

JEE-ADVANCE-MODEL TEST-PAPER I

Time: 3:00 Hours

IMPORTANT INSTRUCTIONS

Max Marks: 264

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 8)	Questions with Integer Answer Type	4	0	8	32
Sec – II(Q.N : 9 – 18)	Questions with Multiple Correct Choice	4	-2	10	40
Sec – III(Q.N : 19 – 20)	Matrix Matching (+2/-1 for every match)	2	-1	2	16
Total				20	88

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 21 – 28)	Questions with Integer Answer Type	4	0	8	32
Sec – II(Q.N : 29 – 38)	Questions with Multiple Correct Choice	4	-2	10	40
Sec – III(Q.N : 39 – 40)	Matrix Matching (+2/-1 for every match)	2	-1	2	16
Total				20	88

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 41 – 48)	Questions with Integer Answer Type	4	0	8	32
Sec – II(Q.N : 49 – 58)	Questions with Multiple Correct Choice	4	-2	10	40
Sec – III(Q.N : 59 – 60)	Matrix Matching (+2/-1 for every match)	2	-1	2	16
Total				20	88

SECTION – I
(INTEGER ANSWER TYPE)

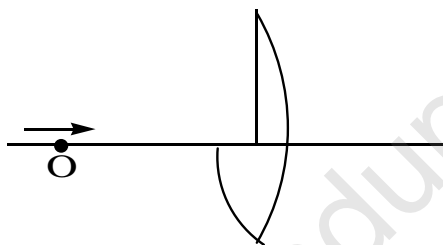
This section contains 8 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

Marking scheme +4 for correct answer , 0 if not attempted and 0 in all other cases.

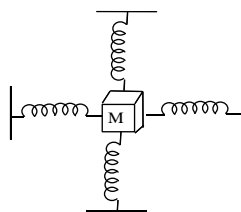
- How many statements of the following are correct?
 - Gravitational field at all points inside a thin uniform hollow cube is zero
 - The presence of a conducting loop is not necessary to have an induced electric field (due to time varying magnetic field)
 - RMS value of a current $i = f(t)$ [$f(t)$ is either sinusoidal or non-sinusoidal] is always greater than or equal to its average value
 - Two moving charges may not exert equal and opposite magnetic forces on each other
 - Magnetic field on the axis of a long straight current carrying conductor whose cross – section is either circular or rectangular is zero.
- A charged particle is projected with initial velocity $\vec{v} = (2\hat{i} + 3\hat{j} + 5\hat{k})\text{ m/s}$ in a uniform magnetic field $\vec{B} = (\hat{j} + \hat{k})\text{ T}$. The maximum value of x – component of its velocity in the subsequent motion is $\sqrt{N}\text{ m/s}$. What is the value of N?
- Three point charges $+Q$ each are placed at the vertices of an equilateral triangle of side $\sqrt{6}\text{ m}$. There is a point P which is equidistant from all the three charges and the magnitude of net electric field (due to all charges) at P is equal to the magnitude of electric field at P due to one of the charges. Then the distance of point P from centre of triangle is $\frac{1}{\sqrt{N}}$ meter. What is the value of N?
- A photon beam containing various energies is passed through a sample of H – atoms in ground state. Another photon beam containing various energies is passed through a sample of Li^{+2} ions in ground state. The two photon beams are non – identical .Assume that excitation of electrons takes place in a single step to

different energy levels, but de – excitation takes place in several possible steps to ground state. Let x_1 and x_2 be the number of dark lines in the absorption spectra of H – atoms and Li^{+2} ions respectively and y_1 and y_2 be the number of bright lines in the emission spectra of H – atoms and Li^{+2} ions respectively. If $x_1 + x_2 = 15$, then the minimum value of $y_1 + y_2 = 14N + 8$. What is N ?

5. A quarter portion of a thin equi-convex lens with focal length 30 cm has been removed by cutting it perpendicular to the principal axis as shown. A small object is placed on principal axis at a large distance from lens and is moving towards the lens. At an instant, it is observed that the relative velocity between the two distinct images (corresponding to paraxial rays) is zero. The distance of object at this instant is $5k$ ($k \neq 0$) centimeters what is 'k'?

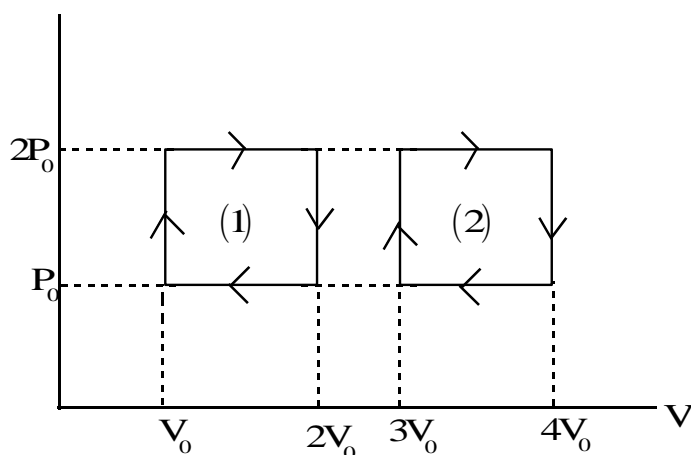


6. A particle of mass M is attached to four springs each of unstretched length l as shown. Initial tension in each spring is F_0 . The period of small oscillations of the particle along a line perpendicular to the plane containing the springs is $2\sqrt{\frac{Ml}{NF_0}}$. What is 'N'? (Neglect effect of gravity and assume that the additional force developed in springs due to displacement is much smaller than the original tension F_0)



7. The same quantity of an ideal diatomic gas is undergone for two cyclic processes (1) and (2) as shown. η_1 and η_2 are the efficiencies of (1) and (2) respectively.

Then $\frac{\eta_1}{\eta_2} = \frac{1+7x}{15+y}$. What is the value of $(x + y)$?



8. Half life of a freshly prepared radioactive sample is one hour. The probability of a selected nucleus that will be decayed during second hour or fourth hour is $\frac{1}{16} + \frac{1}{N}$.

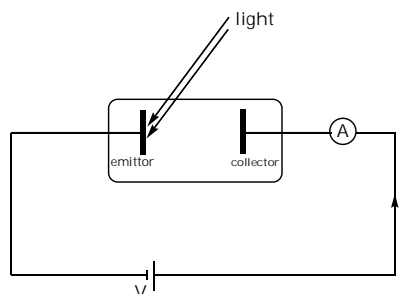
What is the value of 'N'?

SECTION – II
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 10 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

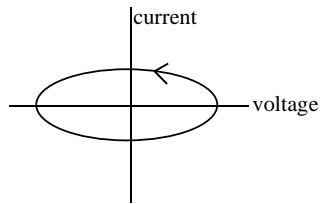
9. The figure given below is the apparatus of photoelectric effect in which the light energy falling on emitter plate per unit time remains constant, but its frequency can be changed. I_1 and I_2 are the photo currents registered when the light has frequency f and $\frac{f}{2}$ respectively. Assume that threshold frequency of emitter is less than $\frac{f}{2}$. The values of I_1 and I_2 (in above two cases) can be varied between zero and their saturated values by changing the magnitude and polarity of applied voltage V .



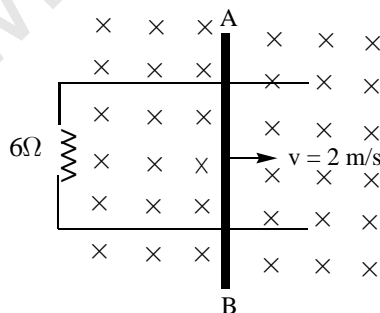
Select the correct statement(s) of the following

- A) A positive value of V can exist so that $I_2 = 2I_1$
- B) A negative value of V (reversed polarity) can exist so that $I_1 = I_2$
- C) A negative value of V (reversed polarity) can exist so that $I_1 = 2I_2$
- D) $I_2 > I_1$ for $V = 0$

10. A rigid square loop is dipped in a wetting liquid and is taken out. A loop of light inextensible thread of total length 15 units is gently put on the liquid film formed in the square frame. Now a hole is pricked inside the thread loop. Take the length of side of square frame is 4 units. Surface tension of liquid is S . Neglect any friction between square frame and thread. What will be the final surface area of liquid film on one side of square frame after the hole is pricked?
- A) $\frac{1}{16 - 4\pi}$ units B) $\frac{1}{15 - 4\pi}$ units C) $\frac{31}{16}$ units D) $\frac{31}{15}$ units
11. The graph shows the current versus voltage in a series RLC circuit at a fixed frequency. The arrow indicates the direction that this curve is drawn as time progresses. Which of the following conclusion(s) can be made?

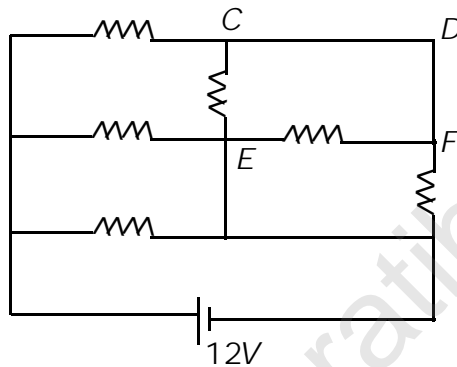


- A) Voltage leads current by $\pi/2$
 B) Impedance is equal to reactance and it is greater than 1Ω
 C) Reactance of circuit is less than 1Ω
 D) Power factor of circuit is zero
12. A uniform resistive rod AB of length 3m is sliding with constant velocity 2 m/s on two long horizontal, parallel and resistanceless rails which are separated by 2m. The resistance of rod AB is 3Ω . The rails are connected with 6Ω resistance at one end. A uniform vertical magnetic field 2T exists as shown. Then select correct statement(s)

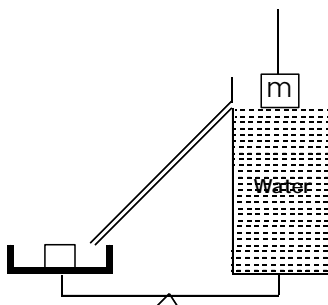


- A) emf induced between the ends of rod is 12 V
 B) emf induced between the ends of rod is 10 V
 C) Potential difference between the ends of rod is 10 V
 D) Potential difference between the ends of rod is 6 V

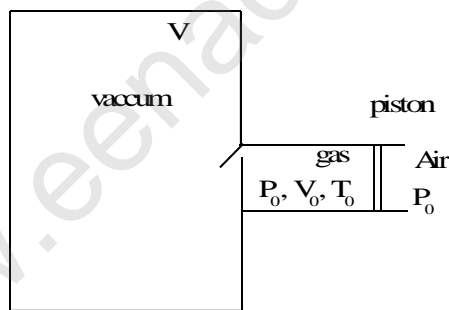
13. An ideal gas is enclosed in a chamber and is undergone for a thermodynamic process. In this process, ΔQ represents the net heat transfer to the gas and ΔU represents the net change in internal energy of the gas. Select the incorrect statement/s
- A) If $\Delta Q = 0$, then the process must be adiabatic
- B) If $\Delta U = 0$, then the process must be isothermal
- C) If $\Delta Q = \Delta U$, then the process must be isochoric
- D) $\Delta Q = \Delta U = 0$, then a particular state may be repeated twice or more
14. In the circuit given below, each resistance is 3Ω . Select the correct statement.



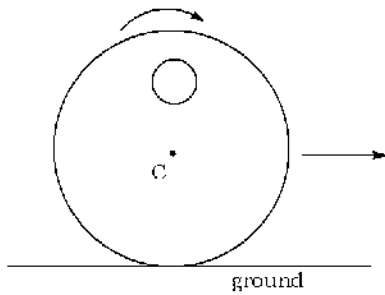
- A) The current in the branch CD is 3A towards right
- B) The current in the branch CD is 2A towards right
- C) The current in the branch EF is 3A towards left
- D) The current in the branch EF is 1A towards right
15. A pan balance has a container of water with an overflow spout on the right-hand pan as shown. It is full of water up to the overflow spout. A container on the left-hand pan is positioned to catch any water that overflows. The entire apparatus is adjusted so that it is balanced. A brass weight on the end of a string is then lowered into the water, but not allowed to rest on the bottom of the container. What happens next?



- A) Water overflows and the right side of the balance tips down.
 B) Water overflows and the left side of the balance tips down.
 C) Water overflows but the balance remains balanced.
 D) Water overflows but which side of the balance tips down depends on whether the brass weight is partly or completely submerged.
16. Choose the correct statement/s regarding the nature of image (I) corresponding to a virtual object in case of a thin lens
 A) If the lens is concave, then I may be real, enlarged and erect
 B) If the lens is concave, then I may be virtual, enlarged and inverted
 C) If the lens is concave, then I may be virtual, diminished and inverted
 D) If the lens is convex, then I may be real, enlarged and erect
17. A large vacuum chamber of volume 'V' is connected to a narrow cylindrical pipe which is initially filled with an ideal gas ($\gamma = 1.4$) at temperature T_0 , pressure P_0 and volume V_0 ($\ll V$). The gas is enclosed by a light insulating piston (which is free to move) and the air outside is at constant pressure P_0 . Now the gas in the pipe is slowly allowed to leak into the vacuum chamber through a small opening as shown. All the walls are insulated. The final pressure 'P' and temperature 'T' of the gas are given by



- A) $P = \frac{P_0 V_0}{V}$ B) $T = T_0$ C) $P = \frac{1.4 P_0 V_0}{V}$ D) $T = 1.4 T_0$
18. A disc with a hole is given some initial motion and released so that it rolls without slipping on the ground. There is sufficient friction. C is geometric centre of disc. At the instant shown in figure, the hole is at its upper position. Considering the motion of disc till it makes half rotation,



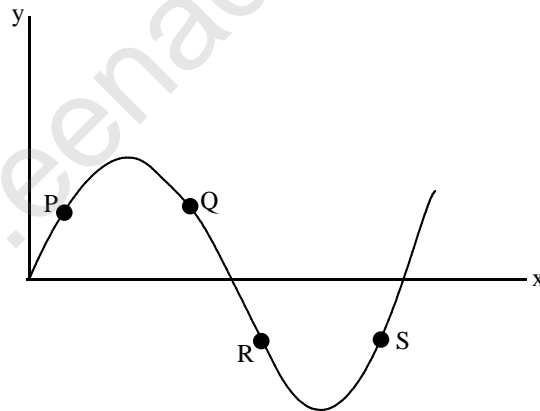
- A) Angular momentum of disc is conserved w. r. t the point of contact.
- B) The speed of point C will decrease
- C) The mechanical energy of disc is conserved.
- D) A backward friction acts on the disc.

SECTION - III
(MATRIX MATCHING ANSWER TYPE)

This section contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and four statements (P, Q, R and S) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in Q and R, then for the particular question darken the bubbles corresponding to Q and R in the OMR sheet. For each correct matching **will be awarded +2 marks ONLY and 0 if not attempted and -1 in all other cases.**

19. The figure shows the displacement versus position of particle in a longitudinal harmonic wave which is traveling in air along +ve x – direction. P, Q, R and S are four points chosen.

Match Column – I with Column – II



Column – I

Column – II

- | | | |
|--|-----|---|
| (A) The points of compression | (P) | P |
| (B) The points of rarefaction | (Q) | Q |
| (C) The points at which pressure is increasing | (R) | R |
| (D) The points at which pressure is decreasing | (S) | S |

20. Consider a circular loop of radius 'R' in XZ-plane with centre at origin. The magnitude of $\oint \vec{B} \cdot d\vec{l}$ is to be evaluated along this loop due to a semi infinite current (I) carrying straight wire in XY-plane. Column – I represents the position of wire and Column – II represents the magnitude of $\oint \vec{B} \cdot d\vec{l}$

Column – I

Column – II

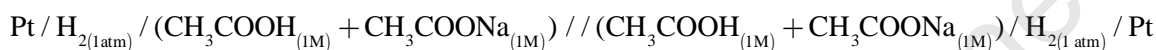
- | | |
|---|-------------------------------------|
| A) Wire extends from (-R, R) to ∞ along the line $y = R$ | P) Zero |
| B) Wire extends from (0, R) to ∞ along the line $y = R$ | Q) equal to $\frac{\mu_0 I}{2}$ |
| C) Wire extends from (0, R) to ∞ along the line $y = x + R$ | R) less than $\frac{\mu_0 I}{2}$ |
| D) Wire extends from $\left(\frac{R}{2}, 0\right)$ to ∞ along the line $y = x - \frac{R}{2}$ | S) greater than $\frac{\mu_0 I}{2}$ |

SECTION – I
(INTEGER ANSWER TYPE)

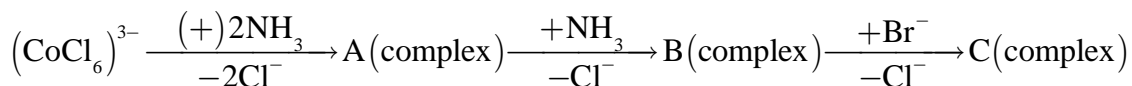
This section contains 8 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

Marking scheme +4 for correct answer , 0 if not attempted and 0 in all other cases.

21. A cell designed below contains one litre of buffer mixture of acetic acid and sodium acetate each 1M in two compartments using platinum electrodes. Pka of acid is 4.74. The emf of the cell at 298 K is ; (neglecting the liquid junction potential if present)



22. Gaseous COF_2 is passed over a catalyst at 1000°C and comes to equilibrium $2\text{COF}_{2(\text{g})} \rightleftharpoons \text{CO}_{2(\text{g})} + \text{CF}_{4(\text{g})}$. The pressure under equilibrium = 10 atm. A sample of the equilibrium mixture is quickly “frozen” i.e., cooled to a low temperature. This prevents any change in the equilibrium concentrations. Analysis of 500 ml (STP) of the equilibrium mixture shows that the combined volumes (STP) of CO_2 and $\text{COF}_2(\text{g})$ is 300 ml. Calculate K_p .
23. In a hydrogen atom the wavelength of ‘m’th line of balmer series is approximately 4102A° . What is the value of ‘m’
24. If 3-bromo-4-methyl hexane is treated with ethanolic KOH solution, how many different alkenes would be formed?
25. $\text{C}_6\text{H}_4\text{Br}_2$ (P) is a dibromo benzene and it is the less polar isomer of its two polar isomers. If P is treated with conc. HNO_3 and conc. H_2SO_4 mixture, theoretically, how many mono nitration products are expected
26. The sum of oxidation states of all the ten N atoms in the following compounds of nitrogen is $N_3\text{H}, \text{NH}_2\text{OH}, \text{NH}_2 - \text{NH}_2, \text{N}_2\text{O}, \text{N}_2\text{O}_4$
27. The sum of stereo isomers of complex A, complex B and complex C in the following sequence of reactions is



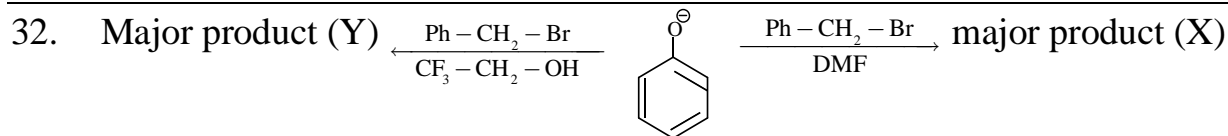
28. The number of minerals in which 'Ca' is present
- | | | |
|--------------|------------|-------------------|
| 1. Aragonite | 2. Calcite | 3. Fluorospar |
| 4. Dolomite | 5. Brucite | 6. Fluoro apatite |

SECTION – II
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 10 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

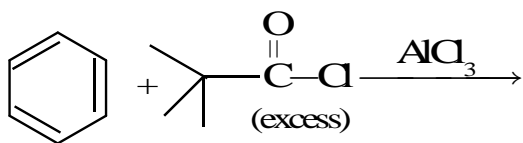
Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

29. 0.56 gm CaO is dissolved in 100 ml of water and a solution is prepared ($k_w = 10^{-13}$). The correct statements are
- A) Concentration of $\text{OH}^- = 0.2\text{M}$
 B) Conc. H^+ would be $= 5 \times 10^{-13}\text{M}$
 C) Degree of dissociation of water in the solution 9×10^{-15}
 D) If 1.12 gm of CaO added to 100 ml at same temperature then conc. OH^- is $= 0.4\text{M}$
30. 0.1 M solution of KI reacts with excess of H_2SO_4 and KIO_3 solutions, according to equation $5\text{I}^- + \text{IO}_3^- + 6\text{H}^+ \rightarrow 3\text{I}_2 + 3\text{H}_2\text{O}$; which of the following statement(s) is/are correct
- A) 200 ml of the KI solution react with 0.004 mole KIO_3
 B) 100 ml of the KI solution reacts with 0.006 mole of H_2SO_4
 C) 0.5 litre of the KI solution produced 0.005 mole of I_2
 D) Equivalent weight of KIO_3 is equal to $\left(\frac{\text{Molecular weight}}{5}\right)$
31. Choose the conclusions which are appropriate for the observations
- | <u>Observation</u> | <u>Conclusion</u> |
|--------------------------|--|
| A) $z = 1$ (at all 'p') | i) The gas need not be showing the ideal behaviour |
| B) $z > 1$ | ii) on applying pressure the gas will respond by increasing volume |
| C) $z < 1$ | iii) The gas has the ability to get liquified |
| D) $z = 1$ (for low 'p') | iv) The gas is approaching ideal behaviour |

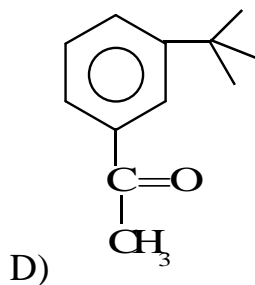
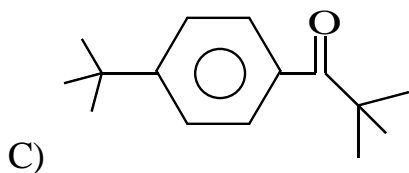
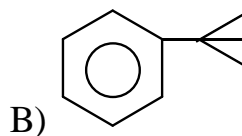
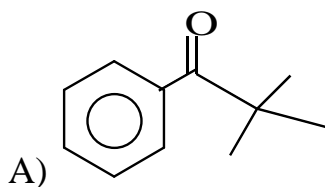


Select the correct statement(s) regarding above reactions

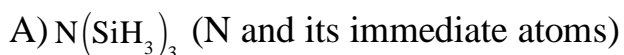
- A) 'X' is O-alkylated product and Y is C-alkylated product
 B) Both X and Y are C-alkylated products only
 C) Mixture of X and Y can be separated by dil NaOH
 D) Product 'Y' can react with sodium metal
33. Chose the correct statements
- A) C-Cl bond of chloroethene is stronger than in chloroethane.
 B) C=C double bond in ethene is shorter than the same in $\text{CH}_2=\text{CH}-\text{OCH}_3$
 C) CH_3SH is weaker acid than CH_3OH
 D) $\text{CH}_3\text{CH}_2\text{NH}_2$ is stronger base than $\text{CH}_2=\text{CH}-\text{NH}_2$
34. The correct combinations of names for isomeric alcohols with molecular formula $\text{C}_4\text{H}_{10}\text{O}$ is/are
- A) *tert*-butanol and 2-methyl propan-2-ol
 B) *tert*-butanol and 1,1-dimethyl ethan-1-ol
 C) *n*-butanol and butan-1-ol
 D) *iso*-butyl alcohol and 2-methyl propan-1-ol



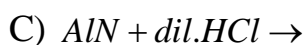
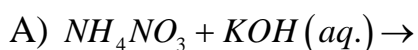
35. Mixture of products are formed in the above reaction, which of the following products are expected.



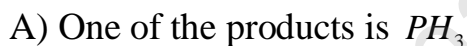
36. The planar Molecules/ions among the following



37. Which of the following reactions does not produce ammonia?



38. Select the correct statement(s) about the following reaction:

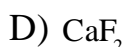
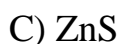


SECTION - III

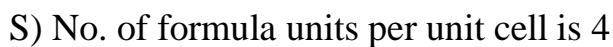
(MATRIX MATCHING ANSWER TYPE)

This section contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and four statements (P, Q, R and S) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in Q and R, then for the particular question darken the bubbles corresponding to Q and R in the OMR sheet. For each correct matching will be awarded +2 marks ONLY and 0 if not attempted and -1 in all other cases.

39. **Column – I**



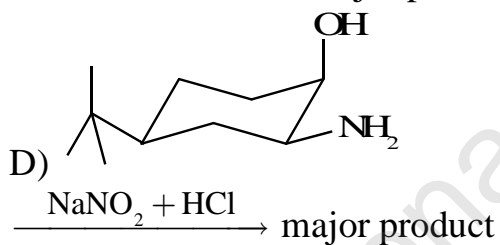
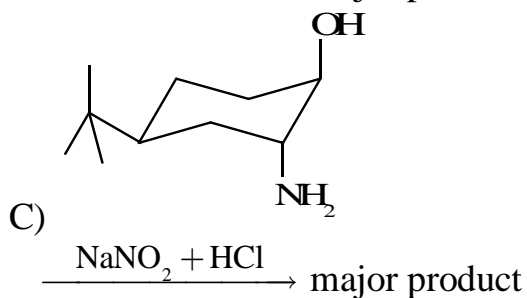
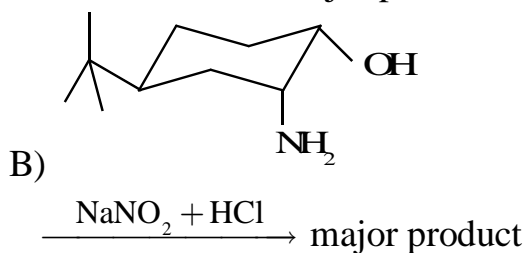
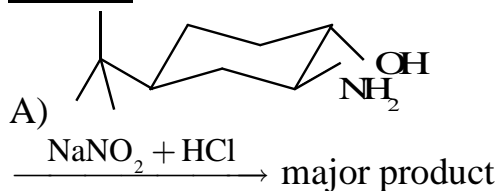
Column – II



40. Properties of major product formed in List – I is given in List – II.

Match the following List – I with List – II

List – I



List – II

P) Product has atleast two enolisable hydrogens

Q) Product can react with CH_3MgBr and forms 2° alcohol

R) Product can give positive tollen's test

S) Product can give 2° alcohol when treated with LiAlH_4

SECTION – I
(INTEGER ANSWER TYPE)

This section contains 8 questions. The answer is a single digit integer ranging from 0 to 9 (both inclusive).

Marking scheme +4 for correct answer , 0 if not attempted and 0 in all other cases.

41. The number of ordered pairs (x, y) where $x, y \in [0, 10]$ satisfy us

$$\sqrt{\sin^2 x - \sin x + \frac{1}{2}} \left(2^{\sec^2 y} \right) \leq 1 \text{ is } 2K \text{ where } K =$$

42. Let $f : R \rightarrow R$ defined as $f(x) = \frac{x^4}{x^8 + 2x^6 - 4x^4 + 8x^2 + 16}$. Also let α and β be maximum and minimum values respectively of $f(x)$. Then $12(\alpha - \beta) =$ _____

43. The normals of parabola $y^2 = 4x$ drawn at the end points of its latus rectum are tangents to $(x - 3)^2 + (y + 2)^2 = a^2$. Then the value of $a^2 =$

44. Let $\vec{a} = -\vec{i} - \vec{k}, \vec{b} = -\vec{i} + \vec{j}, \vec{c} = \vec{i} + 2\vec{j} + 3\vec{k}$ be three given vectors. If \vec{r} is a vector such that $\vec{r} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{r} \cdot \vec{a} = 0$ then $\vec{r} \cdot \vec{b} =$

45. Let $R = \left\{ A = \begin{bmatrix} a & b \\ c & a \end{bmatrix} : a, b, c \in \{0, 1, 2, 3, 4\} \right\}$ be set of 2×2 matrices.

Then number of A in R such that A is either symmetric or skew-symmetric or both and $\det(A)$ is divisible by 5 is _____

46. $\int_0^1 \frac{x^4(1-x)^4}{1+x^2} dx = \frac{A - B\pi}{C} \Rightarrow \frac{A + 2B}{C - 3} =$ _____ (where A, B & C are natural numbers in their lowest terms)

47. Of the three independent events A, B and C the chance that only A occurs is e_1 ; the chance that only B occurs is e_2 ; the chance that only C occurs is e_3 . The chance that none of them occurs is λ and λ satisfies $(e_1 - 2e_2)\lambda = e_1e_2$ and $(e_2 - 3e_3)\lambda = 2e_2e_3$. All the given probabilities lie in $(0, 1)$ then

$$\frac{P(\text{occurrence of A})}{P(\text{occurrence of C})} =$$

48. If the planes $x - cy - bz = 0, cx - y + az = 0, bx + ay - z = 0$ meet on a line then

$$|a^2 + b^2 + c^2 + 2abc - 3| = \underline{\hspace{2cm}}$$

SECTION – II
(MULTIPLE CORRECT ANSWER TYPE)

This section contains 10 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which ONE OR MORE than ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -2 in all other cases.

49. Consider the lines

$$L_1: \frac{x+1}{3} = \frac{y+2}{1} = \frac{z+1}{2}$$

$$L_2: \frac{x-2}{1} = \frac{y+2}{2} = \frac{z-3}{3} \text{ then}$$

A) Unit vector perpendicular to both L_1 & L_2 is $\frac{-\bar{i} - 7\bar{j} + 5\bar{k}}{5\sqrt{3}}$

B) Shortest distance between L_1 & L_2 is $\frac{17\sqrt{2}}{\sqrt{3}}$

C) Shortest distance between L_1 & L_2 is $\frac{17}{5\sqrt{3}}$

D) L_1 & L_2 are non-coplanar

50. Let the complex numbers β and $\frac{1}{\beta}$ lie on circle $(x-x_0)^2 + (y-y_0)^2 = r^2$ and

$(x-x_0)^2 + (y-y_0)^2 = 4r^2$ respectively. If $z_0 = x_0 + iy_0$ satisfies $2|z_0|^2 = r^2 + 2$ then $|\beta|$ is smaller than

A) 1 B) $\frac{1}{\sqrt{2}}$ C) $\frac{1}{3}$ D) $\frac{1}{10}$

51. Consider the hyperbola $H: x^2 - y^2 - 1 = 0$ and a circle S with centre $C(\alpha, 0)$.

Suppose H and S touch each other at $P(\theta, \phi)$ with $\theta > 1$ and $\phi > 0$. The common tangent to H and S at P intersects the x-axis at point Q. If (β, r) is centroid of ΔPQC then the correct expression (s) among the following is (are) _____

A) $\frac{d\beta}{d\theta} = 1 - \frac{1}{3\theta^2} : \theta > 1$ B) $\frac{dr}{d\theta} = \frac{\theta}{3\sqrt{\theta^2 - 1}} : \theta > 1$

C) $\frac{d\beta}{d\theta} = 1 + \frac{1}{3\theta^2} : \theta > 1$ D) $\frac{dr}{d\phi} = \frac{1}{3} : \phi > 0$

52. Let A and B be two 3×3 non-zero matrices such that $AB = BA$. Further if $A \neq B^2$ and $A^2 - B^4 = O$ (Where O is null matrix) then

- A) determinant of $(A^2 + AB^2) = 0$
 B) there is a 3×3 non-zero matrix C such that $(A^2 + AB^2)C$ is zero matrix
 C) determinant of $(A^2 + AB^2) \geq 1$
 D) For a 3×3 matrix C if $(A^2 + AB^2)C$ equals the zero matrix then C is zero matrix
53. Natural numbers are divided into groups as follows
 $S_1 = \{1\}, S_2 = \{2,3\}, S_3 = \{4,5,6\}, S_4 = \{7,8,9,10\}$ and so on..
 A) Last number in S_{50} is 1275
 B) First number in S_{100} is 4951
 C) Sum of numbers in S_{70} is 7500
 D) Sum of middle two numbers in S_{80} is 4000
54. Which of the following statement (s) is (are) incorrect ?
 A) Common tangent to $y^2 = 28x$ and $x^2 - 28y = 0$ can't be $x + y + 7 = 0$
 B) Angle between $y^2 = 4x$ and $xy = \sqrt{32}$ is $\pi/2$
 C) Normals drawn at ends of latus rectum of $y^2 = 8x$ meet on $y + 2 = 0$
 D) A parabola $y^2 = 4x$ and a circle $(x-1)^2 + y^2 = 3$ cut in 4 points
55. The equation $2\sin x = |x| + a$ has no solution possibly for
 A) $a > \frac{3\sqrt{3} - \pi}{3}$ B) $a > 3$ C) $3 < a < 5$ D) $0 < a < \frac{3\sqrt{3} - \pi}{3}$
56. For an ellipse $3x^2 + 4y^2 - 12 = 0$ which of the following statement (s) is (are) correct ?
 A) Maximum area of rectangle inscribed in the ellipse is $4\sqrt{3}$ sq.u
 B) Minimum length of intercept made by any tangent to the ellipse between coordinate axes is $\tan\left(\frac{5\pi}{12}\right)$ units
 C) Maximum distance from centre on any normal is $\cos\left(\frac{5\pi}{12}\right)$ units
 D) area is $2\sqrt{3}\pi$ sq units
57. Let $f : \left[0, \frac{\pi}{2}\right] \rightarrow [0,1]$ be a differentiable function such that $f(0) = 0, f\left(\frac{\pi}{2}\right) = 1$, then

- A) $f'(\alpha) = \sqrt{1 - (f(\alpha))^2}$ for all $\alpha \in \left(0, \frac{\pi}{2}\right)$
- B) $f'(\alpha) = \frac{2}{\pi}$ for all $\alpha \in \left(0, \frac{\pi}{2}\right)$
- C) $f(\alpha)f'(\alpha) = \frac{1}{\pi}$ for at least one $\alpha \in \left(0, \frac{\pi}{2}\right)$
- D) $f'(\alpha) = \frac{8\alpha}{\pi^2}$ for at least one $\alpha \in \left(0, \frac{\pi}{2}\right)$

58. Let $f(x) = \frac{e^x}{1+x^2}$ and $g(x) = f'(x)$ then

- A) $g(x)$ has four points of local extremum
- B) $g(x)$ has two points of local extremum
- C) $g(x)$ has a point of local minimum at $x=1$
- D) $g(x)$ has a point of local maximum at some $x \in (-1, 0)$

SECTION - III
(MATRIX MATCHING ANSWER TYPE)

This section contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and four statements (P, Q, R and S) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in Q and R, then for the particular question darken the bubbles corresponding to Q and R in the OMR sheet. For each correct matching **will be awarded +2 marks ONLY and 0 if not attempted and -1 in all other cases.**

59. Match the following Column – I with Column – II

	Column – I		Column – II
A	The number of polynomials $p(x)$ (with non-negative integer coefficients) of degree ≤ 2 satisfying $p(0) = 0$ and $\int_0^1 p(x) dx = 1$ is _____	P)	4
B	The number of points in the interval $[-\sqrt{13}, \sqrt{13}]$ at which $f(x) = \sin(x^2) + \cos(x^2)$ attains its maximum value is _____	Q)	6
C	$\int_0^{\pi/2} (\sin x)^{\cos x} (\cos x \cot x - \ln(\sin x)^{\sin x}) dx = \underline{\hspace{2cm}}$	R)	1
D	Given $a = \sin 10^\circ, b = \sin 50^\circ, c = \sin 70^\circ$ the value of $\frac{1}{a} + \frac{1}{b} - \frac{1}{c} = \underline{\hspace{2cm}}$	S)	2

60. Match the following Column – I with Column – II

	Column – I		Column – II
A)	The normal at $\left(ct_1, \frac{c}{t_1}\right)$ to the curve $xy = c^2$ meets it again at $\left(ct_2, \frac{c}{t_2}\right)$ ($c, t_1, t_2 \neq 0$) then $t_1^3 + t_2^{-1} = \underline{\hspace{2cm}}$	P)	1
B)	Maximum distance from centre of ellipse $3x^2 + 4y^2 = 12$ from any of its normals is $\underline{\hspace{2cm}}$	Q)	0
C)	Number of solution pairs (x, y) for the equations $ x + y = 1$ and $\sin x + \sin y = \sin(x + y)$ is $\underline{\hspace{2cm}}$	R)	3
D)	A variable plane makes with 3-dimensional co-ordinate axes, a tetrahedron of constant volume $64k^3$. Then locus of centroid of this tetrahedron is $xyz = 2\lambda k^3$ where $\lambda = \underline{\hspace{1cm}}$	S)	6

Sri Chaitanya Educational Institutions

JEE-ADVANCE-MODEL TEST-PAPER I

KEY & SOLUTIONS

PHYSICS

1	4	2	6	3	4	4	4	5	8	6	4
7	8	8	4	9	ABCD	10	A	11	AD	12	AC
13	ABC	14	B	15	B	16	ABC	17	CD	18	BCD
19	A-QR B-PS C-RS D-PQ	20	A-R B-R C-R D-Q								

CHEMISTRY

21	0	22	4	23	4	24	6	25	3	26	4
27	7	28	5	29	ABCD	30	ABD	31	CD	32	ACD
33	ABD	34	BCD	35	ABC	36	ABCD	37	D	38	ABD
39	A-S B-PQ C-RST D-QS	40	A-QR B-PS C-QS D-QR								

MATHEMATICS

41	8	42	1	43	2	44	9	45	9	46	9
47	6	48	2	49	ACD	50	AB	51	ABD	52	AB
53	AB	54	ACD	55	ABC	56	ABD	57	CD	58	BCD
59	A-S B-P C-R D-Q	60	A-Q B-P C-S D-R								

PHYSICS

1. Conceptual
2. Speed is constant and dot product of velocity and \vec{B} is also constant
- 3.

$$\frac{KQ}{y^2 + \frac{l^2}{3}} = \frac{3KQy}{\left(y^2 + \frac{l^2}{3}\right)^{\frac{3}{2}}}$$

$$\therefore y = \frac{l}{\sqrt{24}}$$

$$4. {}^8C_2 + {}^9C_2 = 64$$

$$5. \frac{dv}{dt} = \left(\frac{v^2}{u^2}\right) \frac{du}{dt}$$

$$f_1 = 30, f_2 = 60$$

Relative velocity of images is zero

$$\therefore |v_1| = |v_2|$$

$$\left| \frac{30u}{30+u} \right| = \left| \frac{60u}{60+u} \right|$$

$$\therefore u = -40$$

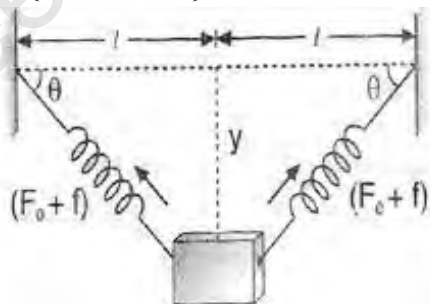
6. Due to the extension the additional tension in each spring will be f .
The restoring force due to these two springs

$$F_{restoring} = 2(F_0 + f) \sin \theta$$

$$\Rightarrow F_{restoring} = 2F_0 \sin \theta \quad (\because f \ll F)$$

$$\Rightarrow F_{restoring} = 2F_0 \theta \quad \{ \text{Assume } \theta \text{ to be small} \}$$

$$\Rightarrow F_{restoring} \approx 2F_0 \left(\frac{y}{\ell}\right) \quad \left\{ \because \sin \theta \approx \frac{y}{\ell} \right\}$$



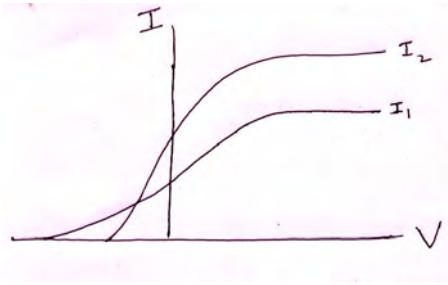
Net restoring force due to all four springs is

$$F_{net} \approx 4F_0 \left(\frac{y}{\ell}\right) \quad \{ \text{directed towards the mean position} \}$$

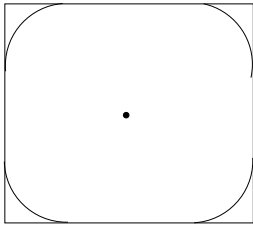
$$7. \eta_1 = \frac{W_{net}}{Q_{in}} = \frac{\eta_1}{\eta_2} = \left(\frac{Q_2}{Q_1}\right)_{input} = \frac{29}{19}$$

$$8. \text{ Probability} = \frac{\left[\frac{N_0}{2} - \frac{N_0}{4} \right] + \left[\frac{N_0}{8} - \frac{N_0}{16} \right]}{N_0} = \frac{5}{16}$$

9.



10. If thread length is 15, the final shape is as given below



11. From the graph, $V = V_0 \cos \omega t$

$$i = i_0 \sin \omega t$$

Where $t = 0$ from V_{\max}

12. $\varepsilon_{AB} = vBl = 12v$

$$V_{AB} = 12 - ir = 10V$$

13.

14. Required $= \frac{4R}{11}$ and current through battery is 11A.

The current in CD is 2A towards right and that in EF is 1A towards left.

15. The force on right pan remains unchanged but the force on left pan is increased due to water flow

16. For convex lens, I is real, diminished and erect

17. W.D by air on gas is $P_0 V_0 = nC_v (\Delta T)$

$$\therefore T = 1.4T_0 \text{ and } P = \frac{1.4P_0V_0}{V}$$

18. Since C.M is not at 'C', torque due to weight exists.

\therefore Angular momentum is not conserved. As hole comes down, PE increases and KE decreases.

19. Conceptual

20. Conceptual

CHEMISTRY

21. Concentration in both cells are same

22. $K_c = \frac{(200)^{200}}{(100)^2} = 4$

23.

$H_\alpha = 6563A^0$	$H_\beta = 4861A^0$
$H_\gamma = 4341A^0$	$H_\delta = 4102A^0$

24.

25.

26. $(0+0-1), (-1), (-2-2), (0+2), (+4+4)$

27. A) $(\text{Co}(\text{NH}_3)_2\text{Cl}_4)^{-1}$ B) $(\text{Co}(\text{NH}_3)_3\text{Cl}_3)$ C) $(\text{Co}(\text{NH}_3)_3\text{Cl}_2\text{Br})^{+1}$

28. Except Brucite, remaining all are calcium minerals

29. $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 \rightarrow \text{Ca}^{+2} + 2\text{OH}^-$

30. m moles at KI = 20

31. Conceptual

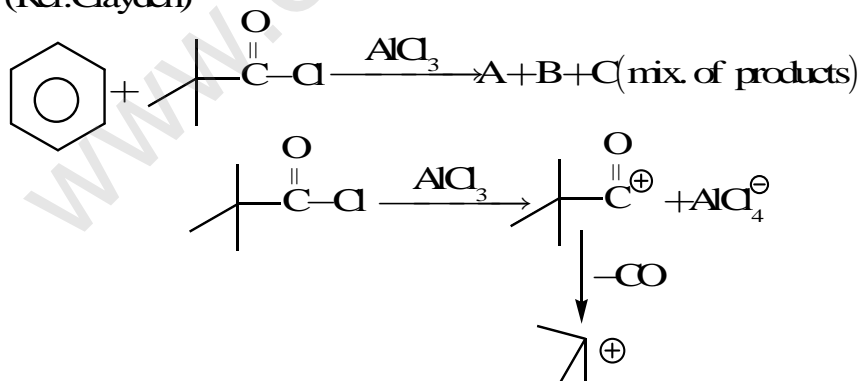
32. Phenoxide acts as ambident nucleophile. In protic solvent oxygen site is more solvated than carbon nucleophilic site.

33.

34. Conceptual

35.

(Ref: Clayden)



36. $\text{N}(\text{SiH}_3)_3$ $d\pi - p\pi$ bond formation

IF_4^- four bond pairs and 2 lone pair sq. planar

XeF_5^- five bond pair and 2 lone pair

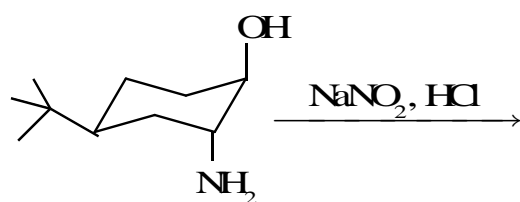
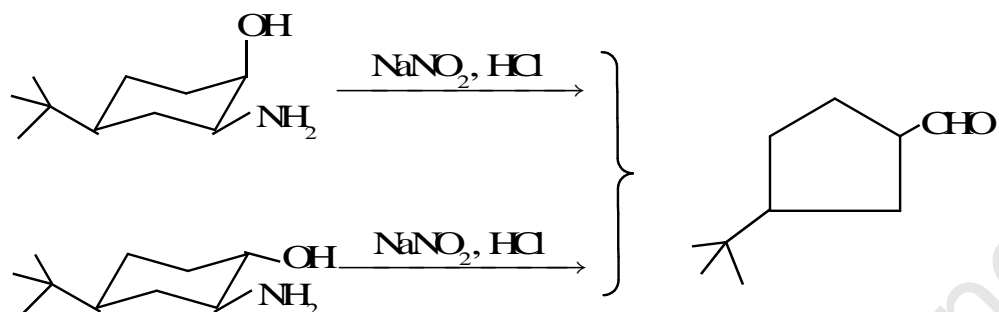
Pentagonal planar BF_3 planar.

37.

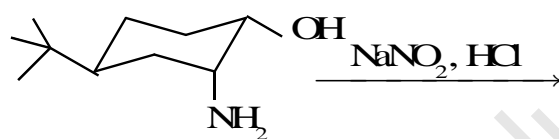
38.

39. Conceptual

40.



Epoxide (Internal S_{N}^2 attack)



ketone (H^- migration)

MATHS

41. Use bounded method, $\sin x = \frac{1}{2}, \sec^2 y = 1$

42.
$$f(x) = \frac{1}{x^4 + \frac{16}{x^4} + 2\left(x^2 + \frac{4}{x^2}\right) - 4}$$

Put $x^2 + \frac{4}{x^2} = t$

43. $x + y = 3$ is tangent to $(x - 3)^2 + (y + 2)^2 = a^2 \Rightarrow a^2 = 2$

44. $\bar{r} = \bar{c} + t\bar{b} \Rightarrow \bar{r} \cdot \bar{b} = \bar{b} \cdot \bar{c} - \frac{\bar{a} \cdot \bar{c}}{\bar{a} \cdot \bar{b}} |\bar{b}|^2$

45. Symmetric $\Rightarrow A = \begin{pmatrix} a & b \\ c & a \end{pmatrix}$

Skew symmetric $\Rightarrow A = \begin{pmatrix} 0 & -\alpha \\ \alpha & 0 \end{pmatrix}$ type

46. Use Binomial expansion and divide we get $\frac{A - B\pi}{C} = \frac{22}{7} - \pi = \frac{22 - 7\pi}{7}$

47. Let $P(A) = x, P(B) = y, P(C) = z$

$$\therefore x(1-y)(1-z) = e_1$$

$$y(1-x)(1-z) = e_2$$

$$z(1-x)(1-y) = e_3$$

$$(1-x)(1-y)(1-z) = \lambda$$

Solve the given equations we get $x=2y=6z$

48. $\begin{vmatrix} 1 & -c & -b \\ c & -1 & a \\ b & a & -1 \end{vmatrix} = 0 \Rightarrow a^2 + b^2 + c^2 + 2abc = 1$

49. Use vector forms $\vec{r} = (-1, -2, -1) + t(3, 1, 2)$ and $\vec{r} = (2, -2, 3) + s(1, 2, 3)$ for the given lines

50. Use $|z - z_0| = r, |z - z_0| = 2r$ and put $z = \beta, \frac{1}{\beta}$ respectively in the two equations.

By using hypothesis we get $|\beta| = 1/\sqrt{7}$

51. $Q = \left(\frac{1}{x}, 0\right) C = (2x, 0)$

$$P = \left(\theta, \sqrt{\theta^2 - 1}\right) \quad \beta = \frac{1}{3} \left(3\theta + \frac{1}{\theta}\right)$$

$$r = \frac{1}{3} \sqrt{\theta^2 - 1}$$

52. $|B^4 + AB^2| = |B|^2 |B^2 + A| = 0$

53. Last members of the n th group = $\frac{n(n+1)}{2}$

First member of $(n+1)$ th group = $\frac{n(n+1)}{2} + 1$

54. a) common tangent : $x + y + 7 = 0$

b) $c^4 = 32a^4$ for $xy = c^2, y^2 = 4ax$

c) Normals meet on axis.

-
- d) Graphical method
55. Graphical method
56. For the standard ellipse in the question
- Max area = $2ab$ for rectangle
 - $a+b = 2 + \sqrt{3} = \tan 75^\circ$
 - $|a - b| =$ maximum distance required
 - πab sq units
57. Use suitable function in each option and apply Rolle's theorem
58. Use the necessary & sufficient conditions for local extremum
59. a) use $p(x) = ax^2 + bx$: we have $(a, b) = (0, 2), (3, 0)$
- $f(x) = \sqrt{2} \sin(x^2 + \pi/4)$
 - Put $t = (\sin x)^{\cos x}$
 - $\operatorname{cosec} 10^\circ + \operatorname{cosec} 50^\circ - \operatorname{cosec} 70^\circ = 6$ by converting into LCM
60. a) $t_1^3 t_2 = -1$
- Max. dist. required = $|a - b|$ from $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
 - Graphical method : $|x| + |y| = 1, x = 2n\pi, y = 2n\pi$
 - $\left(\frac{a}{4}, \frac{b}{4}, \frac{c}{4}\right) = (x, y, z) =$ centroid and volume = $\frac{abc}{6} \therefore \lambda = 3$ in the question

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