JEE MAIN 2026

Sample Paper – 4

Time Allowed: 3 hours **Maximum Marks:** 300

General Instructions:

1. The test consists of total **75 questions.**

2. Each subject **(PCM)** has **25 questions.**

3. Each subject divided into two sections. **Section A** consists of 20 multiple-choice questions & **Section B** consists of 5 numerical value-type questions.

4. Marking Scheme:

- **Section A (MCQs):** +4 marks for each correct answer, –1 mark for each incorrect answer, 0 marks for unattempted.
- **Section B (Numerical):** +4 marks for each correct answer, 0 marks for incorrect or unattempted.

5. Any textual, printed, or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.

6. All calculations/written work should be done in the rough sheet is provided with the Question Paper.

Physics

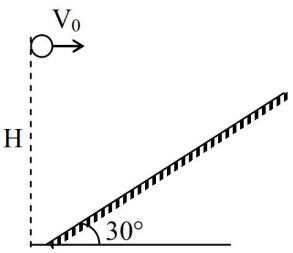
PART – A

SECTION – A

(Single Choice Answer Type)

This section contains **20 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. In the given figure, the angle of inclination of the inclined plane is 30°. A particle is projected horizontally from a height H above the foot of the inclined plane. Find the horizontal velocity V_0 so that the particle will retrace the path after hitting the inclined plane. Collision is perfectly elastic.

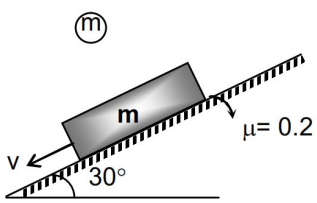


(A) $v_0 = \sqrt{\frac{2gH}{5}}$ (B) $v_0 = \sqrt{\frac{2gH}{7}}$

(C) $v_0 = \sqrt{\frac{gH}{5}}$ (D) $v_0 = \sqrt{\frac{gH}{7}}$

2. A signal of frequency 25 KHz and peak voltage 20 V is used to modulate a carrier wave of frequency 1.5 MHz and peak voltage 50 V. Choose the correct statement.
(A) Modulation index is 0.4, side frequency bands are 1475 KHz and 1525 KHz
(B) Modulation index is 0.4, side frequency bands are 2950 KHz and 3150 KHz
(C) Modulation index is 2.5, side frequency bands are 1475 KHz and 1575 KHz
(D) Modulation index is 2.5, side frequency bands are 2950 KHz and 3150 KHz

3. A ball of mass m falls vertically from a height h = $\frac{20}{3}$m and collides with a block of equal mass m moving down an inclined plane with a velocity v as shown in the figure. The coefficient of kinetic friction between the block and the surface is 0.2, while the coefficient of restitution (e) between the ball and the block is 0.5. Three is no friction acting between the ball and the block. The velocity of the block decreases by



(A) 5 m/s (B) 0
(C) 1 m/s (D) 3 m/s

4. Air column in an open organ pipe of length ℓ = 30 cm resonates with a sonic source emitting wave of frequency f = 1100H_Z. If maximum pressure variation in the pipe over the atmospheric pressure due to standing wave is 0.1 P_0, where P_0 is the atmospheric pressure. Find the difference of the maximum and minimum pressure in the tube at a distance 5 cm from the open end. Take speed of sound in air equal to 330 m/s and ignore the end correction.

(A) $\frac{\sqrt{3}}{20}P_0$ (B) $\frac{\sqrt{3}}{10}P_0$

(C) $\sqrt{3}P_0$ (D) $2P_0$

5. At time t = 0, a horizontal disc starts rotating with angular acceleration 1 rad/sec^2 about an axis perpendicular to its plane and passing though its center. A small block is lying on this disc at a distance 0.5 m from center, coefficient of friction between surface of block and disc is 0.255. The block will start slipping on the disc at time t, is approximately equal to

(A) $2\sqrt{3}$ s (B) $2\sqrt{2}$ s

(C) 6 s (D) $\sqrt{5}$ s

6. A thin spherical conducting shell of radius R has a charge q. Another charge Q is placed at the centre of the shell. Calculate electrostatic potential at a point P a distance R/2 from the centre of the shell.

(A) $\frac{2Q}{2\pi\varepsilon_0 R}-\frac{2q}{4\pi\varepsilon_o R}$ (B) $\frac{Q}{2\pi\varepsilon_0 R}+\frac{q}{4\pi\varepsilon_o R}$

(C) $\frac{(q+Q)}{2\pi\varepsilon_0}\frac{2}{R}$ (D) $\frac{2Q}{2\pi\varepsilon_0 R}$

7. An ammeter reads upto 1 ampere. Its internal resistance is 0.81 ohm. To increase the range to 10A the value of the required shunt is –

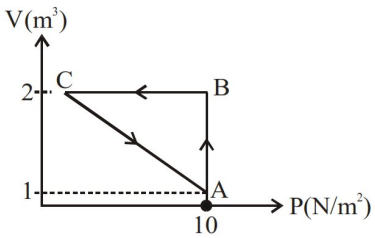
(A) 0.3 Ω (B) 0.9 Ω

(C) 0.09 Ω (D) 0.30 Ω

8. An ideal gas is taken through a cycle A → B → C → A as shown in figure. If the heat supplied in the cycle is 5J, then work done on the gas in the process C → A is in joules is

(A) –5J (B) –10J

(C) –15J (D) –20J



9. A space vehicle approaching a planet has a speed v, when it is very far from the planet. At that moment tangent of its trajectory would miss the centre of the planet by distance R. If the planet has mass M and radius r, what is the value of R in order that the resulting orbit of the space vehicle will just miss the surface of the planet ?

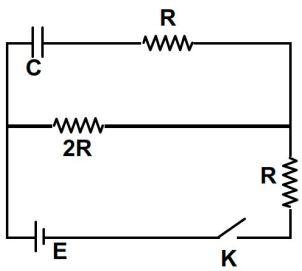
(A) $R=\frac{r}{v}\left[v^2+\frac{2GM}{r}\right]^{1/2}$ (B) $R=vr\left[1+\frac{2GM}{r}\right]$

(C) $R=\frac{r}{v}\left[v^2+\frac{2GM}{r}\right]$ (D) $R=\frac{2GMv}{r}$

10. In the given circuit, the capacitor of capacitance C is charged by closing key K at t = 0. Find the time required to charge the capacitor up to maximum charge for the given circuit, if it were to be charged with the constant initial charging rate at t = 0 in the given circuit.

(A) RC/3 (B) 2RC/3

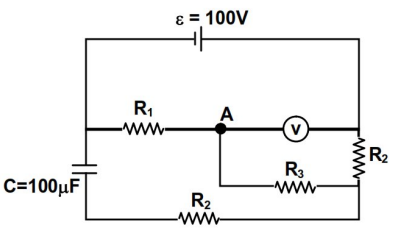
(C) 2RC/3 (D) 5RC/3



11. In the circuit shown in figure E is a battery of emf 100 V. Resistance R_1 = 100Ω, R_2 = 200Ω, R_3 = 200Ω. The voltmeter resistance is 200Ω. What reading will the voltmeter show in steady state ?

(A) 50/3 V (B) 400/7 V

(C) 100/3 V (D) 50 V



12. A ray of light travelling in a medium of refractive index μ is incident at an angle θ on a composite transparent plate consisting of 50 plates of refractive indices 1.01μ, 1.02μ, 1.03μ.....1.50μ. The ray emerges from the composite plate into a medium of refractive index 1.6μ at angle x. Then

(A) $\sin x = \left(\frac{1.01}{1.5}\right)^{50} \sin\theta$

(B) $\sin x = \frac{5}{8}\sin\theta$

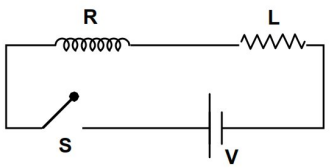
(C) $\sin x = \frac{8}{5}\sin\theta$

(D) $\sin x = \left(\frac{1.5}{1.01}\right)^{50} \sin\theta$

13. The binding energy per nucleon of deuteron $\left({}_1^2H\right)$ and helium nucleus $\left({}_2^4He\right)$ is 1.1 MeV and 7 MeV respectively. If two deuteron nuclei react to form a single helium nucleus, then the energy released is–

(A) 23.6 MeV
(B) 26.9 MeV
(C) 13.9 MeV
(D) 19.2 MeV

14. An inductor of inductance $L = \frac{\tau R}{2}$ and a resistor of resistance R is connected to a battery of emf V as shown in the figure. The potential difference across the resistance at a time, $t = \tau \ln 2$ after the switch S is closed is (τ is constant)



(A) $\frac{V}{4}$

(B) $\frac{3V}{4}$

(C) $\frac{V}{2}$

(D) $\frac{2V}{3}$

15. A resistance R draws P power when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedance of the circuit becomes Z, the power drawn will be

(A) $P\left(\frac{R}{Z}\right)^2$

(B) $P\left(\frac{R}{Z}\right)$

(C) $P\sqrt{\frac{R}{Z}}$

(D) P

16. At STP 44.8 liter of helium gas is confined in a cylindrical vessel by a movable piston. The gas is thermally insulated from surrounding, however, heat is supplied to the gas very slowly by an electric heater consequently piston moves slowly. In this process find the heat supplied to the gas by the heater to increase its temperature by 20°C. Ignore any dissipative force on the piston. (R is universal gas constant)

(A) 200 R
(B) 100 R
(C) 60 R
(D) 140 R

17. Wavelength of K_α X-ray of an element A is λ_1 and wavelength of K_α X-ray element B is λ_2. $\frac{\lambda_1}{\lambda_2}$ is equal to $\frac{1}{4}$ and Z_1 and Z_2 are the atomic numbers of element A and B respectively. Then relation between Z_1 and Z_2 are given by

(A) $2Z_2 - Z_1 = 1$

(B) $Z_2 - 2Z_1 = 1$

(C) $\frac{Z_2}{Z_1} = 4$

(D) $\frac{Z_1}{Z_2} = 4$

18. A radioactive element undergoes two different types of radioactive disintegration, one with disintegration constant λ_1 and the other with λ_2. The half-life of the element is

(A) $\frac{0.693}{\lambda_1+\lambda_2}$ (B) $\frac{0.693}{(\lambda_1+\lambda_2)/2}$

(C) $0.693\frac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$ (D) $\frac{0.693}{2}\frac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$.

19. A photon collides with a stationary hydrogen atom in ground state inelastically. Energy of the colliding photon is 10.2 eV. Almost instantaneously, another photon collides with same hydrogen atom inelastically with an energy of 15 eV. What will be observed by the detector ?

(A) two photons of energy 10.2 eV
(B) two photons of energy 1.4 eV
(C) one photon of energy 10.2 eV and an electron of energy 1.4 eV
(D) one electron having kinetic energy nearly 11.6 eV

20. A uniform string of mass m = 200 g and lengths l = 5m is stretched along x-axis. One end at x = 0 is attached to a harmonic oscillator and the other end is fixed to a rigid support. Tension in the string is T = 1600 N. At the time t = 0, the oscillator starts producing transverse harmonic waves in the string. The y-coordinate of a particle in the string near the source varies with time as y = 0.5 cm sin (100π t), where t is the time in second. Find the y-co-ordinate of the mid point on the string at the instant when first disturbance emitted by the source reaches the fixed end.

(A) $\frac{1}{2\sqrt{2}}$cm (B) $-\frac{1}{2\sqrt{2}}$cm

(C) $\frac{1}{\sqrt{2}}$cm (D) $\frac{1}{2}$cm

SECTION – B
(Numerical Answer Type)

This section contains **5** Numerical based questions. The answer to each question is rounded off to the nearest integer value.

21. An electric lamp designed for operation on 110V AC is connected to a 220 V AC supply, through a choke coil of inductance 2H, for proper operation. The angular frequency of the AC is $100\sqrt{10}$ rad/s. If a capacitor is to be used in place of the choke coil, its capacitance must be (in μF)

22. A cylindrical block of mass m = 200 gm is suspended from a fixed support by a light spring of stiffness k = 90 N/m. The block is slightly pulled down from its equilibrium and then the pulling force is removed. Consequently, the block performs oscillatory motion. If damping constant of air is 40 g/s, the time (in sec) after which displacement amplitude reduces to the half of the initial value is nearly

23. An object is projected with a speed 10 m/s at an angle of 30° with the horizontal. The object breaks down into n equal fragments during its motion. One fragment is found to strike the ground at a distance of $\sqrt{3}$ m from the point of projection in the same azimuthal plane, in which the object is projected. If the centre of mass of the remaining fragments strikes the ground at distance of $7\sqrt{3}$ m from the point of projection, then the value of n is

24. A beam of light converges at a point P. A converging lens of focal length 25 cm is placed in the path of the beam before converging it at P at a distance of 20 cm from the point P. Now locate the point where beam will converge. Find the distance from the position of the lens.

25. All atoms in a sample of helium gas are in the first excited state. Photons emitted from these atoms due to de-excitation are incident on the surface of a metal having work function ϕ = 2.8 eV. Find the stopping potential of the photoelectrons ejected from metal surface. The ionization energy of hydrogen atom is 13.6 eV.

PART – B

SECTION – A

(Single Choice Answer Type)

This section contains **20 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

26. Substance which tends to decompose at their sublimation temperature can preferably purified by sublimation under the following pressure condition
(A) increased pressure
(B) reduced pressure
(C) pressure has no effect on the sublimation temperature of a substance
(D) at atmospheric pressure

27. Liquid A and liquid B form ideal solution. The ratio of the pure vapour pressure of A and B, respectively at 298 K is 1 : 4. Also, the ratio of their masses in liquid phase is 2 : 1. What will be the ratio of their masses in vapour phase?
(A) 1 : 2 (B) 1 : 8
(C) 8 : 1 (D) 2 : 1

28. In which of the following conditions, the electrical conductivity decreases?
(A) ZnO is heated in Zn vapour
(B) NaCl is heated in Na vapour
(C) Silicon is doped with arsenic
(D) Heating metallic conductor

29. Which of the following order is INCORRECT?
(A) $Li < Be < B < C$ (magnitude of effective nuclear charge)
(B) $Li^+ > Na^+ < K^+ < Rb^+$ (ionic radius in aqueous medium)
(C) $N^{3-} > Ne > Mg^{2+} > Al^{3+}$ (ionic radius)
(D) $B > Al < Ga > In$ (first ionization energy)

30. Which of the following orders of given character in the following oxides is CORRECT?
(A) $V_2O_3 < V_2O_4 < V_2O_5$ (basic character)
(B) $CrO < Cr_2O_3 < CrO_3$ (acidic character)
(C) $CO_2 > SO_3 > Cl_2O_7$ (acidic character)
(D) $MgO < CaO > BaO$ (basic character)

31. Which of the following statement about hydrogen peroxide is INCORRECT?
(A) The gas phase bond angles in H_2O_2 is less than that in crystalline phase.
(B) H_2O_2 can be prepared by adding ice-cold dilute H_2SO_4 (20%) on Na_2O_2.
(C) The gas phase O – H bond length is greater than that of in crystalline phase.
(D) The dihedral angle in H_2O_2 in its gas phase is larger than that of bond angle.

32. Electrons in a group of degenerate orbitals can have five Z-components of angular momentum. Which sub-shell does this group of orbitals belong to:
(A) s (B) p
(C) d (D) s + d

33. Two containers containing N_2 and O_2 gases respectively, are present in the same compartment of a train which is moving with 120 km/hr. The volume of first container is twice the size of second one. Find the ratio of the mean square speeds of N_2 gas and O_2 gas, respectively

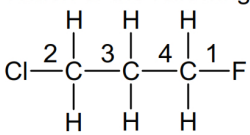
(A) $\frac{8}{7}$ (B) $\frac{7}{8}$

(C) $\frac{1}{2}$ (D) $\frac{2}{1}$

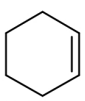
34. He gas and N_2 gas both initially at the same temperature and pressure are compressed adiabatically and reversibly from a volume of V to $\frac{V}{3}$ (Assuming ideal behaviour of both the gases). Which gas will be at higher temperature?

(A) He
(B) N_2
(C) Both remain at same temperature
(D) None of these

35. Which of the following highlighted bond most likely break through homolytic bond cleavage?



(A) 1 (B) 2
(C) 3 (D) 4

36.  $\xrightarrow{\text{Reagent}}$ Product

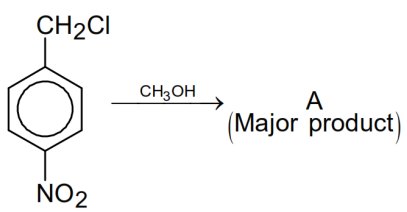
With which reagent, the major product will not be syn addition product?

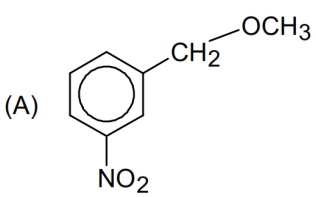
(A) (1) OsO_4, (2) Na_2SO_3, H_2O

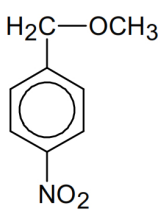
(B) (1) $KMnO_4$, H_2O / OH^- (cold)

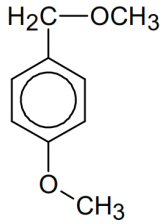
(C) (1) HBr, $(C_6H_5COO)_2$

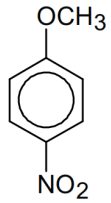
(D) (1) B_2H_6 / THF, (2) H_2O_2 / NaOH

37. 

(A) 

(B) 

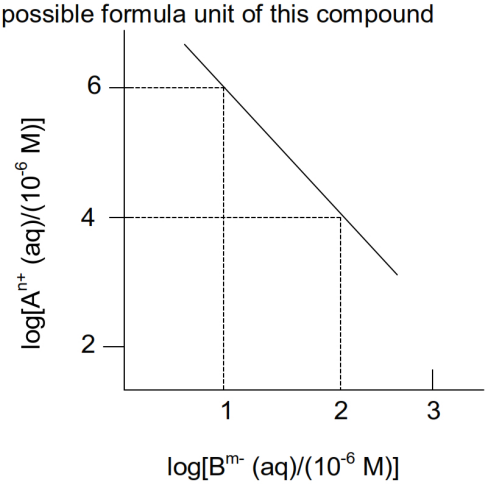
(C) 

(D) 

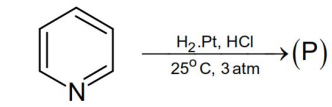
38. Which of the following is CORRECT?
(A) In case of association, value of van't Hoff factor is more than unity while for dissociation it is less than unity.
(B) Solid CO_2 directly sublimes upon heating at atmospheric pressure but it will first liquefy if this heating is done at sufficiently higher pressure.
(C) Even at high pressure solid CO_2 always sublimes upon heating.
(D) When placed in saline water (concentration < 0.9% m/V) blood cells (internal concentration = 0.9% m/V) shrink.

39. In which of the following reactions, the catalyst has been incorrectly marked?
(A) $N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$ (Haber's process)
(B) $4NH_3(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O(g)$ (Ostwald's process)
(C) $2KClO_3 \xrightarrow{MnO_2(s)} 2KCl + 3O_2$
(D) $CH_3COOCH_3(aq) + H_2O(\ell) \xrightarrow{NaOH} CH_3COOH(aq) + CH_3OH(aq)$

40. A sparingly soluble salt A_mB_n shows following relation in its saturated aqueous solution. Find the possible formula unit of this compound



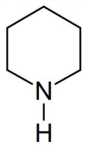
(A) AB
(B) AB_2
(C) A_2B
(D) A_3B

41. 

Pyridine [Q]

Which of the following statement is correct?

(A) Q and P both are aromatic

(B) P is 

(C) P is acyclic amine compound

(D) Q is more basic than P

42. Arrange the following coordination compounds in increasing order of wavelength of light that they absorbed

$[CrCl_6]^{3-}$, $[Cr(H_2O)_6]^{3+}$, $[Cr(NH_3)_6]^{3+}$, $[Cr(CN)_6]^{3-}$

(I) (II) (III) (IV)

(A) I > II > III > IV

(B) IV > II > III > I

(C) I > III > II > IV

(D) IV > III > II > I

43. Order of octahedral ionic radii of M^{2+} for the first row transition elements

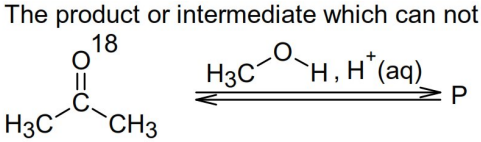
(A) Ca < V < Mn > Zn

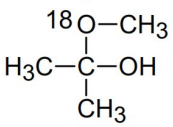
(B) V < Mn > Ni < Zn

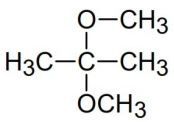
(C) V < Mn < Ni > Zn

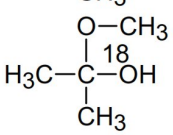
(D) Fe < Co < Ni > Zn

44. The product or intermediate which can not be synthesized from the given reaction



(A) 

(B) 

(C) 

(D) None of these

45. Compound A upon strong heating produces a salt B and a colourless gas C. The gas C is also produced by heating hydrogen peroxide. Aqueous solution of salt B produces white precipitate when aqueous $AgNO_3$ solution is mixed into it. When gas D is passed through hot and concentrated solution of potassium hydroxide, then compound A is formed. In presence of moisture, gas D acts as an oxidizing agent.

Correct option is:

(A) A = KNO_3

(B) A = $KClO_3$

(C) D = O_2

(D) B = NaI

SECTION – B

(Numerical Answer Type)

This section contains **5** Numerical based questions. The answer to each question is rounded off to the nearest integer value.

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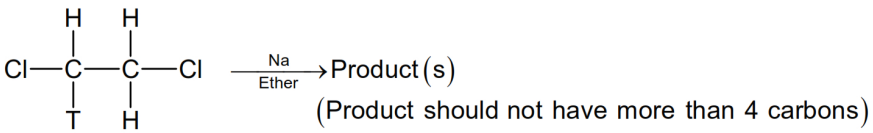
46. Find the total number of bonds in which there is involvement of hybridized orbitals in the following molecules/ions.

CH_4, ClF_3, C_2H_4, C_2H_2, NO_2^+

47. 20 mL of '10 volume' hydrogen peroxide solution upon heating releases that much amount of oxygen at STP which is just sufficient to completely burn 'x mg' of ethene. Find the value of x (to the nearest integer).

48. The total loss in mass (in g) when mixture of 1 mole Li_2CO_3 and 2 moles $Na_2CO_3.10H_2O$ is heated.

49. 

(Product should not have more than 4 carbons)

From all the possible products, how many of them will be chiral?

50. During rusting of iron, iron converted to ferricoxide it has been found that 3.2 kg of iron rust has been formed. How many mole(s) of electrons does iron has given up to form this much rust? (Atomic mass : Fe = 56 u, O = 16 u)

Mathematics

PART – C

SECTION – A

(Single Choice Answer Type)

This section contains **20 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

51. For a data set having 100 observations, mean, median, mode are 50, 60, 70 respectively. If the largest 50 observations are increased by 10, then sum of new mean, median, mode equals
(A) 180 (B) 190
(C) 200 (D) 210

52. Maximum number of compound propositions out of
$p \wedge q \wedge r$, $p \wedge \sim q \wedge r$, $p \wedge q \wedge \sim r$
$\sim p \wedge q \wedge s$, $\sim p \wedge \sim q \wedge s$, $\sim p \wedge \sim q \wedge \sim s$
$q \wedge r \wedge s$, $q \wedge \sim r \wedge s$, $\sim q \wedge \sim r \wedge \sim s$
that can be made simultaneously false by an assignment of the truth values to p, q, r and s, is equal to
(A) 6 (B) 7
(C) 8 (D) 9

53. Let $f(x) = \begin{vmatrix} \cos x & \cos^2 x & \cos^4 x \\ \cos 3x & \cos^2 3x & \cos^4 3x \\ \cos 5x & \cos^2 5x & \cos^4 5x \end{vmatrix}$, then $\int_0^{\pi} f(x)dx$ equals
(A) 9 (B) 18
(C) 27 (D) none of these

54. Let R be a relation defined on first twenty natural numbers such that R = {(a, b) : $\frac{a}{b}$ is a prime number}. Consider the following statements :
(I) R is reflexive and symmetric but not transitive
(II) Range of R^{-1} has 20 elements
(III) Domain of R^{-1} has 10 elements
which of the statements are true ?
(A) I, II, III (B) II, III
(C) II (D) III

55. Value of sin32° sin88° sin152° equals
(A) sin6° (B) $\frac{\sin 6^\circ}{4}$
(C) cos6° (D) $\frac{\cos 6^\circ}{4}$

56. Let α, β be roots of the equation $x^2 - 3x - \sqrt{7} = 0$ and $\alpha^2 + \frac{1}{\beta}$, $\beta^2 + \frac{1}{\alpha}$ be the roots of the equation $x^2 + px + q = 0$, then for the equation $x^2 + p^2q^2x - (11q + p) = 0$, roots are
(A) positive (B) negative
(C) one positive and other negative (D) none of these

57. Let $A = \sum_{i=0}^{2023}\sum_{j=0}^{2023} \min\left\{{}^{2023}C_i, {}^{2023}C_j\right\}$, $B = \sum_{i=0}^{2023}\sum_{j=0}^{2023} \max\left\{{}^{2023}C_i, {}^{2023}C_j\right\}$, then A + B equal

(A) 2024.2^{2023} (B) 2023.2^{2023}

(C) $2024(2^{2023} - 1)$ (D) $2023(2^{2023} - 1)$

58. Let H_L and H_R be two branches of a hyperbola having A, B as endpoints of latus-rectum on H_L. If C be any point on H_R such that $\angle ACB$ is never obtuse, then maximum possible eccentricity of hyperbola is

(A) $\sqrt{2}$ (B) $\sqrt{3}$

(C) 2 (D) 3

59. If chord of contact of pair of tangents from points P and Q on $\frac{x^2}{9}+\frac{y^2}{16}=1$ to the ellipse $\frac{x^2}{3}+\frac{y^2}{4}=1$ is normal to the curve $2x^2 + 2y^2 - 4x - 4y + 1 = 0$, then sum of eccentric angles of P and Q is

(A) $\frac{\pi}{2}$ (B) π

(C) 2π (D) none of these

60. A rectangular hyperbola and ellipse have coincident end points of latus-rectum, then eccentricity of ellipse equals

(A) $\frac{1}{2\sqrt{2}}$ (B) $\frac{1}{\sqrt{2}}$

(C) $\frac{1}{2}$ (D) none of these

61. If $\lim_{x\to 0}\frac{\sin x \sin 2x \sin 3x.....\sin nx - x^n}{x\tan\left((1+x)(1+2x)(1+3x).....(1+2023x)\right)}$ exists and is non-zero, then 'n' equals

(A) 2022 (B) 2023

(C) 2024 (D) no such value of n exists

62. Let $A_k = [a_{ij}]$ be square matrix of order 3 such that $a_{ij} = (i - j)^k$ for all i, j = 1, 2, 3. Then determinant value of $|A_1 + A_3 + A_5 + ... + A_{2023}|$ equals

(A) 3^{4046} (B) 3^{6069}

(C) $3^{6069} - 3^{4046}$ (D) none of these

63. Which of the following functions is differentiable at x = 0 ?

(A) $\left|\tan|x| - \cos|x|\right|$ (B) $\left|\sin|x| - \tan|x|\right|$

(C) $\left|\cos|x| - \sin|x|\right|$ (D) all of these

64. Water is being filled at rate of π cm^3/s in right circular conical vessel (vertex upwards) of height 5cm and diameter 8cm. When the height of water level is 3cm, the rate (in cm^2/s) at which the wet conical surface area of the vessel increases is

(A) $\frac{2\pi}{3}$ (B) $\frac{\sqrt{41}}{12}\pi$

(C) $\frac{\sqrt{41}}{18}\pi$ (D) none of these

65. Let $f(x) = x^7(x^3 + 2x^2 - x - 2) + (x^3 - x)(x + 3) + 2(x^2 - 1)$, then which of the following is **NOT** true?
(A) $y = f(x)$ has 7 critical points
(B) there are exactly 2 points in $(-1, 1)$ where $f'(x) = 0$
(C) $y = f(x)$ does not have an extrema at $x \in I$
(D) $y = f(x)$ has exactly 2 stationary point in $(-2, 1)$

66. Value of $\int_0^1 x^6 \left(x^3 - 1\right)^{2022} dx$ is

(A) $\dfrac{3^{2022}(2022)!}{10.13.16.....6073}$ (B) $\dfrac{3^{2022}(2022)!}{7.10.13.....6073}$

(C) $\dfrac{3^{2022}(2022)!}{4.7.10.....6073}$ (D) none of these

67. If area bounded by an ellipse with its auxiliary circle equals area bounded by its auxiliary circle and director circle, then eccentricity of ellipse equals
(A) $\sqrt{2\sin 18^\circ}$ (B) $\sqrt{2\cos 18^\circ}$
(C) $\sqrt{2\sin 36^\circ}$ (D) $\sqrt{2\cos 36^\circ}$

68. Ajay has to take medicine having 100 mg paracetamol at a gap of every 12 hours. The amount of paracetamol (salt) in Ajay's bloodstream decreases at a rate that is proportional at any time to the amount of salt in bloodstream at that time. If the amount of salt in bloodstream is halved in every 5 hours, then amount of salt in Ajay's bloodstream 15 hours after taking the medicine first time is (in mg)

(A) $100\left(\frac{1}{2}\right)^3$ (B) $100\left(\left(\frac{1}{2}\right)^3 + 1\right)$

(C) $100\left(\left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^{12/5}\right)$ (D) $100\left(\left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^{3/5}\right)$

69. Equation of plane passing through the line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ at minimum possible distance from the point $(-1, -3, 1)$ is
(A) $7x - 2y - 2z + 3 = 0$ (B) $x + 3y + 10 = 0$
(C) $3x + y - z = 2$ (D) none of these

70. $\left[\left(\vec{a}\times\vec{b}\right)\times\left(\vec{b}\times\vec{c}\right)\right]\times\left(\vec{c}\times\vec{a}\right)\cdot\vec{b}$ equal (where $\vec{a},\vec{b},\vec{c}$ are non-coplanar vectors)

(A) $\left[\vec{a}\,\vec{b}\,\vec{c}\right]^2\left|\vec{b}\right|^2$ (B) $\left[\vec{a}\,\vec{b}\,\vec{c}\right]^2\left(\vec{b}\cdot\vec{c}\right)$

(C) $\left[\vec{a}\,\vec{b}\,\vec{c}\right]^2\left(\vec{b}\cdot\vec{a}\right)\left(\vec{c}\cdot\vec{b}\right)$ (D) none of these

SECTION – B

(Numerical Answer Type)

This section contains **5** Numerical based questions. The answer to each question is rounded off to the nearest integer value.

71. Let z_1, z_2, z_3 be represented by A, B, C on Argand plane such that $z_1 = 3 + 3i$, $z_2 = 9-6\sqrt{2}+\left(6\sqrt{2}-3\right)i$ and ΔABC is right angled at C. If minimum and maximum possible value of Argument of z_3 is a, b respectively (Argument of $z_3 \in (-\pi, \pi]$, then $b - a$ is $\frac{\pi}{k}$ where k equals

72. Number of ordered pairs (x, y) satisfying $\frac{4^{\sin x}16^{\sin y}}{\left(1+16^{\sin x}\right)\left(1+256^{\sin y}\right)}=\frac{1}{4}$, $3^{1+\sqrt{\cos^2 x}}+3^{1+\cos y}=10$; x, y $\in [0, 2\pi]$ is

73. Two families each having 4 members are to be seated around a circular table having alternate red and blue chairs. If probability that members of same family are seated together is p, then 35p equals

74. Number of 5-digit natural numbers such that the product of their digits equals number of ways to create a necklace out of 6 beads from 10 distinct beads is

75. Remainder when $(2022)^{2023}$ is divided by 11 is

SOLUTIONS

Physics

PART – A

SECTION – A

1. A

Sol. x-axis along the inclined plane
y-axis perpendicular to the inclined plane.

$$v_{0x} = v_0\cos 30^\circ = v_0\frac{\sqrt{3}}{2},\quad a_x = -g\sin 30^\circ = -\frac{g}{2}$$

$$v_{0y} = v_0\sin 30^\circ = -\frac{v_0}{2},\quad a_y = -g\cos 30^\circ = -g\frac{\sqrt{3}}{2}$$

$$x_0 = 0,\quad y_0 = H\sin 30^\circ = H\frac{\sqrt{3}}{2}$$

When particle reaches the inclined plane, y = 0

$$\Rightarrow 0 = \frac{H\sqrt{3}}{2} - \frac{v_0}{2}t - \frac{1}{2}\frac{g\sqrt{3}}{2}t^2 \qquad \ldots(i)$$

If particle hits the inclined plane at 90°. It will retrace the path for this $v_x = 0$

$$\Rightarrow 0 = \frac{v_0\sqrt{3}}{2} - \frac{g}{2}t$$

$$\Rightarrow t = \frac{v_0\sqrt{3}}{g} \qquad \ldots(ii)$$

$$0 = \frac{H\sqrt{3}}{2} - \frac{v_0}{2}\times\frac{v_0\sqrt{3}}{g} - \frac{1}{2}\times\frac{g\sqrt{3}}{2}\times\frac{v_0^2\times 3}{g^2}$$

$$\Rightarrow v_0 = \sqrt{\frac{2gH}{5}}$$

2. A

Sol. Modulation index = $\frac{A_m}{A_C} = \frac{20}{50} = 0.4$

Side frequency band is $f_C - f_m$ and $f_C + f_m$

3. D

Sol. For the ball along perpendicular to the inclined plane

$\int N dt = mv_0(e+1)$ ...(i) (v_0 = 10 m/s)

For the block along the surface of the inclined plane

$-\int \mu N dt = m(v_f - v_i)$ ...(ii)

$\Rightarrow -\mu \times mv_0(e+1) = m\Delta v$

$\Rightarrow \Delta v = -0.2 \times v_0 \times 1.5 = -3$ m/s

4. B

Sol. $\because \quad f = n\frac{v}{2\ell}$

$\Rightarrow \quad 1100 = n \times \frac{330}{2 \times 30x10^{-2}}$

This shows that air column vibrates in 2nd harmonic. This implies that wavelength $\lambda = \ell = 30$ cm.

$\because \quad \Delta P = 0.1P_0 \sin kx \cos wt.$

x is measured from open end.

At x =5 cm, i.e., at $x = \frac{\lambda}{6}$

$\Delta P = 0.1P_0 \sin\left(\frac{2\pi}{\lambda} \cdot \frac{\lambda}{6}\right)\cos wt$

$\Rightarrow P_{max} - P_{min} = 2 \times 0.1P_0 \cdot \frac{\sqrt{3}}{2}$

$= \sqrt{3} \times 10^4 \, N/m^2$

5. D

Sol. $f_T = m\alpha r$

$f_R = m\omega^2 r = m\alpha^2 t^2 r$

Since $\sqrt{f_T^2 + f_R^2} = \mu mg$

$\Rightarrow m\alpha r\sqrt{1+\alpha^2 t^4} = \mu mg$

$\Rightarrow t = \frac{1}{\sqrt{\alpha}}\left[\left(\frac{\mu g}{\alpha r}\right)^2 - 1\right]^{1/4} = \frac{\left[\left(\frac{0.255 \times 10}{1 \times 0.5}\right)^2 - 1\right]^{1/4}}{\sqrt{\alpha}} = \sqrt{5}$ s

6. B

Sol. $V = \frac{kQ}{\frac{R}{2}} + \frac{kQ}{R} = \frac{Q}{2\pi\varepsilon_0 R} + \frac{Q}{4\pi\varepsilon_0 R}$

7. C

Sol. $1A \times 0.081\ \Omega = 9A \times R$

$\Rightarrow R = 0.09\ \Omega$

8. A

Sol. $\Delta Q_{AB} = \Delta W_{AB} + \Delta U_{AB}$

$= 10 \times + nC_V \frac{10}{nR} = 10 + \frac{10C_V}{R}$

$\Delta Q_{BC} = \Delta W_{BC} + \Delta U_{BC} = 0 + \left(\frac{2P_C - 20}{R}\right)C_V$

$\Delta Q_{CA} = \Delta W_{CA} + \Delta U_{CA} = \Delta W_{CA} + \left(\frac{10 - 2P_C}{R}\right)C_V$

$\Delta Q = \Delta Q_{AB} + \Delta Q_{BC} + \Delta Q_{CA} = 5J$

$\Rightarrow 10 + \frac{10C_V}{R} + \left(\frac{2P_C - 20}{R}\right)C_V + \Delta W_{CA} + \left(\frac{10 - 2P_C}{R}\right)C_V = 5\ J$

$\Rightarrow \Delta W_{CA} = -5J$

9. A

Sol. $mvR = mv'r$ ...(i)

and $\frac{1}{2}mv^2 = -\frac{GMm}{r} + \frac{1}{2}mv'^2$

$\Rightarrow v'^2 = v^2 + \frac{2GM}{r}$

$\Rightarrow \frac{v^2R^2}{r^2} = v^2 + \frac{2GM}{r}$

$R = \frac{r}{v}\left[v^2 + \frac{2GM}{r}\right]^{-1/2}$

10. D

Sol. $q_{max} = \frac{2EC}{3}$

In the beginning current through the cell

$I_0 = \frac{3E}{5R}$

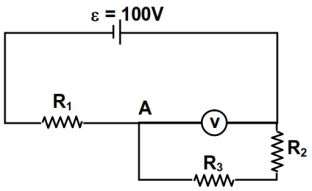
Therefore, $\frac{dq}{dt} = \frac{2}{3}I_0 = \frac{2E}{5R}$

Since, $\left(\frac{2E}{5R}\right) \times t = \frac{2EC}{3}$

$\Rightarrow t\ \frac{5RC}{3}$

11. B

Sol. In the steady state current in the branch having capacitor is zero. The effective circuit is shown in the figure.



Current through the cell

$I = \frac{3}{7}A$

Therefore current through the voltmeter is $I' = \frac{2}{3}I = \frac{2}{7}A$

Therefore, voltmeter reading is $= I'R_V = \frac{400}{7}V$

12. B

Sol. From snell's law

$\mu\sin\theta = 16\mu \sin x$

$\Rightarrow \sin x = \frac{5}{8}\sin\theta$

13. A

Sol. $Q = A_{He}.BE_{He}$ (per nucleon) $- 2A_H(BE_H$ per nuclear)

$= 28$ MeV $- 4.4$ MeV $= 23.6$ MeV

14. B

Sol. $V_R = V\left(1 - e^{-\frac{tR}{L}}\right)$, at $t = \tau\,\ell n2$

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

15. A

Sol. Initially, $P = \frac{v_{rms}^2}{R} \Rightarrow v_{rms} = \sqrt{PR}$

Finally, $P' = I_{rms}^2 R = \frac{v_{rms}^2}{z^2}R = \frac{PR}{z^2} \times R = P\left(\frac{R}{z}\right)^2$

16. B

Sol. The gas expands isobarically, therefore, $\Delta Q = nC_p\Delta T$

At STP. 1 mole of a gas occupies the volume 22.4 liter. This implies that in the vessel 2 mole helium is present

$\Rightarrow \Delta Q = 2 \times \frac{5R}{2} \times 20J = 100R$.

17. A

Sol. $\frac{\lambda_2}{\lambda_1} = \frac{(z_1 - 1)^2}{(z_2 - 1)^2} = 4$

$\Rightarrow 2z_2 - z_1 = 1$

18. A

Sol. The effective decay constant

$\lambda = \lambda_1 + \lambda_2$

Therefore effective half life

$$T_{1/2} = \frac{\ell n2}{\lambda} = \frac{0.693}{\lambda_1 + \lambda_2}$$

19. D

Sol. Collective energy of both photons is 11.6 eV more than the ionization energy of a hydrogen atom.

20. B

Sol. $\because \quad y(x, t) = 0.5\text{cm}\sin\left\{100\pi\left(t - \frac{x}{v}\right)\right\}$

Here, $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{1600}{40\times10^{-3}}} = 200\text{m/s}$

and $t = \frac{5}{200}\text{s}$

$x = \frac{5}{2}\text{m}$

$y\left(x = \frac{5}{2}, t = \frac{5}{200}\text{s}\right) = 0.5\text{cm}\sin\left\{100\pi\left(\frac{5}{200} - \frac{5}{400}\right)\right\}$

$= -\frac{0.5}{\sqrt{2}}\text{cm}$

SECTION – B

21. 5

Sol. Let the resistance be R,

Therefore, $I_{rms} = \frac{110}{R}\text{A}$

With L, $I_{rms} = \frac{220}{\sqrt{R^2 + \omega^2L^2}} = \frac{110}{R}$

$\Rightarrow R^2 = \frac{4}{3}\times10^5\,\Omega^2$

With C, $I_{rms} = \frac{220}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} = \frac{110}{R}$

$\Rightarrow C = 5\mu F$

22. 7

Sol. $\because \quad A = A_0e^{\frac{-bt}{2m}}$

Where, A_0 = initial amplitude

b = damping constant

M = mass of the block

$\Rightarrow \frac{A_0}{2} = A_0e^{\frac{-bt}{2m}}$

$\Rightarrow \quad t = \frac{\ell n2}{b/2m}$

$= \frac{0.693}{40\,g/s}\times2\times200\,g = 7\text{ s}$

23. 3

Sol. $R_{cm} = \frac{u^2 \sin 2\theta}{g} = 5\sqrt{3}$ m

Let M be the mass of each fragment

$\Rightarrow \frac{M\sqrt{3} + (n-1)M \times 7\sqrt{3}}{nM} = 5\sqrt{3}$

$\Rightarrow n = 3$

24. 11

Sol. The point P acts like a virtual object for the lens.

Since, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{25} = \frac{1}{v} - \frac{1}{20}$

$\Rightarrow \frac{1}{v} = \frac{1}{25} + \frac{1}{20} = \frac{9}{100}$

$\Rightarrow v = 11.11$ cm ≈ 11 cm

25. 38

Sol. Energy of the incident photon

$E = E_0 z^2 \times \frac{3}{4} = 40.8$ eV

Stopping potential, $v_0 = \frac{E - \phi}{e} = 38$ V

SECTION – A

26. B

Sol. Decreasing pressure usually decreases the sublimation temperature of the substance and thus preventing it from decomposition.

27. A

Sol. $\frac{Y_A}{Y_B} = \frac{X_A}{X_B}\frac{p_A^o}{p_B^o}$

$\frac{Y_A}{Y_B} = \left(\frac{m_A}{m_B}\right) \times \frac{M_B}{M_A}$; M_A = molar mass of A

M_B = molar mass of B

$\frac{m_A}{m_B}$ = ratio of their masses in vapour phase.

Similarly, $\frac{X_A}{X_B} = \left(\frac{m'_A}{m'_B}\right) \times \frac{M_B}{M_A}$

$\frac{m'_A}{m'_B}$ = (Ratio of their masses in liquid phase)

28. D

Sol. Defect usually increases the conductivity, while heating metallic conductor decreases its conductivity due to increase in the vibration of metal ions which consequently increases the resistance.

29. B

Sol. In aqueous medium,
Size of ion is in the order of
$Li^+ > Na^+ > K^+ > Rb^+$

30. B

Sol. In a particular group, lower member have high basic character of their oxide. For same element with different oxides (having different oxidation states), the oxides having high oxidation state of element have high acidic characer.

31. C

Sol. (Structure of H_2O_2, NCERT)

32. C

Sol. Z-components of angular momentum of an electron in an atomic orbital is governed by magnetic quantum number. For, d sub-shell, there are 5 Z-components possible.

33. A

Sol. Root mean square speed of any gas $= \left(\frac{3RT}{M}\right)^{\frac{1}{2}}$

Mean square speed $= \left(\frac{3RT}{M}\right)$

Both the gases are in same compartment, the temperature is same for both the gases.

Required ratio $= \frac{3RT}{28} \times \frac{32}{3RT} = \frac{32}{28} = \frac{8}{7}$

34. A

Sol. $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$ (for adiabatical change)

$$\left(\frac{T_2}{T_1}\right) = \left(\frac{V_1}{V_2}\right)^{\gamma-1} = 3^{\gamma-1}$$

As γ is more for monoatomic gas He. Hence, temperature will also be more for it.

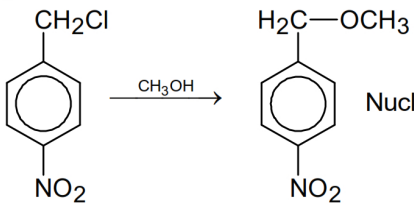
35. C

Sol. $C\overset{3}{—}C$ bond has lowest electronegativity difference. For homolytic bond cleavage a bond should have low electronegative difference.

36. C

Sol. With HBr along with peroxide, the product can both have syn as well as anti addition.

37. B

Sol. 

Nucleophilic substitution at benzylic carbon.

38. B

Sol. Value of van't Hoff factor is more than unity during dissociation. Solid CO_2 first liquefies upon heating at high pressure. Blood cells present in hypotonic solution will swell.

39. D

Sol. $CH_3COOCH_3(aq) + H_2O(\ell) \xrightarrow{NaOH} CH_3COO^-(aq) + CH_3OH(aq)$

40. B

Sol. $AB_2(s) \rightleftharpoons A^{2+}(aq) + 2B^-(aq)$

$K_{SP} = \left[A^{2+}(aq)\right]\left[B^-(aq)\right]^2$

i.e. $\left[A^{2+}(aq)\right]\left[B^-(aq)\right]^2 = \text{Constant}(C)$

$C = K_{SP}$

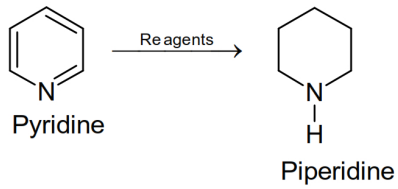
$\log\left[A^{2+}\right] + 2\log\left[B^-\right] = \log C$

$\log\left[A^{2+}\right] = \log C - 2\log\left[B^-\right]$

$y = C - mx \qquad (m = 2)$

41. B

Sol.



42. A

Sol. $Cl^- < H_2O < NH_3 < CN^-$ (Strong ligands)

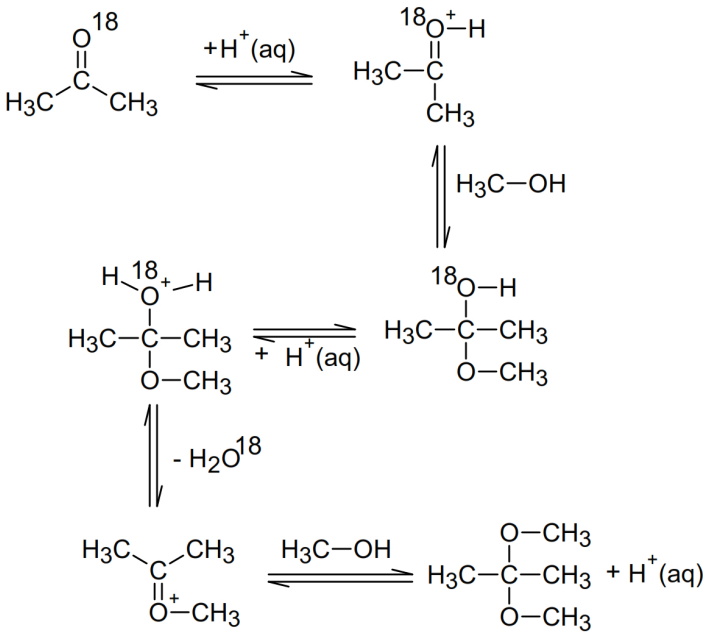
Stronger the ligand, greater will be the splitting and hence the compound will absorbs light of high frequency (or low wavelength).

43. B

Sol. Octahedral ionic radii of these elements in M^{2+} state is related with its stabilization due to CFSE.

44. A

Sol.



45. B

Sol. $KClO_3 \xrightarrow{\Delta} KCl + O_2(g)$

(A) (B) (C)

$KCl(aq) + AgNO_3 \longrightarrow AgCl\downarrow$

(B)

$KOH + Cl_2(g) \longrightarrow KCl + KClO_3 + H_2O$

(D)

SECTION – B

46. 17

Sol. Hybridisation is involved in sigma bond. Hybridisation and number of corresponding bonds, respectively are given as

$CH_4\left(sp^3\right) \rightarrow 4$

$ClF_3\left(sp^3d\right) \rightarrow 3$

$C_2H_4\left(sp^2\right) \rightarrow 5$

$C_2H_2\left(sp\right) \rightarrow 3$

$NO_2^+\left(sp\right) \rightarrow 2$

47. 83

Sol. 20 mL of '10 volume' H_2O_2 solution produces 200 ml of O_2 at STP (or $\frac{200}{22400}$ mole of O_2)

$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

$\frac{200}{22400}$ mole of O_2 will burn $\left(\frac{1}{3} \times \frac{200}{22400} \times 28\right)$ g of C_2H_4

Required answer = 83 mg.

48. 404

Sol. $Li_2CO_3\left(s\right) \xrightarrow{\Delta} Li_2O\left(s\right) + CO_2 \uparrow$

1 mole

$Na_2CO_3.10H_2O\left(s\right) \xrightarrow{\Delta} Na_2CO_3\left(s\right) + 10H_2O \uparrow$

2 moles

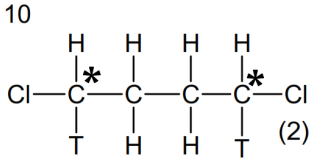
Required answer = 44 + 180 × 2

= 44 + 360

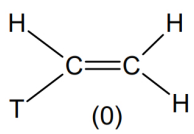
= 404 g.

49. 10

Sol.



(2)



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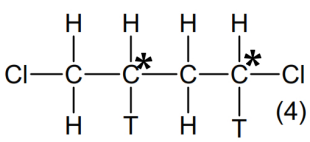
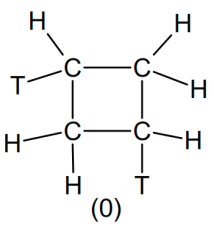
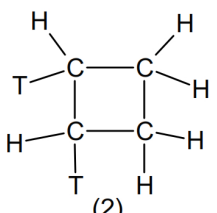


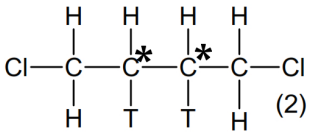
(4)



(0)



(2) (trans)



(2)

50. 120

Sol. $4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$

40 moles 20 moles

So, 40 moles of Fe will give up 120 moles of electrons to form 20 moles of Fe_2O_3.

SECTION – A

51. C
Sol. 55 + 65 + 80 = 200

52. D
Sol. $p \to T, q \to F, r \to F, s \to T$

53. D
Sol. $\frac{1}{2}\int_0^{\pi} f(x)+f(\pi-x)dx = 0$

54. D
Sol. R is symmetric but neither reflexive nor transitive. Domain and range of R has 19 and 10 elements respectively.

55. D
Sol. $\sin32^\circ \sin88^\circ \sin28^\circ = \frac{1}{4}\sin84^\circ = \frac{\cos6^\circ}{4}$

56. C
Sol. $-p = (\alpha+\beta)^2 - 2\alpha\beta + \frac{\alpha+\beta}{\alpha\beta} = 9 - \frac{11}{\sqrt{7}}$

$q = \alpha^2\beta^2 + \alpha + \beta + \frac{1}{\alpha\beta} = 10 - \frac{1}{\sqrt{7}}$

57. A
Sol. $A + B = 2024({}^{2023}C_0 + {}^{2023}C_1 + \ldots\ldots + {}^{2023}C_{2023}) = 2024.2^{2023}$

58. C
Sol. $\frac{b^2}{a} \le a + ae \Rightarrow e^2 - 1 \le 1 + e$

$\Rightarrow e \in (1, 2]$

59. A
Sol. $\cos\theta + \sin\theta = 1 \Rightarrow \theta = 0, \frac{\pi}{2}$

60. B
Sol. $ae = AE, \frac{b^2}{a} = \frac{B^2}{A} \Rightarrow eE = 1 \Rightarrow e = \frac{1}{\sqrt{2}}$

61. D
Sol. Limit equals 0 for $n \ge 1$ and does not exist for $n < 1$

62. D
Sol. $A_1 + A_3 + \ldots\ldots + A_{2023}$ is skew symmetric matrix of order 3 so its determinant equals 0.

63. B

Sol. Check RHD and LHD at x = 0

64. B

Sol. $\frac{dv}{dt} = -\pi r^2 \cot\theta \frac{dr}{dt}, \frac{ds}{dt} = -2\pi r \frac{dr}{dt} \operatorname{cosec}\theta$

$\Rightarrow \frac{ds}{dt} = \frac{\sqrt{41}}{12}\pi$

65. D

Sol. $f(x) = (x + 2)(x + 1)(x - 1)(x^7 + x + 1)$

There are 3 stationary points in $(-2, 1)$

66. B

Sol. Let $I_n = \int_0^1 x^6 \left(x^3 - 1\right)^n dx$

$= \left|\frac{x^7}{7}\left(x^3 - 1\right)^n\right|_0^1 - \frac{3n}{7}\int_0^1 x^9 \left(x^3 - 1\right)^{n-1} dx$

$= -\frac{3n}{7}\left(I_n + I_{n-1}\right) \quad \Rightarrow I_n = -\frac{3n}{3n+7} I_{n-1}$

$I_{n-1} = -\frac{3(n-1)}{3n+4} I_{n-2}$

…

…

…

$I_2 = -\frac{3.2}{13} I_1$ where $I_1 = -\frac{3}{70}$

67. A

Sol. $\pi(a^2 - ab) = \pi(a^2 + b^2 - a^2) \Rightarrow \frac{b}{a} = \frac{\sqrt{5}-1}{2}$

$\Rightarrow e = \sqrt{\frac{2\sqrt{5}-2}{4}} = \sqrt{2\sin 18^\circ}$

68. D

Sol. Let amount of salt in bloodstream a time t = x

$\Rightarrow \frac{dx}{dt} = -kx \Rightarrow x = ce^{-kt}$

where $c = 100$ and $k = \frac{\ln 2}{5}$

$\Rightarrow x = 100e^{-\frac{\ln 2}{5}t}$ (for first 12 hours)

At $t = 12^+$ hrs, initial amount is $100\left(1 + e^{-\frac{12}{5}\ln 2}\right)$

At t = 15 hrs, $x = 100\left(1 + e^{-\frac{12}{5}\ln 2}\right)e^{-\frac{3\ln 2}{5}}$

69. A

Sol. Plane contains (1, 2, 3) and (–1, –3, 1) and parallel to $2\hat{i}+3\hat{j}+4\hat{k}$

70. D

Sol. $\left[\left(\vec{a}\times\vec{b}\right)\times\left(\vec{b}\times\vec{c}\right)\right]\times\left(\vec{c}\times\vec{a}\right)\cdot\vec{b}=\left[\vec{a}\,\vec{b}\,\vec{c}\right]\vec{b}\times\left(\vec{c}\times\vec{a}\right)\cdot\vec{b}$

$=\left[\vec{a}\,\vec{b}\,\vec{c}\right]\left(\left(\vec{b}\cdot\vec{a}\right)c-\left(\vec{b}\cdot\vec{c}\right)\vec{a}\right)\cdot\vec{b}=0$

SECTION – B

71. 4

Sol. $b=\frac{\pi}{2}, a=\frac{\pi}{4}$

72. 3

Sol. $(4^{\sin x}+4^{-\sin x})\,(16^{\sin y}+16^{-\sin y})=4$

$\Rightarrow \sin x=\sin y=0$ (by A.M - G.M)

$3^{|\cos x|}+3^{\cos y}=\frac{10}{3}\Rightarrow 3^{\cos y}=\frac{1}{3}\Rightarrow \cos y=-1$

$y=\pi,\ x=0,\ \pi,\ 2\pi$

73. 2

Sol. $p=\frac{2}{35}$

74. 60

Sol. $x_1x_2x_3x_4x_5=9\times8\times7\times5\times5$

$\Rightarrow$ total numbers $=\frac{5!}{2}=60$

75. 3

Sol. Using Binomial expansion remainder comes out to be 3.