Sri Chaitanya IIT Academy.,India.

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ICON Central Office - Madhapur - Hyderabad

SEC: Sr.Super60_NUCLEUS-BT	**JEE-MAIN**	**Date: 19-07-2025**
Time: 09.00Am to 12.00Pm	**RPTM-02**	**Max. Marks: 300**
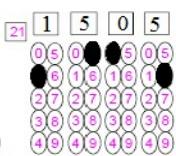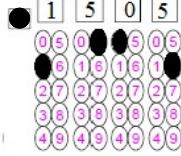
IMPORTANT INSTRUCTION:

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: _____

19-07-2025_Sr.Super60_NUCLEUS-BT_Jee-Main_RPTM-02_Test Syllabus

MATHEMATICS	**: LCD, Differentiation, Differentiability and successive differentiation.**
PHYSICS	**: Thermal Physics: First law of thermodynamics and its applications (only for ideal gases); Isothermal and adiabatic processes, bulk modulus of gases; Equivalence of heat and work; Second law of thermodynamics, Reversible and irreversible processes, Carnot engine and its efficiency (Deleted for MAINS);**
	Heat Transfer: Heat conduction in one dimension; Elementary concepts of convection and radiation; Blackbody radiation: absorptive and emissive powers; Kirchhoff's law; Wien's displacement law, Stefan's law, Newton's law of cooling (Deleted for MAINS);
CHEMISTRY	**: GOC: Inductive effect, Resonance and hyperconjugation; Keto-enol tautomerism; Hydrogen bonding- definition and their effects on physical properties of alcohols and carboxylic acids; Inductive and resonance effects on acidity and basicity of organic acids and bases; Polarity and inductive effects in alkyl halides; Reactive intermediates produced during homolytic and heterolytic bond cleavage; Formation, structure and stability of carbocations, carbanions and free radicals**
	Alkanes: Preparation, properties and reactions of alkanes. Homologous series, physical properties of alkanes(melting points, boiling points and density) and effect of branching on them; Combustion and halogenations of alkanes(including allylic and benzylic halogenation); Preparation of alkanes by Wurtz reaction and decarboxylation reaction, Corey-House Reaction.

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. For $x \in R, f(x) = |\log 2 - \sin x|$ and $g(x) = f(f(x))$, then which of the following is correct?

1) g is not differentiable at $x = 0$

2) $g'(0) = \cos(\log 2)$

3) $g'(0) = -\cos(\log 2)$

4) g is differentiable at $x = 0$, $g'(0) = -\sin(\log 2)$

2. Let $f : R \to R$ be defined by $f(x) = \begin{cases} 2 + \dfrac{x \log_e(\cos x)}{\log_e(1+x^2)} + \log_e(1 - \cos 2x) - 2\log_e x & if \quad x \neq 0 \\ \beta & if \quad x = 0 \end{cases}$

Continuous at x=0 then the value of $\exp(\beta)$ is equal to

1) $2 + \log 2$ 2) $2e$ 3) e^2 4) $2e^2$

3. Let $f : R \to R$ be a function satisfying the equation $f(x) + f(y) = f\left(\dfrac{x+y}{1-xy}\right)$ for all

$x, y \in R$ and $xy \neq 1$, if $\lim\limits_{x \to 0} \dfrac{f(x)}{x} = 2$ then the value of $\left| f'(-2) - f(\sqrt{3}) \right| =$

1) $\dfrac{2}{5} - \dfrac{2\pi}{3}$ 2) $\dfrac{2\pi}{3} - \dfrac{2}{5}$ 3) $\dfrac{2\pi}{3} + \dfrac{2}{5}$ 4) $\dfrac{1}{5} - \dfrac{2\pi}{3}$

4. Which of the following functions has at least one isolated point discontinuity?

1) $f : [0, \infty) \to$ Defined by $f(x) = \sqrt{x + \sqrt{x + \sqrt{x + \ldots \ldots \infty}}}$

2) $f(x) = \sqrt{1-x} + \sqrt{x-1}$ in its natural domain

3) $f(x) = \dfrac{1}{\{x\} + \{-x\} - 1}$ where $\{x\}$ denotes fractional part of x in its domain

4) $f(x) = [x] + [-x]$ in its natural domain ([.] is G.I.F).

5. Let $f:\left(\dfrac{\pi}{4},\dfrac{3\pi}{4}\right)\to R$ be defined as $f(x)=\begin{cases}\left(1+|\cos x|\right)^{\frac{3a}{\cos x}} & if & \dfrac{\pi}{2}<x<\dfrac{\pi}{4}\\[2mm] b & if & x=\dfrac{\pi}{2}\\[2mm] e^{\frac{\cot 4x}{\cot 2x}} & if & \dfrac{\pi}{4}<x<\dfrac{\pi}{2}\end{cases}$

    Is continuous at $x=\dfrac{\pi}{2}$ then the value of $6a+b^2$ is equal to

    1) $e-1$ 2) $e+1$ 3) $1-e$ 4) e

6. For each $x\in R$, let $[x]$ be the greatest integer less than or equal to x. then

    $\displaystyle\lim_{x\to 0^-}\dfrac{x\left([x]+|x|\right)\sin[x]}{|x|}$ is equal to

    1) 0   2) 1   3) $\sin 1$ 4) $-\sin 1$

7. If $\displaystyle\lim_{x\to 0}\dfrac{\alpha e^x+\beta e^{-x}+\gamma\sin x}{x\sin^2 x}=\dfrac{2}{3}$, where $\alpha,\beta,\gamma\in R$, then which of the following is not

    correct?

    1) $\alpha^2+\beta^2+\gamma^2=6$ 2) $\alpha\beta+\beta\gamma+\gamma\alpha+1=0$

    3) $\alpha\beta^2+\beta\gamma^2+\gamma\alpha^2+3=0$ 4) $\alpha^2-\beta^2+\gamma^2=4$

8. $\displaystyle\lim_{x\to 0^+}\dfrac{-1+\sqrt{(\tan x-\sin x)+\sqrt{(\tan x-\sin x)+\sqrt{(\tan x-\sin x)+......\infty}}}}{-1+\sqrt{x^3+\sqrt{x^3+\sqrt{x^3+.....\infty}}}}$

    1) 0   2) $\dfrac{1}{2}$ 3) $-\dfrac{1}{2}$ 4) 1

9. $f(x)=\begin{cases}\dfrac{\sin[x]}{[x]}, & for & [x]\neq 0\\[2mm] 0, & for & [x]=0\end{cases}$,Where $[x]$ denotes the greatest integer less than or equal to

    x. Then $\displaystyle\lim_{x\to 0}f(x)$ is

    1) 1   2) 0   3) -1   4) does not exist

10. $\lim\limits_{x\to\infty}\left(\sqrt{x^2+ax+a^2}-\sqrt{x^2+a^2}\right)=$

    1) 0   2) $\dfrac{a}{2}$ 3) $-\dfrac{a}{2}$ 4) a

11. If $\lim\limits_{n\to\infty}\dfrac{n.3^n}{n(x-2)^n+n.3^{n+1}-3^n}=\dfrac{1}{3}$, then the range of x is $\left(\text{where } n\in N\right)$

    1) $[2,5)$ 2) $(1,5)$ 3) $(-1,5)$ 4) $[1,5]$

12. $\lim\limits_{n\to\infty}\left\{\left(2^{\frac{1}{2}}-2^{\frac{1}{3}}\right)\left(2^{\frac{1}{2}}-2^{\frac{1}{5}}\right)....\left(2^{\frac{1}{2}}-2^{\frac{1}{2n+1}}\right)\right\}$ is equal to

    1) $\dfrac{1}{\sqrt{2}}$ 2) 1   3) 0   4) $\sqrt{2}$

13. Let a function $f:R\to R$ be defined as $f(x)=\begin{cases}2\cos x-e^{-x} & if & x\le 0\\ \lambda-[-x] & if & 0<x<1\\ 5x^2+\mu & if & x\ge 1\end{cases}$

Where $[x]$ denotes the greatest integer $\le x$ is continuous on R then the value of $\lambda+\mu$ is equal to

    1) -2   2)-3   3) 4   4)-4

14. The function $f(x)=\begin{cases}|2x-3|[x] & if & 0\le x\le 2\\ \dfrac{x^2}{2} & if & 2<x\le 3\end{cases}$

Where $[x]$ denote the greatest integer less than or equal to x defined on $[0,3]$, at $x=2$

    1) has left derivative and no right derivative

    2) has no left derivative but has right derivative

    3) has neither left derivative nor right derivative

    4) has both left, right derivatives but $f'(2^-)\ne f'(2^+)$

15. Let $f(x)=\begin{cases}x-3 & if & x<0\\ x^2-3x+2 & if & x\ge 0\end{cases}$ and $g(x)=f(|x|)+|f(x)|$, then $g(x)$ is

    1) Continuous at $x=0,$ but not differentiable at $x=0,1,2$

    2) Discontinuous at $x=0,$ but not differentiable at $x=0,1,2$

    3) Continuous and differentiable on $(-\infty,\infty)$

    4) no where differentiable but every where continuous

16. Let $f(x) = \begin{cases} x^2 \sin\left(\dfrac{1}{x}\right), & x \neq 0 \\ 0, & x = 0 \end{cases}$, then $at\ x = 0$

1) f is continuous but not differentiable

2) f and f' both are continous

3) f' is continuous but not differentiable

4) f is continuous but f' is not continuous

17. Let $f : [0, \infty)$ be a function defined by $f(x) = \begin{cases} \max\{\sin t : 0 \leq t \leq x\}, & if \quad 0 \leq x \leq \pi \\ 2 + \cos x & if \quad x > \pi \end{cases}$

Then which of the following is true?

1) f is continuous everywhere but not differentiable exactly at one point in $(0, \infty)$

2) f is continuous everywhere but not differentiable exactly at two points in $(0, \infty)$

3) f is differentiable everywhere in $(0, \infty)$

4) f is not continuous exactly at two points in $(0, \infty)$

18. Let $f : R \to R$ be differentiable at $c \in R$ and $f(c) = 0$. If $g(x) = |f(x)|$. then at $x = c$, g is

1) Not differentiable if $f'(c) = 0$

2) Differentiable if $f'(c) \neq 0$

3) Differentiable if $f'(c) = 0$

4) Not differentiable

19. Let $f(x) = \begin{cases} x \sin\left(\dfrac{1}{x}\right), & x \neq 0 \\ 0, & x = 0 \end{cases}$

Consider the following statements:

Statement 1: The function $f(x)$ is continuous at $x = 0$

Statement 2: The function $f(x)$ is differentiable at $x = 0$

1) Statement 1 is correct and Statement 2 is correct

2) Statement 1 is correct and Statement 2 is incorrect

3) Statement 1 is incorrect and Statement 2 is correct

4) Statement 1 is incorrect and Statement 2 is incorrect

20. In the following $[x]$ denotes the greatest integer less than or equal to x

Column- I

A) $x|x|$

B) $\sqrt{|x|}$

C) $x + [x]$

D) $|x-1| + |x+1|$

Column- II

P) Continuous in $(-1,1)$

Q) Differentiable in $(-1,1)$

R) strictly increasing $(-1,1)$

S) Not differentiable at least at one point in (-1.1)

1) A-PQR,B-PS,C-RS,D-PQ   **2)** A-PQR,B-RS,C-PS,D-PQ

3) A-PQS,B-PRS,C-RS,D-PCDR   **4)** A-PQ,B-PRS,C-RS,D-PQ

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.

21. Let $f(x) = x^5 + 2x^3 + 3x + 1,\ x \in R$ and g(x) be a function such that $g(f(x)) = x,\ \forall\, x \in R$,

then $\dfrac{g(7)}{g'(7)} =$

22. Suppose a differentiable function $f(x)$ satisfies the identify

$f(x+y) = f(x) + f(y) + xy^2 + x^2 y,$ for all real x and y .If $\displaystyle\lim_{x\to 0}\dfrac{f(x)}{x} = 1,$ then $f'(3)$ is

equal to _____

23. If the function $f(x) = \dfrac{\sec x - \cos(\sin x)}{x^2}$ is continues at each point in its domain and

$f(0) = P$ the value of $2P$ is

24. If $\displaystyle\lim_{x\to 0}\dfrac{3 + \alpha \sin x + \beta \cos x + \log_e(1-x)}{3\tan^2 x} = \dfrac{1}{3},$ then $2\alpha - \beta$ is equal to

25. If $[t]$ denotes the greatest integer $\leq t,$ then the number of points. At which the function

$f(x) = [x + x^3] + |x - x^3| + \left| x + \dfrac{1}{2} \right|$ is not differentiable in the open interval $(-10,10)$ is

_____

**PHYSICS**   **Max Marks: 100**

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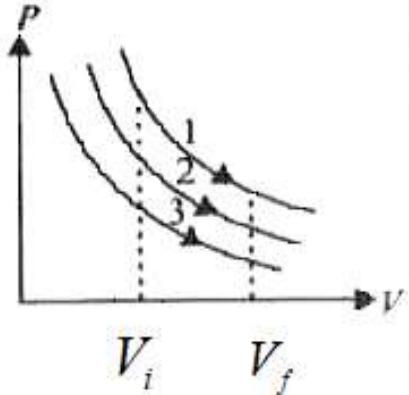
This section contains **20 Multiple Choice Questions**. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

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26. One mole of monatomic gas is heated at constant pressure of 1 atmosphere from 0 K to 100 K. If the gas constant R is taken as $8.32 J/mol - K$, the change in the internal energy of the gas is approximately

1) 2.3J   **2)** 46J   **3)** $1.25 \times 10^3 J$ **4)** $8.67 \times 10^4 J$
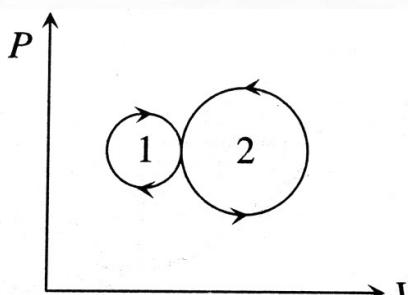
27. In figure, three isothermal process are shown for the same gas and for same change in volume $(V_i - V_f)$ but at different temperature. If $\Delta Q_1, \Delta Q_2$ and ΔQ_3 are the heat transferred in the respective process, then:

1) $\Delta Q_1 = \Delta Q_2 = \Delta Q_3$ **2)** $\Delta Q_1 > \Delta Q_2 > \Delta Q_3$

3) $\Delta Q_1 < \Delta Q_2 < \Delta Q_3$ **4)** $\Delta Q_1 = \Delta Q_2 = \Delta Q_3 = 0$

28. A container of volume $1m^3$ is divided into two equal compartments by a partition. One of these compartments contains an ideal gas at 300 K. The other compartment is vaccum. The whole system is thermally isolated from its surroundings. The partition is removed and the gas expands to occupy the whole volume of the container. Its temperature now would be
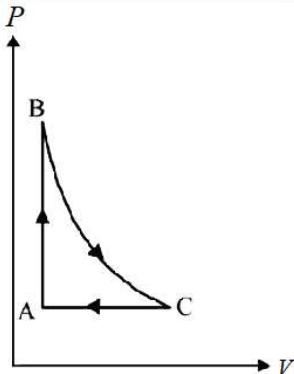
1) 300 K   **2)** 239 K   **3)** 200 K   **4)** 100 K

29. Which of the following statements is correct for any thermodynamic system?

1) The internal energy changes in all processes

2) Internal energy and entropy are state functions

3) The change in entropy can never be zero

4) The work done in an adiabatic process is always zero

30. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio $\dfrac{C_P}{C_V}$ for the gas is

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

31. A carnot engine, having an efficiency of $\eta = \dfrac{1}{10}$ as heat engine is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is

1) 99 J   **2)** 90 J   **3)** 1 J   **4)** 100 J

32. In the following indicator diagram the net amount of work done will be

1) Positive   **2)** Negative   **3)** Zero   **4)** Infinity

33. For an ideal gas the equation of a process for which the heat capacity of the gas varies with temperature as $C = \alpha / T$ $(\alpha \text{ is a constant is given by})$

1) VInT=constant

2) $VT^{1(\gamma-1)}e^{\alpha/RT} = \text{constant}$

3) $VT^{\frac{1}{\gamma-1}}e^{\alpha/RT} = \text{constant}$

4) $V^{\gamma-1} = \text{constant}$

34. One mole of a monoatomic ideal gas is taken through a reversible cycle ABC as shown in the figure. The process BC is adiabatic. The work done per cycle is (given that temperatures of A,B and C are 300,600 and 450 K)

1) 75 R   2) 150 R   3) 112.5 R   4) 45 R

35. Assertion : Two solid cylindrical rods of identical size and different thermal conductivity K_1 and K_2 are connected in series. Then the equivalent thermal conductivity of two rod system is less than the value of thermal conductivity of either rod

Reason : For two cylindrical rods of identical size and different thermal conductivity K_1 and K_2 connected in series, the equivalent thermal conductivity K is given by

$$\frac{2}{K} = \frac{1}{K_1} + \frac{1}{K_2}$$

1) Assertion is True, Reason is True, Reason is correct explanation for Assertion
2) Assertion is True, Reason is True, Reason is not correct explanation for Assertion
3) Assertion is True, Reason is False.
4) Assertion is False, Reason is True.

36. Statement – 1: As the temperature of the blackbody increases, the wavelength at which the spectral intensity (E_λ) is maximum decreases

Statement – 2: The wavelength at which the spectral intensity will be maximum for a black body is proportional to the fourth power of its absolute temperature.
1) Statement -1 is True, Statement -2 is True , Statement -2 is correct explanation for Statement – 1
2) Statement -1 is True, Statement -2 is True , Statement -2 is not correct explanation for Statement – 1
3) Statement -1 is True, Statement -2 is False.
4) Statement -1 is False, Statement -2 is True.

37. An ideal monoatomic gas undergoes different types of processes which are described in column- I. Match the corresponding effects in column-II. The letters have usual meaning.

Column- I   **Column- II**

A) $P = 2V^2$ p) If volume increases then temperature will also increase

B) $PV^2 = $ constant   q) If volume increases then temperature will decrease

C) $C = C_v + 2R$ r) For expansion, heat will have to be supplied to the gas
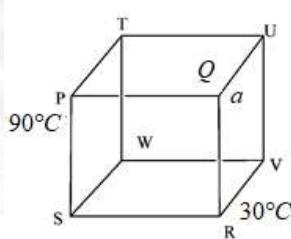
D) $C = C_v - 2R$ s) If temperature increases then work done by gas is positive

1) $A \rightarrow P, r, s; B \rightarrow P; C \rightarrow P, r, D \rightarrow q$ **2)** $A \rightarrow P, r, s; B \rightarrow q\ C \rightarrow p, r, s\ D \rightarrow q, r$

3) $A \rightarrow P, S; B \rightarrow q; C \rightarrow p, r, s\ D \rightarrow r$ **4)** $A \rightarrow P, r, s; B \rightarrow q; C \rightarrow q, r; D \rightarrow P$

38. 12 identical rods made of same material are arranged in the form of a cube. The Temperature Of 'P' and ''R'' are maintained at $90^0 C$ and $30^0 C$ respectively. Then the temperature of point 'V', when steady state us reached
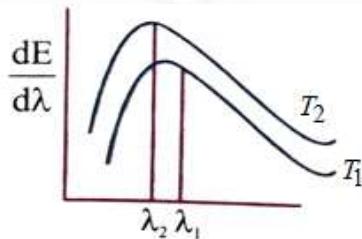
1) $65^0 C$ **2)** $60^0 C$ **3)** $20^0 C$ **4)** $50^0 C$

39. The spectral emissive power E_λ for a body at temperature T_1 is plotted against the wavelength and area under the curve is found to be A. At a different temperature T_2 the area is found to be 9A. Then λ_1 / λ_2 is equal to

1) 3   **2)** 1/3   **3)** $\dfrac{1}{\sqrt{3}}$ **4)** $\sqrt{3}$
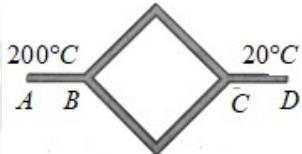
40. Assertion: Red star is at higher temperature than blue star

Reason: Wein's displacement law states that absolute temperature is inversely proportional to wavelength corresponding to maximum intensity

1) Assertion is True, Reason is True, Reason is correct explanation for Assertion

2) Assertion is True, Reason is True, Reason is not correct explanation for Assertion

3) Assertion is True, Reason is False.

4) Assertion is False, Reason is True.

41. Two thin walled spheres of different materials, one with double the radius and one fourth wall thickness of the other, are filled with ice. If the time taken for complete melting of ice in the sphere of larger radius is 25 minutes and that for smaller one is 16 minutes, the ratio of thermal conductivities of the materials of larger sphere to the smaller sphere is:

1) 4 : 5   **2)** 25:1   **3)** 1:25   **4)** 8 :25

42. A rod of length L with sides fully insulated is of a material whose thermal conductivity varies with temperature as $K = \dfrac{\alpha}{T}$, where α is constant . The ends of the rod are kept at temperature T_1 and T_2 .The temperature T at x, where x is the distance from the end whose temperature is T_1 is

1) $T_1 \left(\dfrac{T_2}{T_1} \right)^{\frac{x}{L}}$ **2)** $\dfrac{x}{L} In \dfrac{T_2}{T_1}$ **3)** $T_1 e^{\frac{T_2 x}{T_1 L}}$ **4)** $T_1 + \dfrac{T_2 - T_1}{L} x$

43. A black body is at a temperature of 2800 K. The energy of radiation emitted by this object with wavelength between 499 nm and 500 nm is U_1, between 999 nm and 1000nm is U_2 and between 1999nm and 2000 nm is U_3. The Wien's constant $b = 2.80 \times 10^6 nm K$, Then:

1) $U_1 = 0$ **2)** $U_3 = 0$ **3)** $U_1 > U_2$ **4)** $U_2 > U_1$

44. Six identical conducting rods are joined as shown in figure

Points A and D are maintained at temperatures $200^0 C$ and $20^0 C$ respectively. The temperatures of junction B will be

**1)** $120^0 C$ **2)** $100^0 C$ **3)** $140^0 C$ **4)** $80^0 C$

45. Statement- 1: A body that is a good radiator is also a good absorber of radiation at a given wavelength.

Statement-2: According to Kirchoff's law the absorptivity of a body is equal to its emissivity at a given wavelength

1) Statement -1 is True, Statement -2 is True, Statement -2 is correct explanation for Statement – 1

2) Statement -1 is True, Statement -2 is True, Statement s-2 is not correct explanation for Statement – 1

3) Statement -1 is True, Statement -2 is False.

4) Statement -1 is False, Statement -2 is True

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

46. Four cylindrical rods of same material with length and radius $(l,r),(2l,r),(2l,2r)$ and $(l,2r)$ are connected between two reservoirs at 0^0C and 100^0C. Find the ratio of the maximum to minimum rate of conduction in them

47. A body is cooled in 2 min in a room at temperature of 30^0C from 75^0C to 65^0C. If the same body is cooled from 55^0C to 45^0C in the same room, find the time taken (in minute)

48. Two identical conducting rods are first, connected independently to two vessels, one containing water at 100^0C and the other containing ice at 0^0C. In the second case, rods are joined end to end and are connected to the same vessels. If $q_1 \, and \, q_2 \, (in \, g/s)$ are the rates of melting of ice in two cases, then find the ratio of q_1/q_2.

49. A vessel contains helium,Which expands at constant pressure when $15\,kJ$ of heat is supplied to it. What will be the change of the internal energy of the gas? (in kJ)

50. A long container has air enclosed inside at room temperature and atmospheric pressure $(10^5\,Pa)$.It has a volume $20000\,cc$. The area of cross section is $100\,cm^2$ and force constant of spring $k_{spring}=1000N/m$. We push the right piston isothermally and slowly till it reaches the original position of the left piston which is movable. Final length of air column is found to be $25h\,cm$. Assume that spring is initially relaxed. Find h.
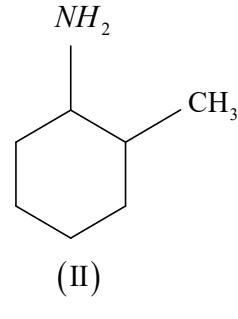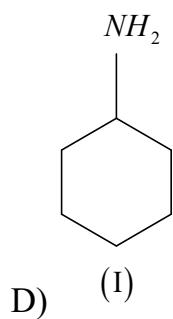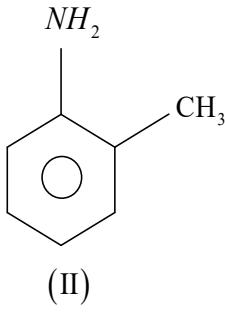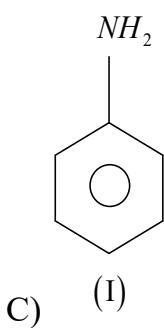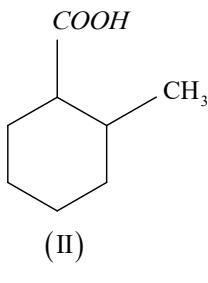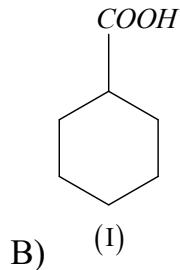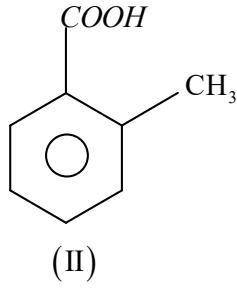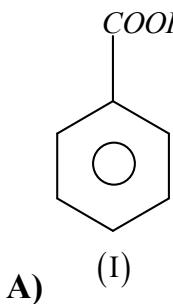
CHEMISTRY
**Max Marks: 100**

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. In the given pair identify most acidic compound in (A) and (B).Most basic in (C) and (D)

A)

COOH (I)   COOH CH₃ (II)

B)

COOH (I)   COOH CH₃ (II)

C)

NH₂ (I)   NH₂ CH₃ (II)

D)

NH₂ (I)   NH₂ CH₃ (II)
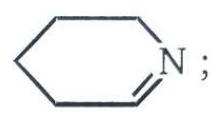
1) $A-I, B-II, C-I, D-II$
2) $A-II, B-I, C-I, D-II$
3) $A-II, B-II, C-II, D-II$
4) $A-I, B-II, C-I, D-I$

52.

NH ; (x)   N–H (with C=O) ; (y)   N= ; (z)
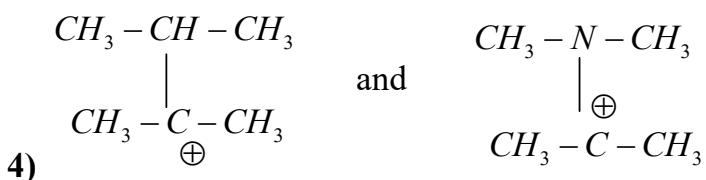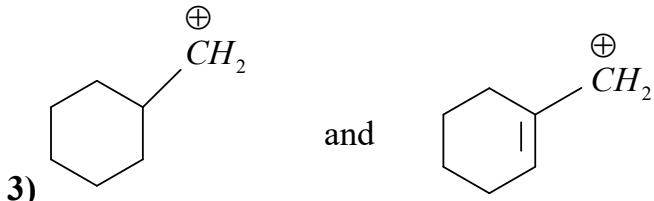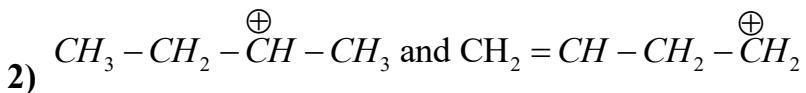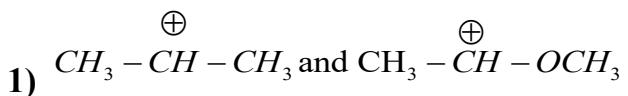
The correct order of decreasing basic strengths of x,y and z is:
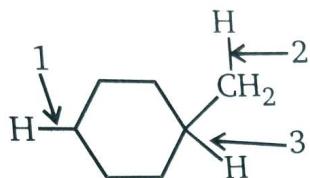
1) $x > y > z$ 2) $x > z > y$ 3) $y > x > z$ 4) $y > z > x$

53. Some pairs of ions are given below. In which pair, first ion is more stable than second?

1) $CH_3 - \overset{\oplus}{CH} - CH_3$ and $CH_3 - \overset{\oplus}{CH} - OCH_3$

2) $CH_3 - CH_2 - \overset{\oplus}{CH} - CH_3$ and $CH_2 = CH - CH_2 - \overset{\oplus}{CH_2}$

3)

 and

4)
$$CH_3 - \underset{\underset{\oplus}{CH_3 - \overset{|}{C} - CH_3}}{\overset{|}{CH}} - CH_3 \quad \text{and} \quad CH_3 - \underset{\underset{}{CH_3 - \overset{|}{C} - CH_3}}{\overset{|}{\underset{\oplus}{N}}} - CH_3$$

54. Rank the bond dissociation energies of the bonds indicated with arrows. (From smallest to largest).
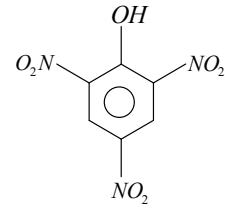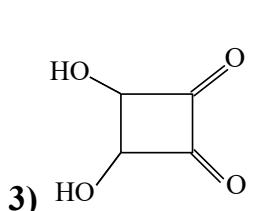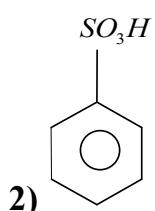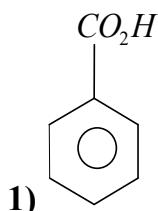
1) 1<2<3   2) 3<2<1   3) 2<3<1   4) 3<1<2

55. Assertion: Solubility of $n-$alcohols in water decreases with increase in molecular weight.
Reason: The relative proportion of the hydrocarbon part in alcohols increases with increasing molecular weight which permits enhanced hydrogen bonding with water.
1) Assertion is correct and Reason is correct
2) Assertion is correct and Reason is incorrect
3) Assertion is incorrect and Reason is correct
4) Assertion is incorrect and Reason is incorrect

56. Which of the following compound will not give effervescence of CO_2 with $NaHCO_3$

1)   2)   3)   4)
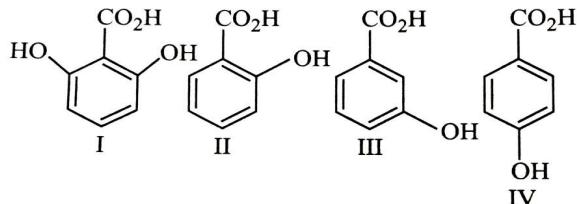
57. The hyperconjugative of *tert -* butyl cation and 2- butene, respectively, are due to:
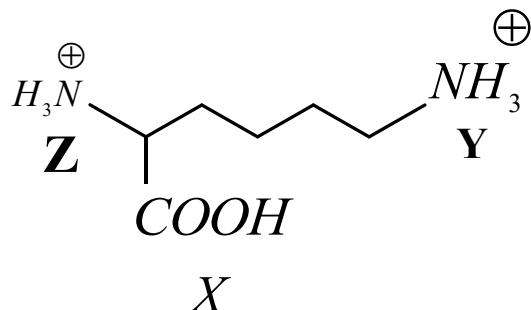
1) $\sigma \to p$ (empty) and $\sigma \to \pi^*$ electron delocalization

2) $\sigma \to \sigma^*$ and $\sigma \to \pi$ electron delocalization

3) $\sigma \to p$ (filled) σ^* and $\sigma \to \pi^*$ electron delocalization

4) p (filled) σ^* and $\sigma \to \pi^*$ electron delocalization

**58.** The correct order of acidity for the following compounds is
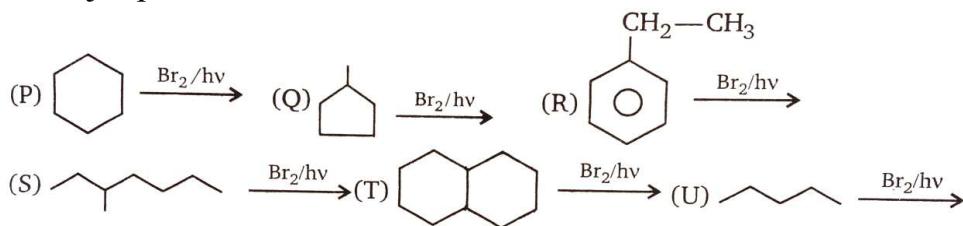
1) $I > II > III > IV$ 2) $III > I > II > IV$

3) $III > IV > II > I$ 4) $I > III > IV > II$

59. Correct order of acidic strengths is:

1) $X > Y > Z$ 2) $Z > Y > X$ 3) $Y > Z > X$ 4) $X > Z > Y$
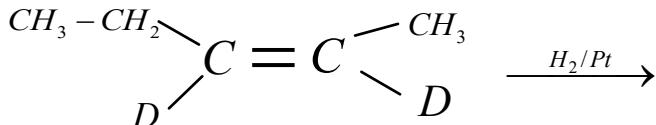
60. Among the following free radical bromination reactions, select those in which 2° halide is the major product –

1) P,Q,R,S 2) P,R,U 3) P,R,S,T 4) P,Q,R,S,T

61.

$$CH_3 - CH_2 \underset{D}{\overset{}{\diagdown}} C = C \underset{D}{\overset{CH_3}{\diagup}} \quad \xrightarrow{H_2/Pt}$$

Product of the above reaction will be:

1) Racemic mixture   **2)** Diastereomers

3) Meso   **4)** Constitutional isomers

62.   On catalytic reduction (H_2 / Pt) how many alkenes will give 2- methylbutane?

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

63.   The lowest boiling point is expected for

1) Isooctane   **2)** n- octane

3) 2,2,3 trimethyl butane   **4)** n-heptane

64.   Which of the following alkane cannot be synthesised by Wurtz reaction in good yield?

A) $(CH_3)_2 CH - CH_2 - CH(CH_3)_2$

B) $(CH_3)_2 CH - CH_2 - CH_2 - CH(CH_3)_2$

C) $CH_3 - CH_2 - C(CH_3)_2 - CH_2 - CH_3$

D) $CH_3 - CH_2 - CH_2 - CH_3$

1) A   **2)** D   **3)** ABC   **4)** AC

65.   Assertion: In both Wurtz and Kolbe's electrolysis methane cannot

be Prepared.

Reason: Anhydrous (moisture free conditions) needs to be

maintained in Wurtz reaction.

1) Assertion is correct, Reason is incorrect

2) Assertion is incorrect, Reason is correct

3) Both Assertion & Reason are correct

4) Both Assertion & Reason are incorrect

66. Match List- I List –II

	List-I Mechanism Steps		**List-II effect**
A)		I)	-E effect
B)		II)	-R effect
C)		III)	+E effect
D)		IV	+R effect

Choose the correct answer from the options given below:

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

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

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

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

67. Given below are two statements:

Statement- I- Tropolone is an aromatic compound and has 8π electrons

Statement-II: π electrons of $\diagup$C=O group in tropolone is involved in aromaticity.

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

1) Both statement –I and Statement –II are true

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

3) Statement –I is false but statement –II is true

4) Both statement-I and Statement- II are false

68. Given below are two statements:

Statement-I: Hyper conjugation is permanent effect.

Statement –II-: Hyper conjugation in ethyl cation $\left(CH_3 - C\overset{+}{H}_2 \right)$ involves the overlapping

of $C_{sp2}H_{1s}$ bond with empty 2p orbital of other carbon.

Choose the correct option:
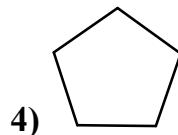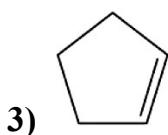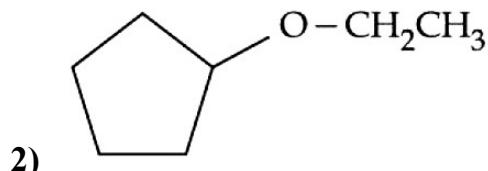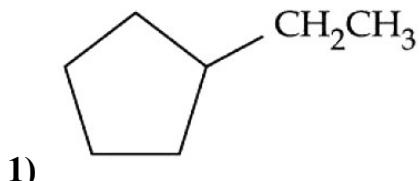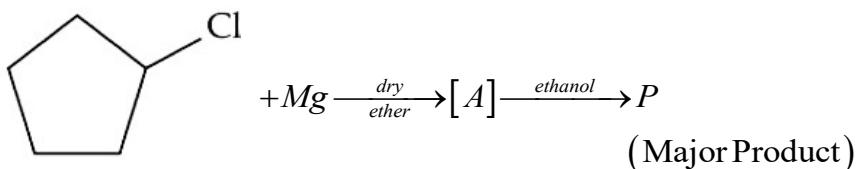
1) Statement -1 is incorrect but Statement-2 is true.

2) Statement -1 is correct but Statement-2 is false.
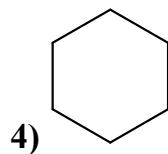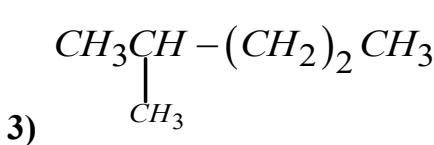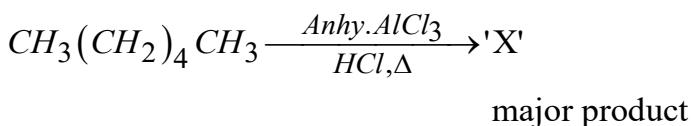
3) Both Statement-I and Statement- II are false

4) Both Statement-I and Statement- II are True

69. In the following sequence of reaction, the P is:

$$+ Mg \xrightarrow[ether]{dry} [A] \xrightarrow{ethanol} P$$

$$\left(Major\ Product \right)$$

1) (cyclopentane with CH$_2$CH$_3$ substituent)   **2)** (cyclopentane with O–CH$_2$CH$_3$ substituent)

3) (cyclopentene)   **4)** (cyclopentane)

70. In the following reaction 'X' is
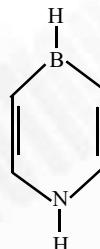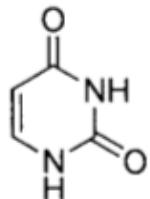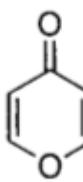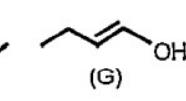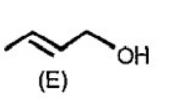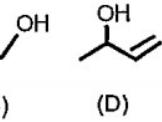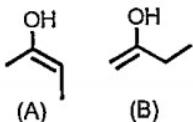
$$CH_3 (CH_2)_4 CH_3 \xrightarrow[HCl, \Delta]{Anhy.AlCl_3} {}'X'$$

major product

1) $CH_3 (CH_2)_4 CH_2 Cl$ **2)** $Cl - CH_2 - (CH_2)_4 - CH_2 - Cl$

3) $CH_3 \underset{\underset{CH_3}{|}}{CH} - (CH_2)_2 CH_3$ **4)** (cyclohexane)

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**
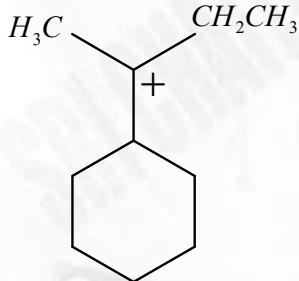
71. Among the following, the number of aromatic compound(s) is.....

72. How many compounds are enol tautomers of 2- butanone

73. The total of contributing structures showing hyperconjugation (involving C- H bonds) for the following carbocation is

H_3C CH_2CH_3

74. How many distinct monochlorinated products, (including stereoisomers) may be obtained when the alkane shown below is heated in the presence of Cl_2

75. How many grams of ethane (NTP; 1 bar, 273 K) is formed from 38 g of sodium propionate by fusion with soda lime?