AIEE-2002

PHYSICS

2. Sol.

$\lambda_{\max}/3 = 40 \Rightarrow \lambda_{\max} = 80$

4. Sol.

Large aperture increases the amount of light gathered by the telescope increasing the resolution.

5. Sol.

$KE = \frac{1}{2} m v_{esc}^2 = \frac{1}{2} m \left(\sqrt{2gR}\right)^2 = mgR$

6. Sol.

A voltmeter is a high resistance galvanometer and is connected in parallel to circuit and ammeter is a low resistance galvanometer so if we connect high resistance in series with ammeter its resistance will be much high.

7. Sol.

In coil $A, B = \frac{\mu_0}{4\pi} \frac{2\pi l}{R}$. $\therefore B \alpha \frac{l}{R}$; Heance, $\frac{B_1}{B_2} = \frac{l_1}{R_1} \cdot \frac{R_2}{l_2} = \frac{2}{2} = 1$

8. Sol.

No. of images, $n = (360/\theta) - 1$. As $\theta = 60°$ so $n = 5$

9. Sol.

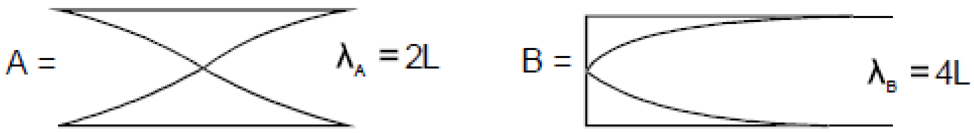
$$P_1 = V^2/R; P_2 = \frac{V^2}{(R/2)} + \frac{V^2}{(R/2)} = 4\frac{V^2}{R} = 4P_1$$

10. Sol.

$$E_n = -\frac{13.6}{n^2} \Rightarrow E_2 = -\frac{13.6}{2^2} = 3.4eV$$

11. Sol.

$$\frac{\lambda_A}{\lambda_B} = \frac{1}{2} \Rightarrow \frac{n_A}{n_B} = \frac{2}{1}$$



12. Sol.

The fact that placing wax decreases the frequency of the unknown fork and also the beat frequency states that the unknown fork is of higher frequency. $n - 288 = 4 \Rightarrow n = 292$ cps

13. Sol.

$$y_1 + y_2 = a\sin(\omega t - kx) - a\sin(\omega t + kx)$$
$$= -2a\cos\omega t \times \sin kx \Rightarrow y_1 + y_2 = 0 \text{ at } x = 0$$

14. Sol.

$$W = qV \Rightarrow V_A - V_B = 2/20 = 0.1V$$

Here W is the work done in moving charge q from point A to B

15. Sol.

$r = mv/Bq$ is same for both

16. Sol.

$K.E.$ is maximum and $P.E$ minimum at mean position

17. Sol.

Angular momentum = conserved

$$\frac{1}{2}MR^2\omega_1 = 2mR^2\omega + \frac{1}{2}MR^2\omega \Rightarrow \omega\frac{M\omega_1}{M + 4m}$$

18. Sol.

The condition to avoid skidding, $v = \sqrt{\mu rg} = \sqrt{0.6 \times 150 \times 10} = 30\,\text{m/s}$

19. Sol.

$$v = \sqrt{2gh} = \sqrt{2\times 10\times 20} = 20\,\text{m/s}$$

20. Sol.

$$W = \int_{x_1}^{x_2} Fdx = \int_{x_1}^{x_2} Kxdx = K\left[\frac{x^2}{2}\right]_{x_1}^{x_2} = \frac{K}{2}\left[x_2^2 - x_1^2\right] = \frac{800}{2}\left[(0.15)^2 - (0.05)^2\right] = 8J$$

21. Sol.

Conserving Linear Momentum

$$2Mv_c = 2Mv - Mv \Rightarrow v_c = v/2$$

22. Sol.

It will compress due to the force of attraction between two adjacent coils carrying current in the same direction

24. Sol.

Semiconductors are insulators at low temperature

27. Sol.

Neutrons can't be deflected by a magnetic field

28. Sol.

$$hc/\lambda_0 = W_0; \frac{(\lambda_0)_1}{(\lambda_0)_2} = \frac{(W_0)_2}{(W_0)_1} = \frac{4.5}{2.3} = 2:1$$

29. Sol.

Covalent bond formation is best explained by orbital theory which uses wave phenomena

32. Sol.

Amount left $N_0/2^n = N_0/8 \quad (\text{Hear } n = 15/5 = 3)$

33. Sol.

Use $R_t = R_0\left(\frac{T}{273}\right)$

34. Sol.

$$E = \sum \frac{1}{2}CV^2 = \frac{1}{2}nCN^2$$

35. Sol.

Black body also emits radiation whereas nothing escapes a black hole.

36. Sol.

The given circuit clearly shows that the inductors are in parallel we have, $\frac{1}{L}=\frac{1}{3}+\frac{1}{3}+\frac{1}{3}$ or $L=1$

37. Sol.

As the velocity at the highest point reduces to zero. The $K.E.$ of the ball also becomes zero.

38. Sol.

As the ball moves down from height 'h' to ground the $P.E$ at height 'h' is converted to $K.E.$ at the ground (Applying Law of conservation of Energy)

Hence, $\frac{1}{2}m_A v_A^2 = m_A g h_A$ of $v_A = \sqrt{2gh_A}$; Similarly, $v_B = \sqrt{2gh}$ or $v_A = v_B$

39. Sol.

Let the initial velocity of the body be v. Hence the final velocity $= v/2$

Applying $v^2 = u^2 - 2as \Rightarrow \left(\frac{v}{2}\right)^2 = v^2 - 2.a.3 \Rightarrow a = v^2/8$

In II^{nd} case when the body comes to rest, final velocity $=0$, initial velocity $=\frac{v}{2}$ Again,

$(0)^2 = \left(\frac{v}{2}\right)^2 - 2.\frac{v^2}{8}.s$; or $s = 1\text{cm}$

So the extra penetration will be 1cm

40. Sol.

When gravitational force becomes zero so centripetal force on satellite becomes zero so satellite will escape its round orbit and becomes stationary.

41. Sol.

The molecular kinetic energy increases, and so temperature increases.

43. Sol.

Because thermal energy decreases, therefore mass should increase

44. Sol.

Maximum in insulators and overlapping in metals

46. Sol.

$$E = (PE)_{final} - (PE)_{initial} = \frac{-GMm}{3R} + \frac{GMm}{R} = \frac{GMm}{6R}$$

47. Sol.

Spring constant becomes n times for each piece. $T = 2\pi\sqrt{m/k}$

$$\frac{T_1}{T_2} = \frac{\sqrt{nK}}{K} \text{ or } T_2 = T/\sqrt{n}$$

48. Sol.

The flux for both the charges exactly cancels the effect of each other

49. Sol.

$$W=\frac{V^2}{R_{net}};150=\frac{(15)^2}{R}+\frac{(15)^2}{2}\Rightarrow R=6\Omega$$

50. Sol.

Resolving power $\alpha(1/\lambda)$. Hence, $\frac{(R.P)_1}{(R.P)_2}=\frac{\lambda_2}{\lambda_1}=\frac{5}{4}$

51. Sol.

$T=2\pi\sqrt{l_{eff}/8};l_{eff}$ decreases when the child stands up.

52. Sol.

Man in the lift is in a non - inertial frame so we have to take into account the pseudo acceleration

53. Sol.

From Faradays law of electrolysis, $m\propto$ it.

54. Sol.

$$v_{rms} \alpha \sqrt{T/m}; \quad \sqrt{\frac{273+47}{32}} \quad \sqrt{\frac{T}{2}} \, of \ \mathrm{T} = 20K$$

55. Sol.

$$T = 2\pi m/Bq$$

57. Sol.

$$l_1 N_1 = l_2 N_2 \Rightarrow l_2 = \frac{4 \times 140}{280} = 2A$$

58. Sol.

Absolute zero temperature is practically not reachable

60. Sol.

Resultant of F_2 and F_3 is of magnitude F_1.

61. Sol.

Use $\tan\alpha = \frac{P\sin\theta}{Q + P\cos\theta} \Rightarrow \tan 90° = \frac{P\sin\theta}{Q + P\cos\theta} = \therefore Q + P\cos\theta = 0 \Rightarrow P\cos\theta = -Q$

$$R = \sqrt{P^2Q^2 + 2PQ\cos\theta} R = \sqrt{P^2 + Q^2 - 2Q^2} \ or \ R = \sqrt{P^2 - Q^2} = 12$$

$$144 = (P+Q)(P-Q) \text{ or } P - Q = 144/18 = 8 \quad \therefore P = 13N \text{ and } Q = 5N$$

62. Sol.

Use $u^2 = 2as$. a is same for both cases

$s_1 = u^2/2a;\ s_2 = 16u^2/2a = 16s_1 \Rightarrow s_1 : s_2 = 1:16$

63. Sol.

γ for resulting mixture should be in between $7/5$ and $5/3$

64. Sol.

Apply the condition for equilibrium of each charge

65. Sol.

$4\pi \in_0 R = 1.1\times 10^{-10}$

66. Sol.

$a = \frac{m_1 - m_2}{m_1 + m_2} g ; \frac{1}{8} = \frac{m_1 - m_2}{m_1 + m_2} \Rightarrow m_1 : m_2 = 9:7$

67. Sol.

Energy radiated $\alpha R^2 T^4$

68. Sol.

Apply Newton's second law

$F - T_{ab} = ma; T_{ab} - T_{bc} = ma \quad \therefore T_{bc} = 7.8\,N$

69. Sol.

$T - 60g = 60a; T = 3000N; \quad \therefore a = ms^{-2}$

70. Sol.

Zero, line of motion through the point P.

72. Sol.

$v_{esc} = \sqrt{2gR}$, where R is radius of the planet Hence escape velocity is independent of m

73. Sol.

β-rays are the beam of fast moving electrons

74. Sol.

Both have the dimension $M^1L^2T^{-2}$