CODE - A

TEST ID 001915

N T P L

ALL INDIA TEST SERIES

JEE (Main) - 2019

PART TEST - 5

Time : 3 Hours ***Maximum Marks : 360***

Syllabus Covered

Physics	:	Magnetics, Modern physics.
Chemistry	:	P- Block Elements, D and F Block, Environmental Chemistry, Acid, Amines, Biomolecules, Atomic structure .
Mathematics	:	Quadratic equations & expressions, Complex number, Matrices and Determinants, Binomial Theorem.

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

A. General :

1. This booklet is your Question Paper containing **90 questions**.
2. The Question Paper **CODE & TEST ID** is printed on the right hand top corner of this booklet. This should be entered on the OMR Sheet.
3. Fill the bubbles completely and properly using a **Blue/Black Ball Point Pen** only.
4. No additional sheets will be provided for rough work.
5. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers, and electronic gadgets in any form are not allowed to be carried inside the examination hall.
6. The answer sheet, a machine-readable Optical mark recognition sheet (OMR Sheet), is provided separately.
7. DO NOT TAMPER WITH / MUTILATE THE OMR OR THE BOOKLET.
8. Do not break the seals of the question-paper booklet before being instructed to do so by the invigilator.

B. Question paper format & Marking Scheme :

9. The question paper consists of **3 parts** (Physics, Chemistry and Mathematics).
10. The test is of **3 hours** duration. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct. Each question carries **+4 marks** for correct answer and **-1 mark** for wrong answer.

Name of the Candidate (in Capitals) ______________________________

Test Centre ____________________ Centre Code ____________________

Candidate's Signature ____________________ Invigilator's Signature ____________________

PHYSICS

SECTION – I

This section contains ***30 questions.*** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ***ONLY ONE*** is correct. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

1. The wavelength of a certain line in the x-ray spectrum for tungsten ($Z = 74$) is 200 Å. What would be the wavelength of the same line for platinum ($Z = 78$)? The screening constant a is unity.

   (a) 179.76 Å (b) 189.76 Å (c) 289.76 Å (d) 379.76 Å

2. The ratio of de-Broglie wavelength of molecules of hydrogen and helium which are at temperatures 27°C and 127°C respectively will be

   (a) $\sqrt{\frac{4}{3}}$ (b) $\sqrt{\frac{8}{3}}$ (c) $\sqrt{\frac{3}{8}}$ (d) $\sqrt{\frac{3}{4}}$

3. An electron of mass m and charge e is accelerated by a potential difference V. It then enters a uniform magnetic field B applied perpendicular to its path. The radius of the circular path of the electron is

   (a) $r = \left(\frac{2mV}{eB^2}\right)^{\frac{1}{2}}$ (b) $r = \left(\frac{2meV}{B^2}\right)^{\frac{1}{2}}$ (c) $r = \left(\frac{2mB}{eV^2}\right)^{\frac{1}{2}}$ (d) $r = \left(\frac{2B^2V}{em}\right)^{\frac{1}{2}}$

4. A hydrogen atom is in an excited state of principle quantum number n. It emits a photon of wavelength λ when returns to the ground state. The value of n is (R = Rydberg constant)

   (a) $\sqrt{\lambda R(\lambda R - 1)}$ (b) $\sqrt{\frac{(\lambda R - 1)}{\lambda R}}$ (c) $\sqrt{\frac{\lambda R}{\lambda R - 1}}$ (d) $\sqrt{\lambda (R - 1)}$

5. A proton of mass m and charge +e is moving in a circular orbit in a magnetic field with energy 1 MeV. What should be the energy of α- particle (mass = 4m and charge = +2e), so that it can revolve in the path of same radius

   (a) 1 MeV (b) 4 MeV (c) 2 MeV (d) 0.5 MeV

6. An electron collides with a fixed hydrogen atom in its ground state. Hydrogen atom gets excited and the colliding electron loses all its kinetic energy. Consequently the hydrogen atom may emit a photon corresponding to the largest wavelength of the Balmer series. The minimum kinetic energy of colliding electron is

   (a) 10.2 eV (b) 1.9 eV (c) 12.09 eV (d) 13.6 eV

7. In a hydrogen atom, an electron of mass m and charge e is in an orbit of radius r making n revolutions per second. If the mass of the hydrogen nucleus is M, the magnetic moment associated with the orbital motion of the electron is

(a) $\dfrac{\pi ner^2 m}{M}$ (b) $\dfrac{\pi ner^2 M}{m}$ (c) $\dfrac{\pi ner^2 m}{(M+m)}$ (d) πner^2

8. The electric potential between a proton and an electron is given by $V = V_0 \ln\dfrac{r}{r_0}$, where r_0 is a constant. Assuming Bohr's model to be applicable, then variation of r_n with n, where n being the principal quantum number is

(a) $r_n \propto n$ (b) $r_n \propto \dfrac{1}{n}$ (c) $r_n \propto n^2$ (d) $r_n \propto \dfrac{1}{n^2}$

9. Nuclei of a radioactive element A are being produced at a constant rate α. The element A has a decay constant λ. At time $t = 0$, there are N_0 nuclei of the element A. The number N of nuclei of A at time t is

(a) $\dfrac{1}{\lambda}[\alpha-(\alpha-\lambda N_0)e^{-\lambda t}]$ (b) $\dfrac{1}{\lambda}[(\alpha-\lambda N_0)e^{-\lambda t}]$ (c) $\lambda[\alpha-(\alpha-\lambda N_0)e^{\lambda t}]$ (d) $\lambda N_0 e^{-\lambda t}$

10. The wavelength of the characteristic X-ray K_α line emitted by a hydrogen-like element is 0.32 Å. The wavelength of K_β line emitted by the same element will be

(a) 0.24 Å (b) 0.27 Å (c) 0.32 Å (d) 0.48 Å

11. Electrons in hydrogen atom revolve in radius 0.53 Å (in ground state). Due to collision, electron starts revolving in radius of 4.77 Å. Change in angular momentum of the electron will be equal to

(a) 2.11×10^{-36} kg m^2/sec (b) 4.22×10^{-30} g m^2/sec

(c) 2.11×10^{-27} g cm^2/sec (d) 4.22×10^{-36} kg m^2/sec

12. A radioactive material has half life's for α and β emission equal to 20 and 100 yrs respectively. $\dfrac{1}{8}$th fraction of the radioactive material will be remain there after

(a) 360 yrs (b) 50 yrs (c) 120 yrs (d) 180 yrs

13. When photons of energy 4.25 eV strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy T_A eV and de Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.70 eV is $T_B = (T_A - 1.50)$ eV. If the de Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$, then choose the incorrect statement.

(a) the work function of A is 1.25 eV (b) the work function of B is 4.20 eV

(c) $T_A = 2.00$ eV (d) $T_B = 0.5$ eV

14. An electron and a proton are separated by a large distance. The electron starts approaching the proton with energy 2eV. The proton captures the electron and forms a hydrogen atom in first excited state. The resulting photon is incident on a photosensitive metal of threshold wavelength 4600Å. The maximum K.E. of the emitted photoelectron is (Take hc = 12420 eV Å)

(a) 2.4 eV (b) 2.7 eV (c) 2.9 eV (d) 5.4 eV

15. What would be the energy required to dissociate completely 1 gram of Ca-40 into its constituent particles?

Mass of proton = 1.007277 amu

Mass of neutron = 1.00866 amu

Mass of Ca-40 = 39.97545 amu (Take one amu= 931 MeV)

(a) 4.843×10^{24} MeV (b) 4.813×10^{24} MeV (c) 4.813×10^{22} MeV (d) none of these

16. Suppose potential energy between electron and proton at separation r is given by $U = k \ln r$, where k is constant. For such hypothetical hydrogen atom, the ratio of energy difference between energy levels (n = 1 and n = 2) and (n = 2 and n = 4) is

(a) 1 (b) 2 (c) $\frac{1}{2}$ (d) 3

17. Two long wires are hanging freely. They are joined first in parallel and then in series and they are connected with a battery. In both cases, which type of force acts between the two wires?

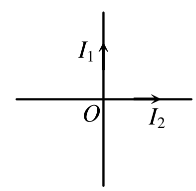
(a) attraction force when in parallel and repulsion force when in series

(b) repulsion force when in parallel and attraction force when in series

(c) repulsion force in both cases

(d) attraction force in both cases

18. Two long wires carrying current are kept crossed (not joined at O). The locus where magnetic field is zero is



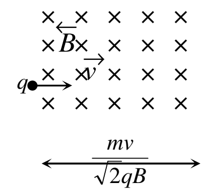
(a) $I_1 = \frac{x}{y} I_2$ (b) $I_1 = \frac{y}{x} I_2$

(c) $x = y$ (d) $x = -y$

19. When a long wire carrying a steady current is bent into a circular coil of one turn, the magnetic induction at its centre is B. When the same wire carrying the same current is bent to form a circular coil of n turns of a smaller radius, the magnetic induction at the centre will be

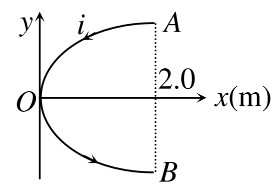
(a) B/n (b) nB (c) B/n^2 (d) n^2B

20. A positive charge q is projected in magnetic field of width $\frac{mv}{\sqrt{2}\,qB}$ with velocity v as shown in figure. Then time taken by charged particle to emerge from the magnetic field is



(a) $\frac{m}{\sqrt{2}\,qB}$
(b) $\frac{\pi m}{4qB}$
(c) $\frac{\pi m}{2qB}$
(d) $\frac{\pi m}{\sqrt{2}\,qB}$

21. A conducting wire bent in the form of a parabola $y^2 = 2x$ carries a current $i = 2$A as shown in figure. This wire is placed in a uniform magnetic field $\vec{B} = -4\hat{k}$ tesla. The magnetic force on the wire is

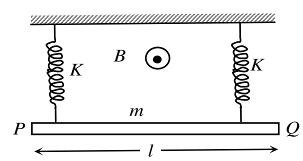


(a) $-16\hat{i}$
(b) $32\hat{i}$
(c) $-32\hat{i}$
(d) $16\hat{i}$

22. Three long straight wires are connected parallel to each other across a battery of negligible internal resistance. The ratio of their resistances are 3 : 4 : 5. What is the ratio of distances of middle wire from the others if the net force experienced by it is zero

(a) 4 : 3 (b) 3 : 1 (c) 5 : 3 (d) 2 : 3

23. A conducting rod of mass m and length l is connected by two identical springs as shown in the figure. Initially the system is in equilibrium. A uniform magnetic field of magnitude B directed perpendicular to the plane of the paper outwards also exists in the region. If a current I is switched on that passes from P to Q through the rod. Further maximum elongation in the spring is [Given: $|mg| = |BIl|$]



(a) $\frac{BIl}{K}$
(b) $\frac{BIl}{4K}$
(c) $\frac{BIl}{8K}$
(d) $\frac{BIl}{16K}$

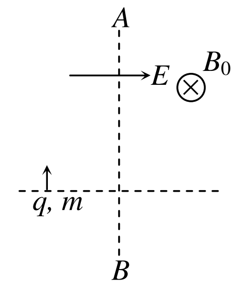
24. A circular current carrying loop of radius R, carries a current i. The magnetic field at a point on the axis of coil is $\frac{1}{\sqrt{8}}$ times the value of magnetic field at the centre. Distance of point from centre is

(a) $\frac{R}{\sqrt{2}}$ (b) $\frac{R}{\sqrt{3}}$ (c) $R\sqrt{2}$ (d) R

25. Three particles each of mass m and charge q are attached to the vertices of a triangular frame, made up of three light rigid rods of equal length l. The frame is rotated at constant angular speed ω about an axis perpendicular to the plane of the triangle and passing through its centre. The ratio of the magnetic moment of the system and its angular momentum about the axis of rotation is

(a) $\frac{q}{2m}$ (b) $\frac{q}{m}$ (c) $\frac{2q}{m}$ (d) $\frac{4q}{m}$

26. A uniform electric field E is present horizontally along the paper throughout region but uniform magnetic field B_0 is present horizontally (perpendicular to plane of paper in inward direction) right to the line AB as shown. A charge particle having charge q and mass m is projected vertically upward and crosses the line AB after time t_0. Find the speed of projection if particle moves after t_0 with constant velocity. (given $qE = mg$)



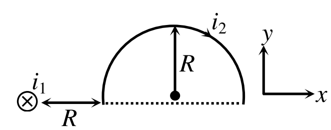
(a) gt_0

(b) $2gt_0$

(c) $\frac{gt_0}{2}$

(d) particle can't move with constant velocity after crossing AB

27. A very long current carrying wire is placed along z-axis having current of magnitude i_1 towards negative z-axis. A semicircular wire of radius R and having current i_2 is placed in x-y plane, such that line joining two end points of the semicircular wire passes through long wire as shown in figure. Nearest distance of semicircular wire from long wire is R. Net magnetic force on semicircular wire will be



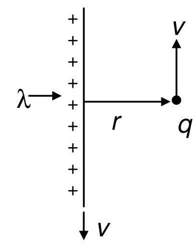
(a) $\frac{\mu_0 i_1 i_2}{2\pi}\ln 3$

(b) $\frac{\mu_0 i_1 i_2}{2\pi}\ln\frac{3}{2}$

(c) zero

(d) $\frac{\mu_0 i_1 i_2}{2\pi}$

28. A long wire having linear charge density λ moving with constant velocity v along its length. A point charge moving with same speed in opposite direction and at that instant it is r distance from the wire. The net force acting on the charge is given by



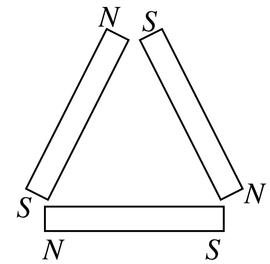
(a) $\frac{\lambda q}{2\pi r}\left[\frac{1}{\varepsilon_0} + v^2\mu_0\right]$

(b) $\frac{\lambda q}{2\pi r}\left[\frac{1}{\varepsilon_0} - \mu_0 v^2\right]$

(c) $\frac{\lambda q}{2\pi r}\sqrt{\left(\frac{1}{\varepsilon_0}\right)^2 + v^4\mu_0^2}$

(d) zero

29. Three identical bar magnets each of magnetic moment M, are placed in the form of an equilateral triangle with north pole of one touching the south pole of the other as shown. The net magnetic moment of the system is



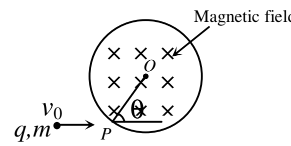
(a) zero

(b) $3M$

(c) $\frac{3M}{2}$

(d) $M\sqrt{3}$

30. A particle charge q and mass m is projected with a velocity v_0 towards a circular region having uniform magnetic field B perpendicular and into the plane of paper from point P as shown in the figure. R is the radius and O is the centre of the circular region. If the line OP makes an angle θ with the direction of v_0 then the value of v_0 so that particle passes through O is



(a) $\frac{qBR}{m\sin\theta}$

(b) $\frac{qBR}{2m\sin\theta}$

(c) $\frac{2qBR}{m\sin\theta}$

(d) $\frac{3qBR}{2m\sin\theta}$

CHEMISTRY

SECTION – II

This section contains ***30 questions.*** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ***ONLY ONE*** is correct. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

31. What will be the charge on Fe^{x+} if the magnetic moment is $\sqrt{24}$ -

(a) + 2 (b) + 3 (c) Zero (d) None of these

32. The ability of d-block elements to form complexes is due to -

(a) small and highly charged ions

(b) Vacant low energy orbital to accept lone pair of electrons from ligands

(c) Both A & B are correct

(d) None is correct

33. Out of $[Fe(CN)_6]^{4-}$, $[Ni(CN)_4]^{2-}$ and $[Ni(CO)_4]$:

(a) All have identical geometry

(b) All are paramagnetic

(c) All are diamagnetic

(d) $[Fe(CN)_6]^{4-}$ is diamagnetic but $[Ni(CN)_4]^{2-}$ & $[Ni(CO)_4]$ are paramagnetic

34. A photon of 300 nm is absorbed by a gas and then re-emits two photons. One re-emitted photon has wavelength 496 nm, the wave-length of second re-emitted photon is

(a) 759 (b) 857 (c) 957 (d) 657

35. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition n = 4 to n = 2 of He^+ spectrum?

(a) $n_1 = 3; n_2 = 2$ (b) $n_1 = 4; n_2 = 2$ (c) $n_1 = 3; n_2 = 4$ (d) $n_1 = 1; n_2 = 2$

36. A bulb emits light of λ, 4500 Å. The bulb is rated as 150 watt and 8% of the energy is emitted as light. How many photons are emitted by the bulb per second?

(a) 20.2×10^{18} (b) 27.2×10^{20} (c) 27.2×10^{18} (d) 20.2×10^{20}

37. Suppose in Rutherford's scattering experiment we use a thin sheet of solid hydrogen in place of gold foil. Then:

(a) large angle scattering of α-particles is possible

(b) large angle scattering of α-particles is not possible

(c) small angle scattering is not possible

(d) all of the above

38. If the nitrogen atom had electronic configuration $1s^7$, it would have energy lower than that of the normal ground state configuration $1s^2 2s^2 2p^3$, because the electrons would be closer to the nucleus. Yet, $1s^7$ is not observed because it violates.

(a) Heisenberg uncertainty principle (b) Hund's rule

(c) Pauli's exclusion principle (d) Bohr postulates of stationary orbits.

39. The number of waves made by a Bohr electron in an orbit of maximum magnetic quantum number +2

(a) 3 (b) 4 (c) 2 (d) 1

40. If a 1.00 g body is travelling along the x-axis at 100 cm s^{-1} within 1 cm s^{-1}, what is the theoretical uncertainty in its position?

(a) 2.636×10^{-30} m (b) 2.636×10^{-25} m (c) 3.636×10^{-20} m (d) 4.636×10^{-20} m

41. Which of the following is not correct about photo electric effect?

(a) Photoelectric effect takes place only when wavelength of the incident radiation is greater than the critical wavelength.

(b) The number of photoelectrons emitted is directly proportional to the intensity of the incident radiation.

(c) The maximum kinetic energy of the photoelectrons emitted is directly proportional to the frequency of the incident radiation.

(d) If frequency of the incident radiation is equal to the critical frequency, the kinetic energy of photoelectrons is zero.

42. Hydrolysis of an ester gives acid A and alcohol B. The acid reduces Fehling's solution. Oxidation of alcohol B gives acid A. The ester is –

(a) Methyl formate (b) Ethyl formate (c) Methyl acetate (d) Ethyl acetate

43. When oxalic acid is heated, which one of the following is formed along with CO_2 –

(a) Acetic acid (b) Glyceric acid (c) Formic acid (d) None of these

44. In the following reactions –

(i) $CH_3CH_2ONa \xrightarrow[\text{under pressure}]{CO,\Delta} A$ (ii) $CH_2 = CH_2 + CO + H_2O \xrightarrow[\text{under pressure}]{H_3PO_4} B$

A and B respectively are :

(a) CH_3CH_2COOH in both cases (b) CH_3CH_2CHO in both cases

(c) CH_3CH_2COOH, CH_3CHO (d) CH_3CHO, CH_3COOH

45. The rate of esterfication of acetic acid with methyl alcohol (I), ethyl alcohol (II) , isopropyl alcohol (III) and tert. butyl alcohol (IV) follows in the order -

(a) I > II > III > IV (b) IV > III > II > I (c) II > I > IV > III (d) III > IV > I > III

46. The major product of nitration of Benzoic acid is –

(a) 3-Nitrobenzoic acid (b) 4-Nitrobenzoic acid

(c) 2-Nitrobenzoic acid (d) 2,4-Dinitrobenzoic acid

47. Which of the following is related to green chemistry

(i) Increased crop production (ii) low energy consumption

(iii) photo synthetic reaction

(iv) cost effective techniques producing less harmful waste

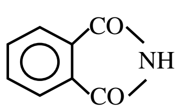
(a) (i) only (b) (ii) only (c) (ii) and (iv) (d) (i) and (iv)

48. Which of the following is not a homopolymer

(a) Starch (b) Protein (c) maltose (d) Glycogen

49. Tertiary butyl amine is a-

(a) 1° Amine (b) 2° Amine (c) 3° Amine (d) Quaternary salt

50. 

$\xrightarrow{KOH} A \xrightarrow{CH_3Br}$

$B \xrightarrow[H^+]{HOH} C + D$, C and D in the sequence are-

(a) Benzoic acid + aniline (b) Phthalic acid + ethylamine

(c) Phthalic acid + aniline (d) Benzoic acid + ethylamine

51. Aliphatic amines are .... basic than NH_3, but aromatic amines are ...... basic than NH_3 -

(a) More, less (b) Less, more (c) Both A and B (d) None of these

52. Suitable explanation for the order of basic character $(CH_3)_3N < (CH_3)_2NH$ is-

(a) Steric hindrance by bulky methyl group

(b) Higher volatility of 3°amine

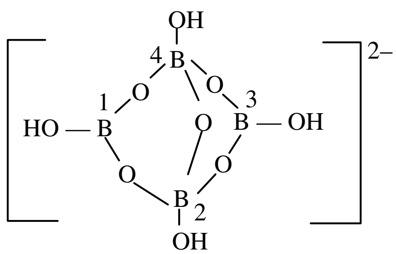
(c) Decreased capacity for H- bond formation with H_2O

(d) Decreased electron- density at N atom

53. How many isomeric amines can have the formula $C_4H_{11}N$ –

(a) Five (b) Six (c) Seven (d) Eight

54. The structure of Borax ion is-



(a) The oxidation state of B = + 3; 1, 2, 3, 4 are sp^2 hybridised.

(b) The oxidation state of B = + 3; 1, 4 are sp^3 hybridised whereas 2, 3 are sp^2 hybridised.

(c) The oxidation state of B = +3; 1, 3 are sp^2 hybridised whereas 2, 4 are sp^3 hybridised.

(d) The oxidation state of B = + 3; 1, 2, 3, 4 are sp^3 hybridised

55. Which of the following is the purest form of carbon?

(a) Charcoal (b) Coal (c) Diamond (d) Graphite

56. $AlCl_3$ can be dimerised whereas BCl_3 cannot be dimerised because –

(a) backbonding is stronger in the case of boron halides

(b) size of boron is quite smaller

(c) size of Al is larger

(d) $AlCl_3$ has incomplete octet

57. Methane is quite stable whereas silane is unstable? Because –

(a) C — C bond energy is large greater than Si — Si bond energy

(b) Si — H bond energy is much lower than C — H bond energy

(c) Si has vacant p orbitals which are more susceptible for nucleophilic attack

(d) All of above reasons

58. Among the trihalides of nitrogen which one is most basic –

(a) NF_3 (b) NCl_3 (c) NI_3 (d) NBr_3

59. The solid PCl_5 exists as –

(a) PCl_5 molecules (b) P_2Cl_{10} (c) $[PCl_4]^+ [PCl_6]^-$ (d) None of these

60. Which one of the following is wrongly matched?

(a) ClO_3^-, sp^3 pyramidal (b) ClO_4^-, sp^3 tetrahedral

(c) ICl_4^-, sp^3d^2 square planar (d) ICl_2^-, dsp^2 trigonal bipyramidal

MATHS

SECTION – III

This section contains ***30 questions.*** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which ***ONLY ONE*** is correct. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

61. If $x^2 + px + 1$ is a factor of the expression $ax^3 + bx + c$, then

(a) $a^2 - c^2 = ab$ (b) $a^2 + c^2 = -ab$

(c) $a^2 - c^2 = -ab$ (d) none of these

62. If $a \in (-1, 1)$, then roots of the quadratic equation $(a-1)x^2 + ax + \sqrt{1-a^2} = 0$ are

(a) real (b) imaginary (c) both equal (d) none of these

63. If α and β are roots of the equation $ax^2 + bx + c = 0$, then the roots of the equation $a(2x+1)^2 - b(2x+1)(3-x) + c(3-x)^2 = 0$ are

(a) $\frac{2\alpha+1}{\alpha-3}, \frac{2\beta+1}{\beta-3}$ (b) $\frac{3\alpha+1}{\alpha-2}, \frac{3\beta+1}{\beta-2}$ (c) $\frac{2\alpha-1}{\alpha-2}, \frac{2\beta+1}{\beta-2}$ (d) none of these

64. The number of values of a for which equations $x^3 + ax + 1 = 0$ and $x^4 + ax^2 + 1 = 0$ have a common root is

(a) 0 (b) 1 (c) 2 (d) infinite

65. The largest interval for which $x^{12} - x^9 + x^4 - x + 1 > 0$ is

(a) $-4 < x \le 0$ (b) $0 < x < 1$ (c) $-100 < x < 100$ (d) $-\infty < x < \infty$

66. If α, β, γ are such that $\alpha + \beta + \gamma = 2$, $\alpha^2 + \beta^2 + \gamma^2 = 6$, $\alpha^3 + \beta^3 + \gamma^3 = 8$, then $\alpha^4 + \beta^4 + \gamma^4$ is

(a) 18 (b) 10 (c) 15 (d) 36

67. The number of real solutions of the equation $(9/10)^x = -3 + x - x^2$ is

(a) 2 (b) 0 (c) 1 (d) none of these

68. For $x^2-(a+3)|x|+4=0$ to have real solutions, the range of a is

(a) $(-\infty,-7]\cup[1,\in)$ (b) $(-3,\infty)$ (c) $(-\infty,-7]$ (d) $[1,\infty)$

69. If $x^2+x+1=0,$ then the value of $(x+1/x)^2+(x^2+1/x^2)^2+.....+(x^{27}+1/x^{27})^2$ is

(a) 27 (b) 72 (c) 45 (d) 54

70. If $\left|\frac{z_1}{z_2}\right|=1$ and $\arg(z_1z_2)=0,$ then

(a) $z_1=z_2$ (b) $|z_2|^2=z_1z_2$ (c) $z_1z_2=1$ (d) none of these

71. If z_1,z_2,z_3 are three complex numbers and $A=\begin{vmatrix}\arg z_1 & \arg z_2 & \arg z_3\\ \arg z_2 & \arg z_3 & \arg z_1\\ \arg z_3 & \arg z_1 & \arg z_2\end{vmatrix}$ then A is divisible by

(a) $\arg(z_1+z_2+z_3)$ (b) $\arg(z_1z_2z_3)$ (c) all numbers (d) cannot say

72. If z_1 and z_2 are the complex roots of the equation $(x-3)^3+1=0,$ then z_1+z_2 equals to

(a) 1 (b) 3 (c) 5 (d) 7

73. 1, $z_1,z_2,z_3,....z_{n-1}$ are the nth roots of unity, then the value of $1/(3-z_1)+1/(3-z_2)+....+1/(3-z_{n-1})$ is equal to

(a) $\frac{n3^{n-1}}{3^n-1}+\frac{1}{2}$ (b) $\frac{n3^{n-1}}{3^n-1}-1$ (c) $\frac{n3^{n-1}}{3^n-1}+1$ (d) none of these

74. The locus of point z satisfying $\text{Re}\left(\frac{1}{z}\right)=k,$ where k is a nonzero real numbers, is

(a) a straight line (b) a circle (c) an ellipse (d) a hyperbola

75. Roots of the equations are $(z+1)^5=(z-1)^5$ are

(a) $\pm i\tan\left(\frac{\pi}{5}\right),\pm i\tan\left(\frac{2\pi}{5}\right)$ (b) $\pm i\cot\left(\frac{\pi}{5}\right),\pm i\cot\left(\frac{2\pi}{5}\right)$

(c) $\pm i\cot\left(\frac{\pi}{5}\right),\pm i\tan\left(\frac{2\pi}{5}\right)$ (d) none of these

76. The coefficient of $1/x$ in the expansion of $(1+x)^n(1+1/x)^n$ is

(a) $\frac{n!}{(n-1)!(n+1)!}$ (b) $\frac{(2n)!}{(n-1)!(n+1)!}$ (c) $\frac{(2n)!}{(2n-1)!(2n+1)!}$ (d) none of these

77. The last two digit of the numbers 3^{400} are

(a) 81 (b) 43 (c) 29 (d) 01

78. If the last term in the binomial expansion of $\left(2^{1/3}-\frac{1}{\sqrt{2}}\right)^n$ is $\left(\frac{1}{3^{5/3}}\right)^{\log_3 8}$, then the 5th term from the beginning is

(a) 210 (b) 420 (c) 105 (d) none of these

79. The number of distinct terms in the expansion of $\left(x+\frac{1}{x}+x^2+\frac{1}{x^2}\right)^{15}$ is/are (with respect to different power of x)

(a) 255 (b) 61 (c) 127 (d) none of these

80. The fractional part of $2^{4n}/15$ is $(n\in N)$

(a) $\frac{1}{15}$ (b) $\frac{2}{15}$ (c) $\frac{4}{15}$ (d) none of these

81. The value of $\sum_{r=1}^{15}\frac{r2^r}{(r+2)!}$ is equal to

(a) $\frac{(17)!-12^{16}}{(17)!}$ (b) $\frac{(18)!-2^{17}}{(18)!}$ (c) $\frac{(16)!-2^{15}}{(16)!}$ (d) $\frac{(15)!-2^{14}}{(15)!}$

82. The value of $\sum_{r=1}^{n}(-1)^{r+1}\frac{{}^nC_r}{r+1}$ is equal to

(a) $-\frac{1}{n+1}$ (b) $-\frac{1}{n}$ (c) $\frac{1}{n+1}$ (d) $\frac{n}{n+1}$

83. If $A(\alpha,\beta)=\begin{bmatrix}\cos\alpha & \sin\alpha & 0\\ -\sin\alpha & \cos\alpha & 0\\ 0 & 0 & e^{\beta}\end{bmatrix}$, then $A(\alpha,\beta)^{-1}$ is equal to

(a) $A(-\alpha,-\beta)$ (b) $A(-\alpha,\beta)$ (c) $A(\alpha,-\beta)$ (d) $A(\alpha,\beta)$

84. If A and B are square matrices of the same order and A is nonsingular, then for a positive integer $n, \left(A^{-1}BA\right)^{n}$ is equal to

(a) $A^{-n}B^{n}A^{n}$ (b) $A^{n}B^{n}A^{-n}$ (c) $A^{-1}B^{n}A$ (d) $n\left(A^{-1}BA\right)$

85. If $A^2-A+I=0$, then the inverse of A is

(a) A^{-2} (b) $A+I$ (c) $I-A$ (d) $A-I$

86. If $k\in R_0$, then $\det\left\{adj\left(kI_n\right)\right\}$ is equal to

(a) k^{n-1} (b) $k^{n(n-1)}$ (c) k^{n} (d) k

87. When the determinant $\begin{vmatrix}\cos 2x & \sin^2 x & \cos 4x\\ \sin^2 x & \cos 2x & \cos^2 x\\ \cos 4x & \cos^2 x & \cos 2x\end{vmatrix}$ is expanded in powers of $\sin x$, then the constant term in that expression is

(a) 1 (b) 0 (c) –1 (d) 2

88. If $\begin{vmatrix}1 & 1 & 1\\ a & b & c\\ a^3 & b^3 & c^3\end{vmatrix}=(a-b)(b-c)(c-a)(a+b+c)$, where a,b,c are all different, then the determinant

$$\begin{vmatrix}1 & 1 & 1\\ (x-a)^2 & (x-b)^2 & (x-c)^2\\ (x-b)(x-c) & (x-c)(x-a) & (x-a)(x-b)\end{vmatrix}$$ vanishes when

(a) $a+b+c=0$ (b) $x=\frac{1}{3}(a+b+c)$ (c) $x=\frac{1}{2}(a+b+c)$ (d) $x=a+b+c$

89. If $\begin{vmatrix} x^n & x^{n+2} & x^{2n} \\ 1 & x^a & a \\ x^{n+5} & x^{a+6} & x^{2n+5} \end{vmatrix} = 0, \forall x \in R,$ where $n \in N,$ then value of a is

(a) n (b) $n-1$ (c) $n+1$ (d) none of these

90. If $\Delta = \begin{vmatrix} 3 & 4 & 5 & x \\ 4 & 5 & 6 & y \\ 5 & 6 & 7 & z \\ x & y & z & 0 \end{vmatrix} = 0,$ then

(a) x, y, z are in A.P. (b) x, y, z are in G. P. (c) x, y, z are in H.P. (d) none of these

SOLUTION OF AITS JEE(MAIN) PART TEST – 5

PHYSICS

1. **(a)**

Using Moseley's law, we get

$$\frac{\lambda_2}{\lambda_1} = \frac{(Z_1 - a)^2}{(Z_2 - a)^2} \quad \lambda_2 = \frac{200 \times (74-1)^2}{(78-1)^2} = 179.76 \text{ Å}$$

2. **(b)**

de-Broglie wavelength is given by

$$\lambda = \frac{h}{\sqrt{3mkT}}$$

$$\therefore \frac{\lambda_{H_2}}{\lambda_{He}} = \sqrt{\frac{m_{He}T_{He}}{m_{H_2}T_{H_2}}} = \sqrt{\frac{8}{3}}$$

3. **(a)**

$$K = eV,\ r = \frac{\sqrt{2mK}}{eB} = \sqrt{\frac{2meV}{e^2B^2}} = \sqrt{\frac{2mV}{eB^2}}$$

4. **(c)**

$$\frac{hc}{\lambda} = Rhc\left(1 - \frac{1}{n^2}\right) \quad n = \sqrt{\frac{\lambda R}{\lambda R - 1}}$$

5. **(a)**

$$r = \frac{\sqrt{2mK}}{qB} \Rightarrow K \propto \frac{q^2}{m} \Rightarrow \frac{K_p}{K_\alpha} = \left(\frac{q_p}{q_\alpha}\right)^2 \times \frac{m_\alpha}{m_p} \Rightarrow \frac{K_p}{K_\alpha} = \left(\frac{q_p}{2q_p}\right)^2 \times \frac{4m_p}{m_p} = 1 \Rightarrow K_\alpha = 1 \text{ MeV}$$

6. **(c)**

For emission of photon corresponding to the target wavelength the transition of electron will be from $n = 3$ to $n = 2$.

Hence after collision of electron with the hydrogen atom, the hydrogen atom will have excited to the state whose quantum number n is at least equal to 3.

Minimum energy of colliding electron $= 13.6\left(\frac{1}{1^2} - \frac{1}{3^2}\right) = 12.09\,\text{eV}$

7. **(d)**

Equivalent current, $I = ne$

Area = πr^2

Magnetic moment = $\pi n e r^2$

8. **(a)**

$$E = \frac{F}{e} = \frac{-dV}{dr} = -\frac{V_0}{r},\ |F| = \frac{V_0 e}{r} = \frac{mv^2}{r} \Rightarrow v \propto r^0,\ v = \sqrt{\frac{v_0 e}{m}},\ mvr_n = \frac{nh}{2\pi}$$

Velocity is constant hence $r_n \propto n$

9. **(a)**

10. **(b)**

$$\frac{1}{\lambda_\alpha} = (Z-b)^2 R\left[\frac{1}{1^2} - \frac{1}{2^2}\right];\ \frac{1}{\lambda_\beta} = (Z-b)^2 R\left[\frac{1}{1^2} - \frac{1}{3^2}\right]$$

$$\frac{\lambda_\beta}{\lambda_\alpha} = \frac{1-\frac{1}{4}}{1-\frac{1}{9}} = \frac{27}{32}\quad \lambda_\beta = \frac{27}{32}\lambda_\alpha = \frac{27}{32}\times(0.32\text{ Å}) = 0.27\text{ Å}$$

11. **(c)**

$$r_n = n^2 r_0,\ 4.77 = 0.53n^2 \Rightarrow n = 3$$

so change in angular momentum $= \frac{(3-1)h}{2\pi} = 2.11\times10^{-34}\text{ kg } m^2/\text{sec} = 2.11\times10^{-27}\ gcm^2/\text{sec}$

12. **(b)**

As $\lambda = \lambda_1 + \lambda_2$

$$T = \frac{T_1 T_2}{T_1 + T_2} = \frac{20\times100}{20+100} = \frac{200}{12} = \frac{50}{3}\text{ yrs also, } \frac{N}{N_0} = \left(\frac{1}{2}\right)^{\frac{t}{T}} \Rightarrow \frac{1}{8} = \left(\frac{1}{2}\right)^{\frac{t}{T}}$$

$$\Rightarrow \frac{t}{T} = 3 \Rightarrow t = 3T = \frac{50\times3}{3} = 50\text{ yrs}$$

13. **(a)**

$\lambda_B = 2\lambda_A \Rightarrow 4T_B = T_A$

$T_B = T_A - 1.5$

$T_B = 0.5$ eV

$T_A = 2$ eV

$\therefore \phi_A = 2.25$ eV and $\phi_B = 4.2$ eV

14. **(b)**

Energy of the H-atom in first excited state = –3.4 eV

Initial energy of the electron = 2 eV

Energy released = 2 – (–3.4) eV = 5.4 eV

Work function of the metal = $\frac{12420}{4600} = 2.7$ eV

$K_{max} = 5.4 - 2.7 = 2.7$ eV

15. **(d)**

16. **(a)**

$$F = -\frac{dU}{dr} = -\frac{k}{r}, \frac{k}{r} = \frac{mv^2}{r} \quad \text{..... (i)}$$

$$E_n = \frac{1}{2}mv^2 + k\ln r \quad \text{..... (ii)}$$

$$mvr = \frac{nh}{2\pi} \quad \text{..... (iii)}$$

Solving these $E_n = \frac{k}{2}\left(1 + \ln\left(\frac{n^2h^2}{4\pi^2 mk}\right)\right)$

required ratio = $\frac{E_2 - E_1}{E_4 - E_2} = 1$

17. **(a)**

When connected in parallel the current will be in the same direction and when connected in series the current will be in the opposite direction.

18. **(a)**

Magnetic field could the zero in 1st or 3rd quadrant.

$$\frac{\mu_0 I_1}{2\pi x} = \frac{\mu_0 I_2}{2\pi y} \text{ or } I_1 = \frac{x}{y} I_2$$

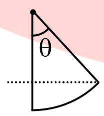
19. **(d)**

$$B_{\text{centre}} = \frac{N.\mu_0 I}{2R}, \quad B_{\text{centre}} \propto \frac{NI}{R}$$

$$B = \frac{\mu_0 i}{2r}, \quad B' = n\frac{\mu_0 i}{2\left(\frac{r}{n}\right)} = n^2 B$$

20. **(b)**

$$\sin\theta = \frac{\frac{mv}{\sqrt{2}qB}}{\frac{mv}{qB}} = \frac{1}{\sqrt{2}}$$



$\Rightarrow \theta = 45°$

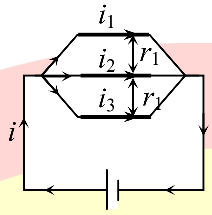
$$t = \frac{T}{8} = \frac{\pi m}{4qB}$$

21. **(b)**

$\vec{F}_m = 2[4(-\hat{j}) \times 4(-\hat{k})] = \vec{F}_m = 32\hat{i}$

22. **(c)**

$i_1 = \frac{k}{3};\ i_2 = \frac{k}{4};\ i_3 = \frac{k}{5}$



$$\frac{\mu_0 i_1 i_2}{2\pi r_1} = \frac{\mu_0 i_2 i_3}{2\pi r_2}$$

$$\therefore\ \frac{r_1}{r_2} = \frac{i_1}{i_3} = \frac{5}{3}$$

23. **(a)**

By work energy theorem

$$mgz + BIlz - \int 2k(x+z)dz = 0$$

$2mgz = 2k\left[\int_0^z x\,dz + \int_0^z z\,dz\right]$ (where x is elongation in the equilibrium position)

$$2mg = mg + kz$$

$$z = \frac{mg}{k} = \frac{BIl}{k}$$

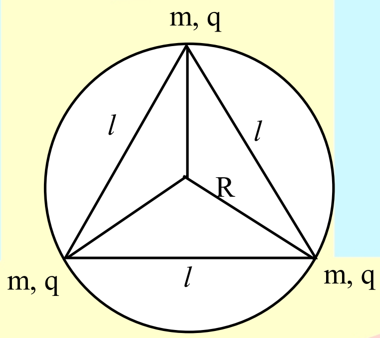
24. **(d)**

$$\frac{\mu_0 i R^2}{2(R^2+x^2)^{3/2}} = \frac{1}{\sqrt{8}}\frac{\mu_0 i}{2R},\quad (R^2+x^2)^{3/2} = R^3\sqrt{8}$$

$$(R^2+x^2)^3 = 8R^6,\ R^2+x^2 = 2R^2,\ x = \pm R$$

25. **(a)**

$$R = \frac{l}{\sqrt{3}}\quad i = \frac{3q}{\frac{2\pi}{\omega}} = \frac{3q\omega}{2\pi}$$



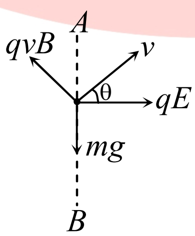
$$\mu_{magnetic} = \frac{3q\omega}{2\pi}.\pi R^2 = \frac{3q\omega R^2}{2}$$

Angular momentum $= (3m)R^2\omega$

$$\frac{\text{Magnetic moment}}{\text{Angular momentum}} = \frac{\mathbf{q}}{\mathbf{2m}}$$

26. **(b)**

When crosses AB



$$qvB_0 \cos\theta = mg$$

$$qvB_0 \sin\theta = qE$$

$$\tan\theta = \frac{qE}{mg} = 1$$

$$\theta = \frac{\pi}{4}$$

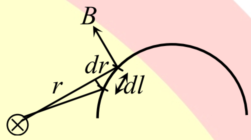
along horizontal $v\cos\theta = \frac{qE}{m}t_0$

$$u - gt_0 = v\sin\theta$$

$$u = \left(g + \frac{qE}{m}\right)t_0 = 2gt_0$$

27. **(a)**

Magnetic field at a distance r from the wire will be



$$B = \frac{\mu_0}{2\pi}\frac{i_1}{r}$$

force on the small element of length dl on semicircular wire is

$$dF = i_2\, d\vec{l} \times \vec{B} = i_2(dl_\perp)B = i_2 B\, dr \quad (\because dl_\perp = dr)$$

$$F = \int_R^{3R} i_2\, B\, dr = \frac{\mu_0}{2\pi} i_1 i_2 \ln 3$$

28. **(a)**

Electrostatics force on $q = \frac{\lambda q}{2\pi\varepsilon_0 r}$ away from line charge

Magnetic force = $\frac{\mu_0 \lambda v}{2\pi r} \times q \times v$ away from line charge

$\therefore$ total force = $\frac{\lambda q}{2\pi r}\left[\frac{1}{\varepsilon_0} + \mu_0 v^2\right]$

29. **(a)**

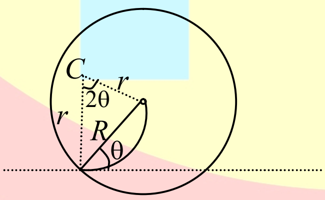
Magnetic moment vectors of three bar magnets represent three side of a triangle taken in order.

30. **(b)**

$$r = \frac{R}{2\sin\theta}$$

$$\frac{mv_0}{qB} = \frac{R}{2\sin\theta}$$

$$v_0 = \frac{qBR}{2m\sin\theta}$$



CHEMISTRY

31. **(a)**	32. **(c)**	33. **(c)**	34. **(a)**
35. **(d)**	36. **(c)**	37. **(b)**	38. **(c)**
39. **(d)**	40. **(a)**	41. **(a)**	42. **(a)**
43. **(c)**	44. **(a)**	45. **(a)**	46. **(a)**

47. **(c)**

48. **(b)**

It contains different types of amino acids.

49. **(a)** 50. **(b)** 51. **(d)** 52. **(a)**

53. **(d)** 54. **(c)** 55. **(c)** 56. **(a)**

57. **(b)**

Si — H bond energy is 393 kJ/mol

Whereas C — H bond energy is 435 kJ/mol

$D_{C-C} \backsimeq 340$ kJ/mol & $D_{Si-Si} = 368$ kJ/mol

C — C and Si — Si bond energies are comparable

58. **(c)** 59. **(c)** 60. **(d)**

MATHS

61. **(a)**

Given that $x^2 + px + 1$ is a factor of $ax^3 + bx + c$. Then let $ax^3 + bx + c = (x^2 + px + 1)(ax + \lambda)$, where λ is a constant. Then equating the coefficients of like powers of x on both sides, we get

$0 = ap + \lambda,\ b = p\lambda + a,\ c = \lambda$

$\Rightarrow p = -\frac{\lambda}{a} = -\frac{c}{a}$

Hence, $b = \left(-\frac{c}{a}\right)c + a$ or $ab = a^2 - c^2$

62. **(a)**

$(a-1)x^2 + ax + \sqrt{1-a^2} = 0$

$\therefore\ D = a^2 - 4(a-1)\sqrt{1-a^2}$

$= a^2 - 4a\sqrt{1-a^2} + 4\sqrt{1-a^2}$

$= \left(a - 2\sqrt{1-a^2}\right)^2 + 4\sqrt{1-a^2}\left(1 - \sqrt{1-a^2}\right)$

> 0 for $a \in (-1, 1)$

63. **(b)**

$a = \frac{(2x+1)^2}{(x-3)^2} + b\frac{(2x+1)}{(x-3)} + c = 0$

$\Rightarrow \frac{2x+1}{x-3} = \alpha$ or $\frac{2x+1}{x-3} = \beta$

or $2x + 1 = \alpha x - 3\alpha$ or $x(\alpha - 2) = 1 + 3\alpha$ or $x = \frac{1+3\alpha}{\alpha-2}, \frac{1+3\beta}{\beta-2}$

64. **(b)**

Given equation are

$x^3 + ax + 1 = 0$

or $x^4 + ax^2 + x = 0$ ...... (i)

or $x^4 + ax^2 + 1 = 0$ ...... (ii)

From (i) – (ii), we get $x = 1$. Thus $x = 1$ is the common roots. Hence,

$1 + a + 1 = 0 \Rightarrow a = -2$

65. **(d)**

66. **(a)**

67. **(b)**

Let $f(x) = -3 + x - x^2$. Then $f(x) < 0$ for all x because coefficient of x^2 is less than 0 and $D < 0$. Thus L.H.S. of the given equation is always is positive, whereas the R.H.S. is always less than zero. Hence, there is no solution.

68. **(d)**

$$a = \frac{x^2 + 4}{|x|} - 3$$

$$= |x| + \frac{4}{|x|} - 3 = \left(\sqrt{|x|} - \frac{2}{\sqrt{|x|}}\right)^2 + 1 \Rightarrow a \ge 1$$

69. **(d)**

70. **(b)**

71. **(b)**

If z_1, z_2, z_3 are three complex numbers, then

$$A = \begin{vmatrix} \arg z_1 & \arg z_2 & \arg z_3 \\ \arg z_2 & \arg z_3 & \arg z_1 \\ \arg z_3 & \arg z_1 & \arg z_2 \end{vmatrix} = (\arg z_1 + \arg z_2 + \arg z_3)\begin{vmatrix} 1 & \arg z_2 & \arg z_3 \\ 1 & \arg z_3 & \arg z_1 \\ 1 & \arg z_1 & \arg z_2 \end{vmatrix} \text{(Using } C_1 \to C_1 + C_2 + C_3\text{)}$$

$$= \arg(z_1 z_2 z_3)\begin{vmatrix} 1 & \arg z_2 & \arg z_3 \\ 1 & \arg z_3 & \arg z_1 \\ 1 & \arg z_1 & \arg z_2 \end{vmatrix}$$

Hence, A is divisible by arg $(z_1 z_2 z_3)$

72. **(d)**

$(x-3)^3 + 1 = 0$

$$\Rightarrow \left(\frac{x-3}{-1}\right)^3 = 1$$

$$\Rightarrow \frac{x-3}{-1} = 1, \omega, \omega^2 \Rightarrow x = 2, 3-\omega, 3-\omega^2$$

73. **(d)**

74. **(b)**

Let $z = x + iy$, then,

$$\text{Re}\left(\frac{1}{z}\right) = k$$

$$\Rightarrow \text{Re}\left(\frac{1}{x+iy}\right) = k \Rightarrow \text{Re}\left(\frac{x}{x^2+y^2} - \frac{iy}{x^2+y^2}\right) = k \Rightarrow \frac{x}{x^2+y^2} = k \Rightarrow x^2 + y^2 - \frac{1}{k}x = 0$$

which is a circle.

75. **(b)**

For $z \neq 1$, the given equation can be written as

$$\left(\frac{x+1}{z-1}\right)^5 = 1 \Rightarrow \frac{z+1}{z-1} = e^{2k\pi i/5}$$

where $k = -2, -1, 1, 2.$

If we denote this value of z by $z_{k,}$ then

$$z_k = \frac{e^{2k\pi i/5} + 1}{e^{2k\pi i/5} - e^{-k\pi i/5}} = -i\cot\left(\frac{k\pi}{5}\right), k = -2, -1, 1, 2$$

Therefore, roots of the equation are

$\pm i\cot(\pi/5), \pm i\cot(2\pi/5).$

76. **(b)**

$$\text{Coefficient of } x^{-1} \text{ in } (1+x)^n\left(1+\frac{1}{x}\right)^n = \text{Coefficient of } x^{-1} \text{ in } \frac{(1+x)^{2n}}{x^n}$$

$$= \text{ Coefficient of } x^{n-1} \text{ in } (1+x)^{2n} = {}^{2n}C_{n-1} = \frac{(2n)!}{(n-1)!(n+1)!}$$

77. **(d)**

$$3^{400} = 81100 = (1+80)^{100} = {}^{100}C_0 + {}^{100}C_1 80 + ... + {}^{100}C_{100} 80^{100}$$

Thus, the last two digits are 01.

78. **(a)**

79. **(b)**

$$\left(x + \frac{1}{x} + x^2 + \frac{1}{x^2}\right)^{15} = \left(\frac{x^3 + x + x^4 + 1}{x^2}\right)^{15} = \frac{a_0 + a_1 x + a_2 x^2 + ... + a_{60} x^{60}}{x^{30}}$$

80. **(a)**

$$\frac{2^{4n}}{15} = \frac{(15+1)^n}{15} = \frac{\left({}^nC_0 15^n + {}^nC_1 15^{n-1} + ... + {}^nC_{n-1} 15 + {}^nC_n\right)}{15} = \text{Integer } + \frac{1}{15}$$

Hence, the fractional part of $\frac{2^{4n}}{15}$ is $\frac{1}{15}$.

81. **(a)**

$$\frac{r\times 2^r}{(r+2)!}=\frac{(r+2-2)2^r}{(r+2)!}=\frac{2^r}{(r+1)!}-\frac{2^{r+1}}{(r+2)!}$$

$$=-\left(\frac{2^{r+1}}{(r+2)!}-\frac{2^r}{(r+1)!}\right)=-\left(V(r)-V(r-1)\right)$$

$$\Rightarrow\sum_{r=1}^{15}\frac{r\times 2^r}{(r+2)!}=-\left(V(15)-V(0)\right)=-\left(\frac{2^{16}}{17!}-\frac{2}{2!}\right)=1-\frac{2^{16}}{(17)!}$$

82. **(d)**

$$\sum_{r=1}^{n}(-1)^{r+1}\frac{{}^nC_r}{(r+1)}=\frac{1}{n+1}\sum_{r=1}^{n}(-1)^{r+1}\ {}^{n+1}C_{r+1}$$

$$=\frac{1}{n+1}\left(0-1+(n+1)\right)=\frac{n}{n+1}$$

83. **(a)**

We have,

$$A(\alpha,\beta)^{-1}=\frac{1}{e^{\beta}}\begin{bmatrix}e^{\beta}\cos\alpha & -e^{\beta}\sin\alpha & 0\\ e^{\beta}\sin\alpha & e^{\beta}\cos\alpha & 0\\ 0 & 0 & 1\end{bmatrix}=A(-\alpha,-\beta)$$

84. **(c)**

85. **(c)**

$A^2-A+I=0$

or $I=A-A^2$

$IA^{-1}=AA^{-1}-A^2A^{-1}\ \Rightarrow\ A^{-1}=I-A$

86. **(b)**

$(kI_n)\,adj\,(kI_n)=|KI_n|I_n$ [Using $A(adj\ A)=|A|I$]

$adj\,(kI_n)=K^{n-1}I_n$

$|adj\,(kI_n)|=k^{n(n-1)}$

87. (c)

$$f(x)=\begin{vmatrix}1-2\sin^2 x & \sin^2 x & 1-8\sin^2 x(1-\sin^2 x)\\ \sin^2 x & 1-2\sin^2 x & 1-\sin^2 x\\ 1-8\sin^2 x(1-\sin^2 x) & 1-\sin^2 x & 1-2\sin^2 x\end{vmatrix}$$ The required constant term is

$$f(0)=\begin{vmatrix}1&0&1\\0&1&1\\1&1&1\end{vmatrix}=\begin{vmatrix}1&0&0\\0&1&1\\1&1&0\end{vmatrix}=1(0-1)=-1$$

88. **(b)**

89. **(c)**

Taking x^5 common from last row, we get

$$x^5\begin{vmatrix} x^n & x^{n+2} & x^{2n} \\ 1 & x^a & a \\ x^n & x^{a+1} & x^{2n} \end{vmatrix} = 0, \forall x \in R \Rightarrow a+1 = n+2 \text{ or } a = n+1$$

(as it will makes first and third row identical)

90. **(a)**

Applying $R_2 \to R_1 + R_3 - 2R_2$, we get

$$\Delta = \begin{vmatrix} 0 & 0 & 0 & x+z-2y \\ 4 & 5 & 6 & y \\ 5 & 6 & 7 & z \\ x & y & z & 0 \end{vmatrix} = -(x+z-2y)\begin{vmatrix} 4 & 5 & 6 \\ 5 & 6 & 7 \\ x & y & z \end{vmatrix} \quad [\text{Expanding along } R_1]$$

$$= -(x+z-2y)\begin{vmatrix} 0 & -1 & 6 \\ 0 & -1 & 7 \\ x-2y+z & y-z & z \end{vmatrix}$$

[Applying $C_1 \to C_1 + C_3 - 2C_2$ and $C_2 \to C_2 - C_3$]

$$= -(x+z-2y)^2\begin{vmatrix} -1 & 6 \\ -1 & 7 \end{vmatrix}$$

$$= (x-2y+z)^2$$

Hence, $\Delta = 0 \Rightarrow x, y, z$ are in A.P.