



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.Super60_NUCLEUS&STERLING_BT**

JEE-MAIN

Date: 26-08-2023

Time: 09.00Am to 12.00Pm

RPTM-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 90 questions. The maximum marks are **300**.
5. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry and Mathematics** having **30 questions** in each subject and subject having **two sections**.

(I) Section –I contains 20 **multiple choice** questions with only one correct option.

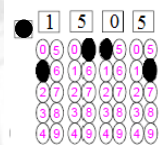
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

(II) Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only, if more than 5 questions attempted, First 5 attempted questions will be considered.

- 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:

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Candidate's Signature: _____

Invigilator's Signature: _____

**26-08-23_Sr.Super60_NUCLEUS&STERLING_BT_Jee-Main_RPTM-04_Test Syllabus****PHYSICS**

: General Physics: General Units and dimensions, dimensional analysis; least count, significant figures; Methods of measurement and error analysis for physical quantities pertaining to the following experiments: Experiments based on using Vernier calipers and screw gauge (micrometer), Determination of g using simple pendulum, Simple Pendulum-dissipation of energy by plotting a graph between the square of amplitude and time, Metre Scale - the mass of a given object by the principle of moments, Kinematics : Kinematics in one and two dimensions, Projectile motion, Relative velocity.

RPTM-04 (15Q-RPTM.4 SYLLABUS+15Q CUMULATIVE SYLLABUS)**CHEMISTRY**

: Benzene, Alkyl Halides & Aryl Halides: Benzene :Reactions of benzene, Structure and aromaticity ; Electrophilic Substitution Reactions; halogenation, nitration, sulphonation, friedel-crafts alkylation and acylation; Effect of directing groups (mono substituted benzenes) in these reactions. Alkyl halides & aryl halides: rearrangement reactions of alkyl carbocation, Grignard reactions, nucleophilic substitution reactions; Haloarenes :Fittig, Wurtz-Fittig, nucleophilic aromatic substitution in haloarenes and substituted haloarenes (excluding Benzyne mechanism and Cine substitution).

RPTM-04 (15Q-RPTM.4 SYLLABUS+15Q CUMULATIVE SYLLABUS)**MATHEMATICS**

: Indefinite Integration

RPTM-04 (15Q-RPTM.4 SYLLABUS+15Q CUMULATIVE SYLLABUS)

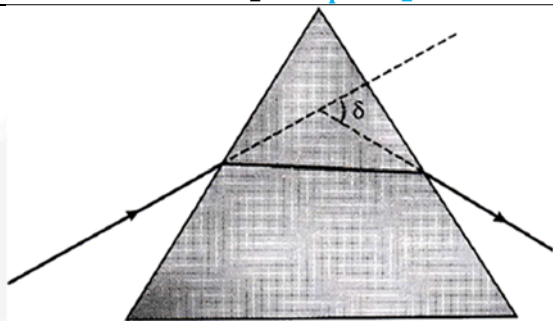
**PHYSICS****Max Marks: 100****(SINGLE CORRECT ANSWER TYPE)**

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.

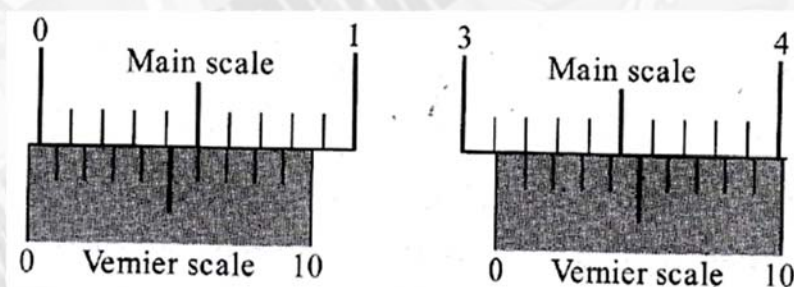
- Consider the diffraction pattern obtained from the sunlight incident on a pinhole of diameter $0.1\mu\text{m}$. If the diameter of the pinhole is slightly increased, it will affect the diffraction pattern such that:
 - Its size decreases, but intensity increases
 - Its size decreases, and intensity decreases
 - Its size increases, and intensity increases
 - Its size increases, but intensity decreases
- The density of a solid ball is to be determined in an experiment. The diameter of the ball is measured with a screw gauge (no zero error), whose pitch is 0.5mm and there are 50 divisions on the circular scale. The reading on the main scale is 2.5mm and that on the circular scale is 20 divisions. If the measured mass of the ball has a relative error of 2%, the relative percentage error in the density is:
 - 0.9%
 - 2.4%
 - 3.1%
 - 4.2%
- The diameter of a cylinder is measured using a Vernier calipers with no zero error. It is found that the zero of the Vernier scale lies between 5.10cm and 5.15cm of the main scale. The Vernier scale has 50 division equivalent to 2.45cm. The 24th division of the vernier scale exactly coincides with one of the main scale divisions. The diameter of the cylinder is:
 - 5.112cm
 - 5.124cm
 - 5.136cm
 - 5.148cm
- The angle of deviation through an equilateral prism is minimum when
 - Incident ray and emergent ray are symmetric to the prism
 - The refracted ray inside the prism becomes parallel to its base
 - Angle of incidence is equal to that of the angle of emergence
 - When angle of emergence is double the angle of incidence





Choose the correct answer from the options given below:

- 1) Statements(a),(b) and (c) are true 2) Only statement(d) is true
 3) Only statements(a) and (b) are true 4) Statements(b) and (c) are true
5. The smallest division on the main scale of a Vernier calipers is 0.1cm. Ten divisions of the Vernier scale correspond to nine divisions of the main scale. The figure below on the left shows the reading of this calipers with no gap between its two jaws. The figure on the right shows the reading with a solid sphere held between the jaws. The correct diameter of the sphere is:



- 1) 3.07cm 2) 3.11cm 3) 3.15cm 4) 3.17cm
6. Match Coloum-I with Coloum-II and select the correct answer using codes given below the lists:

Coloum-I	Coloum-II
P) Boltmann constant	1) $[ML^2T^{-1}]$
Q) Coefficient of viscosity	2) $[ML^{-1}T^{-1}]$
R) Plank constant	3) $[MLT^{-3}K^{-1}]$
S) Thermal conductivity	4) $[ML^2T^{-2}K^{-1}]$

- 1) $P \rightarrow 3; Q \rightarrow 1; R \rightarrow 2; S \rightarrow 4$ 2) $P \rightarrow 3; Q \rightarrow 2; R \rightarrow 1; S \rightarrow 4$
 3) $P \rightarrow 4; Q \rightarrow 2; R \rightarrow 1; S \rightarrow 3$ 4) $P \rightarrow 4; Q \rightarrow 1; R \rightarrow 2; S \rightarrow 3$





7. **Statement-1:** The total translational kinetic energy of all the molecules of a given mass of an ideal gas 1.5 times the product of its pressure and its volume.
because

Statement-2: The molecules of a gas collide with each other and the velocities of the molecules change due to the collision.

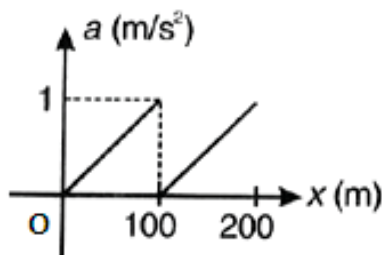
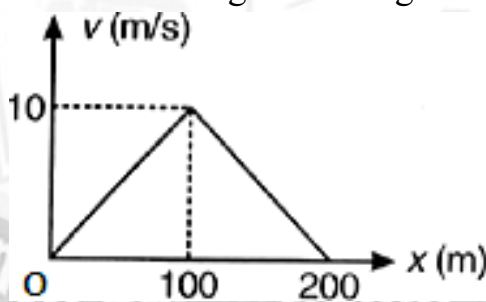
- 1) Statement-1 is True; Statement-2 is True; Statement-2 is a correct explanation for Statement-1
- 2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
- 3) Statement-1 is True; Statement-2 is False
- 4) Statement-1 is False; Statement-2 is True

8. **Statement-1:** The formula connecting u, v and f for a spherical mirror is valid only for mirrors whose sizes are very small compared to their radii of curvature.
because

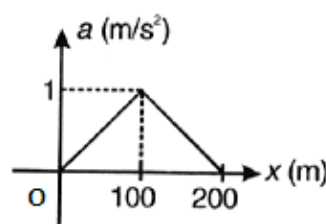
Statement-2: Laws of reflection are strictly valid for plane surface, but not for large spherical surfaces:

- 1) Statement-1 is True; Statement-2 is True; Statement-2 is a correct explanation for Statement-1
- 2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
- 3) Statement-1 is True; Statement-2 is False
- 4) Statement-1 is False; Statement-2 is True

9. The v - x graph for a car in a race on a straight road is given. Identify the correct a - x graph.

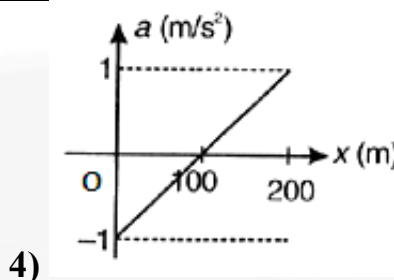
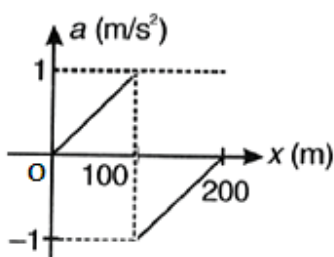


1)

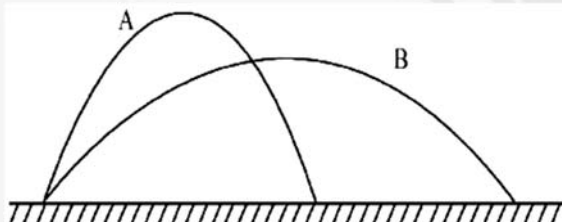


2)





10. A person simultaneously throws two small balls in air with same speed. The balls leave the person's hand at different angles and travel along parabolic trajectories as indicated by 'A' and 'B' in the figure below. Maximum height reached by A is greater than that reached by B. Which of the following statement is incorrect? (Neglect air resistance)



- 1) Motion of ball along B with respect to ball along A, is a straight line (until neither ball touches the ground)
 - 2) Ball moving along the trajectory 'A' hits the ground after the ball moving along the trajectory 'B'.
 - 3) Minimum speed along 'B' is more than the minimum speed along 'A' during flight
 - 4) Both balls collide in air at the intersection point of trajectories
11. Students I, II and III perform an experiment for measuring the acceleration due to gravity(g) using a simple pendulum. They use different lengths of the pendulum and/or record time for different number of oscillations. The observations are shown in the table. Least count for length = 0.1 cm

Least count for time = 0.1 s

Student	Length of the Pendulum (cm)	No. of Oscillations (n)	Total time for (n) oscillations (s)	Time period (s)
I	64.0	8	128.0	16.0
II	64.0	4	64.0	16.0
III	20.0	4	36.0	9.0



If E_I, E_{II} and E_{III} are the percentage errors in g , i.e., $\left(\frac{\Delta g}{g} \times 100\right)$ for students

I, II and III , respectively, then respectively, then

- 1) $E_I = 0$ 2) E_I is minimum 3) $E_I = E_{II}$ 4) E_{II} is maximum

12. Which of the following are dimensionless quantities?

(Here symbols have their usual meanings) & (m = mass, L =coefficient of self induction, I =current)

- 1) $\frac{L}{CR^2}$ 2) $\frac{E^2}{\epsilon_0 \mu_0 B^2}$ 3) $\frac{E^2}{B^2}$ 4) mLI^2

13. **Statement I:** As the temperature of the black body increases, the wave length at which the spectral intensity (E_λ) is maximum decreases.

Statement II: 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) Both statement I and statement II are correct and statement II is the correct explanation of statement I
 2) Both statement I and statement II are correct and statement II is not the correct explanation of statement I
 3) Statement I is correct but statement II is incorrect
 4) Statement II is correct but statement I is incorrect

14. A physical quantity A is dependent on other four physical quantities p, q, r and s as given by

$A = \frac{\sqrt{pq}}{r^2 s^3}$. The percentage error of measurement in p, q, r and s are 1%, 3%, 0.5% and 0.33% respectively, then the maximum percentage error in A is:

- 1) 2 2) 0 3) 4 4) 3

15. The length of a simple pendulum is about 100 cm known to have an accuracy of 1 mm. Its period of oscillation is 2 s determined by measuring the time for 100 oscillations using a clock of 0.1 s resolution. What is the accuracy in the determined value of g ?

- 1) 0.2% 2) 0.5% 3) 0.1% 4) 2%

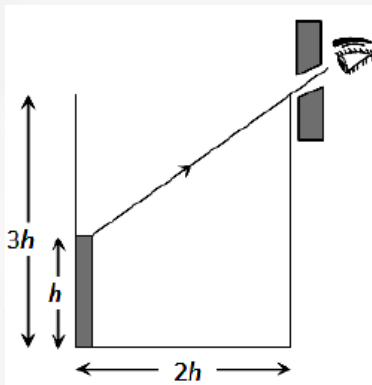
16. A person having eye sight problem. He is not able to see clearly a distant uniform window mesh and it appears to him as non-uniform and distorted. The person suffers the problem as:

- 1) Astigmatism 2) Myopia with Astigmatism
 3) Presbyopia with Astigmatism 4) Myopia and hypermetropia

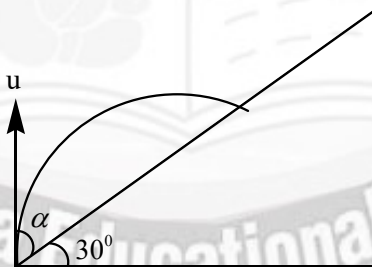




17. An observer can see through a pin-hole the top end of a thin rod of height h , placed as shown in the figure. The beaker height is $3h$ and its radius h . When the beaker is filled with a liquid up to a height $2h$, he can see the lower end of the rod. Then the refractive index of the liquid is



- 1) $\sqrt{\frac{5}{2}}$ 2) $\sqrt{\frac{2}{5}}$ 3) $\sqrt{\frac{3}{2}}$ 4) $\sqrt{\frac{5}{3}}$
18. The accelerations of a particle as seen from two frames S_1 and S_2 have equal magnitude 4 m/s^2 . Choose the correct option
- 1) The frames must be at rest with respect to each other.
 - 2) The frames may be moving with respect to each other but neither should be accelerated with respect to the other.
 - 3) The acceleration of S_2 with respect to S_1 must either be zero or 8 m/s^2
 - 4) The acceleration of S_2 with respect to S_1 may be anything between zero and 8 m/s^2
19. **Statement I :** A particle is projected on an inclined plane of incline 30° as shown in the figure. The value of α for maximum range on the inclined plane is 30° .

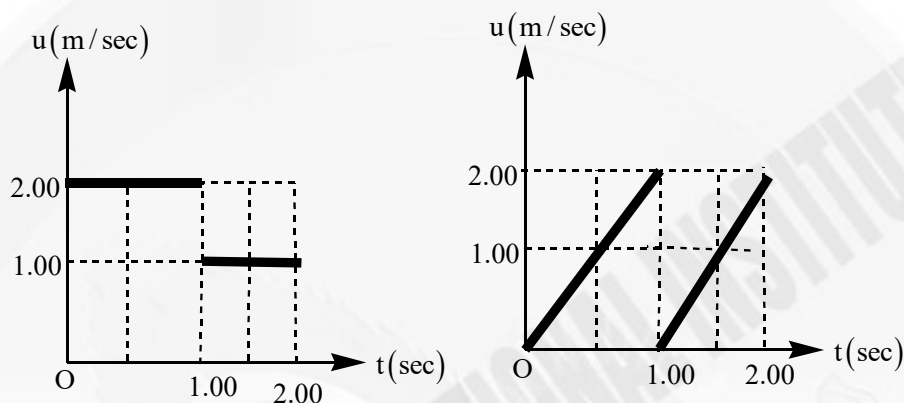


- Statement II :** If R is range, then for maximum range, $\frac{dR}{d\alpha} = 0$.
- 1) Both statement I and statement II are correct and statement II is the correct explanation of statement I
 - 2) Both statement I and statement II are correct and statement II is not the correct explanation of statement I
 - 3) Statement I is correct but statement II is incorrect
 - 4) Statement II is correct but statement I is incorrect





20. Two particles A and B start from the same point ($x=0$ & $t=0$) and move in the positive x -direction. In a time interval of 2.00 s after they start, their velocities u vary with time t as shown in the following figures. What is the maximum separation between particles during this time interval



- 1) 1.00m 2) 1.25m 3) 1.50m 4) 2.00m

(NUMERICAL VALUE TYPE)

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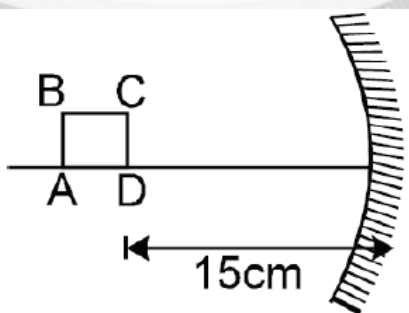
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

21. In a particular system of units, a physical quantity can be expressed in terms of the electric charge e , electron mass m_e , Planck's constant h , and Coulomb's constant $k = \frac{1}{4\pi\epsilon_0}$, where ϵ_0 is the permittivity of vacuum. In terms of these physical constants, the dimension of the magnetic field is $[B] = [e]^\alpha [m_e]^\beta [h]^\gamma [k]^\delta$. The value of $\alpha + \beta + \gamma + \delta$ is
22. To find the distance d over which a signal can be seen clearly foggy conditions, a railways engineer uses dimensional analysis and assume that the distance depends on the mass density ρ of the fog, intensity (power/area) S of the light from the signal and its frequency f . The engineer finds that d is proportional to $S^{1/n}$. The value of n is?
23. The energy of a system as a function of time t is given as $E(t) = A^2 \exp(-\alpha t)$, where $\alpha = 0.2s^{-1}$. The measurement of A has an error of 1.25%. If the error in the measurement of time is 1.50%, the percentage error in the value of $E(t)$ at $t = 5s$ is
24. A source of light is placed in front of a screen. Intensity of light on the screen is I . Two Polaroids P_1 and P_2 are so placed in between the source of light and screen that the intensity of light on screen is $I/2$. P_2 should be rotated by a minimum angle of _____ (degrees) so that the intensity of light on the screen becomes $3I/8$.





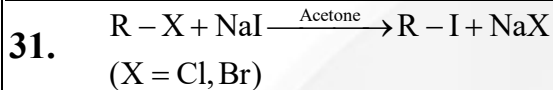
25. Initially a gas of diatomic molecules is contained in a cylinder of volume V_1 at a pressure p_1 and temperature 250 K. Assuming that 25% of the molecules get dissociated causing a change in the number of moles the pressure of the resulting gas at temperature 2000 K, when contained in a volume $2V_1$ is given by P_2 . The ratio of $\frac{P_2}{P_1}$ is _____
26. A liquid at 30°C is poured very slowly into a calorimeter that is at temperature of 110°C . The boiling temperature of the liquid is 80°C . It is found that the first 5 g of the liquid completely evaporates. After pouring another 80 g of the liquid the equilibrium temperature is found to be 50°C . The ratio of the latent heat of the liquid to its specific heat will be $^\circ\text{C}$ (Neglect the heat exchange with surrounding)
27. White light is passed through a double slit and interference is observed on a screen 1.5m away. The separation between the slits is 0.3mm. The first violet and red fringes are formed 2.0mm and 3.5mm away from the central white fringe. The difference in wavelength of red and violet light is _____ nm
28. An equi-molar mixture of a mono atomic and diatomic gas is subjected to continuous expansion such that $dQ = \frac{1}{3}dU + \frac{1}{2}dW$. The equation of the process in terms of the variable P&V is $PV^{\frac{11}{x}} = \text{constant}$. Then the value of x is _____
29. The width of one of the two slits in a Young's double slit experiment is three times the other slit. If the amplitude of the light coming from a slit is proportional to the slit-width, the ratio of maximum to minimum intensity in the interference pattern is $x : 4$ where x is _____
30. A square ABCD of side 1mm is kept at distance 15 cm in front of the concave mirror as shown in the figure. The focal length of the mirror is 10 cm. The length of the perimeter of its image(in mm) will be:



**CHEMISTRY****Max Marks: 100****(SINGLE CORRECT ANSWER TYPE)**

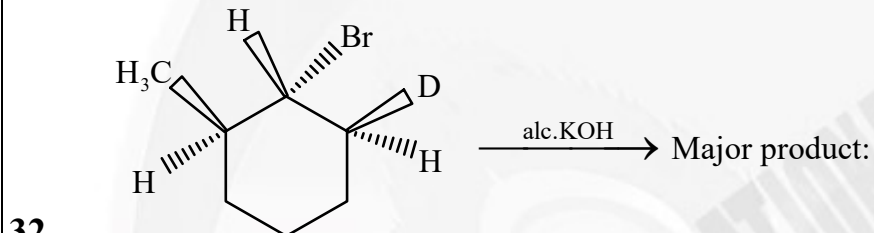
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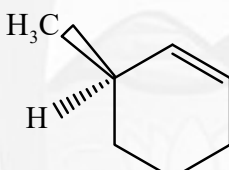
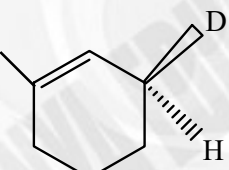
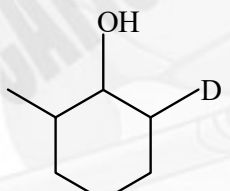
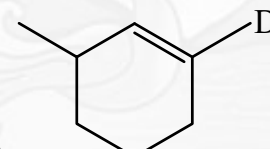
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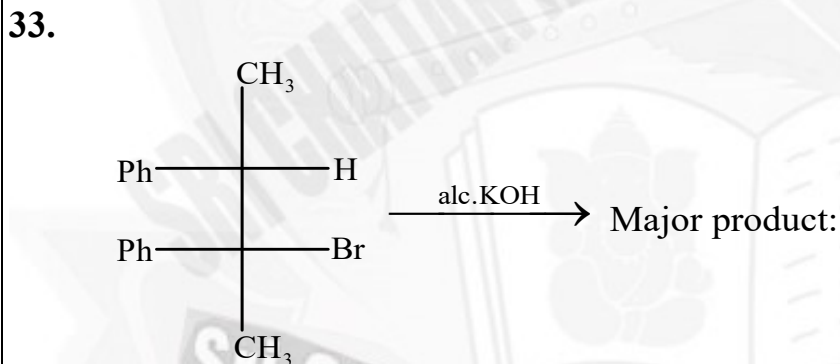


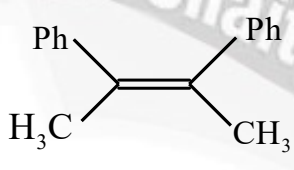
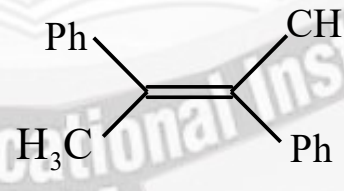
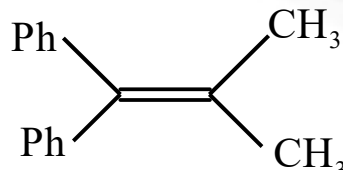
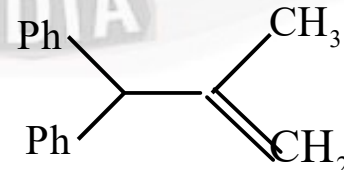
This reaction is known as

- 1) Finkelstein reaction 2) Swart's reaction
3) Hunsdiecker's reaction 4) Simonini reaction



- 1)  2)  3)  4) 



- 1)  2) 
3)  4) 

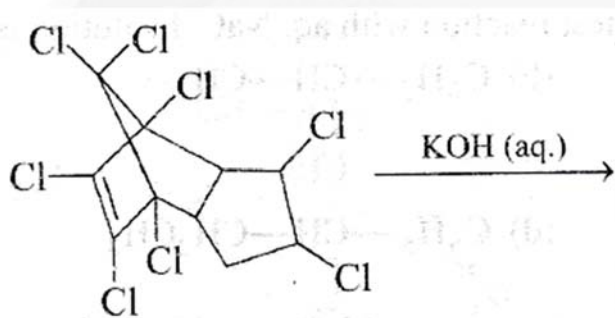


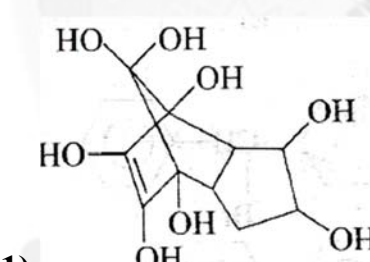
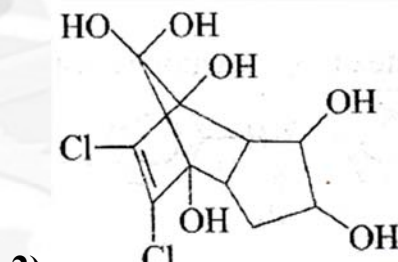
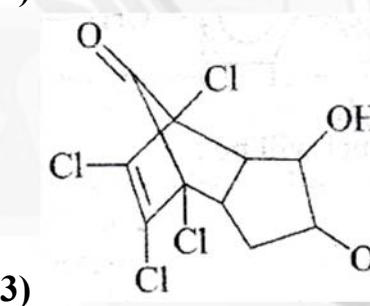
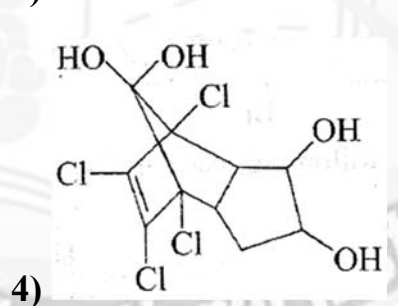


34. **Assertion(A):** Halo alkanes react with KCN to form alkyl cyanides as main product while AgCN forms Isocyanides as major product

Reason(R): KCN is predominantly Ionic, while AgCN is mainly covalent in nature.

- 1) Both Assertion and Reason are correct and Reason is correct explanation for Assertion
- 2) Both Assertion and Reason are correct and Reason is not correct explanation for Assertion
- 3) Assertion is correct and Reason is incorrect
- 4) Assertion is incorrect and Reason is correct



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

36. **Assertion(A):** When the concentration of alkyl halide is triple and concentration of OH^- is reduced to half, the rate of $\text{S}_\text{N}2$ reaction increased by 1.5 times

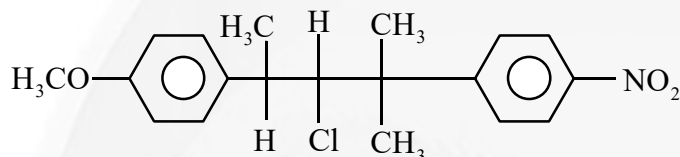
Reason(R): For $\text{S}_\text{N}2$ reactions, $\text{Rate} = K[\text{Alkyl halide}][\text{OH}^-]$



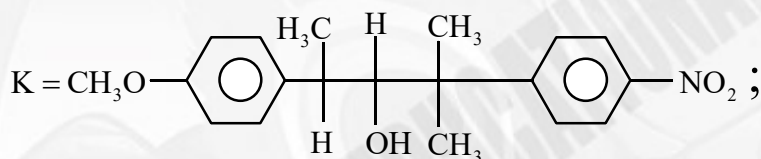


- 1) Both Assertion and Reason are correct and Reason is correct explanation for Assertion
- 2) Both Assertion and Reason are correct and Reason is not correct explanation for Assertion
- 3) Assertion is correct and Reason is incorrect
- 4) Assertion is incorrect and Reason is correct

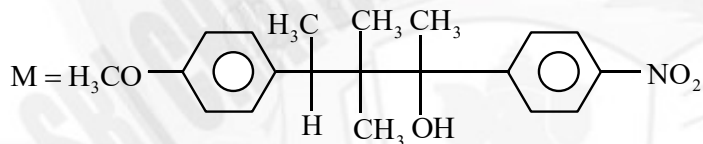
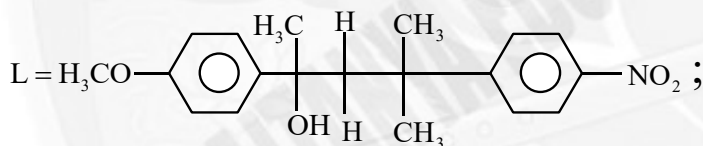
37. The hydrolysis of



in aqueous acetone gives:

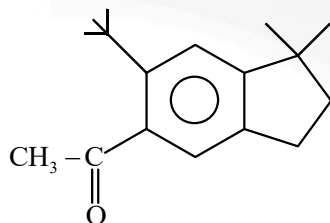


where

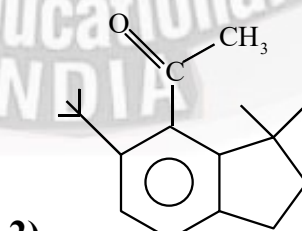


- 1) K and L
- 2) Only K
- 3) L and M
- 4) Only M

38. The major product of the reaction is

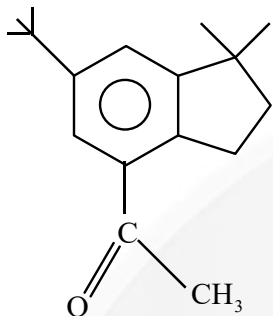


1)

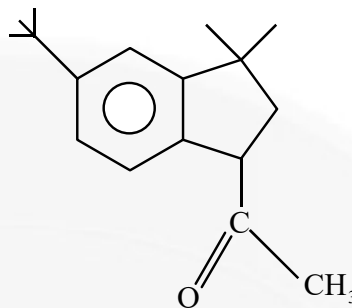


2)





3)

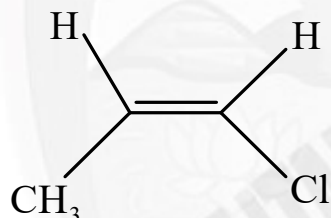


4)

39. The reaction of ethylene with Br_2 in water in the presence of NaCl gives:

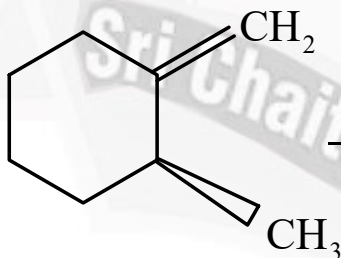
- 1) 1,2-dibromoethane 2) 2-bromoethanol
3) 1-bromo-2-chloroethane 4) all of these

40. Assertion(A): Dipole moment of  compound will be maximum than



Reason(R): Dipole moment is a vector quantity

- 1) Both Assertion and Reason are correct and Reason is correct explanation for Assertion
2) Both Assertion and Reason are correct and Reason is not correct explanation for Assertion
3) Assertion is correct and Reason is incorrect
4) Assertion is incorrect and Reason is correct



41.

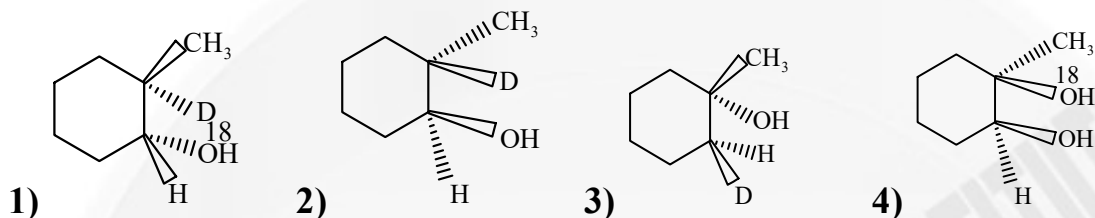
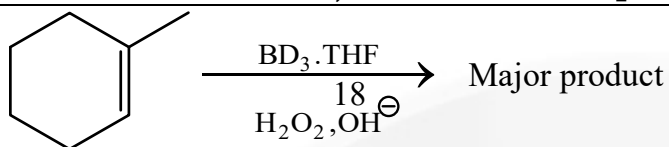
Products of the above reaction will be:

- 1) racemic mixture 2) diastereomers
3) meso 4) structural isomer





42.



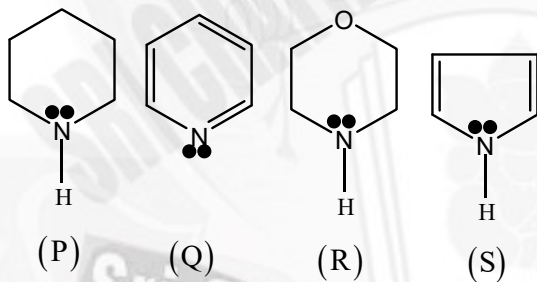
43.

Assertion(A):**Reason(R):** In oxymercuration and Demercuration addition of water takes place according to markonikov's Rule

- 1) Both Assertion and Reason are correct and Reason is correct explanation for Assertion
 2) Both Assertion and Reason are correct and Reason is not correct explanation for Assertion
 3) Assertion is correct and Reason is incorrect
 4) Assertion is incorrect and Reason is correct

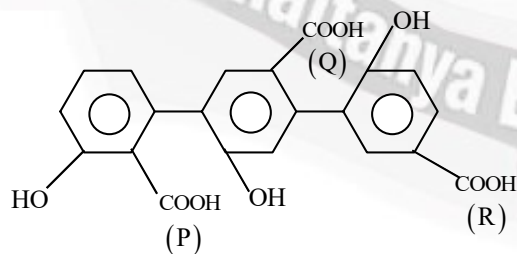
44.

Write the order of basic strength:



- 1) $Q > R > S > P$ 2) $P > R > Q > S$ 3) $R > P > S > Q$ 4) $P > Q > R > S$

45.



The correct acidic strength order of acidic hydrogen P,Q and R is respectively:

- 1) $P > Q > R$ 2) $P > R > Q$ 3) $R > Q > P$ 4) $Q > R > P$





46. The observed rotation of 2.0gm of a compound in 10mL solution in a 25cm long polarimeter tube is $+13.4^\circ$. The specific rotation of compound is:

- 1) $+30.2^\circ$ 2) -26.8° 3) $+26.8^\circ$ 4) $+40.2^\circ$

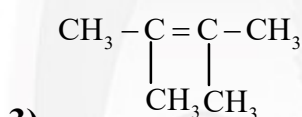
47. **Assertion(A):** Acetylene on Treatment with Tollen's reagent gives white precipitate and Acetylene on treatment with ammonical Cu_2Cl_2 gives red precipitate

Reason(R): Acetylene is acidic in nature

- 1) Both Assertion and Reason are correct and Reason is correct explanation for Assertion
 2) Both Assertion and Reason are correct and Reason is not correct explanation for Assertion
 3) Assertion is correct and Reason is incorrect
 4) Assertion is incorrect and Reason is correct

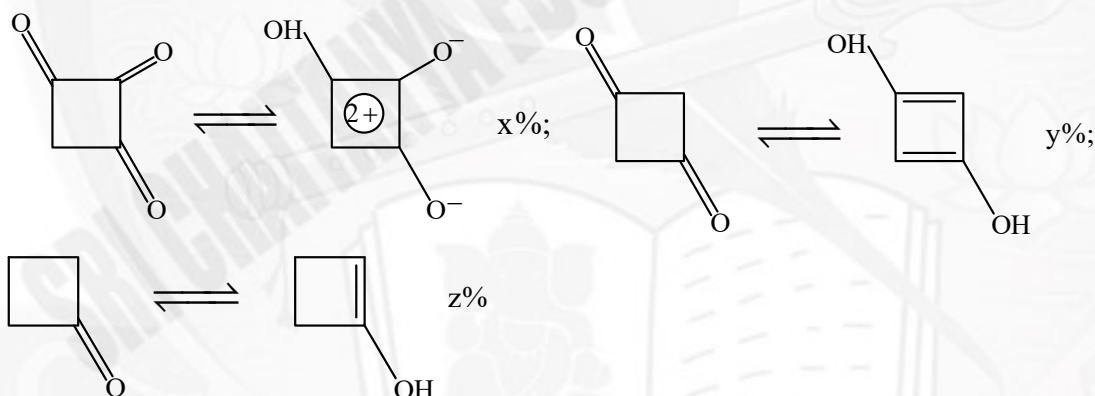
48. Which of the following alkene is more stable

- 1) $\text{CH}_3 - \text{CH} = \text{CH}_2$ 2) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$



- 4) $\text{CH}_2 = \text{CH}_2$

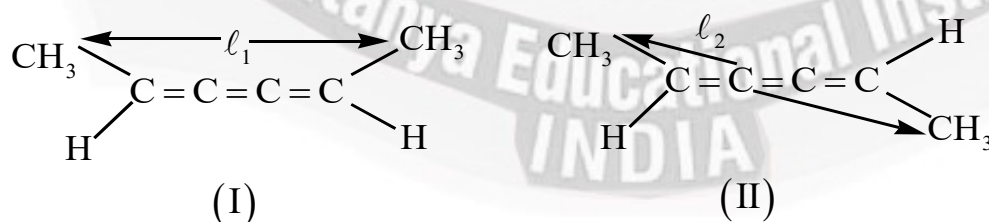
49.



The correct order of enol contents x, y, z is:

- 1) $x > y > z$ 2) $z > y > x$ 3) $y > x > z$ 4) $x > z > y$

50.



I and II are geometrical isomers of each other because

- 1) $l_1 = l_2$ 2) $l_1 > l_2$ 3) $l_2 > l_1$ 4) l_1 and l_2 cannot be compared



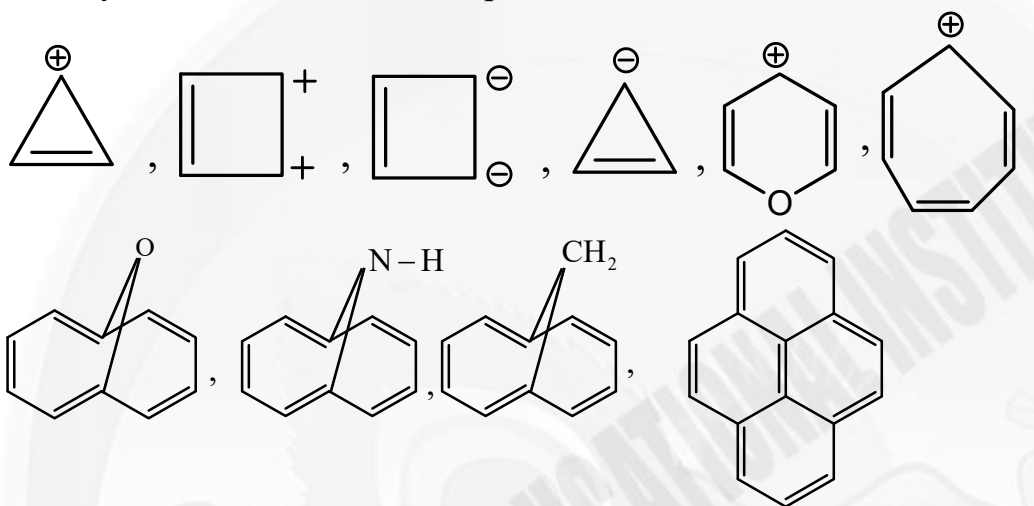


(NUMERICAL VALUE TYPE)

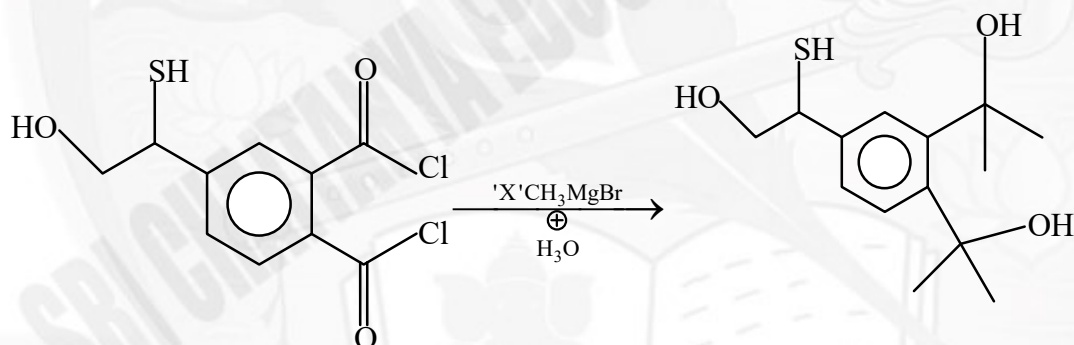
Section-II contains 10 Numerical Value Type questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within 0 to 9999. If the Answer is in Decimal then round off to the nearest Integer value (Example i.e. If answer 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.

51. Identify the no. of Aromatic compounds.



52.

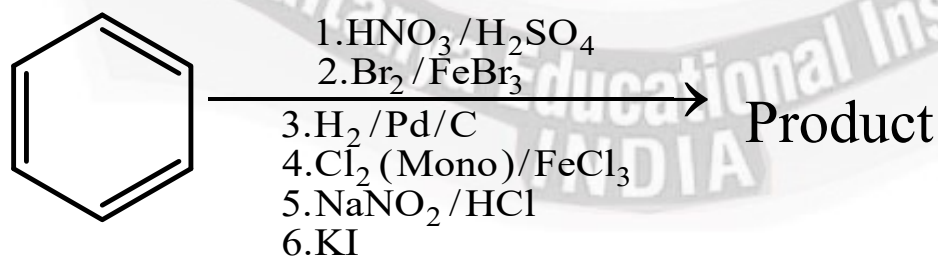


Find out the value of 'X':

53. No. of Halogen atoms present in DDT are?

54. In Gammaxane, the no. of halogen atoms are

55.

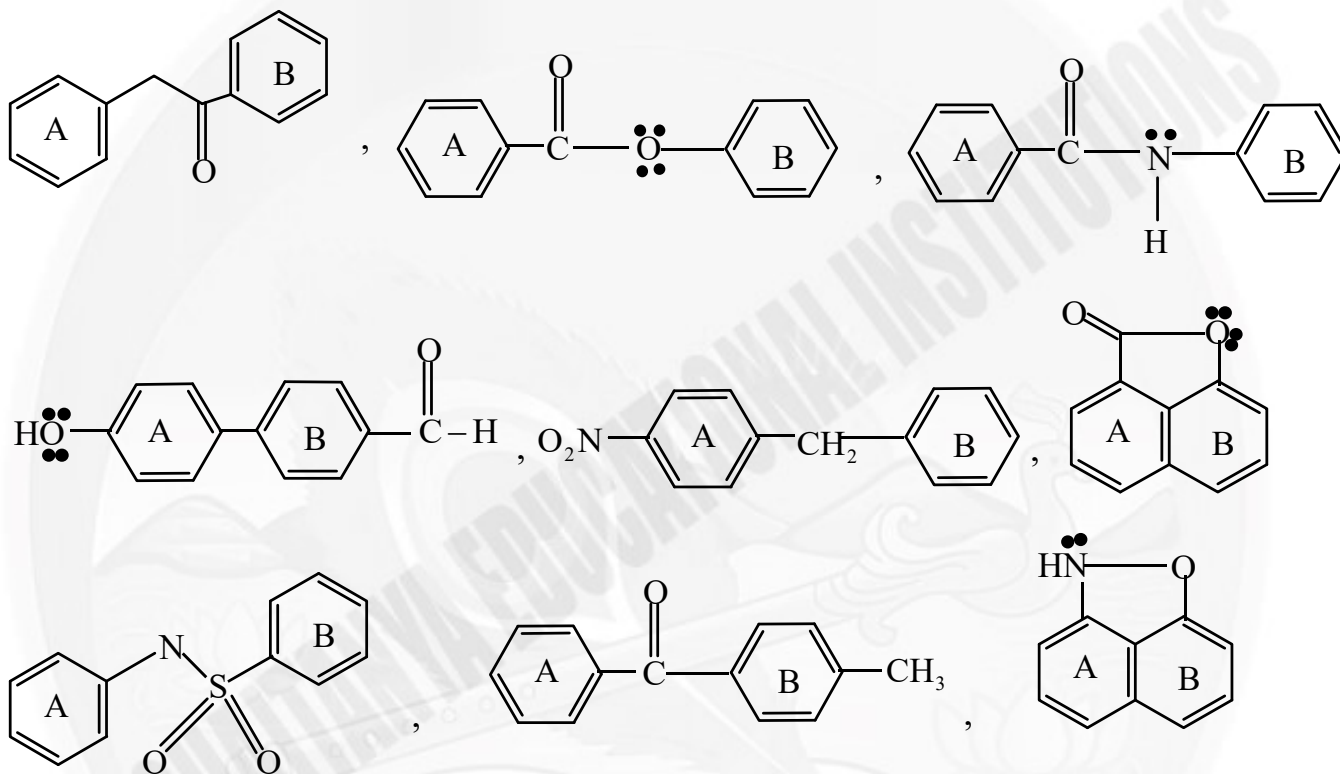


The number of halogen atoms in the product are?

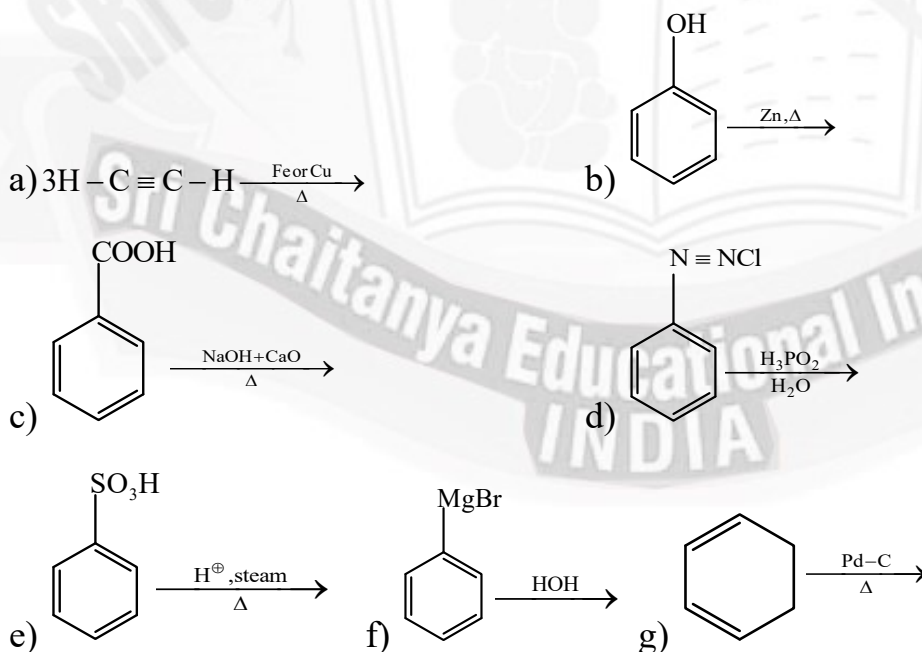




56. Each of the compounds shown below has two aromatic rings, labeled as A and identify number of compounds in which ring B is more active than ring A for electrophilic aromatic substitution reaction

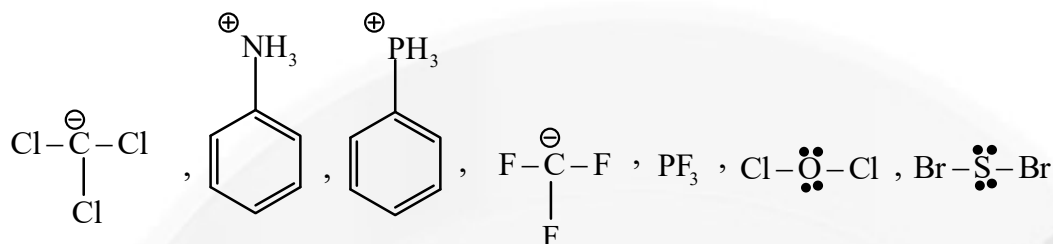


57. Identify number of reactions that can give benzene as major product.

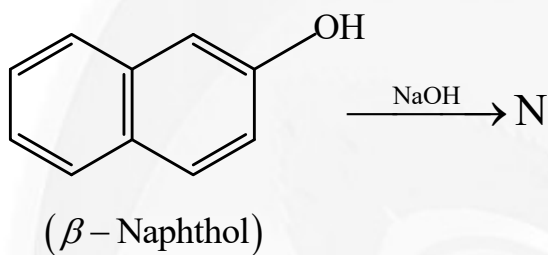




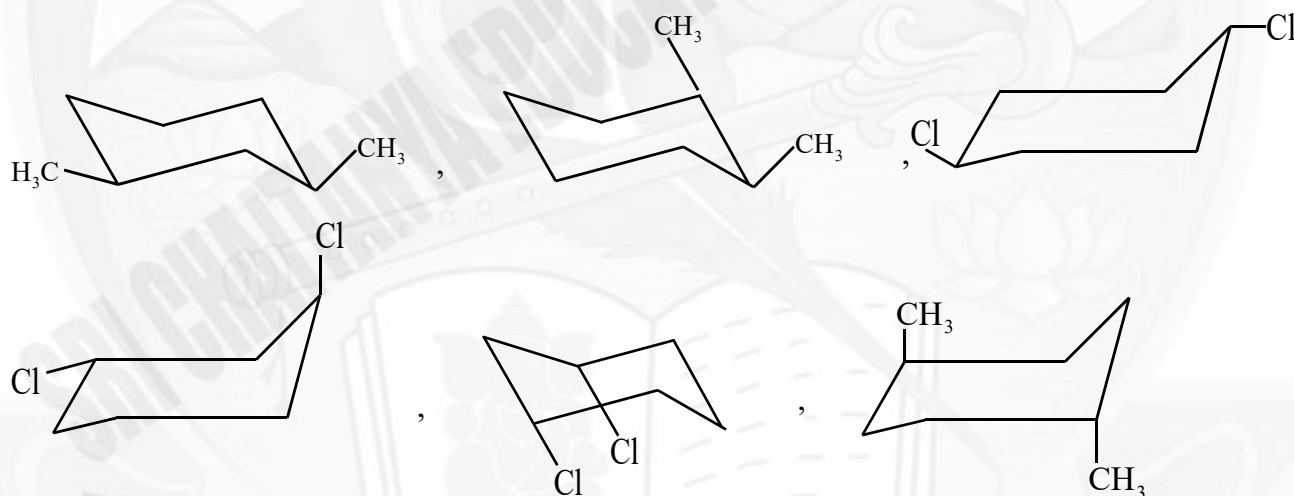
58. How many compounds from following exhibit d-orbital resonance.



59. The no. of resonating structures for 'N' is?



60. Find out number of conformation those have cis geometry.



**MATHEMATICS****Max Marks: 100****(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.

61. The range of function $f(x) = \operatorname{sgn}(\sin x) + \operatorname{sgn}(\cos x) + \operatorname{sgn}(\tan x) + \operatorname{sgn}(\cot x)$, $x \neq \frac{n\pi}{2}$ ($n \in \mathbb{I}$) is:

[Note: $\operatorname{sgn} k$ denotes signum function of k .]

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

62. Let $P(x) = a_1x + a_2x^2 + a_3x^3 + \dots + a_{100}x^{100}$, where $a_1 = 1$ and $a_i \in \mathbb{R} \forall i = 2, 3, 4, \dots, 100$, then

$\lim_{x \rightarrow 0} \frac{\sqrt[100]{1 + P(x)} - 1}{x}$ has the value equal to:

- 1) 100 2) $\frac{1}{100}$ 3) 1 4) 5050

63. $\int \frac{1}{(2x+1)^{5/6} (3x+5)^{7/6}} dx =$

- 1) $\frac{6}{7} \left(\frac{3x+5}{2x+1} \right)^{-1/6} + C$ 2) $-\frac{6}{7} \left(\frac{2x+1}{3x+5} \right)^{-1/6} + C$
 3) $-\frac{6}{7} \left(\frac{3x+5}{2x+1} \right)^{-1/6} + C$ 4) $\frac{6}{7} \left(\frac{2x+1}{3x+5} \right)^{-1/6} + C$

64. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined as $f(x) = x^3 + 2x^2 + 4x + \sin\left(\frac{\pi x}{2}\right)$ and g be the inverse function of f , then $g'(8)$ equals:

- 1) $\frac{1}{9}$ 2) 9 3) $\frac{1}{11}$ 4) 11

65. $\int \frac{\sin^3 x}{(\cos^4 x + 3 \cos^2 x + 1) \tan^{-1}(\sec x + \cos x)} dx$ is equal to

- 1) $\tan^{-1}(\sec x + \cos x) + C$ 2) $\log_e |\tan^{-1}(\sec x + \cos x)| + C$
 3) $\frac{1}{(\sec x + \cos x)^2} + C$ 4) None of these





66. Let θ be the acute angle between the curves $y = x^x \ln x$ and $y = \frac{2^x - 2}{\ln 2}$ at their point of intersection on the line $y = 0$. The value of $\tan \theta$ is equal to:
- 1) $\frac{1}{2}$ 2) 2 3) $\frac{1}{3}$ 4) 3
67. $\int \frac{\sin 12\theta - \sin 9\theta}{2 \cos 7\theta - 1} d\theta = \frac{\cos k\theta}{k} - \frac{\cos \ell\theta}{\ell} + C$, then $k + \ell =$
- 1) 19 2) 21 3) 3 4) 7
68. Consider the three linear equations with respect to X, Y, Z as
- (x) $X + Y + 2Z = 0$
 $(f(x))X + 3Y + x^2Z = 0$
 $(5x)X + 6Y + Z = 0$
- having non-trivial solution for X, Y, Z . The curve $f(x)$:
- 1) is always increasing 2) is always decreasing
 3) has exactly one critical point 4) has three critical points
69. The value of $\int \frac{(1+x)}{x(1+xe^x)^2} dx$, is equal to
- 1) $\log \left| \frac{xe^x}{1+xe^x} \right| + \frac{1}{1+xe^x} + C$ 2) $\log \left| \frac{x}{1+xe^x} \right| + \frac{1}{x(1+xe^x)} + C$
 3) $\log \left| \frac{xe^x}{1+e^x} \right| + \frac{1}{1+xe^x} + C$ 4) None of the above
70. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by $f(x) = 2x^3 - 21x^2 + 78x + 24$. Number of integers in the solutions set of x satisfying the inequality $f(f(f(x) - 2x^3)) \geq f(f(2x^3 - f(x)))$ is
- 1) 3 2) 4 3) 5 4) 6
71. If $\int \frac{\cos x - \sin x + 1 - x}{e^x + \sin x + x} dx = \ln \{f(x)\} + g(x) + C$, where C is the constant of integrating and $f(x)$ is positive, then $\frac{f(x) + g(x)}{e^x + \sin x}$ is equal to
- 1) 1 2) 0 3) 2 4) 3





72. Let $f(x)$ be an odd function defined on \mathbb{R} such that $f(1) = 2, f(3) = 5$ and $f(-5) = -1$. The value of $\frac{f(f(f(-3))) + f(f(0))}{3f(1) - 2f(3) - f(5)}$ is
- 1) $-\frac{2}{5}$ 2) $-\frac{2}{3}$ 3) $\frac{2}{5}$ 4) $\frac{2}{3}$
73. If $\int e^{x^3+x^2-1} (3x^4 + 2x^3 + 2x) dx = h(x) + c$. Then the value of $h(1) \cdot h(-1)$ is _____
- 1) 0 2) 1 3) 2 4) 3
74. Suppose that $f(0) = -3$ and $f'(x) \leq 5$ for all values of x then the largest value which $f(2)$ can attain is:
- 1) 7 2) -7 3) 13 4) 8
75. **Statement I:** If $f(x) = x^2 + bx + c$ and $f(2+t) = f(2-t)$ for all real numbers t , then $f(1) < f(2) < f(4)$
- Statement II:** If $f(x) = x^2 + bx + c$ and $f(2+t) = f(2-t)$ for all real numbers t , then $f(2) < f(1) < f(4)$
- 1) Statement I is true, Statement II is false
- 2) Statement I is false, Statement II is true
- 3) Statement I is false, Statement II is false
- 4) Statement I is true, Statement II is true
76. **Statement I:** The largest term in the sequence $a_n = \frac{n^2}{n^3 + 200}, n \in \mathbb{N}$ is $\frac{(400)^{2/3}}{600}$
- Statement II:** $f(x) = \frac{x^2}{x^3 + 200}, x > 0$, then at $x = (400)^{1/3}, f(x)$ is maximum.
- 1) Statement I is true, Statement II is also true, Statement II is the correct explanation of Statement I
- 2) Statement I is true, Statement II is also true, Statement II is not the correct explanation of Statement I
- 3) Statement I is true, Statement II is false
- 4) Statement I is false, Statement II is true





77. $\int \sin 51x (\sin x)^{49} dx$ equals:

1) $\frac{\sin 50x (\sin x)^{50}}{50} + C$

2) $\frac{\cos 50x (\sin x)^{50}}{50} + C$

3) $\frac{\cos 50x (\cos x)^{50}}{50} + C$

4) $\frac{\sin 50x (\sin x)^{51}}{51} + C$

78. $\int \frac{(x^2 - 1)dx}{(x^4 + 3x^2 + 1)\tan^{-1}\left(\frac{x^2 + 1}{x}\right)} = \ln|f(x)| + C$ then $f(x)$ is:

1) $\ln\left(x + \frac{1}{x}\right)$

2) $\tan^{-1}\left(x + \frac{1}{x}\right)$

3) $\cot^{-1}\left(x + \frac{1}{x}\right)$

4) $\ln\left[\tan^{-1}\left(x + \frac{1}{x}\right)\right]$

79. If $\int \frac{dx}{x + x^{2011}} = f(x) + C_1$ and $\int \frac{x^{2009}}{1 + x^{2010}} dx = g(x) + C_2$ (where C_1 and C_2 are constants of integration).

Let $h(x) = f(x) + g(x)$. If $h(1) = 0$, then $h(e)$ is equal to:

1) 0

2) 1

3) e

4) 2

80. Consider the polynomial function $f(x) = \frac{x^7}{7} - \frac{x^6}{6} + \frac{x^5}{5} - \frac{x^4}{4} + \frac{x^3}{3} - \frac{x^2}{2} + x$

Statement I: The equation $f(x) = 0$ cannot have two or more roots.

Statement II: Rolle's theorem is not applicable for $y = f(x)$ on any interval $[a, b]$, where $a, b \in \mathbb{R}$.

1) Statement I is true, Statement II is also true, Statement II is the correct explanation of Statement I

2) Statement I is true, Statement II is also true, Statement II is not the correct explanation of Statement I

3) Statement I is true, Statement II is false

4) Statement I is false, Statement II is true

(NUMERICAL VALUE TYPE)

Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. 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.

81. If the functions $f(x) = (k^2 - 3k + 2)x^2 + (k^2 - 1) \forall x \in \mathbb{R}$ and

$g(x) = (k^2 - 6k + 5)x^3 + (k^2 - 2k + 1)x + (k^2 - k) \forall x \in \mathbb{R}$ have the same graph, then the number of real values of k , is:





82. Let $f(x) = \lim_{n \rightarrow \infty} \ln \left(\sqrt{e^{\cos x}} \sqrt{e^{3 \cos x}} \sqrt{e^{5 \cos x}} \dots \sqrt{e^{(2n+1) \cos x}} \right)$. If $g(x) = \left[\frac{1}{3} f(x) \right]$, then find the number of points in $[0, 2\pi]$ where $g(x)$ is discontinuous.
[Note: $[y]$ denotes greatest function less than or equal to y .]
83. The smallest natural number c for which the equation $e^x = cx^2$ has exactly three real and distinct solutions, is
84. If the equation $x^3 - 3x + 1 = 0$ has three real roots x_1, x_2, x_3 , where $x_1 < x_2 < x_3$, then the value of $(\{x_1\} + \{x_2\} + \{x_3\})$ is equal to:
[Note: $\{x\}$ denotes the fractional part of x .]
85. If a twice differentiable function satisfying a relation $f(x^2y) = x^2f(y) + yf(x^2)$, $\forall x, y > 0$ and $f'(1) = 1$, then the value of $f''\left(\frac{1}{7}\right)$ is
86. Let $f(x)$ be a cubic polynomial with leading coefficient unity such that $f(0) = 1$ and all the roots of $f'(x) = 0$ are also roots of $f(x) = 0$. If $\int f(x) dx = g(x) + C$, where $g(0) = \frac{1}{4}$ and C is constant of integration, then $g(3) - g(1)$ is equal to:
87. Let $f: \left[0, \frac{\pi}{2}\right] \rightarrow \mathbb{R}$ be continuous and satisfy $f'(x) = \frac{1}{1 + \cos x}$ for all $x \in \left(0, \frac{\pi}{2}\right)$. If $f(0) = 3$, then $f\left(\frac{\pi}{2}\right)$ has the value equal to:
88. If $\int \frac{(2x+3)dx}{x(x+1)(x+2)(x+3)+1} = C - \frac{1}{f(x)}$ where $f(x)$ is of the form of $ax^2 + bx + c$ then $(a+b+c)$ equals:
89. Suppose $\int \frac{1-7\cos^2 x}{\sin^7 x \cos^2 x} dx = \frac{g(x)}{\sin^7 x} + C$, where c is an arbitrary constant of integration. Then find the value of $g'(0) + g''\left(\frac{\pi}{4}\right)$.
90. If $\int \frac{(x-1)dx}{(x+x\sqrt{x}+\sqrt{x})\sqrt{\sqrt{x}(x+1)}} = 4 \tan^{-1}[g(x)] + C$ where C is an arbitrary constant of integration. Find $g^2(1)$.





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