

FIITJEE - JEE (Main)

PHYSICS, CHEMISTRY & MATHEMATICS

BATCH: CTY 1921 batches

PHASE TEST – III

Q.P. CODE:

Time Allotted: 3 Hours

Maximum Marks: 300

- Do not open this Test Booklet until you are asked to do so.
- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections**.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each **Section** is further divided into **Two Parts: Part-A & C** in the OMR. Part-B of OMR to be left unused
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. No candidate is allowed to carry any textual material, printed or written, bits of papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices ext. except the Admit Card inside the examination hall / room.

B. Filling of OMR Sheet:

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with **Blue/Black Ball Point Pen** for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.
4. **Do not fold or make any stray marks on the Answer Sheet.**

C. Marking Scheme for All Two Parts:

- (i) **Part-A (01-20)** – Contains Twenty (20) multiple choice objective questions which have four (4) options each and only one correct option. Each question carries **+4 marks** will be awarded for every correct answer and **-1 mark** will be deducted for every incorrect answer.
- (i) **Part-C (01-05)** contains Five (05) Numerical based questions with single digit integer as answer, ranging from 0 to 9 (both inclusive). Each question carries **+4 marks** will be awarded for every correct answer and **NO MARKS** will be deducted for every incorrect answer.

Name of the Candidate : _____

Batch : _____ Date of Examination : _____

Enrolment Number : _____

Physics

PART – A

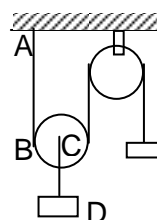
Straight Objective Type

This part contains **20 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

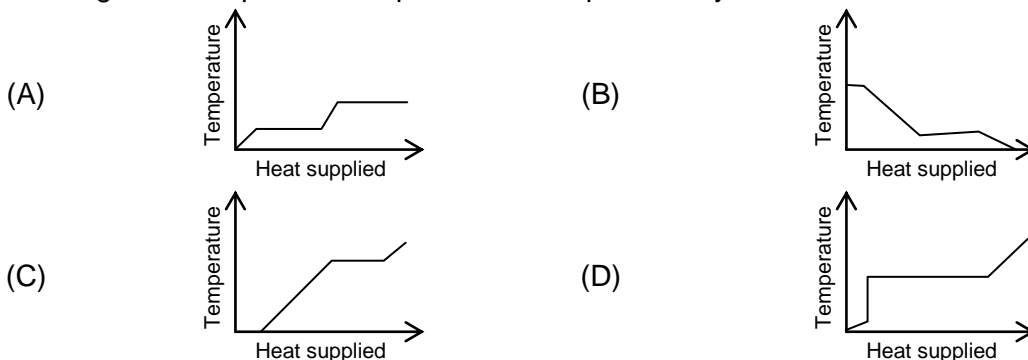
1. A particle of mass m moving along the x -axis has a potential energy $U(x) = a + bx^2$ where a and b are positive constants. It will execute simple harmonic motion with a frequency determined by the value of :
 (A) b alone (B) b and a alone (C) b and m alone (D) b, a and m alone

2. Suppose there is a hole in a copper plate. Upon heating the plate, diameter of hole would
 (A) increases (B) decreases
 (C) remains the same (D) none of these

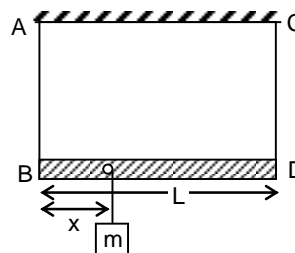
3. Both the string shown figure are made of same material and have same cross – section. The pulleys are light. The wave speed of a transverse wave in the string AB is v_1 and in CD it is v_2 . Then v_1/v_2 is
 (A) 1 (B) 2
 (C) $\sqrt{2}$ (D) $1/\sqrt{2}$



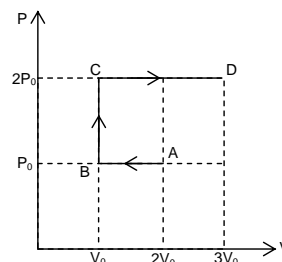
4. A block of ice at -10°C is slowly heated and converted to steam at 100°C . Which of the following curves represent the phenomenon qualitatively?



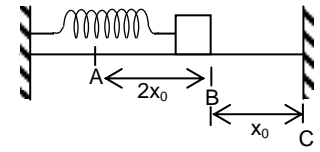
5. A massless rod is suspended by two identical strings AB and CD of equal length. A block of mass m is suspended from point O such that BO is equal to 'x'. Further, it is observed that the frequency of 1st harmonic (fundamental frequency) in AB is equal to 2nd harmonic frequency in CD. Then, length of BO is
 (A) $L/5$ (B) $4L/5$
 (C) $3L/4$ (D) $L/4$



6. $P - V$ diagram of an ideal gas is as shown, work done by the gas in the process ABCD is
 (A) $4 P_0 V_0$ (B) $2 P_0 V_0$
 (C) $3 P_0 V_0$ (D) $P_0 V_0$



7. One end of a spring of force constant k is fixed to a vertical wall and the other to a body of mass m resting on a smooth horizontal surface. There is another wall at a distance x_0 from body. The spring is then compressed by $2x_0$ and released. The time taken to strike the wall is



- (A) $\frac{\pi}{6} \sqrt{\frac{k}{m}}$ (B) $\sqrt{\frac{k}{m}}$
 (C) $\frac{2\pi}{3} \sqrt{\frac{m}{k}}$ (D) $\frac{\pi}{4} \sqrt{\frac{k}{m}}$

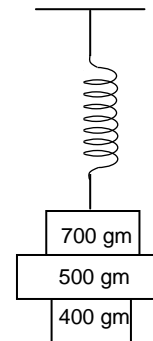
8. A particle executes simple harmonic motion with a frequency 'f'. The frequency with which its kinetic energy oscillates is
 (A) $f/2$ (B) f (C) $2f$ (D) $4f$

9. A cylindrical tube, open at both ends, has a fundamental frequency f in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now
 (A) $f/2$ (B) $3f/4$ (C) f (D) $2f$

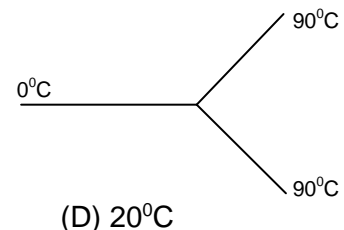
10. A particle executes simple harmonic motion between $x = -A$ and $x = +A$. The time taken for it to go from 0 to $A/2$ is T_1 and to go from $A/2$ to A is T_2 . Then
 (A) $T_1 < T_2$ (B) $T_1 > T_2$ (C) $T_1 = T_2$ (D) $T_1 = 2T_2$

11. The equation $Y = 0.02 \sin(500 \pi t) \cos(4.5x)$ represents
 (A) progressive wave of frequency 250 Hz along $x -$ axis.
 (B) a stationary wave of wavelength 1.4 m.
 (C) a transverse progressive wave of amplitude 0.02 m.
 (D) progressive wave of speed of about 350 ms^{-1} .

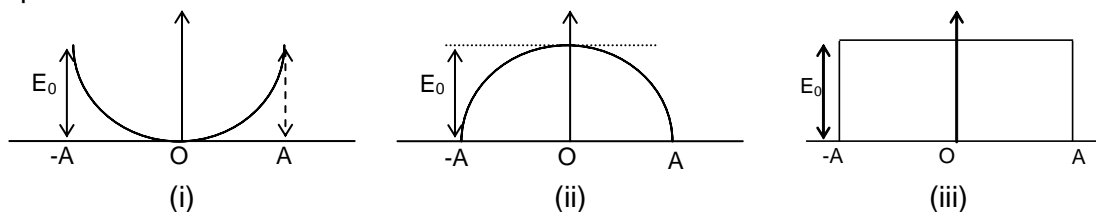
12. Three masses 700gm, 500gm and 400gm are suspended at the end of a massless spring as shown, when 700 gm is removed system oscillates with a period 3sec. What will be its period when 500gm is also removed
 (A) 1 sec (B) 2 sec
 (C) 3 sec (D) $\sqrt{\frac{12}{5}}$ sec



13. Three rods made of same material and having the same cross section have been joined as shown in the figure. Each rod is of the same length. The left and right ends are kept at 0°C and 90°C respectively. The temperature of the junction of the three rods will be
 (A) 45°C (B) 60°C (C) 30°C (D) 20°C



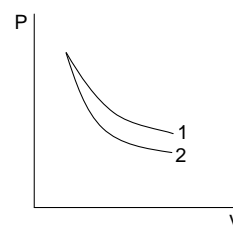
14. Graphs below represent the different energies during a SHM. Choose the correct representation



- (A) (i) Total mechanical energy
(ii) kinetic energy
(iii) Potential energy
- (B) (i) Potential energy
(ii) kinetic energy
(iii) Total mechanical energy
- (C) (i) Potential energy
(ii) Total mechanical energy
(iii) kinetic energy
- (D) None of these

15. P-V plots for two gases during adiabatic processes are shown in the figure. Plots 1 and 2 should correspond respectively to

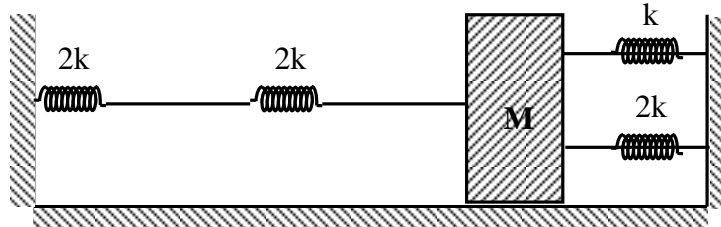
- (A) He and O₂ (B) O₂ and He
(C) He and Ar (D) O₂ and N₂



16. Which of the following is not true for the progressive wave $y = 4 \sin \left\{ 2\pi \left(\frac{t}{0.02} - \frac{x}{100} \right) \right\}$ where x & y are in cm and t in seconds?

- (A) The amplitude is 4 cm (B) The wavelength is 100 cm
(C) The frequency is 50Hz (D) The velocity of propagation is 2 cm/s

17. Four massless springs whose force constants are 2k, 2k, k and 2k respectively are attached to a mass M kept on a frictionless plane (as shown in figure). If the mass M is displaced in the horizontal direction, then the frequency of the system is

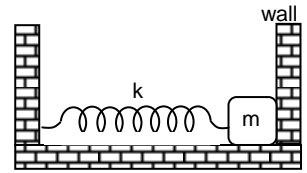


- (A) $\frac{1}{2\pi} \sqrt{\frac{k}{4M}}$ (B) $\frac{1}{2\pi} \sqrt{\frac{4k}{M}}$
(C) $\frac{1}{2\pi} \sqrt{\frac{k}{7M}}$ (D) $\frac{1}{2\pi} \sqrt{\frac{7k}{M}}$

18. Two liquids A and B are at 32°C and 24°C when mixed in equal masses the temperature of the mixture is found to be 28°C. Their specific heats are in the ratio of

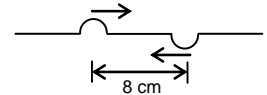
- (A) 3:2 (B) 2:3
(C) 1:1 (D) 4:3

19. In the figure, the block of mass m , attached to the spring of stiffness k is in contact with the completely elastic wall, and the compression in the spring is e . The spring is compressed further by e by displacing the block towards left and is then released. If the collision between the block and the wall is completely elastic then the time period of oscillations of the block will be



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

20. Two pulses in a stretched string whose centres are initially 8 cm apart are moving towards each other as shown in the figure. The speed of each pulse is 2 cm/s. After 2 seconds, the total energy of the pulses will be

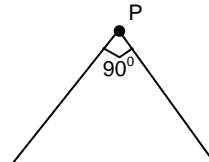


- (A) zero
 (B) purely kinetic
 (C) purely potential
 (D) partly kinetic and partly potential

PART-C
Integer Answer Type

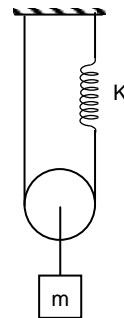
This section contains **5 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

1. S_1 and S_2 are two loudspeakers with the same frequency of 165 Hz and Intensity 1.6×10^{-3} and $2.5 \times 10^{-3} \text{ W/m}^2$ respectively. They vibrate in the same phase. P is a point at a distance 4 m from S_1 and 3m from S_2 . Intensity at P with S_1 and S_2 on is $\chi \times 10^{-4} \text{ W/m}^2$. Find χ (take velocity of sound = 330 m/s)
2. If P-V diagram of a diatomic gas is plotted, it is a straight line passing through origin. The molar heat capacity of the gas in the process is nR where n is an integer. Find the value of n .
3. A system of two identical rods (L shaped) of mass m , length L . System rest on a peg p as shown in the fig period of oscillations $T = 2\pi \sqrt{\frac{n\sqrt{2} L}{3g}}$ then $n = ?$



4. If γ is adiabatic exponent of a perfect gas. The no. of degree of freedom of a molecule of the gas is $\frac{n}{\gamma - 1}$ then $n = ?$

5. Figure below shows a massless pulley, a spring of constant $K = 250 \text{ N/m}$ and a mass 1 kg. On displacing the mass slightly, find its frequency (approximate) of its vertical oscillation



Space For Rough Work

Chemistry

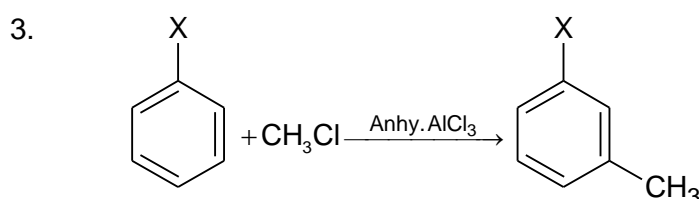
PART – A

Straight Objective Type

This part contains **20 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. The electronic effect of which of the following group is only due to sigma electrons?
 (A) OH (B) NO₂
 (C) Cl (D) CH₃

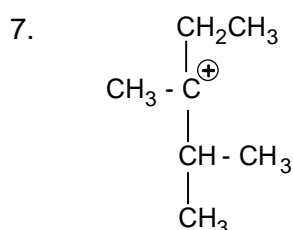
2. Which isomer of CH₃CH₂CH₂CH₂CH₂NH₂ is most basic in gaseous state?
 (A) Chain isomer (B) Position isomer
 (C) Functional isomer (D) Metamer



Which of the following can be 'X' in the above reaction?

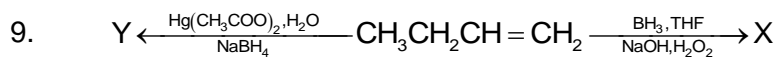
- (A) CH₃ (B) OH
 (C) CN (D) NH₂
4. $\text{CH}_3\text{Cl} + \text{C}_2\text{H}_5\text{Cl} \xrightarrow[\text{Dry ether}]{\text{Na}}$ Products
 Which is not a product of above reaction?
 (A) C₂H₆ (B) C₄H₁₀
 (C) C₃H₈ (D) C₅H₁₂
5. XCH₂CH₂COOH would be most acidic if 'X' is:
 (A) H (B) CH₃
 (C) NO₂ (D) Cl

6. Which of the following gas is NOT responsible for acid rain?
 (A) SO₂ (B) NO₂
 (C) CO₂ (D) CH₄



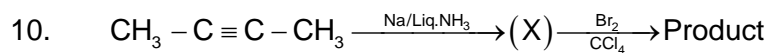
How many hyperconjugative structure(s) is/are possible for the above reaction intermediate (carbocation)?

- (A) 5 (B) 9
 (C) 6 (D) 8
8. $\text{CH}_3 - \text{CH} - \text{CH}_2\text{OH}$
 $\quad \quad \quad |$
 $\quad \quad \quad \text{CH}_3$
- How many functional isomer(s) is/are possible for the above compound?
- (A) 6 (B) 5
 (C) 4 (D) 3



The products X and Y are

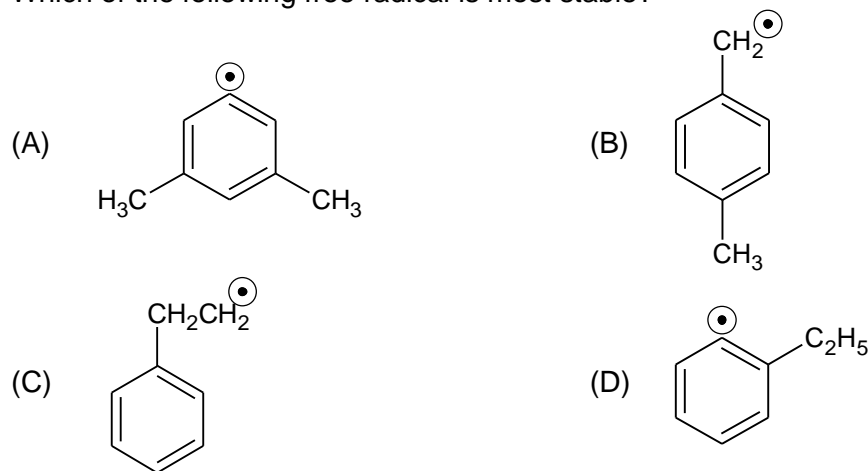
- (A) Chain isomers (B) Functional isomers
(C) Position isomers (D) Geometrical isomers



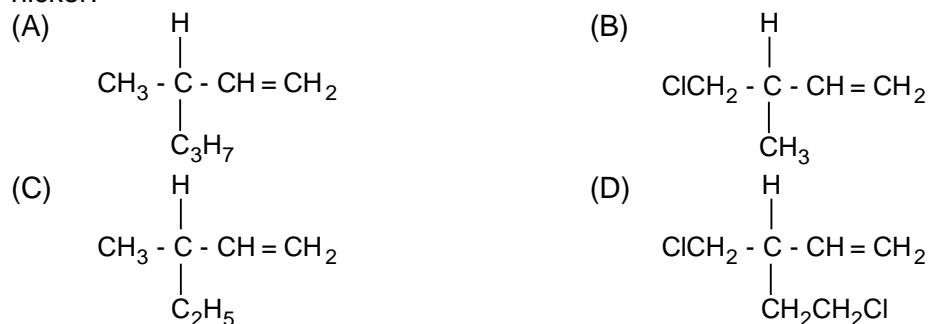
The end product(s) of above reaction is/are

- (A) a pair of enantiomers (B) a pair of diastereomers
(C) a meso compound (D) an optical active compound

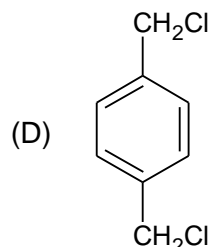
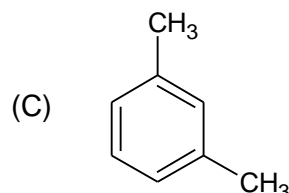
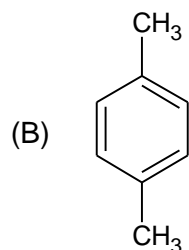
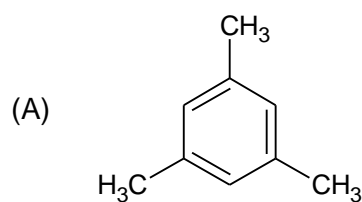
11. Which of the following free radical is most stable?



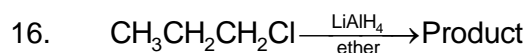
12. Which compound loses its optical activity due to hydrogenation reaction in presence of nickel?



13. Which of the following compounds forms more than one monosubstituted product in Friedel Craft's reaction?



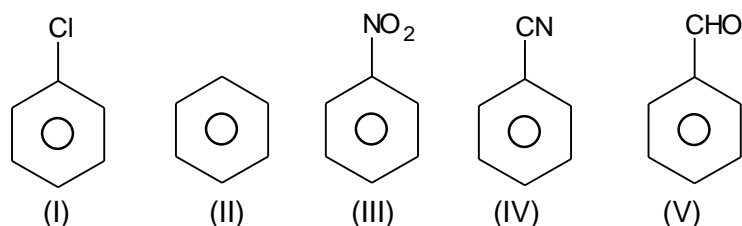
14. In Antarctica, ozone depletion is due to the formation of
 (A) peroxy acetyl nitrate (B) acrolein
 (C) SO₂ and SO₃ (D) chlorine nitrate
15. Which of the following substance is NOT responsible for depletion of ozone layer?
 (A) CFC1₃ (B) CHFCl₂
 (C) CF₂Cl₂ (D) CF₃Cl



The product of above reaction is:

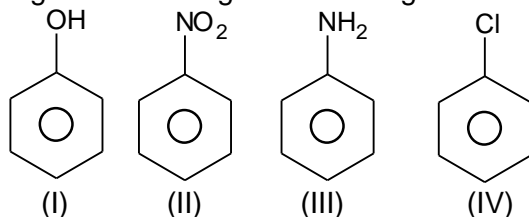
- (A) CH₃CH₂CH₃ (B) CH₃CH=CH₂
 (C) (CH₃CH₂CH₂)₃Al (D) CH₃CH₂CH₂Li
17. Which contains the shortest C-H bond in gaseous state?
 (A) CHF₃ (B) CHCl₃
 (C) CHBr₃ (D) CHI₃

18. Arrange the following in increasing order of their dipole moment.



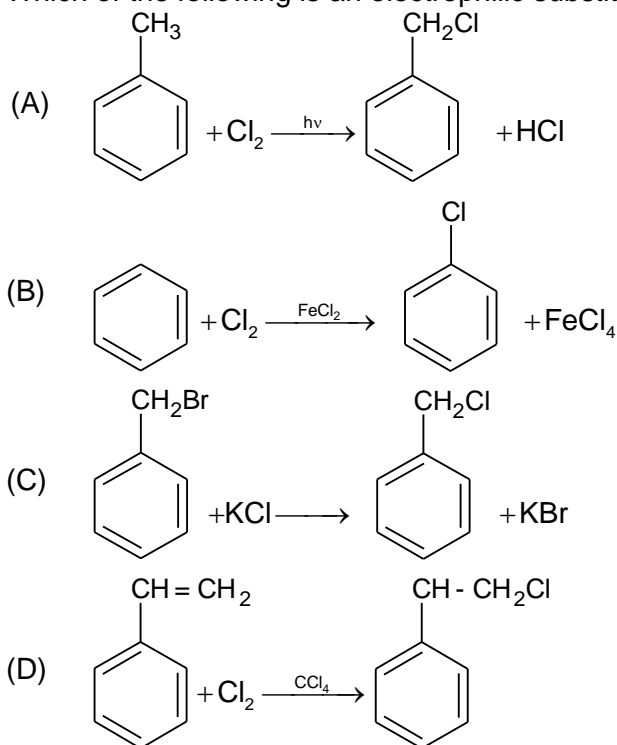
- (A) III > IV > V > I > II (B) III > V > IV > I > II
 (C) III > I > II > IV > V (D) None of these

19. Arrange the following in decreasing order of their reactivity towards EAS reaction.



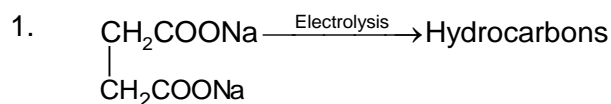
- (A) III > I > II > IV (B) III > IV > III > II
 (C) IV > III > I > II (D) IV > III > II > I

20. Which of the following is an electrophilic substitution reaction?

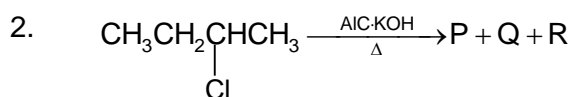


PART-C
Integer Answer Type

This section contains **5 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

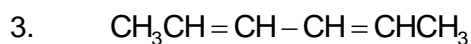


How many hydrogen atom(s) is/are present in the simplest hydrocarbon product of above reaction?

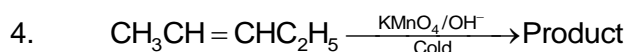


P and Q are a pair of geometrical isomers.

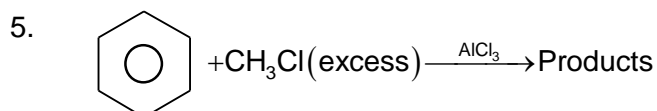
How many carbon atom(s) is/are present in the simplest ozonolysis product of 'R'?



How many geometrical isomer(s) is/are possible for the above compound?



How many asymmetric carbon atom(s) is/are present in the product of above reaction?



How many CH_3 group(s) can be present in the largest aromatic product of above reaction?

Space For Rough Work

Mathematics

PART – A

Straight Objective Type

This part contains **20 multiple choice questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

- Number of different words that can be formed using all the letters of the word "DEEPMALA", if two vowels are together and the other two are also together but separated from the first two is
 (A) 960 (B) 1200
 (C) 2160 (D) 1440
- If all the letters of the word "QUEUE" are arranged in all possible manner as they are in a dictionary, then the rank of the word QUEUE is
 (A) 15th (B) 16th
 (C) 17th (D) 18th
- The remainder obtained when $|1| + |2| + |3| + \dots + |95|$ is divided by 15 is
 (A) 3 (B) 14
 (C) 1 (D) none of these
- The sum ${}^{10}C_3 + {}^{11}C_3 + {}^{12}C_3 + \dots + {}^{20}C_3$ is equal to
 (A) ${}^{21}C_4$ (B) ${}^{21}C_4 + {}^{10}C_4$
 (C) ${}^{21}C_{17} - {}^{10}C_6$ (D) none of these
- The number of values of x in the interval $[0, 5\pi]$ satisfying the equation $3\cos 2x - 10\cos x + 7 = 0$ is
 (A) 5 (B) 6
 (C) 8 (D) 10
- If $|z| = 1$ and $\arg(z) = \frac{\pi}{4}$ and $\theta = \arg(z^5 - iz)$ then $2\cos\theta$ equal to
 (A) 0 (B) 1
 (C) 2 (D) none
- Number of ways in which 6 different toys can be distributed among two brothers in ratio 1 : 2, is
 (A) 30 (B) 60
 (C) 20 (D) 40
- The coefficient of x^4 of in the expansion $(1 + 5x + 9x^2 + \dots)(1 + x^2)^{11}$ is
 (A) ${}^{11}C_2 + 4{}^{11}C_1 + 3$ (B) ${}^{11}C_2 + 3{}^{11}C_1 + 4$
 (C) $3{}^{11}C_2 + 4{}^{11}C_1 + 3$ (D) 171
- In a ΔABC , $\tan \frac{A}{2}$ and $\tan \frac{B}{2}$ satisfy $6x^2 - 5x + 1 = 0$. Then:
 (A) $a^2 + b^2 > c^2$ (B) $a^2 - b^2 = c^2$
 (C) $a^2 + b^2 = c^2$ (D) none of these

10. Coefficient of x^5 in $(1+x^2)^5(1+x)^4$ is
 (A) 60 (B) 50
 (C) 40 (D) 56
11. The remainder when 27^{40} is divided by 12 is
 (A) 3 (B) 7
 (C) 9 (D) 11
12. Two ships are sailing in the sea on the two sides of a lighthouse. The angle of elevation of the top of the lighthouse is observed from the ships are 30° and 45° respectively. If the lighthouse is 100 m high, the distance between the two ships is:
 (A) 173 m (B) 200 m
 (C) 273 m (D) 300 m
13. Let $(5+2\sqrt{6})^n = l+f$ where $n \in \mathbb{N}$ and $l \in \mathbb{N}$ and $0 < f < 1$, then the value of $f^2 - f + lf - l$ is:
 (A) a natural number (B) a negative integer
 (C) a prime number (D) are irrational number
14. In any ΔABC , $\frac{s-a}{\Delta} = \frac{1}{8}$, $\frac{s-b}{\Delta} = \frac{1}{12}$ and $\frac{s-c}{\Delta} = \frac{1}{24}$ then $b =$
 (A) 16 (B) 20
 (C) 24 (D) 28
15. Number of solution of the equation $z^3 + \frac{3(\bar{z})^2}{|z|} = 0$, where z is a complex number is
 (A) 2 (B) 3
 (C) 6 (D) 5
16. If $a = \cos \alpha + i \sin \alpha$, $b = \cos \beta + i \sin \beta$, $c = \cos \gamma + i \sin \gamma$ and $\frac{a}{b} + \frac{b}{c} + \frac{c}{a} = 1$, then:
 $\cos(\alpha - \beta) + \cos(\beta - \gamma) + \cos(\gamma - \alpha) =$
 (A) $\frac{3}{2}$ (B) $\frac{-3}{2}$
 (C) 0 (D) 1
17. The most general solution of the equation $\tan \theta = -1$, $\cos \theta = \frac{1}{\sqrt{2}}$ is
 (A) $n\pi + 7\frac{\pi}{4}$ (B) $n\pi + (-1)^n \frac{7\pi}{4}$
 (C) $2n\pi + \frac{7\pi}{4}$ (D) none of these
18. The number of positive integral solution of the equation $x_1 x_2 x_3 x_4 x_5 = 1050$ is
 (A) 1800 (B) 1600
 (C) 1400 (D) none of these
19. Four dice are rolled. The number of possible outcomes in which at least one die shows 2 is
 (A) 1296 (B) 625
 (C) 671 (D) 1023

20. If $2 \sin^2 \left(\left(\frac{\pi}{2} \right) \cos^2 x \right) = 1 - \cos(\pi \sin 2x)$, $x \neq (2n+1) \frac{\pi}{2}$, $n \in \mathbb{I}$, then $\cos 2x$ is equal to
- (A) $\frac{1}{5}$ (B) $\frac{3}{5}$
 (C) $\frac{4}{5}$ (D) 1

PART-C
Integer Answer Type

This section contains **5 questions**. The answer to each of the questions is a single digit integer, ranging from **0 to 9**.

1. The number of solutions of the equation $\tan^2 \alpha - \operatorname{cosec}^2 \alpha + 4 \cot^2 2\alpha + 4 \tan \alpha \cot 2\alpha = 0$ in $\left(0, \frac{\pi}{2}\right) - \left\{\frac{\pi}{4}\right\}$ is _____
2. If $-3 + x^2yi$ and $x^2 + y + 4i$ are conjugate of each other, then $|x| + |y|$ is _____
3. If $\frac{3iz_2}{5z_1}$ is purely real, then $5 \left| \frac{3z_1 + 7z_2}{3z_1 - 7z_2} \right|$ is _____
4. Let $\alpha = 2 \tan^{-1} \frac{1}{2} + \sin^{-1} \frac{3}{5}$ and $\beta = \sin^{-1} \frac{12}{13} + \cos^{-1} \frac{4}{5} + \cot^{-1} \frac{16}{63}$ be such that $2 \sin \alpha$ and $\cos \beta$ are roots of the equation $x^2 - px + q = 0$, then find $(p - q)$.
5. The value of ${}^{20}C_0 - \frac{{}^{20}C_1}{2} + \frac{{}^{20}C_2}{3} - \frac{{}^{20}C_3}{4} + \dots$ is p then $21p$ is _____

Space For Rough Work

FIITJEE INTERNAL TEST

BATCH: CTY 1921 Batches

PHYSICS, CHEMISTRY & MATHEMATICS**JEE MAIN-PHASE-III**

Paper Code

ANSWER KEY

SECTION – I (PHYSICS)		SECTION – II (CHEMISTRY)		SECTION – III (MATHEMATICS)	
PART – A		PART – A		PART – A	
1.	C	1.	D	1.	D
2.	A	2.	C	2.	C
3.	D	3.	C	3.	A
4.	A	4.	D	4.	C
5.	A	5.	C	5.	C
6.	C	6.	D	6.	A
7.	C	7.	C	7.	A
8.	C	8.	D	8.	D
9.	C	9.	C	9.	C
10.	A	10.	C	10.	A
11.	B	11.	B	11.	C
12.	B	12.	C	12.	C
13.	B	13.	C	13.	B
14.	B	14.	D	14.	A
15.	B	15.	B	15.	D
16.	D	16.	A	16.	D
17.	B	17.	A	17.	C
18.	C	18.	A	18.	D
19.	A	19.	A	19.	C
20.	B	20.	B	20.	B
PART-C		PART-C		PART-C	
1.	1	1.	4	1.	0
2.	3	2.	1	2.	5
3.	2	3.	3	3.	5
4.	2	4.	2	4.	3
5.	5	5.	6	5.	1