JEE Main 2023 Paper 1 (B.E./B.Tech) Apr 15 Shift 1 Question Paper

Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours | **B.E./B.Tech** | **Maximum Marks: 300**

General Instructions

(i) This is **Paper 1 (B.E./B.Tech)** of **JEE (Main) 2023**, conducted by the National Testing Agency on **15 Apr 2023**.

(ii) The paper contains **90 questions**; attempt **75** as specified in the section table. The maximum score is **300 marks**.

(iii) Multiple choice questions have four options. Select one answer. Each correct answer carries **4 marks**; an incorrect answer carries **−1 mark**.

(iv) Numerical value questions carry **4 marks** for a correct answer and **−1 marks** for an incorrect answer. Unanswered questions carry **0 marks**.

(v) Each subject contains Section A (20 multiple choice questions) and Section B (10 numerical value questions).

(vi) In Section B of each subject, attempt **any five of the ten** numerical value questions.

Section	Questions	To attempt	Marks
Mathematics — Section A	20	20	80
Mathematics — Section B	10	5	20
Physics — Section A	20	20	80
Physics — Section B	10	5	20
Chemistry — Section A	20	20	80
Chemistry — Section B	10	5	20

Mathematics — Section A

1. 4 marks

Let x = x(y) be the solution of the differential equation $2(y + 2)\log_e(y + 2)dx + (x + 4 - 2\log_e(y + 2))dy = 0$, $y > -1$ with $x(e^4 - 2) = 1$. Then $x(e^9 - 2)$ is equal to

(1) $\frac{10}{3}$ (2) $\frac{32}{9}$ (3) $\frac{4}{9}$ (4) 3

2. 4 marks

If $\int_0^1 \frac{1}{(5+2x-2x^2)(1+e^{(2-4x)})}dx = \frac{1}{\alpha}\log_e\left(\frac{\alpha+1}{\beta}\right)$, then $\alpha^4 - \beta^4$ is equal to

(1) 21 (2) 0 (3) 19 (4) –21

3. 4 marks

Let [x] denote the greatest integer function and $f(x) = \max\{1 + x + [x], 2 + x, x + 2[x]\}$, $0 \le x \le 2$. Let m be the number of points in [0,2], where f is not continuous and n be the number of points in (0,2) where f is not differentiable. Then $(m + n)^2 + 2$ is equal to

(1) 3 (2) 6 (3) 2 (4) 11

4. 4 marks

The total number of three digit numbers, divisible by 3, which can be formed using the digits 1, 3, 5, 8 , if repetition of digits is allowed , is

(1) 20 (2) 22 (3) 21 (4) 18

5. 4 marks

Let A_1 and A_2 be two arithmetic means and G_1, G_2, G_3 be three geometric means of two distinct positive numbers. Then $G_1^4 + G_2^4 + G_3^4 + G_1^2 G_3^2$ is equal to

(1) $2(A_1 + A_2) G_1^2 G_3^2$ (2) $(A_1 + A_2)^2 G_1 G_3$

(3) $2(A_1 + A_2) G_1 G_3$ (4) $(A_1 + A_2) G_1^2 G_3^2$

6. 4 marks

A bag contains 6 white and 4 black balls. A die is rolled once and the number of balls equal to the number obtained on the die are drawn from the bag at random. The probability that all the balls drawn are white is

(1) $\frac{11}{50}$ (2) $\frac{1}{4}$ (3) $\frac{9}{50}$ (4) $\frac{1}{5}$

7. 4 marks

If the domain of the function $f(x) = \log_e(4x^2 + 11x + 6) + \sin^{-1}(4x + 3) + \cos^{-1}\left(\frac{10x+6}{3}\right)$ is $(\alpha, \beta]$, then $36|\alpha + \beta|$ is equal to

(1) 45 (2) 54 (3) 63 (4) 72

8. 4 marks

Let ABCD be a quadrilateral. If E and F are the mid points of the diagonals AC and BD respectively and $\left(\overrightarrow{AB}-\overrightarrow{BC}\right)+\left(\overrightarrow{AD}-\overrightarrow{DC}\right)=k\overrightarrow{FE}$, then k is equal to

(1) 4 (2) – 4 (3) – 2 (4) 2

9. 4 marks

Let $(a + bx + cx^2)^{10} = \sum_{i=0}^{20} p_i x^i$, a, b, c $\in$ N. If $p_1 = 20$ and $p_2 = 210$, then $2(a + b + c)$ is equal to

(1) 6 (2) 12 (3) 15 (4) 8

10. 4 marks

If the set $\left\{\text{Re}\left(\frac{z-\bar{z}+z\bar{z}}{2-3z+5\bar{z}}\right): z \in C, \text{Re}(z)=3\right\}$ is equal to the interval $(\alpha,\beta]$, then $24(\beta - \alpha)$ is equal to

(1) 27 (2) 36 (3) 42 (4) 30

11. 4 marks

Let the system of linear equations

$-x + 2y - 9z = 7$

$-x + 3y + 7z = 9$

$-2x + y + 5z = 8$

$-3x + y + 13z = \lambda$

has a unique solutions $x = \alpha$, $y = \beta$, $z = \gamma$. Then the distance of the point (α, β, γ) from the plane]

$2x - 2y + z = \lambda$ is

(1) 9 (2) 11 (3) 13 (4) 7

12. 4 marks

The mean and standard deviation of 10 observation are 20 and 8 respectively. Later on, it was observed that one observation was recorded as 50 instead of 40. Then the correct variance is

(1) 12 (2) 13 (3) 11 (4) 14

13. 4 marks

Let S be the set of all values of λ, for which the shortest distance between the line $\frac{x-\lambda}{0}=\frac{y-3}{4}=\frac{z+6}{1}$ and $\frac{x+\lambda}{3}=\frac{y}{-4}=\frac{z-6}{0}$ is 13. Then $8\left|\sum_{\lambda\in S}\lambda\right|$ is equal to

(1) 306 (2) 304 (3) 302 (4) 308

14. 4 marks

The number of common tangent, to the circle $x^2 + y^2 - 18x - 15y + 131 = 0$ and $x^2 + y^2 - 6x - 6y - 7 = 0$, is

(1) 2 (2) 1 (3) 4 (4) 3

15. 4 marks

Let S be the set of all (λ, μ) for which the vectors $\lambda\hat{i}-\hat{j}+\hat{k}, \hat{i}+2\hat{j}+\mu\hat{k}$ and $3\hat{i}-4\hat{j}+5\hat{k}$, where $\lambda - \mu = 5$, are coplanar, then $\sum_{(\lambda,\mu)\in S}80\left(\lambda^2+\mu^2\right)$ is equal to

(1) 2210 (2) 2370 (3) 2130 (4) 2290

16. 4 marks

Let the foot of perpendicular of the point P(3, – 2, – 9) on the plane passing through the points (–1, –2, –3), (9, 3, 4), (9, –2, 1) be Q (α, β, γ). Then the distance of Q from the origin is

(1) $\sqrt{42}$ (2) $\sqrt{29}$ (3) $\sqrt{35}$ (4) $\sqrt{38}$

17. 4 marks

If (α, β) is the orthocentre of the triangle ABC with vertices A(3,–7), B (–1,2) and C(4,5), then $9\alpha - 6\beta + 60$ is equal to

(1) 35 (2) 30 (3) 25 (4) 40

18. 4 marks

Negation of $p\wedge(q\wedge\sim(p\wedge q))$ is

(1) $(\sim(p\wedge q))\vee p$ (2) $(\sim(p\wedge q))\wedge q$ (3) $\sim(p\vee q)$ (4) $p\vee q$

19. 4 marks

The number of real roots of the equation $x|x| - 5|x + 2| + 6 = 0$, is

(1) 4 (2) 3 (3) 6 (4) 5

20. 4 marks

Let the determinant of a square matrix A of order m be m – n , where m and n satisfy 4m + n = 22 and 17m + 4n = 93 . If det (n adj(adj(mA))) = $3^a5^b6^c$, then a + b + c is equal to

(1) 84 (2) 96 (3) 109 (4) 101

Mathematics — Section B

21. Numerical value · 4 marks

Consider the triangle with vertices A(2,1), B (0,0) and C (t,4), $t \in [0,4]$. If the maximum and the minimum perimeters of such triangles are obtained at $t = \alpha$ and $t = \beta$ respectively, then $6\alpha + 21\beta$ is equal to

22. Numerical value · 4 marks

If the area bounded by the curve $2y^2 = 3x$, lines $x + y = 3$, $y = 0$ and outside the circle $(x - 3)^2 + y^2 = 2$ is A, then $4(\pi + 4A)$ is equal to

23. Numerical value · 4 marks

Let an ellipse with centre (1, 0) and latus rectum of length $\frac{'}{2}$ have its major axis along x-axis. If its minor axis subtends an angle 60º at the foci, then the square of the sum of the length of its minor and major axes is equal to

24. Numerical value · 4 marks

A person forgets his 4 digit ATM pin code. But he remembers that in the code all the digits are different, the greatest digit is 7 and the sum of the first two digits is equal to the sum of the last two digit. Then the maximum number of trials necessary to obtain the correct code is

25. Numerical value · 4 marks

Let $f(x) = \int \frac{dx}{(3+4x^2)\sqrt{4-3x^2}}$, $|x| < \frac{2}{\sqrt{3}}$. If $f(0) = 0$ and $f(1) = \frac{1}{\alpha\beta}\tan^{-1}\left(\frac{\alpha}{\beta}\right)$, $\alpha, \beta > 0$, then $\alpha^2 + \beta^2$ is equal to

26. Numerical value · 4 marks

If the line $x = y = z$ intersects the line $x \sin A + y \sin B + z \sin C - 18 = 0 = x \sin 2A + y \sin 2B + z \sin 2C - 9$, where A, B, C are the angles of a triangle ABC, then $80\left(\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}\right)$ is equal to

27. Numerical value · 4 marks

If the sum of the series $\left(\frac{1}{2}-\frac{1}{3}\right)+\left(\frac{1}{2^2}-\frac{1}{2.3}+\frac{1}{3^2}\right)+\left(\frac{1}{2^2}-\frac{1}{2^2.3}+\frac{1}{2.3^2}-\frac{1}{3^3}\right)+$

$\left(\frac{1}{2^4}-\frac{1}{2^3.3}+\frac{1}{2^2.3^2}-\frac{1}{2.3^3}+\frac{1}{3^4}\right)+\ldots..$ is $\frac{\alpha}{\beta}$, where α and β are co-prime , then $\alpha + 3\beta$ is equal to ___

28. Numerical value · 4 marks

Let A = {1, 2, 3, 4} and R be a relation on the set A × A defined by

R = {((a, b), (c, d)) : 2a + 3b = 4c + 5d}. Then the number of element in R is _____

29. Numerical value · 4 marks

The number of element in the set $\{n \in N : 10 \le n \le 100 \text{ and } 3^n - 3 \text{ is a multiple of } 7\}$ is _____

30. Numerical value · 4 marks

Let the plane P contain the line $2x + y - z - 3 = 0 = 5x - 3y + 4z + 9$ and be parallel to the line $\frac{x+2}{2} = \frac{3-y}{-4} = \frac{z-7}{5}$. Then the distance of the point A (8, –1, – 19) from the plane P measured parallel to the line $\frac{x}{-3} = \frac{y-5}{4} = \frac{2-z}{-12}$ is equal to _____

Physics — Section A

31. 4 marks

The position of a particle related to time is given by $x = (5t^2 - 4t + 5)$m. The magnitude of velocity of the particle at t = 2s will be:

(1) 10 ms^{-1} (2) 06 ms^{-1} (3) 16 ms^{-1} (4) 14 ms^{-1}

32. 4 marks

A flask contains Hydrogen and Argon in the ratio 2 : 1 by mass. The temperature of the mixture is 30°C. The ratio of average kinetic energy per molecule of the two gases (K argon/K hydrogen) is :
(Given: Atomic Weight of Ar = 39.9

(1) 1 (2) 39.9 (3) 2 (4) $\frac{39.9}{2}$

33. 4 marks

The de Broglie wavelength of an electron having kinetic energy E is λ. If the kinetic energy of electron becomes $\frac{E}{4}$, then its de-Broglie wavelength will be:

(1) 2λ (2) $\frac{\lambda}{2}$ (3) $\frac{\lambda}{\sqrt{2}}$ (4) $\sqrt{2}\lambda$

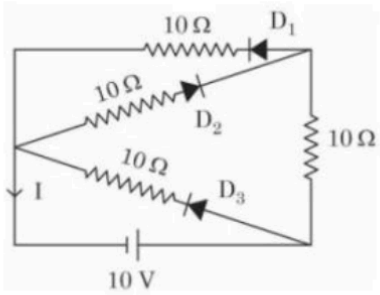
34. 4 marks

A single slit of width a is illuminated by a monochromatic light of wavelength 600 nm. The value of 'a' for which first minimum appears at $\theta = 30$ on the screen will be :

(1) 1.2μm (2) 3 μm (3) 1.8μm (4) 0.6 μm

35. 4 marks

In the given circuit, the current (I) through the battery will be



(1) 1.5 A (2) 2A (3) 1A (4) 2.5A

36. 4 marks

Two identical particles each of mass 'm' go round a circle of radius a under the action of their mutual gravitation attraction. The angular speed of each particle will be:

(1) $\sqrt{\frac{Gm}{8a^3}}$ (2) $\sqrt{\frac{Gm}{4a^3}}$ (3) $\sqrt{\frac{Gm}{a^3}}$ (4) $\sqrt{\frac{Gm}{2a^3}}$

---

37. 4 marks

The height of transmitting antenna is 180 m and the height of the receiving antenna is 245 m. The maximum distance between them for satisfactory communication in line of sight will be:

(given R = 6400 km)

(1) 96 km (2) 56 km (3) 48 km (4) 104 km

---

38. 4 marks

The half-life of a radioactive nucleus is 5 years. The fraction of the original sample that would decay in 15 years is:

(1) $\frac{3}{4}$ (2) $\frac{1}{8}$ (3) $\frac{1}{4}$ (4) $\frac{7}{8}$

---

39. 4 marks

A wire of length 'L' and radius 'r' is clamped rigidly at one end. When the other end of the wire is pulled by a force f, its length increases by '*l*'. Another wire of same material of length '2L' and radius '2r' is pulled by a force '2f. The increase in its length will be :

(1) 2*l* (2) *l* (3) *l*/2 (4) 4*l*

---

40. 4 marks

The position vector of a particle related to time t is given by

$\vec{r} = (10t\,\hat{i} + 15t^2\,\hat{j} + 7\hat{k})m$

The direction of net force experienced by the particle is :

(1) Positivity y - axis (2) In x – y plane (3) Positive z -axis (4) Positive x – axis

---

41. 4 marks

In a linear Simple Harmonic Motion (SHM)

(1) Restoring force is directly proportional to the displacement.

(2) The acceleration and displacement are opposite in direction.

(3) The velocity is maximum at mean position.

(4) The acceleration is minimum at extreme points.

Choose the correct answer from the options given below:

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

(2) (C)and (D) only

(3) (A), (B) and (D) only

(4) (A), (C) and (D) only

---

42. 4 marks

Match List I with List II of Electromagnetic waves with corresponding wavelength range:

(A)	Microwave	(I)	400 nm to 1 nm
(B)	Ultraviolet	(II)	1 nm to 10^{-3} nm
(C)	X-Ray	(III)	1 mm to 700 nm
(4)	Infra-red	(IV)	0.1 m to 1 mm

Choose the correct answer from the options given below:

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

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

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

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

---

43. 4 marks

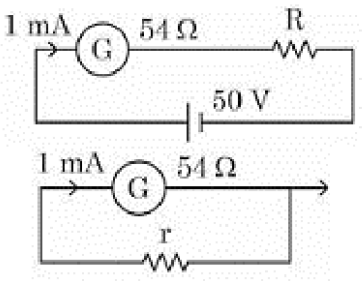
The electric field due to a short electric dipole at a large distance (r) from centre of dipole on the equatorial plane varies with distance as :

(1) $\frac{1}{r}$ (2) r (3) $\frac{1}{r^2}$ (4) $\frac{1}{r^3}$

---

44. 4 marks

For designing a voltmeter of range 50 V and an ammeter of range 10 mA using a galvanometer which has a coil of resistance 54 Ω showing a full scale deflection for 1 mA as in figure.



(A) for voltmeter R ≈ 50 kΩ
(B) for ammeter r ≈ 0.2Ω
(C) for ammeter r = 6Ω
(D) for voltmeter R = 5kΩ
(E) for voltmeter R = 500Ω
Choose the correct answer from the options given below:
(1) (C) and (D) (2) (A) and (B) (3) (C) and (E) (4) (A) and (C)

45. 4 marks

The speed of a wave produced in water is given by $v = \lambda^a g^b \rho^c$. Where λ, g and ρ are wavelength of wave, acceleration due to gravity and density of water respectively. The values of a, b and c respectively, are :

(1) 1, –1, 0 (2) $\frac{1}{2}, \frac{1}{2}, 0$ (3) 1, 1, 0 (4) $\frac{1}{2}, 0, \frac{1}{2}$

46. 4 marks

A body is released from a height equal to the radius ® of the earth. The velocity of the body when it strikes the surface of the earth will be :
(Given g = acceleration due to gravity on the earth)

(1) $\sqrt{4gR}$ (2) $\sqrt{\frac{gR}{2}}$ (3) $\sqrt{2gR}$ (4) $\sqrt{gR}$

47. 4 marks

Given below are two statements:

Statement I : The equivalent resistance of resistors in a series combination is smaller than least resistance used in the combination.

Statement II : The resistivity of the material is independent of temperature.

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

(1) Statement I is false but Statement II is true
(2) Both Statement I and Statement II are false
(3) Statement I is true but Statement II is false
(4) Both Statement I and Statement II are true

48. 4 marks

A vector in x – y plane makes an angle of 30° with y-axis. The magnitude of y-component of vector is 2 $\sqrt{3}$, The magnitude of x-component of the vector will be:

(1) 6 (2) 1 (3) $\sqrt{3}$ (4) 2

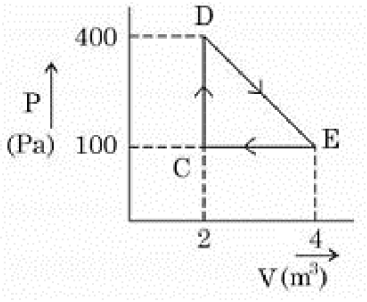
49. 4 marks

A 12 V battery connected to a coil of resistance 6 Ω through a switch, drives a constant current in the circuit. The switch is opened in 1 ms. The emf induced across the coil is 20 V. The inductance of the coil is :

(1) 8 mH (2) 10 mH (3) 5 mH (4) 12 mH

50. 4 marks

A thermodynamics system is taken through cyclic process. The total work done in the process is :



(1) 300 J (2) Zero (3) 200 J (4) 100 J

Physics — Section B

51. Numerical value · 4 marks

The refractive index of a transparent liquid filled in an equilateral hollow prism is $\sqrt{2}$. The angle of minimum deviation for the liquid will be _____.

52. Numerical value · 4 marks

A 20 cm long metallic rod is rotated with 210 rpm about an axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant and uniform magnetic field 0.2T parallel to the axis exists everywhere. The emf developed between the centre and the ring is _____ mV.

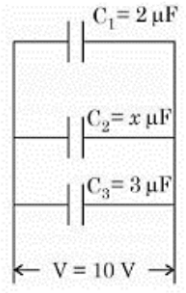
Take $\pi = \frac{22}{7}$

53. Numerical value · 4 marks

An electron in a hydrogen atom revolves around its nucleus with speed of 6.76×10^6 ms^{-1} in an orbit of radius 0.52 A°. The magnetic field produced at the nucleus of the hydrogen atom is _____T.

54. Numerical value · 4 marks

In the given figure the total charge stored in the combination of capacitors is 100 μC The value of 'x' is _____.

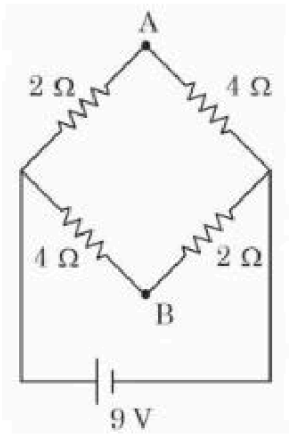


55. Numerical value · 4 marks

A solid sphere and a solid cylinder of same mass and radius are rolling on a horizontal surface without slipping. The ratio of their radius of gyrations respectively (k_{sph} : k_{eyl}) is 2 : $\sqrt{x}$. The value of x is _____.

56. Numerical value · 4 marks

A network of four resistances is connected to 9V battery, as shown in figure. The magnitude of voltage difference between the points A and B is _____V.



57. Numerical value · 4 marks

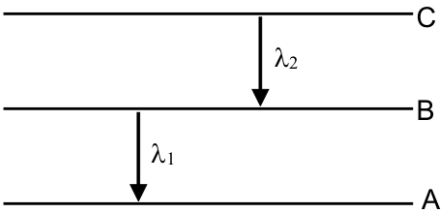
The fundamental frequency of vibration of a string stretched between two rigid support is 50 Hz. The mass of the string is 18 g and its linear mass density is 20 g/m. The speed of the transverse waves so produced in the string is _____ ms^{-1}

58. Numerical value · 4 marks

A block of mass 10 kg is moving along x-axis under the action of force F = 5x N. The work done by the force in moving the block from x = 2m to 4m will be _____J.

59. Numerical value · 4 marks

As per given figure A, B and C are the first, second and third excited energy levels of hydrogen atom respectively. If the ratio of the two wavelengths $\left(\text{i.e.}\frac{\lambda_1}{\lambda_2}\right)$ is $\frac{7}{4n}$, then the value of n will be _____.

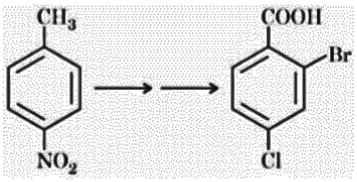


60. Numerical value · 4 marks

There is an air bubble of radius 1.0 mm in a liquid of surface tension 0.0075 Nm^{-1} and density 1000 kg m^{-3} at a depth of 10 cm below the free surface. The amount by which the pressure inside the bubble is greater than the atmospheric pressure is _____ Pa ($g = 10\ ms^{-2}$)

Chemistry — Section A

61. 4 marks



In the above conversion the correct sequence of reagents to be added is
(1) (i) Br_2/Fe, (ii) Fe/H^+, (iii) $KMnO_4$, (iv) Cl_2
(2) (i) $KMnO_4$, (ii) Br_2/Fe, (iii) Fe/H^+, (iv) Cl_2
(3) (i) Fe/H^+, (ii) HONO, (iii) CuCl, (iv) $KMnO_4$, (v) Br_2
(4) (i) Br_2/Fe, (ii) Fe/H^+, (iii) HONO, (iv) CuCl, (v) $KMnO_4$.

---

62. 4 marks

The number of P – O – bonds in $H_4P_2O_7$, $(HPO_3)_3$ and P_4O_{10} are respectively
(1) 1, 3, 6 (2) 0, 3, 4 (3) 0, 3, 6 (4) 1, 2, 4

---

63. 4 marks

Which of the following statement is correct for paper chromatography?
(1) Water present in the pores of the paper forms the stationary phase.
(2) Paper and water present in its pores together form the stationary phase.
(3) Water present in the mobile phase gets absorbed by the paper which then forms the stationary phase.
(4) Paper sheet forms the stationary phase.

---

64. 4 marks

Which one of the following is not an example of calcination?

(1) $CaCo_3 . MgCO3 \xrightarrow{\Delta} CaO+MgO+2CO_2$

(2) $CaCo_3 \xrightarrow{\Delta} CaO+CO_2$

(3) $Fe_2O_3 . xH_2O \xrightarrow{\Delta} Fe_2O_3+xH_2O$

(4) $2PbS+3O_2 \xrightarrow{\Delta} 2PbO+2SO_2$

---

65. 4 marks

Match **List I** with **d**:

	List I-(Monomer)		List II - (Polymer)
(A)	Tetrafluoroethene	(1)	Orlon
(B)	Acrylonitrile	(II)	Natural rubber
(C)	Caprolactam	(III)	Teflon
(D)	Isoprene	(IV)	Nylon-6

Choose the correct answer from the options given below:

(1) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
(2) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
(3) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
(4) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

---

66. 4 marks

The complex with highest magnitude of crystal field splitting energy (Δ_0) is

(1) $[Mn(OH_2)_6]^{3+}$
(2) $[Fe(OH_2)_6]^{3+}$
(3) $[Cr(OH_2)_6]^{3+}$
(4) $[Ti(OH_2)_6]^{3+}$

---

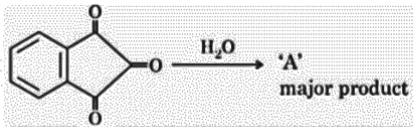
67. 4 marks

The possibility of photochemical smog formation will be minimum at

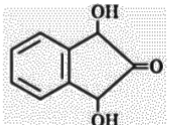
(1) Kolkata in October
(2) New-Delhi in August (Summer)
(3) Srinagar, Jammu and Kashmir in January
(4) Mumbai in May

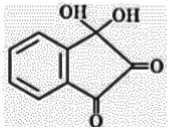
---

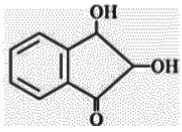
68. 4 marks

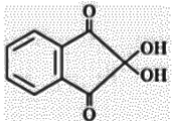


'A' formed in the above reaction is

(1) 

(2) 

(3) 

(4) 

---

69. 4 marks

Consider the following statements:
(A) NFS molecule has a trigonal planar structure.
(B) Bond length of N2 is shorter than O2.
(C) Isoelectronic molecules or ions have identical bond order.
(D) Dipole moment of H2S is higher than that of water molecule.
Choose the correct answer from the options given below:

(1) (C) and (D) are correct
(2) (B) and (C) are correct
(3) (A) and (B) are correct
(4) (A) and (D) are correct

---

70. 4 marks

Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R**:
Assertion (A) : $BeCl_2$ and $MgCl_2$ produce characteristic flame
Reason (R) : The excitation energy is high in $BeCl_2$ and $MgCl_2$
In the light of the above statements, choose the correct answer from the options given below:
(1) **(A)** is false but **(R)** is true
(2) Both **(A)** and **(R)** are true but **(R)** is NOT the correct explanation of **(A)**
(3) **(A)** is true but **(R)** is false
(4) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

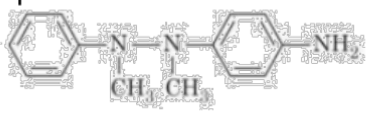
---

71. 4 marks

Consider the following sequence of reactions:



The product 'B' is

(1) 

(2) 

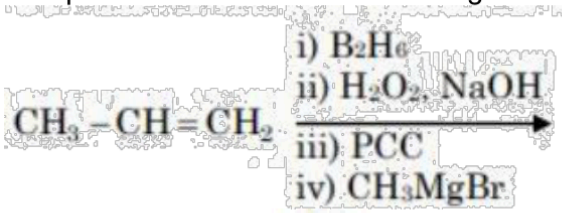
(3) 

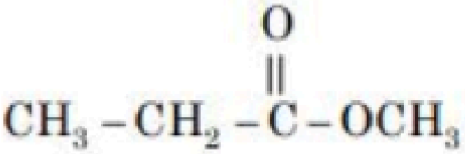
(4) 

---

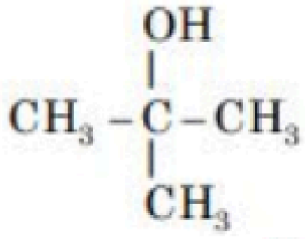
72. 4 marks

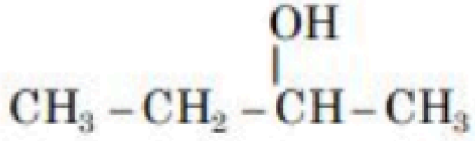
The product formed in the following multistep reaction is:



(1) 

(2) $CH_3 - CH_2 - CH_2 - CH_2 - OH$

(3) 

(4) 

---

73. 4 marks

Which of the following statement(s) is/are correct?
(A) The pH of 1 x 10^{-8} M HCl solution is 8.
(B) The conjugate base of H_2, PO_4^- is HPO_4^{2-}.
(C) K_w increases with increase in temperature.
(D) When a solution of a weak monoprotic acid is titrated against a strong base at half neutralisation point, pH = $\frac{1}{2}pK_a$.
Choose the correct answer from the options given below:
(1) (A), (B), (C) (2) (B), (C) (3) (A), (D) (4) (B), (C), (D)

---

74. 4 marks

During water-gas shift reaction
(1) carbon is oxidized to carbon monoxide. (2) water is evaporated in presence of catalyst.
(3) carbon dioxide is reduced to carbon monoxide. (4) carbon monoxide is oxidized to carbon dioxide.

---

75. 4 marks

Which is not true for arginine?
(1) It is a crystalline solid.
(2) It has a fairly high melting point.
(3) It is associated with more than one pKa values.
(4) It has high solubility in benzene.

---

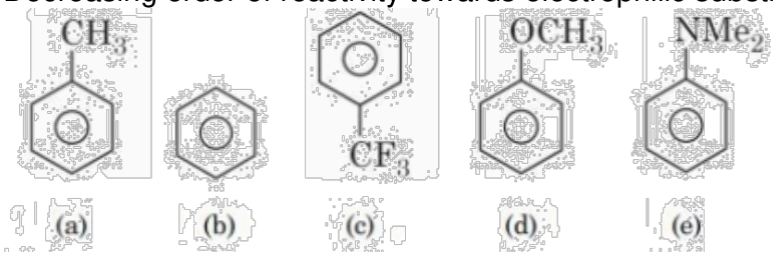
76. 4 marks

Given below are two statements:
Statement I : According to Bohr's model of hydrogen atom, the angular momentum of an electron in a given stationary state is quantised.
Statement II : The concept of electron in Bohr's orbit, violates the Heisenberg uncertainty principle.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) **Statement I** is incorrect but **Statement II** is correct
(2) Both **Statement I** and **Statement II** are incorrect
(3) **Statement I** is correct but **Statement II** is incorrect
(4) Both **Statement I** and **Statement II** are correct

---

77. 4 marks

Decreasing order of reactivity towards electrophilic substitution for the following compounds is:



(1) d > a > e > c > b
(2) c > b > a > d > e
(3) a > d > e > b > c
(4) e > d > a > b > c

---

collegedunia

78. 4 marks

Which of the following expressions is correct in case of a CsCl unit cell (edge length 'a')?

(1) $r_{Cs^+} + r_{Cl^-} = \frac{a}{\sqrt{2}}$

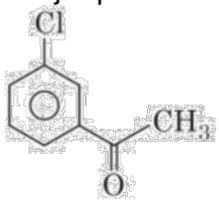
(2) $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$

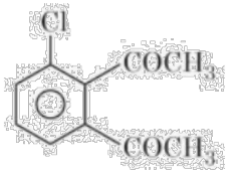
(3) $r_{Cs^+} + r_{Cl^-} = \frac{a}{2}$

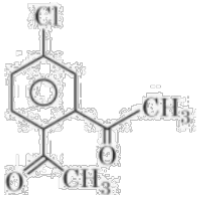
(4) $r_{Cs^+} + r_{Cl^-} = a$

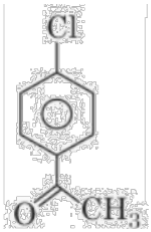
79. 4 marks

The major product formed in the Friedel-Craft acylation of chlorobenzene is

(1) 

(2) 

(3) 

(4) 

80. 4 marks

For a good quality cement, the ratio of silica to alumina is found to be

(1) 1.5

(2) 2

(3) 3

(4) 4.5

Chemistry — Section B

81. Numerical value · 4 marks

The number of correct statements from the following is_____
(A) Conductivity always decreases with decrease in concentration for both strong and weak electrolytes.
(B) The number of ions per unit volume that carry current in a solution increases on dilution.
(C) Molar conductivity increases with decrease in concentration.
(D) The variation in molar conductivity is different for strong and weak electrolytes.
(E) For weak electrolytes, the change in molar conductivity with dilution is due to decrease in degree of dissociation.

---

82. Numerical value · 4 marks

The total number of isoelectronic species from the given set is_____.
O^{2-}, F^-, Al, Mg^{2+}, Na^+, O^+, Mg, Al^{3+}, F

---

83. Numerical value · 4 marks

The total change in the oxidation state of manganese involved in the reaction of KMnO4 and potassium iodide in the acidic medium is .

---

84. Numerical value · 4 marks

The volume (in mL) of 0.1 M $AgNO_3$ required for complete precipitation of chloride ions present in 20 mL of 0.01 M solution of $[Cr(H_2O)_5, Cl]Cl_2$, as silver chloride is .

---

85. Numerical value · 4 marks

In Chromyl chloride, the oxidation state of chromium is (+) .

---

86. Numerical value · 4 marks

The homoleptic and octahedral complex of Co^{2+} and H_2O has_____ unpaired electron(s) in the t_{2g} set of orbitals.

---

87. Numerical value · 4 marks

20 mL of 0.5 M NaCl is required to coagulate 200 mL of As_2,S_3 solution in 2 hours. The coagulating value of NaCl is .

---

88. Numerical value · 4 marks

30.4 kJ of heat is required to melt one mole of sodium chloride and the entropy change at the melting point is 28.4 J K^{-1} mol^{-1} at 1 atm. The melting point of sodium chloride is K (Nearest Integer)

---

89. Numerical value · 4 marks

The vapour pressure of 30% (w/v) aqueous solution of glucose is_____ mm Hg at 25°C.
[Given: The density of 30% (w/v), aqueous solution of glucose is 1.2 g cm^{-3} and vapour pressure of pure water is 24 mm Hg.]
(Molar mass of glucose is 180 g mol^{-1}.)

---

90. Numerical value · 4 marks

For a reversible reaction $A \rightleftharpoons B$, the $\Delta H_{\text{forward reaction}}$ = 20 kJ mol^{-1}. The activation energy of the uncatalysed forward reaction is 300 kJ mol^{-1}. When the reaction is catalysed keeping the reactant concentration same, the rate of the catalysed forward reaction at 27°C is found to be same as that of the uncatalysed reaction at 327°C. The activation energy of the catalysed backward reaction is kJ mol^{w}.