Unit & Dimension

ASSIGNMENT-1
BY : M.R. SIR

1. If force acting on object is given as

$F = 4 \sin\left(\frac{t}{\alpha}\right)\tan\left(\frac{x}{\beta}\right)$ then dimension of $\frac{\beta}{\alpha}$ is same as :

20

(A) Velocity (B) acc^n

(C) Time (D) Length

2. Find dimension of $\sqrt{\mu_0\varepsilon_0} \times \left(\frac{F}{qB}\right)$ F is force, q is charge, B is Magnetic field:

25 (A) $M^\circ L^\circ T^\circ$ (B) MLT^{-1}

(C) $M^3T^2L^7$ (D) MLT^{-2}

3. Measured length of object is 10.84 cm then it is measured by the instrument:

(A) Vernier calipers (B) Screw gauze

20 (C) Metre scale (D) cane be measure by only on the instruments

4. Which of the following set of physical quantity can be considered as fundamental physical quantity?

(A) Mass, force, acceleration (B) Power, Time, Energy

20 (C) Moment, velocity, K.E. (D) Mass, Work, Force

5. Dimension of $\int v\,dt$ is same as –

(A) Radius (B) Mass

20 (C) Wavelength (D) Both (A) and (C)

6. Centripetal force acting on moving object depends on energy, length and mass then dimension of centripetal force will be

20 (A) $E^1L^{-1}M^\circ$ (B) $E^1L^1M^1$

(C) $E^1L^\circ M^1$ (D) $E^\circ L^1M^\circ$

7. Unit for electromotive force is not same as –

(A) $\frac{N-m}{C}$ (B) Volt

25 (C) eV (D) J/C

8. Dimension of kepler's constant in equation $T^2 = KR^3$ where k is kepler constant.

(A) T^2L^{-3} (B) T^2L^3

20 (C) T^2L^{-2} (D) –

9. Which of the following is not a physical quantity?

(A) Inertia (B) Temperature

20 (C) Moment of inertia (D) Force

10. If momentum (p), area (A) and time (t) are taken to be fundamental quantities, than energy has the dimensional formula –

(A) $P^1 A^{-1} t^{-1}$ (B) $P^2 A^1 t^1$

21 (C) $P^1 A^{-1/2} t^1$ (D) $P^1 A^{1/2} t^{-1}$

11. Which of the following pairs of physical quantities does not have same dimension?

21

(A) Work, Torque (B) Angular momentum and Plank's constant

(C) Tension and surface Tension (D) Impulse and linear momentum

12. Young's modulus of steel is 1.9×10^{11} N m^{-2}. When expressed in c.g.s. units of dyne cm^{-2}, it will be equal to

21

(A) 1.9×10^{10} (B) 1.9×10^{11}

(C) 1.9×10^{12} (D) 1.9×10^{13}

13. 1 fermi = _____

21

(A) 10^{-10} m (B) 10^{-15}m

(C) 10^{-9}m (D) 10^{-12} m

14. The dimensional formula of $\frac{L}{R}$ is

26

(A) $M^1L^{-1}T^{-1}$ (B) $M^0L^1T^{-1}$

(C) $M^0L^0T^1$ (D) $M^2L^2T^{-2}$

15. Shake is:

21

(A) Unit of length (B) Unit of time

(C) Unit of mass (D) Unit of temperature

16. The number of significant figures in 0.0305010 is

21

(A) 6 (B) 5

(C) 3 (D) 7

17. In which of the following, the number of signification figure is 3

21

(A) 0.021×10^{-3} kg (B) 240

(C) 9.01 (D) All the option are correct

18. The sum of 3.2421, 0.341 and 0.08 in appropriate significant figure

21

(A) 3.6 (B) 3.66

(C) 3.663 (D) 3.6631

19. The length of rectangular sheet is 1.256 cm an width is 1.0 cm. The area of the sheet to the correct number of significant figure is

21

(A) 1.2 cm^2 (B) 1.25 cm^2

(C) 1.256 cm^2 (D) None of the above

20. The numbers 3.745 and 3.735 on rounding off to 3 significant figures will be :

21

(A) 3.75 and 3.74 (B) 3.74 and 3.73

(C) 3.75 and 3.73 (D) 3.74 and 3.74

21. A force $F = avt^{-1} + bt^{-2}$, where v is velocity and t is time. What are the dimensions of a and b

22

(A) $M^1L^0T^0$ and $M^1L^0T^0$ (B) $M^1L^1T^0$ and $M^1L^1T^1$

(C) $M^1L^0T^0$ and $M^1L^1T^0$ (D) $M^1L^{-1}T^0$ and $M^0L^1T^0$

22. The dimensional formula of term a and b in the given equation will be

$E = a(1 - e^{-bt})$, where E is energy.

22

(A) $M^1L^1T^{-2}$ and $M^0L^1T^1$ (B) $M^1L^2T^{-2}$ and $M^0L^0T^{-1}$

(C) M^0L^0T and $M^0L^0T^{-1}$ (D) $M^0L^1T^{-2}$ and $M^1L^0T^{-1}$

23. A dimensionless quantity

22

(A) Never has a unit (B) Always has unit

(C) May have a unit (D) Does not exist

24. The units that are used for the fundamental physical quantities are called

22

(A) System of unit (B) Base units

(C) Derived units (D) All of these

25. The wrong unit conversion among the following is

26

(A) 1 angstrom = 10^{-10}m (B) 1 fermi = 10^{-15}m

(C) 1 light year = 9.46×10^{15}m (D) 1 astronomical unit = 1.496×10^{-11}m

26. The dimensions of Planck's constant are the same as that of

22

(A) Linear impulse (B) Work

(C) Linear momentum (D) Angular Momentum

27. The solid angle subtended by the periphery of an area 1 cm^2 at a point situated symmetrically at a distance of 5 cm from the area is

26

(A) 2×10^{-2} steradian (B) 4×10^{-2} steradian

(C) 6×10^{-2} steradian (D) 8×10^{-2} steradian

28. Which of the following relations for the displacement of a particle undergoing simple harmonic motion is not correct dimensionally? The symbols have there usual meanings.

22

(A) $y = a\sin\frac{2\pi t}{T}$ (B) y = a cos ωt

(C) $y = \frac{a}{T}\sin\left(\frac{t}{a}\right)$ (D) $y = a\sqrt{2}\left(\sin\frac{2\pi t}{T} + \cos\frac{2\pi t}{T}\right)$

29. Which one of the following instruments is not used for the measurement of length?

(A) Atomic clock (B) Vernier calipers

23

(C) Screw gauge (D) Spherometer

30. Which one of the following methods is used to measure the distance of a planet or a star from the earth?

(A) Echo method (B) Parallax method

23

(C) Triangulation method (D) None of these

31. If the length, $L = G^p h^q c^r$, where G is the universal gravitational constant, h is the Planck's is constant and c is the velocity of light, then the values of p, q and r are respectively

23

(A) –1/2, 1/2 and 5/2 (B) 1/2, –1/2 and –5/2

(C) –1/2, 1/2 and 3/2 (D) 1/2, 1/2 and –3/2

32. If the size of bacteria is 1 micron, what will be the number of it in 1 m length?

23

(A) One hundred (B) One crore

(C) One thousand (D) 10 lack

33. A, B and C are three physical quantities having different dimensions. Which of the combination is never be a meaningful quantity

23

(A) $\frac{AB}{C}$ (B) $\frac{A+B}{C}$

(C) $\frac{A}{BC}$ (D) $AB + C$

23

34. The dimensional formula of physical quantity is $[M^aL^bT^c]$. Then that physical quantity is

(A) Surface tension if a = 1, b = 1, c = –2
(B) Force a = 1, b = 1, c = 2
(C) Angular frequency if a = 0, b = 0, c = –1
(D) Spring constant if a = 1, b = –1, c = –2

35. The device used for measuring the mass of atoms and molecules is

23 (A) Spring balance (B) Torsional balance
(C) Mass spectrograph (D) Common balance

36. 1 unified atomic mass unit (1 u) is equal to

(A) 1.66×10^{-25} kg (B) 1.66×10^{-27} kg
23 (C) 1.66×10^{-29} kg (D) 1.66×10^{-31} kg

37. If the value of force is 100 N and value of acceleration is 0.001 m s^{-2}, what is the value of mass in this system of units?

23 (A) 10^3 kg (B) 10^4 kg
(C) 10^5 kg (D) 10^6 kg

38. The distance of a galaxy from the earth is of the order of 10^{25}m. The time taken by light to reach the earth from the galaxy is

23 (A) 3×10^{14} s (B) 3×10^{16} s
(C) 3×10^{18} s (D) 3×10^{20} s

39. Which of the following is the most precise instrument for measuring length?

24 (A) Metre rod of least count 0.1 cm (B) Vernier calipers of least count 0.01 cm
(C) Screw gauge of least count 0.001 cm (D) None of these

40. Which of the following statements is incorrect?

(A) Every measurement by measuring instrument has some error.
24 (B) A measurement can have more accuracy but less precision and vice versa.
(C) Every calculated quantity that is based on measured values has some error.
(D) The magnitude of the difference between the true value of the quantity and the individual measurement value is called the relative error of the measurement.

41. If $Z = \dfrac{A^4 B^{\frac{1}{3}}}{CD^{\frac{3}{2}}}$ and ΔA, ΔB, ΔC and ΔD are their absolute errors in A, B, C and D respectively. The relative error in Z is

24 (A) $\dfrac{\Delta Z}{Z} = 4\dfrac{\Delta A}{A} + \dfrac{1}{3}\dfrac{\Delta B}{B} + \dfrac{\Delta C}{C} + \dfrac{3}{2}\dfrac{\Delta D}{D}$ (B) $\dfrac{\Delta Z}{Z} = 4\dfrac{\Delta A}{A} + \dfrac{1}{3}\dfrac{\Delta B}{B} - \dfrac{\Delta C}{C} - \dfrac{3}{2}\dfrac{\Delta D}{D}$

(C) $\dfrac{\Delta Z}{Z} = 4\dfrac{\Delta A}{A} + \dfrac{1}{3}\dfrac{\Delta B}{B} + \dfrac{\Delta C}{C} - \dfrac{3}{2}\dfrac{\Delta D}{D}$ (D) $\dfrac{\Delta Z}{Z} = 4\dfrac{\Delta A}{A} + \dfrac{1}{3}\dfrac{\Delta B}{B} - \dfrac{\Delta C}{C} + \dfrac{3}{2}\dfrac{\Delta D}{D}$

42. Two resistors of resistances $R_1 = (300 \pm 3)\ \Omega$ and $R_2 = (500 \pm 4)\ \Omega$ are connected in series. The equivalent resistance of the series combination is

24 (A) $(800 \pm 1)\ \Omega$ (B) $(800 \pm 7)\ \Omega$
(C) $(200 \pm 7)\ \Omega$ (D) $(200 \pm 1)\ \Omega$

43. Percentage errors in the measurement of mass and speed are 2% and 3% respectively. The error in the estimation of kinetic energy obtained by measuring mass and speed will be

(A) 8% (B) 2%
24 (C) 12% (D) 10%

44. The period of oscillation of a simple pendulum is $T = 2\pi\sqrt{\frac{T}{g}}$. Measured value of L is 10 cm known to 1 mm accuracy and time for 100 oscillations of the pendulum is found to be 50 s using a wrist watch of 1 s resolution. What is the accuracy in the determination of g?

24

(A) 2% (B) 3%

(C) 4% (D) 5%

45. Which of the following statements is incorrect regarding significant figures?

(A) All the non-zero digits are significant.

(B) All the zeros between two non-zero digits are significant.

25 (C) Greater the number of significant figures in a measurement, smaller is the percentage error

(D) The power of 10 is counted while counting the number of significant figures.

ANSWER KEY

1. (A)
2. (A)
3. (A)
4. (D)
5. (D)
6. (A)
7. (C)
8. (A)
9. (A)
10. (D)
11. (C)
12. (C)
13. (B)
14. (C)
15. (B)
16. (A)
17. (C)
18. (B)
19. (A)
20. (D)
21. (C)
22. (B)
23. (C)
24. (B)
25. (D)
26. (D)
27. (B)
28. (C)
29. (A)
30. (B)
31. (D)
32. (D)
33. (B)
34. (C)
35. (C)
36. (B)
37. (C)
38. (B)
39. (C)
40. (D)
41. (A)
42. (B)
43. (A)
44. (D)
45. (D)

Hint and Solution

1. Angle is dimensionless.

2. Apply dimensional formula of each physical quantity.

3. Least count of vernier calipers is 0.01 cm

4. Combination of physical quantity which is independent of each other.

5. vdt = $[L^1T^{-1}T^1] = [L]$

6. $F = \frac{w}{x}$

7. Theory based.

8. $T^2 = KR^3$

9. Inertia is property of matter.

10. Using dimensional analysis.

11. Theory based.

12. $\left.\begin{aligned} 1N &= 10^6\, dyne \\ 1m^2 &= 10^4\, cm^2 \end{aligned}\right\}$

13. Theory based.

14. It is time constant.

15. It is practical unit of time (1 shake = 10^{-8} s).

16. Apply rule of counting zero's.

17. Zero in between two non-zero digits in significant.

18. The result should be having least number of decimal places.

19. The result should be having least no. of significant figure.

20. Apply rounding off rule

21. Apply principle of homogeneity.

22. Apply principle of homogeneity.

23. Think about angle.

24. Based on theory.

25. Based on theory.

26. $L = \frac{nh}{2\pi}$

27. $\Omega = \frac{\text{Area}}{r^2}$

28. $\frac{a}{T} = V$ L.H.S. ≠ R.H.S.

29. Atomic clock is for time.

30. Theory based.

31. Solve it by dimensional analysis.

32. Number = $\frac{1m}{10^{-6}m}$

33. By principle of homogeneity

34. $\omega = 2\pi f$

35. Knowledge based.

36. Knowledge based.

37. $m = \frac{F}{a}$

38. $t = \frac{d}{c}$.

39. The reading will be more precise if least court is minimum.

40. Absolute error = True value – Measured value.

41. Working theory.

42. $R = R_1 + R_2$ and $\Delta R = \Delta R_1 + \Delta R_2$

43. $\frac{\Delta K.E.}{K.E.} \times 100 = \left(\frac{\Delta m}{m} + \frac{2\Delta V}{V}\right) \times 100$

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

45. Theory based.