Practice Problems

Problems based on units and dimensions

1. Number of base SI units is [MP PET 2003]

   (a) 4 (b) 7 (c) 3 (d) 5

2. The unit of Planck's constant is [RPMT 1999; MP PET 2003]

   (a) *Joule* (b) *Joule*/s (c) *Joule*/*m* (d) *Joule*- *s*

3. The unit of reactance is [MP PET 2003]

   (a) *Ohm* (b) *Volt* (c) *Mho* (d) *Newton*

4. The dimension of $\frac{R}{L}$ are [MP PET 2003]

   (a) T^2 (b) T (c) T^{-1} (d) T^{-2}

5. Dimensions of potential energy are [MP PET 2003]

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

6. The dimensions of electric potential are [UPSEAT 2003]

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

7. The physical quantities not having same dimensions are [AIEEE 2003]

   (a) Speed and $(\mu_0\varepsilon_0)^{-1/2}$ (b) Torque and work

   (c) Momentum and Planck's constant (d) Stress and Young's modulus

8. The dimensional formula for Boltzmann's constant is [MP PET 2002]

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

9. Which of the following quantities is dimensionless [MP PET 2002]

   (a) Gravitational constant (b) Planck's constant (c) Power of a convex lens (d) None of these

10. Which of the two have same dimensions [AIEEE 2002]

(a) Force and strain (b) Force and stress

(c) Angular velocity and frequency (d) Energy and strain

11. The dimensions of pressure is equal to [AIEEE 2002]

(a) Force per unit volume (b) Energy per unit volume (c) Force (d) Energy

12. Identify the pair whose dimensions are equal [AIEEE 2002]

(a) Torque and work (b) Stress and energy (c) Force and stress (d) Force and work

13. A physical quantity x depends on quantities y and z as follows: $x = Ay + B\tan Cz$, where A, B and C are constants. Which of the following do not have the same dimensions [AMU (Eng.) 2001]

(a) x and B (b) C and z^{-1} (c) y and B/A (d) x and A

14. $ML^3T^{-1}Q^{-2}$ is dimension of [RPET 2000]

(a) Resistivity (b) Conductivity (c) Resistance (d) None of these

15. Two quantities A and B have different dimensions. Which mathematical operation given below is physically meaningful [CPMT 1997]

(a) A/B (b) $A + B$ (c) $A - B$ (d) None of these

16. Let $[\varepsilon_0]$ denotes 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

(a) $[\varepsilon_0] = M^{-1}L^{-3}T^2I$ (b) $[\varepsilon_0] = M^{-1}L^{-3}T^4I^2$ (c) $[\mu_0] = MLT^{-2}I^{-2}$ (d) $[\mu_0] = ML^2T^{-1}I$

17. The dimension of quantity (L/RCV) is [Roorkee 1994]

(a) $[A]$ (b) $[A]^2$ (c) $[A^{-1}]$ (d) None of these

18. The quantity $X = \frac{\varepsilon_0 LV}{t}$; here ε_0 is the permittivity of free space, L is length, V is potential difference and t is time. The dimensions of X are same as that of

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

19. The unit of permittivity of free space ε_0 is [MP PET 1993; MP PMT 2003]

(a) *Coulomb/Newton-metre* (b) *Newton-metre*^{2}*/Coulomb*^{2}

(c) *Coulomb*^{2}*/(Newton-metre)*^{2} (d) *Coulomb*^{2}*/Newton-metre*^{2}

20. Dimensional formula of capacitance is [CPMT 1978; MP PMT 1979; IIT-JEE 1983]

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

21. The dimensional formula for impulse is [EAMCET 1981; CBSE PMT 1991; CPMT 1978; AFMC 1998; BCECE 2003]

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

22. The dimensions of universal gravitational constant are [MP PMT 1984, 87, 97, 2000; CBSE PMT 1988, 92, 2004; MP PET 1984, 96, 99; MNR 1992; DPMT 1984; CPMT 1978, 84, 89, 90, 92, 96; AFMC 1999; NCERT 1975; DPET 1993; AIIMS 2002; RPET 2001;

Pb. PMT 2002; UPSEAT 1999; BCECE 2003]

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

23. How many wavelength of Kr^{86} are there in one *metre* [MNR 1985; UPSEAT 2000]

(a) 1553164.13 (b) 1650763.73 (c) 652189.63 (d) 2348123.73

24. Light year is a unit of [MP PMT 1989; AFMC 1991; CPMT 1991]

(a) Time (b) mass (c) Distance (d) Energy

25. *L*, *C* and *R* represent physical quantities inductance, capacitance and resistance respectively. The combination which has the dimensions of frequency is [IIT-JEE 1984]

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

26. In the relation $P=\frac{\alpha}{\beta}e^{-\frac{\alpha z}{k\theta}}$, *P* is pressure, *z* is distance, *k* is Boltzmann constant and θ is temperature. The dimensional formula of β will be [IIT-JEE (Screening) 2004]

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

27. If the acceleration due to gravity be taken as the unit of acceleration and the velocity generated in a falling body in one second as the unit of velocity then

(a) The new unit of length is g *metre* (b) The new unit of length is 1 *metre*

(c) The new unit of length is g^{2} *metre* (d) The new unit of time is $\frac{1}{g}$ *second*

28. The famous Stefan's law of radiation states that the rate of emission of thermal radiation per unit by a black body is proportional to area and fourth power of its absolute temperature that is $Q=\sigma AT^{4}$ where $A=$ area, $T=$ temperature and σ is a universal constant. In the 'energy- length- time temperature' (E-L-T-K) system the dimension of σ is

(a) $E^{2}T^{2}L^{-2}K^{-2}$ (b) $E^{-1}T^{-2}L^{-2}K^{-1}$ (c) $ET^{-1}L^{-3}K^{-4}$ (d) $ET^{-1}L^{-2}K^{-4}$

29. The resistive force acting on a body moving with a velocity *V* through a fluid at rest is given by $F=C_{D}V^{2}A\rho$ where, C_D = coefficient of drag, *A* = area of cross-section perpendicular to the direction of motion. The dimensions of C_D are

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

30. The dimensions of (angular momentum)/(magnetic moment) are :

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

31. The frequency *n* of vibrations of uniform string of length *l* and stretched with a force *F* is given by $n=\frac{P}{2l}\sqrt{\frac{F}{m}}$ where *p* is the number of segments of the vibrating string and *m* is a constant of the string. What are the dimensions of *m*

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

32. Choose the wrong statement(s)

(a) A dimensionally correct equation may be correct (b) A dimensionally correct equation may be incorrect

(c) A dimensionally incorrect equation may be incorrect (d) A dimensionally incorrect equation may be incorrect

33. A certain body of mass M moves under the action of a conservative force with potential energy V given by $V = \frac{Kr}{x^2 + a^2}$ where x is the displacement and a is the amplitude. The units of K are

(a) *Watt* (b) *Joule* (c) *Joule-metre* (d) None of these.

34. The Richardson equation is given by $I = AT^2 e^{-B/kT}$. The dimensional formula for AB^2 is same as that for

(a) IT^2 (b) kT (c) IK^2 (d) IK^2/T

35. If the units of force, energy and velocity are 10 N, 100 J and 5 ms^{-1}, the units of length, mass and time will be

(a) $10m, 5kg, 1s$ (b) $10m, 4kg, 2s$ (c) $10m, 4kg, 0.5s$ (d) $20m, 5kg, 2s$.

Problems based on error of measurement

36. The period of oscillation of a simple pendulum is given by $T = 2\pi\sqrt{\frac{l}{g}}$ where l is about 100 cm and is known to 1mm accuracy. The period is about 2s. The time of 100 oscillations is measured by a stop watch of least count 0.1 s. The percentage error in g is

(a) 0.1% (b) 1% (c) 0.2% (d) 0.8%

37. The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimation of the kinetic energy obtained by measuring mass and speed **[NCERT 1990; Orissa JEE 1990]**

(a) 11% (b) 8% (c) 5% (d) 1%

38. While measuring the acceleration due to gravity by a simple pendulum, a student makes a positive error of 1% in the length of the pendulum and a negative error of 3% in the value of time period. His percentage error in the measurement of g by the relation $g = 4\pi^2\left(l / T^2\right)$ will be

(a) 2% (b) 4% (c) 7% (d) 10%

39. The random error in the arithmetic mean of 100 observations is x, then random error in the arithmetic mean of 400 observations would be

(a) $4x$ (b) $\frac{1}{4}x$ (c) $2x$ (d) $\frac{1}{2}x$

40. What is the number of significant figures in 0.310×10^3

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

41. Error in the measurement of radius of a sphere is 1%. The error in the calculated value of its volume is

(a) 1% (b) 3% (c) 5% (d) 7%

42. The mean time period of second's pendulum is 2.00*s* and mean absolute error on the time period is 0.05*s*. To express maximum estimate of error, the time period should be written as

(a) $(2.00 \pm 0.01)\ s$ (b) $(2.00 + 0.025)\ s$ (c) $(2.00 \pm 0.05)\ s$ (d) $(2.00 \pm 0.10)\ s$

43. A body travels uniformly a distance of (13.8 ±0.2) m in a time (4.0 ± 0.3) s. The velocity of the body within error limits is

(a) $(3.45 \pm 0.2)\ ms^{-1}$ (b) $(3.45 \pm 0.3)\ ms^{-1}$ (c) $(3.45 \pm 0.4)\ ms^{-1}$ (d) $(3.45 \pm 0.5)\ ms^{-1}$

44. The percentage error in the above problem is

(a) 7% (b) 5.95% (c) 8.95% (d) 9.85%

45. The unit of percentage error is

(a) Same as that of physical quantity

(b) Different from that of physical quantity

(c) Percentage error is unit less

(d) Errors have got their own units which are different from that of physical quantity measured

46. The decimal equivalent of 1/20 upto three significant figures is

(a) 0.0500 (b) 0.05000 (c) 0.0050 (d) 5.0×10^{-2}

47. If 97.52 is divided by 2.54, the correct result in terms of significant figures is

(a) 38.4 (b) 38.3937 (c) 38.394 (d) 38.39

48. Accuracy of measurement is determined by

(a) Absolute error (b) Percentage error (c) Both (d) None of these

49. The radius of a sphere is $(5.3 \pm 0.1)\ cm$. The percentage error in its volume is

(a) $\frac{0.1}{5.3} \times 100$ (b) $3 \times \frac{0.1}{5.3} \times 100$ (c) $\frac{0.1 \times 100}{3.53}$ (d) $3 + \frac{0.1}{5.3} \times 100$

50. A thin copper wire of length *l* metre increases in length by 2% when heated through 10°C. What is the percentage increase in area when a square copper sheet of length *l* metre is heated through $10^{\circ}C$

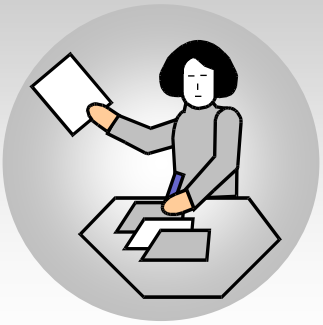
(a) 4% (b) 8% (c) 16% (d) None of the above.

51. In the context of accuracy of measurement and significant figures in expressing results of experiment, which of the following is/are correct

(1) Out of the two measurements 50.14 *cm* and 0.00025 *ampere*, the first one has greater accuracy

(2) If one travels 478 *km* by rail and 397 *m*. by road, the total distance travelled is 478 *km*.

(a) Only (1) is correct (b) Only (2) is correct (c) Both are correct (d) None of them is correct.



Answer Sheet (Practice problems)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
b	d	a	c	b	a	c	a	d	c
11.	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**	**19.**	**20.**
b	a	d	a	a	c	c	d	d	a
21.	**22.**	**23.**	**24.**	**25.**	**26.**	**27.**	**28.**	**29.**	**30.**
b	b	b	c	a	a	a	d	d	b
31.	**32.**	**33.**	**34.**	**35.**	**36.**	**37.**	**38.**	**39.**	**40.**
d	c	c	c	b	c	b	c	d	b
41.	**42.**	**43.**	**44.**	**45.**	**46.**	**47.**	**48.**	**49.**	**50.**
b	c	b	c	c	a	a	b	b	a

51.
c