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JEE Main Model Question Paper

This model question paper is useful for JEE Main appearing candidates.

PAPER - 1

TIME: 3 HRS MAXIMUM MARKS: 240

CHEMISTRY

(Q. Nos. 1-8): Have only one correct option. You will be awarded 3 marks for correct answer and -1 mark (minus one mark) for wrong answer.

(Q. Nos. 9-12): Have one or more than one correct option. You will be awarded 4 marks for correct answer and -1 mark (minus one mark) for wrong answer.

(Q. Nos. 13-18): These Questions are comprehension type, with only one correct option. You will be awarded 4 marks for correct answer and -1 mark for wrong answer.

(Q. Nos. 19 - 20): These Questions in column-1 are to be matched with the answers in the column-2. **These may have one or more correct options.** You will be awarded 8 marks for correct answer. There is no negative marking.


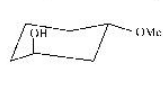
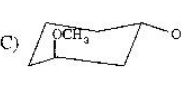
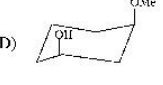
SECTION - I

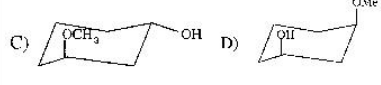
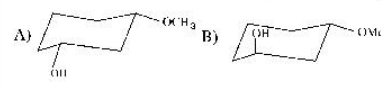
ONLY ONE OPTION CORRECT:

- 40% of mixture of 0.2 mole of N_2 and 0.6 mole of H_2 react to give NH_3 according to equation $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at constant temperature and pressure. Then the ratio of the final volume to the initial volume of gases is
A) 4 : 5 B) 5 : 4 C) 7 : 10 D) 8 : 15

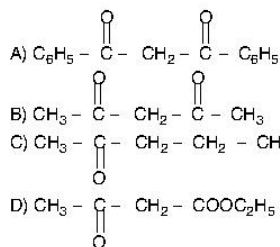
- The ratio of de Broglie wavelengths of molecules of H_2 and He at $27^\circ C$ and $127^\circ C$ respectively is
A) 0.612 B) 1.265 C) 0.79 D) 1.633

- The amount of ice that will separate out on cooling a solution containing 50 gm of ethylene glycol in 200 gm water to $-9.3^\circ C$ is ($K_f = 1.86 K \text{ molality}^{-1}$)
A) 38.71 mg B) 42 gm
C) 42 mg D) 38.71 gm

- The most stable isomer among the following
A)  B) 
C)  D) 



- The maximum enol content in solution is exhibited by



- An alloy of Cu, Ag, Au is found to have copper constituting ccp lattice. If silver atoms occupy the edge centres and gold is present at body centre, the alloy has a formula



- The species with shortest N-O bond length is



- II acceptor nature is characteristic of



SECTION - II

MORE THAN ONE OPTION CORRECT:

- Lithium salts insoluble in water is/ are



- Ionic hydrides are formed by
A) Be B) Ca C) Sr D) Na

- Nitrogen gas is obtained from

- A) Decomposition of NH_4NO_2
B) Decomposition of NH_4NO_3
C) Decomposition of $(NH_4)_2Cr_2O_7$
D) Decomposition of $(NH_4)_2SO_4$

- The acidic strength of hydrogen halides (HX) depends on parameters like

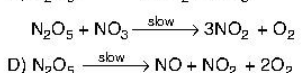
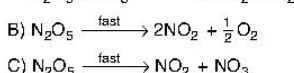
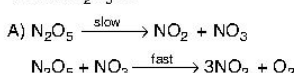
- A) ionization energy of H^+
B) electron affinity of X^-
C) enthalpy of hydration of H^+ and X^-
D) physical state of HX

SECTION - III

COMPREHENSION - 1

The thermal decomposition of N_2O_5 occurs as: $2N_2O_5 \rightarrow 4NO_2 + O_2$. Experimental studies suggest that the rate of decomposition of N_2O_5 rate of formation of NO_2 or rate of formation of O_2 all becomes double if the concentration of N_2O_5 is doubled.

- The correct mechanism for the decomposition of N_2O_5 is

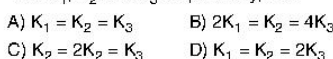


- The rate of reaction is given by

A) $-d\frac{[N_2O_5]}{dt} = K_1[N_2O_5]$
B) $\frac{1}{2}d\frac{[O_2]}{dt} = K_2[N_2O_5]$

C) $-\frac{1}{4}d\frac{[NO_2]}{dt} = K_3[N_2O_5]$
D) $\frac{d[N_2O_5]}{dt} = K_1[N_2O_5]^2$

- If the rate constants for decomposition of N_2O_5 , formation of NO_2 and formation of O_2 are K_1 , K_2 and K_3 respectively, then



COMPREHENSION - 2

(i) $u_{rms} = \sqrt{\frac{3RT}{M}}$

(ii) Translational kinetic energy / mole = $\frac{1}{2}Mu_{rms}^2$

(iii) Collision frequency = $\frac{u_{rms}}{\lambda}$ where λ = mean free path

- The u_{rms} speed of O_2 molecules at a certain temperature T is μ . If the temperature is doubled so that O_2 dissociates into O atoms, then u_{rms} of oxygen atoms is

A) $u_{rms} O_2 = u_{rms} O$ B) $u_{rms} O_2 = 2 \times u_{rms} O$
C) $u_{rms} O_2 = \frac{1}{2} \times u_{rms} O$ D) $u_{rms} O_2 = \frac{1}{3} u_{rms} O$

- A jar contains He and H_2 in the molar ratio 1:5. The ratio of mean translational kinetic energy is in the ratio at the same temperature is

A) 1 : 5 B) 2 : 1 C) 5 : 1 D) 1 : 1

- Identify the correct expression for ideal gas if its pressure is P and translational kinetic energy per unit volume is E

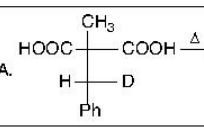
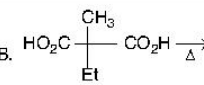
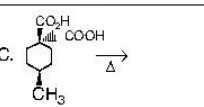
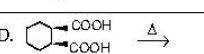
A) $P = \frac{2}{3}E$

B) $P = \frac{3}{2}E$ C) $P = \frac{1}{2}E$ D) $P = 2E$

SECTION - IV

MATCH THE FOLLOWING:

19. Match the following :

| Column - 1 | Column - 2 |
|---|---------------------------|
| Reaction | Product formed |
| A.  | P. Diastereomers |
| B.  | Q. Racemic mixture |
| C.  | R. Meso compounds |
| D.  | S. CO_2 gas will evolve |

20. Match the following:

| Column - 1 | Column - 2 |
|----------------------|--|
| A. Hybridisation | P. Bond length |
| B. No bond resonance | Q. Acidic character of hydrocarbons |
| C. Inductive effect | R. Electrophilic aromatic substitution |
| D. Mesomeric effect | S. Stability of free radicals. |

MATHEMATICS

(Q. Nos. 21-28): Have only one correct option. You will be awarded 3 marks for correct answer and -1 mark (minus one mark) for wrong answer.

(Q. Nos. 29 - 32) : Have one or more than one correct option. You will be awarded 4 marks for correct answer and -1 mark (minus one mark) for wrong answer.

(Q. Nos. 33 - 38) : These Questions are Comprehension type, with only one correct option. You will be awarded 4 marks for correct answer and -1 mark for wrong answer.

(Q. Nos. 39 - 40) : These Questions in column-1 are to be matched with the answers in the column-2. **These may have one or more correct options.** You will be awarded 8 marks for correct answer. There is no negative marking.

SECTION - I

ONLY ONE OPTION CORRECT:

- The direction cosines of a line satisfy the relations $\lambda(l+m) = n$ and $mn + nl + lm = 0$. The value λ for which the two lines are perpendicular to each other is

A) 1 B) 2
C) $\frac{1}{2}$ D) none of these

- If the four plane faces of a tetrahedron are represented by the equation : $\vec{r} \cdot (l\hat{i} + m\hat{j}) = 0$, $\vec{r} \cdot (m\hat{j} + n\hat{k}) = 0$, $\vec{r} \cdot (n\hat{k} + p\hat{i}) = 0$, $\vec{r} \cdot (l\hat{i} + m\hat{j} + n\hat{k}) = p$ then the volume of the tetrahedron is

A) $\frac{p^3}{6lmn}$ B) $\frac{2p^3}{3lmn}$ C) $\frac{3p^3}{lmn}$ D) $\frac{6p^3}{lmn}$

- If $x \sin(\alpha + y) = \sin y$ and $y' = \frac{m}{x^2 + 2nx - 1}$ then

A) $m - n = 1$ B) $m + n = 1$
C) $m^2 + n^2 = 1$ D) $m = n$

- If $f(x)$ and $g(x) = f(x) \sqrt{1 - 2f(x)^2}$ are monotonically increasing, then $\forall x \in R$

A) $|f(x)| \leq 1$ B) $|f(x)| < \frac{2}{3}$
C) $|f(x)| < \frac{1}{2}$ D) $|f(x)| < \frac{1}{\sqrt{2}}$

- The function $f(x)$ is discontinuous only at $x = 0$ such that $f^2(x) = 1 \forall x \in R$. Then the total number of such functions possible is

A) 2 B) 3
C) 6 D) none of these

- A function $f : R \rightarrow R$ is defined such that $2f(x^2) - f^2(x) \geq 1 \forall x \in R$ then

A) f can be one-one B) f must be onto
C) f must be monotonic D) none of these

- If $\sin(\alpha + \beta) \cdot \sin(\alpha - \beta) = \sin \gamma (2\sin \beta + \sin \gamma)$, $0 < \beta$, α , $\gamma < \pi$ then the family of lines $x \sin \alpha + y \sin \beta + \sin \gamma = 0$ passes through

A) $(-1, 1)$ B) $(1, 1)$
C) $(1, -1)$ D) $(-1, -1)$

- If the sides a, b, c of a triangle ABC are in A.P. then $\frac{b}{c}$ belongs to

A) $(0, \frac{2}{3})$ B) $(1, 2)$
C) $(\frac{2}{3}, 2)$ D) $(\frac{2}{3}, \frac{7}{3})$

SECTION - II

ONE OR MORE THAN ONE CORRECT OPTION :

- Let $L = \lim_{x \rightarrow 0} \frac{a - \sqrt{a^2 - x^2 - x^2/4}}{x^4}$, $a > 0$. If L is finite, then

A) $a = 2$ B) $a = 1$
C) $L = \frac{1}{64}$ D) $L = \frac{1}{32}$

- Area of the region bounded by the curve $y = e^x$ and lines $x = 0$ and $y = e$ is

A) $e - 1$ B) $\int_1^e ((e+1)-y) dy$
C) $e - \int_0^1 e^x dx$ D) $\int_4^e \ln y dy$

- Let a, b, c are the A.M's between two numbers such that $a + b + c = 15$ and p, q, r are the H.M's between the same two numbers such that

$\frac{1}{p} + \frac{1}{q} + \frac{1}{r} = \frac{5}{3}$. Then the numbers can be

A) 9, 1 B) 6, 3
C) 1, 9 D) -3, 3

- The roots of the equation : $x^5 - 40x^4 + Px^3 + Qx^2 + Rx + S = 0$ are in G.P. and sum of their reciprocals is 10. Then the value of S can be equal to

A) 32 B) $-\frac{1}{32}$
C) -32 D) $\frac{1}{32}$

SECTION - III

COMPREHENSION - 1

Let $f(x) = 12x^2 \int_0^x f(y) dy + 20 \int_0^x xy^2 f(y) dy + 4x$, then

- The maximum value of $f(x)$ is

A) 8 B) $\frac{1}{8}$ C) 16 D) $\frac{1}{16}$

- The number of solutions of the equation $|f(x)| = e^{|x|}$ is

A) 0 B) 2 C) 4 D) none of these

- The range of $f(-2^x)$ is

A) $(-\infty, 0)$ B) $(0, \infty)$
C) $(-\infty, \frac{1}{8})$ D) none of these

COMPREHENSION - 2

Consider the region R which is enclosed by the curve $y \geq \sqrt{1-x^2}$ and $\max(|x|, |y|) < 4$. The slope of a family of lines defined as $m(t) = -\sin^2 t + \sin t + 1$ where $(t, 2t + 0.4)$ lies inside the region R.

- The area of region R, is

A) $8 + \pi/2$ B) $8 - \pi/2$
C) $4 + \pi/2$ D) $4 - \pi/2$

37. All possible values of 't'
A) [0.14, 1.0] B) [0.14, 0.5]
C) [0.28, 0.5] D) [0.28, 1.0]
38. The maximum slope of any member of family is for t equals to
A) $5\pi/6$ B) 1
C) 0.28 D) none of these

SECTION - IV

MATCH THE FOLLOWING:

| Column - 1 | Column - 2 |
|---|------------|
| A. $n_{C_{r-1}} = n_{C_r} = 35$ and $n_{C_r+1} = 21$ then r equals to | P. 2 |
| B. The product of lengths of perpendiculars drawn from $(-1, 2)$ to the pair of lines $2x^2 - 5x + 2y^2 = 0$ is | Q. 5 |
| C. The square of the length of intercept on the x-axis cut by the pair of lines $2x^2 + 5xy + 3y^2 + 6y + 7 - 1 = 0$ is | R. 4 |
| D. For ω complex number z, $(Z + \bar{z}) = 12 - 4iz^2$ then maximum value of $ z ^2$ is | S. 3 |

| Column - 1 | Column - 2 |
|--|------------|
| A. $\int_{-10}^{10} x \cdot e^{x(x+1/2)} dx$ is equal to ([.] denotes step function) | P. 0 |
| B. The maximum number of normals to $y^2 = 4x$ which touch the hyperbola $x^2 - y^2 = a^2$ is | Q. 1 |
| C. Circle on any focal chord of parabola $y^2 = 4ax$ as diameter cuts the parabolas again and again at points with parameter t and T then $1/T$ is | R. 2 |
| D. The number of real roots of the equation $\sum_{r=1}^{10} (x-r)^3 = 0$ is | S. 3 |

PHYSICS

(Q. Nos. 41 - 48) : Have only one correct option. You will be awarded 3 marks for correct answer and -1 mark (minus one mark) for wrong answer.

(Q. Nos. 49 - 52) : Have one or more than one correct option. You will be awarded 4 marks for correct answer and -1 mark (minus one mark) for wrong answer.

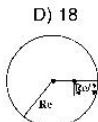
(Q. Nos. 53 - 58) : These Questions are Comprehension type, with only one correct option. You will be awarded 4 marks for correct answer and -1 mark for wrong answer.

(Q. Nos. 59 - 60) : These Questions in column-1 are to be matched with the answers in the column-2. **These may have one or more correct options.** You will be awarded 8 marks for correct answer. There is no negative marking.

SECTION - I

ONLY ONE OPTION CORRECT:

41. A particle moves in space such that the coordinates x, y, z are described by the equations $x = t^3 - 4t$, $y = t^2 + 4t$ and $z = 8t^2 - 3t^3$ where t is time. The tangential acceleration of the particle at $t = 2$ is
A) 20 B) 16 C) 12 D) 18
42. An object of mass m is at rest at a depth $\frac{R_e}{2}$ from the earth's surface. The



work required to make it a near earth satellite is (mass of the earth = M_e , radius of the earth = R_e)

- A) $\frac{3Gmm_e}{8R_e}$ B) $\frac{7Gmm_e}{8R_e}$
C) $\frac{Gmm_e}{R_e}$ D) $\frac{Gmm_e}{2R_e}$

43. A semi-circular conductor abc of a radius R moves in OXY plane through an uniform magnetic field $\vec{B} = B_e \hat{i}$ as shown. The velocity of the conductor is $\vec{v} = v_0 \hat{i}$. The induced emf across ac is

- A) zero B) $2\sqrt{2} v_0 B_0 R$
C) $\frac{v_0 B_0 R}{\sqrt{2}}$ D) $(\sqrt{2}+1) v_0 B_0 R$

44. Two large metal plates having charges +2Q and -3Q are separated by distance d. The potential difference between the plates is (σ = surface charge density on the outer surfaces of the plates)

- A) $\frac{Qd}{2\epsilon_0}$ B) $\frac{3Qd}{2\epsilon_0}$
C) $\frac{5Qd}{\epsilon_0}$ D) $\frac{5Qd}{2\epsilon_0}$

45. A ring of mass M rolls on the ground S without slipping. At a certain instant, the magnitude of the relative velocity of A with respect to B is v_0 (AB = diameter of the ring). The kinetic energy of the ring in ground reference is

- A) $\frac{1}{2} Mv_0^2$ B) Mv_0^2
C) $2Mv_0^2$ D) $\frac{Mv_0^2}{4}$

46. In the LC circuit shown, the capacitor C has an initial charge Q_0 . At time $t = 0$, the switch S is closed. The current through the circuit, at the instant the charge on the capacitor is $\frac{Q_0}{2}$ is

- A) $\frac{Q_0}{2\sqrt{LC}}$ B) $Q_0 \sqrt{\frac{2}{3LC}}$
C) $\frac{Q_0}{2} \sqrt{\frac{3}{LC}}$ D) $\frac{Q_0}{\sqrt{LC}}$

47. The acceleration of a particle P executing SHM along X-axis is given by $a = a_0 \sin 2\pi ft$. The particle is at the origin and has velocity $v_0 \hat{i}$ at $t = 0$. Then a_0 is equal to

- A) $2\pi f v_0$ B) $-\pi f v_0$ C) $-2\pi f v_0$ D) $\frac{\pi f v_0}{2}$

48. An R.L circuit is shown. At time $t = 0$, the switch S is closed. The time taken for the magnetic energy to reach 25% of the maximum value is

- A) $\frac{\ln 4}{5}$ B) $\frac{\ln 2}{5}$ C) $5 \ln 4$ D) $5 \ln 2$

SECTION - II

MORE THAN ONE OPTION CORRECT:

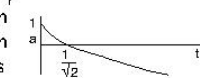
49. The acceleration of a particle moving along x-axis is given by $a = 1 - 2t^2$ where t is time. The particle starts from rest at the origin.

- A) The particle momentarily comes to rest at time $t = \sqrt{\frac{3}{2}}$ s
B) The maximum speed of the particle is $\sqrt{\frac{2}{3}}$ m/s

- C) The position of the particle at time t is given by

$$x = \frac{t^2}{2} \left(1 - \frac{t^2}{3} \right) m$$

- D) The acceleration a - time t graph for the motion is

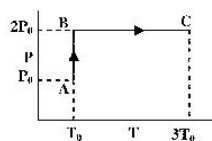


50. The figure shows two semicircular rings, each of mass M and radius R, arranged in OXY plane

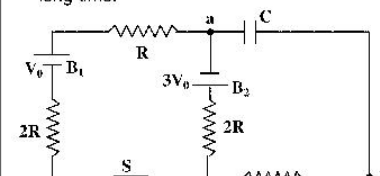


- A) The coordinates of the centre of mass of the arrangement is (2R, 0)
B) The moment of inertia of the arrangement about OX is zero
C) The moment of inertia of the arrangement about OY is $11 MR^2$
D) The radius of gyration of the arrangement about OY is $R\sqrt{5.5}$

51. N moles of an ideal diatomic gas follows the process ABC shown on the pressure P - temperature T diagram.



- A) The change in internal energy of the gas is $5NRT_0$
B) The work done by the gas is $NRT_0(2 + \ln 2)$
C) The heat supplied to the gas is $NRT_0(7 - \ln 2)$
D) The volume of the gas continuously decreases if it follows the process AC.
52. The R-C circuit shown is connected for a long time.



- A) The current through battery B_1 is $\frac{4V_0}{5R}$
B) The potential difference $V_a - V_b$ is equal to $-\frac{7V_0}{5}$
C) The potential difference $V_a - V_b$ depends on the value of C.
D) If the switch S is now opened the instantaneous current through battery B_2 is $\frac{2V_0}{5R}$

SECTION - III

COMPREHENSION - 1

In a mixture of H and He^+ gas, H atom and He^+ ions are excited to their respective first excited states. Subsequently H atoms transfer their total excitation energy to He^+ ions by collision process. Assume Bohr model to be valid.

53. The ratio of the kinetic energy of the $n = 2$ electron for H atom to that of He^+ ion is

- A) $\frac{1}{4}$ B) $\frac{1}{2}$ C) 1 D) 2

54. The quantum number of the state finally populated in He^+ ions is

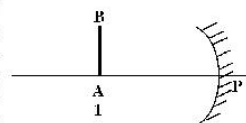
- A) 2 B) 3 C) 4 D) 5

55. The wavelength of the photons emitted by He^+ ions after the collision with H atoms is (R = Rydberg constant = $1.097 \times 10^7 m^{-1}$)

- A) $\frac{4}{15R}$ only B) $\frac{2}{15R}$ only
C) $\frac{4}{15R}$ and $\frac{11}{32R}$ D) $\frac{4}{15R}$ and $\frac{9}{32R}$

COMPREHENSION - 2

In object AB is placed perpendicular to the principal axis of a concave mirror at position 1 such that a real image is formed with magnification 2. The object is shifted to another position 2 (not shown in the figure) 15 cm from position 1 such that a real image is formed with magnification 8.



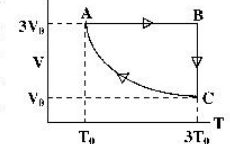
56. Position 1 of the object is between
A) pole and centre of curvature
B) pole and focus
C) focus and centre of curvature
D) centre of curvature and ∞
57. Distances of position 1 and position 2 of the object from the pole are, respectively
A) 45 cm, 30 cm B) 60 cm, 75 cm
C) 75 cm, 60 cm D) 60 cm, 45 cm

58. The focal length of the mirror is
A) 60 cm B) 40 cm C) 30 cm D) 25 cm

SECTION - IV

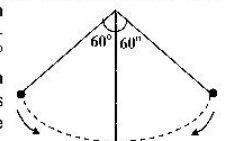
MATCH THE FOLLOWING:

59. An ideal monoatomic gas follows the process ABCA shown on the volume V - temperature T diagram. The process CA follows the equation $VT = \text{constant}$.



| Column 1 | Column 2 |
|---------------|----------------------------------|
| A. Process AB | P. Change in internal energy = 0 |
| B. Process CA | Q. Heat is added to the gas |
| C. Cycle ABCA | R. Heat is rejected by the gas |
| D. Process BC | S. Work done is zero |
| | T. Heat transfer = 0 |

60. A simple pendulum of mass m freely oscillates with an angular amplitude of 60° about the mean position as shown in the figure.



| Column 1 | Column 2 |
|---|----------------------------|
| A. Maximum force acting on the pendulum | P. $\frac{mg}{2}$ |
| B. Maximum force of tension in the string | Q. $\sqrt{\frac{2}{3}} mg$ |
| C. Minimum force acting on the pendulum | R. mg |
| D. Minimum force of tension in the string | S. 2 mg |
| | T. zero |

JEE Main Model Question Paper

PAPER - 2

TIME: 3 HRS MAXIMUM MARKS: 240

CHEMISTRY

(Q. Nos. 1-4) : Have only one correct option. You will be awarded 3 marks for correct answer and -1 mark (minus one mark) for wrong answer.

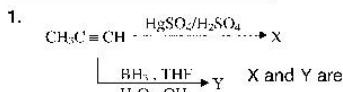
(Q. Nos. 5-9) : Have one or more than one correct answer and -1 mark (minus one mark) for wrong answer.

(Q. Nos. 10-11) : These Questions in column-1 are to be matched with the answers in the column-2. **These may have one or more correct options.** You will be awarded 2 marks each for correct matching answer. There is no negative marking.

(Q. Nos. 12-19) : This section contains 8 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened. You will be awarded 4 marks for correct answer and -1 (minus one mark) for wrong answer.

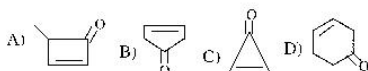
SECTION - I

ONLY ONE CORRECT OPTION:

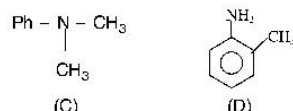


- A) $\text{CH}_3\text{CH}_2\text{CHO}$, CH_3CCH_3
 B) both are $\text{CH}_3\text{CH}_2\text{CHO}$
 C) CH_3CCH_3 , $\text{CH}_3\text{CH}_2\text{CHO}$
 D) both are CH_3CCH_3

2. Dipole moment is maximum for



3. $\text{Ph}-\text{NH}_2$ (A) $\text{Ph}-\text{NH}-\text{CH}_3$ (B)



The decreasing order of basic strength

- A) $\text{A} > \text{B} > \text{C} > \text{D}$ B) $\text{B} > \text{A} > \text{C} > \text{D}$
 C) $\text{C} > \text{B} > \text{A} > \text{D}$ D) $\text{C} > \text{B} > \text{D} > \text{A}$

4. A weak acid HA has a dissociation constant 1.0×10^{-4} . The equilibrium constant for its reaction with a strong base is

- A) 1.0×10^{-4} B) 1.0×10^{-10}
 C) 1×10^{10} D) 1.0×10^{-14}

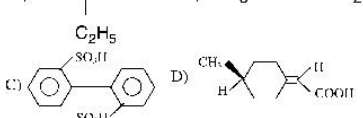
SECTION - II

ONE OR MORE THAN ONE CORRECT OPTION:

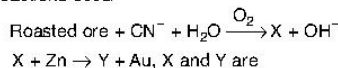
5. Allylic carbocation is formed as intermediate in
 A) 1, 3 - butadiene + $\text{Br}_2 \rightarrow$
 B) $\text{CH}_3\text{CH}=\text{CH}_2 + \text{NBS} \rightarrow$
 C) 1 - Chloro - 2 - butene + aq. AgNO_3
 D) 3 - Chloro - 1-methyl cyclopentene + $\text{NBS} \rightarrow$

6. Optically active compounds are

- A) $\text{Ph}-\text{N}(\text{O}^-)-\text{CH}_3$ B) $\text{CH}_3\text{CH}=\text{C}(\text{H})\text{CH}_2\text{CH}_3$



7. In the process of metal extraction, following reactions occur



- A) $\text{X} = [\text{Au}(\text{CN})_2]^-$ B) $\text{Y} = [\text{Zn}(\text{CN})_4]^{2-}$
 C) $\text{Y} = [\text{Zn}(\text{CN})_6]^{4-}$ D) $\text{X} = [\text{Au}(\text{CN})_4]^{3-}$

8. Hydrogen peroxide has reducing properties. It reduces

- A) moist Ag_2O B) Ozone
 C) acidified KMnO_4 D) Fluorine

9. Optical isomerism is exhibited by

- A) $[\text{Cr}(\text{Ox})_3]^{3-}$ B) $[\text{Rh}(\text{en})_2\text{C}_2\text{I}_2]^+$
 C) $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$ D) $[\text{Co}(\text{en})(\text{NH}_3)_2\text{C}_2\text{I}_2]^+$

SECTION - III

MATCH THE FOLLOWING - (MATRIX MATCHING)

10. Match the following:

| Column - 1 | Column - 2 |
|---|--------------------------------|
| A. Borax + water | P. BO_2^- |
| B. H_2BO_3^- + water | Q. $[\text{B}(\text{OH})_4]^-$ |
| C. $\text{H}_2\text{BO}_3^- + \text{NaOH}$ | R. B_2O_3 |
| D. $\text{H}_2\text{BO}_3^- \xrightarrow{\Delta}$ | S. $\text{B}(\text{OH})_3$ |

11. Match the following:

| Column - 1 | Column - 2 |
|--|--|
| A. $\text{C}_6\text{H}_5-\text{C}\equiv\text{C}-\text{CH}_3$ | P. Haloform reaction |
| B. $\text{CH}_3-\text{C}(=\text{O})-\text{CH}_3$ | Q. Colour with FeCl_3 |
| C. $\text{C}_2\text{H}_5\text{OH}$ | R. Decolourisation by bromine colour |
| D. $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$ | S. Phenolphthalein colour discharged by the alkaline solution. |

SECTION - IV

INTEGER TYPE QUESTIONS:

12. Calculate the ratio of $\frac{\text{molecular wt}}{\text{equivalent wt}}$ of the reactant in the given reaction
 $\text{FeC}_2\text{O}_4 \rightarrow \text{Fe}^{3+} + \text{CO}_2$

13. Determine the no. of possible isomers of cyclic compounds for the molecular formula C_4H_6

14. Find the no. of moles of nitrogendioxide evolved by heating two moles of NaNO_3 .

15. Calculate the order of reaction for which rate becomes half if volume of container having same amount of reactant is doubled (assuming gas phase reaction).

16. The acid ionization constant for $\text{Zn}^{2+} + \text{H}_2\text{O} \rightleftharpoons \text{Zn}(\text{OH})^+ + \text{H}^+$ is 1.0×10^{-9} . Calculate pH of 0.001 M solution of ZnCl_2 .

17. A graph is plotted between E_{cell} and $\log_{10} \left[\frac{\text{Zn}^{2+}}{\text{Cu}^{2+}} \right]$. The curve was linear with

intercept on E_{cell} axis equal to 1.10 V. Calculate E_{cell} for $\text{Zn} | \text{Zn}^{2+}(0.1\text{M}) || \text{Cu}^{2+}(0.01\text{M}) | \text{Cu}$.

18. 0.5 gm of a mixture of K_2CO_3 and Li_2CO_3 required 30 mL of 0.25N HCl solution for neutralization. Find the % of Li_2CO_3 in the mixture.

19. Aluminium dissolves in aqueous NaOH forming aluminates. Find the no. of hydrated water molecules in aluminate formed.

MATHEMATICS

(Q. Nos. 20-23): Have only one correct option. You will be awarded 3 marks for correct answer and -1 mark (minus one mark) for wrong answer.

(Q. Nos. 24-28):

Have one or more than one correct option. You will be awarded 4 marks for correct answer and -1 mark (minus one mark) for wrong answer.

(Q. Nos. 29-30): These Questions in column-1 are to be matched with the answers in the column-2. **These may have one or more correct options.** You will be awarded 2 marks each for correct matching answer. There is no negative marking.

(Q. Nos. 31-38) : This section contains 8 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened. You will be awarded 4 marks for correct answer and -1 (minus one mark) for wrong answer.

SECTION - I

ONLY ONE CORRECT OPTION

20. A curve $f(x)$ passes through the point P (1, 1). The normal to the curve at point P is a $(y-1) + (x-1) = 0$. If the slope of the tangent at any point on the curve is proportional to the ordinate at that point, then the equation of the curve is

- A) $y = e^{ax} - 1$ B) $y - 1 = e^{ax}$
 C) $y = e^{a(x-1)}$ D) $y - a = e^{ax}$

21. Let $f(x)$ and $g(x)$ be differentiable for $0 \leq x \leq 1$ such that $f(0)=2$, $g(0)=0$, $f(1)=6$. Let there exist a real number C in $[0, 1]$ such that $f'(c) = 2g'(c)$. Then the value of $g(1)$ must be

- A) 1 B) 2 C) -2 D) -1

22. Given that the set of equations $2x - 3y = 4$, $7x - 2y = 2$ and $[3\lambda]x - [2\lambda]y = [4\lambda]$ where $[\cdot]$ stands for G.I. function, are consistent then λ should lie in

- A) $[1/2, 1]$ B) $[2, 3]$ C) $[3/2, 7/4]$ D) $[1, 3/2]$

23. Let $f(n) = 10^n + 3 \cdot 4^{n+2} + 5$, $n \in \mathbb{N}$, the greatest value of the integer which divides $f(n)$ for all n is

- A) 27 B) 9 C) 3 D) none of these

SECTION - II

ONE OR MORE THAN ONE CORRECT OPTION:

24. Which of the following is correct?

- A) $10^{100} > 100^{101}$ B) $26^{25} < 25^{26}$
 C) $300^{299} < 299^{300}$ D) $199^{198} = 198^{199}$

25. If $10! = 2^p 3^q 5^r 7^s$ then

- A) $p = 7$ B) $q = 4$ C) $r = 2$ D) $s = 2$

26. Let $p(x=r) = pq^r$ and $p(y=r) = pqr$ where $r = 1, 2, \dots$, $0 < p < 1$, $q = 1 - p$. Suppose x and y are independent. Let $z = \max(x, y)$ then

- A) $p(z \leq m) = (1 - q^m)^2$
 B) $p(z = m) = 2pq^{m-1} - p(1+q)q^{2m-2}$
 C) $\sum_{m=1}^{\infty} p(z = m) = 1/p$
 D) $p(x \leq m) = 1 - q^m$

27. The value(s) of x satisfying the equation

$$\sin^{-1} |\sin x| = \sqrt{\sin^{-1} |\sin x|} \text{ is/ are given by (n is any integer)}$$

- A) $n\pi$ B) $n\pi+1$ C) $n\pi-1$ D) $2n\pi+1$

28. An isosceles triangle ABC is inscribed in a circle $x^2 + y^2 = a^2$ with the vertex A at $(a, 0)$ and the base angle B and C each equal to 75° then coordinates of an end point of the base are

- A) $\left(\frac{\sqrt{3}a}{2}, \frac{a}{2} \right)$ B) $\left(\frac{-\sqrt{3}a}{2}, \frac{a}{2} \right)$ C) $\left(\frac{a}{2}, \frac{\sqrt{3}a}{2} \right)$ D) $\left(\frac{-a}{2}, \frac{\sqrt{3}a}{2} \right)$

SECTION - III

MATCH THE FOLLOWING - (MATRIX MATCHING)

29. Column - 1 Column - 2

A. The differential equation of the family of curves $y = e^x(A \cos x + B \sin x)$ where A, B are arbitrary constants, has the degree n and order m. Then the values of n and m are respectively.

P. 2, 1

B. The degree and order of the differential equation of the family of all parabolas whose axis is the x-axis are respectively

Q. 1, 1

C. The order and degree of the differential equations of the family of circles touching the x-axis at the origin, are respectively

R. 2, 2

D. The degree and order of the differential equation of the family of ellipses having the same foci are respectively

S. 1, 2

30. Column - 1 Column - 2

A. P(θ) is point in 1st quadrant on ellipse $\frac{x^2}{9} + y^2 = 1$, $|\text{POX}| = \Phi$ then

P. $\pi/2$

for max. value of $(\theta - \Phi)$, θ is equal to (where O is centre and OX is major axis of the ellipse).

B. Angle subtended by common tangents of $4(x-4)^2 + 25y^2 = 100$ and $4(x+1)^2 + y^2 = 4$ at origin is

Q. $\pi/4$

C. The angle between asymptotes of hyperbola $5x^2 - 2\sqrt{7}xy - y^2 - 2x + 1 = 0$ is

R. $\pi/3$

D. Portion of asymptotes of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ (between centre and the tangent at vertex) in the 1st quadrant is cut by line $y + \tan \alpha (x-a) = 0$. Then θ can be

S. $\pi/6$

SECTION - IV

INTEGER TYPE QUESTIONS:

31. Find the smallest value of K for which both the roots of the equation $x^2 - 8Kx + 16(K^2 - K + 1) = 0$ are real, distinct and are greater than or equal to 4.

32. Let K be a positive integer such that $36 + K$, $300 + K$, $596 + K$ are the squares of the three consecutive terms of an arithmetic progression. Find $K - 920$.

33. The number of ordered pairs (m, n) , $m, n \in \{1, 2, 3, \dots, 20\}$. Such that $3^m + 7^n$ is a multiple of 10 is equal to k, then $k/50$ is _____.

34. 5 girls and 10 boys sit at random in a row having 15 chairs numbered as 1 to 15. If the probability that the end seats are occupied by the girls and between any two girls odd number of boys take seat is $20/n$ then $n/1001$ is equal to _____.

35. The number of pairs (x, y) satisfying the equation $\sin x + \sin y = \sin(x+y)$ and $|x| + |y| = 1$ is equal to _____.

36. If r_1, r_2, r_3 are the radii of the described circles of a triangle ABC and r is the radius of its incircle then $r_1 r_2 r_3 - r(r_1 r_2 + r_2 r_3 + r_3 r_1)$ is equal to _____.

37. If P is the length of the perpendicular from a focus upon the tangent at any point P of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and r is the distance of P from the focus then $\frac{2a}{r} - \frac{b^2}{a^2}$ is _____.

38. If $\lim_{x \rightarrow 0} \frac{f(x)}{x} = 1$ and $\lim_{x \rightarrow 0} \frac{x(1+\cos x) - b \sin x}{(f(x))^3} = 1$ then $b - 3a$ is equal to _____.

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JEE Main Model Question Paper

PHYSICS

(Q. Nos. 39-42): Have only one correct option. You will be awarded 3 marks for correct answer and -1 mark (minus one mark) for wrong answer.
(Q. Nos. 43-47): Have one or more than one correct option. You will be awarded 4 marks for correct answer and -1 mark (minus one mark) for wrong answer.

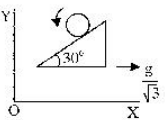
(Q. Nos. 48-49): These Questions in column-1 are to be matched with the answers in the column - 2. **These may have one or more correct options.** You will be awarded 2 marks each for correct matching answer. There is no negative marking.

(Q. Nos. 50-57): This section contains 8 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9. The appropriate bubbles below the respective question numbers in the ORS have to be darkened. You will be awarded 4 marks for correct answer and -1 (minus one mark) for wrong answer.

SECTION - I

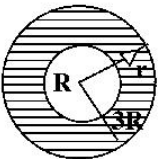
ONLY ONE CORRECT OPTION:

39. A uniform cylinder rolls on the wedge without slipping. The wedge has a constant horizontal acceleration $\frac{g}{\sqrt{3}}$ with respect to ground OX. The acceleration of the cylinder with respect to OXY is



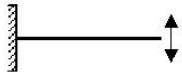
- A) g B) $\frac{g}{\sqrt{3}}$ C) $\frac{g}{3}$ D) $\frac{g}{3\sqrt{3}}$

40. A hollow metal sphere of inner radius R and outer radius $3R$, is made of material of resistivity σ . A constant potential difference V_0 is maintained across the inner and outer surfaces. The steady state current i through the sphere is



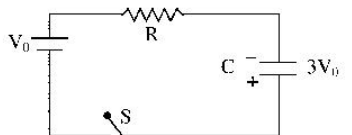
- A) $\frac{\pi R V_0}{\sigma}$ B) $\frac{3\pi R V_0}{\sigma}$ C) $\frac{4\pi R V_0}{\sigma}$ D) $\frac{6\pi R V_0}{\sigma}$

41. A copper rod of length l is clamped at one end. Transverse standing waves are set up in the rod so that it vibrates in the third overtone mode. The frequency of vibration is (wave velocity in the rod = v)



- A) $\frac{3v}{4l}$ B) $\frac{5v}{4l}$ C) $\frac{7v}{4l}$ D) $\frac{v}{l}$

42. In the R-C circuit shown, the capacitor is initially charged to potential $3V_0$. The current through the battery B , at the instant switch S is closed, is

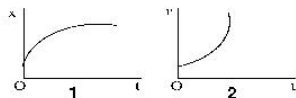


- A) $\frac{4V_0}{R}$ B) $\frac{2V_0}{R}$ C) $\frac{V_0}{R}$ D) zero

SECTION - II

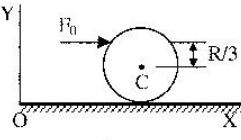
ONE OR MORE THAN ONE CORRECT OPTION:

43. The motion of a particle along x-axis is described by the equation $x = t + t^3$ where 't' is time. The $x-t$ and $v-t$ graphs for the motion are also shown as 1 and 2.



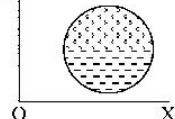
- A) The acceleration is directly proportional to time t .
B) Both graphs 1 and 2 represent the motion correctly according to the equation.
C) The initial velocity is non zero and the initial acceleration is zero.
D) Graphs 1 does not represent the motion correctly.

44. A solid cylinder of radius R and mass M is made to roll on the horizontal surface OX without slipping under the action of the force F_0 as shown. The acceleration of the centre is $\frac{g}{3}$.



- A) $F_0 = \frac{Mg}{3}$
B) The force of friction exerted by the surface OX on the cylinder is $-\frac{F_0}{9}$
C) For pure rolling motion, the minimum coefficient of friction between the cylinder and the surface OX is $\frac{1}{24}$
D) The total torque about the centre of the cylinder C is $\frac{4F_0R}{9}$ ($-\hat{k}$).

45. A dielectric disc (mass M , radius R) is half charged with $+Q$ and the other half with $-Q$. The disc is placed on a horizontal frictionless surface OXY. A uniform electric field $\vec{E} = E_0 \hat{i}$ is switched on.

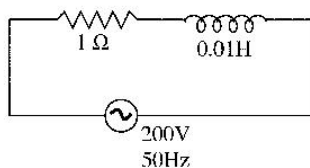


- A) The instantaneous acceleration of the disc is zero.
B) The instantaneous acceleration of the disc is $\frac{2QE_0}{M} \hat{i}$
C) The torque acting on the disc is $\frac{8QRE_0}{3\pi} (-\hat{k})$
D) The torque acting on the disc is zero.

46. The equation of motion of a particle M in inertial reference from OX is given by $\frac{d^2x}{dt^2} + a(x-b) = 0$. Where a, b are positive constants. The following statements are correct regarding the motion.

- A) The motion is periodic but not SHM
B) The motion is SHM with time period $\frac{2\pi}{\sqrt{a}}$
C) The force acting on the particle is $-Ma(x-b) \hat{i}$
D) The kinetic energy of the particle at the instant when $x = b$ is zero.

47. The figure shows an R-L ac circuit.



- A) The reactance of the circuit is $\sqrt{\pi^2 + 1} \Omega$.
B) The peak current is $\frac{200}{\sqrt{1 + \pi^2}} A$
C) The supply voltage leads the current by $\tan^{-1}\pi$
D) The current in the circuit lags the supply

voltage by

$$\tan^{-1}\left(\frac{\pi}{2}\right)$$

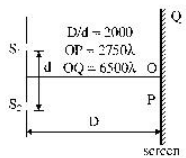
SECTION - III

MATCH THE FOLLOWING - (MATRIX MATCHING):

48. In Column 1, some processes are given for a monoatomic ideal gas while in Column 2 information about the heat transfers and change in internal energy ΔU are given. Match the correct options.

| Column - 1 | Column - 2 |
|---|-------------------|
| A. Volume V increases and temperature T remains constant | P. $\Delta U > 0$ |
| B. Volume increases and equation $VT^2 = \text{constant}$ is followed | Q. $Q > 0$ |
| C. Volume increases and equation $VT^{1.5} = \text{constant}$ is followed | R. $Q < 0$ |
| D. Volume increases and equation $V/T^4 = \text{constant}$ is followed | S. $Q = 0$ |
| | T. $\Delta U < 0$ |

49. In the YDSE set up, the coherent sources S_1 and S_2 are described by equations $E = E_0 \sin \omega t$ and $E = E_0 \cos \omega t$ respectively. At the central point O, the intensity is I_0 ($\lambda = \text{wavelength of light}$).

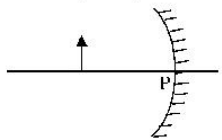


| Column - 1 | Column - 2 |
|--|--|
| A. Intensity of S_1 | P. $I_0 \left(1 - \frac{1}{\sqrt{2}}\right)$ |
| B. Intensity of the maxima on the screen | Q. $I_0 \left(1 + \frac{1}{\sqrt{2}}\right)$ |
| C. Intensity at P | R. $2I_0$ |
| D. Intensity at Q | S. $\frac{I_0}{2}$ |
| | T. zero |

SECTION - IV

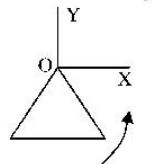
INTEGER TYPE QUESTIONS:

50. An object is placed at right angles to the principal axis of a concave mirror such that a real image double its size is formed. The object is now shifted by 15 cm so that a real image half the size of the object is formed. The focal length of mirror is 10 cm. Find the value of n .



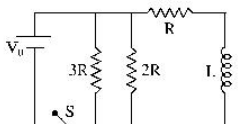
51. A sample of radioactive nuclides (half life 3S) contains 8000 nuclei at time $t = 0$. Find the time in s when 8000 nuclei decay.

52. An equilateral triangular frame is formed by joining three identical rods (each of mass M and length l). The frame rotates in OXY plane about Z axis such that the centre of mass of the frame has a constant speed v_0 . The angular momentum of the frame about



O is given by $\frac{\sqrt{3}nMvl}{2}$. Determine the value of n .

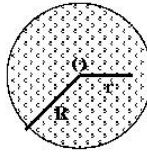
53. In the L-R circuit shown, the switch S is closed at



time $t = 0$. The time, when the current through the inductor L is $(1 - e^{-1})$ times the steady state current in it, is $\frac{nL}{R}$.

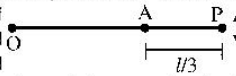
Determine the value of n .

54. The figure shows charge Q distributed over a spherical volume of radius R . The charge density ρ depends upon the distance r from

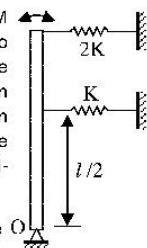


the centre O as $\rho = \rho_0 \left(1 + \frac{r^2}{R^2}\right) \text{ C/m}^3$. The electric potential at the centre is given by $\frac{45Q}{16\pi\epsilon_0 R}$. Determine the value of n .

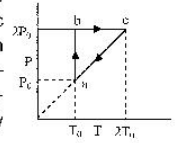
55. Transverse standing waves are set up in a rod OP of length l , fixed at end O and free at end P. The rod vibrates in the fourth overtone mode. The maximum amplitude is y_0 . The amplitude of oscillations of point A is ky_0 . Find the value of k .



56. A uniform rod of mass M and length l is free to rotate in the vertical plane about a fixed hinge O. In equilibrium the rod is in the vertical position. The time period of small oscillations of the rod is $\sqrt{\frac{2\pi}{\frac{3nk}{4M} - \frac{3g}{2l}}}$. Find the value of n .



57. A diatomic ideal gas undergoes a cyclic process abca shown on the pressure P - temperature T diagram. The efficiency of the cycle is $\frac{2 - \ln 4}{n}$. Determine the value of n .



KEY PAPER - 1

CHEMISTRY: 1) A, 2) D, 3) D, 4) D, 5) B, 6) C, 7) B, 8) B, 9) ABC, 10) BCD, 11) AC, 12) ABC, 13) A, 14) A, 15) B, 16) C, 17) D, 18) A, 19) A-PS, B-QS, C-PS, D-R, 20) A-PQ, B-PRS, C-QR, D-PRS.
MATHS: 21) B, 22) B, 23) C, 24) C, 25) C, 26) D, 27) A, 28) C, 29) AC, 30) BCD, 31) AC, 32) AC, 33) B, 34) B, 35) A, 36) B, 37) C, 38) C, 39) A-R, B-R, C-P, D-R, 40) A-P, B-P, C-S, D-Q.
PHYSICS: 41) B, 42) B, 43) A, 44) C, 45) D, 46) C, 47) C, 48) D, 49) AC, 50) ACD, 51) AC, 52) ABD, 53) A, 54) C, 55) D, 56) C, 57) D, 58) B, 59) A-QS, B-R, C-PR, D-PR, 60) A-R, B-S, C-Q, D-P.

PAPER - 2

CHEMISTRY: 1) C, 2) C, 3) C, 4) C, 5) ABCD, 6) ACD, 7) AB, 8) ABC, 9) ABD, 10) A-Q, B-Q, C-PQ, D-PR, 11) A-QR, B-QRS, C-P, D-R, 12) 3, 13) 4, 14) 0, 15) 1, 16) 6, 17) 1, 18) 4, 19) 2.
MATHS: 20) C, 21) B, 22) C, 23) B, 24) BC, 25) BC, 26) ABD, 27) ABC, 28) AD, 29) A-S, B-S, C-Q, D-P, 30) A-R, B-P, C-R, D-PQRS, 31) 2, 32) 5, 33) 2, 34) 3, 35) 6, 36) 0, 37) 1, 38) 3.
PHYSICS: 39) C, 40) D, 41) C, 42) A, 43) ACD, 44) BCD, 45) AC, 46) BC, 47) AC, 48) A-Q, B-QT, C-ST, D-PQ, 49) A-S, B-R, C-P, D-R, 50) 1, 51) 6, 52) 3, 53) 1, 54) 8, 55) 0, 56) 9, 57) 7.

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