JEE MAINS-2013

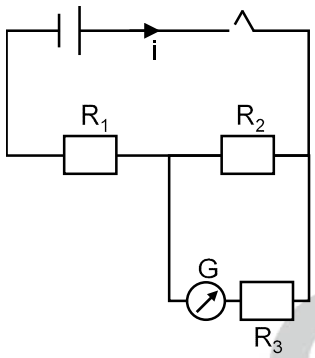
ONLINE_22-04-2013

IMPORTANT INSTRUCTIONS

1. Immediately fill in the particulars on this page of the Test Booklet with **Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.**
2. The test is of **3** hours duration.
3. The Test Booklet consists of **90** questions. The maximum marks are **360**.
4. There are **three** parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for each correct response.
5. Candidates will be awarded marks as stated above in instruction No.5 for correct response of each question. 1/4 (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
6. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 5 above.

PART-A-PHYSICS

1. To find the resistance of a galvanometer by the half deflection method the following circuit is used with resistances R_1 = 9970 Ω, R_2 = 30Ω and R_3 = 0. The deflection in the galvanometer is d. With R_3 = 107 Ω the deflection changed to $\frac{d}{2}$. The galvanometer resistance is approximately :



(1) 137 Ω (2) 107 Ω (3*) 77 Ω (4) 107/2Ω

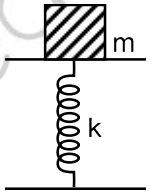
2. Given that 1 g of water in liquid phase has volume 1 cm^3 and in vapour phase 1671 cm^3 at atmospheric pressure and the latent heat of vaporization of water is 2256 J/g ; the change in the internal energy in Joules for 1 g of water at 373 K when it changes from liquid phase to vapour phase at the same temperature is :

(1*) 2089 (2) 2256 (3) 1 (4) 167

3. A mass m = 1.0 kg is put on a flat pan attached to a vertical spring fixed on the ground. The mass of the spring and the pan is negligible. When pressed slightly and released, the mass executes simple harmonic motion. The spring constant is 500 N/m. What is the amplitude A of the motion, so that the mass m tends to get detached from the pan ? (Take g = 10 m/s^2).

The spring is stiff enough so that it does not get distorted during the motion.

(1) A = 2.0 cm
(2) A = 1.5 cm
(3) A < 2.0 cm
(4) A > 2.0 cm



4. The focal length of the objective and the eyepiece of a telescope are 50 cm and 5 cm respectively. If the telescope is focussed for distinct vision on a scale distant 2 m from its objective, then its magnifying power will be :

(1) – 8 (2*) – 2 (3) – 4 (4) + 8

5. The half-life of a radioactive element A is the same as the mean-life of another radioactive element B. Initially both substances have the same number of atoms, then :

(1) A and B both decay at the same rate always

(2) A and B will decay at the same rate initially

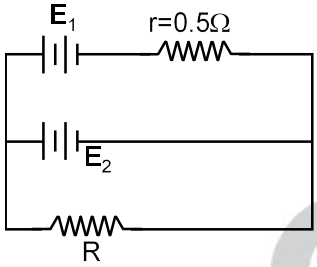
(3) A will decay at a faster rate than B initially

(4*) B will decay at a faster rate than A initially

6. An ideal gas at atmospheric pressure is adiabatically compressed so that its density becomes 32 times of its initial value. If the final pressure of gas is 128 atmospheres, the value of 'γ' of the gas is :

(1) 1.6 (2) 1.5 (3) 1.3 (4) 1.4

7. A dc source of emf E_1 = 100 V and internal resistance r = 0.5 Ω, a storage battery of emf E_2 = 90 V and an external resistance R are connected as shown in figure. For what value of R no current will pass through the battery ?



(1) 5.5 Ω (2*) 4.5 Ω (3) 3.5 Ω (4) 2.5 Ω

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

Statement 1 : In Young's double slit experiment, the number of fringes observed in the field of view is small with longer wave length of light and is large with shorter wave length of light.

Statement 2 : In the double slit experiment the fringe width depends directly on the wave length of light

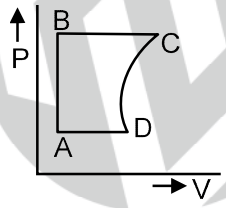
(1) Statement 1 is false and statement 2

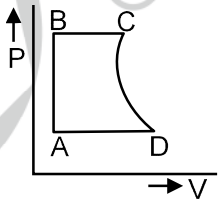
(2) Statement 1 and statement 2 both are true. But statement 2 is not the correct explanation of statement 1

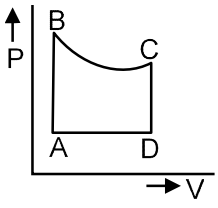
(3) Statement 1 is true and Statement 2

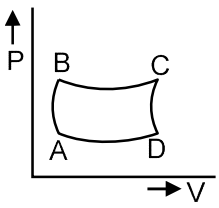
(4) Statement 1 and Statement 2 both are true. Statement 2 is the correct explanation of Statement 1.

9. A certain amount of gas is taken through a cyclic process (A B C D A) that has two isobars, one isochore and one isothermal. The cycle can be represented on a P-V indicator diagram as:

(1) 

(2) 

(3) 

(4) 

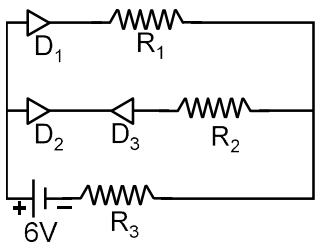
10. Figure shows a circuit in which three identical diodes are used. Each diode has forward resistance of 20 Ω and infinite backward resistance. Resistors $R_1 = R_2 = R_3 = 50\ \Omega$. Battery voltage is 6 V. The current through R_3 is :

(1) 60 mA

(2) 100 mA

(3*) 50 mA

(4) 25 mA



11. To establish an instantaneous current of 2 A through a 1 μF capacitor; the potential difference across the capacitor plates should be changed at the rate of :

(1) 4×10^4 V/s (2) 2×10^4 V/s (3) 4×10^6 V/s (4) 2×10^6 V/s

12. The change in the value of acceleration of earth towards sun, when the moon comes from the position of solar eclipse to the position on the other side of earth in line with sun is :

(mass of the moon = 7.36×10^{22} kg, radius of the moon's orbit = 3.8×10^8 m).

(A*) $6.73 \times 10^{-5} \frac{m}{s^2}$ (B) $6.73 \times 10^{-4} \frac{m}{s^2}$

(C) $6.73 \times 10^{-3} \frac{m}{s^2}$ (D) $6.73 \times 10^{-2} \frac{m}{s^2}$

13. A current i is flowing in a straight conductor of length L. The magnetic induction at a point on its axis at a distance L/4 from its centre will be :

(1) $\frac{4\mu_0 i}{\sqrt{5}\pi L}$ (2) $\frac{\mu_0 i}{\sqrt{2}L}$ (3) $\frac{\mu_0 i}{2\pi L}$ (4) Zero

14. A body starts from rest on a long inclined plane of slope 45°. The coefficient of friction between the body and the plane varies as μ = 0.3 x, where x is distance travelled down the plane. The body will have maximum speed (for g = 10 m/s^2) when x =

(1) 9.8 m (2) 27 m (3*) 3.33 m (4) 12 m

15. The dimensions of angular momentum, latent heat and capacitance are, respectively.

(1) ML^2T^{-1}, L^2T^{-2}, $M^{-1}L^{-2}T^4A^2$ (2) ML^2T^{-2}, L^2T2, $M^{-1}L^{-2}T^4A^2$

(3) ML^2T^{-1}, L^2T^{-2}, ML^2TA^2 (4) $ML^2T^1A^2$, L^2T^{-2}, $M^{-1}L^{-2}T^2$

16. Two small equal point charges of magnitude q are suspended from a common point on the ceiling by insulating massless strings of equal lengths. They come to equilibrium with each string making angle θ from the vertical. If the mass of each charge is m, then the electrostatic potential at the centre of line joining them will be $\left(\frac{1}{4\pi \in_0} = k\right)$:

(A) $\sqrt{k\, mg \tan\theta}$ (B*) $4\sqrt{k\, mg \tan\theta}$ (C) $2\sqrt{k\, mg \tan\theta}$ (D) $4\sqrt{k\, mg / \tan\theta}$

17. A plane electromagnetic wave in a non-magnetic dielectric medium is given by $\vec{E} = \vec{E}_0(4 \times 10^{-7} x - 50t)$ with distance being in meter and time in seconds. The dielectric constant of the medium is :

(1) 4.8 (2) 8.2 (3) 5.8 (4) 2.4

18. This 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 : Short wave transmission is achieved due to the total internal reflection of the e-m wave from an appropriate height in the ionosphere.

Statement 2 : Refractive index of a plasma is independent of the frequency of e-m waves.

(1) Statement 1 is false and statement 2 true

(2) Statement 1 and statement 2 both are true. But statement 2 is not the correct explanation of statement 1

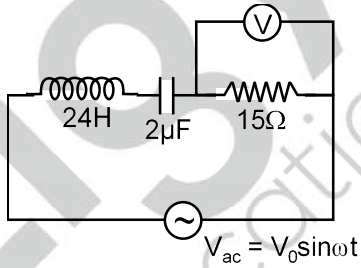
(3*) Statement 1 is true and Statement 2 false

(4) Statement 1 and Statement 2 both are true. Statement 2 is the correct explanation of Statement 1.

19. A uniform wire (Young's modulus 2×10^{11} Nm^{-2}) is subjected to longitudinal tensile stress of 5×10^{7} Nm^{-2}. If the overall volume change in the wire is 0.02%, the fractional decrease in the radius of the wire is close to :

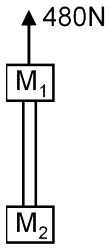
(1*) 0.25×10^{-4} (2) 1.0×10^{-4} (3) 5×10^{-4} (4) 1.5×10^{-4}

20. An LCR circuit as shown in the figure is connected to a voltage source V_{ac} whose frequency can be varied. The frequency, at which the voltage across the resistor is maximum, is :



(1*) 23 Hz (2) 345 Hz (3) 143 Hz (4) 902 Hz

21. Two blocks of mass M_1 = 20 kg and M_2 = 12 kg are connected by a metal rod of mass 8 kg. The system is pulled vertically up by applying a force of 480 N as shown. The tension at the mid-point of the rod is :



(1) 240 N (2) 96 N (3) 192 N (4) 144 N

22. A ball projected from ground at an angle of 45° just clears a wall in front. If point of projection is 4 m from the foot of wall and ball strikes the ground at a distance of 6 m on the other side of the wall, the height of the wall is :

(1) 4.4 m (2*) 2.4 m (3) 3.6 m (4) 1.6 m

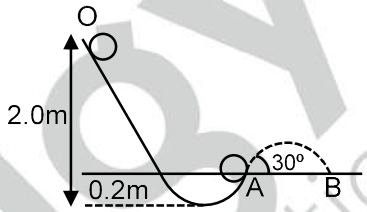
23. Orbits of a particle moving in a circle are such that the perimeter of the orbit equals an integer number of de - Broglie wavelengths of the particle. For a charged particle moving in a plane perpendicular to a magnetic field, the radius of the n^{th} orbital will therefore be proportional to :

(1) n^2 (2) $n^{1/2}$ (3) $n^{1/4}$ (4) n

24. Air of density 1.2 kg m^{-3} is blowing across the horizontal wings of an aeroplane in such a way that its speeds above and below the wings are 150 ms^{-1} and 100 ms^{-1}, respectively. The pressure difference between the upper and lower sides of the wings, is :

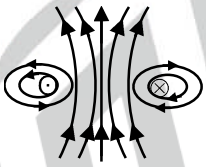
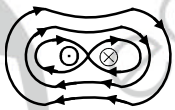
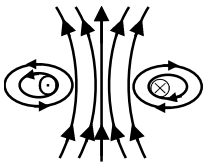
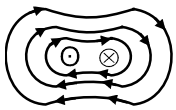
(1) 180 Nm^{-2} (2*) 7500 Nm^{-2} (3) 12500 Nm^{-2} (4) 60 Nm^{-2}

25. A tennis ball (treated as hollow spherical shell) starting from O rolls down a hill. At point A the ball becomes air borne leaving at an angle of 30° with the horizontal. The ball strikes the ground at B. What is the value of the distance AB ? (Moment of inertia of a spherical shell of mass m and radius R about its diameter $= \frac{2}{3}mR^2$)



(1*) 1.87 m (2) 1.77 m (3) 1.57 m (4) 2.08 m

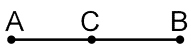
26. Choose the correct sketch of the magnetic field lines of a circular current loop shown by the dot **Θ** and the cross ⊗.

(1)  (2)  (3)  (4) 

27. In a series L-C-R circuit, C = 10^{-11} Farad, L = 10^{-5} Henry and R = 100 Ohm, when a constant D.C voltage E is applied to the circuit, the capacitor acquires a charge 10^{-9}C. The D.C. source is replaced by a sinusoidal voltage source in which the peak voltage E_0 is equal to the constant D.C. voltage E. At resonance the peak value of the charge acquired by the capacitor will be :

(A) 10^{-10} C (B*) 10^{-8} C (C) 10^{-15} C (D) 10^{-6} C

28. A and B are two sources generating sound waves. A listener is situated at C. The frequency of the source at A is 500 Hz. A, now, moves towards C with a speed 4 m/s. The number of beats heard at C is 6. When A moves away from C with speed 4 m/s, the number of beats heard at C is 18. The speed of sound is 340 m/s. The frequency of the source at B is :



(1) 506 Hz (2) 500 Hz (3*) 512 Hz (4) 494 Hz

29. The image of an illuminated square is obtained on a screen with the help of a converging lens. The distance of the square from the lens is 40 cm. The area of the image is 9 times that of the square. The focal length of the lens is :

(1) 60 cm (2) 30 cm (3) 36 cm (4) 27 cm

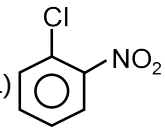
30. A point charge of magnitude +100μC is fixed at (0,0,0). An isolated uncharged spherical conductor, is fixed with its center at (4, 0, 0). The potential and the induced electric field at the centre of the sphere is:

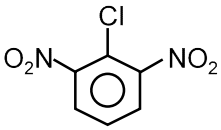
(1) 1.8 $\times 10^5$ V and – 5.625 $\times 10^6$ V/m (2*) 2.25$\times 10^5$ V and – 5.625 $\times 10^6$ V/m

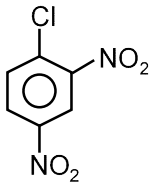
(3) 2.25 $\times 10^5$ V and 0 V/m (4) 0 V and 0 V / m

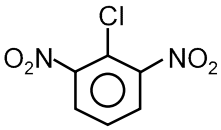
PART-B-CHEMISTRY

31. A major component of Borsch reagent is obtained by reacting hydrazine hydrate with which of the following ?

(1) 

(2) 

(3) 

(4) 

32. In Williamson synthesis of mixed ether having a primary and a tertiary alkyl group if tertiary halide is used, then :

(1) Alkene will be the main product

(2) Simple ether will instead of mixed ether

(3) Expected mixed ether will be formed

(4) Rate of reaction will be slow due to show cleavage of carbon-halogen bond

33. The Wurtz-Fittig reaction involves condensation of :

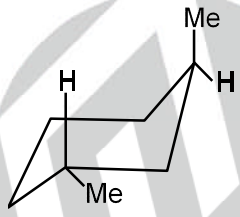
(1) Two molecules of aralkyl-halides

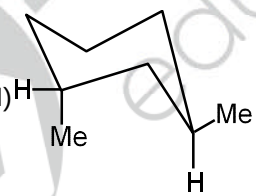
(2) one molecule of each aryl-halide and phenol

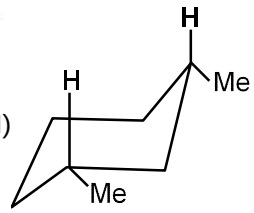
(3) two molecules of aryl halides

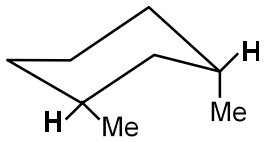
(4) one molecule of each of aryl-halide and alkyl-halide

34. Arrange in the correct order of stability (decreasing order) for the following molecules:

(I) 

(II) 

(III) 

(IV) 

(1) III > I ≈ II > IV (2) IV > III > II ≈ I (3) I > II ≈ III > IV (4) I > II > III > IV

35. XeO_4 molecule is tetrahedral having :

(1) Four pπ–dπ bonds (2) One pπ–dπ bond (3) Three pπ–dπ bonds (4) Two pπ-dπ bonds

36. Oxidation state of sulphur in anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ increases in the orders :

(1) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$ (2) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$

(3) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$ (4) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$

37. A molecule M associates in a given solvent according to the equations $M \rightleftharpoons (M)_n$. For a certain concentration of M, the van't Hoff factor was found to be 0.9 and the fraction of associated molecules was 0.2. The value of n is :

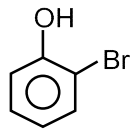
(1) 4 (2) 5 (3) 2 (4) 3

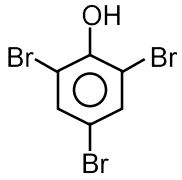
38. The solubility order for alkali metal fluoride in water is :

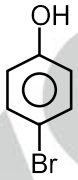
(1) RbF < KF < NaF < LiF (2) LiF < RbF < KF < NaF

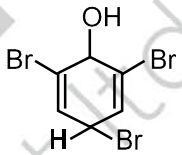
(3) LiF > NaF > KF > RbF (4) LiF < NaF < KF < RbF

39. What is the structure of the major product when phenol is treated with bromine water ?

(1) 

(2) 

(3) 

(4) 

40. Which of the following statements is incorrect?

(1) Fe^{3+} ion gives blood red colour with SCN^- ion

(2) Fe^{2+} ion also gives blood red colour with SCN^- ion.

(3) On passing H_2S into Na_2ZnO_2 solution, a white ppt of ZnCl is formed.

(4) Cupic ion react with excess of ammonia soln to give deep blue colour of $[Cu(NH_3)_4]^{2+}$ ion

41. Values of dissociation constant, K_a are given as follows :

Acid	**K_a**
HCN	6.2×10^{-10}
HF	7.2×10^{-4}
HNO_2	4.0×10^{-4}

Correct order of increasing base strength of the base CN^-, F^- and NO_2^- will be :

(1) $F^- < NO_2^- < CN^-$ (2) $NO_2^- < CN^- < F^-$ (3) $F^- < CN^- < NO_2^-$ (4) $NO_2^- < F^- < CN^-$

42. Clemmensen reduction of a ketone is carried out in the presence of :

(1) Zn–Hg with HCl (2) H_2 with Pt as catalyst

(3) Glycol with KOH (4) $LiAlH_4$

43. Which of the following would not give 2–phenylbutane as the major product in a Friedel-Crafts alkylation reaction ?

(1) Butanoylchloride + $AlCl_3$ then Zn, HCl (2) 2–butanol + H_2SO_4

(3) 1–butene + HF (4) Butyl chloride + $AlCl_3$

44. Which one of the following arrangements represents the correct order of solubilities of sparingly soluble salts Hg_2Cl_2,$Cr_2(SO_4)_3$, $BaSO_4$ and $CrCl_3$ respectively ?

(1) $\left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}},\left(\frac{K_{sp}}{103}\right)^{\frac{1}{5}},(K_{sp})^{\frac{1}{2}},\left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}}$ (2) $\left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}},\left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}},(K_{sp})^{\frac{1}{2}},\left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}}$

(3) $(K_{sp})^{\frac{1}{2}},\left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}},\left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}},\left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}}$ (4) $(K_{sp})^{\frac{1}{2}},\left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}},\left(\frac{K_{sp}}{27}\right)^{\frac{1}{4}},\left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}}$

45. Which of the following is diamagnetic ?

(1) $[Co(OX)]^{3-}$ (2) $[FeF_6]^{3-}$ (3) $[Co(F_6)]^{3-}$ (4) $[Fe(CN)_6]^{3-}$

46. Bond order normally gives idea of stability of a molecular species. All the molecules viz. H_2, Li_2 and B_2 have the same bond order yet they are not equally stable. Their stability order is :

(1) $Li_2 > H_2 > Br_2$ (2) $Li_2 > B_2 > H_2$ (3) $H_2 > B_2 > Li_2$ (4) $B_2 > H_2 > Li_2$

47. Which of the following structures represents thymine ?

(1) (2) (3) (4)

48. Which one of the following statements about packing in solids is incorrect ?

(1) Coordination number in bcc mode of packing is 8

(2) Coordination number in hcp mode of packing is 12

(3) Void space in hcp mode of packing is 32%

(4) Void space in ccp mode of packing is 26%

49. NaOH is a strong base. What will be pH of 5.0×10^{-2} M NaOH solution ? (log2 = 0.3)

(1) 14.00 (2) 13.70 (3) 13.00 (4) 12.70

50. In Goldschmidt alumino thermic process which of the following reducing agents is used :

(1) Al-powder (2) sodium (3) coke (4) calcium

51. Which of the following statements about aspirin is not true ?

(1) It is effective in relieving pain (2) It belongs to narcotic analgesics

(3) It has antiblood clotting action (4) It is a neurologically active drug

52. The polymer used for optical lenses is :

(1) Polymethyl methacrylate (2) Polythene

(3) Polyvinyl chloride (4) polypropylene

53. The order of increasing sizes of atomic radii among the elements O, S, Se and As is :

(1) Se < S As < O (2) As < S O < Se

(3) O < S Se < As (4) O < S < As < Se

54. The reaction X $\rightarrow$ Y is an exothermic reaction. Activation energy of the reaction for X into Y is 150 kJ mol^{-1}. Enthalpy of reaction is 135 kJ mol^{-1}. The activation energy for the reverse reaction, Y $\rightarrow$ X will be:

(1) 270 kJ mol^{-1} (2) 15 kJ mol^{-1} (3) 285 kJ mol^{-1} (4) 280 kJ mol^{-1}

55. Given

Reaction	Energy Change (in kJ)
$Li(s) \rightarrow Li(g)$	161
$Li(g) \rightarrow Li^+(g)$	520
$½F_2(g) \rightarrow F(g)$	77
$F(g) + e^- \rightarrow F^-(g)$	(Electron gain enthalpy)
$Li^+(g) + F^-(g) \rightarrow LiF(s)$	–1047
$Li(s) + ½F_2(g) \rightarrow LiF(s)$	–617

Based on data provided, the value of electron gain enthalpy of fluorine would be :

(1) –300 kJ mol–1 (2) –228 kJ mol^{-1} (3) – 328 kJ mol^{-1} (4) –350 kJ mol^{-1}

56. The wave number of the first emission line in the Balmer series of H–Spectrum is :

(R = Rydberg constant) :

(1) $\frac{9}{400}R$ (2) $\frac{3}{4}R$ (3) $\frac{7}{6}R$ (4) $\frac{5}{36}R$

57. For which of the following compounds Kjeldahl method can be used to determine the percentage of Nitrogen ?

(1) Pyridine (2) Nitrobenzene (3) Alanine (4) Diazomethane

58. Amongst the following alcohols which would react fastest with conc. HCl and $ZnCl_2$?

(1) 2–methylbutan-2-ol (2) 2-pentanol (3) pentanol (4) 2-methylbutanol

59. Flocculation value of $BaCl_2$ is much less than that of KCl for sol A and flocculation value of Na_2SO_4 is much less than that of NaBr for sol B. The correct statement among the following is :

(1) Sol A is negatively charged and sol B is positively charged

(2) Both the sols A and B are positively charged

(3) Both the sols A and B are negatively charged

(4) Sol A is positively charged and so B is negatively charged.

60. The density of 3M solution of sodium chloride is 1.252 g mL^{-1}. The molality of the solution will be :

(Molar mass, NaCl = 58.5 g mol^{-1})

(1) 2.18 m (2) 3.00 m (3) 2.60 m (4) 2.79 m

PART-C-MATHEMATICS

61. If a complex number z satisfies the equation $z + \sqrt{2}\,|z + 1| + i = 0$, then $|z|$ is equal to :

(1*) $\sqrt{5}$ (2) 1 (3) 2 (4) $\sqrt{3}$

62. Given two independent events, if the probability that exactly one of them occurs is $\frac{26}{49}$ and the probability that none of them occurs is $\frac{15}{49}$, then the probability of more probable of the two events is :

(1) $\frac{5}{7}$ (2) $\frac{3}{7}$ (3*) $\frac{4}{7}$ (4) $\frac{6}{7}$

63. Mean of 5 observations is 7. If four of these observations are 6, 7, 8, 10 and one is missing then the variance of all the five observations is :

(1) 6 (2) 8 (3*) 4 (4) 2

64. The number of solutions of the equation $\sin^{-1}x = 2\tan^{-1}x$ (in principal values) is :

(1) 4 (2*) 3 (3) 1 (4) 2

65. If α and β are roots of the equation $x^2 + px + \frac{3p}{4} = 0$, such that $|\alpha - \beta| = \sqrt{10}$, then p belongs to the set :

(1*) {– 2, 5} (2) {3, – 5} (3) {2, – 5} (4) {– 3, 2}

66. The acute angle between two lines such that the direction cosines 1, m, n of each of them satisfy the equations $1 + m + n = 0$ and $1^2 + m^2 + n^2 = 0$ is :

(1*) 60° (2) 30° (3) 15° (4) 45°

67. Let the equations of two ellipses be

$E_1 : \frac{x^2}{3} + \frac{y^2}{2} = 1$ and $E_2 : \frac{x^2}{16} + \frac{y^2}{b^2} = 1.$

If the product of their eccentricities is $\frac{1}{2}$, then the length of the minor axis of ellipse E_2 is :

(1) 9 (2*) 4 (3) 8 (4) 2

68. The number of ways in which an examiner can assign 30 marks to 8 questions, giving not less than 2 marks to any question, is :

(1*) $^{21}C_7$ (2) $^{21}C_8$ (3) $^{30}C_7$ (4) $^{30}C_8$

69. **Statement-1:** The line $x - 2y = 2$ meets the parabola, $y^2 + 2x = 0$ only at the point $(-2, -2)$.

Statement-2: The line $y = mx - \frac{1}{2m}$ $(m \neq 0)$ is tangent to the parabola, $y^2 = -2x$ at the point $\left(\frac{-1}{2m^2}, \frac{-1}{m}\right)$

(1) Statement-1 is true; Statement-2 is false

(2) Statement-1 is true; Statement-2 is true; Statement-2 is not a correct explanation for statement-1

(3*) Statement-1 is true; Statement-2 is true; Statement-2 is a correct explanation for statement-1

(4) Statement-1 is false; Statement-2 is true.

70. If two vertices of an equilateral triangle are A $(-a, 0)$ and B $(a, 0)$, $a > 0$ and the third vertex C lies above x-axis then the equation of the circumcircle of ΔABC is :

(1*) $3x^2 + 3y^2 - 2\sqrt{3}\,ay = 3a^2$ (2) $3x^2 + 3y^2 - 2ay = 3a^2$

(3) $x^2 + y^2 - \sqrt{3}\,ay = a^2$ (4) $x^2 + y^2 - 2ay = a^2$

71. Consider the differential equation $\frac{dy}{dx} = \frac{y^3}{2(xy^2 - x^2)}$.

Statement-1: The substitution $z = y^2$ transforms the above equation into a first order homogenous differential equation.

Statement-2: The solution of this differential equation is $y^2 e^{\frac{-y^2}{x}} = C$.

(1) both statements are false.

(2) Statement-1 is false; Statement-2 is true

(3) Statement-1 is true; Statement-2 is false

(4*) both statements are true.

72. If a circle C passing through $(4, 0)$ touches the circle $x^2 + y^2 + 4x - 6y - 12 = 0$ externally at a point $(1, -1)$, then the radius of the circle C is :

(1) $\sqrt{57}$ (2) 4 (3) $2\sqrt{5}$ (4*) 5

73. The maximum area of a right angled triangle with hypotenuse h is :

(1) $\frac{h^2}{2}$ (2*) $\frac{h^2}{4}$ (3) $\frac{h^2}{\sqrt{2}}$ (4) $\frac{h^2}{2\sqrt{2}}$

74. If the 7th term in the binomial expansion of $\left(\frac{3}{\sqrt[3]{84}} + \sqrt{3}\ln x\right)^9$, $x > 0$ is equal to 729, then x can be :

(1*) e (2) e^2 (3) 2e (4) $\frac{e}{2}$

75. If $\int \frac{x^2 - x + 1}{x^2 + 1} e^{\cot^{-1} x}\, dx = A(x) e^{\cot^{-1} x} + C$, then A(x) is equal to :

(1*) x (2) – x (3) $\sqrt{1 - x}$ (4) $\sqrt{1 + x}$

76. The area of the region (in sq. units), in the first quadrant, bounded by the parabola $y = 9x^2$ and the lines x = 0, y = 1 and y = 4 is :

(1) $\frac{14}{3}$ (2*) $\frac{14}{9}$ (3) $\frac{7}{3}$ (4) $\frac{7}{9}$

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

(1) $p \to q$ (2) $p \to (p \to q)$ (3*) $p \to (p \vee q)$ (4) $p \to (p \wedge q)$

78. **Statement-1:** The function $x^2 (e^x + e^{-x})$ is increasing for all x > 0.

Statement-2: The functions x^2e^x and x^2e^{-x} are increasing for all x > 0 and the sum of two increasing functions in any interval (a, b) is an increasing function in (a, b).

(1) Statement-1 is false; Statement-2 is true.

(2*) Statement-1 is true; Statement-2 is false

(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

79. For $a > 0, t \in \left(0, \frac{\pi}{2}\right)$, let $x = \sqrt{a^{\sin^{-1} t}}$ and $y = \sqrt{a^{\cos^{-1} t}}$. Then $1 + \left(\frac{dy}{dx}\right)^2$ equals :

(1*) $\frac{x^2 + y^2}{x^2}$ (2) $\frac{x^2}{y^2}$ (3) $\frac{y^2}{x^2}$ (4) $\frac{x^2 + y^2}{y^2}$

80. Given sum of the first n terms of an A.P. is $2n + 3n^2$. Another A.P. is formed with the same first term and double of the common difference, the sum of n terms of the new A.P. is :

(1) $3n + 2n^2$ (2*) $6n^2 - n$ (3) $n + 4n^2$ (4) $n^2 + 4n$

81. If the system of linear equations

$x_1 + 2x_2 + 3x_3 = 6$

$x_1 + 3x_2 + 5x_3 = 9$

$2x_1 + 5x_2 + ax_3 = b$

is consistent and has infinite number of solutions, then :

(1) b = 15, a can be any real number

(2*) a = 8, b =15

(3) $a \in R - \{8\}$ and $b \in R - \{15\}$

(4) a = 8, b can be any real number

82. If $\hat{a}, \hat{b}$ and $\hat{c}$ are unit vectors satisfying $\hat{a} - \sqrt{3}\,\hat{b} + \hat{c} = \vec{0}$, then the angle between the vectors $\hat{a}$ and $\hat{c}$ is:

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

83. If p, q, r are 3 real numbers satisfying the matrix equation, $\begin{bmatrix} p & q & r \end{bmatrix}\begin{bmatrix} 3 & 4 & 1 \\ 3 & 2 & 3 \\ 2 & 0 & 2 \end{bmatrix} = [3 \;\; 0 \;\; 1]$, then (2p + q – r) equals :

(1*) – 3 (2) 2 (3) 4 (4) – 1

84. If the x-intercept of some line L is double as that of the line, 3x + 4y = 12 and the y-intercept of L is half as that of the same line, then the slope of L is :

(1) $\frac{-3}{8}$ (2) $\frac{-3}{2}$ (3*) $\frac{-3}{16}$ (4) – 3

85. Let R = {(3, 3), (5, 5), (9, 9), (12, 12), (5, 12), (3, 9), (3, 12), (3, 5)} be a relation on the set A = {3, 5, 9, 12}. Then R is :

(1*) reflexive, transitive but not symmetric (2) an equivalence relation

(3) reflexive, symmetric but not transitive (4) symmetric, transitive but not reflexive

86. **Statement-1:** The number of common solutions of the trigonometric equations $2\sin^2\theta - \cos 2\theta = 0$ and $2\cos^2\theta - 3\sin\theta = 0$ in the interval $[0, 2\pi]$ is two.

Statement-2: The number of solutions of the equations, $2\cos^2\theta - 3\sin\theta = 0$ in the interval $[0, \pi]$ is two.

(1) Statement-1 is true; Statement-2 is true; Statement-2 is a correct explanation for statement-1

(2*) Statement-1 is true; Statement-2 is true; Statement-2 is not a correct explanation for statement-1

(3) Statement-1 is false; Statement-2 is true.

(4) Statement-1 is true; Statement-2 is false.

87. Let f(x) = – 1 + | x – 2 |, and g(x) = 1 – | x |; then the set of all points where fog is discontinuous is

(1*) an empty set (2) {0, 1, 2} (3) {0, 2} (4) {0}

88. The sum $\frac{3}{1^2} + \frac{5}{1^2+2^2} + \frac{7}{1^2+2^2+3^2} + \ldots\ldots n$ upto 11-terms is :

(1) $\frac{60}{11}$ (2) $\frac{11}{4}$ (3*) $\frac{11}{2}$ (4) $\frac{7}{2}$

89. Let Q be the foot of perpendicular from the origin to the plane $4x - 3y + z + 13 = 0$ and R be a point $(-1, 1, -6)$ on the plane. Then length QR is :

(1*) $3\sqrt{\frac{7}{2}}$ (2) $\sqrt{14}$ (3) $\sqrt{\frac{19}{2}}$ (4) $\frac{3}{\sqrt{2}}$

90. The integral $\int_{\frac{7\pi}{4}}^{\frac{7\pi}{3}} \sqrt{\tan^2 x}\, dx$ is equal to :

(1) log 2 (2) 2log 2 (3) $\log\sqrt{2}$ (4*) $\log 2\sqrt{2}$