



# PHYSICS

## BOOKS - JBD PUBLICATION

### PHYSICAL WORLD AND MEASUREMENT

#### Exercise

1.1 KILOWATT-HOUR IS EQUIVALENT TO :

A.  $10^{-7}$  joule

B.  $1.6 \times 10^{-19}$  joule

C. 4.186 joule

D.  $3.6 \times 10^6$  joule

**Answer:**



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2. Pick out the only vector quantity in the following list:

A. Temperature

B. Impulse

C. Current

D. Charge

**Answer:**



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3. Percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the

estimate of KE obtained by measuring mass and speed?

A. 2 %

B. 5 %

C. 8 %

D. 11 % .

**Answer:**



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4. If 9.535 is rounded off to give three significant figures then it is equal to :

A. 9.52

B. 9.53

C. 9.54

D. 09.5.

**Answer:**



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5. Which of the following is most accurate?

A.  $200.0m$

B.  $20 \times 10^1m$

C.  $2 \times 10^2m$

D.  $2000 \times 10^{-1}m.$

**Answer:**



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6. SI unit of length is metre .Suppose we adopt a new unit of length which equals  $x$  metre.The area of  $1m^2$  expressed in terms of the new unit has a magnitude:

A.  $x^2$

B.  $x^{-1}$

C.  $x^1$

D.  $x^2$

**Answer:**



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7. If frequency  $\nu$ , velocity  $v$  and density  $d$  are considered as fundamental units, then dimensional formula for momentum will be:

A.  $duv^2$

B.  $d^2u^2v^2$

C.  $dv^2v^{-1}$

D.  $du^4v^{-3}$ .

**Answer:**







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8. Number of significant figures in 6.0023 is :

A. 2

B. 3

C. 4

D. 5

**Answer:**



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9. Which of the following have same dimensions?

A. Force and torque

B. Potential energy and torque

C. Force and potential energy

D. Potential energy and momentum

**Answer:**



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10. If  $M, L$  and  $T$  are considered to be fundamental quantities, dimension of Planck constant would be:

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

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

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

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

**Answer:**



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11. Dimensional formula for the coefficient of viscosity is :

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

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

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

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

**Answer:**



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12. SI unit of magnetic flux is :

A. Oersted

B. Gauss

C. Tesla

D. Weber

**Answer:**



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**13.** If percentage change in current through a resistor is  $1\%$  ,then change in power through it would be :

A.  $1\%$

B.  $2\%$

C.  $3\%$

D.  $4\%$  .

**Answer:**



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14. The velocity of a body is given by the

$$\text{equation } v = \frac{b}{t} + c^2 + d$$

The dimensional formula of  $b$  is :

A.  $[M^0 L^1 T^0]$

B.  $[M^1 L^0 T^0]$

C.  $[M^0 L^0 T^1]$

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

**Answer:**



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15. Dimensional formula  $\{M^1 L^{-1} T^{-2}\}$

CRRESPONDS TO :

A. viscosity

B. pressure

C. moment of force

D. modulus of elasticity

**Answer:**



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16. A resistor of  $4k\Omega$  with tolerance 10% is connected in parallel with resistor of  $6k\Omega$  with tolerance 10%. The tolerance of parallel combination is nearly:

A. 0.1

B. 0.2

C. 0.3

D. 0.4

**Answer:**



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17. The radius of a sphere is  $(4.3 \pm 0.1)$  cm

.The percentage error in its volume is :

A.  $\frac{0.1}{4.3} \times 100$

B.  $\frac{3 \times 0.1 \times 100}{4.3}$

C.  $3 + \frac{0.1 \times 100}{4.3}$

D.  $\frac{1}{3} + \frac{0.1 \times 100}{4.3}$

**Answer:**



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18. Dimensional formula of universal gas constant is :

A.  $[M^1 L^0 T^0 K^1]$

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

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

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

**Answer:**



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19. In van der Waal's gas equation:

$$\left[ p + \frac{a}{v^2} \right] (V - b) = RT, \text{ Calculate the}$$

dimensions of van der Waal's constant  $a$ .

A.  $V$

B.  $P$

C.  $VP$

D.  $V^2P$

**Answer:**



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20. The force of is given in terms of time  $t$  and displacement  $x$  by the equation

$F = A \cos Bx + C \sin Dt$ . The dimensional formula of  $D/B$  is :

A.  $[M^0 L^1 T^0]$

B.  $[M^0 L^{-1} T^0]$

C.  $[M^0 L^0 T^1]$

D.  $[M^0 L^1 T^{-1}]$

**Answer:**



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21. Which of the following is not dimensionless?

A. Relative density

B. Relative velocity

C. Relative permittivity

D. Relative refractive index

**Answer:**



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22. Which of the following cannot be expressed as  $Nm^{-2}$  ?

- A. Bulk modulus of elasticity
- B. Pressure of mercury column
- C. Compressial stress
- D. Energy density of electric field

**Answer:**



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23. According to Newton's law of gravitation, force between two point masses,  $m_1$  and  $m_2$ , separated by a distance,  $d$  is given by  $F = G \frac{m_1 m_2}{d^2}$ .

Here, constant  $G$  depends on:

- A. medium between the two point masses only
- B. distance between two point masses only
- C. material of the point masses only
- D. system of units only.



**Answer:**



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**24.** Electron volt (eV) is the unit of :

A. charge

B. power

C. energy

D. potential difference.

**Answer:**



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25. Unit of Planck constant is :

A.  $J s$

B.  $J s^{-1}$

C.  $J s^{-2}$

D.  $j^{-1} s.$

**Answer:**



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26. Which of the following is the smallest unit?

A.  $\text{\AA}$

B. fm

C. mm

D. nm

**Answer:**



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27. If C and R represent capacitance and resistance respectively, then dimensions of RC are :

A.  $[M^1 L^0 t^{-1}]$

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

C.  $[M^0 L^0 T^1]$

D.  $[M^0 L^2 T^{-1} \Lambda^{-1}]$ .

**Answer:**



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28. Which of the following have same dimensions?

- A. Torque and energy
- B. Energy and acceleration
- C. Acceleration and torque
- D. Momentum and torque.

**Answer:**



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29. In an experiment on Ohm's law, the reading of voltmeter across resistor is 15.0 V and reading of current is 0.20 A. The resistance of the resistor in correct significant figure is :

A.  $75.0\Omega$

B.  $75\Omega$

C.  $70\Omega$

D. none of these.

**Answer:**



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30. A pair of physical quantities having same dimensions is :

- A. stress and strain
- B. work and energy
- C. angular velocity and linear velocity
- D. kinetic energy and momentum.

**Answer:**



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31. What is dimensional representative of Young's modulus?

A.  $M^1 L^1 t^{-2}$

B.  $M^1 L^2 T^{-2}$

C.  $M^1 L^{-2} T^{-2}$

D.  $M^1 L^{-1} T^{-2}$ .

**Answer:**



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32. Which one is not a unit of time ?

A. Year

B. Leap year

C. Light year

D. Shake.

**Answer:**



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**33.** The difference in the length of a mean solar day and a sidereal day is about

A. 1 min

B. 4 min

C. 15 min

D. 56 min.

**Answer:**



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**34.** C.V. Raman received Nobel Prize for the discovery of the following phenomenon?

- A. Scatterubg if light
- B. Theory of relativity
- C. Photoelectric effect
- D. Law of gravitation.

**Answer:**



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35. The unit of permittivity of free space ( $\epsilon_0$ )

is :

A.  $\frac{N \cdot m^2}{C^2}$

B.  $\frac{C^2}{N \cdot m^2}$

C.  $\frac{C^2}{(N \cdot m)^2}$

D.  $\frac{C}{N \cdot m}$

**Answer:**



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**36.** Parsec is the unit of

A. time

B. frequency

C. distance

D. angular acceleration.

**Answer:**



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**37.** Dimensions of electrical resistance is

A.  $M^1 L^2 T^{-3} A^{-2}$

B.  $M^1 L^2 T^{-3} A^{-1}$

C.  $M^1 L^3 T^{-3} A^{-2}$

D.  $M^1 L^{-1} T^{-2}$ .

**Answer:**



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**38.** In a system of units, if force (f), acceleration (A) and time (T) are taken as fundamental units then dimensional formula of energy is :

A.  $FAT^2$

B.  $FA^2T$

C.  $F^2AT$

D.  $FAT.$

**Answer:**



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**39.** A force  $F$  given by  $F = at + bt^2$  where  $t$  is time. What are dimensions of  $a$  and  $b$ ?

A.  $M^1 L^1 t^{-3}$  and  $M^1 L^1 T^{-4}$

B.  $M^1 L^1 T^{-1}$  and  $M^1 L^1 T^0$

C.  $M^1 L^1 T^{-4}$  and  $M^1 L^1 T^0$

D.  $M^1 L^{-3} t^1$  and  $M^1 L^1 T^{-4}$ .

**Answer:**



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**40.** Ratio of dimension of Planck constant and that of moment of inertia is the dimension of :



A. frequency

B. time

C. velocity

D. angular momentum

**Answer:**



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**41.** The dimensions of the quantity  $\vec{E} \times \vec{B}$ , where  $\vec{E}$  represents the electric field and  $\vec{B}$

the magnetic field may be given as:

A.  $[M^1 T^{-3}]$

B.  $[M^2 L^1 T^{-5} A^{-2}]$

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

D.  $[M^1 L^1 T^{-2d} A^{-2}]$ .

**Answer:**



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**42.** Dimensions of  $(\mu_0 \epsilon_0)^{-\frac{1}{2}}$  are :

A.  $[L^1 t^{-1}]$

B.  $[L^{-1}T^1]$

C.  $\left[\frac{L^1}{2}T^{-\frac{21}{2}}\right]$

D.  $\left[L^{-\frac{1}{2}}T^{\frac{1}{2}}\right].$

**Answer:**



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**43.** The dimension of energy density,  $\frac{1}{2}\epsilon_0 E^2$ ,

where  $\epsilon_0$  is permittivity of free space

and E is electric field is :

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

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

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

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

**Answer:**



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**44.** The number of significant figures in 0.002305 is :

A. 2

B. 3

C. 4

D. 6

**Answer:**



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**45.** The dimensional formula for the magnetic field is :

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

B.  $[M^1 T^{-2} A^{-2}]$

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

D.  $[M^1 T^{-1} A^{-1}]$

**Answer:**



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**46.** If E is energy ,G is gravitational constant,l is impulse and M is mass the dimensions of

$\frac{GIM^2}{E^2}$  are same as that of :

A. mass

B. time

C. force

D. length

**Answer:**



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47. What is dimensional formula of thermal conductivity?

A.  $[M^1 L^1 T^{-3} \theta^{-1}]$

B.  $[M^1 L^1 T^{-1} \theta^{-1}]$

C.  $[M^2 L^1 T^{-3} \theta^{-2}]$

D.  $[M^1 L^2 T^{-1} \theta^{-1}]$ .

**Answer:**



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48. The magnetic moment has midensions of :

A.  $[L^1 A^1]$

B.  $[L^2 A^1]$

C.  $[L^2 T^{-1} A^1]$

D.  $[L^1 T^{-1} A^1]$ .

**Answer:**



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49. Volume of a cube in  $m^3$  is equal to the surface area of the cube in  $m^2$ . Volume of the cube is :

A.  $108m^3$

B.  $216m^3$

C.  $512m^3$

D. none of these.

**Answer:**



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## Example

1. What is the dimensional formula of electric field intensity ?



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2. State whether the equation

$y = y_0 \sin \frac{g(2\pi)}{v} t$  is correct, where  $t$  is time and

$v$  is velocity.



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3. Are all constants dimensionless? Give examples in your support.



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4. Give an example of a physical quantity which has a unit but no dimensions.



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5. Can a quantity have units but still be dimensionless?



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6. Can a physical quantity have dimensions but no units?



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7. How is Avogadro's number denoted ?



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8. Name two physical quantities which have same dimensions as that of light year.



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9. Can a physical quantity have different dimensions in different systems of units?



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**10.** Which of the following has same dimensions as heat? Work, torque, surface energy.



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**11.** What is science ?



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12. Is physics, philosophy of mathematical science?



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13. Is SI system a coherent one?



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14. Do  $\overset{\circ}{\text{A}}$  and A.U. stand for the same length?



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**15.** What is the order of size of a galaxy?



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**16.** What is the order of magnitude of light year in metre?



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**17.** What is the shortest distance measured indirectly so far?



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**18.** How are pitch and least count of a screw gauge related to each other?



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**19.** What is the order of mass of the universe?



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20. What is the smallest mass measured indirectly so far?



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21. Which type of mass of a body is measured by a physical balance?



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**22.** How are the inertial and gravitational mass of a body related to each other?



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**23.** What is the order of human life expectancy?



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**24.** Give an example of a physical quantity which has neither unit nor dimensions.



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**25.** Can a quantity have units but still be dimensionless?



**Watch Video Solution**

**26.** Can a physical quantity have dimensions but no units?



**Watch Video Solution**

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**28.** How is Avogadro's number denoted ?



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**29.** Name two physical quantities which have same dimensions as that of light year.



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**30.** Does the ratio of same quantity depend upon system of unit used?



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**31.** Name a scalar and a vector quantity having same dimensions.



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**32.** If a physical quantity is  $P = \frac{a^3 b^2}{c}$  and the percentage errors in the measurement of  $a, b$  and  $c$  are 1%, 2% and 3% respectively. Find the



maximum percentage error in the measurement of physical quantity P.



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**33.** Check whether  $\frac{1}{2}mv^2 = mgh$  equation is dimensionally correct or not. Here  $m$  = mass of material,  $v$  = velocity,  $g$  = gravitational acceleration,  $h$  = height.



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**34.** Though India now has a large base in science and technology, which is fast expanding, it is still a long way from realising its potential of becoming a world leader in science. Name some important factors, which in your view have hindered the advancement of science in India.



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**35.** "Every great physical theory starts as a heresy and ends as a dogma". Give some examples from the history of science of the validity of this incisive remark.



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**36.** The shells of crabs found around a particular coastal location in Japan seem mostly to resemble the legendary face of a Samurai. Given below are two explanations of

this observed fact. Which of these strikes you as a scientific explanation? -

(a) A tragic sea accident several centuries ago drowned a young Samurai. As a tribute to his bravery, nature through its inscrutable ways immortalised his face by imprinting it on the crab shells in that area.

(b) After the sea tragedy, fishermen in that area, in a gesture of honour to their dead hero, let free any crab shell caught by them which accidentally had a shape resembling the face of a Samurai. Consequently, the particular shape of the crab shell survived longer and

therefore in course of time the shape was genetically propagated. This is an example of evolution by artificial selection.



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genetically propagated. This is an example of evolution by artificial selection.



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**38.** Some of the most profound statements on the nature of science have come from Albert Einstein, one of the greatest scientists of all time. What do you think did Einstein mean when he said : "The most incomprehensible thing about the world is that it is comprehensible"?



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**39.** No physicist has ever "seen" an electron. Yet, all physicists believe in the existence of electron. An intelligent but superstitious man advances this analogy to argue that 'ghosts' exist even though no one has 'seen' one. How will you refute his argument?



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**41.** The industrial revolution in England and Western Europe more than two centuries ago

was triggered by some key scientific and technological advances. What were these advances?



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**42.** "It is more important to have beauty in the equations of physics than to have them agree with experiments". The great British physicist P. A. M. Dirac held this view. Criticize this statement. Look out for some equations and

results in this book which strike you as beautiful.



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**43.** Though the statement quoted above may be disputed, most physicists do have a feeling that the great laws of physics are at once simple and beautiful. Some of the notable physicists, besides Dirac, who have articulated this feeling, are : Einstein, Bohr, Heisenberg, Chandrasekhar and Feynman. You are urged to

make special efforts to get access to the general books and writings by these and other great masters of physics. (See the Bibliography at the end of this book.) Their writings are truly inspiring !



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**44.** Textbooks on science may give you a wrong impression that studying science is dry and all too serious and that scientists are absent-minded introverts who never laugh or

grin. This image of science and scientists is patently false. Scientists, like any other group of humans, have their share of humorists, and many have led their lives with a great sense of fun and adventure, even as they seriously pursued their scientific work. Two great physicists of this genre are Gamow and Feynman. You will enjoy reading their books listed in the Bibliography.



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**45.** What do you understand by the term scientific method?



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**46.** Mention the fundamental forces in nature.



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**47.** Name a unit which can be used to measure very small mass.



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**48.** How many kilograms are contained in (i) 1 amu and (ii) 1 slug?



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**49.** What is Laser?



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**50.** Define amu.



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**51.** Define a second in terms of vibrations of caesium -133 atom.



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**52.** An observer takes 10 observations in an experiment .I he repeats the same experiment



by taking 20 observations by what factor error will be reduced ?



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**53.** Round off the following number

(i) 7.250 to two digits



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**54.** Round off the following number

(ii) 9.350 to two digits



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**55.** Round off the following number

(iii) 0.89991 to two digits



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**56.** Round off the following number

(iv) 12.853 to three digits.



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**57.** Round off the following number

(v)  $6.993 \times 10^4$  to three digits.



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**58.** Solve with due regard to significant figure

$(12.4 - 12.21)^{\frac{1}{2}}$ .



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**59.** Weight of a body is 6.34 g and its volume is  $1.7\text{cm}^3$ . What will be the density of the substance?



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**60.** If the error in the measurement of radius of a sphere is 3%, then what will be the percentage error in the volume of the sphere?



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**61.** Which of the following is the most precise device for measuring length :-



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**62.** Which of the following is the most precise device for measuring length :-



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**63.** Which of the following is the most precise device for measuring length :-



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**64.** What is the number of significant figures in 0.00680?



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**65.** Are all constants dimensionless? Give examples in your support.



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**66.** What are dimensions of energy density?



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**67.** Can a physical quantity have different dimensions in different systems of units?



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68. What is the dimension of  $[T]$  in angular acceleration?



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69. Match the physical quantities with their dimensions:

Physical quantity	Dimensions
(i) Planck constant	$[M^1 L^1 T^{-1}]$
(ii) Gravitational constant	$[M^1 L^2 T^{-1}]$
(iii) Enthalpy	$[M^{-1} L^3 T^{-2}]$
(iv) Impulse	$[M^1 L^2 T^{-2}]$







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70. What is dimension of length in angular momentum?



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71. Dimensional formula for the coefficient of viscosity is :



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72. Name three physical quantities having the same dimensional formula as that of length.



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73. How many joules are present in 1 kilowatt hour?



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74. State whether the equation

$y = y_0 \frac{\sin(2\pi)}{v} t$  is correct, where  $t$  is time

and  $v$  is velocity.



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**75.** What are the dimensions of  $a$  and  $b$  in the relation  $F = a - bx^2$ , where  $F$  is force and  $x$  is distance?



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**76.** What do you understand by dimensions?



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**77.** Write down the dimensions of each of the following in terms of mass, length, time and charge:

magnetic flux



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**78.** Write down the dimensions of each of the following in terms of mass, length, time and

charge:

modulus of rigidity.



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**79.** Deduce the dimensions of Planck's constant. Which other quantity has same dimensions?



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**80.** Dimensional formula of universal gas constant is :



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**81.** Write the dimensions of  $a, b$  and  $c$  in the formula  $y = a - bt + cx$  where  $y$  is displacement,  $t$  is time and  $x$  is distance.



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**82.** Write down the dimensional formula of gravitational constant (G).



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**83.** In van der Waal's gas equation:

$$\left[ p + \frac{a}{v^2} \right] (V - b) = RT, \text{ Calculate the}$$

dimensions of van der Waal's constant a.



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**84.** KE of a rotating body is given by  $\frac{1}{2}I\omega^2$ , where  $I$  is moment of inertia and  $\omega$  is angular velocity of the body. Find the dimensions of  $I$ .



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**85.** The number of particles given by  $n = D \frac{n_2 - n_1}{x_2 - x_1}$  are crossing a unit area perpendicular to x-axis in unit-time.  $n_1$  and  $n_2$  are the number of particles per unit volume for the values of  $x$  meant to be  $x_1$  and  $x_2$



.What is the dimensional formula of diffusion constant  $D$ ?



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**86.** If velocity of light  $c$ , Plank's constant  $h$  and gravitational constant  $G$  are taken as fundamental quantities then express mass, length and time in terms of dimensions of these quantities.



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**87.** Why do we have different units for the same physical quantity?



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**88.** Why length, mass and time are chosen as base quantities in mechanics?



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**89.** Express unified atomic mass unit in kg.





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90. A function  $f(\theta)$  is defined as

$$f(\theta) = 1 - \theta + \frac{\theta^2}{2!} + \frac{\theta^3}{3!} + \frac{\theta^4}{4!} + \dots \dots \dots \text{Why}$$

is it necessary for  $f(\theta)$  to be dimensionless quantity?



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91. Which of the following time measuring device is most precise? Give reasons for your answers.



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**92.** Which of the following time measuring device is most precise? Give reasons for your answers.



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**93.** Which of the following time measuring device is most precise? Give reasons for your answers.





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**94.** Which of the following time measuring device is most precise? Give reasons for your answers.



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**95.** The distance of a galaxy is of the order of  $10^{25}$  m. Calculate the order of magnitude of time taken by light to reach us from the galaxy.



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**96.** Mention three conservation laws of mechanics.



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**97.** "Politics is the art of the possible". Similarly, " Science is the art of the soluble". Explain this beautiful aphorism on the nature and practice of science.



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**98.** Though India now has a large base in science and technology, which is fast expanding, it is still a long way from realising its potential of becoming a world leader in science. Name some important factors, which in your view have hindered the advancement of science in india.



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**99.** It is often said that the world is witnessing now a second industrial revolution, which will transform the society as radically as did the first. List some key contemporary areas of science and technology, which are responsible for this revolution.



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**100.** What are the characteristics of physical standard?







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**101.** What are order of magnitude? Give two examples.



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**102.** What is the advantage in choosing the wavelength of light radiation as a standard of length?



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**103.** The average wavelength of the yellow light emitted from a sodium lamp is  $5893\text{\AA}$ . Express it in nanometres.



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**104.** Define a second in terms of vibrations of caesium-133 atom.



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**105.** Why distances of only nearby stars can be found only by parallax method ?



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