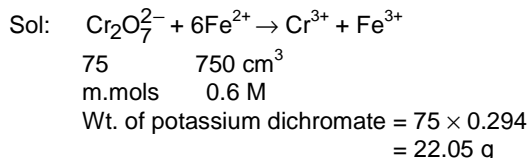


SOLUTIONS & ANSWERS FOR AIEEE-2011 [11-05-2011]

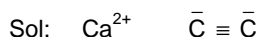
VERSION – D

PART A – CHEMISTRY

1. Ans: 22.05 g



2. Ans: One sigma, two pi



3. Ans: $\text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$

Sol: The correct increasing order of field strength for the ligands is $\text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$

4. Ans: $5.55 \times 10^{-4} \text{ m}$

Sol: $m = \frac{0.01}{60 \times 0.3} = 5.55 \times 10^{-4} \text{ m}$

5. Ans: $\sqrt[4]{1.6 \times 10^{-30} / 27}$

Sol: $K_{sp} = 27S^4$
 $S = \sqrt[4]{\frac{K_{sp}}{27}}$

6. Ans: -219 kJ

Sol: $\Delta_r H = -111 - 2 \times 54 \text{ kJ}$
 = -219 kJ

7. Ans: 68.4

Sol: $\frac{5}{342} = \frac{1}{w}$
 $w = 68.4$

8. Ans: Ozone absorbs infrared radiation

Sol: Ozone does not absorb I.R radiation

9. Ans:



Sol: Cyclopentadiene is not aromatic.

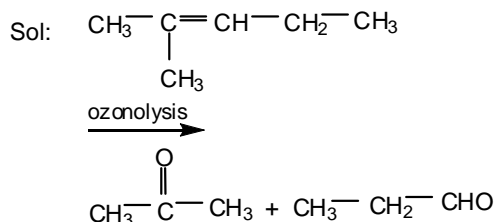
10. Ans: mutarotation

Sol: It is the definition of mutarotation

11. Ans: $D > C > A > B$

Sol: p-nitrophenol is the most acidic among the given phenols.

12. Ans: 2-Methyl-2-pentene



13. Ans: $[\text{Co}(\text{NH}_3)_2(\text{en})_2]^{3+}$

Sol: $[\text{Co}(\text{NH}_3)_2(\text{en})_2]^{3+}$ exists in cis & trans isomers.

14. Ans: For lead +2, for tin +4

Sol: Pb^{+2} is more stable than Pb^{+4} , since $\Delta_r G^\circ$ is negative.

Sn^{+4} is more stable than Sn^{+2} , since $\Delta_r G^\circ$ is positive.

15. Ans: $n = 2$ to $n = 1$

Sol: At. no. of H = 1 and He = 2
 For He^+ $n = 4$ to $n = 2$
 For H $n = \frac{4}{2}$ to $n = \frac{2}{2}$

16. Ans: $6.25 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$

Sol: $K = C \times \frac{l}{a}$

$\frac{l}{a} = 1.3 \times 50 \text{ S m}^{-1}$

$\wedge = C \times \frac{l}{a} \times \frac{10^{-3}}{M}$

$= \frac{1}{260} \times 1.3 \times 50 \times \frac{10^{-3}}{0.4}$
 = $6.25 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$

17. Ans: Oxide ion accepts sharing in a pair of electrons

Sol: O^{2-} becomes OH^- by sharing a pair of 2 electrons between hydrogen & oxygen.

18. Ans: HCHO

Sol: The monomers of bakelite are phenol and formaldehyde.

19. Ans: 128 pm

Sol: $\sqrt{2} a = 4r$

$$r = \frac{\sqrt{2} \times 361}{4} = 128 \text{ pm}$$

20. Ans: XeF₂

Compound	Lone pairs
XeF ₄	2
XeF ₆	1
XeF ₂	3
XeO ₃	1

21. Ans: RS⁽⁻⁾ is less basic but more nucleophilic than RO⁽⁻⁾

Sol: Since RSH is more acidic than ROH, RS⁽⁻⁾ will be less basic than RO⁽⁻⁾. Since the negative charge on sulphur is more polarisable, RS⁽⁻⁾ is more nucleophilic than RO⁽⁻⁾

22. Ans: 1×10^{-10}

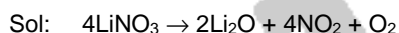
Sol: $[H^+] = C\alpha$
 $\alpha = 10^{-5}$

$$K_a = C\alpha^2 = 10^{-10}$$

23. Ans: Cl > F > Br > I

Sol: The electron gain enthalpies of I, Br, F & Cl are -295, -325, -328 & -349 kJ mol⁻¹

24. Ans: Li₂O + NO₂ + O₂

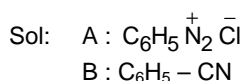


25. Ans: $(P_A / P_B)(M_B / M_A)^{1/2}$

Sol: $r_A \propto P_A \frac{1}{\sqrt{M_A}}$

$$\frac{r_A}{r_B} = \frac{P_A}{P_B} \sqrt{\frac{M_B}{M_A}}$$

26. Ans: Benzene diazonium chloride and benzonitrile



27. Ans: $k_1 = A k_2 - e^{\frac{E_{a_1}}{RT}}$

Sol: $k_1 = A_1 e^{-E_{a_1}/RT}$
 $k_2 = A_2 e^{-E_{a_2}/RT}$

$$\frac{k_1}{k_2} = \frac{A_1}{A_2} - e^{\frac{E_{a_2} - E_{a_1}}{RT}}$$

$$k_1 = A k_2 - e^{\frac{E_{a_1}}{RT}}$$

28. Ans: Acetylene

Sol: Acetylene is not formed by treating ethanol with con.H₂SO₄.

29. Ans: directly proportional to square root of temperature

Sol: $V \propto \sqrt{\frac{T}{M}}$

30. Ans: -1364.0 kJ

Sol: $\Delta H = \Delta U + \Delta nRT$
 $-1366.5 = \Delta H - 8.314 \times 10^{-3} \times 300$
 $\Delta H = -1364 \text{ kJ}$

PART C – MATHEMATICS

31. Ans: $\frac{p}{0}$

Sol: $(a + 3b) + 6c = (k_1 + 6)c = (1 + 3k_2)a$
C & a are non-collinear
 \therefore coefficients are zero
 $a + 3b + 6c = 0$

32. Ans: R - {2, -3}

Sol: $\begin{vmatrix} 1 & -k & 1 \\ k & 3 & -k \\ 3 & 1 & -1 \end{vmatrix} \neq 0$
 $2k^2 + 2k - 12 \neq 0$
 $k^2 + k - 6 \neq 0$
 $k \neq -3, 2$

33. Ans: Statement-1 is true, Statement-2 is true; statement-2 is a correct explanation for statement-1.

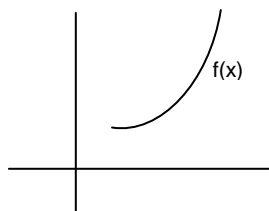
Sol: $f(x) = f^{-1}(x)$, this point lies on $f(x) = x$
 $\Leftrightarrow f(x) = x$
 $(x-1)^2 + 1 = x \Rightarrow x^2 - 3x + 2 = 0$
 $\Rightarrow x = 1, 2$

Statement-1 is true

$f(x)$ is a bijection and $f^{-1}(x) = 1 + \sqrt{x-1}$

Statement 2 is true

and Statement-1 follows from Statement-2



34. Ans: Statement-1 is true, statement-2 is false

Sol: $\lim_{x \rightarrow 0} \sin \frac{1}{x}$ does not exist
 $\therefore f_2(x)$ is not continuous at $x = 0$
 Statement-2 is false

35. Ans: $[A \wedge (A \rightarrow B)] \rightarrow B$

Sol: Using following truth table we can see that only
 $A \wedge (A \rightarrow B) \rightarrow B$ is tautology

A	B	A \rightarrow B	A \cap (A \rightarrow B)	(A \cap (A \rightarrow B)) \rightarrow B
1	2	3	1 \cap 3 = 4	4 \rightarrow 2
T	T	T	T	T
T	F	F	T	T
F	T	T	F	T
F	F	T	F	T

36. Ans: $x^2 + y^2 - x - y = 0$

Sol: $(x - 1)x + y(y - 1) = 0$
 $x^2 + y^2 - x - y = 0$

37. Ans: 18

Sol: $P(x) = f(x) - g(x) = Ax^2 + Bx + C$
 Since $P(-1) = 0$ is the only one root
 $\therefore P(x) = k(x + 1)^2$
 Given $P(-2) = 2 \Rightarrow k = 2$
 $\therefore P(2) = 18$

38. Ans: $[1, \infty)$

Sol: $x + y |x|, ax - y = 1$

$$x = \frac{|a| + 1}{a + 1}, y = |a| - \frac{|a| + 1}{a + 1}$$

$$= \frac{a|a| - 1}{a + 1}$$

$$\text{If } x > 0 \Rightarrow a + 1 > 0 \Rightarrow a > -1$$

$$y > 0 \Rightarrow |a| - 1 > 0 \Rightarrow |a| > 1$$

$$\text{If } -1 < a < 0 - a^2 > 1 \text{ no soln}$$

$$\text{If } a \geq 0$$

$$a^2 \geq 1 \Rightarrow |a| \geq 1$$

$$\therefore a \in [1, \infty)$$

39. Ans: Statement-1 is true, Statement-2 is true; statement-2 is a correct explanation for statement-1.

Sol: R is an equivalence relation since reflexivity, symmetry, transitivity are satisfied. \therefore Statement-1 is true
 Statement-2 is always true
 And it is correct explanation of Statement-1

40. Ans: $\frac{3}{4}$

Sol:

$$\int_0^{1.5} x[x^2] dx = \int_0^1 x \times 0 dx + \int_1^{\sqrt{2}} x dx + \int_{\sqrt{2}}^{1.5} 2x dx$$

$$= \frac{x^2}{2} \Big|_1^{\sqrt{2}} + x^2 \Big|_{\sqrt{2}}^{1.5}$$

$$= \frac{1}{2} + 2.25 - 2$$

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

41. Ans: $N \leq 100$

Sol: Maximum number of triangles are possible if rest of the points are non-collinear.

$$\text{Then } N_{\max} = {}^{10}C_3 - {}^6C_3 = 100$$

$$\therefore N \leq 100$$

42. Ans: 32, 2

$$\text{Sol: Mean} = 30 + 2 = 32$$

$$\text{Standard deviation remains same} = 2$$

43. Ans: $\sqrt{53}$

Sol: General point on line Q $(2\lambda, 3\lambda + 2, 4\lambda + 3)$

$$\Rightarrow 2(2\lambda - 3) + 3(3\lambda + 3) + 4(4\lambda - 8) = 0$$

$$\Rightarrow \lambda = 1$$

$$\therefore \text{point Q } (2, 5, 7) \text{ given point P } (3, -1, 11)$$

$$\therefore \text{length PQ} = \sqrt{53}$$

44. Ans: $2af(a) - a^2f'(a)$

$$\text{Sol: } \lim_{x \rightarrow a} \frac{x^2f(a) - a^2f(x)}{x - a} \quad \left(\frac{0}{0} \right)$$

$$\lim_{x \rightarrow a} \frac{f(a)2x - a^2f'(x)}{1}$$

$$\Rightarrow 2af(a) - a^2f'(a)$$

45. Ans: Statement-1 is true and Statement-2 is false.

Sol: Statement-1 is true

In Statement-2

$$\text{Det}(A^T) = \text{det}(A) \text{ But}$$

$\text{Det}(-A) = -\text{Det}(A)$ only for odd order so it is not true.

46. Ans: $P(A^C) - P(B)$

$$\text{Sol: } P(A^C \cap B^C / C)$$

$$= \frac{P(C) - P(B \cap C) - P(A \cap C)}{P(C)}$$

$$= 1 - P(B) - P(A)$$

$$= 1 - P(A) - P(B)$$

$$= P(A^C) - P(B)$$

47. Ans: 3

Sol: $\lim_{x \rightarrow 5} \frac{(f(x))^2 - 9}{\sqrt{1x-5}} = 0$
 $\lim_{x \rightarrow 5} \frac{(f(x))^2 - 9}{\sqrt{x-5}} = 0$
 $\lim_{x \rightarrow 5} (f(x))^2 - 9 = 0$
 $\lim_{x \rightarrow 5} f(x) = 3$

48. Ans: $\frac{16}{3}$

Sol: $y^2 = 9ax$
 $x^2 = 9by$
 $A = \frac{16}{3} ab = \frac{1}{3}$
 \therefore Required Area = $\frac{16}{3}$

49. Ans: $3x^2 - y^2 = 3$

Sol: $e = 2$
 $ae = 2 \Rightarrow a = 1$
 $e = \sqrt{1 + \frac{b^2}{a^2}} \Rightarrow b^2 = 3$
 \therefore required equation is $x^2 - \frac{y^2}{3} = 1$
 $3x^2 - y^2 = 3$

50. Ans: H

Sol: $H = \begin{bmatrix} \omega & 0 \\ 0 & \omega \end{bmatrix} = \omega I$
 $\therefore H^{70} = \omega^{70} I = \omega I = H$

51. Ans: $10\sqrt{3}$

Sol: Equation of the line through (1, -5, 9) parallel to $x = y = 12$ is
 $\frac{x-1}{1} = \frac{y+5}{1} = \frac{z-9}{1} = \lambda$
 $p(\lambda + 1, \lambda - 5, \lambda + 9)$
 $(\lambda + 1) - (\lambda - 5) + (\lambda + 9) = 5$
 $\Rightarrow \lambda = -10$
 $\therefore p(-9, -15, -1)$
 \therefore distance = $10\sqrt{3}$

52. Ans: $1 + \frac{1}{y} - \frac{e^{1/y}}{e}$

Sol: $y^2 dx + x dy - \frac{1}{y} dy = 0$

$$\Rightarrow \frac{dx}{dy} + n \cdot \frac{1}{y^2} = \frac{1}{y^3}$$

$$I. F = e^{-1/y}$$

$$\therefore x e^{-1/y} = \int \frac{1}{y^3} e^{-1/y} dy \quad z = \frac{1}{y}$$

$$\int z \cdot e^{-z} - dy \quad dz = \frac{-1}{y^2} dy$$

$$- [z e^{-z} + \int e^{-z} dz]$$

$$x e^{-1/y} = z e^{-z} + e^{-z} + C$$

$$x = z + 1 + c e^{-1/y}$$

$$x = \frac{1}{y} + 1 + c e^{1/y}$$

$$y = 1 \Rightarrow x = 1 \Rightarrow 1 = 2 + ce$$

$$\Rightarrow c = -\frac{1}{e}$$

$$\therefore x = \frac{1}{y} + 1 - \frac{1}{e} e^{1/y}$$

$$x = 1 + \frac{1}{y} - \frac{e^{1/y}}{e}$$

53. Ans: $\frac{2\pi}{9}, \frac{\pi}{4}, \frac{4\pi}{9}, \frac{\pi}{2}, \frac{3\pi}{4}, \frac{8\pi}{9}$

Sol: $\sin \theta + \sin 4\theta + \sin 7\theta = 0$
 $\Rightarrow \sin 4\theta + 2 \sin 4\theta \cos 3\theta = 0$
 $\Rightarrow \sin 4\theta (1 + 2 \cos 3\theta) = 0$
 $\Rightarrow \sin 4\theta = 0 \quad \cos 3\theta = -\frac{1}{2} = \cos \frac{2\pi}{3}$
 $\Rightarrow 4\theta = n\pi \quad 3\theta = 2n\pi \pm \frac{2\pi}{3}$

$$\Rightarrow \theta = \frac{n\pi}{4}, \theta = \frac{2n\pi}{3} \pm \frac{2\pi}{9}$$

$$\frac{\pi}{2}, \frac{\pi}{4}, \frac{3\pi}{4}, \frac{8\pi}{9}, \frac{4\pi}{9}, \frac{2\pi}{9}$$

54. Ans: -2

Sol: $\begin{vmatrix} p & 1 & 1 \\ 1 & q & 1 \\ 1 & 1 & r \end{vmatrix} = 0 \Rightarrow pqr - (p + q + r) = -2$

55. Ans: 6, 1

Sol: Sum of roots = $4 + 3 = 7$
 product = $3 \times 2 = 6$
 \therefore correct equation is $x^2 - 7x + 6 = 0$
 Roots are 6, 1

56. Ans: $2x + 3y = 1$

Sol: Let (x, y) be coordinates of centroid
 $x = \frac{2-2+x_3}{3} \quad y = \frac{-3+1+y_3}{3}$

$$\frac{x_3}{3} = \frac{2-y_3}{3}$$

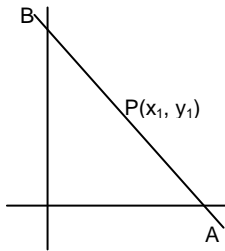
$$x_3 = 3x \quad y_3 = 3y + 2$$

$$2x_3 + 3y_3 = 9 \Rightarrow 6x + 9y + 6 = 9$$

$$2x + 3y = 1$$

57. Ans: $y = \frac{6}{4}$

Sol:



Let m be the slope of tangent at $P(x_1, y_1)$
 \therefore Equation of AB
 $y - y_1 = m(x - x_1)$
 \therefore A is $(0, y_1 - mx_1)$ and B is $(x_1 - \frac{y_1}{m}, 0)$
 \therefore and point of AB (x_1, y_1)
 $\Rightarrow 2x_1 = x_1 - \frac{y_1}{m} \Rightarrow \frac{dx}{x} + \frac{dy}{y} = 0$
 $\Rightarrow xy = k$ it passes in $(2, 3)$
 $xy = 6 \Rightarrow y = \frac{6}{4}$

58. Ans: $\frac{\alpha - \beta}{100}$

Sol: $\alpha - \beta = \sum_{r=1}^{100} (a_{2r} - a_{2r-1})$
 $= \sum_{r=1}^{100} d = 100d \Rightarrow d = \frac{\alpha - \beta}{100}$

59. Ans: Statement-1 is true, Statement-2 is true; statement-2 is a correct explanation for statement-1.

Sol: Statement-2 is true
 Clearly $f(x)$ has minimum at $x = 0$ at minimum point $f'(x) = 0$
 \therefore follows from 1

60. Ans: Statement-1 is true, Statement-2 is true; statement-2 is a correct explanation for statement-1.

Sol: Statement-2
 By induction $p(1)$ is true
 Let $p(m)$ be true
 Then $(m+1) : (m+1)^7 - (m+1)$
 $= m^7 + {}^7C_1 m^6 + \dots + 7m + 1 - m - 1$
 $= (m^7 - m) + 7k$ divisible by 7
 $\therefore p(n)$ is true

Statement-2 is true
 $\therefore (n+1)^7 - (n+1)$ divisible by 7
 Also, $n^7 - n$ divisible by 7
 Subtracting, $(n+1)^7 - n^7 - 1$ divisible by 7
 Statement-1 is true and follows from Statement-2

PART C – PHYSICS

61. Ans: 2

Sol: $I_1 = 4I$, for coherent light
 $I_2 = I + I = 2I$ for incoherent light
 $\therefore \frac{I_1}{I_2} = \frac{4I}{2I} = 2$

62. Ans: $\frac{P}{2}, T$

Sol: There is no heat loss and no work is done
 $\Rightarrow U$ is same $\Rightarrow T$ is same.
 $V \Rightarrow 2V$, so $P \Rightarrow \frac{P}{2}$ for T to be same
 ($\Theta PV = \text{constant}$ for T to be constant)
 $\therefore \frac{P}{2}, T$ is the final state.

63. Ans: NOR gate

Sol: Becomes combination of OR gate and NOT gate
 \Rightarrow NOR gate

64. Ans: 3

Sol: It is assumed that F_1 and F_2 are applied parallel to the plane.
 $F_1 = mg \sin \theta + \mu mg \cos \theta$
 $F_2 = mg \sin \theta - \mu mg \cos \theta$
 $\frac{F_1}{F_2} = \frac{\tan \theta + \mu}{\tan \theta - \mu} = \frac{2\mu + \mu}{2\mu - \mu} = \frac{3}{1}$

65. Ans: $\sqrt{\frac{GM}{4R}}$

Sol: $\frac{mv^2}{R} = \frac{Gm^2}{4R^2}$
 $v = \sqrt{\frac{GM}{4R}}$ w.r.t centre of circle, which also is centre of mass of system.
 Centre of mass of system is at rest.

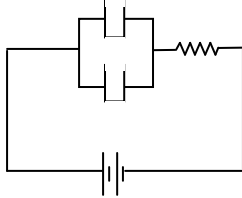
66. Ans: λ

Sol: Considering the nucleus to be at rest initially, total linear momentum = zero for system
 $\Rightarrow p$ of m_1 and p of $5m$, are equal in magnitude but opposite in direction.

$$\lambda = \frac{h}{p} = \text{same for both}$$

67. Ans: 2.5 second

Sol:



$$\tau_P = RC' = 2 RC$$

$$V = V_0 e^{-\frac{t}{\tau_P}}$$

$$\Rightarrow \frac{1}{2} = e^{-\frac{10}{\tau_P}}$$

$$\Rightarrow -\lambda \ln 2 = \frac{-10}{\tau_P}$$

$$\Rightarrow \tau_P = \frac{-10}{-\lambda \ln 2} = \frac{10}{\lambda \ln 2} = 2 RC$$

$$\tau_S = RC'' = \frac{RC}{2} = \frac{2RC}{4} = \frac{5}{2\lambda \ln 2}$$

$$\Rightarrow \frac{1}{2} = e^{-\frac{t}{\tau_S}} \Rightarrow -\lambda \ln 2 = -\frac{t \times 2\lambda \ln 2}{5}$$

$$\Rightarrow t = \frac{5}{2} = 2.5 \text{ s} \Rightarrow t = 2.5 \text{ second}$$

68. Ans: $\frac{\pi R^4}{4} \sigma \omega$

Sol: $dq = (2\pi r dr) \sigma$ for an elemental ring of radius r and width dr .

$$di = (dq) \omega = \frac{(dq)\omega}{2\pi} = \omega \sigma r dr$$

$$dM = \pi r^2 di = \pi \omega \sigma r^3 dr$$

$$\therefore M = \int_0^R dM = \frac{\pi \omega \sigma R^4}{4}$$

69. Ans: A standing wave having nodes at

$$x = \left(n + \frac{1}{2}\right) \frac{\lambda}{2}, (n = 0, 1, 2, \dots)$$

Sol: $y_1 = A \sin(\omega t - kx)$

$$y_2 = A \sin(\omega t + kx)$$

$$y = y_1 + y_2$$

$$= A [2 \sin \omega t \cos(-kx)]$$

$$= 2 A \cos kx \sin \omega t \Rightarrow \text{standing wave;}$$

$$k = \frac{2\pi}{\lambda} \text{ Nodes are at}$$

$$x = \left(n + \frac{1}{2}\right) \frac{\lambda}{2}, (n = 0, 1, 2, \dots)$$

70. Ans: $Y \propto t$

Sol: Thermal stress = $Y \propto t$

71. Ans: 0.1 V m^{-1}

Sol: $R = \frac{\rho \lambda}{A}; V = iR$

$$V = \frac{i \rho \lambda}{A} \Rightarrow \frac{V}{\lambda} = \frac{i \rho}{A}$$

$$\therefore \frac{V}{\lambda} = \frac{0.2 \times 4 \times 10^{-7}}{8 \times 10^{-7}} = 0.1 \text{ V m}^{-1}$$

72. Ans: Statement - 1 is true, statement - 2 is true, statement - 2 is not the correct explanation of statement - 1.

Sol: Statement - 1 is correct. Statement 2 is correct but does not explain 1.

73. Ans: Statement - 1 is true, statement - 2 is true, statement - 2 is the correct explanation of statement - 1.

Sol: Statement - 1 is true, statement - 2 is true and explain 1.

74. Ans: $2\pi \sqrt{\frac{\lambda d}{\rho g}}$

Sol: $m = \lambda^3 d$

$$\Delta F = -\lambda^2 \rho g x$$

$$\therefore a = \frac{\Delta F}{m} = \frac{-\rho g x}{\lambda d}$$

$$\Rightarrow \omega^2 = \frac{\rho g}{\lambda d}$$

$$T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{\lambda d}{\rho g}}$$

75. Ans: $\frac{1}{\sqrt{t}}$

Sol: $u = 0$ at $t = 0$

$$\frac{1}{2} m v^2 = kt$$

$$\Rightarrow v^2 = \frac{2kt}{m}, k = +ve \text{ constant}$$

$$\Rightarrow v = \sqrt{\frac{2kt}{m}}$$

$$a = \frac{dv}{dt} = \frac{B}{\sqrt{t}} \Rightarrow F = ma \propto \frac{1}{\sqrt{t}}$$

76. Ans: $2^{8/3} \pi^2 T$

Sol: $R = 2^{1/3} r$

$$E = 4\pi R^2 T$$

$$= 2^2 \cdot \pi \cdot 2^{2/3} \cdot r^2 T$$

$$= 2^{8/3} \pi^2 T$$

77. Ans: $11q$

Sol: $\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$
 $= (3q\hat{i} + q\hat{j} + 2q\hat{k})$
 $+ q(3\hat{i} + 4\hat{j} + \hat{k})(\hat{i} + \hat{j} - 3\hat{k})$
 $[\vec{F}_y = q\hat{j} + (9q\hat{j} + q\hat{j})] = 11q\hat{j}$

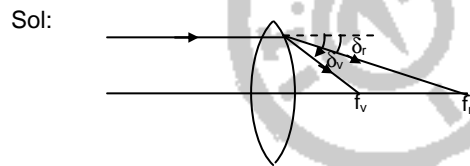
78. Ans: $\frac{\sqrt{3}}{16} \frac{mv^3}{g}$

Sol: $v_H = v \cos 30^\circ = \frac{\sqrt{3}}{2} v$
 $p = mv_H = \frac{\sqrt{3}}{2} mv$
 $H_{\max} = \frac{v^2 \sin^2 30^\circ}{2g} = \frac{v^2}{8g}$

$\therefore L_H = p H_{\max}$

$= \frac{\sqrt{3} mv^3}{16g}$

79. Ans: Increase



$f_r > f_v$

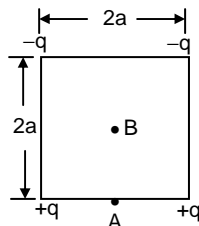
80. Ans: 5%

Sol: $R_S = 4R$
 $\therefore \Delta R_S = 4\Delta R$
 $\Rightarrow \frac{\Delta R_S}{R_S} = \frac{4\Delta R}{4R} = \frac{\Delta R}{R} = 5\%$

81. Ans: To reduce the time lag between transmission and reception of the information signal.

82. Ans: $\frac{1}{4\pi\epsilon_0} \frac{2qQ}{a} \left[1 - \frac{1}{\sqrt{5}} \right]$

Sol:



$V_A = \frac{2q}{4\pi\epsilon_0 a} - \frac{2q}{4\pi\epsilon_0 \sqrt{5}a} = \frac{2q}{4\pi\epsilon_0 a} \left[1 - \frac{1}{\sqrt{5}} \right]$

$\therefore U_1 = \frac{2qQ}{4\pi\epsilon_0} \left[1 - \frac{1}{\sqrt{5}} \right]; V_B = 0 \Rightarrow U_2 = 0$

$\therefore KE_2 = \Delta U = U_1 = \frac{2qQ}{4\pi\epsilon_0 a} \left[1 - \frac{1}{\sqrt{5}} \right]$

83. Ans: $\frac{5}{2} k$

Sol: $k \propto \frac{1}{N} \propto \frac{1}{\lambda}$
 $\Rightarrow k\lambda = \text{constant}$
 $k_A \lambda_A = k\lambda$
 $\Rightarrow k_A = \frac{k\lambda}{\lambda_A} = k \frac{5\lambda}{2\lambda} = \frac{5k}{2}$

84. Ans: $6.25 \times 10^{-4} \text{ cm s}^{-1}$

Sol: $v = \frac{2r^2 g (\rho - \sigma)}{9\eta}$
 $\frac{v_2}{v_1} = \frac{\eta_1 (7.8 - 1.2)}{\eta_2 (7.8 - 1.0)}$
 $\Rightarrow v_2 = v_1 \frac{\eta_1}{\eta_2} \times \frac{6.6}{6.8}$
 $= \frac{10 \times 8.5 \times 10^{-4}}{13.2} \times \frac{6.6}{6.8} = 6.25 \times 10^{-4} \text{ cm s}^{-1}$

85. Ans: $\left(1 - \frac{1}{\mu_1} \right) h_1 + \left(1 - \frac{1}{\mu_2} \right) h_2$

Sol: $S = S_1 + S_2$
 $= \left(1 - \frac{1}{\mu_1} \right) h_1 + \left(1 - \frac{1}{\mu_2} \right) h_2$

86. Ans: 28.9 cc

Sol: $\Delta V = V_0 \gamma \Delta \theta$
 $= V_0 [3 \propto \Delta \theta]$
 $= \frac{\pi}{6} D^3 [3 \propto \Delta \theta]$
 $= \frac{\pi}{6} \times 20^3 [3 \times 23 \times 10^{-6} \times 100]$
 $= 28.9 \text{ cm}^3$

87. Ans: 3 mV

Sol: $\lambda = 20 \text{ m}$
 $v = 5 \text{ m s}^{-1}$
 $B_h = 0.3 \times 10^{-4} \text{ Wb m}^{-2}$
 $\mathcal{E} = B_h v \lambda$
 $= 0.3 \times 10^{-4} \times 5 \times 20 = 0.3 \times 10^{-2} \text{ V}$
 $= 3 \text{ mV}$

88. Ans: between 0.148 kJ and 0.028 kJ

Sol: $dQ = -mS dT$

$$\begin{aligned}
&= -\frac{100}{1000} \times \frac{32 T^3}{(400)^3} dT \text{ (kJ)} \\
&= -\frac{1}{10} \times \frac{32}{64 \times 10^6} T^3 dT \\
&= -\frac{1}{2 \times 10^7} T^3 dT \text{ (kJ)} \\
\therefore Q &= \int_{20\text{K}}^{4\text{K}} dQ = \int_{20}^4 \frac{-T^3 dT}{2 \times 10^7} \text{ kJ} = \left. \frac{T^4}{8 \times 10^7} \right]_4^{20} \\
&= \frac{[20^4 - 4^4]}{8 \times 10^7} \text{ kJ} = 19968 \times 10^{-7} \text{ kJ} \\
&= 0.0019968 \text{ kJ} \\
\text{COP} &= \frac{Q}{W} = \frac{T_2}{(T_1 - T_2)} \Rightarrow W = \frac{Q(T_1 - T_2)}{T_2} \\
W_{\max} &= \frac{0.0019968 \times (300 - 4)}{4} \\
&= 0.148 \text{ kJ} \\
W_{\min} &= \frac{0.0019968 \times (300 - 20)}{20} \\
&= 0.028 \text{ kJ}
\end{aligned}$$

89. Ans: Statement – 1 is correct, statement – 2 is correct and statement – 2 is not the correct explanation of statement-1.

Sol: Statement – 1 is correct as energy of antineutrino is negligible.

Statement – 2 is also correct but does not explain-1.

90. Ans: 2 : 1

Sol: $I_P = 4I$
 $I_Q = I + I + 2I \cos 90^\circ = 2I$

$$\therefore \frac{I_P}{I_Q} = \frac{4I}{2I} = 2 : 1$$

(Path difference $\frac{\lambda}{4}$)

= phase difference $\frac{\pi}{2}$ rad)



T.I.M.E.
Triumphant Institute of
Management Education Pvt. Ltd.