31-Jan.-2024 (Morning) : PCM

MATHEMATICS **Section - A (Single Correct Answer)**

1. For $0 < c < b < a$, let $(a + b - 2c)x^2 + (b + c - 2a)x + (c + a - 2b) = 0$ and $\alpha \neq 1$ be one of its root. Then, among the two statements.

   (I) If $\alpha \in (-1, 0)$, then b cannot be the geometric mean of a and c

   (II) If $\alpha \in (0, 1)$, then b may be the geometric mean of a and c

   (A) Both (I) and (II) are true (B) Neither (I) nor (II) is true

   (C) Only (II) is true (D) Only (I) is true

2. Let a be the sum of all coefficients in the expansion of $(1 - 2x + 2x^2)^{2023}(3 - 4x^2 + 2x^3)^{2024}$ and $b = \lim\limits_{x\to 0}\left(\dfrac{\int_0^x \frac{\log(1+t)}{t^{2024}+1}dt}{x^2}\right)$. If the equations $cx^2 + dx + e = 0$ and $2bx^2 + ax + 4 = 0$ have a common root, where $c, d, e \in R$, then d : c : e equals

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

3. If the foci of a hyperbola are same as that of the ellipse $\dfrac{x^2}{9} + \dfrac{y^2}{25} = 1$ and the eccentricity of the hyperbola is $\dfrac{15}{8}$ times the eccentricity of the ellipse, then the smaller focal distance of the point $\left(\sqrt{2}, \dfrac{14}{3}\sqrt{\dfrac{2}{5}}\right)$ on the hyperbola, is equal to

   (A) $7\sqrt{\dfrac{2}{5}} - \dfrac{8}{3}$ (B) $14\sqrt{\dfrac{2}{5}} - \dfrac{4}{3}$

   (C) $14\sqrt{\dfrac{2}{5}} - \dfrac{16}{3}$ (D) $7\sqrt{\dfrac{2}{5}} + \dfrac{8}{3}$

4. If one of the diameters of the circle $x^2 + y^2 - 10x + 4y + 13 = 0$ is a chord of another circle C, whose center is the point of intersection of the lines $2x + 3y = 12$ and $3x - 2y = 5$, then the radius of the circle C is

   (A) $\sqrt{20}$ (B) 4 (C) 6 (D) $3\sqrt{2}$

5. The area of the region $\left\{(x, y) : y^2 \leq 4x,\ x < 4,\ \dfrac{xy(x-1)(x-2)}{(x-3)(x-4)} > 0,\ x \neq 3\right\}$ is

   (A) $\dfrac{16}{3}$ (B) $\dfrac{64}{3}$ (C) $\dfrac{8}{3}$ (D) $\dfrac{32}{3}$

6. If $f(x)=\frac{4x+3}{6x-4}$, $x\neq\frac{2}{3}$ and (fof) (x), where $g:\mathbb{R}-\left\{\frac{2}{3}\right\}\to\mathbb{R}-\left\{\frac{2}{3}\right\}$, then (gogog) (4) is equal to

(A) $-\frac{19}{20}$ (B) $\frac{19}{20}$ (C) –4 (D) 4

7. $\lim\limits_{x\to0}\frac{e^{2|\sin x|}-2|\sin x|-1}{x^2}$

(A) is equal to –1 (B) does not exist (C) is equal to 1 (D) is equal to 2

8. If the system of linear equations,

$x-2y+z=-4$

$2x+\alpha y+3z=5$

$3x-y+\beta z=3$

has infinitely many solutions, then $12\alpha+13\beta$ is equal to

(A) 60 (B) 64 (C) 54 (D) 58

9. The solution curve of the differential equation $y\frac{dx}{dy}=x(\log_e x-\log_e y+1)$, $x>0$, $y>0$ passing through the point (e, 1) is

(A) $\left|\log_e\frac{y}{x}\right|=x$ (B) $\left|\log_e\frac{y}{x}\right|=y^2$ (C) $\left|\log_e\frac{x}{y}\right|=y$ (D) $2\left|\log_e\frac{x}{y}\right|=y+1$

10. Let $\alpha, \beta, \gamma, \delta \in Z$ and let A(α, β), B(1, 0), C (α, δ) and D(1, 2) be the vertices of a parallelogram ABCD. If $AB=\sqrt{10}$ and the points A and C lie on the line $3y = 2x + 1$, then $2(\alpha+\beta+\gamma+\delta)$ is equal to

(A) 10 (B) 5 (C) 12 (D) 8

11. Let $y = y(x)$ be the solution of the differential equation $\frac{dy}{dx}=\frac{(\tan x)+y}{\sin x(\sec x-\sin x\tan x)}$, $x\in\left(0,\frac{\pi}{2}\right)$ satisfying the condition $y\left(\frac{\pi}{4}\right)=2$. Then, $y\left(\frac{\pi}{3}\right)$ is

(A) $\sqrt{3}(2\log_e\sqrt{3})$ (B) $\frac{\sqrt{3}}{2}(2+\log_e 3)$

(C) $\sqrt{3}(1+\log_e 3)$ (D) $\sqrt{3}(2+\log_e 3)$

12. Let $\vec{a}=3\hat{i}+\hat{j}-2\hat{k}$, $\vec{b}=4\hat{i}+\hat{j}+7\hat{k}$ and $\vec{c}=\hat{i}-3\hat{j}+4\hat{k}$ be three vectors. If a vectors $\vec{p}$ satisfies $\vec{p}\times\vec{b}=\vec{c}+\vec{b}$ and $\vec{p}\cdot\vec{a}=0$, then $\vec{p}\cdot\vec{a}=0$, is equal to

(A) 24 (B) 36 (C) 28 (D) 32

13. The sum of the series $\frac{1}{1-3\cdot1^2+1^4}+\frac{2}{1-3\cdot2^4}+\frac{3}{1-3\cdot3^2+3^4}+\ldots..$ up to 10 terms is

(A) $\frac{45}{109}$ (B) $-\frac{45}{109}$ (C) $\frac{55}{109}$ (D) $-\frac{55}{109}$

14. The distance of the point Q(0, 2, –2) form the line passing through the point P(5, –4, 3) and perpendicular to the lines $\vec{r} = (-3\hat{i} + 2\hat{k}) + \lambda(2\hat{i} + 3\hat{j} + 5\hat{k}),\ \lambda \in \mathbb{R}$ and $\vec{r} = (\hat{i} - 2\hat{j} + \hat{k}) + \mu(-\hat{i} + 3\hat{j} + 2\hat{k}),\ \mu \in \mathbb{R}$ is

(A) $\sqrt{86}$ (B) $\sqrt{20}$

(C) $\sqrt{54}$ (D) $\sqrt{74}$

15. For $\alpha, \beta, \gamma \neq 0$. If $\sin^{-1}\alpha + \sin^{-1}\beta + \sin^{-1}\gamma = \pi$ and $(\alpha + \beta + \gamma)(\alpha - \gamma + \beta) = 3\alpha\beta$, then γ equal to

(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{1}{\sqrt{2}}$ (C) $\frac{\sqrt{3}-1}{2\sqrt{2}}$ (D) $\sqrt{3}$

16. Two marbles are drawn in succession from a box containing 10 red, 30 white, 20 blue and 15 orange marbles, with replacement being made after each drawing. Then the probability, that first drawn marble is red and second drawn marble is white, is

(A) $\frac{2}{25}$ (B) $\frac{4}{25}$ (C) $\frac{2}{3}$ (D) $\frac{4}{75}$

17. Let g(x) be a linear function and $f(x) = \begin{cases} g(x), & x \leq 0 \\ \left(\frac{1+x}{2+x}\right)^{\frac{1}{x}}, & x > 9 \end{cases}$, is continuous at x = 0. If f '(1) = f (–1), then the value of g(3) is

(A) $\frac{1}{3}\log_e\left(\frac{4}{9e^{1/3}}\right)$ (B) $\frac{1}{3}\log_e\left(\frac{4}{9}\right)+1$

(C) $\log_e\left(\frac{4}{9}\right)-1$ (D) $\log_e\left(\frac{4}{9e^{1/3}}\right)$

18. If $f(x) = \begin{vmatrix} x^3 & 2x^2+1 & 1+3x \\ 3x^2+2 & 2x & x^3+6 \\ x^3-x & 4 & x^2-2 \end{vmatrix}$ for all $x \in \mathbb{R}$, then 2f(0) + f '(0) is equal to

(A) 48 (B) 24 (C) 42 (D) 18

19. Three rotten apples are accidently mixed with fifteen good apples. Assuming the random variable x to be the number of rotten apples in a draw of two apples, the variance of x is

(A) $\frac{37}{153}$ (B) $\frac{57}{153}$

(C) $\frac{47}{153}$ (D) $\frac{40}{153}$

20. Let S be the set of positive integral values of a for which $\frac{ax^2 + 2(a+1)x + 9a + 4}{x^2 - 8x + 32} < 0,\ \forall x \in \mathbb{R}$. Then, the number of elements in S is :

(A) 1 (B) 0 (C) ∞ (D) 3

Section - B (Numerical Value Type)

21. If the integral $525\int_0^{\frac{\pi}{2}} \sin 2x \cos^{\frac{11}{2}} x \left(1+\cos^{\frac{5}{2}} x\right)^{\frac{1}{2}} dx$ is equal to $(n\sqrt{2}-64)$, then n is equal to _____

22. Let $S=(-1, \infty)$ and $f: S \to \mathbb{R}$ defined as

$$f(x)=\int_{-1}^{x}(e^t-1)^{11}(2t-1)^5(t-2)^7(t-3)^{12}(2t-10)^{61}dt.$$

Let p = Sum of square of the values of x, where f(x) attains local maxima on S. and q = Sum of the values of x, where f(x) attains local minima on S. Then, the value of $p^2 + 2q$ is _____

23. The total number of words (with or without meaning) that can be formed out of the letters of the word 'DISTRIBUTION' taken four at a time, is equal to_____

24. Let Q and R be the feet of perpendiculars from the point P(a, a, a) on the lines x = y, z = 1 and x = –y, $z=-1$ respectively. If $\angle QPR$ is a right angle, then $12a^2$ is equal to_____

25. In the expansion of $(1+x)(1-x^2)\left(1+\frac{3}{x}+\frac{3}{x^2}+\frac{1}{x^3}\right)^5$, $x \neq 0$, the sum of the coefficient of x^3 and x^{-13} is equal to_____

26. If α denotes the number of solutions of $|1-i|^x = 2^x$ and $\beta=\left(\frac{|z|}{\arg(z)}\right)$,

where $z=\frac{\pi}{4}(1+i)^4\left(\frac{1-\sqrt{\pi}i}{\sqrt{\pi}+i}+\frac{\sqrt{\pi}-i}{1+\sqrt{\pi}i}\right)$, $i=\sqrt{-1}$,

then the distance of the point (α, β) from the line $4x - 3y = 7$ is_____

27. Let the foci and length of the latus rectum of an ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, $a > b$ be $(\pm 5, 0)$ and $\sqrt{50}$, respectively.

Then, the square of the eccentricity of the hyperbola $\frac{x^2}{b^2}-\frac{y^2}{a^2b^2}=1$ equals

28. Let $\vec{a}$ and $\vec{b}$ be two vectors such that $|\vec{a}|=1$, $|\vec{b}|=4$ and $\vec{a}\cdot\vec{b}=2$. If $\vec{c}=(2\vec{a}\times\vec{b})-3\vec{b}$ and the angle between $\vec{b}$ and $\vec{c}$ is α, then $192\sin^2\alpha$ is equal to _____

29. Let A = {1, 2, 3, 4} and R = {(1, 2), (2, 3), (1, 4)} be a relation on A.
Let S be the equivalence relation on A such that $R \subset S$ and the number of elements in S is n. Then, the minimum value of n is _____.

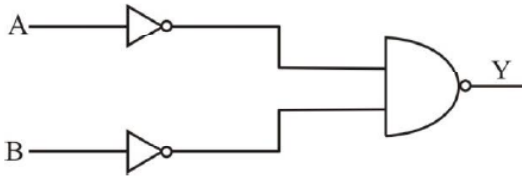
30. Let $f: \mathbb{R} \to \mathbb{R}$ be a function defined by

$$f(x)=\frac{4^x}{4^x+2} \text{ and } M=\int_{f(a)}^{f(1-a)} x\sin^4(x(1-x))dx,\ N=\int_{f(a)}^{f(1-a)} \sin^4(x(1-x))dx;\ a \neq \frac{1}{2}.$$

If $\alpha M = \beta N$, $\alpha, \beta \in \mathbb{N}$, then the least value of $\alpha^2 + \beta^2$ is equal to ____

31. The parameter that remains the same for molecules of all gases at a given temperature is :
(A) kinetic energy (B) momentum
(C) mass (D) speed

32. Identify the logic operation performed by the given circuit.

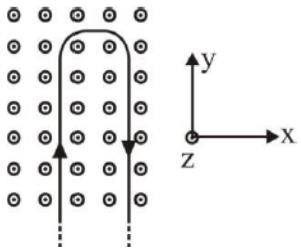


(A) NAND (B) NOR (C) OR (D) AND

33. The relation between time 't' and distance 'x' is $t = \alpha x^2 + \beta x$, where α and β are constants. The relation between acceleration (a) and velocity (v) is:
(A) $a = -2\alpha v^3$ (B) $a = -5\alpha v^5$
(C) $a = -3\alpha v^2$ (D) $a = -4\alpha v^4$

34. The refractive index of a prism with apex angle A is cot A/2. The angle of minimum deviation is :
(A) $\delta_m = 180° - A$ (B) $\delta_m = 180° - 3A$
(C) $\delta_m = 180° - 4A$ (D) $\delta_m = 180° - 2A$

35. A rigid wire consists of a semicircular portion of radius R and two straight sections. The wire is partially immerged in a perpendicular magnetic field $B = B_0\hat{j}$ as shown in figure. The magnetic force on the wire if it has a current i is :

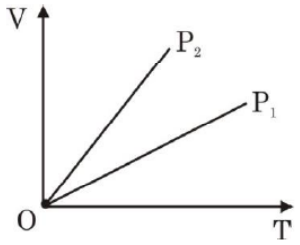


(A) $-iBR\hat{j}$ (B) $2iBR\hat{j}$
(C) $iBR\hat{j}$ (D) $-2iBR\hat{j}$

36. If the wavelength of the first member of Lyman series of hydrogen is λ. The wavelength of the second member will be
(A) $\frac{27}{32}\lambda$ (B) $\frac{32}{27}\lambda$ (C) $\frac{27}{5}\lambda$ (D) $\frac{5}{27}\lambda$

37. Four identical particles of mass m are kept at the four corners of a square. If the gravitational force exerted on one of the masses by the other masses is $\left(\frac{2\sqrt{2}+1}{32}\right)\frac{Gm^2}{L^2}$, the length of the sides of the square is
(A) L/2 (B) 4L (C) 3L (D) 2L

38. The given figure represents two isobaric processes for the same mass of an ideal gas, then



(A) $P_2 \geq P_1$ (B) $P_2 > P_1$ (C) $P_1 = P_2$ (D) $P_1 > P_2$

39. If the percentage errors in measuring the length and the diameter of a wire are 0.1% each. The percentage error in measuring its resistance will be:

(A) 0.2% (B) 0.3% (C) 0.1% (D) 0.144%

40. In a plane EM wave, the electric field oscillates sinusoidally at a frequency of 5×10^{10} Hz and an amplitude of 50 Vm^{-1}. The total average energy density of the electromagnetic field of the wave is :

[Use $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/Nm^2]

(A) 1.106×10^{-8} Jm^{-3} (B) 4.425×10^{-8} Jm^{-3}

(C) 2.212×10^{-8} Jm^{-3} (D) 2.212×10^{-10} Jm^{-3}

41. A force is represented by $F = ax^2 + bt^{1/2}$ Where x = distance and t = time. The dimensions of b^2/a are :

(A) $[ML^3T^{-3}]$ (B) $[MLT^{-2}]$

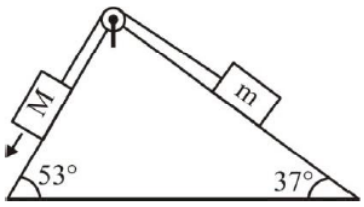
(C) $[ML^{-1}T^{-1}]$ (D) $[ML^2T^{-3}]$

42. Two charges q and 3q are separated by a distance 'r' in air. At a distance x from charge q, the resultant electric field is zero. The value of x is :

(A) $\frac{\left(1+\sqrt{3}\right)}{r}$ (B) $\frac{r}{3\left(1+\sqrt{3}\right)}$ (C) $\frac{r}{\left(1+\sqrt{3}\right)}$ (D) $r\left(1+\sqrt{3}\right)$

43. In the given arrangement of a doubly inclined plane two blocks of masses M and m are placed. The blocks are connected by a light string passing over an ideal pulley as shown. The coefficient of friction between the surface of the plane and the blocks is 0.25. The value of m, for which M = 10 kg will move down with an acceleration of 2 m/s^2, is :

(take g = 10 m/s^2 and tan 37° = 3/4)



(A) 9 kg (B) 4.5 kg (C) 6.5 kg (D) 2.25 kg

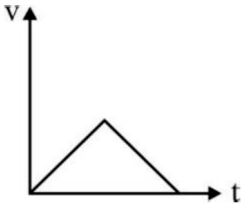
44. A coil is placed perpendicular to a magnetic field of 5000 T. When the field is changed to 3000 T in 2s, an induced emf of 22 V is produced in the coil. If the diameter of the coil is 0.02 m, then the number of turns in the coil is :

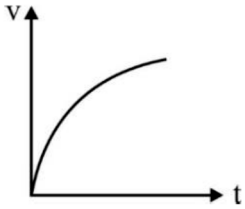
(A) 7 (B) 70 (C) 35 (D) 140

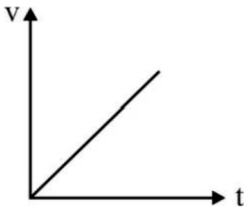
45. The fundamental frequency of a closed organ pipe is equal to the first overtone frequency of an open organ pipe. If length of the open pipe is 60 cm, the length of the closed pipe will be :

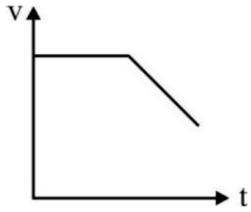
(A) 60 cm (B) 45 cm (C) 30 cm (D) 15 cm

46. A small steel ball is dropped into a long cylinder containing glycerine. Which one of the following is the correct representation of the velocity time graph for the transit of the ball ?

(A) 

(B) 

(C) 

(D) 

47 A coin is placed on a disc. The coefficient of friction between the coin and the disc is μ. If the distance of the coin from the center of the disc is r, the maximum angular velocity which can be given to the disc, so that the coin does not slip away, is :

(A) $\frac{\mu g}{r}$ (B) $\sqrt{\frac{r}{\mu g}}$ (C) $\sqrt{\frac{\mu g}{r}}$ (D) $\frac{\mu}{\sqrt{rg}}$

48. Two conductors have the same resistances at 0°C but their temperature coefficients of resistance are α_1 and α_2. The respective temperature coefficients for their series and parallel combinations are :

(A) $\alpha_1+\alpha_2, \frac{\alpha_1+\alpha_2}{2}$ (B) $\frac{\alpha_1+\alpha_2}{2}, \frac{\alpha_1+\alpha_2}{2}$

(C) $\alpha_1+\alpha_2, \frac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}$ (D) $\frac{\alpha_1+\alpha_2}{2}, \alpha_1+\alpha_2$

49. An artillery piece of mass M_1 fires a shell of mass M_2 horizontally. Instantaneously after the firing, the ratio of kinetic energy of the artillery and that of the shell is :

(A) $M_1/(M_1+M_2)$ (B) $\frac{M_2}{M_1}$ (C) $M_2/(M_1+M_2)$ (D) $\frac{M_1}{M_2}$

50. When a metal surface is illuminated by light of wavelength λ, the stopping potential is 8V. When the same surface is illuminated by light of wavelength 3λ, stopping potential is 2V. The threshold wavelength for this surface is :

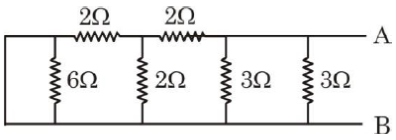
(A) 5λ (B) 3λ (C) 9λ (D) 4.5λ

Section - B (Numerical Value Type)

51. An electron moves through a uniform magnetic field $\vec{B}=B_0\hat{i}+2B_0\hat{j}T$. At a particular instant of time, the velocity of electron is $\vec{u}=3\hat{i}+5\hat{j}$ m/s. If the magnetic force acting on electron is $\vec{F}=5ek$ N, where e is the charge of electron, then the value of B_0 is ____ T.

52. A parallel plate capacitor with plate separation 5mm is charged up by a battery. It is found that on introducing a dielectric sheet of thickness 2 mm, while keeping the battery connections intact, the capacitor draws 25% more charge from the battery than before. The dielectric constant of the sheet is ____.

53. Equivalent resistance of the following network is _____ Ω.



54. A solid circular disc of mass 50 kg rolls along a horizontal floor so that its center of mass has a speed of 0.4 m/s. The absolute value of work done on the disc to stop it is _____ J.

55. A body starts falling freely from height H hits an inclined plane in its path at height h. As a result of this perfectly elastic impact, the direction of the velocity of the body becomes horizontal. The value of H/h for which the body will take the maximum time to reach the ground is _____.

56. Two waves of intensity ratio 1 : 9 cross each other at a point. The resultant intensities at the point, when (a) Waves are incoherent is I_1 (b) Waves are coherent is I_2 and differ in phase by 60°.

If $\frac{I_1}{I_2}=\frac{10}{x}$ then x = _____.

57. A small square loop of wire of side l is placed inside a large square loop of wire of side L ($L = l^2$). The loops are coplanar and their centers coinside. The value of the mutual inductance of the system is $\sqrt{x}\times10^{-7}$ H, where x = _____.

58. The depth below the surface of sea to which a rubber ball be taken so as to decrease its volume by 0.02% is _____ m.

[Take density of sea water = 10^3 kgm^{-3}, Bulk modulus of rubber = 9×10^8 Nm^{-2} and g = 10 ms^{-2}]

59. A particle performs simple harmonic motion with amplitude A. Its speed is increased to three times at an instant when its displacement is 2A/3. The new amplitude of motion is nA/3. The value of n is _____.

60. The mass defect in a particular reaction is 0.4g.

The amount of energy liberated is n × 10^7 kWh, where n = _____. (speed of light = 3×10^8 m/s)

CHEMISTRY Section - A (Single Correct Answer)

61. Give below are two statements :

Statement-I : Noble gases have very high boiling points.

Statement-II : Noble gases are monoatomic gases. They are held together by strong dispersion forces. Because of this they are liquefied at very low temperature. Hence, they have very high boiling points.

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

(A) Statement I is false but Statement II is true.

(B) Both Statement I and Statement II are true.

(C) Statement I is true but Statement II is false.

(D) Both Statement I and Statement II are false.

62. For the given reaction, choose the correct expression of K_C from the following :

$$Fe^{3+}_{(aq)} + SCN^{-}_{(aq)} \rightleftharpoons (FeSCN)^{2+}_{(aq)}$$

(A) $K_C=\frac{[FeSCN^{2+}]}{[Fe^{3+}][SCN^-]}$

(B) $K_C=\frac{[Fe^{3+}][SCN^-]}{[FeSCN^{2+}]}$

(C) $K_C=\frac{[FeSCN^{2+}]}{[Fe^{3+}]^2[SCN^-]^2}$

(D) $K_C=\frac{[FeSCN^{2+}]^2}{[Fe^{3+}][SCN^-]}$

63. Identify the mixture that shows positive deviations from Raoult's Law.

(A) $(CH_3)_2CO + C_6H_5NH_2$ (B) $CHCl_3 + C_6H_6$

(C) $CHCl_3 + (CH_3)_2CO$ (D) $(CH_3)_2CO + CS_2$

64. The compound that is white in color is

(A) ammonium sulphide (B) lead sulphate

(C) lead iodide (D) ammonium arsinomolybdate

65. The metals that are employed in the battery industries are –

A. Fe **B.** Mn **C.** Ni

D. Cr **E.** Cd

Choose the **correct answer** from the options given below :

(A) B, C and E only (B) A, B, C, D and E

(C) A, B, C and D only (D) B, D and E only

66. A species having carbon with sextet of electrons and can act as electrophile is called.

(A) carbon free radical (B) carbanion

(C) carbocation (D) pentavalent carbon

67. Identify the factor from the following that does not affect electrolytic conductance of a solution.

(A) The nature of the electrolyte added. (B) The nature of the electrode used.

(C) Concentration of the electrolyte. (D) The nature of solvent used.

68. The product (C) in the below mentioned reaction is :

$$CH_3 - CH_2 - CH_2 - Br \xrightarrow[\Delta]{KOH_{(alc.)}} A \xrightarrow{HBr} B \xrightarrow[KOH_{(aq)}]{\Delta} C$$

(A) Propan-1-ol (B) Propene (C) Propyne (D) Propan-2-ol

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

Assertion A : Alcohols react both as nucleophiles and electrophiles.

Reason R : Alcohols react with active metals such as sodium, potassium and aluminum to yield corresponding alkoxides and liberate hydrogen.

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

(A) A is false but R is true.

(B) A is true but R is false.

(C) Both A and R are true and R is the correct explanation of A.

(D) Both A and R are true but R is NOT the correct explanation of A.

70. The correct sequence of electron gain enthalpy of the elements listed below is

A. Ar **B.** Br **C.** F **D.** S

Choose the most appropriate from the options given below :

(A) C > B > D > A (B) A > D > B > C

(C) A > D > C > B (D) D > C > B > A

71. Identify correct statements from below :

A. The chromate ion is square planar.

B. Dichromates are generally prepared from chromates.

C. The green manganate ion is diamagnetic.

D. Dark green coloured K_2MnO_4 disproportionates in a neutral or acidic medium to give permanganate.

E. With increasing oxidation number of transition metal, ionic character of the oxides decreases.

Choose the correct answer from the options given below :

(A) B, C, D only (B) A, D, E only (C) A, B, C only (D) B, D, E only

72. 'Adsorption' principle is used for which of the following purification method ?

(A) Extraction (B) Chromatography

(C) Distillation (D) Sublimation

73. Integrated rate law equation for a first order gas phase reaction is given by :

[where P_i is initial pressure and P_t is total pressure at time t]

(A) $k = \frac{2.303}{t} \times \log \frac{P_i}{(2P_i - P_t)}$ (B) $k = \frac{2.303}{t} \times \log \frac{2P_i}{(2P_i - P_t)}$

(C) $k = \frac{2.303}{t} \times \log \frac{(2P_i - P_t)}{P_i}$ (D) $k = \frac{2.303}{t} \times \frac{P_i}{(2P_i - P_t)}$

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

Assertion A : pK_a value of phenol is 10.0 while that of ethanol is 15.9.

Reason R : Ethanol is stronger acid than phenol.

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

(A) A is true but R is false.

(B) A is false but R is true.

(C) Both A and R are true and R is the correct explanation of A.

(D) Both A and R are true but R is NOT the correct explanation of A.

75. Given below are two statements :

Statement I : IUPAC name of $HO–CH_2–(CH_2)_3–CH_2–COCH_3$ is 7-hydroxyheptan-2-one.

Statement II : 2-oxoheptan-7-ol is the correct IUPAC name for above compound.

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

(A) Statement I is correct but Statement II is incorrect.

(B) Both Statement I and Statement II are incorrect.

(C) Both Statement I and Statement II are correct.

(D) Statement I is incorrect but Statement II is correct.

76. The correct statements from following are :

A. The strength of anionic ligands can be explained by crystal field theory.

B. Valence bond theory does not give a quantitative interpretation of kinetic stability of coordination compounds.

C. The hybridization involved in formation of $[Ni(CN)_4]^{2-}$ complex is dsp^2.

D. The number of possible isomer(s) of cis-$[PtCl_2(en)_2]^{2+}$ is one

Choose the correct answer from the options given below.

(A) A, D only (B) A, C only (C) B, D only (D) B, C only

77. The linear combination of atomic orbitals to form molecular orbitals takes place only when the combining atomic orbitals.

A. have the same energy

B. have the minimum overlap

C. have same symmetry about the molecular axis

D. have different symmetry about the molecular axis

Choose the most appropriate from the options given below.

(A) A, B, C only (B) A and C only

(C) B, C, D only (D) B and D only

78. Match List I with List II :

	LIST-I		LIST-II
A.	Glucose/$NaHCO_3/\Delta$	I.	Gluconic acid
B.	Glucose/HNO_3	II.	No reaction
C.	Glucose/HI/Δ	III.	n-hexane
D.	Glucose/Bromine water	IV.	Saccharic acid

Choose the correct answer from the options given below.

(A) A-IV, B-I, C-III, D-II (B) A-II, B-IV, C-III, D-I

(C) A-III, B-II, C-I, D-IV (D) A-I, B-IV, C-III, D-II

79. Consider the oxides of group 14 elements SiO_2, GeO_2, SnO_2, PbO_2, CO and GeO. The amphoteric oxides are

(A) GeO, GeO_2 (B) SiO_2, GeO_2 (C) SnO_2, PbO_2 (D) SnO_2, CO

80. Match List I with List II :

	LIST I (Technique)		LIST II (Application)
A.	Distillation	I.	Separation of glycerol from spent-lye
B.	Fractional distillation	II.	Aniline - Water mixture
C.	Steam distillation	III.	Separation of crude oil fractions
D.	Distillation under reduced pressure	IV.	Chloroform-Aniline

Choose the ***correct answer*** from the options given below.

(A) A-IV, B-I, C-II, D-III (B) A-IV, B-III, C-II, D-I

(C) A-I, B-II, C-IV, D-III (D) A-II, B-III, C-I, D-IV

Section - B (Numerical Value Type)

81. Molar mass of the salt from NaBr, $NaNO_3$, KI and CaF_2 which does not evolve coloured vapours on heating with concentrated H_2SO_4 is _____ g mol^{-1}.

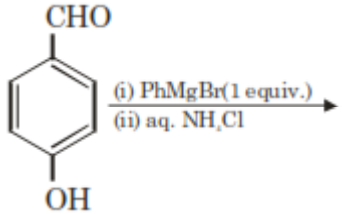
[Molar mass in g mol^{-1} : Na : 23, N : 14, K : 39, O : 16, Br : 80, I : 127, F : 19, Ca : 40]

82. The 'Spin only' Magnetic moment for $[Ni(NH_3)_6]^{2+}$ is _____ $\times 10^{-1}$ BM.

[given = Atomic number of Ni : 28]

83. Number of moles of methane required to produce 22 g $CO_{2(g)}$ after combustion is $x \times 10^{-2}$ moles. The value of 'x' is

84. The product of the following reaction is P.



The number of hydroxyl groups present in the product P is _____.

85. The number of species from the following in which the central atom uses sp^3-hybrid orbitals in its bonding is _____.

NH_3, SO_2, SiO_2, $BeCl_2$, CO_2, H_2O, CH_2, BF_3

86. $CH_3CH_2Br + NaOH \xrightarrow[H_2O]{C_2H_5OH} \begin{matrix}\text{Product A}\\ \text{Product B}\end{matrix}$

The total number of hydrogen atoms in product A and product B is _____.

87. Number of alkanes obtained on electrolysis of a mixture of CH_3COONa and C_2H_5COONa is _____.

88. Consider the following reaction at 298 K.

$$\frac{3}{2}O_{2(g)} \rightleftharpoons O_{3(g)};\ K_p = 2.47 \times 10^{-29}$$

$\Delta_r G^{\ominus}$ for the reaction is _____ kJ.

[**Given :** R = 8.314 JK^{-1} mol^{-1}]

89. The ionization energy of sodium in kJ mol^{-1}. If electromagnetic radiation of wavelength 242 nm is just sufficient to ionize sodium atom is _____.

90. One Faraday of electricity liberates x × 10^{-1} gram atom of copper from copper sulphate, x is _____.

● ● ●

31-Jan.-2024 (Morning) : PCM

MATHEMATICS

Single Choice Correct									
1.	A	2.	D	3.	A	4.	C	5.	D
6.	D	7.	D	8.	D	9.	C	10.	D
11.	A	12.	D	13.	D	14.	D	15.	A
16.	D	17.	D	18.	C	19.	D	20.	B
Numerical Value									
21.	176	22.	27	23.	3734	24.	12	25.	118
26.	3	27.	51	28.	48	29.	16	30.	5

PHYSICS

Single Choice Correct									
31.	A	32.	C	33.	A	34.	D	35.	D
36.	A	37.	B	38.	D	39.	B	40.	A
41.	A	42.	C	43.	B	44.	B	45.	D
46.	B	47.	C	48.	B	49.	B	50.	C
Numerical Value									
51.	5	52.	2	53.	1	54.	6	55.	2
56.	13	57.	128	58.	18	59.	7	60.	1

CHEMISTRY

Single Choice Correct									
61.	D	62.	A	63.	D	64.	B	65.	A
66.	C	67.	B	68.	D	69.	D	70.	B
71.	D	72.	B	73.	A	74.	A	75.	A
76.	D	77.	B	78.	B	79.	C	80.	B
Numerical Value									
81.	78	82.	28	83.	50	84.	0	85.	4
86.	10	87.	3	88.	163	89.	494	90.	5