

(1001CJA101021240036)



CLASSROOM CONTACT PROGRAMME
(Academic Session : 2024 - 2025)

Test Pattern

JEE(Main)
FULL SYLLABUS
08-01-2025

JEE(Main+Advanced) : ENTHUSIAST COURSE (SCORE-I)

Time : 3 Hours

PAPER (OPTIONAL)

Maximum Marks : 300

IMPORTANT NOTE : Students having 8 digits **Form No.** must fill two zero before their Form No. in OMR. For example, if your **Form No.** is 12345678, then you have to fill **0012345678**.

READ THE INSTRUCTIONS CAREFULLY

Important Instructions :

1. Immediately fill in the form number on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The candidates should not write their Form Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
3. The Test Booklet consists of **75** questions.
4. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry and Mathematics** having **25 questions** in each subject and each 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 attempted and -1 in all other cases.
 - (ii) Section-II contains 05 **Numerical Value Type** questions.
Marking scheme : +4 for correct answer, 0 if not attempted and -1 in all other cases.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc, except the Identity Card inside the examination hall/room.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
8. **Do not fold or make any stray marks on the Answer Sheet.**
9. **Take $g = 10 \text{ m/s}^2$ unless otherwise stated.**

Name of the Candidate (in Capitals) _____

Form Number : in figures _____

: in words _____

Centre of Examination (in Capitals) : _____

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

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SECTION-I : (Maximum Marks: 80)

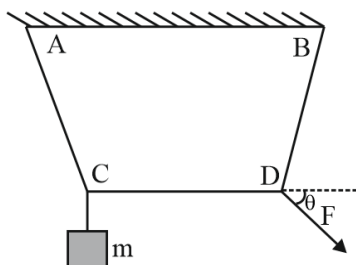
This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

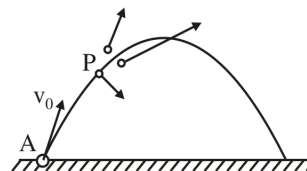
Negative Marks : -1 If wrong option is selected.

1. Three identical massless rods are connected by hinges to each other, the outmost ones are hinged to a ceiling at points A and B. The distance between these points is twice the length of a rod. A weight of mass m is hanged onto hinge C. If least force is applied onto hinge D to keep the system stationary with the rod CD horizontal then find angle made by the applied force with horizontal:



- (A) 30° (B) 45°
(C) 60° (D) 90°

2. A particle of mass $3m$ is projected from point-A with speed v_0 as shown in figure. When the particle is at point P, it instantaneously explodes in three identical particles. Choose the **INCORRECT** statement regarding the physical quantities just before and just after explosion.

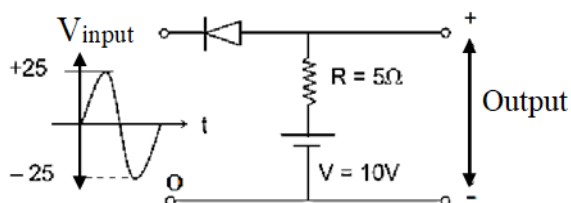


- (A) The linear momentum of system can be conserved just before and just after explosion.
(B) As long as all three fragments are in air, the centre of mass of the system will trace same path as it will follow without explosion.
(C) The mechanical energy (kinetic energy + gravitational potential energy) of the system remains conserved just before and just after explosion.
(D) The impulse given by the weight of particle during explosion is negligible as compared to that by the explosive forces.
3. A composite bar has two segments of equal length L each. Both segments are made of same material but cross sectional area of segment OB is twice that of OA. The bar is kept on a smooth table. Temperature of the composite bar is uniformly raised by $\Delta\theta$. How does the joint shift if coefficient of linear thermal expansion for the material is $\alpha^\circ\text{C}^{-1}$?
[Take $L = 10\text{m}$, $\alpha = 12 \times 10^{-4}$, $\Delta\theta = 25^\circ\text{C}$]

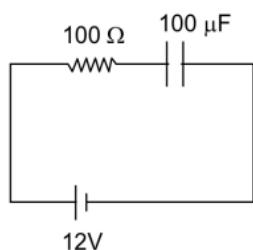


- (A) 10 cm left (B) 5 cm right
(C) 10 cm right (D) 5 cm left

4. An ideal diode is connected in a circuit with resistance $R = 5\Omega$ and $V = 10$ volt as shown in figure. A sinusoidal input is connected on the left as shown. Find range of output voltage.



- (A) 10V, -25V (B) 10V, -15V
(C) 25V, -25V (D) 25V, -15V
5. The value of total displacement current through the area between the capacitor plates after 1 time constant is (initially capacitor is uncharged)



- (A) $\frac{120}{e}$ mA (B) $\frac{120}{e^2}$ mA
(C) 120 mA (D) None of these
6. M_x and M_y denote the atomic masses of the parent and the daughter nuclei respectively in a radioactive decay. The Q-value for a β^- decay is Q_1 and that for a β^+ decay is Q_2 . If m_e denotes the mass of an electron, then which of the following statements is correct?
- (A) $Q_1 = (M_x - M_y)c^2$ and $Q_2 = (M_x - M_y - 2m_e)c^2$
(B) $Q_1 = (M_x - M_y)c^2$ and $Q_2 = (M_x - M_y)c^2$
(C) $Q_1 = (M_x - M_y - 2m_e)c^2$ and $Q_2 = (M_x - M_y + 2m_e)c^2$
(D) $Q_1 = (M_x - M_y + 2m_e)c^2$ and $Q_2 = (M_x - M_y + 2m_e)c^2$

7. A tuning fork A is being tested using an accurate oscillator. It is found that they produce 2 beats per second when the oscillator reads 514 Hz and 6 beats per second when it reads 510 Hz. The actual frequency of the fork is:

- (A) 512 Hz (B) 504 Hz
(C) 516 Hz (D) 510 Hz

8. In case of polytropic process relation between Pressure and volume of ideal gas is given as $Pv^k = \text{constant}$. In certain thermodynamic process molar heat capacity is $C = \frac{C_p + C_v}{2}$; where C_p and C_v are specific molar heat capacities at constant pressure and constant volume respectively, then find k value for this process.

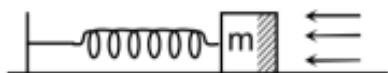
- (A) 1 (B) 2 (C) -1 (D) -2

9. Column-I gives the name of optical device and object type column-II gives the associated image type obtained. After the matrix, 4 options are given. Choose the appropriate one that includes all the possible matches.

	Column-I		Column-II
(A)	Convex mirror, virtual object	(P)	Real image
(B)	Concave mirror, virtual object	(Q)	Virtual image
(C)	Concave lens, real object	(R)	Magnified image
(D)	Convex lens, real object	(S)	Diminished image

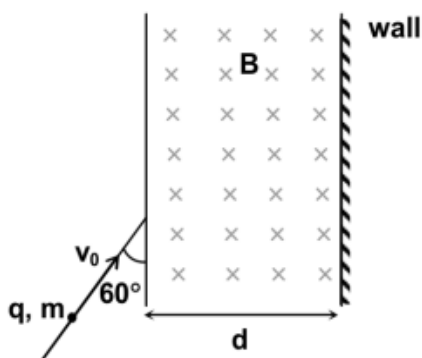
- (A) $A \rightarrow P, R; B \rightarrow P, S; C \rightarrow R; D \rightarrow P, Q, R, S$
(B) $A \rightarrow P, Q, R, S; B \rightarrow P, S; C \rightarrow Q, S; D \rightarrow P, Q, R, S$
(C) $A \rightarrow P, Q; B \rightarrow P, S; C \rightarrow Q, S; D \rightarrow Q, R$
(D) $A \rightarrow P, Q, R, S; B \rightarrow P, S; C \rightarrow R; D \rightarrow P, Q, R, S$

10. A spring block system with mass of block m and spring constant K (all the surfaces of block are perfectly absorbing and smooth) is placed on a smooth horizontal plane as shown in the diagram at rest. A light beam of intensity I is switched on its right side. Find the amplitude of oscillations of the block. (face area of cubical block is A and c is the speed of light in vacuum)



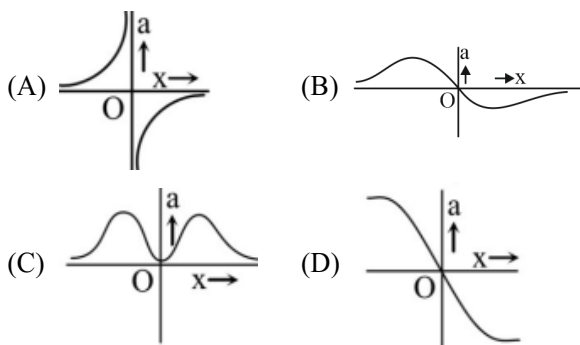
- (A) $\frac{I}{Kc}A$ (B) $\frac{2I}{Kc}A$
(C) $\frac{4I}{Kc}A$ (D) Zero

11. A positively charged particle (q, m) enters in a uniform magnetic field ' B ' at an angle of 60° as shown in figure with speed v_0 . Collision between the charge particle and the wall is perfectly elastic. Then find the time in which the charge particle comes out from the magnetic field. Take : $d = \frac{(\sqrt{3} - 1)mv}{2qB}$



- (A) $\frac{\pi m}{2qB}$ (B) $\frac{\pi m}{6qB}$
(C) $\frac{\pi m}{3qB}$ (D) $\frac{2\pi m}{3qB}$

12. Two identical positive charges are fixed on the y -axis, at equal distances from the origin O . A particle with a negative charge starts on the negative x -axis at a large distance from O , moves along the x -axis, passed through O and moves far away from O . Its acceleration a is taken as positive along its direction of motion. The particle's acceleration a is plotted against its x -coordinate. Which of the following best represents the plot ?



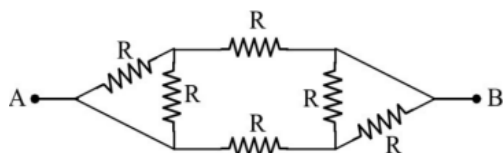
13. A parallel beam of light of wavelength λ passes through a slit of width d . The transmitted light is collected on a screen D away ($D \gg d$). Find the distance between the two second order minima.

- (A) $\frac{3D\lambda}{d}$ (B) $\frac{D\lambda}{2d}$ (C) $\frac{2D\lambda}{d}$ (D) $\frac{4D\lambda}{d}$

14. An artificial satellite is moving in a circular orbit around the earth with a speed equal to $3/8$ times of the magnitude of escape velocity from the earth. If the satellite is stopped suddenly in its orbit and allowed to fall freely onto the earth, then the speed with which it hits the surface of the earth is (take $g_{\text{surface}} = 10 \text{ m/s}^2$ and $R_{\text{earth}} = 6400 \text{ Km}$)

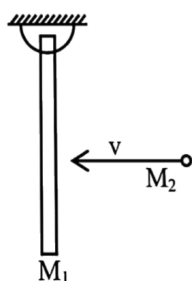
- (A) $2\sqrt{23} \text{ Km/s}$ (B) $\sqrt{\frac{23}{2}} \text{ Km/s}$
(C) $\sqrt{\frac{29}{6}} \text{ Km/s}$ (D) $\sqrt{\frac{29}{13}} \text{ Km/s}$

15. Equivalent resistance between A and B is:



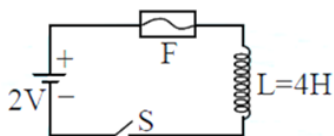
- (A) $\frac{R}{2}$ (B) $\frac{3R}{4}$
(C) $\frac{5R}{8}$ (D) $\frac{7R}{12}$

16. A uniform rod of mass M_1 is hinged at its upper end. A particle of mass M_2 moving horizontally strikes the rod at its mid point elastically. If the particle comes to rest after collision, the value of $\frac{M_1}{M_2}$ is:



- (A) $\frac{3}{4}$ (B) $\frac{4}{3}$
(C) $\frac{2}{3}$ (D) $\frac{3}{2}$

17. In the circuit shown the cell is ideal. The coil has an inductance of $4H$ and zero resistance. F is a fuse of zero resistance and will blow when the current through it reaches $5A$. The switch is closed at $t = 0$. The fuse will blow

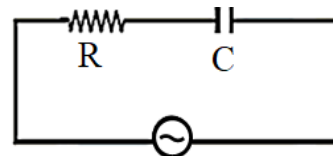


- (A) after 5 sec (B) after 2 sec
(C) after 10 sec (D) almost at once

18. The binding energy of an electron in ground state of He is equal to 24.6 eV . Then energy required to remove both electrons (in eV) is :

- (A) 54.4 eV (B) 38.2 eV
(C) 79.0 eV (D) Insufficient data

19. A 50 Hz ac source of 20 volts is connected across R and C as shown in figure. The voltage across R is 12 volt . The voltage across C is:



- (A) 8 V
(B) 16 V
(C) 10 V
(D) not possible to determine unless values of R and C are given

20. A liquid is kept in a cylindrical vessel which is rotated along its axis. The liquid rises at its sides. If the radius of the vessel is 0.05 m and the speed of rotation is 2 rev s^{-1} the difference in the height of liquid at the centre of the vessel and its sides is ($g = 10 \text{ m/s}^2$)

- (A) 0.001 m
(B) 0.002 m
(C) 0.01 m
(D) 0.02 m

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

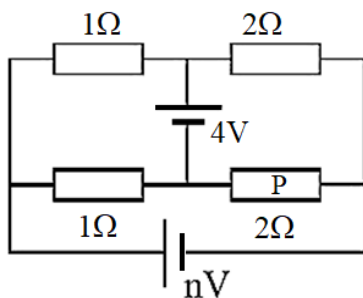
Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

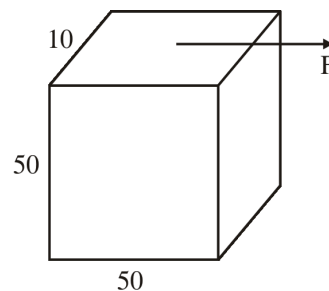
Negative Marks : -1 If wrong answer is entered.

1. Four resistors and two ideal batteries are connected as shown in figure. Electromotive force of the batteries are 4 volt and n volt. If current through the 'P' resistor is zero then n is:



2. Unpolarised light of intensity 32 watt m^{-2} passes through three polarisers such that the transmission axes of the first and second polarises makes an angle 30° with each others and the transmission axes of the second and third polarises makes an angle 60° with each other. The intensity of final emerging light will be. (answer in watt/m^2)

3. A plane progressive transverse wave travels in a medium M_1 and enters into another medium M_2 in which its speed decreases to 60%. Then the ratio of the intensity of the transmitted and the incident waves is n then $64n$ is:
4. A solenoid has a core of a material with relative permeability 400. The windings of the solenoid are insulated from the core and carry a current of 2A. If the number of turns is 1000 per metre, calculate the magnetising current I_M in A. ($\pi = 3.125$)
5. A square lead slab of side 50 cm and thickness 10 cm is subject to a shearing force (on its top face) of $9.0 \times 10^4 \text{ N}$. The bottom face is riveted to the floor. How much will the upper face be displaced (in mm)? ($\eta = 7200 \text{ KN/m}^2$)



PART-2 : CHEMISTRY

SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : -1 If wrong option is selected.

- The red colour of ruby is due to
 - d-d transition of Cr^{3+} ion in Cr_2O_3 lattice
 - d-d transition of Cr^{3+} ion in Al_2O_3 lattice
 - Ligand to metal charge transfer transition
 - Metal to ligand charge transfer transition
- Which of the following statement is **INCORRECT**?
 - The melting point of hydrides of Group 15 : $\text{NH}_3 > \text{SbH}_3 > \text{AsH}_3 > \text{PH}_3$
 - ΔH_{eg} kJ mol^{-1} : $\text{S} > \text{Se} > \text{O} > \text{Te} > \text{Po}$
 - Melting point : $\text{B} > \text{Al} > \text{Tl} > \text{In} > \text{Ga}$
 - Bond enthalpy : $\text{C} - \text{C} > \text{Si} - \text{Si} > \text{Ge} - \text{Ge} > \text{Sn} - \text{Sn}$
- Assertion** : PbI_4 doesn't exist and converts into PbI_2 and I_2 spontaneously at room temperature but PbCl_4 needs heating to convert into PbCl_2 and Cl_2 .
Reason : Pb^{2+} is more stable than Pb^{4+} due to inert pair effect.
 - Assertion** is true, **Reason** is true and **Reason** is correct explanation for **Assertion**
 - Assertion** is true, **Reason** is true and **Reason** is NOT the correct explanation for **Assertion**
 - Assertion** is true, **Reason** is false
 - Assertion** is false, **Reason** is true

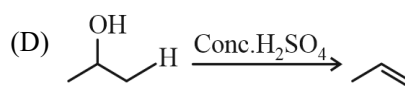
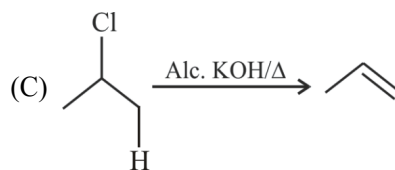
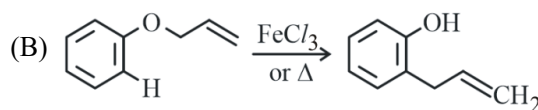
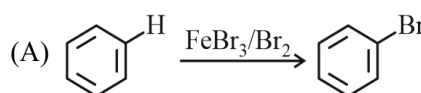
- The pH of an aqueous buffer prepared using CH_3COOH and $\text{CH}_3\text{COO}^-\text{Na}^+$ is 4.80.

The quantity $\frac{[\text{CH}_3\text{COO}^-] - [\text{CH}_3\text{COOH}]}{[\text{CH}_3\text{COOH}]}$ is _____

(Round off to three decimal places) [Given: pK_a of CH_3COOH in water is 4.75] (Given $10^{0.05} = 1.1220$)

- 0.122
- 0.125
- 0.120
- 0.123

- The reaction that is expected to show primary kinetic isotope effect for the indicated H-atom (C – H) is:



- The complementary strand for the following single strand of DNA is

$5' \leftarrow \text{A} - \text{T} - \text{G} - \text{C} - \text{T} \rightarrow 3'$

- $3' \leftarrow \text{T} - \text{A} - \text{C} - \text{G} - \text{A} \rightarrow 5'$
- $3' \leftarrow \text{A} - \text{T} - \text{G} - \text{C} - \text{T} \rightarrow 5'$
- $5' \leftarrow \text{T} - \text{A} - \text{C} - \text{G} - \text{A} \rightarrow 3'$
- $5' \leftarrow \text{A} - \text{A} - \text{C} - \text{G} - \text{T} \rightarrow 3'$

7. Which one of the following statements is **INCORRECT**?

- (A) The actinoids show a greater range of oxidation states than the lanthanoids because the 5f, 6d and 7s levels are of comparable energies.
- (B) 5f electrons can participate in bonding to a far greater extent than that 4f orbitals because unlike 4f orbitals, 5f orbitals are not as buried as 4f orbitals.
- (C) Lanthanoid contraction is more important than the actinoid contraction because the chemistry of elements succeeding the actinoids are much less known at the present time.
- (D) The magnetic properties of the actinoids are less complex than the lanthanoids.

8. Iodination of benzene is not easily carried out. How can one prepare p-iodobenzoic acid from p-nitro toluene?

- (A) (i) $\text{Br}_2 + \text{FeBr}_3$ (ii) Mg in ether, CO_2
(iii) $3\text{H}_2/\text{Pt}$ catalyst (iv) HNO_2 at 0°C
(v) KI solution, Δ
- (B) (i) NBS in CCl_4 and Δ (ii) NaI in acetone
(iii) $3\text{H}_2/\text{Pt}$ catalyst (iv) HNO_2 at 0°C
(v) $\text{H}_3\text{PO}_2 + \text{H}_2\text{O}$
- (C) (i) NBS in CCl_4 and Δ (ii) HNO_2 at 0°C
(iii) $\text{CuBr} + \text{HBr}$ (iv) KMnO_4/Δ
(v) KI solution, Δ
- (D) (i) KMnO_4/Δ (ii) $\text{Sn} + \text{HCl}$
(iii) HNO_2 at 0°C (iv) KI solution, Δ

9. Identify the **INCORRECT** match in the following

	Column A (Vitamines)	Column B (Deficiency diseases)
(1)	A	Xerophthalmia
(2)	B_1	Cheilosis
(3)	B_6	Convulsions
(4)	D	Osteomalacia

- (A) 1 (B) 2
(C) 3 (D) 4

10. The amount of heat released on combustion of $\text{C}_{(\text{s})}$ is completely absorbed by 54.0 g of Al to raise the temperature from 25°C to 45°C , then calculate the amount $\text{C}_{(\text{s})}$ must take part in combustion reaction?

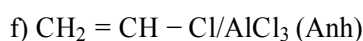
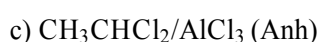
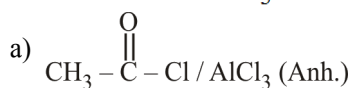
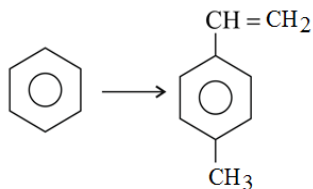
Given, enthalpy of combustion of $\text{C}_{(\text{s})}$ to CO_2 is $-393.5 \text{ KJ mol}^{-1}$ and molar heat capacity of Al is $24 \text{ J mol}^{-1} \text{ K}^{-1}$ (Atomic mass : $\text{Al} = 27$)

- (A) $3.50 \times 10^{-2} \text{ mol}$
(B) $1.97 \times 10^{-3} \text{ mol}$
(C) $2.44 \times 10^{-3} \text{ mol}$
(D) $5.2 \times 10^{-2} \text{ mol}$

11. Which of the following substance forms the maximum number of monochloro products including stereoisomers

- (A) 2-Methylbutane
(B) 2, 4-Dimethylpentane
(C) 2, 3-Dimethylbutane
(D) 2-Methylpentane

12. In order to bring about the given conversion is best possible way, choose the reagents from the list given below and put them in correct order



- (A) b, a, e, d (B) c, d, b
(C) f, b (D) a, b, e, d

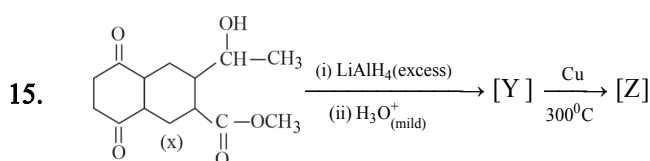
13. The conductivity of solution formed by mixing 100 ml of 0.001 M CH_3COOH with 10 ml of 0.01 M NaOH is $80 \times 10^{-5} \text{ mho cm}^{-1}$, calculate $\lambda_m^0 (\text{CH}_3\text{COO}^-)$ if $\lambda_m^0 (\text{Na}^+) = 500 \text{ mho cm}^2 \text{ mol}^{-1}$,
- (A) $110 \text{ mho cm}^2 \text{ mol}^{-1}$
(B) $380 \text{ mho cm}^2 \text{ mol}^{-1}$
(C) $610 \text{ mho cm}^2 \text{ mol}^{-1}$
(D) $880 \text{ mho cm}^2 \text{ mol}^{-1}$

14. **Statement I:** Maltose has two α -D-glucose unit linked at C_1 and C_4 and is a reducing sugar.

Statement II: Maltose has two monosaccharides α -D-glucose and β -D-glucose linked at C_1 and C_6 and it is a non reducing sugar.

In the light of above statements choose the **CORRECT** answer from the options given below.

- (A) Both Statement-I and Statement-II are **TRUE**
(B) Both Statement-I and Statement-II are **FALSE**
(C) Statement-I is **TRUE** but Statement-II is **FALSE**
(D) Statement-I is **FALSE** but Statement-II is **TRUE**

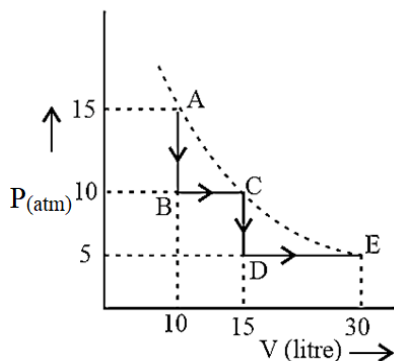


Which of the following tests is not given by compound (Z)

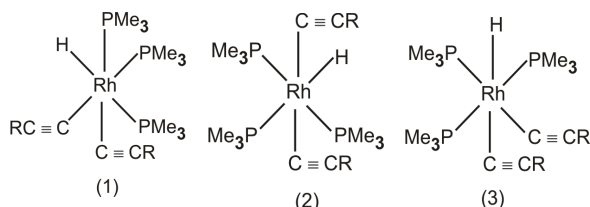
- (A) Fehling test (B) Tollen's test
(C) Iodoform test (D) Lucas test

16. Calculate $-\log [\text{CH}_3\text{COO}^-]$ in 0.1M $\text{CH}_3\text{COOH}(\text{aq.})$ solution when mixed with equal volume of 1M HCl (K_a of $\text{CH}_3\text{COOH} = 10^{-5}$)
- (A) 3 (B) 6 (C) 9 (D) 12
17. If Ar gas is bubbled through water at 298 K, how many moles of Ar gas would dissolve in 1 litre of water? Assume that Ar exerts a partial pressure of 0.403 bar. Given that Henry's law constant for Ar at 298 K is 40.3 K bar
- (A) 6.02×10^{-3} (B) 1×10^{-5}
(C) 18×10^{-5} (D) 55.56×10^{-5}

18. An ideal gas has been expanded irreversibly from state A to state E (curve ACE is an isotherm). Which of the following is incorrect statement for the above process?



- (A) $w = -125 \text{ L atm}$
 (B) $q = 100 \text{ L atm}$
 (C) $\Delta U = 0$
 (D) $\Delta H = 0$
19. Which of the following is not obtained when KMnO_4 is heated at 513 K?
- (A) K_2MnO_4 (B) MnO
 (C) MnO_2 (D) O_2
20. Consider the following geometrical isomer of complex $[\text{RhH}(\text{C} \equiv \text{CR})_2 (\text{PMe}_3)_3]$:-



Identify which geometrical isomer is/are optically active?

- (A) 1, 2, and 3
 (B) 1 and 2 only
 (C) 1 only
 (D) None is optically active.

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

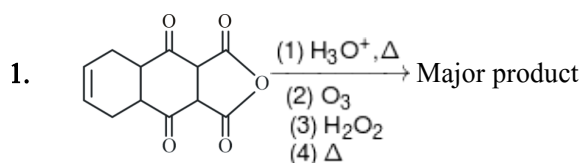
For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

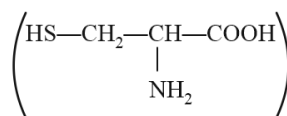
Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.



The ratio of number of carbons in the product to the number of keto groups in the product is

2. If pK_{a1} , pK_{a2} & pK_{a3} values for the amino acid cysteine are respectively 2.0, 8.0, 10.0, then



the isoelectric point of cysteine amino acid is

3. 9 mole of equimolar mixture of Ferric oxalate and ferrous oxalate reacts with acidified KMnO_4 for complete oxidation. Find the number of mole of KMnO_4 required for it. (Write your answer to nearest whole no.)

4. How many of the following combination(s) is/are **CORRECT**?
- (i) PbCrO_4 - Yellow ppt.,
 - (ii) $\text{Cu}_2[\text{Fe}(\text{CN})_6]$ - Chocolate brown colour ppt.,
 - (iii) ZnS - Black ppt.,
 - (iv) NiS - White ppt.,
 - (v) CaCl_2 - Brick red flame on flame test,
 - (vi) $\text{Mg}(\text{NH}_4)\text{PO}_4$ - White ppt.
5. The area and circumference of the n^{th} orbit of a H-atom are $549 (\text{\AA})^2$ and 83.05\AA respectively. The maximum number of lines that can be produced when this electron falls from this orbit to 2nd orbit in that atom, is ____

PART-3 : MATHEMATICS

SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : -1 If wrong option is selected.

1. Let C_1 , C_2 and C_3 be three parallel chords of a circle on the same side of the centre. The distance between C_1 and C_2 is the same as the distance between C_2 and C_3 . The lengths of the chords C_1 , C_2 , C_3 are 10, 8 and 4 respectively. If the radius of the circle is r , then r^2 equals

(A) 36 (B) 28 (C) $\frac{275}{2}$ (D) $\frac{275}{8}$

2. The function $f(x) = 3|x| + |x-1| - ||x-1| - 3|x||$, has a local maximum or minimum at

(A) $\frac{1}{4}$ (B) $\frac{1}{3}$ (C) $\frac{1}{2}$ (D) $\frac{3}{4}$

3. **Assertion (A)** : Let $f(x) = \begin{cases} \frac{1-\sin^3 x}{3\cos^2 x} & \text{if } x < \frac{\pi}{2} \\ a & \text{if } x = \frac{\pi}{2} \\ \frac{b(1-\sin x)}{(\pi-2x)^2} & \text{if } x > \frac{\pi}{2} \end{cases}$.

If $f(x)$ is continuous at $x = \pi/2$, then the values of a and b are, $1/2$ and 4 respectively.

Reason (R) : A function $f(x)$ is continuous at $x = c$, if and only if $\lim_{x \rightarrow c^-} f(x) = \lim_{x \rightarrow c^+} f(x) = f(c)$

- (A) **A** is correct but **R** is not correct
(B) **A** is not correct but **R** is correct
(C) Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**
(D) Both **A** and **R** are correct and **R** is the correct explanation of **A**

4. Let $T_n = (2 + \sqrt{3})^n \forall n \in \mathbb{N}$

If $T_n = I_n + f_n$ where $I_n \in \mathbb{Z}$ and $f_n \in (0, 1)$.

Then $\frac{\sum_{r=1}^{2025} T_{2r} (1 - f_{2r})}{\sum_{s=1}^{2025} T_s (1 - f_s)}$ is

(A) 4 (B) 3 (C) 2 (D) 1

5. Let $f_n : \mathbb{R} \rightarrow \mathbb{R}$ be a continuous function such that

$$f_n(x) = \int_0^x t^n \sin t \, dt.$$

Then the value of

$$\left| \int_{-1}^1 f_{2025}(x) \, dx \right| + \left| \frac{d}{dx} (f_{2026}(x)) \right|_{x=\pi} + |f_0(\pi/2)| \text{ is}$$

(A) 0 (B) 1
(C) 2 (D) 3

6. The solution of differential equation $y(\sin^2 x) \, dy + (\sin x \cos x) y^2 \, dx = x \, dx$, is (where C is constant of integration)

(A) $(\sin^2 x) y = x^2 + C$
(B) $(\sin^2 x) y^2 = x^2 + C$
(C) $(\sin x) y = x^2 + C$
(D) $(\sin^2 x) y^2 = x + C$

7. Let α, β be roots of equation $x^2 - x - 3 = 0$.

If $S_n = \frac{\alpha^{n+1}}{\alpha^{n+2} - \alpha^{n+1} - \alpha^n + \alpha^{n-1}} + \frac{\beta^{n+1}}{\beta^{n+2} - \beta^{n+1} - \beta^n + \beta^{n-1}}$, then $|S_3|$ equals

(A) $\frac{2}{9}$ (B) $\frac{4}{9}$
(C) $\frac{1}{9}$ (D) $\frac{8}{9}$

8. Let Z_1, Z_2 be two distinct complex, such that $Z_1 + Z_2 = 3 + 4i$ and $|Z_1 - Z_2| = 3$, then the value of $|Z_1| \left| 1 - \sqrt{1 - \left(\frac{Z_2}{Z_1}\right)^2} \right| + |Z_2| \left| \frac{Z_1}{Z_2} + \sqrt{\left(\frac{Z_1}{Z_2}\right)^2 - 1} \right|$ is equal to

(A) 2 (B) 8
(C) 5 (D) 4

9. Match the items of List-I with those of List-II

	List-I		List-II
(A)	The area bounded by the curves $y = x^2$, $y = -x^2$ and $y^2 = 4x - 3$ is	(I)	$\log_e \left(\frac{3}{2} \right)$
(B)	The area bounded by the curve $y = x(x-1)^2$, the y-axis and the line $y = 2$ where $0 \leq x \leq 2$, is	(II)	$\log_e \left(\frac{9}{2} \right)$
(C)	The area of the region bounded by the curves $y = \tan x$, $-\frac{\pi}{3} \leq x \leq \frac{\pi}{3}$, $y = \cot x$, $\frac{\pi}{6} \leq x \leq \frac{\pi}{2}$ and the x-axis is	(III)	$\frac{1}{3}$
(D)	$\int_0^{\log_e 3} \left[\frac{3}{e^x} \right] dx$ (where $[.]$ denotes the integer part) is	(IV)	$\frac{10}{3}$

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

10. Let AB be a chord of the parabola $x^2 = 4y$. A circle drawn with AB as diameter passes through the vertex C of the parabola. Given area of $\Delta ABC = 20$ sq. units then the coordinates of A can be

(A) (6,9) (B) (-6,9) (C) (-8,16) (D) (8,-16)

11. ABCD is a parallelogram whose diagonals AC and BD are $2x + y = 3$ and $x + 2y = 3$ respectively. If $AC = 4$ units and area of parallelogram ABCD is 8 sq. units then length of other diagonal BD is _____ units

(A) $\frac{10}{3}$ (B) 2 (C) $\frac{20}{3}$ (D) $\frac{25}{3}$

12. For $0 < x < \frac{\pi}{2}$, let $f_1(x) = \sum_{r=1}^n \sec \left(x + \frac{r\pi}{6} \right) \sec \left(x + (r-1) \frac{\pi}{6} \right)$ and $f_1(x) - 2f_2(x) = 2 \tan \left(x + \frac{n\pi}{6} \right)$ also $f_2(x) + f_3(x) = 0$ then $f_3(x)$ is

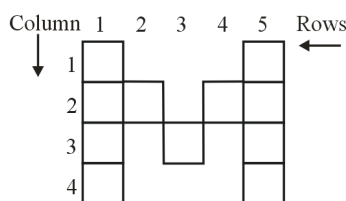
(A) Discontinuous and non-differentiable at $x = \frac{\pi}{4}$ and $x = \frac{\pi}{3}$
(B) Neither continuous nor differentiable at $x = \frac{2\pi}{5}$
(C) Continuous and differentiable in $\left(0, \frac{\pi}{2} \right)$
(D) Continuous but not differentiable at $x = \frac{2\pi}{5}$

13. Let $g(x)$ be a non-constant twice differentiable function defined such that $y = g(x)$ is symmetric about the line $x = 2$. If $I_1 = \int_{-\pi}^{\pi} g(x+2) \sin x \, dx$ and

$$I_2 = \int_0^4 \frac{1}{1 + e^{g'(x)}} dx, \text{ then } (I_1 + I_2) \text{ equals}$$

(A) 2 (B) 3 (C) 1 (D) 0

14. Number of ways in which first 11 natural numbers can be arranged in the given figure such that $a_{ij} > a_{kj}$ whenever $i > k \forall j$ is (a_{ij} represents element of i^{th} row and j^{th} column)



- (A) 69300 (B) 5775
(C) 34650 (D) 11550
15. **Statement I** : If $z_1 = 9 + 5i$, $z_2 = 3 + 5i$ and $\arg \left[\frac{(z - z_1)}{(z - z_2)} \right] = \pi/4$, then the values of $|z - 6 - 8i|$ is $3\sqrt{2}$
Statement II : In a circle, the angle subtended by a chord at the centre is double the angle subtended by the same chord on the circumference of the circle.
- (A) **I** is correct but **II** is not correct
(B) **I** is not correct but **II** is correct
(C) Both **I** and **II** are correct but **II** is **NOT** the correct explanation of **I**
(D) Both **I** and **II** are correct and **II** is the correct explanation of **I**
16. Many states use a sequence of three letters followed by a sequence of three digits as their standard license-plate pattern. Given that each three-letter and three-digit arrangement is equally likely, the probability that such a license plate will contain at least one palindrome (a three-letter arrangement or a three-digit arrangement that reads the same left-to-right as it does right-to-left) is $\frac{m}{n}$, where m and n are relatively prime positive integers, then the value of $(m + n)$ equals
- (A) 58 (B) 59 (C) 60 (D) 63

17. The number of 3×3 matrices M with entries from elements of set $\{0, 1, 2, 3, 4\}$ are there for which the $\text{tr}(M) = 5$ are (where $\text{tr}(M)$ denotes trace of matrix M)
- (A) $12(5^6)$ (B) $6(5^6)$
(C) $21(5^6)$ (D) $18(5^6)$
18. For two data sets, each size 5, the variances are given to be 4 and 5 and the corresponding means are given to be 2 and 4, respectively. The variance of the combined data set is
- (A) $\frac{5}{2}$ (B) $\frac{11}{2}$
(C) $\frac{\sqrt{11}}{2}$ (D) $\frac{13}{2}$
19. Sum of the coefficients in the expansion of $(2x + y + z)^{37}$ which are divisible by 37 can be written as $(a^p - b^p - c)$ where p is a prime number and a, b, c are even natural number, then $\left(\frac{a + b + c + 2}{2} \right)$ is equal to
- (A) 6 (B) 7
(C) 4 (D) 5
20. Let $f(x) = \frac{x^3}{3} + \frac{x^2}{2} + x + 2$ and $g'(x) = (x^2 - 9)(x^2 - 4x + 3)(x^2 - 3x + 2)(x^2 - 2x - 3)$. If n_1 & n_2 respectively denote the number of points of local minima and the number of points of local maxima of the function $f(g(x))$ then the value of $(n_1 + n_2)$.
- (A) 2 (B) 3
(C) 4 (D) 1

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.

1. If $a = \cot 50^\circ$, $b = \cot 60^\circ$ and $c = \cot 70^\circ$, then the value of

$$\begin{vmatrix} -bc & b^2 + bc & c^2 + bc \\ a^2 + ac & -ac & c^2 + ac \\ a^2 + ab & b^2 + ab & -ab \end{vmatrix} \text{ is}$$

2. Let $S = \{a_1, a_2, \dots, a_n\}$, has n -distinct element. If the number of relation defined on 'S' that is both symmetric and reflexive is 64, then the value of n is (where $n \in \mathbb{N}$)

3. Let

$$f(n) = \sum_{K=-n}^n \left(\cot^{-1} \frac{1}{K} - \tan^{-1} K \right), K \neq 0, n \in \mathbb{N}.$$

If the value of $\sum_{n=2}^{10} [f(n) + f(n-1)]$ is $m\pi$, then the value of m is

4. In a tetrahedron OABC, the edges are of lengths $|\overline{OA}| = |\overline{BC}| = a$, $|\overline{OB}| = |\overline{AC}| = b$, $|\overline{OC}| = |\overline{AB}| = c$.

Let G_1 and G_2 be the centroids of the triangle ABC and AOC (Where AOC is not a right angled triangle)

such that $\overline{OG_1} \perp \overline{BG_2}$ then the value of $\frac{a^2 + c^2}{b^2}$ is

5. If the value of $\prod_{r=1}^{45} \sin(2r-1)^\circ = 2^{-\alpha}$, then the value of $[\alpha]$ is equal to (where $[.]$ is G.I.F.)

Space for Rough Work

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