JEE Main – 2024

30th JANUARY 2024 (Morning Shift)

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300.**
2. The question paper consists of **3 Subjects** (Subject I: **Mathematics**, Subject II: **Physics**, Subject III: **Chemistry**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE CHOICE** is correct.
4. **Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. You will NOT be allowed to attempt the sixth question. If you wish to attempt any other question apart from the five already attempted, then you will have to delete any one response from the five previously answered and then proceed to answer the new one.**
   The answer to each question should be **rounded off to the nearest integer**.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
6. On completion of the test, the candidate must hand over the Answer Sheet to the **Invigilator** on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them**.

Marking Scheme

1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.

SUBJECT I: MATHEMATICS	MARKS: 100

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

1. Let $\vec{a}=a_1\hat{i}+a_2j+a_3k$ and $\vec{b}=b_1\hat{i}+b_2j+b_3k$ be two vectors such that $|\vec{a}|=1$, $\vec{a}\cdot\vec{b}=2$ and $|\vec{b}|=4$. If $\vec{c}=2\left(\vec{a}\times\vec{b}\right)-3\vec{b}$, then the angle between $\vec{b}$ and $\vec{c}$ is equal to:

(1) $\cos^{-1}\left(\frac{2}{\sqrt{3}}\right)$ **(2)** $\cos^{-1}\left(\frac{2}{3}\right)$ **(3)** $\cos^{-1}\left(-\frac{1}{\sqrt{3}}\right)$ **(4)** $\cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$

2. If $2\sin^3 x+\sin 2x\cos x+4\sin x-4=0$ has exactly 3 solutions in the interval $\left[0,\frac{n\pi}{2}\right], n\in N$, then the roots of the equation $x^2+nx+(n-3)=0$ belong to:

(1) $(0,\infty)$ **(2)** $\left(-\frac{\sqrt{17}}{2},\frac{\sqrt{17}}{2}\right)$ **(3)** z **(4)** $(-\infty,0)$

3. Consider the system of linear equations

$x+y+z=4\mu$, $x+2y+2\lambda z=10\mu$, $x+3y+4\lambda^2 z=\mu^2+15$, where, $\lambda,\mu\in R$. Which one of the following statements is NOT correct?

(1) The system has infinite number of solutions if $\lambda=\frac{1}{2}$ and $\mu=15$

(2) The system is inconsistent if $\lambda=\frac{1}{2}$ and $\mu\neq 1$

(3) The system is consistent if $\lambda\neq\frac{1}{2}$

(4) The system has unique solution if $\lambda\neq\frac{1}{2}$ and $\mu\neq 1,15$

4. The area (in square units) of the region bounded by the parabola $y^2=4(x-2)$ and the line $y=2x-8$, is:

(1) 9 **(2)** 8 **(3)** 6 **(4)** 7

5. Let M denote the median of the following frequency distribution

Class	0-4	4-8	8-12	12-16	16-20
Frequency	3	9	10	8	6

Then 20 M is equal to:

(1) 52 **(2)** 208 **(3)** 104 **(4)** 416

6. A line passing through the point $A(9, 0)$ makes an angle of 30° with the positive direction of x-axis. If this line is rotated about A through an angle of 15° in the clockwise direction, then its equation in the new position is:

(1) $\frac{y}{\sqrt{3}-2}+x=9$ **(2)** $\frac{x}{\sqrt{3}-2}+y=9$ **(3)** $\frac{x}{\sqrt{3}+2}+y=9$ **(4)** $\frac{y}{\sqrt{3}+2}+x=9$

7. If the domain of the function $f(x)=\cos^{-1}\left(\frac{2-|x|}{4}\right)+\{\log_e(3-x)\}^{-1}$ is $[-\alpha,\beta)-\{\gamma\}$, then $\alpha+\beta+\gamma$ is equal to:

(1) 11 **(2)** 8 **(3)** 12 **(4)** 9

8. Let S_n denote the sum of first n terms of an arithmetic progression. If $S_{20}=790$ and $S_{10}=145$, then $S_{15}-S_5$ is:

(1) 390 **(2)** 410 **(3)** 405 **(4)** 395

9. Let $f:\left[-\frac{\pi}{2},\frac{\pi}{2}\right]\to \boldsymbol{R}$ be a differentiable function such that $f(0)=\frac{1}{2}$. If the $\lim\limits_{x\to 0}\frac{x\int_0^x f(t)dt}{e^{x^2}-1}=\alpha$, then $8\alpha^2$ is equal to:

(1) 2 **(2)** 16 **(3)** 4 **(4)** 1

10. Let $g:R\to R$ be a non constant twice differentiable function such that $g'\left(\frac{1}{2}\right)=g'\left(\frac{3}{2}\right)$. If a real valued function f is defined as $f(x)=\frac{1}{2}[g(x)+g(2-x)]$, then:

(1) $f'\left(\frac{3}{2}\right)+f'\left(\frac{1}{2}\right)=1$

(2) $f''(x)=0$ for at least two x in (0, 2)

(3) $f''(x)=0$ for exactly one x in (0, 1)

(4) $f''(x)=0$ for no x in (0, 1)

11. Let $y=y(x)$ be the solution of the differential equation $\sec x dy+\{2(1-x)\tan x+x(2-x)\}dx=0$ such that $y(0)=2$. Then $y(2)$ is equal to:

(1) 1 **(2)** $2\{\sin(2)+1\}$ **(3)** 2 **(4)** $2\{1-\sin(2)\}$

12. If $f(x)=\begin{vmatrix} 2\cos^4 x & 2\sin^4 x & 3+\sin^2 2x \\ 3+2\cos^4 x & 2\sin^4 x & \sin^2 2x \\ 2\cos^4 x & 3+2\sin^4 x & \sin^2 2x \end{vmatrix}$, then $\frac{1}{5}f'(0)=$ is equal to:

(1) 2 **(2)** 6 **(3)** 0 **(4)** 1

13. If the length of the minor axis of an ellipse is equal to half of the distance between the foci, then the eccentricity of the ellipse is:

(1) $\frac{\sqrt{5}}{3}$ **(2)** $\frac{\sqrt{3}}{2}$ **(3)** $\frac{1}{\sqrt{3}}$ **(4)** $\frac{2}{\sqrt{5}}$

14. Two integers x and y are chosen with replacement from the set {0, 1, 2, 3,..., 10}. Then the probability that $|x-y|>5$, is:

(1) $\frac{62}{121}$ **(2)** $\frac{31}{121}$ **(3)** $\frac{30}{121}$ **(4)** $\frac{60}{121}$

15. Let $A(2,3,5)$ and $C(-3,4,-2)$ be opposite vertices of a parallelogram $ABCD$. If the diagonal $\overrightarrow{BD}=\hat{i}+2j+3k$, then the area of the parallelogram is equal to:

(1) $\frac{1}{2}\sqrt{410}$ **(2)** $\frac{1}{2}\sqrt{306}$ **(3)** $\frac{1}{2}\sqrt{586}$ **(4)** $\frac{1}{2}\sqrt{474}$

16. If $z = x + iy,\ xy \neq 0,$ satisfies the equation $z^2 + i\bar{z} = 0,$ then $\left|z^2\right|$ is equal to:

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

17. Let (α, β, γ) be the foot of perpendicular from the point (1, 2, 3) on the line $\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3}$. Then $19(\alpha + \beta + \gamma)$ is equal to:

(1) 102 **(2)** 101 **(3)** 100 **(4)** 99

18. If the circles $(x+1)^2 + (y+2)^2 = r^2$ and $x^2 + y^2 - 4x - 4y + 4 = 0$ intersect at exactly two distinct points, then:

(1) $5 < r < 9$ **(2)** $0 < r < 7$ **(3)** $\frac{1}{2} < r < 7$ **(4)** $3 < r < 7$

19. The maximum area of a triangle whose one vertex is at (0, 0) and the other two vertices lie on the curve $y = -2x^2 + 54$ at points (x, y) and $(-x, y),$ where $y > 0,$ is:

(1) 92 **(2)** 122 **(3)** 88 **(4)** 108

20. The value of $\lim\limits_{n\to\infty} \sum\limits_{k=1}^{n} \frac{n^3}{(n^2 + k^2)(n^2 + 3k^2)}$ is:

(1) $\frac{\left(2\sqrt{3} + 3\right)\pi}{24}$ **(2)** $\frac{13\left(2\sqrt{3} - 3\right)\pi}{8}$ **(3)** $\frac{\pi}{8\left(2\sqrt{3} + 3\right)}$ **(4)** $\frac{13\pi}{8\left(4\sqrt{3} + 3\right)}$

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

21. Let the latus rectum of the hyperbola $\frac{x^2}{9}-\frac{y^2}{b^2}=1$ subtend an angle of $\frac{\pi}{3}$ at the centre of the hyperbola. If b^2 is equal to $\frac{l}{m}\left(1+\sqrt{n}\right)$, where l and m are co-prime numbers, then $l^2+m^2+n^2$ is equal to _____.

22. If d_1 is the shortest distance between the lines $x+1=2y=-12z, x=y+2=6z-6$ and d_2 is the shortest distance between the lines $\frac{x-1}{2}=\frac{y+8}{-7}=\frac{z-4}{5}, \frac{x-1}{2}=\frac{y-2}{1}=\frac{z-6}{-3}$, then the value of $\frac{32\sqrt{3}d_1}{d_2}$ is:

23. A group of 40 students appeared in an examination of 3 subjects – Mathematic, Physics and Chemistry. It was found that all students passed in at least one of the subjects, 20 students passed in Mathematics, 25 students passed in Physics, 16 students passed in Chemistry, at most 11 students passed in both Mathematics and Physics, at most 15 students passed in both Physics and Chemistry, at most 15 students passed in both Mathematics and Chemistry. The maximum number of students passed in all the three subjects is____.

24. If the function $f(x)=\begin{cases}\frac{1}{|x|} & , |x|\geq 2\\ ax^2+2b & , |x|<2\end{cases}$ is differentiable on $\boldsymbol{R}$, then $48(a+b)$ is equal to _____.

25. Let $y=y(x)$ be the solution of the differential equation $\left(1-x^2\right)dy=\left[xy+\left(x^3+2\right)\sqrt{3\left(1-x^2\right)}\right]dx$, $-1<x<1, y(0)=0$. If $y\left(\frac{1}{2}\right)=\frac{m}{n}, m$ and n are co-prime numbers, then $m+n$ is equal to____.

26. Let $\alpha,\beta\in N$ be roots of the equation $x^2-70x+\lambda=0$, where $\frac{\lambda}{2},\frac{\lambda}{3}\notin \boldsymbol{N}$. If λ assumes the minimum possible value, then $\frac{\left(\sqrt{\alpha-1}+\sqrt{\beta-1}\right)(\lambda+35)}{|\alpha-\beta|}$ is equal to:

27. Let $\alpha=1^2+4^2+8^2+13^2+19^2+26^2+\ldots$ upto 10 terms and $\beta=\sum_{n=1}^{10}n^4$. If $4\alpha-\beta=55k+40$, then k is equal to_____.

28. Number of integral terms in the expansion of $\left\{7^{\left(\frac{1}{2}\right)}+11^{\left(\frac{1}{6}\right)}\right\}^{824}$ is equal to_____.

29. The value of $9\int_0^9\left[\sqrt{\frac{10x}{x+1}}\right]dx$, where $[t]$ denotes the greatest integer less than or equal to t, is

30. Let $A=\{1,2,3,\ldots,7\}$ and let $P(A)$ denote the power set of A. if the number of functions $f: A\to P(A)$ such that $a\in f(a), \forall\, a\in A$ is m^n, m and $n\in N$ and m is least, then $m+n$ is equal to_____.

SUBJECT II: PHYSICS	MARKS: 100

SECTION-1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

31. The diffraction pattern of a light of wavelength 400 nm diffracting from a slit of width 0.2 mm is focused on the focal plane of a convex lens of focal length 100 cm. The width of the 1st secondary maxima will be:

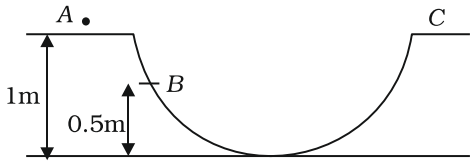
(1) 0.02 mm **(2)** 2 mm **(3)** 0.2 mm **(4)** 2 cm

32. The electric field of an electromagnetic wave in free space is represented as $\vec{E} = E_0 \cos(\omega t - kz)\hat{i}$. The corresponding magnetic induction vector will be:

(1) $\vec{B} = E_0 C \cos(\omega t - kz) j$ **(2)** $\vec{B} = \frac{E_0}{C}\cos(\omega t - kz) j$

(3) $\vec{B} = E_0 C \cos(\omega t + kz) j$ **(4)** $\vec{B} = \frac{E_0}{C}\cos(\omega t + kz) j$

33. A particle is placed at the point A of a frictionless track ABC as shown in figure. It is gently pushed towards right. The speed of the particle when it reaches the point B is: (Take $g = 10\, m/s^2$).

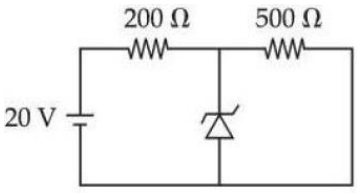


(1) $\sqrt{10}\ m/s$ **(2)** $2\sqrt{10}\ m/s$ **(3)** $10\ m/s$ **(4)** $20\ m/s$

34. A series L.R circuit connected with an ac source $E = (25 \sin 1000t)\ V$ has a power factor of $\frac{1}{\sqrt{2}}$. If the source of emf is changed to $E = (20 \sin 2000t) V$, the new power factor of the circuit will be:

(1) $\frac{1}{\sqrt{3}}$ **(2)** $\frac{1}{\sqrt{2}}$ **(3)** $\frac{1}{\sqrt{5}}$ **(4)** $\frac{1}{\sqrt{7}}$

35. A Zener diode of breakdown voltage 10 V is used as a voltage regulator as shown in the figure. The current through the Zener diode is:



(1) 30 mA **(2)** 0 **(3)** 20 mA **(4)** 50 mA

36. The electrostatic potential due to an electric dipole at a distance 'r' varies as:

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

37. Young's modules of material of a wire of length 'L' and cross-sectional area A is Y. If the length of the wire is doubled and cross-sectional area is halved then Young's modules will be:

(1) Y **(2)** $2Y$ **(3)** $\frac{Y}{4}$ **(4)** $4Y$

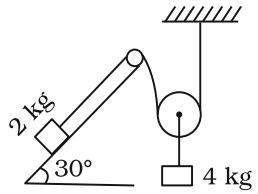
38. All surfaces shown in figure are assumed to be frictionless and the pulleys and the string are light. The acceleration of the block of mass 2 kg is:

(1) $\frac{g}{3}$

(2) $\frac{g}{2}$

(3) $\frac{g}{4}$

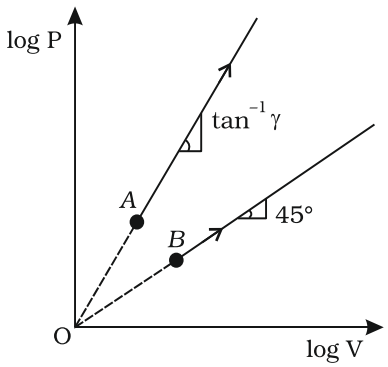
(4) g



39. A particle of mass m is projected with a velocity 'u'making an angle of 30° with the4 horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is:

(1) $\frac{\sqrt{3}}{16}\frac{mu^3}{g}$ **(2)** $\frac{mu^3}{\sqrt{2}\,g}$ **(3)** $\frac{\sqrt{3}}{2}\frac{mu^2}{g}$ **(4)** zero

40. Two thermodynamical processes are shown in the figure. The molar heat capacity for process A and B are B are C_A and C_B. The molar heat capacity at constant pressure and constant volume are represented by C_P and C_V, respectively. Choose the correct statement.



(1) $C_P > C_V > C_A = C_B$ **(2)** $C_A = 0$ and $C_B = \infty$

(3) $C_B = \infty, C_A = 0$ **(4)** $C_A > C_P > C_V$

41. At which temperature the r.m.s velocity of a hydrogen molecule equal to that of an oxygen molecule at 47°C?

(1) – 73 K **(2)** 20 K **(3)** 80 K **(4)** 4 K

42. Match **List-I** with **List-II**.

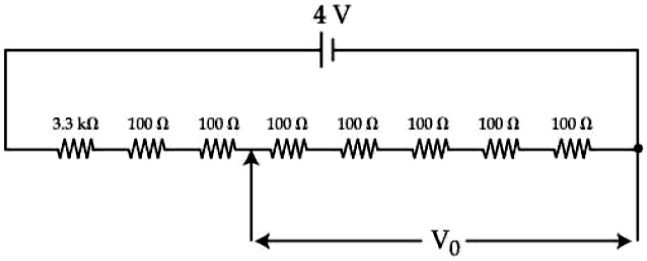
	List-I		**List-II**
(A)	Coefficient of viscosity	(I)	$\left[M\,L^2\,T^{-2}\right]$
(B)	Surface tension	(II)	$\left[M\,L^2\,T^{-1}\right]$
(C)	Angular momentum	(III)	$\left[M\,L^{-1}\,T^{-1}\right]$
(D)	Rotational kinetic energy	(IV)	$\left[M\,L^0\,T^{-2}\right]$

Chose the correct answer from the options given below:

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

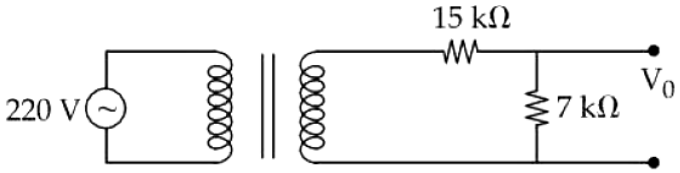
(3) **(A)**-(II), **(B)**-(I), **(C)**-(IV), **(D)**-(III) **(4)** **(A)**-(IV), **(B)**-(III), **(C)**-(II), **(D)**-(I)

43. A potential divider circuit is shown in figure. The output voltage V_0 is:



(1) 12 mV **(2)** 0.5 V **(3)** 4V **(4)** 2 mV

44. Primary coil of a transformer is connected to 220 V ac. Primary and secondary turns of the transforms are 100 and 10 respectively. Secondary coil of transformer is connected to two series resistances shown in figure. The output voltage (V_0) is:



(1) 15 V **(2)** 44 V **(3)** 22 V **(4)** 7 V

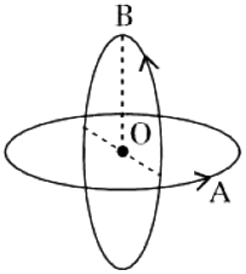
45. Two insulated circular loop A and B of radius $'a'$ carrying a current of $'I'$ in the anti clockwise direction as shown in the figure. The magnitude of the magnetic induction at the centre will be:

(1) $\frac{2\mu_0 I}{a}$

(2) $\frac{\mu_0 I}{\sqrt{2}a}$

(3) $\frac{\sqrt{2}\mu_0 I}{a}$

(4) $\frac{\mu_0 I}{2a}$



46. The work function of a substance is 3.0 eV. The longest wavelength of light that can cause the emission of photoelectrons from this substance is approximately.

(1) 400 nm **(2)** 200 nm **(3)** 414 nm **(4)** 215 nm

47. The gravitational potential at a point above the surface of earth is $-5.12\times10^7\ J/kg$ and the acceleration due to gravity at that point is $6.4\ m/s^2$. Assume that the mean radius of earth to be 6400 km. The height of this point above the earth's surface is:

(1) 1200 km **(2)** 1600 km **(3)** 1000 km **(4)** 540 km

48. An electric toaster has resistance of 60 Ω at room temperature (27 °C). The toaster is connected to a 220 V supply. If the current flowing through it reaches 2.75 A, the temperature attained by toaster is around: (if $\alpha = 2\times10^{-4}\ /°C$)

(1) 1694°C **(2)** 1667°C **(3)** 694°C **(4)** 1235°C

49. A spherical body of mass 100 g is dropped from a height of 10 m from the ground. After hitting the ground, the body rebounds to a height of 5 m. The impulse of force impaired by the ground to the body is given by : (given , $g = 9.8\ m/s^2$)

(1) 43.2 $kg\ ms^{-1}$ **(2)** 2.39 $kg\ ms^{-1}$ **(3)** 23.9 $kg\ ms^{-1}$ **(4)** 4.32 $kg\ ms^{-1}$

50. The ratio of the magnitude of the kinetic energy to the potential energy of an electron in the 5th excited state of a hydrogen atom is:

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

SECTION-2

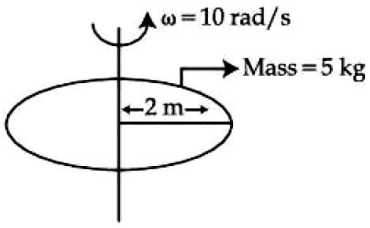
Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

51. A capacitor of capacitance C and potential V has energy E. It is connected to another capacitor of capacitance 2 C and potential 2 V. Then the loss of energy is $\frac{x}{3}E$, where x is_____.

52. The displacement and the increase in the velocity of a moving particle in the time interval of t to $(t+1)$ s are 125 m and 50 m/s, respectively. The distance travelled by the particle in $(t+2)^{th}$ s is_____ m.

53. A electron of hydrogen atom on an excited state is having energy $E_n = -0.85\ eV$. The maximum number of allowed transitions to lower energy level is_____.

54.

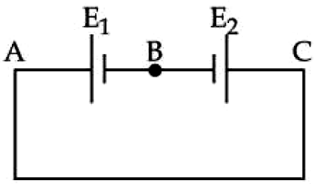


Consider a Disc of mass 5 kg, radius 2 m, rotating with angular velocity of 10 rad/s about an axis perpendicular to the plane of rotation. An identical disc is kept gently over the rotating disc along the same axis. The energy dissipated so that both the discs continue to rotate together without slipping is____J.

55. In a closed organ pipe, the frequence of fundamental note is 30 Hz. A certain amount of water is now poured in the organ pipe so that the fundamental frequency is increased to 110 Hz. If the organ pipe has a cross-sectional area of $2\ cm^2$, the amount of water poured in the organ tube is _____ g. (Take speed of sound in air is 330 m/s)

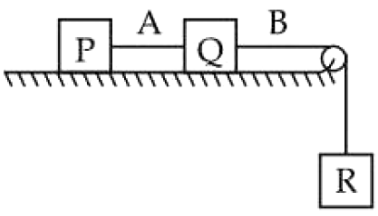
56. A ceiling fan having 3 blades of length 80 cm each is rotating with an angular velocity of 1200 rpm. The magnetic field of earth in that region is 0.5 G and angle of dip is 30°. The emf induced across the blades is $N\pi \times 10^{-5}\ V$. The value of N is_____.

57. Two cells are connected in opposition as shown. Cell E_1 is of 8 V *emf* and 2 Ω internal resistance; the cell E_2 is of 2 V *emf* and 4 Ω internal resistance. The terminal potential difference of cell E_2 is ____ V.



58. The distance between object and its two times magnified real image as produced by a convex lens is 45 cm. The focal length of the lens used is _____ cm.

59. Each of three blocks P, Q and R shown in figure has a mass of 3 kg. Each of the wires A and B has cross-sectional area $0.005\ cm^2$ and Young's modulus $2 \times 10^{11}\ N\ m^{-2}$. Neglecting friction, the longitudinal strain on wire B is _____ $\times 10^{4}$. (Take $g = 10\ m/s^2$)



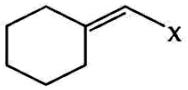
60. The horizontal component of earth's magnetic field at a place is $3.5 \times 10^{-5} T$. A very long straight conductor carrying current of $\sqrt{2}A$ in the direction from South-East to North-West is placed. The force per unit length experienced by the conductor is _____$\times 10^{-6}$ N / m.

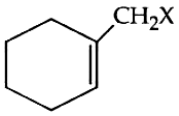
SUBJECT III: CHEMISTRY	MARKS: 100

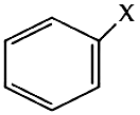
SECTION-1

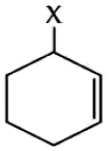
This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

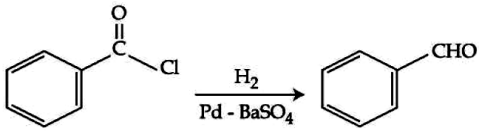
61. Example of vinylic halide is:

(1) 

(2) 

(3) 

(4) 

62. 

This reduction reaction is known as:

(1) Rosenmund reduction **(2)** Etard reduction

(3) Wolff-Kishner reduction **(4)** Stephen reduction

63. Choose the correct statements from the following:

(A) Ethane-1, 2-diamine is a chelating ligand.

(B) Metallic aluminium is produced by electrolysis of aluminium oxide in presence of cryolite.

(C) Cyanide ion is used as ligand for leaching of silver.

(D) Phosphine act as a ligand in Wilkinson catalyst.

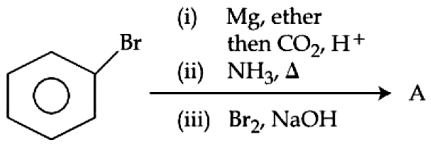
(E) The stability constants of Ca^{2+} and Mg^{2+} are similar with EDTA complexes.

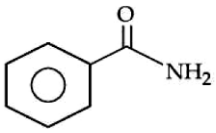
Choose the correct answer from the options given below:

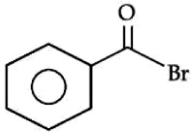
(1) (B), (C), (E) only **(2)** (A), (B), (C) only

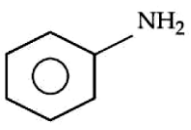
(3) (C), (D), (E) only **(4)** (A), (D), (E) only

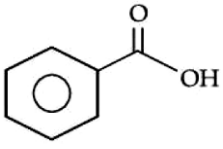
64. The final product A, formed in the following multistep reaction sequence is:



(1) 

(2) 

(3) 

(4) 

65. Given below are two statements:

Statement (I): The gas liberated on warming a salt with dil H_2SO_4, turns a piece of paper dipped in lead acetate into black, it is a confirmatory test for sulphide ion.

Statement (II): In statement-I the colour of paper turns black because of formation of lead sulphite. In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is false but Statement II is true

(2) Statement I is true but Statement II is false

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

66. Match **List-I** with **List-II**.

	List-I		**List-II**
	Species		**Electronic distribution**
(A)	Cr^{+2}	(I)	$3d^8$
(B)	Mn^{+}	(II)	$3d^3 4s^1$
(C)	Ni^{+2}	(III)	$3d^4$
(D)	V^{+}	(IV)	$3d^5 4s^1$

Choose the correct answer from the options given below:

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

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

67. Match **List-I** with **List-II**.

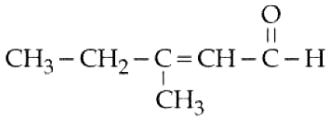
	List-I		**List-II**
	Molecule		**Shape**
(A)	BrF_5	(I)	T-shape
(B)	H_2O	(II)	See saw
(C)	ClF_3	(III)	Bent
(D)	SF_4	(IV)	Square pyramidal

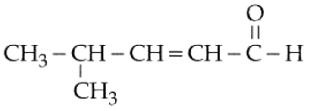
Choose the correct answer from the options given below:

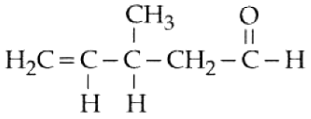
(1) **(A)**-(II), **(B)**-(I), **(C)**-(III), **(D)**-(IV) **(2)** **(A)**-(IV), **(B)**-(III), **(C)**-(I), **(D)**-(II)

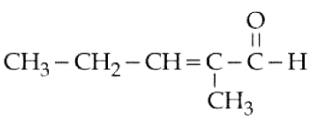
(3) **(A)**-(I), **(B)**-(II), **(C)**-(IV), **(D)**-(III) **(4)** **(A)**-(III), **(B)**-(IV), **(C)**-(I), **(D)**-(II)

68. Structure of 4-Methylpent-2-enal is:

(1) 

(2) 

(3) 

(4) 

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

Assertion (A): There is a considerable increase in covalent radius from N to P. However from as to Bi only a small increase in covalent radius is observed.

Assertion (R): Covalent and ionic radii in a particular oxidation state increases down the group. In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(2) (A) is false but (R) is true

(3) Both (A) and (R) are true and (R) is the correct explanation of (A)

(4) (A) is true but (R) is false

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

Assertion (A): $CH_2 = CH - CH_2 - Cl$ is an example of allyl halide.

Assertion (R): Allyl halides are the compounds in which the halogen atom is attached to sp^2 hybridized carbon atom.

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

(1) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(2) (A) is false but (R) is true

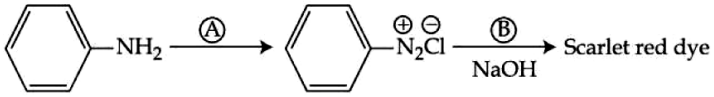
(3) Both (A) and (R) are true and (R) is the correct explanation of (A)

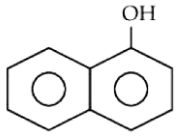
(4) (A) is true but (R) is false

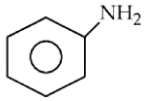
71. Diamagnetic Lanthanoid ions are:

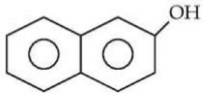
(1) La^{3+} & Ce^{4+} **(2)** Nd^{3+} & Eu^{3+} **(3)** Lu^{3+} & Eu^{3+} **(4)** Nd^{3+} & Ce^{4+}

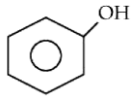
72. Following is a confirmatory test for aromatic primary amines. Identify reagent (A) and (B).



(1) A = $NaNO_2$ + HCl, 0 – 5°C; B = 

(2) A = $NaNO_2$ + HCl, 0 – 5°C; B = 

(3) A = $NaNO_2$ + HCl, 0 – 5°C; B = 

(4) A = HNO_3 / H_2SO_4 B = 

73. Which of the following molecule/species is most stable?

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

74. Compound A formed in the following reaction reacts with B gives the product C. Find out A and B.

$$CH_3-C\equiv CH+Na \longrightarrow A \xrightarrow{B} \underset{(C)}{CH_3-C\equiv C-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH_2}}} + NaBr$$

(1) $A = CH_3-C\equiv \overset{-}{C}\,\overset{+}{N}a,\ B = CH_3-CH_2-CH_3$

(2) $A = CH_3-CH=CH_2,\ B = CH_3-CH_2-CH_2-Br$

(3) $A = CH_3-C\equiv \overset{-}{C}\,\overset{+}{N}a,\ B = CH_3-CH_2-CH_2-Br$

(4) $A = CH_3-CH_2-CH_3,\ B = CH_3-C\equiv CH$

75. Given below are two statements:

Statement (I): The orbitals having same energy are called as degenerate orbitals.

Statement (II): In hydrogen atom, 3p and 3d orbitals are not degenerate orbitals.

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

(1) Statement I is true but Statement II is false

(2) Statement I is false but Statement II is true

(3) Both Statement I and Statement II are true

(4) Both Statement I and Statement II are false

76. What happens to freezing point of benzene when small quantity of naphthalene is added to benzene?

(1) First decreases and then increases **(2)** Decreases

(3) Remains unchanged **(4)** Increases

77. Aluminium chloride in acidified aqueous solution forms an ion having geometry.

(1) Trigonal bipyramidal **(2)** Tetrahedral

(3) Square planar **(4)** Octahedral

78. The Lassiagne's extract is boiled with dil HNO_3 before testing for halogens because,

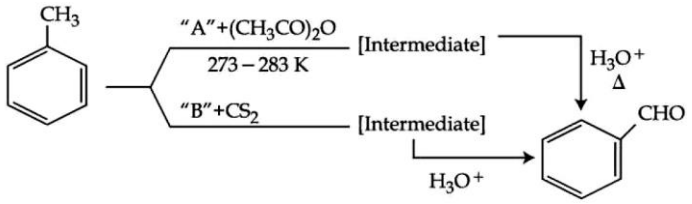
(1) Ag_2S is soluble in HNO_3.

(2) Silver halides are soluble in HNO_3.

(3) Na_2S and NaCN are decomposed by HNO_3.

(4) AgCN is soluble in HNO_3.

79. In the given reactions, identify the reagent A and reagent B.



(1) A – CrO_2Cl_2 B – CrO_3 **(2)** A – CrO_3 B – CrO_3

(3) A – CrO_2Cl_2 B – CrO_2Cl_2 **(4)** A – CrO_3 B – CrO_2Cl_2

80. Sugar which does not given reddish brown precipitate with Fehling's reagent, is:

(1) Maltose **(2)** Sucrose **(3)** Glucose **(4)** Lactose

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be **rounded off to the nearest integer**.

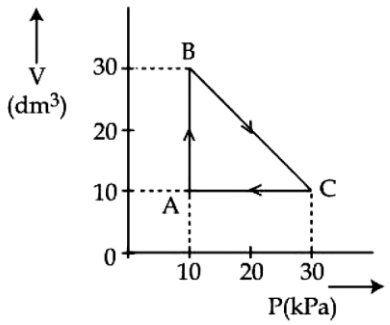
81. The total number of molecular orbitals formed from 2s and 2p atomic orbitals of a diatomic molecule is_____.

82. The pH at which $Mg(OH)_2$ $[K_{sp} = 1 \times 10^{-11}]$ begins to precipitate from a solution containing $0.10\ M\ Mg^{2+}$ ions is_____.

83. $2MnO_4^- + bI^- + cH_2O \rightarrow x\ I_2 + yMnO_2 + z\overline{O}H$

If the above equation is balanced with integer coefficients, the value of z is_____.

84.



An ideal gas undergoes a cyclic transformation starting from the point A and coming back to the same point by tracing the path $A \rightarrow B \rightarrow C \rightarrow A$ as shown in the diagram above. The total work done in the process is _____J.

85. The compound formed by the reaction of ethanal with semi carbazide contains _____ number of nitrogen atoms.

86. On a thin layer chromatographic place, an organic compound moved by 3.5 cm, while the solvent moved by 5 cm. The retardation factor of the organic compound is _____ $\times 10^{-1}$.

87. If IUPAC name of an element is "Ununnunnium" then the element belongs to nth group of Periodic table. The value of n is _____.

88. The rate of first order reaction is $0.04\ mol\ L^{-1}s^{-1}$ at 10 minutes and $0.03\ mol\ L^{-1}\ s^{-1}$ at 20 minutes after initiation. Half life or the reaction is _____ minutes. (Given $\log 2 = 0.3010, \log 3 = 0.4771$)

89. 0.05 cm thick coating of silver is deposited on a plate of $0.05\ m^2$ area. The number of silver atoms deposited on plate are _____ $\times 10^{23}$. (At mass Ag = 108, d = 7.9 g cm^{-3})

90. The mass of sodium acetate (CH_3COONa) required to prepare 250 mL of 0.35 M aqueous solution is _____g. (Molar mass of CH_3COONa is 82.02 g mol^{-1})