SAMPLE PAPERS

JEE Advanced

PAPER - 2

Maximum Marks: 180

Important Instruction:

Please read the instructions carefully. INSTRUCTIONS
A. General:
1. This booklet is your Question Paper.
2. Blank papers, clipboards, log tables, slide rules, calculators, cameras, cellular phones, pagers and electronic gadgets are NOT allowed inside the examination hall.
3. Using a black ball point pen to darken the bubbles .

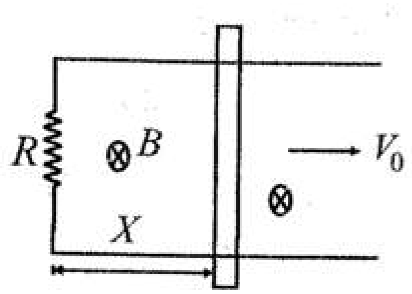
B. Question Paper Format :
4. The question paper consists of three parts (Physics, Chemistry and Mathematics). Each part consists of three sections. Section 1 contains 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE are correct
5. Section 2 contains 4 paragraphs each describing theory, experiment, data etc. Eight questions relate to four paragraphs with two questions on each paragraph. Each question of a paragraph has ONLY ONE correct answer among the four choices (A), (B), (C) and (D).
6. Section 3 contains 4 Matching type Questions.
Each question has ONLY ONE CORRECT ANSWER among the four choices (A), (B), (C) and (D).

C. Marking Scheme
7. For each question in Section 1, you will be awarded 3 marks if you darken all the bubble(s) corresponding to only the correct answer(s) and zero mark if no bubbles are darkened. In all other cases, minus one (–1) mark will be awarded.
8. For each question Section 2 and 3, you will be awarded 3 marks if you darken the bubble corresponding to only the correct answer and zero mark if no bubbles are darkened. In all other cases, minus one (–1) mark will be awarded.

PART – A (PHYSICS)
SECTION - 1

This section contains 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE are correct

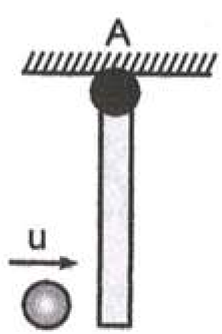
1. A conducting rod of length ℓ is moved at constant velocity 'V_0' on two parallel, conducting, smooth, fixed rails that are placed in a uniform constant magnetic field B perpendicular to the plane of the rails as shown in figure. A resistance R is connected between the two ends of the rail. Then which of the following is/are correct:



(a) The thermal power dissipated in the resistor is equal to rate of work done by external person pulling the rod (b) If applied external force is suddenly doubled then the velocity of rod will instantly double.
(c) If applied external force is suddenly doubled then the velocity of rod will instantly quadruple.
(d) If resistance R is doubled then power required to maintain the constant velocity V_0 becomes half.

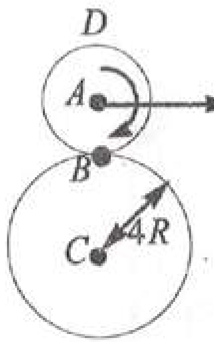
2. An ideal inductor is connected in series with a resistor and an ideal battery. The battery supplies energy at a rate P(t), the resistor dissipates energy at a rate $P_R(t)$, and the inductor stores energy at a rate $P_L(t)$. What can be concluded about the relationship between $P_R(t)$ and $P_L(t)$?
(a) $P_R(t) > P_L(t)$ for all times t while charging
(b) $P_R(t) = P_L(t)$ for some value of t while charging
(c) $P_R(t) > P_L(t)$ only near the beginning of the charging
(d) $P_R(t) < P_L(t)$ only near the beginning of the charging

3. In the given figure a ball strikes a rod at its end elastically and rod is hinged smoothly at point A. Then which of the statement(s) is/are correct (regarding just before and after the collision)



(a) Linear momentum of system (ball + rod) is not conserved
(b) Angular momentum of system (ball + rod) about hinged point A is conserved
(c) Kinetic energy of ball is conserved
(d) Linear momentum of ball is conserved

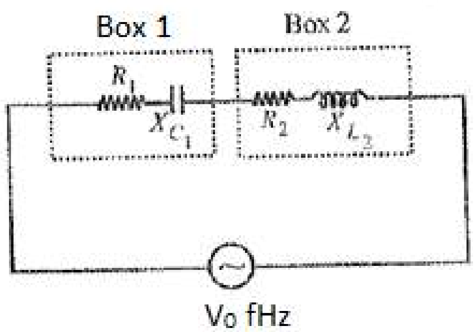
4. A ring of radius R is rolling purely on the outer surface of a fixed pipe of radius 4R. At some instant, the centre of the ring has a constant speed = v as shown in fig.



(a) The acceleration of the point on the ring which is in contact with the surface of the pipe w.r.t ground is $4v^2/5R$
(b) The acceleration of the point on the ring which is in contact with the surface of the pipe w.r.t ground is v^2/R (c) The acceleration of the point on the ring which is farthest from the centre of the pipe at the given moment is $\frac{6v^2}{5R}$

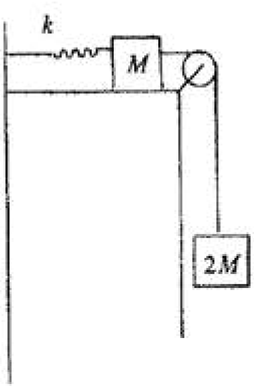
(d) Acceleration of B w.r.t. A is v^2/R

5. If $X_{L_2} > X_{C_1}$ and $R_1 = R_2$ then. Choose the correct alternative



(a) source voltage v will lead the current
(b) Power factor of box 1 will be greater than power factor of box 2
(c) Power factor of box 1 is less than power factor of circuit
(d) Voltage across box-1 will lag current

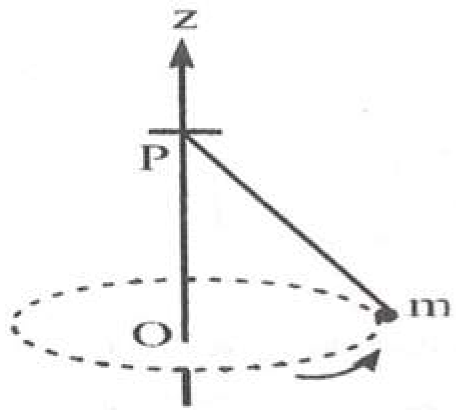
6. Two blocks of masses M and 2M are connected to a light spring constant k. That has one end fixed as shown in the figure. The horizontal surface and pulley are frictionless. The blocks are released from rest when the spring is in its relaxed state.



(a) Maximum extension in the spring is $\frac{4Mg}{k}$
(b) Maximum kinetic energy of the system is $\frac{2M^2g^2}{k}$
(c) Maximum energy stored in the spring is four times that of maximum kinetic energy of the system

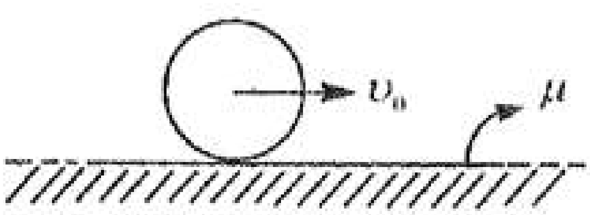
(d) When kinetic energy of the system is maximum, energy stored in the spring is $\frac{4M^2g^2}{k}$

7. A small mass m is attached to a massless string whose other end is fixed at P as shown in the figure. The mass is undergoing circular motion in the x-y plane with center at O and constant angular speed ω. If the angular momentum of the system calculated about O and P are denoted by $\vec{L}_0$ and $\vec{L}_r$ respectively, then



(a) $\vec{L}_0$ and $\vec{L}_r$ do not vary with time
(b) $\vec{L}_0$ varies with time while $\vec{L}_r$ remains constant
(c) $\vec{L}_0$ remains constant while $\vec{L}_r$ varies with time
(d) $\vec{L}_0$ and $\vec{L}_r$ both vary with time

8. A sphere is thrown along a rough surface as shown. Mass of the sphere is M and radius is R. If t is total time taken to start pure rolling after thrown, then:

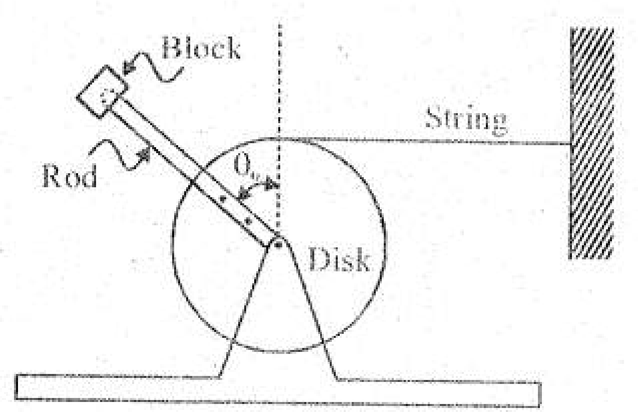


(a) Speed of the sphere when it start pure rolling is $\frac{5v_0}{7}$
(b) Work done by friction is greater in first half i.e. 0 to $\frac{t}{2}$ compare to later half i.e., $\frac{t}{2}$ to t
(c) Work done by friction zero after time t
(d) The met work done on the sphere is $\frac{1}{4}\ Mv_0^2$

SECTION – 2

This section contains 4 paragraphs each describing theory, experiment, data etc. Eight questions relate to four paragraphs with two questions on each paragraph. Each question of a paragraph has ONLY ONE correct answer among the four choices (A), (B), (C) and (D).

Paragraph – 1
As shown below, a uniform disc is mounted to a fixed axle and is free to rotate without friction. A thin uniform rod is rigidly attached to the disc so that it will rotate with the disc. A block is attached to the rod.



Disc : mass = 3m, radius = R, moment of inertia about center $I_D = \frac{3}{2} mR^2$

Rod : mass = m, length = 2R, moment of inertia about one end $I_R = \frac{4}{3} mR^2$

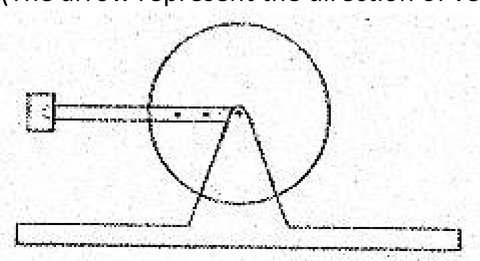
Block : mass 2m

The system is held in equilibrium with the rod at an angle θ_0 to the vertical, as shown above, by a horizontal string of negligible mass one end attached to the disc and the other to a wall.

9. The tension in the string is

(a) $mg \sin \theta_0$ (b) $3mg \sin \theta_0$ (c) $5 mg \cos \theta_0$ (d) $5mg \sin \theta_0$

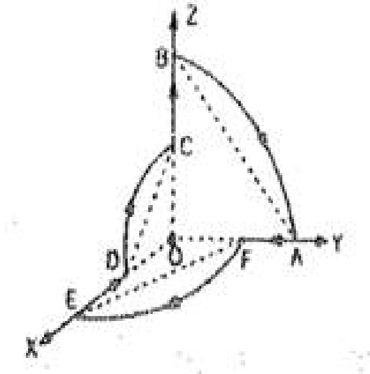
10. The string is now cut, and the disc-rod-block system is free to rotate. As disc rotates, the rod passes the horizontal position shown below. The linear speed of the end of the rod for the instant the rod is in the horizontal position is :
(The arrow represent the direction of vector quantities)



(a) $\sqrt{\frac{48}{13} gR\cos\theta_0} \downarrow$ (b) $\sqrt{\frac{12}{13} gR\cos\theta_0} \downarrow$ (c) $\sqrt{\frac{12}{13} gR\cos\theta_0} \leftarrow$ (d) $\sqrt{\frac{48}{13} gR\cos\theta_0} \rightarrow$

Paragraph – 2

In a rigid wire frame ABCDEFA, as shown in the figure, a current I_0 flows through the wire from A to F as shown in the figure. Radii of the three quarters, AB, CD and EF are $r_1 = 3^{\frac{1}{4}}$, r = $3^{\frac{1}{4}}$ m and r_3 = 1m respectively with common center at O. All the wires are light except for the portion ED which have a mass of ‘m’ kg.



11. The magnetic moment of the loop is

(a) $\frac{\pi I_0}{4}\left(\sqrt{3}\hat{i}+\sqrt{3}\hat{j}+\hat{k}\right)$ (b) $-\frac{\pi I_0}{4}\left(\sqrt{3}\hat{i}+\sqrt{3}\hat{j}+\hat{k}\right)$

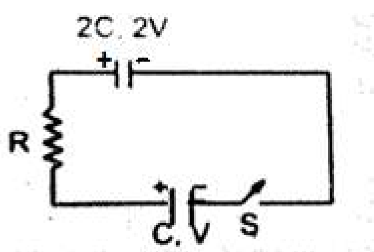
(c) $\frac{\pi I_0}{4}\left(-\sqrt{3}\hat{i}-\sqrt{3}\hat{j}+\hat{k}\right)$ (d) $\frac{\pi I_0}{4}\left(-\sqrt{3}\hat{i}+\sqrt{3}\hat{j}+\hat{k}\right)$

12. If this loop is kept in a magnetic field of magnetic 2T which is directed along positive y-axis, torque acting on the loop is

(a) $\frac{\pi I_0}{4}\left(-\hat{i}+\sqrt{3}\hat{k}\right)$ (b) $\frac{\pi I_0}{4}\left(\hat{i}+\sqrt{3}\hat{k}\right)$ (c) $\frac{\pi I_0}{4}\left(\hat{i}-\sqrt{3}\hat{k}\right)$ (d) $\frac{\pi I_0}{4}\left(-\hat{i}-\sqrt{3}\hat{k}\right)$

Paragraph – 3

Two capacitors of capacitance 2C and C are charged to potential difference 2V and V respectively. Now the charged capacitors are connected with a resistor R as shown in figure. Switch 'S' is closed at t = 0.



13. What is the total heat produced in circuit till steady state is obtained?

(a) $\frac{1}{3}$ CV^2 (b) $\frac{CV^2}{2}$ (c) $\frac{2}{3}$ CV^2 (d) $\frac{3}{5}$ CV^2

14. What is the current in circuit as function of time?

(a) $\frac{V}{R}\ e^{-3t/RC}$ (b) $\frac{2V}{R}\ e^{-2t/3RC}$ (c) $\frac{V}{R}\ e^{-t/RC}$ (d) $\frac{V}{R}\ e^{-3t/2RC}$

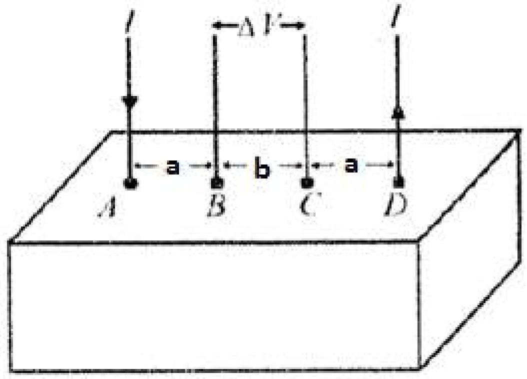
Paragraph – 4

Consider a block of conducting material of resistivity ρ shown in the figure. Current I enters A and B leaves from D. We apply superposition principle to find voltage ΔV developed between B and C. The calculation is done in the following steps:

(a) Take current I entering from A and assume it to spread over a hemispherical surface in the block.

(b) Calculate field E(r) at distance r from A by using Ohm's law E = ρj, where j is the current per unit area at r.

(c) From the r dependence of E(r), obtain the potential V(r) at r.
(d) Repeat (i), (ii) and (iii) for current I leaving D superpose results for A to D.



15) ΔV measured B and C is

a) $\frac{\rho L}{\pi a} - \frac{\rho L}{\pi(a+b)}$ b) $\frac{\rho L}{a} - \frac{\rho L}{(a+b)}$ c) $\frac{\rho L}{2\pi a} - \frac{\rho L}{2\pi(a+b)}$ d) $\frac{\rho L}{2\pi(a+b)}$

16) For current at A, the electric field at a distance 'r' from A is

a) $\frac{\rho I}{8\pi r^2}$ b) $\frac{\rho I}{\pi r^2}$ c) $\frac{\rho I}{2\pi r^2}$ d) $\frac{\rho I}{4\pi r^2}$

SECTION – 3

This section contains 4 Matching type Questions. Each question has ONLY ONE CORRECT ANSWER among the four choices (A), (B), (C) and (D).

17. A rigid body of mass M and radius R rolls without slipping on an inclined plane of inclination θ, under gravity. Match the type of body with magnitude of the force of friction.

Column I		Column II	
(a)	For ring	(p)	$\frac{Mg\sin\theta}{2.5}$
(b)	For solid sphere	(q)	$\frac{Mg\sin\theta}{3}$
(c)	For solid cylinder	(r)	$\frac{Mg\sin\theta}{3.5}$
(d)	For hollow spherical shell	(s)	$\frac{Mg\sin\theta}{2}$

(a) A – P; B – Q; C – S; D – S
(b) A – P; B – S; C – Q; D – Q
(c) A – R; B – Q; C – P; D – S
(d) A – S; B – R; C – Q; D – P

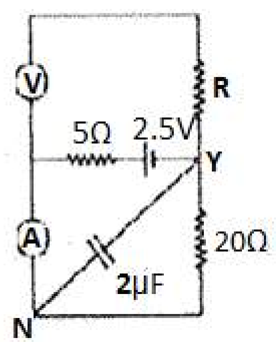
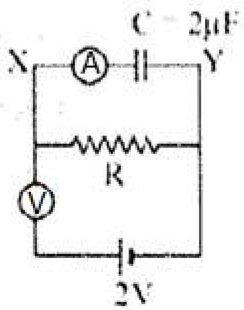
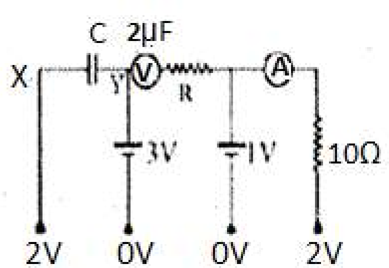
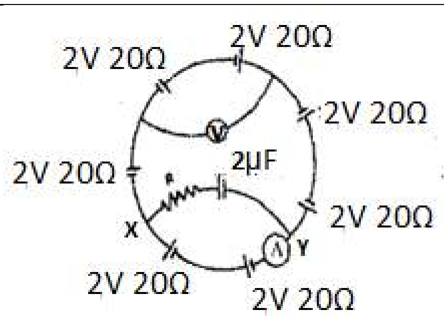
18. A charged particle with some initial velocity is projected in a region where non-zero uniform electric and/or magnetic fields are present. In column I, information about the existence of a electric and/or magnetic field and direction of initial velocity of charged is mentioned. Match the entries of Column I with the entries of Column II (Consider all possibilities)

Column I		Column II	
(a)	$\vec{E} = 0, \vec{B} \neq 0$ and initial velocity may be at any angle with $\vec{B}$ including 0^0	(p)	Straight line
(b)	$\vec{E} \neq 0, \vec{B} = 0$ and initial velocity may be at any angle with $\vec{E}$ including 0^0	(q)	Parabola
(c)	$\vec{E} \neq 0, \vec{B} \neq 0$ $\vec{E} \parallel \vec{B}$ and initial velocity is $\perp$ to both $\vec{E}$ and $\vec{B}$	(r)	Circular

(d)	$\vec{E} \neq 0, \vec{B} \neq 0, \vec{E}$ is perpendicular to $\vec{B}$ and initial velocity is perpendicular to both $\vec{E}$ and $\vec{B}$	(s)	Helical path

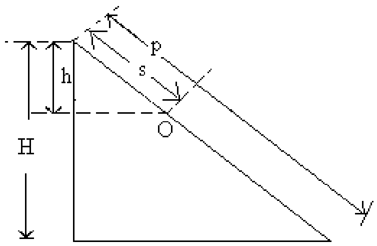
(a) A – PRS, B – PQ, C – S, D – P
(b) A – QRS, B – PQR, C – S, D – RS
(c) A – QR, B – PQRS, C – PQ, D – QS
(d) A – PRS, B – PQ, C – PS, D – PR

19. Column I gives electrical circuits in steady state. Column II gives some statements regarding the circuits. Match appropriately (assume ammeter and voltmeter to be ideal)

	Column I		**Column II**
(a)		(p)	Reading of voltmeter is 2V
(b)		(q)	Reading of ammeter is 0.1 A
(c)		(r)	Current through 'R' is zero
(d)		(s)	Charge of capacitor is 4μC

(a) A – PQR, B – PRS, C – PQR, D – QR
(b) A – PR, B – RS, C – Q, D – PQRS
(c) A – QR, B – PQS, C – S, D – RS
(d) A – PQR, B – PR, C – PQRS, D – Q

20. A particle slides down from rest on an inclined plane of angle θ with horizontal. The distances are as shown. The particle slides down from top to position A where its velocity is v. Match the options of two columns.



Column I		Column II	
(a)	$(v^2 - 2gh)$ will	(p)	Increase
(b)	$(v^2 - 2gs \sin\theta)$ will	(q)	Decrease
(c)	$\left(v^2 - 2g\frac{H}{p}\right)$ will	(r)	Remains constant
(d)	$\left[v^2 - \frac{2gs\,(H-h)}{(p-s)}\right]$ will	(s)	May increase or decrease

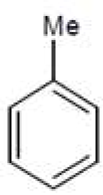
(a) A-r; B-r; C-r; D-r (b) A-r; B-s; C-q; D-p (c) A-p; B-q; C-r; D-s (d) A-q; B-r; C-r; D-q

PART – B (CHEMISTRY)
SECTION - 1

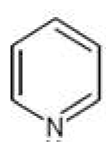
This section contains 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE are correct

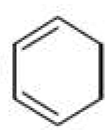
21. Which of the following pairs can be distinguished by the action of heat?
(a) Na_2CO_3 and $CaCO_3$
(b) K_2CO_3 and $MgCO_3$
(c) $Ca(NO_3)_2$ and $NaNO_3$
(d) $MgCl_2 \cdot 6H_2O$ and $CaCl_2 \cdot 6H_2O$

22. Which of the following does not react with aq. $KMnO_4$?

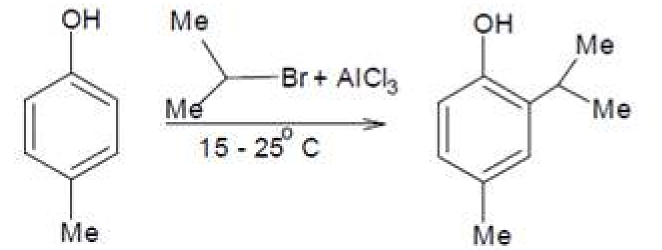
(a) 

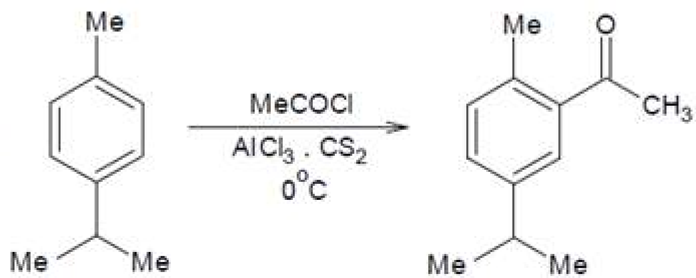
(b) $F_2C = CF_2$

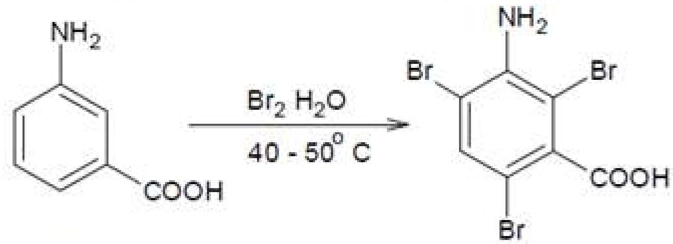
(c) 

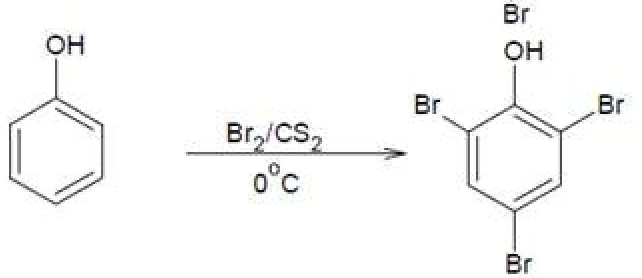
(d) 

23. In which of the following reactions is the correct major product formed?

(a) 

(b) 

(c) 

(d) 

24. Which of the following statements is/are true for the complexes, $[Fe(H_2O)_6]^{2+}$, $[Fe(CN)_6]^{3-}$, $[Fe(C_2O_4)_3]^{3-}$ and $[Fe(CO)_5]$?

(a) only $[Fe(C_2O_4)_3]^{3-}$ show optical isomerism

(b) $[Fe(C_2O_4)_3]^{3-}$ is less stable than $[Fe(CN)_6]^{2-}$

(c) All complexes have same effective atomic number

(d) $[Fe(CO)_5]$ shows back bonding

25. Which complex of the following pairs has the larger value of Δ_0?

(i) $[Co(CN)_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$

(ii) $[Co(H_2O_6]^{3+}$ and $[Rh(H_2O)_6]^{3+}$

(iii) $[Co(H_2O_6]^{3+}$ and $[Co(H_2O)_3]^{3+}$

(iv) $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$

Select the correct one

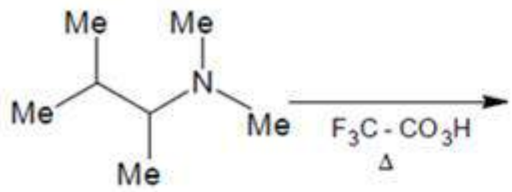
(a) $[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+}$

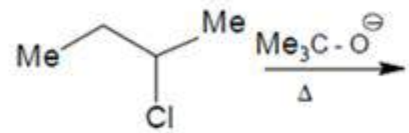
(b) $[Co(H_2O)_6]^{2+} < [Co(H_2O)_6]^{3+}$

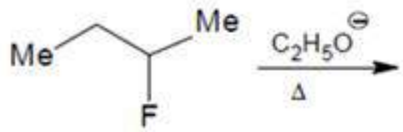
(c) $[Co(H_2O_6]^{3+} > [Rh(H_2O)_6]^{3+}$

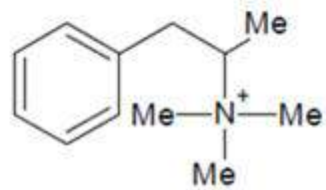
(d) $[Co(NH_3)_6]^{3+} < [CoF_6]^{3-}$

26. Which of the following will give Hofmann alkene?

(a) 

(b) 

(c) 

(d) 

27. Sodium sulphate is soluble in water but barium sulphate is sparingly soluble because
(a) The hydration enthalpy of Na_2SO_4 is more than its lattice enthalpy
(b) The lattice enthalpy of $BaSO_4$ is more than its hydration enthalpy
(c) The lattice enthalpy has no role to play in solubility
(d) The lattice enthalpy of Na_2SO_4 is more than its hydration enthalpy

28. In which of the following, hydration enthalpy is greater than the lattice enthalpy?
(a) $BaSO_4$ (b) $BaCO_3$ (c) Na_2SO_4 (d) Na_2CO_3

SECTION – 2

This section contains 4 paragraphs each describing theory, experiment, data etc. Eight questions relate to four paragraphs with two questions on each paragraph. Each question of a paragraph has ONLY ONE correct answer among the four choices (A), (B), (C) and (D).

Paragraph - 1

Tollen's reagent is used for the detection of aldehyde, when a solution of $AgNO_3$ is added to glucose with NH_4OH then gluconic acid is formed.

$Ag^+ + e^- \rightarrow Ag$; $E^\circ_{red} = 0.8$ V

$C_6H_{12}O_6 + H_2O \rightarrow C_6H_{12}O_7$ (Gluconic acid) $+ 2H^+ + 2e$; $E^\circ_{red} = 0.05$ V

$[Ag(NH_3)_2]^+ + e^- \rightarrow Ag(S) + 2NH_3$; $E^\circ = -0.337$V

$\left[\text{Use } 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 \text{ at } 298 \text{ K}\right]$

29. (i) $2Ag^+ + C_6H_{12}O_6 + H_2O \rightarrow 2Ag(s) + C_6H_{12}O_7 + 2H^+$. Find ln K of this reaction.
(a) 66.21 (b) 58.38 (c) 28.30 (d) 46.29

30. (ii) When ammonia is added to the solution, pH is raised to 11. Which half-cell reaction is affected by pH abd by how much?
(a) E_{oxd} will increase by a factor of 0.65 from E°_{oxd}
(b) E_{oxd} will decrease by a factor of 0.65 from E°_{oxd}
(c) E_{red} will increase by a factor of 0.65 from E°_{red}
(d) E_{red} will decrease by a factor of 0.65 from E°_{red}

Paragraph - 2

A research guide instructed his two students to synthesize complex

$[Co(NH_3)_5(NO_2)]Cl_2$
They synthesized the complexes with identical molecular formula, molar mass, geometry, conductance and spin, but they differed in colour. Bases on the above facts the following question.

31. (i) The difference in colour is due to:
(a) optical isomerism (b) geometrical isomerism (c) linkage isomerism (d) nuclear isomerism

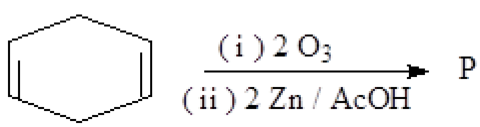
32. (ii) Which of the ligands can show ambient property?
(a) NO_2 (b) NH_3 (c) H_2O (d) CO_3^{2-}

Paragraph - 3

Ozonolysis of alkenes gives ozonide which gives aldehydes and / or ketones. When a stream of O_3 is passed through a solution of alkene in an inert solvents at low temperature the molecule adds up to form ozonide. This ozonide is unstabel and easily decompose either by reduction or hydrolysis and forms compound having $>C=O$ group. This is known as ozonolysis.

33. 2-methyl-but-2-ene on ozonolysis followed by reductive hydrolysis gives
(a) 2 moles of CH_3CHO (b) 1 mole of CH_3CHO
(c) 2 moles of CH_3COCH_3 (d) 1 mole of acetone and one mole of acetaldehyde

34.



Product P is

(a) 1 mole $CH_2(CHO)_2$ (b) 2 moles $CH_2(COOH)_2$

(c) 2 moles $CH_2(CHO)_2$ (d) 1 mole $CH_2(COOH)_2$

Paragraph - 4

Electrochemical series is a series of elements arranged in increasing order of their reduction potential and $E^0_{H^+/H_2} = 0$. The metals above H_2 have – ve reduction potential, they are more reactive than hydrogen whereas metals below hydrogen are less reactive than H_2. Reduction potential of metal depends upon
(i) sublimation energy (ii) ionization energy and (iii) hydration energy of ions.

35. Which of the following is best reducing agent?

(a) Li (b) Na (c) K (d) Cs

36. Which of the following cannot displace H_2 from dil. Acid?
(a) Pt (b) Zn (c) Mg (d) Pb

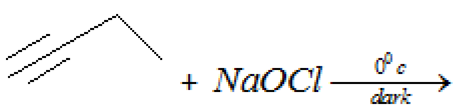
SECTION – 3

This section contains 4 Matching type Questions. Each question has ONLY ONE CORRECT ANSWER among the four choices (A), (B), (C) and (D).

37. Match the following :

Column-I		Column-II	
(a)	SOF_2	(p)	One of the elements has-1 oxidation state.
(b)	IOF_4^-	(q)	Central atom has lone pair(s) of electrons.
(c)	XeO_3F_2	(r)	Central atom has sp^3 hybridization.
(d)	H_2SO_5	(s)	$p\pi - d\pi$ bonding.

38.

Column-I		Column-II	
(a)		(p)	Dichloro acetaldehyde
(b)	$C_2H_2 + 2HOCl \rightarrow$	(q)	Propanal
(c)	propyne $\xrightarrow[ii)\ H_2O_2/OH^-]{i)\ B_2H_6}$	(r)	1-Chloro-1-butyne
(d)	propyne $\xrightarrow[ii)\ HgSO_4]{i)\ H_2SO_4}$	(s)	Propanone

39.

Column-I		Column-II	
(a)	1.8 ml H_2O (d = 1g\ml)	(p)	10.8 g
(b)	500 ml of 2.24 V H_2O_2	(q)	2.4×10^{23} atoms
(c)	per hydrol	(r)	0.1 moles
(d)	0.1 gm atom of Ag	(s)	1.8×10^{23} atoms
		(t)	30.35 % w\v

40. Match the complexes in Column-I with their properties listed in Column-II

Column-I		Column-II	
(a)	$[Co(NH_3)_4(H_2O)_2]Cl_2$	(p)	Geometrical isomers
(b)	$[Pt(NH_3)_2Cl_2]$	(q)	Paramagnetic
(c)	$Co(H_2O)_5Cl]Cl$	(r)	Diamagnetic
(d)	$[Ni(H_2O)_6]Cl_2$	(s)	Metal ion with +2 oxidation state

PART – C (MATHEMATICS)

Multiple Correct Answer(s) Type :

This section contains 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE are correct

41. If f(x) = $\begin{cases} \frac{3x-x^2}{2}, & x < 2 \\ [x-1], & 2 \le x < 3 \\ x^2 - 8x + 17, & x \ge 3 \end{cases}$

then which of the following hold(s) good?

[Note : [x] denotes largest integer less than or equal to x.]

(a) $\lim\limits_{x \to 2}$ f(x) = 1 (b) f(x) is differentiable at x = 2.

(c) f(x) is continuous at x =2 (d) f(x) is discontinuous at x = 3.

42. If the position vector of a point P is $\vec{r}$ = x$\hat{\imath}$ + y$\hat{\jmath}$ + z$\hat{k}$, where x, y, z ∈ N and projection of $\vec{r}$ on $\vec{a}$ = $\hat{\imath}$ + $\hat{\jmath}$ + $\hat{k}$ is $\frac{10}{\sqrt{3}}$ then number of possible position of P is also equal to

(a) number of natural solution of the equation x + y + z = 7.

(b) number of ways of selecting two objects out of 10 distinct objects arranged in a row so that no two of them are next to each other

(c) the total number of outcomes when a pair of dice are rolled once.

(d) number of positive divisors of 1800.

43. For x, y, z ∈$\left(0,\ \frac{\pi}{2}\right)$, let x, y, z be first three consecutive terms of an arithmetic progression such that cos x + cox y + cos z = 1 and sin x + sin y + sin z = $\frac{1}{\sqrt{2}}$, then which of the following is/are correct?

(a) cot y = $\sqrt{2}$ (b) cos (x- y) = $\frac{\sqrt{3}-1}{2\sqrt{2}}$ (c) tan 2y = $\frac{2\sqrt{2}}{3}$ (d) sin (x – y) + sin (z – y) = 0

44. A plane P passes through a point P (3, -2, 1) and is perpendicular to the vector $\overline{V} = 4\hat{\imath} + 7\hat{\jmath} - 4\hat{k}$. The distance between the plane P and the plane $\overline{r} \,.\, \left(4\hat{\imath} + 7\hat{\jmath} - 4\hat{k}\right) + 33 = 0$, equals

(a) 3 (b) 2 (c) 1 (d) $\frac{28}{9}$

45. If cosα = $\frac{3}{5}$ and cos β = $\frac{5}{13}$ and α , β are in first quadrant then which of the following is/are true?

(a) cos (α + β) = $\frac{33}{65}$ (b) sin (α + β) = $\frac{56}{65}$

(c) $\sin^2\left(\frac{\alpha-\beta}{2}\right) = \frac{1}{65}$

(d) $\cos(\alpha - \beta) = \frac{63}{65}$

46. Let α and β (α > β) be roots of the quadratic equation $ax^2 + bx + c = 0$. If $0 < a < c$ and $a + c = b$, then which of the following statement(s) is/are correct?

(a) Larger root is 1

(b) Larger root is – 1

(c) Smaller root is $\frac{c}{a}$

(d) b is greater than zero

47. If z be a non- real complex number satisfying $|z|=2$, then which of the following is/are true?

(a) $\arg\left(\frac{z-2}{z+2}\right) = \pm\frac{\pi}{2}$

(b) $\arg\left(\frac{z+1+i\sqrt{3}}{z-1+i\sqrt{3}}\right) = \frac{\pi}{6}$

(c) $\left|z^2-1\right| \geq 3$

(d) $\left|z^2-1\right| \leq 5$

48. Possible integral value(s) of m for the equation $\sin x - \sqrt{3}\cos x = \frac{4m-6}{4-m}$ can be valid for some $x \in [0, 2\pi]$, is

(a) –1 (b) 0 (c) 1 (d) 2

SECTION - 2

PARAGRAPH QUESTIONS :

This section contains 4 paragraphs each describing theory, experiment, data etc. Eight questions relate to four paragraphs with two questions on each paragraph. Each question of a paragraph has ONLY ONE correct answer among the four choices (A), (B), (C) and (D).

Paragraph - 1

Consider the function f : R → R, defined as f(x) = $\begin{cases} x^2 - x + 3, & x \in (-\infty, 3) \cap Q \\ x + a, & x \in (-\infty, 2) - Q \\ 2^x + 1, & x \in (2, 3) - Q \\ 9\tan\left(\frac{\pi x}{12}\right), & x \in [3, 6) \end{cases}$

49. If f(x) is continuous at x = 2 then the value of a is

(a) 1 (b) 2 (c) 3 (d) indeterminate

50. The function f(x) at x = 3

(a) has non-removable discontinuity

(b) has removable discontinuity

(c) is differentiable

(d) is continuous but not differentiable

Paragraph – 2

Let P, Q, R, S and T are five sets about the quadratic equation
$(a-5)x^2 - 2ax + (a-4) = 0$, $a \neq 5$ such that
P : All values of 'a' which the product of roots of given quadratic equation is positive.
Q : All values of 'a' which the product of roots of given quadratic equation is negative.
R : All values of 'a' which the product of real roots of given quadratic equation is positive.
S : All values of 'a' for which the roots of given quadratic are real.
T : All values of 'a' for which the given quadratic equation has complex roots.

51. Which statement is correct regarding sets, P, Q and R ?

(a) $P \cap Q = \varphi$

(b) $R \subseteq P$

(c) $P \cup Q = R^* \sim \{4, 5\}$(where '$R^*$' is the set of real numbers)

(d) All of the above

52. Which of the following statement is correct?

(a) least positive integer for set R is 2

(b) least positive integer for set R is 3

(c) greatest positive integer for set T is 3

(d) none of the above.

Paragraph – 3

If $\cos\frac{\pi}{7} \cdot \cos\frac{3\pi}{7} \cdot \cos\frac{5\pi}{7}$ are the roots of the equation $8x^3 - 4x^2 - 4x + 1 = 0$

53. The value of $\sec\frac{\pi}{7} + \sec\frac{3\pi}{7} + \sec\frac{5\pi}{7}$ is

(a) 2 (b) 4 (c) 8 (d) none of these

54. The value of $\sin\frac{\pi}{14}\ \sin\frac{3\pi}{14}\ \sin\frac{5\pi}{14}$ is

(a) $\frac{1}{4}$ (b) $\frac{1}{8}$ (c) $\frac{\sqrt{7}}{4}$ (d) $\frac{\sqrt{7}}{8}$

Paragraph – 4

In a parallelogram OABC, vectors $\vec{a}, \vec{b}, \vec{c}$ are respectively the position vectors of vertices A, B, C with reference to O is origin. A point $\vec{E}$ is taken on the side BC which divides it in the ratio of 2 : 1. Also, the line segment AE intersects the line bisecting the angel O internally in point P. If CP, when extended meets AB in point F. Then

55. The position vector of point p is

(a) $\frac{3|\vec{a}||\vec{c}|}{3|\vec{c}|+2|\vec{a}|}\left\{\frac{\vec{a}}{|\vec{a}|}+\frac{\vec{c}}{|\vec{c}|}\right\}$

(b) $\frac{|\vec{a}||\vec{c}|}{3|\vec{c}|+2|\vec{a}|}\left\{\frac{\vec{a}}{|\vec{a}|}+\frac{\vec{c}}{|\vec{c}|}\right\}$

(c) $\frac{2|\vec{a}||\vec{c}|}{3|\vec{c}|+2|\vec{a}|}\left\{\frac{\vec{a}}{|\vec{a}|}+\frac{\vec{c}}{|\vec{c}|}\right\}$

(d) none of these

56. The position vector of point F is

(a) $\vec{a} + \frac{1}{3}\frac{|\vec{a}|}{|\vec{c}|}\vec{c}$ (b) $\vec{a} + \frac{2|\vec{a}|}{|\vec{c}|}\vec{c}$ (c) $\vec{a} + \frac{1}{2}\frac{|\vec{a}|}{|\vec{c}|}\vec{c}$ (d) $\vec{a} + \frac{|\vec{a}|}{|\vec{c}|}\vec{c}$

SECTION – 3

This section contains 4 Matching type Questions. Each question has ONLY ONE CORRECT ANSWER among the four choices (A), (B), (C) and (D).

MATCHING - 1 :

57.

	Column – I	Column – II	
(a)	The minimum value of $9^3 27^{\cos 2x} 81^{\sin 2x}$ is	(p)	1
(b)	Number of solutions of the equation $\cos^7 x + \sin^4 x = 1,\ x \in [0, 2\pi]$	(q)	2
(c)	Value of a for which the equation $a^2 - 2a + \sec^2 \pi(a + x) = 0$ has a solution	(r)	3
(d)	If $\cos(P \sin x) = \sin(P \cos x)$, then the minimum possible value of $\frac{4\sqrt{2}}{\pi} P$ is	(s)	4

Which of the following is correct?

(a) A-P,B-R,C-S,D-Q (b) A-S,B-R,C-P,D-Q (c) A-R,B-R,C-P,D-Q (d) A-R,B-S,C-P,D-Q

58.

	Column – I	Column – II	
(a)	$\arg\left(\frac{z+1}{z-1}\right) = \frac{\pi}{4}$	(p)	Parabola
(b)	$z = \frac{3i - t}{2 + it}(t \in R)$	(q)	Part of a circle
(c)	$\arg z = \frac{\pi}{4}$	(r)	Full circle
(d)	$z = t + it^2 (t \in R)$	(s)	Line

Which of the following is correct?

(a) A-Q,B-R,C-S,D-Q (b) A-S,B-R,C-P,D-Q (c) A-Q,B-R,C-S,D-P (d) A-R,B-S,C-P,D-Q

59. Match the following

	Column – I	Column – II	
(a)	The maximum value attained by $y = 10 - \lvert x - 10 \rvert, -1 \le x \le 3$ is	(p)	3
(b)	If P(t^2, 2t) ; t ∈ [0, 2] is an arbitrary point on parabola $y^2 = 4x$, Q is foot of perpendicular from focus S on the tangent at P, then maximum area of ΔPQS is	(q)	$\frac{1}{3}$
(c)	If a + b = 1, a, b > 0 then minimum value of $\sqrt{\left(1+\frac{1}{a}\right)\left(1+\frac{1}{b}\right)}$ is	(r)	5
(d)	For real values of x, the least value of expression $\frac{x+2}{2x^2+3x+6}$ is	(s)	$-\frac{1}{13}$

Which of the following is correct?

(a) A-Q,B-R,C-S,D-Q (b) A-P,B-R,C-P,D-S (c) A-Q,B-R,C-S,D-P (d) A-R,B-S,C-P,D-Q

60. Match the following

	Column – I	Column – II	
(a)	The equation x logx = 3 – x has atleast one root in	(p)	(0, 1)
(b)	If 27a + 9b + 3c + d = 0, then the equation $4ax^3 + 3bx^2 + 2cx + d = 0$ has atleast one	(q)	(1, 3)

	root in		
(c)	If $c=\sqrt{3}$ and $f(x)=x+\frac{1}{x}$, then interval of x in which LMVT is applicable for f(x) is	(r)	(0,3)
(d)	If $c=\frac{1}{2}$ and $f(x)=2x-x^2$, then interval of x in which LMVT is applicable for f(x) is	(s)	(-1, 1)

Which of the following is correct?

(a) A-Q,B-R,C-S,D-Q (b) A-P,B-R,C-P,D-Q (c) A-Q,B-R,C-S,D-P (d) A-Q,B-R,C-Q,D-P