ANSWER KEY

1. [B]	2. [A]	3. [C]	4. [A]	5. [D]	6. [B]
7. [D]	8. [C]	9. [D]	10. [A]	11. [C]	12. [B]
13. [B]	14. [D]	15. [A]	16. [C]	17. [A]	18. [B]
19. [C]	20. [D]	21. [B]	22. [A]	23. [D]	24. [C]
25. [A]	26. [D]	27. [D]	28. [B]	29. [A]	30. [D]
31. [A]	32. [B]	33. [B]	34. [C]	35. [B]	36. [A]
37. [C]	38. [B]	39. [A]	40. [D]	41. [B]	42. [B]
43. [A]	44. [A]	45. [C]	46. [C]	47. [A]	48. [A]
49. [A]	50. [D]				

1. $\omega = \frac{2\pi}{T}$

$\omega_{min} = \frac{2\pi}{60 \times 60}$ rad/s

$\omega_{second} = \frac{2\pi}{60}$ rad/s

$\omega_{min} - \omega_{sec} = \frac{2\pi}{60}\left(\frac{1}{60} - 1\right)$

$\frac{59\pi}{1800}$ rad/s

2. $F_{cp} = m\omega^2 r$ & $\omega = \frac{2\pi}{T}$

T, ω & masses are same

$\therefore F_{cp} \alpha r$

Hence $\frac{(F_{cp})_1}{(F_{cp})_2} = \frac{r_1}{r_2}$

3. From Newton's law of gravitation

$F = \frac{GM_1 M_2}{r^2}$

If $M_1 = M_2 = 1$ unit of mass &

r = 1 unit of distance then

F = G = universal gravitational constant.

4. Change in potential energy in displacing a body from r_1 to r_2 is given by

$\Delta U = GMm\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$

$= GMm\left(\frac{1}{2R} - \frac{1}{3R}\right)$

$= \frac{GMm}{6R}$

5. As angular momentum is conserved

$I_1\omega_1 = I_2\omega_2$

$\frac{2}{5} MR^2 \times \left(\frac{2\pi}{24}\right) = \frac{2}{5}\left(\frac{M}{3}\right) \times \left(\frac{R}{2}\right)^2 \times \left(\frac{2\pi}{T}\right)$

$\therefore$ T = 2 hrs.

6. Linear K.E. = $\frac{1}{2} MV^2 = \frac{1}{2} Mr^2\omega^2$

Angular K.E. = $\frac{1}{2} I\omega^2 = \frac{1}{2} Mr^2\omega^2$

$\therefore$ Ratio = 1:1

7. $x = a \sin \omega t$ ===> $2.5 = 5 \sin\left(\frac{2\pi}{6} t\right)$

$\frac{2\pi t}{6} = \frac{\pi}{6}$

$\therefore$ t = ½ sec

phase difference corresponding to 6s is 2π so phase difference corresponding to ½ s is $\frac{\pi}{6}$

8. Given P.E. = $\frac{25}{100}$ T.E.

$\therefore \frac{1}{2} M\omega^2x^2 = \frac{1}{4} \left(\frac{1}{2} M \omega^2A^2 \right)$

$x^2 = \frac{A^2}{4}$

$\therefore x = \frac{A}{2}$

9. $Y = \frac{FL}{Al}$

$\therefore F = YA \frac{l}{L}$

$F \alpha \frac{r^2}{L}$

$\frac{F_1}{F_2} = \left(\frac{r_1}{r_2}\right)^2 x \left(\frac{L_2}{L_1}\right) = \left(\frac{2}{1}\right)^2 \cdot \left(\frac{1}{4}\right) = 1:1$

10. Poisson's ratio = $\frac{\text{lateral strain}}{\text{longitudinal strain}}$

$= 0.4 \text{ x } \frac{0.05}{100}$

= is reduced by 0.02 %.

11. Work done = change in area x T

= (96 - 24) x 2 x 30

= 4320 erg

12. Volume of big drop = 10^6 x volume of each droplet

$$\frac{4}{3}\pi R^3 = 10^6 \times \frac{4}{3}\pi R^3$$

$$R = 10^2 r$$

$$r = \frac{R}{10^2} = \frac{10^{-3}}{10^2} = 10^{-5}\ \text{m}$$

13. Distance between a compression and the nearest rarefaction is $\frac{\lambda}{2}$ = 1m. Hence

$$n = \frac{V}{\lambda} = \frac{360}{2} = 180\ \text{Hz.}$$

14. $y = 0.01 \sin 4\pi (100 t - x)$

$= 0.01 \sin 2\pi (200 t - 2x)$

equation of the standard simple harmonic wave is

$$y = A \sin 2\pi \left(nt - \frac{x}{\lambda}\right)$$

comparing both equations we get

n = 200 Hz.

15. $y = 4 \cos\left(\frac{2\pi x}{50}\right) \sin (100\pi t)$

Amplitude $A = 4 \cos\left(\frac{2\pi x}{50}\right)$ At node A = 0

$$\therefore \cos\left(\frac{2\pi x}{50}\right) = 0$$

$$\therefore \left(\frac{2\pi x}{50}\right) = \frac{\pi}{2}, \frac{3\pi}{2}, \ldots$$

$$\therefore x = \frac{50}{4}, \frac{150}{4}$$

$$\therefore x = 12.5, 37.5, \ldots$$

Thus node will occur at a distance of 12.5 cm from the origin.

16. Fundamental frequency of closed pipe $n = \frac{V}{4l} = 220$ Hz

$\therefore v = 220 \times 4l$

If $\left(\frac{1}{4}\right)^{th}$ of the pipe is filled with water, then the remaining length of air column is $\frac{3l}{4}$

Now the fundamental frequency $= \frac{V}{4\left(\frac{3l}{4}\right)} = \frac{V}{3l}$ and

First overtone = 3 x fundamental frequency $= 3 \times \frac{V}{3l} = \frac{220 \times 4l}{l} = 880$ Hz.

17. By Newton's law of cooling

$$\frac{\theta_2 - \theta_1}{t} = k\left(\frac{\theta_1 + \theta_2}{2} - \theta_0\right) \quad \text{………. 1.}$$

$$\frac{70 - 60}{5} = k\,(65 - \theta_0) \quad \text{………. 2.}$$

$$\frac{60 - 54}{5} = k\,(57 - \theta_0) \quad \text{………. 3.}$$

Dividing eq^n 1 by eq^n 2

$$\frac{5}{3} = \frac{65 - \theta_0}{57 - \theta_0}$$

$\therefore \theta_0 = 45^0$ C

18. $E = \sigma T^4$

$$\therefore T = \left(\frac{E}{\sigma}\right)^{1/4}$$

$$= \left(\frac{5.67 \times 10^{4}}{5.67 \times 10^{-8}}\right)^{1/4} = 10^3 \text{ k}$$

19. $\frac{E_2}{E_1} = \frac{T_2}{T_1}$ Given $E_2 = 3E_1$

$$\therefore \frac{3E_1}{E_1} = \frac{T_2}{T_1}$$

$\therefore T_2 = 3T_1 = 3(227 + 273) = 1500$ k

$T_2 = 1500 - 273 = 1227^0$ C

20. Free Path.

21. $V = \frac{4}{3}\pi r^3$

$\therefore$ Percentage error in volume = 3 x percentage error in radius

$$= 3 \times \frac{0.1}{5.3} \times 100$$

22. Strain

23. Velocity

24. Kinetic energy

25. By principle of dimensional homogeneity

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

$[a] = [p]\,[v^2]$

$= [M^1L^{-1}T^{-2}]\,[L^6]$

$= [M^1L^5T^{-2}]$

26. $F \propto \frac{q_1 q_2}{r^2}$ ……… colum's law

$F_{AB} \propto \frac{8}{x^2}$

$F_{AD} \propto \frac{8}{y^2}$

$F_{BD} \propto \frac{16}{x^2+y^2}$

$F_{AC} \propto \frac{4}{x^2+y^2}$

Therefore from all equations the electric force will be least between A and C.

27. Resistance of each part will be R/n such 'n' parts are joined in parallel.

So, $R_{eq} = \frac{R}{n^2}$

28. Formula.

29. $P = p_1 + p_2 = \frac{1}{f_1\ (m)} + \frac{1}{f_2\ (m)}$

$= \frac{1}{0.4} + \frac{1}{-0.25}$ (focal length of concave lens –ve)

$= \frac{1}{0.4} - \frac{1}{0.25} = -1.5\ D$

30. Explanation not required.

31. $V = V_1 + V_2 = E_1t_1 + E_2t_2 = \frac{\sigma}{K_1 \epsilon_0} t_1 + \frac{\sigma}{K_2 \epsilon_0} t_2$

$= \frac{\sigma}{\epsilon_0}\left(\frac{t_1}{K_1} + \frac{t_2}{K_2}\right)$

$= \frac{Q}{A\epsilon_0}\left(\frac{t_1}{K_1} + \frac{t_2}{K_2}\right)$ ($\sigma = Q/A$)

32. For a balanced wheatstone's network $\frac{P}{Q} = \frac{R}{S}$,

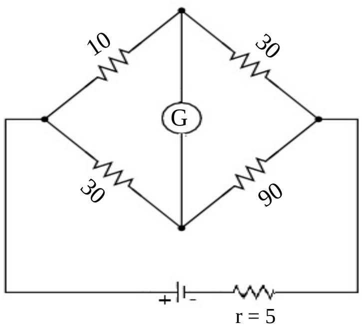
As the bridge is balanced, no current will flow through galvanometer.

Thus equivalent resistance is

$R_{eq} = \frac{(10+30)\ (30+90)}{(10+30+30+90)}$

$= \frac{40 \times 120}{160}$

$= 30$ Ohm



∴ $R_{effective} = 30 + 5 = 35$ Ohm.

Now $I = \frac{V}{R_{eff}} = \frac{7}{35} = \frac{1}{5} = 0.2\ A$

33. $K.E. = \frac{q^2B^2R^2}{2M_P} = \frac{(1.6 \times 10^{-19})^2\ (0.5)^2\ (4 \times 10^{-1})^2}{2 \times 1.67 \times 10^{-27}}$

$= 3.06 \times 10^{-13}$ J

$= \frac{3.06 \times 10^{-13}}{1.6 \times 10^{-19}}$ eV

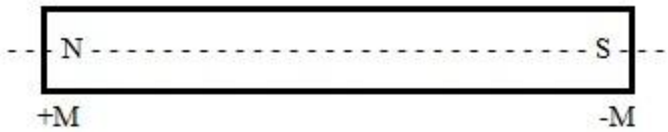
$= 1.9 \times 10^{6}$ eV

$= 1.9$ MeV

34. M = NIA

$\therefore$ M α A

35.



New Length $L^1 = L$

New pole strength $M^1 = M/2$

$\therefore$ New Magnitude dipole moment $M^1 = 2M^1L$

$= 2\ M/2\ L$

$= M/2$

36. $Y = kt^2 \Rightarrow \frac{dy}{dt} = 2kt$

$= \frac{d^2y}{dt^2} = 2k$

$= a_y = 2\ m/s^2$ ……… (k = 1)

$T_1 = 2\pi\sqrt{\frac{l}{g}}$, $T_2 = 2\pi\sqrt{\frac{l}{g+a_y}}$

$\frac{T_1^{\ 2}}{T_2^{\ 2}} = \frac{g+a_y}{g} = \frac{10+2}{10} = \frac{12}{10} = \frac{6}{5}$

37. The potential on each of them can be zero, if

$q_{net} = 0$

$\therefore q_1 \pm q_2 = 0$

$\therefore C_1V_1 \pm C_2V_2 = 0$

$\therefore 120\ C_1 \pm 200\ C_2 = 0$

$\therefore 3\ C_1 \pm 5\ C_2 = 0$

38. $I = I_{max} . \cos^2\frac{\theta}{2}$ ……… 1

Given $I = \frac{I_{max}}{2}$ ……… 2

From 1 & 2

$\theta = \frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}, \ldots\ldots\ldots$

$\therefore$ path difference, $\Delta x = \left(\frac{\lambda}{2\pi}\right)\theta$

$$\therefore\ \Delta x = \frac{\lambda}{4}, \frac{3\lambda}{4}, \frac{5\lambda}{4} \ldots\ldots\ldots \left(\frac{2n+1}{4}\right)\lambda$$

39. Explanation not required.

40. $\alpha = \frac{\Delta I_C}{\Delta I_E}$, $\beta = \frac{\Delta I_C}{\Delta I_B}$

$\beta = \frac{\alpha}{1-\alpha} = \frac{0.95}{1-0.95} = 19$

$\therefore\ \Delta I_C = \beta \cdot \Delta I_B = 19 \times 0.4 = 7.6$ mA

41. $E = mc^2$

$E^1 = m\left(\frac{c}{2}\right)^2$ $\quad (C^1 = C/2)$

$= \frac{mc^2}{4}$

$= \frac{E}{4}$

$\therefore$ Percentage decrease $= \frac{E-E^1}{E} \times 100$

$= \frac{E-E/4}{E} \times 100$

$= \frac{3}{4} \times 100$

$= 75\ \%$

42. $\frac{I_{max}}{I_{min}} = 9 = \left(\frac{a_1+a_2}{a_1-a_2}\right)^2 = 9$

$\frac{a_1+a_2}{a_1-a_2} = 3 \Rightarrow \frac{a_1}{a_2} = \frac{3+1}{3-1} = 2$

$\therefore I_1 : I_2 = 4:1$ $\quad \ldots\ldots\ldots (I \propto a^2)$

43. K.E. = $\frac{nc}{\lambda}$ - ϕ

$\frac{nc}{\lambda_1} - \phi = k_1$ ……… 1

$nc - \phi\lambda_1 = k_1\lambda_1$

$\frac{nc}{\lambda_2} - \phi = k_2$ ……… 2

$nc - \phi\lambda_2 = k_2\lambda_2$

From eq^n 1 & 2

$(\lambda_2 - \lambda_1)\phi = k_1\lambda_1 - k_2\lambda_2$

$$\phi = \frac{k_1\lambda_1 - k_2\lambda_2}{\lambda_2 - \lambda_1}$$

44. P.E. $\alpha \frac{-1}{r}$ and K.E. $\alpha \frac{1}{r}$

$\therefore$ As r increases, K.E. decreases but P.E. increases.

45. The majority carriers in n - type semiconductors are electrons.

46. Explanation not required.

47. Explanation not required.

48. i) Emission of α particles mass no decreases by 4 and atomic no decreases by 2.
ii) Emission of β particles mass no remains same but atomic no increases by 1.
iii) Emission of γ particles remains same.

49. Explanation not required.

50. Explanation not required.