DPP - Daily Practice Problems

Name :

Date :

Start Time :

End Time :

PHYSICS 01

SYLLABUS : Physical World, Units & Dimensions

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** choice is correct.

Q.1 If L, C and R represent inductance, capacitance and resistance respectively, then which of the following does not represent dimensions of frequency?

(a) $\frac{1}{RC}$ (b) $\frac{R}{L}$

(c) $\frac{1}{\sqrt{LC}}$ (d) $\frac{C}{L}$

Q.2 Number of particles crossing unit area perpendicular to X-axis in unit time is given by $n = -D\frac{n_2 - n_1}{x_2 - x_1}$, where n_1 and n_2 are number of particles per unit volume in the position x_1 and x_2. Find dimensions of D called as diffusion constant.

(a) $[M^0 L T^2]$ (b) $[M^0 L^2 T^{-4}]$

(c) $[M^0 L T^{-3}]$ (d) $[M^0 L^2 T^{-1}]$

Q.3 $X = 3YZ^2$ find dimensions of Y in (MKSA) system, if X and Z are the dimensions of capacity and magnetic field respectively

(a) $[M^{-3}L^{-2}T^{-4}A^{-1}]$ (b) $[ML^{-2}]$

(c) $[M^{-3}L^{-2}T^4A^4]$ (d) $[M^{-3}L^{-2}T^8A^4]$

Q.4 In the relation $P = \frac{\alpha}{\beta}e^{-\frac{\alpha Z}{k\theta}}$, P is pressure, Z is the distance, k is Boltzmann constant and θ is the temperature. The dimensional formula of β will be

(a) $[M^0L^2T^0]$ (b) $[M^1L^2T^1]$

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

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

Space for Rough Work

Q.5 The frequency of vibration of string is given by $\nu = \frac{P}{2l}\left[\frac{F}{m}\right]^{1/2}$.

Here P is number of segments in the string and l is the length. The dimensional formula for m will be

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

Q.6 What is the relationship between dyne and newton of force?

(a) 1 dyne = 10^{-5} newton (b) 1 dyne = 10^{-7} newton
(c) 1 dyne = 10^5 newton (d) 1 dyne = 10^7 newton

Q.7 The speed of light (c), gravitational constant (G) and Planck's constant (h) are taken as the fundamental units in a system. The dimensions of time in this new system should be

(a) $G^{1/2}h^{1/2}c^{-5/2}$ (b) $G^{-1/2}h^{1/2}c^{1/2}$
(c) $G^{1/2}h^{1/2}c^{-3/2}$ (d) $G^{1/2}h^{1/2}c^{1/2}$

Q.8 If the constant of gravitation (G), Planck's constant (h) and the velocity of light (c) be chosen as fundamental units. The dimensions of the radius of gyration is

(a) $h^{1/2}c^{-3/2}G^{1/2}$ (b) $h^{1/2}c^{3/2}G^{1/2}$
(c) $h^{1/2}c^{-3/2}G^{-1/2}$ (d) $h^{-1/2}c^{-3/2}G^{1/2}$

Q.9 The magnitude of any physical quantity

(a) depends on the method of measurement
(b) does not depend on the method of measurement
(c) is more in SI system than in CGS system
(d) directly proportional to the fundamental units of mass, length and time

Q.10 The unit of Stefan's constant σ is

(a) $Wm^{-2}K^{-1}$ (b) Wm^2K^{-4}
(c) $Wm^{-2}K^{-4}$ (d) $Wm^{-2}K^4$

Q.11 In $S = a + bt + ct^2$, S is measured in metres and t in seconds. The unit of c is

(a) ms^{-2} (b) m
(c) ms^{-1} (d) None

Q.12 Wavelength of ray of light is 0.00006 m. It is equal to

(a) 6 microns (b) 60 microns
(c) 600 microns (d) 0.6 microns

Q.13 SI unit of permittivity is

(a) $C^2m^2N^{-2}$ (b) $C^{-1}m^2N^{-2}$
(c) $C^2m^2N^2$ (d) $C^2m^{-2}N^{-1}$

Q.14 The dimensions of $\frac{1}{2}\varepsilon_0 E^2$ (ε_0 = permittivity of free space and E = electric field) are

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

Q.15 Which of the following pairs is wrong?

(a) Pressure-Baromter
(b) Relative density-Pyrometer
(c) Temperature-Thermometer
(d) Earthquake-Seismograph

Q.16 A physical quantity x depends on quantities y and z as follows: $x = Ay + B \tan Cz$, where A, B and C are constants. Which of the following do not have the same dimensions?

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

Q.17 If the time period (T) of vibration of a liquid drop depends on surface tension (S), radius (r) of the drop and density (ρ) of the liquid, then the expression of T is

(a) $T = k\sqrt{\rho r^3 / S}$ (b) $T = k\sqrt{\rho^{1/2} r^3 / S}$
(c) $T = k\sqrt{\rho r^3 / S^{1/2}}$ (d) None of these

Q.18 The dimensional formula for Planck's constant (h) is

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

Q.19 What are the dimensions of permeability (μ_0) of vaccum?

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

RESPONSE GRID					
	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ
	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ
	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ

Space for Rough Work

Q.20 A small steel ball of radius r is allowed to fall under gravity through a column of a viscous liquid of coefficient of viscosity η. After some time the velocity of the ball attains a constant value known as terminal velocity v_T. The terminal velocity depends on (i) the mass of the ball m, (ii) η, (iii) r and (iv) acceleration due to gravity g. Which of the following relations is dimensionally correct?

(a) $v_T \propto \dfrac{mg}{\eta r}$ (b) $v_T \propto \dfrac{\eta r}{mg}$

(c) $v_T \propto \eta rmg$ (d) $v_T \propto \dfrac{mgr}{\eta}$

Q.21 The equation of state of some gases can be expressed as $\left(P+\dfrac{a}{V^2}\right)(V-b)=RT$. Here P is the pressure, V is the volume, T is the absolute temperature and a, b and R are constants. The dimensions of 'a' are

(a) ML^5T^{-2} (b) $ML^{-1}T^{-2}$

(c) $M^0L^3T^0$ (d) $M^0L^6T^0$

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct

(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 The frequency of vibration f of a mass m suspended from a spring of spring constant k is given by a relation of the type $f = c\, m^x k^y$, where c is a dimensionless constant. The values of x and y are

(1) $x=\dfrac{1}{2}$ (2) $x=-\dfrac{1}{2}$

(3) $y=-\dfrac{1}{2}$ (4) $y=\dfrac{1}{2}$

Q.23 P represents radiation pressure, c represents speed of light and S represents radiation energy striking unit area per sec. The non zero integers x, y, z such that $P^x S^y c^z$ is dimensionless are

(1) x = 1 (2) y = – 1

(3) z = 1 (4) x = – 1

Q.24 Which of the following pairs have same dimensions?

(1) Angular momentum and work

(2) Torque and work

(3) Energy and Young's modulus

(4) Light year and wavelength

DIRECTION (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

Three of the fundamental constants of physics are the universal gravitational constant, $G = 6.7 \times 10^{-11} m^3kg^{-1}s^{-2}$, the speed of light, $c = 3.0 \times 10^8$ m/s, and Planck's constant, $h = 6.6 \times 10^{-34}$ kg m^2 s^{-1}.

Q.25 Find a combination of these three constants that has the dimensions of time. This time is called the Planck time and represents the age of the universe before which the laws of physics as presently understood cannot be applied.

(a) $\sqrt{\dfrac{hG}{c^4}}$ (b) $\sqrt{\dfrac{hG}{c^3}}$

(c) $\sqrt{\dfrac{hG}{c}}$ (d) $\sqrt{\dfrac{hG}{c^5}}$

Q.26 Find the value of Planck time in seconds

(a) 1.3×10^{-33} s (b) 1.3×10^{-43} s

(c) 2.3×10^{-13} s (d) 0.3×10^{-23} s

Q.27 The energy of a photon is given by $E=\dfrac{hc}{\lambda}$.

If $\lambda = 4 \times 10^{-7} m$, the energy of photon is

(a) 3.0 eV (b) 4.5 eV

(c) 2.10 eV (d) 3.95 eV

RESPONSE GRID					
	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ
	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ		

Space for Rough Work

DIRECTIONS (Q. 28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(c) Statement -1 is False, Statement-2 is True.
(d) Statement -1 is True, Statement-2 is False.

Q.28 Statement -1 : Unit of Rydberg constant R is m^{-1}

Statement -2 : It follows from Bohr's formula $\bar{v} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$, where the symbols have their usual meaning.

Q.29 Statement -1: The time period of a pendulum is given by the formula, $T = 2\pi\sqrt{g/l}$.

Statement -2: According to the principle of homogeneity of dimensions, only that formula is correct in which the dimensions of L.H.S. is equal to dimensions of R.H.S.

Q.30 Statement -1: L/R and CR both have same dimensions.

Statement -2: L/R and CR both have dimension of time.

RESPONSE GRID	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 1 - PHYSICS			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	30	Qualifying Score	50
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

1. (d) $f = \frac{1}{2\pi\sqrt{LC}}$

$\therefore \left(\frac{C}{L}\right)$ does not represent the dimension of frequency.

2. (d) $[n]$ = Number of particles crossing a unit area in unit time $= [L^{-2}T^{-1}]$

$[n_2] = [n_1]$ = number of particles per unit volume $= [L^{-3}]$

$[x_2] = [x_1]$ = positions

$\therefore \quad D = \frac{[n][x_2 - x_1]}{[n_2 - n_1]} = \frac{[L^{-2}T^{-1}]\times[L]}{[L^{-3}]} = [L^2T^{-1}]$

3. (d) $Y = \frac{X}{3Z^2} = \frac{M^{-1}L^{-2}T^4A^2}{[MT^{-2}A^{-1}]^2} = [M^{-3}L^{-2}T^8A^4]$

4. (a) In given equation, $\frac{\alpha Z}{k\theta}$ should be dimensionless

$\therefore \quad \alpha = \frac{k\theta}{Z} \Rightarrow [\alpha] = \frac{[ML^2T^{-2}K^{-1}\times K]}{[L]} = [MLT^{-2}]$

and $P = \frac{\alpha}{\beta} \Rightarrow [\beta] = \left[\frac{\alpha}{P}\right] = \frac{[MLT^{-2}]}{[ML^{-1}T^{-2}]} = [M^0L^2T^0]$

5. (c) $v = \frac{P}{2l}\left[\frac{F}{m}\right]^{1/2} \Rightarrow v^2 = \frac{P^2}{4l^2}\left[\frac{F}{m}\right] \therefore m \propto \frac{F}{l^2v^2}$

$\Rightarrow \quad [m] = \left[\frac{MLT^{-2}}{L^2T^{-2}}\right] = [ML^{-1}T^0]$

6. (d) By substituting the dimensions of mass $[M]$, length $[L]$ and coefficient of rigidity $[ML^{-1}T^{-2}]$ we get

$T = 2\pi\sqrt{\frac{M}{\eta L}}$ is the right formula for time period of oscillations.

7. (a) Time $\propto c^xG^yh^z \Rightarrow T = kc^xG^yh^z$

Putting the dimensions in the above relation

$\Rightarrow \quad [M^0L^0T^1] = [LT^{-1}]^x[M^{-1}L^3T^{-2}]^y[ML^2T^{-1}]^z$

$\Rightarrow \quad [M^0L^0T^1] = [M^{-y+z}L^{x+3y+2z}T^{-x-2y-z}]$

Comparing the powers of M, L and T

$-y+z=0$ ....(i)

$x+3y+2z=0$ ....(ii)

$-x-2y-z=1$ ....(iii)

On solving equations (i) and (ii) and (iii)

$x = \frac{-5}{2}, y = z = \frac{1}{2}$

Hence, dimension of time are $[G^{1/2}h^{1/2}c^{-5/2}]$.

8. (a) Let radius of gyration $[k] \propto [h]^x[c]^y[G]^z$

By substituting the dimension of

$[k] = [L]$ $[h] = [ML^2T^{-1}], [c] = [LT^{-1}]$,

$[G] = [M^{-1}L^3T^{-2}]$

and by comparing the power of both sides we can get $x = 1/2, y = -3/2, z = 1/2$

So dimension of radius of gyration are $[h]^{1/2}[c]^{-3/2}[G]^{1/2}$

9. (b) Because magnitude is absolute.

10. (c) Stefan's law is $E = \sigma(T^4) \Rightarrow \sigma = \frac{E}{T^4}$

where, $E = \frac{\text{Energy}}{\text{Area}\times\text{Time}} = \frac{\text{Watt}}{\text{m}^2}$

$\sigma = \frac{\text{Watt}-\text{m}^{-2}}{\text{K}^4} = \text{Watt}-\text{m}^{-2}\text{K}^{-4}$

11. (d) ct^2 must have dimensions of L

$\Rightarrow$ c must have dimensions of $L/T^2 = LT^{-2}$

12. (b) $6\times10^{-5} = 60\times10^{-6} = 60$ microns

13. (d) $F = \frac{1}{4\pi\epsilon_0}\frac{q_1q_2}{r^2} \Rightarrow \epsilon_0 = \frac{1}{4\pi}\frac{q_1q_2}{Fr^2} = C^2m^{-2}N^{-1}$

14. (b) According to the defition.

15. (b) Pyrometer is used for measurement of temperature.

16. (d) $x = Ay + B\tan Cz$,

From the dimensional homogenity

$[x] = [Ay] = [B] \Rightarrow \left[\frac{x}{A}\right] = [y] = \left[\frac{B}{A}\right]$

$[Cz] = [M^0L^0T^0]$ = Dimensionless

x and B; C and z^{-1}; y and $\frac{B}{A}$ have the same dimension but x and A have the different dimensions.

17. (a) Let $T \propto S^xr^y\rho^z$

by substituting the dimension of

$[T] = [T]$, $[S] = [MT^{-2}], [r] = [L], [\rho] = [ML^{-3}]$

and by comparing the power of both the sides

$x = -1/2, y = 3/2, z = 1/2$

so $T \propto \sqrt{\rho r^3/S} \Rightarrow T = k\sqrt{\frac{\rho r^3}{S}}$

18. (c) $E = hv \Rightarrow [ML^2T^{-2}] = [h][T^{-1}] \Rightarrow [h] = [ML^2T^{-1}]$

19. (c) $\vec{P} = \vec{A} + \vec{B}$

$\vec{Q} = \vec{A} - \vec{B}$

$\vec{P}.\vec{Q}=0 \Rightarrow (\vec{A}+\vec{B}).(\vec{A}-\vec{B})=0$

$\Rightarrow A^2-B^2=0 \Rightarrow |\vec{A}|=|\vec{B}|$

$\because \overline{P} \perp \overline{Q}$

20. (a) By substituting dimension of each quantity in R.H.S. of option (a) we get

$$\left[\frac{mg}{\eta r}\right]=\left[\frac{M \times LT^{-2}}{ML^{-1}T^{-1} \times L}\right]=[LT^{-1}].$$

This option gives the dimension of velocity.

21. (a) By principle of dimensional homogeneity

$$\left[\frac{a}{V^2}\right]=[P]$$

$\therefore \quad [a]=[P][V]^2=[ML^{-1}T^{-2}]\times[L^6]=[ML^5T^{-2}]$

22. (c) $f = c\, m^x k^y$;

Spring constant k = force/length.

$[M^0L^0T^{-1}] = [M^x (MT^{-2})^y] = [M^{x+y} T^{-2y}]$

$\Rightarrow x+y=0, -2y=-1 \text{ or } y=\frac{1}{2}$

Therefore, $x=-\frac{1}{2}$

23. (a) Try out the given alternatives.

When x = 1, y = –1, z = 1

$$P^xS^yC^z = P^1S^{-1}C^1 = \frac{PC}{S}$$

$$=\frac{[ML^{-1}T^{-2}][LT^{-1}]}{[ML^2T^{-2}/L^2T]}=[M^0L^0T^0]$$

24. (c) Dimensions of angular momentum, $[L]=\left[ML^2T^{-1}\right]$

Dimensions of work, $[W]=\left[ML^2T^{-2}\right]$

Dimensions of torque, $[\tau]=\left[ML^2T^{-2}\right]$

Dimensions of energy, $[E]=\left[ML^2T^{-2}\right]$

Dimensions of Young's modulus,

$$[Y]=\left[ML^{-1}T^{-2}\right]$$

Dimensions of light year = [L]

Dimension of wavelength = [L]

25. (d), **26.** (b)

$$\sqrt{\frac{hG}{c^5}}=\sqrt{\frac{kgm^2s^{-1}\times m^3kg^{-1}s^{-2}}{m^5/s^5}}=\sqrt{s^2}=s$$

Putting the values of h, G and c in above relation

Planck time = 1.3×10^{-43} s.

27. (a) $E=\frac{hc}{\lambda}=\frac{6.6\times10^{-34}\times3\times10^8}{4\times10^{-7}}=4.95\times10^{-19}$ J

= 3.0 eV

28. (a) Both statement -1 and statement -2 are correct and statement -1 follows from statement -2

29. (c) Let us write the dimension of various quantities on two sides of the given relation.

L.H.S. = $T = [T]$,

$$\text{R.H.S.}=2\pi\sqrt{g/l}=\sqrt{\frac{LT^{-2}}{L}}=[T^{-1}]$$

($\therefore$ 2π has no dimension).

As dimension of L.H.S. is not equal to dimension of R.H.S. therefore according to principle of homogeneity the relation.

$$T=2\pi\sqrt{g/l}.$$

30. (a) Unit of quantity (L/R) is Henry/ohm.

As Henry = ohm × sec,

hence unit of L/R is sec

i.e. $[L/R]=[T]$.

Similarly, unit of product CR is farad × ohm

or $\frac{\text{Coulomb}}{\text{Volt}}\times\frac{\text{Volt}}{\text{Amp}}$

or $\frac{\text{Sec}\times\text{Amp}}{\text{Amp}}=\text{second}$

i.e. $[CR]=[T]$

therefore, $[L/R]$ and $[CR]$ both have the same dimension.