PHYSICS

CLASS-XI NEET

EXPLANATIONS

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Answer Key

Topic-wise Questions

1	2	3	43	5	6	7	8	9	42	11	12	13	14	15	16	17	18
b	c	c	b	c	c	a	a	a	d	c	b	a	a	d	b	b	a
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
b	a	b	a	d	c	c	a	a	b	c	a	a	b	b	d	c	d
37	38	39	40	41	4	10	44	45	46	47	48	49	50	51	52	53	54
c	d	d	a	d	a	d	c	c	b	a	d	b	c	b	d	d	b
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
a	d	d	a	b	c	a	c	c	c	b	a	c	a	c	c	c	a
73	74	75															
b	d	a															

c

Learning-Plus

b

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
b	a	b	d	d	c	d	c	b	b	d	a	a	a	d	a	a	c
19	20	21	22	23	24	25	26	27	28	29							
a	b	c	d	c	c	a	d	c	d	c							

Multi-Concept Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
d	b	b	c	a	c	c	a	d	c	b	d	c	b	d	c

NEET Past 10 Year Questions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b	a	c	c	d	b	d	d	c	c	b	b	d	b	c	c	b

Physics Hints and Solutions Booklet Part-1 (XI & XII)

Contents

Class-XI

Class-XII

1. Units and Measurements

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Topic-wise Questions

1. (b) Magnetic moment = Current × Area = L^2A^1

2. (c) As C is added to t, therefore, C has the dimensions of T.

As $\frac{b}{t} = V$, $\quad b = V \times t = LT^{-1} \times T = (L)$

From V = at, $a = \frac{v}{t} = \frac{LT^{-1}}{T} = [LT^{-2}]$

3. (c) (a) Work = force x distance= $[MLT^{-2}][L] = [ML^2T^{-2}]$
Torque = force × distance = $[ML^2 T^{-2}]$

(b) Angular momentum = mvr = $[M][LT^{-1}][L] = [ML^2T^{-1}]$

Planck's constant $= \frac{E}{\nu} = \frac{[ML^2T^{-2}]}{[T^{-1}]} = [ML^2L^{-1}]$

(c) Tension = force = $[MLT^{-2}]$

Surface tension $= \frac{\text{force}}{\text{length}} = \frac{[MLT^{-2}]}{[L]} = [ML^0T^{-2}]$

(d) Impulse = force × time = $[MLT^{-2}][T] = [MLT^{-1}]$
Momentum = mass × velocity $=[M][LT^{-1}] = [MLT^{-1}]$

4. (b) From the principle of homogenity $\left(\frac{x}{v}\right)$ and K has dimensions of T.

5. (c) A unitless quantity never has a non-zero dimension, i.e., it is dimensionless.

6. (c) Given, Young's modulus Y = 1.9×10^{11} N/m^2

1N = 10^5 dyne

Hence,Y = $1.9 \times 10^{11} \times 10^5$ dyne/$(100)^2$ cm^2

We know that 1m = 100 cm

$\therefore$ Y = $1.9 \times 10^{11} \times 10^5$ dyne/$(100)^2$ cm^2

= $1.9 \times 10^{16-4}$ dyne/cm^2

Y = 1.9×10^{12} dyne/cm^2

7. (a) A dimensionless quantity may have a unit. For example: angle has a unit but is dimensionless.

8. (a) As a × t is dimensionless

$a = \frac{1}{t} = \frac{1}{T} = [T^{-1}]$

Also; $x = \frac{v_0}{a} \Rightarrow v_0 = xa = [LT^{-1}]$

9. (a) Intensity = Energy per second per unit area

$$= \frac{ML^2T^{-2}}{TL^2} = [M^1L^0T^{-3}]$$

10. (d) Surface tension $= \frac{\text{Force}}{\text{Length}} = \frac{[MLT^{-2}]}{[L]} = [ML^0\,T^{-2}]$

Spring constant $= \frac{\text{Force}}{\text{Length}} = \frac{[MLT^{-2}]}{[L]} = [ML^0\,T^{-2}]$

11. (c) $P = \frac{F}{A} = \frac{MLT^{-2}}{L^2} = [ML^{-1}T^{-2}] = \frac{M}{LT^2}$

12. (b) $RC = \left(\frac{V}{I}\right)\left(\frac{q}{V}\right) = \frac{q}{I} = \frac{I \times t}{I} = t$

13. (a) From; $F = \frac{Gm_1m_2}{r^2}$

$$G = \frac{Fr^2}{m_1m_2} = \frac{(MLT^{-2})L^2}{M^2} = [M^{-1}L^3T^{-2}]$$

14. (a) Magnetic flux (ϕ) = BA = $\left(\frac{F}{I\ell}\right)A$

$$= \frac{(MLT^{-2}(L^2))}{AL} = [M^1L^2T^{-2}A^{-1}]$$

15. (d) $h = \frac{E}{\nu} = \frac{ML^2T^{-2}}{T^{-1}} = [ML^2T^{-1}]$

$$L = I\omega = (ML^2)(T^{-1}) = [M^1L^2T^{-1}]$$

16. (b) We know that energy of radiation, E = hv,

$[h] = \frac{[E]}{[v]} = \frac{[ML^2T^{-2}]}{[T^{-1}]} = [ML^2T^{-1}]$

Angular impulse = τdt = ΔL = Change in angular momentum

Hence, dimension of angular impulse

= Dimension of angular momentum = $[ML^2T^{-1}]$.

This is similar to the dimension of Planck's constant *h*.

17. (b) Dimensions of work and torque = $[ML^2T^{-2}]$

18. (a) Resistivity$(\rho) = \frac{[R][A]}{[L]}$ where; R = $[ML^2T^{-1}Q^{-2}]$

19. (b) Power $= \dfrac{\text{Work}}{\text{Time}}$

$$\therefore [\text{Power}] = \frac{[\text{Work}]}{[\text{Time}]} = \frac{[ML^2T^{-2}]}{[T]} = [ML^2T^{-3}]$$

20. (a) $\dfrac{R}{L} = \dfrac{V/I}{V \times T/I} = \dfrac{1}{T} = \text{Frequency}$

21. (b) We know that pressure $= \dfrac{\text{Force}}{\text{Area}}$

$$\text{Pressure} = \frac{\text{Force} \times \text{Distance}}{\text{Area} \times \text{Distance}} = \frac{\text{Work}}{\text{Volume}} = \frac{\text{Energy}}{\text{Volume}}$$

22. (a) $K = \gamma \times r_0 = [ML^{-1}T^{-2}]\,[L] = [MT^{-2}]$

γ = Young's modulus and r_0 = Interatomic distance

23. (d) $e = L\dfrac{di}{dt}$

$$[e] = [ML^2T^{-2}A^{-2}]\left[\frac{A}{T}\right] = \left[\frac{ML^2T^{-2}}{AT}\right] = [ML^2T^{-2}Q^{-1}]$$

24. (c) Momentum $[MLT^{-1}]$, Planck's constant $[ML^2T^{-1}]$

25. (c) $[X] = [F] \times [\rho]^{1/2}$

$$= [MLT^{-2}] \times \left[\frac{M}{L^3}\right]^{1/2} = [M^{3/2}L^{-1/2}T^{-2}]$$

26. (a) $\dfrac{1}{\sqrt{\mu_0\varepsilon_0}} = C = \text{Velocity of light}$

So dimension of velocity and $\dfrac{1}{\sqrt{\mu_0\varepsilon_0}}$ is same

27. (a) Angle of banking;

$$\tan\theta = \frac{V^2}{rg} \text{ i.e., } \frac{V^2}{rg} \text{ is dimensionless}$$

28. (b) We know that 1 light year $= 9.46 \times 10^{11}$ m = distance that light travels in 1 year with speed 3×10^8 m/s.

1 parsec $= 3.08 \times 10^{16}$ m

= Distance at which average radius of earth's orbit subtends an angle of 1 per second

Here, second and year represent time.

29. (c) According to definition of potential.

30. (a) As $Q = mL \Rightarrow [L] = \dfrac{[Q]}{[m]} = \dfrac{[ML^2T^{-2}]}{[M]} = [M^0L^2T^{-2}]$

31. (a) $V = \sqrt{\dfrac{\gamma P}{\rho}}$ or $\gamma = \dfrac{V^2\rho}{P}$

$$[\gamma] = \frac{[LT^{-1}]^2[ML^{-3}]}{[ML^{-1}T^{-2}]} = [M^0L^0T^0]$$

32. (b) Here; kx is dimensionless. Hence,

$$[k] = \left[\frac{2\pi}{\lambda}\right] = [M^0L^{-1}T^0]$$

33. (b) Here, [a] = [y].

So, $\dfrac{a}{y}$ is dimensionless. Same is the case with kx.

34. (d) As, $\mu = \dfrac{\text{Velocity of light in vaccum}}{\text{Velocity of light in medium}}$, hence μ is dimensionless.

Thus, each term on the RHS of given equation should be dimensionless.

$\therefore \dfrac{\beta}{\lambda^2}$ is dimensionless, i.e., β should have dimensions of λ^2, i.e., area.

35. (c) $E = \dfrac{\text{stress}}{\text{strain}} \Rightarrow E = \text{stress}$ (strain has no dimensions)

36. (d) Here, $(\omega t + \phi_0)$ is dimensionless because it is an argument of a trignometric function.

37. (c) According to stefan's law, energy emitted per second per unit area is:

$$E = e\,\sigma\,T^4 \Rightarrow [\sigma] = \frac{[ML^2T^{-2}/L^2T]}{[\theta^4]} = [MT^{-3}\theta^{-4}]$$

38. (d) $e = L\left[\dfrac{dI}{dt}\right]$

$$\therefore [L] = \frac{[e][dt]}{[dI]} = \frac{[w/q][dt]}{[dI]} = \frac{[w][dt]}{[q][dI]} = \frac{[w]}{[dI]^2}$$

$$= \frac{[ML^2T^{-2}]}{[A]^2} = [ML^2T^{-2}A^{-2}]$$

$$[C] = \frac{[q]}{[v]} \Rightarrow \frac{[q^2]}{[w]} \Rightarrow \frac{[A^2T^2]}{[ML^2T^{-2}]} \Rightarrow [M^{-1}L^{-2}T^4A^2]$$

$$[\sqrt{LC}] = \left([ML^2T^{-2}A^{-2}] \times [M^{-1}L^{-2}T^4A^2]\right)^{1/2}$$

$$= [T^2]^{1/2} = [T] \Rightarrow \therefore \left[\frac{1}{\sqrt{LC}}\right] = [T]^{-1}$$

39. (d) Angular momentum L = Moment of inertia I × Angular velocity ω

$\therefore$ Dimensional formula $L = [ML^2]\,[T^{-1}] = ML^2T^{-1}$

40. (a) $W = \frac{1}{2}Kx^2 \Rightarrow [K] = \frac{[w]}{[x^2]} = \frac{[ML^2T^{-2}]}{[L^2]} = [MT^{-2}]$

41. (d) According to the relation

$L = \frac{nh}{2\pi}$ = Angular momentum

42. (a) $F = [M^1L^1T^{-2}]$

$= [(10g)^1 (10cm)^1 (0.1s)^{-2}]$

$= [(10^{-2}kg)^1 (10^{-1}m)^1 (10^2s^{-2})] \Rightarrow F = 10^{-1} N = 0.1 N$

43. (d) Given, fundamental quantities are momentum (p), area(A) and Time (T).We can write energy, $E \propto p^a A^b T^c$, $E = kp^a A^b T^c$

Where k is dimensionless constant of proportionality.

Dimensions of $E = [E] = [ML^2T^{-2}]$ and $[p] = [MLT^{-1}]$

$[A] = [A]$

$[T] = [T]$

$[E] = [k]\,[p]^a\,[A]^b\,[T]^c$

Putting all the dimensions, we get

$ML^2T^{-2} = [MLT^{-1}]^a [L^2]^b [T]^c \Rightarrow M^aL^{2b+a}T^{-a+c}$

By principle of homogeneity of dimensions,

a = 1, 2b + a = 2

$\Rightarrow \quad 2b+1=2 \Rightarrow \quad b=1/2 - a+c=-2$

$\Rightarrow \quad c=-2+a=-2+1=-1$

Hence, $E = pA^{1/2}T^{-1}$

44. (c) $F = M^1 L^1 T^{-2}$

$\therefore T^2 = \frac{M^1 L^1}{F} \Rightarrow T = M^{1/2} L^{1/2} F^{-1/2}$

45. (c) Let $G = C^x g^y P^z$

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

$= M^z L^{x+y-z} T^{-x-2y-2z}$

Applying principle of homogeneity of dimensions, we get

$z = -1$, $x + y - z = 3 \Rightarrow -x - 2y - 2z = -2$

On solving, we get,

$y = 2$, $x = 0 \Rightarrow \therefore G = C^0 g^2 P^{-1}$

46. (b) Let $m \propto E^x V^y F^z$

By substituting the following dimensions:

$[E] = [ML^2T^{-2}]$, $[V] = [LT^{-1}]$, $[F]$, $[MLT^{-2}]$

and by equating the both sides

$x = 1$, $y = -2$, $z = 0$, So $[m] = [EV^{-2}]$

47. (a) $F = A^\alpha V^\beta \rho^\gamma$

or $[MLT^{-2}] = [L^2]^\alpha [LT^{-1}]^\beta [ML^{-3}]^\gamma$

$= [M^\gamma L^{2\alpha+\beta-3\gamma} T^{-\beta}]$

This gives : $\gamma = 1$, $\beta = 2$, $2\alpha + \beta - 3\gamma = 1$

or $\alpha = 1$; $F = [AV^2\rho]$

48. (d) Dimensions of RHS $= \left[\frac{M^{-1}L^3T^{-2} \times M}{L^2}\right]^{1/2}$

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

Hence; equation is dimensionally incorrect

Also; $V_e = \sqrt{\frac{2GM}{R}}$

Hence; given equation is dimensionally incorrect.

49. (b) In 0.06900, the underlined zeros are not significant. Hence, number of significant figures is four.

50. (c) $\Delta x = a - b \pm (\Delta a + \Delta b)$

$= 4.19 - 3.25 \pm (0.01 + 0.01) \Rightarrow 0.94 \pm 0.02$ cm

51. (b) The sum of the numbers can be calculated as 663.821 arithmetically. The number with least decimal places is 227.2 is correct to only one decimal place.

The final result should, therefore be rounded off to one decimal place i.e., 664.

52. (d) Percentage error in $A = \left(2\times1+3\times3+1\times2+\frac{1}{2}\times2\right)\% = 14\%$

53. (d) Rounding off 2.745 to 3 significant figures it would be 2.74. Rounding off 2.735 to 3 significant figures it would be 2.74.

54. (b) $\frac{\Delta V}{V} = 3\times\frac{\Delta r}{r} = 3\times\frac{1}{100} = \frac{3}{100} = 3\%$

55. (a) Given, $A = 2.5\ ms^{-1} \pm 0.5\ ms^{-1}$, $B = 0.10\ s \pm 0.01\ s$

$x = AB = (2.5)(0.10) = 0.25$ m,

$\frac{\Delta x}{x} = \frac{\Delta A}{A} + \frac{\Delta B}{B} \Rightarrow \frac{0.5}{2.5} + \frac{0.01}{0.10} = \frac{0.05+0.025}{0.25} = \frac{0.075}{0.25}$

$\Delta x = 0.075 = 0.08$ m, rounding off to two significant figures.

$AB = (0.25 \pm 0.08)$ m

56. (d) Since; $\rho = \frac{m}{\pi r^2 L}$

$\therefore \left(\frac{\Delta\rho}{\rho}\right)\times100 = \left(\frac{\Delta m}{m} + \frac{2\Delta r}{r} + \frac{\Delta L}{L}\right)\times100$

$$= \left(\frac{0.003}{0.3} + 2\times\frac{0.005}{0.5} + \frac{0.06}{6}\right)\times 100$$

$= (0.01 + 0.02 + 0.01) \times 100 = 4$

57. (d) $R_1 = (6 \pm 0.3)K\Omega$, $R_2 = (10 \pm 0.2)\ K\Omega$, $R_p = ?$

$R_p = \dfrac{R_1R_2}{R_1+R_2}$ [Let $(R_1 + R_2) = X$]

or $R_p = \dfrac{R_1R_2}{X} \Rightarrow R_p = \ln R_1 + \ln R_2 - \ln X$

Differentiating, $\dfrac{\Delta R_p}{R_p} = \dfrac{\Delta R_1}{R_1} + \dfrac{\Delta R_2}{R_2} + \left(-\dfrac{\Delta x}{x}\right)$

In addition or subtraction, errors are calculated as follows:

Δx is mean $(\Delta R_1 + \Delta R_2) = \Delta x_{mean} = \dfrac{0.3+0.2}{2} = 0.25\Omega$

$R_{mean} = \dfrac{6\Omega+10\Omega}{2} = 8\Omega \Rightarrow \dfrac{\Delta x}{x} = \dfrac{0.25}{8} = 0.31$

$\therefore$ Total errors $= \dfrac{0.3}{6} + \dfrac{0.2}{10} + \dfrac{0.25}{8}$

$= 0.05 + 0.02 + 0.03125 = 0.10125 \qquad \therefore \dfrac{\Delta R}{R} \approx 10\%$

58. (a) All given measurements are correct upto two decimal places. As here 5.00 mm has the smallest unit and the error in 5.00 mm is least (commonly taken as 0.01 mm if not specified). Hence, 5.00 mm is most precise.

59. (b) If, $x = a^n$ then; $\dfrac{\Delta x}{x} = \pm n\left(\dfrac{\Delta a}{a}\right)$

60. (c) Given : Voltage $V = (100 \pm 5)V$

Current $I = (10 \pm 0.2)A$

According to ohm's law, $V = IR$ or $R = V/I$

Taking log on both sides, $\log R = \log V - \log I$

Differentiating, we get; $\dfrac{\Delta R}{R} = \dfrac{\Delta V}{V} - \dfrac{\Delta I}{I}$

For maximum error, $\dfrac{\Delta R}{R} = \dfrac{\Delta V}{V} + \dfrac{\Delta I}{I}$

Multiplying both sides by 100 for taking percentage,

We get, $\dfrac{\Delta R}{R}\times 100 = \dfrac{\Delta V}{V}\times 100 + \dfrac{\Delta I}{I}\times 100$

Percentage error in resistance R

$= \dfrac{\Delta V}{V}\times 100 + \dfrac{\Delta I}{I}\times 100 \qquad = \dfrac{5}{100}\times 100 + \dfrac{0.2}{10}\times 100 = 7\%$

61. (a) Given length $l = 5$ cm

Now, checking the errors with each option one by one, we get

$\Delta l_1 = 5 - 4.9 = 0.1$ cm $\qquad \Delta l_2 = 5 - 4.805 = 0.195$ cm

$\Delta l_3 = 5.25 - 5 = 0.25$ cm $\qquad \Delta l_4 = 5.4 - 5 = 0.4$ cm

Error Δl_1 is least.

Hence, 4.9 cm is most precise.

62. (c) **63. (c)** **64. (c)**

65. (b) **66. (a)**

67. (c) One main scale division, 1 M.S.D = x cm

One vernier scale division, 2 V.S.D = $\dfrac{(n-1)x}{n}$

Least count = 1 M.S.D – 1 V.S.D

$= \dfrac{nx - nx + x}{n} = \dfrac{x}{n}$ cm

68 . (a) Correct diameter of the thick wire

= M.S.R + (n × LC) – zero error

= 0.2 + (50 × 0.001) – 0.002

= 0.2 + 0.05 – 0.002

= 0.248

Note: We have to subtract the zero error from the reading as here zero error is positive.

69. (c) **70. (c)** **71. (c)** **72. (a)**

73. (b) **74. (d)** **75. (a)**

Learning-Plus

1. (b) $P = P_0 \exp(-\alpha t^2)$

As P and P_0 have the same units, therefore αt^2 must be dimensionless for which $\alpha = \dfrac{1}{T^2} = T^{-2}$

2. (a) Length, time and velocity can be deduced from one another. Therefore, they cannot enter into the list of fundamental quantities in any system.

3. (b) $\dfrac{h}{e^2} = \dfrac{ML^2T^{-1}}{(AT)^2} = ML^2T^{-3}A^{-2}$ = Resistance (ohm)

4. (d) $[\varepsilon_0 \times L] = [C] \qquad \left(\because c = \dfrac{\varepsilon A}{d}\right)$

$\therefore X = \dfrac{\varepsilon_0 LV}{t} = \dfrac{CV}{t} = \dfrac{Q}{t}$ = current

5. (d) $V = at + bt^2 \qquad [V] = [bt^2]$

$LT^{-1} = bT^2 \Rightarrow [b] = [LT^{-3}]$

6. (c) $F = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q_1q_2}{d^2}$

$\therefore [\varepsilon_0] = \dfrac{[q_1q_2]}{[Fd^2]} = \dfrac{[IT \times IT]}{[FL^2]} = [F^{-1}L^{-2}T^2I^2]$

7. (c) We know that dimension of

$h = [h] = [ML^2T^{-1}]$; $[c] = [LT^{-1}]$, $[m_e] = M$

$[G] = [M^{-1}L^3T^{-2}]$ $\qquad$ $[e] = [AT]$, $[m_p] = [M]$

$$\left[\frac{hc}{G}\right] = \frac{[ML^2T^{-1}][LT^{-1}]}{[M^{-1}L^3T^{-2}]} = [M^2] \qquad M = \sqrt{\frac{hc}{G}}$$

$$\frac{h}{c} = \frac{[ML^2T^{-1}]}{[LT^{-1}]} = [ML] \qquad L = \frac{h}{cM} = \frac{h}{c}\sqrt{\frac{G}{hc}} = \frac{\sqrt{Gh}}{c^{3/2}}$$

$$\text{As, } C = LT^{-1} \Rightarrow [T] = \frac{[L]}{[c]} = \frac{\sqrt{Gh}}{c^{3/2}.c} = \frac{\sqrt{Gh}}{c^{5/2}}$$

Hence, a, b or d, any can be used to express L, M and T in terms of three chosen fundamental quantities.

8. (d) Dimensions in L.H.S and R.H.S are same for II and IV.

9. (c) Quantity C has maximum power, irrespective of sign. So it brings maximum error in P.

10. (b) Here ; $S = (13.8 \pm 0.2)$cm ; $t = (4.0 \pm 0.3)$sec

$$\therefore V = \frac{13.8}{4} = 3.45\,\text{m/sec}$$

$$\text{Also; } \frac{\Delta V}{V} = \pm\left(\frac{\Delta S}{S} + \frac{\Delta t}{t}\right) \qquad = \pm\left(\frac{0.2}{13.8} + \frac{0.3}{4.0}\right) = \pm 0.0895$$

$\Delta V = \pm\, 0.0895 \times 3.45 = \pm\, 0.3$

$V = (3.45 \pm 0.3)$ m/sec

11. (b) Here, maximum fraction error is:

$$\frac{\Delta Q}{Q} = \pm\left(n\frac{\Delta x}{x} + \frac{m\Delta y}{y}\right)$$

$\therefore$ Absolute error in Q, i.e.,

$$\Delta Q = \pm\left(n\frac{\Delta x}{x} + \frac{m\Delta y}{y}\right)Q$$

12. (d) In the sum or difference of measurements we do not retain significant digits in those places after the decimal in which there were no significant digits in any one of the original values.

13. (a) The fundamental frequency is given by $f = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$

μ = mass per unit length

$$\mu = \rho\pi\frac{D^2}{4} \qquad \Rightarrow \qquad f = \frac{1}{2L}\sqrt{\frac{T}{\rho\pi\frac{D^2}{4}}} = \frac{1}{LD}\sqrt{\frac{T}{\pi\rho}}$$

$$\therefore \qquad f \propto \frac{1}{LD} \text{ (as T, } \pi \text{ and } \rho \text{ are constants)}$$

14. (a) Substituting the dimension of G,I, M and E, we get,

$$\text{Dimension of } \frac{GIM^2}{E^2} = \frac{[M^{-1}L^3T^{-2}][MLT^{-1}][M^2]}{[ML^2T^{-2}]^2}$$

$= [T] =$ dimension of time

15. (a) We know that, $[e] = [AT]$, $[\varepsilon_0] = [M^{-1}L^{-3}T^4A^2]$,

$[h] = [ML^2T^{-1}]$ and $[c] = [LT^{-1}]$

$$\therefore \left[\frac{e^2}{4\pi\varepsilon_0 hc}\right] = \left[\frac{A^2T^2}{M^{-1}L^{-3}T^4A^2 \times ML^2T^{-1} \times LT^{-1}}\right]$$

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

16. (d) According to question, $T \propto p^a d^b E^c$

$[M^0L^0T] = k\,[ML^{-1}T^{-2}]^a\,[ML^{-3}]^b\,[ML^2T^{-2}]^c$

Where, k is constant.

On comparing dimensions of similar terms, we have

$[M^0L^0T] = k[M^{a+b+c}\,L^{-a-3b+2c}\,T^{-2a-2c}]$

On comparing powers of M, L and T, we have

$0 = a + b + c$ ...(i)

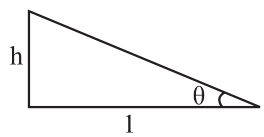
$0 = -a - 3b + 2c$ ...(ii)

$1 = -2a - 2c$ ...(iii)

On solving Eqs. (i), (ii) and (iii), get

$$a = -\frac{5}{6}, b = \frac{1}{2}, c = \frac{1}{3}$$

17. (a) $\frac{h}{1} = \theta$



$$\frac{h}{1} = 1.8 \times \frac{\pi}{180}\,\text{m}$$

$$h = \frac{1.8 \times \pi \times 100}{180} \Rightarrow h = \pi \text{ cm}$$

18. (a) In given equation, $\frac{\alpha z}{k\theta}$ should be dimensionless-

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

19. (c) $$\left[\frac{d}{dt}\left(\int \vec{F}\cdot d\vec{S}\right)\right] = \left[A\left(\vec{F}\cdot\vec{p}\right)\right] \Rightarrow \left[\frac{FS}{t}\right] = [AFp]$$

$$\Rightarrow [A] = \left[\frac{S}{pt}\right] = \frac{L}{MLT^{-1} \times T} = M^{-1}$$

20. (a) Physical quantities having different dimensions cannot be added or subtracted.

As P, Q and R are physical quantites having different dimensions, therefore they can neither be added nor quantity.

21. (b) Trigonometric function are dimensionless

$$D = M^0L^0T^0 \qquad C = \frac{1}{T} = M^0L^0T^{-1} \qquad B = \frac{1}{x} = M^0L^{-1}T^0$$

A = Dimension of y = $M^0L^1T^0$ [ABCD] = $M^0L^0T^{-1}$

22. (c) $[\alpha]=[F][\sqrt{d}]$ $= MLT^{-2}[ML^{-3}]^{1/2}$ $= M^{3/2}L^{-1/2}T^{-2}$

23. (d) Let $n = k\rho^a a^b T^c$ where $[\rho]=[ML^{-3}]$, $[a]=[L]$ and $[T]=[MT^{-2}]$

Comparing dimensions both sides, we get-

a = –1/2 , b = –3/2 and c = 1/2

$\therefore \eta = k\rho^{-1/2}\, a^{-3/2}\, T^{-1/2}$ $= \dfrac{k\sqrt{T}}{\rho^{1/2}a^{3/2}}$

24. (c) L.H.S = P = $(M^1L^{-1}T^{-2})$

$$\text{R.H.S} = \frac{8\eta lv}{\pi r^4} = \frac{ML^{-1}T^{-1}(L)(L^3T^{-1})}{L^4} = (ML^{-1}T^{-2})$$

25. (c) In this question, density should be reported to two significant figures.

$$\text{Density} = \frac{4.237\text{ g}}{2.5\text{ cm}^3} = 1.6948$$

As rounding off the number, we get density = 1.7

26. (a) Given, length l = (16.2 ± 0.1) cm

Breadth b = (10.1 ± 0.1) cm

Area $A = l \times b$

= (16.2 cm) × (10.1 cm) = 163.62 cm^2

Rounding off to three significant digits, area A = 164 cm^2

$$\frac{\Delta A}{A} = \frac{\Delta l}{l} + \frac{\Delta b}{b} = \frac{0.1}{16.2} + \frac{0.1}{10.1} \quad = \frac{1.01+1.62}{16.2\times 10.1} = \frac{2.63}{163.62}$$

$$\Delta A = A\times\frac{2.63}{163.62} = 163.62\times\frac{2.63}{163.62} = 2.63\text{ cm}^2$$

$\Delta A = 3\text{ cm}^2$ (By rounding off to one significant figure)

Area, $A = A \pm \Delta A = (164 \pm 3)\text{ cm}^2$.

27. (d) Given, A = 1.0 m ± 0.2 m, B = 2.0 m ± 0.2 m

Let, $Y = \sqrt{AB} = \sqrt{(1.0)(2.0)} = 1.414\text{ m}$

Rounding off to two significant digit Y = 1.4

$$\frac{\Delta Y}{Y} = \frac{1}{2}\left[\frac{\Delta A}{A} + \frac{\Delta B}{B}\right] = \frac{1}{2}\left[\frac{0.2}{1.0} + \frac{0.2}{2.0}\right] = \frac{0.6}{2\times 2.0}$$

$$\Rightarrow \quad \Delta Y = \frac{0.6Y}{2\times 2.0} = \frac{0.6\times 1.4}{2\times 2.0} = 0.212$$

Rounding off to one significant digit ΔY = 0.2 m

Thus, correct value for $\sqrt{AB} = r + \Delta r = 1.4 \pm 0.2$ m

28. (c) Now by principle of homogeneity of dimensions L.H.S and R.H.S of (a) and (d) will be same and is L.

For (c)[L.H.S] = L $[RHS] = \dfrac{L}{T} = LT^{-1}$

[L.H.S] ≠ [R.H.S]

Hence, (c) is not correct option.

In option (b) dimension of angle is [vt] i.e., L

$\Rightarrow$ R.H.S = L.L = L^2 and L.H.S = L $\Rightarrow$ L.H.S ≠ R.H.S.

So, option (b) is also not correct.

29. (d) In this question, it is given that P, Q and R are having different dimensions, hence they cannot be added or subtracted.

Multi-Concept Questions

1. (d) $\ell \propto h^x G^y c^z$

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

$= [M]^{x-y} [L]^{2x+3y+z} [T]^{-x-2y-z}$

equation: x – y = 0   2x + 3y + z = 1   –x – 2y – z = 0

$\ell \propto \dfrac{\sqrt{hG}}{C^{3/2}}$

2. (b) According to the principal of homogeneity of dimensions, if the dimensions of each term adding or subtracting in a given relation are same, then it is correct, if not, then it is wrong.

3. (b) Relative density = $\dfrac{\text{Weight in air}}{\text{Loss of weight in water}}$

$P = \dfrac{5.00}{1.00} = 5.00$ $\dfrac{dP}{P} = \dfrac{0.05}{5.00} + \dfrac{0.1}{1.00} = 0.11 = 11\%$

P = 5.00 ± 11%

4. (c) One main scale division, 1 M.S.D = x cm

One vernier scale division, 2 V.S.D = $\dfrac{(n-1)x}{n}$

Least count = 1 M.S.D – 1 V.S.D

$= \dfrac{nx - nx + x}{n} = \dfrac{x}{n}$ cm

5. (a) Time $\propto c^x G^y h^z \Rightarrow T = kc^x G^y h^z$

K = dimension proportionality constant

[LHS] = [RHS]

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

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

Comparing the powers of M, L and T, we get

– y + z = 0 ...(i)

α + 3y + 2z = 0 ...(ii)

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

On solving Eqs. (i), (ii) and (iii), we get

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

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

6. (c) As, $Y = At^3 - Bt^3$ $\quad$ $[Y] = [Bt^3]$

$[L] = B\,[T^3]$ $\quad$ $\therefore\ [B] = [LT^{-3}]$

7. (c) $x = \dfrac{2k^3l^2}{m\sqrt{n}}$

Percentage error in

$$x, \frac{\Delta x}{x} \times 100 = \left(\frac{3\Delta k}{k} + \frac{2\Delta \ell}{\ell} + \frac{1}{2}\frac{\Delta n}{n} + \frac{\Delta m}{m}\right) \times 100$$

$$\frac{\Delta x}{x} \times 100 = \left[3 \times 1 + 2 \times 2 + \frac{1}{2} \times 4 + 3\right] = 12\%$$

8. (a) We have $[T] = [G]^a\,[M]^b\,[R]^c$

$[M]^0\,[L]^0\,[T]^1 = [M]^{-a}\,[L]^{3a}\,[T]^{-2a} \times [M]^b \times [L]^c$

$= [M]^{b-a}\,[L]^{c+3a}\,[T]^{-2a}$

Comparing the exponents

$$\text{For } [T]: 1 = -2a \Rightarrow a = -\frac{1}{2}$$

$$\text{For } [M]: 0 = b - a \Rightarrow b = a = -\frac{1}{2}$$

$$\text{For } [L]: 0 = c + 3a \Rightarrow c = -3a = -\frac{1}{2}$$

Putting the values we get

$$T \propto G^{-1/2}M^{-1/2}R^{3/2} \propto \sqrt{\frac{R^3}{GM}}$$

The actual expression is $T = 2\pi\sqrt{\dfrac{R^3}{GM}}$

9. (d) $m \propto (F)^a\,(M)^b\,(L)^c$

$T^{-1} = (MLT^{-2})^a\,(M)^b\,(L)^c$

$T^{-1} = M^{a+b}\,L^{a+c}\,T^{-2a}$

$a + b = 0$ $\quad \boxed{b = \frac{-1}{2}}$ $\quad a + c = 0$ $\quad \boxed{c = \frac{-1}{2}}$

$-2a = -1$ $\quad \boxed{a = \frac{1}{2}}$ $\quad \mu = k\,F^{1/2}\,M^{-1/2}\,L^{-1/2}$

$$\mu = k\sqrt{\frac{F}{ML}}$$

10. (c) $\beta^3 = \text{density} = M^1L^{-3}$ $\quad$ $\beta = M^{1/3}L^{-1}$

Also; $\alpha = \text{force} \times \text{density} = MLT^{-2} \times M^1L^{-3} = [M^2L^{-2}T^{-2}]$

11. (b) $\dfrac{a - t^2}{b} = P\,x \Rightarrow \left[\dfrac{a - t^2}{b}\right] = [P\,x]$

$$\Rightarrow \left[\frac{a}{b}\right] = [Px] = ML^{-1}T^{-2}L = MT^{-2}$$

12. (d) $\therefore\ \left[\dfrac{El^2}{m^5G^2}\right] = \dfrac{[ML^2T^{-2}][M^2L^4T^{-2}]}{[M^5][M^{-2}L^6T^{-4}]} = [M^0L^0T^0]$

As angle has no dimensions, therefore $\dfrac{El^2}{m^5G^2}$ has the same dimensions as that of angle.

13. (c) $P = L^a\,V^b\,F^c$

$[ML^2T^{-3}] = [L]^a\,[LT^{-1}]^b\,[MLT^{-2}]^c$

$c = 1$ $\quad 2 = a + b + c$ $\quad a + b = 1$

$-3 = -b - 2c$ $\quad a = 0$

$b = 1$

$P = V^1F^1$

14. (b) $[P] = M^xV^yT^z$

$$\frac{MLT^{-2}}{L^2} = M^x\left(\frac{L}{T}\right)^y T^z \qquad ML^{-1}T^{-2} = M^xL^yT^{z-y}$$

$\Rightarrow x = 1, y = -1$ $\quad z - y = -2 \Rightarrow z = -2 + y = -3$

15. (d) Dimensions of velocity gradient $\dfrac{\Delta V}{\Delta Z} = \dfrac{[LT^{-1}]}{[L]} = [T^{-1}]$

Given $F = -\eta\dfrac{\Delta V}{\Delta Z}$

$$\eta = \frac{F}{(A)\left(\frac{\Delta V}{\Delta Z}\right)} = \frac{[MLT^{-2}]}{[L^2][T^{-1}]} = [ML^{-1}\,T^{-1}]$$

16. (c) The integral on LHS is in the form of log x, which is a number. Hence; a^n must be a number, for which $n = 0$.

NEET Past 10 Year Questions

1. (b) $\text{Least count} = \dfrac{\text{Pitch}}{\text{Number of divisions on circular scale}}$

$$\Rightarrow 0.01\text{mm} = \frac{\text{Pitch}}{50}$$

$\Rightarrow$ pitch = 0.5 mm.

2. (a) In subtraction the number of decimal places int he result should be equal to the number of decimal places of that term in the operation which contain lesser number of decimal places.

$$\begin{array}{r} 9.99 \\ -0.0099 \\ \hline 9.98 \end{array} \rightarrow 3 \text{ significant figures.}$$

3. (c) Stress $= \dfrac{\text{Force}}{\text{Area}}$

$$= \frac{M^1L^1T^{-2}}{L^2}$$

Stress $= M^1L^{-1}T^{-2}$

4. (c) ***NCERT (XI) Ch - 2, Pg. 24***

Mean of given observations

$$= \frac{1.25 + 1.24 + 1.27 + 1.21 + 1.28}{5} = 1.25 \text{ sec}$$

Mean of errors

$$= \frac{0 + 0.01 + 0.02 + 0.04 + 0.03}{5}$$

$$= \frac{0.1}{5}$$

$$\% \text{ error} = \frac{0.1 \times 100}{5 \times 1.25} = 1.6\%$$

5. (d) ***NCERT (XI) Ch - 2, Pg. 17***

1 minute of arc $= 1' = \left(\dfrac{1}{60}\right)^0 = \dfrac{1}{60} \times \dfrac{\pi}{180}$ radian

$= 2.91 \times 10^{-4}$ radian.

6. (b) ***NCERT (XI) Ch - 2, Pg. 27***

$$X = \frac{A^2B^{\frac{1}{2}}}{C^{\frac{1}{3}}D^3}$$

$$\%\text{error}, \frac{\Delta X}{X} \times 100 = 2\frac{\Delta A}{A} \times 100 + \frac{1}{2}\frac{\Delta B}{B} \times 100 + \frac{1}{3}\frac{\Delta C}{C} \times 100 + 3\frac{\Delta D}{D} \times 100$$

$= 2\% + 1\% + 1\% + 12\%$

$= 16\%$

7. (d) ***NCERT (XI) Ch - 2, Pg. 24***

Reading = MSR + (n × LC) + zero error

= 0.5 + (25 × 0.001) + 0.004

= 0.529 cm

8. (d) ***NCERT (XI) Ch - 2, Pg. 214 APPENDIX A9***

$$L = [c]^a [G]^b \left[\frac{e^2}{4\pi\varepsilon_0}\right]^c$$

$= [LT^{-1}]^a [M^{-1} L^3 T^{-2}]^b [ML^3 T^{-2}]^c$

$= L^{a + 3b + 3c} T^{-a - 2b - 2c} M^{-b + c}$

$a + 3b + 3c = 1$; $-a - 2b - 2c = 0$; $-b + c = 0$

$b = \dfrac{1}{2}$ $c = \dfrac{1}{2}$ $\downarrow$

$a = -2$

$$L = c^{-2}G^{1/2}\left[\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$$

$$L = \frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{1/2}$$

9. (c) ***NCERT (XI) Ch - 2, Pg. 24***

Least count = 1MSD – 1VSD

$$= 5 \times 10^{-2} - \frac{49}{50} \times 5 \times 10^{-2}$$

Thickness $= 7 + 23 \times 10^{-3} = 7.023$ cm

10. (c) ***NCERT (XI) Ch - 2, Pg. 31***

$\ell \propto h^xG^yc^z$

$$M^0L^1T^0 = (ML^2T^{-1})^x (M^{-1}L^3T^{-2})^y (LT^{-1})^z$$

$$= M^{x-y}L^{2x+3y+z}T^{-x-2y-z}$$

Equating:

$$\left.\begin{aligned} x - y &= 0 \\ 2x + 3y + z &= 1 \\ -x - 2y - z &= 0 \end{aligned}\right\} \begin{aligned} &\Rightarrow x = \frac{1}{2}; y = \frac{1}{2}; z = -\frac{3}{2} \\ &\Rightarrow \ell \propto \frac{\sqrt{hG}}{c^{3/2}} \end{aligned}$$

11. (b) ***NCERT (XI) Ch - 2, Pg. 32-33***

$S.T \propto [E]^a [V]^b [T]^c$

$\propto [ML^2T^{-2}]^a [LT^{-1}]^b [T]^c$

$MT^{-2} \propto M^a L^{2a+b} T^{-2a-b+c}$

On comparing both sides

$2a + b = 0$, $-2a - b + c = -2$

$a = 1$, $b = -2$, $c = -2$

we get

$ST = EV^{-2} T^{-2}$

12. (b) ***NCERT (XI) Ch - 2, Pg. 32-33***

$\nu_c \propto [\eta^x\rho^yr^z]$

$[L^1T^{-1}] \propto [M^1L^{-1}T^{-1}]^x [M^1L^{-3}]^y [L^1]^z$

$[L^1T^{-1}] \propto [M^{x+y}][L^{-x-3y+z}][T^{-x}]$

Taking comparison on both size

$x + y = 0$, $-x - 3y + z = 1$, $-x = -1$

$x = 1$, $y = -1$, $z = -1$

13. (d) ***NCERT (XI) Ch - 2, Pg. 32-33***

$$[\text{Mass}] = \left[\frac{\text{Force}}{\text{Acceleration}}\right] = \left[\frac{\text{Force}}{\text{Velocity/time}}\right]$$

$$= [FV^{-1}T]$$

14. (b) ***NCERT (XI) Ch - 2, Pg. 26-27***

$$P = \frac{a^3b^2}{cd} \Rightarrow \frac{\Delta P}{P} = \pm\left(3\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{\Delta c}{c} + \frac{\Delta d}{d}\right)$$

$$= \pm(3\times 1 + 2\times 2 + 3 + 4) \Rightarrow \pm 14\%$$

15. (c) ***NCERT (XI) Ch - 2, Pg. 32-33***

Speed of light, $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = \left[LT^{-1}\right]$

16. (c) ***NCERT (XI) Ch - 2, Pg. 32-33***

Let F = kv

$$[k] = \left[\frac{F}{v}\right] = \left[\frac{MLT^{-2}}{LT^{-1}}\right] = \left[MT^{-1}\right]$$

Hence units of k is kgs^{-1}

17. (b) $\therefore n_1u_1 = n_2u_2$

$$4\frac{g}{cm^3} = n_2\frac{100\ g}{(10\ cm)^3}$$

$$\Rightarrow n_2 = 40$$