PHYSICS

The following question given below consist of an "Assertion" (A) and "Reason" (R) Type questions. Use the following Key to choose the appropriate answer.

(A) If both (A) and (R) are true, and (R) is the correct explanation of (A).

(B) If both (A) and (R) are true but (R) is not the correct explanation of (A).

(C) If (A) is true but (R) is false.

(D) If (A) is false but (R) is true.

Q.1 **Assertion :** All numericals are dimensionless constants.
Reason : They have neither units nor dimension. **[B]**

Q.2 **Assertion :** The equation $v^2 = u^2 + t^2$ can not be true, where v, u are velocity and t is time.
Reason : Quantities with different dimensions can not be added. **[A]**

Q.3 **Assertion :** The unit of surface tension is N/m.
Reason : The dimension of surface tension is MT^{-2} **[B]**

Q.4 **Assertion :** Energy can not be divided by volume.
Reason : Dimensions of energy and volume are different. **[D]**

Q.5 **Assertion** : light year is a unit of time.
Reason : light year is the distance travelled by light in vacuum in one year. **[D]**

Q.6 **Assertion** : When we change the unit of measurement of a quantity, its numerical value changes.
Reason : Smaller the unit of measurement, smaller is its numerical value. **[C]**

Q.7 **Assertion** : The equation y = x + t cannot be true, where x, y are distance and t is time.
Reason : Quantities with different dimensions cannot be added. **[A]**

Q.8 **Assertion** : All numerals are dimensionless constants
Reason : They have neither units nor dimension **[B]**

Q.9 **Assertion :** If Y = A sin kt then dimension of k is $[T^{-1}]$ where t is in second.
Reason : Sine and cosine function in any physical expression must have dimensionless argument. **[A]**

Q.10 **Assertion :** We may write A = B + C, where A, B and C are three different physical quantities, but of same dimensions.
Reason : An equation is dimensionally correct if the dimensions of the various terms on either side of the equation are the same. **[A]**

Q.11 **Statement I :** Light year is an unit of time.
Statement II : Light year is the distance travelled by light in vacuum in one year. **[D]**

Q.12 **Statement I :** When we change unit of measurement of a quantity, its numerical value changes.
Statement II : Smaller the unit of measurement, smaller is its numerical value. **[C]**

Q.13 **Statement I :**The equation y = x + t cannot be true, where x,y are distance and t is time.
Statement II : Quantities with different dimensions can't be added: **[A]**

Q.14 **Assertion :** When we change the unit of measurement of a quantity, its numerical value changes.
Reason : Smaller the unit of measurement smaller is its numerical value. **[C]**

Q.15 In the context of accuracy of measurement and significant figures in expressing results of experiment, which of the following is/are correct -
Assertion : (1) Out of the two measurements 50.14 cm and 0.00025 ampere, the first one has greater accuracy
Reason : (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 **[C]**

Q.16 **Assertion :** $\frac{40.40}{2.0}$ = 20.20 becomes 20.2 as per significant figures.

Reason : In the case of measured values to be divided, the quotients will have the number of significant digits equal to the least numbered numerator or denominator. **[D]**

Q.17 **Assertion :** If $x = \frac{a^n}{b^m}$ then

maximum percentage error in x is

$$\frac{\Delta x}{x} \times 100 = n\left(\frac{\Delta a}{a}\right)\times 100 - m\left(\frac{\Delta b}{b}\right)\times 100$$

Reason : The above relation is valid when $\Delta a << a$ and $\Delta b << b$. **[C]**

Q.18 **Assertion :** A body moving along a straight line is momentarily at rest when it reverses the direction. (infinite acceleration is not possible.)

Reason : A body can not have acceleration if its velocity is zero at a given instant of time. **[C]**

Q.19 **Assertion :** A particle has positive aeeeleration it means that its speed always increases.

Reason : Acceleration is the rate of change of velocity with respect to time. **[B]**

Q.20 **Assertion :** The equation $A = B + \sqrt{C}$ may be true, where dimension of A , B and C are same.

Reason : Quantities with different dimension can not be added. **[D]**

PHYSICS

Q.1

Column-I	Column-II
(A) Linear momentum of fluid per unit area	(P) $ML^{-1}T^{-1}$
(B) Coefficient of viscosity	(Q) Poise
(C) Specific gravity	(R) $M^{-1}L^{3}T^{0}$
(D) Specific volume	(S) $M^{0}L^{0}T^{0}$

Ans. **(A) → PQ (B) → PQ (C) → S (D) → R**

Q.2

Column I	Column II
(A) Angular momentum	(P) MT^{-2}
(B) Torque	(Q) MLT^{-1}
(C) Impulse	(R) $ML^{2}T^{-2}$
(D) Surface tension	(S) $ML^{2}T^{-1}$

Ans. **(A) → S (B) → R (C) → Q (D) → P**

Q.3

Column I	Column II
(A) Coefficient of viscosity	(P) Dimensionless
(B) Strain	(Q) Unitless
(C) Angle	(R) $ML^{-1}T^{-1}$
(D) Stress	(S) $ML^{-1}T^{-2}$

Ans. **(A) → R (B) → P,Q (C) → P (D) → S**

Q.4

Column I	Column II
(A) Length	(P) Fundamental quantity
(B) Mass	(Q) Ampere
(C) Current	(R) Dimensionless
(D) Relative permittivity	(S) Supplementary unit

Ans. **(A) → P (B) → P (C) → P,Q (D) → R**

Q.5

Column-I	Column-II
(A)Young's modulus	(P) $L^{2}T^{-2}$
(B) Gravitational potential	(Q) $M^{-1}L^{3}T^{-2}$
(C) Latent heat	(R) $ML^{-1}T^{-2}$
(D) Gravitational constant	(S) $ML^{2}T^{-2}$

Ans. **(A) → R (B) → P (C) → P (D) → Q**

Q.6

Column-I	Column-II
(A) Electric potential	(P) $ML^{2}T^{-2}A^{-2}$
(B) Resistance	(Q) $ML^{2}T^{-3}A^{-1}$
(C) Capacitance	(R) $ML^{2}T^{-3}A^{-2}$
(D) Inductance	(S) $M^{-1}L^{-2}T^{4}A^{2}$

Ans. **(A) → Q (B) → R (C) → S (D) → P**

Q.7

Column-I	Column-II
(A) Conductance	(P) $ML^{2}T^{-3}A^{-2}$
(B) Conductivity	(Q) $M^{-1}L^{-2}T^{3}A^{2}$
(C) Resistivity	(R) $M^{-1}L^{-3}T^{3}A^{2}$
(D) Permittivity	(S) $M^{-1}L^{-3}A^{2}T^{4}$

Ans. **(A) → Q (B) → R (C) → P (D) → S**

Q.8

Column-I	Column-II
(A) Radiation energy	(P) Joule/m^2
(B) Surface tension	(Q) $ML^{2}T^{-2}$
(C) Torque	(R) $ML^{-1}T^{-1}$
(D) Coefficient of viscosity	(S) MT^{-2}

Ans. **A → Q ; B → P, S ; C → Q ; D → R**

Q.9

Column-I	Column-II
(A) Coefficient of elasticity	(P) Dimensionless
(B) Strain	(Q) Unitless
(C) Pressure	(R) $ML^{-1}T^{-2}$
(D) Angle	(S) Joule/m^3

Ans. **A → R, S ; B → P, Q ; C → R, S ; D → P**

Q.10 In the column given below :

C stands for capacitance
R stands for resistance
k stands for Boltgmann constant
c stands for speed of light
e stands for electronic charge
H stands for Henry

Column-I	Column-II
(A) $e^2/2\in_0 hc$	(P) Joule
(B) $\sqrt{\frac{R^2C^2}{\mu_0\varepsilon_0}}$	(Q) Dimensionless
(C) kT	(R) m^{-1}
(D) $\frac{e^4.m}{8\varepsilon_0^2 h^3 c}$	(S) Unitless

Ans. **A → Q, S ; B → R ; C → P ; D → R**

Q.11 Column I gives three physical quantities. Select the appropriate units for these from choices given in Column II. Some of the physical quantities may have more than one choice

[IIT-1990]

Column I		Column II	
(a)	Capacitance	(i)	Ohm-second
(b)	Inductance	(ii)	$Coulomb^2\ Joule^{-1}$
(c)	Magnetic Induction	(iii)	$Coulomb\ (volt)^{-1}$
		(iv)	$Newton\ (ampere\ meter)^{-1}$
		(v)	$Volt\ second\ (ampere)^{-1}$

Ans. **(a) → (ii) & (iii), (b) → (i) & (v), (c) → (iv)**

Q.12 Match the physical quantities given in column I with dimensions expressed in column II in tabular form : **[IIT-1993]**

Column I		Column II	
(a)	Angular Momentum	(i)	ML^2T^{-2}
(b)	Latent Heat	(ii)	ML^2Q^{-2}
(c)	Torque	(iii)	ML^2T^{-1}
(d)	Capacitance	(iv)	$ML^3T^{-1}Q^{-2}$
(e)	Inductance	(v)	$M^{-1}L^{-2}T^2Q^2$
(f)	Resistivity	(vi)	L^2T^{-2}

Ans. **(a) → (iii), (b) → (vi), (c) → (i), (d) → (v), (e) → (ii), (f) → (iv)**

Q.13

Column I	Column II
(A) Refractive Index	(P) Unitless
(B) Relative Density	(Q) Dimensionless
(C) Strain	(R) Radian
(D) Angle	(S) Ratio of two physical quantities

Ans. **A→P,Q,S; B → PQS ; C → P,Q,S ; D → Q,R,S**

Q.14 Match the Physical quantities given in column I with dimensional formula expressed in column II in tabular form

Column - I	Column - II
(A) Coefficient of viscosity ($\eta = \frac{F}{6\pi vr}$)	(P) MLT^{-1}
(B) Angular momentum ($L = \vec{r}\times m\vec{v}$)	(Q) ML^2T^{-2}
(C) Torque ($\tau = \vec{r}\times\vec{F}$)	(R) LT^{-1}
(D) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$	(S) $ML^{-1}T^{-1}$

Ans. **A→S; B → P ; C → Q ; D → R**

Q.15 Match the physical quantities given in column I with unit expressed in column II in tabular form

Column - I	Column - II
(A) Pressure	(P) Watt
(B) Power	(Q) Pascal
(C) Charge	(R) Hertz
(D) Frequency	(S) Coulomb

Ans. **A→ Q; B → P ; C → S ; D → R**

Q.16 The Stefan-Boltzman's constant is not a fundamental constant and one can write it in terms of fundamental constant and written as $\sigma = ah^{\alpha} C^{\beta} G^{\gamma} K_B^{\delta}$, a is dimensionless constant, h is planck constant, C is speed of light, G is universal gravitational constant and K_B is Boltzman constant.

Column – I	Column - II
(A) α	(P) – 2
(B) β	(Q) – 3
(C) γ	(R) 4
(D) δ	(S) 0

Ans. **A → Q ; B → P ; C → S ; D → R**

Q.17

Column I	Column II
(A) Angular momentum	(P) $ML^{-1}T^{-1}$
(B) Torque	(Q) MT^{-2}
(C) Surface tension	(R) ML^2T^{-1}
(D) Coefficient of viscosity	(S) ML^2T^{-2}

Ans. **A → R ; B → S ; C → Q ; D → P**

Q.18 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 and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the ORS.

[IIT - 2007]

Column I	Column II
(A) GM_eM_s G - universal gravitational Constant M_e- mass of the earth M_s - mass of the Sun	(P) (volt) (coulomb) (metre)
(B) $\frac{3RT}{M}$ R - universal gas constant T - absolute temperature M - molar mass	(Q) (kilogram) $(metre)^3(second)^{-2}$
(C) $\frac{F^2}{q^2B^2}$ F- force q - charge B - magnetic field	(R) $(metre)^2$ $(second)^{-2}$

(D) $\frac{GM_e}{R_e}$ (S) (farad) $(volt)^2$ $(kg)^{-1}$

G - universal gravitational constant

M_e - mass of the earth

R_e - radius of the earth

Ans. **$A \rightarrow P,Q$; $B \rightarrow R, S$; $C \rightarrow R,S$; $D \rightarrow R,S$**

Q.19 Match the physical quantities given in column I with unit expressed in column II in tabular form

Column - I	**Column - II**
(A) Pressure	(P) Watt
(B) Power	(Q) Pascal
(C) Charge	(R) Hertz
(D) Frequency	(S) Coulomb

Ans. **[$A \rightarrow Q$, $B \rightarrow P$, $C \rightarrow S$, $D \rightarrow R$]**

Q.20 Match the physical quantities given in column I with dimensions expressed in column II in tabular form

Column I	**Column II**
(A) Moment of Inertia ($I = Mr^2$, M = mass, r = radius)	(P) $ML T^{-1}$
(B) Momentum	(Q) ML^2T^{-1}
(C) Planck's constant ($E = h\nu$, E = Energy, ν = frequency, h = Planck constant)	(R) ML^2
(D) Gravitational constant	(S) $M^{-1}L^3T^{-2}$

Ans. **[$A \rightarrow R$, $B \rightarrow P$, $C \rightarrow Q$, $D \rightarrow S$]**

PHYSICS

Q. 1 Which of the following pairs have same dimensions?
(A) Torque and energy
(B) Angular momentum and work
(C) Energy and Young's modulus
(D) Light year and wavelength **[A,D]**

Q.2 A book with many printing errors contains four different expressions for the displacement y of a particle executing simple harmonic motion -
(A) $y = A \sin (2\pi t/T)$
(B) $y = A \sin vt$
(C) $y = (A/T) \sin (t/A)$
(D) $y = (A/\sqrt{2}) (\sin \omega t + \cos \omega t)$
Find the wrong formulae on dimensional ground. (where A is length) **[B,C]**

Q.3 Pressure is defined as -
(A) Momentum per unit area
(B) Momentum per unit area per unit time
(C) Momentum per unit volume
(D) Energy per unit volume **[B,D]**

Q.4 Choose the correct statements -
(A) A dimensionally correct equation may be correct
(B) A dimensionally incorrect equation must be incorrect
(C) A dimensionally correct equation may be incorrect
(D) A dimensionally incorrect equation may be correct **[A,B,C]**

Q.5 If L, C and R represent the physical quantities inductance, capacitance and resistance respectively, the combinations which have the dimensions of frequency are -
Energy stored in inductor, $U_L = 1/2\ LI^2$
Energy stored in capacitor, $U_C = \frac{1}{2}\frac{Q^2}{C}$
Power consumed in resister, $P = I^2R$
(A) (1/RC) (B) (R/L)
(C) $(1/\sqrt{LC})$ (D) (C/R
[A,B,C]

Q.6 Which of the following is dimensionally incorrect ?
(A) moment of force = force × length
(B) moment of force = force per unit volume
(C) moment of force = force per unit area
(D) moment of force = force per unit length.
[B,C,D]

Q.7 Which of the following is a unit of permeability ?
(A) H/m (B) wb/Am
(C) Ohm × s/m (D) $V \times s/m^2$
[A,B,C]

Q.8 Which of the following combination have the dimension of time ? L, C, R represents as usual.
(A) RC (B) $\sqrt{LC}$
(C) R/L (D) C/L **[A,D]**

Q.9 If L, C, R represents as usual, then the combination having dimensions of frequency are -
(A) $1/\sqrt{LC}$ (B) L/C
(C) R/L (D) R/C **[A,C]**

Q.10 Choose the correct statements -
(A) A dimensionally correct equation may be correct
(B) A dimensionally incorrect equation must be incorrect
(C) A dimensionally correct equation may be incorrect
(D) A dimensionally incorrect equation may be correct **[A,B,C]**

Q.11 Which of the following pairs have same dimensions ? **[IIT-1986]**
(A) Torque and work
(B) Angular momentum and work
(C) Energy and Young's modulus
(D) Light year and wavelength **[A,D]**

Q.12 The SI unit of the inductance, the henry can by written as - **[IIT-1998]**
(A) weber/ampere
(B)volt-second/ampere
(C) $joule/(ampere)^2$
(D) ohm-second **[A,B,C,D]**

Q.13 Let ε_0 denote the dimension formula of the permittivity of the vacuum and μ_0 that of permeability of the vacuum, then - **[IIT-1998]**

(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) $[\mu_0] = ML^2T^{-1}I$ **[B,C]**

Q.14 Dimension of Young's Modulus are same as

(A) Pressure

(B) Energy density

(C) Work per unit volume

(D) Torque **[A,B,C]**

Q.15 A force F is given by $F = at + bt^2$, where t is time.

(A) dimensions of a are MLT^{-3}

(B) dimensions of a are MLT^{-2}

(C) dimensions of b are MLT^{-3}

(D) dimensions of b are MLT^{-4} **[A,D]**

Q.16 Which of the following physical quantities do not have the same dimension

(A) Heat, Energy

(B) Density, Relative density

(C) Tension, Surface tension

(D) Momentum, Angular momentum **[B,C.D]**

Q.17 The velocity 'v' of a particle is given by $v = a + bt + ct^2$, then

(A) Dimensions of a is same as v

(B) Dimensions of b is same as ct

(C) Dimensions of c is same as v/t^2

(D) Dimensions of b^2 is same as ac **[A,B,C,D]**

Q.18 The units of electrical permittivity $\left[\varepsilon_0 = \frac{q^2}{4\pi Fr^2}\right]$ are –

(A) $N^{-1}m^{-2}C^2$ (B) $Nm^{-2}C^2$

(C) C^2/Nm^2 (D) N/Cm^2 **[A,C]**

Q.19 The unit of charge is -

(A) Ampere (B) Coulomb

(C) Ampere/sec (D) Ampere-sec **[B,D]**

Q.20 Which of the following pairs have same dimensions -

(A) Torque and Work

(B) Angular momentum and Work

(C) Energy and Young's Modulus

(D) Light year and wavelength **[A, D]**

PHYSICS

Q.1 The dimensional formula of a physical quantity x is $[M^{-1}L^3T^{-2}]$ the percentage error in measuring the quantities M, L and T are 2%, 3% and 4%. Find the maximum percentage error that occurs in measuring the quantity x.

[0019]

Q.2 Force applied by water jet from a pipe depends upon (i) velocity of water (ii) density of water (iii) cross-sectional area of pipe. How many times force will be increased if velocity of a water is increased 2 times ?

Sol. **[4]**

$F \propto v^a$

$\propto \rho^b$

$\propto A^c$

$\Rightarrow F = k\, v^a \rho^b A^c$ k : dimensional constant.

By dimension analysis $a = 2 \Rightarrow F \propto v^2$.

Q.3 A student measures diameter of a sphere using vernier calliper having least count 0.1 mm and reports diameter equal to 0.025307 meter. Numbers of significant figure in diameter will be-

Sol. **[4]**

Numbers of significant digits in a number is equal numbers of all reliable digits in that number plus 1.

Q.4 A quantity x is defined as $x = \dfrac{a^3 - b^2}{\sqrt{c+d}}$. Value of a, b, c and d are reported as $a = 3 \pm 0.001$, $b = 5 \pm 0.0013$, $c = 6 \pm 0.24$ and $d = 10 \pm 0.4$. Percentage error in x will be -

Sol. **[4]**

% error in x = x error in $(a^3 - b^2) + \dfrac{1}{2}$ % error in $(c + d)$

% error in $(a^3 - b^2) = \dfrac{3a^2\Delta a + 2b\Delta b}{a^3 - b^2} \times 100$

% error in $(c + d) = \dfrac{\Delta c + \Delta d}{c+d} \times 100$

Q.5 Lifting power of helicopter depends upon hovering speed of blades (ω), length of blades (ℓ) and density of air (ρ). how many times lifting power will increase if hovering speed is increased two times. **[0008]**

Sol. $P = k\, \omega^a \rho^b \ell^c$

$\Rightarrow \quad ML^2T^{-3} = (T^{-1})^a (ML^{-3})^b L^c$

$\Rightarrow \quad a = 3 \qquad \therefore P \propto \omega^3$

Q.6 Dimension of a base quantity in other base quantities is equal to ..... **[0000]**

Q.7 Find the missing number in the expression given below $A = s\, e^{-\frac{at^{[\,]}}{A}}$ where s : displacement, t : time , a : acceleration.

[0002]

Sol. $\left[\dfrac{at^x}{A}\right] = 1 \Rightarrow \dfrac{[a][t]^x}{[s]} = 1 \Rightarrow x = 2$

Q.8 A physical quantity A is dependent on other four physical quantities p, q, r and s as given below

$A = \dfrac{\sqrt{pq}}{r^2 s^3}$. The percentage error of measurement in p, q, r and s are 1%, 3%, 0.5% and 0.33% respectively, then what is the maximum percentage error in A ?

Sol. **[4]**

$$\frac{\Delta A}{A} = \frac{1}{2}\left(\frac{\Delta P}{P} + \frac{\Delta q}{q}\right) + \frac{2\Delta r}{r} + \frac{3\Delta S}{S}$$

$$= \frac{1}{2}[1\% + 3\%] + 2 \times 0.5 + 3 \times 0.33 = 2 + 1 + 1 = 4\%$$

Q.9 The lengths of sides of cuboid are a, 2a and 3a. If the relative percentage error in the measurement of a is 1%, then what is the relative percentage error in the measurement of volume of cube.

Sol. **[3]**

$V = a \times 2a \times 3a \quad \Rightarrow \quad V = 6a^3$

$$\frac{\Delta V}{V} = 3\frac{\Delta a}{a} = 3\%$$

Q.10 The length of a cylinder is measured with a metre rod having least count 0.1 cm. Its diameter is measured with vernier calipers having least count 0.01 cm. Given that length is 5.0 cm and radius is 2.0 cm. The percentage

error in the calculated value of the volume will be -

Sol. **[3]**

$V = \pi r^2 h$ or $\frac{\Delta V}{V} = 2\frac{\Delta r}{r} + \frac{oh}{h}$

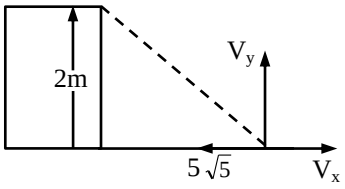
$\frac{\Delta V}{V} \times 100 = \left(2 \times \frac{0.01}{2} + \frac{0.1}{5}\right) \times 100$

$= (0.01 + 0.02) \times 100$

$\frac{\Delta V}{V} \times 100 = (0.03) \times 100 = 3\%$

Q.11 A 2m wide truck is moving with a speed of $5\sqrt{5}$ m/s along a straight horizontal road. A man starts crossing the road with a uniform speed v when the truck is 4m away from him. The minimum value of v (in m/s) to cross the truck safely is-

Sol. **[5]**



In frame of out of track, track will be at rest

$\frac{V_y}{5\sqrt{5} - V_x} = \frac{2}{4} = \frac{1}{2}$ or $2V_y = 5\sqrt{5} - V_x$ ....(i)

$V_x^2 + V_y^2 = V^2$

for V to be minimum $\frac{dV}{dV_x} = 0$

Solving we get V = 5 m/s

Q.12 A particle of mass m is located in a region where its potential energy [U(x)] depends on the position x as Potential Energy [U(x)] = $\frac{a}{x^2} - \frac{b}{x}$ here a & b are positive constants ….

(i) Write dimensional formula of a & b

(ii) If the time period of oscillation which is calculated from above formula is stated by a student as $T = 4\pi a\sqrt{\frac{ma}{b^2}}$, check whether his answer is dimensionally correct.

Sol. (i) ML^4T^{-2}, ML^3T^{-2} (ii) Incorrect

Q.13 Find the number of significant digits in 0.01050

Sol. **[4]**

Q.14 Dimensional formula of capacitance is written as $[M^{-1} L^{-2} T^{x} A^{+2}]$. Find x. C = $\frac{q^2}{2U}$ where U stands for energy and q charge.

Sol. **[x = 4]** $[\overline{C}] = M^{-1}L^{-2}T^4A^{+2}$

Q.15 The area of a rectangle of size 1.25 cm ×1.55 cm is 1.9 y, where y is single digit numbers. Find y.

Sol. [4] 1.25× 1.55 = 1.94

Q.16 Dimensional formula of electric potential (V) is given by $[ML^2T^{-x}A^{-1}]$. Find x.

Given : $\boxed{V = \frac{\text{Energy}}{\text{Charge}}}$

Sol.[3] $[V] = \frac{ML^2T^{-2}}{AT} = ML^2T^{-3}A^{-1}$

Q.17 Dimensional formula of inductance (L) is given by $[ML^2T^{-x}A^{-2}]$. Find x.

Given : Inductance (L) = $\frac{2 \times \text{energy}}{(\text{current})^2}$

Sol. **[x = 2]** $[L] = \frac{ML^2T^{-2}}{A^2} = ML^2T^{-2}A^{-2}$

PHYSICS

Q.1 Which of the following physical quantities has neither dimensions nor unit ?
(A) angle
(B)Luminous intensity
(C) coefficient of friction
(D) current **[C]**

Q.2 The dimensional formula of latent heat is –
(A) $M^0L^2T^{-2}$ (B) ML^2T^{-1}
(C) MLT^{-1} (D) $M^0L^2T^{-1}$ **[A]**

Q.3 The dimensional formula of angular momentum is–
(A) ML^2T^{-2} (B) MLT^{-2}
(C) ML^2T^{-2} (D) ML^2T^{-1} **[B]**

Q.4 A pressure of 10^6 dynes/cm^2 is equivalent to
(A) 10^5 N/m^2 (B) 10^4 N/m^2
(C) 10^6N/m^2 (D) 10^7N/m^2 **[A]**

Q.5 Which one of the following has the dimensions of $[ML^{-1}T^{-2}]$
(A) torque (B) surface tension
(C) viscosity (D) stress **[D]**

Q.6 If C and L denote the capacitance and inductance, then the units of LC are –
(A) $M^0L^0T^2$ (B) $M^0L^2T^{-2}$
(C) MLT^{-2} (D) M^0L^0T **[A]**

Q.7 The dimensions of torque are –
(A) $[MLT^{-2}]$ (B) $[ML^{-1}T^{-2}]$
(C) $[ML^2T^{-2}]$ (D) $[ML^{-2}T^{-2}]$ **[C]**

Q.8 The frequency of vibrations of a mass m suspended from a spring of spring constant k is given by $\nu = cm^x k^y$, where c is a dimensionless constant. The values of x and y are respectively.
(A) $\frac{1}{2}, \frac{1}{2}$ (B) $-\frac{1}{2}, -\frac{1}{2}$
(C) $\frac{1}{2}, -\frac{1}{2}$ (D) $-\frac{1}{2}, \frac{1}{2}$ **[D]**

Q.9 The velocity v of a particles is given in terms of time t by the equation.
$\mathbf{v} = at + \frac{b}{t+c}$. The dimension of a, b and c are
(A) L^2, T, $L\,T^2$ (B) LT^2, LT, L
(C) LT^{-2}, L, T (D) L, LT, T^2 **[C]**

Q.10 Which of the following pairs of physical quantities have different dimensions.
(A) Stress, pressure
(B) Young's modulus, energy
(C) Density, relative density
(D) Energy, torque **[C]**

Q.11 Which of the following pairs have identical dimensions
(A) Momentum and force
(B) Pressure and surface tension
(C) Moment of force and angular momentum
(D) Surface tension and surface energy **[D]**

Q.12 if force F, acceleration A and time T are basic physical quantities, the dimensions of energy are –
(A) $[F^2A^{-1}T]$ (B) $[FAT^2]$
(C) $[FAT^{-2}]$ (D) $[FA^{-1}T]$ **[B]**

Q.13 The dimensional formula of resistivity of Conductor is –
(A) $[ML^2T^{-2}A^{-2}]$ (B) $[ML^3T^{-3}A^{-2}]$
(C) $[ML^{-2}T^{-3}A^{-2}]$ (D) $[ML^2T^{-2}A^{-3}]$ **[B]**

Q.14 The dimensions of $\frac{1}{2}\varepsilon_0 E^2$($\varepsilon_0$ = permittivity of free space and E = electric field) are –
(A) $[ML^2T^{-1}]$ (B) $[ML^{-1}T^{-2}]$
(C) $[ML^2T^{-2}]$ (D) $[MLT^{-1}]$ **[B]**

Q.15 If force (F), length (L) and time (T) be considered fundamental units, then units of mass will be –
(A) $[F\,L^{-1}T^{-2}]$ (B) $[F^2\,L\,T^{-2}]$
(C) $[F\,L\,T^{-2}]$ (D) $[F\,L^{-2}\,T^{-1}]$ **[A]**

Q.16 Which of the following pairs do not have identical dimensions –
(A) Pressure and stress
(B) Work and pressure energy
(C) Angular momentum and Plank's constant

(D) Moment of force and momentum **[D]**

Q.17 The product (PV) has the dimensions –
(A) $[ML^{-1}T^{-2}]$ (B) $[M^1L^2T^{-2}]$
(C) $[M^1L^2T^{-2}]$ (D) $[M^1L^2T^{-3}]$ **[C]**

Q.18 kg m/s^2 stand for the unit of –
(A) Energy (B) acceleration
(C) Force (D) Momentum **[C]**

Q.19 In the SI system, the unit of temperature is –
(A) Degree centigrade (B) Degree Celsius
(C) Kelvin (D) Degree Fahrenheit **[C]**

Q.20 The dimensional formula for impulse is –
(A) $[M\,L\,T^{-1}]$ (B) $[M\,L\,T^{-2}]$
(C) $[M\,L^2\,T^{-1}]$ (D) $[M^2\,L\,T^{-1}]$ **[A]**

Q.21 Choose the physical quantity that is different from others –
(A) Moment of Inertia
(B) Electric current
(C) Pressure energy
(D) Rate of change of velocity **[D]**

Q.22 The frequency (n) of vibration of a string is given as $n = \frac{1}{2\ell}\sqrt{\frac{T}{m}}$, where T is tension and ℓ is the length of vibrating string, then the dimensional formula for m is –
(A) $[M^0L^1T^1]$ (B) $[M^0L^0T^0]$
(C) $[M^1L^{-1}T^0]$ (D) $[ML^0T^0]$ **[C]**

Q.23 In the relation y = r sin (ωt – kx) the dimensions of $\frac{\omega}{k}$ are–
(A) $[M^0L^0T^0]$ (B) $[M^0L^1T^{-1}]$
(C) $[M^0L^0T^1]$ (D) $[M^0L^1T^0]$ **[B]**

Q.24 Dimensions of $\in_0\mu_0$ are –
(A) $[L\,T^{-1}]$ (B) $[L\,T^{-2}]$
(C) $[L^2T^{-2}]$ (D) $[L^{-2}\,T^2]$ **[D]**

Q.25 The equation of state of a real gas can be expressed as $\left(P+\frac{a}{V^2}\right)(V-b) = cT$, where P is the pressure, V the volume, T the absolute temperature and a, b, c are constants. What are the dimensions of 'a'–
(A) $M^0\,L^3\,T^{-2}$ (B) $M\,L^{-2}\,T^5$
(C) $M\,L^5\,T^{-2}$ (D) $M^0\,L^3\,T^0$ **[C]**

Q.26 What is the physical quantity whose dimensions are $M\,L^2\,T^{-2}$ –
(A) Pressure (B) Kinetic energy
(C) Power (D) Momentum **[B]**

Q.27 If the velocity (V), acceleration (A) and force (F) are taken as fundamental quantities instead of mass (M), length (L) and time (T), the dimensions of Young's modulus would be –
(A) $FA^2\,V^{-4}$ (B) $FA^2\,V^{-5}$
(C) $FA^2\,V^{-3}$ (D) $FA^2\,V^{-2}$ **[A]**

Q.28 If L, R, C and V respectively represent inductance, resistance, capacitance and potential difference then the dimensions of $\frac{L}{RCV}$ are the same as those of –
(A) Charge (B) $\frac{1}{\text{Charge}}$
(C) Current (D) $\frac{1}{\text{Current}}$ **[D]**

Q.29 A gas bubble from an explosion under water oscillates with a period proportional to $P^a\,d^b\,E^c$, where P is the static pressure, d is the density of water and E is the energy of explosion. Then a, b, c are respectively –
(A) 1, 1, 1 (B) $\frac{1}{3},\frac{1}{2},\frac{-5}{6}$
(C) $\frac{-5}{6},\frac{1}{2},\frac{1}{3}$ (D) $\frac{1}{2},\frac{-5}{6},\frac{1}{3}$ **[A]**

Q.30 Subtract 0.2 J from 5.27 J and express the result with correct number of significant figures -
(A) 5.1 J (B) 5.06 J
(C) 5.0 J (D) 5 J **[A]**

Q.31 Error in the measurement of radius of a sphere is 2%. Then error in the measurement of volume is -
(A) 2% (B) 4%
(C) 8% (D) 6% **[D]**

Q.32 The velocity v of waves produced in water depends on their wavelength λ, the density of

water ρ, and acceleration due to gravity g. The square of velocity is proportional to -

(A) $\lambda^{-1}g^{-1}\rho^{-1}$ (B) λg

(C) $\lambda\rho g$ (D) $\lambda^2 g^{-2}\rho^{-1}$ **[B]**

Q.33 The maximum error in the measurement of mass and length of the side of a cube are 2% and 1% respectively. The maximum error in its density is-

(A) 2% (B) 1% (C) 3% (D) 5%

[D]

Q.34 The equation $\frac{dv}{dt} = At - Bv$ is describing the rate of change of velocity of a body falling from rest in a resisting medium. The dimensions of A and B are -

(A) LT^{-3}, T (B) LT^{-3}, T^{-1}

(C) LT, T (D) LT, T^{-1} **[B]**

Q.35 If x = a – b, the maximum percentage error in the measurement of x will be -

(A) $\left(\frac{\Delta a}{a}+\frac{\Delta b}{b}\right)\times 100\%$

(B) $\left(\frac{\Delta a}{a}-\frac{\Delta b}{b}\right)\times 100\%$

(C) $\left(\frac{\Delta a}{a-b}+\frac{\Delta b}{a-b}\right)\times 100\%$

(D) $\left(\frac{\Delta a}{a-b}-\frac{\Delta b}{a-b}\right)\times 100\%$ **[C]**

Q.36 When 96.54 is divided by 2.40, the correct result is -

(A) 40.2250 (B) 40.225

(C) 40.23 (D) 40.2 **[D]**

Q.37 The velocity 'v' of a particle at time t is given by, $v = \frac{a}{t} + \frac{bt}{t^2+c}$. The dimensions of a, b, c are respectively -

(A) LT^{-2}, L, T (B) L, L, T^2

(C) L, LT, T^{-2} (D) L, L, LT^2 **[B]**

Q.38 The time dependence of physical quantity P is given by $P = P_0\ e^{-\alpha t^2+\beta t+\gamma}$, where α, β, γ are constants and their dimensions are given by (where t is time) -

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

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

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

(D) M, L, T, M L T^0, $M^0 L^0 T^0$ **[A]**

Q.39 The potential energy of a particle varies with distance x from a fixed origin as $V = \frac{A\sqrt{x}}{x+B}$ where A and B are constants. The dimensions of AB are -

(A) $ML^{5/2} T^{-2}$ (B) $M^1L^2T^{-2}$

(C) $M^{3/2} L^{5/2} T^{-2}$ (D) $M^1L^{7/2}T^{-2}$ **[D]**

Q.40 Error in measurement of radius of a sphere is 1%. Then error in measurement of area is-

(A) 2% (B) 3%

(C) 4 % (D) 5% **[A]**

Q.41 The time period of a body under S.H.M. is represented by : $T = P^\alpha D^\beta S^\gamma$ where P is pressure, D is density and S is surface tension, then values of α, β and γ are -

(Surface tension $S = \frac{F}{\ell}$)

(A) $-\frac{3}{2}, \frac{1}{2}, 1$ (B) $1, 2, \frac{1}{3}$

(C) –1,–2 , 3 (D) $\frac{1}{2}, \frac{-3}{2}, \frac{-1}{2}$ **[A]**

Q.42 If x = ab, the maximum percentage error in the measurement of x will be-

(A) $\left(\frac{\Delta a}{a}\times 100\%\right)\times\left(\frac{\Delta b}{b}\times 100\%\right)$

(B) $\left(\frac{\Delta a}{a}\times 100\%\right)\div\left(\frac{\Delta b}{b}\times 100\%\right)$

(C) $\left(\frac{\Delta a}{a}-\frac{\Delta b}{b}\right)\times 100\%$

(D) $\left(\frac{\Delta a}{a}+\frac{\Delta b}{b}\right)\times 100\%$ **[D]**

Q.43 The percentage errors in measurement of mass and speed are 3 % and 2% respectively. The error in kinetic energy will be-

(A) 6% (B) 7 %

(C) 10% (D) 12% **[B]**

Q.44 What is the fractional error in g calculated from $T = 2\pi\sqrt{\ell/g}$? Given fraction errors in T and ℓ are ± x and ± y respectively-

(A) x + y (B) 2x – y

(C) 2x + y (D) x – 2y **[C]**

Q.45 In the equation $\left(P + \frac{a}{V^2}\right)(V–b)$ = constant, the unit (s) a is/are-

(A) N m^5 (B) N m^4

(C) N m^3 (D) N m^2 **[B]**

Q.46 If P = 2.347 cm, Q = 2.4 cm, then P + Q =

(A) 4.747 (B) 4.75

(C) 4.8 (D) 4.7 **[C]**

Q.47 Which physical quantities have same dimensions?

(A) Torque and work

(B) Force and power

(C) Latent heat and specific heat

(D) Work and power **[A]**

Q.48 The wavelength associated with a moving particle depends upon power p of its mass m, qth power of its velocity v and rth power of Planck's constant h. Then the correct set of values of p, q and r is –

(A) p =1, q = – 1, r = 1

(B) p = 1, q = 1, r = 1

(C) p = –1, q = –1, r = –1

(D) p = –1, q = –1, r = 1 **[D]**

Q.49 Which of the following is the most accurate ?

(A) 200.0m (B) 20×10^1m

(C) 2×10^2m (D) Data is inadequate

[A]

Q.50 The number of significant figures in 0.01020 is

(A) 3 (B) 4

(C)5 (D) 6 **[B]**

PHYSICS

Q.1 Can unit of energy be written as watt × day ?

Ans. Yes. Similar as kWh = 1000 W × h

Q.2 Write down the dimensions of coefficient of viscosity (η).

Ans. $[M\,L^{-1}\,T^{-1}]$

Q.3 If a composite physical quantity in terms of moment of inertia I, force F, velocity v, work W and length L is defined as ,

$$Q = (IFv^2/WL^3),$$

find the dimensions of Q and identify it.

Ans . $[Q] = MT^{-2}$. The quantity may be surface tension, force constant or surface energy. The physical quantity will not be unique.

Q.4 In case of diffusion the number of molecules crossing unit area per unit time is given by

$$N = -D\frac{(n_2 - n_1)}{(x_2 - x_1)}$$

where n_1 and n_2 are the number of molecules per unit volume at positions x_1 and x_2. The dimensions of coefficient of diffusion D are.....

Ans. $[L^2\,T^{-1}]$

Q.5 Check whether the following equations are dimensionally correct.

(a) $\int \frac{dx}{\sqrt{a^2 - x^2}} = \frac{1}{a}\sin^{-1}\frac{x}{a}$, where x and a stand for distances.

(b) $\nu = \frac{1}{2\pi}\sqrt{\frac{mg\ell}{I}}$, where I = moment of inertia

Ans. (a) Incorrect (b) Correct

Q.6 If in the equation y = a sin (ωt – Kx), y and x stand for distances and t for time respectively, then find the dimensions of a, ω, and K.

Ans. L, T^{-1}, L^{-1}

Q.7 The speed of a particle as a function of time is represented by $V = A_1 \cos A_2 t$. What are the dimensions and S.I. units of constants A_1 and A_2 ?

Ans. $[LT^{-1}]$ and $[T^{-1}]$; m/s and rad/s.

Q.8 Taking force, length and time to be the fundamental quantities find the dimension of -

(A) density (B) pressure

(C) momentum (D) energy

Ans. (a) $FL^{-4}T^2$, (b) FL^{-2}, (c) FT, (d) FL

Q.9 The SI and C.G.S. units of energy are joule and erg respectively. How many ergs are equal to one joule ?

Ans. 10^7 erg

Q.10 Young's modulus of steel is 19 x 10^{10} N/m^2. Express it in dyne/ cm^2. Here dyne is the C.G.S. unit of force

Ans. 19×10^{11} $dyne/cm^2$.

Q.11 The heat produced in a wire carrying an electric current depends on the current, the resistance and the time, Assuming that the dependence is of the product of powers type, guess an equation between these quantities using, dimensional analysis. The dimensional formula of resistance is $ML^2I^{-2}T^{-3}$ and heat is a form of energy.

Ans. $H = KI^2Rt$

Q.12 The frequency of vibration of a string depends on the length L between the nodes, the tension F in the string and its mass per unit length M. Guess the expression for its frequency from dimensional analysis.

Ans. $\nu = \frac{K}{L}\sqrt{\frac{F}{m}}$

Q.13 The kinetic energy K of a rotating body depends on its moment of inertia I and its angular speed ω. Assuming the relation to be $K = \alpha I^a \omega^b$ where α is a dimensionless constant, find a and b. MI of the sphere about its diameter is 2/5 Mr^2.

Ans. $KE = kI\omega^2$

Q.14 The refractive index (μ) of water in an experiment is recorded as 1.29, 1.33, 1.34, 1.31, 1.33 and 1.36 respectively. Determine

(i) mean value of refractive index

(ii) mean absolute error

(iii) relative error and the percentage error

Ans. (i) 1.33, (ii) 0.02, (iii) 1.5 %

Q.15 The position of a particle at any time is given by, $s(t) = \frac{V_0}{a}(1 - e^{-at})$, where $a > 0$ and V_0 are constants. What are the dimensions of a and V_0 ?

Ans. $[T^{-1}]$, $[LT^{-1}]$

Q.16 The equation of a wave travelling on a string stretched along the x-axis is given by $y = A\ e^{-\left[\frac{x}{a}+\frac{t}{T}\right]^2}$. Write the dimensions of A, a and T.

Ans. L, L, T

Q.17 Test if following equation are dimensionally correct, where symbols have their usual meaning –

(a) $H = \frac{2S\cos\theta}{\rho rg}$ (b) $v = \sqrt{\frac{p}{\rho}}$

(c) $v = \sqrt{\frac{\pi pr^4 t}{8\eta\rho}}$ (d) $n = \frac{1}{2\pi}\sqrt{\frac{mgh}{I}}$

Ans. All are dimensionally correct

Q.18 The distance covered by a particle in time t is given by $x = a + bt + ct^2 + dt^3$, find the dimensions of a, b, c & d.

Ans. $[a] = L$, $[b] = LT^{-1}$, $[c] = LT^{-2}$, $[d] = LT^{-3}$

Q.19 The volume of liquid flowing per second Q through a tube depends upon (i) coefficient of viscosity of fluid η , (ii) radius of the tube r, (iii) the pressure gradient (P/ℓ). Deduce by method of dimension the formula for the volume of liquid flowing per second.

Ans. $Q \propto \frac{Pr^4}{\eta\ell}$

Q.20 Find the dimensions of a and b in relation $P = \frac{b - x^2}{at}$ where P, x and t represent power, distance and time respectively.

Ans. $a = [M^{-1}L^0T^2]$, $b = [M^0L^2T^0]$