

(1803CJA101029240113)



CLASSROOM CONTACT PROGRAMME

(Academic Session : 2024-2025)

Test Pattern

JEE (Main)

FULL SYLLABUS

30-12-2024

JEE(MAIN) : ENTHUSIAST COURSE PHASE-I(A), I(B), I, II & LEADER COURSE PHASE-I, II & III

Time : 3 Hours

Maximum Marks : 300

F4

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

READ THE INSTRUCTIONS CAREFULLY

Important Instructions :

1. Immediately fill in the form number on this page of the Test Booklet and OMR sheet (Side-1 & Side-2) with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The candidates should not write their Form Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
3. The Test Booklet consists of 90 questions.
4. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry and Mathematics** having **30 questions** in each subject and each subject having **Two sections**.
 - (a) Section-I contains 20 **multiple choice** questions with **only one correct** option.

Marking scheme : +4 for correct answer, 0 if not attempted and -1 in all other cases.
 - (b) Section-II contains 05 **Numerical Value Type** questions.

Marking scheme : +4 for correct answer, 0 if not attempted and -1 in all other cases.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc, except the Identity Card inside the examination hall/room.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/Hall.

However, the candidate are allowed to take away this Test Booklet with them.
8. Do not fold or make any stray marks on the Answer Sheet.
9. Take $g = 10 \text{ m/s}^2$ unless otherwise stated.

Name of the Candidate (in Capitals) : _____

Form Number : in figures _____

: in words _____

Centre of Examination (in Capitals) : _____

Candidate's Signature : _____

Invigilator's Signature : _____

Your Target is to secure Good Rank in JEE(Main) 2025

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DO NOT BREAK THE SEALS WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR

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SECTION-I : (Maximum Marks: 80)

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

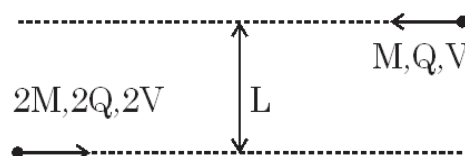
Full Marks : +4 If correct answer is selected.

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

Negative Marks : -1 If wrong option is selected.

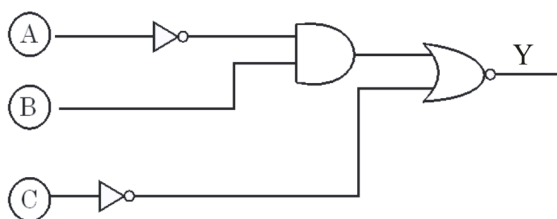
1. A boy throws several balls out of the window of his house at different angles to the horizontal. All balls are thrown at speed $u = \sqrt{10}$ m/s and it was found that all of them hit the ground making an angle of 60° or larger than that with the horizontal. Find the height (in meter) of the window above the ground. [$g = 10 \text{ m/s}^2$]
(A) 1.75 (B) 1.5 (C) 1.85 (D) 2
2. A ball of mass (m) is rolling without sliding down an inclined plane. Choose the correct statement.
(A) Net force applied by ball on inclined plane is less than it's own weight(mg)
(B) Net force applied by ball on inclined plane is larger than it's own weight(mg)
(C) Net force applied by ball on inclined plane is equal to it's own weight(mg)
(D) We cannot determine the relation between net force by ball on inclined plane and weight(mg)

3. Two particles approach each other from very large distance as shown, (consider gravitational force between the particle is negligible). If the least separation between the particles is b, what is the speed of M in center of mass frame when particles are closest ?



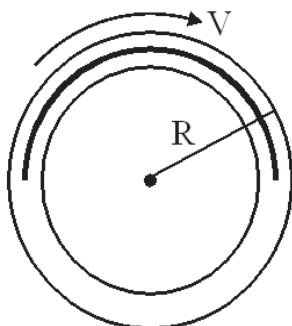
- (A) LV/b
(B) $2LV/b$
(C) $3LV/b$
(D) $4LV/b$
4. An ice cream cone of mass $3M$ has base radius R and height h . Assume its wall to be thin and uniform. When ice cream is filled inside it (so as to occupy the complete conical space) its mass becomes $7M$. Find the distance of the centre of mass of the ice cream filled cone from its vertex.
(A) $\frac{3h}{4}$
(B) $\frac{2h}{3}$
(C) $\frac{5h}{7}$
(D) $\frac{6h}{7}$

5. For the logic in circuit shown in figure, choose the correct output from following options.



- (A) $Y = \bar{A}B + \bar{C}$
 (B) $Y = \bar{A}B \cdot C$
 (C) $Y = \bar{A}B + \bar{C}$
 (D) $Y = \bar{A}B + C$

6. A metal wire having mass M is bent in the shape of a semicircle of radius R and is sliding inside a smooth circular groove of radius R present in a horizontal table. The wire just fits into the groove and is moving at a constant speed V . Find the magnitude of angular speed of COM of wire.

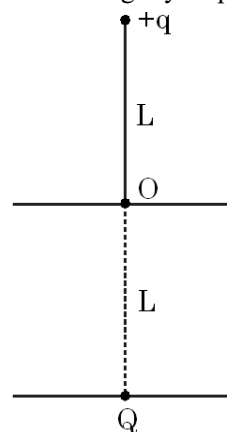


- (A) $\frac{V}{R}$
 (B) $\frac{3\pi V}{2R}$
 (C) $\frac{\pi V}{2R}$
 (D) None of these

7. A total charge Q is spread onto a non-conducting, flat circular annular disc of inner radius a and outer radius b . The charge distributed is such that the charge density is given by $\sigma = \frac{k}{r^3}$, when r is the distance from the center. Find the potential at the center of disc.

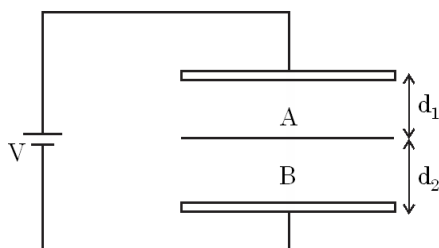
- (A) $\frac{1}{8\pi\epsilon_0}Q \left(\frac{a+b}{ab} \right)$ (B) $\frac{1}{4\pi\epsilon_0}Q \left(\frac{a+b}{ab} \right)$
 (C) $\frac{1}{4\pi\epsilon_0} \frac{Q}{a}$ (D) $\frac{1}{4\pi\epsilon_0} \frac{Q}{b}$

8. A particle of mass m and charge $+q$ is attached to a light insulating thread of length L . The other end of the thread is secured at point O . Exactly below point O , there is a small ball having charge $+Q$ fixed on an insulating horizontal surface. The particle remains in equilibrium vertically above the ball with tension in string equal to $2mg$. Distance of the ball from point O is L . Find time period of SHM if it is slightly displaced



- (A) $2\pi\sqrt{\frac{2L}{g}}$ (B) $2\pi\sqrt{\frac{4L}{g}}$
 (C) $2\pi\sqrt{\frac{5L}{g}}$ (D) $2\pi\sqrt{\frac{6L}{g}}$

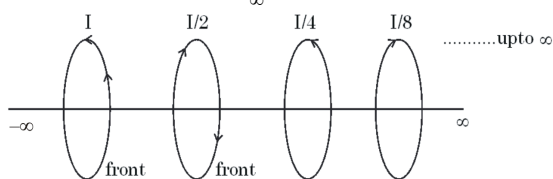
9. The figure shows a parallel plate capacitor filled with two different layers of materials. The upper layer 'A' is a material of thickness d_1 and conductivity σ_1 and the lower layer 'B' is a material of thickness d_2 and conductivity σ_2 . The capacitor is connected across an ideal battery of emf 'V' volt. The electric field in the material A is :



- (A) $\frac{V \sigma_1}{d_1 \sigma_1 + d_2 \sigma_2}$ (B) $\frac{V \sigma_2}{d_1 \sigma_1 + d_2 \sigma_2}$
(C) $\frac{V \sigma_1}{d_1 \sigma_2 + d_2 \sigma_1}$ (D) $\frac{V \sigma_2}{d_1 \sigma_2 + d_2 \sigma_1}$

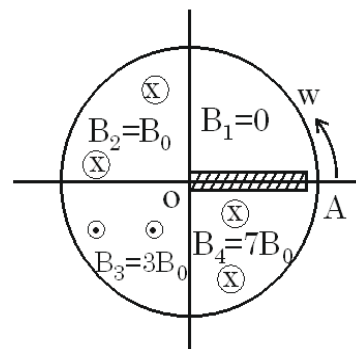
10. Infinite number of circular current carrying loops are coaxially placed with their planes parallel as shown in the diagram. The current in the first loop is I, in second loop is I/2, in third loop is I/4 and so on. In the first loop the current is upwards in the portion close to the observer. The value of the line integral of magnetic field over the axis

from $-\infty$ to $+\infty$ i.e., $\int_{-\infty}^{+\infty} \vec{B} \cdot d\vec{x}$ is :



- (A) $\frac{4\mu_0 I}{3}$ (B) $\frac{2\mu_0 I}{3}$
(C) $\frac{-2\mu_0 I}{3}$ (D) $\frac{-4\mu_0 I}{3}$

11. A conducting rod OA has one of its ends at the centre O and the other end at the periphery of a circular region of radius R which contains four different uniform magnetic fields in the four quadrants as shown



$B_1 = 0, B_2 = B_0, B_3 = 3B_0, B_4 = 7B_0$. B_3 is out of the plane while B_2 and B_4 are into the plane. The average emf induced in one cycle is

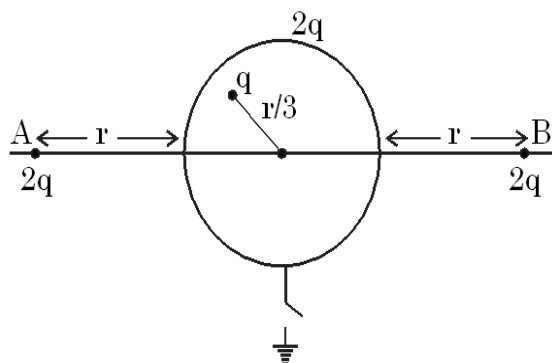
- (A) $\frac{11}{4} B_0 \omega R^2$ (B) $\frac{11}{2} B_0 \omega R^2$
(C) $\frac{5}{8} B_0 \omega R^2$ (D) $\frac{8}{2} B_0 \omega R^2$

12. A cylinder is closed at both ends and has insulating walls. It is divided into two compartments by an adiabatic partition that is perpendicular to the axis of the cylinder. Each compartment contains 1.00mol of oxygen that behaves as an ideal gas with $\gamma = \frac{7}{5}$. Initially, the two compartments have equal volumes and their temperatures are 550K and 250K. The partition is then allowed to move slowly until the pressures on its two sides are equal. Find the final temperature in the compartment which has initial temperature 550K. (Take : $\left(\frac{550}{250}\right)^{\frac{5}{7}} = 1.756$).

temperature 550K. (Take : $\left(\frac{550}{250}\right)^{\frac{5}{7}} = 1.756$).

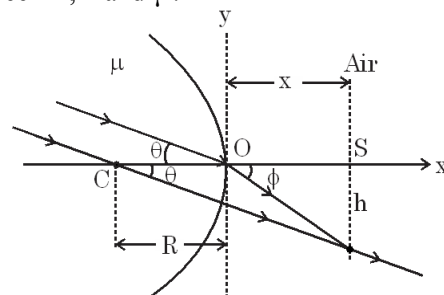
- (A) 510K (B) 590K
(C) 210K (D) 290K

13. The figure shows a conducting shell of radius r having charge $2q$ on it. Two point charges, of magnitude $2q$ each are placed at distance $2r$ from the centre of the shell at A and B respectively. A charge q is residing inside the shell at distance $r/3$ from its centre. The charge flow to earth if the switch is closed is



- (A) $2q$
 (B) $3q$
 (C) $5q$
 (D) None of these
14. A combination of 0.250 kg of water at 20.0°C , 0.400 kg of aluminium at 26.0°C and 0.100 kg of copper at 100°C is mixed in an insulated container and allowed to come to thermal equilibrium. Ignore any energy transfer to or from the container and determine the final temperature of the mixture. ($s_{\text{Water}} = 4186 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$, $s_{\text{Aluminium}} = 900 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$, $s_{\text{Copper}} = 387 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$)
- (A) 23.6°C
 (B) 40°C
 (C) 20°C
 (D) 26°C

15. A spherical surface of radius R separates air from a medium of refractive index μ . Parallel beam of light is incident, from medium side, making a small angle θ with the principal axis of the spherical surface. Choose the correct relation between R , x and μ .

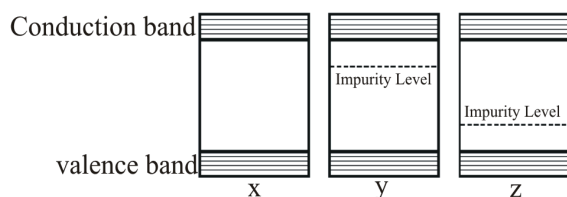


- (A) $x = \frac{R}{\mu - 1}$ (B) $x = \frac{R}{\mu}$
 (C) $x = \frac{R}{\mu + 1}$ (D) $x = \frac{R(\mu + 1)}{\mu}$
16. For the β^+ decay process a reaction is done as follows ${}_Z^A\text{Y} \rightarrow {}_{Z-1}^A\text{X} + {}_{+1}^0\beta + \nu$. If mass of neutrino particle is negligible and atomic mass of Y is m_Y and atomic mass of X is m_X then choose correct option for β^+ decay reaction to be feasible, m_e is the mass of β^+ particle.
- (A) $m_X - m_Y > 2m_e$ (B) $m_Y - m_X > 2m_e$
 (C) $m_X + m_Y > 2m_e$ (D) $m_Y - m_X > m_e$
17. In a radioactive process a sample contains two isotopes, one stable and the other unstable. Number of stable nuclei is equal to N_s and the number of unstable nuclei is equal to N_u . After certain time the activity of sample decreased to $\frac{1}{x}$ times initial activity. After this certain time total number of nuclei (excluding decayed nuclei) became one third of initial nuclei, then find the ratio of N_s/N_u .

- (A) $\frac{x+3}{2}$ (B) $\frac{x-3}{2x}$
 (C) $\frac{x-2}{x}$ (D) $\frac{x-1}{x}$

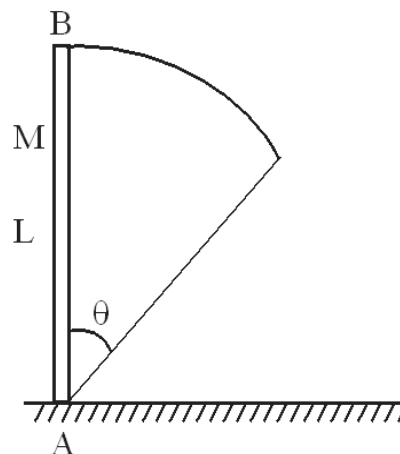
18. The energy band diagrams for three semiconductor samples of silicon are as shown.

We can then choose the correct statement



- (A) Sample X is undoped while samples Y and Z have been doped with a trivalent and a pentavalent impurity respectively
- (B) Sample X is undoped while both samples Y and Z have been doped with a pentavalent impurity
- (C) Sample X has been doped with equal amounts of trivalent and pentavalent impurities while samples Y and Z are undoped
- (D) Sample X is undoped while samples Y and Z have been doped with a pentavalent and a trivalent impurity respectively
19. The magnetic susceptibility of aluminium at 300 K is 2.5×10^{-5} . The magnetic intensity H inside a solenoid with aluminium core is 2000 Am^{-1} . If the temperature of the core is raised to 350 K what will be magnetisation at 350 K?
- (A) $2.14 \times 10^{-4} \text{ Am}^{-1}$
- (B) $4.28 \times 10^{-2} \text{ Am}^{-1}$
- (C) $4.28 \times 10^{-4} \text{ Am}^{-1}$
- (D) $2.14 \times 10^{-2} \text{ Am}^{-1}$

20. A rod of mass $M = 5\text{kg}$ and length $L = 1.5\text{m}$ is held vertical on a table as shown. A gentle push is given to it and it starts falling. Friction is large enough to prevent end A from slipping on the table. Find the sum of linear momentum of all the particles of the rod when it rotates through an angle $\theta = 37^\circ$.



- (A) 15 kg m/s (B) 5 kg m/s
- (C) 7.5 kg m/s (D) 3 kg m/s

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

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

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

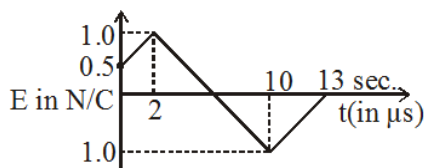
Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

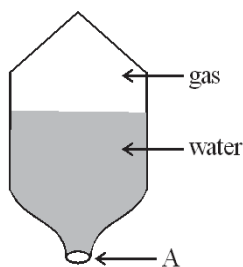
Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.

1. The electric field through an area of 2m^2 varies with time as shown in the graph. The time (in sec) at which greatest displacement current through the area is observed, is

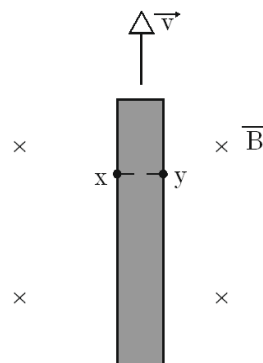


2. A container having pressurized gas in its upper part and water in its lower part. Pressure of the gas is 4.0 MPa . Mass of empty container is 1.0 kg and mass of its content is also 1.0 kg . The nozzle at the bottom is opened to impart a vertical acceleration to the container. The square of velocity at the exit of the nozzle is $n \times 10^3$ (in m^2/s^2). Then fill the value of n . Neglect the pressure due to height of water in the container and take atmosphere pressure to be 1.0 MPa . ($g = 10\text{ ms}^{-2}$)



3. A current carrying coil, having current $\frac{3}{4}\text{ A}$ and number of turns 50 is placed such that its plane is vertical and axis is along magnetic meridian. At the centre of the coil, a dip needle is placed. Axis of rotation is horizontal and is in the plane of the coil. Initially the angle of dip is found to be 30° when the given current is flowing through the coil. The angle of dip becomes 60° when this current is reversed. Assuming that the magnetic field due to coil is smaller than the horizontal component of earth's magnetic field, $B_H = 3 \times 10^{-5}\text{ T}$ if radius of the coil in metre is $\frac{k\pi}{4}$ find the value of k .

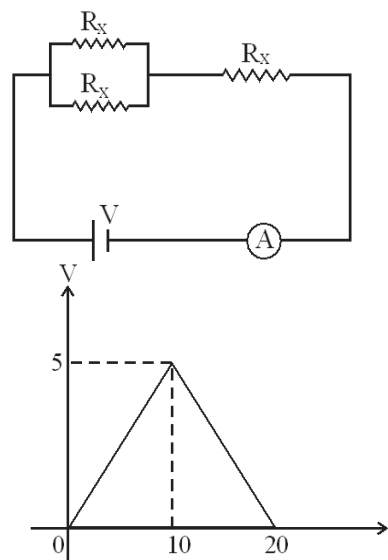
4. A metal strip 6.5 cm long, 3 cm wide, and 0.76 mm thick moves with constant speed v through a magnetic field $B = 1.2\text{ mT}$ perpendicular to the strip, as shown in figure. A potential difference of $3.6\text{ }\mu\text{V}$ is measured between the points x and y across the strip. Calculate the speed v in (cm/sec)



5. The emf(V) of source changes with time after switch is closed at $t = 0$. The variation of V with time t is shown in figure below. Each resistance has resistance R_x which depends on voltage V_x across it as:

$$v_x \leq 2; R_x = 1\Omega; v_x > 2; R_x = 1\Omega$$

Find current in Amperes through ideal Ammeter at $t = 10\text{ s}$.



SECTION-I : (Maximum Marks: 80)

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

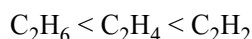
Full Marks : +4 If correct answer is selected.

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

Negative Marks : -1 If wrong option is selected.

1. Which of the following options is incorrect :-

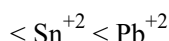
(A) Order of electronegativity of carbon atom -



(B) Order of electron affinity (magnitude only)



(C) Order of stability of oxidation state - Ge^{+2}



(D) Order of second ionisation energy - $O > F >$



2. The incorrect statement among the following is :-

(A) Hydration energy - $Al^{+3} > Mg^{+2}$

(B) magnetic moment - $O_2 > N_2^\ominus$

(C) Dipole moment - $H-F < H_3C-F$

(D) Thermal stability - $Li_2CO_3 < BeCO_3$

3. Regarding borax which of the following statement is incorrect :-

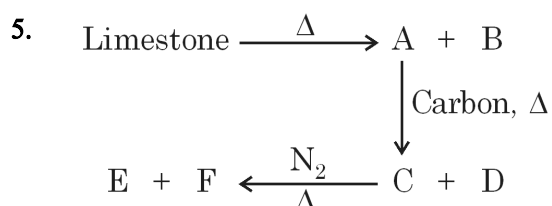
(A) It contains two six membered heterocyclic rings

(B) Its aqueous solution can act as buffer

(C) It give blue bead with copper salt in reducing flame

(D) In its structure, two four-coordinated boron centers and two three-coordinated boron centers are present.

4. In which of the following reaction H_3PO_3 , will form as a product



Compound 'D' reacts with iron to form (X).

Choose the correct statement about (X)

(A) It is a paramagnetic complex

(B) It is a high spin complex

(C) It has dsp^3 hybridisation and square pyramidal geometry

(D) It obeys the EAN rule

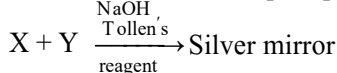
6. Atoms of small non metallic atoms get trapped inside the crystal lattice of iron to form a compound [X]. Which of the following statements is not true for [X] ?

(A) [X] has higher melting point than iron
(B) [X] has more metallic conductivity than iron
(C) [X] is harder than iron
(D) [X] is chemically inert

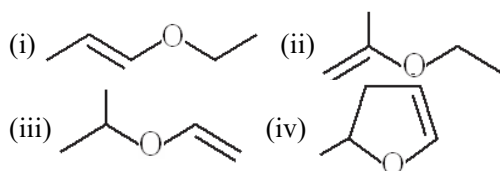
7. Which of the following statements is true?

(A) NH_3 is an electron precise hydride
(B) In ice, each oxygen atom is surrounded in a regular tetrahedral by four hydrogen atoms
(C) 10 volume solution of H_2O_2 contains 3% H_2O_2 by weight.
(D) Calgon is a zeolite used to remove hardness of water

8. $\text{C}_5\text{H}_{10}\text{O} \xrightarrow[\text{dry HCl}]{\text{CH}_3\text{OH}} \text{C}_6\text{H}_{14}\text{O}_2$
(A) (B)

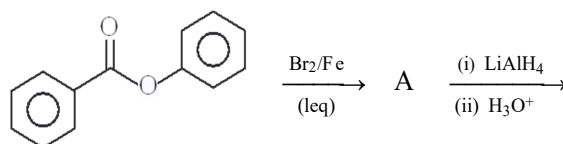


A can be



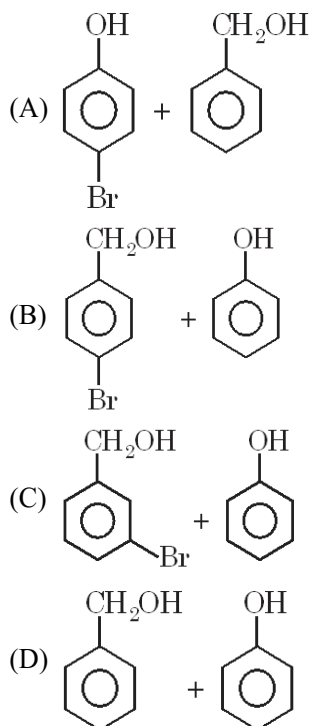
(A) All of these
(B) (i), (ii) and (iii) only
(C) (i) and (iii) only
(D) (i), (ii) and (iv) only

9.

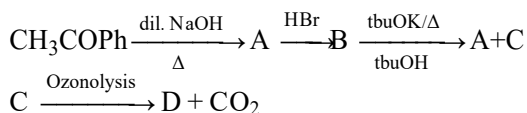


Products

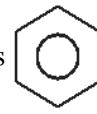
The products are

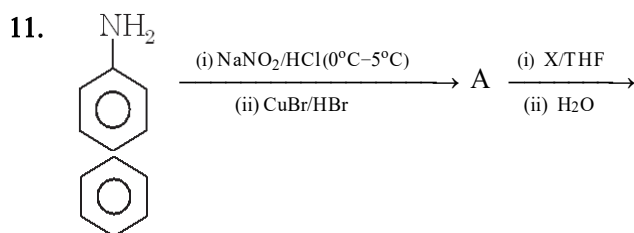


10.



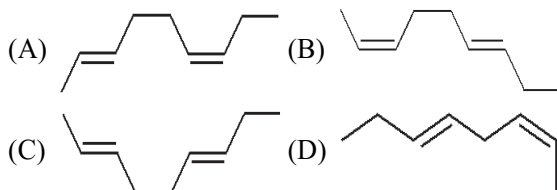
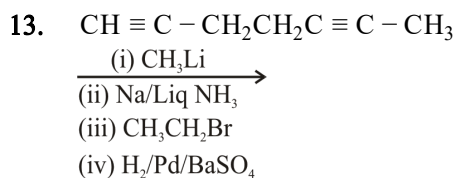
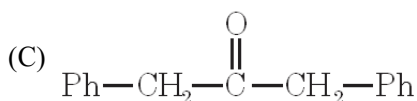
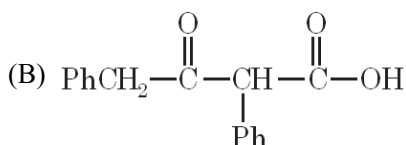
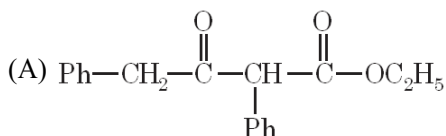
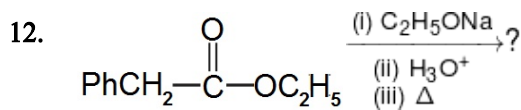
Which of the following statements is incorrect about D.

(A) It gives  on reaction with PhMgBr
(B) It gives +ve iodoform test
(C) It gives +ve test with Tollen's Reagent
(D) It decolorizes Bromine water solution

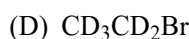
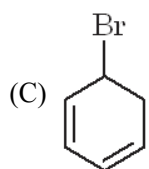
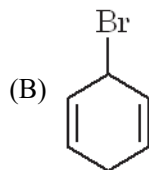
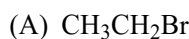


Which statement is incorrect about X ?

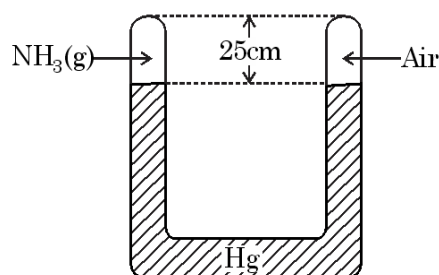
- (A) It reacts with water to give H_2
- (B) It reacts with N_2 to give nitrate salt
- (C) It combines with O_2 to form oxides
- (D) It can displace Cu from an aqueous solution of $CuSO_4$.



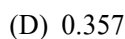
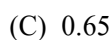
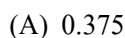
14. Which of the following alkyl bromides undergo fastest SN_1 reaction in water ?



15. $NH_3(g)$ is sealed in a U-tube manometer of uniform area of cross-section at 80 cm of Hg, as shown



After sometime, due to the dissociation of NH_3 , it was observed that the air column has shrunk by 5cm. Assuming that temperature remains constant, what is the degree of dissociation of NH_3 ?



16. To the dissociation reaction $2\text{N}_2\text{O}_5(\text{g}) \rightleftharpoons 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$, $\text{O}_2(\text{g})$ was added, maintaining its partial pressure constant.

- (A) K_p increases and equilibrium shifts backwards
- (B) K_p remains constant and the equilibrium shifts forwards
- (C) K_p remains constant and the equilibrium remains undisturbed
- (D) K_p remains constant and the equilibrium shifts backwards

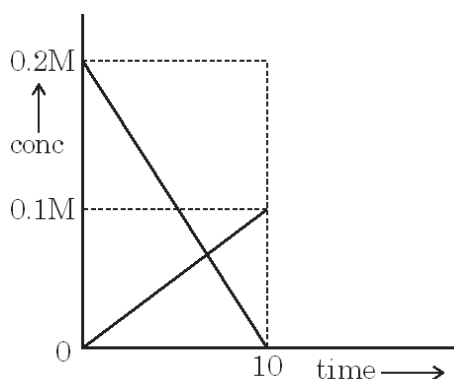
17. 1 mole of an ideal monoatomic gas occupying a volume of 20L at 1 atm undergoes single step adiabatic compression against a constant external pressure of 10 atm. The final volume of gas is -

- (A) 20 L
- (B) 2 L
- (C) 10.6 L
- (D) 9.2 L

18. What is the solubility of CaCO_3 in 0.4M H_2CO_3 solution ? Assume H_2CO_3 to be stable in aqueous solution for the duration of the reaction and $\text{Ca}(\text{HCO}_3)_2$ to be completely soluble. K_{sp} of $\text{CaCO}_3 = 10^{-9}$ M, K_1 , K_2 of $\text{H}_2\text{CO}_3 = 10^{-7}$ and 10^{-11} respectively

- (A) 1 g per L
- (B) 1 mol per L
- (C) 0.1 g per L
- (D) 0.1 mol per L

19.



For the reaction $x\text{A}(\text{g}) \rightarrow y\text{B}(\text{g})$, which of the following statements are correct ?

- (i) Reaction is a zero order reaction
- (ii) Rate constant for the reaction is 0.02 s^{-1}
- (iii) If concentration of A is changed, then rate constant changes, but rate of reaction remains constant.
- (iv) The reaction is a complex reaction

- (A) (i), (ii) and (iv) are correct
- (B) (i), (iii) and (iv) are correct
- (C) Only (i) and (iv) are correct
- (D) All statements are correct

20. Electrons in H atom get excited from the ground state to an orbit in which the wavelength of the electron is 10 times the wavelength of an electron in the ground state of He^+ . How many spectral lines are observed in the visible range when these electrons are de-excited to the ground state ?

- (A) 10
- (B) 15
- (C) 4
- (D) 3

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a Numerical Value.

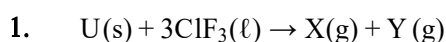
For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

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

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

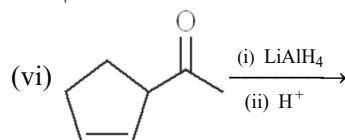
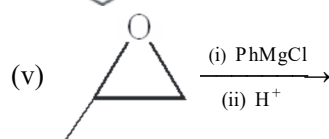
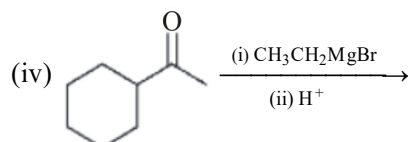
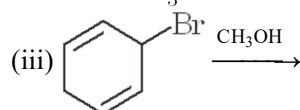
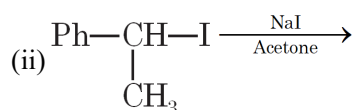
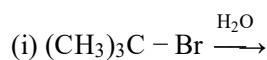
Negative Marks : -1 If wrong answer is entered.



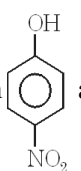
X is uranium containing compound. Oxidation state of uranium in X is :-

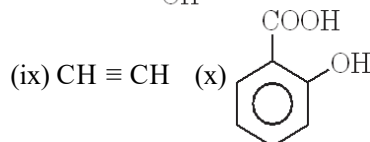
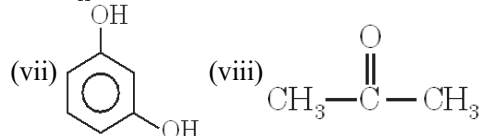
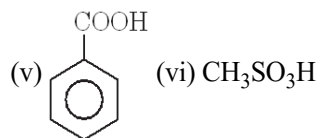
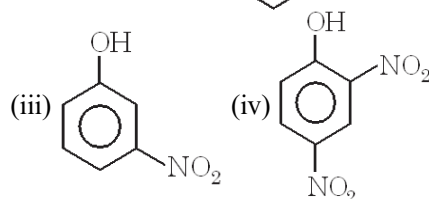
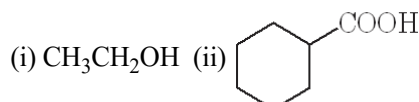
2. How many of the following give a racemic mixture as the major product ?

All chiral reactants used are optically pure.

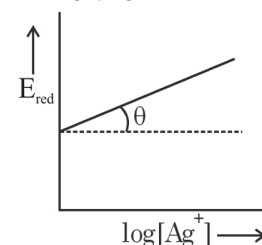


3.

Number of compounds more acidic than  are



4. The plot of Reduction Potential (E_{red}) vs $[Ag^+]$ for $Ag^+|Ag$ half cell is given as



Given :

$$E_{Ag^+/Ag}^0 = 0.8V \text{ (independent of temperature) ;}$$

$$\frac{2.303RT}{F} = 0.06 \text{ at } 300K; \tan \theta = 0.062$$

What is the temperature of the solution in $^{\circ}C$

5. The radius of $A^+ = 1.4\text{\AA}$ and $B^- = 2.6\text{\AA}$. What is the edge length of the cubic unit cell of AB in \AA ?

SECTION-I : (Maximum Marks: 80)

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

Full Marks : +4 If correct answer is selected.

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

Negative Marks : -1 If wrong option is selected.

- There are several tea cups in the kitchen, some with handles and other without handles. The number of ways of selecting one cup without a handle and one cup with a handle is exactly 36. Then the minimum possible numbers of cups in the kitchen is equal to
(A) 20 (B) 12
(C) 10 (D) 28
- The sum of values of a ($a \in \mathbb{I}$) such that the equation $(x + 10)(x - a) + 5 = 0$ has integral roots
(A) -4 (B) -16
(C) -20 (D) 0
- If $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1$, for $x, y, z > 0$ then the least value of $(x - 1)(y - 1)(z - 1)$ is
(A) 3 (B) 6
(C) 0 (D) 8

- The number of points in square $|x| + |y| = 2$ which lie on the curve $y = x + \cos x$ and at which the tangent to the curve is parallel to the x-axis is
(A) 0 (B) 2
(C) 4 (D) 8
- Let $f(x) = \max\{|x|, x - [x]\}$, where $[.]$ denotes greatest integer function, then $\int_{-1}^1 f(x) dx$ is equal to
(A) $\frac{1}{4}$ (B) $\frac{3}{4}$
(C) $\frac{5}{4}$ (D) $\frac{7}{4}$
- Length of the line segment joining the feet of the perpendicular drawn from the point (3, 4) on the pair of lines $x^2 - 4xy + y^2 = 0$ is
(A) $\frac{5\sqrt{3}}{2}$
(B) $5\sqrt{3}$
(C) $2\sqrt{3}$
(D) $\sqrt{3}$
- Let z_1, z_2, z_3 be the complex numbers such that $|z_1 - 1| = |z_2 - 1| = |z_3 - 1|$ and $\arg\left(\frac{z_3 - z_1}{z_2 - z_1}\right) = \frac{\pi}{6}$ then $z_2(z_2 - 1) - z_3(z_2 + 1) + (z_3 + 1)(z_3 - 1) =$
(A) 0 (B) 1
(C) 2 (D) -2

8. $\theta \in [0, \pi]$ and z_1, z_2, z_3 are three complex numbers such that they are collinear and $(1 + |\sin \theta|)z_1 + (|\cos \theta| - 1)z_2 - 2z_3 = 0$.
If complex numbers z_1, z_2, z_3 are non-zero then number of possible values of θ is :-
(A) 0 (B) 1
(C) 2 (D) More than 2
9. The curve satisfying the differential equation $(2x^2y - 2y^4)dx + (2x^3 + 3xy^3)dy = 0$ and passing through $(1, 1)$ is given by $2 \ln(xy) + \frac{y^m}{x^n} = 1$, $(m, n \in \mathbb{N})$, then the value of $m + n$ is
(A) 5
(B) 4
(C) 3
(D) 6
10. The real no. x and y satisfying $(x - 4)^2 + (y - 5)^2 = 7^2$ then the minimum value of $\sqrt{x^2 + y^2 - 2x - 2y + 2}$ is
(A) 1
(B) 2
(C) 3
(D) 4
11. Two tangents on a parabola are $x - y = 0$ and $x + y = 0$. If $(2, 3)$ is focus of the parabola then the equation of tangent at vertex is
(A) $4x - 6y + 5 = 0$ (B) $4x - 6y + 3 = 0$
(C) $4x - 6y + 1 = 0$ (D) $4x - 6y + \frac{3}{2} = 0$
12. If $(6, 13)$ and $(25, 8)$ are the foci of a hyperbola passing through the point $(1, 1)$ then the eccentricity of the hyperbola is
(A) $\frac{\sqrt{386}}{38}$ (B) $\frac{\sqrt{386}}{25}$
(C) $\frac{\sqrt{386}}{13}$ (D) $\frac{\sqrt{386}}{12}$
13. The number of points of non-differentiability of function $f(x) = \max \{ \operatorname{sgn} x, 2^{-x}, x^2 \}$,
 $\operatorname{sgn} x = \begin{cases} \frac{|x|}{x} & x \neq 0 \\ 0 & x = 0 \end{cases}$
(A) 4
(B) 3
(C) 2
(D) 1
14. If f is a differentiable function satisfying $2f(x) = f(xy) + f\left(\frac{x}{y}\right), \forall x, y \in \mathbb{R}^+ f(1) = 0$ and $f'(1) = \frac{1}{\ln 6}$, then the value of $f(7776)$, is
(A) 3
(B) 4
(C) 5
(D) 6
15. If $(\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a}) = 3\vec{c}$ then the value of $[\vec{b} \times \vec{c} \quad \vec{c} \times \vec{a} \quad \vec{a} \times \vec{b}]$ ($[.]$ denotes scalar triple product) is
(A) 2 (B) 3
(C) 7 (D) None of these

16. The standard deviation of 35 numbers is 50. If each number is increased by 10, then new standard deviation will be :-

(A) 40 (B) 50
(C) 60 (D) 500

17. The number of skew symmetric matrix of order at least 2 with distinct elements except principal diagonal formed by the elements 0, ± 1 , ± 2 , ± 3 taking any number of elements at a time is

(A) 48 (B) 54
(C) 106 (D) 102

18. If $\Delta_r = \begin{vmatrix} r \cdot r! & ({}^m C_r)^2 & 2r-1 \\ \sin^2(m^2) & \sin^2(m) & \sin^2(m+1) \\ (m+1)!-1 & {}^{2m}C_m & m^2-1 \end{vmatrix}$,

then $\sum_{r=0}^m \Delta_r$ is

(A) 0 (B) m
(C) m^2 (D) $m^2 + \sin^2 m$

19. The number of integral values of 'b' for which origin and the point (1,1,1) lie on the opposite side of the plane $2x + a^2y + abz - 1 = 0$, for all $a \in \mathbb{R} - \{0\}$ is

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

20. Let $x, y > 0$. If $x^3 y^2 = 2^{15}$, then the least value of $3x + 2y$ is

(A) 30 (B) 32
(C) 36 (D) 40

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

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

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

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

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.

- Let p be the product of the non-real roots of the equation $x^4 - 4x^3 + 6x^2 - 4x = 2021$ then find $(p-1)^2$
- How many tangents to the circle $x^2 + y^2 = 3$ are there which are normal to the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$
- Find the no. of values of 'x' satisfying $\sin x \cdot \sin\left(\frac{1}{x}\right) - 1 = 0, x \in \mathbb{R} - \{0\}$
- Let an ordered pair A be defined as $A(x, y)$ where $x \in$ prime number, such that $x < 10$ and $y \in$ natural no. and $y \leq 10$. If the probability that the ordered pair A satisfies the relation $x^2 - 3y^2 = 1$ is P then $20P$ equals.
- $\lim_{k \rightarrow \infty} \int_0^{k[x]} (kt - [kt])^k dt; k \in \mathbb{N}$ is $\left[\frac{\lambda x}{2} \right]$ where $[.]$ denotes greatest integer function then find the value of λ .

SPACE FOR ROUGH WORK

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