SOLUTION & ANSWER FOR AIEEE-2008
VERSION – A1

[PHYSICS, CHEMISTRY & MATHEMATICS]

PART A – PHYSICS

1. A body of mass m = 3.513 kg …….

Ans : 3

Sol: min (4, 3)
= 3

2. Consider a uniform square plate of side …….

Ans : $\frac{2}{3}ma^2$

Sol: $I = I_{cm} + md^2$

$= \frac{ma^2}{6} + \frac{ma^2}{2}$

$= \frac{2}{3}ma^2$

3. The speed of sound in oxygen ……..

*Ans : 1419 m/s

Sol: $\frac{v_0}{v_{He}} = \sqrt{\frac{\gamma_0}{\gamma_{He}} \times \frac{M_{He}}{M_0}}$

$\frac{460}{v_{He}} = \sqrt{\frac{\frac{7}{5}}{\frac{5}{3}} \times \frac{4}{32}}$

$= \sqrt{\frac{21}{25} \times \frac{4}{32}}$

$\frac{460}{v_{He}} = \sqrt{\frac{21}{25 \times 8}}$

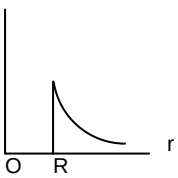
$v_{He} = 460\sqrt{\frac{200}{21}}$

= 1419 m/s

**** None of the given answers matches with our answer.***

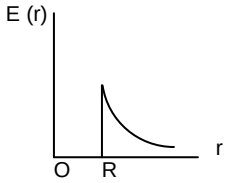
4. A thin spherical shell of radius R has ……..

Ans :



Sol: E = 0, r < R

$E = \frac{1}{4\pi\in_0}\frac{1}{r^2}$ r > R



5. Relative permittivity and permeability of a ……

Ans : $\varepsilon_r = 1.5$, $\mu_r = 0.5$

Sol: $\mu_r < 1$ for diamagnetic
$\varepsilon_r > 1$ for all materials

6. Suppose an electron is attracted towards the …..

Ans : T_n independent of n, $r_n \propto n$

Sol: $\frac{mv^2}{r} = \frac{k}{r}$

$\Rightarrow \frac{1}{2}mv^2$ independent of n

$mvr = \frac{nh}{2\pi} \Rightarrow r \propto n$

7. A block of mass 0.50 kg is moving with a speed…

Ans : 0.67 J

Sol: $\frac{1}{2}\frac{m_1 m_2}{m_1 + m_2}\left(1 - e^2\right)(u_1 - u_2)^2$

$= \frac{2}{3} = 0.67$

8. A wave traveling along the x-axis is …..

Ans : $\alpha = 25.00\,\pi$, $\beta = \pi$

Sol: $\alpha = \frac{2\pi}{\lambda} = \frac{2\pi}{0.08} = 25\,\pi$

$\beta = \omega = \frac{2\pi}{T} = \pi$

$\Rightarrow \alpha = 25.00\,\pi, \beta = \pi$

9. A working transistor with its three legs….

Ans : it is npn transistor with R as base.

Sol: Emitter to collector will always be non conducting.

10. A jar is filled with two non-mixing …….

Ans : $\rho_1 < \rho_3 < \rho_2$

Sol: ρ_3 floats in ρ_2 and sinks in ρ_1
$= \rho_1 < \rho_3 < \rho_2$

11. An athlete in the Olympic games…….

Ans : 2000 J – 5000 J

Sol: v is of the order of 10 ms^{-1} and mass is around 50 kg $\Rightarrow$ 2000 J – 5000 J

12. A parallel plate capacitor with air between……

Ans : 40.5 pF

Sol: $C_1 = 9 \times 3 \times 3 = 81$

$C_2 = 9 \times \frac{3}{2} \times 6 = 81$

$C = \frac{81}{2} = 40.5$ pF

13. The dimension of magnetic field in …….

Ans : $MT^{-1}C^{-1}$

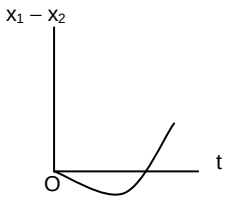
Sol: $F = Bqv$

$[B] = \frac{[F]}{qv}$

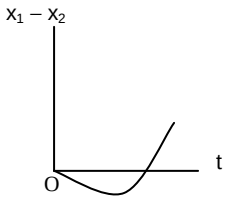
$= MT^{-1}C^{-1}$

14. A body is at rest at x = 0. At t = 0 …….

Ans :



Sol: $x_1 - x_2 = \frac{1}{2}at^2 - ut$



15. In the circuit below, A and B represent …..

Ans : OR gate

Sol: Either A or B is high, it pulls C high
$\Rightarrow$ OR gate

16. While measuring the speed of sound ……

Ans : x > 54

Sol: Speed increases slightly with temperature $\Rightarrow \lambda$ increases $\Rightarrow$ for second resonance x > 54

17. Shown in the figure below is a meter-bridge…..

Ans : 220 Ω

Sol: $\frac{R}{55} = \frac{100-20}{20}$

R = 220 Ω

18. A spherical solid ball of volume V is …….

Ans : $\sqrt{\frac{Vg(\rho_1 - \rho_2)}{K}}$

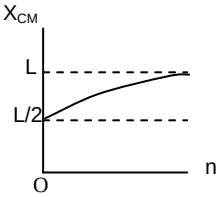
Sol: $Kv^2 = mg - F_B$

$= (\rho_1 - \rho_2)\,Vg$

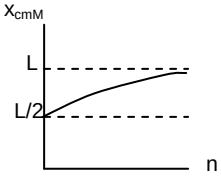
$v = \sqrt{\frac{Vg(\rho_1 - \rho_2)}{K}}$

19. A thin rod of length ‘L’ is lying along ……

Ans :



Sol: $x_{cm} = \frac{\int_0^L x.K\left(\frac{x}{L}\right)^n dx}{\int_0^L K\left(\frac{x}{L}\right)^n dx} = \frac{n+1}{n+2}$



20. A planet in a distant solar system is ……

Ans : 110 km s^{-1}

Sol: $v_{esc} = \sqrt{\frac{2GM}{r}}$

$\frac{v_2}{v_1} = \sqrt{\frac{10}{1/10}} = 10$

$\Rightarrow v_2 = 110$ km/s

21. An insulated container of gas has two……

Ans : $\frac{T_1T_2(P_1V_1+P_2V_2)}{P_1V_1T_2+P_2V_2T_1}$

Sol: $n_1 C_V T_1 + n_2 C_V T_2 = (n_1 + n_2) C_V T$

$T = \frac{T_1T_2(P_1V_1+P_2V_2)}{P_1V_1T_2+P_2V_2T_1}$

22. Two full turns of the circular scale …..

Ans : 3.38 mm

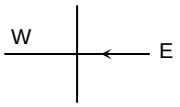
Sol: $3 + \frac{35}{50}\times 0.5 + 0.03$

= 3.38 mm

23. A horizontal overhead powerline is …….

Ans : 5×10^{-6} T southward

Sol:



$B = \frac{\mu_0 I}{2\pi r} = 5 \times 10^{-6}$ T

24. An experiment is performed to find …..

Ans : a vernier scale provided on the microscope

Sol: Vernier scale on the microscope

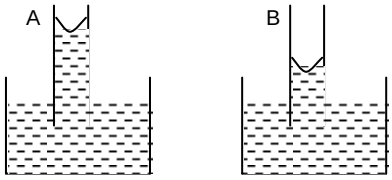
25. A 5 V battery with internal resistance …..

Ans : 0.03 A P_2 to P_1

Sol: $E_{eff} = \frac{5\times 1 - 2\times 2}{2+1} \Rightarrow I = 0.03$ A P_2 to P_1

26. A capillary tube (A) ……

Ans :



Sol: Surface tension is lowered.

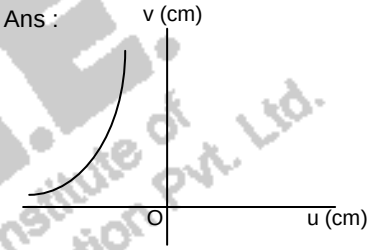
27. Two coaxial solenoids are made ……

Ans : $2.4\,\pi \times 10^{-4}$ H

Sol: $M = \frac{\mu_0 N_1 N_2 A}{\ell} = 2.4\,\pi \times 10^{-4}$ H

28. A student measures the focal ….

Ans :



Sol: u < 0, v > 0

29. This question contains statement – 1

Ans : Statement – 1 is true, Statement – 2 is true; Statement – 2 is a correct explanation for Statement -1

Sol: Gauss law for gravitation

30. This question contains statement – 1

Ans : Statement – 1 is true, Statement – 2 is false'

Sol: BE per nucleon increases for lighter nuclei and decreases for heavy nuclei.

31. For current entering ….

Ans : $\frac{\rho I}{2\pi r^2}$

Sol: $j \times 2\pi r^2 = I$

$E = \rho j = \frac{\rho I}{2\pi r^2}$

32. ΔV measured between B and C is

Ans : $\frac{\rho I}{\pi a} - \frac{\rho I}{\pi(a+b)}$

Sol: $\Delta V = 2.\int_a^{a+b} E dr$

$= \frac{\rho I}{\pi a} - \frac{\rho I}{\pi(a+b)}$

33. If a strong diffraction peak is observed when electrons are incident at an angle `i' –

Ans: $2d \cos i = n \lambda_{dB}$

Sol: $2d \cos i = n \lambda_{dB}$

34. Electrons accelerated by potential V are diffracted from a crystal. –

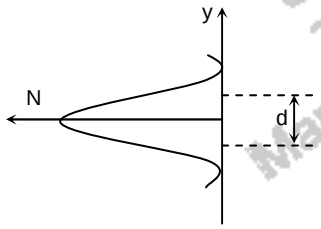
Ans: 50 V

Sol: $\frac{12.25}{\sqrt{V}} = 2d\cos\theta$

= 50 V

35. In an experiment, electrons are made to pass through a narrow slit of

Ans:



PART B – CHEMISTRY

36. The ionization enthalpy of hydrogen …….

Ans: 9.84×10^5 J mol^{-1}

Sol : $\Delta E = 1.312 \times 10^6 \left[\frac{1}{1} - \frac{1}{4}\right]$

$= 1.312 \times \frac{3}{4} \times 10^6$

$= 9.84 \times 10^5$ J mol^{-1}

37. ….. pairs of species have the same bond order?

Ans: CN^- and NO^+

Sol : Both CN^- and NO^+ contain 14 electrons each and hence they have the same bond order.

38. …….. a group of the isoelectronic species?

Ans: NO^+ , C_2^{2-}, CN^-, N_2

Sol : Total no. of electrons in NO^+ = 14 (7+8–1), C_2^{2-} = 14 (6+6+2), CN^- = 14 (6+7+1) and N_2 = 14 (7+7).

39. Four species are…….

i. ii. iii. iv.

…… the correct sequence of their acid strength?

Ans: i < iii < ii < iv

Sol : Fluoro sulphonic acid is the strongest, followed by H_3O^+, HSO_4^- and HCO_3^-.

i < iii < ii < iv

40. The pK_a of a weak acid, HA is ……

Ans: 7.01

Sol : $pH = \frac{1}{2}[pK_w + pK_a - pK_b]$

$= \frac{1}{2}[14 + 4.8 - 4.78] = 7.01$

41. …… decreasing order of priority for the functional groups of …….

Ans: –COOH, $-SO_3H$, $-CONH_2$, –CHO

Sol : Priority order is

–COOH > $-SO_3H$ > $-CONH_2$ > –CHO

42. ……. CH_3MgX with $CH_3C \equiv C-H$ …….

Ans: CH_4

Sol : $CH_3-C \equiv C-H + CH_3MgX \rightarrow$

$CH_3-C \equiv CMgX + CH_4$

43. **…….**can react with sodium in liquid ammonia

Ans: $CH_3–CH_2–C \equiv CH$

Sol : $CH_3–CH_2–C \equiv CH$ is a terminal alkyne containing acidic hydrogen. So it reacts with sodium in liquid ammonia forming the corresponding sodium derivative.

44. The vapour pressure of water at 20^0C is ……

Ans: 17.325 mm Hg

Sol : $\frac{p^0 - p}{p^0} = \frac{w_2}{M_2} x \frac{M_1}{w_1}$

$\frac{17.5 - p}{17.5} = \frac{18}{180} x \frac{18}{178.2}$

$17.5 – p = 0.175$

$P = 17.325$

45. Gold numbers of protective colloids A, B, C and D …….

Ans: A < C < B < D.

Sol : Lesser the gold number greater is the protective action. Protective action follows the order A < C < B < D.

46. ……. atoms of element Y form ccp ……

Ans: X_4Y_3

Sol : $X_{8 x \frac{2}{3}}Y_4 = X_4Y_3$

47. …… the industrial preparation of hydrogen from water gas ……..

Ans: CO is oxidized to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali.

Sol : From water gas (CO + H_2), CO is oxidized to CO_2 with steam and which is then absorbed in alkali.

48. …… substituted silane the one ……. to cross linked silicone ……..

Ans: $RSiCl_3$

Sol : Among the substituted silanes, $RSiCl_3$ on hydrolysis give rise to cross linked silicone polymers.

49. Amount of oxalic acid present in a solution can ….

Ans: reduces permanganate to Mn^{2+} .

Sol : Mn^{+7} oxidises both $C_2O_4^{2-}$ and Cl^-.

50. Given $E^\circ_{Cr^{3+}/Cr} = –0.72$ V $E^\circ_{Fe^{2+}/Fe} = –0.42$ V. The potential for the cell …….

Ans: 0.26 V

Sol : Cell reaction is $3Fe^{2+} + 2Cr \rightarrow 2Cr^{3+} + 3Fe$

$E_{cell} = E^o_{cell} + \frac{0.06}{n} \log \frac{[Fe^{2+}]^3}{[Cr^{3+}]^2}$

$= (0.72 – 0.42) + \frac{0.06}{6} \log \frac{10^{-6}}{10^{-2}}$

$= 0.3 – 0.04$

$= 0.26$ V

51. …… the correct statement?

Ans: Chlorides of both beryllium and aluminium have bridged chloride structures in solid phase.

Sol : Beryllium and aluminium chlorides have bridged structures in solid phase.

52. Identify the wrong statement …….

Ans: Ozone layer does not permit infrared radiation from the sun to reach the earth.

Sol : The incorrect statement is “Ozone layer does not permit I.R radiation from the sun to reach the earth”. Actualy ozone layer prevents u.v. radiation from the sun to reach the earth.

53. The coordination number and the oxidation state of the element …….

Ans: 6 and 3

Sol : en and $C_2O_4^{2-}$ are bidendate ligands.

$\therefore$Coordination number of E is 6 and oxidation state of E is 3 (en is neutral and NO_2^-)

54. ……. Octahedral complexes of Co ….

Ans: $[Co(CN)_6]^{3-}$

Sol : The strongest ligand is CN^- and hence Δ_0 will be the highest for $[Co(CN)_6]^{3-}$.

55. Larger number of oxidation states are exhibited …..

Ans: lesser energy difference between 5f and 6d than between 4f and 5d orbitals.

Sol : The energy difference between 5f and 6d (actinoids) is less than between 4f and 5d (lanthanoids) and hence actinoids exhibit larger number of oxidation states.

56. ……. no significance for roasting sulphide ores to ……

Ans: CO_2 is more volatile than CS_2

Sol : The insignificant statement is 'CO_2 is more volatile than CS_2'.
The reduction process is based on the thermodynamic stability of the products and not on their volatility.

57. Oxidising power of chlorine in aqueous solution …. $\frac{1}{2}Cl_2(g)$ ……$Cl^-(aq)$

The energy involved in the conversion of …….

Ans: –610 kJ mol^{-1}

Sol : Energy involved the conversion of $\frac{1}{2}Cl_{2(g)} \rightarrow Cl^-_{(aq)}$

$= \frac{240}{2} - 349 - 381$

$= -610$ kJ mol^{-1}

58. …… the alkene affords the compound ….

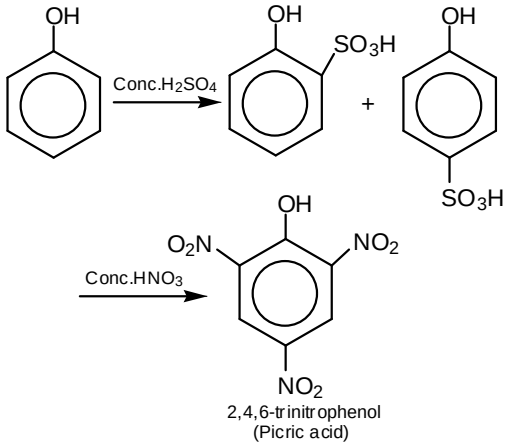
Ans: CH_3CHO

Sol : $CH_3–CH=CH–CH_3 \xrightarrow[(ii)H_2O/Zn]{(i)O_3} 2CH_3CHO$.

59. Phenol, when it first reacts with concentrated sulphuric acid …..

Ans: *2,4,6-trinitrophenol.

Sol: :

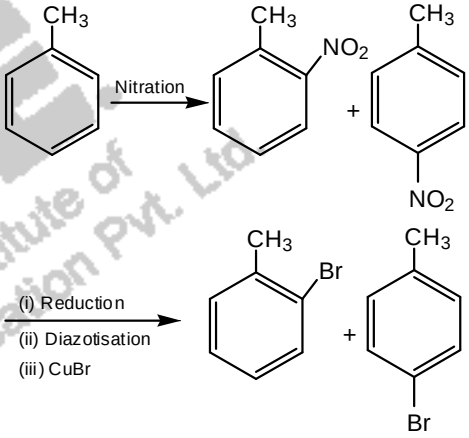


**** None of the given answers matches with our answer.***

60. Toluene is nitrated and the resulting ……

Ans: mixture of o– and p–bromotoluenes

Sol :



61. The organic chloro compound, which …..

Ans: CH_3Cl

Sol : Primary alkyl halides undergo S_N2 reaction with inversion of configuration.

62. The absolute configuration of …….

Ans: R, R

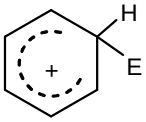
Sol : The absolute configuration of both the carbons are 'R'.

63. α -D-(+)-glucose and β -D-(+)-glucose are

Ans: anomers

Sol : α-D(+)glucose and β-D(+)glucose are anomers.

64. The electrophile, $E^{\oplus}$ attacks …….

Ans: 

Sol : $-NO_2$ group is a deactivating group.
Hence the intermediate formed from benzene will have lower energy than that formed from nitro benzene.

65. Standard entropy of X_2, Y_2 and XY_3 …….

Ans: 750K

Sol : $T = \frac{\Delta H}{\Delta S}$

$\Delta S = -40$ J

$\therefore T = \frac{-30000}{-40}$

$= 750K$

66. For the following three reactions a, b and c, …..

Ans : $K_3 = K_1 K_2$.

Sol : The first two reactions are added to get the third reaction, hence $K_3 = K_1 \times K_2$.

67. Bakelite is obtained from phenol …..

Ans: HCHO

Sol : Bakelite is a polymer of phenol and formaldehyde.

68. The equilibrium constant K_{P_1} and K_{P_2} for ……

Ans: 1 : 36

Sol : $X \rightleftharpoons 2Y$, Equilibrium constant = K_{p_1}

$Z \rightleftharpoons P + Q$, Equilibrium constant = K_{p_2}

When the degree of dissociation is the same for the two reactions, then $K_{p_1} = 4p_1$ and $K_{p_2} = p_2$.

$\frac{K_{p_1}}{K_{p_2}} = \frac{4p_1}{p_2}$

i.e., $\frac{1}{9} = \frac{4p_1}{p_2}$; $\frac{p_1}{p_2} = \frac{1}{36}$

69. For a reaction $\frac{1}{2}A \rightarrow 2B$, rate of …….

Ans: $-\frac{d[A]}{dt} = \frac{1}{4}\frac{d[B]}{dt}$

Sol : For the give reaction,

$2 X -\frac{d[A]}{dt} = \frac{1}{2}\frac{[d[B]}{dt}$

or $-\frac{d[A]}{dt} = \frac{1}{4}\frac{d[B]}{dt}$

70. At 80^0C, the vapour pressure of pure liquid 'A' is 520 mm Hg and that of ……..

Ans: 50 mol percent

Sol : $p^0_A.x_A + p^0_B.x_B = 760$

$520X_A + 1000(1 - X_A) = 760$

$x_A = \frac{240}{480} = \frac{1}{2}$

Mole percent = 50

PART C – MATHEMATICS

71. Let f : N $\rightarrow$ Y be a function defined as …….

Ans: $g(y) = \frac{y - 3}{4}$

Sol: $y = 4x + 3$

$x = \frac{y - 3}{4}$

$g(y) = \frac{y - 3}{4}$

72. Let R be the real line. Consider the following…..

Ans: T is an equivalence relation on R but S is not

Sol: S = {(x, y): y = x + 1 0 < x < 2
(x, x) → x = x + 1 → not reflexive
(x, y) ≠ (y, x) → not symmetric

73. The conjugate of a complex number is $\frac{1}{i-1}$ …….

Ans: $\frac{-1}{i+1}$

Sol: $\frac{1}{i-1}$

Conjugate number = $\frac{1}{-i-1}$

$= \frac{-1}{(1+i)}$

74. The quadratic equations $x^2 - 6x + a = 0$ and ……

Ans: 2

Sol: Let α, β be the roots of $x^2 - 6x + a = 0$ and α, γ be the roots of $x^2 - cx + 6 = 0$

$\Rightarrow \alpha + \beta = 6$ $\quad \alpha + \gamma = c$

and

$\alpha\beta = a$ $\quad \alpha\gamma = 6$

and $\frac{\beta}{\gamma} = \frac{4}{3} \Rightarrow \gamma = \frac{3}{4}\beta$

$\therefore \alpha\left(\frac{3}{4}\beta\right) = 6 \Rightarrow \alpha\beta = 8 \Rightarrow a = 8$

$\therefore$ The first equation is $x^2 - 6x + 8 = 0$

$\Rightarrow$ 2 and 4 are the roots.

If $\beta = 2$, then $\gamma = \frac{3}{2}$ $\Rightarrow$ Not possible, since roots are integers

If $\beta = 4 \Rightarrow \gamma = 3 \Rightarrow$ possible

$\therefore$ The common root is 2

75. Let A be a square matrix all of whose entries……

Ans: If det A = ±1, then A^{-1} exists and all its entries are integers

Sol: If det $A \neq \pm 1$, then det A may be zero $\Rightarrow A^{-1}$ does not exist.

When det A = ± 1, then A is orthogonal

$\Rightarrow A^{-1} = A^T \Rightarrow A^{-1}$ will have all enteries as integers

76. Let a, b, c be any real numbers. Suppose…….

Ans: 1

Sol: x – cy – bz = 0
–cx + y – az = 0
–bx – ay + z = 0
Given that x, y, z not all zero.
$\Rightarrow$ The given homogeneous system has non-trivial solutions.

$\Rightarrow \begin{vmatrix} 1 & -c & -b \\ -c & 1 & -a \\ -b & -a & 1 \end{vmatrix} = 0$

$\Rightarrow 1(1 - a^2) + c(-c - ab) - b(ac + b) = 0$
$\Rightarrow -a^2 - b^2 - c^2 - 2abc + 1 = 0$
$\Rightarrow a^2 + b^2 + c^2 + 2abc = 1$

77. How many different words can be formed by ……

Ans: $7.^6C_4.^8C_4$

Sol: 4I, 2p, 4s and 1 M are there in MISSISSIPPI.
Arrange the remaining 7 letters → $\frac{7!}{4!2!}$
* – * – * – * – * – * – *
In the eight places in between (marked as *) we can arrange the 4s's in $^8C_4$.wsays
$\therefore$ Total number of words = $\frac{7!}{4!2!} \times {}^8C_4$
$= 7.^6C_4.^8C_4$

78. The first two terms of a geometric progression….

Ans : – 12

Sol: a + ar = 12
$ar^2 + ar^3 = 48$
$r^2 (a + ar) = 48$
$r^2 = 4$
$r = \pm 2$
r = – 2, since terms are alternately positive and negative
$a = \frac{12}{1+r} = -12$

79. Let $f(x) = \begin{cases} (x-1)\sin\frac{1}{x-1} & \text{if } x \neq 1 \\ 0 & \text{if } x = 1 \end{cases}$ ……..

Ans : f is differentiable at x = 0 but not at x = 1

Sol : $f(x) = \begin{cases} (x-1)\sin\left(\frac{1}{x-1}\right) & \text{if } x \neq 1 \\ 0 \quad , & \text{if } x = 1 \end{cases}$

$$\lim_{x\to 1}(x-1)\sin\left(\frac{1}{x-1}\right)$$

$$= \lim_{x\to 1}\frac{\sin\left(\frac{1}{x-1}\right)}{\left(\frac{1}{x-1}\right)}$$

$$= \lim_{y\to\infty}\frac{\sin y}{y} = 0$$

$$f'(1) = \lim_{h\to 0}\frac{f(1+h)-f(1)}{h}$$

$$= \lim_{h\to 0}\frac{h\sin\left(\frac{1}{h}\right)}{h}$$

$$= \lim_{h\to 0}\sin\left(\frac{1}{h}\right)$$

does not exist

80. How many real solutions does the equation……..

Ans: 1

Sol: $f(x) = x^7 + 14x^5 + 16x^3 + 36x - 560$

$f'(x) = 7x^6 + 70x^6 + 48x^2 + 30$

> 0 for all $x \in R$

$f(x)$ is monotonic increasing

$f(x) = 0$ has only one real solution

81. Suppose the cubic $x^3 - px + q$ has three distinct..

Ans: The cubic has minima at $\sqrt{\frac{p}{3}}$ and maxima at $-\sqrt{\frac{p}{3}}$

Sol: $f(x) = x^3 - px + q$

$f'(x) = 3x^2 - p$

$f''(x) = 6x$

$3x^2 = p \Rightarrow x = \pm\sqrt{\frac{p}{3}}$

$f(x)$ is minimum at $x = \sqrt{\frac{p}{3}}$ and

maximum at $x = -\sqrt{\frac{p}{3}}$

82. The value of $\sqrt{2}\int\frac{\sin x\,dx}{\sin\left(x-\frac{\pi}{4}\right)}$ is …….

Ans: $x + \log\left|\sin\left(x-\pi/4\right)\right| + c$

Sol: $\sqrt{2}\int\frac{\sin x\,dx}{\sin\left(x-\frac{\pi}{4}\right)}$

$$= \sqrt{2}\int\frac{\sin\left(x-\pi/4+\pi/4\right)dx}{\sin\left(x-\pi/4\right)}$$

$$= \sqrt{2}\int\frac{\frac{1}{\sqrt{2}}\sin\left(x-\pi/4\right)+\frac{1}{\sqrt{2}}\cos\left(x-\pi/4\right)}{\sin\left(x-\pi/4\right)}dx$$

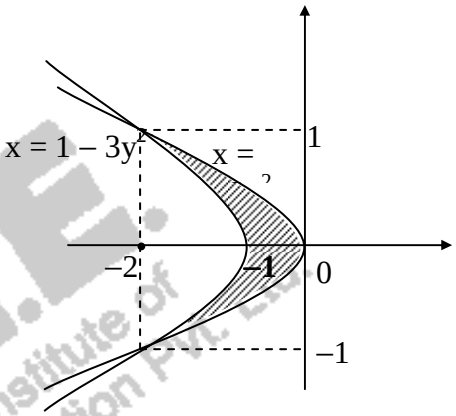
$= x + \log\left|\sin\left(x-\pi/4\right)\right| + c$

83. The area of the plane region bounded by the …..

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

Sol: $x + 2y^2 = 0 \Rightarrow x = -2y^2$

$x + 3y^2 = 1 \Rightarrow x = 1 - 3y^2$



Shaded portion is the required area

$$\text{Required area} = 2\int_0^1\left[\left(1-3y^2\right)-\left(-2y^2\right)\right]dy$$

$$= 2\int_0^1\left(1-y^2\right)dy = 2\left(y-\frac{y^3}{3}\right)\Big]_0^1$$

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

84. Let $I = \int_0^1\frac{\sin x}{\sqrt{x}}dx$ and $J = \int_0^1\frac{\cos x}{\sqrt{x}}dx$ …….

Ans : $I < \frac{2}{3}$ and $J < 2$

Sol : $I = \int_0^1\frac{\sin x}{\sqrt{x}}\,dx$

$< \int_0^1 \frac{1}{\sqrt{x}}\,dx$

< 2

$J = \int_0^1 \frac{\cos x}{\sqrt{x}}\,dx$

$< \int_0^1 \frac{1}{\sqrt{x}}\,dx$

< 2

In $(0, 1) \Rightarrow \sin x < x$

$\frac{\sin x}{\sqrt{x}} < \sqrt{x}$

$I < \int_0^1 \sqrt{x}\,dx = \frac{2}{3}$

85. The differential equation of the family of circles…

Ans: $(y-2)^2 y'^2 = 25 - (y-2)^2$

Sol : $(x-h)^2 + (y-2)^2 = 25$

$2(x-h) + 2(y-2)\frac{dy}{dx} = 0$

$(x-h) = -(y-2)\frac{dy}{dx}$

Differential equation is

$(y-2)^2\left[1+\left(\frac{dy}{dx}\right)^2\right] = 25$

86. The solution of the differential equation $\frac{dy}{dx} = \frac{x+y}{x}$ ……

Ans: $y = x \ln x + x$

Sol: Put $y = Vx$

$\frac{dy}{dx} = V + x\frac{dv}{dx}$

$\therefore V + x\frac{dv}{dx} = \frac{x+Vx}{x}$

$V + x\frac{dv}{dx} = 1 + V$

$x\frac{dv}{dx} = 1 \Rightarrow dv = \frac{dx}{x}$

$\therefore V = \log x + C$

$\frac{y}{x} = \log x + C$

$y(1) = 1 \Rightarrow C = 1$

$\therefore \frac{y}{x} = \log x + 1$

$y = x\log x + x$

87. The perpendicular bisector of the line segment ...

Ans: –4

Sol : Slope of the line = $\frac{1-k}{-1} = k - 1$

Passes through $\left(\frac{1+k}{2}, \frac{7}{2}\right)$

Perpendicular bisector is

$y - \frac{7}{2} = (k-1)\left[x - \left(\frac{1+k}{2}\right)\right]$

$2y - 7 = 2x(k-1) - (k^2 - 1)$

$2x(k-1) - 2y = k^2 - 8$

$\frac{k^2-8}{-2} = -4$

$k^2 - 8 = 8$

$\Rightarrow k = \pm 4$

88. The point diametrically opposite to the point P(1, 0) on the circle……..

Ans: (–3, –4)

Sol: Centre (–1, –2) . P(1, 0)

$\therefore$ opposite point Q(x, y)

$\therefore$ mid point of PQ = Centre

$\therefore \frac{x+1}{2} = -1 \quad \frac{y+0}{2} = -2$

$x = -3, y = -4$

$\therefore$ Point (–3, –4)

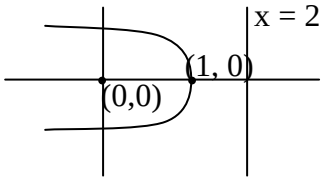
89. A parabola has the origin as its focus and the …..

Ans: (1, 0)

Sol: Parabola

$\therefore$ Vertex (1, 0)

$\Rightarrow$ (1)



90. A focus of an ellipse is at the origin. The directrix.

Ans: $\frac{8}{3}$

Sol: $\frac{a}{e} - ae = 4$

$2a - \frac{a}{2} = 4$

$\frac{3a}{2} = 4$

$a = \frac{8}{3}$

91. If the straight lines $\frac{x-1}{k} = \frac{y-2}{2} = \frac{z-3}{3}$ and ……

Ans : –5

Sol : $\begin{vmatrix} 1 & 1 & -2 \\ k & 2 & 3 \\ 3 & k & 2 \end{vmatrix} = 0$

$\Rightarrow (4 - 3k) - (2k - 9) - 2(k^2 - 6) = 0$

$\Rightarrow 4 - 3k - 2k + 9 - 2k^2 + 12 = 0$

$\Rightarrow 2k^2 + 5k - 25 = 0$

$k = \frac{5}{2}, -5$

$\Rightarrow k = -5$

92. The line passing through the points (5, 1, a)….

Ans: a = 6, b = 4

Sol: Equation of the line

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

crossed the yz-plane x = 0

$\therefore \frac{y-1}{b-1} = \frac{5}{2} \Rightarrow y - 1 = \frac{5}{2}(b-1)$

$\Rightarrow y = \frac{5(b-1)+2}{2}$

$\Rightarrow \frac{17}{2} = \frac{5(b-1)+2}{2}$

$\Rightarrow 20 = 5b \quad \therefore b = 4$

similarly $\frac{z-a}{1-a} = \frac{5}{2}$

$\Rightarrow 3a = 18$

$\Rightarrow a = 6$

93. The non-zero vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are related..

Ans: π

Sol: $a = 8\bar{b}$ $\quad \bar{a}$ is parallel to $\bar{b}$

$\bar{c} = -7\bar{b}$ $\quad \bar{c}$ is parallel to $\bar{c}$

$\Rightarrow \bar{a}$ and $\bar{c}$ are opposite

$\therefore$ angle = π

94. The vector $\vec{a} = \alpha\hat{i} + 2\hat{j} + \beta\hat{k}$ lies in the ….

Ans: $\alpha = 1, \beta = 1$

Sol: $\bar{a}, \bar{b}, \bar{c}$ are coplanar

$\begin{vmatrix} \alpha & 2 & \beta \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{vmatrix} = 0$

$\alpha - 2 + \beta = 0$

$\Rightarrow \alpha + \beta - 2 = 0$

True only $\alpha = 1, \beta = 1$

95. The mean of the numbers a, b, 8, 5, 10 is 6 .....

Ans: a = 3, b = 4

Sol : $\frac{a+b+8+5+10}{5} = 6$

$a + b + 23 = 30$

$a + b = 7$ — (1)

$\frac{(a-6)^2 + (b-6)^2 + (8-6)^2 + (5-6)^2 + (10-6)^2}{5}$

$= 6.8$

$(a - 6)^2 + (b - 6)^2 + 21 = 34$

$(a - 6)^2 + (b - 6)^2 = 13$

$a^2 + b^2 - 12(a + b) = -59$

$(a + b)^2 - 2ab - 12(a + b) = -59$

$49 - 2ab - 84 = -59$

$2ab = -35 + 59$

$= 24$

$ab = 12$ — (2)

a = 3, b = 4

96. A die is thrown. Let A be the event that the…..

Ans: 1

Sol: $P(A) = \frac{3}{6} \quad P(B) = \frac{4}{6} \quad P(A \cap B) = \frac{1}{6}$

$\therefore P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= \frac{3}{6} + \frac{4}{6} - \frac{1}{6} = 1$

97. It is given that the events A and B are such…..

Ans: $\frac{1}{3}$

Sol: $P\left(\frac{A}{B}\right) = \frac{1}{2}$

$\Rightarrow \frac{1}{2} = \frac{P(A \cap B)}{P(B)} \Rightarrow P(A \cap B) = \frac{P(B)}{2}$

$\frac{2}{3} = \frac{P(A \cap B)}{P(A)} \Rightarrow \frac{2}{3} = \frac{P(B)}{2P(A)}$

$\Rightarrow P(B) = \frac{4}{3} P(A) = \frac{1}{3}$

98. AB is a vertical pole with B at the ground level…..

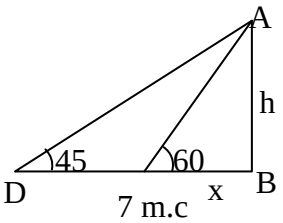
Ans: $\frac{7\sqrt{3}}{2}\left(\sqrt{3} + 1\right)$ m

Sol: From the figure

$\tan 60 = \frac{h}{x}$

$\Rightarrow \sqrt{3}\, x = h$

$\tan 45 = \frac{x+7}{h}$



$\Rightarrow h = x + 7$

$\Rightarrow h = 7 + \frac{h}{\sqrt{3}}$

$\Rightarrow h = \frac{7\sqrt{3}}{\sqrt{3}-1}$

$= \frac{7\sqrt{3}\left(\sqrt{3}+1\right)}{2}$

99. The value of $\cot\left(\operatorname{cosec}^{-1}\frac{5}{3}+\tan^{-1}\frac{2}{3}\right)$ is

Ans: $\frac{6}{17}$

Sol: $\cot\left(\operatorname{cosec}^{-1}\left(\frac{5}{3}\right)+\tan^{-1}\frac{2}{3}\right)$

$= \cot\left(\tan^{-1}\frac{3}{4}+\tan^{-1}\frac{2}{3}\right)$

$= \cot\tan^{-1}\left(\frac{17}{6}\right)$

$= \cot\cot^{-1}\frac{6}{17} = \frac{6}{17}$

100. The statement $p \to (q \to p)$ is equivalent to

Ans: Clearly $p \to (p \vee q)$

101. Let A be a 2×2 matrix with real entries. Let……

Ans: Statement 1 is true, Statement 2 is false

Sol : Let $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$

$\Rightarrow A^2 = \begin{pmatrix} a^2+bc & (a+d)b \\ c(a+d) & d^2+bc \end{pmatrix}$

Given : $A^2 = I$

$\Rightarrow a^2 = d^2 = 1 - bc$

$\Rightarrow a = \pm d$

Case 1 $a = -d$

$A = \begin{pmatrix} a & 1-a \\ 1+a & -a \end{pmatrix}$

and we find that $A^2 = I$ and $|A| = -1$

Case 2 $a = d$

$A = \begin{pmatrix} a & 1-a \\ 1+a & a \end{pmatrix}$

However, $A^2 = \begin{pmatrix} 1 & 2a(1-a) \\ 2a(1+a) & 1 \end{pmatrix}$

A^2 will be I if $a = 0$

When $a = 0$, $A = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

and $|A| = -1$

Statement 1 is true.

But, in both cases above tr(A) = 0

Therefore, statement 2 is false.

102. Statement 1 : For every natural number $n \geq 2$,…..

Ans: Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation for Statement 1

Sol : AM > GM

$$\frac{\frac{1}{\sqrt{1}}+\frac{1}{\sqrt{2}}+.....+\frac{1}{\sqrt{n}}}{n} > \left(\frac{1}{\sqrt{n!}}\right)^{1/n}$$

$$> \left(\frac{1}{n^{n/2}}\right)^{1/n}$$

$$> \frac{1}{n^{1/2}}$$

$$\frac{1}{\sqrt{1}}+\frac{1}{\sqrt{2}}+.....+\frac{1}{\sqrt{n}} > \sqrt{n}$$

Statement 1 is true

Statement 2 is true

From statement 2, we get

$\frac{1}{\sqrt{n}} > \frac{1}{\sqrt{n+1}}$ for $n \geq 2$

$$\frac{1}{\sqrt{1}}+\frac{1}{\sqrt{2}}+\frac{1}{\sqrt{3}}.+.....+\frac{1}{\sqrt{n}}$$

$$> 1 + \frac{1}{\sqrt{n}}+\frac{1}{\sqrt{n}}+.....+\frac{1}{\sqrt{n}}$$

$$> 1 + \frac{n-1}{\sqrt{n}}$$

$$> 1 + \sqrt{n} - \frac{1}{\sqrt{n}}$$

$> \sqrt{n}$, since $1 - \frac{1}{\sqrt{n}} > 0$

Statement 1 is a correct explanation for statement 1

103. Statement 1 : $\sum_{r=0}^{n}(r+1)^n C_r = (n+2)2^{n-1}$

Ans: Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation for Statement 1

Sol: $(1 + x)^n = C_0 + C_1x + C_2x^2 + .. + C_nx^n$

$n(1 + x)^{n-1} = C_1 + C_2 \times 2x + C_3 \times 3x^2 + .$

$+ C_n \times nx^{n-1}$

$nx\,(1 + x)^{n-1} = C_1x + C_2 \times 2x^2 + C_3 \times 3x^3 + ..$

$+ C_n \times nx^3$

$(1 + x)^n + nx(1 + x)^{n-1}$

$= C_0 + C_1(1 + 1)x + C_2\,(2 + 1)x^2 +$

$+ C_n(n + 2)x^n$

$= \sum_{r=0}^{n} (r+1)\ {}^{n}C_r\ x^r$

Statement 2 is true and Statement 1 follows from Statement 2 by substituting x = 1 is Statement 2.

104. In a shop there are five types of ice-creams…..

Ans: Statement 1 is false, Statement 2 is true

Sol: Statement 1
The required number is the number of non negative integral solutions of the equation
$x_1 + x_2 + x_3 + x_4 + x_5 = 6$
is ${}^{(6+5-1)}C_{5-1} = {}^{10}C_4$
Statement 1 is false
But statement 2 is true,
Since the number of ways = $\frac{10!}{6!\ 4!} = {}^{10}C_4$

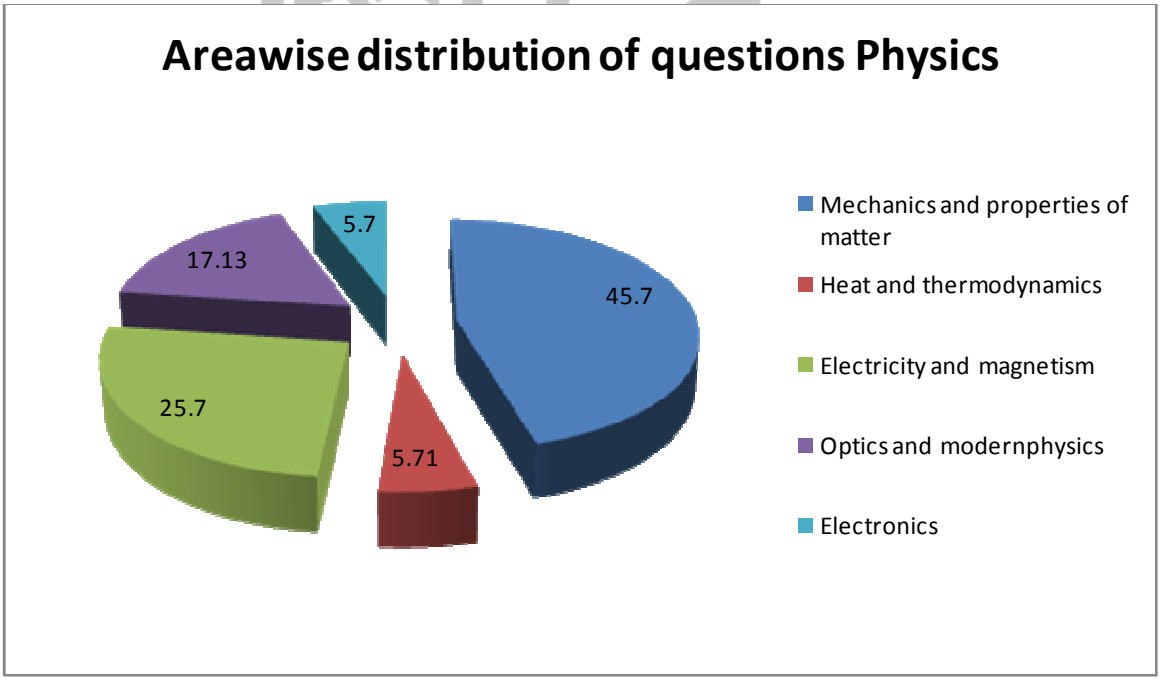
105. Let p be the statement "x is an irrational number"

Ans: Statement 1 is false.
Statement 2 is true.

Sol: p: x is irrational
q : y is transcendental
r : x is rational if and only if y is true.
Statement 1 – $r \equiv p \vee q$
Statement 2 - $r \equiv \sim (p \leftrightarrow \sim q)$
$r \equiv (p \vee q) \wedge (\sim q \vee \sim p)$
$\equiv (p \vee q) \wedge \sim (p \wedge q) \equiv$ false
Statement 1 is false

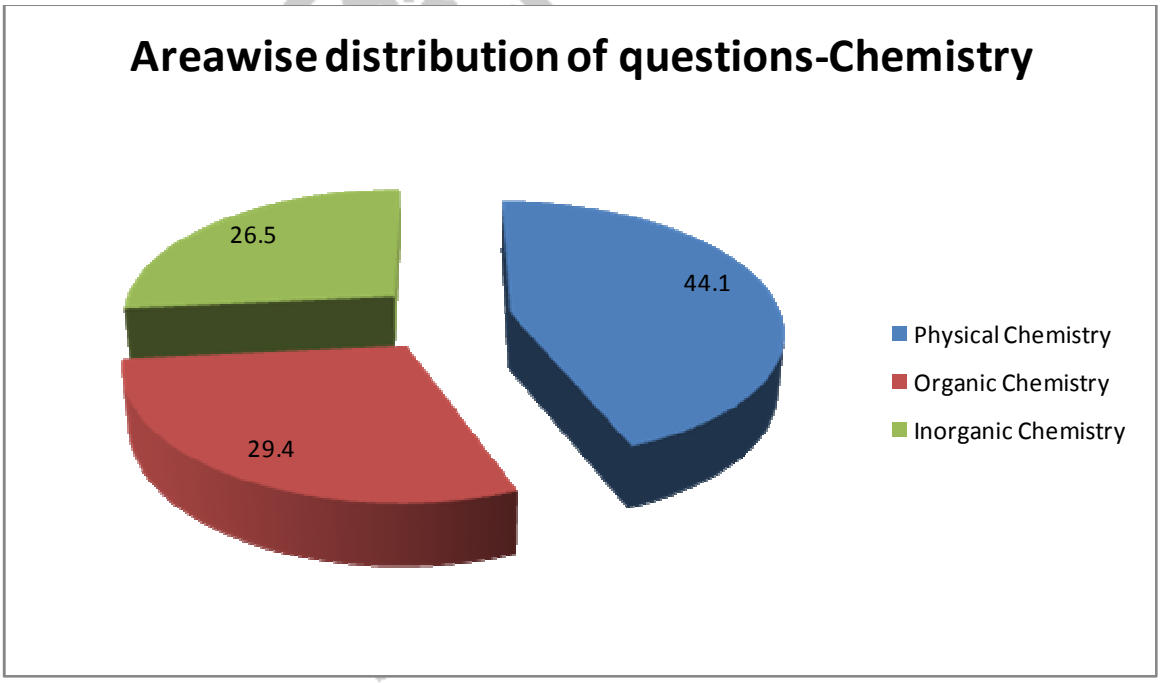
AREAWISE DISTRIBUTION OF QUESTIONS FOR PHYSICS

Sl. No.	Name of the Area	No. of Questions	Difficulty Level			Percentage
			No. of E	No. of M	No. of D	
1	Mechanics	13	3	8	2	37.14
2	Properties of Matter	3	1	2	0	8.57
3	Heat & Thermodynamics	2	0	1	1	5.71
4	Electricity & Magnetism	9	3	6	0	25.71
5	Optics	1	1	0	0	2.85
6	Modern Physics	5	3	2	0	14.28
7	Electronics & Communications	2	0	1	1	5.71
	Total:	**35**	**11**	**20**	**4**	**100**
	Percentage:					



AREAWISE DISTRIBUTION OF QUESTIONS FOR CHEMISTRY

No.	Name of the Area	No. of Questions	Difficulty Level			Percentage
			No. of E	No. of M	No. of D	
1	Physical Chemistry	15	5	8	2	44.1
2	Organic Chemistry	10	6	4	--	29.4
3	Inorganic Chemistry	9	4	5	--	26.5



AREAWISE DISTRIBUTION OF QUESTIONS FOR MATHEMATICS

Sl. No.	Name of the Area	No. of Questions	Difficulty Level			Percentage
			No. of E	No. of M	No. of D	
1	ALGEBRA	13	6	4	3	37.14
2	COORDINATE GEOMETRY	4	2	2	-	11.42
3	DIFFERENTIAL CALCULUS	4	1	3	-	11.42
4	TRIGONOMETRY	2	2		-	5.74
5	VECTORS, 3-D, MATRICES & DETERMINANTS	7	4	3	-	20
6	INTEGRAL CALCULUS	5	2	2	1	14.28