

JEE Main 2024 Paper 1 (B.E./B.Tech) 4 April 2024 Shift 1 Question Paper



Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours

Paper 1: B.E./B.Tech.

Maximum Marks: 300

General Instructions

- (i) This paper is **Paper 1 (B.E./B.Tech.)** of **JEE (Main) 2024 - Session 2**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 4 April 2024, Shift 1. The total duration is **3 hours**.
- (ii) The paper has **90 questions**, of which **75 are to be attempted**, and a maximum of **300 marks**: Mathematics, Physics and Chemistry carry 30 questions (100 marks) each, in that order.
- (iii) Each subject has **two sections**. **Section A** has **20 multiple choice questions** (MCQs) with four options each. Select the most appropriate answer. **Section B** has **10 numerical value questions**; attempt **any 5** of them.
- (iv) **All Section A questions are compulsory**. Attempt only the specified number of Section B questions. For Section B, the answer is an integer value; the answer should be **rounded off to the nearest integer**. Use only the constants given in the question while calculating.
- (v) **Marking scheme** (Sections A and B): **+4** for a correct answer, **-1** for an incorrect answer, and **0** for an unanswered or marked-for-review question.
- (vi) All calculations and rough work are to be done on the rough sheets only. Calculators, log tables, slide rules and electronic gadgets are not allowed.

1.

Let $f(x) = \begin{cases} -2, & -2 \leq x \leq 0 \\ x-2, & 0 < x \leq 2 \end{cases}$ and h

$(x) = f(|x|) + |f(x)|$. Then $\int_{-2}^2 h(x)dx$

is equal to:

- (A) 2 (B) 6
(C) 4 (D) 1

2. One of the points of intersection of the curves $y = 1 + 3x - 2x^2$ and

$$y = \frac{1}{x}$$

is

$$\left(\frac{1}{2}, 2\right)$$

. Let the area of the region enclosed by these curves be

$$\frac{1}{24}(l\sqrt{5} + m) - n \log_e(1 + \sqrt{5})$$

, where $l, m, n \in \mathbf{N}$. Then $l + m + n$ is equal to

- (A) 30 (B) 29
(C) 31 (D) 32

3. Let $\alpha \in (0, \infty)$ and

$$A = \begin{bmatrix} 1 & 2 & \alpha \\ 1 & 0 & 1 \\ 0 & 1 & 2 \end{bmatrix}$$

. If

$$\det(\text{adj}(2A - A^T) \cdot \text{adj}(A - 2A^T)) = 2^8$$

, then $(\det(A))^2$ is equal to:

- (A) 16 (B) 36
(C) 49 (D) 1

4. There are 5 points P_1, P_2, P_3, P_4, P_5 on the side AB , excluding A and B , of a triangle ABC . Similarly there are 6 points $P_6, P_7, \dots, P_{11}$ on the side BC and 7 points $P_{12}, P_{13}, \dots, P_{18}$ on the side CA of the triangle. The number of triangles, that can be formed using the points $P_1, P_2, \dots, P_{18}$ as vertices, is:

- (A) 751 (B) 776
(C) 796 (D) 771

5. A square is inscribed in the circle

$$x^2 + y^2 - 10x - 6y + 30 = 0$$

. One side of this square is parallel to $y = x + 3$. If (x_i, y_i) are the vertices of the square, then $\Sigma (x_i^2 + y_i^2)$ is equal to:

- (A) 152 (B) 148
(C) 156 (D) 160

6. Let $\alpha, \beta \in \mathbf{R}$. Let the mean and the variance of 6 observations $-3, 4, 7, -6, \alpha, \beta$ be 2 and 23, respectively. The mean deviation about the mean of these 6 observations is :

- (A) $\frac{16}{3}$
(B) $\frac{11}{3}$
(C) $\frac{14}{3}$
(D) $\frac{13}{3}$

7. Let

$$f(x) = x^5 + 2e^{x/4}$$

for all $x \in \mathbf{R}$. Consider a function $g(x)$ such that

$$(g \circ f)(x) = x$$

for all $x \in \mathbf{R}$. Then the value of $8g'(2)$ is :

- (A) 4 (B) 2
(C) 16 (D) 8

8. Let a unit vector which makes an angle of 60° with $2\hat{i} + 2\hat{j} - \hat{k}$ and an angle of 45° with $\hat{i} - \hat{k}$ be $\vec{C}$. Then

$$\vec{C} + \left(-\frac{1}{2}\hat{i} + \frac{1}{3\sqrt{2}}\hat{j} - \frac{\sqrt{2}}{3}\hat{k} \right)$$

is:

(A) $-\frac{\sqrt{2}}{3}\hat{i} + \frac{\sqrt{2}}{3}\hat{j} + \left(\frac{1}{2} + \frac{2\sqrt{2}}{3} \right)\hat{k}$

(B) $\left(\frac{1}{\sqrt{3}} + \frac{1}{2} \right)\hat{i} + \left(\frac{1}{\sqrt{3}} - \frac{1}{3\sqrt{2}} \right)\hat{j} + \left(\frac{1}{\sqrt{3}} + \frac{\sqrt{2}}{3} \right)\hat{k}$

(C) $\frac{\sqrt{2}}{3}\hat{i} - \frac{1}{2}\hat{k}$

(D) $\frac{\sqrt{2}}{3}\hat{i} + \frac{1}{3\sqrt{2}}\hat{j} - \frac{1}{2}\hat{k}$

9. If the domain of the function

$$\sin^{-1}\left(\frac{3x-22}{2x-19}\right) + \log_e\left(\frac{3x^2-8x+5}{x^2-3x-10}\right)$$

is $(\alpha, \beta]$, then $3\alpha + 10\beta$ is equal to:

- (A) 95 (B) 100
(C) 97 (D) 98

10. Let the point, on the line passing through the points $P(1, -2, 3)$ and $Q(5, -4, 7)$, farther from the origin and at a distance of 9 units from the point P , be (α, β, γ) . Then $\alpha^2 + \beta^2 + \gamma^2$ is equal to :

- (A) 150 (B) 155
(C) 160 (D) 165

11. The vertices of a triangle are $A(-1, 3)$, $B(-2, 2)$ and $C(3, -1)$. A new triangle is formed by shifting the sides of the triangle by one unit inwards. Then the equation of the side of the new triangle nearest to origin is :

- (A) $-x + y - (2 - \sqrt{2}) = 0$
(B) $x + y - (2 - \sqrt{2}) = 0$
(C) $x + y + (2 - \sqrt{2}) = 0$
(D) $x - y - (2 + \sqrt{2}) = 0$

12. Three urns A, B and C contain 7 red, 5 black; 5 red, 7 black and 6 red, 6 black balls, respectively. One of the urn is selected at random and a ball is drawn from it. If the ball drawn is black, then the probability that it is drawn from urn A is :

- (A) $\frac{4}{17}$
(B) $\frac{5}{16}$
(C) $\frac{5}{18}$
(D) $\frac{7}{18}$

13. If the solution

$$y = y(x)$$

of the differential equation

$$(x^4 + 2x^3 + 3x^2 + 2x + 2)dy - (2x^2 + 2x + 3)dx = 0$$

satisfies

$$y(-1) = -\frac{\pi}{4}$$

, then $y(0)$ is equal to :

- (A) $-\frac{\pi}{12}$
(B) $\frac{\pi}{2}$
(C) 0
(D) $\frac{\pi}{4}$

14. Let the first three terms 2, p and q, with $q \neq 2$, of a G.P. be respectively the 7th, 8th and 13th terms of an A.P. If the 5th term of the G.P. is the n^{th} term of the A.P., then n is equal to:

- (A) 151 (B) 177
(C) 163 (D) 169

15. The sum of all rational terms in the expansion of

$$\left(2^{\frac{1}{5}} + 5^{\frac{1}{3}}\right)^{15}$$

is equal to :

- (A) 633 (B) 6131
(C) 3133 (D) 931

16. If 2 and 6 are the roots of the equation $ax^2 + bx + 1 = 0$, then the quadratic equation, whose roots are

$$\frac{1}{2a+b}$$

and

$$\frac{1}{6a+b}$$

, is :

- (A) $x^2 + 8x + 12 = 0$
(B) $2x^2 + 11x + 12 = 0$
(C) $4x^2 + 14x + 12 = 0$
(D) $x^2 + 10x + 16 = 0$

17. Let the sum of the maximum and the minimum values of the function

$$f(x) = \frac{2x^2 - 3x + 8}{2x^2 + 3x + 8}$$

be $\frac{m}{n}$, where

$$\gcd(m, n) = 1$$

. Then $m + n$ is equal to :

- (A) 217 (B) 182
(C) 201 (D) 195

18. If the system of equations

$$x + (\sqrt{2} \sin \alpha)y + (\sqrt{2} \cos \alpha)z = 0$$

$$x + (\cos \alpha)y + (\sin \alpha)z = 0$$

$$x + (\sin \alpha)y - (\cos \alpha)z = 0$$

has a non-trivial solution, then

$$\alpha \in \left(0, \frac{\pi}{2}\right)$$

is equal to :

- (A) $\frac{5\pi}{24}$
(B) $\frac{11\pi}{24}$
(C) $\frac{7\pi}{24}$
(D) $\frac{3\pi}{4}$

19. Let α and β be the sum and the product of all the non-zero solutions of the equation

$$(\bar{z})^2 + |z| = 0, z \in \mathbb{C}$$

. Then $4(\alpha^2 + \beta^2)$ is equal to :

- (A) 4 (B) 2
(C) 6 (D) 8

20. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function given by

$$f(x) = \begin{cases} \frac{1 - \cos 2x}{x^2}, & x < 0 \\ \alpha, & x = 0, \\ \frac{\beta \sqrt{1 - \cos x}}{x}, & x > 0 \end{cases}$$

where $\alpha, \beta \in \mathbb{R}$. If f is continuous at $x = 0$, then $\alpha^2 + \beta^2$ is equal to :

- (A) 48 (B) 6
(C) 3 (D) 12

21. Let the solution

$$y = y(x)$$

of the differential equation

$$\frac{dy}{dx} - y = 1 + 4 \sin x$$

satisfy

$$y(\pi) = 1$$

. Then

$$y\left(\frac{\pi}{2}\right) + 10$$

is equal to _____.

22. If the shortest distance between the lines

$$\frac{x+2}{2} = \frac{y+3}{3} = \frac{z-5}{4}$$

and

$$\frac{x-3}{1} = \frac{y-2}{-3} = \frac{z+4}{2}$$

is

$$\frac{38}{3\sqrt{5}}k$$

, and

$$\int_0^k [x^2] dx = \alpha - \sqrt{\alpha}$$

, where $[x]$ denotes the greatest integer function, then $6\alpha^3$ is equal to _____.

23. Let A be a square matrix of order 2 such that $|A| = 2$

and the sum of its diagonal elements is -3 . If the points (x, y) satisfying

$$A^2 + xA + yI = O$$

lie on a hyperbola, whose transverse axis is parallel to the x -axis, eccentricity is e and the length of the latus rectum is l , then $e^4 + l^4$ is equal to _____.

24. If

$$\lim_{x \rightarrow 1} \frac{(5x+1)^{1/3} - (x+5)^{1/3}}{(2x+3)^{1/2} - (x+4)^{1/2}} = \frac{m\sqrt{5}}{n(2n)^{2/3}}$$

, where

$$\gcd(m, n) = 1$$

, then $8m + 12n$ is equal to _____.

25. Let A be a 3×3 matrix of non-negative real elements such that

$$A \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = 3 \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

. Then the maximum value of $\det(A)$ is _____.

26. If

$$\int_0^{\frac{\pi}{4}} \frac{\sin^2 x}{1 + \sin x \cos x} dx = \frac{1}{a} \log_e \left(\frac{a}{3} \right) + \frac{\pi}{b\sqrt{3}}$$

, where $a, b \in \mathbb{N}$, then $a + b$ is equal to _____.

27. In a survey of 220 students of a higher secondary school, it was found that at least 125 and at most 130 students studied Mathematics; at least 85 and at most 95 studied Physics; at least 75 and at most 90 studied Chemistry; 30 studied both Physics and Chemistry; 50 studied both Chemistry and Mathematics; 40 studied both Mathematics and Physics and 10 studied none of these subjects. Let m and n respectively be the least and the most number of students who studied all the three subjects. Then $m + n$ is equal to _____.

28. Let the length of the focal chord PQ of the parabola $y^2 = 12x$ be 15 units. If the distance of PQ from the origin is p , then $10p^2$ is equal to _____.

29. Let ABC be a triangle of area $15\sqrt{2}$ and the vectors

$$\vec{AB} = \hat{i} + 2\hat{j} - 7\hat{k}, \vec{BC} = a\hat{i} + b\hat{j} + c\hat{k}$$

and

$$\vec{AC} = 6\hat{i} + d\hat{j} - 2\hat{k}, d > 0$$

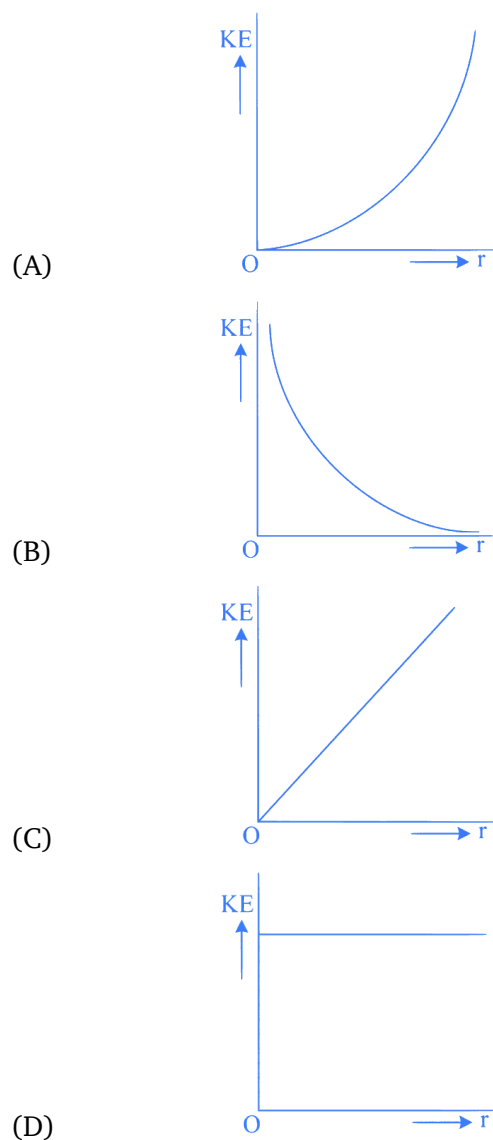
. Then the square of the length of the largest side of the triangle ABC is _____.

30. Let

$$\begin{aligned} a &= 1 + \frac{{}^2C_2}{3!} + \frac{{}^3C_2}{4!} + \frac{{}^4C_2}{5!} + \dots, b \\ &= 1 + \frac{{}^1C_0 + {}^1C_1}{1!} + \frac{{}^2C_0 + {}^2C_1 + {}^2C_2}{2!} + \\ &\quad \frac{{}^3C_0 + {}^3C_1 + {}^3C_2 + {}^3C_3}{3!} + \dots \end{aligned}$$

Then $\frac{2b}{a^2}$ is equal to _____.

31. An infinitely long positively charged straight thread has a linear charge density $\lambda \text{ Cm}^{-1}$. An electron revolves along a circular path having axis along the length of the wire. The graph that correctly represents the variation of the kinetic energy of electron as a function of radius of circular path from the wire is :



32. An electron is projected with uniform velocity along the axis inside a current carrying long solenoid. Then :

- (A) the electron will experience a force at 45° to the axis and execute a helical path. (B) the electron will be accelerated along the axis.
- (C) the electron path will be circular about the axis. (D) the electron will continue to move with uniform velocity along the axis of the solenoid.

33. A metal wire of uniform mass density having length L and mass M is bent to form a semicircular arc and a particle of mass m is placed at the centre of the arc. The gravitational force on the particle by the wire is :

- (A) $\frac{GmM\pi^2}{L^2}$
- (B) $\frac{GMm\pi}{2L^2}$
- (C) 0
- (D) $\frac{2GmM\pi}{L^2}$

34. An effective power of a combination of 5 identical convex lenses which are kept in contact along the principal axis is 25D. Focal length of each of the convex lens is:

- (A) 50 cm (B) 20 cm
- (C) 25 cm (D) 500 cm

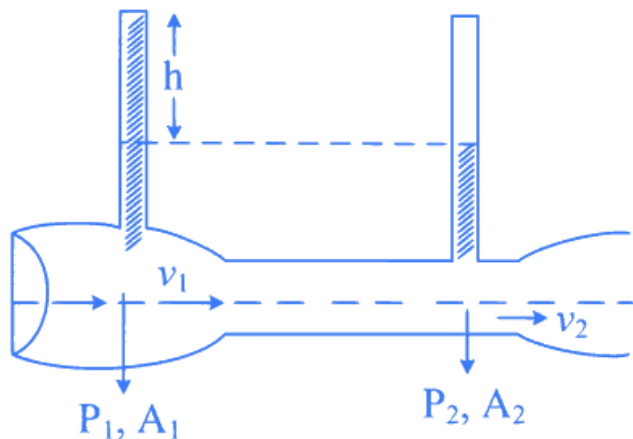
35. Given below are two statements :

Statement I : When speed of liquid is zero everywhere, pressure difference at any two points depends on equation

$$P_1 - P_2 = \rho g (h_2 - h_1)$$

Statement II : In ventury tube shown

$$2gh = v_1^2 - v_2^2$$



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 correct. |
| (C) Both Statement I and Statement II are incorrect. | (D) Statement I is incorrect but Statement II is correct. |

36. If a rubber ball falls from a height h and rebounds upto the height of $h/2$. The percentage loss of total energy of the initial system as well as velocity ball before it strikes the ground, respectively, are :

- | | |
|-----|----------------------------|
| (A) | 50%, $\sqrt{2gh}$ |
| (B) | 50%, $\sqrt{gh}$ |
| (C) | 50%, $\sqrt{\frac{gh}{2}}$ |
| (D) | 40%, $\sqrt{2gh}$ |

37. In an ac circuit, the instantaneous current is zero, when the instantaneous voltage is maximum. In this case, the source may be connected to :

- A. pure inductor.
 B. pure capacitor.
 C. pure resistor.
 D. combination of an inductor and capacitor.
 Choose the correct answer from the options given below :

- | | |
|---------------------|---------------------|
| (A) A, B and C only | (B) A and B only |
| (C) A, B and D only | (D) B, C and D only |

38. Which of the following nuclear fragments corresponding to nuclear fission between neutron (${}_0^1\text{n}$) and uranium isotope (${}_{92}^{235}\text{U}$) is correct :

- | | |
|-----|---|
| (A) | ${}_{56}^{140}\text{Xe} + {}_{38}^{94}\text{Sr} + {}_0^1\text{n}$ |
| (B) | ${}_{51}^{153}\text{Sb} + {}_{41}^{99}\text{Nb} + {}_0^1\text{n}$ |
| (C) | ${}_{56}^{144}\text{Ba} + {}_{36}^{89}\text{Kr} + {}_0^1\text{n}$ |
| (D) | ${}_{56}^{144}\text{Ba} + {}_{36}^{89}\text{Kr} + {}_0^1\text{n}$ |

39. A body travels 102.5 m in n^{th} second and 115.0 m in $(n + 2)^{\text{th}}$ second. The acceleration is :

- | | |
|-----|-----------------------|
| (A) | 6.25 m/s ² |
| (B) | 5 m/s ² |
| (C) | 12.5 m/s ² |
| (D) | 9 m/s ² |

40. In an experiment to measure focal length (f) of convex lens, the least counts of the measuring scales for the position of object (u) and for the position of image (v) are Δu and Δv , respectively. The error in the measurement of the focal length of the convex lens will be:

- (A) $2f \left[\frac{\Delta u}{u} + \frac{\Delta v}{v} \right]$
 (B) $f \left[\frac{\Delta u}{u} + \frac{\Delta v}{v} \right]$
 (C) $f^2 \left[\frac{\Delta u}{u^2} + \frac{\Delta v}{v^2} \right]$
 (D) $\frac{\Delta u}{u} + \frac{\Delta v}{v}$

41. The co-ordinates of a particle moving in x - y plane are given by :

$$x = 2 + 4t, y = 3t + 8t^2$$

The motion of the particle is :

- (A) uniform motion along a straight line. (B) non-uniformly accelerated.
 (C) uniformly accelerated having motion along a straight line. (D) uniformly accelerated having motion along a parabolic path.

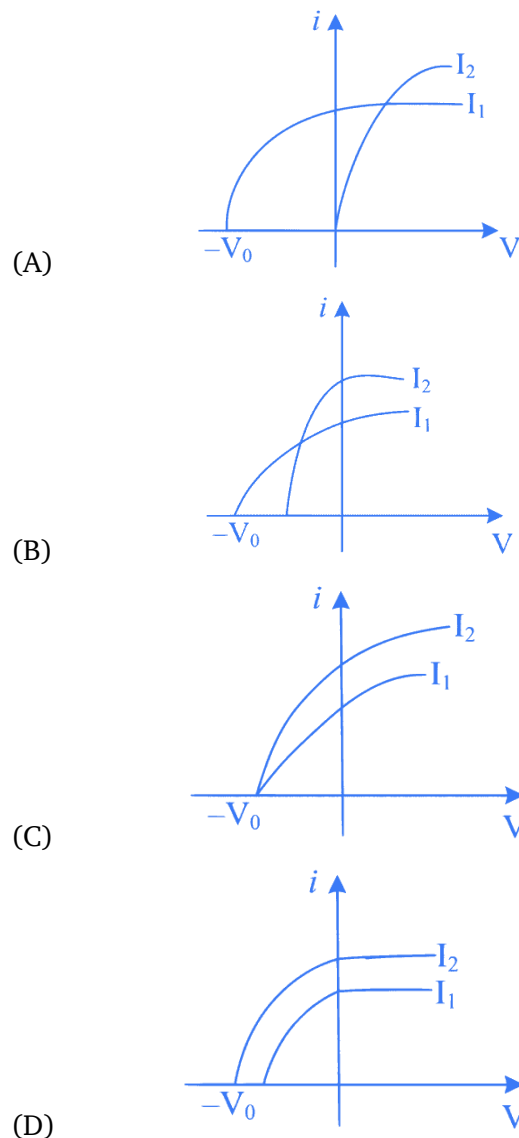
42. The equation of stationary wave is :

$$y = 2a \sin\left(\frac{2\pi nt}{\lambda}\right) \cos\left(\frac{2\pi x}{\lambda}\right).$$

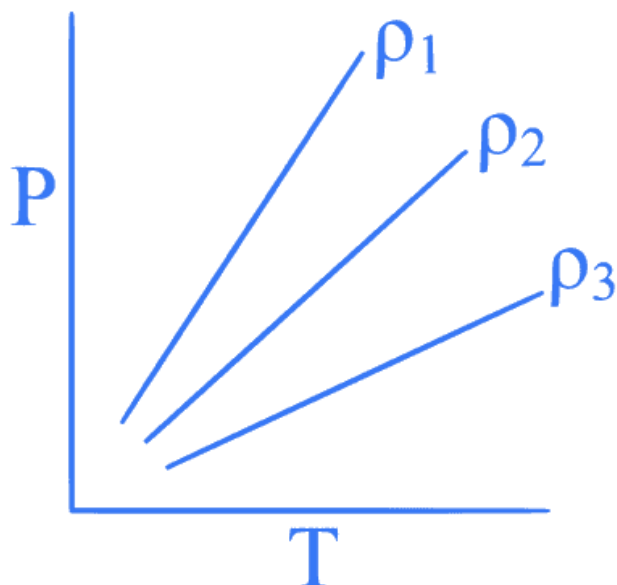
Which of the following is NOT correct :

- (A) The dimensions of nt is $[L]$ (B) The dimensions of n is $[LT^{-1}]$
 (C) The dimensions of x is $[L]$ (D) The dimensions of n/λ is $[T]$

43. Which figure shows the correct variation of applied potential difference (V) with photoelectric current (I) at two different intensities of light ($I_1 < I_2$) of same wavelengths :



44. P-T diagram of an ideal gas having three different densities ρ_1, ρ_2, ρ_3 (in three different cases) is shown in the figure. Which of the following is correct :



- (A) $\rho_1 > \rho_2$
 (B) $\rho_2 < \rho_3$
 (C) $\rho_1 = \rho_2 = \rho_3$
 (D) $\rho_1 < \rho_2$

45. The electric field in an electromagnetic wave is given by

$$\vec{E} = \hat{i}40 \cos \omega(t - z/c) \text{ NC}^{-1}$$

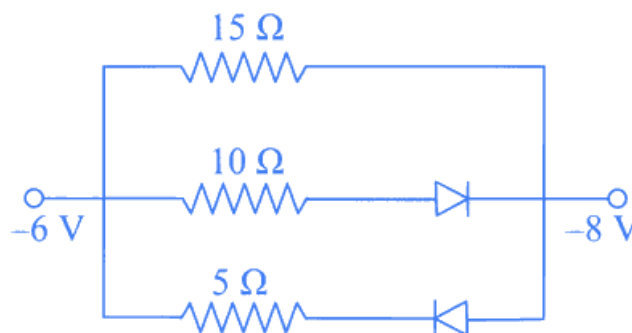
. The magnetic field induction of this wave is (in SI unit) :

- (A) $\vec{B} = \hat{j} \frac{40}{c} \cos \omega(t - z/c)$
 (B) $\vec{B} = \hat{i} \frac{40}{c} \cos \omega(t - z/c)$
 (C) $\vec{B} = \hat{j}40 \cos \omega(t - z/c)$
 (D) $\vec{B} = \hat{k} \frac{40}{c} \cos \omega(t - z/c)$

46. The resistances of the platinum wire of a platinum resistance thermometer at the ice point and steam point are 8Ω and 10Ω respectively. After inserting in a hot bath of temperature 400°C , the resistance of platinum wire is :

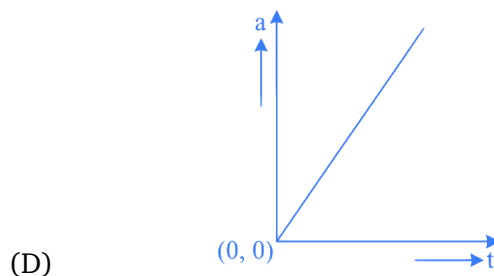
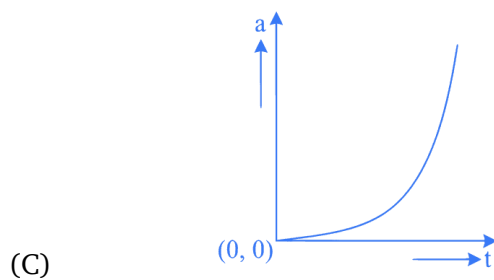
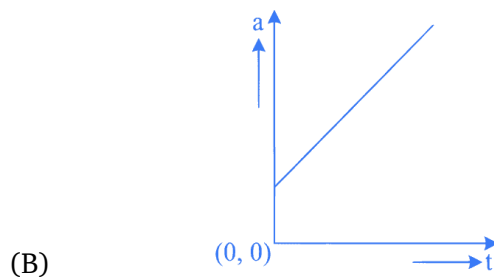
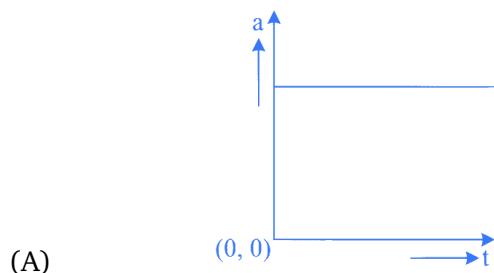
- (A) 10Ω (B) 16Ω
 (C) 8Ω (D) 2Ω

47. The value of net resistance of the network as shown in the given figure is :



- (A) $(30/11)\Omega$
 (B) 6Ω
 (C) $(5/2)\Omega$
 (D) $(15/4)\Omega$

48. A wooden block, initially at rest on the ground, is pushed by a force which increases linearly with time t . Which of the following curve best describes acceleration of the block with time :



49. To measure the internal resistance of a battery, potentiometer is used. For $R = 10\Omega$, the balance point is observed at $l = 500\text{ cm}$ and for

$R = 1\Omega$ the balance point is observed at $l = 400\text{ cm}$. The internal resistance of the battery is approximately :

- | | |
|-----|-------------|
| (A) | 0.1Ω |
| (B) | 0.3Ω |
| (C) | 0.2Ω |
| (D) | 0.4Ω |

50. On celcius scale the temperature of body increases by 40°C . The increase in temperature on Fahrenheit scale is :

- | | |
|-----|--------------------|
| (A) | 75°F |
| (B) | 70°F |
| (C) | 72°F |
| (D) | 68°F |

51. A solid sphere and a hollow cylinder roll up without slipping on same inclined plane with same initial speed v . The sphere and the cylinder reaches upto maximum heights h_1 and h_2 respectively, above the initial level. The ratio $h_1 : h_2$ is $\frac{n}{10}$. The value of n is _____.

52. An infinite plane sheet of charge having uniform surface charge density $+\sigma_s \text{ C/m}^2$ is placed on $x-y$ plane. Another infinitely long line charge having uniform linear charge density $+\lambda_e \text{ C/m}$ is placed at

$$z = 4 \text{ m}$$

plane and parallel to y -axis. If the magnitude values

$$|\sigma_s| = 2|\lambda_e|$$

then at point $(0, 0, 2)$, the ratio of magnitudes of electric field values due to sheet charge to that of line charge is $\pi\sqrt{n} : 1$. The value of n is _____.

53. A hydrogen atom changes its state from $n = 3$ to $n = 2$. Due to recoil, the percentage change in the wave length of emitted light is approximately 1×10^{-n} . The value of n is _____.

[Given Rhc

$$= 13.6 \text{ eV}, hc = 1242 \text{ eV nm}, h = 6.6 \times 10^{-34} \text{ J s}$$

$$\text{mass of the hydrogen atom} = 1.6 \times 10^{-27} \text{ kg}$$

]

54. A soap bubble is blown to a diameter of 7 cm . 36960 erg of work is done in blowing it further. If surface tension of soap solution is 40 dyne/cm then the new radius is _____ cm Take

$$\left(\pi = \frac{22}{7}\right)$$

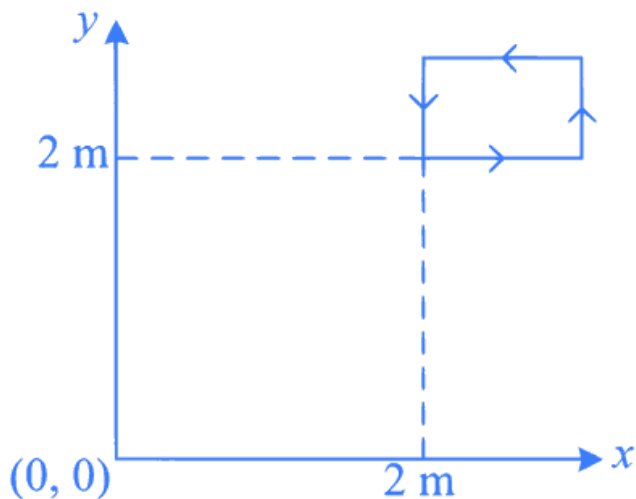
.

55. An elastic spring under tension of 3 N has a length a . Its length is b under tension 2 N. For its length $(3a - 2b)$, the value of tension will be _____ N.

56. The magnetic field existing in a region is given by

$$\vec{B} = 0.2(1 + 2x)\hat{k}$$

. A square loop of edge 50 cm carrying 0.5 A current is placed in x - y plane with its edges parallel to the x - y axes, as shown in figure. The magnitude of the net magnetic force experienced by the loop is _____ mN.



57. Two forces $\vec{F}_1$ and $\vec{F}_2$ are acting on a body. One force has magnitude thrice that of the other force and the resultant of the two forces is equal to the force of larger magnitude. The angle between $\vec{F}_1$ and $\vec{F}_2$ is

$$\cos^{-1}\left(\frac{1}{n}\right)$$

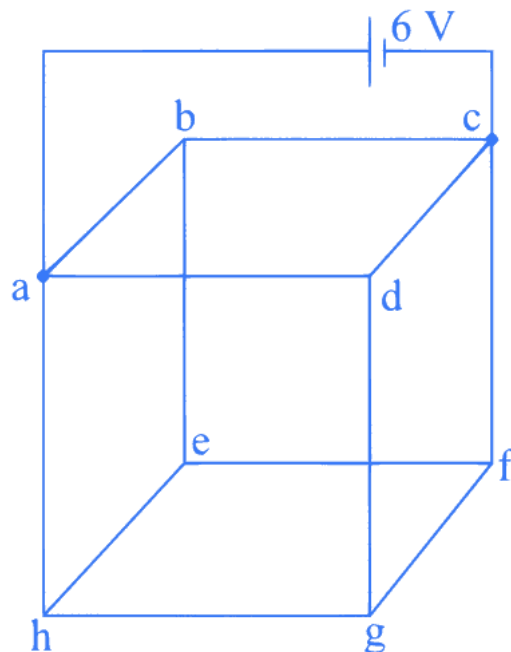
. The value of $|n|$ is _____.

58. A alternating current at any instant is given by

$$i = [6 + \sqrt{56} \sin(100\pi t + \pi/3)]$$

A. The *rms* value of the current is _____ A.

59. Twelve wires each having resistance 2Ω are joined to form a cube. A battery of 6 V emf is joined across point a and c . The voltage difference between e and f is _____ V.



60. Two wavelengths λ_1 and λ_2 are used in Young's double slit experiment.

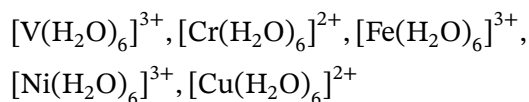
$$\lambda_1 = 450 \text{ nm}$$

and

$$\lambda_2 = 650 \text{ nm}$$

. The minimum order of fringe produced by λ_2 which overlaps with the fringe produced by λ_1 is n . The value of n is _____.

61. Number of complexes from the following with even number of unpaired "d" electrons is



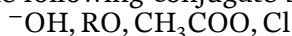
[Given atomic numbers:

V = 23, Cr = 24, Fe = 26, Ni = 28, Cu = 29

]

- (A) 1 (B) 5
(C) 2 (D) 4

62. What will be the decreasing order of basic strength of the following conjugate bases?



- (A) $Cl > RO > ^-OH > CH_3COO$
(B) $^-OH > RO > CH_3COO > Cl$
(C) $Cl > ^-OH > RO > CH_3COO^-$
(D) $RO > ^-OH > CH_3COO > Cl$

63. Given below are two statements :

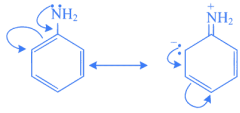
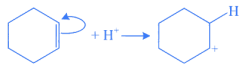
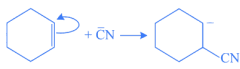
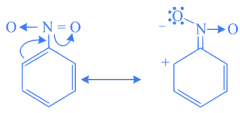
Statement I : Acidity of α -hydrogens of aldehydes and ketones is responsible for Aldol reaction.

Statement II : Reaction between benzaldehyde and ethanal will NOT give Cross - Aldol product.

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

- (A) Both Statement I and Statement II are incorrect
(B) Statement I is correct but Statement II is incorrect
(C) Both Statement I and Statement II are correct
(D) Statement I is incorrect but Statement II is correct

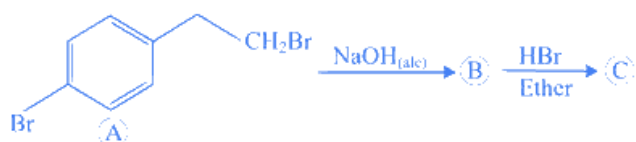
64. Match List I with List II :

	LIST I Mechanism steps		LIST II Effect
A.		I.	- E effect
B.		II.	- R effect
C.		III.	+ E effect
D.		IV.	+ R effect

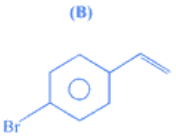
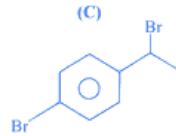
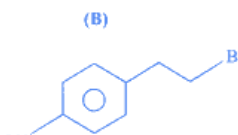
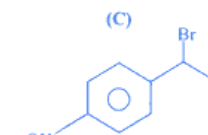
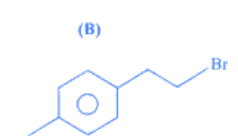
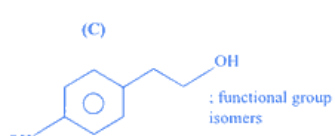
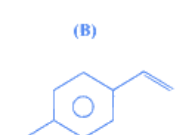
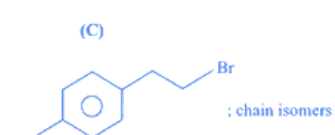
Choose the correct answer from the options given below :

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

65.



Identify B and C and how are A and C related?

- (A)   : position isomers
- (B)   : Derivative
- (C)   : functional group isomers
- (D)   : chain isomers

66. Identify the correct set of reagents or reaction conditions 'X' and 'Y' in the following set of transformation.



- (A) dil.aq. $\text{NaOH}, 20^\circ\text{C}$, $\text{Y} = \text{HBr}/\text{acetic acid}$
- (B) conc.alc. $\text{NaOH}, 80^\circ\text{C}$, $\text{Y} = \text{Br}_2/\text{CHCl}_3$
- (C) dil.aq. $\text{NaOH}, 20^\circ\text{C}$, $\text{Y} = \text{Br}_2/\text{CHCl}_3$
- (D) conc.alc. $\text{NaOH}, 80^\circ\text{C}$, $\text{Y} = \text{HBr}/\text{acetic acid}$

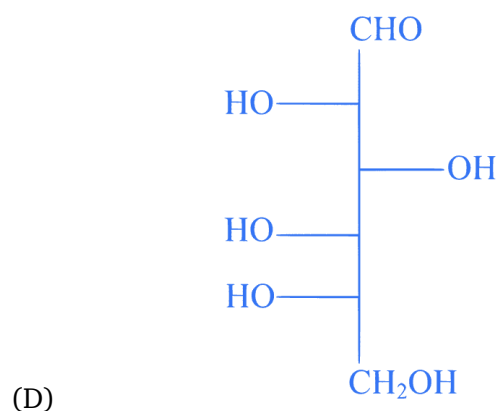
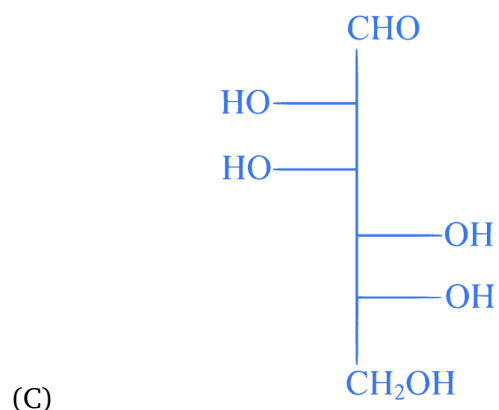
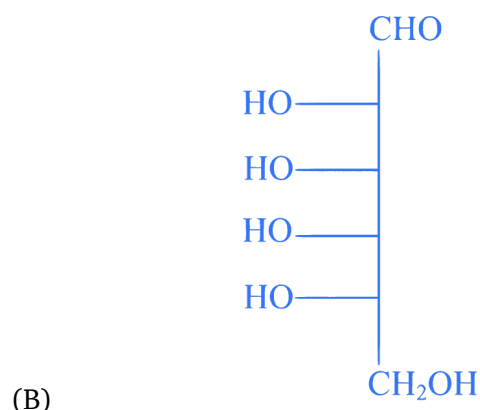
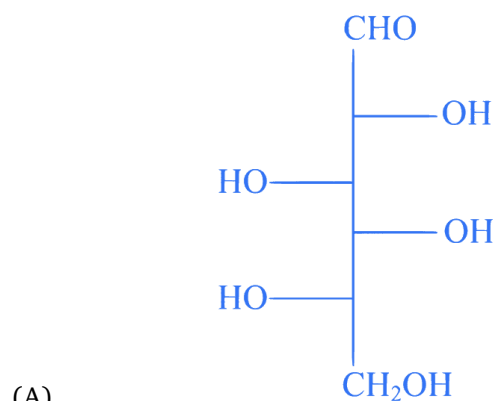
67. In the precipitation of the iron group (III) in qualitative analysis, ammonium chloride is added before adding ammonium hydroxide to :

- (A) decrease concentration of OH^- ions
- (B) increase concentration of Cl^- ions
- (C) prevent interference by phosphate ions
- (D) increase concentration of NH_4^+ ions

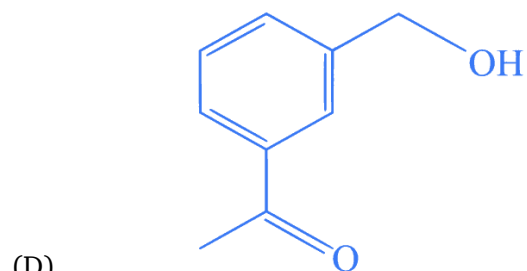
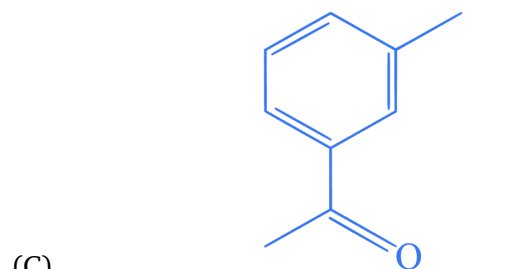
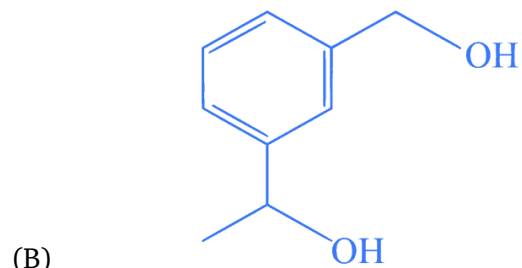
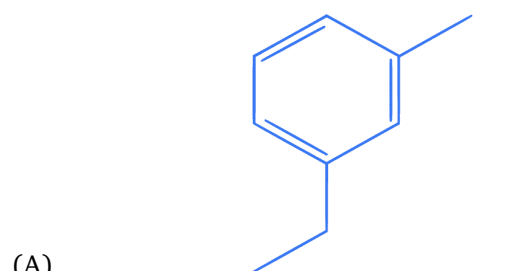
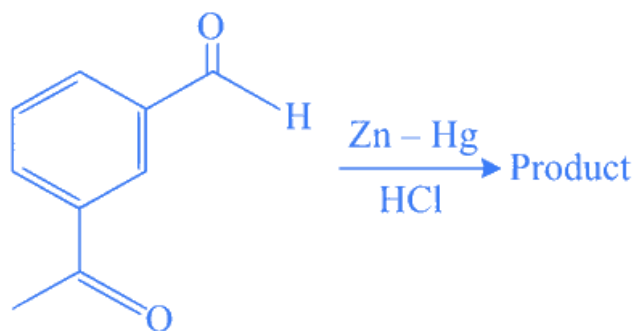
68. The element which shows only one oxidation state other than its elemental form is :

- (A) Nickel
- (B) Titanium
- (C) Cobalt
- (D) Scandium

69. Which of the following is the correct structure of L-Glucose?



70. Identify the product in the following reaction:



71. Number of molecules/ions from the following in which the central atom is involved in sp^3 hybridization is _____.
 $NO_3^-, BCl_3, ClO_2^-, ClO_3^-$

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

72. The correct sequence of ligands in the order of decreasing field strength is :

- (A) $NCS^- > EDTA^{4-} > CN^- > CO$
 (B) $CO > H_2O > F^- > S^{2-}$
 (C) $S^{2-} > ^-OH > EDTA^{4-} > CO$
 (D) $^-OH > F^- > NH_3 > CN^-$

73. The Molarity (M) of an aqueous solution containing 5.85 g of NaCl in 500 mL water is :
 (Given : Molar Mass Na : 23 and Cl : 35.5 $gmol^{-1}$)

- (A) 20 (B) 4
(C) 2 (D) 0.2

74. Which among the following is incorrect statement?

- (A) The electromeric effect is, temporary effect
 (B) Hydrogen ion (H^+) shows negative electromeric effect
 (C) The organic compound shows electromeric effect in the presence of the reagent only.
 (D) Electromeric effect dominates over inductive effect

75. One of the commonly used electrode is calomel electrode. Under which of the following categories, calomel electrode comes?

- (A) Metal ion - Metal electrodes
 (B) Oxidation - Reduction electrodes
 (C) Metal - Insoluble Salt - Anion electrodes
 (D) Gas - Ion electrodes

76. The correct order of first ionization enthalpy values of the following elements is :

- (A) O
(B) N
(C) Be
(D) F
(E) B

Choose the correct answer from the options given below :

- (A) $A < B < D < C < E$
 (B) $C < E < A < B < D$
 (C) $E < C < A < B < D$
 (D) $B < D < C < E < A$

77. Which of the following nitrogen containing compound does not give Lassaigne's test ?

- (A) Glycine (B) Phenyl hydrazine
(C) Urea (D) Hydrazine

78. Which one of the following molecules has maximum dipole moment?

- (A) CH_4
 (B) NF_3
 (C) NH_3
 (D) PF_5

79. What pressure (bar) of H_2 would be required to make emf of hydrogen electrode zero in pure water at $25^\circ C$?

- (A) 0.5
 (B) 10^{-14}
 (C) 1
 (D) 10^{-7}

80. Number of elements from the following that CANNOT form compounds with valencies which match with their respective group valencies is _____. B, C, N, S, O, F, P, Al, Si

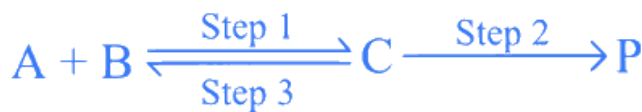
- (A) 7 (B) 3
(C) 5 (D) 6

81. 2.5 g of a non-volatile, non-electrolyte is dissolved in 100 g of water at 25°C. The solution showed a boiling point elevation by 2°C. Assuming the solute concentration is negligible with respect to the solvent concentration, the vapor pressure of the resulting aqueous solution is _____ mm of Hg (nearest integer)

[Given : Molal boiling point elevation constant of water (K_b) = 0.52 K.kgmol⁻¹, 1 atm pressure = 760 mm of Hg, molar mass of water = 18 g mol⁻¹]

82. Only 2 mL of KMnO₄ solution of unknown molarity is required to reach the end point of a titration of 20 mL of oxalic acid (2M) in acidic medium. The molarity of KMnO₄ solution should be _____ M.

83. Consider the following transformation involving first order elementary reaction in each step at constant temperature as shown below.



Some details of the above reactions are listed below.

Step	Rate constant (sec ⁻¹)	Activation energy (kJ mol ⁻¹)
1	k_1	300
2	k_2	200
3	k_3	E_{a3}

If the overall rate constant of the above transformation (k) is given as

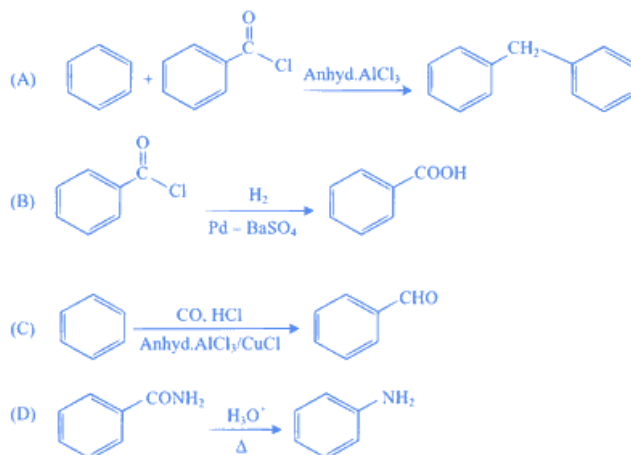
$$k = \frac{k_1 k_2}{k_3}$$

and the overall activation energy (E_a) is 400 kJ mol⁻¹, then the value of E_{a3} is _____ integer)

84. The enthalpy of formation of ethane (C₂H₆) from ethylene by addition of hydrogen where the bond-energies of C – H, C – C, C = C, H – H are 414 kJ, 347 kJ, 615 kJ and 435 kJ respectively is – _____ kJ

85. Xg of ethylamine is subjected to reaction with NaNO₂/HCl followed by water; evolved dinitrogen gas which occupied 2.24 L volume at STP. X is _____ × 10⁻¹ g.

86. The number of the correct reaction(s) among the following is _____.



87. The de-Broglie's wavelength of an electron in the 4th orbit is _____ $\frac{\pi a_0}{a_0}$ (Bohr's radius)

88. The number of different chain isomers for C₇H₁₆ is _____.

89. Number of molecules/species from the following having one unpaired electron is _____.
O₂, O₂⁻¹, NO, CN⁻¹, O₂²⁻

90. Consider the following reaction
 $\text{MnO}_2 + \text{KOH} + \text{O}_2 \rightarrow \text{A} + \text{H}_2\text{O}$.
Product 'A' in neutral or acidic medium disproportionate to give products 'B' and 'C' along with water. The sum of spin-only magnetic moment values of B and C is _____ BM. (nearest integer) (Given atomic number of Mn is 25)

- End of Question Paper -