

JEE Main 2024 Paper 1 (B.E./B.Tech) 30 January 2024 Shift 2 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 1**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 30 January 2024, Shift 2. 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 $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by

$$f(x) = \frac{x}{(1+x^4)^{1/4}}$$

, and

$$g(x) = f(f(f(f(x))))$$

. Then, $18 \int_0^{\sqrt[2]{\sqrt{5}}} x^2 g(x) dx$ is equal to

- (A) 36 (B) 33
(C) 39 (D) 42

2. Let a and b be two distinct positive real numbers. Let 11^{th} term of a GP whose first term is a and third term is b , is equal to p^{th} term of another GP whose first term is a and fifth term is b . Then p is equal to

- (A) 20 (B) 24
(C) 21 (D) 25

3. Let

$$y = f(x)$$

be a thrice differentiable function in $(-5, 5)$. Let the tangents to the curve

$$y = f(x)$$

at $(1, f(1))$ and $(3, f(3))$ make angles $\pi/6$ and $\pi/4$, respectively with positive x -axis. If

$$27 \int_1^3 \left((f'(t))^2 + 1 \right) f''(t) dt = \alpha + \beta\sqrt{3}$$

where α, β are integers, then the value of $\alpha + \beta$ equals

- (A) 26 (B) -16
(C) 36 (D) -14

4. For $\alpha, \beta \in (0, \pi/2)$, let

$$3 \sin(\alpha + \beta) = 2 \sin(\alpha - \beta)$$

and a real number k be such that

$$\tan \alpha = k \tan \beta$$

. Then, the value of k is equal to

- (A) 5 (B) $-2/3$
(C) -5 (D) $2/3$

5. If z is a complex number, then the number of common roots of the equations

$$z^{1985} + z^{100} + 1 = 0$$

and

$$z^3 + 2z^2 + 2z + 1 = 0$$

, is equal to

- (A) 0 (B) 2
(C) 1 (D) 3

6. Let $f : \mathbb{R} - \{0\} \rightarrow \mathbb{R}$ be a function satisfying

$$f\left(\frac{x}{y}\right) = \frac{f(x)}{f(y)}$$

for all $x, y, f(y) \neq 0$. If

$$f'(1) = 2024$$

, then

- (A) $xf'(x) + 2024f(x) = 0$
(B) $xf'(x) - 2023f(x) = 0$
(C) $xf'(x) - 2024f(x) = 0$
(D) $xf'(x) + f(x) = 2024$

7. Let

$$R = \begin{pmatrix} x & 0 & 0 \\ 0 & y & 0 \\ 0 & 0 & z \end{pmatrix}$$

be a non-zero 3×3 matrix, where

$$x \sin \theta = y \sin \left(\theta + \frac{2\pi}{3} \right) = z \sin \left(\theta + \frac{4\pi}{3} \right) \neq 0,$$

$$\theta \in (0, 2\pi)$$

. For a square matrix M , let $\text{trace}(M)$ denote the sum of all the diagonal entries of M . Then, among the statements:

(I) Trace

$$(R) = 0$$

(II) If trace

$$(\text{adj}(\text{adj}(R))) = 0$$

, then R has exactly one non-zero entry.

- (A) Only (I) is true (B) Only (II) is true
(C) Both (I) and (II) are true (D) Neither (I) nor (II) is true

8. If

$x^2 - y^2 + 2hxy + 2gx + 2fy + c = 0$ is the locus of a point, which moves such that it is always equidistant from the lines $x + 2y + 7 = 0$ and $2x - y + 8 = 0$, then the value of $g + c + h - f$ equals

- (A) 8 (B) 14
(C) 29 (D) 6

9. Let a and b be real constants such that the function f defined by

$$f(x) = \begin{cases} x^2 + 3x + a & , x \leq 1 \\ bx + 2 & , x > 1 \end{cases}$$

be differentiable on $\mathbb{R}$. Then, the value of

$$\int_{-2}^2 f(x) dx$$

equals

- (A) 21 (B) 19/6
(C) 17 (D) 15/6

10. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined as

$$f(x) = ae^{2x} + be^x + cx$$

. If

$$f(0) = -1, f'(\log_e 2) = 21$$

and

$$\int_0^{\log_e 4} (f(x) - cx) dx = \frac{39}{2}$$

, then the value of $|a + b + c|$ equals

- (A) 16 (B) 12
(C) 8 (D) 10

11. Let

$$L_1 : \vec{r} = (\hat{i} - \hat{j} + 2\hat{k}) + \lambda(\hat{i} - \hat{j} + 2\hat{k}), \lambda \in \mathbb{R}$$

,

$$L_2 : \vec{r} = (\hat{j} - \hat{k}) + \mu(3\hat{i} + \hat{j} + p\hat{k}), \mu \in \mathbb{R}$$

$$, \text{ and } L_3 : \vec{r} = \delta(\ell\hat{i} + m\hat{j} + n\hat{k}), \delta \in \mathbb{R}$$

be three lines such that L_1 is perpendicular to L_2 and L_3 is perpendicular to both L_1 and L_2 . Then, the point which lies on L_3 is

- (A) (1, 7, -4)
(B) (1, -7, 4)
(C) (-1, 7, 4)
(D) (-1, 1 - 7, 4)

12. Let

$$\vec{a} = \hat{i} + \alpha\hat{j} + \beta\hat{k}, \alpha, \beta \in \mathbb{R}$$

. Let a vector $\vec{b}$ be such that the angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{4}$ and

$$|\vec{b}|^2 = 6$$

. If

$$\vec{a} \cdot \vec{b} = 3\sqrt{2}$$

, then the value of $(\alpha^2 + \beta^2) |\vec{a} \times \vec{b}|^2$ is equal to

- (A) 85 (B) 90
(C) 75 (D) 95

13. Let P be a point on the hyperbola

$$H : \frac{x^2}{9} - \frac{y^2}{4} = 1$$

, in the first quadrant such that the area of triangle formed by P and the two foci of H is $2\sqrt{13}$. Then, the square of the distance of P from the origin is

- (A) 26 (B) 22
(C) 20 (D) 18

14. Let

$$f(x) = (x+3)^2(x-2)^3, x \in [-4, 4]$$

. If M and m are the maximum and minimum values of f , respectively in $[-4, 4]$, then the value of $M - m$ is

- (A) 108 (B) 392
(C) 608 (D) 600

15. Suppose $2 - p, p, 2 - \alpha, \alpha$ are the coefficients of four consecutive terms in the expansion of $(1+x)^n$. Then the value of $p^2 - \alpha^2 + 6\alpha + 2p$ equals

- (A) 8 (B) 4
(C) 6 (D) 10

16. Consider the system of linear equations

$x + y + z = 5, x + 2y + \lambda^2 z = 9, x + 3y + \lambda z = \mu$, where $\lambda, \mu \in \mathbb{R}$. Then, which of the following statement is NOT correct?

- (A) System is consistent if $\lambda \neq 1$ and $\mu = 13$ (B) System is inconsistent if $\lambda = 1$ and $\mu \neq 13$
(C) System has unique solution if $\lambda \neq 1$ and $\mu \neq 13$ (D) System has infinite number of solutions if $\lambda = 1$ and $\mu = 13$

17. Let $\vec{a}$ and $\vec{b}$ be two vectors such that

$$|\vec{b}| = 1$$

and

$$|\vec{b} \times \vec{a}| = 2$$

. Then $|\vec{b} \times \vec{a} - \vec{b}|^2$ is equal to

- (A) 1 (B) 3
(C) 5 (D) 4

18. If the domain of the function

$$f(x) = \log_e \left(\frac{2x+3}{4x^2+x-3} \right) + \cos^{-1} \left(\frac{2x-1}{x+2} \right)$$

is $(\alpha, \beta]$, then the value of $5\beta - 4\alpha$ is equal to

- (A) 9 (B) 12
(C) 11 (D) 10

19. Bag A contains 3 white, 7 red balls and Bag B contains 3 white, 2 red balls. One bag is selected at random and a ball is drawn from it. The probability of drawing the ball from the bag A, if the ball drawn is white, is

- (A) 1/4 (B) 1/3
(C) 3/10 (D) 1/9

20. Let $A(\alpha, 0)$ and $B(0, \beta)$ be the points on the line $5x + 7y = 50$. Let the point P divide the line segment AB internally in the ratio $7:3$. Let $3x - 25 = 0$ be a directrix of the ellipse

$$E: \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

and the corresponding focus be S . If from S , the perpendicular on the x -axis passes through P , then the length of the latus rectum of E is equal to,

- (A) $\frac{25}{3}$
(B) $\frac{25}{9}$
(C) $\frac{32}{5}$
(D) $\frac{32}{9}$

21. In an examination of Mathematics paper, there are 20 questions of equal marks and the question paper is divided into three sections :

A, B

and C . A student is required to attempt total 15 questions taking at least 4 questions from each section. If section A has 8 questions, section B has 6 questions and section C has 6 questions, then the total number of ways a student can select 15 questions is _____.

22. Let

$$Y = Y(X)$$

be a curve lying in the first quadrant such that the area enclosed by the line

$$Y - y = Y'(x)(X - x)$$

and the co-ordinate axes, where (x, y) is any point on the curve, is always

$$\frac{-y^2}{2Y'(x)} + 1, Y'(x) \neq 0$$

. If

$$Y(1) = 1$$

, then $12Y(2)$ equals _____.

23. The number of real solutions of the equation $x(x^2 + 3|x| + 5|x - 1| + 6|x - 2|) = 0$ is _____.

24. Consider two circles

$$C_1 : x^2 + y^2 = 25$$

and

$$C_2 : (x - \alpha)^2 + y^2 = 16$$

, where $\alpha \in (5, 9)$. Let the angle between the two radii (one to each circle) drawn from one of the intersection points of C_1 and C_2 be

$$\sin^{-1}\left(\frac{\sqrt{63}}{8}\right)$$

. If the length of common chord of C_1 and C_2 is β , then the value of $(\alpha\beta)^2$ equals _____.

25. Let a line passing through the point $(-1, 2, 3)$ intersect the lines

$$L_1 : \frac{x-1}{3} = \frac{y-2}{2} = \frac{z+1}{-2}$$

at $M(\alpha, \beta, \gamma)$ and

$$L_2 : \frac{x+2}{-3} = \frac{y-2}{-2} = \frac{z-1}{4}$$

at $N(a, b, c)$. Then, the value of

$$\frac{(\alpha + \beta + \gamma)^2}{(a + b + c)^2}$$

equals _____.

26. The variance σ^2 of the data

x_i	0	1	5	6	10	12	17
f_i	3	2	3	2	6	3	3

is _____.

27. The area of the region enclosed by the parabola

$$(y - 2)^2 = x - 1$$

, the line $x - 2y + 4 = 0$ and the positive co-ordinate axes is _____.

28. The number of symmetric relations defined on the set $\{1, 2, 3, 4\}$ which are not reflexive is _____.

29. Let

$$\alpha = \sum_{k=0}^n \left(\frac{{}^nC_k}{k+1} \right)^2$$

and

$$\beta = \sum_{k=0}^{n-1} \left(\frac{{}^nC_k {}^nC_{k+1}}{k+2} \right)$$

If $5\alpha = 6\beta$, then n equals _____.

30. Let S_n be the sum to n -terms of an arithmetic progression 3, 7, 11, If

$$40 < \left(\frac{6}{n(n+1)} \sum_{k=1}^n S_k \right) < 42$$

, then n equals _____.

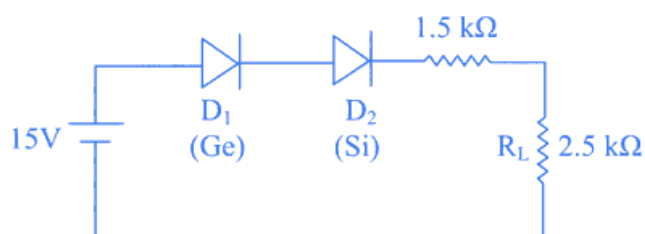
31. If 50 Vernier divisions are equal to 49 main scale divisions of a traveling microscope and one smallest reading of main scale is 0.5 mm, the Vernier constant of traveling microscope is

- (A) 0.01 mm (B) 0.01 cm
(C) 0.1 mm (D) 0.1 cm

32. An electron revolving in n^{th} Bohr orbit has magnetic moment μ_n . If $\mu_n \propto n^x$, the value of x is

- (A) 2 (B) 0
(C) 3 (D) 1

33.



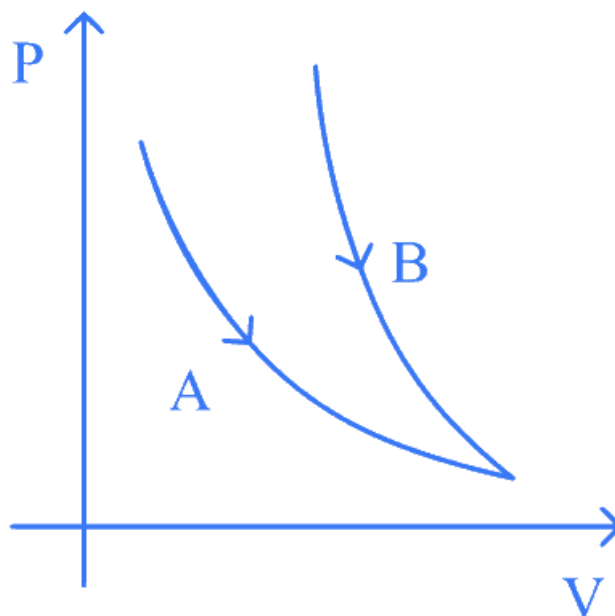
In the given circuit, the voltage across load resistance (R_L) is :

- (A) 8.75 V (B) 9.00 V
(C) 8.50 V (D) 14.00 V

34. An alternating voltage $V(t) = 220 \sin 100\pi t$ volt is applied to a purely resistive load of 50Ω . The time taken for the current to rise from half of the peak value to the peak value is:

- (A) 7.2 ms (B) 3.3 ms
(C) 5 ms (D) 2.2 ms

35. Choose the correct statement for processes A & B shown in figure.



(A) $PV = k$ for process B and A.

(B) $\frac{P^{\gamma-1}}{T^{\gamma}} = k$ for process B and $T = k$ for process A.

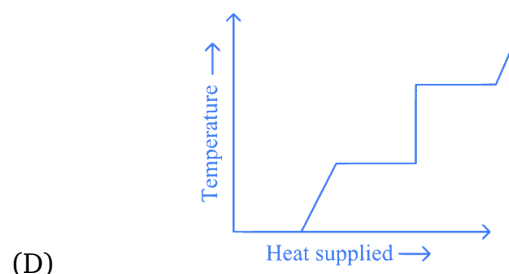
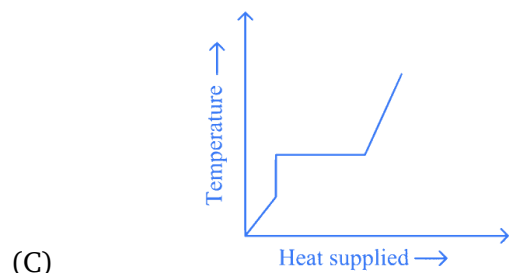
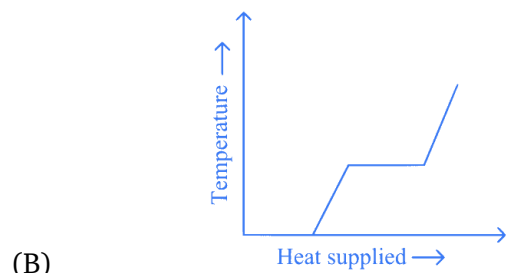
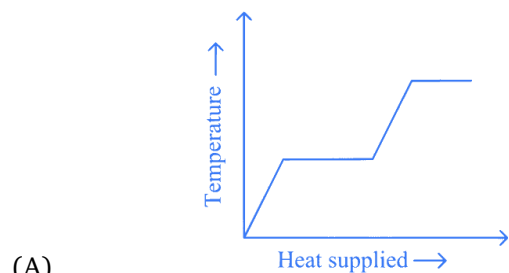
(C) $\frac{T^{\gamma}}{P^{\gamma-1}} = k$ for process A and $PV = k$ for process B.

(D) $\frac{PV^{\gamma}}{T} = k$ for process B and $PV = k$ for process A.

36. A block of mass m is placed on a surface having vertical cross-section given by $y = x^2/4$. If coefficient of friction is 0.5, the maximum height above the ground at which block can be placed without slipping is:

- (A) 1/2 m (B) 1/3 m
(C) 1/6 m (D) 1/4 m

37. A block of ice at -10°C is slowly heated and converted to steam at 100°C . Which of the following curves represent the phenomenon qualitatively:



38. When a potential difference V is applied across a wire of resistance R , it dissipates energy at a rate W . If the wire is cut into two halves and these halves are connected mutually parallel across the same supply, the energy dissipation rate will become:

- (A) $1/2W$ (B) $4W$
(C) $1/4W$ (D) $2W$

39. Match List I with List II

	List I		List II
(A)	Gauss's law of magnetostatics	(I)	$\oint \vec{E} \cdot d\vec{a} = \frac{1}{\epsilon_0} \int \rho dV$
(B)	Faraday's law of electro magnetic induction	(II)	$\oint \vec{B} \cdot d\vec{a} = 0$
(C)	Ampere's law	(III)	$\int \vec{E} \cdot d\vec{l} = -\frac{d}{dt} \int \vec{B} \cdot d\vec{a}$
(D)	Gauss's law of electrostatics	(IV)	$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$

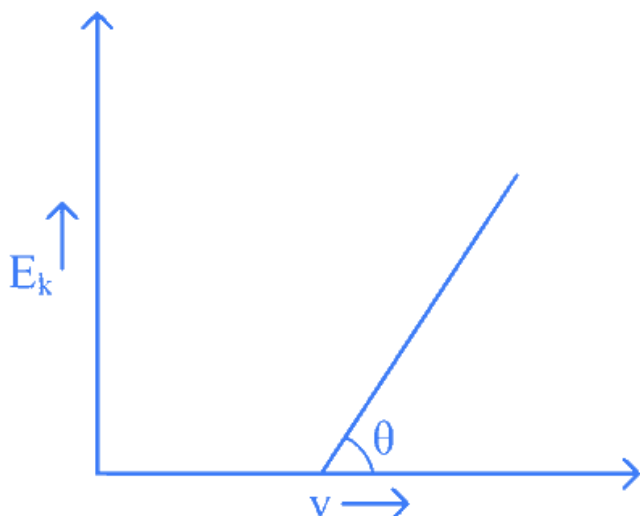
Choose the correct answer from the options given below:

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

40. In a nuclear fission reaction of an isotope of mass M , three similar daughter nuclei of same mass are formed. The speed of a daughter nuclei in terms of mass defect ΔM will be :

- (A) $c\sqrt{\frac{3\Delta M}{M}}$
(B) $\frac{\Delta Mc^2}{3}$
(C) $c\sqrt{\frac{2\Delta M}{M}}$
(D) $\sqrt{\frac{2c\Delta M}{M}}$

41. For the photoelectric effect, the maximum kinetic energy (E_k) of the photoelectrons is plotted against the frequency (ν) of the incident photons as shown in figure. The slope of the graph gives



- (A) Planck's constant (B) Work function of the metal
(C) Charge of electron (D) Ratio of Planck's constant to electric charge

42. A beam of unpolarised light of intensity I_0 is passed through a polaroid A and then through another polaroid B which is oriented so that its principal plane makes an angle of 45° relative to that of A . The intensity of emergent light is:

- (A) $I_0/2$
(B) $I_0/8$
(C) $I_0/4$
(D) I_0

43. If three moles of monoatomic gas

$$\left(\gamma = \frac{5}{3}\right)$$

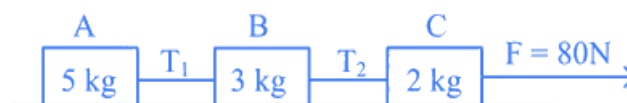
is mixed with two moles of a diatomic gas

$$\left(\gamma = \frac{7}{5}\right)$$

, the value of adiabatic exponent γ for the mixture is

- (A) 1.35 (B) 1.52
(C) 1.40 (D) 1.75

44. Three blocks A , B and C are pulled on a horizontal smooth surface by a force of 80 N as shown in figure



The tensions T_1 and T_2 in the string are respectively :

- (A) 40N, 64N (B) 60N, 80N
(C) 80N, 100N (D) 88N, 96N

45. A particle of charge ' $-q$ ' and mass ' m ' moves in a circle of radius ' r ' around an infinitely long line charge of linear charge density ' $+\lambda$ '. Then time period will be given as :

(Consider k as Coulomb's constant)

- (A) $T^2 = \frac{4\pi^2 m}{2k\lambda q} r^3$
(B) $T = \frac{1}{2\pi r} \sqrt{\frac{m}{2k\lambda q}}$
(C) $T = \frac{1}{2\pi} \sqrt{\frac{2k\lambda q}{m}}$
(D) $T = 2\pi r \sqrt{\frac{m}{2k\lambda q}}$

46. Escape velocity of a body from earth is 11.2 km/s. If the radius of a planet be onethird the radius of earth and mass be one-sixth that of earth, the escape velocity from the planet is :

- (A) 7.9 km/s (B) 8.4 km/s
(C) 4.2 km/s (D) 11.2 km/s

47. Projectiles A and B are thrown at angles of 45° and 60° with vertical respectively from top of a 400 m high tower. If their ranges and times of flight are same, the ratio of their speeds of projection $v_A : v_B$ is :

[Take

$$g = 10 \text{ ms}^{-2}$$

]

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

48. If the total energy transferred to a surface in time t is $6.48 \times 10^5 \text{ J}$, then the magnitude of the total momentum delivered to this surface for complete absorption will be:

- (A) $2.16 \times 10^{-3} \text{ kg m/s}$
(B) $2.46 \times 10^{-3} \text{ kg m/s}$
(C) $1.58 \times 10^{-3} \text{ kg m/s}$
(D) $4.32 \times 10^{-3} \text{ kg m/s}$

49. If mass is written as

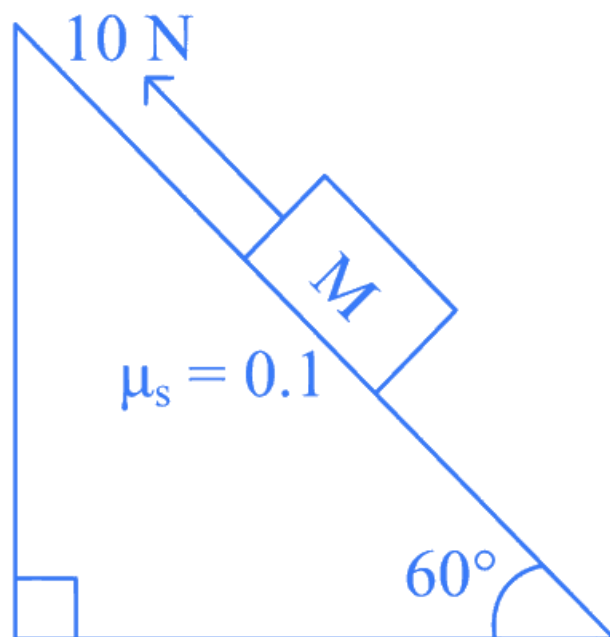
$$m = kc^p G^{-1/2} h^{1/2}$$

then the value of P will be : (Constants have their usual meaning with k a dimensionless constant)

- (A) $1/3$ (B) $-1/3$
(C) $1/2$ (D) 2

50. A block of mass 1 kg is pushed up a surface inclined to horizontal at an angle of 60° by a force of 10 N parallel to the inclined surface as shown in figure. When the block is pushed up by 10 m along inclined surface, the work done against frictional force is :

$$[g = 10 \text{ m/s}^2]$$



- (A) $5\sqrt{3} \text{ J}$ (B) 5 J
(C) $5 \times 10^3 \text{ J}$ (D) 10 J

51. A big drop is formed by coalescing 1000 small identical drops of water. If E_1 be the total surface energy of 1000 small drops of water and E_2 be the surface energy of single big drop of water, then $E_1 : E_2$ is $x : 1$ where $x =$ _____.

52. A power transmission line feeds input power at 2.3 kV to a step down transformer with its primary winding having 3000 turns. The output power is delivered at 230 V by the transformer. The current in the primary of the transformer is 5 A and its efficiency is 90%. The winding of transformer is made of copper. The output current of transformer is _____ A.

53. The current of 5 A flows in a square loop of sides 1 m is placed in air. The magnetic field at the centre of the loop is $X\sqrt{2} \times 10^{-7} T$. The value of X is _____.

54. Two discs of moment of inertia
 $I_1 = 4 \text{ kg m}^2$

and

$$I_2 = 2 \text{ kg m}^2$$

, about their central axes & normal to their planes, rotating with angular speeds 10 rad/s & 4 rad/s respectively are brought into contact face to face with their axes of rotation coincident. The loss in kinetic energy of the system in the process is _____ J.

55. A point source is emitting sound waves of intensity $16 \times 10^{-8} \text{ W m}^{-2}$ at the origin. The difference in intensity (magnitude only) at two points located at a distances of 2 m and 4 m from the origin respectively will be _____ $\times 10^{-8} \text{ W m}^{-2}$.

56. Two resistance of 100Ω and 200Ω are connected in series with a battery of 4 V and negligible internal resistance. A voltmeter is used to measure voltage across 100Ω resistance, which gives reading as 1 V. The resistance of voltmeter must be _____ Ω .

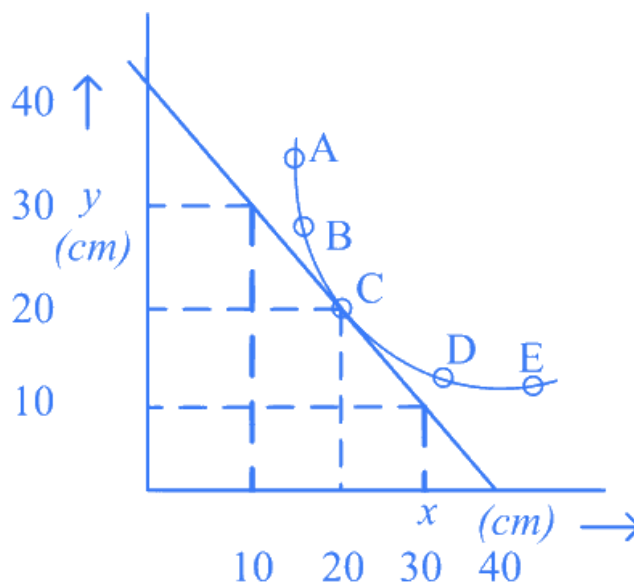
57. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 37° with each other. When suspended in a liquid of density 0.7 g/cm^3 , the angle remains same. If density of material of the sphere is 1.4 g/cm^3 , the dielectric constant of the liquid is _____

$$\left(\tan 37^\circ = \frac{3}{4} \right)$$

58. A simple pendulum is placed at a place where its distance from the earth's surface is equal to the radius of the earth. If the length of the string is 4 m, then the time period of small oscillations will be _____ s. [take $g = \pi^2 \text{ ms}^{-2}$]

59. In an experiment to measure the focal length (f) of a convex lens, the magnitude of object distance (x) and the image distance (y) are measured with reference to the focal point of the lens. The y - x plot is shown in figure.

The focal length of the lens is _____ cm.



60. A vector has magnitude same as that of

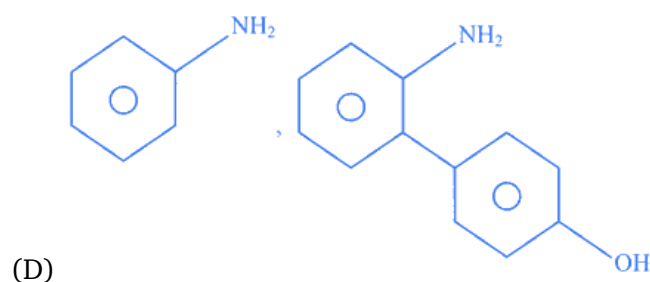
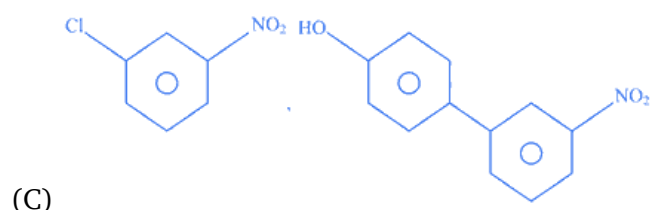
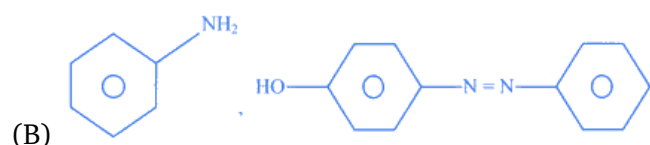
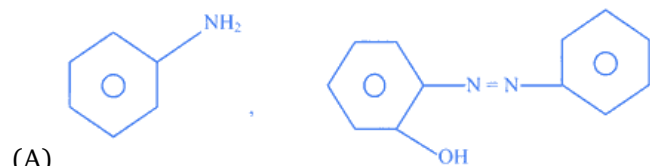
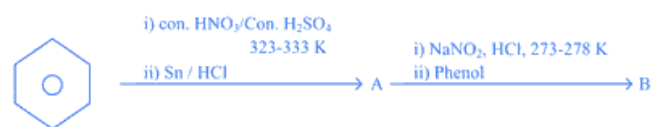
$$\vec{A} = 3\hat{i} + 4\hat{j}$$

and is parallel to

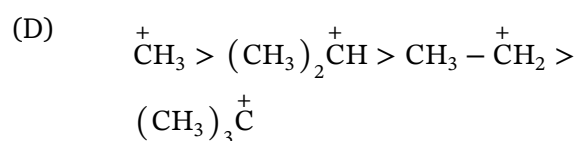
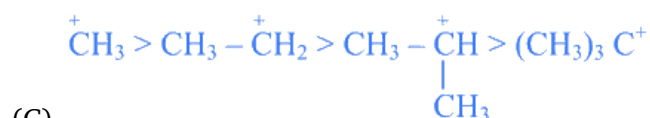
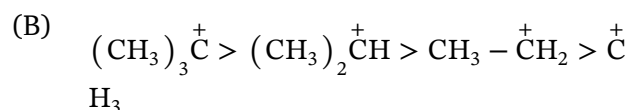
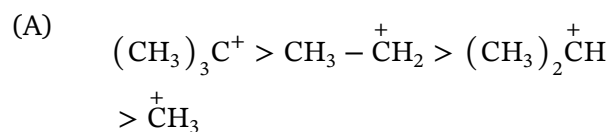
$$\vec{B} = 4\hat{i} + 3\hat{j}$$

. The x and y components of this vector in first quadrant are x and 3 respectively where $x =$ _____.

61. The products A and B formed in the following reaction scheme are respectively



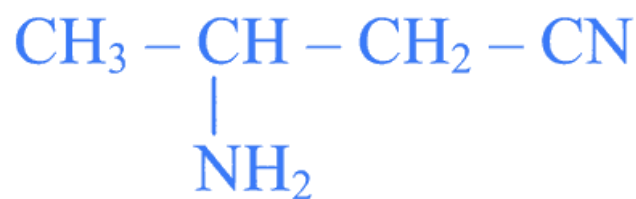
62. The correct stability order of carbocations is



63. Which among the following purification methods is based on the principle of "Solubility" in two different solvents?

- (A) Distillation (B) Sublimation
(C) Column Chromatography (D) Differential Extraction

64. IUPAC name of following compound is :



- (A) 2-Aminobutanenitrile
(B) 3-Aminopropanenitrile
(C) 2-Aminopentanenitrile
(D) 3-Aminobutanenitrile

65. The solution from the following with highest depression in freezing point/lowest freezing point is

- (A) 180 g of acetic acid dissolved in benzene (B) 180 g of acetic acid dissolved in water
(C) 180 g of benzoic acid dissolved in benzene (D) 180 g of glucose dissolved in water

66. Given below are two statements:

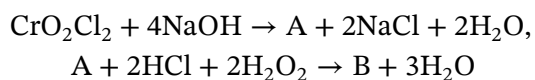
Statement - I: Since Fluorine is more electronegative than nitrogen, the net dipole moment of NF_3 is greater than NH_3 .

Statement - II: In NH_3 , the orbital dipole due to lone pair and the dipole moment of NH bonds are in opposite direction, but in NF_3 the orbital dipole due to lone pair and dipole moments of N-F bonds are in same direction.

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

- | | |
|--|--|
| (A) Statement I is true but Statement II is false. | (B) Both Statement I and Statement II are true. |
| (C) Both Statement I and Statement II are false. | (D) Statement I is false but Statement II is true. |

67. A and B formed in the following reactions are:



- | | |
|-----|--|
| (A) | $\text{A} = \text{Na}_2\text{Cr}_2\text{O}_7, \text{B} = \text{CrO}_5$ |
| (B) | $\text{A} = \text{Na}_2\text{CrO}_4, \text{B} = \text{CrO}_5$ |
| (C) | $\text{A} = \text{Na}_2\text{Cr}_2\text{O}_4, \text{B} = \text{CrO}_4$ |
| (D) | $\text{A} = \text{Na}_2\text{Cr}_2\text{O}_7, \text{B} = \text{CrO}_3$ |

68. If a substance 'A' dissolves in solution of a mixture of 'B' and 'C' with their respective number of moles as n_A, n_B and n_C . Mole fraction of C in the solution is

- | | |
|-----|---|
| (A) | $\frac{n_C}{n_A \times n_B \times n_C}$ |
| (B) | $\frac{n_B}{n_A + n_B}$ |
| (C) | $\frac{n_C}{n_A + n_B + n_C}$ |
| (D) | $\frac{n_C}{n_A - n_B - n_C}$ |

69. The molecule / ion with square pyramidal shape is

- | | |
|-----|---------------------------------|
| (A) | PCl_5 |
| (B) | $[\text{Ni}(\text{CN})_4]^{2-}$ |
| (C) | PF_5 |
| (D) | BrF_5 |

70. Given below are two statements:

Statement - I: High concentration of strong nucleophilic reagent with secondary alkyl halides which do not have bulky substituents will follow S_N^2 mechanism.

Statement - II: A secondary alkyl halide when treated with a large excess of ethanol follows S_N^1 mechanism.

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

- | | |
|--|--|
| (A) Both Statement I and Statement II are true. | (B) Statement I is true but Statement II is false. |
| (C) Both Statement I and Statement II are false. | (D) Statement I is false but Statement II is true. |

71. Choose the correct statements about the hydrides of group 15 elements.

A. The stability of the hydrides decreases in the order



B. The reducing ability of the hydride increases in the order



C. Among the hydrides, NH_3 is strong reducing agent while BiH_3 is mild reducing agent.

D. The basicity of the hydrides increases in the order



Choose the most appropriate from the options given below :

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

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

Assertion A:

H_2Te
is more acidic than H_2S .

Reason R: Bond dissociation enthalpy of H_2Te is lower than H_2S .

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

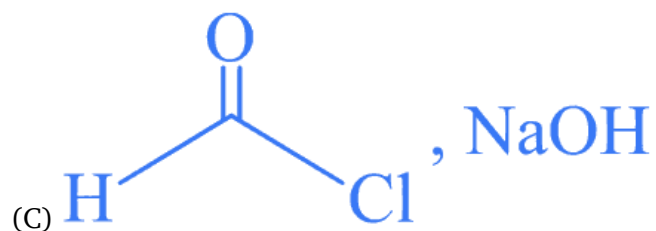
- | | |
|--|--|
| (A) Both A and R are true and R is the correct explanation of A. | (B) Both A and R are true but R is NOT the correct explanation of A. |
| (C) A is false but R is true. | (D) A is true but R is false. |

73. Alkaline oxidative fusion of MnO_2 gives "A" which on electrolytic oxidation in alkaline solution produces B. A and B respectively are

- | | |
|---|---|
| (A) Mn_2O_3 and MnO_4^{2-} | (B) Mn_2O_7 and MnO_4^- |
| (C) MnO_4^{2-} and MnO_4^- | (D) MnO_4^{2-} and Mn_2O_7 |

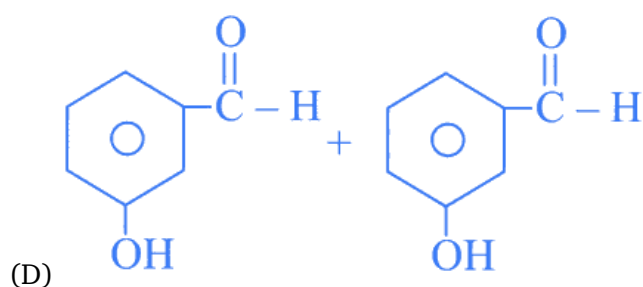
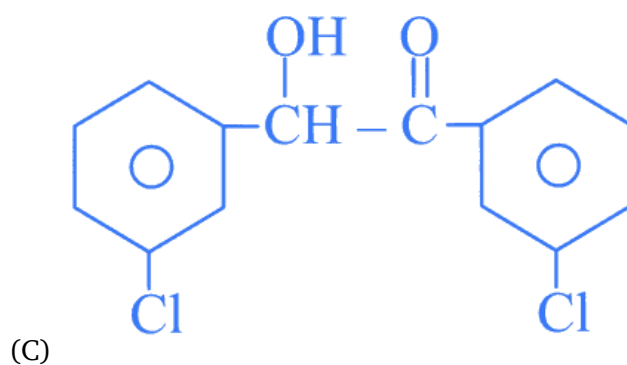
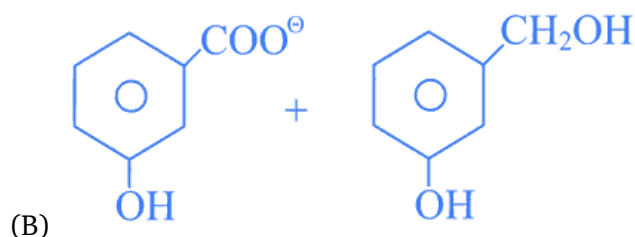
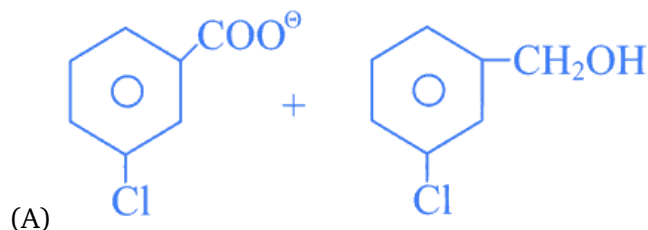
74. Salicylaldehyde is synthesized from phenol, when reacted with

- | | |
|-----|------------------------------|
| (A) | $\text{HCCl}_3, \text{NaOH}$ |
| (B) | CO_2, NaOH |

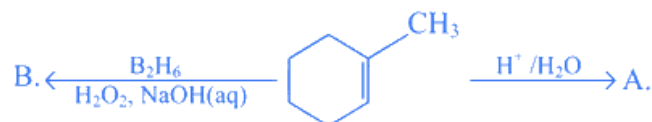


- (D) $\text{CCl}_4, \text{NaOH}$

75. m-chlorobenzaldehyde on treatment with 50% KOH solution yields :



76. Products A and B formed in the following set of reactions are



- (A) $A = \text{cyclohexyl-CH}_2\text{OH}$ $B = \text{1-methylcyclohexanol}$
- (B) $A = \text{1-methylcyclohexanol}$ $B = \text{1-methylcyclohexyl-CH}_2\text{OH}$
- (C) $A = \text{cyclohexyl-CH}_2\text{OH}$ $B = \text{1-methylcyclohexyl-CH}_2\text{OH}$
- (D) $A = \text{1-methylcyclohexyl-CH}_2\text{OH}$ $B = \text{1-methylcyclohexanol}$

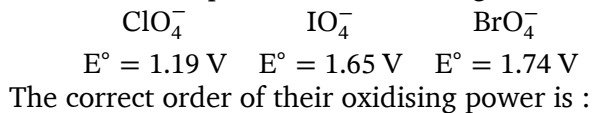
77. The orange colour of $\text{K}_2\text{Cr}_2\text{O}_7$ and purple colour of KMnO_4 is due to

- (A) Charge transfer transition in both. (B) $d \rightarrow d$ transitions in KMnO_4 and charge transfer transitions in $\text{K}_2\text{Cr}_2\text{O}_7$.
- (C) $d \rightarrow d$ transitions in both (D) $d \rightarrow d$ transitions in $\text{K}_2\text{Cr}_2\text{O}_7$ and charge transfer transitions in KMnO_4 .

78. The coordination geometry around the manganese in decacarbonyldimanganese (0) is

- (A) Trigonal bipyramidal (B) Square pyramidal
(C) Square planar (D) Octahedral

79. Reduction potential of ions are given below:



- (A) $\text{IO}_4^- > \text{BrO}_4^- > \text{ClO}_4^-$
(B) $\text{BrO}_4^- > \text{ClO}_4^- > \text{IO}_4^-$
(C) $\text{ClO}_4^- > \text{IO}_4^- > \text{BrO}_4^-$
(D) $\text{BrO}_4^- > \text{IO}_4^- > \text{ClO}_4^-$

80. Given below are two statements:

Statement - I: Along the period, the chemical reactivity of the elements gradually increases from group 1 to group 18 .

Statement - II: The nature of oxides formed by group 1 elements is basic while that of group 17 elements is acidic.

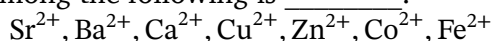
In the light of the above statements, choose the most appropriate from the options given below:

- (A) Statement I is False but Statement II is true (B) Both Statement I and Statement II are False
(C) Statement I is True But Statement II is False (D) Both Statement I and Statement II are True

81. The total number of correct statements, regarding the nucleic acids is _____.

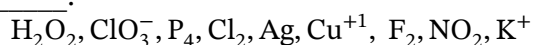
- A. RNA is regarded as the reserve of genetic information
- B. DNA molecule self-duplicates during cell division
- C. DNA synthesizes proteins in the cell
- D. The message for the synthesis of particular proteins is present in DNA
- E. Identical DNA strands are transferred to daughter cells.

82. Number of metal ions characterized by flame test among the following is _____.

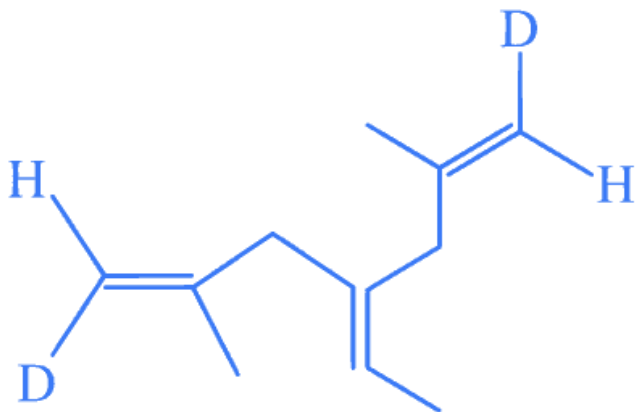


83. Number of spectral lines obtained in He^+ spectra, when an electron makes transition from fifth excited state to first excited state will be _____.

84. Total number of species from the following which can undergo disproportionation reaction is _____.



85. Number of geometrical isomers possible for the given structure is/are _____.

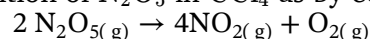


86. The pH of an aqueous solution containing 1M benzoic acid

$$(\text{pK}_a = 4.20)$$

and 1M sodium benzoate is 4.5. The volume of benzoic acid solution in 300 mL of this buffer solution is _____ mL. (given : $\log 2 = 0.3$)

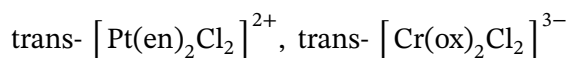
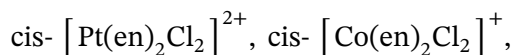
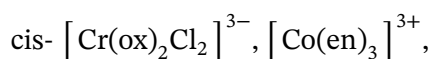
87. NO_2 required for a reaction is produced by decomposition of N_2O_5 in CCl_4 as by equation



The initial concentration of N_2O_5 is 3 mol L^{-1} and it is 2.75 mol L^{-1} after 30 minutes.

The rate of formation of NO_2 is $x \times 10^{-3} \text{ mol L}^{-1} \text{ min}^{-1}$, value of x is _____. (nearest integer)

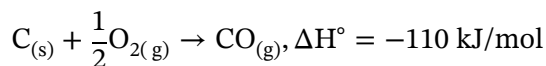
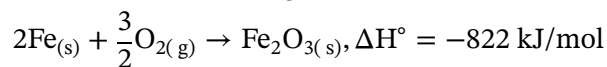
88. Number of complexes which show optical isomerism among the following is _____.



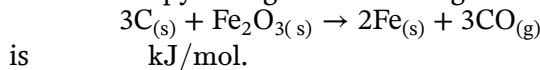
89. 2-chlorobutane + $\text{Cl}_2 \rightarrow \text{C}_4\text{H}_8\text{Cl}_2$ (isomers)

Total number of optically active isomers shown by $\text{C}_4\text{H}_8\text{Cl}_2$, obtained in the above reaction is _____.

90. Two reactions are given below:



Then enthalpy change for following reaction



- End of Question Paper -