

JEE Main 2024 Paper 1 (B.E./B.Tech) 6 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 6 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. A circle is inscribed in an equilateral triangle of side of length 12. If the area and perimeter of any square inscribed in this circle are m and n , respectively, then $m + n^2$ is equal to

- (A) 408 (B) 414
(C) 312 (D) 396

2. Let a variable line of slope $m > 0$ passing through the point $(4, -9)$ intersect the coordinate axes at the points A and B . The minimum value of the sum of the distances of A and B from the origin is

- (A) 30 (B) 15
(C) 10 (D) 25

3. Let

$$A = \{n \in [100, 700] \cap \mathbb{N} : n$$

is neither a multiple of 3 nor a multiple of 4}. Then the number of elements in A is

- (A) 300 (B) 310
(C) 290 (D) 280

4. Let C be the circle of minimum area touching the parabola $y = 6 - x^2$ and the lines

$$y = \sqrt{3} |x|$$

. Then, which one of the following points lies on the circle C ?

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

5. If

$$A(3,1,-1), B\left(\frac{5}{3}, \frac{7}{3}, \frac{1}{3}\right), C(2,2,1)$$

and

$$D\left(\frac{10}{3}, \frac{2}{3}, \frac{-1}{3}\right)$$

are the vertices of a quadrilateral $ABCD$, then its area is

- (A) $\frac{4\sqrt{2}}{3}$
(B) $\frac{2\sqrt{2}}{3}$
(C) $\frac{5\sqrt{2}}{3}$
(D) $2\sqrt{2}$

6. Let the relations R_1 and R_2 on the set

$$X = \{1, 2, 3, \dots, 20\}$$

be given by

$$R_1 = \{(x, y) : 2x - 3y = 2\}$$

and

$$R_2 = \{(x, y) : -5x + 4y = 0\}$$

. If M and N be the minimum number of elements required to be added in R_1 and R_2 , respectively, in order to make the relations symmetric, then $M + N$ equals

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

7. Let the area of the region enclosed by the curves

$$y = 3x, 2y = 27 - 3x$$

and

$$y = 3x - x\sqrt{x}$$

be A . Then $10A$ is equal to

- (A) 172 (B) 154
(C) 162 (D) 184

8.

$$\text{If } f(x) = \begin{cases} x^3 \sin\left(\frac{1}{x}\right), & x \neq 0 \\ 0, & x = 0 \end{cases}, \text{ then}$$

- (A) $f''(0) = 0$
 (B) $f''(0) = 1$
 (C) $f''\left(\frac{2}{\pi}\right) = \frac{24 - \pi^2}{2\pi}$
 (D) $f''\left(\frac{2}{\pi}\right) = \frac{12 - \pi^2}{2\pi}$

9. The shortest distance between the lines

$$\frac{x-3}{2} = \frac{y+15}{-7} = \frac{z-9}{5}$$

and

$$\frac{x+1}{2} = \frac{y-1}{1} = \frac{z-9}{-3}$$

is

- (A) $8\sqrt{3}$
 (B) $6\sqrt{3}$
 (C) $5\sqrt{3}$
 (D) $4\sqrt{3}$

10. Let

$$y = y(x)$$

be the solution of the differential equation

$$(2x \log_e x) \frac{dy}{dx} + 2y = \frac{3}{x} \log_e x, x > 0$$

and

$$y(e^{-1}) = 0$$

. Then, $y(e)$ is equal to

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

11. Let α, β be the distinct roots of the equation $x^2 - (t^2 - 5t + 6)x + 1 = 0, t \in \mathbb{R}$ and $a_n = \alpha^n + \beta^n$. Then the minimum value of $\frac{a_{2023} + a_{2025}}{a_{2024}}$

is

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

12. For $\alpha, \beta \in \mathbb{R}$ and a natural number n , let

$$A_r = \begin{vmatrix} r & 1 & \frac{n^2}{2} + \alpha \\ 2r & 2 & n^2 - \beta \\ 3r - 2 & 3 & \frac{n(3n-1)}{2} \end{vmatrix}$$

. Then $2A_{10} - A_8$ is

- (A) $4\alpha + 2\beta$
 (B) 0
 (C) $2n$
 (D) $2\alpha + 4\beta$

13. Let $f : (-\infty, \infty) - \{0\} \rightarrow \mathbb{R}$ be a differentiable function such that

$$f'(1) = \lim_{a \rightarrow \infty} a^2 f\left(\frac{1}{a}\right)$$

. Then

$$\lim_{a \rightarrow \infty} \frac{a(a+1)}{2} \tan^{-1}\left(\frac{1}{a}\right) + a^2 - 2 \log_e a$$

is equal to

- (A) $\frac{5}{2} + \frac{\pi}{8}$
 (B) $\frac{3}{8} + \frac{\pi}{4}$
 (C) $\frac{3}{4} + \frac{\pi}{8}$
 (D) $\frac{3}{2} + \frac{\pi}{4}$

14.

$$\int_0^{\pi/4} \frac{\cos^2 x \sin^2 x}{(\cos^3 x + \sin^3 x)^2} dx \text{ is equal to}$$

- (A) 1/9 (B) 1/6
(C) 1/3 (D) 1/12

15. The mean and standard deviation of 20 observations are found to be 10 and 2, respectively. On rechecking, it was found that an observation by mistake was taken 8 instead of 12. The correct standard deviation is

- (A) 1.94
(B) $\sqrt{3.96}$
(C) $\sqrt{3.86}$
(D) 1.8

16. Let

$y = y(x)$
be the solution of the differential equation
 $(1 + x^2) \frac{dy}{dx} + y = e^{\tan^{-1} x}$

, $y(1) = 0$

. Then $y(0)$ is

- (A) $\frac{1}{4}(e^{\pi/2} - 1)$
(B) $\frac{1}{2}(1 - e^{\pi/2})$
(C) $\frac{1}{4}(1 - e^{\pi/2})$
(D) $\frac{1}{2}(e^{\pi/2} - 1)$

17. The number of triangles whose vertices are at the vertices of a regular octagon but none of whose sides is a side of the octagon is

- (A) 56 (B) 16
(C) 24 (D) 48

18. The function

$$f(x) = \frac{x^2 + 2x - 15}{x^2 - 4x + 9}, x \in \mathbb{R}$$

is

- (A) both one-one and onto. (B) onto but not one-one.
(C) neither one-one nor onto. (D) one-one but not onto.

19. The interval in which the function

$$f(x) = x^x, x > 0$$

, is strictly increasing is

- (A) $(0, \infty)$
(B) $\left(0, \frac{1}{e}\right]$
(C) $\left[\frac{1}{e^2}, 1\right)$
(D) $\left[\frac{1}{e}, \infty\right)$

20. A company has two plants A and B to manufacture motorcycles. 60% motorcycles are manufactured at plant A and the remaining are manufactured at plant B. 80% of the motorcycles manufactured at plant A are rated of the standard quality, while 90% of the motorcycles manufactured at plant B are rated of the standard quality. A motorcycle picked up randomly from the total production is found to be of the standard quality. If p is the probability that it was manufactured at plant B, then $126p$ is

- (A) 54 (B) 66
(C) 56 (D) 64

21. Let x_1, x_2, x_3, x_4 be the solution of the equation

$$4x^4 + 8x^3 - 17x^2 - 12x + 9 = 0$$

and

$$(4 + x_1^2)(4 + x_2^2)(4 + x_3^2)(4 + x_4^2) = \frac{125}{16}m$$

. Then the value of m is _____.

22. Let a conic C pass through the point $(4, -2)$ and $P(x, y), x \geq 3$, be any point on C . Let the slope of the line touching the conic C only at a single point P be half the slope of the line joining the points P and $(3, -5)$. If the focal distance of the point $(7, 1)$ on C is d , then $12d$ equals _____.

23. If the second, third and fourth terms in the expansion of $(x + y)^n$ are 135, 30 and $\frac{10}{3}$, respectively, then $6(n^3 + x^2 + y)$ is equal to _____.

24. Let

$$\alpha\beta\gamma = 45; \alpha, \beta, \gamma \in \mathbb{R}$$

. If

$$x(\alpha, 1, 2) + y(1, \beta, 2) + z(2, 3, \gamma) = (0, 0, 0)$$

for some $x, y, z \in \mathbb{R}, xyz \neq 0$, then $6\alpha + 4\beta + \gamma$ is equal to _____.

25. Let P be the point $(10, -2, -1)$ and Q be the foot of the perpendicular drawn from the point $R(1, 7, 6)$ on the line passing through the points $(2, -5, 11)$ and $(-6, 7, -5)$. Then the length of the line segment PQ is equal to _____.

26. Let the first term of a series be $T_1 = 6$ and its r^{th} term

$$T_r = 3T_{r-1} + 6^r, r = 2, 3$$

, ... n . If the sum of the first n terms of this series is

$$\frac{1}{5}(n^2 - 12n + 39)(4 \cdot 6^n - 5 \cdot 3^n + 1)$$

, then n is equal to _____.

27. For $n \in \mathbb{N}$, if

$$\cot^{-1} 3 + \cot^{-1} 4 + \cot^{-1} 5 + \cot^{-1} n = \frac{\pi}{4}$$

, then n is equal to _____.

28. Let

$$r_k = \frac{\int_0^1 (1 - x^7)^k dx}{\int_0^1 (1 - x^7)^{k+1} dx}, k \in \mathbb{N}$$

. Then the value of

$$\sum_{k=1}^{10} \frac{1}{7(r_k - 1)}$$

is equal to _____.

29. Let

$$\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}, \vec{b} = 3\hat{i} + 4\hat{j} - 5\hat{k}$$

and a vector $\vec{c}$ be such that

$$\vec{a} \times (\vec{b} + \vec{c}) + \vec{b} \times \vec{c} = \hat{i} + 8\hat{j} + 13\hat{k}$$

. If

$$\vec{a} \cdot \vec{c} = 13$$

, then $(24 - \vec{b} \cdot \vec{c})$ is equal to _____.

30. Let L_1, L_2 be the lines passing through the point $P(0, 1)$ and touching the parabola

$$9x^2 + 12x + 18y - 14 = 0$$

. Let Q and R be the points on the lines L_1 and L_2 such that the $\triangle PQR$ is an isosceles triangle with base QR . If the slopes of the lines QR are m_1 and m_2 , then $16(m_1^2 + m_2^2)$ is equal to _____.

Physics - Section A · Multiple Choice Questions

31. A bullet of mass 50 g is fired with a speed 100 m/s on a plywood and emerges with 40 m/s. The percentage loss of kinetic energy is :

- (A) 44%
- (B) 16%
- (C) 84%
- (D) 32%

32. The specific heat at constant pressure of a real gas obeying $PV^2 = RT$ equation is:

- (A) R
- (B) $C_V + R$
- (C) $C_V + \frac{R}{2}$
- (D) $\frac{R}{3} + C_V$

33. The correct truth table for the following logic circuit is :



A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(A)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

(B)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

(C)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1

(D)

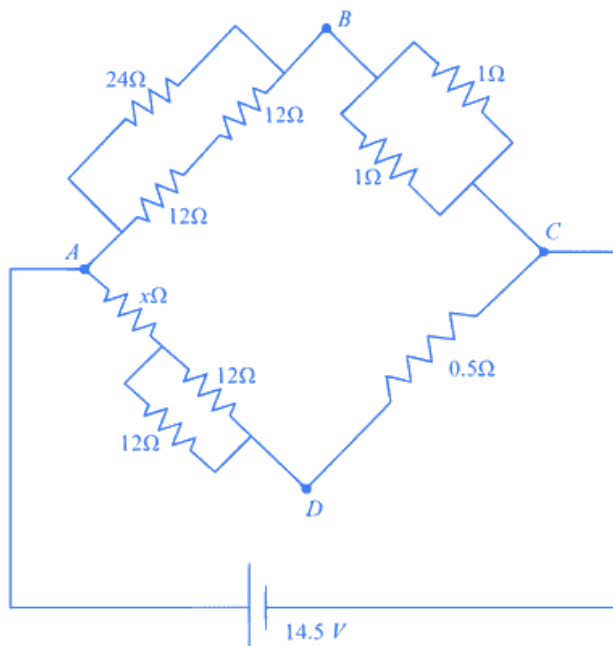
34. Electromagnetic waves travel in a medium with speed of $1.5 \times 10^8 \text{ m s}^{-1}$. The relative permeability of the medium is 2.0. The relative permittivity will be:

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

35. To find the spring constant (k) of a spring experimentally, a student commits 2% positive error in the measurement of time and 1% negative error in measurement of mass. The percentage error in determining value of k is :

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

36. The value of unknown resistance (x) for which the potential difference between B and D will be zero in the arrangement shown, is :



- (A) 3Ω (B) 42Ω
(C) 6Ω (D) 9Ω

37. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (where

$$m_2 > m_1)$$

. If the acceleration of the system is

$$\frac{g}{\sqrt{2}}$$

, then the ratio of the masses $\frac{m_1}{m_2}$ is:

- (A) $\frac{1 + \sqrt{5}}{\sqrt{5} - 1}$
(B) $\frac{\sqrt{3} + 1}{\sqrt{2} - 1}$
(C) $\frac{\sqrt{2} - 1}{\sqrt{2} + 1}$
(D) $\frac{1 + \sqrt{5}}{\sqrt{2} - 1}$

38. To project a body of mass m from earth's surface to infinity, the required kinetic energy is (assume, the radius of earth is

$$R_E, g =$$

acceleration due to gravity on the surface of earth):

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

39. Match List I with List II

	LIST I		LIST II
A.	Torque	I.	$[M^1L^1T^{-2}A^{-2}]$
B.	Magnetic field	II.	$[L^2A^1]$
C.	Magnetic moment	III.	$[M^1T^{-2}A^{-1}]$
D.	Permeability of free space	IV.	$[M^1L^2T^{-2}]$

Choose the correct answer from the options given below:

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

40. Which of the following phenomena does not explain by wave nature of light.

- A. reflection
B. diffraction
C. photoelectric effect
D. interference
E. polarization

Choose the most appropriate answer from the options given below:

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

41. Four particles A, B, C, D of mass

$$\frac{m}{2}, m, 2m, 4m$$

, have same momentum, respectively. The particle with maximum kinetic energy is :

- (A) B (B) C
(C) D (D) A

42. In photoelectric experiment energy of 2.48 eV irradiates a photo sensitive material. The stopping potential was measured to be 0.5 V. Work function of the photo sensitive material is :

- (A) 1.98 eV (B) 1.68 eV
(C) 2.48 eV (D) 0.5 eV

43. While measuring diameter of wire using screw gauge the following readings were noted. Main scale reading is 1 mm and circular scale reading is equal to 42 divisions. Pitch of screw gauge is 1 mm and it has 100 divisions on circular scale. The diameter of the wire is

$$\frac{x}{50} \text{ mm}$$

. The value of x is :

- (A) 42 (B) 71
(C) 21 (D) 142

44. Given below are two statements :

Statement I : In an LCR series circuit, current is maximum at resonance.

Statement II : Current in a purely resistive circuit can never be less than that in a series LCR circuit when connected to same voltage source.

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

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

45. σ is the uniform surface charge density of a thin spherical shell of radius R. The electric field at any point on the surface of the spherical shell is :

- (A) $\sigma/\epsilon_0 R$
(B) σ/ϵ_0
(C) $\sigma/2\epsilon_0$
(D) $\sigma/4\epsilon_0$

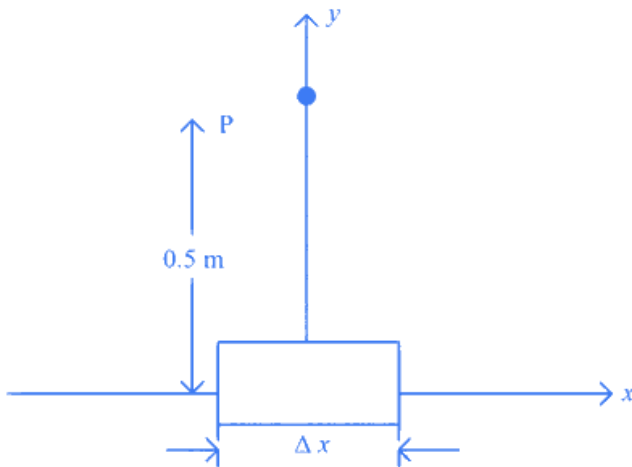
46. An element

$$\Delta l = \Delta x \hat{i}$$

is placed at the origin and carries a large current

$$I = 10 \text{ A}$$

. The magnetic field on the y -axis at a distance of 0.5 m from the elements Δx of 1 cm length is:



- (A) $10 \times 10^{-8} \text{ T}$
 (B) $8 \times 10^{-8} \text{ T}$
 (C) $4 \times 10^{-8} \text{ T}$
 (D) $12 \times 10^{-8} \text{ T}$

47. A small ball of mass m and density ρ is dropped in a viscous liquid of density ρ_0 . After sometime, the ball falls with constant velocity. The viscous force on the ball is :

- (A) $mg \left(1 - \frac{\rho_0}{\rho} \right)$
 (B) $mg \left(\frac{\rho_0}{\rho} - 1 \right)$
 (C) $mg (1 - \rho \rho_0)$
 (D) $mg \left(1 + \frac{\rho}{\rho_0} \right)$

48. A train starting from rest first accelerates uniformly up to a speed of 80 km/h for time t , then it moves with a constant speed for time $3t$. The average speed of the train for this duration of journey will be (in km/h) :

- (A) 70 (B) 40
 (C) 30 (D) 80

49. A sample contains mixture of helium and oxygen gas. The ratio of root mean square speed of helium and oxygen in the sample, is :

- (A) $\frac{1}{2\sqrt{2}}$
 (B) $\frac{1}{4}$
 (C) $\frac{2\sqrt{2}}{1}$
 (D) $\frac{1}{32}$

50. The ratio of the shortest wavelength of Balmer series to the shortest wavelength of Lyman series for hydrogen atom is :

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

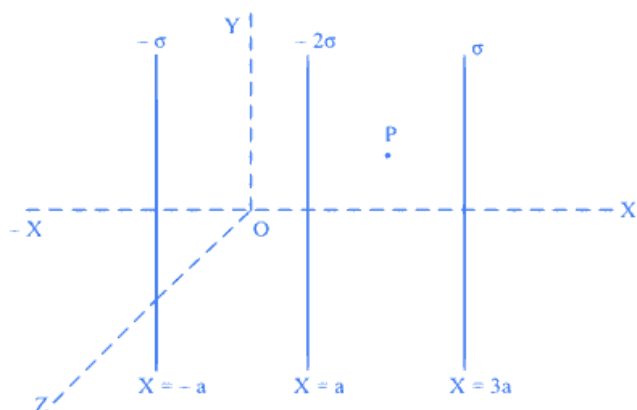
51. A big drop is formed by coalescing 1000 small droplets of water. The ratio of surface energy of 1000 droplets to that of energy of big drop is $\frac{10}{x}$. The value of x is _____.

52. If the radius of earth is reduced to three-fourth of its present value without change in its mass then value of duration of the day of earth will be _____ hours 30 minutes.

53. A particle is doing simple harmonic motion of amplitude 0.06 m and time period 3.14 s. The maximum velocity of the particle is _____ cm/s.

54. Three infinitely long charged thin sheets are placed as shown in figure. The magnitude of electric field at the point P is $\frac{x\sigma}{\epsilon_0}$.

. The value of x is _____ (all quantities are measured in SI units).



55. Radius of a certain orbit of hydrogen atom is 8.48

$\overset{\circ}{\text{Å}}$
If energy of electron in this orbit is E/x . then
 $x = \frac{\overset{\circ}{\text{Å}}}{a_0}$ (Given $a_0 = 0.529$

$\overset{\circ}{\text{Å}}$, E = energy of electron in ground state).

56. For three vectors

$$\vec{A} = (-x\hat{i} - 6\hat{j} - 2\hat{k}), \vec{B} = (-\hat{i} + 4\hat{j} + 3\hat{k})$$

and

$$\vec{C} = (-8\hat{i} - \hat{j} + 3\hat{k})$$

, if

$$\vec{A} \cdot (\vec{B} \times \vec{C}) = 0$$

, then value of x is _____.

57. The refractive index of prism is

$$\mu = \sqrt{3}$$

and the ratio of the angle of minimum deviation to the angle of prism is one. The value of angle of prism is _____°.

58. A wire of resistance R and radius r is stretched till its radius became $r/2$. If new resistance of the stretched wire is xR , then value of x is _____.

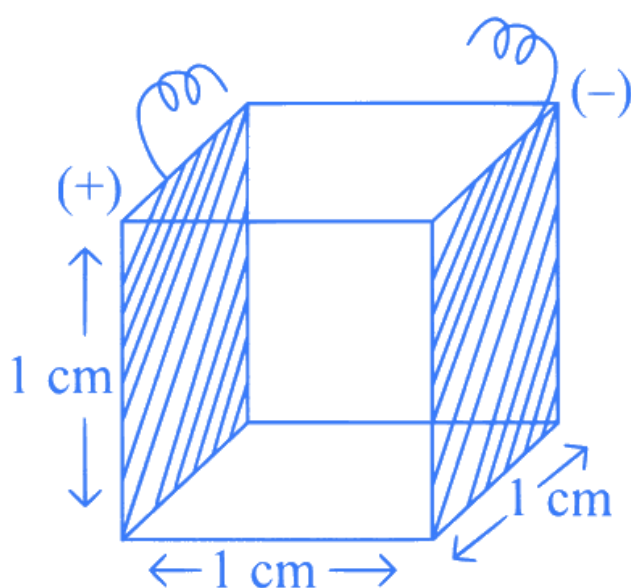
59. When a *dc* voltage of 100 V is applied to an inductor, a *dc* current of 5 A flows through it. When an *ac* voltage of 200 V peak value is connected to inductor, its inductive reactance is found to be $20\sqrt{3}\Omega$. The power dissipated in the circuit is _____ W.

60. A circular coil having 200 turns, $2.5 \times 10^{-4} \text{ m}^2$ area and carrying $100\mu\text{A}$ current is placed in a uniform magnetic field of 1 T. Initially the magnetic dipole moment ($\vec{M}$) was directed along $\vec{B}$. Amount of work, required to rotate the coil through 90° from its initial orientation such that $\vec{M}$ becomes perpendicular to $\vec{B}$, is _____ μJ .

61. The number of element from the following that do not belong to lanthanoids is Eu, Cm, Er, Tb, Yb and Lu

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

62. A conductivity cell with two electrodes (dark side) are half filled with infinitely dilute aqueous solution of a weak electrolyte. If volume is doubled by adding more water at constant temperature, the molar conductivity of the cell will -



- (A) depend upon type of electrolyte (B) increase sharply
(C) decrease sharply (D) remain same or can not be measured accurately

63. Match List I with List II

	LIST I (Compound)		LIST II (Uses)
A.	Idoform	I.	Fire extinguisher
B.	Carbon tetrachloride	II.	Insecticide
C.	CFC	III.	Antiseptic
D.	DDT	IV.	Refrigerants

Choose the correct answer from the options given below:

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

64. At -20°C and 1 atm pressure, a cylinder is filled with equal number of H_2 , I_2 and HI molecules for the reaction $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$, the K_p for the process is $x \times 10^{-1}$.
 $x =$

[Given :

$$R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$$

]

- (A) 2 (B) 1
(C) 10 (D) 0.01

65. The electron affinity value are negative for

- A. $\text{Be} \rightarrow \text{Be}^-$
B. $\text{N} \rightarrow \text{N}^-$
C. $\text{O} \rightarrow \text{O}^{2-}$
D. $\text{Na} \rightarrow \text{Na}^-$
E. $\text{Al} \rightarrow \text{Al}^-$

Choose the most appropriate answer from the options given below :

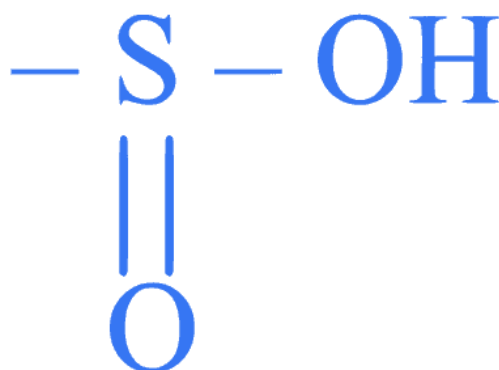
- (A) A, B, D and E only (B) D and E only
(C) A and D only (D) A, B and C only

66. Consider the following complexes
 (A) $[\text{CoCl}(\text{NH}_3)_5]^{2+}$, (B) $[\text{Co}(\text{CN})_6]^{3-}$, (C) $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{3+}$, (D) $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$
 The correct order of A, B, C and D in terms of wavenumber of light absorbed is :

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

67. Functional group present in sulphonic acids is :

- (A) $-\text{SO}_2$



- (B)
 (C) $-\text{SO}_3\text{H}$
 (D) $-\text{SO}_4\text{H}$

68. Match List I with List II

	LIST I (Precipitating reagent and conditions)		LIST II (Cation)
A.	$\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$	I.	Mn^{2+}
B.	$\text{NH}_4\text{OH} + \text{Na}_2\text{CO}_3$	II.	Pb^{2+}
C.	$\text{NH}_4\text{OH} + \text{NH}_4\text{Cl} + \text{H}_2\text{S gas}$	III.	Al^{3+}
D.	dilute HCl	IV.	Sr^{2+}

Choose the correct answer from the options given below:

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

69. Given below are two statements :

Statement I : Gallium is used in the manufacturing of thermometers.

Statement II : A thermometer containing gallium is useful for measuring the freezing point (256 K) of brine solution.

In the light of the above statements, choose the correct answer 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) Statement I is false but Statement II is true (D) Both Statement I and Statement II are false

70. The density of 'x' M solution ('x' molar) of NaOH is 1.12 g mL^{-1} , while in molality, the concentration of the solution is 3 m (3 molal). Then x is

(Given : Molar mass of NaOH is 40 g/mol)

- (A) 3.8 (B) 3.0
 (C) 3.5 (D) 2.8

71. Match List I with List II

	LIST I (Compound/Species)		LIST II (Shape/Geometry)
A.	SF_4	I.	Tetrahedral
B.	BrF_3	II.	Pyramidal
C.	BrO_3^-	III.	See saw
D.	NH_4^+	IV.	Bent T-Shape

Choose the correct answer from the options given below:

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

72. Match List I with List II

	LIST I (Molecule/Species)		LIST II (Property/Shape)
A.	SO_2Cl_2	I.	Paramagnetic
B.	NO	II.	Diamagnetic
C.	NO_2^-	III.	Tetrahedral
D.	I_3^-	IV.	Linear

Choose the correct answer from the options given below:

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

73. Which of the following statements are correct?

- A. Glycerol is purified by vacuum distillation because it decomposes at its normal boiling point.
B. Aniline can be purified by steam distillation as aniline is miscible in water.
C. Ethanol can be separated from ethanol water mixture by azeotropic distillation because it forms azeotrope.
D. An organic compound is pure, if mixed M.P. is remained same.

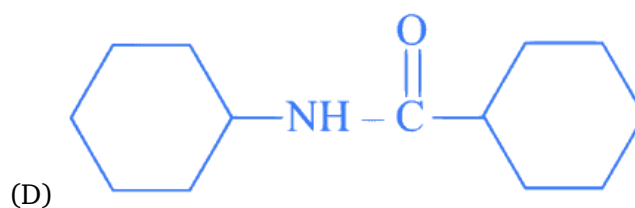
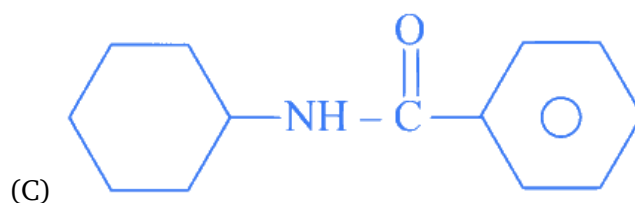
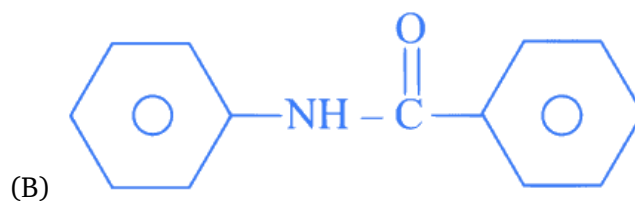
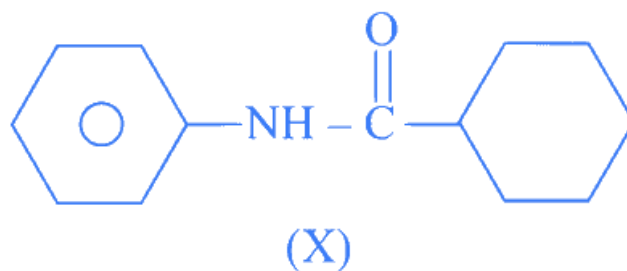
Choose the most appropriate answer from the options given below :

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

74. Which of the following material is not a semiconductor.

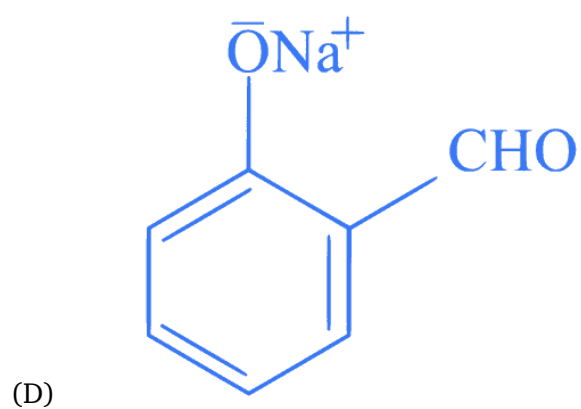
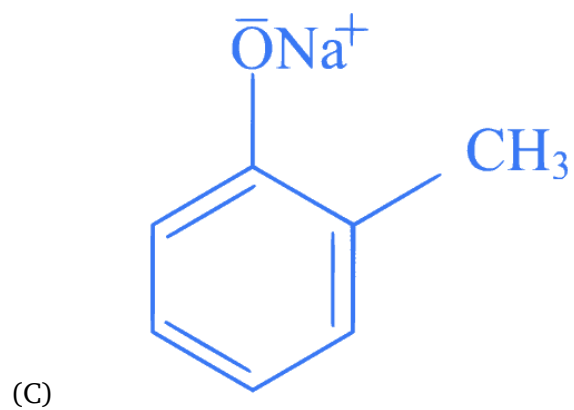
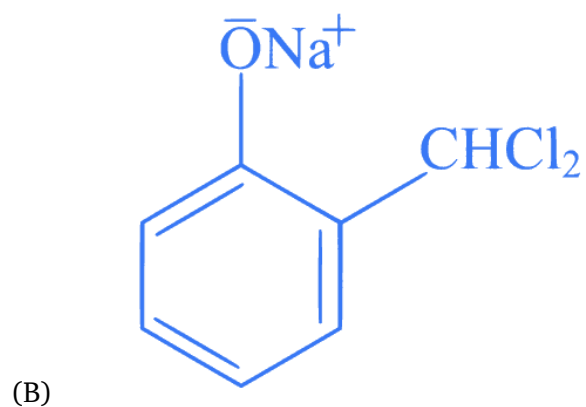
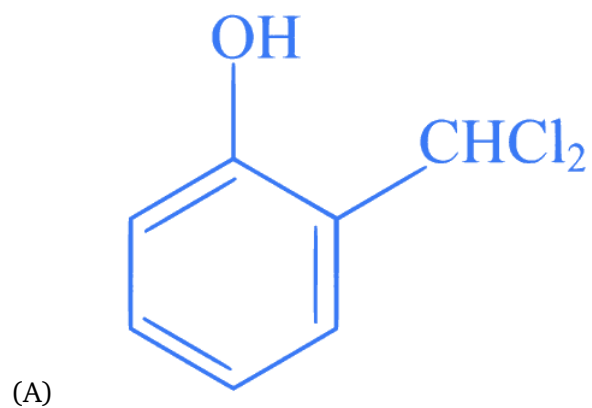
- (A) Copper oxide (B) Graphite
(C) Silicon (D) Germanium

75. Which of the following is metamer of the given compound (X) ?

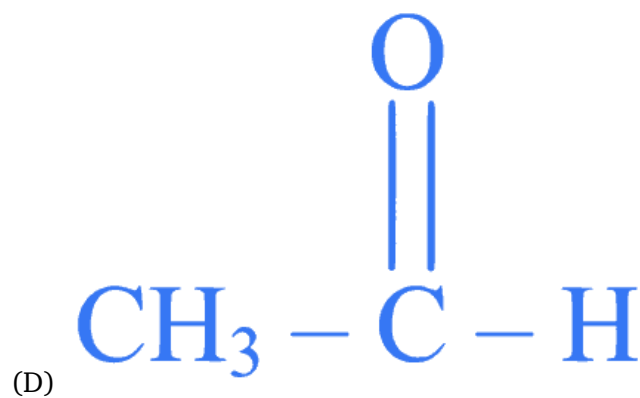
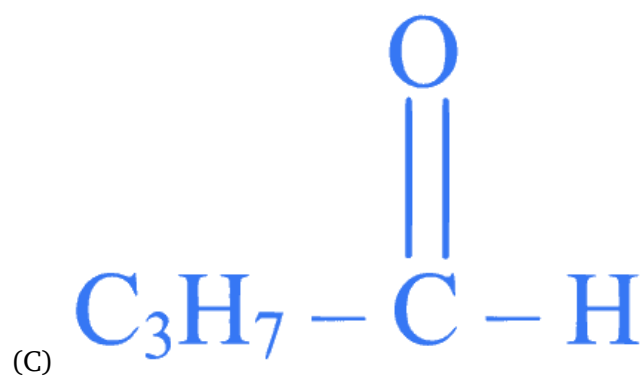
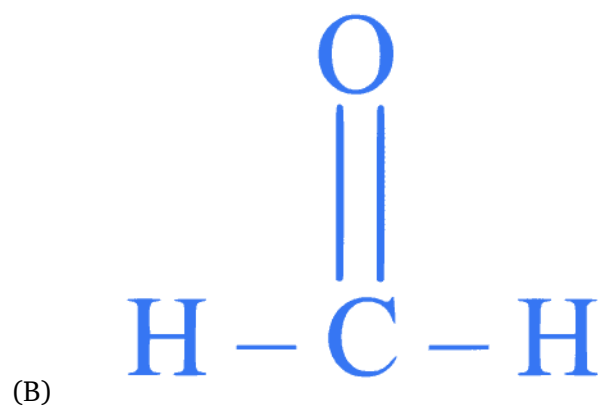
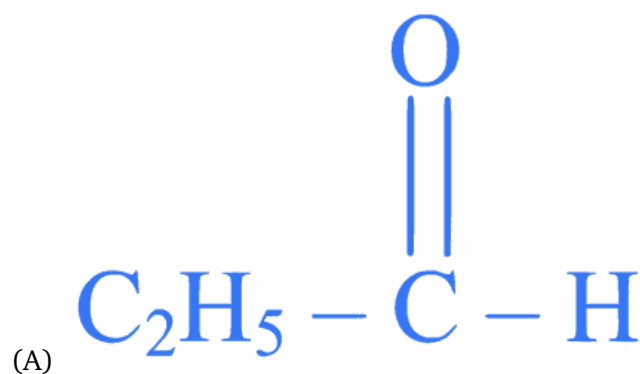


76. In Reimer - Tiemann reaction, phenol is converted into salicylaldehyde through an intermediate. The structure of intermediate is _____.

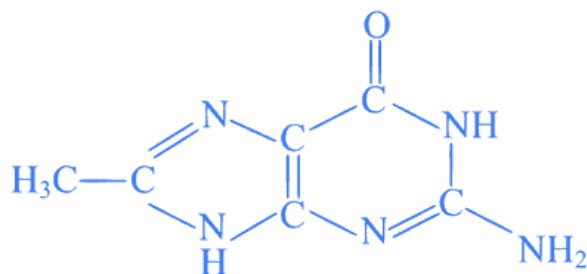
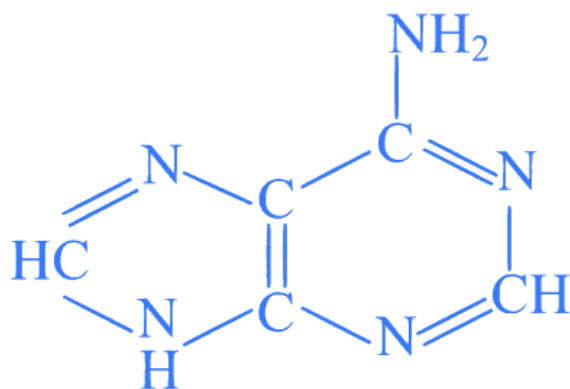
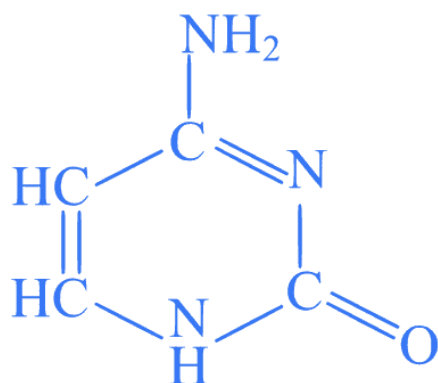
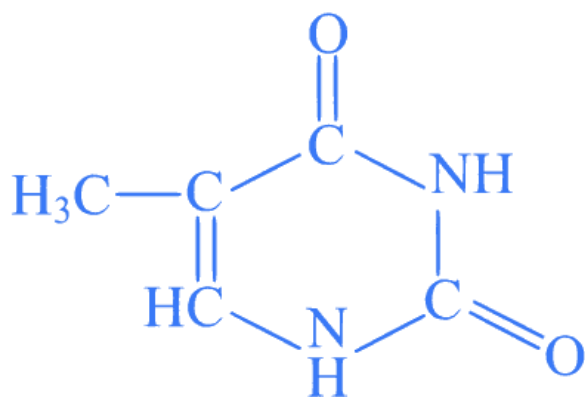
76. (continued)



77. Which among the following aldehydes is most reactive towards nucleophilic addition reactions?



78. DNA molecule contains 4 bases whose structure are shown below. One of the structures is not correct, identify the incorrect base structure.



79. Match List I with List II

	LIST I (Hybridization)		LIST II (Orientation Shape) in
A.	sp^3	I.	Trigonal bipyramidal
B.	dsp^2	II.	Octahedral
C.	sp^3d	III.	Tetrahedral
D.	sp^3d^2	IV.	Square planar

Choose the correct answer from the options given below:

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

80. Given below are two statements :

Statement I : Picric acid is 2,4,6 - trinitrotoluene.

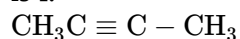
Statement II : Phenol - 2,4 - disulphonic acid is treated with Conc. HNO_3 to get picric acid.

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

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

Chemistry - Section B · Numerical Value Questions

81. The major product of the following reaction is P



(i) Na /liq. NH_3

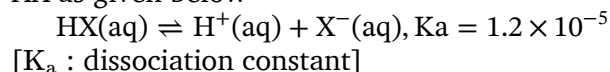
$\xrightarrow{\text{(ii) dil. KMnO}_4}$
273 K

'P'

Number of oxygen atoms present in product 'P' is _____. (nearest integer)

82. Time required for 99.9% completion of a first order reaction is _____ times the time required for completion of 90% reaction. (nearest integer)

83. Consider the dissociation of the weak acid HX as given below



The osmotic pressure of 0.03M aqueous solution of HX at 300 K is _____ $\times 10^{-2}$ bar (nearest integer).

[Given :

$$R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$$

]

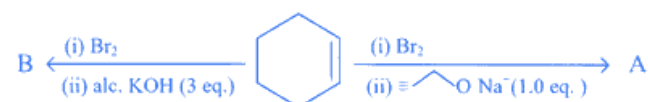
84. An ideal gas,

$$C_v = \frac{5}{2}R$$

, is expanded adiabatically against a constant pressure of 1 atm until it doubles in volume. If the initial temperature and pressure is 298 K and 5 atm, respectively then the final temperature is _____ K (nearest integer).

[$\bar{C}_v$ is the molar heat capacity at constant volume]

85. The major products from the following reaction sequence are product A and product B.

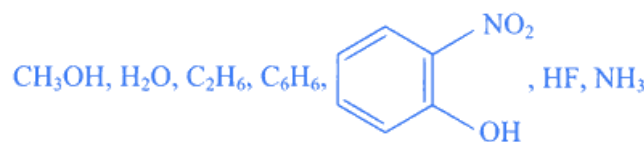


The total sum of π electrons in product A and product B are _____ (nearest integer)

86. The difference in the 'spin-only' magnetic moment values of KMnO_4 and the manganese product formed during titration of KMnO_4 against oxalic acid in acidic medium is _____ BM. (nearest integer)

87. 9.3 g of pure aniline upon diazotisation followed by coupling with phenol gives an orange dye. The mass of orange dye produced (assume 100% yield/conversion) is _____ g. (nearest integer)

88. Number of molecules from the following which can exhibit hydrogen bonding is _____. (nearest integer)



89. Among $\text{CrO}, \text{Cr}_2\text{O}_3$ and CrO_3 , the sum of spin-only magnetic moment values of basic and amphoteric oxides is _____ 10^{-2} BM (nearest integer).

(Given atomic number of Cr is 24)

90. Frequency of the de-Broglie wave of electron in Bohr's first orbit of hydrogen atom is _____ $\times 10^{13}$ Hz (nearest integer).

[Given :

$$\begin{aligned} R_H &= 2.18 \times 10^{-18} \text{ J} \\ (\text{Rydberg constant}) & \\ h &= 6.6 \times 10^{-34} \text{ J.s} \\ (\text{Plank's constant}) & \end{aligned}$$

.]

- End of Question Paper -