JEE Main – 2025

24th JANUARY 2025 (Evening 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 **5 Numerical Value Type Questions**. The answer to each question is an **integer** ranging from 0 to 999.
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 $[x]$ denote the greatest integer function, and let m and n respectively be the numbers of the points, where the function $f(x) = [x] + |x - 2|$, $-2 < x < 3$, is not continuous and not differentiable. Then $m + n$ is equal to :

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

2. In an arithmetic progression, if $S_{40} = 1030$ and $S_{12} = 57$, then $S_{30} - S_{10}$ is equal to:

(1) 515 **(2)** 525 **(3)** 510 **(4)** 505

3. Let (2, 3) be the largest open interval in which the function $f(x) = 2\log_e(x-2) - x^2 + ax + 1$ is strictly increasing and (b, c) be the largest open interval, in which the function $g(x) = (x-1)^3(x+2-a)^2$ is strictly decreasing. Then $100(a + b - c)$ is equal to :

(1) 420 **(2)** 160 **(3)** 280 **(4)** 360

4. The number of real solution(s) of the equation $x^2 + 3x + 2 = \min\{|x-3|, |x+2|\}$ is :

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

5. The equation of the chord, of the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$, whose mid-point is (3, 1) is:

(1) $5x + 16y = 31$ **(2)** $48x + 25y = 169$

(3) $4x + 122y = 134$ **(4)** $25x + 101y = 176$

6. If $7 = 5 + \frac{1}{7}(5+\alpha) + \frac{1}{7^2}(5+2\alpha) + \frac{1}{7^3}(5+3\alpha) + ...\infty$, then the value of α is:

(1) 1 **(2)** $\frac{1}{7}$ **(3)** $\frac{6}{7}$ **(4)** 6

7. Let the points $\left(\frac{11}{2}, \alpha\right)$ lie on or inside the triangle with sides $x + y = 11$, $x + 2y = 16$ and $2x + 3y = 29$, Then the product of the smallest and the largest values of α is equal to :

(1) 44 **(2)** 33 **(3)** 55 **(4)** 22

8. Group A consists of 7 boys and 3 girls, while group B consists of 6 boys and 5 girls. The number of ways, 4 boys and 4 girls can be invited for a picnic if 5 of them must be from group A and the remaining 3 from group B, is equal to :

(1) 8925 **(2)** 8575 **(3)** 9100 **(4)** 8750

9. Let $f : (0, \infty) \to \mathbf{R}$ be a function which is differentiable at all points of its domain and satisfies the condition $x^2 f'(x) = 2xf(x) + 3$, with $f(1) = 4$. Then $2f(2)$ is equal to:

(1) 23 **(2)** 29 **(3)** 19 **(4)** 39

10. Let $A=\left[a_{ij}\right]$ be a square matrix of order 2 with entries either 0 or 1. Let E be the event that A is an invertible matrix. Then the probability $P(E)$ is :

(1) $\frac{3}{16}$ **(2)** $\frac{3}{8}$ **(3)** $\frac{5}{8}$ **(4)** $\frac{1}{8}$

11. Let $\vec{a}=3\hat{i}-\hat{j}+2\hat{k}$, $\vec{b}=\vec{a}\times(\hat{i}-2\hat{k})$ and $\vec{c}=\vec{b}\times\hat{k}$. Then the projection of $\vec{c}-2\hat{j}$ on $\vec{a}$ is:

(1) $2\sqrt{7}$ **(2)** $2\sqrt{14}$ **(3)** $\sqrt{14}$ **(4)** $3\sqrt{7}$

12. Suppose A and B are the coefficients of 30^{th} and 12^{th} terms respectively in the binomial expansion of $(1+x)^{2n-1}$. If $2A = 5B$, then n is equal to:

(1) 22 **(2)** 21 **(3)** 19 **(4)** 20

13. If the equation of the parabola with vertex $V\left(\frac{3}{2},3\right)$ and the directrix $x+2y=0$ is $\alpha x^2+\beta y^2-\gamma xy-30x-60y+225=0$, then $\alpha+\beta+\gamma$ is equal to:

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

14. The area of the region enclosed by the curves $y=e^x$, $y=|e^x-1|$ and y-axis is:

(1) $1+\log_e 2$ **(2)** $\log_e 2$ **(3)** $2\log_e 2-1$ **(4)** $1-\log_e 2$

15. Let $A=\left\{x\in(0,\pi)-\left\{\frac{\pi}{2}\right\}:\log_{(2/\pi)}|\sin x|+\log_{(2/\pi)}|\cos x|=2\right\}$ and

$B=\left\{x\geq 0:\sqrt{x}(\sqrt{x}-4)-3|\sqrt{x}-2|+6=0\right\}$. Then $n(A\cup B)$ is equal to:

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

16. If the system of equations

$x+2y-3z=2$

$2x+\lambda y+5z=5$

$14x+3y+\mu z=33$

has infinitely many solutions, then $\lambda+\mu$ is equal to :

(1) 10 **(2)** 13 **(3)** 11 **(4)** 12

17. For some a, b, let $f(x)=\begin{vmatrix} a+\frac{\sin x}{x} & 1 & b \\ a & 1+\frac{\sin x}{x} & b \\ a & 1 & b+\frac{\sin x}{x}\end{vmatrix}, x\neq 0$, $\lim\limits_{x\to 0} f(x)=\lambda+\mu a+\upsilon b$. Then $(\lambda+\mu+\upsilon)^2$ is equal to:

(1) 36 **(2)** 16 **(3)** 25 **(4)** 9

18. If $\alpha>\beta>\gamma>0$, then the expression

$\cot^{-1}\left\{\beta+\frac{(1+\beta^2)}{(\alpha-\beta)}\right\}+\cot^{-1}\left\{\gamma+\frac{(1+\gamma^2)}{(\beta-\gamma)}\right\}+\cot^{-1}\left\{\alpha+\frac{(1+\alpha^2)}{(\gamma-\alpha)}\right\}$ is equal to:

(1) π **(2)** $\frac{\pi}{2}-(\alpha+\beta+\gamma)$ **(3)** 0 **(4)** 3π

19. Let the position vectors of three vertices of a triangle be $4\vec{p}+\vec{q}-3\vec{r}, -5\vec{p}+\vec{q}+2\vec{r}$ and $2\vec{p}-\vec{q}+2\vec{r}$. If the position vectors of the orthocenter and the circumcenter of the triangle are $\frac{\vec{p}+\vec{q}+\vec{r}}{4}$ and $\alpha\vec{p}+\beta\vec{q}+\gamma\vec{r}$ respectively, then $\alpha+2\beta+5\gamma$ is equal to:

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

20. The function $f:(-\infty,\infty)\to(-\infty,1)$, defined by $f(x)=\frac{2^x-2^{-x}}{2^x+2^{-x}}$ is:

(1) One-one but not onto **(2)** Both one-one and onto

(3) Onto but not one-one **(4)** Neither one-one nor onto

SECTION-2

This section contains Five (05) Numerical Value Type Questions. The answer to each question is an integer ranging from 0 to 999.

21. Let P be the image of the point $Q(7, -2, 5)$ in the line $L: \frac{x-1}{2} = \frac{y+1}{3} = \frac{z}{4}$ and $R(5, p, q)$ be a point on L. Then the square of the area of ΔPQR is _____.

22. Let $y = y(x)$ be the solution of the differential equation $2\cos x \frac{dy}{dx} = \sin 2x - 4y \sin x,\ x \in \left(0, \frac{\pi}{2}\right)$. If $y\left(\frac{\pi}{3}\right) = 0$, then $y'\left(\frac{\pi}{4}\right) + y\left(\frac{\pi}{4}\right)$ is equal to _____.

23. Number of functions $f: \{1, 2, ..., 100\} \to \{0, 1\}$, that assign 1 to exactly one of the positive integers less than or equal to 98, is equal to _____.

24. Let $H_1: \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ and $H_2: -\frac{x^2}{A^2} + \frac{y^2}{B^2} = 1$ be two hyperbolas having length of latus rectums $15\sqrt{2}$ and $12\sqrt{5}$ respectively. Let their ecentricities be $e_1 = \sqrt{\frac{5}{2}}$ and e_2 respectively. If the product of the lengths of their transverse axes is $100\sqrt{10}$, then $25e_2^2$ is equal to _____.

25. If $\int \frac{2x^2 + 5x + 9}{\sqrt{x^2 + x + 1}} dx = x\sqrt{x^2 + x + 1} + \alpha\sqrt{x^2 + x + 1} + \beta \log_e \left| x + \frac{1}{2} + \sqrt{x^2 + x + 1} \right| + C$, where C is the constant of integration, then $\alpha + 2\beta$ is equal to _____.

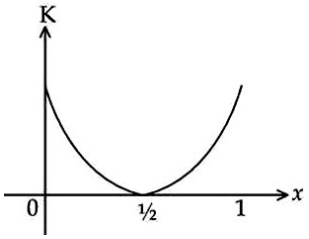
SUBJECT II: PHYSICS	MARKS: 100

SECTION-1

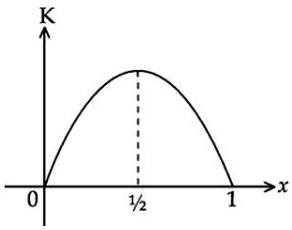
This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

26. A particle oscillates along the *x*-axis according to the law, $x(t) - x_0 \sin^2\left(\frac{t}{2}\right)$ where $x_0 = 1m$. The kinetic energy (*K*) of the particle as a function of *x* is correctly represented by the graph.

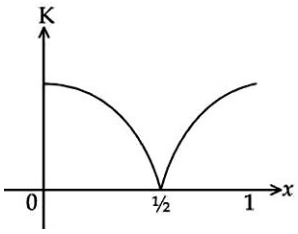
(1)



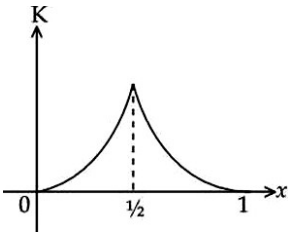
(2)



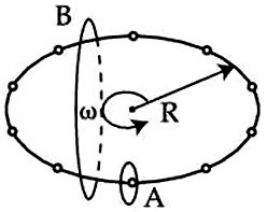
(3)



(4)



27.

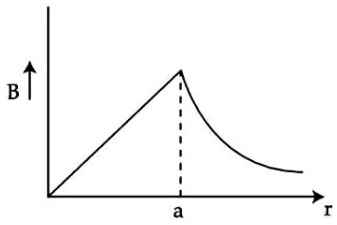


N equally spaced charges each of value *q*, are placed on a circle of radius *R*. The circle rotates about its axis with an angular velocity ω as shown in the figure. A bigger Amperian loop *B* encloses the whole circle where as a smaller Amperian loop *A* encloses a small segment. The difference between enclosed currents, $I_A - I_B$, for the given Amperian loops is:

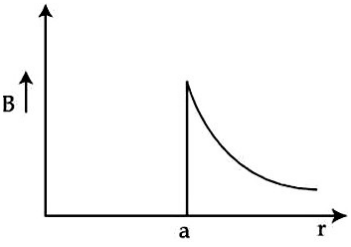
(1) $\frac{2\pi}{N}q\omega$ **(2)** $\frac{N}{\pi}q\omega$ **(3)** $\frac{N}{2\pi}q\omega$ **(4)** $\frac{N^2}{2\pi}q\omega$

28. A long straight wire of a circular cross-section with radius '*a*' carries a steady current *I*. The current *I* is uniformly distributed across this cross-section. The plot of magnitude of magnetic field *B* with distance *r* from the centre of the wire is given by:

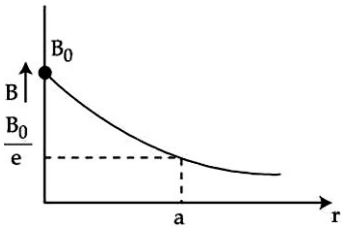
(1)



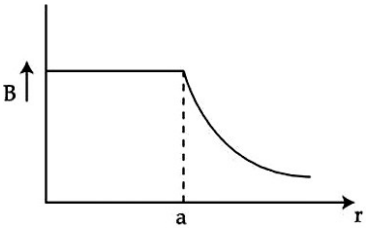
(2)



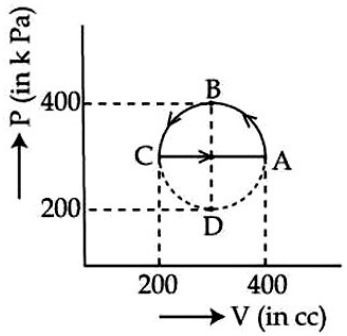
(3)



(4)



29. The magnitude of heat exchanged by a system for the given cyclic process *ABCA* (as shown in figure) is (in SI unit)



(1) Zero **(2)** 10π **(3)** 5π **(4)** 40π

30. A small uncharged conducting sphere is placed in contact with an identical sphere but having $4\times10^{-8}C$ charge and then removed lo a distance such that the force of repulsion between them is $9\times10^{-3}N$. The distance between them is (Take $\frac{1}{4\pi\epsilon_0}$ as 9×10^{9} in SI units)

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

31. The position vector of a moving body at any instant of time is given as $\vec{r}=(5t^2\hat{i}-5\hat{tj})m$. The magnitude and direction of velocity at $t = 2s$ is:

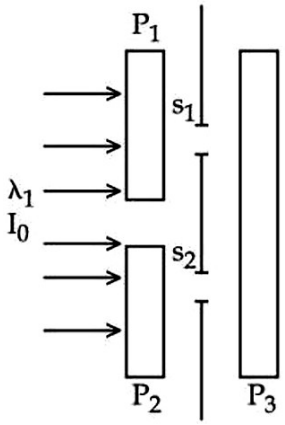
(1) $5\sqrt{15}$ m/s , making an angle of $\tan^{-1}4$ with –ve Y axis

(2) $5\sqrt{17}$ m/s , making an angle of $\tan^{-1}4$ with –ve Y axis

(3) $5\sqrt{15}$ m/s , making an angle of $\tan^{-1}4$ with +ve X axis

(4) $5\sqrt{17}$ m/s , making an angle of $\tan^{-1}4$ with +ve X axis

32. In a Young's double slit experiment, three polarizers are kept as shown in the figure. The transmission axes of P_1 and P_2 are orthogonal to each other. The polarizer P_3 covers both the slits with its transmission axis at 45° to those of P_1 and P_2. An unpolarized light of wavelength λ and intensity I_0 is incident on P_1 and P_2. The intensity at a point after P_3 where the path difference between the light waves from s_1 and s_2 is $\frac{\lambda}{3}$, is:



(1) $\frac{I_0}{2}$ **(2)** I_0 **(3)** $\frac{I_0}{4}$ **(4)** $\frac{I_0}{3}$

33. In photoelectric effect, the stopping potential (V_0) v/ s frequency (υ) curve is plotted.

(h is the Planck's constant and ϕ_0 is work function of metal)

(A) V_0 υ / s υ is linear

(B) The slope of V_0 v/ s ν curve $= \frac{\phi_0}{h}$

(C) h constant is related to the slope of V_0 v/ s ν line

(D) The value of electric charge of electron is not required to determine h using the V_0 v/ s ν curve

(E) The work function can be estimated without knowing the value of h.

Choose the **correct** answer from the options given below:

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

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

34. A photograph of a landscape is captured by a drone camera at a height of 18 km. The size of the camera film is 2 cm × 2 cm and the area of the landscape photographed is 400 km^2. The focal length of the lens in the drone camera is :

(1) 0.9 cm **(2)** 1.8 cm **(3)** 2.8 cm **(4)** 2.5 cm

35. Arrange the following in the ascending order of wavelength (λ) :

(A) Microwaves (λ_1) (B) Ultraviolet rays (λ_2)

(C) Infrared rays (λ_3) (D) X-rays (λ_4)

Choose the **most appropriate** answer from the options given below:

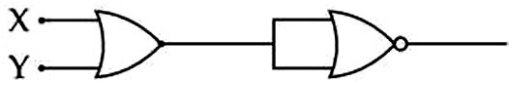
(1) $\lambda_4 < \lambda_3 < \lambda_1 < \lambda_2$ **(2)** $\lambda_4 < \lambda_2 < \lambda_3 < \lambda_1$

(3) $\lambda_4 < \lambda_3 < \lambda_2 < \lambda_1$ **(4)** $\lambda_3 < \lambda_4 < \lambda_2 < \lambda_1$

36. Young's double slit interference apparatus is immersed in a liquid of refractive index 1.44, It has slit separation of 1.5 mm. The slits are illuminated by a parallel beam of light whose wavelength in air is 690 nm. The fringe-width on a screen placed behind the plane of slits at a distance of 0.72 m, will be:

(1) 0.63 mm **(2)** 0.33 mm **(3)** 0.46 mm **(4)** 0.23 mm

37. The output of the circuit is low (zero) for:



(A) X = 0, Y = 0

(B) X = 0, Y = 1

(C) X = 1, Y = 0

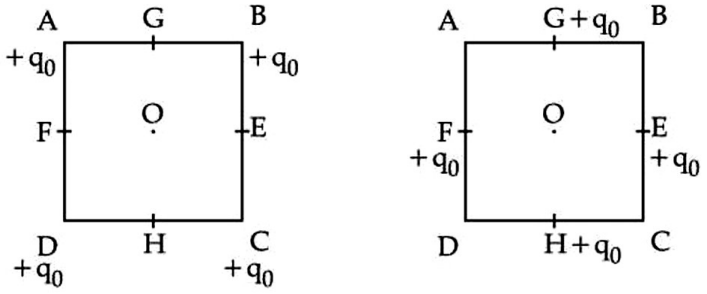
(D) X = 1, Y = 1

Choose the **correct** answer from the options given below:

(1) (A), (B) and (C) only **(2)** (B), (C) and (D) only

(3) (A), (C) and (D) only **(4)** (A), (B) and (D) only

38.



Configuration (1) Configuration (2)

In the first configuration (1) as shown in the figure, four identical charges (q_0) are kept at the corners *A, B, C* and *D* of square of side length '*a*'. In the second configuration (2), the same charges are shifted to mid points *G, E, H* and *F*, of the square. If $K = \frac{1}{4\pi \in_0}$, the difference between the potential energies of configuration (2) and (1) is given by:

(1) $\frac{Kq_0^2}{a}(4-2\sqrt{2})$ **(2)** $\frac{Kq_0^2}{a}(4\sqrt{2}-2)$

(3) $\frac{Kq_0^2}{a}(3-\sqrt{2})$ **(4)** $\frac{Kq_0^2}{a}(3\sqrt{2}-2)$

39. A solid sphere is rolling without slipping on a horizontal plane. The ratio of the linear kinetic energy of the centre of mass of the sphere and rotational kinetic energy is:

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

40. The energy *E* and momentum *p* of a moving body of mass *m* are related by some equation. Given that *c* represents the speed of light, identify the correct equation

(1) $E^2 = pc^2 + m^2c^2$ **(2)** $E^2 = p^2c^2 + m^2c^4$

(3) $E^2 = pc^2 + m^2c^4$ **(4)** $E^2 = p^2c^2 + m^2c^2$

41. A solid sphere and a hollow sphere of the same mass and of same radius are rolled on an inclined plane. Let the time taken to reach the bottom by the solid sphere and the hollow sphere be t_1 and t_2, respectively, then:

(1) $t_1 > t_2$ **(2)** $t_1 = 2t_2$

(3) $t_1 = t_2$ **(4)** $t_1 < t_2$

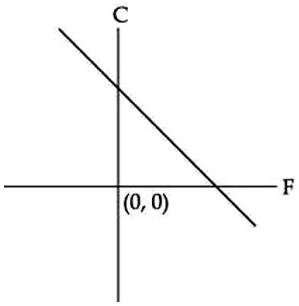
42. The temperature of a body in air falls from 40°C to 24°C in 4 minutes. The temperature of the air is 16°C. The temperature of the body in the next 4 minutes will be :

(1) $\frac{42}{3}°C$ **(2)** $\frac{56}{3}°C$

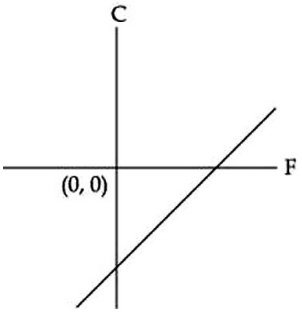
(3) $\frac{14}{3}°C$ **(4)** $\frac{28}{3}°C$

43. Which of the following figure represents the relation between Celsius and Fahrenheit temperatures?

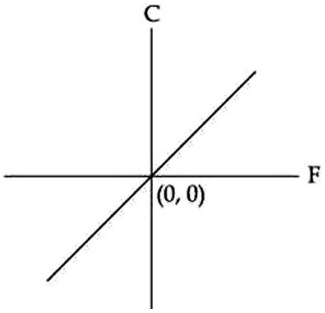
(1)



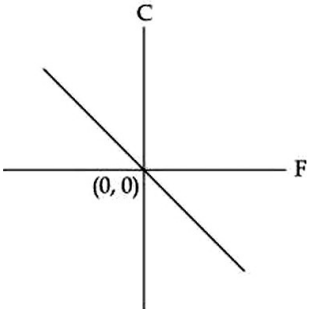
(2)



(3)



(4)



44. Given below are two statements. One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : A electron in a certain region of uniform magnetic field is moving with constant velocity in a straight line path.

Reason (R) : The magnetic field in that region is along the direction of velocity of the electron.

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

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

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

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

(4) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

45. Given below are two statements. One is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : In an insulated container, a gas is adiabatically shrunk to half of its initial volume. The temperature of the gas decreases.

Reason (R) : Free expansion of an ideal gas is an irreversible and an adiabatic process.

In the light of the above statements, choose the **correct** 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 true but (R) is false

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

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

SECTION-2

This section contains Five (05) Numerical Value Type Questions. The answer to each question is an integer ranging from 0 to 999.

46. A tightly wound long solenoid carries a current of 1.5 A. An electron is executing uniform circular motion inside the solenoid with a time period of 75 ns. The number of turns per metre in the solenoid is _____.

[Take mass of electron $m_e = 9\times10^{-31} kg$, charge of electron $|q_e| = 1.6\times10^{-19} C$,

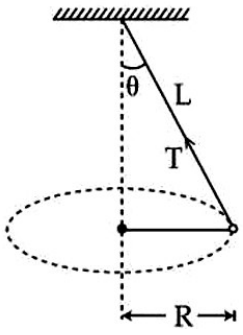
$\mu_0 = 4\pi\times10^{-7}\frac{N}{A^2}, 1ns = 10^{-9}s$]

47. The increase in pressure required to decrease the volume of a water sample by 0.2% is $P\times10^5 Nm^{-2}$. Bulk modulus of water is $2.15\times10^9\ Nm^{-2}$. The value of P is _____.

48. Acceleration due to gravity on the surface of earth is 'g'. If the diameter of earth is reduced to one third of its original value and mass remains unchanged, then the acceleration due to gravity on the surface of the earth is _____ g.

49. The ratio of the power of a light source S_1 to that the light source S_2 is 2. S_1 is emitting 2×10^{15} photons per second at 600 nm. 1f the wavelength of the source S_2 is 300 nm, then the number of photons per second emitted by S_2 is _____ $\times10^{14}$.

50.



A string of length L is fixed at one end and carries a mass of M at the other end. The mass makes $\left(\frac{3}{\pi}\right)$ rotations per second about the vertical axis passing through end of the string as shown. The tension in the string is _____ ML.

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.

51. Identify correct statement/s:

(A) $-OCH_3$ and $-NHCOCH_3$ are activating group.

(B) –CN and –OH are meta directing group.

(C) –CN and $-SO_3H$ are meta directing group.

(D) Activating groups act as ortho - and para directing groups.

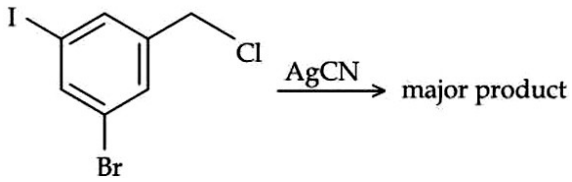
(E) Halides are activating groups.

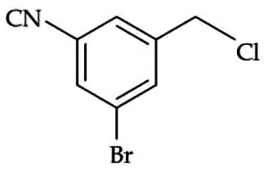
Choose the **correct** answer from the options given below :

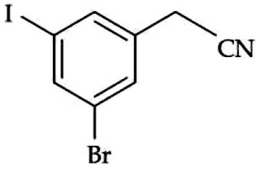
(1) (A), (B) and (E) only **(2)** (A), only

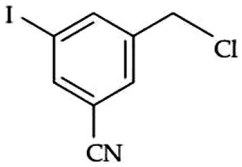
(3) (A), (C) and (D) only **(4)** (A) and (C) only

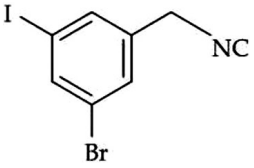
52. The structure of the major product formed in the following reaction is :



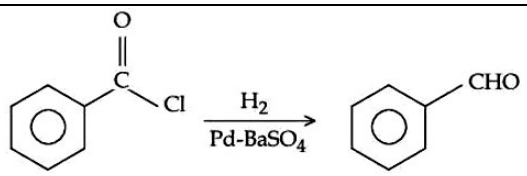
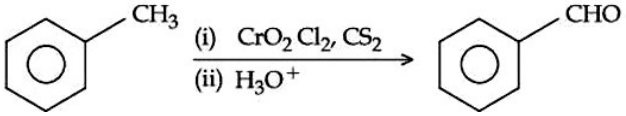
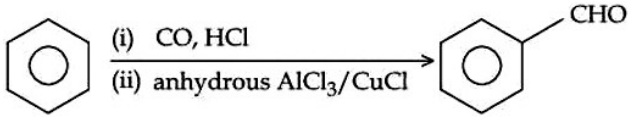
(1) 

(2) 

(3) 

(4) 

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

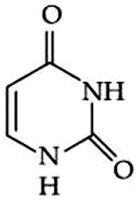
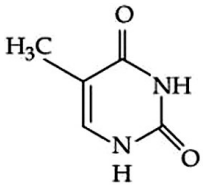
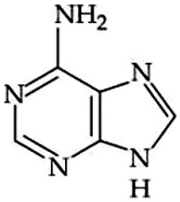
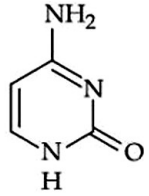
	List-I		**List-II**
(A)	$RCN \xrightarrow[(ii)\,H_3O^+]{(i)\,SnCl_2, HCl} R\,CHO$	(I)	Etard reaction
(B)		(II)	Gatterman-Koch reaction
(C)		(III)	Rosenmund reduction
(D)		(VI)	Stephen reaction

Choose the **correct** answer from the options given below :

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

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

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

List-I		**List-II**	
(A)	Adenine	(I)	
(B)	Cytosine	(II)	
(C)	Thymine	(III)	
(D)	Uracil	(VI)	

Choose the **correct** answer from the options given below :

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

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

55. Given below are two statements :

Statement (I) : Experimentally determined oxygen-oxygen bond lengths in the O_3 are found to be same and the bond length is greater than that of a O = O (double bond) but less than that of a single (O – O) bond.

Statement (II) : The strong lone pair-lone pair repulsion between oxygen atoms is solely responsible for the fact that the bond length in ozone is smaller than that of a double bond (O = O) but more than that of a single bond (O – O).

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

(1) Both **Statement I** and **Statement II** are false.

(2) Both **Statement I** and **Statement II** are true.

(3) **Statement I** is false but **Statement II** is true.

(4) **Statement I** is true but **Statement II** is false.

56. The elemental composition of a compound is 54.2% C, 9.2% H and 36.6% O. If the molar mass of the compound is $132\,g\,mol^{-1}$, the molecular formula of the compound is:

[Given: The relative atomic mass of C : H : O = 12 : 1 : 16]

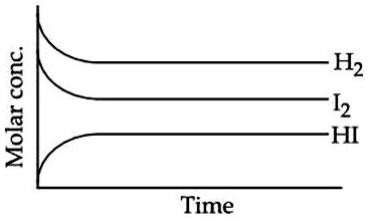
(1) $C_4H_8O_2$ **(2)** $C_6H_{12}O_3$ **(3)** $C_4H_9O_3$ **(4)** $C_6H_{12}O_6$

57. For the reaction,

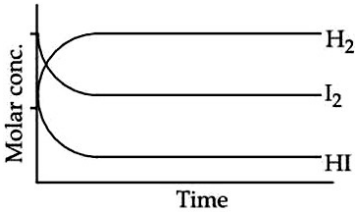
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

Attainment of equilibrium is predicted correctly by:

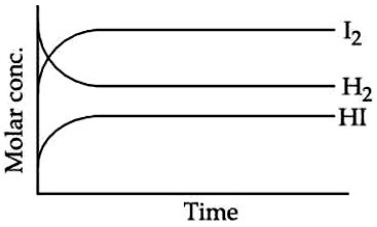
(1)



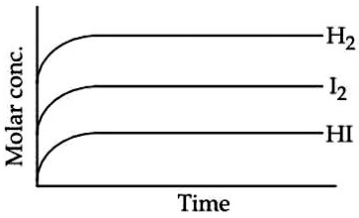
(2)



(3)



(4)



58. The conditions and consequence that favours the $t_{2g}^3 e_g^1$ configuration in a metal complex are :

(1) weak field ligand, low spin complex **(2)** weak field ligand, high spin complex

(3) strong field ligand, low spin complex **(4)** strong field ligand, high spin complex

59. Which of the following mixing of 1M base and 1M acid leads to the largest increase in temperature ?

(1) 50 mL HCl and 20 mL NaOH **(2)** 45 mL CH_3COOH and 25 mL NaOH

(3) 30 mL CH_3COOH and 30 mL NaOH **(4)** 30 mL HCl and 30 mL NaOH

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

List-I (Transition metal ion)		**List-II (spin only magnetic moment (B.M.))**	
(A)	Ti^{3+}	(I)	3.87
(B)	V^{2+}	(II)	0.00
(C)	Ni^{2+}	(III)	1.73
(D)	Sc^{3+}	(VI)	2.84

Choose the **correct** answer from the options given below :

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

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

61. $S(g) + \frac{3}{2}O_2(g) \rightarrow SO_3(g) + 2x\,kcal$

$SO_2(g) + \frac{1}{2}O_2(g) \rightarrow SO_3(g) + y\,kcal$

The heat of formation of $SO_2(g)$ is given by:

(1) y – 2x kcal **(2)** $\frac{2x}{y}$ kcal **(3)** 2x + y kcal **(4)** x + y kcal

62. Find the compound 'A' from the following reaction sequences.

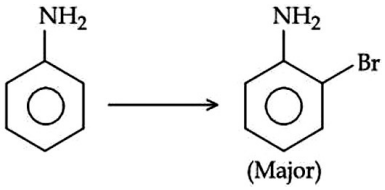
$$A \xrightarrow{\text{aqua-regia}} B \xrightarrow[(2)\,AcOH]{(1)\,KNO_2/NH_4OH} \text{yellow ppt}$$

(1) MnS **(2)** ZnS **(3)** NiS **(4)** CoS

63. The successive 5 ionisation energies of an element are 800, 2427, 3658, 25024 and 32824 kJ/mol, respectively. By using the above values predict the group in which the above element is present:

(1) Group 2 **(2)** Group 4 **(3)** Group 14 **(4)** Group 13

64. For reaction

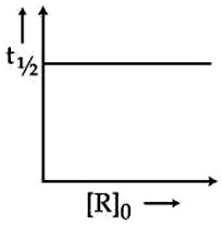


The correct order of set of reagents for the above conversion is :

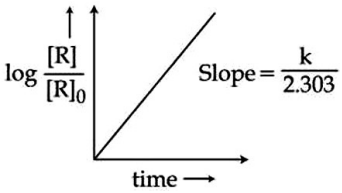
(1) Ac_2O, Br_2, $H_2O(\Delta)$, NaOH **(2)** H_2SO_4, Ac_2O, Br_2, $H_2O(\Delta)$, NaOH

(3) Br_2 |$FeBr_3$, $H_2O(\Delta)$, NaOH **(4)** Ac_2O, H_2SO_4, Br_2, NaOH

65. Given below are two statements :

Statement (I): 

is valid for first order reaction.

Statement (II): 

is valid for first order reaction.

In the light of the above statements, choose the **correct** 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

66. For hydrogen atom, the orbital/s with lowest energy is/are :

(A) 4s (B) $3p_x$ (C) $3d_{x^2-y^2}$

(D) $3d_{z^2}$ (E) $4p_z$

Choose the **correct** answer from the options given below:

(1) (A) only **(2)** (A) and (E) only

(3) (B), (C) and (D) only **(4)** (B) only

67. When Ethane-1,2-diamine is added progressively to an aqueous solution of Nickel (II) chloride, the sequence of colour change observed will be :

(1) Violet → Blue → Pale Blue → Green

(2) Pale Blue → Blue → Violet → Green

(3) Green → Pale Blue → Blue → Violet

(4) Pale Blue → Blue → Green → Violet

68. Given below are two statements :

Statement (I) : The first ionization energy of Pb is greater than that of Sn.

Statement (II) : The first ionization energy of Ge is greater than that of Si.

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

(1) Both **Statement I** and **Statement II** are false

(2) Both **Statement I** and **Statement II** are true

(3) **Statement I** is false but **Statement II** is true

(4) **Statement I** is true but **Statement II** is false

69. Based on the data given below :

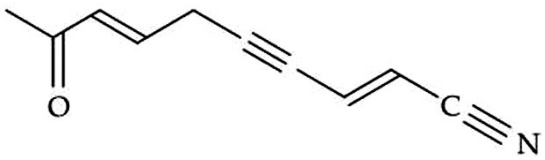
$E^{\circ}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V$ $E^{\circ}_{Cl_2/Cl^-} = 1.36\,V$

$E^{\circ}_{MnO_4^-/Mn^{2+}} = 1.51\,V$ $E^{\circ}_{Cr^{3+}/Cr} = -0.74\,V$

The strongest reducing agent is:

(1) Mn^{2+} **(2)** Cl^- **(3)** Cr **(4)** MnO_4^-

70. In the given structure, number of sp and sp^2 hybridized carbon atoms present respectively are :



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

SECTION-2

This section contains Five (05) Numerical Value Type Questions. The answer to each question is an integer ranging from 0 to 999.

71. The hydrocarbon (X) with molar mass 80 g mol^{-1} and 90% carbon has _____ degree of unsaturation.

72. In Carius method of estimation of halogen, 0.25 g of an organic compound gave 0.15 g of silver bromide (AgBr). The percentage of Bromine in the organic compound is _____ $\times 10^{-1}$% (Nearest integer).

(Given: Molar mass of Ag is 108 and Br is 80 g mol^{-1})

73. Consider a complex reaction taking place in three steps with rate constants k_1, k_2 and k_3 respectively. The overall rate constant k is given by the expression $k = \sqrt{\frac{k_1 k_3}{k_2}}$. If the activation energies of the three steps are 60, 30 and 10 kJ mol^{-1} respectively, then the overall energy of activation in kJ mol^{-1} is _____. (Nearest integer)

74. The possible number of stereoisomers for 5-phenylpent-4-en-2-ol is _____.

75. The observed and normal molar masses of compound MX_2 are 65.6 and 164 respectively. The percent degree of ionisation of MX_2 is _____. %, (Nearest integer)