

JEE Main 2024 Paper 1 (B.E./B.Tech) 5 April 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 2**, conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 5 April 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 the circle

$$C_1 : x^2 + y^2 - 2(x + y) + 1 = 0$$

and C_2 be a circle having centre at $(-1, 0)$ and radius 2. If the line of the common chord of C_1 and C_2 intersects the y-axis at the point P, then the square of the distance of P from the centre of C_1 is:

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

2. Let $f, g : \mathbf{R} \rightarrow \mathbf{R}$ be defined as :

$$f(x) = |x - 1| \text{ and } g(x) = \begin{cases} e^x, & x \geq 0 \\ x + 1, & x \leq 0. \end{cases}$$

Then the function $f(g(x))$ is

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

3. Let ABCD and AEFG be squares of side 4 and 2 units, respectively. The point E is on the line segment AB and the point F is on the diagonal AC. Then the radius r of the circle passing through the point F and touching the line segments BC and CD satisfies :

- (A) $r = 1$
(B) $2r^2 - 4r + 1 = 0$
(C) $2r^2 - 8r + 7 = 0$
(D) $r^2 - 8r + 8 = 0$

4. Let (α, β, γ) be the image of the point $(8, 5, 7)$ in the line

$$\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-2}{5}$$

. Then $\alpha + \beta + \gamma$ is equal to :

- (A) 16 (B) 20
(C) 18 (D) 14

5. Let

$$S_1 = \{z \in \mathbf{C} : |z| \leq 5\}, S_2 = \{z \in \mathbf{C} : \operatorname{Im}\left(\frac{z+1-\sqrt{3}i}{1-\sqrt{3}i}\right) \geq 0\}$$

and

$$S_3 = \{z \in \mathbf{C} : \operatorname{Re}(z) \geq 0\}$$

. Then the area of the region $S_1 \cap S_2 \cap S_3$ is :

- (A) $\frac{125\pi}{24}$
(B) $\frac{125\pi}{6}$
(C) $\frac{125\pi}{12}$
(D) $\frac{125\pi}{4}$

6. If the constant term in the expansion of

$$\left(\frac{\sqrt[5]{3}}{x} + \frac{2x}{\sqrt[3]{5}}\right)^{12}, x \neq 0$$

, is $\alpha \times 2^8 \times \sqrt[5]{3}$, then 25α is equal to :

- (A) 724 (B) 742
(C) 693 (D) 639

7. Let

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

and $\vec{c}$ be three vectors such that

$$(\vec{c} + \hat{i}) \times (\vec{a} + \vec{b} + \hat{i}) = \vec{a} \times (\vec{c} + \hat{i})$$

. If

$$\vec{a} \cdot \vec{c} = -29$$

, then $\vec{c} \cdot (-2\hat{i} + \hat{j} + \hat{k})$ is equal to:

- (A) 15 (B) 10
(C) 5 (D) 12

8. Let $A(-1, 1)$ and $B(2, 3)$ be two points and P be a variable point above the line AB such that the area of $\triangle PAB$ is 10. If the locus of P is $ax + by = 15$, then $5a + 2b$ is :

- (A) $-\frac{12}{5}$
 (B) $-\frac{6}{5}$
 (C) 6
 (D) 4

9. The values of m, n , for which the system of equations

$$\begin{aligned} x + y + z &= 4, \\ 2x + 5y + 5z &= 17, \\ x + 2y + mz &= n \end{aligned}$$

has infinitely many solutions, satisfy the equation :

- (A) $m^2 + n^2 - m - n = 46$
 (B) $m^2 + n^2 + mn = 68$
 (C) $m^2 + n^2 - mn = 39$
 (D) $m^2 + n^2 + m + n = 64$

10. If

$$y(\theta) = \frac{2 \cos \theta + \cos 2\theta}{\cos 3\theta + 4 \cos 2\theta + 5 \cos \theta + 2}$$

, then at

$$\theta = \frac{\pi}{2}, y'' + y' + y$$

is equal to :

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

11. Let

$$\beta(m, n) = \int_0^1 x^{m-1}(1-x)^{n-1} dx, \quad m, n > 0$$

. If

$$\int_0^1 (1-x^{10})^{20} dx = a \times \beta(b, c)$$

, then $100(a + b + c)$ equals _____.

- (A) 2012
 (B) 1021
 (C) 1120
 (D) 2120

12. Let $f : [-1, 2] \rightarrow \mathbf{R}$ be given by

$$f(x) = 2x^2 + x + [x^2] - [x]$$

, where $[t]$ denotes the greatest integer less than or equal to t . The number of points, where f is not continuous, is :

- (A) 5
 (B) 6
 (C) 4
 (D) 3

13. Let the set

$$S = \{2, 4, 8, 16, \dots, 512\}$$

be partitioned into 3 sets A, B, C with equal number of elements such that

$$A \cup B \cup C = S$$

and

$$A \cap B = B \cap C = A \cap C = \phi$$

. The maximum number of such possible partitions of S is equal to:

- (A) 1640
 (B) 1520
 (C) 1710
 (D) 1680

14. The coefficients a, b, c in the quadratic equation

$$ax^2 + bx + c = 0$$

are from the set $\{1, 2, 3, 4, 5, 6\}$. If the probability of this equation having one real root bigger than the other is p , then $216p$ equals :

- (A) 38
 (B) 76
 (C) 57
 (D) 19

15. Let $\alpha\beta \neq 0$ and

$$A = \begin{bmatrix} \beta & \alpha & 3 \\ \alpha & \alpha & \beta \\ -\beta & \alpha & 2\alpha \end{bmatrix}$$

. If

$$B = \begin{bmatrix} 3\alpha & -9 & 3\alpha \\ -\alpha & 7 & -2\alpha \\ -2\alpha & 5 & -2\beta \end{bmatrix}$$

is the matrix of cofactors of the elements of A , then $\det(AB)$ is equal to :

- (A) 64 (B) 343
(C) 125 (D) 216

16. For $x \geq 0$, the least value of K , for which

$$4^{1+x} + 4^{1-x}, \frac{K}{2}, 16^x + 16^{-x}$$

are three consecutive terms of an A.P., is equal to :

- (A) 10 (B) 4
(C) 8 (D) 16

17. The area enclosed between the curves

$$y = x|x|$$

and

$$y = x - |x|$$

is :

- (A) $\frac{8}{3}$
(B) $\frac{2}{3}$
(C) $\frac{4}{3}$
(D) 1

18. 60 words can be made using all the letters of the word BHBJO, with or without meaning. If these words are written as in a dictionary, then the 50th word is:

- (A) OBBJH (B) HBBJO
(C) OBBHJ (D) JBBOH

19. Consider three vectors $\vec{a}, \vec{b}, \vec{c}$. Let

$$|\vec{a}| = 2, |\vec{b}| = 3$$

and

$$\vec{a} = \vec{b} \times \vec{c}$$

. If

$$\alpha \in \left[0, \frac{\pi}{3}\right]$$

is the angle between the vectors $\vec{b}$ and $\vec{c}$, then the minimum value of $27|\vec{c} - \vec{a}|^2$ is equal to:

- (A) 124 (B) 110
(C) 121 (D) 105

20. The differential equation of the family of circles passing through the origin and having centre at the line $y = x$ is :

- (A) $(x^2 - y^2 + 2xy)dx = (x^2 - y^2 + 2xy)dy$
(B) $(x^2 + y^2 - 2xy)dx = (x^2 + y^2 + 2xy)dy$
(C) $(x^2 + y^2 + 2xy)dx = (x^2 + y^2 - 2xy)dy$
(D) $(x^2 - y^2 + 2xy)dx = (x^2 - y^2 - 2xy)dy$

21. Let

$y = y(x)$
be the solution of the differential equation
 $\frac{dy}{dx} + \frac{2x}{(1+x^2)^2}y = xe^{\frac{1}{(1+x^2)}}; y(0) = 0.$

Then the area enclosed by the curve

$f(x) = y(x)e^{-\frac{1}{(1+x^2)}}$
and the line $y - x = 4$ is _____.

22. Let the mean and the standard deviation of the probability distribution

X	α	1	0	-3
P(X)	$\frac{1}{3}$	K	$\frac{1}{6}$	$\frac{1}{4}$

be μ and σ , respectively. If $\sigma - \mu = 2$, then $\sigma + \mu$ is equal to _____.

23. Let the maximum and minimum values of $(\sqrt{8x - x^2 - 12} - 4)^2 + (x - 7)^2, x \in \mathbf{R}$ be M and m, respectively. Then $M^2 - m^2$ is equal to _____.

24. Let the point $(-1, \alpha, \beta)$ lie on the line of the shortest distance between the lines

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

and

$$\frac{x+2}{-1} = \frac{y+6}{2} = \frac{z-1}{0}$$

. Then $(\alpha - \beta)^2$ is equal to _____.

25. If

$$1 + \frac{\sqrt{3} - \sqrt{2}}{2\sqrt{3}} + \frac{5 - 2\sqrt{6}}{18} + \frac{9\sqrt{3} - 11\sqrt{2}}{36\sqrt{3}} + \frac{49 - 20\sqrt{6}}{180} + \dots$$

upto

$$\infty = 2 + \left(\sqrt{\frac{b}{a}} + 1 \right) \log_e \left(\frac{a}{b} \right)$$

, where a and b are integers with
 $\gcd(a, b) = 1$

, then $11a + 18b$ is equal to _____.

26. Let

$a > 0$
be a root of the equation $2x^2 + x - 2 = 0$. If

$$\lim_{x \rightarrow \frac{1}{a}} \frac{16(1 - \cos(2 + x - 2x^2))}{(1 - ax)^2} = \alpha + \beta\sqrt{17}$$

, where $\alpha, \beta \in \mathbf{Z}$, then $\alpha + \beta$ is equal to _____.

27. If

$$f(t) = \int_0^\pi \frac{2x \, dx}{1 - \cos^2 t \sin^2 x}, 0 < t < \pi$$

, then the value of

$$\int_0^{\frac{\pi}{2}} \frac{\pi^2 dt}{f(t)}$$

equals _____.

28. The number of real solutions of the equation
 $x|x+5| + 2|x+7| - 2 = 0$
is _____.

29. The number of solutions of

$$\sin^2 x + (2 + 2x - x^2) \sin x - 3(x - 1)^2 = 0$$

, where $-\pi \leq x \leq \pi$, is _____.

30. Let a line perpendicular to the line
 $2x - y = 10$ touch the parabola

$$y^2 = 4(x - 9)$$

at the point P. The distance of the point P from the centre of the circle

$$x^2 + y^2 - 14x - 8y + 56 = 0$$

is _____.

Physics - Section A · Multiple Choice Questions

31. A body is moving unidirectionally under the influence of a constant power source. Its displacement in time t is proportional to :

- (A) $t^{2/3}$ (B) $t^{3/2}$
(C) t (D) t^2

32. What is the dimensional formula of ab^{-1} in the equation

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

, where letters have their usual meaning.

- (A) $[M^6 L^7 T^4]$
(B) $[M^{-1} L^5 T^3]$
(C) $[M^0 L^3 T^{-2}]$
(D) $[ML^2 T^{-2}]$

33. A particle moves in x - y plane under the influence of a force $\vec{F}$ such that its linear momentum is

$$\vec{p}(t) = \hat{i}\cos(kt) - \hat{j}\sin(kt)$$

. If k is constant, the angle between $\vec{F}$ and $\vec{p}$ will be :

- (A) $\frac{\pi}{2}$
(B) $\frac{\pi}{3}$
(C) $\frac{\pi}{4}$
(D) $\frac{\pi}{6}$

34. Match List I with List II :

	LIST I EM-Wave		LIST II Wavelength Range
A.	Infra-red	I.	$< 10^{-3}$ nm
B.	Ultraviolet	II.	400 nm to 1 nm
C.	X-rays	III.	1 mm to 700 nm
D.	Gamma rays	IV.	1 nm to 10^{-3} nm

Choose the correct answer from the options given below :

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

35. During an adiabatic process, if the pressure of a gas is found to be proportional to the cube of its absolute temperature, then the ratio of

$$\frac{C_P}{C_V}$$

for the gas is :

- (A) $\frac{5}{3}$
(B) $\frac{3}{2}$
(C) $\frac{7}{5}$
(D) $\frac{9}{7}$

36. A heavy box of mass 50 kg is moving on a horizontal surface. If co-efficient of kinetic friction between the box and horizontal surface is 0.3 then force of kinetic friction is :

- (A) 1470 N (B) 147 N
(C) 1.47 N (D) 14.7 N

37. A man carrying a monkey on his shoulder does cycling smoothly on a circular track of radius 9 m and completes 120 revolutions in 3 minutes. The magnitude of centripetal acceleration of monkey is (in m/s^2) :

- (A) $4\pi^2 \text{ ms}^{-2}$
 (B) $16\pi^2 \text{ ms}^{-2}$
 (C) $57600\pi^2 \text{ ms}^{-2}$
 (D) Zero

38. A series LCR circuit is subjected to an ac signal of 200 V, 50 Hz. If the voltage across the inductor

$$(L = 10 \text{ mH})$$

is 31.4 V, then the current in this circuit is _____.

- (A) 10 A (B) 10 mA
 (C) 68 A (D) 63 A

39. Which of the following statement is not true about stopping potential (V_0) ?

- (A) It depends upon frequency of the incident light. (B) It is $1/e$ times the maximum kinetic energy of electrons emitted.
 (C) It increases with increase in intensity of the incident light. (D) It depends on the nature of emitter material.

40. Given below are two statements :

Statement I : When the white light passed through a prism, the red light bends lesser than yellow and violet.

Statement II : The refractive indices are different for different wavelengths in dispersive medium. In the light of the above statements, chose 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

41. Match List I with List II :

	LIST I		LIST II
A.	A force that restores an elastic body of unit area to its original state	I.	Bulk modulus
B.	Two equal and opposite forces parallel to opposite faces	II.	Young's modulus
C.	Forces perpendicular everywhere to the surface per unit area same everywhere	III.	Stress
D.	Two equal and opposite forces perpendicular to opposite faces Choose the correct answer from the options given below :	IV.	Shear modulus

Choose the correct answer from the options given below :

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

42. A satellite revolving around a planet in stationary orbit has time period 6 hours. The mass of planet is one-fourth the mass of earth. The radius of planet is :

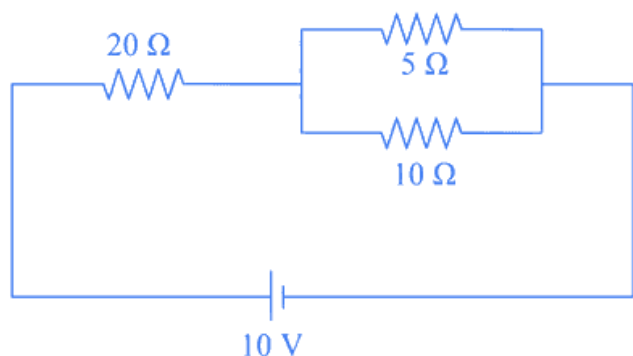
(Given = Radius of geo-stationary orbit for earth is $4.2 \times 10^4 \text{ km}$)

- (A) $1.68 \times 10^5 \text{ km}$
 (B) $1.4 \times 10^4 \text{ km}$
 (C) $8.4 \times 10^4 \text{ km}$
 (D) $1.05 \times 10^4 \text{ km}$

43. A vernier callipers has 20 divisions on the vernier scale, which coincides with 19th division on the main scale. The least count of the instrument is 0.1 mm. One main scale division is equal to _____ mm.

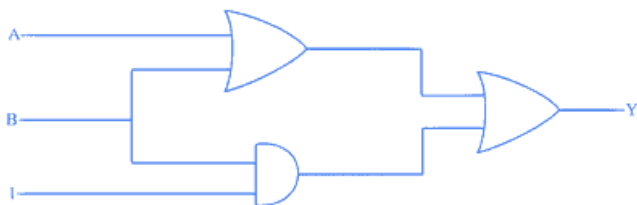
- (A) 5 (B) 2
 (C) 1 (D) 0.5

44. The ratio of heat dissipated per second through the resistance 5Ω and 10Ω in the circuit given below is:



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

45. The output (Y) of logic circuit given below is 0 only when :



- (A) $A = 0, B = 0$
(B) $A = 0, B = 1$
(C) $A = 1, B = 0$
(D) $A = 1, B = 1$

46. The angular momentum of an electron in a hydrogen atom is proportional to : (Where r is the radius of orbit of electron)

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

47. The vehicles carrying inflammable fluids usually have metallic chains touching the ground:

- (A) To protect tyres from catching dirt from ground
(B) It is a custom
(C) To alert other vehicles
(D) To conduct excess charge due to air friction to ground and prevent sparking

48. A galvanometer of resistance 100Ω when connected in series with 400Ω measures a voltage of upto 10 V. The value of resistance required to convert the galvanometer into ammeter to read upto 10 A is $x \times 10^{-2}\Omega$. The value of x is :

- (A) 2
(B) 20
(C) 800
(D) 200

49. The electrostatic force ($\vec{F}_1$) and magnetic force ($\vec{F}_2$) acting on a charge q moving with velocity $\vec{v}$ can be written :

- (A) $\vec{F}_1 = q\vec{B}, \vec{F}_2 = q(\vec{B} \times \vec{v})$
(B) $\vec{F}_1 = q\vec{V} \cdot \vec{E}, \vec{F}_2 = q(\vec{B} \cdot \vec{V})$
(C) $\vec{F}_1 = q\vec{E}, \vec{F}_2 = q(\vec{V} \times \vec{B})$
(D) $\vec{F}_1 = q\vec{E}, \vec{F}_2 = q(\vec{B} \times \vec{V})$

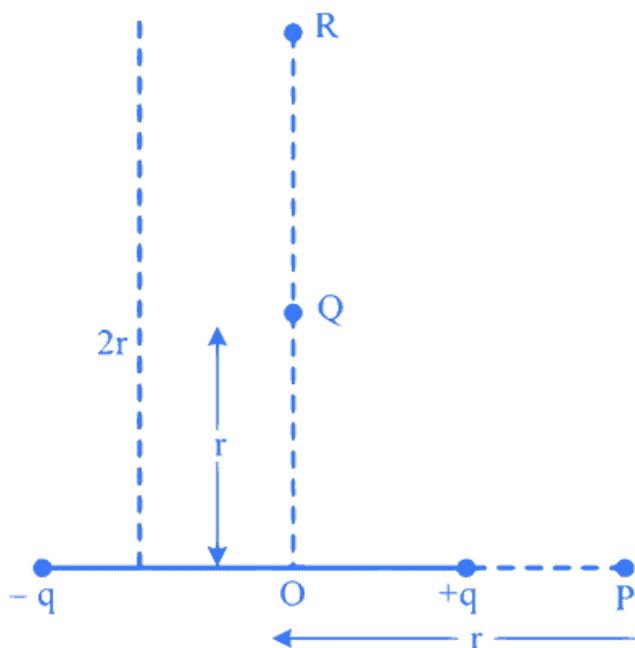
50. If n is the number density and d is the diameter of the molecule, then the average distance covered by a molecule between two successive collisions (i.e. mean free path) is represented by :

- (A) $\frac{1}{\sqrt{2} n \pi d^2}$
(B) $\frac{1}{\sqrt{2} n^2 \pi^2 d^2}$
(C) $\frac{1}{\sqrt{2} n \pi d^2}$
(D) $\sqrt{2} n \pi d^2$

51. The electric field at point p due to an electric dipole is E. The electric field at point R on equatorial line will be

$$\frac{E}{x}$$

. The value of x :



52. A sonometer wire of resonating length 90 cm has a fundamental frequency of 400 Hz when kept under some tension. The resonating length of the wire with fundamental frequency of 600 Hz under same tension _____ cm.

53. In a single slit experiment, a parallel beam of green light of wavelength 550 nm passes through a slit of width 0.20 mm. The transmitted light is collected on a screen 100 cm away. The distance of first order minima from the central maximum will be $x \times 10^{-5}$ m. The value of x is :

54. A hollow sphere is rolling on a plane surface about its axis of symmetry. The ratio of rotational kinetic energy to its total kinetic energy is $\frac{x}{5}$. The value of x is _____.

55. A wire of resistance 20Ω is divided into 10 equal parts, resulting pairs. A combination of two parts are connected in parallel and so on. Now resulting pairs of parallel combination are connected in series. The equivalent resistance of final combination is _____ Ω .

56. The maximum height reached by a projectile is 64 m. If the initial velocity is halved, the new maximum height of the projectile is _____ m.

57. The shortest wavelength of the spectral lines in the Lyman series of hydrogen spectrum is

$$915 \text{ \AA}$$

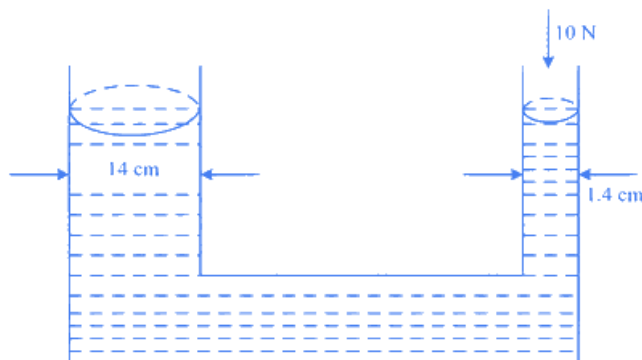
. The longest wavelength of spectral lines in the Balmer series will be _____ $\text{\AA}$.

58. The current in an inductor is given by

$$I = (3t + 8)$$

where t is in second. The magnitude of induced emf produced in the inductor is 12 mV. The self-inductance of the inductor _____ mH.

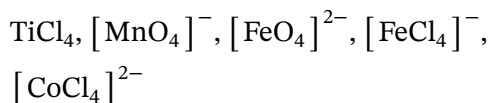
59.



A hydraulic press containing water has two arms with diameters as mentioned in the figure. A force of 10 N is applied on the surface of water in the thinner arm. The force required to be applied on the surface of water in the thicker arm to maintain equilibrium of water is _____ N.

60. A solenoid of length 0.5 m has a radius of 1 cm and is made up of 'm' number of turns. It carries a current of 5 A. If the magnitude of the magnetic field inside the solenoid is 6.28×10^{-3} T then the value of m is _____.

61. The number of complexes from the following with no electrons in the t_2 orbital is _____.



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

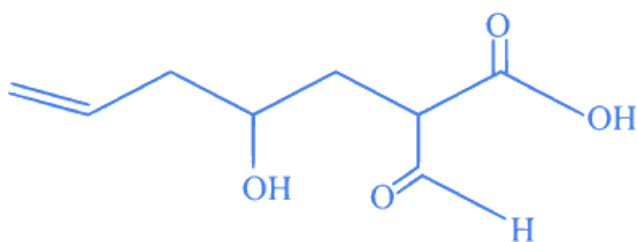
62. Match List I with List II.

	LIST I		LIST II
A.	ICl	I.	T - shape
B.	ICl ₃	II.	Square pyramidal
C.	ClF ₅	III.	Pentagonal bipyramidal
D.	IF ₇	IV.	Linear

Choose the correct answer from the options given below :

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

63. The correct nomenclature for the following compound is :



- (A) 2-carboxy-4-hydroxyhept-7-enal (B) 2-formyl-4-hydroxyhept-7-enoic acid
(C) 2-carboxy-4-hydroxyhept-6-enal (D) 2-formyl-4-hydroxyhept-6-enoic acid

64. Given below are two statements :

Statement I : On passing $\text{HCl}_{(g)}$ through a saturated solution of BaCl_2 , at room temperature white turbidity appears.

Statement II : When HCl gas is passed through a saturated solution of NaCl , sodium chloride is precipitated due to common ion effect.

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

65. Match List - I with List - II.

	LIST I (Pair of Compounds)		LIST II (Isomerism)
A.	n-propanol and Isopropanol	I.	Metamerism
B.	Methoxypropane and ethoxyethane	II.	Chain Isomerism
C.	Propanone and propanal	III.	Position Isomerism
D.	Neopentane and Isopentane	IV.	Functional Isomerism

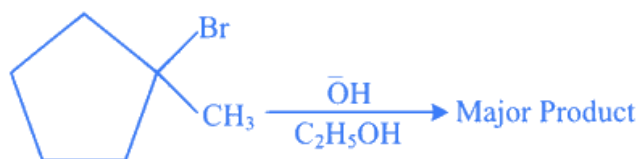
Choose the correct answer from the options given below :

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

66. While preparing crystals of Mohr's salt, dil H_2SO_4 is added to a mixture of ferrous sulphate and ammonium sulphate, before dissolving this mixture in water, dil H_2SO_4 is added here to :

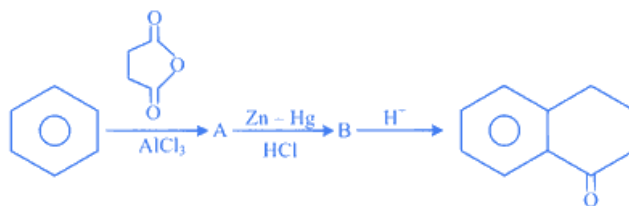
- (A) prevent the hydrolysis of ferrous sulphate (B) prevent the hydrolysis of ammonium sulphate
(C) increase the rate of formation of crystals (D) make the medium strongly acidic

67. Identify the major product in the following reaction.



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

68. Identify A and B in the given chemical reaction sequence :



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

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

Assertion (A) :



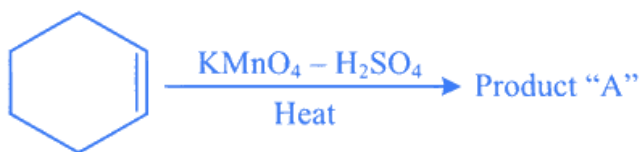
and NF_3 molecule have pyramidal shape with a lone pair of electrons on nitrogen atom. The resultant dipole moment of NH_3 is greater than that of NF_3 .

Reason (R) : In NH_3 , the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of the N – H bonds. F is the most electronegative element.

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

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

70. Consider the given chemical reaction :



Product "A" is :

- | | |
|-----------------|-----------------|
| (A) picric acid | (B) oxalic acid |
| (C) adipic acid | (D) acetic acid |

71. The correct statements from the following are :

(A) The decreasing order of atomic radii of group 13 elements is



(B) Down the group 13 electronegativity decreases from top to bottom.

(C) Al dissolves in dil. HCl and liberates H_2 but conc. HNO_3 renders Al passive by forming a protective oxide layer on the surface.

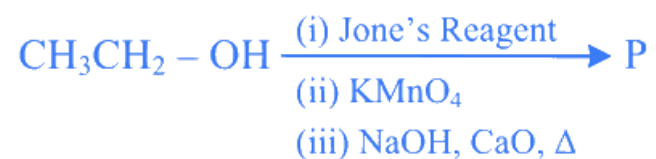
(D) All elements of group 13 exhibits highly stable +1 oxidation state.

(E) Hybridisation of Al in $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ ion is sp^3d^2 .

Choose the correct answer from the options given below :

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

72.



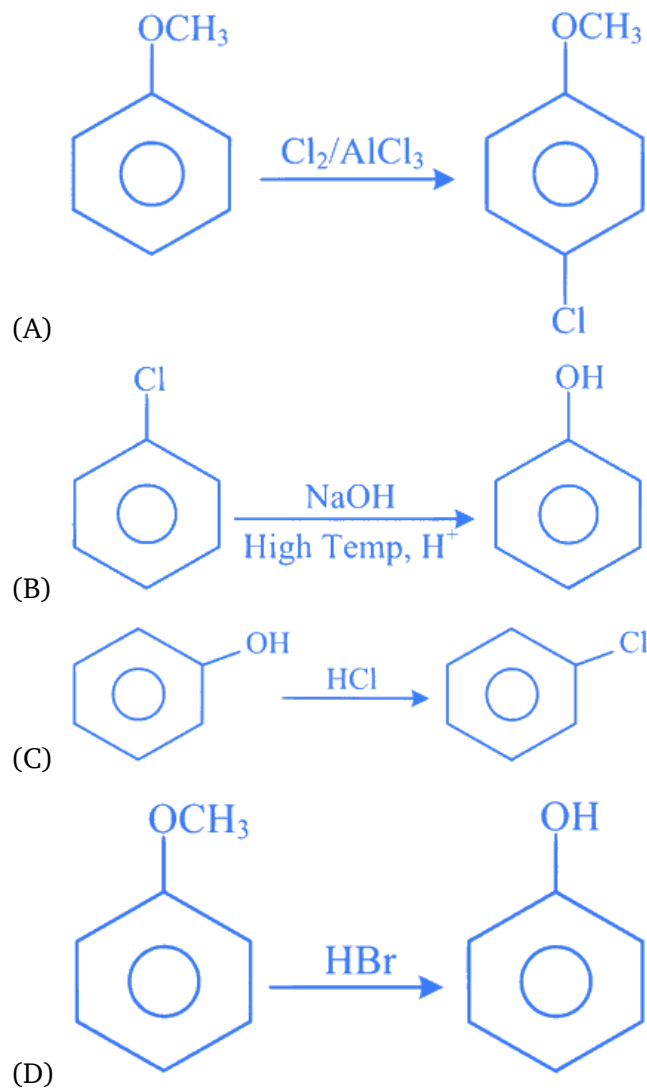
Consider the above reaction sequence and identify the major product P.

- | | |
|--------------------|--------------------|
| (A) Methanoic acid | (B) Methoxymethane |
| (C) Methane | (D) Methanal |

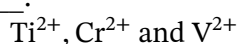
73. Coagulation of egg, on heating is because of :

- | | |
|--|--|
| (A) Denaturation of protein occurs | (B) Biological property of protein remains unchanged |
| (C) Breaking of the peptide linkage in the primary structure of protein occurs | (D) The secondary structure of protein remains unchanged |

74. Which one of the following reactions is NOT possible?



75. The number of ions from the following that have the ability to liberate hydrogen from a dilute acid is _____.



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

76. The number of moles of methane required to produce 11 g $\text{CO}_2(\text{g})$ after complete combustion is : (Given molar mass of methane in g mol^{-1} : 16)

- (A) 0.35 (B) 0.25
(C) 0.5 (D) 0.75

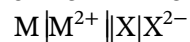
77. The quantity of silver deposited when one coulomb charge is passed through AgNO_3 solution :

- (A) 0.1 g atom of silver (B) 1 chemical equivalent of silver
(C) 1 g of silver (D) 1 electrochemical equivalent of silver

78. The metal atom present in the complex MABXL (where A, B, X and L are unidentate ligands and M is metal) involves sp^3 hybridization. The number of geometrical isomers exhibited by the complex is :

- (A) 0 (B) 2
(C) 3 (D) 4

79. For the electro chemical cell



If

$$E^0_{(\text{M}^{2+}/\text{M})} = 0.46 \text{ V}$$

and

$$E^0_{(\text{X}/\text{X}^{2-})} = 0.34 \text{ V}$$

Which of the following is correct?

- (A) $E_{\text{cell}} = 0.80 \text{ V}$
(B) $\text{M} + \text{X} \rightarrow \text{M}^{2+} + \text{X}^{2-}$ is a spontaneous reaction
(C) $E_{\text{cell}} = -0.80 \text{ V}$
(D) $\text{M}^{2+} + \text{X}^{2-} \rightarrow \text{M} + \text{X}$ is a spontaneous reaction

80. Given below are two statements :

Statement I : The metallic radius of Na is $1.86 \text{ \AA}$ and the ionic radius of Na^+ is lesser than $1.86 \text{ \AA}$

Statement II : Ions are always smaller in size than the corresponding elements.

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 incorrect but Statement II is true
(C) Both Statement I and Statement II are false (D) Statement I is correct but Statement II is false

81. In an atom, total number of electrons having quantum numbers

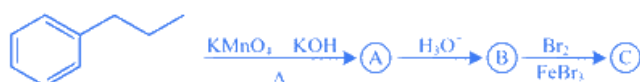
$$n = 4, |m_l| = 1$$

and

$$m_s = -\frac{1}{2}$$

is _____.

82. The product C in the following sequence of reactions has _____ π bonds.



83. Using the given figure, the ratio of R_f values of sample A and sample C is $x \times 10^{-2}$. Value of x is _____.

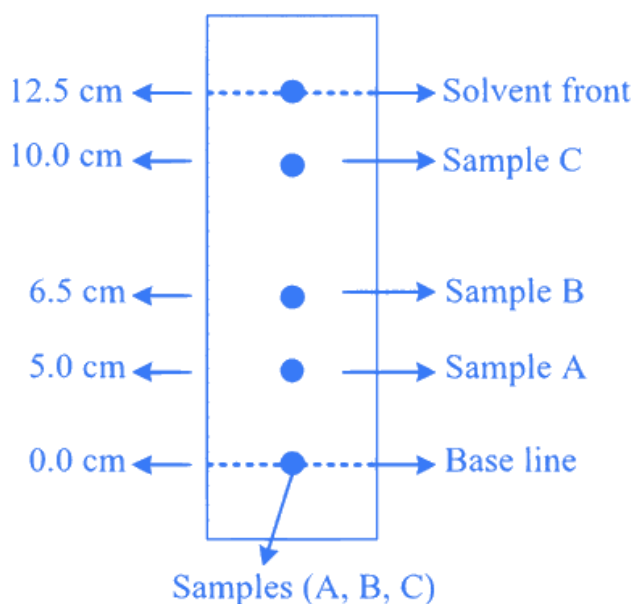


Fig : Paper chromatography of Samples

84. Considering acetic acid dissociates in water, its dissociation constant is 6.25×10^{-5} . If 5 mL of acetic acid is dissolved in 1 litre water, the solution will freeze at $-x \times 10^{-2}^\circ\text{C}$, provided pure water freezes at 0°C .

$x =$ _____. (Nearest integer)

Given : $(K_f)_{\text{water}} = 1.86 \text{ K kg mol}^{-1}$

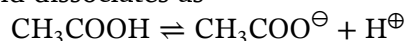
density of acetic acid is 1.2 g mol^{-1} .

molar mass of water = 18 g mol^{-1} .

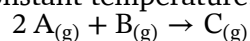
molar mass of acetic acid = 60 g mol^{-1} .

density of water = 1 g cm^{-3}

Acetic acid dissociates as



85. Consider the following single step reaction in gas phase at constant temperature.



The initial rate of the reaction is recorded as r_1 when the reaction starts with 1.5 atm pressure of A and 0.7 atm pressure of B. After some time, the rate r_2 is recorded when the pressure of C becomes 0.5 atm. The ratio $r_1 : r_2$ is _____ $\times 10^{-1}$. (Nearest integer)

86. The fusion of chromite ore with sodium carbonate in the presence of air leads to the formation of products A and B along with the evolution of CO_2 . The sum of spin-only magnetic moment values of A and B is _____ B.M. (Nearest integer)

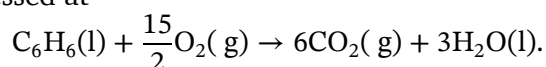
[Given atomic number :

C : 6, Na : 11, O : 8, Fe : 26, Cr : 24

]

87. In the Claisen-Schmidt reaction to prepare 351 g of dibenzalacetone using 87 g of acetone, the amount of benzaldehyde required is _____ g. (Nearest integer)

88. Combustion of 1 mole of benzene is expressed at



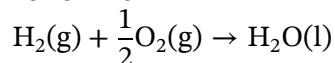
The standard enthalpy of combustion of 2 mol of benzene is $-x'\text{kJ}$. $x =$ _____.

Given :

1. standard Enthalpy of formation of 1 mol of $\text{C}_6\text{H}_6(\text{l})$, for the reaction 6C (graphite) $+ 3\text{H}_2(\text{g}) \rightarrow \text{C}_6\text{H}_6(\text{l})$ is 48.5 kJ mol^{-1} .

2. Standard Enthalpy of formation of 1 mol of $\text{CO}_2(\text{g})$, for the reaction C (graphite) $+ \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$ is $-393.5 \text{ kJ mol}^{-1}$.

3. Standard and Enthalpy of formation of 1 mol of $\text{H}_2\text{O}(\text{l})$, for the reaction



is -286 kJ mol^{-1} .

89. X g of ethanamine was subjected to reaction with NaNO_2/HCl followed by hydrolysis to liberate N_2 and HCl . The HCl generated was completely neutralised by 0.2 moles of NaOH . X is _____ g.

90. Number of compounds from the following with zero dipole moment is _____.

HF , H_2 , H_2S , CO_2 , NH_3 , BF_3 , CH_4 , CHCl_3 , SiF_4 , H_2O , BeF_2

- End of Question Paper -