



Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: **Sr.Super60_NUCLEUS&STERLING_BT**

JEE-MAIN

Date: 19-08-2023

Time: 09.00Am to 12.00Pm

RPTM-03

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.

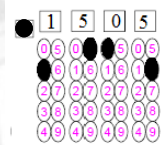
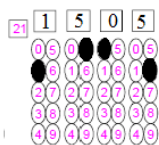
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

(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: _____

**19-08-23_ **Sr.Super60_NUCLEUS&STERLING_BT** _Jee-Main_ **RPTM-03**_Test Syllabus****PHYSICS**

: Wave optics: Wave nature of light: Huygen's principle, interference limited to Young's double slit experiment. Diffraction due to a single slit. Polarization of light, plane polarized light; Brewster's law, Polaroids. Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers, Resolving power of microscopes and astronomical telescopes.

15Q-RPTM.3 SYLLABUS+15Q CUMULATIVE SYLLABUS**CHEMISTRY**

: Alkene & Alkyne: Preparation, properties and reactions of alkenes and alkynes. Physical properties of alkenes and alkynes (boiling point, density and dipole moments); Acidity of alkynes; Acid catalysed hydration of alkenes and alkynes (excluding the stereochemistry of addition and elimination); Reactions of alkenes; Preparation of alkenes and alkynes by elimination reactions; Electrophilic addition reactions of alkenes with X_2 , HX , HOX (X =halogen); Effect of peroxide on addition reactions; cyclic polymerization reaction of alkynes, Addition reactions of alkynes; Metal acetylides. Reactions of alkenes with $KMnO_4$ and ozone; Reduction of alkenes and alkynes

15Q-RPTM.3 SYLLABUS+15Q CUMULATIVE SYLLABUS**MATHEMATICS : TOTAL DIFFERENTIAL CALCULUS****15Q-RPTM.3 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.

- A metal ball immersed in alcohol weighs W_1 at 0°C and W_2 at 50°C . The coefficient of expansion of cubical the metal is less than that of the alcohol. Assuming that the density of the metal is large compared to that of alcohol, it can be shown that
 1) $W_1 > W_2$ 2) $W_1 = W_2$ 3) $W_1 < W_2$ 4) None of these
- When M_1 gram of ice at -10°C (Specific heat = $0.5\text{ cal g}^{-1} {}^\circ\text{C}^{-1}$) is added to M_2 gram of water at 50°C , finally no ice is left and the water is at 0°C . The value of latent heat of ice, in cal g^{-1} is:
 1) $\frac{50M_2}{M_1} - 5$ 2) $\frac{5M_1}{M_2} - 50$ 3) $\frac{50M_2}{M_1}$ 4) $\frac{5M_2}{M_1} - 5$
- Two spherical stars A and B emit blackbody radiation. The radius of A is 400 times that of B and A emits 10^4 times the power emitted from B. The ratio $\left(\frac{\lambda_A}{\lambda_B}\right)$ of their wavelengths λ_A and λ_B at which the peaks occur in their respective radiation curves is
 1) 2 2) 5 3) 7 4) 3
- A metallic sphere cools from 50°C to 40°C in 300 s. if atmospheric temperature around is 20°C , then the sphere's temperature after the next 5 minutes will be close to:
 1) 31°C 2) 33.3°C 3) 28°C 4) 35°C
- A heat engine is involved with exchange of heat of 1915 J , -40 J , $+125\text{ J}$ and $-Q\text{ J}$, during one cycle achieving an efficiency of 50.0%. The value of Q is:
 1) 640 J 2) 40 J 3) 980 J 4) 400 J
- A convex lens is in contact with concave lens. The magnitude of the ratio of their focal length is $2/3$. Their equivalent focal length is 30 cm. What are their individual focal lengths?
 1) -15,10 2) -10,15 3) 75,50 4) -75,50



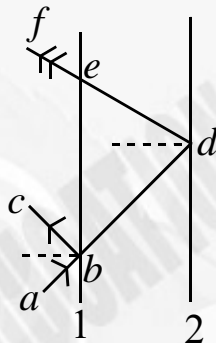


7. **Assertion :** Image formed by a convex mirror can never be real.
Reason : Convex mirror is diverging in nature.
- 1) If both **Assertion (A)** and **Reason (R)** are correct and **Reason (R)** is the correct explanation of the **Assertion (A)**
 - 2) If both **Assertion (A)** and **Reason (R)** are correct but **Reason (R)** is not correct explanation of **Assertion (A)**
 - 3) If **Assertion (A)** is correct but **Reason (R)** is incorrect
 - 4) If **Assertion (A)** is incorrect but **Reason (R)** is correct
8. **Assertion :** If angle of incidence in case of a prism is gradually increased, then deviation produced by prism will first decrease, then increase.
- Reason :** At minimum deviation, $\eta = \frac{A}{2}$.
- 1) If both **Assertion (A)** and **Reason (R)** are correct and **Reason (R)** is the correct explanation of the **Assertion (A)**
 - 2) If both **Assertion (A)** and **Reason (R)** are correct but **Reason (R)** is not correct explanation of **Assertion (A)**
 - 3) If **Assertion (A)** is correct but **Reason (R)** is incorrect
 - 4) If **Assertion (A)** is incorrect but **Reason (R)** is correct
9. A thin air film is formed by putting the convex surface of a plane-convex lens over a plane glass plate. With monochromatic light, this film gives an interference pattern due to light reflected from the top (convex) surface and the bottom (glass plate) surface of the film.
- Statement 1:** When light reflects from the air-glass plate interface, the reflected wave suffers a phase change of π .
- Statement 2:** The centre of the interference pattern is dark.
- 1) Statement 1 is true but statement 2 is false
 - 2) Statement 1 is true, statement 2 is true,
 - 3) Statement 1 is false, statement 2 is false
 - 4) Statement 1 is false but statement 2 is true
10. A myopic adult has a far point at 0.1 m. His power of accommodation is 4D.
- Statement 1:** Power of lens are required to see distant object is $-10D$
- Statement 2 :** Nearest point without glasses is $0.07m$
- 1) Statement 1 is true but statement 2 is false
 - 2) Statement 1 is true, statement 2 is true,
 - 3) Statement 1 is false, statement 2 is false
 - 4) Statement 1 is false but statement 2 is true

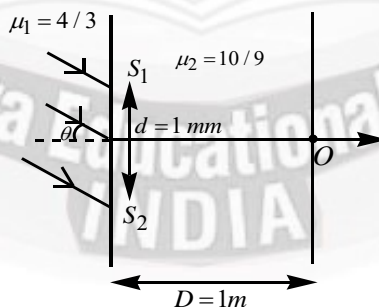




11. A narrow monochromatic beam of light of intensity I is incident on a glass plate labeled 1 as shown in figure (not drawn to scale). Another identical glass plate labeled 2 is kept close to the first one and parallel to it. Each glass plate reflects 25% of the light incident on it and transmits the remaining. Find the ratio $\sqrt{\frac{I_{\max}}{I_{\min}}}$ of the interference pattern formed by two beams obtained after one reflection at each plate. (I_{\max} and I_{\min} represent the maximum value and minimum value of intensity respectively. Ignore the distance between plates 1 and 2 in the diagram. It is drawn for the sake of readability. Consider only the first reflection from the glass plates)



- 1) 3 2) 5 3) 6 4) 7
12. The two coherent sources with intensity ratio β produce interference. The fringe visibility will be:
- 1) $\frac{2\sqrt{\beta}}{1+\beta}$ 2) 2β 3) $\frac{2}{(1+\beta)}$ 4) $\frac{\sqrt{\beta}}{(1+\beta)}$
13. In YDSE experiment shown in the figure, a parallel beam of light of wavelength $\lambda = 0.4 \text{ mm}$ in air, is incident at an angle $\theta = 30^\circ$ as shown. If the intensity due to each light source at point 'O' is I_0 , then the resultant intensity at point 'O' will be (Refractive indices of media before and after the plane of slits are shown in the figure)



- 1) Zero 2) $2I_0 \left[1 + \cos\left(\frac{40\pi}{9}\right) \right]$ 3) $3I_0$ 4) I_0



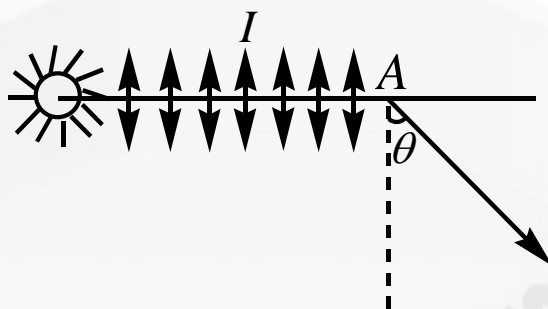


14. A plane wave front of light, whose wavelength can be varied continuously, falls normally on a uniform thin film of oil which covers a glass plate. Constructive interference is observed in reflected light for $\lambda_1 = 5000 \text{ \AA}$ and $\lambda_2 = 7500 \text{ \AA}$ and for no other wavelength in between. If μ of oil is 1.25 and that of glass is 1.5, the thickness of oil nearly will be:
- 1) $\frac{1}{5} \mu\text{m}$ 2) $\frac{2}{3} \mu\text{m}$ 3) $\frac{3}{5} \mu\text{m}$ 4) $\frac{1}{10} \mu\text{m}$
15. A glass plate of reflective index $\mu_3 = 1.5$ is coated with a thin layer of thickness t and refractive index $\mu_2 = 1.8$. Light of wavelength λ travelling in air is incident normally on the layer. It is partly reflected at the upper and the lower surfaces of the layer and the two reflected rays interfere. If $\lambda = 648 \text{ nm}$. The least value of t for which the waves interfere constructively is
- 1) 90 nm 2) 180 nm 3) 108 nm 4) 216 nm
16. In YDSE how many maxima can be obtained on the screen if wavelength of light used is 200 nm and $d = 700 \text{ nm}$:
- 1) 12 2) 7 3) 18 4) 5
17. A slit of width d is placed in front of a lens of focal length 0.5m and is illuminated with light of wavelength $5.89 \times 10^{-7} \text{ m}$. The first diffraction minima on either side of the central diffraction maximum are separated by $2 \times 10^{-3} \text{ m}$. The width d of the slit is (approximately in m)
- 1) 2.045×10^{-4} 2) 2.105×10^{-4} 3) 2.945×10^{-4} 4) 0.125×10^{-4}
18. In a Fraunhofer diffraction experiment at a single slit using light of wavelength 400 nm, the first minimum is formed at an angle of 30° with the direction of incident light. Then the angular position θ (with the direction of incident light) of the first secondary maximum is
- 1) $\tan^{-1}\left(\frac{4}{3}\right)$ 2) 60° 3) $\sin^{-1}\left(\frac{3}{4}\right)$ 4) $\tan^{-1}\left(\frac{3}{4}\right)$





19. Unpolarized light of intensity I scattered from point A. Intensity of light perceived by given observer is:



- 1) I 2) $\frac{I}{2} \cos^2 \theta$ 3) $\frac{I}{2} + \frac{I}{2} \sin^2 \theta$ 4) $\frac{I}{2} + \frac{I}{2} \cos^2 \theta$
20. When the angle of incidence on a material is 60° , the reflected light is completely polarized. The velocity of the refracted ray inside the material in m/s is
- 1) 3×10^8 2) $\frac{3}{\sqrt{2}} \times 10^8$ 3) $\sqrt{3} \times 10^8$ 4) 0.5×10^8

(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.

21. A geyser heats water flowing at a rate of 2.0 kg per minute from 30°C to 70°C . If geyser operates on a gas burner, the rate of combustion of fuel will be _____ g min^{-1}
22. 1 mole of rigid diatomic gas performs a work of $\frac{Q}{5}$ when heat Q is supplied to it. The molar heat capacity of the gas during this transformation is $\frac{xR}{8}$. The value of x is _____.
[R = universal gas constant]
23. A thin lens of refractive index 1.5 has a focal length of 15 cm in air. When the lens is placed in a medium of refractive index $\frac{4}{3}$, its focal length will become..... cm.
24. A ray of light is incident normally on one of the faces of a prism of apex angle 30° and refractive index $\sqrt{2}$. The angle of deviation of the ray is... degrees.





25. A compound microscope consists of an objective lens of focal length 1 cm and an eye piece of focal length 5 cm with a separation of 10 cm.
- The distance between an object and the objective lens, at which strain on the eye is minimum is $\frac{n}{40} \text{ cm}$. The value of n is _____.
26. A thin glass plate receives light from one side. Each surface of the glass plate reflects 20 percent of light incident on it and rest is refracted. The ratio of the maximum and minimum intensities in the reflected light due to interference between the first two order reflected beam is x , and in transmitted light the same ratio is y , then if $\frac{x}{y}$ is $6n$. find n
27. Interference fringes were produced with white light by a double slit arrangement. When a mica sheet of uniform thickness of refractive index 1.6 (relative to air) is placed in the path of light from one of the slits. The central fringe moves through a distance equal to the width of 30 interference bands if light of wavelength 4800 \AA is used. The thickness ($\text{in } 10^{-6} \text{ m}$) of mica is $4n$. Find n .
28. Light from a source emitting two wavelengths λ_1 and λ_2 is allowed to fall on Young's double slit apparatus after filtering one of the wavelengths. The position of interference maxima is noted. When the filter is removed i.e. both the wavelengths are now incident on the apparatus, it is found that maximum intensity is now produced where the fourth maximum occurred previously. If the other wavelength is filtered at the same location the third maxima is found. If $\lambda_1 : \lambda_2$ is $6:n$, find n
29. Two beams of light having intensities I and $4I$ interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\frac{\pi}{2}$ at point A and π at point B. The ratio of the resultant intensities at A and B is.....
30. A beam of unpolarised light of intensity I_0 is passed through a Polaroid A and then through another Polaroid B which is oriented so that its principle plane makes an angle of 45° relative to that of A. The intensity of the emergent light is $\frac{I_0}{n}$. The value of 'n' is



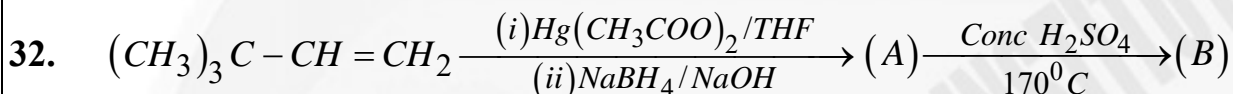
**CHEMISTRY****Max Marks: 100****(SINGLE CORRECT ANSWER TYPE)**

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.

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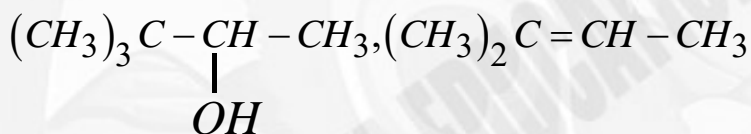
31. What characteristic is the best common to both cis-2-butene and trans-2-butene

- 1) Boiling point
- 2) Dipole moment
- 3) Heat of hydrogenation
- 4) Product of hydrogenation

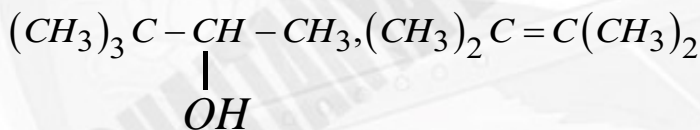


In the above reaction 'A' and 'B' are

- 1) $(CH_3)_3C-CH_2-CH_2-OH, (CH_3)_2C=CH-CH_3$

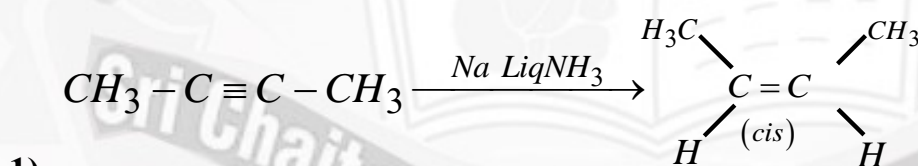


3)

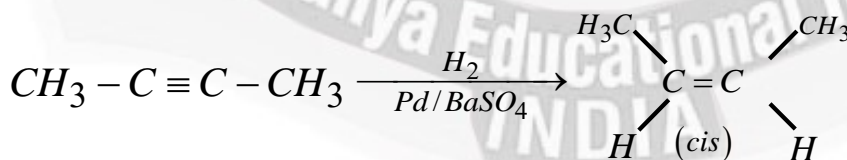


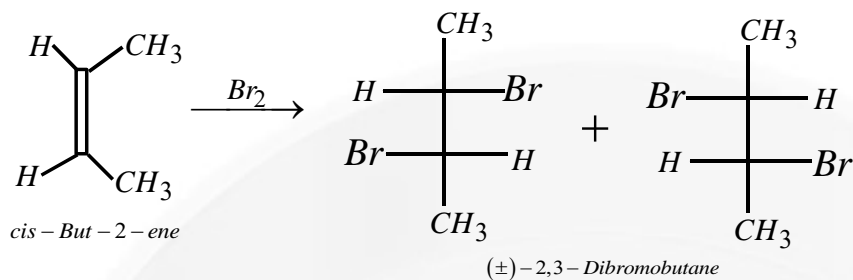
33.

Which is incorrect product?

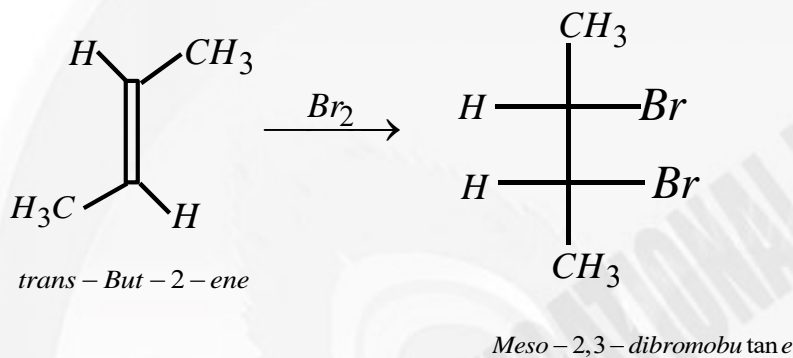


2)



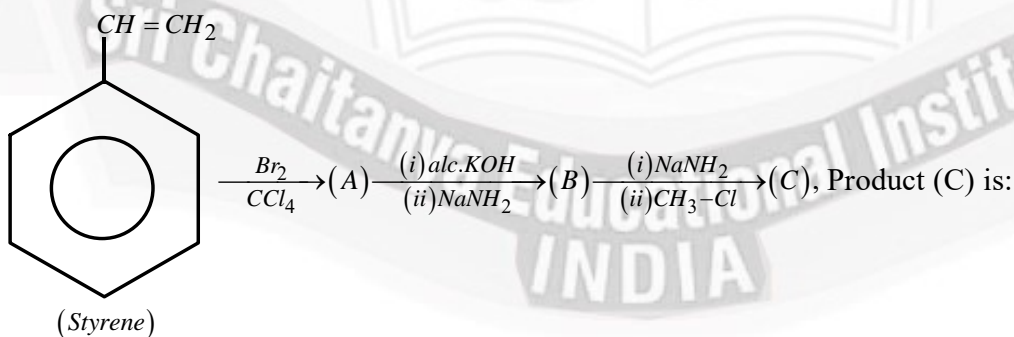
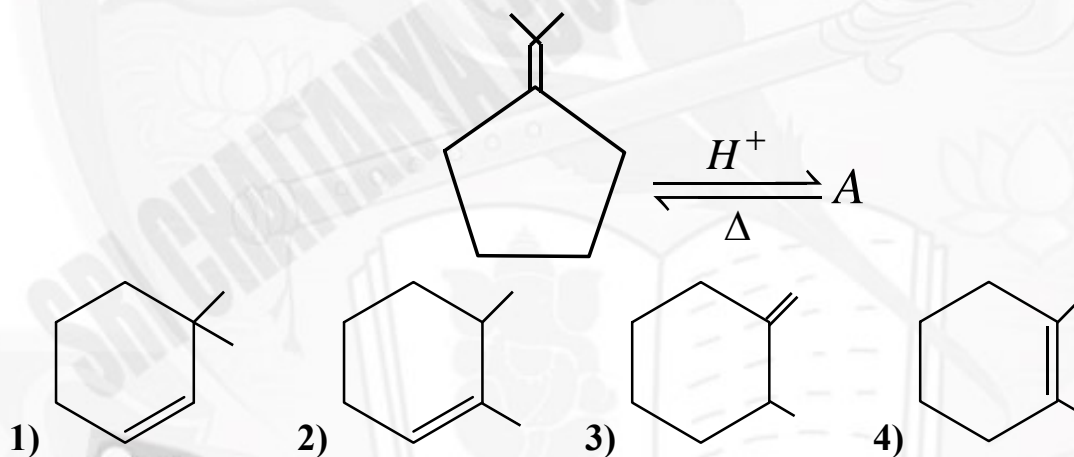


3)



4)

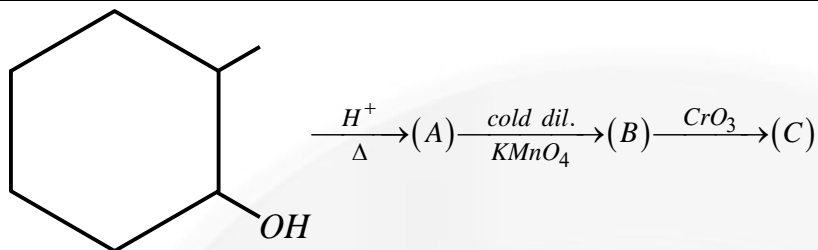
34. Predict the product (A) of the following reaction



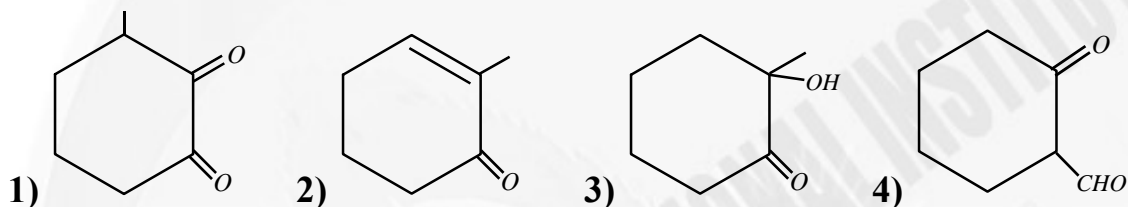
35.

- 1) $\text{Ph}-\text{C} \equiv \text{CNa}$ 2) $\text{Ph}-\text{CH}_2-\text{C} \equiv \text{CH}$
 3) $\text{Ph}-\text{C} \equiv \text{C}-\text{CH}_3$ 4) $\text{Ph}-\text{CH}=\text{C}=\text{CH}_2$





36. Product (C) of the reaction is:



37. **Assertion** : 1-Butene on reaction with HBr in presence of a peroxide produces 1-bromobutane.

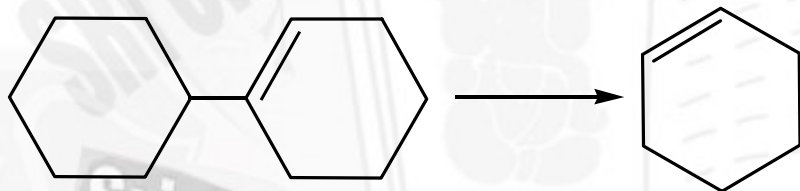
Reason: It involves the formation of a tertiary free radical.

1) If both **Assertion** (A) and **Reason** (R) are correct and **Reason** (R) is the correct explanation of the **Assertion** (A)

2) If both **Assertion** (A) and **Reason** (R) are correct but **Reason** (R) is not correct explanation of **Assertion** (A)

3) If **Assertion** (A) is correct but **Reason** (R) is incorrect

4) If **Assertion** (A) is incorrect but **Reason** (R) is correct



38. To achieve above conversion, the reagents used will be:

1) $O_3 / H_2O_2, HO^- / \Delta$

2) $HBr, alc.KOH, O_3, LiAlH_4, H^+ / \Delta$

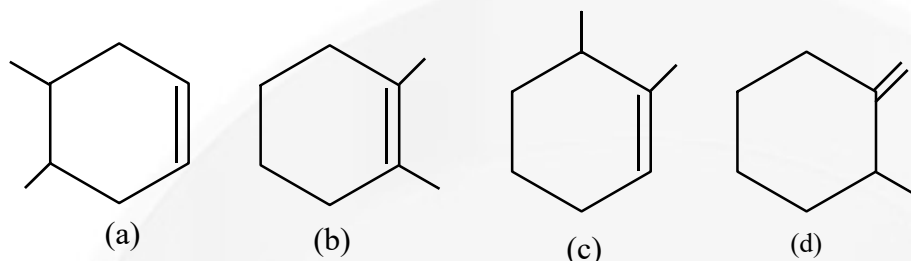
3) $HBr, t-BuOK, O_3, KMnO_4, \Delta$

4) $HCl, KMnO_4(cold), H^+ / \Delta$

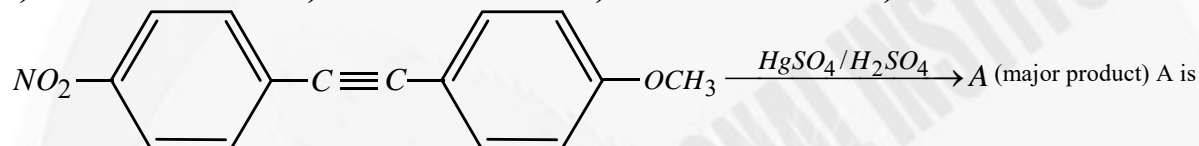




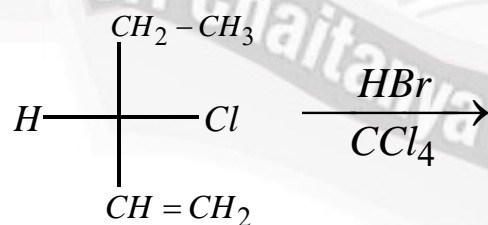
39. Decreasing order of heat evolved upon catalytic hydrogenation of given reactants with a $H_2(Pd/C)$ is:



- 1) $b > c > a > d$ 2) $d > a > c > b$ 3) $d > c > a > b$ 4) $a > b > c > d$



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



What is stereochemistry of product?

- 1) Racemic mixture 2) Optically inactive
3) Diastereomers 4) Meso product





42. One mole of 1, 2-dibromopropane on treatment with X moles of NaNH_2 followed by treatment with ethyl bromide gave a pentyne. The value of X is:

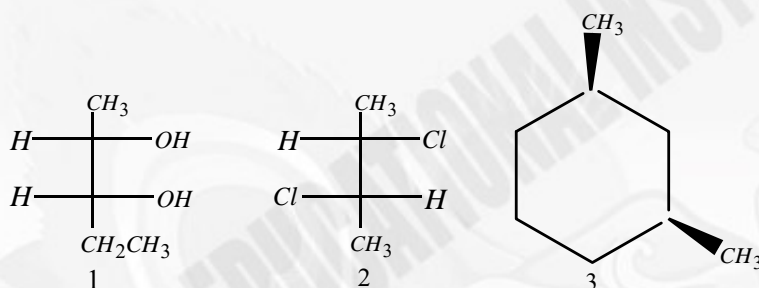
- 1) One 2) Two 3) Three 4) Four

43. $\text{HO}-\text{CH}_2-\text{CH}_2-\text{F}$
(2) (3)

Which conformer of above compound is most stable across C_2-C_3 ?

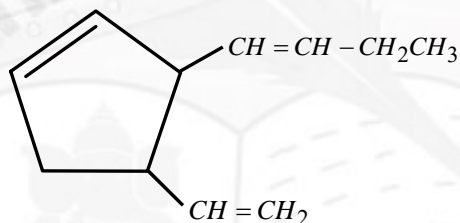
- 1) staggered 2) eclipsed (partially) 3) gauche 4) fully eclipsed

44. Which of the following compounds are meso forms?



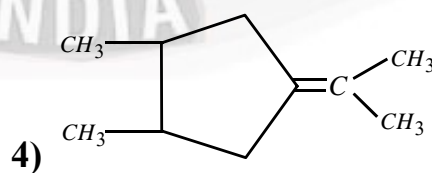
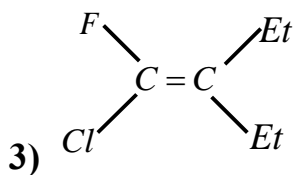
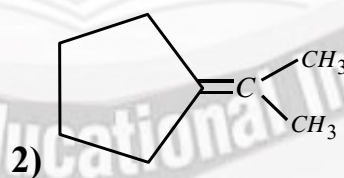
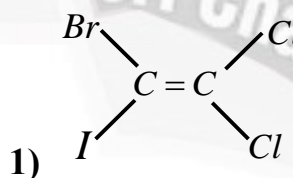
- 1) 1 only 2) 3 only 3) 1 and 2 4) 2 and 3

45. Total number of stereoisomers possible for following compound is:



- 1) 8 2) 16 3) 32 4) 64

46. Which of the following compound can show geometrical isomerism?





47. **Assertion** : All compounds having $C = C$ bond exhibit geometrical isomerism.
Reason : Rotation about $C = C$ bond is restricted.
1) If both **Assertion** (A) and **Reason** (R) are correct and **Reason** (R) is the correct explanation of the **Assertion** (A)
2) If both **Assertion** (A) and **Reason** (R) are correct but **Reason** (R) is not correct explanation of **Assertion** (A)
3) If **Assertion** (A) is correct but **Reason** (R) is incorrect
4) If **Assertion** (A) is incorrect but **Reason** (R) is correct
48. **Assertion** : Molecules that are not superimposable on their mirror images are chiral.
Reason : All chiral molecules have chiral centre.
1) If both **Assertion** (A) and **Reason** (R) are correct and **Reason** (R) is the correct explanation of the **Assertion** (A)
2) If both **Assertion** (A) and **Reason** (R) are correct but **Reason** (R) is not correct explanation of **Assertion** (A)
3) If **Assertion** (A) is correct but **Reason** (R) is incorrect
4) If **Assertion** (A) is incorrect but **Reason** (R) is correct
49. **Statement 1**: Addition of Br_2 to 1-butene gives two optical isomers
Statement 2: The product contains one a symmetric carbon
1) Statement 1 and Statement 2 are correct
2) Statement 1 is correct statement 2 is wrong
3) Statement 1 is wrong statement 2 is correct
4) Statement 1 and statement 2 are wrong.
50. **Statement 1**: The boiling point of n-alkanes increases with increase in number of carbon atoms
Statement 2: Vander waal's force of attraction increases with increase in number of carbon and molecular mass
1) Statement 1 and Statement 2 are correct
2) Statement 1 is correct statement 2 is wrong
3) Statement 1 is wrong statement 2 is correct
4) Statement 1 and statement 2 are wrong.

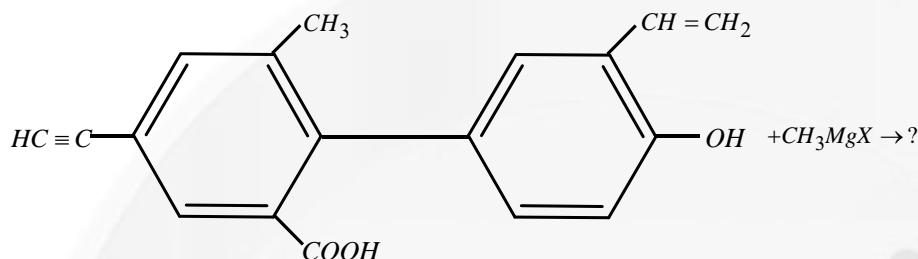




(NUMERICAL VALUE TYPE)

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.

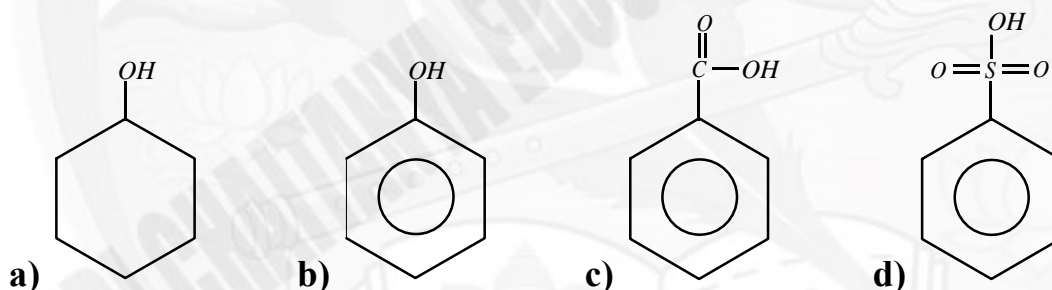


51.

How many mole alkane will be formed?

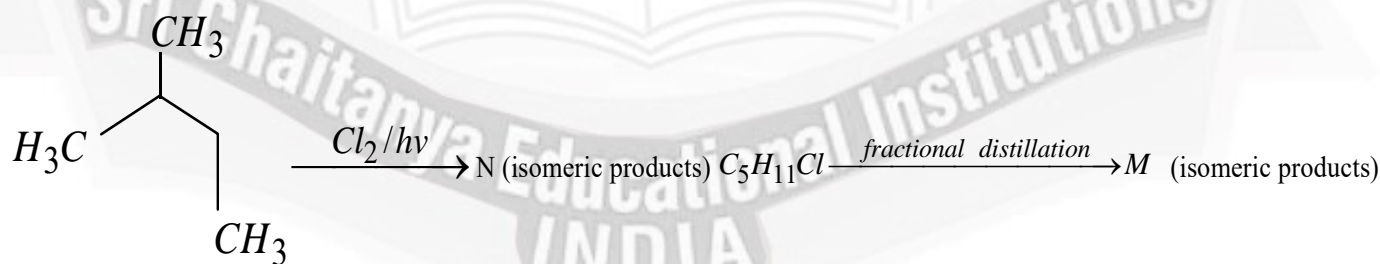
52. How many isomers of $\text{C}_4\text{H}_{10}\text{O}$ reacts with Na metal to evolve H_2 gas? (excluding stereoisomer)

53 Which of the following compound will react with NaHCO_3 or soluble in NaHCO_3 ?



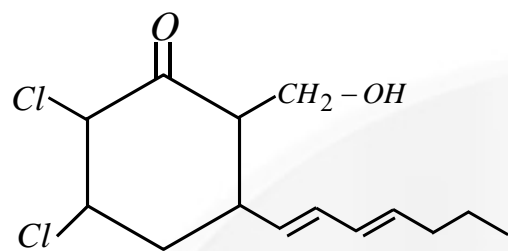
e) $\text{CH}_3 - \text{C}\equiv\text{CH}$

54.



Find the value of M

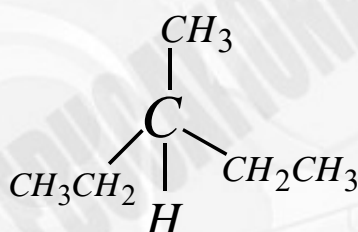




Number of stereoisomer are

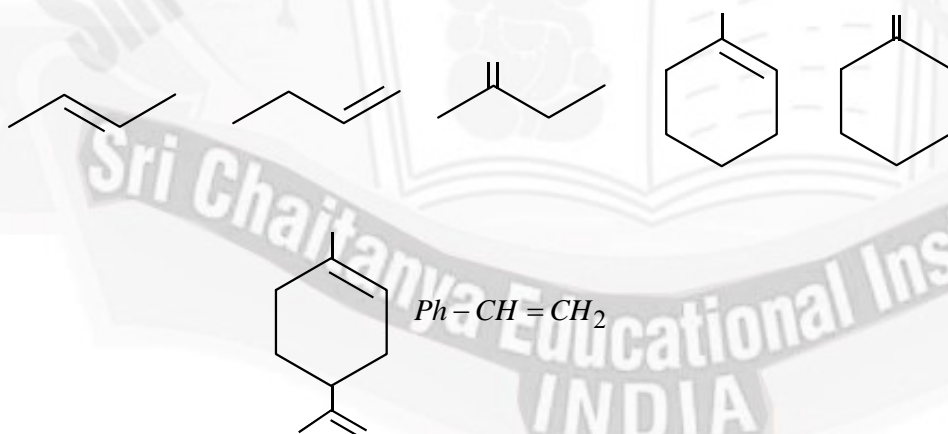
56. Find the total number of isomers of C_7H_{14} (only 5-membered ring). (including stereo)

57. The maximum number of isomers (including stereoisomers) that are possible on monochlorination of the following compound is



58. Number of Benzenoid compounds possible which can be represented by the molecular formula C_7H_8O is _____

59. Examine the structural formula of following compounds and find how many compounds will produce CO_2 on oxidative ozonolysis



60. If 3-bromo-4-methylhexane is treated with alc. KOH solution, how many different alkenes would be formed. (Including stereo isomers)



**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 domain of $f(x) = \frac{\log_{(x+1)}(x-2)}{e^{2\log_e x} - (2x+3)}$, $x \in R$ is
 1) $R - \{1, -3\}$ 2) $(2, 3) \cup (3, \infty)$ 3) $(-1, \infty) - \{3\}$ 4) $R - \{3\}$
62. **Statement 1:** The function, $f : R \rightarrow R$ given by $f(x) = 2x$ is one-one and onto.
Statement 2 : The function $f : R \rightarrow R$ defined by $f(x) = x^2$ is both one-one and onto.
 1) Statement 1 is false 2) Statement 2 is true
 3) Statement 1 is true Statement 2 is false
 4) Both Statement 1 and Statement 2 are true
63. The value of $\lim_{x \rightarrow 2} \frac{2^x + 2^{3-x} - 6}{\sqrt{2^{-x}} - 2^{1-x}}$ is
 1) 16 2) 8 3) 4 4) 2
64. **Assertion (A):** If the value of $\lim_{x \rightarrow 0} (2 - \cos x \sqrt{\cos 2x})^{\left(\frac{x+2}{x^2}\right)}$ is equal to e^a , then a^2 is equal to 9
Reason (R) : If $\lim_{x \rightarrow a} f(x) = 1$ and $\lim_{x \rightarrow a} g(x) = \infty$ then $\lim_{x \rightarrow a} [f(x)]^{g(x)} = e^{\lim_{x \rightarrow a} g(x)[f(x)-1]}$
 1) If both **Assertion (A)** and **Reason (R)** are correct and **Reason (R)** is the correct explanation of the **Assertion (A)**
 2) If both **Assertion (A)** and **Reason (R)** are correct but **Reason (R)** is not correct explanation of **Assertion (A)**
 3) If **Assertion (A)** is correct but **Reason (R)** is incorrect
 4) If **Assertion (A)** is incorrect but **Reason (R)** is correct
65. If $f : A \rightarrow B, g : B \rightarrow C$ are two functions such that $g \circ f : A \rightarrow C$ is onto then
 1) g is onto 2) g is into 3) g is one-one 4) f is onto
66. If $\lim_{x \rightarrow 0} \frac{e^{ax} - \cos(bx) - \frac{cxe^{-cx}}{2}}{1 - \cos(2x)} = 17$, then $\frac{5a^2 + b^2}{2}$ is equal to
 1) 68 2) 32 3) 34 4) 64





67. **Statement 1:** Let $f : R \rightarrow R$ be a function such that $f(2) = 4$ and $f'(2) = 1$. Then, the value of $\lim_{x \rightarrow 2} \frac{x^2 f(2) - 4f(x)}{x - 2}$ is 12

Statement 2 : $\lim_{x \rightarrow \frac{\pi}{2}} (\tan^2 x ((2\sin^2 x + 3\sin x + 4)^{\frac{1}{2}} - (\sin^2 x + 6\sin x + 2)^{\frac{1}{2}}))$ is equal to k

then $12k$ is 1

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

68. Let the function $f(x) = \begin{cases} \frac{\log_e(1+5x) - \log_e(1+\alpha x)}{x} & ; \text{ if } x \neq 0 \\ 10 & ; \text{ if } x = 0 \end{cases}$ be continuous at $x = 0$. The value of $|\alpha|$ is equal to:

- 1) 10
- 2) -10
- 3) 5
- 4) -5

69. Let $f : R \rightarrow R$ be defined as $f(x) = \begin{cases} \frac{\lambda |x^2 - 5x + 6|}{\mu(5x - x^2 - 6)}, & x < 2 \\ \frac{\tan(x-2)}{e^{x-[x]}}, & x > 2 \\ \mu & , x = 2 \end{cases}$ where $[x]$ is the greatest integer less than or equal to x . If $f(x)$ is continuous at $x = 2$, then $\lambda - \mu$ is equal to:

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

70. The number of points where the function $f(x) = \begin{cases} 1 + \left[\cos \frac{\pi x}{2} \right], & 1 < x \leq 2 \\ 1 - \{x\}, & 0 \leq x < 1 \\ |\sin \pi x|, & -1 \leq x < 0 \end{cases}$ and $f(1) = 0$ is

continuous but non-differentiable is/are (where $[.]$ and $\{.\}$ represent greatest integer and fractional part functions, respectively)

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





71. If the function $f(x) = \begin{cases} -x, & x < 1 \\ a + \cos^{-1}(x+b), & 1 \leq x \leq 2 \end{cases}$ is differentiable at $x = 1$, then b/a is equal to
- 1) $\frac{\pi+2}{2}$ 2) $\frac{2}{\pi+2}$ 3) $\frac{-\pi-2}{2}$ 4) $-1 - \cos^{-1}(2)$
72. Let $f: R \rightarrow R$ and $g: R \rightarrow R$ be respectively given by $f(x) = |x| + 1$ and $g(x) = x^2 + 1$. Define $h: R \rightarrow R$ by $h(x) = \begin{cases} \max \{f(x), g(x)\} & \text{if } x \leq 0 \\ \min \{f(x), g(x)\} & \text{if } x > 0 \end{cases}$. Then number of points at which $h(x)$ is not differentiable is
- 1) 2 2) 1 3) 4 4) 3
73. Suppose $f(x) = e^{ax} + e^{bx}$, where $a \neq b$, and that $f''(x) - 2f'(x) - 15f(x) = 0$ for all x . Then the product ab is
- 1) 25 2) 9 3) -15 4) -9
74. If $f(x) = \begin{cases} 2x - [x] + x \sin(x - [x]); & x \neq 0 \\ 0; & x = 0 \end{cases}$ where $[.]$ denotes the greatest integer function, then
- 1) $f(x)$ is differentiable at $x = 0$
 2) $f(x)$ is differentiable at $x = 2$
 3) $f(x)$ is continuous but not differentiable at $x = 0$
 4) $f(x)$ is discontinuous at $x = 0$
75. $f(x) = 4 \log_e(x-1) - 2x^2 + 4x + 5, x > 1$, which one of the following is NOT correct?
- 1) f is increasing in $(1, 2)$ and decreasing in $(2, \infty)$
 2) $f(x) = -1$ has exactly two solutions
 3) $f^1(e) - f^{11}(2) < 0$
 4) $f(x) = 0$ has a root in the interval $(e, e+1)$
76. The number of points on the curve $y = 54x^5 - 135x^4 - 70x^3 + 180x^2 + 210x$ at which the normal lines are parallel to $x + 90y + 2 = 0$ is l then $\frac{l}{4}$ is
- 1) 2 2) 3 3) 4 4) 1





77. The tangent and the normal lines at the point $(\sqrt{3}, 1)$ to the circle $x^2 + y^2 = 4$ and the x-axis form a triangle. Then the square of the area of this triangle (in square units) is:
- 1) $\frac{4}{3}$ 2) $\frac{1}{3}$ 3) $\frac{2}{\sqrt{3}}$ 4) $\frac{1}{\sqrt{3}}$
78. **Assertion (A):** A wire of length 20m is to be cut into two pieces. A piece of length l_1 is bent to make a square of area A_1 and the other piece of length l_2 is made into a circle of area A_2 . If $2A_1 + 3A_2$ is minimum then $(\pi l_1) : l_2$ is equal to 6:1
- Reason (R):** If the length of the side of square is a then its area is a^2 and if the radius of a circle is r then its area is πr^2 .
- 1) If both **Assertion (A)** and **Reason (R)** are correct and **Reason (R)** is the correct explanation of the **Assertion (A)**
- 2) If both **Assertion (A)** and **Reason (R)** are correct but **Reason (R)** is not correct explanation of **Assertion (A)**
- 3) If **Assertion (A)** is correct but **Reason (R)** is incorrect
- 4) If **Assertion (A)** is incorrect but **Reason (R)** is correct
79. Let $f(x)$ be a cubic polynomial with $f(1) = -10$, $f(-1) = 6$ and has a local minima at $x = 1$, and $f'(x)$ has a local minima at $x = -1$. Then $f(2)$ is equal to ____
- 1) 3 2) 22 3) -3 4) -22
80. The curve $y(x) = ax^3 + bx^2 + cx + 5$ touches the x-axis at the point $P(-2, 0)$ and cuts the y-axis at the point Q, where y^1 is equal to 3. Then the local maximum value of $y(x)$ is:
- 1) $\frac{27}{4}$ 2) $\frac{29}{4}$ 3) $\frac{37}{4}$ 4) $\frac{9}{2}$

(NUMERICAL VALUE TYPE)

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

81. Let $f(n) = \left[\frac{1}{3} + \frac{3n}{100} \right] n$, where $[n]$ denotes the greatest integer less than or equal to n . Then
- $\sum_{n=1}^{56} f(n)$ is equal to:





82. $\lim_{x \rightarrow \infty} \frac{(\sqrt{3x+1} + \sqrt{3x-1})^6 + (\sqrt{3x+1} - \sqrt{3x-1})^6}{(x + \sqrt{x^2-1})^6 + (x - \sqrt{x^2-1})^6} x^3$
83. If $f(x) = \sin\left(\cos^{-1}\left(\frac{1-2^{2x}}{1+2^{2x}}\right)\right)$ and its first derivative with respect to x is $-\frac{b}{a} \log_e 2$ when $x=1$, where a and b are integers, then the minimum value of $|a^2 + b^2|$ is ____
84. A curve is defined parametrically by the equations $x=t^2$ and $y=t^3$. A variable pair of perpendicular lines through the origin O meet the curve at P and Q . If the locus of the point of intersection of the tangents at P and Q is $ay^2 = bx - 1$, then the value of $(a+b)$ is ____.
85. The number of points where the function $f(x) = \begin{cases} |2x^2 - 3x - 7| & \text{if } x \leq -1 \\ [4x^2 - 1] & \text{if } -1 < x < 1, [t] \text{ denotes} \\ |x+1| + |x-2| & \text{if } x \geq 1 \end{cases}$ the greatest integer $\leq t$, is discontinuous is ____
86. A box, constructed from a rectangular metal sheet, is 21 cm by 16 cm by cutting equal squares of sides x from the corners of the sheet and then turning up the projected portions. The value of x so that volume of the box is maximum is ____
87. The surface area of balloon of spherical shape being inflated, increases at a constant rate. If initially, the radius of balloon is 3 units and after 5 seconds, it becomes 7 units, then its radius after 9 seconds is: ____
88. If the curves $x = y^4$ and $xy = k$ cut right angles, then $(4k)^{12}$ is equal to ____
89. If the functions $f(x) = \frac{x^3}{3} + 2bx + \frac{ax^2}{2}$ and $g(x) = \frac{x^3}{3} + ax + bx^2$, $a \neq 2b$ have a common extreme point, then $a + 2b + 9$ is equal to ____
90. The total number of local maxima and local minima of the function $f(x) = \begin{cases} (2+x)^3, & -3 < x \leq -1 \\ x^{2/3}, & -1 < x < 2 \end{cases}$ is ____





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10
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BELOW
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All India Open
Category Ranks

32

BELOW
1000
All India Open
Category Ranks

181

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