

PART-I PHYSICS**SECTION-A**

1. A 2-meter-long scale with least count of 0.2 cm is used to measure the locations of objects on an optical bench. While measuring the focal length of a convex lens, the object pin and the convex lens are placed at 80 cm mark and 1m mark, respectively. The image of the object pin on the other side of lens coincides with image pin that is kept at 180 cm mark. The % error in the estimation of focal length is:
(a) 1.02 (b) 0.85
(c) 1.70 (d) 0.51
2. A capacitor of capacitance $150.0\mu\text{F}$ is connected to an alternating source of emf given by $E = 36 \sin(120\pi t)\text{V}$. The maximum value of current in the circuit is approximately equal to:
(a) 2 A (b) $\frac{1}{\sqrt{2}}$ A
(c) $\sqrt{2}$ A (d) $2\sqrt{2}$ A
3. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: When you squeeze one end of a tube to get toothpaste out from the other end, Pascal's principle is observed.

Reason R: A change in the pressure applied to an enclosed incompressible fluid is transmitted undiminished to every portion of the fluid and to the walls of its container.

In the light of the above statements, choose the most appropriate answer from the options given below

- (a) A is not correct but R is correct
- (b) A is correct but R is not correct
- (c) Both A and R are correct and R is the correct explanation of A
- (d) Both A and R are correct but R is NOT the correct explanation of A

4. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

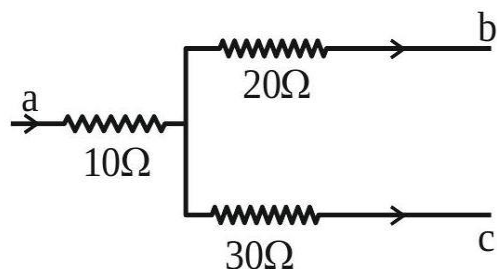
Assertion A: The phase difference of two light waves change if they travel through different media having same thickness, but different indices of refraction.

Reason R: The wavelengths of waves are different in different media.

In the light of the above statements, choose the most appropriate answer from the options given below

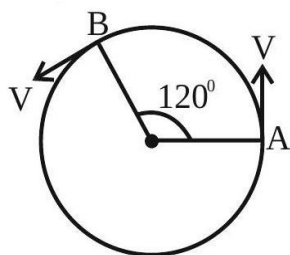
- (a) Both A and R are correct but R is NOT the correct explanation of A
- (b) A is correct but R is not correct
- (c) Both A and R are correct and R is the correct explanation of A
- (d) A is not correct but R is correct

5. Figure shows a part of an electric circuit. The potentials at points a, b and c are 30 V, 12 V and 2 V respectively. The current through the 20Ω resistor will be.



- (a) 0.4 A (b) 0.2 A
(c) 0.6 A (d) 1.0 A

6. As shown in the figure, a particle is moving with constant speed π m/s. Considering its motion from A to B, the magnitude of the average velocity is:



- (a) π m/s (b) $\sqrt{3}$ m/s
(c) $2\sqrt{3}$ m/s (d) $1.5\sqrt{3}$ m/s

7. The work functions of Aluminium and Gold are 4.1 eV and 5.1 eV respectively. The ratio of the slope of the stopping potential versus frequency plot for Gold to that of Aluminium is

- (a) 1.24 (b) 2
(c) 1 (d) 1.5

8. The ratio of speed of sound in hydrogen gas to the speed of sound in oxygen gas at the same temperature is:

- (a) 4:1 (b) 1:2
(c) 1:4 (d) 1:1

9. A child of mass 5 kg is going round a merry-go-round that makes 1 rotation in 3.14 s. The radius of the merry-go-round is 2 m. The centrifugal force on the child will be

- (a) 80 N (b) 50 N
(c) 100 N (d) 40 N

10. A particle starts with an initial velocity of 10.0 ms^{-1} along x-direction and accelerates uniformly at the rate of 2.0 ms^{-2} . The time taken by the particle to reach the velocity of 60.0 ms^{-1} is

- (a) 6 s (b) 3 s
(c) 30 s (d) 25 s

11. Choose the incorrect statement from the following:

- (a) The speed of satellite in a given circular orbit remains constant.
(b) For a planet revolving around the sun in an elliptical orbit, the total energy of the planet remains constant.
(c) When a body falls towards earth, the displacement of earth towards the body is negligible.
(d) The linear speed of a planet revolving around the sun remains constant.

12. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: Diffusion current in a p-n junction is greater than the drift current in magnitude if the junction is forward biased.

Reason R: Diffusion current in a p-n junction is from the n-side to the p-side if the junction is forward biased.

In the light of the above statements, choose the most appropriate answer from the options given below

- (a) Both A and R are correct and R is the correct explanation of A
 (b) Both A and R are correct but R is NOT the correct explanation of A
 (c) A is correct but R is not correct
 (d) A is not correct but R is correct

13. A dipole comprises of two charged particles of identical magnitude q and opposite in nature. The mass ' m ' of the positive charged particle is half of the mass of the negative charged particle. The two charges are separated by a distance ' l '. If the dipole is placed in a uniform electric field ' $\vec{E}$ '; such a way that dipole axis makes a very small angle with the electric field, ' $\vec{E}$ '. The angular frequency of the oscillations of the dipole when released is given by:

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

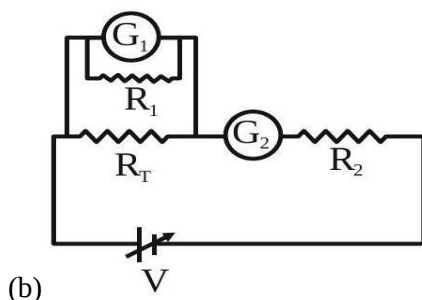
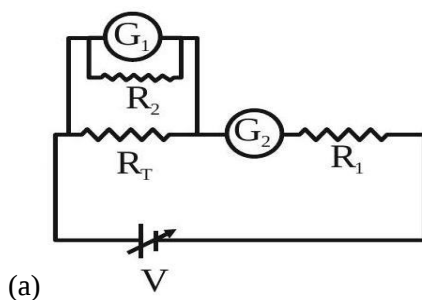
14. The energy density associated with electric field $\vec{E}$ and magnetic field $\vec{B}$ of an electromagnetic wave in free space is given by (ϵ_0 – permittivity of free space, μ_0 – permeability of free space)

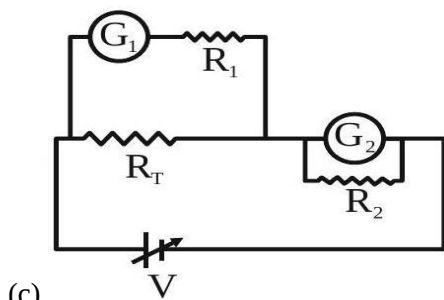
- (a) $U_E = \frac{E^2}{2\epsilon_0}, U_B = \frac{B^2}{2\mu_0}$ (b) $U_E = \frac{E^2}{2\epsilon_0}, U_B = \frac{\mu_0 B^2}{2}$
 (c) $U_E = \frac{\epsilon_0 E^2}{2}, U_B = \frac{\mu_0 B^2}{2}$ (d) $U_E = \frac{\epsilon_0 E^2}{2}, U_B = \frac{B^2}{2\mu_0}$

15. The temperature of an ideal gas is increased from 200 K to 800 K. If r.m.s. speed of gas at 200 K is v_0 . Then, r.m.s. speed of the gas at 800 K will be:

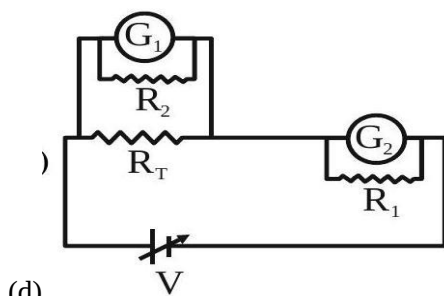
- (a) v_0 (b) $4v_0$
 (c) $\frac{v_0}{4}$ (d) $2v_0$

16. A student is provided with a variable voltage source V , a test resistor $R_T = 10\Omega$, two identical galvanometers G_1 and G_2 and two additional resistors, $R_1 = 10M\Omega$ and $R_2 = 0.001\Omega$. For conducting an experiment to verify ohms law, the most suitable circuit is:





(c)



(d)

17. A body cools in 7 minutes from 60°C to 40°C . The temperature of the surrounding is 10°C . The temperature of the body after the next 7 minutes will be:

- (a) 32°C (b) 30°C
(c) 28°C (d) 34°C

18. A small particle of mass m moves in such a way that its potential energy $U = \frac{1}{2}m\omega^2r^2$ where ω is constant and r is the distance of the particle from origin. Assuming Bohr's quantization of momentum and circular orbit, the radius of n^{th} orbit will be proportional to.

- (a) $\sqrt{n}$ (b) n
(c) n^2 (d) $\frac{1}{n}$

19. For an amplitude modulated wave the minimum amplitude is 3 V, while the modulation index is 60%. The maximum amplitude of the modulated wave is:

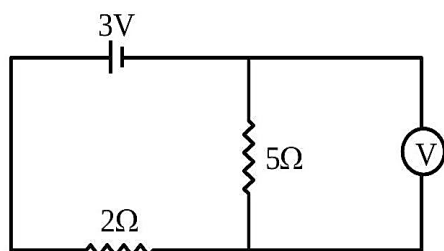
- (a) 15 V (b) 12 V
(c) 10 V (d) 5 V

20. The weight of a body on the surface of the earth is 100 N. The gravitational force on it when taken at a height, from the surface of earth, equal to one fourth the radius of the earth is:

- (a) 100 N (b) 64 N
(c) 50 N (d) 25 N

SECTION-B

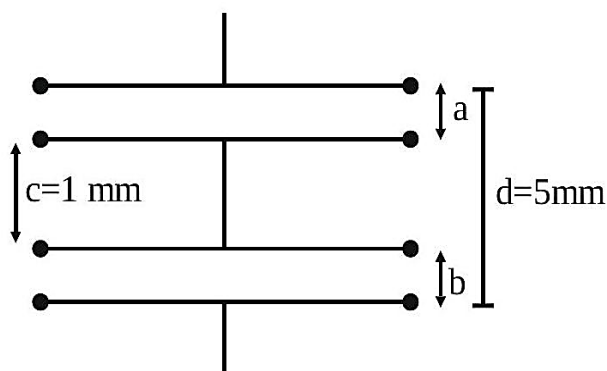
21. As shown in the figure, the voltmeter reads 2 V across 5Ω resistor. The resistance of the voltmeter is ____ Ω .



22. A metal block of mass m is suspended from a rigid support through a metal wire of diameter 14 mm. The tensile stress developed in the wire under equilibrium state is $7 \times 10^5 \text{ Nm}^{-2}$. The value of mass m is ____ kg.

(Take, $g = 9.8 \text{ ms}^{-2}$ and $\pi = \frac{22}{7}$)

23. As shown in the figure, two parallel plate capacitors having equal plate area of 200 cm^2 are joined in such a way that $a \neq b$. The equivalent capacitance of the combination is $x \epsilon_0 \text{ F}$. The value of x is ____



24. A ring and a solid sphere rotating about an axis passing through their centers have same radii of gyration. The axis of rotation is perpendicular to plane of ring. The ratio of radius of ring to that of sphere is $\sqrt{\frac{2}{x}}$. The value of x is ____
25. A simple pendulum with length 100 cm and bob of mass 250 g is executing S.H.M. of amplitude 10 cm. The maximum tension in the string is found to be $\frac{x}{40} \text{ N}$. The value of x is ____
26. Two concentric circular coils with radii 1 cm and 1000 cm, and number of turns 10 and 200 respectively are placed coaxially with centers coinciding. The mutual inductance of this arrangement will be $__ \times 10^{-8} \text{ H}$.
27. A beam of light consisting of two wavelengths $7000 \text{ \AA}$ and $5500 \text{ \AA}$ is used to obtain interference pattern in Young's double slit experiment. The distance between the slits is 2.5 mm and the distance between the plane of slits and the screen is 150 cm. The least distance from the central fringe, where the bright fringes due to both the wavelengths coincide, is $n \times 10^{-5} \text{ m}$. The value of n is ____
28. A body is dropped on ground from a height ' h_1 ' and after hitting the ground, it rebounds to a height ' h_2 '. If the ratio of velocities of the body just before and after hitting ground is 4, then percentage loss in kinetic energy of the body is $\frac{x}{4}$. The value of x is ____
29. Experimentally it is found that 12.8 eV energy is required to separate a hydrogen atom into a proton and an electron. So the orbital radius of the electron in a hydrogen atom is $\frac{9}{x} \times 10^{-10} \text{ m}$. The value of the x is ____

($1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$, $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$ and electronic charge = $1.6 \times 10^{-19} \text{ JC}$)

30. A proton with a kinetic energy of 2.0 eV moves into a region of uniform magnetic field of magnitude $\frac{\pi}{2} \times 10^{-3}$ T. The angle between the direction of magnetic field and velocity of proton is 60° . The pitch of the helical path taken by the proton is ____ cm.

(Take, mass of proton = 1.6×10^{-27} kg and Charge on proton = 1.6×10^{-19} C).

PART-II CHEMISTRY

SECTION-A

31. Ion having highest hydration enthalpy among the given alkaline earth metal ions is: -

- (a) Be^{2+} (b) Ba^{2+}
(c) Sr^{2+} (d) Ca^{2+}

32. The IUPAC name of $\text{K}_3[\text{Co}(\text{C}_2\text{O}_4)_3]$ is :-

- (a) Potassium trioxalatocobaltate (III)
(b) Potassium tris(oxalato)cobalt (III)
(c) Potassium tris(oxalato) cobaltate (III)
(d) Potassium trioxalatocobalt (III)

33. Match List I with List II

List I	List II
Natural Amino acid	One Letter Code
(A) Arginine	(I) D
(B) Aspartic acid	(II) N
(C) Asparagine	(III) A
(D) Alanine	(IV) R

Choose the correct answer from the options given below:

- (a) (A)-IV, (B)-I, (C)-III, (D)-II
(b) (A)-I, (B)-III, (C)-IV, (D)-II
(c) (A)-III, (B)-I, (C)-II, (D)-IV
(d) (A)-IV, (B)-I, (C)-II, (D)-III

34. Element not present in Nessler's reagent is: -

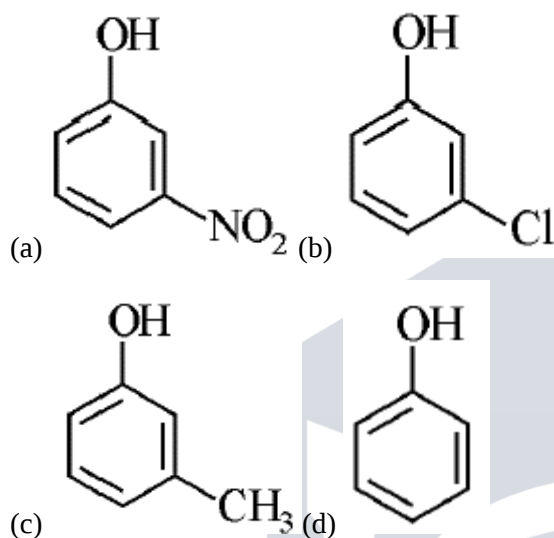
- (a) Hg (b) I

- (c) K (d) N

35. Structure of BeCl_2 in solid state, vapour phase and at very high temperature respectively are :-

- (a) Dimeric, Polymeric, Monomeric
 (b) Polymeric, Dimeric, Monomeric
 (c) Monomeric, Dimeric, Polymeric
 (d) Polymeric, Monomeric, Dimeric

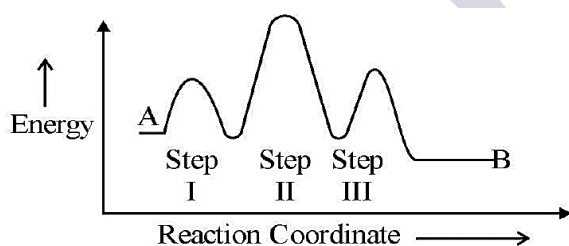
36. The strongest acid from the following is



37. Group-13 elements react with O_2 in amorphous form to form oxides of type M_2O_3 (M = element). Which among the following is the most basic oxide?

- (a) Al_2O_3 (b) Ga_2O_3
 (c) Tl_2O_3 (d) B_2O_3

38. Consider the following reaction that goes from A to B in three steps as shown below: -



Choose the correct

Number of	Number of	Rate
intermediates	Activated	determining
complexes	step	

- (a) 3 2 II
 (b) 2 3 II
 (c) 2 3 I

(d) 2 3 III

39. Given below are two statements: one is labelled as "Assertion A" and the other is labelled as "Reason R".

Assertion A: In the complex $\text{Ni}(\text{CO})_4$ and $\text{Fe}(\text{CO})_5$, the metals have zero oxidation state.

Reason R: Low oxidation states are found when a complex has ligands capable of π -donor character in addition to the σ -bonding.

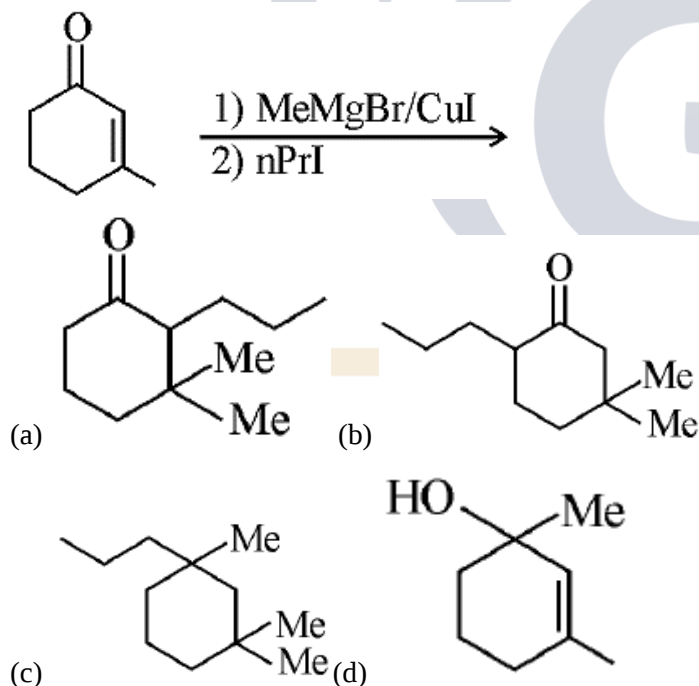
In the light of the above statements, choose the most appropriate answer from the option given below.

- (a) A is correct but R is not correct
- (b) A is not correct but R is correct
- (c) Both A and R are correct but R is NOT the correct explanation of A
- (d) Both A and R are correct and R is the correct explanation of A.

40. During the reaction of permanganate with thiosulphate, the change in oxidation of manganese occurs by value of 3. Identify which of the below medium will favour the reaction.

- (a) aqueous acidic
- (b) aqueous neutral
- (c) both aqueous acidic and neutral
- (d) both aqueous acidic and faintly alkaline.

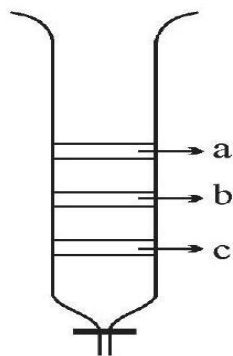
41. Find out the major product from the following reaction



42. Formation of which complex, among the following, is not a confirmatory test of Pb^{2+} ions

- (a) lead chromate
- (b) lead iodide
- (c) lead nitrate
- (d) lead sulphate

43. From the figure of column chromatography given below, identify incorrect statements.



A. Compound 'c' is more polar than 'a' and 'b'

B. Compound 'a' is least polar

C. Compound 'b' comes out of the column before 'c' and after 'a'

D. Compound 'a' spends more time in the column Choose the correct answer from the options given below:

(a) A, B and C only (b) B, C and D only

(c) A, B and D only (d) B and D only

44. Given below are two statements: -

Statement-I: Morphine is a narcotic analgesic. It helps in relieving pain without producing sleep.

Statement-II: Morphine and its derivatives are obtained from opium poppy.

In the light of the above statements, choose the correct answer from the options given below.

(a) Statement I is true but Statement II is false

(b) Both Statement I and Statement II are false

(c) Both Statement I and Statement II are true

(d) Statement I is false but Statement II is true

45. The volume of 0.02M aqueous HBr required to neutralize 10.0 mL of 0.01M aqueous $\text{Ba}(\text{OH})_2$ is (Assume complete neutralization)

(a) 2.5 mL (b) 5.0 mL

(c) 10.0 mL (d) 7.5 mL

46. The product, which is not obtained during the electrolysis of brine solution is

(a) NaOH (b) Cl_2

(c) H_2 (d) HCl

47. The group of chemicals used as pesticide is

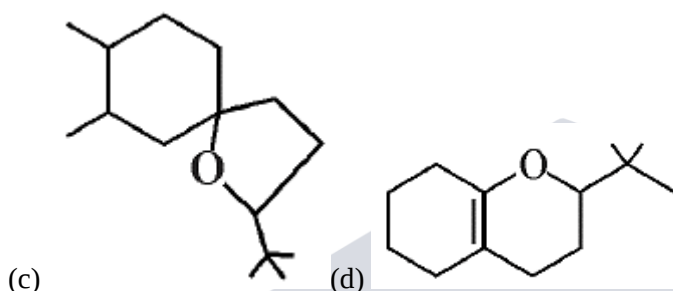
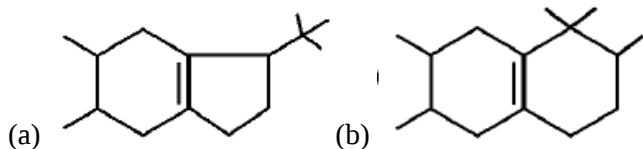
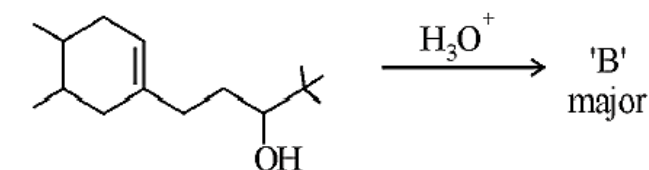
(a) Sodium chlorate, DDT, PAN

(b) Aldrin, Sodium chlorate, Sodium arsinite

(c) DDT, Aldrin

(d) Dieldrin, Sodium arsinite, Tetrachloroethene

48. In the following reaction, 'B' is



49. Which one of the following elements will remain as liquid inside pure boiling water?

- (a) Cs (b) Ga
(c) Li (d) Br

50. If the radius of the first orbit of hydrogen atom a_0 , then de Broglie's wavelength of electron in 3^{rd} orbit is

- (a) $\frac{\pi a_0}{6}$ (b) $\frac{\pi a_0}{3}$
(c) $6\pi a_0$ (d) $3\pi a_0$

SECTION-B

51. In an ice crystal, each water molecule is hydrogen bonded to..... neighbouring molecules.

52. The equilibrium composition for the reaction $\text{PCl}_3 + \text{Cl}_2 \rightleftharpoons \text{PCl}_5$ at 298 K is given below.

$$[\text{PCl}_3]_{\text{eq}} = 0.2 \text{ mol L}^{-1} \quad [\text{Cl}_2]_{\text{eq}} = 0.1 \text{ mol L}^{-1},$$

$$[\text{PCl}_5]_{\text{eq}} = 0.40 \text{ mol L}^{-1}$$

If 0.2 mol of Cl_2 is added at the same temperature, the equilibrium concentrations of PCl_5 is $\times 10^{-2} \text{ mol L}^{-1}$.

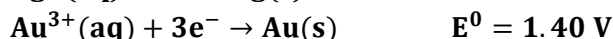
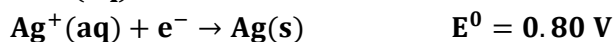
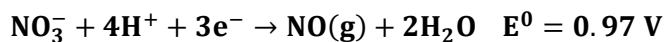
Given: K_c for the reaction at 298 K is 20

53. Consider the following pairs of solution which will be isotonic at the same temperature. The number of pairs of solutions is/are

- A. 1M aq. NaCl and 2M aq. Urea
B. 1M aq. CaCl_2 and 1.5M aq. KCl

- C. 1. 5M aq. AlCl_3 and 2M aq. Na_2SO_4
D. 2. 5M aq. KCl and 1M aq. $\text{Al}_2(\text{SO}_4)_3$

54. The standard reduction potential at 298 K for the following half cells are given below:

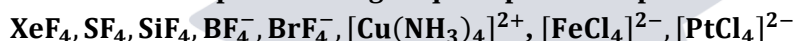


The number of metal(s) which will be oxidized by NO_3^- in aqueous solution is ____

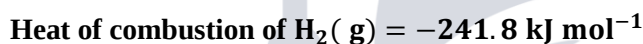
55. The number of colloidal systems from the following, which will have 'liquid' as the dispersion medium, is ____

Gem stones, paints, smoke, cheese, milk, hair cream, insecticide sprays, froth, soap lather.

56. The number of species having a square planar shape from the following is ____



57. Consider the following data



The heat of formation of $\text{C}_2\text{H}_5\text{OH}(\text{a})$ is (–) ____ kJ mol^{-1} (Nearest integer)

58. Among the following, the number of compounds which will give positive iodoform reaction is ____

(a) 1-Phenylbutan-2-one (b) 2-Methylbutan-2-ol

(c) 3-Methylbutan-2-ol (d) 1-Phenylethanol

(e) 3,3-dimethylbutan-2-one (f) 1-Phenylpropan-2-ol

59. Number of isomeric aromatic amines with molecular formula $\text{C}_8\text{H}_{11}\text{N}$, which can be synthesized by Gabriel Phthalimide synthesis is ____

60. Number of crystal systems from the following where body centred unit cell can be found, is.....

Cubic, tetragonal, orthorhombic, hexagonal, rhombohedral, monoclinic, triclinic.

SECTION-A

61. Three dice are rolled. If the probability of getting different numbers on the three dice is $\frac{p}{q}$, where p and q are co-prime, then $q - p$ is equal to

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

62. Among the statements:

(S1): $2023^{2022} - 1999^{2022}$ is divisible by 8.

(S2): $13(13)^n - 11n - 13$ is divisible by 144 for infinitely many $n \in \mathbb{N}$.

- (a) both (S1) and (S2) are incorrect
(b) only (S2) is correct
(c) both (S1) and (S2) are correct
(d) only (S1) is correct

63. $\lim_{n \rightarrow \infty} \left\{ \left(2^{\frac{1}{2}} - 2^{\frac{1}{3}} \right) \left(2^{\frac{1}{2}} - 2^{\frac{1}{5}} \right) \dots \dots \left(2^{\frac{1}{2}} - 2^{\frac{1}{2n+1}} \right) \right\}$ is equal to

- (a) $\frac{1}{\sqrt{2}}$ (b) 1
(c) $\sqrt{2}$ (d) 0

64. Let $a \neq b$ be two non-zero real numbers.

Then the number of elements in the set $X = \{z \in \mathbb{C} : \operatorname{Re}(az^2 + bz) = a \text{ and } \operatorname{Re}(bz^2 + az) = b\}$ is equal to

- (a) 1 (b) 3
(c) 0 (d) 2

65. Let the sets A and B denote the domain and range respectively of the function $f(x) = \frac{1}{\sqrt{[x] - x}}$, where $[x]$ denotes the smallest integer greater than or equal to x . Then among the statements

(S1) : $A \cap B = (1, \infty) - \mathbb{N}$ and

(S2) : $A \cup B = (1, \infty)$

- (a) only (S1) is true
(b) both (S1) and (S2) are true
(c) neither (S1) nor (S2) is true
(d) only (S2) is true

66. If the solution curve $f(x, y) = 0$ of the differential equation $(1 + \log_e x) \frac{dx}{dy} - x \log_e x = e^y$, $x > 0$, passes through the points $(1, 0)$ and $(\alpha, 2)$ then α^α is equal to

- (a) $e^{2e^{\sqrt{2}}}$ (b) $e^{\sqrt{2}e^2}$

(c) e^{e^2}

(d) e^{2e^2}

67. The sum of all values of α , for which the points whose position vectors $\hat{i} - 2\hat{j} + 3\hat{k}$, $2\hat{i} - 3\hat{j} + 4\hat{k}$, $(\alpha + 1)\hat{i} + 2\hat{k}$ and $9\hat{i} + (\alpha - 8)\hat{j} + 6\hat{k}$ are coplanar, is equal to

(a) 6 (b) 4

(c) -2 (d) 2

68. For the system of equations

$$x + y + z = 6$$

$$x + 2y + \alpha z = 10$$

$x + 3y + 5z = \beta$, which one of the following is NOT true?

(a) System has a unique solution for $\alpha = 3, \beta \neq 14$.

(b) System has no solution for $\alpha = 3, \beta = 24$.

(c) System has a unique solution for $\alpha = -3, \beta = 14$.

(d) System has infinitely many solutions for $\alpha = 3, \beta = 14$.

69. The area bounded by the curves $y = |x - 1| + |x - 2|$ and $y = 3$ is equal to

(a) 3 (b) 4

(c) 5 (d) 6

70. Let P be a square matrix such that $P^2 = I - P$. For $\alpha, \beta, \gamma, \delta \in \mathbb{N}$, if $P^\alpha + P^\beta = \gamma I - 29P$ and $P^\alpha - P^\beta = \delta I - 13P$, then $\alpha + \beta + \gamma - \delta$ is equal to

(a) 18 (b) 40

(c) 24 (d) 22

71. All the letters of the word PUBLIC are written in all possible orders and these words are written as in a dictionary with serial numbers. Then the serial number of the word PUBLIC is

(a) 580 (b) 582

(c) 578 (d) 576

72. Let the line L pass through the point $(0, 1, 2)$, intersect the line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and be parallel to the plane $2x + y - 3z = 4$. Then the distance of the point $P(1, -9, 2)$ from the line L is

(a) 9 (b) $\sqrt{54}$

(c) $\sqrt{69}$ (d) $\sqrt{74}$

73. A plane P contains the line of intersection of the plane $\vec{r} \cdot (\hat{i} + \hat{j} + \hat{k}) = 6$ and $\vec{r} \cdot (2\hat{i} + 3\hat{j} + 4\hat{k}) = -5$. If P passes through the point $(0, 2, -2)$, then the square of distance of the point $(12, 12, 18)$ from the plane P is

(a) 1240 (b) 620

(c) 310 (d) 155

74. Let $f(x)$ be a function satisfying $f(x) + f(\pi - x) = \pi^2, \forall x \in \mathbb{R}$. Then $\int_0^\pi f(x) \sin x dx$ is equal to

(a) $\frac{\pi^2}{4}$ (b) $\frac{\pi^2}{2}$

(c) $2\pi^2$ (d) π^2

75. If the coefficients of x^7 in $\left(ax^2 + \frac{1}{2bx}\right)^{11}$ and x^{-7} in $\left(ax - \frac{1}{3bx^2}\right)^{11}$ are equal, then

- (a) $64ab = 243$ (b) $729ab = 32$
(c) $243ab = 64$ (d) $32ab = 729$

76. Among the statements

(S1): $(p \Rightarrow q) \vee ((\sim p) \wedge q)$ is a tautology

(S2): $(q \Rightarrow p) \Rightarrow ((\sim p) \wedge q)$ is a contradiction

- (a) neither (S1) and (S2) is True
(b) only (S1) is True
(c) only (S2) is True
(d) both (S1) and (S2) are True

77. If the tangents at the points P and Q on the circle $x^2 + y^2 - 2x + y = 5$ meet at the point $R\left(\frac{9}{4}, 2\right)$, then the area of the triangle PQR is

- (a) $\frac{13}{4}$ (b) $\frac{13}{8}$
(c) $\frac{5}{4}$ (d) $\frac{5}{8}$

78. Let the vectors $\vec{a}, \vec{b}, \vec{c}$ represent three coterminous edges of a parallelopiped of volume V. Then the volume of the parallelopiped, whose coterminous edges are represented by $\vec{a}, \vec{b} + \vec{c}$ and $\vec{a} + 2\vec{b} + 3\vec{c}$ is equal to

- (a) $3V$ (b) $6V$
(c) V (d) $2V$

79. If $\gcd(m, n) = 1$ and $1^2 - 2^2 + 3^2 - 4^2 + \dots + (2021)^2 - (2022)^2 + (2023)^2 = 1012m^2n$, then $m^2 - n^2$ is equal to

- (a) 200 (b) 240
(c) 220 (d) 180

80. In a group of 100 persons 75 speak English and 40 speak Hindi. Each person speaks at least one of the two languages. If the number of persons, who speak only English is α and the number of persons who speak only Hindi is β , then the eccentricity of the ellipse $25(\beta^2x^2 + \alpha^2y^2) = \alpha^2\beta^2$ is

- (a) $\frac{3\sqrt{15}}{12}$ (b) $\frac{\sqrt{117}}{12}$
(c) $\frac{\sqrt{119}}{12}$ (d) $\frac{\sqrt{129}}{12}$

SECTION-B

81. Let $f(x) = \frac{x}{(1+x^n)^{\frac{1}{n}}}$, $x \in \mathbb{R} - \{-1\}$, $n \in \mathbb{N}$, $n > 2$ If $f^n(x) = (\text{fofof} \dots \text{upto } n \text{ times})(x)$, then $\lim_{n \rightarrow \infty} \int_0^1 x^{n-2}(f^n(x))dx$ is equal to

82. The value of $\tan 9^\circ - \tan 27^\circ - \tan 63^\circ + \tan 81^\circ$ is ____

83. If the lines $\frac{x-1}{2} = \frac{2-y}{-3} = \frac{z-3}{\alpha}$

and $\frac{x-4}{5} = \frac{y-1}{2} = \frac{z}{\beta}$ intersect,

then the magnitude of the minimum value of $8\alpha\beta$ is ____

84. If $(20)^{19} + 2(21)(20)^{18} + 3(21)^2(20)^{17} +$

$+20(21)^{19} = k(20)^{19}$, then k is equal to_____

85. The number of 4-letter words, with or without meaning, each consisting of 2 vowels and 2 consonants, which can be formed from the letters of the word UNIVERSE without repetition is_____

86. The number of points, where the curve $y = x^5 - 20x^3 + 50x + 2$ crosses the x -axis, is

87. For $\alpha, \beta, z \in \mathbb{C}$ and $\lambda > 1$, if $\sqrt{\lambda - 1}$ is the radius of the circle $|z - \alpha|^2 + |z - \beta|^2 = 2\lambda$, then $|\alpha - \beta|$ is equal to_____

88. Let a curve $y = f(x)$, $x \in (0, \infty)$ pass through the points $P\left(1, \frac{3}{2}\right)$ and $Q\left(a, \frac{1}{2}\right)$. If the tangent at any point $R(b, f(b))$ to the given curve cuts the y -axis at the point $S(0, c)$ such that $bc = 3$, then $(PQ)^2$ is equal to_____

89. Let the eccentricity of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is reciprocal to that of the hyperbola $2x^2 - 2y^2 = 1$. If the ellipse intersects the hyperbola at right angles, then square of length of the latus-rectum of the ellipse is_____

90. If the mean and variance of the frequency distribution

x_i	2	4	6	8	10	12	14	16
f_i	4	4	α	15	8	β	4	5

are 9 and 15.08 respectively, then the value of $\alpha^2 + \beta^2 - \alpha\beta$ is__