1998

Ans. (d) : Magnetic flux $(\phi_B) = B \times A \times \cos\theta$
Where, B = Magnetic Field
A = Surface Area
θ = Angle between the magnetic field and normal to the surface.

Therefore, dim. $(\phi_B) = [M^1T^{-2}A^{-1}][M^0L^2T^0]$

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

Since, θ is a dimensionless quantity.

102. Dimensions of $1/\mu_0\varepsilon_0$, where symbols have their usual meaning, are

(a) $[L^{-1}T]$ (b) $[L^2T^2]$
(c) $[L^2T^{-2}]$ (d) $[LT^{-1}]$

AFMC-1986, AIIMS-1993
AIPMT-1992, UPCPMT-1997, 1992

Ans. (c) : We know,

$c = \frac{1}{\sqrt{\mu_0\varepsilon_0}}$

$c^2 = \frac{1}{\mu_0\varepsilon_0}$

Then, dimensional formula of $\frac{1}{\mu_0\varepsilon_0}$ is given as –

$\frac{1}{\mu_0\varepsilon_0} = c^2 = [LT^{-1}]^2 = [L^2T^{-2}]$

103. Dimensional formula for ε_0 is

(a) $[M^{-1}L^{-2}A^2T^2]$ (b) $[ML^2A^{-2}T^4]$
(c) $[M^{-1}L^{-3}A^2T^4]$ (d) $[ML^3A^{-2}T^4]$

AP EAMCET (17.09.2020) Shift-II
AIIMS-2004

Ans. (c) : From Coulomb's law,

$F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1q_2}{r^2}$

$\therefore \quad \varepsilon_0 = \frac{1}{4\pi F} \cdot \frac{q_1q_2}{r^2}$

$\therefore$ Dimensions of $\varepsilon_0 = \frac{1}{[MLT^{-2}]} \times \frac{[AT]^2}{[L^2]}$

$= [M^{-1}L^{-3}A^2T^4]$

104. The dimension of light year

(a) $[LT^{-1}]$ (b) [T]
(c) $[ML^2T^{-2}]$ (d) [L]

UPCPMT-1991

Ans. (d) : Light year is a distance that light can travel in one year since its unit is in meter.
$\therefore$ Dimension of light year is [L]

105. The dimensional formula for Young's modulus is

OR

The dimensional formula of modulus of rigidity is

OR

The dimensional formula of pressure is

OR

The dimensional formula for volume elasticity is

OR

The dimensional formula of modulus of elasticity is

OR

Dimension of Bulk modulus is

OR

What is the dimension of stress?

(a) $ML^{-1}T^{-2}$ (b) M^0LT^{-2}
(c) MLT^{-2} (d) ML^2T^{-2}

NEET (Sep.) 2020
JIPMER-2005,
UP CPMT-2004, 1991
AP EAMCET (Med.)-1995
AIPMT-1990, IIT-1982

Ans. (a) : Young's modulus = $\frac{\text{stress}}{\text{strain}}$

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

$$\text{Strain} = \frac{\Delta l}{l} \Rightarrow \frac{[L]}{[L]} = [M^0L^0T^0]$$

Dimension of Young's modulus = $\frac{[ML^{-1}T^{-2}]}{[M^0L^0T^0]}$

Dimensional formula of Young's modulus = $[ML^{-1}T^{-2}]$

106. If M, L, T, and I stand for mass, length, time and electric current respectively, the dimensional formula for capacitance is

(a) $[M^{-1}L^2T^{-4}I^2]$ (b) $[M^{-1}L^{-2}T^4I^2]$
(c) $[ML^2T^4I^2]$ (d) $[ML^2T^{-4}I^{-2}]$

AIIMS-25.05.2019 (E)-Shift-II
AP EAMCET(Medical)-1997

Ans. (b) : Capacitance = $\frac{\text{charge}}{\text{voltage}}$

Capacitance = charge × voltage^{-1} …….. (i)

Dim. of charge = [IT]

Voltage = Electric field × displacement

Electric field = force × charge^{-1}

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

Dim. (Electric field) = $[ML^1T^{-3}I^{-1}]$

Now, dimension of voltage = $[MLI^{-1}T^{-3}]$ [L]

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

Put in the equation (i),

Dim. (Capacitance) = $[IT] \times [M L^2 I^{-1} T^{-3}]^{-1}$

$= [M^{-1} L^{-2} T^4 I^2]$

107. 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

(a) $[ML^2T^{-3}I^{-1}]$ (b) $[ML^2T^{-2}]$
(c) $[ML^2T^{-1}I^{-1}]$ (d) $[ML^2T^{-3}I^{-2}]$

JIPMER-2009,
AIIMS-2005, UPCPMT-2008, [AIPMT 2007]

Ans. (d) : From the relation of ohm's law-

V = IR

Where – V = Voltage
I = current of the circuit
R = Resistance of the wire

or

$$R = \frac{V}{I} \qquad \left(\because \; V = \frac{W}{q}\right)$$

$$\therefore \quad R = \frac{W}{q.I} \qquad (\because \; q = I.t)$$

or

$$R = \frac{W}{I.t.I} = \frac{[ML^2T^{-2}]}{[IT][I]}$$

or

$R = [ML^2T^{-3}I^{-2}]$

108. The dimensional formula for latent heat is

(a) $[MLT^{-2}]$ (b) $[ML^2T^{-2}]$
(c) $[M^0L^2T^{-2}]$ (d) $[MIT^{-1}]$

UPCPMT-1986, 1978

Ans. (c) : Formula of latent heat given by $L = \frac{Q}{m}$

Where, L= latent heat
Q= amount of heat
M = mass of substance

Dimension of heat or work = force × displacement

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

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

Dimension of mass = [M]

Dimension of Latent heat L = $\frac{\text{dim.of Q}}{\text{dim.of m}}$

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

$= [M^0L^2T^{-2}]$

109. If C and R denote capacitance and resistance respectively, then the dimensional formula of CR is

(a) $[M^0L^0T]$
(b) $[M^0L^0T^0]$
(c) $[M^0L^0T^{-1}]$
(d) Not expressible in terms of [MLT]

[AIPMT-1995, 1992, 1988]
UPCPMT-2005, 1985, 1981

Ans. (a):

Capacitance $(C)=\frac{q}{v}=\frac{q}{\frac{w}{q}}=\frac{q^2}{w}=\frac{(it)^2}{F.d}$

Where q = charge

C = Capacitance

v = voltage

$=\frac{(it)^2}{Fx}=\frac{[AT]^2}{[ML^2T^{-2}]}$

$=[M^{-1}L^{-2}T^4A^2]$

and R = $\frac{V}{i}=\frac{w}{qi}=\frac{F.d}{i^2.t}=\frac{[MLT^{-2}][L]}{[A]^2[T]}$

$[ML^2T^{-3}A^{-2}]$

Dimensional formula of CR

$=[M^{-1}L^{-2}T^4A^2][ML^2T^{-3}A^{-2}]$

$=[M^0L^0T^1]$

110. The dimensional formula for permeability of free space, μ_0 is

(a) $[MLT^{-2}A^{-2}]$ (b) $[ML{-}1T^{-2}A^2]$

(c) $[ML^{-1}T^{-2}A^2]$ (d) $[MLT^{-2}A^{-1}]$

UPCPMT-2007, AIIMS-2003

AIPMT-1993, 1991

Ans. (a) : The dimensional formula for permeability of free space,

$\mu_0=\frac{2\pi\times \text{force}\times \text{distance}}{\text{current}\times \text{current}\times \text{length}}$

Dimension of force = $[MLT^{-2}]$

Dimension of current = [A]

Dimension of length and distance = [L]

$\therefore \mu_0=\frac{[MLT^{-2}][L]}{[A][A][L]}$

$\mu_0=[MLT^{-2}A^{-2}]$

111. $[ML^{-1}T^{-1}]$ stand for dimension of

(a) work

(b) torque

(c) linear momentum

(d) coefficient of viscosity

AIIMS-2010, UP CPMT-2001

Ans. (d) :

(i) Dimension of work

W = f.d

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

(ii) Dimension of torque

T = f × r

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

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

(iii) Linear momentum

P = m.v.

= [M] $[LT^{-1}]$ = $[MLT^{-1}]$

(iv) Dimension of coefficient of viscosity

F = 6πηrv

$\eta=\frac{F}{6\pi r.v}$

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

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

(a) $[ML^{-2}T^{-1}I^0]$ (b) $[M^0L^0T^3I^0]$

(c) $[M^{-1}L^{-2}T^6I^2]$ (d) $[M^0L^0T^2I^0]$

Manipal UGET-2014

UP CPMT-2014

Ans. (b) : We know that,

Dimension of Inductance (L) = $[ML^2T^{-2}I^{-2}]$

Dimension of Capacitance [C] = $[M^{-1}L^{-2}T^4I^2]$

Dimension of Resistance (R) = $[ML^2T^{-3}I^{-2}]$

So,

The dimension formula of C^2LR is

C^2LR = $[M^{-1}L^{-2}T^4I^2]^2$ $[ML^2T^{-2}I^{-2}]$ $[ML^2T^{-3}I^{-2}]$

= $[M^{-2}L^{-4}T^8I^4]$ $[M^2L^4T^{-5}I^{-4}]$

= $[M^0L^0T^3I^0]$

113. If $P=\frac{RT}{V-b}e^{-\alpha V/RT}$, then dimensional formula of α is

(a) P (b) R

(c) T (d) V

UP CPMT-2010

Ans. (a) : Given $P=e^{-\frac{\alpha V}{RT}}\frac{RT}{V-b}$

$\frac{\alpha V}{RT}$ should be dimensionless

$[\alpha]=\frac{[RT]}{[V]}$ ____(i)

We know that PV = nRT

$[P]=\frac{[nRT]}{[V]}$ ___(ii)

From equation (i) and (ii)

$\alpha = P$

114. If E = energy , G = gravitational constant, I = impulse and M = mass, then dimensions of $\frac{GIM^2}{E^2}$

(a) time (b) mass

(c) length (d) force

UP CPMT-2006

Ans. (a): The dimensional formula of given equation is : -

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

$$= \frac{[M^2L^4T^{-3}]}{[M^2L^4T^{-4}]}$$

$$= [M^0L^0T^1]$$

So, it is clear that dimensions of $\frac{GIM^2}{E^2}$ are same as that of the time.

115. In the relation $p = \frac{\alpha}{\beta} e^{-\alpha z/k\theta}$ p is pressure, Z is distance, k is Boltzmann constant and θ is the temperature. The dimensional formula of β will be

(a) $[ML^2T]$ (b) $[M^0L^2T^0]$
(c) $[ML^0T^{-1}]$ (d) $[M^0L^2T^{-1}]$

UP CPMT-2011

Ans. (b) : $p = \frac{\alpha}{\beta} e^{-\frac{\alpha z}{k\theta}}$

As we know that exponential term is dimensionless,

Dimension of α, $[\alpha] = \frac{[k][\theta]}{[z]}$

Where, k = Boltzmann constant

θ = Temperature

z = Distance

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

$$\alpha = [MLT^{-2}]$$

$$[p] = \frac{[\alpha]}{[\beta]} \quad (\text{from equation})$$

$$\beta = \frac{[\alpha]}{[P]} = \frac{[MLT^{-2}]}{[ML^{-1}T^{-2}]} = [L^2] \quad \text{or}$$

$$\beta = [M^0L^2T^0]$$

116. Number of particles is given by

$n = -D\frac{n_2 - n_1}{x_2 - x_1}$ crossing a unit area perpendicular to X-axis in unit time, where n_1 and n_2 are number of particles per unit volume. Find dimensions of D called as diffusion constant

(a) $[M^0LT^{-2}]$ (b) $[M^0L^2T^{-4}]$
(c) $[M^0LT^{-3}]$ (d) $[M^0L^2T^{-1}]$

UP CPMT-2014

Ans. (d): Given

Number of particles (n) = $-D\frac{n_2 - n_1}{x_2 - x_1}$

$n_1 = n_2$ = number of particles per unit volume = $[L^{-3}]$

So,

$$n = \frac{\text{Number of particles}}{A \times t} = \frac{[M^0L^0T^0]}{[L^2][T]} = [L^{-2}T^{-1}]$$

Now, from formula

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

117. An object is moving through the liquid the viscous damping force acting on it' is proportional to the velocity. then dimensional formula of constant of proportionality is

(a) $[ML^{-1}T^{-1}]$ (b) $[MLT^{-1}]$
(c) $[ML^0LT^{-1}]$ (d) $[ML^0T^{-1}]$

UP CPMT-2009

Ans. (d) :

$F \propto V$

$F = LV$

$$L = \frac{F}{V} = \frac{[MLT^{-2}]}{[LT^{-1}]}$$

$= [ML^{\circ}T^{-1}]$

118. If E, M, J and G respectively denote energy, mass, angular momentum and universal gravitational constant, the quantity, which has the same dimensions as the dimensions of $\frac{EJ^2}{M^5G^2}$

(a) Time (b) Angle
(c) Mass (d) Length

AP EAMCET -2013

Ans. (b) : E = Energy = $[ML^2T^{-2}]$

M = Mass = [M]

J = Angular momentum $[M^1L^2T^{-1}]$

G = Universal gravitational constant $[M^{-1}L^3T^{-2}]$

$$\frac{EJ^2}{M^5G^2} = \frac{[ML^2T^{-2}][M^1L^2T^{-1}]^2}{[M]^5[M^{-1}L^3T^{-2}]^2}$$

$$= \frac{[ML^2T^{-2}][M^2L^4T^{-2}]}{[M^5][M^{-2}L^6T^{-4}]}$$

$$= [M^0L^0T^0]$$

$[M^0L^0T^0]$ is dimension of angle.

119. The dimensional formula of $\frac{1}{2}\mu_0 H^2$ (μ_0 = magnetic field intensity) is

(a) $[MLT^{-1}]$ (b) $[ML^2T^{-2}]$
(c) $[ML^{-1}T^{-2}]$ (d) $[ML^2T^{-1}]$

AP EAMCET -2011

Ans. (c) : $\frac{1}{2}\mu_0 H^2$ is energy density of a magnetic field
Hence, its dimension is same as that of energy density.

$$\frac{1}{2}\mu_0 H^2 = \frac{[ML^2T^{-2}]}{[L^3]}$$

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

120. If velocity [v], time [T] and force [F] are choosen as the base quantities, the dimensions of the mass will be

(a) $[FT^{-1}v^{-1}]$ (b) $[FTv^{-1}]$
(c) $[FT^2v]$ (d) $[FvT^{-1}]$

[AIPMT 2014]

Ans. (b) : Let,
mass (m) $\propto F^a v^b T^c$ … (i)

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

$$[M^1L^0T^0] \propto [M^a L^{a+b} T^{-2a-b+c}]$$

On comparing both side, we get
a = 1
a + b = 0 ⇒ 1 + b = 0 ⇒ b = –1
–2a – b + c = 0 ⇒ –2 × 1 – (–1) + c = 0, c = 1
On putting value of a, b & c in equation (i), we get
Dimension of m = $[F]^1 [v]^{-1} [T] = [F v^{-1} T]$

121. The potential energy of a particle varies with distance x from a fixed origin as $v = \left(\frac{A\sqrt{x}}{x+B}\right)$; where, A and B are constants. The dimensions of AB are

(a) $[ML^{5/2}T^{-2}]$ (b) $[ML^2T^{-2}]$
(c) $[M^{3/2}L^{3/2}T^{-2}]$ (d) $[ML^{7/2}T^{-2}]$

JIPMER-2010

Ans. (d) : Given , $v = \frac{A\sqrt{x}}{x+B}$ ....(i)
Dimensions of v = dimensions of potential energy
$= [ML^2T^{-2}]$
From equation (i)
Dimensions of B = dimensions of x = $[M^0LT^0]$
∴ Dimensions of A

$$= \frac{\text{dimensions of v} \times \text{dimensions of } (x+B)}{\text{dimensions of } \sqrt{x}}$$

$$= \frac{[ML^2T^{-2}][M^0LT^0]}{[M^0L^{1/2}T^0]} = [ML^{5/2}T^{-2}]$$

Hence, dimensions of AB
$= [ML^{5/2}T^{-2}] [M^0LT^0] = [ML^{7/2}T^{-2}]$

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

(a) $[Ev^{-2}T^{-1}]$ (b) $[Ev^{-1}T^{-2}]$
(c) $[Ev^{-2}T^{-2}]$ (d) $[E^{-2}v^{-1}T^{-3}]$

[AIPMT 2015]
AP EAMCET(Medical)-2009

Ans. (c) : We know that,

Surface Tension [T] = $\frac{\text{Force}}{\text{Length}}$

$$[T] = \frac{\text{Mass} \times \text{Acceleration}}{\text{Length}} \text{ …….. (i)}$$

and Energy (E) = $\frac{1}{2}mv^2$

$$m = \frac{E}{v^2} \times 2$$

$[M] = [Ev^{-2}]$
Now, in equation (i)

$$[T] = \frac{[Ev^{-2}][LT^{-2}]}{[L]}$$

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

123. The velocity υ of a particle at time t is given by $\upsilon = at + \frac{b}{t+C}$, where a, b and c are constants. The dimensions of a b, and c are respectively

(a) $[LT^{-2}]$,[L] and [T] (b) $[L^2]$,[T] and $[LT^2]$
(c) $[LT^2]$,[LT] and [L] (d) [L],[LT] and $[T^2]$

[AIPMT 2006]

Ans. (a) : Given,

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

The dimension of v = The dimension of a.t = the dimension of $\frac{b}{t+c}$
Then,
The dimension of v = dimension of a.t
$[LT^{-1}]$ = a.t

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

The dimension of a = $[LT^{-2}]$
The dimension of b = [V] [T]
$= [LT^{-1}]$ [T]
= [L]
The dimension of c = [T]
Hence, option (a) is correct.

124. According to Newton, the viscous force acting between liquid layers of area A and velocity gradient $\frac{\Delta v}{\Delta z}$ is given by $F = -\eta A \frac{dv}{dz}$, where η is constant called coefficient of viscosity. The dimensional formula of η is

(a) $[ML^{-2}T^{-2}]$ (b) $[M^0L^0T^0]$
(c) $[ML^2T^{-2}]$ (d) $[ML^{-1}T^{-1}]$

[AIPMT 1990]

Ans. (d) : Given,

$$F = -\eta A \frac{dv}{dz}$$

where η is coefficient of viscosity
The dimensions of F = $[MLT^{-2}]$
The dimensions of A = $[L^2]$
The dimensions of dz = [L]
The dimensions of dv = $[LT^{-1}]$
∴ The dimensions of η

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

$\eta = [ML^{-1}T^{-1}]$

125. 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 distance x from the axis of the tube. The dimensions of η are

(a) $[M^0L^0T^0]$ (b) $[MLT^{-1}]$
(c) $[ML^2T^{-2}]$ (d) $[ML^{-1}T^{-1}]$

[AIPMT 1993]

Ans. (d) : Given,

$$\eta = \frac{P(r^2 - x^2)}{4vl}$$

Where,
P = Pressure difference
r = radius
l = length
v = velocity
x = distance

The dimension of P = $[ML^{-1}T^{-2}]$
The dimension of $(r^2 - x^2)$ = $[L^2]$
The dimension of velocity = $[LT^{-1}]$
The dimension of distance = [L]

$$[\eta] = \frac{[P][r^2 - x^2]}{[v][L]} \Rightarrow [\eta] = \frac{[ML^{-1}T^{-2}][L^2]}{[LT^{-1}][L]}$$

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

126. The velocity of light 'c', the constant of gravitation 'G' and Planck's constant 'h' be chosen as fundamental units, the dimensions of mass in terms of c, G and h is

(a) $[h^{1/2}c^{-3/2}G^{1/2}]$ (b) $[h^{1/2}c^{1/2}G^{-1/2}]$
(c) $[h^{1/2}c^{-5/2}G^{1/2}]$ (d) $[h^{1/2}c^{-1/2}G^{1/2}]$

AP EAMCET -2014

Ans. (b) : We know that, dimensional formula of
Speed of light [c] = $[LT^{-1}]$
Gravitational constant [G] = $[M^{-1}L^3T^{-2}]$
Planck's constant [h] = $[ML^2T^{-1}]$
Let formula of mass in term of c, G and h be

$M = c^x G^y h^z$
$[M] = [LT^{-1}]^x [M^{-1}L^3T^{-2}]^y [ML^2T^{-1}]^z$
$[M] = [M^{-y+z} L^{x+3y+2z} T^{-x-2y-z}]$

where,
$-y + z = 1, x + 3y + 2z = 0, -x - 2y - z = 0$
On solving, we get

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

So, dimension of [M] = $[h^{1/2} c^{1/2} G^{-1/2}]$

127. If m is mass $\underset{\sim}{Q}$ is charge and B is magnetic induction, then $\frac{m}{B\underset{\sim}{Q}}$ has the same dimensions as:

(a) frequency (b) $\frac{1}{\text{frequency}}$
(c) velocity (d) acceleration

AP EAMCET(Medical)-1999

Ans. (b) : Magnetic induction (B) = $ML^0T^{-2}A^{-1}$
Charge (Q) = TA
Mass (m) = M
Hence,

$$\frac{m}{BQ} = \frac{[M]}{[ML^0T^{-2}A^{-1}][TA]}$$

$$\frac{m}{BQ} = \frac{1}{[L^0T^{-1}A^0]}$$

$$\frac{m}{BQ} = [T]$$

$$\text{Time} = \frac{1}{\text{frequency}}$$

128. The dimensional formula of the product of two physical quantities P and Q is $[ML^2T^{-2}]$. The dimensional formula of $\frac{P}{Q}$ is $[MT^{-2}]$ P and Q respectively are:

(a) force, velocity
(b) momentum, displacement
(c) force, displacement
(d) work, velocity

AP EAMCET(Medical)-2001

Ans. (c): Given, PQ = $[ML^2T^{-2}]$

$$\frac{P}{Q} = [MT^{-2}]$$

$$PQ \times \frac{P}{Q} = ML^2T^{-2} \times MT^{-2}$$

$$P^2 = M^2L^2T^{-4}$$

$$P = MLT^{-2} = \text{Force}$$

Now,

$$\frac{PQ}{\left(\frac{P}{Q}\right)} = \frac{PQ}{P} \times Q = \frac{ML^2T^{-2}}{MT^{-2}}$$

$$Q^2 = L^2$$

$$Q = L \quad = \text{Displacement}$$

129. According to Bernoulli's theorem $\frac{P}{d} + \frac{V^2}{2} + gh = \text{constant}$. The dimensional formula of the constant is: (P = pressure, d = density, h = height, V = velocity and g = acceleration due to gravity)

(a) $[M^0L^0T^0]$ (b) $[M^0LT^0]$

(c) $[M^0L^2T^{-2}]$ (d) $[M^0L^2T^{-4}]$

AP EAMCET(Medical)-2005

Ans. (c) : Bernoulli's theorem $\frac{P}{d} + \frac{V^2}{2} + gh = \text{constant}$

Dimensional formula of the constant is same as dimensional formula of $\frac{P}{d}, \frac{V^2}{2}$, gh.

So, dimensional formula of gh = $[LT^{-2}][L]$

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

$= [M^0L^2T^{-2}]$

130. The van der Waal's equation for n moles of a real gas is

$$\left(p + \frac{a}{V^2}\right)(V - b) = nRT$$

Where p is pressure, V is volume, T is absolute temperature, R is molar gas constant a, b and c are van der Waal's constants. The dimensional formula for ab is

(a) $[ML^8L^{-2}]$ (b) $[ML^6L^{-2}]$

(c) $[ML^4L^{-2}]$ (d) $[ML^2L^{-2}]$

AP EAMCET(Medical)-2012

Ans. (a) : P must be same as $\frac{a}{V^2}$

Hence, $\frac{[a]}{L^6} = \left[ML^{-1}T^{-2}\right]$

$[a] = \left[ML^5T^{-2}\right]$

The dimension of b must be same as that of V

Hence, $[b] = L^3$

$[ab] = \left[ML^8T^{-2}\right]$

131. In the equation $\left(\frac{1}{p\beta}\right) = \frac{y}{K_BT}$, where p is the pressure, y is the distance, K_B is Boltzmann constant and T is the temperature Dimensions of β are

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

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

AP EAMCET(Medical)-2013

Ans. (b) : From the equation $= \frac{1}{p.\beta} = \frac{y}{K_BT}$

$$\beta = \frac{K_BT}{p.y} = \frac{[ML^2T^{-3}][T]}{[ML^{-1}T^{-2}][L]}$$

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

Hence, the dimension of β is $[L^2]$

132. 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 is time

(a) Power (b) Surface tension

(c) Torsional constant (d) Force

AP EAMCET(Medical)-2016

Ans. (c) : Given, $P = \frac{x^2 - b}{at}$

The dimension of b = The dimension of x^2

∴ $[b] = [L^2]$------------(1)

Also,

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

$[t] = [T^1]$

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

$[a] = [M^{-1}T^2]$---------------(2)

∴ $\frac{[b]}{[a]} = \frac{[L^2]}{[M^{-1}T^2]} = [ML^2T^{-2}]$---------(3)

Torsional constant $k = \frac{\tau}{\theta}$

∴ $[k] = [\tau]$

$[k] = [ML^2T^{-2}]$-------------(4)

From 3 and 4,

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

133. If the force is given by F = at + bt² with t as time. The dimensions of a and b are

(a) $[MLT^{-4}]$ and $[MLT^{-2}]$

(b) $[MLT^{-3}]$ and $[MLT^{-4}]$

(c) $[ML^2T^{-3}]$ and $[ML^2T^{-2}]$

(d) $[ML^2T^{-3}]$ and $[ML^3T^{-4}]$

JIPMER-2013, 2005, AP EAMCET -2010, BCECE-2003

Ans. (b): Given, $F = at + bt^2$

Dimension of F = Dimension of at

$$[MLT^{-2}] = a[T]$$

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

$$a = [MLT^{-3}]$$

Dimension of F = Dimension of bt^2

$$F = bt^2$$

$$[MLT^{-2}] = b[T]^2$$

$$b = \frac{[MLT^{-2}]}{[T^2]}$$

$$b = [MLT^{-4}]$$

134. The equation of state of some gases can be expressed as

$$\left(p + \frac{a}{V^2}\right)(V - b) = RT$$

where, p is the pressure, V the volume, T the absolute temperature and a and b are constants. The dimensional formula of a is

(a) $[ML^5T^{-2}]$ (b) $[M^{-1}L^5T^{-2}]$
(c) $[ML^{-1}T^{-2}]$ (d) $[ML^{-5}T^{-2}]$

UPCPMT-1997

Ans. (a) : According to the principle of dimensional homogeneity the dimensions of each the terms of a dimensional equation on both sides are the same.

So, dimension of p and $\frac{a}{V^2}$ will be same

$$p = \left[\frac{a}{V^2}\right]$$

$$a = [p][V^2]$$

$$a = [ML^{-1}T^{-2}][L^6]$$

$$a = [ML^5T^{-2}]$$

135. If the capacitance of a nanocapacitor is measured in terms of a unit 'u' made by combining the electric charge 'e', Bohr radius 'a_0', Planck's constant 'h' and speed of light 'c' then

(a) $u = \frac{e^2h}{a_0}$ (b) $u = \frac{hc}{e^2a_0}$

(c) $u = \frac{e^2c}{ha_0}$ (d) $u = \frac{e^2a_0}{hc}$

AIIMS-2016

Ans. (d): Let 'u' related with e, a_0, h and c as

$$[u] = [e]^a [a_0]^b [h]^c [c]^d \quad .....(i)$$

Using dimension formula,

$$[M^{-1}L^{-2}T^4A^2] = [A^1T^1]^a [L]^b [ML^2T^{-1}]^c [LT^{-1}]^d$$

$$[M^{-1}L^{-2}T^4A^2] = [M^cL^{b+2c+d}T^{a-c-d}A^a]$$

Comparing power

a = 2, c = –1,

a – c – d = 4

d = – 4 + 3 = –1

Putting the value of d,

b + 2c + d = –2

b = 1

Hence, a = 2, b = 1, c = –1, d = –1

Putting the value of a, b, c, d in equation (i)

$$u = e^2 a_0^1 h^{-1} c^{-1}$$

$$\therefore \quad u = \frac{e^2a_0}{hc}$$

136. The equation $\left(p + \frac{a}{V^2}\right)(V - b)$ = constant. The units of a is

(a) Dyne × cm^5 (b) Dyne × cm^4
(c) Dyne/cm^3 (d) Dyne/cm^2

UP CPMT-2014

Ans. (b) : Given that,

$$\left(P + \frac{a}{V^2}\right)(V - b) = \text{constant}$$

In the term $\left(P + \frac{a}{V^2}\right)$, the units of p and $\frac{a}{V^2}$ are the same

∴ $a = PV^2$ [here v is the volume]

∴ Unit of a = unit of P × unit of v^2

$$\therefore \text{Unit of a} = \frac{\text{dyne}}{cm^2} \times (cm^3)^2$$

$$= \frac{\text{dyne}}{cm^2} \times cm^6$$

$$= \text{dyne} \times cm^4$$

Note:– Here we use CGS system. In SI system unit of a is N-m^4

137. If $x = at + bt^2$, where x is the distance travelled by the body in kilometer while t is the time in second, then the unit of b is

(a) km/s (b) km-s
(c) km/s^2 (d) km-s^2

[AIPMT 1989]

Ans. (c) : Given that,

$x = at + bt^2$ (where x is distance)

From principle of Homogeneity

$[x] = [at] = [bt^2]$

$[L] = b[T^2] \Rightarrow b = [LT^{-2}]$

So, Unit of b = km/s^2

Statement Based Question

138. Which two of the following five physical parameters have the same dimensions?
(i) Energy density (ii) Refractive index
(iii) Dielectric constant (iv) Young's modulus
(v) Magnetic field
(a) (ii) and (iv) (b) (iii) and (v)
(c) (i) and (iv) (d) (i) and (v)

[AIPMT 2008]

Ans. (c) :

	Physical parameter		Dimensions
(i)	Energy density	-	$[ML^{-1}T^{-2}]$
(ii)	Refractive index	-	$[M^0L^0T^0]$
(iii)	Dielectric constant	-	$[M^0L^0T^0]$
(iv)	Young's modulus	-	$[ML^{-1}T^{-2}]$
(v)	Magnetic field	-	$[MA^{-1}T^{-2}]$

Hence, Energy density and Young's modulus has the same dimension.

Numerical Answer Type (NATs)

139. If dimensions of critical velocity V_c of a liquid flowing through a tube are expressed as $[\eta^x\rho^y r^z]$ r , 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
(a) 1, –1, –1 (b) –1, –1, 1
(c) –1, –1, –1 (d) 1, 1, 1

[AIPMT 2015]

Ans. (a) : We know that, $[V_c] = [M^0LT^{-1}]$

$$\eta = \frac{F\times r}{A\times v}$$

$$[\eta] = \frac{[MLT^{-2}]\times[L]}{[L^2]\times[LT^{-1}]}$$

$$[\eta] = [ML^{-1}T^{-1}]$$

$$\rho = \frac{\text{Mass}[M]}{\text{Volume}[L^{-3}]}$$

$$[\rho] = [ML^{-3}]$$

$$[r] = [L]$$

We have given that the critical velocity is given as,

$$V_c = [\eta^x\rho^y r^z]$$

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

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

Now, comparing the power of M, L and T on the both sides, we get

For M, $M^0 = M^{x+y}$

$x = -y$

For T, $T^{-1} = T^{-x}$

$-1 = -x$

$x = 1, y = -1$

For L, $L^1 = L^{-x-3y+z}$

$1 = -1 + 3 + z$

$z = -1$

So,

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

140. If the dimensions of a physical quantity are given by $[M^a L^b T^c]$, then the physical quantity will be
(a) pressure if a = 1,b = −1,c = −2
(b) velocity if a =1, b =0, c = −1
(c) acceleration if a =1, b =1, c = −2
(d) force if a =0, b = −1, c = −2

[AIPMT 2009]

Ans. (a) : We know that-

$$P = \frac{F}{A}$$

Where, P = Pressure
F = Force
A = Area

$$\therefore \quad P = \frac{[MLT^{-2}]}{[L^2]} \qquad (\because \; F = [MLT^{-2}])$$

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

The value of a, b and c are 1, –1 and –2 respectively.

$$\because \quad V = \frac{S}{t}$$

Where, v = velocity
s = displacement
t = time

$$\therefore \quad V = \frac{[L]}{[T]}$$

$v = [M^0LT^{-1}]$

Here, a = 0, b = 1 and c = –1

$$\because \quad a = \frac{v}{t}$$

Where a = acceleration
v = velocity
t = time

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

or

$a = [M^0LT^{-2}]$

Here, a = 0, b =1 and c = –2

$\because$ F = ma

Where, F = force
m = Mass
a = Acceleration
$\therefore$ F = [M] [LT^{-2}]

or F = [MLT^{-2}]
Here, a = 1, b = 1 and c = –2

141. The velocity of water waves (v) may depend on their wavelength λ, the density of water ρ and the acceleration due to gravity g. The method of dimensions gives the relation between these quantities is

(a) v (b) $v^2 \propto g\lambda$
(c) $v^2 \propto g\lambda^2$ (d) $v^2 \propto g^{-1}\lambda^2$

AIIMS-26.05.2018(E)

Ans. (b) : Let, $v \propto \lambda^a \rho^b g^c$
The dimensional formula for all quantities we get,
$$[LT^{-1}] \propto [L]^a [ML^{-3}]^b [LT^{-2}]^c$$
$$[M^0L^1T^{-1}] \propto [M^b L^{a-3b+c} T^{-2c}]$$
Comparing power of M,L and T
b = 0, a – 3b + c = 1, and –2c = –1
$a - 3 \times 0 + \frac{1}{2} = 1$ $c = \frac{1}{2}$
$a = 1 - \frac{1}{2} = \frac{1}{2}$
$a = \frac{1}{2}$
$\therefore$ $v \propto \lambda^{1/2}\rho^0 g^{1/2}$
$v = \sqrt{\lambda g}$
So, $v^2 \propto \lambda g$

142. The speed of light (c), gravitation constant (G), and Plank's constant (h) are taken as the fundamental units in a system. The dimension of time in this new system should be:

(a) $\left[G^{1/2} h^{1/2} c^{-5/2}\right]$ (b) $\left[G^{-1/2} h^{1/2} c^{1/2}\right]$
(c) $\left[G^{1/2} h^{1/2} c^{-3/2}\right]$ (d) $\left[G^{1/2} h^{1/2} c^{1/2}\right]$

AIIMS-2008

Ans. (a) : dimension
$$[C] = LT^{-1}$$
$$[G] = M^{-1}L^3T^{-2}$$
$$[h] = M^1L^2T^{-1}$$
Let $t \propto c^x G^y h^z$
$$T = (LT^{-1})^x (M^{-1}L^3T^{-2})^y (ML^2T^{-1})^z$$
$$= [M]^{-y+z} [L]^{x+3y+2z} [T]^{-x-2y-z}$$
By equating
$-y + z = 0$ ___(i)
$x + 3y + 2z = 0$ ___(ii)
$-x - 2y - z = 1$ ___(iii)
By Solving eq^n (i), (ii) & (iii)
We get, $x = \frac{-5}{2},\ y = \frac{1}{2},\ z = \frac{1}{2}$
$$[t] = \left[C^{-5/2}G^{1/2}h^{1/2}\right]$$

143. The frequency of vibration f of a mass m suspended from a spring of spring constant k is given by a relation of the type $f = Cm^x k^y$, where C is a dimensionless constant. The values of x and y are

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

[AIPMT 1990]

Ans. (d): Given,
$f = Cm^x.K^y$
where, C = dimensionless constant
m = mass
K = spring constant
The dimension of frequency, f = [T^{-1}]
The dimension of mass, m = [M]
The dimension of spring constant, k = [MT^{-2}]
F =$Cm^x.K^y$
[$M^0L^0T^{-1}$] = $[M]^x$ $[MT^{-2}]^y$
[$M^0L^0T^{-1}$] = [M^{x+y}. T^{-2y}]
x + y = 0 and –2y = –1
x = –y and $y = \frac{1}{2}$
$\Rightarrow x = -\frac{1}{2}, y = \frac{1}{2}$

144. If p represents radiation pressure, c represents speed of light and S represents radiation energy striking unit area per sec. The non-zero integers x, y, z such that p^x S^y c^z is dimensionless are

(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

[AIPMT 1992], UPCPMT-1992, 1981

Ans. (c) : Given,
P = radiation pressure
C = speed of light
S = radiation energy
x,y and z are non zero intezers.
[P^x S^y C^z] = [$M^0L^0T^0$] …(i)
The dimension of P = [$ML^{-1}T^{-2}$]
The dimension of S = [MT^{-3}]

The dimension of C = $[LT^{-1}]$
Putting the dimension in equation (i)
$[ML^{-1}T^{-2}]^x\ [MT^{-3}]^y.\ [LT^{-1}]^z = [M^0L^0T^0]$
$[M^{x+y}.L^{-x+z}.T^{-2x-3y-z}] = [M^0L^0T^0]$
$x + y = 0$ …(ii)
$z - x = 0$ …(iii)
$-2x - 3y - z = 0$ …(iv)
From equation (iii)
$x = z$
From equation (ii)
$\therefore\ z = -y$
By solving, we get,
$x = 1, y = -1, z = 1$
Hence, option (c) is correct.

Match the Column

145. Match list-I with List-II

	List-I		List-II
(a)	Gravitational constant	(i)	$[L^2T^{-2}]$
(b)	Gravitational potential energy	(ii)	$[M^{-1}L^3T^{-2}]$
(c)	Gravitational potential	(iii)	$[LT^{-1}]$
(d)	Gravitational intensity	(iv)	$[ML^2T^{-2}]$

Choose the correct answer from the options given below
(a) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)
(b) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)
(c) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(d) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

NEET 17.07.2022

Ans. (d) : (a) – (ii) , (b) – (iv), (c) – (i), (d) – (iii)

List-I		List-II	
A.	Gravitational constant	(ii)	$[M^{-1}L^3T^{-2}]$
B.	Gravitational Potential Energy	(iv)	$[ML^2T^{-2}]$
C.	Gravitational Potential	(i)	$[L^2T^{-2}]$
D.	Gravitational Intensity	(iii)	$[LT^{-1}]$

146. Match the List I with List II.

	List-I		List-II
A.	Boltzmann constant	I.	$[ML^0T^0]$
B.	Coefficient of viscosity	II.	$[ML^{-1}T^{-1}]$
C.	Water equivalent	III.	$[MLT^{-3}K^{-1}]$
D.	Coefficient of thermal conductivity	IV.	$[ML^2T^{-2}K^{-1}]$

The correct match in the following is
(a) A–III; B– I; C–II; D–IV
(b) A–III; B– II; C–I; D–IV
(c) A–IV; B– II; C–I; D–III
(d) A–IV; B– I; C–II; D–III

AP EAMCET -2016

Ans. (c) :
• Baltzman constant = $[ML^2T^{-2}K^{-1}]$
• Coefficient of viscosity = $\frac{MLT^{-2}}{[L^2 \times T^{-1}]} = [ML^{-1}T^{-1}]$
• Water equivalent = [ML°T°]
• Coefficient of thermal conductivity = $[MLT^{-3}K^{-1}]$

147. Match the following

A. Angular momentum	1. $\left[M^{-1}L^2T^{-2}\right]$
B. Torque	2. $\left[M^1T^{-2}\right]$
C. Gravitational constant	3. $\left[M^1L^2T^{-2}\right]$
D. Tension	4. $\left[M^1L^2T^{-1}\right]$

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

JIPMER-2014

Ans. (b) : Dimensional formula of angular momentum
angular momentum = mvr
= kg (m/s)m
= $[M][LT^{-1}]$ [L]
= $[ML^2T^{-1}]$
Dimensional formula of Torque
Torque τ = F.r = ma.r
= kg (m/s^2)m
= [M] $[LT^{-2}]$ [L] = $[ML^2T^{-2}]$
Dimensonal formula of Gravitiational constant -
$$\text{Gravitational constant } (G) = \frac{F.r^2}{M_e.m}$$
$$= \frac{\left[MLT^{-2}\right]\left[L^2\right]}{[M][M]} = [M^{-1}L^3T^{-2}]$$
Dimensional formula of Tension -
Tension force = Gravity force = mg
= kg. (m/s^2)
= [M] $[LT^{-2}]$ = $[MLT^{-2}]$

148. Some physical constants are given in List 1 and their dimensional formulae are given in List 2. Match the correct pairs in the lists:

	List-1		List 2
(A)	Planck's constant	(1)	$[ML^{-1}T^{-2}]$
(B)	gravitational constant	(2)	$[ML^{-1}T^{-2}]$
(C)	bulk modulus	(3)	$[ML^2T^{-1}]$
(D)	coefficient of viscosity	(4)	$[M^{-1}L^3T^{-2}]$

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

AP EAMCET(Medical)-2006

Ans. (d) :

$$h = \frac{E}{\nu} = \frac{[ML^2T^{-2}]}{[T^{-1}]}$$

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

• Gravitational constant (G)

$$g = \frac{GM}{R^2}$$

$$G = \frac{gR^2}{M}$$

$$G = \frac{[LT^{-2}][L^2]}{[M]}$$

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

• Bulk modulus (K)= $K = -V\frac{dP}{dV}$

Where, P = Pressure
V = Volume
P = F/A

$$K = \frac{F/A}{\left\{\frac{\Delta V}{V}\right\}}$$

$$K = \frac{F}{A} = \frac{[MLT^{-2}]}{[L^2]}$$

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

• Coefficient of viscosity (η) = $\frac{F}{A.\left\{\frac{dv}{dx}\right\}}$

$$(\eta) = \frac{[MLT^{-2}]}{[L^2][T^{-1}]}$$

$$= [ML^{-1}T^{-1}]$$

149. If energy (E), force (F) and linear momentum (P) are fundamental quantities, then match the following and give the correct answer.

(A)	**(B)**
Physical quantity	**Dimensional formula**
(a) Mass	(d) $[E^0 F^{-1} P^1]$
(b) Length	(e) $[E^{-1} F^0 P^2]$
(c) Time	(f) $[E^1 F^{-1} P^0]$

(a) a-d, b-e, c-f (b) a-f, b-e, c-d
(c) a-e, b-f, c-d (d) a-e, b-d, c-f

AP EAMCET(Medical)-2015

Ans. (c) : (A)	**(B)**
Physics quantity	**Dimensional formula**
(A) Mass	(E) $E^{-1} F^0 p^2$
(B) Length	(F) $E^1 F^{-1} p^0$
(C) Time	(D) $E^0 F^{-1} p^1$

Assertion and Reason

150. Assertion: The dimensional formula for relative velocity is same as that of the change in velocity.
Reason: Relative velocity of P w.r.t. Q is the ratio of velocity of P and that of Q.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2002

Ans. (c) : The relative velocity is defined as the velocity of an object with respect to another object or observer. It is vector subtraction of two velocities.
Relative velocity of P w.r.t Q

$$V_r = V_P - V_Q$$

So, the dimensional formula of relative velocity is same as that of the change in velocity.

151. Assertion: Specific gravity of a fluid is a dimensionless quantity.
Reason: It is the ratio of density of fluid to the density of water.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2005

Ans. (a) : Specific gravity of fluid,

$$(G) = \frac{\text{Density of fluid}}{\text{Density of water at } 4°C}$$

It is clear that the specific gravity of fluid is dimensionless quantity.

02.

Kinematics

Chapter-1. Scalar and Vector

Numerical Answer Type (NATs)

1. Which of the following statement is not true?
(a) Pressure is a vector quantity
(b) Relative density is a scalar quantity
(c) Coefficient of viscosity is a scalar quantity
(d) Surface tension is a scalar quantity

RE-NEET (UG)-06.06.2023 (Manipur)

Ans. (a) : • Scalar quantity - Those physical quantity which require only magnitude but no direction for their complete representation are called scalars.
Example– distance, speed, work, mass, density, Relative density, **Pressure**, coefficient of viscosity, surface tension.
• **Vector quantity :** Those physical quantities which require magnitude as well as direction for their complete representation.
Example– displacement, velocity, acceleration.

2. The angle between $\vec{A}$ and $\vec{B}$ is θ. The value of the triple product $\vec{A}.(\vec{B}\times\vec{A})$ is
(a) A^2B (b) zero
(c) $A^2B\sin\theta$ (d) $A^2B\cos\theta$

JIPMER-2007
AIPMT-1989

Ans. (b) : Let $\vec{A}\cdot(\vec{B}\times\vec{A})=\vec{A}\cdot\vec{C}$
Here $\vec{C}=\vec{B}\times\vec{A}$ which is perpendicular to both vector $\vec{A}$ and $\vec{B}$.
$\therefore \quad \vec{A}\cdot\vec{C}=0$
$\because \quad \vec{C}$ is perpendicular to $\vec{A}$ and $\vec{B}$
$\therefore$ Angle between $\vec{A}$ and $\vec{C}$ is 90°
$\vec{A}\cdot\vec{C}=AC\cos\theta$
$\vec{A}\cdot\vec{C}=0$
$\therefore \quad \vec{A}\cdot(\vec{B}\times\vec{A})=0$

3. Which of the following is not a vector quantity?
(a) Speed (b) Velocity
(c) Torque (d) Displacement

[AIPMT 1995]

Ans. (a) : The physical quantities for which having both direction and magnitude is called vector quantity.
Example- force, torque, momentum, acceleration velocity etc.

4. If $|\vec{A}\times\vec{B}|=\sqrt{3}\vec{A}.\vec{B}$ then the value of $|A+B|$ is
(a) $(A^2+B^2+AB)^{1/2}$
(b) $\left(A^2+B^2+\frac{AB}{\sqrt{3}}\right)^{1/2}$
(c) $A+B$
(d) $\left(A^2+B^2+\sqrt{3}AB\right)^{1/2}$

[AIPMT 2004]

Ans. (a) : Given that, $|\vec{A}\times\vec{B}|=\sqrt{3}\vec{A}.\vec{B}$
$AB\sin\theta=\sqrt{3}\,AB\cos\theta$
$\tan\theta=\sqrt{3}$
$\theta=60°$
We know that,
Law of parallelogram of addition
$|\vec{A}+\vec{B}|=\sqrt{A^2+B^2+2AB\cos\theta}$
$|\vec{A}+\vec{B}|=\sqrt{A^2+B^2+2AB\times\frac{1}{2}}$
$|\vec{A}+\vec{B}|=(A^2+B^2+AB)^{1/2}$

5. A and B are two vectors and θ is the angle between them. If $|\vec{A}\times\vec{B}|=\sqrt{3}(\vec{A}.\vec{B})$, then the value of θ is
(a) 60° (b) 30°
(c) 30° (d) 90°

[AIPMT 2007]

Ans. (a) : $|A\times B|=\sqrt{3}\,(A.B)$
$AB\sin\theta=\sqrt{3}\,AB\cos\theta$
$\tan\theta=\sqrt{3}$
$\theta=\tan^{-1}(\sqrt{3})$
$\theta=60°$

6. Two vectors are perpendicular, if
(a) $\vec{A}\cdot\vec{B}=1$ (b) $\vec{A}\times\vec{B}=0$
(c) $\vec{A}\cdot\vec{B}=0$ (d) $\vec{A}\times\vec{B}=\vec{A}\vec{B}$

UP CPMT-2007

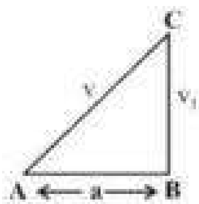
Ans. (c) : We know that,
$\vec{A}\cdot\vec{B}=|\vec{A}||\vec{B}|\cos\theta$
$\vec{A}.\vec{B}=|\vec{A}||\vec{B}|\cos 90°$
$\therefore \quad \vec{A}.\vec{B}=0 \qquad (\because \cos 90°=0)$
Hence, two vector are perpendicular if their dot product is equal to zero.

7. **The vector sum of two forces is perpendicular to their vector differences. In that case, the forces -**
(a) are not equal to each other in magnitude
(b) cannot be predicted
(c) are equal to each other
(d) are equal to each other in magnitude
[AIPMT 2003]
AIIMS- 2012

Ans. (d) : Let $\vec{f_1}$ and $\vec{f_2}$ be the two forces
Then sum of forces, $\vec{a} = \vec{f_1} + \vec{f_2}$
And difference, $\vec{b} = \vec{f_1} - \vec{f_2}$
The two forces are perpendicular to each other $(\vec{a}.\vec{b}) = 0$
$$(\vec{f_1} + \vec{f_2}).(\vec{f_1} - \vec{f_2}) = 0$$
$$|\vec{f_1}|^2 - |\vec{f_2}|^2 = 0$$
$$|\vec{f_1}|^2 = |\vec{f_2}|^2$$
$$|\vec{f_1}| = |\vec{f_2}|$$
In that case both the force are equal and have same magnitude.

8. **Two boys are standing at the ends A and B of a ground, where AB = a. The boy at B starts running in a direction perpendicular to AB with velocity v_1 The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is**
(a) $\frac{a}{\sqrt{v^2 + v_1^2}}$ (b) $\sqrt{\frac{a^2}{v^2 - v_1^2}}$
(c) $\frac{a}{v - v_1}$ (d) $\frac{a}{v + v_1}$
JIPMER-2013

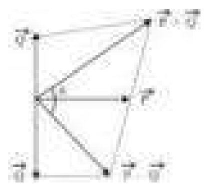
Ans. (b): Let two boys meet at point C after time 't' from the starting,



$$AC = vt \text{ and } BC = v_1t$$
We know that,
$$(AC)^2 = (AB)^2 + (BC)^2$$
$$v^2t^2 = a^2 + v_1^2t^2$$
$$v^2t^2 - v_1^2t^2 = a^2$$
$$t^2(v^2 - v_1^2) = a^2$$
$$t = \sqrt{\frac{a^2}{v^2 - v_1^2}}$$

9. **The angle between $(\vec{P} + \vec{Q})$ and $(\vec{P} - \vec{Q})$ will be**
(a) 90º only (b) between 0º and 180º
(c) 180º only (d) none of these
AIIMS-1999

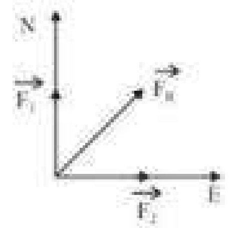
Ans. (b) :



Clearly from figure, angle (θ) between $(\vec{P} + \vec{Q})$ and $(\vec{P} - \vec{Q})$ between 0 to 180°.

10. **If two forces of equal magnitudes act simultaneously on a body in the east and the north directions then**
(a) the body will displace in the north direction
(b) the body will displace in the east direction
(c) the body will displace in the north-east direction
(d) the body will remain at the rest
AIIMS-2009

Ans. (c) :



Let, the force acting on body $\vec{F_1}$ in north direction and $\vec{F_2}$ in east direction.
∴ So, the resultant force on the body $\vec{F_R} = \vec{F_1} + \vec{F_2}$ in North –East direction.

11. **The sum of two vectors $\vec{A}$ and $\vec{B}$ is at right angles to their difference. Then**
(a) A = B
(b) A = 2B
(c) B = 2A
(d) $\vec{A}$ and $\vec{B}$ have the same direction
UP CPMT - 2006

Ans. (a) : Let r_1 and r_2 be the sum and difference of vectors $\vec{A}$ and $\vec{B}$ respectively i.e.,
$$r_1 = \vec{A} + \vec{B}$$
$$r_2 = \vec{A} - \vec{B}$$
r_1 is perpendicular to r_2 (given)
Taking the dot product of r_1 and r_2
$$r_1 . r_2 = (\vec{A} + \vec{B}) . (\vec{A} - \vec{B})$$
$$0 = A^2 - B^2$$
$$A^2 = B^2$$
$$A = B$$

12. Of the vectors given below, the parallel vectors are,

$$\vec{A} = 6\hat{i} + 8\hat{j}$$

$$\vec{B} = 210\hat{i} + 280\hat{k}$$

$$\vec{C} = 5.1\hat{i} + 6.8\hat{j}$$

$$\vec{D} = 3.6\hat{i} + 6\hat{j} + 48\hat{k}$$

(a) $\vec{A}$ and $\vec{B}$ (b) $\vec{A}$ and $\vec{C}$

(c) $\vec{A}$ and $\vec{D}$ (d) $\vec{C}$ and $\vec{D}$

AP EAMCET(Medical)-2006

Ans. (b) : If component of vector is same then vectors will be same.

$\vec{A} = 6\hat{i} + 8\hat{j}$

$\vec{B} = 210\hat{i} + 280\hat{k}$

$\vec{C} = 5.1\hat{i} + 6.8\hat{j}$

$\vec{D} = 3.6\hat{i} + 6\hat{j} + 48\hat{k}$

$\because \vec{C} = 5.1\hat{i} + 6.8\hat{j} = \frac{1.7}{2}\left(6\hat{i} + 8\hat{j}\right)$

Hence, it is clear that $\vec{A}$ and $\vec{C}$ are parallel and we can write as, $\vec{C} = \frac{1.7}{2}\vec{A}$

This implies that A is parallel to C.

13. The component of vector $A = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$ along the direction of $\hat{i} - \hat{j}$ is

(a) $a_x - a_y + a_z$ (b) $a_x - a_y$

(c) $\left(a_x - a_y\right)/\sqrt{2}$ (d) $(a_x + a_y + a_z)$

EAMCET-2008

Ans. (c) : Given,

$\vec{A} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$

Let $\vec{B} = \hat{i} - \hat{j}$

Component of vector A along any vector B

$= \frac{\vec{A}.\vec{B}}{|\vec{B}|}$

Component of vector $\vec{A} = a_x\hat{i} + a_y\hat{j} + a_z\hat{k}$ along $\vec{B} = \left(\hat{i} - \hat{j}\right)$

$$= \frac{\left(a_x\hat{i} + a_y\hat{j} + a_z\hat{k}\right).\left(\hat{i} - \hat{j}\right)}{\sqrt{(1)^2 + (-1)^2}} = \frac{a_x - a_y}{\sqrt{2}}$$

14. When two vectors $\vec{A}$ and $\vec{B}$ of magnitude a and b are added, the magnitude of the resultant vector is always

(a) equal to (a + b)

(b) less than (a + b)

(c) greater than (a + b)

(d) not greater than (a + b)

EAMCET-1993

Ans. (d) : Given,

$|\vec{A}| = a, |\vec{B}| = b$

$|\vec{A} + \vec{B}| = \sqrt{a^2 + b^2 + 2ab\cos\theta}$

$|\vec{A} + \vec{B}|_{max} = \sqrt{a^2 + b^2 + 2ab}$ [For max, θ = 0]

$|\vec{A} + \vec{B}|_{max} = (a + b)$

Hence, magnitude of resultant vector is not greater than (a + b)

15. The resultant of the vectors A and B depends also on the angle θ between them. The magnitude of the resultant is always given by

(a) $A + B + 2AB\cos\theta$

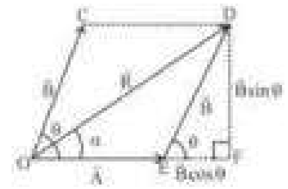
(b) $\sqrt{(A + B + 2AB\cos\theta)}$

(c) $\sqrt{A^2 + B^2 + 2AB\cos\theta}$

(d) $\left(A^2 + B^2 + 2AB\cos\theta\right)^2$

EAMCET-1992

Ans. (c) :



Resultant vector, $\vec{R}$

From ΔDOF,

$(OD)^2 = (OF)^2 + (DF)^2$

$(OD)^2 = (OE + EF)^2 + (DF)^2$

$\vec{R}^2 = (\vec{A} + \vec{B}\cos\theta)^2 + (\vec{B}\sin\theta)^2$

$= A^2 + B^2\cos^2\theta + 2AB\cos\theta + B^2\sin^2\theta$

$= A^2 + B^2(\cos^2\theta + \sin^2\theta) + 2AB\cos\theta$

$\vec{R}^2 = A^2 + B^2 + 2AB\cos\theta$

$|\vec{R}| = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

Numerical Answer Type (NATs)

16. If $\vec{A} = (2\hat{i} + 3\hat{j} - \hat{k})$m and $\vec{B} = (\hat{i} + 2\hat{j} + 2\hat{k})$m. The magnitude of component of vector $\hat{A}$ along vector $\hat{B}$ will be ——— m.

JEE Main-26.07.2022, Shift-II

Ans. (2) : $\vec{A} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{B} = \left(\hat{i} + 2\hat{j} + 2\hat{k}\right)$

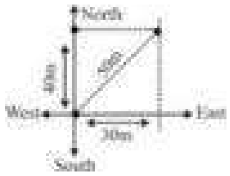
Magnitude of $\vec{A}$ along $\vec{B} = \frac{\vec{A}\cdot\vec{B}}{|\vec{B}|}$

$$\frac{\left(2\hat{i} + 3\hat{j} - \hat{k}\right)\left(\hat{i} + 2\hat{j} + 2\hat{k}\right)}{\sqrt{(1)^2 + (2)^2 + (2)^2}}$$

$$\frac{2 + 6 - 2}{\sqrt{9}} = \frac{6}{3} = 2$$

17. **A particle moves towards east for 2 s with velocity 15 m/s and move towards north for 8 s with velocity 5 m/s. Then, average velocity of the particle is**
(a) 1 m/s (b) 5 m/s
(c) 7 m/s (d) 10 m/s
JIPMER-2014

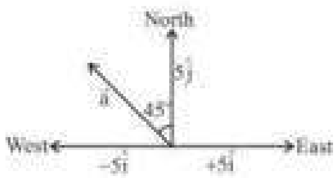
Ans. (b) : Average velocity $= \dfrac{\text{Total Displacement}}{\text{Total time}}$



Particle moves towards east for 2s with velocity 15m/s.
So, displacement of particle in east direction = velocity x time
$s_1 = 15 \times 2 = 30$ m
When particle move towards north for 8 second with the velocity 5 m/s.
So displacement of particle in north direction-
$s_2 = 5 \times 8$
$s_2 = 40$ m
Resultant displacement of particle $= \sqrt{(30)^2 + (40)^2}$
$s_R = \sqrt{900+1600} = \sqrt{2500}$
$s_R = 50$ m
Average velocity (v) $= \dfrac{s_R}{t_1 + t_2}$
$v = \dfrac{50}{2+8}$
$v = \dfrac{50}{10} \text{m/s}$
v = 5 m/s

18. **A particle is moving eastwards with a velocity of 5 m/sec. If in 10 s the velocity changes by 5 m/s northwards, what is the average acceleration in this time ?**
(a) $\dfrac{1}{\sqrt{2}} \text{m/s}^2$ (North-west)
(b) $\dfrac{1}{\sqrt{2}} \text{m/s}^2$ (North-east)
(c) $\sqrt{2} \text{m/s}^2$ (North-west)
(d) $\sqrt{2} \text{m/s}^2$ (North-east)
MP PMT-2013

Ans. (a) : Initial velocity (u) = 5 m/s due east
Final velocity (v) = 5 m/s due north

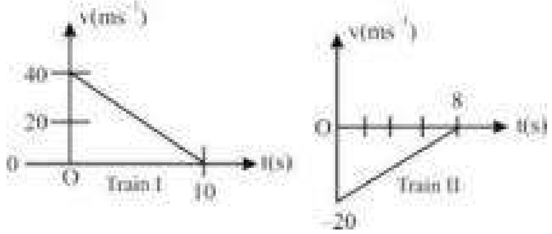


Now, change in velocity = $\vec{v} - \vec{u}$
$|\Delta v| = (v^2 + u^2)^{1/2} = \sqrt{5^2 + 5^2}$
$\Rightarrow \Delta v = 5\sqrt{2} \text{m/s}$
Direction of Δv is given by,
$\tan = \dfrac{v}{u} = \dfrac{5}{-5} = -1$
$\Rightarrow \theta = -\pi/4$
Thus, the acceleration is
$a = \dfrac{\Delta v}{t} = \dfrac{5\sqrt{2}}{10}$
$a = \dfrac{1}{\sqrt{2}} \text{m/s}^2$ and is directed towards North-West direction

19. **A body is moving with velocity 30 m/s towards East. After 10s, its velocity becomes 40m/s towards North. The average acceleration of the body is**
(a) 7 m/s^2 (b) $\sqrt{7} \text{m/s}^2$
(c) 5 m/s^2 (d) 1 m/s^2
[AIPMT 2011]

Ans. (c) : Given :
Velocity, $(v\hat{i})$ = 30 m/s
Velocity, $(v\hat{j})$ = 40 m/s
Time = (Δt)=10 second
Average acceleration $= \dfrac{\text{Change in velocity}}{\text{Time taken}}$
$a = \dfrac{|v\hat{i} - v\hat{j}|}{\Delta t}$
$a = \dfrac{\sqrt{(30)^2 + (40)^2}}{10}$
$a = \dfrac{\sqrt{900+1600}}{10}$
$a = \dfrac{\sqrt{2500}}{10}$
$a = \dfrac{50}{10}$
a = 5 m/s^2
Hence, the average acceleration of the body is 5 m/s^2

20. **Two trains, which are moving along different tracks in opposite directions, are put on the same track by mistake. On noticing the mistake, when the trains are 300 m apart the drivers start slowing down the trains. The graphs given below show decrease in their velocities as function of time. The separation between the trains when both have stopped is**



(a) 120 m (b) 20 m
(c) 60 m (d) 280 m

AP EAMCET -2016

Ans. (b) :
Train-I

$v_1 = 40\ ms^{-1}$

According first law of motion ($v = u + at$)

$v_1 = u_1 + a_1 t$

$0 = 40 + a_1(10)$

$a_1 = \frac{-40}{10} = -4\ ms^{-2}$

Train-II

$v_2 = u_2 + a_2 t$

$0 = -20 + a_2(8)$

$a_2 = \frac{20}{8} = \frac{5}{2} ms^{-2}$

Train-I

According second law of motion ($v^2 = u^2 - 2as$)

$v_1^2 = u_1^2 - 2a_1 s_1$

$0 = u_1^2 - 2a_1 s_1$

$s_1 = \frac{u_1^2}{2a_1} = \frac{(40)^2}{2 \times 4} = \frac{1600}{8} = 200m$

Train-II

$v_2^2 = u_2^2 - 2a_2 s_2$

$0 = u_2^2 - 2a_2 s_2$

$\frac{u_2^2}{2a_2} = s_2 \Rightarrow s_2 = \frac{400 \times 2}{10} = 80m$

Total distance covered by both trains,

$s = s_1 + s_2$

$s = 200 + 80$

$s = 280$ m

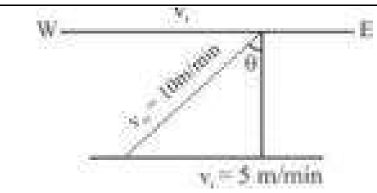
$\therefore$ Remaining Distance = 300 – 280=20 m

21. A river is flowing from west to east with a speed of 5 m/min. A man can swim in still water with a velocity 10m/min. In which direction should the man swim so, as to take the shortest possible path to go to the south?

(a) 30° east of south (b) 60° east of south
(c) 60° west of south (d) 30° west of south

JIPMER-2005

Ans. (d) : Given,
Velocity of river flow (v_r) = 5m/min.
Velocity of man (v_m) = 10m/min



From, the figure, $\sin\theta = \frac{v_r}{v_m} = \frac{5}{10} = \frac{1}{2}$

$\sin\theta = \frac{1}{2}$

$\theta = \sin^{-1}\frac{1}{2}$

$\boxed{\theta = 30^o}$ west of south.

22. A motor cyclist is riding North in still air at 36 km/h, the wind starts blowing westward with a velocity 18 km/h. The direction of apparent velocity is

(a) $\tan^{-1}\frac{1}{2}$ West of North

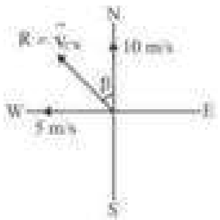
(b) $\tan^{-1}\frac{1}{2}$ North of West

(c) $\tan^{-1}\frac{1}{2}$ East of North

(d) $\tan^{-1}\frac{1}{2}$ North of East

UP CPMT-2012

Ans. (a) :



Velocity of cyclist in north (v_c)= 36 km/h

$36 km/h = 36 \times \frac{5}{18} m/s = 10 m/s$

Velocity of wind in west = v_w = 18 km/h

$= 18 \times \frac{5}{18} m/s = 5 m/s$

Direction of motion = tan β

$\therefore \tan\beta = \frac{v_w}{v_c} = \frac{5}{10} = \frac{1}{2}$

$\beta = \tan^{-1}\left(\frac{1}{2}\right)$ west of north

23. A bus is moving on a straight road towards North with a uniform speed of 50 km/h. If the speed remains unchanged after turning through 90°, the increase in the velocity of bus in the turning process is

(a) 70.7 km/h along South-West direction
(b) zero
(c) 50 km/h along West
(d) 70.7 km/h along North-West direction

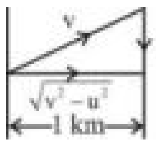
[AIPMT 1989]

Ans. (a) : Let $\vec{v}_1 = 50\hat{j}$ kmph
and $\vec{v}_2 = -50\hat{i}$ kmph
Let North = Y axis
West = X-axis (when the car turns left)
Change in velocity is
$\vec{v}_2 - \vec{v}_1 = (-50\hat{i} - 50\hat{j})$kmph
$\therefore$ Magnitude of change in velocity is =
$\left|\vec{V}_2 - \vec{V}_1\right| = \sqrt{50^2 + 50^2}$
= $50\sqrt{2}$ = 50 × 1.414
= 70.7 km/h along south -west direction

24. The speed of a boat is 5 km/h in still water. It crosses a river of width 1.0 km along the shortest possible path in 15min. The velocity of the river water is (in km/h)
(a) 5 (b) 1
(c) 3 (d) 4

[AIPMT 1998]

Ans. (c) : Given, speed of a boat (v) = 5 km/h
Let speed of river = u
Shortest possible path = 1km = s
Time taken = 15 min = 0.25 hr = t
We know that,



$\frac{\text{distance}}{\text{time}} = \text{speed}$

$\frac{s}{t} = \sqrt{v^2 - u^2}$

$\frac{1}{0.25} = \sqrt{25 - u^2}$

$\frac{100}{25} = \sqrt{25 - u^2}$

$4 = \sqrt{25 - u^2}$

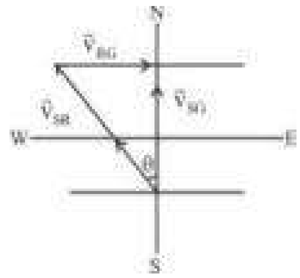
$16 = \left(\sqrt{25 - u^2}\right)^2$

$16 = 25 - u^2$
$u^2 = 9$
u = 3 km/h

25. The speed of a swimmer in still water is 20 m/s. The speed of river water is 10m/s and is flowing due east. If he is standing on the south bank and wishes to cross the river along the shortest path the angle at which he should make his strokes w.r.t. north is given by
(a) 0^o (b) 60^o west
(c) 45^o west (d) 30^o west

[NEET (National) 2019]

Ans. (d) : Given,



Speed of river flow, $\vec{v}_{RG} = 10 m/s$
Speed of swimmer w.r.t. river,
$\vec{v}_{SR} = 20 m/s$
$\therefore$ $\vec{v}_{SG} = \vec{v}_{SR} + \vec{v}_{RG}$

Then, $\sin\theta = \frac{|\vec{v}_{RG}|}{|\vec{v}_{SR}|}$

$\sin\theta = \frac{10}{20}$

$\sin\theta = \frac{1}{2}$

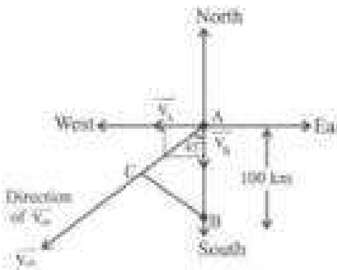
$\theta = \sin^{-1}\frac{1}{2}$

$\theta = 30^o$ West

26. A ship A is moving Westwards with a speed of 10 km h^{-1} and a ship B 100 km South of A, is moving Northwards with a speed of 10 kmh^{-1}. The time after which the distance between them becomes shortest is
(a) 0 h (b) 5 h
(c) $10\sqrt{2}$ h (d) $10\sqrt{2}$ h

[AIPMT 2015]

Ans. (b): Given,
velocity of ship 'A', $\overrightarrow{v_A} = -10\hat{i}$ km/h
velocity of ship 'B', $\overrightarrow{v_B} = 10\hat{j}$ km/h
$\therefore$ $\overrightarrow{v_{AB}} = \overrightarrow{v_B} - \overrightarrow{v_A} = \left(10\hat{j} + 10\hat{i}\right)$km/h
$\left|\overrightarrow{v_{AB}}\right| = \left|\overrightarrow{v_B} - \overrightarrow{v_A}\right| = \sqrt{(10)^2 + (10)^2}$
$= 10\sqrt{2}$ km/h along AC



From figure, $AC = \frac{100}{\sqrt{2}} km. = 50\sqrt{2}$

So, $t = \frac{AC}{|\vec{v}_{AB}|}$

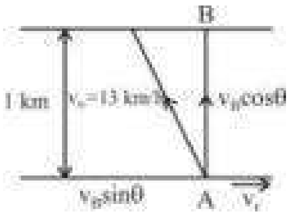
$t = \frac{50\sqrt{2}}{10\sqrt{2}} = 5h$

27. A boat which has a speed of 13 km/h in still water, crosses a river of width 1 km along the shortest possible path in 12 minute. the velocity of the river water in km/h is:

(a) 12 (b) 10
(c) 8 (d) 6

AP EAMCET(Medical)-2002

Ans. (a) : Given that,
Speed of boat 13 km/h in still water.
A river of width 1 km along the shortest possible path in 12 minute.



Therefore,
Speed of boat relative to ground

$$= \frac{1}{\left(\frac{12}{60}\right)} km/h$$

$$= \frac{60}{12} = 5 km/h$$

Now,

$5^2 = 13^2 - x^2$ (where, x is speed of water)

$\Rightarrow$ $25 - 169 = -x^2$

$\Rightarrow$ $144 = x^2$

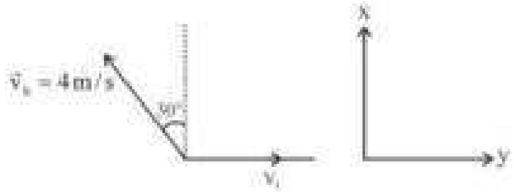
$\Rightarrow$ $x = 12$ km/h

28. A gun mounted on the top of a moving truck is aimed in the backward direction at an angle of 30° to the vertical. If the muzzle velocity of the gun is 4m/s, the value of the speed of the truck that will make the bullet come out vertically is :

(a) 1m/s (b) $\frac{\sqrt{3}}{2}$ m/s
(c) 0.5 m/s (d) 2m/s

AP EAMCET(Medical)-1998

Ans. (d): Given that, Angle in backward direction = 30°
Muzzle velocity of bullet = 4 m/s
For bullet to come out vertically



$v_b \sin 30° = v_t$

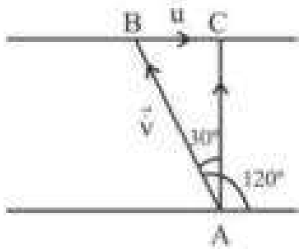
$4 \times \frac{1}{2} = v_t \Rightarrow \frac{4}{2} = v_t \Rightarrow v_t = 2$ m/s

29. A person swims in a river aiming to reach exactly on the opposite point on the bank of a river. His speed of swimming is 0.5 m/s at an angle of 120° with the direction of flow of water. The speed of water is

(a) 1.0 m/s (b) 0.5 m/s
(c) 0.25 m/s (d) 0.43 m/s

AIIMS-26.05.2018(E)
CBSE AIPMT-1999

Ans. (c) : Speed of water = $\vec{u}$
Speed of swimmer = $\vec{v}$ = 0.5 m/s



Angle between $\vec{v}$ and $\vec{u}$ is 120° then

$\sin\theta = \frac{\vec{u}}{\vec{v}} \Rightarrow \sin 30° = \frac{u}{0.5}$

$\frac{1}{2} = \frac{u}{0.5}$

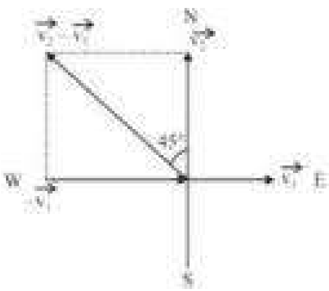
u = 0.25 m/s

30. A particle is moving eastwards with a velocity of 15 m/s. In a time of 10 s, the velocity changes to 15 m/s northwards. Average acceleration during this time is, in m/s².

(a) $\frac{3}{\sqrt{2}}$ (b) $3\sqrt{2}$ north-east
(c) $\frac{3}{\sqrt{2}}$ north-west (d) $3\sqrt{2}$ north-west

AP EAMCET(Medical)-1997

Ans. (c):



Given,

$\vec{v}_1 = -15\hat{i}, v_2 = 15\hat{j}$

$\Delta\vec{v}_{12} = \vec{v}_2 - \vec{v}_1 = \vec{v}_2 - (-\vec{v}_1)$

$\Delta\vec{v}_{12} = 15\hat{j} + 15\hat{i}$

$\vec{a}_{avg} = \frac{\Delta\vec{v}_{12}}{\Delta t} = \frac{15\hat{j}+15\hat{i}}{10} = \frac{3}{2}\hat{j} + \frac{3}{2}\hat{i}$

$|\vec{a}_{avg}| = \sqrt{\left(\frac{3}{2}\right)^2 + \left(\frac{3}{2}\right)^2} = \frac{3}{\sqrt{2}}$ m/s^2

Average acceleration is $\frac{3}{\sqrt{2}}$ m/s^2 along north-west.

31. A man is walking due east at the rate of 2 km/h. The rain appears to him to come down vertically at the rate of 2 km/h. The actual velocity and direction of rainfall with the vertical respectively are

(a) $2\sqrt{2}$ km/h, 45° (b) $\frac{1}{\sqrt{2}}$ km/h, 30°

(c) 2km/h, 0° (d) 1 km/h, 90°

AP EAMCET(Medical)-2008

Ans. (a) : The velocity of rain appearing to man is relative velocity of rain with respect to man,

$$\vec{v}_{rm} = \vec{v}_m - \vec{v}_r$$

$$= 2\hat{i} - (-2\hat{j})$$

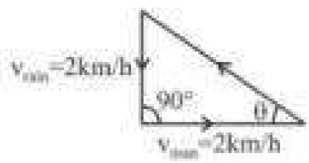
$$\vec{v}_{rm} = 2\hat{i} + 2\hat{j}$$

$$|\vec{v}_{rm}| = \sqrt{(2)^2 + (2)^2}$$

$$= \sqrt{8}$$

Magnitude of velocity $|\vec{v}_{rm}| = 2\sqrt{2}$ = km/h

For direction,



$$\tan\theta = \frac{P}{B} = \frac{v_{rain}}{v_{man}} = \frac{2}{2} = 1$$

$\Rightarrow$ $\theta = \tan^{-1}(1)$

$\Rightarrow$ $\theta = 45°$

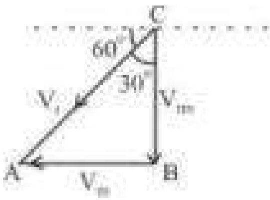
32. A man running at a speed of 5 km/h, find that the rain falls vertically. When he stops running, he finds that the rain is falling at an angle of 60° with the horizontal. The velocity of rain with respect to running man is

(a) $\frac{5}{\sqrt{3}}$ km/h (b) $\frac{5\sqrt{3}}{2}$ km/h

(c) $\frac{4\sqrt{3}}{2}$ km/h (d) $5\sqrt{3}$ km/h

AP EAMCET -2015

Ans. (d) : By figure,



In ΔACB

$$\tan 30° = \frac{V_m}{V_{rm}}$$

$$\frac{1}{\sqrt{3}} = \frac{5}{V_{rm}}$$

or $\boxed{V_{rm} = 5\sqrt{3} \text{ kmph}}$

Hence, option (d) is correct.

33. A car travels 6 km towards north at an angle of 45° to the east and then travels distance of 4 km towards north at an angle 135° to east. How far is the point from the starting point? What angle does the straight line joining its initial and final position makes with the east?

(a) $\sqrt{50}$ km and $\tan^{-1}(5)$

(b) 10 km and $\tan^{-1}(\sqrt{5})$

(c) $\sqrt{52}$ km and $\tan^{-1}(5)$

(d) $\sqrt{52}$ km and $\tan^{-1}(\sqrt{5})$

AIIMS-2008

Ans. (c) : Distance traveled along x-direction-

$s_x = (6-4)\cos 45° = 2\cos 45° = \sqrt{2}$ km

And, distance traveled along y- direction-

$s_y = (6+4)\cos 45° = 10 \times \frac{1}{\sqrt{2}} = 5\sqrt{2}$ km

Net distance travelled from starting point,

$$s = \sqrt{s_x^2 + s_y^2}$$

$$= \sqrt{(\sqrt{2})^2 + (5\sqrt{2})^2} = \sqrt{52} \text{ km}$$

Angle which the resultant makes with the east direction

$$a_s = \tan^{-1}\left(\frac{s_y}{s_x}\right) \Rightarrow \tan^{-1}\left(\frac{5\sqrt{2}}{\sqrt{2}}\right) = \tan^{-1}(5)$$

34. A bus is moving with a velocity of 10 ms^{-1} on a straight road. A scootorist wishes to overtake the bus in one minute. If the bus is at a distance of 1.2 km ahead, then the velocity with which he has to chase the bus is

(a) 20 ms^{-1} (b) 25 ms^{-1}

(c) 60 ms^{-1} (d) 30 ms^{-1}

AIIMS-26.05.2018(M)

Ans. (d): Given,

t = 60sec, Distance = 1.2 km = 1200m

v_{bus} = 10m/s

The relative speed with respect to the bus is –

$$\mathbf{v} = \frac{d}{t} = \frac{1200}{60} = 20\text{m/s}$$

The scooter and the bus are moving along the same direction, so-

speed (v) = $v_{scooter} - v_{bus}$

$20 = v_{scooter} - 10$

$v_{scooter} = 30$ m/s

35. A person travelling in a straight line moves with a constant velocity v_1 for certain distance 'x' and with a constant velocity v_2 for next equal distance. The average velocity v is given by the relation

(a) $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2}$ (b) $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

(c) $\frac{v}{2} = \frac{v_1 + v_2}{2}$ (d) $v = \sqrt{v_1 v_2}$

[NEET (Odisha) 2019]

Ans. (b) : Given,

Total distance = 2x

Time taken during 1st x distance = $\frac{x}{v_1}$

Time taken during 2nd x distance = $\frac{x}{v_2}$

Now, average velocity $= \frac{\text{total distance}}{\text{total time}}$

$$= \frac{2x}{\frac{x}{v_1} + \frac{x}{v_2}}$$

$$v = \frac{2}{\frac{1}{v_1} + \frac{1}{v_2}}$$

$$\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$$

36. The sum of magnitudes of two forces acting at a point is 16 N. If their resultant is normal to smaller force, and has a magnitude 8 N, then forces are

(a) 6 N, 10 N (b) 8 N, 8 N

(c) 4 N, 12 N (d) 2 N, 14 N

AP EAMCET -2012

Ans. (a): Let a and b is two forces.

Then given,

$$|\vec{a}| + |\vec{b}| = 16\,\text{N}, \ |\vec{R}| = 8\,\text{N}$$

$\therefore$ $\vec{R} = \vec{a} + \vec{b}$

Squaring both side,

$$\left(\vec{R}\right)^2 = \left(\vec{a} + \vec{b}\right)^2$$

$$|\vec{R}| = \sqrt{a^2 + b^2 + 2ab\cos\theta}$$

Let, $\vec{a} > \vec{b}$

$\vec{R}.\vec{b} = 0$

$\left(\vec{a} + \vec{b}\right).\vec{b} = 0$

$\vec{a}.\vec{b} = -(b)^2$

ab cos□ = $-b^2$ ....(i)

$8 = \sqrt{(16-b)^2 + b^2 + 2(-b)^2}$

Squaring both side-

$64 = 256 + b^2 - 32b + b^2 - 2b^2$

$32b = 256 - 64$

$32b = 192$

b = 6 N

$\therefore$ a = 16 – 6 = 10 N

37. A certain vector in the xy-plane has an x-component of 4 m and a y-component of 10m. It is then rotated in the xy-plane so that its x-component is doubled. Then its new y-component is (approximately)

(a) 20m (b) 7.2m

(c) 5.0m (d) 4.5m

AP EAMCET -2011

Ans. (b) : Given that,

Initially : X – component = 4 m

Y – component = 10 m

Finally : X – component = 2 × 4 = 8 m

Y – component = y

The magnitude of vector do not change by its rotation

So,

$$\sqrt{4^2 + 10^2} = \sqrt{8^2 + y^2}$$

$$y = \sqrt{52}$$

y = 7.2 m

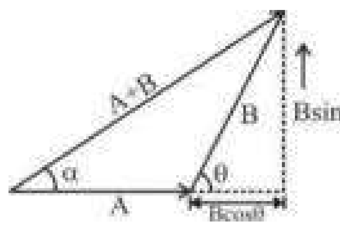
38. $\vec{A}$ and $\vec{B}$ are two vectors of equal magnitudes and θ is the angle between them. The angle between $\vec{A}$ or $\vec{B}$ with their resultant is

(a) $\frac{\theta}{4}$ (b) $\frac{\theta}{2}$

(c) 2 θ (d) Zero

AP EAMCET -2010

Ans. (b): Given, $|\vec{A}| = |\vec{B}|$



$\therefore \quad \tan\alpha = \frac{B\sin\theta}{A+B\cos\theta} \qquad (\because |A| = |B|)$

$$\tan\alpha = \frac{\sin\theta}{1+\cos\theta}$$

$$\tan\alpha = \frac{2\sin\frac{\theta}{2}.\cos\frac{\theta}{2}}{1+2\cos^2\frac{\theta}{2}-1}$$

$$\tan\alpha = \frac{2\sin\frac{\theta}{2}.\cos\frac{\theta}{2}}{2\cos^2\frac{\theta}{2}}$$

$$\tan\alpha = \tan\frac{\theta}{2}$$

$$\alpha = \frac{\theta}{2}$$

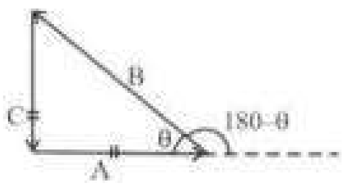
39. If A + B = C and that C is perpendicular to A. What is the angle between A and B, if |A| = |C|?

(a) $\frac{\pi}{4}$ rad (b) $\frac{\pi}{2}$ rad

(c) $\frac{3\pi}{4}$ rad (d) π rad

JIPMER-2016

Ans. (c) : Given, $|\vec{A}| = |\vec{C}|$



From figure,

$$\tan\theta = \frac{C}{A}$$

$$\cot\theta = \frac{A}{C} = \frac{C}{C} = 1 \qquad (\therefore A = C)$$

$$\theta = 45°$$

So the angle between $\vec{A}$ and $\vec{B}$

$180 - \theta = 180 - 45$

$= 135°$

$= 135 \times \frac{\pi}{180}$

$= 3\pi/4$ radian

40. If a unit vector is represented by $0.5\hat{i} + 0.8\hat{j} + c\hat{k}$, then the value of c is

(a) 1 (b) $\sqrt{0.11}$

(c) $\sqrt{0.01}$ (d) 0.39

[AIPMT 1999]

Ans. (b): Given, $\vec{A} = 0.5\hat{i} + 0.8\hat{j} + c\hat{k}$

It is unit vector so it has magnitude

$$|\vec{A}| = 1$$

$$\sqrt{(0.5)^2 + (0.8)^2 + c^2} = 1$$

$$c^2 = 0.11$$

$$c = \sqrt{0.11}$$

41. If vectors $A = \cos\omega t\,\hat{i} + \sin\omega t\,\hat{j}$ and $B = \cos\frac{\omega t}{2}\hat{i} + \sin\frac{\omega t}{2}\hat{j}$ are functions of time, then the value of t at which they are orthogonal to each other, is

(a) $t = \frac{\pi}{4\omega}$ (b) $t = \frac{\pi}{2\omega}$

(c) $t = \frac{\pi}{\omega}$ (d) $t = 0$

[AIPMT 2015]

Ans. (c) : Given, $\vec{A} = \cos\omega t\hat{i} + \sin\omega t\hat{j}$

$$\vec{B} = \cos\frac{\omega t}{2}\hat{i} + \sin\frac{\omega t}{2}\hat{j}$$

If two vector are orthogonal then their dot product will be zero–

$$\vec{A}\cdot\vec{B} = 0$$

$$(\cos\omega t\hat{i} + \sin\omega t\hat{j})\cdot\left(\cos\frac{\omega t}{2}\hat{i} + \sin\frac{\omega t}{2}\hat{j}\right) = 0$$

$$\cos\omega t\cdot\cos\frac{\omega t}{2} + \sin\omega t\cdot\sin\frac{\omega t}{2} = 0$$

$$\cos\left(\omega t - \frac{\omega t}{2}\right) = 0$$

[$\because$ cos A cos B + sin A sin B = cos (A – B)]

$$\cos\left(\omega t - \frac{\omega t}{2}\right) = \cos\frac{\pi}{2}$$

$$\omega t - \frac{\omega t}{2} = \frac{\pi}{2}$$

$$\frac{\omega t}{2} = \frac{\pi}{2} \text{ or } t = \frac{\pi}{\omega}$$

42. A body is rotating with angular velocity $\omega = (3\hat{i} - 4\hat{j} + \hat{k})$. The linear velocity of a point having position vector $r = (5\hat{i} - 6\hat{j} + 6\hat{k})$ is

(a) $6\hat{i} + 2\hat{j} - 3\hat{k}$ (b) $18\hat{i} + 13\hat{j} - 2\hat{k}$

(c) $-18\hat{i} - 13\hat{j} + 2\hat{k}$ (d) $6\hat{i} - 2\hat{j} + 8\hat{k}$

UP CPMT-2001

Ans. (c): Given that,

$$\omega = (3\hat{i} - 4\hat{j} + \hat{k})$$

$$r = (5\hat{i} - 6\hat{j} + 6\hat{k})$$

We know that,

Linear velocity (v) = $= \vec{\omega} \times \vec{r} = \left(\vec{\omega} \times \vec{r}\right)$

$$v = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -4 & 1 \\ 5 & -6 & 6 \end{vmatrix}$$

$$v = \hat{i}(-24+6) - \hat{j}(18-5) + \hat{k}(-18+20)$$

$$v = -18\hat{i} - 13\hat{j} + 2\hat{k}$$

43. If force $\mathbf{F = 5\hat{i} + 3\hat{j} + 4\hat{k}}$ makes a displacement of $\mathbf{s = 6\hat{i} - 5\hat{k}}$ work done by the force is

(a) 10 units (b) $122\sqrt{5}$ units

(c) $5\sqrt{122}$ units (d) 20 units

UP CPMT-2003

Ans. (a) : Given that,

Force (F) = $5\hat{i} + 3\hat{j} + 4\hat{k}$

Displacement (s) = $6\hat{i} - 5\hat{k}$

The work done is given by the following relation.

W = $\vec{F}.\vec{d}$

W = $\left(5\hat{i} + 3\hat{j} + 4\hat{k}\right).\left(6\hat{i} - 5\hat{k}\right)$

W = $\left(5\hat{i} + 3\hat{j} + 4\hat{k}\right).\left(6\hat{i} + 0\hat{j} - 5\hat{k}\right)$

W = 30 + 0 – 20

W = 10 units

44. Find the torque of a force $\mathbf{F = -3\hat{i} + 2\hat{j} + 1\hat{k}}$ acting at the point $\mathbf{r = 8\hat{i} + 2\hat{j} + 3\hat{k}}$.

(a) $14\hat{i} - 38\hat{j} + 16\hat{k}$ (b) $4\hat{i} + 4\hat{j} + 6\hat{k}$

(c) $-14\hat{i} + 38\hat{j} - 16\hat{k}$ (d) $-4\hat{i} - 17\hat{j} + 22\hat{k}$

UP CPMT-2010

Ans. (d) : Torque of the force

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$\tau = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8 & 2 & 3 \\ -3 & 2 & 1 \end{vmatrix}$$

$$= \hat{i}(2-6) - \hat{j}(8+9) + \hat{k}(16+6)$$

$$= -4\hat{i} - 17\hat{j} + 22\hat{k}$$

45. Given two vectors $\vec{\mathbf{A}} = -\hat{\mathbf{i}} + 2\hat{\mathbf{j}} - 3\hat{\mathbf{k}}$ and $\vec{\mathbf{B}} = 4\hat{\mathbf{i}} - 2\hat{\mathbf{j}} + 6\hat{\mathbf{k}}$. The angle made by $(\vec{\mathbf{A}} + \vec{\mathbf{B}})$ with x-axis is

(a) 30° (b) 45°

(c) 60° (d) 90°

AP EAMCET(Medical)-2007

Ans. (b): $\vec{A} = -\hat{i} + 2\hat{j} - 3\hat{k}$

$\vec{B} = 4\hat{i} - 2\hat{j} + 6\hat{k}$

$\vec{A} + \vec{B} = (-\hat{i} + 2\hat{j} - 3\hat{k}) + (4\hat{i} - 2\hat{j} + 6\hat{k})$

$\vec{A} + \vec{B} = 3\hat{i} + 0\hat{j} + 3\hat{k}$

α is angle with x–axis

$$\cos\alpha = \frac{x - \text{component of}\left(\vec{A} + \vec{B}\right)}{|\vec{A} + \vec{B}|}$$

$$\cos\alpha = \frac{3}{\sqrt{9+0+9}} = \frac{3}{3\sqrt{2}}$$

$$\cos\alpha = \frac{1}{\sqrt{2}}$$

$$\alpha = 45^\circ$$

46. $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are vectors such that $|\vec{\mathbf{A}} + \vec{\mathbf{B}}|$ = $|\vec{\mathbf{A}} - \vec{\mathbf{B}}|$. Then, the angle between them is

(a) 90° (b) 60°

(c) 45° (d) 0°

EAMCET-1993

Ans. (a) : Given,

$$|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$$

Squaring both sides,

$|\vec{A} + \vec{B}|^2 = |\vec{A} - \vec{B}|^2$

$\vec{A}^2 + \vec{B}^2 + 2\vec{A} \cdot \vec{B} = \vec{A}^2 + \vec{B}^2 - 2\vec{A} \cdot \vec{B}$

$4\vec{A} \cdot \vec{B} = 0$

$\vec{A} \cdot \vec{B} = 0$

$|\vec{A}||\vec{B}|\cos\theta = 0$

$\cos\theta = 0$

$\theta = 90^\circ$

47. The initial velocity of a particle, $\vec{\mathbf{u}} = 4\hat{\mathbf{i}} + 3\hat{\mathbf{j}}$. It is moving with uniform acceleration $\vec{\mathbf{a}} = 0.4\hat{\mathbf{i}} + 0.3\hat{\mathbf{j}}$. Its velocity after 10 seconds is:

(a) 3 unit (b) 4 unit

(c) 5 unit (d) 10 unit

AP EAMCET(Medical)-2001

Ans. (d) : Given,

$\vec{u} = 4\hat{i} + 3\hat{j}$

$\vec{a} = 0.4\hat{i} + 0.3\hat{j}$

Velocity of x-component

$\vec{v}_x = \vec{u}_x + \vec{a}_x t$

$= 4\hat{i} + \left(0.4\hat{i}\right) \times 10 = 8\hat{i}\ \text{m/s}$

Velocity of y-component

$\vec{v}_y = \vec{u}_y + \vec{a}_y t$

$= 3\hat{j} + \left(0.3\hat{j}\right) \times 10$

$= 6\hat{j}\ \text{m/s}$