



CLASSROOM CONTACT PROGRAMME

(Academic Session : 2019 - 2020)

JEE(Advanced)
FULL SYLLABUS
29-06-2020

JEE(Main + Advanced) : ENTHUSIAST COURSE [SCORE-II (PHASE-TEAS, T-AS, TOAS, TNAS, TRAS & TMAS)]

PAPER-1

Time : 3 Hours

Maximum Marks : 180

READ THE INSTRUCTIONS CAREFULLY

GENERAL :

1. This sealed booklet is your Question Paper. Do not break the seal till you are told to do so.
2. Use the Optical Response sheet (ORS) provided separately for answering the questions.
3. Blank spaces are provided within this booklet for rough work.
4. Write your name, form number and sign in the space provided on the back cover of this booklet.
5. After breaking the seal of the booklet, verify that the booklet contains **28** pages and that all the **20** questions in each subject and along with the options are legible. If not, contact the invigilator for replacement of the booklet.
6. You are allowed to take away the Question Paper at the end of the examination.

OPTICAL RESPONSE SHEET :

7. The ORS will be collected by the invigilator at the end of the examination.
8. Do not tamper with or mutilate the ORS. **Do not use the ORS for rough work.**
9. Write your name, form number and sign with pen in the space provided for this purpose on the ORS. **Do not write any of these details anywhere else on the ORS.** Darken the appropriate bubble under each digit of your form number.

DARKENING THE BUBBLES ON THE ORS :

10. Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.
11. Darken the bubble **COMPLETELY.**
12. The correct way of darkening a bubble is as :
13. The ORS is machine-gradable. Ensure that the bubbles are darkened in the correct way.
14. Darken the bubbles **ONLY IF** you are sure of the answer. There is **NO WAY** to erase or "un-darken" a darkened bubble.
15. Take **$g = 10 \text{ m/s}^2$** unless otherwise stated.

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

Please see the last page of this booklet for rest of the instructions

SOME USEFUL CONSTANTS

Atomic No. : H = 1, B = 5, C = 6, N = 7, O = 8, F = 9, Al = 13, P = 15, S = 16,
Cl = 17, Br = 35, Xe = 54, Ce = 58

Atomic masses : H = 1, Li = 7, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24,
Al = 27, P = 31, S = 32, Cl = 35.5, Ca=40, Fe = 56, Br = 80, I = 127,
Xe = 131, Ba=137, Ce = 140,

- | | |
|------------------------------------|--|
| • Boltzmann constant | $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$ |
| • Coulomb's law constant | $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ |
| • Universal gravitational constant | $G = 6.67259 \times 10^{-11} \text{ N-m}^2 \text{ kg}^{-2}$ |
| • Speed of light in vacuum | $c = 3 \times 10^8 \text{ ms}^{-1}$ |
| • Stefan-Boltzmann constant | $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{-K}^{-4}$ |
| • Wien's displacement law constant | $b = 2.89 \times 10^{-3} \text{ m-K}$ |
| • Permeability of vacuum | $\mu_0 = 4\pi \times 10^{-7} \text{ NA}^{-2}$ |
| • Permittivity of vacuum | $\epsilon_0 = \frac{1}{\mu_0 c^2}$ |
| • Planck constant | $h = 6.63 \times 10^{-34} \text{ J-s}$ |

Space for Rough Work

HAVE CONTROL → HAVE PATIENCE → HAVE CONFIDENCE ⇒ 100% SUCCESS

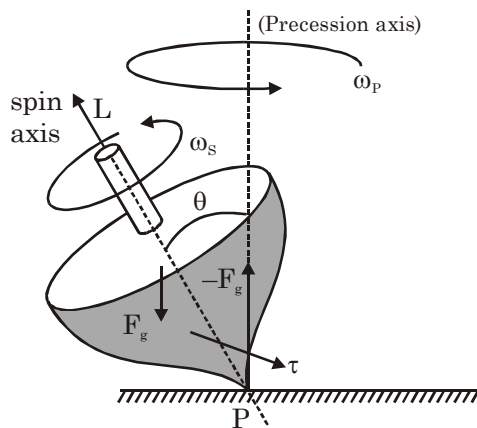
BEWARE OF NEGATIVE MARKING

PART-1 : PHYSICS

SECTION-I(i) : (Maximum Marks : 20)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
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Full Marks : +2 If only the bubble corresponding to the correct option is darkened.
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1. Precession is the result of the angular velocity of rotation (spin) and the angular velocity produced by the torque. It is an angular velocity about a line that makes an angle θ with the permanent rotation axis. In the diagram, a top of mass m is performing precession motion. The torque due to gravitational force F_g causes a change in the angular momentum L in the direction of that torque causing the top to process with angular velocity ω_p which is given by: (Given r is the distance of COM from point of rotation 'P'. I_s & ω_s are the moment of inertia and angular velocity of top about spin axis respectively.)



(A) $\frac{mgr}{I_s \omega_s^2}$

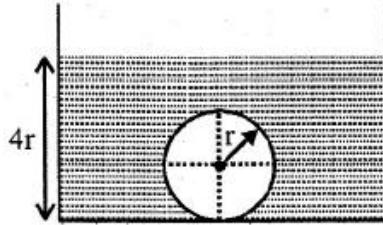
(B) $\frac{mgr^2}{I_s \omega_s^2}$

(C) $\frac{\omega_s I_s}{mgr}$

(D) $\frac{mgr}{\omega_s I_s}$

Space for Rough Work

2. A spherical metal ball of radius 'r' is lying at the bottom of stationary container containing liquid of density ρ as shown in the figure. The force exerted on the upper hemispherical portion of the sphere due to pressure ($p_0 =$ atmospheric pressure) is:

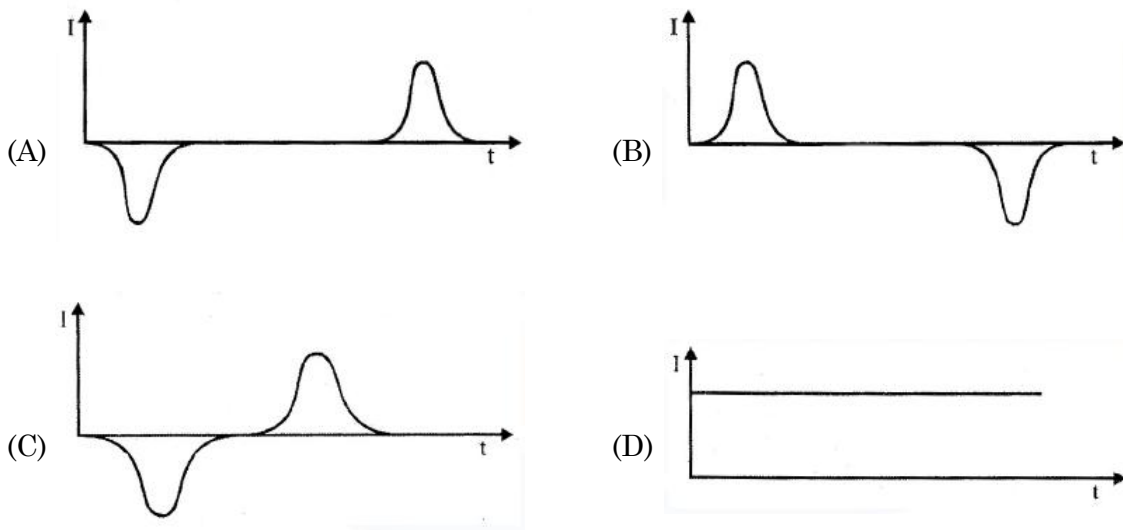
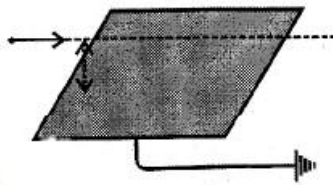


- (A) $\frac{\pi r^2}{3} [3P_0 + 7r\rho g]$ (B) $\frac{\pi r^2}{2} [3P_0 + 7r\rho g]$ (C) $\pi r^2 [3P_0 + 7r\rho g]$ (D) $2\pi r^2 [3P_0 + 7r\rho g]$
3. A real object is placed 1 cm above the optical axis of a convex lens of focal length 40cm. The object distance is 60cm. If the object now starts moving perpendicularly away from the optical axis with a speed = 10 cm/s, the speed of the image is
- (A) 5 cm/sec (B) 10 cm/sec (C) 20 cm/sec (D) 40 cm/sec
4. In the Bohr's atomic model, electron revolves in an orbit with speed v . It produces magnetic field B at centre. The magnetic dipole moment of the electron is M . Which of the following quantity is independent of quantum number of the orbit?

- (A) $\frac{Mr}{Bv}$ (B) $\frac{Br^2}{Mv^2}$ (C) $\frac{Mr^2}{Bv^2}$ (D) $\frac{Mv^2}{Br^3}$

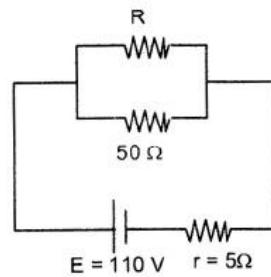
Space for Rough Work

5. Two identical blocks of same metal are at 20°C and 80°C respectively. Specific heat of the material of the two blocks increase with temperature. Which of the following is true about the final temperature T_f when the two blocks are brought into contact? (Assume that no heat is lost to the surroundings):
- (A) T_f will be 50°C
 - (B) T_f will be more than 50°C
 - (C) T_f will be less than 50°C
 - (D) T_f can be either more than or less than 50°C depending on the precise variation of the specific heat with temperature.
6. A broad metal plate is connected to earth through a conducting wire as shown. An electron flies with constant velocity along a straight line above the plate at a distance much less than the linear dimensions of the plate. If the current I flowing from the earth to the plate is considered to be positive, then which of the following graph correctly depicts the variation of current I with time?

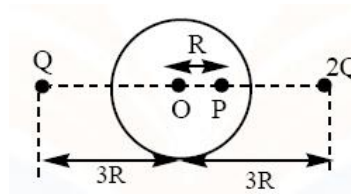


Space for Rough Work

7. An electric circuit consists of a battery emf $E = 110\text{V}$, with internal resistance 5Ω and two resistors connected in parallel to the source as shown in figure. Determine the value of R so that maximum power get dissipated in resistance R .



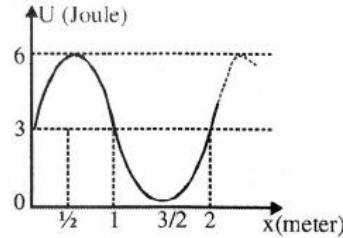
- (A) $\frac{50}{11}$ (B) $\frac{50}{12}$ (C) 50 (D) $\frac{50}{13}$
8. A solid conducting sphere of center 'O', radius $2R$, carrying charge Q is surrounded by two point charges Q and $2Q$ as shown in the figure. The electric field at point P due to the total charges of conducting sphere is: ($OP = R$ and $K = \frac{1}{4\pi\epsilon_0}$)



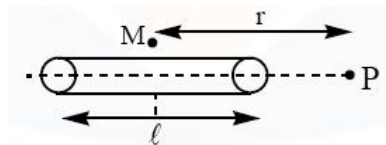
- (A) $\frac{7}{16} \frac{KQ}{R^2}$ towards right (B) $\frac{1}{8} \frac{KQ}{R^2}$ towards right
- (C) $\frac{KQ}{R^2}$ towards right (D) zero

Space for Rough Work

9. Potential energy curve (sinusoidal) is shown graphically for a particle. The potential energy does not depend on y and z coordinates. The maximum value of corresponding conservative force (in magnitude) for range $0 < x < 2$ is $(\beta\pi)$. Find the value of β .



- (A) 3N (B) 6N (C) 4N (D) 8N
10. An insulating cylindrical rod of diameter d and length ℓ ($\ell \gg d$) has a uniform surface charge density such that the electric field just outside the curved surface of the cylinder at point M is E_0 . Find the electric field due to charge distribution at point P ($r \gg \ell$).



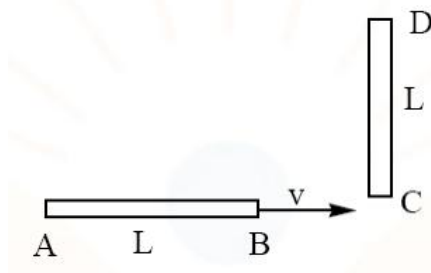
- (A) $E_0 \frac{\ell d}{2r^2}$ (B) $E_0 \frac{\ell d}{4r^2}$ (C) $E_0 \frac{\ell d}{3r^2}$ (D) $E_0 \frac{2\ell d}{r^2}$

Space for Rough Work

SECTION-I(ii) : (Maximum Marks: 20)

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- For each question, choose the correct option(s) to answer the question.
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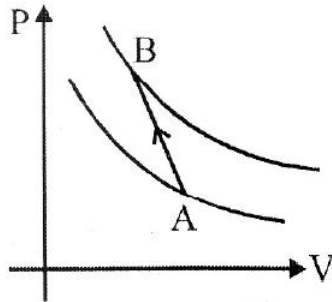
11. A rod CD of length L and mass M is placed horizontally on a frictionless horizontal surface as shown. A second identical rod AB which is also placed horizontally (perpendicular to CD) on the same horizontal surface is moving along the surface with a velocity v in a direction perpendicular to rod CD and its end B strikes the rod CD at end C and sticks to it rigidly. Then:



- (A) speed of centre of mass of the system just after impact is $\frac{v}{4}$.
- (B) the ω (angular speed) of system just after collision is $\frac{3v}{5L}$.
- (C) speed of centre of mass of the system just after impact is $\frac{v}{2}$.
- (D) the ω (angular speed) of system just after collision is $\frac{5v}{3L}$.

Space for Rough Work

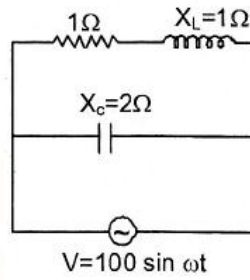
12. Two adiabatic process involving an ideal gas are plotted on a P - V diagram. A and B are two points on these curves as shown in the diagram. Which of the following statements is/are true?



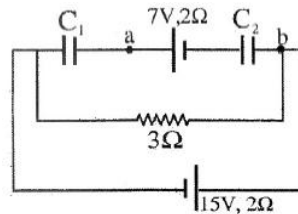
- (A) Heat is given to system in the process AB.
 - (B) Heat is rejected by system in the process AB.
 - (C) Whether heat is rejected or absorbed by the system during the process AB does not depend on the magnitude of the slope of line AB.
 - (D) Whether heat is rejected or absorbed by the system during the process AB does not depend on the position of the points A and B on the P - V diagram.
13. Choose the **CORRECT** option(s):
- (A) Waves from two coherent sources may be in same phase always at some points.
 - (B) Waves from two incoherent sources have fixed phase difference at a point always
 - (C) Initial phase difference between the waves emitted by two coherent sources may vary with time.
 - (D) Waves from two coherent sources may be in opposite phase always at some points.

Space for Rough Work

14. In the given a.c. circuit, choose the **CORRECT** statement(s).



- (A) Impedance of circuit is 2Ω
 - (B) Power factor of circuit is $\frac{1}{\sqrt{2}}$
 - (C) Peak value of current through resistance is $50\sqrt{2}$ A
 - (D) Average power supplied by source is 2500W.
15. In the figure shown, $C_1 = 11\mu\text{F}$ and $C_2 = 5\mu\text{F}$, then at steady state:



- (A) the potential difference across C_1 is 5V.
- (B) the potential difference across C_2 is 2V.
- (C) the potential difference between points a and b is 4V.
- (D) the potential difference between the terminals of 15 V battery is 9V.

Space for Rough Work

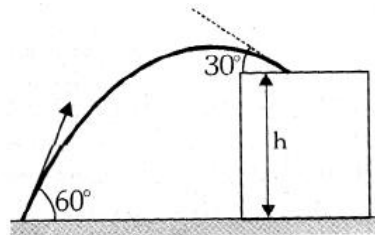
SECTION-II : Numerical Value Type (Up to second decimal place)

No question will be asked in section II

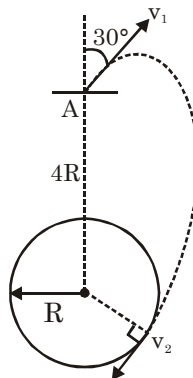
SECTION-III : (Maximum Marks : 20)

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1. A stone projected at an angle of 60° from the ground level strikes at an angle of 30° on the roof of a building of height 'h'. If the speed of projection of the stone is \sqrt{Ngh} , find N.

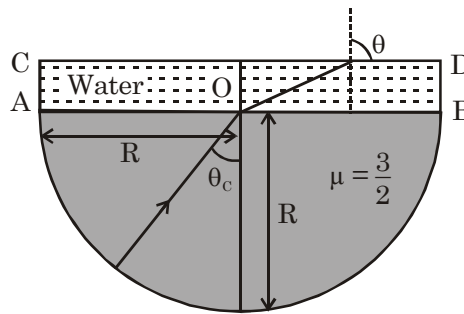


2. A particle is projected from point A, that is at a distance $4R$ from the centre of the earth, with speed v_1 in a direction making 30° with the line joining the centre of the earth and point A, as shown. Find v_1 if the particle passes grazing the surface of the earth. Consider gravitational interaction only between these two. Express your answer in the form $\frac{1000X}{\sqrt{2}}$ m/s and fill value of X. (use $\frac{GM}{R} = 6.4 \times 10^7 \text{ m}^2/\text{s}^2$)



Space for Rough Work

3. Two tuning forks A and B lying on opposite sides of observer 'O' and of natural frequency 85Hz move with velocity 10 m/s relative to stationary observer O. Fork A moves away from the observer while the fork B move towards him. A wind with a speed 10 m/s is blowing towards fork A. Find the beat frequency measured by the observer in Hz. [Take speed of sound in air as 340 m/s]
4. A ray of light travelling in glass ($\mu = 3/2$) is incident on a horizontal glass air surface at the critical angle θ_c . If a thin layer of water ($\mu = 4/3$) is now poured on the glass air surface, the ray of light emerge into air at the water air surface at an angle of π/k radians from the normal at that point, find the value of k.



5. A solid has a volume v_0 when external pressure is p_0 . Bulk modulus of the material is B . Now the pressure is increased to p . The additional energy per unit volume now stored in the material is $\frac{3(p^2 - p_0^2)}{zB}$. Find $z = ?$

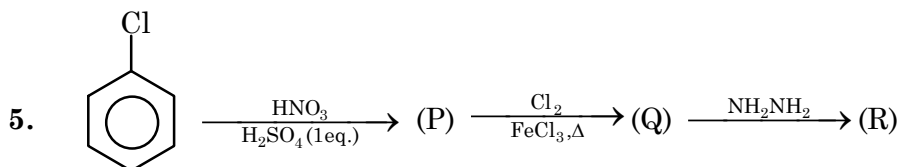
Space for Rough Work

PART-2 : CHEMISTRY

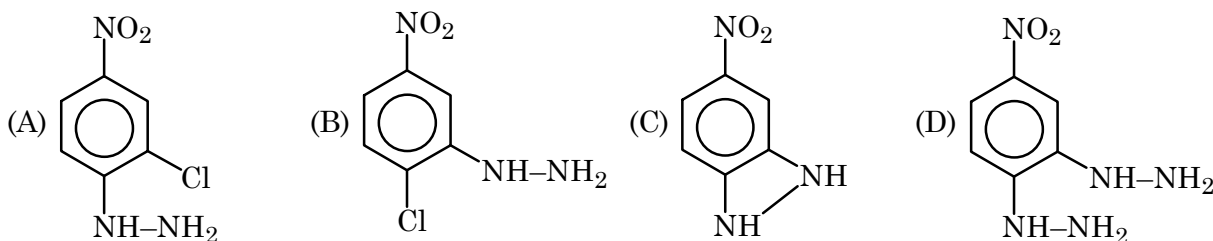
SECTION-I(i) : (Maximum Marks : 20)

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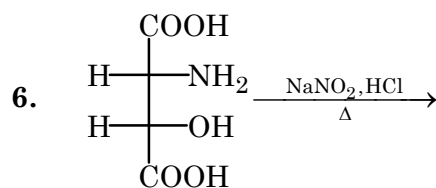
1. The number of waves made by a Bohr electron in an orbit of maximum magnetic quantum number +2 is
 (A) 3 (B) 4 (C) 2 (D) 1
2. Under which of the following conditions a real gas resembles an ideal gas –
 (A) 'a' and 'b' are very large (B) 'a' and 'b' are very small
 (C) 'a' is large and 'b' is small (D) 'a' is small and 'b' is large
3. If valence factor (n-factor) of compound $\text{NaHC}_2\text{O}_4 \cdot 2\text{H}_2\text{C}_2\text{O}_4 \cdot 3\text{K}_2\text{C}_2\text{O}_4 \cdot 4\text{Al}_2(\text{C}_2\text{O}_4)_3 \cdot 3\text{FeC}_2\text{O}_4$ in acid base titration is x and redox titration with KMnO_4 is y then value of y/x is –
 (A) 8.4 (B) 9 (C) 11.25 (D) 12
4. An ammonia-ammonium chloride buffer has a pH value of 9 with $[\text{NH}_3] = 0.25\text{M}$. What will be the new pH if 500 ml 0.1 M KOH is added to 200 ml buffer solution ($K_b = 2 \times 10^{-5}$) [$\log 2 = 0.3$]
 (A) 8.4 (B) 9.6 (C) 5.6 (D) 4.4



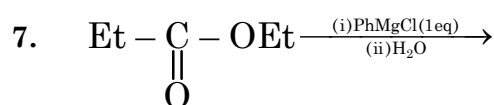
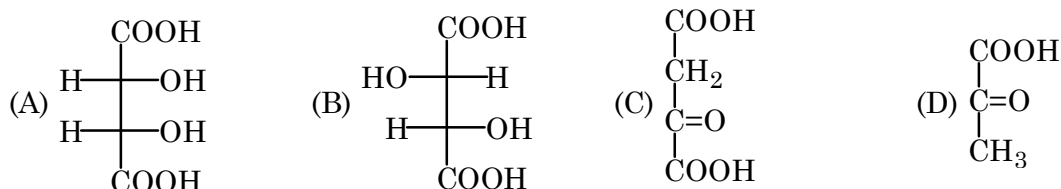
(R) is -



Space for Rough Work



The major product in the given reaction is

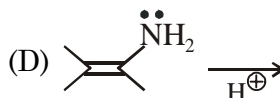
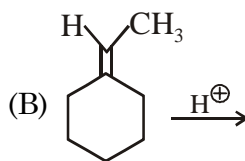
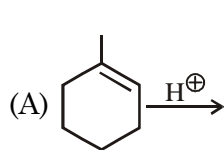


P_1 (Ketone) + P_2 (Alcohol) True about product of above reaction

- (A) P_1 will give + ve iodoform test
 - (B) Product P_2 will give CO_2 on heating
 - (C) Product P_1 will give only one oxime with NH_2OH
 - (D) Product P_1 will give alcohol with CH_3MgBr followed by hydrolysis.
8. Generally diamonds are good conductors of heat. This property of diamonds can be utilized
- (A) To estimate the hardness of diamonds
 - (B) To determine the refractive index of diamonds
 - (C) To find out whether the given diamond is fake or original
 - (D) To determine its chemical reactivity

Space for Rough Work

9. Which of the following will form 2° carbocation?



10. Synthetic detergents are more effective than ordinary soaps in hard water because

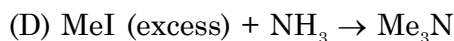
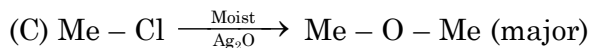
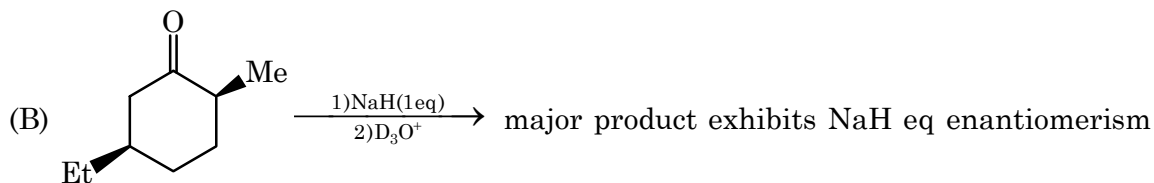
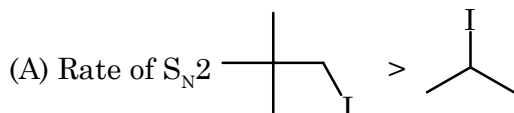
- (A) They are highly soluble in water
- (B) Their calcium and magnesium salts are water soluble
- (C) Their calcium and magnesium salts are insoluble in water
- (D) They convert calcium and magnesium ions by converting them to stable Complex compounds

Space for Rough Work

SECTION-I(ii) : (Maximum Marks: 20)

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11. Which of the following is/are characteristic of chemisorptions
- (A) It is irreversible (B) It is specific
 (C) It is multilayer phenomenon (D) Magnitude of heat of adsorption is 80-240 kJ
12. Find compounds given below, which produce metallic residue on heating
- (A) Ag_2CO_3 (B) HgO (C) BaO_2 (D) $\text{Ba}(\text{N}_3)_2$
13. Choose the incorrect option(s)



Space for Rough Work

14. Select correct for hybridization
- (A) As % s-character increases in hybrid orbital, bond angle increases
 - (B) As % s-character decreases in hybrid orbital, bond strength increases
 - (C) As % s-character increases in hybrid orbital electro negativity increases
 - (D) As % s-character increases in hybrid orbital, orbital length is decreases
15. Which of the following statements are correct?
- (A) $[\text{Ag}(\text{NH}_3)_2]^+$ is less stable than $[\text{Ag}(\text{CN})_2]^-$
 - (B) $[\text{Ag}(\text{NH}_3)_2]^+$ is more stable than $[\text{Ag}(\text{en})]^+$
 - (C) AgCl is soluble in conc HCl
 - (D) AgCl converts into AgI when it is dissolve in NH_4OH followed by the addition of $\text{KI}_{(\text{aq})}$.

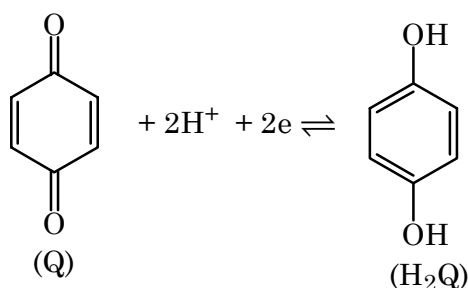
Space for Rough Work

**SECTION-II : Numerical Value Type (Up to second decimal place)
No question will be asked in section II**

SECTION-III : (Maximum Marks : 20)

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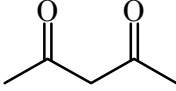
- Total number of layers between a distance of $14R\sqrt{\frac{2}{3}}$ in hcp unit cell is (including first and last)
- Quinhydrone is a sparingly soluble one-to-one addition compound formed from hydroquinone and quinone. When solid quinhydrone is dissolved in an aqueous medium, equal concentrations of hydroquinone and quinone result. If a platinum wire is dipped into the solution, the potential of the electrode is governed by the reversible reaction :



Where Q denotes quinone and H_2Q denotes hydroquinone. The E° value of this half cell reaction is +0.46V with respect to the saturated calomel reference electrode (SCE). Because the potential of the quinone-hydroquinone half reaction depends on the concentration of hydrogen ion, it is possible to use this system to measure pH. A sample solution of unknown pH was saturated with quinhydrone and a platinum electrode was dipped into it. If the potential of the such electrode was found to be +0.22V with respect to SCE, what was the PH of the sample solution?

[Given : $\frac{2.303RT}{F} = 0.06$]

Space for Rough Work

3.  $\xrightarrow[\text{I}_2]{\text{KOH}}$ number of iodoform molecules produced per molecule.
4. The electro negativity difference between two elements A and B is 0.5. the magnitude of percent ionic character in single A–B would be nearest to
5. PCl_5 reacts with P_4O_{10} to give a single product. The number of PCl_5 molecules required to react with one mole of P_4O_{10} in the balanced reaction is

Space for Rough Work

PART-3 : MATHEMATICS

SECTION-I(i) : (Maximum Marks : 20)

- This section contains **TEN** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +2 If only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 In all other cases

1. The term independent of x any y in the expansion of

$$\left[\left(\sqrt{x} + \frac{1}{\sqrt{x}} \right)^2 + \left(\sqrt{y} + \frac{1}{\sqrt{y}} \right)^2 + \left(\sqrt{xy} + \frac{1}{\sqrt{xy}} \right)^2 - 4 \right]^n$$
 is

- (A) $\left(\sum_{r=0}^n {}^n C_r \right)^2$ (B) $\sum_{r=0}^n ({}^n C_r)^2$ (C) $\left(\sum_{r=0}^n {}^n C_r \right)^3$ (D) $\sum_{r=0}^n ({}^n C_r)^3$

2. If $y = 2 \cot^{-1} \left(\frac{x}{2} \right) + x$ then $\int \frac{x^2 dx}{(x^2 - 4) \sin x + 4x \cos x} =$

- (A) $\ln |\operatorname{cosec} 2y + \cot y| + C$ (B) $\ln |\operatorname{cosec} 2y - \cot y| + C$
 (C) $\ln |\operatorname{cosec} y + \cot y| + C$ (D) $\ln |\operatorname{cosec} y - \cot y| + C$

3. Consider a curve $|x| + |y| = 1$ such that lines $y = mx, y = nx$ make points of intersection in the same quadrant. Let A, B be two such points lying in the same quadrant such that OA, AB, OB are in A.P. If θ is angle between OA and OB then the maximum angle θ is (0 is origin)

- (A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{4}$ (D) None of these

Space for Rough Work

4. n balls are arranged to form an equilateral triangle such that first row consists of 1 ball, second row consist of 2 balls, third row consists of 3 balls and so on 49 more balls are added to form a square. If each side of square contains 3 balls more than that of equilateral triangle then $n =$
- (A) 10 (B) 20 (C) 50 (D) 15
5. A line L cuts the lines AB , AC and AD of a parallelogram $ABCD$ at points B_1 , C_1 and D_1 respectively. If $\overline{AB_1} = \lambda_1 \overline{AB}$, $\overline{AD_1} = \lambda_2 \overline{AD}$ and $\overline{AC_1} = \lambda_3 \overline{AC}$ then $\frac{1}{\lambda_3} =$
- (A) $\frac{1}{\lambda_1} + \frac{1}{\lambda_2}$ (B) $\frac{1}{\lambda_1} - \frac{1}{\lambda_2}$ (C) $-\lambda_1 + \lambda_2$ (D) $\lambda_1 + \lambda_2$
6. If $[x^3 + x^2 + x + 1] = [x^3 + x^2 + 1] + x$, (where $[.]$ denotes the greatest integer function), then number of solutions of the equation $\log |[x]| = 2 - |[x]|$ is
- (A) 1 (B) 0 (C) 3 (D) 2
7. Let the circle $(x - 1)^2 + (y - 2)^2 = 25$ cuts rectangular hyperbola with transverse axis along $y = x$ at 4 points A, B, C and D having coordinates (x_i, y_i) , $i = 1, 2, 3, 4$ such that origin is centre of hyperbola. If $\ell = x_1 + x_2 + x_3 + x_4$, $m = x_1^2 + x_2^2 + x_3^2 + x_4^2$, $n = y_1^2 + y_2^2 + y_3^2 + y_4^2$ then $\frac{m+n}{\ell} =$
- (A) 100 (B) 10 (C) 50 (D) 20

Space for Rough Work

8. If $P = (\tan 3^{n+1}\theta - \tan\theta)$ and $Q = \sum_{r=0}^n \frac{\sin 3^r \theta}{\cos 3^{r+1} \theta}$ then
 (A) $P = 3Q$ (B) $P = 2Q$ (C) $2P = Q$ (D) $3P = Q$
9. A, B, C are vertices of a triangle with right angle at A and $P(-4, 0)$; $Q(0, 6)$ are two given points. If the ratio of distances from each vertex to P, to that of Q is 2 : 3, then the centroid of ΔABC lies on a circle with radius equal to
 (A) $\frac{4\sqrt{13}}{5}$ units (B) 4 units
 (C) $\frac{8\sqrt{13}}{5}$ units (D) 8 units
10. A line is drawn from the point $P(1, 1, 1)$ and perpendicular to a line with direction ratios $(1, 1, 1)$ to intersect the plane $x + 2y + 3z = 4$ at Q. The locus of point Q is
 (A) $\frac{x}{1} = \frac{y-5}{-2} = \frac{z+2}{1}$ (B) $\frac{x}{-2} = \frac{y-5}{1} = \frac{z+2}{1}$
 (C) $x = y = z$ (D) $\frac{x}{2} = \frac{y}{3} = \frac{z}{5}$

Space for Rough Work

SECTION-I(ii) : (Maximum Marks: 20)

- This section contains **FIVE** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -1 In all other cases.

11. Consider ΔABC whose circumcircle is $|z| = r$ in the argand plane with A, B, C be represented by complex numbers a, b, c respectively. The foot of altitudes from A, B, C meet the opposite side at D, E and F and the altitudes when produced meet the circle $|z| = r$ at L, M and N respectively then which of following is/are correct ?

(A) centroid of ΔLMN is $\frac{-(a^2b^2 + b^2c^2 + c^2a^2)}{3abc}$

(B) the mirror image of orthocenter of ΔABC with respect to BC lies on $|z| = r$

(C) the mirror image of orthocenter of ΔABC with respect to BC is $\frac{-bc}{a}$

(D) none of these

12. If $f(x) + f(y) = \frac{1}{x} + \frac{1}{y}, \forall x, y \in \mathbb{R} - \{0\}$ and $\int_2^3 \frac{3(f(x))^5 - f(x)}{1 - (f(x))^4} dx = \frac{1}{2} \log \frac{2^\alpha}{3^\beta}$, then

(A) $\alpha > \beta$

(B) β is prime

(C) $\alpha < 2\beta$

(D) $(\alpha + \beta)$ is prime

Space for Rough Work

13. Three students A, B, C appear for IIT-JEE exam. Their respective probabilities of clearing the exams being $\frac{3}{10}$, $\frac{1}{2}$ and $\frac{2}{5}$. Each student clearing or not clearing the exam is independent of other. If the probability of A passing the exam be $\frac{m}{n}$ ($m, n \in \mathbb{N}$) given that only one of the student has cleared the exam, then the least value of $(m + n)$ is greater than
(A) 10 (B) 20 (C) 40 (D) 80
14. For a given parabola $y^2 = 4ax$, two variable chords PQ and RS at right angles are drawn through the fixed point $A(x_1, y_1)$ inside the parabola, making variable angles θ and α with x-axis. If r_1, r_2, r_3, r_4 are distances of P, Q, R and S from A, then the value of $\frac{1}{r_1 r_2} + \frac{1}{r_3 r_4}$
(A) independent of θ (B) independent of α
(C) depends upon both θ & α (D) is a constant
15. Let $f(x) = |(x - 1)| + |(x - 4)| + |(x - 9)| + \dots + |(x - 2401)| + |(x - 2500)| \forall x \in \mathbb{R}$. If m and n denote the number of points of non differentiability of $f(x)$ and number of integral points where $f(x)$ has minimum value respectively then
(A) $m = 50$ (B) $n = 52$ (C) $m + n = 100$ (D) $m = n = 50$

Space for Rough Work

SECTION-II : Numerical Value Type (Up to second decimal place)

No question will be asked in section II

SECTION-III : (Maximum Marks : 20)

- This section contains **FIVE** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : -1 In all other cases

-
1. Let $x, y \in \mathbb{R}$ such that $\cos x \cos y + 2 \sin y + 2 \sin x \cos y = 3$, then find the value of $\tan^2 x + 5 \tan^2 y$.
 2. Suppose $f : \mathbb{R} \rightarrow \mathbb{R}$ be a continuous function such that $f(3x) = f(x), \forall x \in \mathbb{R}$ and $f(2) = 5$, then value of $\int_2^5 \operatorname{sgn}(f(x)) dx$ is equal to (where $\operatorname{sgn}(x)$ represents signum function)
 3. If $\log_{245} 175 = a, \log_{1715} 875 = b$, then the value of $\frac{1-ab}{a-b}$ is _____

Space for Rough Work

4. The value of the expression $\lim_{y \rightarrow \infty} ((8y + 3)(y + 1)(y + 2)(y + 3)(2y + 3)(4y + 5)(2y + 7))^{1/7} - 2y$ is of the form $\frac{A}{B}$ (Where A, B are coprime number). Then the value $\left[\frac{A}{B} \right]$ (where $[\cdot]$ denotes the greatest integer function), is _____
5. The plane $\frac{x}{1} + \frac{y}{2} + \frac{z}{3} = 1$ intersect x-axis, y-axis, z-axis at A, B, C respectively. If the distance between origin and orthocenter of ΔABC is equal to k then value of $7k$ is equal to

Space for Rough Work

Space for Rough Work

QUESTION PAPER FORMAT AND MARKING SCHEME :

16. The question paper has three parts : Physics, Chemistry and Mathematics.

17. Each part has two sections as detailed in the following table.

Section	Que. Type	No. of Que.	Category-wise Marks for Each Question				Maximum Marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
I(i)	Single correct option	10	+2 If only the bubble corresponding to the correct option is darkened	—	0 In all other cases	—	20
I(ii)	One or more correct option(s)	5	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	—	0 If none of the bubbles is darkened	-1 In all other cases	20
III	Single digit Integer (0-9)	5	+4 If only the bubble corresponding to correct answer is darkened	—	0 If none of the bubbles is darkened	-1 In all other cases	20

NAME OF THE CANDIDATE	
FORM NO.	
I have read all the instructions and shall abide by them. _____ Signature of the Candidate	I have verified the identity, name and Form number of the candidate, and that question paper and ORS codes are the same. _____ Signature of the Invigilator