JEE MAIN
GRAND TEST

Sri Chaitanya IIT Academy.,India.

✪ A.P ✪ T.S ✪ KARNATAKA ✪ TAMILNADU ✪ MAHARASTRA ✪ DELHI ✪ RANCHI

A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

| SEC: Sr.S60_Elite, Target & LIIT-BTs	JEE-MAIN	Date: 25-12-2024
Time: **09.00Am to 12.00Pm**	GTM-09/04	Max. Marks: 300

IMPORTANT INSTRUCTION:

1. Immediately fill in the Admission number on this page of the Test Booklet with **Blue/Black** Ball Point **Pen** only.

2. The candidates should not write their Admission Number anywhere (except in the specified space) on the Test Booklet/ Answer Sheet.

3. The test is of **3 hours** duration.

4. The Test Booklet consists of **75 Questions.** The maximum marks are **300.**

5. There are **three** parts in the question paper 1,2,3 consisting of **Mathematics, Physics** and **Chemistry** having **25 Questions** in each subject and subject having **two sections.**

    (I) Section –I contains **20 Multiple Choice Questions** with only one correct option.

    Marking scheme: +4 for correct answer, **0** if not attempt and **-1** in all other cases.

    (II) Section-II contains **05 Numerical Value Type Questions.**

■ The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

To cancel any attempted question bubble on the question number box.

For example: To cancel attempted Question 21. Bubble on 21 as shown below
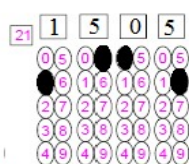
Question Answered for Marking   Question Cancelled for Marking

Marking scheme: +4 for correct answer, **0** if **not attempt** and **-1** in all other cases.

6.   Use **Blue / Black Point Pen only** for writing particulars / marking responses on the Answer Sheet. **Use of pencil is strictly prohibited.**

7.   No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electron device etc, except the Identity Card inside the examination hall.

8.   Rough work is to be done on the space provided for this purpose in the Test Booklet only.

9.   On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Hall. **However, the candidate are allowed to take away this Test Booklet with them.**

10.   **Do not fold of make any stray marks on the Answer Sheet**

Name of the Candidate (in Capital): _____

Admission Number:

Candidate's Signature:_____   Invigilator's Signature: _____

25-12-2024_Sr.S60_Elite, Target & LIIT-BTs_Jee-Main-GTM-09/04_Test Syllabus

MATHEMATICS   : TOTAL SYLLABUS

PHYSICS   : TOTAL SYLLABUS

CHEMISTRY   : TOTAL SYLLABUS

MATHEMATICS   Max Marks: 100

SECTION-I (SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions**. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.
Marking scheme: +4 for correct answer, 0 if not attempted and −1 in all other cases.

1. Let e be the eccentricity of a hyperbola and $f(e)$ be the eccentricity of its conjugate hyperbola then $\int (f(e) + f(f(e))) de = g(e)$ and $g(\sqrt{2}) = 2$, then $g(e) =$

   1) $\dfrac{1}{2}\sqrt{e^2 - 1} + \dfrac{e^2}{2}$ **2)** $\dfrac{1}{2}\sqrt{e^2 + 1} + \dfrac{e^2}{2}$ **3)** $\sqrt{e^2 - 1} + \dfrac{e^2}{2}$ **4)** $\sqrt{e^2 + 1} + \dfrac{e^2}{2}$

2. The integral $\displaystyle\int_0^1 \dfrac{\tan^{-1}x}{1+x} dx$ equals

   1) $\pi\log_e 2$ **2)** $\dfrac{\pi}{4}\log_e 2$ **3)** $\dfrac{\pi}{8}\log_e 2$ **4)** $\dfrac{\pi}{2}\log_e 2$

3. Let z_1 and z_2 be two complex number such that $|z_1| = 1$ and $|z_2| = 10$.

   If $\theta = arg\left(\dfrac{z_1 - z_2}{z_2}\right)$ then maximum value of $\tan^2\theta$ is

   1) $\dfrac{1}{10}$ **2)** $\dfrac{1}{100}$ **3)** $\dfrac{1}{99}$ **4)** $\dfrac{10}{99}$

4. The probability that the birthdays of six different persons will fall in exactly two calendar months

   1) $\dfrac{342}{12^5}$ **2)** $\dfrac{341}{12^6}$ **3)** $\dfrac{341}{12^5}$ **4)** $\dfrac{342}{12^6}$

5. The system of equations
$(1-\lambda)x + 3y - 4z = 0$
$x - (3+\lambda)y + 5z = 0$
$3x + y - \lambda z = 0$

   possesses non-trivial solutions for
   1) exactly three distinct real values of λ
   2) exactly two distinct real values of λ
   3) exactly one real values of λ
   4) infinite number of distinct real values of λ

6.

	List-I		List-II
(A)	If the line $\dfrac{x-4}{1} = \dfrac{y-2}{1} = \dfrac{z-2k}{2}$ lies in the plane $2x - 4y + z = 3$, then k is equal to	(I)	$\dfrac{9}{2}$
(B)	If the lines $\dfrac{x-1}{2} = \dfrac{y+1}{3} = \dfrac{z-1}{4}$ and $\dfrac{x-3}{1} = \dfrac{y-k}{2} = \dfrac{z}{1}$ intersect, then value of k is	(II)	$\dfrac{3}{2}$
(C)	If a plane passes through the point $(1,1,1)$ cuts the coordinate axes at A, B & C respectively such that $OA = OB = OC$ where O is the origin, then volume of tetrahedron OABC is equal to	(III)	$\dfrac{5}{2}$
(D)	If a plane P passes through $(1,-2,1)$ is perpendicular to two planes $2x - 2y + z = 0$ and $x - y + 2z = 4$. The distance of plane P from the point $\left(-1, \dfrac{5}{\sqrt{2}}, \dfrac{3}{\sqrt{2}}\right)$ is	(IV)	$\dfrac{7}{2}$

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

7. Let $\vec{a}, \vec{b}$ be two non collinear unit vectors and $\vec{x} = \vec{a} - (\vec{a} \cdot \vec{b})\vec{b}$ and $\vec{y} = \vec{a} \times \vec{b}$. Now consider the following statements :

Statement-I: $|\vec{x}| = |\vec{y}|$

Statement-II : $|\vec{y}| = |\vec{x}| + |\vec{x} \cdot \vec{b}|$

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

8. The smaller area (in sq. units) included between the curves $\sqrt{x} + \sqrt{|y|} = 1$ and $|x| + |y| = 1$ is

1) $\dfrac{1}{3}$ 2) $\dfrac{4}{3}$ 3) $\dfrac{2}{3}$ 4) $\dfrac{5}{3}$

9. Exhaustive value of x such that $\cos^{-1}\left(\dfrac{8x}{1+16x^2}\right) = -\dfrac{\pi}{2} + 2\tan^{-1}(4x)$

1) $\left(\dfrac{1}{8}, \infty\right)$ 2) $\left(\dfrac{1}{16}, \dfrac{1}{8}\right)$ 3) $\left[\dfrac{1}{4}, \infty\right)$ 4) $\left(\dfrac{1}{8}, \dfrac{1}{4}\right)$

10. Parabola $y^2 = 4a(x - c_1)$ & $x^2 = 4a(y - c_2)$ touch each other where c_1 & c_2 are variables, then locus of their point of contact is :

1) $xy = a^2$ 2) $xy = 2a^2$ 3) $xy = 4a^2$ 4) $xy = 3a^2$

11. If A is a square matrix of order n then, $\underbrace{(\text{adj adj adj adj}\ldots\text{adj}A)}_{(n-1)\ \text{times}} . \underbrace{(\text{adj adj adj}\ldots\text{adj}A)}_{n\ \text{times}}$ is equal

to:

1) $|A^{n-1}|^{(n-1)^2}$ 2) $|A^{-1}|^{(n-1)^{(n-1)}}$

3) $\dfrac{1}{n}|A|^{(n-1)^{(n-1)}} \cdot I_{n \times n}$ 4) $|A|^{(n-1)^{(n-1)}} \cdot I_{n \times n}$

12. Two dice are thrown simultaneously to get the co-ordinates on $x - y$ plane. Then the probability that this point lies inside or on the region bounded by $|x| + |y| = 3$, is:

1) $\dfrac{3}{14}$ 2) $\dfrac{2}{3}$ 3) $\dfrac{1}{12}$ 4) $\dfrac{4}{14}$

13. The vector equation of the plane through the line of intersection of the planes $x + y + z = 1$ and $2x + 3y + 4z = 5$ which is perpendicular to the plane $x - y + z = 0$ is :

1) $\vec{r} \times (\hat{i} + \hat{k}) + 2 = 0$ 2) $\vec{r} \cdot (\hat{i} - \hat{k}) - 2 = 0$

3) $\vec{r} \cdot (\hat{i} - \hat{k}) + 2 = 0$ 4) $\vec{r} \times (\hat{i} - \hat{k}) + 2 = 0$

14. In a survey, it was found out that 100 people don't use any of laptop, mobile or wrist watches. 80 persons use all the three gadgets. There are 150 who use laptop and mobile, 200 who use mobile and wristwatch and 200 who use laptop and wristwatch. The number of people who use only laptop, only mobile and only wristwatch is equal. If this survey was conducted on 1000 persons, how many people use only wristwatch?

1) 200   **2)** 170   **3)** 150   **4)** 900

15. Let $f(x) = \begin{cases} |1-2x^2|, & 0 \le x < 1 \\ [x^2 - 2x], & 1 \le x < 2 \end{cases}$

If m, n are number of points of discontinuity and non-differentiability of $f(x)$ in $(0, 2)$ then ([.] represents greatest integer function)

1) m = 1, n = 2   **2)** m = 1, n = 1   **3)** m = 2, n = 2   **4)** m=3,n=2

16. The area of the region between the curves $y = \sqrt{\dfrac{1+\sin x}{\cos x}}$ and $y = \sqrt{\dfrac{1-\sin x}{\cos x}}$ bounded by the lines $x = 0$ and $x = \dfrac{\pi}{4}$ is

1) $\displaystyle\int_{\sqrt{2}+1}^{\sqrt{2}-1} \frac{t}{(1+t^2)\sqrt{1-t^2}} dt$

2) $\displaystyle\int_{0}^{\sqrt{2}-1} \frac{4t}{(1+t^2)\sqrt{1-t^2}} dt$

3) $\displaystyle\int_{0}^{\sqrt{2}+1} \frac{4t}{(1+t^2)\sqrt{1-t^2}} dt$

4) $\displaystyle\int_{0}^{\sqrt{2}+1} \frac{t}{(1+t^2)\sqrt{1-t^2}} dt$

17. A water tank has the shape of an inverted circular cone with its axis vertical and vertex lowermost. Its semi-vertical angle is $\tan^{-1}(0.5)$. Water is poured into it at a constant rate of 5 cubic meter per hour. The rate at which the level of the water is rising at the instant when the depth of water in tank is 4m is (Take $\pi = \dfrac{22}{7}$)

1) 1m/h   **2)** $\dfrac{30}{17}$m/h   **3)** $\dfrac{70}{88}$m/h   **4)** $\dfrac{35}{88}$m/h

18. Let $\alpha_1, \alpha_2, ..., \alpha_8$ be roots of the equation $1 + z + z^2 + ... + z^8 = 0$. On throwing three dice simultaneously, sum of the numbers appearing on them is n. The probability such that $\sum_{i=1}^{8} (\alpha_i)^n = 8$ is $\dfrac{a}{b}$ (where a and b are co-prime) then the value $|7a - b|$ is:

  1) 22   **2)** 16   **3)** 26   **4)** 17

19. Area bounded by $-8z^2 - 8\bar{z}^2 + 20z\bar{z} = 144$ is (where z is a complex number):

  1) π **2)** 6π **3)** 12π **4)** 4π

20. $f(x)$ is a differentiable function satisfy the relationship $f^2(x) + f^2(y) + 2(xy - 1) = f^2(x + y) \ \forall x, y \in R$. Also $f(x) > 0 \ \forall \ x \in R$, and $f(\sqrt{2}) = 2$. then $f(\sqrt{7}) =$

  1) 3   **2)** 4   **3)** 5   **4)** 7

<div align="center">

SECTION-II (NUMERICAL VALUE TYPE)

</div>

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

21. The mean weight of 9 items is 15. If one more item is added to the series, the mean becomes 16. The value of 10th item is

22. Let $\{a_n\}$ and $\{b_n\}$ be two different sequences such that $a_{n+1} = 2 + a_n \ \forall \ n \in N$, $a_{10} = 21$ and $b_n = \dfrac{1}{a_n \, a_{n+2}} \ \forall n \in N$, then the value of $15 \sum_{r=1}^{\infty} b_r$ is

23. A variable chord of the hyperbola $\dfrac{x^2}{4} - \dfrac{y^2}{8} = 1$, subtends a right angle at the centre of the hyperbola. If this chord touches a fixed circle which is concentric with the hyperbola and r is radius of the circle, then r^2 is

24. If the integral $\int \dfrac{5\tan x \, dx}{\tan x - 2} = x + a \ell n |\sin x - 2\cos x| + C$ then $'a'$ is equal to (C is constant of integration)

25. The value of $\lim_{n \to \infty} \dfrac{\left(\lim_{x \to 0^-} \sum_{r=1}^{2n+1} [x^r] \right) + n + 3}{\ell n (1+n)^n - \ell n(n)^n}$; where [.] denotes greatest integers functions

PHYSICS   Max Marks: 100

SECTION-I (SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions**. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and −1 in all other cases.

26. A vernier calipers has a least count of 1 mm of its main scale. If 11 divisions of its main scale coincides with 12 divisions of vernier scale then its least count will be :-

1) $\dfrac{1}{12}$ mm   2) $\dfrac{1}{11}$ mm   3) $\dfrac{11}{12}$ mm   4) $\dfrac{12}{11}$ mm

27. The truth table for digital circuit shown in figure is:

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

2)
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

3)
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0
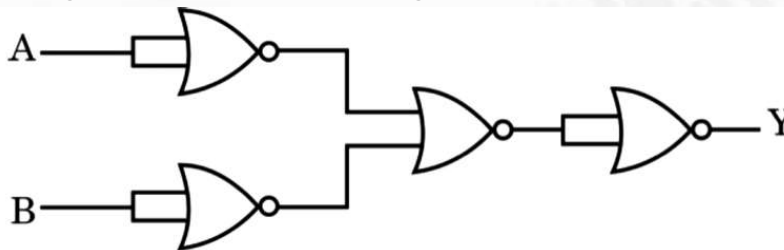
4)
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

28. Calculate the binding energy of an alpha particle (in MeV) (approx.) from the following data:-

mass of H atom = 1.007862 u
mass of neutron = 1.008656 u
mass of He atom = 4.00206 u
Take 1 u = 931 MeV/c^2.

1) 25   2) 40   3) 29   4) 19

29. **Statement-1:** Two particle moving in the same direction do not lose all their energy in a completely inelastic collision.
Statement-2: In accordance with the principle of conservation of momentum, kinetic energy will not be zero once collision is over

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1) Statement-1 is true, Statement-2 is false

2) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1

3) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1

4) Statement-1 is false, Statement-2 is true

30. The diagram shows a force-extension graph for a rubber band. Consider the following statements-

I. it will be easier to compress this rubber than expand it.

II. Rubber does not return to its original length after it is stretched.

III. The rubber band will get heated if it is stretched and released.

Which of these can deduced from the graph
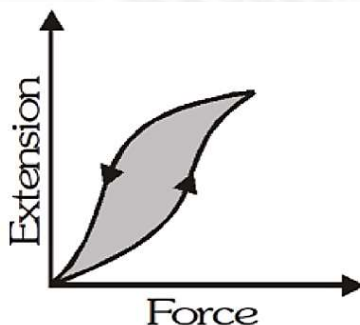
1) III only   **2)** II and III   **3)** I and III   **4)** I only

31. For a step-up transformer, the turns ratio is 3 and its efficiency is 0.75. The current flowing in the primary coil is 2A and the voltage applied to it is 100 V. Then the voltage and the current flowing in the secondary coil are _____ respectively:

1) 150 V, 1.5 A   **2)** 300 V, 0.5 A   **3)** 300 V, 1.5 A   **4)** 150 V, 0.5 A

32. The intensity of light from a source is $\left(\dfrac{500}{\pi}\right) W/m^2$. Find the amplitude of electric field in this wave.

1) $\sqrt{3} \times 10^2 \, N/C$ **2)** $2\sqrt{3} \times 10^2 \, N/C$ **3)** $\dfrac{\sqrt{3}}{2} \times 10^2 \, N/C$ **4)** $2\sqrt{3} \times 10^1 \, N/C$

33. The armature of an electric drill motor has a resistance of 15Ω. When connected to a 120.0 V outlet, the motor rotates at its normal speed and develops a back emf of 108 V. What is the current when the motor runs at only half speed?

     1) 0.3 A   **2)** 4.4 A   **3)** 1.2 A   **4)** 2.0 A

34. Light is incident on the surface of metallic sodium, whose work function is 2.3 eV. The maximum speed of the photoelectrons emitted by the surface is $1.2 \times 10^6 \text{ m/s}$. What is the wavelength of the light?

     1) 570 nm   **2)** 710 nm   **3)** 320 nm   **4)** 194 nm

35. The number of possible natural oscillations of air column in a pipe closed at one end of length 85 cm whose frequencies lie below 1250 Hz are: (velocity of sound $= 340 \text{ ms}^{-1}$)

     1) 4   **2)** 5   **3)** 7   **4)** 6

36. Statement-1: Three orbits are marked as 1, 2 and 3. These three orbits have same semi-major axis although their shapes (eccentricities) are different. The three identical satellites are orbiting in these three orbits, respectively. These three satellites have the same binding energy.
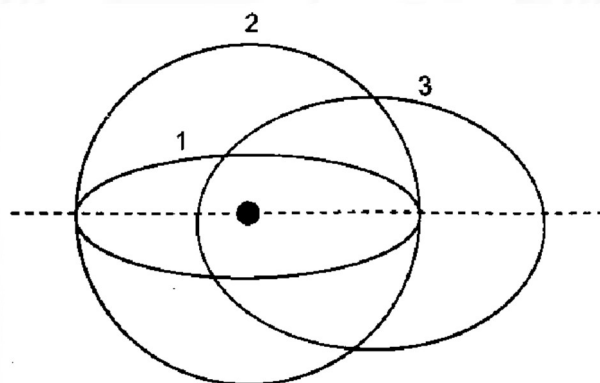
Statement-2: Total energy of a satellite depends on the semi-major axis of orbit according to the expression, $E = -\dfrac{GMm}{2a}$.

1) Statement-1 is true, Statement-2 is false

2) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1

3) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1

4) Statement-1 is false, Statement-2 is true

37. A travelling wave is described by the equation $y(x,t) = 0.05 \sin(8x - 4t)$m. The velocity of the wave is: - [all the quantities are in SI unit]

1) $4\,\text{ms}^{-1}$ 2) $2\,\text{ms}^{-1}$ 3) $0.5\,\text{ms}^{-1}$ 4) $8\,\text{ms}^{-1}$

38. **Assertion**: For practical purposes, the earth is used as a reference at zero potential in electrical circuits.

and

Reason: The earth can be considered to be sphere of extremely large radius so for any finite value of charge its potential remain unchanged and hence can be used as reference.

1) Assertion and Reason are True; Reason is a correct explanation for Assertion

2) Assertion and Reason are True; Reason is not a correct explanation for Assertion

3) Assertion is True, Reason is False

4) Assertion is False, Reason is True

39. A solid non conducting sphere of radius R having variable volume charge density $d = \dfrac{Ar}{R}$ where r is the distance from centre. If electric field at distance $\dfrac{R}{2}$ from the centre of charged sphere is $E = \dfrac{2R}{\epsilon_0}\text{N/C}$. Value of $\dfrac{A}{16}$ will be

1) 2   2) 4   3) 6   4) 8

40. In Young's double slit experiment, the slits are 2mm apart and are illuminated by photons of two wavelengths $\lambda_1 = 12000\text{Å}$ and $\lambda_2 = 10000\text{Å}$. At what minimum distance in mm from the common central bright fringe on the screen 2m from the slit will a bright fringe from one interference pattern coincide with a bright fringe from the order?

1) 8   2) 6   3) 5   4) 3

41. **Assertion (A):** A ball is dropped from rest. A second ball is dropped from rest from the same height as the first, but 1s later. The distance between the balls when both are moving remains constants.

Reasons (R): When both the balls are falling freely, the acceleration of one ball with respect to another is zero.

1) Assertion and Reason are True; Reason is a correct explanation for Assertion

2) Assertion and Reason are True; Reason is not a correct explanation for Assertion

3) Assertion is True, Reason is False

4) Assertion is False, Reason is True

42. Two polarizers whose transmission axes are perpendicular to each other are placed so that they partially overlap. The polarizers in this arrangement are used to view the calm surface of a lake. To explain the light pattern in the diagram shown below, we need.
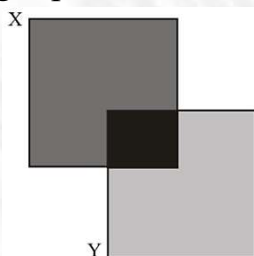
1) Both Brewster's law and Malus law **2)** Neither Brewster's law or Malus law

3) Brewster's law but not Malus law **4)** Malus law but not Brewster's law

43. In the adjoining circuit, initially the switch S is open. The switch 'S' is closed at $t = 0$. The difference between the maximum and minimum current that can flow through the battery is
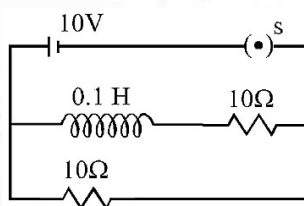
1) 2A **2)** 3A **3)** 1A **4)** 0.5 A

44. A hollow sphere of radius R is filled completely with an ideal liquid of density ρ. Sphere is moving horizontally with an acceleration 2g, where g is acceleration due to gravity in the sphere. If minimum pressure of liquid is P_0, then pressure at the centre of sphere is:-
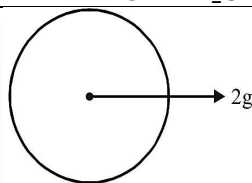
1) $P_0 + \rho g R$ **2)** $P_0 + \rho g R\sqrt{2}$ **3)** $P_0 + \rho g R\sqrt{5}$ **4)** $P_0 + \dfrac{\rho g R}{\sqrt{5}}$

45. In the figure shown below block A is executing SHM on a smooth level ground. Another block *B* is kept gently on *A* in any of the positions mentioned in column-I. The block *B* sticks to *A*. Match with appropriate descriptions in column-II.
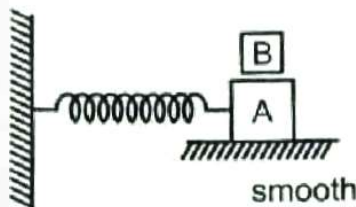
	Column-I		Column-II
A)	Block *B* placed on the block *A* when *A* is at right extreme.	(P)	Momentum of $(A + B)$ can be assumed to be conserved at the time block *A* is placed on block *B*.
B)	Block *B* placed on the block *A* when *A* is at mean position.	(Q)	Mechanical energy is conserved.
C)	Block *B* placed on the block *A* when *A* is midway between extreme and mean.	(R)	Time period of SHM increases.
		(S)	Amplitude of SHM decreases.

1) (A) – P,   (B) – Q,   (C) – S
2) (A) – P, Q, R   (B) – P,   (C) – P
3) (A) – P, Q, R   (B) – P, R, S   (C) – P, R, S
4) (A) – P, Q   (B) – P   (C) – P, R, S

SECTION-II (NUMERICAL VALUE TYPE)

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

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46. Two strings have different lengths and linear densities, as the drawing shows. They are joined together and stretched so that the tension in each string is 216.0 N. The free ends of the joined string are fixed in place. Find the lowest frequency (in Hz) that permits standing waves in both strings with a node at the junction. The standing wave pattern in each string may have a different number of loops.
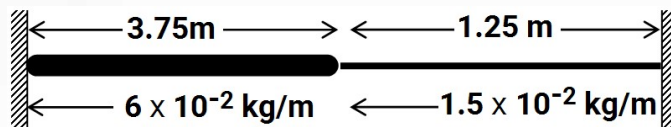
47. A particle of mass $m = 2$ kg is moving at $5\,\text{m/s}$ in a given direction and is struck by an impulsive force F that deflects its direction of motion through $60°$ and doubles the magnitude of its velocity. The same impulsive force F is applied to a mass of 5m at rest. What is the resulting kinetic energy of mass 5m (in J)?

48. The minimum energy of an electron necessary for ionization of an atom of hydrogen, is equal to W_0. Suppose that a hydrogen atom and helium atom both in ground state collide inelastically so that hydrogen atom is ionized. If the hydrogen was at rest and helium was moving with at least energy of xW_0, find the value of x.

49. In a coordinate system an electric field E and a magnetic field B exist in X-direction and particle of charge q and mass m is projected with a velocity v from origin along Y-direction. A target is located at point $(x_0,0,0)$. Find the magnitude of magnetic induction B (in Tesla) so that the particle will hit the target when it is crossing the X-axis third time. [Consider that $\pi^2 = 10, E = 1, x_0 = 1,\ m = 2, q = 10$ all quantities in SI Unit]

50. Find the value of instantaneous power (in W) supplied by battery at the moment after the switch is closed.
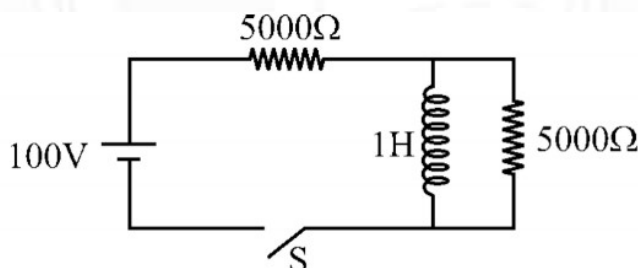
CHEMISTRY   Max Marks: 100

SECTION-I (SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions**. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and −1 in all other cases.

51. Given below are two statements :

Statement I : The limiting molar conductivity of KCl (strong electrolyte) is higher compared to that of CH_3COOH (weak electrolyte).

Statement II : Molar conductivity increases with decrease in concentration of electrolyte.

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.

52. Column-I and Column-II contains four entries each. Entries of Column-I are to be matched with some entries of Column-II. One or more than one entries of Column-I may have the matching with the same entries of Column-II

	Column-I		Column-II
(A)	Very dilute solution of HCl	(P)	O_2 evolved at anode
(B)	Very dilute solution of NaCl	(Q)	H_2 evolved at cathode
(C)	Concentrated solution of NaCl	(R)	Cl_2 evolved at anode
(D)	Aqueous $AgNO_3$	(S)	Ag deposition at cathode

1) $A \rightarrow P,Q; B \rightarrow R,Q; C \rightarrow Q,R; D \rightarrow P,S$ **2)** $A \rightarrow P,Q; B \rightarrow P,Q; C \rightarrow Q,R; D \rightarrow P,Q$

3) $A \rightarrow Q,R; B \rightarrow R,Q; C \rightarrow Q,R; D \rightarrow P,S$ **4)** $A \rightarrow P,Q; B \rightarrow P,Q; C \rightarrow Q,R; D \rightarrow P,S$
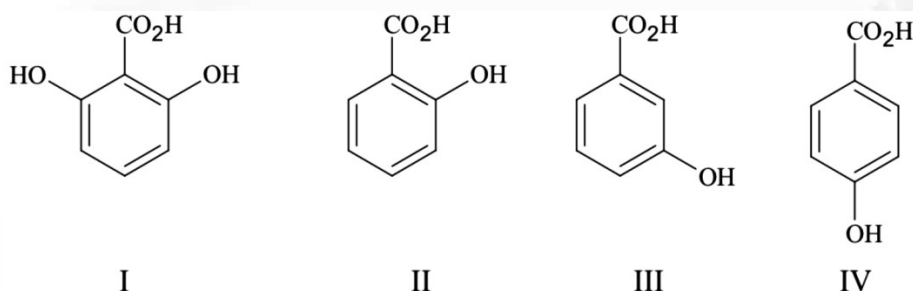
53. Which of the following organic compounds responds positively to both iodoform test and Fehling's test?

    1) Ethanol   **2)** Methanal   **3)** Ethanal   **4)** Propanone

54. Which one of the following bases is not present in DNA?

    1) Cytosine   **2)** Thymine   **3)** Quinoline   **4)** Adenine

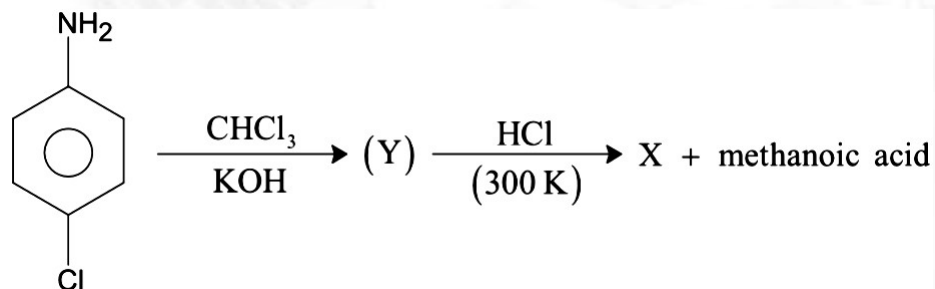**55.** The correct order of acidity for the following compounds is

     I   II   III   IV

    1) I > II > III > IV   **2)** III > I > II > IV   **3)** III > IV > II > I   **4)** I > III > IV > II

56. Which of the following is a neutral oxide?

    1) Na_2O **2)** N_2O **3)** NaO_2 **4)** NO_2

57. Identify X in the sequence given:

1)   **2)**

3)   **4)**

58. The rate constant for the forward reaction $A(g) \rightarrow 2\,B(g)$ is 1.5×10^{-3} s^{-1} at 100 K. If 10^{-5} moles of A and 100 moles of B are present in a 10 litre vessel at equilibrium then rate constant for the backward reaction at this temperature is

1) 1.50×10^4 L mol^{-1} s^{-1} **2)** 1.5×10^{11} L mol^{-1} s^{-1}

3) 1.5×10^{10} L mol^{-1} s^{-1} **4)** 1.5×10^{-11} L mol^{-1} s^{-1}

59. **Assertion:** The bond length of C-O in phenol is shorter than bond length of alcohol; in general.

Reason: In phenol OH undergo resonance with benzene ring but in alcohol it not possible

Statements, namely, Assertion (A) and Reason (R) For selecting the correct answer, use the following code:

1) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).

2) Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A).

3) Assertion (A) is true and Reason (R) is false.

4) Assertion (A) is false and Reason (R) is true

60. From the given statements, incorrect statements are:

I.   H.O.M.O. of dioxygen is π^*2p [H.O.M.O = highest occupied Molecular orbital]

II.   L.U.M.O. of dinitrogen is $\pi2p$ [L.U.M.O = lowest unoccupied Molecular orbital]

III.   Bond strength of $B_2 > F_2$

1) I, II and III   **2)** II only   **3)** II and III only   **4)** III only

61. Which of the following process will produce 2° amine?
1) Gabriel synthesis   **2)** Hoffmann bromamide reaction
3) Reduction of carbylamines   **4)** Reduction of nitro compounds

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62. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Amylose is water insoluble component.

Reason (R): Amylose is a long unbranched chain molecule with more than 200

$\alpha - D - (+) - glucose$ units.

In the light of the above statements

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

2) Both (A) and (R) are correct and (R) is NOT the correct explanation of (A)

3) (A) is correct but (R) is not correct

4) (A) is not correct but (R) is correct

63. Given below are the two statements.
Statement-I: All $F - Cl - F$ angles are equal in ClF_3.

Statement-II: All $Cl - F$ bond lengths are equal in ClF_3.

In the light of the above statements, choose correct answer from the options given below:
1) Both Statement-I and Statement-II are true
2) Both Statement-I and Statement-II are false
3) Statement-I is true but Statement-II is false
4) Statement-I is false but Statement-II is true.

64. Consider the expansion of one mole of an ideal gas from an initial state to a final state, with ΔS representing the entropy change in the process. The correct statement is:
1) If the process is carried out reversibly, the value of ΔS will be higher in comparison to its irreversible counterpart
2) If the process is adiabatic, the value of ΔS is always zero, irrespective of whether the process is carried out reversibly or irreversibly
3) If the process is isothermal, there will not be any heat exchange with the surrounding

since the temperatures of the system and the surrounding are equal

4) If the process is isothermal and the final volume is double of the initial volume, the value of ΔS will be independent of the temperature

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65. Choose the **CORRECT** statements?

a) Alcohols (ROH) are weaker acids than benzene sulphonic acid.

b) Water is a better proton donor than ethanol.

c) $\overset{\ominus}{N}H_2$ ion is a better proton acceptor than $\overset{\ominus}{O}H$ ion.

d) Sodium ethoxide is a stronger base than sodium hydroxide

**1)** a, b and c only   **2)** b and c only   **3)** b, c and d only   **4)** a, b, c and d only

66. The electronic configurations of bivalent europium and trivalent cerium are

(atomic number : $Xe = 54, Ce = 58, Eu = 63$)

1) $[Xe]4f^2$ and $[Xe]4f^7$ **2)** $[Xe]4f^7$ and $[Xe]4f^1$

3) $[Xe]4f^7 6s^2$ and $[Xe]4f^2 6s^2$ **4)** $[Xe]4f^4$ and $[Xe]4f^9$

67. A liquid mixture contain 10 moles of $A(P_A^\circ = 200\,mmHg)$ and 10 moles of

$B(P_B^\circ = 100mmHg)$. The vapour pressure over liquid mixture is 160 mm Hg. Which is

correct statement?

1) $\Delta G_{mix} = +ve$ **2)** $\Delta V_{mix} = -ve$

3) $\Delta S_{surrounding} = +ve$ **4)** $\Delta S_{surrounding} = -ve$

68. The above reaction requires which of the following reaction conditions?
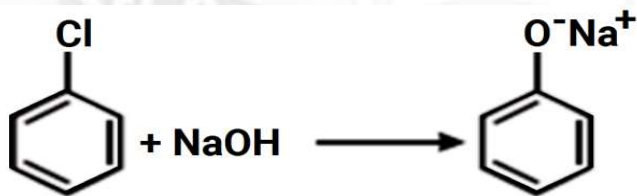
1) 623 K, Cu, 300 atm   **2)** 573 K, 300 atm

3) 573 K, Cu, 300 atm   **4)** 623 K, 300 atm

69. Consider following orders against the mentioned property:

I: $Mg < Si < Al < S < P$ (2nd ionisation potential)

II: $Na_2O < MgO < Al_2O_3 < P_2O_5$ (Acidic strength)

III: $C < N < O < F$ (Electron affinity)

The incorrect order(s) is/are

1) Only I   **2)** Only III   **3)** Only I and III   **4)** I, II and III

70. 100 mL of $0.5M\, Na_3PO_4$ aqueous solution is mixed with 80 mL of 1.25 M HCl solution.

The pH of the final solution is (Given: K_{a_1}, K_{a_2} and K_{a_3} of H_3PO_4 are $10^{-3}, 10^{-5}$ and

10^{-7} respectively)

1) 6   **2)** 4   **3)** 3.5   **4)** 4.7

SECTION-II (NUMERICAL VALUE TYPE)

This section contains **5 Numerical Value Type Questions**. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).

Marking scheme: **+4 for correct answer, 0 if not attempt and -1 in all other cases**

71. From the following data, calculate the standard enthalpy change for the combustion of cyclopropane at 298 K: The standard enthalpy of formation of $CO_2(g), H_2O(\ell)$ and propene(g) are $-393.5,\ -285.8$ and $20.42\, kJ\, mol^{-1}$ respectively.

The standard enthalpy of isomerization of cyclopropane to propene is $-33.0\, kJ\, mol^{-1}$.

Report your answer by rounding off to nearest integer [magnitude only]

72. Tollen's test is used for detection of aldehydic group in organic compounds like glucose. The test is as follows: An aqueous solution of $AgNO_3$ is added to an aqueous solution of glucose in a test tube. When concentrated ammonia is added, silver is deposited. This is a redox reaction as Ag^+ is reduced to Ag and glucose is oxidized to gluconic acid. The following half-cell reactions and the standard half-cell potentials are given :

$$Ag^+ + e^- \rightarrow Ag \qquad E^0_{red} = 0.8 \text{ V}$$

$$C_6H_{12}O_6 + H_2O \rightarrow C_6H_{12}O_7 + 2H^+ + 2e^- \qquad E^0_{ox} = -0.05 \text{ V}$$

$$[Ag(NH_3)_2]^+ + e^- \rightarrow Ag + 2NH_3 \qquad E^0_{red} = 0.37 \text{ V}$$
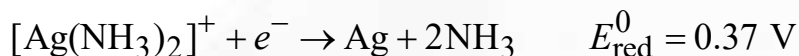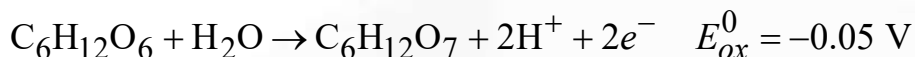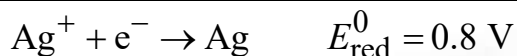
Given : $2.303RT/F = 0.0592 \text{ V}, F/RT = 38.90 \text{ V}^{-1}$ at 298 K

Then find the value of the logarithm of the equilibrium constant (ln K) of the following reaction

$$C_6H_{12}O_6 + 2Ag^+ + H_2O \rightleftharpoons C_6H_{12}O_7 + 2H^+ + 2Ag\downarrow$$
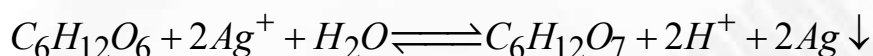
[Report your answer by rounding off to nearest integer value]

73. Number of unpaired electrons in $Mn^{+7} = a$

Number of d-subshell electrons in $Cr = b$

Number of f-subshell electrons in Hf (Atomic no. = 72) = c.

Find the value of $c - b + a$.

74. How many mono cyclic structures are possible for C_4H_6 [Consider structural isomers only]

75. The number of deBroglie waves made by an electron in an orbit having lowest principal quantum number that contains f sub level are

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