AIEEE-2011 QUESTION PAPER

PART-A : MATHEMATICS

1. Consider the following statements
P : Suman is brilliant; Q : Suman is rich
R : Suman is honest
The negation of the statement "Suman is brilliant and dishonest if and only is Suman is rich" can be expressed as

1) $\sim Q \leftrightarrow \sim P \wedge R$ 2) $\sim (P \wedge \sim R) \leftrightarrow Q$
3) $\sim P \wedge (Q \leftrightarrow \sim R)$ 4) $\sim (Q \leftrightarrow (P \wedge \sim R))$

2. Let R be the set of real numbers
Statement-1 : $A = \{(x, y) \in R \times R : y - x$ is an integer$\}$ is an equivalence relation on R
Statement-2 : $B = \{(x, y) \in R \times R : x = \alpha y$ for some rational number $\alpha\}$ is an equivalence relation of R.

1) Statement-1 is true, Statement-2 is false
2) Statement-1 is false, Statement-2 is true
3) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1
4) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

3. The domain of the function $f(x) = \frac{1}{\sqrt{|x| - x}}$

1) $(-\infty, 0)$ 2) $(-\infty, \infty) - \{0\}$
3) $(-\infty, \infty)$ 4) $(0, \infty)$

4. Let α, β be real and z be a complex number. If $z^2 + \alpha z + \beta = 0$ has two distinct roots on the line Re z = 1, then it is necessary that

1) $|\beta| = 1$ 2) $\beta \in (1, \infty)$
3) $\beta \in (0, 1)$ 4) $\beta \in (-1, 0)$

5. If $\omega (\neq 1)$ is a cube root of unit, and $(1 + \omega)^7 = A + B\omega$. Then (A, B) equals :

1) (1, 0) 2) (–1, 1)
3) (0, 1) 4) (1, 1)

6. Let A and B be two symmetric matrices of order 3.
Statement-1 : $A(BA)$ and $(AB)A$ are symmetric matrices.
Statement-2 : AB is symmetric matrix if matrix multiplication of A with B is commutative.

1) Statement-1 is true, Statement-2 is false
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3) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1
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7. The number of values of k for which the linear equations $4x + ky + 2z = 0$; $kx + 4y + z = 0$; $2x + 2y + z = 0$ possess a non-zero solution is:

1) 1 2) zero 3) 3 4) 2

8. Statement- 1 : The number of ways of distributing 10 identical balls in 4 distinct boxes such that no box is empty is $^9C_3$.
Statement- 2 : The number of ways of choosing any 3 places form 9 different places is $^9C_3$.

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9. Coefficient of x^7 in the expansion of $(1 - x - x^2 + x^3)^6$ is

1) –144 2) 132 3) 144 4) –132

10. A man saves Rs. 200 in each of the first three months of his service. In each of the subsequent months his saving increases by Rs. 40 more than the saving of immediately previous month. His total saving from the start of service will be Rs. 11040 after :

1) 20 months 2) 21 months
3) 18 months 4) 19 months

11. $\frac{d^2x}{dy^2}$ **equals**

1) $\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-2}$ 2) $-\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-3}$

3) $\left(\frac{d^2y}{dx^2}\right)^{-1}$ 4) $-\left(\frac{d^2y}{dx^2}\right)^{-1}\left(\frac{dy}{dx}\right)^{-3}$

12. $\lim\limits_{x\to 2}\left(\frac{\sqrt{1-\cos\{2(x-2)\}}}{(x-2)^2}\right)$

1) equals $-\sqrt{2}$ 2) equals $\frac{1}{\sqrt{2}}$

3) does not exist 4) equals $\sqrt{2}$

13. The values of p and q for which the function

$$f(x)=\begin{cases}\frac{\sin(p+1)x+\sin x}{x}, & x<0\\ q, & x=0\\ \frac{\sqrt{x+x^2}-\sqrt{x}}{x^{3/2}}, & x>0\end{cases}$$

is continuous for all x in R, are :

1) $p=-\frac{3}{2}, q=\frac{1}{2}$ 2) $p=\frac{1}{2}, q=\frac{3}{2}$

3) $p=\frac{1}{2}, q=-\frac{3}{2}$ 4) $p=\frac{5}{2}, q=\frac{1}{2}$

14. For $x\in\left(0,\frac{5\pi}{2}\right)$, define $f(x)=\int_0^x \sqrt{t}\sin t\,dt$ then f has

1) local minimum at π and local maximum at 2π

2) local maximum at π and local minimum at 2π

3) local maximum at π and 2π

4) local minimum at π and 2π

15. The value of $\int_0^1 \frac{8\log(1+x)}{1+x^2}dx$ is

1) $\frac{\pi}{2}\log 2$ 2) $\log 2$

3) $\pi\log 2$ 4) $\frac{\pi}{8}\log 2$

16. The area of the region enclosed by the curves $y = x$, $x = e$, $y=\frac{1}{x}$ and the positive x-axis is :

1) $\frac{3}{2}$ square units 2) $\frac{5}{2}$ square units

3) $\frac{1}{2}$ square units 4) 1 square units

17. Let I be the purchase value of an equipment and $V(t)$ be the value after it has been used for t years. The value $V(t)$ depreciates at a rate given by differential equation $\frac{dV(t)}{dt}=-k(T-t)$, where $k > 0$ is a constant and T is the total life in years of the equipment. Then the scrap value $V(T)$ of the equipment is :

1) $I-\frac{k(T-t)^2}{2}$ 2) e^{-kT}

3) $T^2-\frac{I}{k}$ 4) $I-\frac{kT^2}{2}$

18. If $\frac{dy}{dx}=y+3>0$ and $y(0) = 2$, then $y(\ell n2)$ is equal to :

1) 13 2) –2 3) 7 4) 5

19. The lines $L_1 : y - x = 0$ and $L_2 : 2x + y = 0$ intersect the line $L_3 : y + 2 = 0$ at P and Q respectively. The bisector of the acute angle between L_1 and L_2 intersects L_3 at R.

Statement- 1 : The ratio $PR : RQ$ equals $2\sqrt{2}:\sqrt{5}$.

Statement- 2 : In any triangle, bisector of an angle divides the triangle into two similar triangles.

1) Statement-1 is true, Statement-2 is false.

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20. The two circles $x^2+y^2=ax$ and $x^2+y^2=c^2 (c>0)$ touch each other if :

1) $a = 2c$ 2) $|a| = 2c$

3) $2|a| = c$ 4) $|a| = c$

21. The shortest distance between line $y - x = 1$ and curve $x = y^2$ is :

1) $\frac{8}{3\sqrt{2}}$ 2) $\frac{4}{\sqrt{3}}$ 3) $\frac{\sqrt{3}}{4}$ 4) $\frac{3\sqrt{2}}{8}$

22. Equation of the ellipse whose axes are the axes of coordinates and which passes through the point (–3,1) and has eccentricity $\sqrt{\frac{2}{5}}$ is:

1) $3x^2 + 5y^2 - 15 = 0$ 2) $5x^2 + 3y^2 - 32 = 0$

3) $3x^2 + 5y^2 - 32 = 0$ 4) $5x^2 + 3y^2 - 48 = 0$

23. Statement-1 : The point $A(1, 0, 7)$ is the mirror image of the point $B(1, 6, 3)$ in the line $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$

Statement-2 : The line $\frac{x}{1}=\frac{y-1}{2}=\frac{z-2}{3}$ bisects the line segment joining $A(1, 0, 7)$ and $B(1, 6, 3)$

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24. If the angle between the line $x=\frac{y-1}{2}=\frac{z-3}{\lambda}$ and the plane $x + 2y + 3z = 4$ is $\cos^{-1}\left(\sqrt{\frac{5}{14}}\right)$, then λ equals :

1) $\frac{2}{5}$ 2) $\frac{5}{3}$ 3) $\frac{2}{3}$ 4) $\frac{3}{2}$

25. If $\bar{a}=\frac{1}{\sqrt{10}}\left(3\bar{i}+\bar{k}\right)$ and $\bar{b}=\frac{1}{7}\left(2\bar{i}+3\bar{j}-6\bar{k}\right)$, then the value of

$(2\bar{a}-\bar{b}).\left[\left(\bar{a}\times\bar{b}\right)\times\left(\bar{a}+2\bar{b}\right)\right]$

1) 5 2) 3 3) –5 4) –3

26. The vectors $\bar{a}$ and $\bar{b}$ are not perpendicular and $\bar{c}$ and $\bar{d}$ are two vectors satisfying $\bar{b}\times\bar{c}=\bar{b}\times\bar{d}$ and $\bar{a}.\bar{d}=0$. Then the vector $\bar{d}$ is equal to

1) $\bar{b}+\left(\frac{\bar{b}.\bar{c}}{\bar{a}.\bar{b}}\right)\bar{c}$ 2) $\bar{c}-\left(\frac{\bar{a}.\bar{c}}{\bar{a}.\bar{b}}\right)\bar{b}$

3) $\bar{b}-\left(\frac{\bar{b}.\bar{c}}{\bar{a}.\bar{b}}\right)\bar{c}$ 4) $\bar{c}+\left(\frac{\bar{a}.\bar{c}}{\bar{a}.\bar{b}}\right)\bar{b}$

27. If C and D are two events such that $C \subset D$ and $P(D) \neq 0$. Then the correct statement is

1) $P(C/D) < P(C)$ 2) $P(C/D) = \frac{P(D)}{P(C)}$

3) $P(C/D) = P(C)$ 4) $P(C/D) \geq P(C)$

28. Consider 5 independent Bernoulli's trials each with probability of success p. If the probability of atleast one failure is greater than or equal to $\frac{31}{32}$, then p lies in the interval

1) $\left[0,\frac{1}{2}\right]$ 2) $\left[\frac{11}{12},1\right]$ 3) $\left(\frac{1}{2},\frac{3}{4}\right]$ 4) $\left(\frac{3}{4},\frac{11}{12}\right]$

29. If the mean deviation about the median of the numbers a, $2a$, ..., $50a$ is 50, then $|a|$ equals:

1) 4 2) 5 3) 2 4) 3

30. If $A = \sin^2 x + \cos^4 x$, then for all real x :

1) $1 \leq A \leq 2$ 2) $\frac{3}{4} \leq A \leq \frac{13}{16}$

3) $\frac{3}{4} \leq A \leq 1$ 4) $\frac{13}{16} \leq A \leq 1$

PART-B : CHEMISTRY

31. 'a' and 'b' are van der Waal's constants for gases. Chlorine is more easily liquefied than ethane because

1) a for Cl_2 < a for C_2H_6 but b for Cl_2 > b for C_2H_6

2) a for Cl_2 > a for C_2H_6 but b for Cl_2 < b for C_2H_6

3) a and b for Cl_2 > a and b for C_2H_6

4) a and b for Cl_2 < a and b for C_2H_6

32. In a face centred cubic lattice, atom A occupies the corner positions and atoms B occupies the face centre positions. If one atom of B is missing from one of the face centred points, the formula of the compound is

1) A_2B_3 2) A_2B_5 3) A_2B 4) AB_2

33. The outer electron configuration of Gd (Atomic No. : 64) is

1) $4f^4\ 5d^4 6s^2$ 2) $4f^7\ 5d^1 6s^2$
3) $4f^3\ 5d^5 6s^2$ 4) $4f^8\ 5d^0 6s^2$

34. A gas absorbs a photon of 355 nm and emits at two wavelengths. It one of the emissions is at 680 nm, the other is at

1) 743 2) 518 3) 1035 4) 325 nm

35. Which one of the following orders presents the correct sequence of the increasing basic nature of the given oxides ?

1) $Na_2O < K_2O < MgO < Al_2O_3$
2) $K_2O < Na_2O < Al_2O_3 < MgO$
3) $Al_2O_3 < MgO < Na_2O < K_2O$
4) $MgO < K_2O < Al_2O_3 < Na_2O$

36. Among the following the maximum covalent character is shown by the compound

1) $AlCl_3$ 2) $MgCl_2$ 3) $FeCl_2$ 4) $SnCl_2$

37. The structure of IF_7 is

1) octahedral 2) pentagonal bipyramid
3) square pyramid 4) trigonal bipyramid

38. The hybridisation of orbitals of N atom in NO_3^-, NO_2^+ and NH_4^+ are respectively

1) sp, sp^3, sp^2 2) sp^2, sp^3, sp
3) sp, sp^2, sp^3 4) sp^2, sp, sp^3

39. Boron cannot form which one of the following anions ?

1) $B(OH)_4^-$ 2) BO_2^- 3) BF_6^{3-} 4) BH_4^-

40. Which of the following statements regarding sulphur is incorrect ?

1) At 600^0C the gas mainly consists of S_2 molecules
2) The oxidation state of sulphur is never less than + 4 in its compounds
3) S_2 molecule is paramagnetic
4) The vapour at 200^0C consists mostly of S_8 rings

41. Which of the following statements is wrong ?

1) Single N – N bond is weaker than the single P – P bond.
2) N_2O_4 has two resonance structures
3) The stability of hybrides increases from NH_3 to BiH_3 in group 15 of the periodic table.
4) Nitrogen can not form $d_\pi - p_\pi$ bond.

42. The magnetic moment (spin only) of $[NiCl_4]^{2-}$ is

1) 2.82 BM 2) 1.41 BM
3) 1.82 BM 4) 5.46 BM

43. Which of the following facts about the complex $[Cr(NH_3)_6]Cl_3$ is wrong ?

1) The complex is an outer orbital complex
2) The complex gives white precipitate with silver nitrate solution.
3) The complex involves d^2sp^3 hybridisation and is octahedral in shape
4) The complex is paramagnetic

44. In context of the lanthanoids, which of the following statements is not correct ?

1) Because of similar properties the separation of lanthanoids is not easy
2) Availability of 4f electrons results in the formation of compounds in + 4 state for all the members of the series
3) There is a gradual decrease in the radii of the members with increasing atomic number in the series
4) All the members exhibit + 3 oxidation state

45. Identify the compound that exhibits tautomerism

1) 2 – Pentanone 2) Phenol
3) 2 - Butene 4) Lactic acid

46. Ozonolysis of an organic compound gives formaldehyde as one of the products. This confirms the presence of :

1) an isopropyl group
2) an acetylenic triple bond
3) two ethylenic double bonds
4) a vinyl group

47. Phenol is heated with a solution of mixture of KBr and $KBrO_3$. The major product obtained in the reaction is

1) 4–Bromophenol
2) 2, 4, 6–Tribromophenol
3) 2–Bromophenol 4) 3–Bromophenol

48. Silver Mirror test is given by which one of the following compounds ?

1) Formaldehyde 2) Benzophenone
3) Acetaldehyde 4) Acetone

49. Trichloroacetaldehyde was subjected to Cannizzaro's reaction by using NaOH. The mixture of the products contains sodium trichloroacetate and another compound. The other compound is

1) 2, 2, 2 - Trichloropropanol
2) Chloroform
3) 2, 2, 2 - Trichloroethanol
4) Trichloromethanol

50. The strongest acid amongest the following compounds is

1) $CH_3CH_2CH(Cl)CO_2H$
2) $ClCH_2CH_2CH_2$ COOH
3) CH_3COOH 4) HCOOH

51. Sodium ethoxide has reacted with ethanoyl chloride. The compound that is produced in the above reaction is

1) Ethyl chloride 2) Ethyl ethanoate
3) Diethyl ether 4) 2 - Butanone

52. Which of the following reagents may be used to distinguish between phenol and benzoic acid?

1) Molisch reagent 2) Neutral $FeCl_3$
3) Aqueous NaOH 4) Tollen's reagent

53. A 5.2 molal aqueous solution of methyl alcohol, CH_3OH, is supplied. What is the mole fraction of methyl alcohol in the solution ?

1) 0.086 2) 0.050 3) 0.100 4) 0.190

54. Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at -6^0C will be : (K_f for water = 1.86 K kg mol^{-1}, and molar mass of ethylene glycol = 62 g mol^{-1})

1) 400.0 g 2) 304.60 g
3) 804.32 g 4) 204.30 g

55. The degree of dissociation (α) of a weak electrolyte, A_xB_y is related to van't Hoff factor (i) by the expression

1) $\alpha = \frac{x+y-1}{i-1}$ 2) $\alpha = \frac{x+y+1}{i-1}$
3) $\alpha = \frac{i-1}{(x+y-1)}$ 4) $\alpha = \frac{i-1}{(x+y+1)}$

56. The rate of a chemical reaction doubles for every 10^0C rise of temperature. If the temperature is raised by 50^0C, the rate of the reaction increases by about

1) 32 times 2) 64 times
3) 10 times 4) 24 times

57. The reduction potential of hydrogen half-cell will be negative if :

1) $P(H_2)$ = 2 atm and $[H^+]$ = 1.0 M
2) $P(H_2)$ = 2 atm and $[H^+]$ = 2.0 M
3) $P(H_2)$ = 1 atm and $[H^+]$ = 2.0 M
4) $P(H_2)$ = 1 atm and $[H^+]$ = 1.0 M

58. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted in to CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K is

1) 0.3 atm 2) 0.18 atm
3) 1.8 atm 4) 3 atm

59. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at 27^0C is

1) 32.3 J $mol^{-1}K^{-1}$ 2) 42.3 J $mol^{-1}K^{-1}$
3) 38.3 J $mol^{-1}K^{-1}$ 4) 35.8 J $mol^{-1}K^{-1}$

60. The presence or absence of hydroxy group on which carbon atom of sugar differentiates RNA and DNA ?

1) 3rd 2) 4th 3) 1st 4) 2nd

PART-C : PHYSICS

61. A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the foutain is υ, the total area around the fountain that gets wet is

1) $\frac{\pi}{2}\frac{\upsilon^4}{g^2}$ 2) $\pi\frac{\upsilon^2}{g^2}$ 3) $\pi\frac{\upsilon^2}{g}$ 4) $\pi\frac{\upsilon^4}{g^2}$

62. An object, moving with a speed of 6.25 m/s, is declerated at a rate given by $\frac{dv}{dt} = -2.5\sqrt{v}$. where v is the instantaneous speed. The time taken by the object, to come to rest, would be

1) 4s 2) 8s 3) 1s 4) 2s

63. A mass m hangs with the help of a string wrapped around a pulley on frictionless beraing. The pulley has mass m and radius R. Assuming pulley to be a perfect uniform circular disc. The acceleration of the mass m, if the string does not slip on the pulley, is

1) $\frac{2}{3}g$ 2) $\frac{g}{3}$ 3) $\frac{3}{2}g$ 4) g

64. A thin horizontal circular disc is rotating about a vertical axis passing through its centre. An insect is at rest at a point near the rim of the disc. The insect now moves along a diameter of the disc to reach its other ene. During the journey of the insect, the angular speed of the disc:

1) continuously increase
2) first increase and then decrease
3) remains unchanged
4) continuoulsy decrease

65. A pulley of radius 2m is rotated about its axis by a force F = (20t - 5t²) newton (where t is measured in seconds) applied tangentially. If the moment of inertia of the pulley about its axis of rotations is 10kg m², the number of rotations made by the pulley before its direction of motion if reversed, is

1) more than 6 but less than 9
2) more than 9
3) less than 3
4) more than 3 but less than 6

66. Two bodies of masses m and 4m are placed at a distance r. The gravitational potential at a point on the line joining them where the gravitational field is zero is

1) $-\frac{6Gm}{r}$ 2) $-\frac{9Gm}{r}$

3) zero 4) $-\frac{4Gm}{r}$

67. Work done in increasing the size of a soap bubble from a radius of 3cm to 5cm is nearly (Surface tension of soap solution = 0.0Nm⁻¹):

1) 2π mJ 2) 0.4π mJ
3) 4π mJ 4) 0.2π mJ

68. Water is flowing continuously from a tap having an internal diameter 8×10^{-3} m. The water velocity as it leaves the tap is 0.4 ms⁻¹. The diameter of the water stream at a distance 2×10^{-3} m below the tap is close to

1) 9.6×10^{-3}m 2) 3.6×10^{-3}m
3) 5.0×10^{-3}m 4) 7.5×10^{-3}m

69. A carnot engine operating between temperatures T_1 and T_2 has efficiency $\frac{1}{6}$. When T_2 is lowered by 62K, its efficiency increases to $\frac{1}{3}$. Then T_1 and T_2 are, respectively :

1) 330 K and 268 K 2) 310 K and 248 K
3) 372 K and 310 K 4) 372 K and 330 K

70. A thrmally insulated vessel contains an ideal gas of molecular mass M and ration of specific heats γ. It is moving with speed υ and is suddenly brought to rest. Assuming no heat is lost to the surroundings, its temperature increases by

1) $\frac{\gamma M\upsilon^2}{2R}K$ 2) $\frac{(\gamma-1)}{2R}M\upsilon^2K$

3) $\frac{(\gamma-1)}{(\gamma+1)R}M\upsilon^2K$ 4) $\frac{(\gamma-1)}{2\gamma R}M\upsilon^2K$

71. Three perfect gases at absolute temparatures T_1, T_2 and T_3 are mixed. The masses of molecules are m_1, m_2 and m_3 and the number of molecules are n_1, n_2 and n_3 respectively. Assuming no loss of energy, the final temparature of the mixture is

1) $\frac{n_1T_1^2+n_1T_2^2+n_3T_3^2}{n_1T_1+n_2T_2+n_3T_3}$ 2) $\frac{n_1^2T_1^2+n_2^2T_2^2+n_3^2T_3^2}{n_1T_1+n_2T_2+n_3T_3}$

3) $\frac{(T_1+T_2+T_3)}{3}$ 4) $\frac{n_1T_1+n_2T_2+n_3T_3}{n_1+n_2+n_3}$

72. 100g of water is heated from 30⁰C to 50⁰C Ignoring slight expansion of the water, the change in its internal energy is (specific heat of water is 418 J/Kg/K)

1) 84 kJ 2) 2.1kJ
3) 4.2 kJ 4) 8.4 kJ

73. The transverse displacement y(x,t) of a wave on a string is given by $y(x,t) = e^{-\left(ax^2+bt^2+2\sqrt{abxt}\right)}$. This represents a :

1) Standing wave of frequency $\sqrt{b}$

2) Standing wave of frequency $\frac{1}{\sqrt{b}}$

3) Wave moving in + x direction with speed $\sqrt{\frac{a}{b}}$

4) Wave moving in - x direction with speed $\sqrt{\frac{b}{a}}$

74. Two particles are executing simple harmonic motion of the same amplitude A and frequency ω along the x-axis. Their mean position is separated by distance x_0 ($x_0 > A$). If the maximum separation between them is ($X_0 + X$), the phase difference between their motion is

1) $\frac{\pi}{4}$ 2) $\frac{\pi}{6}$ 3) $\frac{\pi}{2}$ 4) $\frac{\pi}{3}$

75. A mass M, attached to a horizontal spring, excutes S.H.M. with amplitude A_1. When the mass M passes through its mean position then a smaller mass m is placed over it and both of them move together with amplitude A_2. The ratio of $\left(\frac{A_1}{A_2}\right)$ is

1) $\left(\frac{M}{M+m}\right)^{\frac{1}{2}}$ 2) $\left(\frac{M+m}{M}\right)^{\frac{1}{2}}$

3) $\frac{M}{M+m}$ 4) $\frac{M+m}{M}$

76. The electrostatic potential inside a charged spherical ball is given by $\phi = ar^2 + b$ where r is the distance from the centre; a,b are constatns. Then the charge density inside the ball is

1) $-24\pi a\varepsilon_0$ 2) $-6a\varepsilon_0$ 3) $-24\pi a\varepsilon_0 r$ 4) $-6a\varepsilon_0 r$

77. Two identical charged spheres suspended from a common point by two massless strings of length *l* are initially a distance d (d<<*l*) apart because of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result the charges approach each other with a velocity u. Then as a function of distance x between them,

1) $v \propto x^{\frac{1}{2}}$ 2) $v \propto x$ 3) $v \propto x^{\frac{1}{2}}$ 4) $v \propto x^{-\frac{1}{2}}$

78. If a wire is streched to make it 0.1% longer, its resistance will :

1) decrese by 0.2% 2) decrese by 0.05%

3) increase by 0.05% 4) increase by 0.2%

79. A current I flows in a inifinitely long wire with cross section in the form of a semicircular ring of radius R. The magnitude of the magnetic induction along its axis is

1) $\frac{\mu_0 I}{2\pi R}$ 2) $\frac{\mu_0 I}{4\pi R}$ 3) $\frac{\mu_0 I}{\pi^2 R}$ 4) $\frac{\mu_0 I}{2\pi^2 R}$

80. A boat is moving due east in a region where the earth's magnetic field is 5.0×10^{-5} NA^{-1} due north and horizontal. The boat carries a vertical aerial 2m long. If the speed of the boat is $1.50 ms^{-1}$, the magnitude of the induced emf in the wire of aerial is

1) 0.50 mV 2) 0.15 mV

3) 1 mV 4) 0.75 mV

81. A resistor 'R' and 2 μF capacitor in series is connected through a switch to 200 V direct supply. Across the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5s after the switch has been closed. ($\log_{10} 2.5 = 0.4$)

1) $2.7 \times 10^6 \Omega$ 2) 3.3×10^7 Ω

3) 1.3×10^4 Ω 4) 1.7×10^5 Ω

82. A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at t = 0. The time at which the energy is stored equally between the electric and the magnetic field s is

1) $2\pi\sqrt{LC}$ 2) $\sqrt{LC}$

3) $\pi\sqrt{LC}$ 4) $\frac{\pi}{4}\sqrt{LC}$

83. A car is fitted with a convex side - view mirror of focal length 20cm. A second car 2.8m behind the first car is overtaking the first car at a relative speed of 15m/s. The speed of the image of the second car as seen in the mirror of the first one is

1) 10m/s 2) 15 m/s

3) $\frac{1}{10}$ m/s 4) $\frac{1}{15}$ m/s

84. Let the x-y plane be the boundary between two transparent media. medium 1 in $z \geq 0$ has a refractive index of $\sqrt{2}$ and medium 2 with z<0 has a refractive index of $\sqrt{3}$. A ray of light in medium 1 given by the vector $\vec{A} = 6\sqrt{3}\hat{i} + 8\sqrt{3}\hat{j} - 10\hat{k}$ is incident on the plane of separation. The angle o refraction in medium 2 is

1) 60^0 2) 75^0 3) 30^0 4) 45^0

85. Direction :

The question has a paragraph followed by two statements, statement-1 and statement-2 of the given four alternateves after the statements, choose the one that describes the statements.

A thin air film is formed by putting the convex surface of a plate. With monochromatic light, this film gives an interference pattern due to light reflected from the top (convex) surface and the bottom (glass plate)surface of the film.

Statement-1: When light reflects from the air-glass plate interface, the reflected wave suffers a phase change of π

Statement-2 : The centre of the interference pattern is dark.

1) statement-1 is true , statement-2 is true and statement-2 is **not** the correct explanation of statement-1.
2) statement-1 is false, statement-2 is true.
3) statement-1 is true, statement-2 is false
4) statement-1 is true, statement-2 is true and statement-2 is the correct explanation of statement-1.

86. The half life of a radioactive substance is 20 minutes. The approximate time interval $(t_2 - t_1)$ between the time t_2 when $\frac{2}{3}$ of it has decayed and time t_1 when $\frac{1}{3}$ of it had decayed is

1) 20 min 2) 29 min
3) 7 min 4) 14 min

87. The question has Statement-1 and Statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement - 1

A metallic surface is irradiated by a monochromatic light of requency $v > v_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are K_{max} and V_0 respectively. If the frequency incident on the surface is doubled, both the K_{max} and V_0 are also doubled.

Statement - 2

The maximum kinetic energy and the stopping potential of photoelectrons emitted from a surface are linearly dependent on the frequency of incident light

1) Statement - 1 is true, Statement - 2 is true, Statement - 2 is not the correct explanation of Statement - 1
2) Statement - 1 is false, Statement - 2 is true.
3) Statement - 1 is true, Statement - 2 is false.
4) Statement - 1 is true, Statement - 2 is true, Statement - 2 is the correct explanation of Statement - 1

88. Energy required for the electron excitation in Li^{++} from the first to the third-Bohr orbit is

1) 108.8eV b) 122.4eV
3) 12.1 eV d) 36.3 eV

89. The question has statement-1 and statement-2 of the four choices given after the statements, choose the one that best describes the statements.

statement-1 : Sky wave signals are used for long distance radio communication. these signals are in general, less stabel than ground wave signals.

statement-2 : The state of ionosphere varies from hour to hour, day to day and season ot season.

1) statement-1 is true, statement-2 is true and statement-2 is **not** the correct explanation of statement-1.
2) statement-1 is false, statement-2 is true.
3) statement-1 is true, statement-2 is false
4) statement-1 is true, statement-2 is true and statemnet-2 is the correct explanationof statement-1.

90. A screw gauge gives following reading when used to measure the diameter of a wire.

Main scale reading : 0 mm

Circular scale reading : 52 divisions

Given that 1 mm on main scale corresponds to100 divisions of the circular scale. The diameter of wire from the above data is

1) 0.26cm 2) 0.005cm

3) 0.52 cm 4) 0.052 cm

AIEEE 2011 ANSWERS

PART-A : MATHEMATICS

1) **4**	2) **1**	3) **1**	4) **2**	5) **4**
6) **4**	7) **4**	8) **3**	9) **1**	10) **2**
11) **2**	12) **3**	13) **1**	14) **2**	15) **3**
16) **1**	17) **4**	18) **3**	19) **1**	20) **4**
21) **4**	22) **2**	23) **4**	24) **3**	25) **3**
26) **2**	27) **4**	28) **1**	29) **1**	30) **3**

PART-B CHEMISTRY

31) **2**	32) **2**	33) **2**	34) **1**	35) **3**
36) **1**	37) **2**	38) **4**	39) **3**	40) **2**
41) **3**	42) **1**	43) **1**	44) **2**	45) **1**
46) **4**	47) **2**	48) **1**	49) **2**	50) **1**
51) **2**	52) **2**	53) **1**	54) **3**	55) **3**
56) **1**	57) **1**	58) **3**	59) **3**	60) **4**

PART-C PHYSICS

61) **4**	62) **4**	63) **1**	64) **2**	65) **4**
66) **2**	67) **2**	68) **2**	69) **3**	70) **2**
71) **4**	72) **4**	73) **4**	74) **4**	75) **2**
76) **2**	77) **4**	78) **4**	79) **3**	80) **2**
81) **1**	82) **4**	83) **4**	84) **4**	85) **2**
86) **1**	87) **2**	88) **1**	89) **4**	90) **4**

AIEEE 2011 HINTS AND SOLUTIONS

PART-A : MATHEMATICS

1. **(4)**

Statement is $(P \wedge \sim R) \leftrightarrow Q$

Negation of the statement is

$$\sim [Q \leftrightarrow (P \wedge \sim R)]$$

2. **(1)** Since $x - x = 0 \in Z$, $(x, x) \in A$

$\Rightarrow A$ is reflexive

$(x, y) \in A \Rightarrow x - y \in z \Rightarrow y - x \in Z$

$\Rightarrow (y, x) \in A \Rightarrow A$ is symmetric

$(x, y) \in A, (y, z) \in A \Rightarrow x - y \in z, y - z \in Z$

$\Rightarrow x - z \in Z \Rightarrow (x, z) \in A$

$\Rightarrow A$ is equivalence relation

$(0, 1) \in B \quad \because 0 = (0)(1), 0 \in ...Q$

But $(1, 0) \notin B \Rightarrow B$ is not symmetric

$\Rightarrow B$ is not equivalence.

3. **(1)** $f(x) = \dfrac{1}{\sqrt{|x| - x}}$

for $x \geq 0, |x| - x = 0$

$\Rightarrow f(x)$ is not defined for $x \in [0, \infty]$

$\Rightarrow D_f = (-\infty, 0)$

4. **(3)** Since α, β are real, Real part of the different roots is 1, sum..... and product of the roots are real

$\Rightarrow$ The roots may be $1 + ai$ and $1 - ai$, $a \in R^*$

$\Rightarrow \beta = 1 + a^2 > 1$

$\Rightarrow \beta \in (1, \infty)$

5. **(4)** $(1 + \omega)^7 = (-\omega^2)^7 = -\omega^{14} = -\omega^2$

$= 1 + \omega = A + B\omega$

$\Rightarrow A = 1, B = 1$

6. **(4)** $A^| = A, B^| = B$

$[A(BA)]^| = [(AB)A]^| = A^|(AB)^|$

$= A^|(B^|A^|) = A(BA)$

Similarly $[(AB)A]^| = (AB)A$

$\Rightarrow$ Statement - 1 is true

$(AB)^| = B^|A^| = BA = AB \Leftrightarrow$

multiplication is commutative

$\Rightarrow$ Statement - 2 is true

7. **(4)** $\begin{vmatrix} 4 & k & 2 \\ 5 & 4 & 1 \\ 2 & 2 & 1 \end{vmatrix} = 0$

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

$\Rightarrow 8 - k^2 + 2k + 4k - 16 = 0$

$\Rightarrow k^2 - 6k + 8 = 0$

$\Rightarrow (k-2)(k-4) = 0$

$\Rightarrow k = 2$ or 4

8. **(3)** no.of positive integral solutions

$(n-1)C_{r-1} = {}^9C_3$

STATEMENT (1) is true

STATEMENT (2) is also true

and correct explanation

9. **(1)** $(1 - x - x^2 + x^3)^6 = [(1-x)(1-x^2)]^6$

$= (1-x^2)^6 (1-x)^6$

$= (1 - {}^6C_1x^2 + {}^6C_2x^4 - {}^6C_3x^6 \ldots\ldots) \times$

$(1 - {}^6C_1x + {}^6C_2x^2 - {}^6C_3x^3 + {}^6C_4x^4 - {}^6C_5x^5 + x^6)$

Coefficient of $x^7 = ({}^6C_1)({}^6C_5) - {}^6C_2\,{}^6C_3 + {}^6C_3 \cdot {}^6C_1$

$= (6)(6) - (15)(20) + 20 \times 6$

$= 156 - 300 = -144$

10. **(2)** $600 + 240 + 280 + \ldots\ldots\ldots = 11040$

$\Rightarrow 240 + 280 + \ldots\ldots\ldots = 10440$

$$\frac{n}{2}[480 + 40n - 40] = 10440$$

$\Rightarrow 20n^2 + 220n = 10440$

$\Rightarrow n^2 + 11n = 522$

$n(n+11) = 18 \times 29$

$\Rightarrow n = 18$

required no. of months $= 18 + 3 = 21$

11. **(2)** $\dfrac{d^2x}{dy^2} = \dfrac{d}{dy}\left(\dfrac{dx}{dy}\right) = \dfrac{d}{dx}\left[\dfrac{1}{\frac{dy}{dx}}\right]\cdot\dfrac{dx}{dy}$

$$= -\frac{1}{\left(\frac{dy}{dx}\right)^2}\cdot\frac{d}{dx}\left(\frac{dy}{dx}\right)\cdot\frac{1}{\frac{dy}{dx}}$$

$$= -\frac{d^2y}{dx^2}\cdot\frac{1}{\left(\frac{dy}{dx}\right)^3} = -\frac{d^2y}{dx^2}\left(\frac{dy}{dx}\right)^{-3}$$

12. **(3)** $\underset{x\to 2}{Lt}\dfrac{\sqrt{1-\cos\{2(x-2)\}}}{x-2}$

$= \underset{x\to 2}{Lt}\dfrac{\sqrt{2\sin^2(x-2)}}{x-2}$

$= \sqrt{2}\ \underset{x\to 2}{Lt}\dfrac{|\sin(x-2)|}{x-2}$

does not exist

13. **(1)** $\underset{x\to 0}{Lt} f(x) = p + 1 + 1 = p + 2 = q = f(0)$

$q - p = 2$

14. **(2)** $f'(x) = \sqrt{x}\sin x$

$f'(x) = 0 \Leftrightarrow x = \pi$ or 2π

$f''(x) = \sqrt{x}\cos x + \dfrac{1}{2\sqrt{x}}\sin x$

$\left[f''(x)\right]_{x=\pi} = -\sqrt{\pi} < 0$

$\left[f''(x)\right]_{x=2\pi} = \sqrt{2\pi} > 0$

$\Rightarrow$ Local maximum at $x = \pi$, minimum at $x = 2\pi$

15. **(3)**

$$\int_0^1 \frac{8\log(1+x)}{1+x^2}dx$$

Put $x = \tan\theta$

$\theta = \text{Tan}^{-1}x$

$$d\theta = \frac{1}{1+x^2}dx$$

$$I = \int_0^{\pi/4} 8\log(1+\tan\theta)d\theta$$

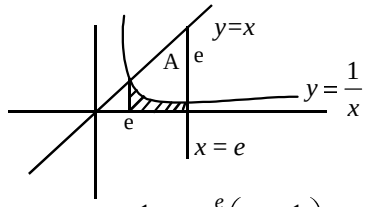
$$= \int_0^{\pi/4} 8\log\left[1+\tan\left(\frac{\pi}{4}-\theta\right)\right]d\theta$$

$$2I = \int_0^{\pi/4} 8\log 2\,d\theta$$

$$\left[\because A + B = \frac{\pi}{4} \Rightarrow (1+\tan A)(1+\tan B) = 2\right]$$

$$\Rightarrow I = (\log 2)\frac{\pi}{4} = \pi\log 2$$

16. **(1)**



required A $= \frac{1}{2}e^2 - \int_1^e \left(x - \frac{1}{x}\right)dx$

$= \frac{1}{2}e^2 - \left[\frac{x^2}{2} - \log x\right]_1^e$

$= \frac{e^2}{2} - \frac{e^2}{2} + 1 + \frac{1}{2} = \frac{3}{2}$

17. **(4)** $\int_0^T \frac{dV(t)}{dt}dt = -k\int_0^T (T-t)$

$\Rightarrow V(T) - V(0) = -k\left[Tt - \frac{t^2}{2}\right]_0^T$

$\Rightarrow V(T) - I = \frac{-kT^2}{2}$

18. **(3)** $\frac{dy}{y+3} = dx$

$\log(y+3) = x + c$

If $x = 0, y = 2 \Rightarrow c = \log 5$

$\Rightarrow \log\frac{y+3}{5} = x \Rightarrow y + 3 = 5e^x$

If $x = \log 2, y + 3 = 5(2) = 10 \Rightarrow y = 7$

$y(\log 2) = 7$

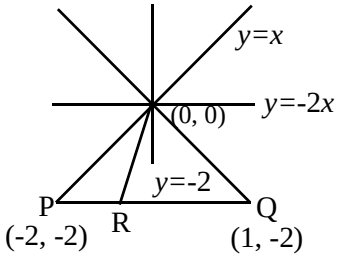
$-\frac{dt}{dx} - t\tan x = -\sec x \Rightarrow \frac{dt}{dx} + (\tan x)t = \sec x$

$I.F. = e^{\int \tan x dx} = \sec x$

Solution is $t(I.F.) = \int (I.F)\sec x dx$

$\frac{1}{y}\sec x = \tan x + c$

19 **(1)**



$PR : RQ = OP : OQ = 2\sqrt{2} : \sqrt{5}$

STATEMENT is true.

For scalean triangle, bisector of an angle does not devide the triangle into two similar triangles

$\Rightarrow$

Statement (2) is not true

20. **(4)** Common tangent at point of contact is

$ax - c^2 = 0$

touches $x^2 + y^2 = c^2$

$\Rightarrow \frac{c^2}{|a|} = c \Rightarrow |a| = c$

21. **(4)** Tangent parallel to $x - y + 1 = 0$ ..... (1)

to $y^2 = x$ is $x - y + a = 0$

(i.e.) $x - y + 1/4 = 0$ ..... (2)

Shortest distance = distance between

(1) and (2) $= \frac{\frac{1}{4} - 1}{\sqrt{2}} = \frac{3}{4\sqrt{2}} = \frac{3\sqrt{2}}{8}$

22. **(2)** $e^2 = \frac{2}{5} \Rightarrow \frac{b^2}{a^2} = 1 - \frac{2}{5} = \frac{3}{5}$

$\Rightarrow \frac{x^2}{5k} + \frac{y^2}{3k} = 1$

passes through (–3, 1)

$\Rightarrow \frac{9}{5} + \frac{1}{3} = k \Rightarrow k = \frac{32}{15}$

Equation of ellipse is $\frac{3x^2}{32} + \frac{5y^2}{32} = 1$

23. **(4)** Drs of $\overline{AB}$ = (0, 6, –4)

Drs of Given line (1, 2, 3)

Now 0(1) + 6(2) – 4(3) = 0

$\Rightarrow$ The two lines are perpendicular. The mid-point of AB lies on the line

$\Rightarrow$ Statement - 1 is true, Statement - 2 is also true, but not correct explanation of statement-1

24. **(3)** $\cos\theta = \frac{\sqrt{5}}{\sqrt{14}} \Rightarrow \sin\theta = \frac{3}{\sqrt{14}}$

$\Rightarrow \frac{3}{\sqrt{14}} = \frac{1 + 4 + 3\lambda}{\sqrt{5 + \lambda^2}\sqrt{14}}$

$9\left(5 + \lambda^2\right) = (3\lambda + 5)^2$

$\Rightarrow 30\lambda + 25 = 45 \Rightarrow \lambda = 2/3$

25. **(3)** $\bar{a}=\frac{1}{\sqrt{10}}(3\bar{i}+\bar{k})$

$\bar{b}=\frac{1}{7}(2\bar{i}+3\bar{j}-6\bar{k})$

$|\bar{a}|=|\bar{b}|=1,\ \bar{a}.\bar{b}=0$

$\Rightarrow|\bar{a}\times\bar{b}|=|\bar{a}||\bar{b}|\sin 90^0=1$

$[2\bar{a}-\bar{b}\quad\bar{a}\times\bar{b}\quad\bar{a}+2\bar{b}]$

$=(\bar{a}\times\bar{b}).[(\bar{a}+2\bar{b})\times(2\bar{a}-\bar{b})]$

$=(\bar{a}\times\bar{b}).5(\bar{b}\times\bar{a})$

$=-5(\bar{a}\times\bar{b})^2=-5(1)=-5$

26. **(2)** $\bar{b}\times\bar{d}=\bar{b}\times\bar{c}$

$\Rightarrow(\bar{b}\times\bar{d})\times\bar{a}=(\bar{b}\times\bar{c})\times\bar{a}$

$\Rightarrow(\bar{a}.\bar{b})\bar{d}-0(\bar{b})=(\bar{a}.\bar{b})\bar{c}-(\bar{a}.\bar{c})\bar{b}$

$\Rightarrow\bar{d}=\bar{c}-\left(\frac{\bar{a}.\bar{c}}{\bar{a}.\bar{b}}\right)\bar{b}$

27. **(4)** $P\left(\frac{C}{D}\right)=\frac{P(C\cap D)}{P(D)}=\frac{P(C)}{P(D)}\geq P(C)$

28. **(1)** B.D. is $(q+p)^5$

Given $1-p^5\geq\frac{31}{32}$

$\Rightarrow p\leq\frac{1}{2}\Rightarrow 0\leq p\leq\frac{1}{2}$

$\Rightarrow p\in\left[0,\frac{1}{2}\right]$

29. **(1)** M = Median = $=\frac{25a+26a}{2}=(25.5)a$

M.D = $\frac{\sum|x_i-M}{n}=\frac{|a|}{50}[24.5+23.5+.5]2$

$=\frac{|a|}{50}[1+3+5+.....+47+49]$

$=\frac{|a|}{50}\times 25^2=\frac{25|a|}{2}=50$ (given)

$\Rightarrow|a|=4$

30. **(3)** A = $1-\cos^2 x+\cos^4 x$

$=1-\cos^2 x(1-\cos^2 x)$

$=1-\cos^2 x\sin^2 x$

$=1-\frac{1}{4}(\sin^2 2x)\Rightarrow 1-\frac{1}{4}(1)\leq A\leq 1-\frac{1}{4}(0)$

$\Rightarrow\frac{3}{4}\leq A\leq 1$

PART-B CHEMISTRY

31. **(2)** Inter molecular forces and molecular weight is more for Cl_2, hence Cl_2 has high boiling point than C_2H_6.

But the size of molecule C_2H_6 is greater than Cl_2 hence for C_2H_6 b is greater than Cl_2.

$a_{Cl_2}>a_{C_2H_6}$ but $b_{C_2H_6}>b_{Cl_2}$

32. **(2)** In the given structure, each unit cell contains one atom of A and three atoms of B.

Missing atom is B on one face.After removing B atom, formula is $AB_{5/2}$

It can be written as A_2B_5

33. **(2)** Gadalonium exhibits half filled F^7 configuration

Gd (64) : [Xe] $4f^7\ 5d^1 6s^2$

34. **(1)** $E_r=E_1+E_2$ (or) $\frac{hc}{\lambda_r}=\frac{hc}{\lambda_1}+\frac{hc}{\lambda_2}$

35. **(3)** As electropositive character increases basic nature metal oxides increases

$Al_2O_3<MgO<Na_2O<K_2O$

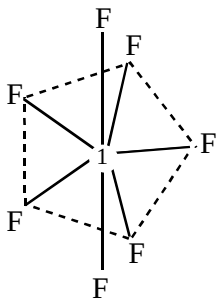
36. **(1)** According to Fajan's rule, polarisation is proportional to charge on cation

in turn polarisation is proportional to covalent character

$Al^{+3}\ Cl_3$, $Mg^{+2}Cl_2$, $Fe^{+2}Cl_2$, $Sn^{+2}\ Cl_2$

$AlCl_3$ is most covalent

37. **(2)** IF_7 exhibits Pentagonal bipyramidal shape



38. **(4)** NO_3^-,S.No. = $\frac{5+0-(-1)}{2} = 3(sp^2)$

$NO_2^{\oplus}$,S.No. = $\frac{5+0-1}{2} = 2(sp)$

$NH_4^{\oplus}$,S.No. = $\frac{5+4-1}{2} = 4(sp^3)$

39. **(3)** Maximum covalency for any 2nd period element possible is only 4. Hence BF_6^{-3} is not possible

40. **(2)** Sulphur can exhibit – 2, + 2, + 1 oxidation states also

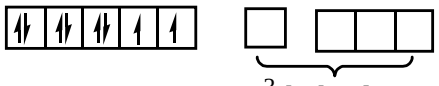
41. **(3)** Stability of VA group hybrides decreases from NH_3 to BiH_3 due to the decrease in M – H bond energy

$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

42. **(1)** $[NiCl_4]^{-2}$

Ni^{+2} : $3d^8\ 4s^0$

Cl^- is a weak ligand have no pairing of non bonding electrons takes place



sp^3-hybridisation

Number of unpaired electrons, n = 2

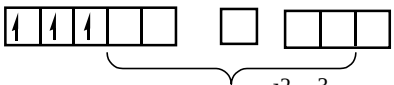
hence $\mu = \sqrt{n(n+2)}B.M$

$= \sqrt{2(2+2)} = 2.82BM$

43. **(1)** $[Cr(NH_3)_6]Cl_3$

NH_3 acts as strong ligand

Configuration of $Cr^{+3} = 3d^3 4s^0$



d^2sp^3

Its is inner orbital complex

44. **(2)** All the Lanthanides can not form + 4 oxidation state

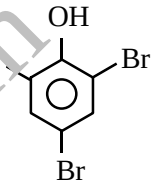
45. **(1)**

$$CH_3 - \overset{\overset{O}{\|}}{C} - CH_2 - CH_2 - CH_3 \rightleftharpoons CH_2 = \overset{\overset{OH}{|}}{C} - CH_2 - CH_2 - CH_3$$

2 – Pentanone present in the liquid state. Hence it exhibits tautomerism ($C_6H_5O_{11}$ is solid, MP = 42^0C)

46. **(4)** Ozonolysis of an organic compound give formaldehyde when it containing atleast one vinylic double bond. H_2C = CH - R

47. **(2)** In aqueous medium phenol gives tribromo phenol



48. **(1 or 3)** Organic compounds containing $-\overset{\overset{O}{\|}}{C} - H$ group can give silver mirror test.

49. **(2)** $2CCl_3 - CHO \xrightarrow{NaOH}$

$CCl_3 - COONa + CHCl_3$

$CCl_3 - CHO + NaOH \rightarrow CHCl_3 + HCOONa$

50. **(1)** $CH_3 - CH_2 - \underset{\underset{Cl}{|}}{CH} - COOH$ is the strongest acid due to - I inductive effet at α - carbon

51. **(2)** $CH_3 - \overset{\overset{O}{\|}}{C} - Cl + NaO - CH_2 - CH_3 \longrightarrow$

$$CH_3 - \overset{\overset{O}{\|}}{C} - O - CH_2 - CH_3 + NaCl$$

Nucleophilic substitution of CH_3–CH_2–O^- on CH_3COCl results esterification

52. **(2)** $6C_6H_5OH + FeCl_3 \longrightarrow$

$3H^+ + \underset{\text{Blood red colour}}{\left[Fe(OC_6H_5)_6\right]^{-3}} + 3HCl$

53. **(1)** 5.2 mol of CH_3OH is present in one Kg (=55.55 mol) of water

Mole fraction of $CH_3OH = \frac{n_{CH_3OH}}{n_{total}}$

$$= \frac{5.2}{60.75} = 0.0856$$

54. **(3)** $\Delta T_f = K_f.m$, whre 'm' is molality

$6 = 1.86\ m$

$m = \frac{6}{1.86} = 3.226$ mol per Kg

Mass of ethylene glycol per one kg water = 200g

Mass of ethylene glycol per four kg water = 800g

55. **(3)** $A_xB_y \rightarrow xA^{+y} + y.B^{-x}$

$1-\alpha \quad x\alpha \quad y\alpha$

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

56. **(1)** $r_2 = r_1.2^n$

where $n = \frac{\text{raise in temperature}}{10}$

57. **(1)** $E_{H^+/H_2,Pt} = E^0_{H^+/H_2,Pt} + \frac{0.0591}{2}\log\frac{[H^+]^2}{P_{H_2}}$

Hence P_{H_2} = 2 atm

$[H^+]$ = 1M

58. **(3)** $CO_{2(g)} + C_{(s)} \rightleftharpoons CO_{(g)}$

at eq. pressures $0.5 - x - 2x$

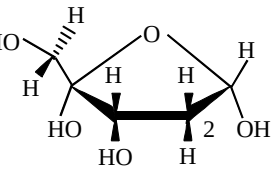
$P_r = 0.5 + x = 0.8$

So,

$\therefore Kp = 1.8$

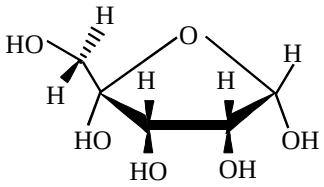
59. **(3)** $\Delta S = 2.303nR\log\left(\frac{V_2}{V_1}\right)$

60. **(4)**



Deoxy ribose

In DNA Deoxy ribose is present which has 2 Hydrogen atoms on the 2nd carbon.



Ribose

In RNA Ribose is present, which has –OH on 2nd carbon.

PART-C : PHYSICS

61. **(4)** $R_{max} = \frac{\upsilon^2}{g} \Rightarrow \text{and}\ A = \pi R^2_{max} = \frac{\pi\upsilon^4}{g^2}$

62. **(4)** u = 6.25ms^{-1}

$$\frac{dv}{dt} = -2.5\sqrt{V}$$

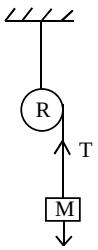
$$\int\frac{dv}{\sqrt{V}} = -2.5\int dt$$

$$2\left[V^{\frac{1}{2}}\right]_{v=6.25}^{v=0} = -2.5\left[t\right]_{t=0}^{t=T}$$

2[0 - 2.5] = - 2.5[T]

T = 2 sec

63. **(1)**



$F_{net} = ma$

$Mg - T = Ma$ ----- (1)

$\tau_{net} = I\propto$

$$TR = \frac{MR^2}{2}\frac{a}{R}$$

$$\Rightarrow T = \frac{Ma}{2} \quad \text{----- (2)}$$

Solving 1 and 2 $\Rightarrow a = \frac{2g}{3}$

64. **(2)** Since there is no external torque acting on system, angular momentum of the system is constant. As the insect moves from A to B, moment of inertia of system first decreases then increases. Since $\omega = \frac{L}{I}$, ω first increase then decreases.

65. **(4)** Direction of motion is reversed $\Rightarrow$ the pulley comes to momentary rest

$$\tau = FR = \left(20t - 5t^2\right) \times 2 = I\alpha$$

$$\alpha = \frac{\left(20t - 5t^2\right)}{5} = \frac{dw}{dt}$$

$$\int_{t=0}^{t} \left(4t - t^2\right) dt = \int_{0}^{\omega} dw$$

$$w = \frac{4t^2}{2} - \frac{t^3}{3}$$

When it comes to rest

$w = 0$

$\Rightarrow t = 0$ & $t = 6s$

$$\frac{d\theta}{dt} = 2t^2 - \frac{t^3}{3}$$

$$\theta = 2\frac{t^3}{3} - \frac{1}{12}t^4$$

$$= 2 \times 6^2 \times 2 - \frac{1}{12} \times 6^2 \times 6 \times 6$$

$= 6^2(4 - 3) = 6^2 = 36$

$$n = \frac{\theta}{2\pi}$$

$$= \frac{36}{2 \times 3.14} \text{revolutions}$$

$$= \frac{11.46}{2} \text{revolution} = 5.73$$

66. **(2)** $\frac{Gm}{x^2} = \frac{G(4m)}{(r-x)^2}$

$$\frac{1}{x} = \frac{2}{r-x}$$

$x = r/3$

$$v_{net} = \frac{-Gm}{r/3} - \frac{G(4m)}{2r/3} = \frac{-9Gm}{r}$$

67. **(2)** Surface energy : $8\pi r^2 T$

$W = \Delta$ surface energy

$$= T.8\pi\left[r_2^2 - r_1^2\right]$$

$$= 0.03 \times 8\pi\left[5^2 - 3^2\right] \times 10^{-4} J$$

$= 0.24\ \pi \times 16 \times 10^{-4}$ J

$= 0.384\ \pi \times 10^{-3}$ J $= 0.4\ \pi$ mJ

68. **(2)** $r_1 = 8 \times 10^{-3} m$

$v_1 = 0.4 ms^{-1}$

h = 0.2 m

$$\ell gh + \frac{1}{2}\ell v_1^2 = \frac{1}{2}\ell V_2^2$$

$$V_2^2 = V_1^2 + 2gh = 4.16$$

from principle of continuity $A_1V_1 = A_2V_2$

$$r_1^2 v_1 = r_2^2 v_2$$

$$\frac{r_1\sqrt{V_1}}{\sqrt{V_2}} = r_2 \Rightarrow r_2 = 3.6 \times 10^{-3} m$$

69. **(3)** $1 - \frac{T_2}{T_1} = \frac{1}{6}$

$$\frac{T_2}{T_1} = \frac{5}{6}$$

$$1 - \left(\frac{T_2 - 62}{T_1}\right) = \frac{1}{3}$$

$$1 - \frac{T_2}{T_1} + \frac{62}{T_1} = \frac{1}{3} \Rightarrow \frac{1}{6} + \frac{62}{T_1} = \frac{1}{3} \Rightarrow \frac{62}{T_1} = \frac{1}{6}$$

$$\Rightarrow T_1 = 62 \times 6 = 372^k$$

and $T_2 = \frac{5}{6}T_1 = 310^k$

70. **(2)** $\frac{1}{2}mv^2 = du = nc_v dT$

$$\frac{1}{2}mv^2 = \frac{m}{M}\frac{R}{\gamma - 1}dT$$

$$dT = \frac{mv(\gamma - 1)}{2R}$$

71. **(4)** Final temperature of the mixture

$$T = \frac{\frac{n_1}{N_A}T_1 + \frac{n_2}{N_A}T_2 + \frac{n_3}{N_A}T_3}{\frac{n_1}{N_A} + \frac{n_2}{N_A} + \frac{n_3}{N_A}}$$

$$= \frac{n_1T_1 + n_2T_2 + n_3T_3}{n_1 + n_2 + n_3}$$

here N_A = Avogadro's number

72. **(4)** M = 0.1 kg

$d\theta = 20$

$du = MCd\theta$

= 0.1(4184)(20)

= 8368 J

= 8.4 KJ

73. **(4)** $y = e^{-}\left(\sqrt{a}x + \sqrt{b}t\right)^2 = f(x + vt)$,

This is a wave travelling in – *x* direction speed of the wave = $\frac{w}{k} = \sqrt{\frac{b}{a}}$

74. **(4)** Let $x_1 = A \sin \omega t$

$x_2 = x_0 + A \sin(\omega t + \phi)$

$x_2 - x_1 = x_0 + A[\sin(\omega t + \phi) - \sin \omega t]$

$$x_0 + 2A \sin\frac{\phi}{2} \cos\left(\omega t + \frac{\phi}{2}\right)$$

hence the value of $x_2 - x_1$ changes with time from a minimum value of $x_0 - 2A\sin\frac{\phi}{2}$ to a maximum value of $x_0 + 2A\sin\frac{\phi}{2}$

$(x_2 - x_1)_{max} = x_0 + 2A\sin\frac{\phi}{2} = x_0 + A$

$$\Rightarrow \sin\frac{\phi}{2} = \frac{1}{2} \Rightarrow \frac{\phi}{2} = 30^0$$

$$\Rightarrow \phi = 60^0 = \frac{\pi^c}{3}$$

75. **(2)** $\omega = \sqrt{\frac{K}{M}} \Rightarrow \frac{\omega_1}{\omega_2} = \sqrt{\frac{M_2}{M_1}}$

Here $M_1 = M$ $M_2 = M + m$

$$\frac{\omega_1}{\omega_2} = \sqrt{\frac{m+M}{M}}$$

$P_1 = P_2$

$M_1A_1W_1 = M_2A_2W_2$

$$\frac{A_1}{A_2} = \frac{M+m}{M}\sqrt{\frac{M}{M+m}} = \sqrt{\frac{M+m}{M}}$$

76. **(2)** $\phi = ar^2 + b$ $q = -8\pi \in_0 ar^3$

$$E = \frac{-\partial\phi}{dr} = -2ar \qquad v = \frac{4}{3}\pi r^3$$

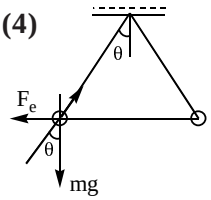
$$\oint \vec{E}.d\vec{s} = \frac{q}{\in_0}$$

$$-2ar \times 4\pi r^2 = \frac{q}{\in_0}$$

Charge density $\rho = \frac{dq}{dv}$

$\rho = -6 \in_0 a$

77. **(4)**



$T\cos\theta = mg$

$T\sin\theta = F_e$

$$\tan\theta = \frac{F_e}{mg} \Rightarrow F_e = mg\tan\theta$$

$$\frac{kq^2}{x^2} = mg = \frac{x/2}{l}$$

$\therefore q^2 \propto x^3$

$$\left(\frac{dq}{dt}\right).2q \propto 3x^2\left(\frac{dx}{dt}\right)$$

As $\frac{dq}{dt}$ is constant

$q \propto x^2.\frac{dx}{dt}$

$x^{3/2} \propto x^2.\frac{dx}{dt}$

$\frac{dx}{dt} \propto x^{-1/2}\,(\text{or})\, v \propto x^{-1/2}$

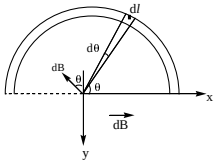
78. **(4)** $R = \frac{\ell L}{A} = \frac{\ell L^2}{v}$ where v is the volume of wire

$R \propto L^2$

$\frac{\Delta R}{R} = 2\frac{\Delta L}{L} \Rightarrow$ % change in resistance of wire = 2 (%change in L)

= 2 (0.1%) = + 0.2%

79. **(3)** $dI = \frac{I}{\pi R}.Rd\theta = \frac{1}{\pi}d\theta$



$B = \int_0^{\pi} dB\sin\theta$

$= \int \frac{\mu_0}{2\pi}\frac{di}{R}\sin\theta$ here $di = \frac{i}{\pi R}R.d\theta$

$\therefore B = \frac{\mu_0 i}{2\pi^2 R}\int_0^{\pi}\sin\theta.d\theta \qquad \Rightarrow B = \frac{\mu_0 i}{\pi^2 R}$

80. **(2)** $1 = 2m \Rightarrow \varepsilon = Blv = 5\times10^{-5}\times2\times1.5$

$= 15\times10^{-5} = 0.15mV$

81. **(1)** $q = 120V\times2\mu F = 240\,\mu C$

$q_0 = 200V\times2\mu F = 400\,\mu C$

$q = q_0(1-e^{-t/\tau})$

$240 = 400(1-e^{-t/\tau}) \Rightarrow 1-e^{-t/\tau} = \frac{240}{400} = \frac{3}{5}$

$1-\frac{3}{5} = e^{-t/\tau} \Rightarrow e^{t/\tau} = \frac{5}{2} = 2.5$

$t/\tau = \ln 2.5$

$t = \tau.2.303.\log_{10}^{2.5}$

$5 = RC\times2.303\times0.4$

$R = \frac{5}{2.303\times0.4\times2\times10^{-6}}$

$R \approx 2.7\times10^6\,\Omega$

82. **(4)** In L.C oscillation energy is transferred from c to L (or) from L to C

maximum energy in C = $\frac{1}{2}\frac{q_0^2}{C}$

maximum energy in L = $\frac{1}{2}Li_0^2$

If energy is stored equally between electric and magnetic fields then

$\frac{1}{2}Li^2 = \frac{1}{2}\left[\frac{1}{2}Li_0^2\right]$

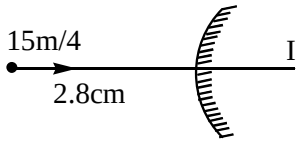
$i = \frac{i_0}{\sqrt{2}}$

$i_0 \sin\omega t = \frac{1}{\sqrt{2}}$

$\omega t = \frac{\pi}{4} \Rightarrow t = \frac{T}{8} = \frac{2\pi\sqrt{LC}}{8}$

$\therefore t = \frac{\pi}{4}\sqrt{LC}$

83. **(4)** focal length of convex mirror f = 20 cm



For convex mirror

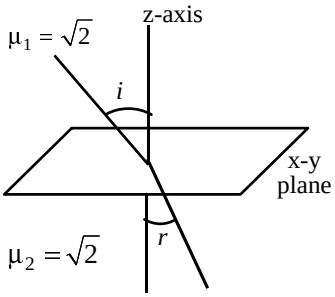
$\frac{1}{u}+\frac{1}{v}=\frac{1}{f} \Rightarrow -1/u^2.\frac{du}{dt}-\frac{1}{v^2}\left(\frac{dv}{dt}\right)=0$

$\left(\frac{dv}{dt}\right) = -\left(\frac{v^2}{u^2}\right)\frac{du}{dt} = -\left[\frac{f}{f-U}\right]^2.\frac{dv}{dt}$

$= -\left[\frac{20}{20+280}\right]^2\frac{dv}{dt}$

$= -\frac{1}{15^2}\times15 = \frac{1}{15}$ m / sec

84. **(4)**



$\vec{A} = 6\sqrt{3}\,\hat{i} + 8\sqrt{3}\,\hat{j} - 10\,\hat{k}$

angle made by the incident ray with axis

$$\cos i = \frac{\vec{A}.(-\hat{K})}{|\vec{A}|} = \frac{10}{\sqrt{36\times3+64\times3+100}} = \frac{1\cancel{0}}{2\cancel{0}}$$

using snelle's law $\mu_1 \sin i = \mu_2 \sin r$

$\therefore i = 60^0$

$\sqrt{2}.\sin 60 = \sqrt{3}.\sin r$

$\sqrt{2}.\frac{\sqrt{3}}{2} = \sqrt{3}.\sin r \Rightarrow r = 45^0$

85. **(2)** Statement - 1 : When light is reflected from a denser medium (Glass) a phase drift of 'π' is generated

Statement - 2 : centre of interference pattern is bright (or) dark that depends on thickness of lens.

86. **(1)** Half life period = 20 min

At t = t_1 $N_1 = N_0 - \frac{N_0}{3} = \frac{2N_0}{3}$ (un decayed)

At t = t_2 $N_2 = N_0 - \frac{2N_0}{3} = \frac{N_0}{3}$ (un decayed)

$t_2 - t_1$ = half life period = 20 min

87. **(2)** $h\vartheta = \phi + K_1$ ..... (1)

$2h\vartheta = \phi + K_2$ ..... (2)

$K_2 - 2K_1 = \phi \Rightarrow K_2 > 2K_1$

Also K.E = eV_0 hence when frequency is doubled K.E and stopping potential become more than doubled.

88. **(1)** Energy of electron $E = \frac{-13.6z^2}{n^2}$

$E_1 = \frac{-13.6\times3^2}{1^2}$ and $E_3 = \frac{-13.6\times3^2}{3^2}$

$\Delta E = E_3 - E_1 = 13.6\times3^2\left[1-\frac{1}{9}\right]$

$= 13.6\times9\times\frac{8}{9} = 108.8$ eV.

89. **(4)** Because of variation in composition of ionosphere the signals are unstable.

90. **(4)** Diameter = main scale reading + circular scale reading $\times$ LC

$\text{Reading} = 0 + 52\times\frac{1}{100}\text{mm} = 0.52\text{mm} = 0.052\text{cm}$