Units

1. Candela is the unit of

(A) Acoustic intensity **(B)** electric intensity
(C) luminous intensity **(D)** magnetic intensity

2. The SI unit of the universal gravitational constant G is

(A) $Nm\ kg^{-2}$ **(B)** Nm^2kg^{-2}
(C) $Nm^2\ kg^{-1}$ **(D)** $Nm\ kg^{-1}$

3. Surface tension has unit of-

(A) $Joule.m^2$ **(B)** $Joule.m^{-2}$
(C) Joule.m **(D)** $Joule.m^3$

4. Which of the following is not the name of a physical quantity ?

(A) kilogram **(B)** impulse
(C) energy **(D)** density

5. The SI unit of Stefan's constant is :

(A) $Ws^{-1}\ m^{-2}\ K^{-4}$ **(B)** $J\ s\ m^{-1}\ K^{-1}$
(C) $J\ s^{-1}\ m^{-2}\ K^{-1}$ **(D)** $W\ m^{-2}\ K^{-4}$

Dimensions

6. A pair of physical quantities having the same dimensional formula is -

(A) work and power **(B)** work and energy
(C) force and work **(D)** force and torque

7. Dimensions of ε_0 are

(A) $M^{-1}\ L^{-3}\ T^4\ A^2$ **(B)** $M^0\ L^{-3}\ T^3\ A^2$
(C) $M^{-1}\ L^{-3}\ T^3\ A$ **(D)** $M^{-1}\ L^{-3}\ TA^2$

8. The angular frequency is measured in rad s^{-1}. Its dimension in length are :

(A) –2 **(B)** –1
(C) 0 **(D)** 2

9. A dimensionless quantity :

(A) never has a unit **(B)** always has a unit
(C) may have a unit **(D)** does not exit

10. Which one of the following has the dimensions of $ML^{-1}T^{-2}$?

(A) torque **(B)** surface tension
(C) viscosity **(D)** stress

11. The potential energy (U) of a particle can be expressed in certain case as $U = \frac{A^2}{2mr^2} - \frac{BMm}{r}$ Where m and M are mass and r is distance. Find the dimensional formula for constants.

(A) **(B)**
(C) **(D)**

12. The speed (v) of wave on surface of water is given by $v = \sqrt{\frac{a\lambda}{2\pi} + \frac{2\pi b}{\rho\lambda}}$ where λ is the wavelength of the wave and ρ is density of water. a is a constant and b is a quantity that changes with liquid temperature.Find the dimensional formula for a and b.

(A) **(B)**
(C) **(D)**

13. If velocity [V] time [T] and force [F] are chosen as the base quantities, the dimensions of the mass will be:

(A) $[FTV^{-1}]$ **(B)** $[FT^2V]$
(C) $[FVT^{-1}]$ **(D)** $[FT^{-1}V^{-1}]$

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

(A) $[FL^{-4}T^2]$ **(B)** $[FL^{-3}T^3]$
(C) $[FL^{-3}T^2]$ **(D)** $[FL^{-5}T^2]$

15. The distance covered by a particle in time t is given by $x = a + bt + ct^2 + dt^3$. The dimensions of a and d are –

(A) L, T^{-3} **(B)** L, LT^{-3}
(C) L^0, T^3 **(D)** none of these

16. Given that v is the speed, r is radius and g is acceleration due to gravity. Which of the following is dimension less

(A) $\frac{v^2g}{r}$ **(B)** v^2rg
(C) vr^2g **(D)** $\frac{v^2}{rg}$

17. For $10^{(at+3)}$, the dimension of a is-

(A) $M^0 L^0 T^0$ **(B)** $M^0 L^0 T^1$
(C) $M^0 L^0 T^{-1}$ **(D)** None of these

18. "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 $T = 4\pi a\sqrt{\frac{ma}{b^2}}$, cleck whether his answer is dimensionally correct.

(A) **(B)**
(C) **(D)**

19. The loss of pressure when a fluid flows through a pipe is given by $P = k\rho^a \ell V^b d^c \mu$ where d and ℓ are diameter and length of the pipe respectively, ρ and μ are the mass density and coefficient of viscosity of the fluid, V is the mean velocity of flow through the pipe and k is a numerical constant. Find the value of a.

(A) **(B)**
(C) **(D)**

20. The displacement of air particle in a flute is given by $x = a\sin(\omega t)\cos(kx)$ where t is time in second and ω is a quantity which depends on the length of the flute (L), gas constant (R), temperature of air (T) and mass per unit mole of the air (u) Find an expression for ω in terms of all these quantities (Use PV = nRT]

(A) **(B)**
(C) **(D)**

21. $300° =$ .....

(A) $\frac{2}{3}\pi$ rad **(B)** π rad

(C) $\frac{7}{3}\pi$ rad **(D)** $\frac{5}{3}\pi$ rad

22. If $f(x) = \frac{x+2}{x-2}$, The value $f(-1)$ is :

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

(C) 3 **(D)** -3

23. Value of $\sin 37^\circ \times \operatorname{cosec} 37^\circ$

(A) 1 **(B)** 2

(C) $\frac{4}{3}$ **(D)** $\frac{3}{4}$

24. If $\frac{p}{q} = \frac{39}{17}$ then $\frac{p+q}{p-q}$

(A) $\frac{22}{17}$ **(B)** $\frac{28}{11}$

(C) $\frac{11}{28}$ **(D)** $\frac{17}{22}$

25. If $\sin\theta = \frac{3}{5}$, then $\tan\theta = ?$

(A) $\frac{3}{4}$ **(B)** $\frac{4}{3}$

(C) 37° **(D)** 53°

26. $x^2 - 5x - 6 = 0$, the value of x is -

(A) $-1, 6$ **(B)** $1, 3$

(C) $2, 2$ **(D)** $3, 3$

27. $\log_2 x = 3$, find the value of x

(A) 8 **(B)** 16

(C) 32 **(D)** 64

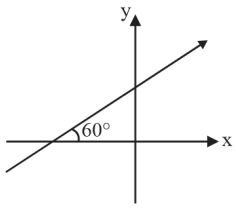
28. sinA is equal to -

(A) $2\sin^2\frac{A}{2} - 1$ **(B)** $2\cos^2\frac{A}{2} - 1$

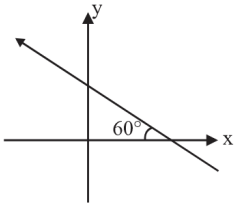
(C) $2\sin\frac{A}{2}\cos\frac{A}{2}$ **(D)** $2\sin A\cos A$

29. For the straight line $y = \sqrt{3}x + 2\sqrt{3}$, choose the correct option(s) :

(A) Graph of given straight line can be represented by



(B) Graph of given straight line can be represented by



(C) Slope is Negative **(D)** Y intercept is negative.

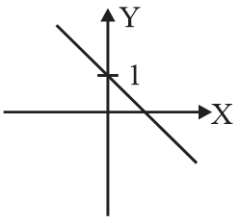
30. Which of following is true :

(A) $\sin 37° + \cos 37° = \sin 53° + \cos 53°$ **(B)** $\sin 37° + \cos 37° = \cos 53° - \sin 53°$

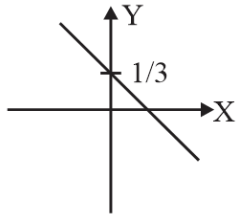
(C) $\tan 37° + 1 = \tan 53° - 1$ **(D)** $\tan 37° / \tan 53° = 1$

31. Correct graph of $4x + 3y + 1 = 0$ is -

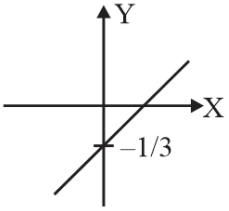
(A)



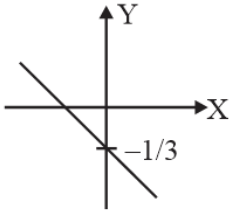
(B)



(C)

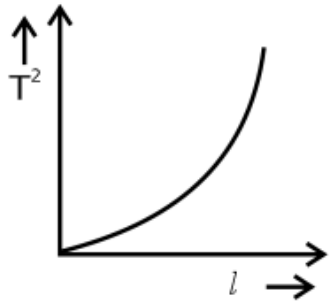


(D)

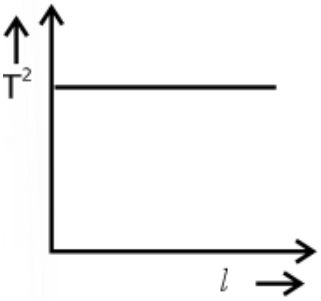


32. Which of the following curve is related to function $T^2 \propto \ell^3$

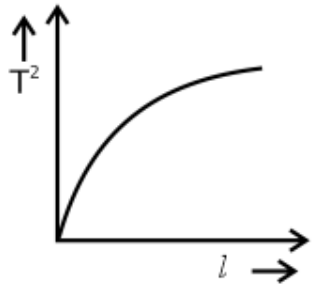
(A)



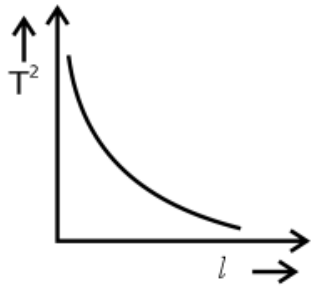
(B)



(C)



(D)

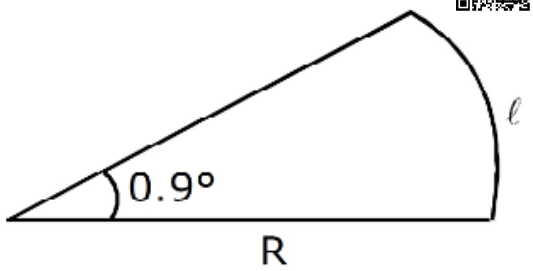


33. A pole of 6 m height casts a shadow of $2\sqrt{3}$ long on the ground then the elevation angle of sun is

(A) 60° **(B)** 45°

(C) 30° **(D)** 90°

34. As shown in diagram what is the leng rc ℓ.



(A) $\frac{\pi R}{100}$ **(B)** 0.8

(C) $\frac{\pi R}{200}$ **(D)** None of these

35. Cos (120°) is-

(A) 1/2 **(B)** $\sqrt{\frac{3}{2}}$

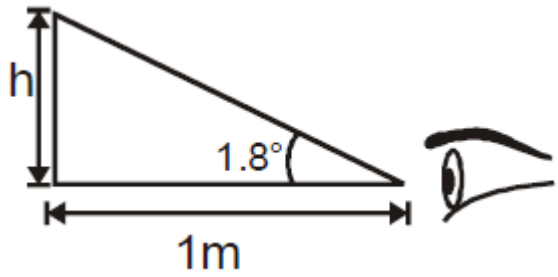
(C) –1/2 **(D)** $-\sqrt{\frac{3}{2}}$

36. Internal radius of a ball is 3 cm and external radius is 4 cm. What will be the volume of the material used.

(A) $\frac{74\pi}{3}$ **(B)** $\frac{148\pi}{3}$

(C) $\frac{148\pi}{9}$ **(D)** none of these

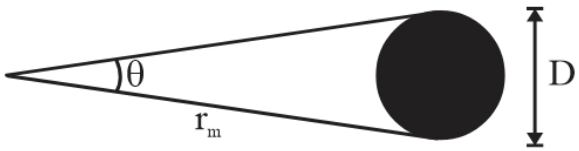
37. A normal human eye can see an obj king an angle of 1.8° at the eye. W the approximate height of object which can be seen by an eye placed at a distance of 1 m from the eye.



(A) π cm **(B)** 2π cm

(C) 3π cm **(D)** 4π cm

38. The angle subtended by the moon's d r at a point on the earth is about 0.50°. Use d the fact that the moon is about 384000 km away to find the approximate diameter of the moon.



(A) 192000 km **(B)** 3350 km

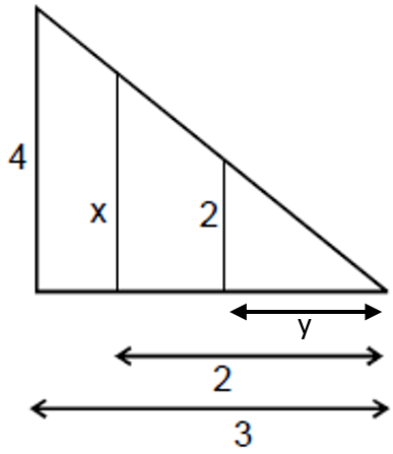
(C) 1600 km **(D)** 1920 km

39. The radius of two circles are r and 4r what will be the ratio of their Area and perimeter.

(A) $\frac{1}{4}, \frac{1}{8}$ **(B)** $\frac{1}{4}, \frac{1}{16}$

(C) $\frac{1}{16}, \frac{1}{4}$ **(D)** $\frac{1}{8}, \frac{1}{4}$

40. Find x and y :



(A) $x = \frac{4}{3}, y = \frac{3}{2}$ **(B)** $x = \frac{8}{3}, y = \frac{6}{2}$

(C) $x = \frac{8}{3}, y = \frac{3}{2}$ **(D)** $x = \frac{3}{2}, y = \frac{8}{3}$

41. The following equations describe the motion of objects. In each case, what must the units be for the variables A, B and C? (Assuming x & y are displacements, v and v_0 are velocities, m is mass and t is time).

(a) $y = A\cos(Bx - Ct)$

(b) $v = Axe^{Bm - \frac{C^2}{v_0}}$

(A) **(B)**

(C) **(D)**

42. Write SI unit of (a) Dipole moment, (b) Electric flux & (c) Angular dispersion

(A) **(B)**

(C) **(D)**

Units (Single Correct)

1. Which of the following is not the unit of time

(A) solar day **(B)** parallactic second

(C) leap year **(D)** lunar month

Dimensions (Single Correct)

2. The time dependence of a physical quantity $P = P_0 \exp(-at^2)$ where a is a constant and t is time. The constant a

(A) will be dimensionless **(B)** will have dimensions of T^{-2}

(C) will have dimensions as that of P **(D)** will have dimensions equal to the dimension of P multiplied by T^{-2}

3. The position of a particle at time t , is given by the relation, $x(t) = \frac{v_0}{\alpha}\left(1 - e^{-\alpha t}\right)$ where v_0 is a constant and $\alpha > 0$. The dimension of v_0 & α are respectively

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

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

(Multiple Correct)

4. Choose the correct statement(s) :

(A) All quantities may be represented dimensionally in terms of the base quantities.

(B) A base quantity cannot be represented dimensionally in terms of the rest of the base quantities.

(C) The dimension of a base quantity in other base quantities is always zero.

(D) The dimension of a derived quantity is never zero in any base quantity.

(Column Match)

5.

Column-I		Column-II	
(A)	Resistivity	(P)	$[K^{-1}]$
(B)	Coefficient of volume expansion	(Q)	$[M^1L^2T^{-3}A^{-1}]$
(C)	Gravitational Potential	(R)	$[M^1L^3T^{-3}A^{-2}]$
(D)	Electric Potential	(S)	$[L^2T^{-2}]$

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

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

Use Of Dimensions (Single Correct)

6. In a certain system of units, 1 unit of time is 5 sec, 1 unit of mass is 20 kg and unit of length is 10m. In this system, one unit of power will correspond to

(A) 16 watts **(B)** 1/16 watts

(C) 25 watts **(D)** none of these

7. Dimension of $\frac{\text{Energy}}{\text{Force}}$ is equal to which of the following –

(A) (Velocity)^2/Acceleration

(B) Work done/Force

(C) $\frac{\text{Time}}{\sqrt{\mu_0\varepsilon_0}}$

(D) $\frac{\text{Force}}{\frac{1}{2}\varepsilon_0 E^2}$

8. A wave is propagating along x-axis in a medium, so that displacement y of particle at any position x, at any time t is given by $Y = \frac{a}{t^2}e^{-\left[\frac{t}{b}-\frac{x}{c}\right]}$ where a, b and c are constants. choose the correct option(s)

(A) dimension of b is [T]

(B) dimension of a is [LT^2]

(C) dimension of c is [L]

(D) $e^{-\left[\frac{t}{b}-\frac{x}{c}\right]}$ is dimensionless

Question No. 9 & 10

9. Which of the following formula can represent length in terms of $\hbar$, c and G

(A) $\sqrt{\frac{\hbar G}{c^3}}$

(B) $\sqrt{\frac{\hbar c}{G}}$

(C) $\sqrt{\frac{Gc}{\hbar}}$

(D) $\sqrt{G\hbar c}$

10. Which among the following would be the order of numerical value of a unit of mass defined in terms of $\hbar$, c and G

(A) 10^{-8} kg

(B) 10^{-10} kg

(C) 10^{-5} kg

(D) 10^{-27} kg

Basic Mathematics (Single Correct)

11. log 25 + log 4 – log 5 is equal to

(A) log 20

(B) log 25

(C) log 15

(D) log 10

Exercise 3 — Numerical Type

Use of Dimensions

1. In a new system of units, the unit of mass is 100 kg, unit of length is 4m and unit of time is 2s. Find the numerical value of 400J in this system.

2. If the units of force and that of length are doubled, the unit of energy will be (in times) :

3. If the unit of velocity is 'run', the unit of force is 'strength' and unit of time is 'second' is a hypothetical system of unit. In this system of unit, the unit of mass is $(\text{strength})^x\,(\text{second})^y\,(\text{run})^z$.
Then find the value of $x + y + z$

4. One unit of power of a motor is 150 Watts in some system of units. If the unit of force is doubled and unit of velocity tripled, then one new unit of power of motor is 5x find x

5. The units of three physical quantities x, y and z are gm cm^2s^{-5}, gm s^{-1} and cm s^{-2} respectively. The relation between x, y and z is $x = yz^n$. Find value of n.

6. If the dimension of a physical quantity $\frac{EB}{\mu}$ is $M^aL^bT^c$. Find the value of $\left(\frac{b-c}{a}\right)$. Here
$E \Rightarrow$ magnitude of electric field
$B \Rightarrow$ Magnitude of magnetic field
$\mu \Rightarrow$ Permeability of medium

7. The equation for the velocity of sound in a gas states that $v = \sqrt{\gamma k_b \frac{T}{m}}$. Velocity (v) is measured in m/s. γ is a dimensionless constant, T is temperature in kelvin (K), and m is mass in kg. The units of the Boltzmann constant is $kg.\,m^x.\,s^{-2}K^{-1}$. What is the value of x?

8. 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 :

(A) PV **(B)** P
(C) RT **(D)** R

9. Given below are two statements :
Statements (I) : Planck's constant and angular momentum have same dimensions
Statements (II) : Linear momentum and moment of force have same dimensions
In the light of the above statements choose the correct answer from the option given below

(A) Statements (I) is true but statement II is false
(B) Statements (I) is false but statement II is true
(C) Both statement I and statement II are true
(D) Both statement I and statement II are false

10. Match List - I with List - II.

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

Choose the correct answer from the options given below :

(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)

11. If mass is written as $m = kc^P G^{-1/2} h^{1/2}$ then the value of P will be : (Constants have their usual meaning with k a dimensionless constant)

(A) 1/2
(B) 1/3
(C) 2
(D) –1/3

12. 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:

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

13. 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 (ø)	III.	$[M^1\ L^2\ T^{-1}]$
D.	Momentum (p)	IV.	$[M^1\ L^2\ T^{-3}\ A^{-1}]$

Choose the correct answer from the options given below :

(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

14. Match List I with List II

List-I		List-II	
A.	Surface tension	I.	$kgm^{-1}s^{-1}$
B.	Pressure	II.	$kg\ ms^{-1}$
C.	Viscosity	III.	$kg\ m^{-1}s^{-2}$
D.	Impulse	IV.	$kg\ s^{-2}$

Choose the correct answer from the options given below:

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

15. 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	VI.	$[ML^2T^{-1}]$

Choose the correct answer from the options given below :

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

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

16. 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 correct option given below

(A) $A - IV,\ B - I,\ C - III,\ D - II$

(B) $A - IV,\ B - III,\ C - I,\ D - II$

(C) $A - IV,\ B - I,\ C - II,\ D - III$

(D) $A - I,\ B - IV,\ C - III,\ D - II$

17. In the equation $\left[x + \frac{a}{y^2}\right][y - b] = RT$, x is pressure, y is volume, R is universal gas constant T is temperature. The physical quantity equivalent to the ratio $\frac{a}{b}$ is :

(A) Coefficient of viscosity **(B)** Energy

(C) Impulse **(D)** Pressure gradient

18. 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 :

(A) Both Statements I and Statements II are incorrect. **(B)** Both Statements I and Statements II are correct.

(C) Statements I is incorrect but Statements II is correct. **(D)** Statements I is correct but Statements II is incorrect.

19. 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 $\left[T^{-1}\right]$.

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

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

(C) $A = \left[L^{-1}T\right],\ B = \left[LT^{-1}\right]$

(D) $A = \left[L^{-1}T^{-1}\right],\ B = \left[LT^{-1}\right]$

20. If momentum [P], area [A] and time [T] are taken as fundamental quantities, then the dimensional formula for coefficient of viscosity is:

(A) $[P\,A^{-1}\,T^{0}]$ **(B)** $[P\,A\,T^{-1}]$

(C) $[P\,A^{-1}\,T]$ **(D)** $[P\,A^{-1}\,T^{-1}]$

21. In Vandar 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 $\frac{a}{b}$ is dimensionally equal to:

(A) $\frac{P}{V}$ **(B)** $\frac{V}{P}$

(C) PV **(D)** PV^3

22. Given below are two statement : One is labelled as Assertion (A) and other is labelled as Reason (R).

Assertion (A) : Time period of oscillation of a liquid drop depends on surface tension (S), if density of the liquid is ρ and radius of the drop is r, then $T=K\sqrt{\frac{\rho r^3}{S^{\frac{3}{2}}}}$ is dimensionally correct, where K is dimensionless.

Reason (R): Using dimensional analysis we get R.H.S. having different dimension than that of time period.In the light of above statements, choose the correct answer from the options given below.

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

(B) Both (A) and (R) are true 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

23. Velocity (v) and acceleration (a) in two systems of units 1 and 2 are related as $v_2=\frac{n}{m^2}v_1$ and $a_2=\frac{a_1}{mn}$ respectively. Here m and n are constants. The relations for distance and time in two systems respectively are :

(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 $\frac{n^4}{m^2}T_1=T_2$

24. Consider the efficiency of carnot's engine is given by $\eta=\frac{\alpha\beta}{\sin\theta}\log\left(\frac{\beta x}{kT}\right)$, 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

(A) Dimensions of β is same as that of force.

(B) Dimension of $\alpha^{-1}x$ is same as that of energy.

(C) Dimensions of $\eta^{-1}\sin\theta$ is same as that of αβ.

(D) Dimensions of α is same as that of β.

25. 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 dimesnsions of β will be :

(A) $[ML^2\,T^{-2}\theta^{-1}]$ **(B)** $[M^{-2}L^2T^0]$

(C) $[M^0L^0T^0]$ **(D)** $[M^0L^2T^0]$

26. Which of the following physical quantities have the same dimensions?

(A) Electric displacement ($\vec{D}$) and surface charge density (σ)

(B) Displacement current and electric field

(C) Current density and surface charge density

(D) Electric potential and energy

27. If E, L, M and G denote the quantities as energy, angular momentum, mass and gravitational constant respectively, then the dimension of P in the formula $P = EL^2M^{-5}G^{-2}$ is:

(A) $[M^0\ L^1\ T^0]$ **(B)** $[M^{-1}\ L^{-1}\ T^2]$

(C) $[M^0\ L^0\ T^0]$ **(D)** $[M^1\ L^1\ T^{-2}]$

28. Match **List I** with **List 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)

29. In a typical combustion engine the workdone 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 :

(A) $[M^0\ L\ T^0]$ **(B)** $[M^2\ L\ T^{-2}]$

(C) $[M\ L\ T^{-2}]$ **(D)** $[M\ L\ T^{-1}]$

30. 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 :

(A) $[LT^{-1}]$ **(B)** $[M^0\ L^0\ T^0]$

(C) $[M\ L\ T^0]$ **(D)** $[M\ L\ T^{-1}]$

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

(A) Power factor **(B)** Quality factor

(C) Permeabilitv of free space (μ_0) **(D)** Relative magnetic permeability (μ_r)

32. The entropy of any system is given by $S = \alpha^2\beta\ \ln\left[\frac{\mu kR}{J\beta^2} + 3\right]$ Where α and β are the constants. μ,J,K and R are no. of moles, mechanical equivalent of heat, Boltzmann constant and gas constant repectively. $\left[\text{Take } S = \frac{dQ}{T}\right]$

Choose the incorrect option from the following :

(A) S, β, k and μR have the same dimensions.

(B) α and J have the same dimensions.

(C) S and α have different dimensions.

(D) α and k have the same dimensions.

33. 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 Plank's constant. Dimension of f is that of :

(A) energy **(B)** volume
(C) momentum **(D)** area

34. If momentum (P), area (A) and time (T) are taken to be the fundamental quantities then the dimensional formula for energy is:

(A) $[P^{1/2} AT^{-1}]$ **(B)** $[PA^{1/2} T^{-1}]$
(C) $\left[P^2 A^{1/2} T^{-1}\right]$ **(D)** $[P^2 AT^{-2}]$

35. 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 :

(A) $h^{-2/3}c^{-1/3}G^{4/3}A^{-1}$ **(B)** $h^{2/3}c^{5/3}G^{1/3}A^{-1}$
(C) $h^2/G^{3/2}C^{1/3}A^{-1}$ **(D)** $h^0A^{-1}G^{-1}c^5$

36. Expression for time in terms of G (universal gravitational constant). h (Plank constant) and c (speed of light) is proportional to :

(A) $\sqrt{\frac{c^3}{Gh}}$ **(B)** $\sqrt{\frac{Gh}{c^3}}$
(C) $\sqrt{\frac{hc^5}{G}}$ **(D)** $\sqrt{\frac{Gh}{c^5}}$

37. In SI units, the dimensions of $\sqrt{\frac{\varepsilon_0}{\mu_0}}$ is :

(A) $AT^2M^{-1}L^{-1}$ **(B)** $AT^{-3}ML^{3/2}$
(C) $A^{-1}TML^3$ **(D)** $A^2T^3M^{-1}L^{-2}$

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

(A) $\alpha = 7, \beta = -1, \gamma = -2$
(B) $\alpha = -7, \beta = -1, \gamma = -2$
(C) $\alpha = 7, \beta = -1, \gamma = 2$
(D) $\alpha = -7, \beta = 1, \gamma = -2$

39. 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 $\left[B\right] = [e]^{\alpha}[m_e]^{\beta}[h]^{\gamma}[k]^{\delta}$. The value of $\alpha + \beta + \gamma + \delta$ is _____.
The magnetic field B is given by $B = \frac{F}{ev}$ F is force and v is speed, r is distance and $F = \frac{Ke^2}{r^2}$

40. 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] = $[????^{????}]$; [speed] = $[????^{????}]$; [acceleration] = $[????^{????}]$; [linear momentum] = $[????^{????}]$; [force] = $[????^{????}]$. Then

(A) $\alpha + p = 2\beta$ **(B)** $p + q - r = \beta$
(C) $p - q + r = \alpha$ **(D)** $p + q + r = \beta$

41. 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 ?

(A) The dimension of force is L^{-3} **(B)** The dimension of energy is L^{-2}

(C) The dimension of power is L^{-5} **(D)** The dimension of linear momentum is L^{-1}

Question No. 7 & 8

42. The relation between [E] and [B] is

(A) [E]=[B] [L] [T] **(B)** $\frac{[E]}{[T]}=[B]\,[L]^{-1}$

(C) $[E]_1=[B]\,[L]\,[T]^{-}$ **(D)** $\frac{[E]}{[T]^{-1}}=[B]\,[L]^{-1}$

43. The relation between $[\varepsilon_0]$ and $[\mu_0]$ is -

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

44. A length-scale (ℓ) depends on the permittivity (ε) of a dielectric material. Boltzmann 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 ?

(A) $\ell=\sqrt{\left(\frac{nq^2}{\varepsilon k_B T}\right)}$ **(B)** $\ell=\sqrt{\left(\frac{\varepsilon k_B T}{nq^2}\right)}$

(C) $\ell=\sqrt{\left(\frac{q^2}{\varepsilon n^{2/3} k_B T}\right)}$

(D) $\ell=\sqrt{\left(\frac{q^2}{\varepsilon n^{1/3} k_B T}\right)}$

45. 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 option (s) is (are).

(A) $M \propto \sqrt{c}$ **(B)** $M \propto \sqrt{G}$

(C) $L \propto \sqrt{h}$ **(D)** $L \propto \sqrt{G}$

46. In terms of potential difference V, electric current I, permittivity ε_0, permeability μ_0 and speed of light c, the dimensionally correct equation (s) is (are)

(A) $\mu_0 I^2=\varepsilon_0 V^2$ **(B)** $\varepsilon_0 I=\mu_0 V$

(C) $I=\varepsilon_0 CV$ **(D)** $\mu_0 CI=\varepsilon_0 V$

47. Match List I with List-II and select the correct answer using the codes given below the lists.

	Column I		Column II
(A)	Boltzmann constant	(P)	$[ML^2T^{-1}]$
(B)	Coefficient of viscosity	(Q)	$[ML^{-1}T^{-1}]$
(C)	Planck constant	(R)	$[MLT^{-3}K^{-1}]$
(D)	Thermal conductivity	(S)	$[ML^2T^{-2}K^{-1}]$

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

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

48. Taking the electronic charge as 'e' and the permittivity as 'ε_0' use dimensional analysis to determine to correct expression for ω_p?

(A) $\sqrt{\frac{Ne}{m\varepsilon_0}}$ **(B)** $\sqrt{\frac{m\varepsilon_0}{Ne}}$

(C) $\sqrt{\frac{Ne^2}{m\varepsilon_0}}$ **(D)** $\sqrt{\frac{m\varepsilon_0}{Ne^2}}$

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

(A) 800 nm **(B)** 600 nm

(C) 300 nm **(D)** 200 nm

ANSWER KEYS

Exercise 1 (Level-A)

1. **C**	2. **B**	3. **B**	4. **A**	5. **D**	6. **B**	7. **A**	8. **C**
9. **C**	10. **D**	11.	12.	13. **A**	14. **A**	15. **B**	16. **D**
17. **C**	18.	19. **0**	20. **0**	21. **D**	22. **B**	23. **A**	24. **B**
25. **A**	26. **A**	27. **A**	28. **C**	29. **A**	30. **A**	31. **D**	32. **A**
33. **A**	34. **C**	35. **C**	36. **B**	37. **A**	38. **B**	39. **C**	40. **C**
41.	42.						

Exercise 2

1. **B**	2. **B**	3. **C**	4. **A,B,C**	5. **C**	6. **A**	7. **A,B,C**	8. **A,B,C,D**
9. **A**	10. **A**	11. **A**					

Exercise 3

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