

B-MAT PART TEST-2
FOR OUR STUDENTS
TOWARDS
JOINT ENTRANCE EXAMINATION (MAIN), 2013

PHYSICS – MATHEMATICS – CHEMISTRY

QUESTION PAPER CODE

2

Time: 3 Hours

Maximum Marks: 360

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

INSTRUCTIONS:

1. The Test Booklet consists of **90** questions. The maximum marks are **360**.
2. There are **three** parts in the question paper A, B, C consisting of **Physics, Mathematics** and **Chemistry** having 30 questions in each part of equal weightage. Each question is allotted **4(four)** marks for each correct response.
3. Candidates will be awarded marks as stated above in instruction No. 2 for correct response of each question. $\frac{1}{4}$ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 3 above.
5. Use **Blue/Black Ball Point Pen only** for writing particulars / marking response on **side-1** and **side-2** of the Answer Sheet. **Use of pencil is strictly prohibited.**
6. No candidate is allowed to carry any textual material printed or written, bits of papers, pager, mobile phone, any electronic device etc; except the Admit Card inside the examination hall/room.

DO NOT BREAK THE SEALS ON THIS BOOKLET, AWAIT INSTRUCTIONS FROM THE INVIGILATOR

SEAL

Name:

Enrollment No.:

I have read all the instructions and shall abide by them.

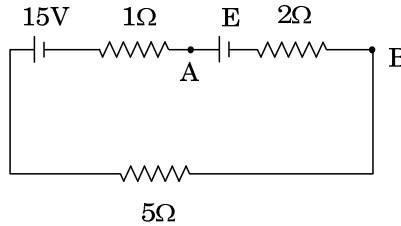
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Signature of the Candidate

I have verified all the informations filled in by the Candidate.

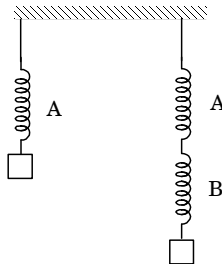
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PART A: PHYSICS

1. For what value of E the potential of A is equal to the potential of B?



- (1) 5V (2) 7V (3) 10V (4) 15V
2. A circular wire loop of radius R carries a total charge q distributed uniformly over its length. A small length x ($\ll R$) of the wire is cut off. Find the electric field due to the remaining wire, at the centre of the ring.
- (1) $\frac{qx}{4\pi^2\epsilon_0 R^3}$ (2) $\frac{qx}{8\pi^2\epsilon_0 R^3}$ (3) $\frac{3qx}{4\pi^2\epsilon_0 R^3}$ (4) $\frac{5qx}{8\pi\epsilon_0 R^3}$
3. What is the density of ice if 0.11% of the volume of iceberg is projecting out of marine water of density 1.03 g cm^{-3} ?
- (1) 0.98 g cm^{-3} (2) 0.85 g cm^{-3}
(3) 0.92 g cm^{-3} (4) 0.8 g cm^{-3}
4. Two closed organ pipes are sounded simultaneously. When length of the shorter pipe is 1.10 m long, 5 beats are produced. To restrict the beats to 3, to what length should the shorter pipe be adjusted? [velocity of sound in air is 340 m/s] and $\frac{12}{340} = 0.035$
- (1) 1.04 m (2) 1.08 m (3) 1.16 m (4) 1.13 m
5. **Figure** below shows three identical springs. When a 4 kg wt. is hung on A, the spring shows an elongation of 1cm. When a weight of 6 kg is hung on B, the hook descends by

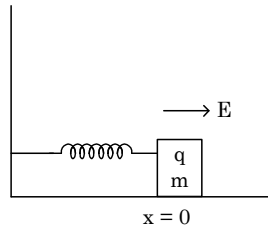


- (1) 3 cm (2) 2 cm (3) 1 cm (4) 0.5 cm
6. A sonometer wire, 65 cm long, is in resonance with a tuning fork of frequency n . If the length of the wire is decreased by 1 cm and is vibrated with the same tuning fork, 8 beats are heard per second. What is the value of n ?
- (1) 256 Hz (2) 384 Hz (3) 512 Hz (4) 480 Hz

13. A point charge q_1 is held stationary at the origin. When the second charge is moved from point a to point b, the electric force on the charge does $4.2 \times 10^{-8} \text{ J}$ of work. What is the electric potential energy of the pair of charges when the second charge is at b, if the potential energy at point a is $-6.4 \times 10^{-8} \text{ J}$?

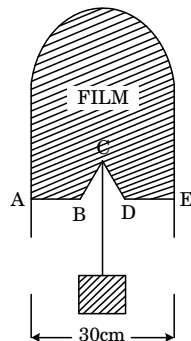
- (1) $-2.2 \times 10^{-8} \text{ J}$ (2) $-10.6 \times 10^{-8} \text{ J}$
 (3) $8.2 \times 10^{-8} \text{ J}$ (4) $-8.2 \times 10^{-8} \text{ J}$

14. A block of mass $m = 4 \text{ kg}$ and charge $q = 50 \mu\text{C}$ is connected to a spring having a force constant $k = 100 \text{ N/m}$. The block lies on a frictionless horizontal track and a uniform electric field $E = 5 \times 10^5 \text{ V/m}$ acts on the system as shown in **figure**.



When the spring is unstretched, the block is released from rest. To what extent, does the spring extend from the equilibrium position after oscillation starts?

- (1) 0.25 m (2) 0.30 m
 (3) 0.45 m (4) 0.50 m
15. A thin liquid film formed between an inverted v-shaped wire and a light slider supports a weight of $1.5 \times 10^{-2} \text{ N}$ as shown in **figure**.



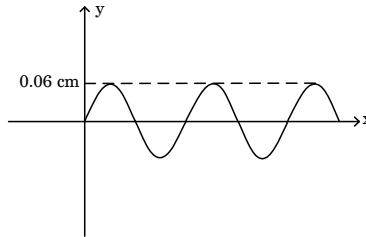
The weight of the slider is negligible. The length of each segment of the slider is 10 cm and $\hat{BCD} = 60^\circ$. What is the surface tension of the liquid?

- (1) 0.015 Nm^{-1} (2) 0.025 Nm^{-1}
 (3) 0.035 Nm^{-1} (4) 0.045 Nm^{-1}

22. A battery of emf 1.4 V and internal resistance $2\ \Omega$ is connected to a $100\ \Omega$ resistor through an ammeter. The resistance of the ammeter is $\frac{4}{3}\ \Omega$. What is the resistance of the voltmeter if the ammeter reads 0.02 A?

- (1) $500\ \Omega$ (2) $400\ \Omega$ (3) $300\ \Omega$ (4) $200\ \Omega$

23. The **figure** given below shows a sinusoidal wave on a string. If the frequency of the wave is 150 Hz and the density of the wire is 7 g/cm, the average energy density in the string is



- (1) $1120\ \text{J/m}^3$ (2) $284\ \text{J/m}^3$ (3) $184\ \text{J/m}^3$ (4) $2180\ \text{J/m}^3$

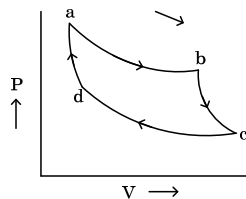
24. Resistance of a given wire is obtained by measuring the current flowing in it and the potential difference applied across it. The ammeter is calibrated into $\frac{1}{20}$ th of an ampere. The percentage error in the measurement of voltage is 3%. What is the error in the value of resistance of the wire?

- (1) 6% (2) 8% (3) 10% (4) 12%

25. A capacitor of capacitance C is fully charged by a 200V supply. It is then discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat $2.5 \times 10^2\ \text{Jkg}^{-1}\text{K}^{-1}$ and of mass 0.1 kg. If the temperature of the block rises by 0.4K, find the value of C .

- (1) $300\ \mu\text{F}$ (2) $400\ \mu\text{F}$ (3) $500\ \mu\text{F}$ (4) $600\ \mu\text{F}$

26. Refer to the carnot cycle of an ideal gas shown in the **figure**. Let W represent the work done by the system and Q the heat absorbed by the system. Consider the following relations.



- (a) $W_{a \rightarrow b} + W_{c \rightarrow d} > 0$
 (b) $W_{a \rightarrow b} + W_{b \rightarrow c} + W_{c \rightarrow d} + W_{d \rightarrow a} < 0$
 (c) $Q_{a \rightarrow b} + Q_{c \rightarrow d} < 0$
 (d) $Q_{a \rightarrow b} - Q_{c \rightarrow d} > 0$

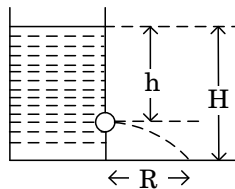
Which of the above relations is/are true?

- (1) (a) and (b) only (2) (a) and (c) only
 (3) (a), (b) and (c) only (4) (a) and (d) only

27. Eight charged water drops each with a radius of 1 mm and a charge of 10^{-10} C merge into a single drop. What is the potential of the bigger drop?

- (1) 3600 V (2) 3000 V (3) 2600 V (4) 2000 V

28. Liquid is contained in a vessel having an orifice on its side, h metre below the level of liquid as shown in **figure**. The ground level is H meter below the water level. The liquid coming out of the orifice strikes the ground at a distance R metre. What is the maximum value of R ?



- (1) h (2) H (3) $\frac{h}{2}$ (4) $\frac{H}{2}$

29. The ratio of the balancing lengths corresponding to two cells are 3:1. The balancing length is ℓ_1 when the cells are connected to support each other. When they are connected so as to oppose each other the balancing length is ℓ_2 .

What will be the ratio of ℓ_1 and ℓ_2 ?

- (1) 1 : 3 (2) 2 : 4 (3) 4 : 2 (4) 3 : 1

30. **Figure** below shows four plates each of area S and separated from one another by a distance d . What is the capacitance between A and B?



- (1) $\frac{2\epsilon_0 S}{d}$ (2) $\frac{4\epsilon_0 S}{d}$ (3) $\frac{3\epsilon_0 S}{d}$ (4) $\frac{6\epsilon_0 S}{d}$

PART B: MATHEMATICS

- 31.** If $\sum_{r=0}^n \frac{a_r}{x+r} = \frac{|n|}{x(x+1)(x+2)\dots(x+r)}$ then $\sum_{r=0}^n |a_r|$ is
 (1) 2^n (2) $2^n - 1$ (3) 4^n (4) $4^n - 1$
- 32.** If $\binom{n}{0}C_0 + \binom{n}{1}C_1 - \binom{n}{2}C_2 - \binom{n}{3}C_3 + \binom{n}{4}C_4 + \binom{n}{5}C_5 - \binom{n}{6}C_6 - \binom{n}{7}C_7 + \dots = 0$ then n may be
 (1) 50 (2) 52 (3) 53 (4) 47
- 33.** An ellipse is represented by the equation $\frac{x^2}{25} + \frac{y^2}{16} = 1$. A hyperbola which is confocal with the above ellipse is such that the length of its transverse axis is equal to the semi-minor axis of the ellipse. Then the sum of the abscissae of the feet of the perpendiculars from a common point of the two curves to their corresponding directrices is
 (1) $\frac{29}{3}$ (2) $\frac{28}{3}$ (3) 9 (4) none of these
- 34.** If z is a complex number such that $3 \leq |z| \leq 5$ and if $\ell \leq \left| z + \frac{1}{z} \right| \leq m$ then the value of $3\ell + 5m$ is
 (1) 32 (2) 34 (3) 36 (4) 38
- 35.** If the roots of $x^5 + x^2 + 1 = 0$ are $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ and $g(x) = x^2 - 1$ then the value of $g(\alpha_1)g(\alpha_2)g(\alpha_3)g(\alpha_4)g(\alpha_5) - 20g(\alpha_1)\alpha_2\alpha_3\alpha_4\alpha_5$ is
 (1) 23 (2) 24 (3) 25 (4) none of these
- 36.** F_1 and F_2 are the foci of the ellipse represented by $\frac{4x^2}{361} + \frac{y^2}{b^2} = 1$ where $b < \frac{19}{2}$. If P is a point of intersection of the ellipse and the circle on $F_1 F_2$ as diameter, such that area of triangle $F_1 P F_2$ is 35 sq units, then $(F_1 F_2)$ is
 (1) 15 (2) $\sqrt{221}$ (3) $\sqrt{224}$ (4) 14
- 37.** AB is a diameter of the rectangular hyperbola given by $xy = 16$, then the locus of the point of intersection of the tangent at A and a line parallel to either of the asymptotes through B is
 (1) $xy - 32 = 0$ (2) $xy + 22 = 0$ (3) $xy - 48 = 0$ (4) $xy + 48 = 0$
- 38.** The digit at the unit place of $2^{9^{100}}$ is
 (1) 2 (2) 4 (3) 6 (4) 8

39. A five digit number divisible by 15 is to be formed by using 0, 1, 2, 3, 4, 5 (no two digits being repeated). The number of such numbers is
 (1) 24 (2) 18 (3) 66 (4) 120
40. If a square matrix A is such that $A^2 = A$ and I is unit matrix of the same order and $(I + A)^3 = I + \lambda A$ then value of λ is
 (1) 5 (2) 6 (3) 7 (4) 4
41. Tangents PA, PB are drawn to the circle $x^2 + y^2 = r^2$, from a point P which lies on $ax + by + c = 0$, then the locus of the circumcentre of triangle APB is
 (1) $ax + by - c = 0$ (2) $2ax + 2by - c = 0$
 (3) $2ax + 2by + c = 0$ (4) $ax + by - r = 0$
42. A parabola touches x and y axes at $A\left(\frac{50}{3}, 0\right)$, $B\left(0, \frac{50}{4}\right)$. Then its focus is
 (1) (0, 0) (2) (8, 6) (3) (6, 8) (4) (2, 4)
43. If α and β , ($\alpha < \beta$) are the roots of the equation $2x^2 - 20x + \lambda = 0$ such that $4 < \alpha < 5$ and $5 < \beta < 6$, then λ can be
 (1) 48 (2) 49 (3) 50 (4) 51
44. The sum of the possible integral solutions of the inequation $\left|x^2 - 6x + 8\right| \leq 4 - x$ is
 (1) 6 (2) 9 (3) 8 (4) 12
45. The number of terms with rational coefficients in the expansion of $(\sqrt[3]{5x} + \sqrt[2]{3y} + z)^6$ is
 (1) 6 (2) 7 (3) 8 (4) 9
46. A, B, C are the 3 players among the 11 players selected for a cricket match. B refuses to bat before A. C refuses to bat before B, and also to bat as a last batsman. The number of batting order is
 (1) $\underline{8}$ (2) $3 \underline{8}$ (3) $\underline{3} \underline{8}$ (4) $\underline{5} \underline{8}$
47. If the equations $ax^2 + bx + c = 0$ and $px^2 + qx + r = 0$ have a root in common, and the other root of the second equation is the square of the other root of the first equation, then $\frac{pc^2}{ra} + \frac{ra^2}{pc}$ is equal to
 (1) q (2) - q (3) b (4) - b

48. Five digit numbers with 9 as a digit and divisible by 9 are to be formed using the non zero digits (without repetition).

The number of such numbers is

- (1) 720 (2) 960 (3) 600 (4) none of these

49. The locus of the image of $\left(\frac{1}{4}, 3\right)$ on the family of lines represented by

$$(x + 3y - 7) + \mu(4x - y - 2) = 0 \text{ is}$$

- (1) a straight line (2) a parabola
(3) a circle (4) an ellipse

50. If $\cos^4 \alpha - \sin^4 \alpha + 3$ and $\cos^2 \alpha - \sin^2 \alpha + 5$ are the roots of $x^2 - 7x + \lambda = 0$ for some α , then the value of λ is

- (1) $\frac{45}{4}$ (2) $\frac{35}{4}$ (3) $\frac{25}{4}$ (4) 15

51. If $x, y, z \in \mathbb{R}$ and the matrix $\begin{pmatrix} x & y & z \\ y & z & x \\ z & x & y \end{pmatrix}$ is orthogonal, then the value of

$$x^3 + y^3 + z^3 - 3xyz \text{ is}$$

- (1) 1 only (2) -1 only (3) ± 1 (4) none of these

52. The number of positive terms in the expansion of $(1 - 2x + x^2)^{2n} (1 + x + x^2)^{4n}$ where x is positive is

- (1) $2n + 1$ (2) $2n$ (3) $2n + 2$ (4) none of these

53. Value of $C_1^2 + 2 \cdot C_2^2 + 3 \cdot C_3^2 + \dots + 30 \cdot C_{30}^2$ where $C_r = 30C_r$ $r = 0, 1, 2, \dots, 30$ is

- (1) $29 \cdot 59C_{21}$ (2) $30 \cdot 59C_{21}$ (3) $20 \cdot 59C_{29}$ (4) none of these

54. If A , and B are square matrices such that

$$AB = B \text{ and } BA = A \text{ then } A^3 + B^3 \text{ is}$$

- (1) $A + B$ (2) 0 (3) $A^3 B^3$ (4) $3(A + B)$

55. If z is a complex number such that $8iz^3 + 12z^2 - 18z + 27i = 0$ where $i = \sqrt{-1}$ then $4|z|$ is

- (1) 3 (2) 4 (3) 6 (4) none of these

56. If z is a complex number such that $|z-1| \leq 1$ and $|z-2| \leq 1$ then the maximum possible value of $|z|^2$ is

- (1) 5 (2) 3 (3) 4 (4) none of these

57. If $\begin{vmatrix} {}^{12}C_3 & {}^{12}C_4 & {}^{13}C_n \\ {}^{13}C_5 & {}^{13}C_6 & {}^{14}C_{n+2} \\ {}^{14}C_7 & {}^{14}C_8 & {}^{15}C_{n+4} \end{vmatrix} = 0$ then the value of n is

- (1) 4 (2) 5 (3) 6 (4) 8

58. If $A = \begin{bmatrix} 1 & 2 & -1 \\ -1 & 1 & 2 \\ 2 & -1 & 1 \end{bmatrix}$ then $\det(\text{Adj}(\text{Adj} A))$ is

- (1) 12^4 (2) 13^4 (3) 14^3 (4) 14^4

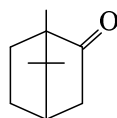
59. z_1 and z_2 be two complex numbers represented by the points P and Q in the Argand diagram and O is the origin. Further $OP = OQ$, $\angle POQ = \frac{\pi}{3}$ and z_1 and z_2 are the roots of the equation $z^2 + pz + q = 0$ where p and q may be constants then q is

- (1) $3p^2$ (2) $2p^2$ (3) p^3 (4) $5p^2$

60. If $\log_2 3 = x$, $\log_3 5 = y$ and $z = \log_7 2$ then $\log_{42} 70$ is

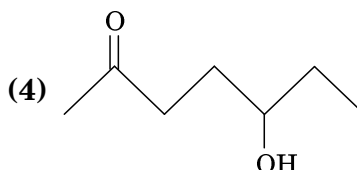
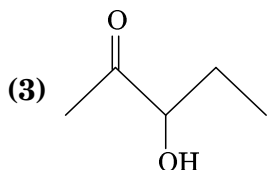
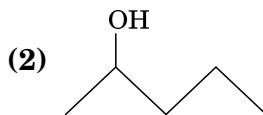
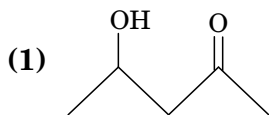
- (1) $\frac{z+yz+1}{x+yz+1}$ (2) $\frac{z+xyz+1}{z+xz+1}$ (3) $\frac{z+xz+1}{x+xz+1}$ (4) none of these

75. Which one of the following characteristics is **not correct** for physical adsorption?
- (1) adsorption on solids is reversible
 - (2) adsorption increases with increase in temperature
 - (3) adsorption is spontaneous.
 - (4) both enthalpy and entropy of adsorption are negative
76. An organic compound having molecular mass 60 is found to contain C = 20%, H = 6.67% and N = 46.46% while rest is oxygen. On heating it gives NH₃ alongwith a solid residue. The solid residue give violet colour with alkaline copper sulphate solution. The compound is
- (1) CH₃CH₂CONH₂
 - (2) (NH₂)₂CO
 - (3) CH₃CONH₂
 - (4) CH₃NCO
77. IUPAC name of camphor is



- (1) 6-oxo-1,2,2-trimethylbicyclo [2, 2, 1] heptane
 - (2) 1, 7, 7-trimethylbicyclo [2, 2, 1] heptan-2-one
 - (3) 1, 5, 5-trimethylbicyclo [2, 7, 1] hexan-2-one
 - (4) 1, 7, 7-trimethylbicyclo [2, 1, 2] heptan-2-one
78. For the reversible reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at 500°C. The value of K_p is 1.44×10^{-5} , when partial pressure is measured in atmospheres. The corresponding value of K_c with concentration in mol L⁻¹ is
- (1) $1.44 \times 10^{-5} / (0.082 \times 500)^{-2}$
 - (2) $1.44 \times 10^{-5} / (8.314 \times 773)^{-2}$
 - (3) $1.44 \times 10^{-5} / (0.082 \times 500)^2$
 - (4) $1.44 \times 10^{-5} / (0.082 \times 773)^{-2}$
79. In this reaction
- $$2Ag + 2H_2SO_4 \rightarrow Ag_2SO_4 + 2H_2O + SO_2$$
- the sulphuric acid acts as
- (1) Oxidizing agent
 - (2) Reducing agent
 - (3) Catalyst
 - (4) Acid as well as oxidant.
80. State of hybridisation of carbon atom of carbene in the singlet state is
- (1) sp²
 - (2) sp
 - (3) sp³
 - (4) None of the above

81. Which of the following will most readily be dehydrated in acidic solutions?

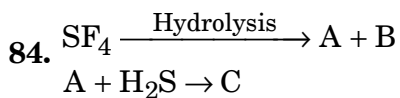


82. A bond with maximum covalent character between non-metallic elements is found

- (1) Between atoms of same size
- (2) Between chemically dissimilar atoms
- (3) Between identical atoms
- (4) Between atoms of widely differing electronegativities

83. At the isoelectric point, aminoacids are present as

- | | |
|---|---|
| (1) $\text{H}_2\text{N} - \text{CHR} - \text{COOH}$ | (2) $\overset{+}{\text{N}}\text{H}_3 - \text{CHR} - \text{COO}^-$ |
| (3) $\text{NH}_2 - \text{CHR} - \text{COO}^-$ | (4) $\overset{+}{\text{N}}\text{H}_4 - \text{CHR} - \text{COO}^-$ |



The product 'C' of the above reactions is

- | | |
|-------------------|-----------------------|
| (1) Solid sulphur | (2) Colloidal sulphur |
| (3) SO_3 | (4) Gaseous sulphur |

85. Two oxides of a metal contain 36.4% and 53.4% of oxygen by mass respectively. If the formula of the first oxide is M_2O , then that of the second is

- | | | | |
|----------------------------|-----------------|-------------------|----------------------------|
| (1) M_2O_3 | (2) MO | (3) MO_2 | (4) M_2O_5 |
|----------------------------|-----------------|-------------------|----------------------------|

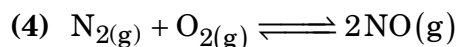
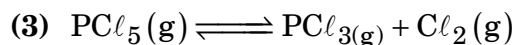
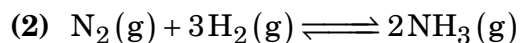
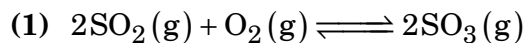
86. The transition metal ion that has 'spin-only' magnetic moment value of 5.916 BM is

- | | | | |
|----------------------|----------------------|---------------------|----------------------|
| (1) Mn^{2+} | (2) Fe^{2+} | (3) V^{2+} | (4) Cu^{2+} |
|----------------------|----------------------|---------------------|----------------------|

87. Which one of the following is not a greenhouse gas?

- (1) Methane (2) Ozone (3) Carbon dioxide (4) Nitrogen

88. In which one of the following reactions, the yield of the product decreases by increasing the pressure?



89. Which of the following nitrates on strong heating leaves the metal as the residue?

- (1) AgNO_3 (2) $\text{Pb}(\text{NO}_3)_2$ (3) $\text{Cu}(\text{NO}_3)_2$ (4) $\text{Al}(\text{NO}_3)_3$

90. Mendius reaction converts an alkyl cyanide to

- (1) a primary amine (2) an aldehyde
(3) a ketone (4) an oxime

READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. The candidates should fill in the required particulars on the Test Booklet and Answer Sheet (**Side-1**) with **Blue/Black Ball Point Pen**.
2. For writing/marketing particulars on **Side-2** of the Answer Sheet, use **Blue/Black Ball Point Pen only**.
3. The candidates should not write their Roll Numbers anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
4. Out of the four options given for each question only one option is the correct answer.
5. For each incorrect response, one-fourth of the total marks allotted to the question would be deducted from the total score. No deduction from the total score, however, will be made if no response is indicated for an item in the Answer Sheet.
6. Handle the Test Booklet and Answer Sheet with care, as under no circumstances (except for discrepancy in Test Booklet Code and Answer Sheet Code) will another set be provided.
7. The candidates are not allowed to do any rough work or writing work on the Answer Sheet. All calculations/writing work are to be done in the space provided for this purpose in the Test Booklet itself, marked 'Space for Rough Work'. This space is given at the bottom of each page and in 3 pages at the end of the booklet.
8. On completion of the test, the candidates must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them.**
9. Each candidate must show on demand his/her Admit Card to the Invigilator.
10. No candidate, without special permission of the Superintendent or Invigilator, should leave his/her seat.
11. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet again. Cases where a candidate has not signed the Attendance Sheet a second time will be deemed not to have handed over the Answer Sheet and dealt with as an unfair means case. **The candidates are also required to put their left hand THUMB impression in the space provided in the Attendance Sheet.**
12. Use of Electronic/Manual Calculator and any Electronic Item like mobile phone etc., is prohibited.
13. The candidates are governed by all Rules and Regulations of the Board with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of the Board.
14. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
Candidates are not allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, electronic device or any other material except the Admit Card inside the examination hall/room.