1 Units and Measurements

JEE-Main

Units, System of Units

1. Electric field in a certain region is given by $\vec{E}=\left(\frac{A}{x^2}\hat{i}+\frac{B}{y^3}\hat{j}\right)$.

The SI unit of A and B are: **[30 Jan, 2023 (Shift-I)]**

(*a*) $Nm^3C^{-1}; Nm^2C^{-1}$ (*b*) $Nm^2C^{-1}; Nm^3C^{-1}$

(*c*) $Nm^3C; Nm^2C$ (*d*) $Nm^2C; Nm^3C$

2. Match List-I with List-II. **[27 Aug, 2021 (Shift-II)]**

List-I		List-II	
A.	R_H (Rydberg constant)	I.	kg m^{-1} s^{-1}
B.	h(Planck's constant)	II.	kg m^2 s^{-1}
C.	μ_B (Magnetic field energy density)	III.	m^{-1}
D.	η(coefficient of viscocity)	IV.	kg m^{-1} s^{-2}

(*a*) A-II, B-III, C-IV, D-I (*b*) A-III, B-II, C-I, D-IV

(*c*) A-III, B-II, C-IV, D-I (*d*) A-IV, B-II, C-I, D-III

3. If E and H represents the intensity of electric field and magnetising field respectively, then the unit of E/H will be: **[27 Aug, 2021 (Shift-I)]**

(*a*) Joule (*b*) Newton

(*c*) Ohm (*d*) Mho

4. A physical quantity $\vec{S}$ is defined as $\vec{S}=(\vec{E}\times\vec{B})/\mu_0$, where $\vec{E}$ is electric field, $\vec{B}$ is magnetic field and μ_0 is the permeability of free space. The dimensions of $\vec{S}$ are the same as the dimensions of which of the following quantity (ies)? **[JEE Adv, 2021]**

(*a*) $\frac{\text{Energy}}{\text{Charge}\times\text{Current}}$ (*b*) $\frac{\text{Force}}{\text{Length}\times\text{Time}}$

(*c*) $\frac{\text{Energy}}{\text{Volume}}$ (*d*) $\frac{\text{Power}}{\text{Area}}$

5. The density of a material in SI units is 128 kg m^{-3}. In certain units in which the unit of length is 25 cm and the unit of mass 50 g, the numerical value of density of the material is **[10 Jan, 2019 (Shift-I)]**

(*a*) 40 (*b*) 16

(*c*) 640 (*d*) 410

Dimension, Dimensional Formula

6. The dimensional formula of latent heat is: **[09 April, 2024 (Shift-I)]**

(*a*) $[M^0LT^{-2}]$ (*b*) $[MLT^{-2}]$

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

7. If ε_0 is the permittivity of free space and E is the electric field, then ε_0E^2 has the dimensions: **[08 April, 2024 (Shift-II)]**

(*a*) $[M^oL^{-2}TA]$ (*b*) $[ML^{-1}T^{-2}]$

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

8. Given below are two statements:

Statement (I): Dimensions of specific heat is $[L^2T^{-2}K^{-1}]$

Statement (II): Dimensions of gas constant is $[ML^2T^{-1}K^{-1}]$

[06 April, 2024 (Shift-II)]

(*a*) Statement (I) is incorrect but statement (II) is correct

(*b*) Both statement (I) and statement (II) are incorrect

(*c*) Statement (I) is correct but statement (II) is incorrect

(*d*) Both statement (I) and statement (II) are correct

9. Match List I with List II

	List-I		List-II
A.	Torque	I.	$[M^1L^1T^{-2}A^{-2}]$
B.	Magnetic field	II.	$[L^2A^1]$
C.	Magnetic moment	III.	$[M^1T^{-2}A^{-1}]$
D.	Permeability of free space	IV.	$[M^1L^2T^{-2}]$

Choose the correct answer from the options given below: **[06 April, 2024 (Shift-I)]**

(*a*) A-I, B-III, C-II, D-IV

(*b*) A-IV, B-III, C-II, D-I

(*c*) A-III, B-I, C-II, D-IV

(*d*) A-IV, B-II, C-III, D-I

10. What is the dimensional formula of ab^{-1} in the equation $\left(P + \frac{a}{V^2}\right)(V - b) = RT$, where letters have their usual meaning.

[05 April, 2024 (Shift-II)]

(*a*) $[M^0L^3T^{-2}]$ (*b*) $[ML^2T^{-2}]$
(*c*) $[M^{-1}L^5T^3]$ (*d*) $[M^6L^7T^4]$

11. If G be the gravitational constant and u be the energy density then which of the following quantity have the dimension as that the $\sqrt{uG}$: **[05 April, 2024 (Shift-I)]**

(*a*) Pressure gradient per unit mass
(*b*) Force per unit mass
(*c*) Gravitational potential
(*d*) Energy per unit mass

12. The dimensional formula of angular impulse is:

[1 Feb, 2024 (Shift-I)]

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

13. Given below are two statements: **[27 Jan, 2024 (Shift-I)]**

Statement-I: Planck's constant and angular momentum have same dimensions.

Statement-II: Linear momentum and moment of force have same dimensions.

In the light of the above statements, choose the correct answer from the options given below:

(*a*) Statement-I is true but Statement-II is false
(*b*) Both Statement-I and Statement-II are false
(*c*) Both Statement-I and Statement-II are true
(*d*) Statement-I is false but Statement-II is true

14. Match List-I with List-II. **[30 Jan, 2024 (Shift-I)]**

	List-I		List-II
A.	Coefficient of viscosity	I.	$[M\ L^2T^{-2}]$
B.	Surface Tension	II.	$[M\ L^2T^{-1}]$
C.	Angular momentum	III.	$[M\ L^{-1}T^{-1}]$
D.	Rotational kinetic energy	IV.	$[M\ L^0T^{-2}]$

(*a*) A-II, B-I, C-IV, D-III (*b*) A-I, B-II, C-III, D-IV
(*c*) A-III, B-IV, C-II, D-I (*d*) A-IV, B-III, C-II, D-I

15. Match List-I with List-II.

List-I		List-I	
A.	Young's Modulus (Y)	I.	$[ML^{-1}\ T^{-1}]$
B.	Coefficient of Viscosity (η)	II.	$[ML^2\ T^{-1}]$
C.	Planck's Constant (h)	III.	$[ML^{-1}\ T^{-2}]$
D.	Work Function (ϕ)	IV.	$[ML^2\ T^{-2}]$

Choose the correct answer from the options given below:

[25 Jan, 2023 (Shift-II)]

(*a*) A-II, B-III, C-IV, D-I
(*b*) A-III, B-I, C-II, D-IV
(*c*) A-I, B-III, C-IV, D-II
(*d*) A-I, B-II, C-III, D-IV

16. Match List-I with List-II:

List-I (Physical Quantity)		List-II (Dimensional Formula)	
A.	Pressure gradient	I.	$[M^0\ L^2\ T^{-2}]$
B.	Energy density	II.	$[M^1\ L^{-1}\ T^{-2}]$
C.	Electric Field	III.	$[M^1\ L^{-2}\ T^{-2}]$
D.	Latent heat	IV.	$[M^1L^1T^{-3}A^{-1}]$

Choose the correct answer from the options given below:

[29 Jan, 2023 (Shift-I)]

(*a*) A-III, B-II, C-I, D-IV (*b*) A-II, B-III, C-IV, D-I
(*c*) A-III, B-II, C-IV, D-I (*d*) A-II, B-III, C-I, D-IV

17. Match List-I with List-II

List - I		List - II	
A.	Surface tension	I.	$Kgm^{-1}\ s^{-1}$
B.	Pressure	II.	$Kgms^{-1}$
C.	Viscosity	III.	$Kgm^{-1}\ s^{-2}$
D.	Impulse	IV.	Kgs^{-2}

Choose the correct answer from the options given below :

[25 Jan, 2023 (Shift-I)]

(*a*) A-(IV), B-(III), C-(II), D-(I)
(*b*) A-(IV), B-(III), C-(I), D-(II)
(*c*) A-(III), B-(IV), C-(I), D-(II)
(*d*) A-(II), B-(I), C-(III), D-(IV)

18. Match List-I with List-II

List-I		List-II	
A.	Spring constant	I.	(T^{-1})
B.	Angular speed	II.	(MT^{-2})
C.	Angular momentum	III.	(ML^2)
D.	Moment of Inertia	IV.	(ML^2T^{-1})

Choose the correct answer from the options given below:

[12 April, 2023 (Shift-I)]

(*a*) A-II, B-I, C-IV, D-III (*b*) A-IV, B-I, C-III, D-II
(*c*) A-II, B-III, C-I, D-IV (*d*) A-I, B-III, C-II, D-IV

19. Match List-I with List-II.

List-I		List-II	
A.	Angular momentum	I.	$[ML^2\ T^{-2}]$
B.	Torque	II.	$[ML^{-2}\ T^{-2}]$
C.	Stress	III.	$[ML^2\ T^{-1}]$
D.	Pressure gradient	IV.	$[ML^{-1}\ T^{-2}]$

Choose the correct answer from the options given below:

[31 Jan, 2023 (Shift-II)]

(*a*) A-I, B-IV, C-III, D-II (*b*) A-III, B-I, C-IV, D-II
(*c*) A-II, B-III, C-IV, D-I (*d*) A-IV, B-II, C-I, D-III

20. Match List-I with List-II.

List-I		List-II	
A.	Torque	I.	$kg\ m^{-1}\ s^{-2}$
B.	Energy density	II.	$kg\ ms^{-1}$
C.	Pressure gradient	III.	$kg\ m^{-2}\ s^{-2}$
D.	Impulse	IV.	$kg\ m^2\ s^{-2}$

Choose the correct answer from the options given below:

[30 Jan, 2023 (Shift-II)]

(*a*) A-IV, B-III, C-I, D-II (*b*) A-I, B-IV, C-III, D-II
(*c*) A-IV, B-I, C-II, D-III (*d*) A-IV, B-I, C-III, D-II

21. Dimension of $\frac{1}{\mu_0 \in_0}$ should be equal to **[8 April, 2023 (Shift-I)]**

(*a*) T^2/L^2 (*b*) L/T (*c*) L^2/T^2 (*d*) T/L

22. Match List-I with List-II

List-I		List-II	
A.	Planck's constant (*h*)	I.	$[M^1 L^2 T^{-2}]$
B.	Stopping potential (*Vs*)	II.	$[M^1 L^1 T^{-1}]$
C.	Work function (ϕ)	III.	$[M^1 L^2 T^{-1}]$
D.	Momentum (*p*)	IV.	$[M^1 L^2 T^{-3}A^{-1}]$

[24 Jan, 2023 (Shift-I)]

(*a*) A-III, B-I, C-II, D-IV (*b*) A-III, B-IV, C-I, D-II
(*c*) A-II, B-IV, C-III, D-I (*d*) A-I, B-III, C-IV, D-II

23. Identify the pair of physical quantities that have same dimensions:

[24 June, 2022 (Shift-II)]

(*a*) Velocity gradient and decay constant
(*b*) Wien's constant and Stefan constant
(*c*) Angular frequency and angular momentum
(*d*) Wave number and Avogadro number

24. The dimension of mutual inductance is:

[26 June, 2022 (Shift-II)]

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

25. The SI unit of a physical quantity is pascal-second. The dimensional formula of this quantity will be **[27 June, 2022 (Shift-II)]**

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

26. If momentum [P], area [A] and time [T] are taken as fundamental quantities, then the dimensional formula for coefficient of viscosity is: **[25 July, 2022 (Shift-I)]**

(*a*) $[PA^{-1}T^0]$ (*b*) $[PAT^{-1}]$
(*c*) $[PA^{-1}T]$ (*d*) $[PA^{-1}T^{-1}]$

27. The dimensions of $\left(\frac{B^2}{\mu_0}\right)$ will be

(if μ_0 : permeability of free space and *B* : magnetic field)

[28 July, 2022 (Shift-I)]

(*a*) $\left[ML^2 T^{-2}\right]$ (*b*) $\left[MLT^{-2}\right]$
(*c*) $\left[ML^{-1} T^{-2}\right]$ (*d*) $\left[ML^2 T^{-2} A^{-1}\right]$

28. Which of the following physical quantities have the same dimensions? **[25 July, 2022 (Shift-I)]**

(*a*) Electric displacement ($\vec{D}$) and surface charge density
(*b*) Displacement current and electric field
(*c*) Current density and surface charge density
(*d*) Electric potential and energy

29. Match Column-I with Column-II.

Column-I		Column-II	
A.	Torque	p.	Nms^{-1}
B.	Stress	q.	$J\,kg^{-1}$
C.	Latent heat	r.	Nm
D.	Power	s.	Nm^{-2}

Choose the correct answer from the options given below

[29 July, 2022 (Shift-II)]

(*a*) A-(r); B-(q); C-(p); D-(s)
(*b*) A-(r); B-(s); C-(q); D-(p)
(*c*) A-(s); B-(p); C-(r); D-(q)
(*d*) A-(q); B-(r); C-(p); D-(s)

30. Identify the pair of physical quantities which have different dimensions: **[24 June, 2022 (Shift-I)]**

(*a*) Wave number and Rydberg's constant.
(*b*) Stress and Coefficient of elasticity.
(*c*) Coercivity and Magnetisation.
(*d*) Specific heat capacity and Latent heat.

31. Match List-I with List-II. **[27 July, 2021 (Shift-II)]**

List-I		List-II	
A.	Capacitance, C	I.	$M^1L^1T^{-3}A^{-1}$
B.	Permittivity of free space, ε_0	II.	$M^{-1}L^{-3}T^4A^2$
C.	Permeability of free space, μ_0	III.	$M^{-1}L^{-2}T^4A^2$
D.	Electric field, E	IV.	$M^1L^1T^{-2}A^{-2}$

Choose the correct answer from the options given below:

(*a*) A-III, B-II, C-IV, D-I (*b*) A-III, B-IV, C-II, D-I
(*c*) A-IV, B-II, C-III, D-I (*d*) A-IV, B-III, C-II, D-I

32. If *E*, *L*, *M* and *G* denote the quantities as energy, angular momentum, mass and constant of gravitation respectively, then the dimensions of *P* in the formula $P = EL^2M^{-5}G^{-2}$ are :- **[26 Aug, 2021 (Shift-I)]**

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

33. If '*C*' and '*V*' represent capacity and voltage respectively then what are the dimensions of λ where $C/V = \lambda$?

[26 Feb, 2021 (Shift-II)]

(*a*) $[M^{-1}L^{-3}I^2T^7]$ (*b*) $[M^{-2}L^{-3}I^2T^6]$
(*c*) $[M^{-3}L^{-4}I^3T^7]$ (*d*) $[M^{-2}L^{-4}I^3T^7]$

34. Which of the following is not a dimensionless quantity?

[27 Aug, 2021 (Shift-I)]

(*a*) Relative magnetic permeability (μ_r)
(*b*) Power factor
(*c*) Quality factor
(*d*) Permeability of free space (μ_0)

35. Match List-I with List-II: **[25 Feb, 2021 (Shift-I)]**

List-I		List-I	
A.	*h* (Planck's constant)	I.	$[MLT^{-1}]$
B.	*E* (kinetic energy)	II.	$[ML^2T^{-1}]$
C.	*V* (electric potential)	III.	$[ML^2T^{-2}]$
D.	*P* (liner momentum)	IV.	$[ML^2I^{-1}T^{-3}]$

Choose the correct answer from the options given below:

(*a*) A-I, B-II, C-IV, D-III (*b*) A-III, B-II, C-IV, D-I
(*c*) A-II, B-III, C-IV, D-I (*d*) A-III, B-IV, C-II, D-I

36. If force (F), length (L) and time (T) are taken as the fundamental quantities. Then what will be the dimension of density:

[27 Aug, 2021 (Shift-II)]

(a) $[FL^{-3}T^2]$ (*b*) $[FL^{-5}T^2]$
(*c*) $[FL^{-4}T^2]$ (*d*) $[FL^{-3}T^3]$

37. Match List-I with List-II. **[31 Aug, 2021 (Shift-I)]**

List-I		List-I	
A.	Torque	I.	MLT^{-1}
B.	Impulse	II.	MT^{-2}
C.	Tension	III.	ML^2T^{-2}
D.	Surface Tension	IV.	MLT^{-2}

Choose the most appropriate answer from the option given below:

(*a*) A-II, B-I, C-IV, D-III (*b*) A-I, B-III, C-IV, D-II
(*c*) A-III, B-I, C-IV, D-II (*d*) A-III, B-IV, C-I, D-II

38. If surface tension (S), Moment of inertia (I) and Planck's constant (h), were to be taken as the fundamental units, the dimensional formula for linear momentum would be

[8 April, 2019 (Shift-II)]

(*a*) $S^{3/2}I^{1/2}h^0$ (*b*) $S^{1/2}I^{1/2}h^0$
(*c*) $S^{1/2}I^{1/2}h^{-1}$ (*d*) $S^{1/2}I^{3/2}h^{-1}$

39. Which of the following combinations has the dimension of electrical resistance (ϵ_0 is the permittivity of vacuum and μ_0 is the permeability of vacuum)? **[12 April, 2019 (Shift-I)]**

(*a*) $\sqrt{\frac{\epsilon_0}{\mu_0}}$ (*b*) $\frac{\mu_0}{\epsilon_0}$ (*c*) $\frac{\epsilon_0}{\mu_0}$ (*d*) $\sqrt{\frac{\mu_0}{\epsilon_0}}$

40. In SI units, the dimensions of $\sqrt{\frac{\varepsilon_0}{\mu_0}}$ is: **[8 April, 2019 (Shift-I)]**

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

Dimensional Analysis, Principle of Homogeneity

41. Applying the principle of homogeneity of dimensions, determine which one is correct.

where T is time period, G is gravitational constant, M is mass, r is radius of orbit. **[04 April, 2024 (Shift-II)]**

(*a*) $T^2 = \frac{4\pi^2 r}{GM^2}$ (*b*) $T^2 = 4\pi^2 r^3$

(*c*) $T^2 = \frac{4\pi^2 r^3}{GM}$ (*d*) $T^2 = \frac{4\pi^2 r^2}{GM}$

42. Consider two physical quantities A and B related to each other as $E = \frac{B - x^2}{At}$ where E, x and t have dimensions of energy, length and time respectively. The dimension of AB is

[31 Jan, 2024 (Shift-II)]

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

43. A force is represented by $F = ax^2 + bt^{1/2}$ Where x = distance and t = time. The dimensions of b^2/a are: **[31 Jan, 2024 (Shift-I)]**

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

44. If mass is written as $m = k\, c^P\, G^{-1/2}\, h^{1/2}$ then the value of P will be: (Constants have their usual meaning with k a dimensionless constant) **[30 Jan, 2024 (Shift-II)]**

(*a*) 1/2 (*b*) 1/3 (*c*) 2 (*d*) −1/3

45. The equation of state of a real gas is given by $\left(P + \frac{a}{V^2}\right)(V - b) = RT$, where P, V and T are pressure.

volume and temperature respectively and R is the universal gas constant. The dimensions of $\frac{a}{b^2}$ is similar to that of:

[27 Jan, 2024 (Shift-II)]

(*a*) PV (*b*) P
(*c*) RT (*d*) R

46. If the velocity of light c, universal gravitational constant G and planck's constant h are chosen as fundamental quantities. The dimensions of mass in the new system is:

[1 Feb, 2023 (Shift-II)]

(*a*) $\left[h^{\frac{1}{2}}c^{-\frac{1}{2}}G^1\right]$ (*b*) $\left[h^1c^1G^{-1}\right]$

(*c*) $\left[h^{-\frac{1}{2}}c^{\frac{1}{2}}G^{\frac{1}{2}}\right]$ (*d*) $\left[h^{\frac{1}{2}}c^{\frac{1}{2}}G^{-\frac{1}{2}}\right]$

47. $\left(P + \frac{a}{V^2}\right)(V - b) = RT$ represents the equation of state of some gases. Where P is the pressure, V is the volume, T is the temperature and a, b, R are the constants. The physical quantity, which has dimensional formula as that of $\frac{b^2}{a}$, will be:

[1 Feb, 2023 (Shift-I)]

(*a*) Bulk modulus (*b*) Modulus of rigidity
(*c*) Compressibility (*d*) Energy density

48. The equation of a circle is given by $x^2 + y^2 = a^2$, where a is the radius. If the equation is modified to change the origin other than (0, 0), then find out the correct dimensions of A and B in a new equation: $(x - At)^2 + \left(y - \frac{t}{B}\right)^2 = a^2$. The dimensions of t is given as $[T^{-1}]$.

[29 Jan, 2023 (Shift-II)]

(*a*) $A = \left[L^{-1}T\right], B = \left[LT^{-1}\right]$
(*b*) $A = \left[LT\right], B = \left[L^{-1}T^{-1}\right]$
(*c*) $A = \left[L^{-1}T^{-1}\right], B = \left[LT^{-1}\right]$
(*d*) $A = \left[L^{-1}T^{-1}\right], B = \left[LT\right]$

49. The frequency (ν) of an oscillating liquid drop may depend upon radius (r) of the drop, density (ρ) of liquid and the surface tension (s) of the liquid as: $\nu = r^a\rho^b s^c$. The values of a, b and c respectively are **[24 Jan, 2023 (Shift-II)]**

(*a*) $\left(-\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}\right)$ (*b*) $\left(\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}\right)$

(*c*) $\left(\frac{3}{2}, \frac{1}{2}, -\frac{1}{2}\right)$ (*d*) $\left(-\frac{3}{2}, \frac{1}{2}, \frac{1}{2}\right)$

50. If force (F), velocity (V) and time (T) are considered as fundamental physical quantity, then dimensional formula of density will be:

[11 Apr, 2023 (Shift-II)]

(*a*) $FV^{-2}T^2$ (*b*) $FV^{-4}T^{-2}$
(*c*) FV^4T^{-6} (*c*) $F^2V^2T^2$

51. In the equation $\left[X+\frac{a}{Y^2}\right][Y-b]=RT, X$ is pressure, Y is volume, R is universal gas constant and T is temperature. The physical quantity equivalent to the ratio $\frac{a}{b}$ is: **[13 Apr, 2023 (Shift-II)]**

(*a*) Energy (*b*) Impulse
(*c*) Pressure gradient (*d*) Coefficient of viscosity

52. Young's modulus of elasticity Y is expressed in terms of three derived quantities, namely, the gravitational constant G. Planck's constant h and the speed of light c, as $Y = c^{\alpha}h^{\beta}G^{\gamma}$. Which of the following is the correct option ? **[JEE Adv, 2023]**

(*a*) $\alpha = 7, \beta = -1, \gamma = -2$ (*b*) $\alpha = -7, \beta = -1, \gamma = -2$
(*c*) $\alpha = 7, \beta = -1, \gamma = 2$ (*d*) $\alpha = -7, \beta = 1, \gamma = -2$

53. Velocity (υ) and acceleration (a) in two systems of units 1 and 2 are related as $\upsilon_2 = \frac{n}{m^2}\upsilon_1$ and $a_2 = \frac{a_1}{mn}$ respectively. Here m and n are constants. The relations for distance and time in two system respectively are: **[28 June, 2022 (Shift-II)]**

(*a*) $\frac{n^3}{m^3}L_1 = L_2$ and $\frac{n^2}{m}T_1 = T_2$

(*b*) $L_1 = \frac{n^4}{m^2}L_2$ and $T_1 = \frac{n^2}{m}T_2$

(*c*) $L_1 = \frac{n^2}{m}L_2$ and $T_1 = \frac{n^4}{m^2}T_2$

(*d*) $\frac{n^2}{m}L_1 = L_2$ and $\frac{n^4}{m^2}T_1 = T_2$

54. An expression of energy density is given by $u = \frac{\alpha}{\beta}\sin\left(\frac{\alpha x}{kt}\right)$, where α, β are constants, x is displacement, k is Boltzmann constant and t is the temperature. The dimensions of β will be: **[27 July, 2022 (Shift-II)]**

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

55. Consider the efficiency of Carnot's engine is given by $\eta = \frac{\alpha\beta}{\sin\theta}\log_e\frac{\beta x}{kT}$, where α and β are constants. If T is temperature, k is Boltzmann constant, θ is angular displacement and x has the dimensions of length. Then, choose the incorrect option. **[28 July, 2022 (Shift-II)]**

(*a*) Dimension of β is same as that of force.
(*b*) Dimension of $\alpha^{-1}x$ is same as that of energy.
(*c*) Dimension of $\eta^{-1}\sin\theta$ is same of $\alpha\beta$.
(*d*) Dimension of α is same of β.

56. An expression for a dimensionless quantity P is given by $P = \frac{\alpha}{\beta}\log_e\left(\frac{kt}{\beta x}\right)$; where α and β are constants, x is distance; k is Boltzmann constant and t is the temperature. Then the dimensions of α will be: **[26 June, 2022 (Shift-I)]**

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

57. In Vander Waals equation $\left[P+\frac{a}{V^2}\right][V-b] = RT$; P is pressure. V is volume, R is universal gas constant and T is temperature. The ratio of constants a/b is dimensionally equal to **[29 June, 2022 (Shift-I)]**

(*a*) P/V (*b*) V/P (*c*) PV (*d*) PV^3

58. In a particular system of units, a physical quantity can be expressed in terms of the electric charge e, electron mass m_e, Planck's constant h, and coulomb's constant $k = \frac{1}{4\pi\varepsilon_0}$, where ε_0 is the permittivity of vacuum. In terms of these physical constants, the dimension of the magnetic field is $[B] = [e]^{\alpha}[m_e]^{\beta}[h]^{\gamma}[k]^{\delta}$. The value of $\alpha+\beta+\gamma+\delta$ is _____. **[JEE Adv, 2022]**

59. If time (t), velocity (v), and angular momentum (ℓ) are taken as the fundamental units. Then the dimension of mass (m) in terms of t, v,and ℓ is: **[20 July, 2021 (Shift-II)]**

(*a*) $[t^{-2}v^{-1}\ell^1]$ (*b*) $[t^{-1}v^1\ell^{-2}]$
(*c*) $[t^{-1}v^{-2}\ell^1]$ (*d*) $[t^1v^2\ell^{-1}]$

60. In a typical combustion engine the work done by a gas molecule is given by $W = \alpha^2\beta e^{-\frac{\beta x^2}{kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. If α and β are constants, dimensions of α will be : **[26 Feb, 2021 (Shift-I)]**

(*a*) $[MLT^{-1}]$ (*b*) $[M^0LT^0]$
(*c*) $[M^2LT^{-2}]$ (*d*) $[MLT^{-2}]$

61. Which of the following equations is dimensionally incorrect? Where t = time, h = height, s = surface tension, θ = angle, ρ = density, r = radius, g = acceleration due to gravity, v = volume, p = pressure, W = work done, τ = torque, $\in$ = permittivity, E = electric field, J = current density, L = length. **[31 Aug, 2021 (Shift-I)]**

(*a*) $W = \tau\theta$ (*b*) $h = \frac{2s\cos\theta}{\rho rg}$
(*c*) $v = \frac{\pi pa^4}{8\eta L}$ (*d*) $J = \in\frac{\partial E}{\partial t}$

62. If e is the electronic charge, c is the speed of light in free space and h is Planck's constant, the quantity $\frac{1}{4\pi\varepsilon_0}\frac{|e|^2}{hc}$ has dimensions of: **[25 Feb, 2021 (Shift-II)]**

(*a*) $[M\,L\,T^0]$ (*b*) $[M\,L\,T^{-1}]$ (*c*) $[M^0\,L^0\,T^0]$ (*d*) $[L\,C^{-1}]$

63. The work done by a gas molecule in an isolated system is given by $W = \alpha\beta^2 e^{-\frac{x^2}{\alpha kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. α and β are constants. Then the dimensions of β will be: **[24 Feb, 2021 (Shift-I)]**

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

64. If velocity [V], time [T] and force [F] are chosen as the base quantities, the dimensions of the mass will be : **[31 Aug, 2021 (Shift-II)]**

(*a*) $[FT^2\,V]$ (*b*) $[FTV^{-1}]$ (*c*) $[FVT^{-1}]$ (*d*) $[FT^{-1}\,V^{-1}]$

65. The force is given in terms of time t and displacement x by the equation $F = A\cos Bx + C\sin Dt$. The dimensional formula of AD/B is **[25 July, 2021 (Shift-II)]**

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

66. The dimension of stopping potential V_0 in photoelectric effect in units of Planck's constant 'h', speed of light 'c' and Gravitational constant 'G' and ampere A is: **[24 Feb, 2021 (Shift-I)]**

(*a*) $h^{1/3}G^{2/3}c^{1/3}A^{-1}$ (*b*) $h^{-2/3}c^{-1/3}G^{4/3}A^{-1}$
(*c*) $h^{2/3}c^{5/3}G^{1/3}A^{-1}$ (*d*) $h^2G^{3/2}c^{1/3}A^{-1}$

67. Dimensional formula for thermal conductivity is (here K denotes the temperature): **[04 Sep, 2020 (Shift-I)]**

(a) $MLT^{-3}K^{-1}$ (b) $MLT^{-2}K^{-2}$
(c) $MLT^{-2}K$ (d) $MLT^{-3}K$

68. Amount of solar energy received on the earth's surface per unit area per unit time is defined a solar constant. Dimension of solar constant is **[3 Sep, 2020 (Shift-II)]**

(a) ML^2T^{-2} (b) MLT^{-2} (c) $M^2L^0T^{-1}$ (d) ML^0T^{-3}

69. A quantity x is given by (IFv^2/WL^4) in terms of moment of inertia I, force F, velocity v, work W and length L. The dimensional formula for x is same as that of **[04 Sep, 2020 (Shift-II)]**

(a) Coefficient of viscosity (b) Force constant
(c) Energy density (d) Planck's constant

70. A quantity f is given by $f=\sqrt{\frac{hc^5}{G}}$ where c is speed of light, G universal gravitational constant and h is the Planck's constant. Dimension of f is that of: **[9 Jan, 2020 (Shift-I)]**

(a) energy (b) momentum
(c) area (d) volume

71. If speed V, area A and force F are chosen as fundamental units, then the dimension of Young's modulus will be **[2 Sep, 2020 (Shift-I)]**

(a) $FA^{-1}V^0$ (b) FA^2V^{-1} (c) FA^2V^{-2} (d) FA^2V^{-3}

72. If momentum (P), area (A) and time (T) are taken to be the fundamental quantities then the dimensional formula for energy is **[2 Sep, 2020 (Shift-II)]**

(a) $\left[P^{\frac{1}{2}}AT^{-1}\right]$ (b) $[P^2AT^{-2}]$
(c) $\left[PA^{\frac{1}{2}}T^{-1}\right]$ (b) $[PA^{-1}T^{-2}]$

73. The quantities $x=\frac{1}{\sqrt{\mu_0\varepsilon_0}}$, $y=\frac{E}{B}$ and $z=\frac{I}{CR}$ are defined where C-capacitance, R-resistance, l-length, E-electric field, B-magnetic field and ε_0, μ_0-free space permitivity and permeability respectively. Then **[5 Sep, 2020 (Shift-II)]**

(a) Only x and y have the same dimension.
(b) Only x and z have the same dimension.
(c) x, y and z have the same dimension.
(d) Only y and z have the same dimension.

74. Sometimes it is convenient to construct a system of units so that all quantities can be expressed in terms of only one physical quantity. In one such system, dimensions of different quantities are given in terms of a quantity x as follows: [position] = $[x^\alpha]$; [speed] = $[x^\beta]$; [acceleration] = $[x^p]$; [linear momentum] = $[x^q]$; [force] = $[x^r]$. Then **[JEE Adv, 2020]**

(a) $\alpha+p=2\beta$ (b) $p+q-r=\beta$
(c) $p-q+r=\alpha$ (d) $p+q+r=\beta$

75. Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to: **[9 Jan, 2019 (Shift-II)]**

(a) $\sqrt{\frac{hc^5}{G}}$ (b) $\sqrt{\frac{c^3}{Gh}}$
(c) $\sqrt{\frac{Gh}{c^5}}$ (d) $\sqrt{\frac{Gh}{c^3}}$

76. The force of interaction between two atoms is given by $F=\alpha\beta exp\left(-\frac{x^2}{\alpha kt}\right)$; where x is the distance, k is the Boltzmann constant and T is temperature and α and β are two constants. The dimension of β is: **[11 Jan, 2019 (Shift-I)]**

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

77. If speed (V), acceleration (A) and force (F) are considered as fundamental units, the dimension of Young's modulus will be: **[11 Jan, 2019 (Shift-II)]**

(a) $V^{-2}A^2F^{-2}$ (b) $V^{-2}A^2F^2$ (c) $V^{-4}A^{-2}F$ (d) $V^{-4}A^2F$

78. Let L, R, C and V represent inductance, resistance, capacitance and voltage, respectively. The dimension of $\frac{L}{RCV}$ in SI units will be: **[12 Jan, 2019 (Shift-II)]**

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

79. Let us consider a system of units in which mass and angular momentum are dimensionless. If length has dimension of L, which of the following statement(s) is/are correct? **[JEE Adv, 2019]**

(a) The dimension of force is L^{-3}.
(b) The dimension of energy of L^{-2}.
(c) The dimension of power is L^{-5}.
(d) The dimension of linear momentum is L^{-1}.

Errors in Measurement

80. Young's modulus is determined by the equation given by $Y=49000\frac{m}{\ell}\frac{dyne}{cm^2}$ where m is the mass and ℓ is the extension of wire used in the experiment. Now error in Young modules (Y) is estimated by taking data from m-ℓ plot in graph paper. The smallest scale divisions are 5 g and 0.02 cm along load axis and extension axis respectively. If the value of m and ℓ are 500 g and 2 cm respectively then percentage error of Y is: **[08 April, 2024 (Shift-I)]**

(a) 0.2% (b) 0.02% (c) 2% (d) 0.5%

81. In an expression $a\times10^b$: **[08 April, 2024 (Shift-I)]**

(a) a is order of magnitude for $b\le5$
(b) b is order of magnitude for $a\le5$
(c) b is order of magnitude for $5<a\le10$
(d) b is order of magnitude for $a\ge5$

82. To find the spring constant (k) of a spring experimentally, a student commits 2% positive error in the measurement of time and 1% negative error in measurement of mass. The percentage error in determining value of k is: **[06 April, 2024 (Shift-I)]**

(a) 3% (b) 1% (c) 4% (d) 5%

83. Time periods of oscillation of the same simple pendulum measured using four different measuring clocks were recorded as 4.62 s, 4.632 s, 4.6 s and 4.64 s. The arithmetic mean of these reading in correct significant figure is. **[05 April, 2024 (Shift-I)]**

(a) 4.623 s (b) 4.62 s
(c) 4.6 s (d) 5 s

84. In an experiment to measure focal length (f) of convex lens, the least counts of the measuring scales for the position of object (u) and for the position of image (v) are Δu and Δv, respectively. The error in the measurement of the focal length of the convex lens will be: **[04 April, 2024 (Shift-I)]**

(a) $\frac{\Delta u}{u}+\frac{\Delta v}{v}$ (b) $f^2\left[\frac{\Delta u}{u^2}+\frac{\Delta v}{v^2}\right]$

(c) $2f\left[\frac{\Delta u}{u}+\frac{\Delta v}{v}\right]$ (d) $f\left[\frac{\Delta u}{u}+\frac{\Delta v}{n}\right]$

85. Match List-I with List-II.

	List-I (Number)		List-II (Significant figure)
(A)	1001	(I)	3
(B)	010.1	(II)	4
(C)	100.100	(III)	5
(D)	0.0010010	(IV)	6

Choose the correct answer from the options given below:

[1 Feb, 2024 (Shift-II)]

(a) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
(b) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
(c) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
(d) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

86. The radius (r), length (l) and resistance (R) of a metal wire was measured in the laboratory as

$r = (0.35 \pm 0.05)$ cm, $R = (100 \pm 10)$ ohm, $l = (15 \pm 0.2)$ cm

The percentage error in resistivity of the material of the wire is: **[1 Feb, 2024 (Shift-I)]**

(a) 25.6% (b) 39.9% (c) 37.3% (d) 35.6%

87. The measured value of the length of a simple pendulum is 20 cm with 2 mm accuracy. The time for 50 oscillations was measured to be 40 seconds with 1 second resolution. From these measurements, the accuracy in the measurement of acceleration due to gravity is N%. The value of N is: **[31 Jan, 2024 (Shift-II)]**

(a) 4 (b) 8 (c) 6 (d) 5

88. If the percentage errors in measuring the length and the diameter of a wire are 0.1% each. The percentage error in measuring its resistance will be: **[31 Jan, 2024 (Shift-I)]**

(a) 0.2% (b) 0.3% (c) 0.1% (d) 0.144%

89. The resistance R = $\frac{V}{I}$ where V = (200 ± 5)V and I = (20 ± 0.2)A, the percentage error in the measurement of R is: **[29 Jan, 2024 (Shift-I)]**

(a) 3.5% (b) 7% (c) 3% (d) 5.5%

90. A physical quantity Q is found to depend on quantities a, b, c by the relation $Q=\frac{a^4b^3}{c^2}$ The percentage error in a, b and c are 3%, 4% and 5% respectively. Then, the percentage error in Q is: **[29 Jan, 2024 (Shift-II)]**

(a) 66% (b) 43% (c) 33% (d) 14%

91. A 2 meter long scale with least count of 0.2 cm is used to measure the locations of objects on an optical bench. While measuring the focal length of a convex lens, the object pin and the convex lens are placed at 80 cm mark and 1m mark respectively. The image of the object pin on the other side of lens coincides with image pin that is kept at 180 cm mark. The % error in the estimation of focal length is: **[06 Apr, 2023 (Shift-II)]**

(a) 1.02 (b) 0.85 (c) 1.70 (d) 0.51

92. A physical quantity P is given as

$$P=\frac{a^2b^3}{c\sqrt{d}}$$

The percentage error in the measurement of a, b, c and d are 1%, 2%, 3% and 4% respectively. The percentage error in the measurement of quantity P will be **[10 Apr, 2023 (Shift-I)]**

(a) 13% (b) 14% (c) 12% (d) 16%

93. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: A spherical body of radius (5 ± 0.1) mm having a particular density is falling through a liquid of constant density. The percentage error in the calculation of its terminal velocity is 4%.

Reason R: The terminal velocity of the spherical body falling through the liquid is inversely proportional to its radius.

In the light of the above statements, choose the correct answer from the options given below **[13 Apr, 2023 (Shift-II)]**

(a) Both A and R are true but R is not the correct explanation of A
(b) Both A and R are true and R is the correct explanation of A
(c) A is false but R is true
(d) A is true but R is false

94. Two resistances are given as $R_1 = (10 \pm 0.5)\Omega$ and $R_2 = (15 \pm 0.5\ \Omega$. The percentage error in the measurement of equivalent resistance when they are connected in parallel is **[6 Apr, 2023 (Shift-I)]**

(a) 6.33 (b) 2.33
(c) 4.33 (d) 5.33

95. A body of mass (5 ± 0.5) kg is moving with a velocity of (20 ± 0.4) m/s. Its kinetic energy will be **[13 Apr, 2023 (Shift-I)]**

(a) $(1000 \pm 140)\ J$ (b) $(1000 \pm 0.14)\ J$
(c) $(500 \pm 0.14)\ J$ (d) $(500 \pm 140)\ J$

96. A cylindrical wire of mass $(0.4 \pm 0.01)g$ has length (8 ± 0.04) cm and radius (6 ± 0.03) mm. The maximum error in its density will be **[08 Apr, 2023 (Shift-I)]**

(a) 1% (b) 3.5% (c) 4% (d) 5%

97. If $Z=\frac{A^2B^3}{C^4}$, then the relative error in Z will be: **[25 June, 2022 (Shift-I)]**

(a) $\frac{\Delta A}{A}+\frac{\Delta B}{B}+\frac{\Delta C}{C}$ (b) $\frac{2\Delta A}{A}+\frac{3\Delta B}{B}-\frac{4\Delta C}{C}$

(c) $\frac{2\Delta A}{A}+\frac{3\Delta B}{B}+\frac{4\Delta C}{C}$ (b) $\frac{\Delta A}{A}+\frac{\Delta B}{B}-\frac{\Delta C}{C}$

98. In an experiment to determine the Young's modulus of wire of a length exactly 1 m, the extension in the length of the wire is measured as 0.4 mm with an uncertainty of ±0.02 mm when a load of 1 kg is applied. The diameter of the wire is measured as 0.4 mm with an uncertainty of ±0.01mm.

The error in the measurement of Young's modulus (ΔY) is found to be $x \times 10^{10}\text{Nm}^{-2}$. The value of x is _____.

(take g = 10 ms^{-2}) **[26 July, 2022 (Shift-I)]**

99. A torque meter is calibrated to reference standards of mass, length and time each with 5% accuracy. After calibration, the measured torque with this torque meter will have net accuracy of

[27 July, 2022 (Shift-I)]

(*a*) 15% (*b*) 25%
(*c*) 75% (*d*) 5%

100. A silver wire has a mass (0.6 ± 0.006)g, radius (0.5 ± 0.005)mm and length(4 ± 0.04) cm. The maximum percentage error in the measurement of its density will be: **[27 June, 2022 (Shift-I)]**

(*a*) 4% (*b*) 3% (*c*) 6% (*d*) 7%

101. For $z = a^2x^3y^{\frac{1}{2}}$, where '*a*' is a constant. If percentage error in measurement of '*x*' and '*y*' are 4% and 12% respectively, then the percentage error for '*z*' will be _____ %.

[25 June, 2022 (Shift-I)]

102. A student in the laboratory measures thickness of a wire using screw gauge. The readings are 1.22 mm, 1.23 mm, 1.19 mm and 1.20 mm. The percentage error is $\frac{x}{121}\%$. The value of *x* is _____.

[28 June, 2022 (Shift-II)]

103. In experiment to find acceleration due to gravity (g) using simple pendulum, time period of 0.5 s is measured from time of 100 oscillation with a watch of 1 s resolution. If measured value of length is 10 cm known to 1 mm accuracy, The accuracy in the determination of g is found to be *x* %. The value of *x* is _____.

[28 July, 2022 (Shift-II)]

104. A student measuring the diameter of a pencil of circular cross-section with the help of a vernier scale records the following four readings 5.50 mm, 5.55 mm, 5.45 mm, and 5.65 mm. The average of these four readings is 5.5375 mm and the standard deviation of the data is 0.07395 mm. The average diameter of the pencil should therefore be recorded as

[6 Sep, 2022 (Shift-II)]

(*a*) (5.5375 ± 0.0739) mm (*b*) (5.54 ± 0.07) mm
(*c*) (5.538 ± 0.074) mm (*d*) (5.5375 ± 0.0740) mm

105. In order to determine the Young's modulus of a wire of radius 0.2 cm (measured using a scale of least count = 0.001 cm) and length 1m (measured using a scale of least count = 1 mm), a weight of mass 1kg (measured using a scale of least count = 1g) was hanged to get the elongation of 0.5 cm (measured using a scale of least count 0.001 cm). What will be the fractional error in the value of Young's modulus determined by this experiment?

[16 March, 2021 (Shift-II)]

(*a*) 0.14% (*b*) 9%
(*c*) 1.4% (*d*) 0.9%

106. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{L}{g}}$. Measured value of '*L*' is 1.0 m from meter scale having a minimum division of 1 mm and time of one- complete oscillation is 1.95 s measured from stopwatch of 0.01 s resolution. The percentage error in the determination of '*g*' will be: **[24 Feb, 2021 (Shift-II)]**

(*a*) 1.33% (*b*) 1.13%
(*c*) 1.03% (*d*) 1.30%

107. In the experiment of Ohm's law, a potential difference of 5.0V is applied across the end of a conductor of length 10.0 cm and diameter of 5.00 mm. The measured current in the conductor is 2.00 A. The maximum permissible percentage error in the resistivity of the conductor is: **[18 March, 2021 (Shift-I)]**

(*a*) 3.9 (*b*) 8.4 (*c*) 3.0 (*d*) 7.5

108. A wire of 1Ω has a length of 1m. It is stretched till its length increases by 25%. The percentage change in resistance to the nearest integer is: **[26 Feb, 2021 (Shift-II)]**

(*a*) 56% (*b*) 76% (*c*) 12.5% (*d*) 25%

109. Three students S_1, S_2 and S_3 perform an experiment for determining the acceleration due to gravity (g) using a simple pendulum. They use different lengths of pendulum and record time for different number of oscillations. The observations are as shown in the table.

[22 July, 2021 (Shift-II)]

Student No.	Length of Pendulum (cm)	No. of oscillations (*n*)	Total for *n* Time oscillations	Period (*s*)
1	64.0	8	128.0	16.0
2	64.0	4	64.0	16.0
3	20.0	4	36.0	9.0

(Least count of length = 0.1 cm,
least count for time = 0.1 s)
If E_1, E_2 and E_3 are the percentage errors '*g*' for students 1, 2 and 3 respectively, then the minimum percentage error is obtained by student no._____.

110. If the length of the pendulum in pendulum clock increases by 0.1%, then the error in time per day is **[26 Aug, 2021 (Shift-II)]**

(*a*) 8.64 s (*b*) 43.2 s (*c*) 86.4 s (*d*) 4.32 s

111. The time period of a simple pendulum is given by $T = 2\pi\sqrt{\frac{l}{g}}$. The measured value of the length of pendulum is 10 cm known to a 1 mm accuracy. The time for 200 oscillations of the pendulum is found to be 100 second using a clock of 1 s resolution. The percentage accuracy in the determination of '*g*' using this pendulum is '*x*'. The value of '*x*' to be nearest integer is **[18 March, 2021 (Shift-I)]**

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

112. A physical quantity '*y*' is represented by the formula $y = m^2r^{-4}g^x\ell^{-\frac{3}{2}}$ if the percentage errors found in y, *m*, *r*, ℓ and *g* are 18, 1, 0.5, 4 and *p* respectively, then find the value of *x* and *p*.

[27 July, 2021 (Shift-II)]

(*a*) 5 and ± 2 (*b*) $\frac{16}{3}$ and $\pm\frac{3}{2}$
(*c*) 8 and ± 2 (*d*) 4 and ± 3

113. A student determined Young's Modulus of elasticity using the formula $Y = \frac{MgL^3}{4bd^3\delta}$. The value of *g* is taken to be 9.8 m/s^2, without any significant error, his observation are as follows:

[1 Sept, 2021 (Shift-II)]

Physical Quantity	Least count of the Equipment used for measurement	Observed value
Mass (M)	1 g	2 kg
Length of bar (L)	1 mm	1 m
Breadth of bar (b)	0.1 mm	4 cm
Thickness of bar (d)	0.01 mm	0.4 cm
Depression (δ)	0.01 mm	5 mm

Then the fractional error in the measurement of Y is:

(a) 0.083 (b) 0.0155 (c) 0.0083 (d) 0.155

114. The acceleration due to gravity is found upto an accuracy of 4% on a planet. The energy supplied to a simple pendulum of known mass 'm' to undertake oscillations of time period T is being estimated. If time period is measured to an accuracy of 3%, the accuracy to which E is known as _____%. **[26 Aug, 2021 (Shift-II)]**

115. The resistance $R = \frac{V}{I}$, where $V = (50 \pm 2)$ V and $I = (20 \pm 0.2)$ A. The percentage error in R is 'x' %. The value of 'x' to the nearest integer is _____. **[16 March, 2021 (Shift-I)]**

116. The radius of a sphere is measured to be (7.50 ± 0.85) cm. Suppose the percentage error in its volume is x. The value of x, to the nearest integer, is _____ **[18 March, 2021 (Shift-II)]**

117. A simple pendulum is being used to determine the value of gravitational acceleration g at a certain place. The length of the pendulum is 25.0 cm and a stop watch with 1s resolution measures the time taken for 40 oscillations to be 50 s. The accuracy in g is: **[8 Jan, 2020 (Shift-II)]**

(a) 4.40% (b) 3.40% (c) 2.40% (d) 5.40%

118. A physical quantity z depends on four observables a, b, c and d, as $\frac{a^2 b^{\frac{2}{3}}}{\sqrt{c}\, d^3}$. The percentages of error in the measurement of a, b, c and d are 2%, 1.5%, 4% and 2.5% respectively. The percentage of error in z is **[05 Sep, 2020 (Shift-I)]**

(a) 13.5% (b) 14.5% (c) 16.5% (d) 12.25%

119. The density of a solid metal sphere is determined by measuring its mass and its diameter. The maximum error in the density of the sphere is $\left(\frac{x}{100}\right)$%. If the relative errors in measuring the mass and the diameter are 6.0% and 1.5% respectively, the value of x is _____ **[6 Sep, 2020 (Shift-I)]**

(a) 5010 (b) 5100 (c) 1050 (d) 5101

120. In the density measurement of a cube, the mass and edge length are measured as (10.00 ± 0.10) kg and (0.10 ± 0.01)m, respectively. The error in the measurement of density is: **[9 April, 2019 (Shift-I)]**

(a) 0.10 kg/m^3 (b) 0.31 kg/m^3
(c) 0.07 kg/m^3 (d) 0.01 kg/m^3

121. In a simple pendulum experiment for determination of acceleration due to gravity (g), time taken for 20 oscillations is measured by using a watch of 1 second least count. The mean value of time taken comes out to be 30s. The length of pendulum is measured by using a meter scale of least count 1 mm and the value obtained is 55.0 cm. The percentage error in the determination of g is close to: **[8 April, 2019 (Shift-II)]**

(a) 0.7% (b) 3.5% (c) 6.8% (d) 0.2%

122. The diameter and height of a cylinder are measured by a meter scale to be 12.6 ± 0.1 cm and 34.2 ± 0.1 cm respectively. What will be the value of its volume in appropriate significant figures? **[10 Jan, 2019 (Shift-II)]**

(a) 4264 ± 81 cm^3 (b) 4264 ± 81.0 cm^3
(c) 4260 ± 80 cm^3 (d) 4300 ± 80 cm^3

123. A copper wire is stretched to make it 0.5% longer. The percentage change in its electric resistance if its volume remains unchanged is **[9 Jan, 2019 (Shift-I)]**

(a) 2.0% (b) 2.5% (c) 1.0% (d) 0.5%

Measuring Instruments

124. One main scale division of a vernier caliper is equal to m units. If nth division of main scale coincides with $(n+1)^{th}$ division of vernier scale, the least count of the vernier caliper is: **[09 April, 2024 (Shift-I)]**

(a) $\frac{n}{(n+1)}$ (b) $\frac{m}{(n+1)}$ (c) $\frac{1}{(n+1)}$ (d) $\frac{m}{n(n+1)}$

125. There are 100 divisions on the circular scale of a screw gauge of pitch 1 mm. With no measuring quantity in between the jaws, the zero of the circular scale lies 5 divisions below the reference line. The diameter of a wire is then measured using this screw gauge. It is found the 4 linear scale divisions are clearly visible while 60 divisions on circular scale coincide with the reference line. The diameter of the wire is: **[08 April, 2024 (Shift-II)]**

(a) 4.65 mm (b) 4.55 mm
(c) 4.60 mm (d) 3.35 mm

126. Least count of a vernier caliper is $\frac{1}{20N}$ cm. The value of one division on the main scale is 1 mm. Then the number of divisions of main scale that coincide with N divisions of vernier scale is: **[08 April, 2024 (Shift-II)]**

(a) $\left(\frac{2N-1}{20N}\right)$ (b) $\left(\frac{2N-1}{2}\right)$
(c) $(2N-1)$ (d) $\left(\frac{2N-1}{2N}\right)$

127. The diameter of a sphere is measured using a vernier caliper whose 9 divisions of main scale are equal to 10 divisions of vernier scale. The shortest division on the main scale is equal to l mm. The main scale reading is 2 cm and second division of vernier scale coincides with a division on main scale. If mass of the sphere is 8.635 g, the density of the sphere is: **[08 April, 2024 (Shift-I)]**

(a) 2.5 g/cm^3 (b) 1.7 g/cm^3
(c) 2.2 g/cm^3 (d) 2.0 g/cm^3

128. In a vernier calliper, when both jaws touch each other, zero of the vernier scale shifts towards left and its 4th division coincides exactly with a certain division on main scale. If 50 vernier scale divisions equal to 49 main scale divisions and zero error in the instrument is 0.04 mm then how many main scale divisions are there in 1 cm? **[06 April, 2024 (Shift-II)]**

(a) 40 (b) 5 (c) 20 (d) 10

129. In finding out refractive index of glass slab the following observations were made through travelling microscope 50 vernier scale division = 49 MSD; 20 divisions on main scale in each cm

[06 April, 2024 (Shift-II)]

For mark on paper

MSR = 8.45 cm, VC = 26

For mark on paper seen through slab

MSR = 7.12 cm, VC = 41

For powder particle on the top surface of the glass slab

MSR = 4.05 cm, VC = 1

(MSR = Main Scale Reading, VC = Vernier Coincidence)

Refractive index of the glass slab is:

(*a*) 1.42 (*b*) 1.52 (*c*) 1.24 (*d*) 1.35

130. While measuring diameter of wire using screw gauge the following readings were noted. Main scale reading is 1 mm and circular scale reading is equal to 42 divisions. Pitch of screw gauge is 1 mm and it has 100 divisions on circular scale. The diameter of the wire is $\frac{x}{50}$ mm. The value of x is:

[06 April, 2024 (Shift-I)]

(*a*) 142 (*b*) 71

(*c*) 42 (*d*) 21

131. A vernier callipers has 20 divisions on the vernier scale, which coincides with 19th division on the main scale. The least count of the instrument is 0.1 mm. One main scale division is equal to ____ mm. **[05 April, 2024 (Shift-II)]**

(*a*) 1 (*b*) 0.5

(*c*) 2 (*d*) 5

132. 10 divisions on the main scale of a Vernier calliper coincide with 11 divisions on the Vernier scale. If each division on the main scale is of 5 units, the least count of the instrument is:

[1 Feb, 2024 (Shift-I)]

(*a*) $\frac{1}{2}$ (*b*) $\frac{10}{11}$ (*c*) $\frac{50}{11}$ (*d*) $\frac{5}{11}$

133. If 50 Vernier divisions are equal to 49 main scale divisions of a travelling microscope and one smallest reading of main scale is 0.5 mm, the Vernier constant of travelling microscope is:

[30 Jan, 2024 (Shift-II)]

(*a*) 0.1 mm (*b*) 0.1 cm (*c*) 0.01 cm (*d*) 0.01 mm

134. Identify the physical quantity that cannot be measured using spherometer: **[27 Jan, 2024 (Shift-I)]**

(*a*) Radius of curvature of concave surface

(*b*) Specific rotation of liquids

(*c*) Thickness of thin plates

(*d*) Radius of curvature of convex surface

135. Given below are two statements: one is labelled as Assertion(A) and the other is labelled as Reason (R).

Assertion (A): In Vernier calliper if positive zero error exists, then while taking measurements, the reading taken will be more than the actual reading.

Reason (R): The zero error in Vernier Calliper might have happened due to manufacturing defect or due to rough handling.

In the light of the above statements, choose the correct answer from the options given below:

[27 JAN, 2024 (Shift-II)]

(*a*) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(*b*) Both (A) and (R) are correct 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

136. In an experiment with Vernier callipers of least count 0.1 mm, when two jaws are joined together the zero of Vernier scale lies right to the zero of the main scale and 6th division of Vernier scale coincides with the main scale division. While measuring the diameter of a spherical bob, the zero of vernier scale lies in between 3.2 cm and 3.3 cm marks, and 4th division of vernier scale coincides with the main scale division. The diameter of bob is measured as :

[10 Apr, 2023 (Shift-II)]

(*a*) 3.18 cm (*b*) 3.25 cm (*c*) 3.26 cm (*d*) 3.22 cm

137. Given below are two statements :

Statements I : Astronomical unit (Au). Parsec (Pc) and Light year (ly) are units for measuring astronomical distances.

Statements II: Au < Parsec (Pc) < ly

In the light of the above statements. Choose the most appropriate answer from the options given below: **[11 Apr, 2023 (Shift-I)]**

(*a*) Both Statements I and Statements II are correct

(*b*) Statements I is correct but Statements II is incorrect

(*c*) Both Statements I and Statements II are incorrect

(*d*) Statements I is incorrect but statements II is correct

138. In a screw gauge, there are 100 divisions on the circular scale and the main scale moves by 0.5 mm on a complete rotation of the circular scale. The zero of circular scale lies 6 divisions below the line of graduation when two studs are brought in contact with each other. When a wire is placed between the studs, 4 linear scale divisions are clearly visible while 46th division the circular scale coincide with the reference line. The diameter of the wire is _____ × 10^{-2} mm. **[30 Jan, 2023 (Shift-I)]**

139. In a Vernier Calliper, 10 divisions of Vernier scale is equal to the 9 divisions of main scale. When both jaws of Vernier calipers touch each other, the zero of the Vernier scale is shifted to the left of zero of the main scale and 4th Vernier scale division exactly coincides with the main scale reading. One main scale division is equal to 1 mm. While measuring diameter of a spherical body, the body is held between two jaws. It is now observed that zero of the Vernier scale lies between 30 and 31 divisions of main scale reading and 6th Vernier scale division exactly coincides with the main scale reading. The diameter of the spherical body will be

[26 July, 2022 (Shift-II)]

(*a*) 3.02 cm (*b*) 3.06 cm

(*c*) 3.10 cm (*d*) 3.20 cm

140. The distance of the Sun from earth is 1.5×10^{11} m and its angular diameter is (2000) s when observed from the earth. The diameter of the Sun will be: **[27 June, 2022 (Shift-II)]**

(*a*) 2.45×10^{10} m (*b*) 1.45×10^{10} m

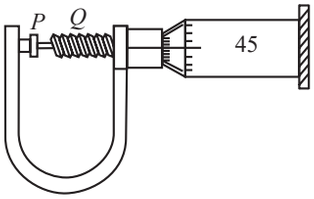
(*c*) 1.45×10^{9} m (*d*) 0.14×10^{9} m

141. A travelling microscope has 20 divisions per cm on the main scale while its vernier scale has total 50 divisions and 25 vernier scale divisions are equal to 24 main scale divisions, what is the least count of the travelling microscope? **[29 July, 2022 (Shift-I)]**

(*a*) 0.001 cm (*b*) 0.002 mm

(*c*) 0.002 cm (*d*) 0.005 cm

142. In an experiment to find out the diameter of wire using screw gauge, the following observations were noted?



A. Screw moves 0.5 mm or main scale in one complete rotation.
B. Total divisions on circular scale = 50
C. Main scale reading is 2.5 mm
D. 45th division of circular scale is in the pitch line

Then the diameter of wire is **[29 July, 2022 (Shift-I)]**

(*a*) 2.92 mm (*b*) 2.54 mm (*c*) 2.98 mm (*d*) 3.45 mm

143. The Vernier constant of Vernier callipers is 0.1 mm and it has zero error of (–0.05) cm. While measuring diameter of a sphere, the main scale reading is 1.7 cm and coinciding vernier division is 5. The corrected diameter will be _____$\times 10^{-2}$ cm.

[29 June, 2022 (Shift-II)]

144. The one division of main scale of Vernier callipers reads 1 mm and 10 divisions of Vernier scale is equal to the 9 divisions on main scale. When the two jaws of the instrument touch each other, the zero of the Vernier lies to the right of zero of the main scale and its fourth division coincides with a main scale division. When a spherical bob is tightly placed between the two jaws, the zero of the Vernier scale lies in between 4.1 cm and 4.2 cm and 6th Vernier division coincides with a main scale division. The diameter of the bob will be _____ $\times 10^{-2}$ cm **[27 July, 2022 (Shift-I)]**

145. In a vernier callipers, each cm on the main scale is divided into 20 equal parts. If tenth vernier scale division coincides with ninth main scale division. Then the value of vernier contant will be _____ $\times 10^{-2}$ mm. **[26 June, 2022 (Shift-I)]**

146. A screw gauge of pitch 0.5 mm is used to measure the diameter of uniform wire of length 6.8cm, the main scale reading is 1.5 mm and circular scale reading is 7. The calculated curved surface area of wire to appropriate significant figures is:

[26 July, 2022 (Shift-I)]

[Screw gauge has 50 divisions on its circular scale]

(*a*) 6.8 cm^2 (*b*) 3.4 cm^2
(*c*) 3.9 cm^2 (*d*) 2.4 cm^2

147. In a Screw Gauge, fifth division of the circular scale coincides with the reference line when the ratchet is closed. There are 50 divisions on the circular scale, and the main scale moves by 0.5 mm on a complete rotation. For a particular observation the reading on the main scale is 5mm and the 20th division of the circular scale coincides with reference line. Calculate the true reading.

[26 Aug, 2021 (Shift-I)]

(*a*) 5.25 mm (*b*) 5.15 mm
(*c*) 5.20 mm (*d*) 5.00 mm

148. The vernier scale used for measurement has a positive zero error of 0.2 mm. If while taking a measurement it was noted that zero on the vernier scale lies between 8.5 cm and 8.6 cm. and vernier coincidence is 6, then the correct value of measurement is _____ (least count = 0.01 cm) **[17 March, 2021 (Shift-I)]**

(*a*) 8.58 cm (*b*) 8.54 cm
(*c*) 8.56 cm (*d*) 8.36 cm

149. Suppose you have taken a dilute solution of oleic acid in such a way that its concentration becomes 0.01 cm^3 of oleic acid per cm^3 of the solution. Then you make a thin film of this solution (monomolecular thickness) of area 4 cm^2 by considering 100 spherical drops of radius $\left(\frac{3}{40\pi}\right)^{\frac{1}{3}} \times 10^{-3}$ cm. Then the thickness of oleic acid Layer will be $x \times 10^{-14}$ m. Where x is _____. **[17 March, 2021 (Shift-II)]**

150. The pitch of the screw gauge is 1 mm and there are 100 divisions on the circular scale. When nothing is put in between the jaws, the zero of the circular scale lies 8 divisions below the reference line. When a wire is placed between the jaws, the first linear scale division is clearly visible while 72nd division on circular scale coincides with the reference line, The radius of the wire is:

[25 Feb, 2021 (Shift-I)]

(*a*) 0.82 mm (*b*) 1.64 mm (*c*) 0.90 mm (*d*) 1.80 mm

151. **Assertion A:** If in five complete rotations of the circular scale, the distance travelled on main scale of the screw gauge is 5 mm and there are 50 total divisions on circular scale, then least count is 0.001 cm.

Reason R: Least Count $= \dfrac{\text{Pitch}}{\text{Total divisions on circular scle}}$

In the light of the above statement, choose the most appropriate answer from the options given below: **[27 July, 2021 (Shift-I)]**

(*a*) **A** is correct but **R** is not correct.
(*b*) **A** is not correct but **R** is correct.
(*c*) Both **A** and **R** are correct and **R** is NOT the correct explanation of **A**.
(*d*) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

152. One main scale division of a vernier calipers is 'a' cm and n^{th} division of the vernier scale coincide with $(n-1)^{th}$ division of the main scale. The least count of the calipers (in mm) is

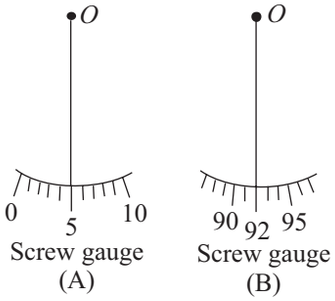
[16 March, 2021 (Shift-I)]

(*a*) $\dfrac{10na}{n-1}$ (*b*) $\dfrac{10a}{n-1}$ (*c*) $\dfrac{10a}{n}$ (*d*) $\left(\dfrac{n-1}{10n}\right)a$

153. The diameter of a spherical bob is measured using a vernier callipers. 9 divisions of the main scale, in the vernier callipers, are equal to 10 divisions of vernier scale. One main scale division is 1 mm. The main scale reading is 10 mm and 8th division of vernier scale was found to coincide exactly with one of the main scale division. If the given vernier callipers has positive zero error of 0.04 cm, then the radius of the bob is_____ $\times 10^{-2}$ cm. **[31 Aug, 2021 (Shift-II)]**

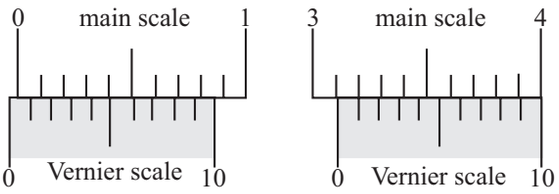
154. Student *A* and Student *B* used two screw gauges of equal pitch and 100 equal circular divisions to measure the radius of a given wire. The actual value of the radius of the wire is 0.322 cm. The absolute value of the difference between the final circular scale readings observed by the students *A* and *B* is _____.

[25 July, 2021 (Shift-I)]



[Figure shows position of reference '*O*' when jaws of screw gauge are closed] Given pitch = 0.1 cm.

155. The smallest division on the main scale of a Vernier callipers is 0.1 cm. Ten divisions of the Vernier scale correspond to nine divisions of the main scale. The figure below on the left shows the reading of this calliper with no gap between its two jaws. The figure on the right shows the reading with a solid sphere held between the jaws. The correct diameter of the sphere is **[JEE Adv, 2021]**



(*a*) 3.07 cm (*b*) 3.11 cm (*c*) 3.15 cm (*d*) 3.17 cm

156. A screw gauge has 50 divisions on its circular scale. The circular scale is 4 units ahead of the pitch scale marking, prior to use. Upon one complete rotation of the circular scale, a displacement of 0.5 mm is noticed on the pitch scale. The nature of zero error involved, and the least count of the screw gauge, are respectively:

[6 Sep, 2020 (Shift-I)]

(*a*) Negative, 2μm
(*b*) Positive, 10μm
(*c*) Positive, 0.1 mm
(*d*) Positive, 0.1 μm

157. For the four sets of three measured physical quantities as given below. Which of the following options is correct?

[9 Jan, 2020 (Shift-II)]

(i) $A_1 = 24.36, B_1 = 0.0724, C_1 = 256.2$

(ii) $A_2 = 24.44, B_2 = 16.082, C_2 = 240.2$

(iii) $A_3 = 25.2, B_3 = 19.2812, C_3 = 236.183$

(iv) $A_4 = 25, B_4 = 236.191, C_4 = 19.5$

(*a*) $A_4+B_4+C_4 < A_1+B_1+C_1 = A_2+B_2+C_2 = A_3+B_3+C_3$

(*b*) $A_1+B_1+C_1 < A_3+B_3+C_3 < A_2+B_2+C_2 < A_4+B_4+C_4$

(*c*) $A_1+B_1+C_1 = A_2+B_2+C_2 = A_3+B_3+C_3 = A_4+B_4+C_4$

(*d*) $A_4+B_4+C_4 < A_1+B_1+C_1 < A_3+B_3+C_3 < A_2+B_2+C_2$

158. Using screw gauge of pitch 0.1 cm and 50 divisions on its circular scale, the thickness of an object is measured. It should correctly be recorded as **[3 Sep, 2020 (Shift-I)]**

(*a*) 2.121 cm (*b*) 2.123 cm (*c*) 2.124 cm (*d*) 2.125 cm

159. The least count of the main scale of a screw gauge is 1 mm. The minimum number of divisions on its circular scale required to measure 5 μm diameter of a wire is

[12 Jan, 2019 (Shift-I)]

(*a*) 50 (*b*) 200
(*c*) 100 (*d*) 500

JEE-Advanced

Units, System of Units

Single Correct

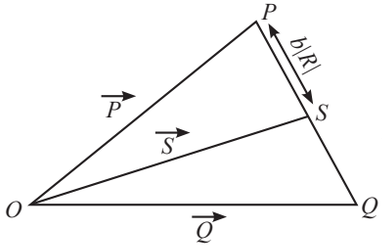
1. Consider an expanding sphere of instantaneous radius R whose total mass remains constant. The expansion is such that the instantaneous density ρ remains uniform throughout the volume. The rate of fractional change in density $\left(\frac{1}{\rho}\frac{d\rho}{dt}\right)$ is constant. The velocity v of any point of the surface of the expanding sphere is proportional to

C-26.78 W-30.86 UA-42.37 (JEE Adv. 2017)

(*a*) R (*b*) $\frac{1}{R}$ (*c*) R^3 (*d*) $R^{\frac{2}{3}}$

2. Three vectors $\vec{P}$, $\vec{Q}$ and $\vec{R}$ are shown in the figure. Let S be any point on the vector $\vec{R}$. The distance between the points P and S is $b|\vec{R}|$. The general relation among vectors $\vec{P}$, $\vec{Q}$ and $\vec{S}$ is

C-46.13 W-17.08 UA-36.79 (JEE Adv. 2017)



$\vec{R} = \vec{Q} - \vec{P}$

(*a*) $\vec{S} = (1-b^2)\vec{P} + b\vec{Q}$

(*b*) $\vec{S} = (b-1)\vec{P} + b\vec{Q}$

(*c*) $\vec{S} = (1-b)\vec{P} + b\vec{Q}$

(*d*) $\vec{S} = (1-b)\vec{P} + b^2\vec{Q}$

3. A cube has a side of length 1.2×10^{-2} m. Calculate its volume.

(IIT-JEE 2003)

(*a*) 1.7×10^{-6} m^3 (*b*) 1.73×10^{-6} m^3
(*c*) 1.70×10^{-6} m^3 (*d*) 1.732×10^{-6} m^3

Subjective

4. Write the dimensions of the following in terms of mass, time, length and charge. **(IIT-JEE 1982)**

A. Magnetic flux B. Rigidity modulus

5. Give the MKS units for each of the following quantities.

(IIT-JEE 1980)

1. Young's modulus 2. Magnetic induction
3. Power of a lens

Multiple Correct

6. A physical quantity $\vec{S}$ is defined as $\vec{S} = (\vec{E} \times \vec{B})/\mu_0$, where $\vec{E}$ is electric field, $\vec{B}$ is magnetic field and μ_0 is the permeability of free space. The dimensions of $\vec{S}$ are the same as the dimensions of which of the following quantity (ies)?

C-40.2 W-27.78 UA-22.17 PC-9.84 (JEE Adv. 2021)

(*a*) $\frac{\text{Energy}}{\text{Charge} \times \text{Current}}$ (*b*) $\frac{\text{Force}}{\text{Length} \times \text{Time}}$

(*c*) $\frac{\text{Energy}}{\text{Volume}}$ (*d*) $\frac{\text{Power}}{\text{Area}}$

7. The SI unit of the inductance, the henry can by written as **(IIT-JEE 1998)**

(*a*) weber/ampere (*b*) volt-second/ampere

(*c*) joule/(ampere)^2 (*d*) ohm-second

Match the Column

8. Some physical quantities are given in Column-I and some possible SI units in which these quantities may be expressed are given in Column-II. Match the physical quantities in Column-I with the units in Column-II. **(IIT-JEE 2007)**

Column-I		Column-II	
A.	GM_eM_sG - universal gravitational constant, M_e - mass of the earth, M_s - mass of the sun,	p.	(volt) (coulomb) (meter)
B.	$\frac{3RT}{M}$ R - universal gas constant, T - absolute temperature, M - molar mass,	q.	(kilogram) (meter)^3 (second)$^{-2}$
C.	$\frac{F^2}{q^2B^2}$ F - force, q - charge, B - magnetic field,	r.	(meter)^2 (second)$^{-2}$
D.	$\frac{GM_e}{R_e}$ G - universal gravitational constant, M_e - mass of the earth, R_e - radius of the earth,	s.	(farad) (volt)^2 (kg)$^{-1}$

9. Column-I gives three physical quantities. Select the appropriate units for the choices given in Column-II. Some of the physical quantities may have more than one choice. **(IIT-JEE 1990)**

Column-I	Column-II
Capacitance	ohm-second
Inductance	Coulomb^2-joule^{-1}
Magnetic induction	Coulomb (volt)$^{-1}$
	Newton (ampere metre)$^{-1}$
	volt-second (ampere)$^{-1}$

Fill in the Blanks

10. Two vectors $\overline{A}$ and $\overline{B}$ are defined as $\overline{A} = a\,\hat{i}$ and $\overline{B} = a$ (cos $\omega t\,\hat{i}$ + sin $\omega t\,\hat{j}$), where a is a constant and $\omega = \pi/6$ rad s^{-1}. If $|\overline{A} + \overline{B}| = \sqrt{3}\ |\overline{A} - \overline{B}|$ at time $t = \tau$ for the first time, the value of τ, in seconds, is ..... . **C-35.57 W-49.68 UA-14.75 (JEE Adv.2018)**

Dimension, Finding Dimensional Formula

Single Correct

11. Which of the following sets have different dimensions? **(IIT-JEE 2005)**

(*a*) Pressure, Young's modulus, Stress

(*b*) Emf, Potential difference, Electric potential

(*c*) Heat, Work done, Energy

(*d*) Dipole moment, Electric flux, Electric field

12. In the relation, $p = \frac{\alpha}{\beta} e^{-\left(\frac{\alpha z}{k\theta}\right)}$ is pressure, z is distance, k is Boltzmann's constant and θ is the temperature. The dimensional formula of β will be **(IIT-JEE 2004)**

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

13. A quantity X is given by $\varepsilon_0 L\frac{\Delta V}{\Delta t}$, where ε_0 is the permittivity of free space, L is a length, ΔV is a potential difference and Δt is a time interval. The dimensional formula for X is the same as that of **(IIT-JEE 2001)**

(*a*) Resistance (*b*) Charge (*c*) Voltage (*d*) Current

14. The dimensions of $\frac{1}{2}\varepsilon_0 E^2$ (ε_0 : permittivity of free space; E : electric field) is: **(IIT-JEE 2001)**

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

15. Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = length, T = Time and A = electric current, then **(IIT-JEE 1998)**

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

(*c*) $[\varepsilon_0] = [M^{-2}L^2T^{-1}A^{-2}]$ (*d*) $[\varepsilon_0] = [M^{-1}L^2T^{-1}A^2]$

Multiple Correct

16. A length-scale (l) depends on the permittivity (ε) of a dielectric material, Boltzmann's constant (k_B), the absolute temperature (T), the number per unit volume (n) of certain charged particles and the charge (q) carried by each of the particles. Which of the following expression(s) for l is (are) dimensionally correct?

C-17.85 W-20.89 UA-49.13 PC-12.13 (JEE Adv. 2016)

(*a*) $l = \sqrt{\left(\frac{nq^2}{\varepsilon k_B T}\right)}$ (*b*) $l = \sqrt{\left(\frac{Ek_E T}{nq^2}\right)}$

(*c*) $l = \sqrt{\left(\frac{q^2}{\varepsilon h^{2/3} k_B T}\right)}$ (*d*) $l = \sqrt{\left(\frac{q^2}{\varepsilon n^{1/3} k_B T}\right)}$

17. Planck's constant h, speed of light c and gravitational constant G are used to form a unit of length L and a unit of mass M. Then, the correct options is/are **(JEE Adv. 2015)**

(*a*) $M \propto \sqrt{c}$ (*b*) $M \propto \sqrt{G}$

(*c*) $L \propto \sqrt{h}$ (*d*) $L \propto \sqrt{G}$

18. In terms of potential difference V, electric current I, permittivity ε_0, permeability μ_0 and speed of light c the dimensionally correct equations is/are **(JEE Adv. 2015)**

(*a*) $\mu_0 I^2 = E_0 V^2$ (*b*) $\varepsilon_0 I = \mu_d V$

(*c*) $I = E_0 cV$ (*d*) $\mu_0 cI = \varepsilon_0 V$

19. Let $[\varepsilon_0]$ denote the dimensional formula of the permittivity of the vacuum and $[\mu_0]$ that of the permeability of the vacuum. If M = mass, L = length, T = time and I = electric current. Then, **(IIT-JEE1998)**

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

(*c*) $[\mu_0] = [MLT^{-2}A^{-2}]$ (*d*) $[\mu_0] = [ML^2T^{-1}I]$

20. The pairs of physical quantities that have the same dimensions is (are) **(IIT-JEE 1995)**

(*a*) Reynolds number and coefficient of friction

(*b*) Curie and frequency of a light wave

(*c*) Latent heat and gravitational potential

(*d*) Planck's constant and torque

21. The dimensions of the quantities in one (or more) of the following pairs are the same. Identify the pair (*s*). **(IIT-JEE 1986)**

(*a*) Torque and work

(*b*) Angular momentum and work

(*c*) Energy and Young's modulus

(*d*) Light year and wavelength

22. L, C and R represent the physical quantities inductance, capacitance and resistance, respectively. The combinations which have the dimensions of frequency are **(IIT-JEE 1984)**

(*a*) $\frac{1}{RC}$ (*b*) $\frac{R}{L}$ (*c*) $\frac{1}{\sqrt{LC}}$ (*d*) $\frac{C}{L}$

Match the Column

23. Match the physical quantities given in Column-I with dimensions expressed in terms of mass (M), length (L), time (T) and charge (Q) given in Column-II and write the correct answer against the matched quantity in a tabular form in your answer book. **(IIT-JEE 1990)**

Column-I		Column-II	
A.	Angular momentum	p.	$[ML^2T^{-2}]$
B.	Latent heat	q.	$[ML^2Q^{-2}]$
C.	Torque	r.	$[ML^2T^{-1}]$
D.	Capacitance	s.	$[ML^3T^{-1}Q^{-2}]$
E.	Inductance	t.	$[M^{-1}L^{-2}T^2Q^2]$
F.	Resistivity	u.	$[L^2T^{-2}]$

Subjective

24. Planck's constant has dimensions: **(IIT-JEE 1985)**

Fill in the Blanks

25. The equation of state of a real gas is given by **(IIT-JEE 1997)**

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

where p, V and T are pressure, volume and temperature, respectively and R is the universal gas constant. The dimensions of the constant a in the above equation is…….

Principle of Homogeneity of Dimension

Subjective

26. A gas bubble, from an explosion under water, oscillates with a period T proportional to $p^a d^b E^c$, where p is the static pressure, d is the density of water and E is the total energy of the explosion. Find the values of a, b and c. **(IIT-JEE 1981)**

Application of Dimensional Analysis

Single Correct

27. Young's modulus of elasticity Y is expressed in terms of three derived quantities, namely, the gravitational constant G. Planck's constant h and the speed of light c, as $Y = c^\alpha h^\beta G^\gamma$. Which of the following is the correct option?

C-60.51 W-20.88 UA-18.62 (JEE Adv. 2023)

(*a*) $\alpha = 7, \beta = -1, \gamma = -2$ (*b*) $\alpha = -7, \beta = -1, \gamma = -2$

(*c*) $\alpha = 7, \beta = -1, \gamma = 2$ (*d*) $\alpha = -7, \beta = 1, \gamma = -2$

Comprehension Based/Passage Based

Paragraph (Q. 28-29): In electromagnetic theory, the electric and magnetic phenomena are related to each other. Therefore, the dimensions of electric and magnetic quantities must also be related to each other. In the questions below, $[E]$ and $[B]$ stand for dimensions of electric and magnetic fields respectively, while $[\varepsilon_0]$ and $[\mu_0]$ stand for dimensions of the permittivity and permeability of free space, respectively. $[L]$ and $[T]$ are dimensions of length and time, respectively. All the quantities are given in SI units. (There are two questions based on PARAGRAPH "*X*", the question given below is one of them)

28. The relation between $[E]$ and $[B]$ is

C-64.34 W-23.48 UA-12.18 (JEE Adv. 2018)

(*a*) $[E] = [B][L][T]$ (*b*) $[E] = [B][L]^{-1}[T]$

(*c*) $[E] = [B][L][T]^{-1}$ (*d*) $[E] = [B][L]^{-1}[T]^{-1}$

29. The relation between $[\varepsilon_0]$ and $[\mu_0]$ is **(JEE Adv. 2018)**

(*a*) $[\mu_0] = [\varepsilon_0][L]^2[T]^{-2}$ (*b*) $[\mu_0] = [\varepsilon_0][L]^{-2}[T]^2$

(*c*) $[\mu_0] = [\varepsilon_0]^{-1}[L]^2[T]^{-2}$ (*d*) $[\mu_0] = [\varepsilon_0]^{-1}[L]^{-2}[T]^2$

Paragraph (Q. 30-31): A dense collection of equal number of electrons and positive ions is called neutral plasma. Certain solids containing fixed positive ions surrounded by free electrons can be treated as neutral plasma. Let N be the number density of free electrons, each of mass m. When the electrons are subjected to an electric field, they are displaced relatively away from the heavy positive ions. If the electric field becomes zero, the electrons begin to oscillate about the positive ions with a natural angular frequency ω_p, which is called the plasma frequency.

To sustain the oscillations, a time varying electric field needs to be applied that has an angular frequency ω, where a part of the energy is absorbed and a part of it is reflected. As ω approaches ω_p, all the free electrons are set to resonance together and all the energy is reflected. This is the explanation of high reflectivity of metals.

30. Taking the electronic charge as e and the permittivity as ε_0, use dimensional analysis to determine the correct expression for ω_p **(IIT-JEE 2011)**

(*a*) $\sqrt{\frac{Ne}{m\varepsilon_0}}$ (*b*) $\sqrt{\frac{m\varepsilon_0}{Ne}}$

(*c*) $\sqrt{\frac{Ne^2}{m\varepsilon_0}}$ (*d*) $\sqrt{\frac{m\varepsilon_0}{Ne^2}}$

31. Estimate the wavelength at which plasma reflection will occur for a metal having the density of electrons $N = 4 \times 10^{27}$ m^{-3}. Take $\varepsilon_0 = 10^{-11}$ and $m = 10^{-30}$, where these quantities are in proper SI units **(IIT-JEE 2011)**

(*a*) 800 nm (*b*) 600 nm

(*c*) 300 nm (*d*) 200 nm

Multiple Correct

32. Sometimes it is convenient to construct a system of units so that all quantities can be expressed in terms of only one physical quantity. In one such system, dimensions of different quantities are given in terms of a quantity X as follows: [position] = [X^α]; [speed] = [X^β]; [acceleration] =[X^p]; [linear momentum] = [X^q]; [force] = [X^r]. Then **C-45.21 W-20.85 UA-20.46 PC-13.47 (JEE Adv. 2020)**

(*a*) $\alpha + p = 2\beta$ (*b*) $p + q - r = \beta$

(*c*) $p - q + r = \alpha$ (*c*) $p + q + r = \beta$

33. Let us consider a system of units in which mass and angular momentum are dimensionless. If length has dimension of L, which of the following statement(s) is/are correct? **C-36, W-12, UA-14, PC-38 (JEE Adv, 2019)**

(*a*) The dimension of force is L^{-3}.

(*b*) The dimension of energy of L^{-2}.

(*c*) The dimension of power is L^{-5}.

(*d*) The dimension of linear momentum is L^{-1}.

Numerical Types/Integer Types

34. To find the distance d over which a signal can be seen clearly in foggy conditions, a railway engineer uses dimensional analysis and assumes that the distance depends on the mass density ρ of the fog, intensity (power/area) S of the light from the signal and its frequency f. The engineer finds that d is proportional to $S^{1/n}$. The value of n is **C-34 W-57.91 UA-8.09 (JEE Adv. 2014)**

Fill in the Blanks

35. In a particular system of units, a physical quantity can be expressed in terms of the electric charge e, electron mass m_e, Planck's constant h, and coulomb's constant $k = \frac{1}{4\pi\varepsilon_0}$, where ε_0 is the permittivity of vacuum. In terms of these physical constants, the dimension of the magnetic field is $[B] = [e^\alpha [m_e]^\beta [h]^\gamma [k]^\delta$. The value of $\alpha + \beta + \gamma + \delta$ is _____. **C-14.97 W-28.88 UA-56.15 (JEE Adv. 2022)**

Errors in Measurement

Single Correct

36. A person measures the depth of a well by measuring the time interval between dropping a stone and receiving the sound of impact with the bottom of the well. The error in his measurement of time is $\delta T = 0.01$s and he measures the depth of the well to be $L = 20$ m. Take the acceleration due to gravity $g = 10$ ms^{-2} and the velocity of sound is 300 ms^{-1}. Then the fractional error in the measurement $\frac{\delta L}{L}$ is closest to **C-17.92 W-40 UA-42.08 (JEE Adv. 2017)**

(*a*) 1% (*b*) 5% (*c*) 3% (*d*) 0.2%

37. The current voltage relation of diode is given by $I = (e^{1000V/T} - 1)$ mA, where the applied voltage V is in volt and the temperature T is in kelvin. If a student makes an error measuring ±0.01 V while measuring the current of 5 mA at 300 K, what will be the error in the value of current in mA? **(JEE Adv. 2014)**

(*a*) 0.2 mA (*b*) 0.02 mA (*c*) 0.5 mA (*d*) 0.05 mA

38. In the determination of Young's modulus $\left(Y = \frac{4.MLg}{\pi l d^2}\right)$ by using Searle's method, a wire of length L = 2 m and diameter $d = 0.5$ mm is used. For a load $M = 2.5$ kg, an extension $l = 0.25$ mm in the length of the wire is observed. Quantities d and l are measured using a screw gauge and a micrometer, respectively. They have the same pitch of 0.5 mm. The number of divisions on their circular scale is 100. The contributions to the maximum probable error of the Y measurement is **C-10.96 W-38.26 UA-50.78 (IIT-JEE 2012)**

(*a*) Due to the errors in the measurements of d and l are the same

(*b*) Due to the error in the measurement of d is twice that due to the error in the measurement of l

(*c*) Due to the error in the measurement of l is twice that due to the error in the measurement of d

(*d*) Due to the error in the measurement of d is four times that due to the error in the measurement of I

39. The density of a solid ball is to be determined in an experiment. The diameter of the ball is measured with a screw gauge, whose pitch is 0.5 mm and there are 50 divisions on the circular scale. The reading on the main scale is 2.5 mm and that on the circular scale is 20 divisions. If the measured mass of the ball has a relative error of 2%, the relative percentage error in the density is **(IIT-JEE 2011)**

(*a*) 0.9% (*b*) 2.4% (*c*) 3.1% (*d*) 4.4%

40. A student uses a simple pendulum of exactly 1 m length to determine g, the acceleration due to gravity. He uses a stop watch with the least count of 1s for this and records 40s for 20 oscillations. For this observation, which of the following statement(s) is/are true? **(IIT-JEE 2010)**

(*a*) Error ΔT in measuring T, the time period, is 0.05s

(*b*) Error ΔT in measuring T, the time period, is 1s

(*c*) Percentage error in the determination of g is 5%

(*d*) Percentage error in the determination of g is 2.5%

41. A student performs an experiment to determine the Young's modulus of a wire, exactly 2 m long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of ±0.05 mm at a load of exactly 1.0 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of ±0.01 mm. Take $g = 9.8$ m/s^2 (exact). The Young's modulus obtained from the reading is close to **(IIT-JEE 2007)**

(*a*) $(2.0 \pm 0.3) \times 10^{11}$ N/m^2

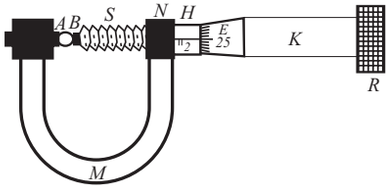
(*b*) $(2.0 \pm 0.2) \times 10^{11}$ N/m^2

(*c*) $(2.0 \pm 0.1) \times 10^{11}$ N/m^2

(*d*) $(2.0 \pm 0.05) \times 10^{11}$ N/m^2

42. The circular scale of a screw gauge has 50 divisions and pitch of 0.5 mm. Find the diameter of the sphere. Main scale reading is 2.

(IIT-JEE 2006)



(*a*) 1.2 mm (*b*) 1.25 mm (*c*) 2.20 mm (*d*) 2.25 mm

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

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

Comprehension Based/Passage Based

Paragraph (Q. 44-45): If the measurement errors in all the independent quantities are known, then it is possible to determine the error in any dependent quantity. This is done by the use of series expansion and truncating the expansion at the first power of the error. For example, consider the relation $z = x/y$. If the errors in x, y and z are Δx, Δy and, Δz respectively, then

$$z \pm \Delta z = \frac{x \pm \Delta x}{y \pm \Delta y} = \frac{x}{y}\left(1 \pm \frac{\Delta x}{x}\right)\left(1 \pm \frac{\Delta y}{y}\right)^{-1}$$

The series expansion for $\left(1 \pm \frac{\Delta y}{y}\right)^{-1}$, to first power in $\Delta y/y$, is $1 \mp (\Delta y/y)$. The relative errors in independent variables are always added. So the error in z will be $\Delta z = z\left(\frac{\Delta x}{x} + \frac{\Delta y}{y}\right)$. The above derivation makes the assumption that $\Delta x/x << 1$, $\Delta y/y << 1$. Therefore, the higher powers of these quantities are neglected. **(JEE Adv. 2018)**

44. Consider the ratio $r = \frac{(1-a)}{(1+a)}$ to be determined by measuring a dimensionless quantity a. If the error in the measurement of a is Δa ($\Delta a/a << 1$), then what is the error Δr in determining r?

C-34.7 W-33.81 UA-31.49 (JEE Adv. 2018)

(*a*) $\frac{\Delta a}{(1+a)^2}$ (*b*) $\frac{-2\Delta a}{(1+a)^2}$ (*c*) $\frac{2\Delta a}{(1-a)^2}$ (*d*) $\frac{2a\Delta a}{(1-a^2)}$

45. In an experiment, the initial number of radioactive nuclei is 3000. It is found that 1000 ± 40 nuclei decayed in the first 10s. For $|x| < 1$, ln $(1 + x) = x$ up to first power in x. The error $\Delta\lambda$, in the determination of the decay constant λ in s^{-1}, is

C-13.32 W-38.29 UA-48.39 (JEE Adv. 2018)

(*a*) 0.04 (*b*) 0.03

(*c*) 0.02 (*d*) 0.01

Subjective

46. The energy of a system as a function of time t is given as $E(t) = A^2 \exp(-\alpha t)$, where $\alpha = 0.2 s^{-1}$. The measurement of A has an error of 1.25%. If the error in the measurement of time is 1.50%, the percentage error in the value of $E(t)$ at $t = 5$s is

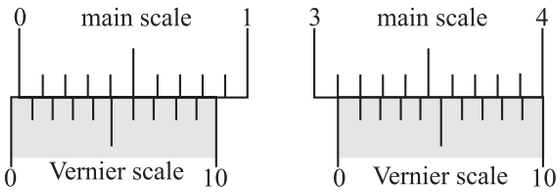
(JEE Adv. 2015)

Measuring Instruments

Single Correct

47. The smallest division on the main scale of a Vernier calipers is 0.1 cm. Ten divisions of the Vernier scale correspond to nine divisions of the main scale. The figure below on the left shows the reading of this caliper with no gap between its two jaws. The figure on the right shows the reading with a solid sphere held between the jaws. The correct diameter of the sphere is

C-17.89, W-46.36, UA-35.75 (JEE Adv. 2021)



(*a*) 3.07 cm (*b*) 3.11 cm

(*c*) 3.15 cm (*d*) 3.17 cm

48. A steel wire of diameter 0.5 mm and Young's modulus 2×10^{11} Nm^{-2} carries a load of mass m. The length of the wire with the load is 1.0 m. A vernier scale with 10 divisions is attached to the end of this wire. Next to the steel wire is a reference wire to which a main scale, of least count 1.0 mm, is attached. The 10 divisions of the vernier scale correspond to 9 divisions of the main scale. Initially, the zero of vernier scale coincides with the zero of main scale. If the load on the steel wire is increased by 1.2 kg, the vernier scale division which coincides with a main scale division is ($g = 10$ ms^{-2} and $\pi = 3.2$).

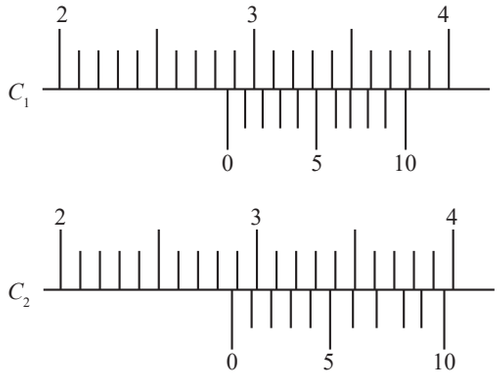
C-10.09 W-63.21 UA-26.7 (JEE Adv. 2018)

(*a*) 1 (*b*) 3

(*c*) 2 (*d*) 4

49. There are two vernier calipers both of which have 1 cm divided into 10 equal divisions on the main scale. The vernier scale of one of the calipers (C_1) has 10 equal divisions that correspond to 9 main scale divisions. The vernier scale of the other caliper (C_2) has 10 equal divisions that correspond to 11 main scale divisions. The readings of the two calipers are shown in the figure. The measured values (in cm) by calipers C_1 and C_2 respectively, are

C-28.16 W-43.44 UA-28.4 (JEE Adv. 2016)



(*a*) 2.87 and 2.87 (*b*) 2.87 and 2.83

(*c*) 2.85 and 2.82 (*d*) 2.87 and 2.86

50. The diameter of a cylinder is measured using a vernier calipers with no zero error. It is found that the zero of the vernier scale lies between 5.10 cm and 5.15 cm of the main scale. The vernier scale has 50 division equivalent to 2.45 cm. The 24th division of the vernier scale exactly coincides with one of the main scale divisions. The diameter of the cylinder is

C-36.72 W-54.07 UA-9.21 (JEE Adv. 2013)

(*a*) 5.112 cm (*b*) 5.124 cm (*c*) 5.136 cm (*d*) 5.148 cm

51. A vernier calipers has 1 mm marks on the main scale. It has 20 equal divisions on the vernier scale which match with 16 main scale divisions. For this vernier calipers, the least count is

(IIT-JEE 2010)

(*a*) 0.02 mm (*b*) 0.05 mm

(*c*) 0.1 mm (*d*) 0.2 mm

52. Students I, II and III perform an experiment for measuring the acceleration due to gravity (g) using a simple pendulum. They use different lengths of the pendulum and/or record time for different number of oscillations. The observations are shown in the table. Least count for length = 0.1 cm. Least count for time = 0.1s

Student	Length of the pendulum	Number of for (n) Oscillations (n)	Total time period Oscillation (cm)	Time(s)
I	64.0	8	128.0	16.0
II	64.0	4	64.0	16.0
III	20.0	4	36.0	9.0

If E_1, E_{11} and E_{II} are the percentage errors in g i.e., $\left(\frac{\Delta_g}{g}\times 100\right)$ for students I, II and III, respectively **(IIT-JEE 2008)**

(*a*) $E_I = 0$ (*b*) E_1 is minimum

(*c*) $E_1 = E_2$ (*d*) E_3 is maximum

Multiple Correct

53. Consider a vernier caliper in which each 1 cm on the main scale is divided into 8 equal divisions and a screw gauge with 100 divisions on its circular scale. In the vernier calipers, 5 divisions of the vernier scale coincide with 4 divisions on the main scale and in the screw gauge, one complete rotation of the circular scale moves it by two divisions on the linear scale. Then **(JEE Adv. 2015)**

(*a*) If the pitch of the screw gauge is twice the least count of the vernier caliper, the least count of the screw gauge is 0.01 mm

(*b*) If the pitch of the screw gauge is twice the least count of the Vernier caliper, the least count of the screw gauge is 0.05 mm

(*c*) If the least count of the linear scale of the screw gauge is twice the least count of the Vernier calipers, the least count of the screw gauge is 0.01 mm

(*d*) If the least count of the linear scale of the screw gauge is twice the least count of the vernier caliper, the least count of the screw gauge is 0.005 mm

Numerical Types/Integer Types

54. During Searle's experiment, zero of the vernier scale lies between 3.20×10^{-2} m and 3.25×10^{-2} m of the main scale. The 20th division of the vernier scale exactly coincides with one of the main scale divisions. When an additional load of 2 kg is applied to the wire, the zero of the vernier scale still lies between 3.20×10^{-2} m and 3.25×10^{-2} m of the main scale but now the 45th division of vernier scale coincides with one of the main scale divisions. The length of the thin metallic wire is 2 m and its cross-sectional area is 8×10^{-7} m^2. The least count of the vernier scale is 1.0×10^{-5} m. The maximum percentage error in the Young's modulus of the wire is

C-16.38 W-67.42 UA-16.2 (JEE Adv. 2014)

55. The edge of a cube is measured using a vernier caliper. (9 divisions of the main scale is equal to 10 divisions of vernier scale and 1 main scale division is 1 mm). The main scale division reading is 10 and 1 division of vernier scale was found to be coinciding with the main scale. The mass of the cube is 2.736 g. Calculate the density in g/cm^3 upto correct significant figures. **(IIT-JEE 2005)**

56. The pitch of a screw gauge is 1 mm and there are 100 divisions on the circular scale. While measuring the diameter of a wire, the linear scale reads 1 mm and 47th division on the circular scale coincides with the reference line. The length of the wire is 5.6 cm. Find the curved surface area (in cm^2) of the wire in appropriate number of significant figures **(IIT-JEE 2004)**

Subjective

57. N divisions on the main scale of a vernier calipers coincide with $(N+1)$ divisions on the vernier scale. If each division on the main scale is of a units, determine the least count of instruments. **(IIT-JEE 2003)**

Function, Differentiation as a Rate Measurement

Numerical Types/Integer Types

58. A person of height 1.6 m is walking away from a lamp post of height 4 m along a straight path on the flat ground. The lamp post and the person are always perpendicular to the ground. If the speed of the person is 60 cm s^{-1}, the speed of the tip of the person's shadow on the ground with respect to the person is _____ cm s^{-1}.

C-12.69 W-65.37 UA-21.94 (JEE Adv. 2023)

ANSWER KEY

JEE-Main

1. (*b*)	**2.** (*c*)	**3.** (*c*)	**4.** (*b*,*d*)	**5.** (*a*)	**6.** (*c*)	**7.** (*b*)	**8.** (*c*)	**9.** (*b*)	**10.** (*d*)
11. (*b*)	**12.** (*d*)	**13.** (*a*)	**14.** (*c*)	**15.** (*b*)	**16.** (*c*)	**17.** (*b*)	**18.** (*a*)	**19.** (*b*)	**20.** (*d*)
21. (*c*)	**22.** (*b*)	**23.** (*a*)	**24.** (*c*)	**25.** (*a*)	**26.** (*a*)	**27.** (*c*)	**28.** (*a*)	**29.** (*b*)	**30.** (*d*)
31. (*a*)	**32.** (*a*)	**33.** (*d*)	**34.** (*d*)	**35.** (*c*)	**36.** (*c*)	**37.** (*c*)	**38.** (*b*)	**39.** (*d*)	**40.** (*c*)
41. (*c*)	**42.** (*b*)	**43.** (*a*)	**44.** (*a*)	**45.** (*b*)	**46.** (*d*)	**47.** (*c*)	**48.** (*b*)	**49.** (*a*)	**50.** (*b*)
51. (*a*)	**52.** (*a*)	**53.** (*a*)	**54.** (*d*)	**55.** (*d*)	**56.** (*c*)	**57.** (*c*)	**58.** [4]	**59.** (*c*)	**60.** (*b*)
61. (*c*)	**62.** (*c*)	**63.** (*a*)	**64.** (*b*)	**65.** (*c*)	**66.** (*)	**67.** (*a*)	**68.** (*d*)	**69.** (*c*)	**70.** (*a*)
71. (*a*)	**72.** (*c*)	**73.** (*c*)	**74.** (*a*,*b*)	**75.** (*c*)	**76.** (*b*)	**77.** (*c*)	**78.** (*b*)	**79.** (*a*,*b*,*d*)	**80.** (*c*)
81. (*b*)	**82.** (4)	**83.** (*c*)	**84.** (2)	**85.** (*c*)	**86.** (*b*)	**87.** (*c*)	**88.** (*b*)	**89.** (*a*)	**90.** (*c*)
91. (*c*)	**92.** (*a*)	**93.** (*d*)	**94.** (*c*)	**95.** (*a*)	**96.** (*c*)	**97.** (*c*)	**98.** [1.99]	**99.** (*b*)	**100.** (*a*)
101. [18]	**102.** [150]	**103.** [5]	**104.** (*b*)	**105.** (*c*)	**106.** (*b*)	**107.** (*a*)	**108.** (*a*)	**109.** [1]	**110.** (*b*)
111. (*b*)	**112.** (*b*)	**113.** (*b*)	**114.** [14]	**115.** [5]	**116.** [34]	**117.** (*a*)	**118.** (*b*)	**119.** (*c*)	**120.** (*)
121. (*c*)	**122.** (*c*)	**123.** (*c*)	**124.** (*b*)	**125.** (*b*)	**126.** (*b*)	**127.** (*d*)	**128.** (*c*)	**129.** (*a*)	**130.** (*b*)
131. (*a*)	**132.** (*d*)	**133.** (*d*)	**134.** (*b*)	**135.** (*b*)	**136.** (*a*)	**137.** (*b*)	**138.** [220]	**139.** (*c*)	**140.** (*c*)
141. (*c*)	**142.** (*a*)	**143.** [180]	**144.** [412]	**145.** [5]	**146.** (*b*)	**147.** (*b*)	**148.** (*b*)	**149.** [25]	**150.** (*a*)
151. (*b*)	**152.** (*c*)	**153.** [52]	**154.** [13]	**155.** (*c*)	**156.** (*b*)	**157.** (*)	**158.** (*c*)	**159.** (*b*)	

JEE-Advanced

1. (*a*)	**2.** (*c*)	**3.** (*a*)	**6.** (*b*,*d*)	**7.** (*a*,*c*,*d*)	**8.** A-p,q B-r,s C-r,s D-r,s		**11.** (*d*)	**12.** (*a*)	**13.** (*d*)
14. (*c*)	**15.** (*b*)	**16.** (*b*,*d*)	**17.** (*a*, *c*, *d*)	**18.** (*a*,*c*)	**19.** (*b*,*c*)	**20.** (*a, b, c*)	**21.** (*a*, *d*)	**22.** (*a*, *b*, *c*)	
23. A-(r), B-(u), C-(p), D-(t), E-(q), F-(s)			**27.** (*a*)	**28.** (*c*)	**29.** (*d*)	**30.** (*c*)	**31.** (*b*)	**32.** (*a*, *b*)	**33.** (*a*,*b*,*d*)
34. [3]	**35.** [4]	**36.** (*a*)	**37.** (*a*)	**38.** (*a*)	**39.** (*c*)	**40.** (*a*,*c*)	**41.** (*b*)	**42.** (*d*)	**43.** (*d*)
44. (*b*)	**45.** (*c*)	**47.** (*c*)	**48.** (*b*)	**49.** (*b*)	**50.** (*b*)	**51.** (*d*)	**52.** (*d*)	**53.** (b,c)	**54.** [4]
55. [2.66]	**56.** [2.6]	**58.** [40]							