FIITJEE

ALL INDIA INTERNAL TEST SERIES

CHEMISTRY, MATHEMATICS & PHYSICS

SET – A

APT - 3 | **123232** | **Ai²TS-1**

Time Allotted : 3 Hours **Maximum Marks: 300**

CLASS XII

INSTRUCTIONS

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

- ✓ Attempt ALL the questions. Answers have to be marked on the OMR sheets.
- ✓ This question paper contains **Three Sections**.
- ✓ **Section – I** is *"Chemistry"*, **Section – II** is *"Mathematics"* and **Section – III** is *"Physics"*.
- ✓ Each Section is further divided into three Parts: **Part – A, Part – B** & **Part – C**.
- ✓ Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
- ✓ Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with HB pencil for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **PART-A (01 – 04)** contains 4 Multiple Choice Questions which have Only One Correct answer. Each question carries **+5 marks** for correct answer and **–3 marks** for wrong answer.
PART-A (05 – 10) contains 6 Multiple Choice Questions which have One or More Than One Correct answer. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

(ii) **PART-B (01 – 04)** contains 4 Matrix Match Type Question which have statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. There may be One or More Than One Correct choices. Each question carries **+8 marks** for all correct answer however for each correct row **+2 marks** will be awarded. There is no negative marking.

(iii) **PART-C (01 – 06)** contains 6 Numerical Based questions with Single Digit Integer as answer, ranging from 0 to 9 and each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

Name of Candidate :

Batch ID : **Date of Examination :** / / 2 0 1

Enrolment Number :

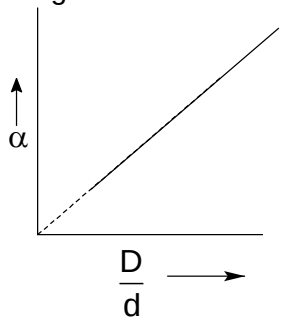
Section – I (CHEMISTRY)

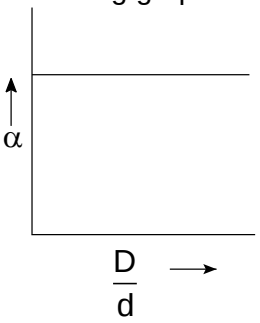
PART – A

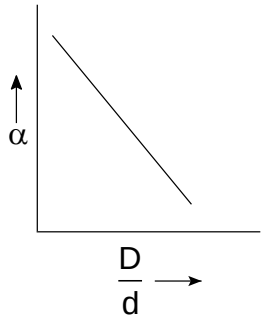
(Single Correct Choice Type)

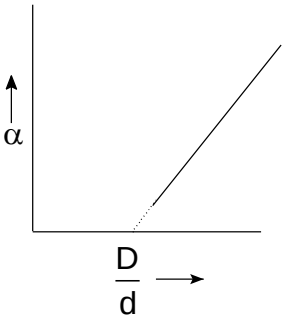
This section contains 4 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. D is vapour density of PCl_5 at initial stage and d is the vapour density of the equilibrium mixture and α is the degree of dissociation of PCl_5. Which of the following graph is correct?

(A) 

(B) 

(C) 

(D) 

2. 50 ml of 0.1 M $AgNO_3$ is added in 150 ml of 0.1 M HCl. If the K_{sp} of AgCl is 10^{-12}, the solubility of AgCl and pH of solution respectively are (Log 3 = 0.48, log2=0.3)
   (A) 2×10^{-11} M & 1.12 (B) 10^{-10} M & 2
   (C) 10^{-8} M & 3 (D) 10^{-11} M & 0.5

3. The type of hydridization of boron in diborane is
   (A) sp–hybridisation (B) sp^2–hybridisation
   (C) sp^3 hybridization (D) sp^3d^2–hybridisation

4. The ion(s) that act/s as an oxidising agent in solution is/are
   (A) Tl^+ and Al^{3+} (B) B^{3+} and Al^{3+}
   (C) Tl^{3+} (D) B^{3+}

space for rough work

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

5. For reaction

$A(g) \rightleftharpoons B(g) + C(g) + D(g)$, equilibrium constant $= K_{C_1}$

$B(g) + D(g) \rightleftharpoons C(g) + E(g)$, equilibrium constant $= K_{C_2}$

1 mole of A(g) is placed in closed container at temperature T K and at one atmospheric pressure. A is heated, it is observed that total pressure at equilibrium is twice the partial pressure of A and pressure of gas C is observed to be 3/8 atm
Select the correct option

(A) Pressure of Gas E is 1/8 atm (B) $K_{C_1} = \frac{1}{128}$

(C) $K_{C_2} = 3$ (D) A $\rightleftharpoons$ 2C + E, K_c= 3/128

6. Which of the following compounds will not show mutarotation?
(A) Methyl-α-D-glucopyranoside
(B) 4-O-α-D-glucopyranosyl-D-glucopyranose
(C) β-D-galactopyranose
(D) α-D-glucopyranosyl-β-D-fructofuranoside

7. $CH_3 - CH = CH - CH_3 \xrightarrow{OsO_4/KIO_4} (A) \xrightarrow[2.H_2O]{1.\ PhMgBr} (B)$

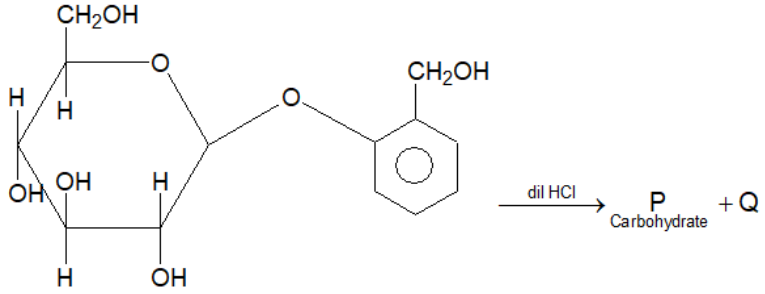
(A) Compound (B) on oxidation with (CrO_3 + H_2SO_4) gives a compound which gives 2, 4-DNP test positive
(B) Compound (B) on reaction with Cerric ammonium nitrate gives red colouration
(C) Compound (B) gives iodoform test positive
(D) Compound (B) on oxidation with hot alkaline $KMnO_4$ then neutralization gives Benzoic acid

8. $B_2 \xleftarrow{Sn/HCl} A_2 \xleftarrow{alc\ AgCN} CH_3 - Br \xrightarrow{alc\ KCN} A_1 \xrightarrow{Sn/HCl} B_1$

B_1 and B_2 can be distinguished by
(A) HNO_2 (B) $CHCl_3$ + NaOH
(C) CS_2 and $HgCl_2$ (D) Hinsberg reagent

space for rough work

9. Salicin (structure given below) is a glycoside, found in the bark of willow tree, used in relieving pain. Observe the following reaction of salicin.



The correct statement(s) is (are) :
(A) P is D-Glucose
(B) Q is 2-hydroxybenzyl alcohol
(C) Q can be converted to a modern analgesic (pain-killer), aspirin
(D) The above reaction occurs through a carbocation

10. A buffer solution can be prepared from a mixture of
(A) Sodium acetate and acetic acid in water
(B) Sodium acetate and sodium hydroxide in water
(C) Ammonia and ammonium chloride in water
(D) Ammonia and sodium hydroxide in water

PART – B

(*Matrix Match Type*)

1. Match the Columns .

Column – I		Column – II	
(A)	Cubic	(P)	$a = b = c \quad \alpha = \beta = \gamma = 90^o$
(B)	Tetragonal	(Q)	$a = b \neq c \quad \alpha = \beta = \gamma = 90^o$
(C)	Orthorombic	(R)	$a \neq b \neq c \quad \alpha = \beta = \gamma = 90^o$
(D)	Monoclinic	(S)	$a \neq b \neq c \quad \alpha = \gamma = 90^o, \beta \neq 90^o$

2. Match the following

Column – I		Column – II	
(A)	$t_{3/4} = 3/2 \times t_{1/2}$	(P)	99.9% completion
(B)	$t_{3/4} = 2 \times t_{1/2}$	(Q)	Zero order
(C)	6.909 / K	(R)	First order
(D)	2.303 / K	(S)	90% completion

space for rough work

3. Match the following:

Column – I		Column – II	
(A)	$K_p > Q$	(P)	Non–spontaneous
(B)	$H_2O(l) \longrightarrow H_2O(s)$	(Q)	Equilibrium
(C)	$K_p = Q$	(R)	Spontaneous and Endothermic
(D)	$T > \frac{\Delta H}{\Delta S}$	(S)	Spontaneous

4. Match the column

Column-I		Column-II	
(A)	Rock salt structure	(P)	Co-ordinate number of cation is 4
(B)	Zinc blend structure	(Q)	$\frac{\sqrt{3}a}{4} = r_+ + r_-$
(C)	Fluorite structure	(R)	Co-ordination umber of cation and anion are same
(D)	CsCl structure	(S)	Distance between two nearest anion is $\frac{a}{\sqrt{2}}$

PART – C

(Numerical Based)

This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

1. The work done (in calories) in an open vessel at 300K, when 112g iron reacts with dil. HCl to form $FeCl_3$ is 300x then the value of x is

2. The conductivity of a saturated solution of a sparingly soluble salt MX_2 is found to be $4 \times 10^{-5}\ \Omega^{-1}cm^{-1}$. If $\lambda_m^{\infty}\left(\frac{1}{2}M^{2+}\right) = 50\ \Omega^{-1}cm^2mol^{-1}$ and $\lambda^{\infty}\left(X^-\right) = 50\ \Omega^{-1}cm^2mol^{-1}$, the solubility product of the salt is $x \times 10^{-12}$ M, where value of x is

3. How many compounds liberate NH_3 on heating from the following?
$(NH_4)_2SO_4$, $(NH_4)_2CO_3$, NH_4Cl, NH_4NO_3, $(NH_4)_2Cr_2O_7$.

4. The packing fraction of the element that crystallises in simple cubic arrangement is π/x. The value of x is

5. Find the order of reaction
$2\ A(g) \longrightarrow B(g) + 3C(g)$

Pressure (atm)	100	200	400
Half life(hr)	7.04	3.52	1.76

6. What is the minimum volume (in litre) of water required to dissolve 1.224 g of $CaSO_4$ at 298 K (K_{sp} of $CaSO_4 = 9 \times 10^{-6}$)

space for rough work

Section – II (MATHEMATICS)

PART – A

(Single Correct Choice Type)

This section contains 4 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. If a, b and c are complex numbers, the determinant $\Delta = \begin{vmatrix} 0 & -b & -c \\ \bar{b} & 0 & -a \\ \bar{c} & \bar{a} & 0 \end{vmatrix}$ is

(A) a non – zero real number (B) purely imaginary
(C) 0 (D) None of these

2. For a matrix $A = \begin{bmatrix} 1 & 2r-1 \\ 0 & 1 \end{bmatrix}$, the value of $\prod_{r=1}^{50} \begin{bmatrix} 1 & 2r-1 \\ 0 & 1 \end{bmatrix}$ is equal to

(A) $\begin{bmatrix} 1 & 100 \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 4950 \\ 0 & 1 \end{bmatrix}$
(C) $\begin{bmatrix} 1 & 5050 \\ 0 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 2500 \\ 0 & 1 \end{bmatrix}$

3. The sum of the roots of the equation $2^{33x-2} + 2^{11x+2} = 2^{22x+1} + 1$ is

(A) $\frac{1}{11}$ (B) $\frac{2}{11}$
(C) $\frac{3}{11}$ (D) $\frac{4}{11}$

4. If $\Delta(x) = \begin{vmatrix} 1 & \cos x & 1-\cos x \\ 1+\sin x & \cos x & 1+\sin x-\cos x \\ \sin x & \sin x & 1 \end{vmatrix}$, then $\int_0^{\pi/2} \Delta(x)\,dx$ is equal to

(A) $-\frac{1}{2}$ (B) 0
(C) $\frac{1}{4}$ (D) $\frac{1}{2}$

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

5. If the system of equations $a^2x - by = a^2 - b$ and $bx - b^2y = 2 + 4b$ possess an infinite number of solutions, the possible values of a and b are

(A) $a = 1, b = -1$ (B) $a = 1, b = -2$
(C) $a = -1, b = -1$ (D) $a = -1, b = -2$

space for rough work

6. Let A and B are two square idempotent matrices such that $AB \pm BA$ is a null matrix, the value of $\det(A-B)$ can be equal

(A) –1 (B) 0
(C) 1 (D) 2

7. Let $f(x)$ be a differentiable function satisfying $f(x)=\int_0^x e^t \sin(x-t)dt$ and $g(x)=f''(x)-f(x)$, where $f''(x)$ is second order derivative of $f(x)$. Then which of the following is/are true?

(A) Period of $g(x)$ is 2π (B) Range of $g(x)$ is $\left[-\sqrt{2},\sqrt{2}\right]$

(C) $\int_0^{\pi/2} e^x.g(x)dx = e^{\pi/2}$ (D) None of these

8. A and B are two events, such that $P(A\cup B)\geq \frac{3}{4}$ and $\frac{1}{8}\leq P(A\cap B)\leq \frac{3}{8}$, then

(A) $P(A)+P(B)\leq \frac{11}{8}$ (B) $P(A).P(B)\leq \frac{3}{8}$

(C) $P(A)+P(B)\geq \frac{7}{8}$ (D) None of these

9. Let $f(x)=\begin{vmatrix} 1 & 1 & 1 \\ 3-x & 5-3x^2 & 3x^3-1 \\ 2x^2-1 & 3x^5-1 & 7x^8-1 \end{vmatrix}$. Then which of the following is/are correct?

(A) $f(x)=0$ has at least two real roots (B) $f(x)=0$ has at least one real root

(C) $f(x)$ is many – one function (D) none of these

10. Let $\vec{a}=\begin{bmatrix}1\\0\\-3\end{bmatrix}, \vec{b}=\begin{bmatrix}2\\1\\1\end{bmatrix}, \vec{c}=\begin{bmatrix}1\\-1\\1\end{bmatrix}$. If the numbers α,β and γ are such that $\alpha\vec{a}+\beta\vec{b}+\gamma\vec{c}=\begin{bmatrix}-2\\-5\\6\end{bmatrix}$ then

(A) $\alpha=-1$ (B) $\beta=-2$
(C) $\gamma=3$ (D) $\alpha+\beta+\gamma=0$

PART – B

(*Matrix Match Type*)

1. If n positive integers taken at random are multiplied together.

Column-I		Column-II	
(A)	The probability that the last digit is 1, 3, 7 or 9 is P (n), then 100 P (2) is divisible by	(P)	3
(B)	The probability that the last digit is 2, 4, 6 or 8 is Q (n), then 100 Q (2) is divisible by	(Q)	4
(C)	The probability that the last digit is 5 is R (n), then 100 R (2) is divisible by	(R)	6
(D)	The probability that the last digit is zero is S (n), then 100 S (2) is divisible by	(S)	9

space for rough work

2. Match the following

Column-I		Column-II	
(A)	If the vectors $\vec{a},\vec{b}$ and $\vec{c}$ form sides $\overrightarrow{BC},\overrightarrow{CA}$ and $\overrightarrow{AB}$ of ΔABC, then	(P)	$\vec{a}.\vec{c}=\vec{b}.\vec{c}=\vec{c}.\vec{a}$
(B)	If $\vec{a},\vec{b}$ and $\vec{c}$ are forming three adjacent sides of regular tetrahedron, then	(Q)	$\vec{a}.\vec{b}=\vec{b}.\vec{c}=\vec{c}.\vec{a}=0$
(C)	If $\vec{a}\times\vec{b}=\vec{c}$ and $\vec{b}\times\vec{c}=\vec{a}$ then	(R)	$\vec{a}\times\vec{b}=\vec{b}\times\vec{c}=\vec{c}\times\vec{a}$
(D)	$\vec{a},\vec{b}$ and $\vec{c}$ are unit vectors and $\vec{a}+\vec{b}+\vec{c}=0$ then	(S)	$\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}=\frac{-3}{2}$

3. Match the following

Column-I		Column-II	
(A)	If $\lvert z+4i\rvert\le 2$, then the minimum value of $\lvert z+3\rvert$ is	(P)	1
(B)	If $\lvert z_1\rvert=15, \lvert z_2+3-4i\rvert=5$, then the minimum value of $\lvert z_1-z_2\rvert$ is	(Q)	2
(C)	If $\alpha^5=1, a\ne 1$, then $\log_2\left\lvert 1+\alpha+\alpha^2+\alpha^3-\frac{7}{\alpha}\right\rvert$ is	(R)	3
(D)	If $\alpha^5=1,\alpha\ne 1$ and $x=\alpha-\alpha^4$ then x^4+5x^2+7 is	(S)	4
		(T)	5

4. Match the following

Column-I		Column-II	
(A)	The number of linear function satisfying $f(x+f(x))=x+f(x)\,\forall x$ is	(P)	1
(B)	The number of continuous function f such that $(f(x))^2=x^2\,\forall x$ in $[-1,1]$ is	(Q)	2
(C)	If $f(x)$ is twice differentiable function such that $f'(2)=3, f'(0)=1, f(2)=1, f(0)=-1$, then $\int_0^2 xf''(x)dx$	(R)	3
(D)	If $\lvert f''(x)\rvert\le 1\forall x\in R$ and $f(0)=f'(0)$, then the greatest value of $f(2)$ is	(S)	4

space for rough work

PART – C

(Numerical Based)

This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

1. If $\Delta_r = \begin{vmatrix} r & r-1 \\ r-1 & r \end{vmatrix}$, where r is a natural number the value of $\sqrt[10]{\sum_{r=1}^{1024} \Delta_r}$ is

2. Let A be a 3×3 diagonal matrix which commutes with every 3×3 matrix. If $\det(A)=8$, then tr A is

3. The vertices of a triangle are A (1, 0, 0), B (0, 2, 0) and C (0, 0, 3). If $\left(a\hat{i}+b\hat{j}+c\hat{k}\right)$ is position vector of orthocenter of ΔABC then $\sqrt{\frac{6}{(a-b-c)}}$ is

4. If $(31.6)^a=(0.0000316)^b=100$, the value of $\frac{1}{a}-\frac{1}{b}$ is

5. A biquadratic function $y=ax^4+bx^3+cx^2+dx+e(a\neq0)$ touches $y=px+q$ at $x=\alpha,\beta(\alpha<\beta)$. Area of the region bounded by these graphs is $\frac{a(\beta-\alpha)^5}{\lambda}$ then $\frac{\lambda}{5}=$

6. If $6+f''(x)+f'(x)=x^2+f^2(x)$ is the differential equation of a curve and let P be the point of minima of this curve then the number of tangents which can be drawn from P to the circle $x^2+y^2=4$ is

space for rough work

Section – III (PHYSICS)

PART – A

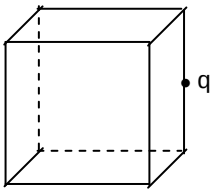
(Single Correct Choice Type)

This section contains 4 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. A body (solid sphere) of mass m makes an elastic collision with another identical body at rest. Just after collision the angle between the velocity vector of one body with the initial line of motion is 15° then the angle between velocity vector of the other body with the initial line of motion is
   (A) 75^0 (B) 60^0
   (C) 45^0 (D) 30^0

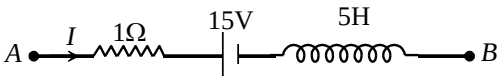
2. A superconducting rigid planar loop of area A and self-inductance L carrying a current is held motionless in a region of free space. Now a uniform magnetic field of induction B pointing every where parallel to the magnetic moment $\vec{m}$ of the loop is switched on. Current in the loop after the magnetic field is switched on, is given by
   (A) $\frac{AB}{L}$ (B) $\frac{m}{A}$
   (C) $\frac{m}{A}-\frac{AB}{L}$ (D) $\frac{m}{A}+\frac{AB}{L}$

3. The total flux of electric lines of forces of a charge q placed at the mid point of the edge of a side of rectangular box, as shown in figure through the box is



   (A) $\frac{q}{2\in_o}$ (B) $\frac{q}{4\in_o}$
   (C) $\frac{q}{8\in_o}$ (D) $\frac{q}{16\in_o}$

4. The network shown in the following figure is part of a circuit. What is the potential difference ($V_A - V_B$) when current I is 5A and is decreasing at a rate of 1 As^{-1}?



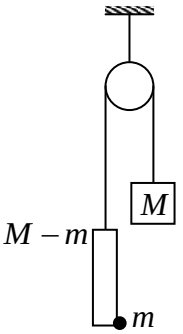
   (A) 5 V (B) 10 V
   (C) 15 V (D) zero

space for rough work

(Multi Correct Choice Type)

This section contains 6 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

5. A rod of mass '$M-m$' carries an insect of mass 'm' at its bottom end and its top end is connected with a string which passes over a smooth pulley and the other end of the string is connected to a counter mass M. Initially the insect is at rest. Choose the correct option(s).



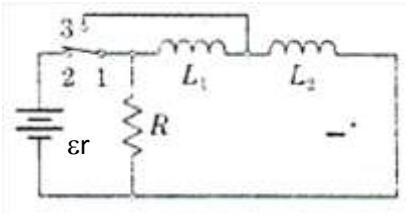
(A) As insect starts moving up relative to rod, the acceleration of centre of mass of the system (insect + rod + counter mass) becomes non-zero.

(B) As insect starts moving up relative to rod, tension in the string remains constant and is equal to Mg.

(C) As insect starts moving up relative to rod, the tension in the string becomes more than Mg.

(D) Acceleration of centre of mass of the system (insect + rod +counter mass) is zero when insect moves with constant velocity.

6. A circuit consists of two inductance L_1 and L_2 a resistance R, a two way switch, a battery of electromotive force and internal resistance r. The switch was in position 2 for a long time and at the instant t = 0, it is thrown to position 3.



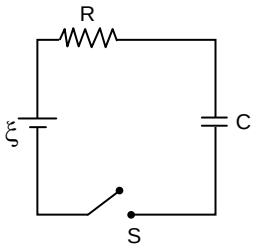
(A) Current through the switch as a function of time t after the switching is $\frac{\varepsilon}{r}\left\{1-e^{\frac{-Rt}{L_2}}\right\}$

(B) Total heat dissipated in resistance R after the switching is $\frac{L_2\varepsilon^2}{2r^2}$

(C) Current through the switch as a function of time t after the switching is $\frac{\varepsilon}{r}\left\{1-e^{\frac{-Rt}{L_1+L_2}}\right\}$

(D) Total heat dissipated in resistance R after the switching is $\frac{L_2\varepsilon^2}{r^2}$

7. As situation shown in figure the maximum value of rate of energy stored in the capacitor after the switch is closed



(A) $\frac{\xi^2}{2R}$

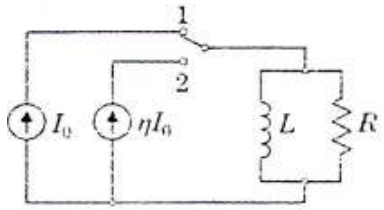
(B) $\frac{\xi^2}{4R}$

(C) $\frac{\xi^2}{8R}$

(D) none of these

space for rough work

8. A parallel combination of an inductance L and a resistance R can be connected to either of the two ideal current sources of current I_0 and ηI_0 through a switch as shown. Initially the switch is in position 1 for a long time. Now the switch is thrown to position 2. Then after the switching until a steady state is established.



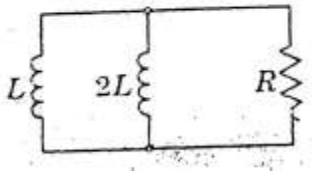
(A) Amount of charge that will pass through the resistance $\frac{(\eta-1)Li_0}{R}$

(B) Heat dissipated in resistance $\frac{(\eta-1)^2 Li_0^2}{2}$

(C) Amount of charge that will pass through the resistance $\frac{(\eta-1)Li_0}{2R}$

(D) Heat dissipated in resistance $\frac{(\eta+1)^2 Li_0^2}{2}$

9. A parallel circuit consists two ideal inductances L and 2L and a resistance R. At an instant the same current I_0 is flowing in both the inductances in the same direction. after this instant.



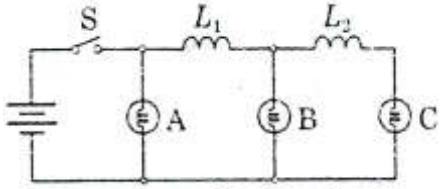
(A) Net charge will flow in the resistance $\frac{4Li_0}{3R}$

(B) Total heat will be dissipated in the resistance $\frac{4Li_0^2}{2}$

(C) Total heat will be dissipated in the resistance $\frac{4Li_0^2}{3}$

(D) Net charge will flow in the resistance $\frac{2Li_0}{3R}$

10. Three identical lamps A, B and C and two identical inductive coils L_1 and L_2 are connected to a DC power supply through a switch S as shown in the figure. Initially the switch is closed for a long time and steady state is reached. Now the switch S is opened. Which of the following statements correctly describes order of brightness of the bulbs immediately after the switch is opened?



(A) Brightness of A suddenly increases but that of B and C remains unchanged.

(B) Brightness of C suddenly increases but hat of A and B remains unchanged.

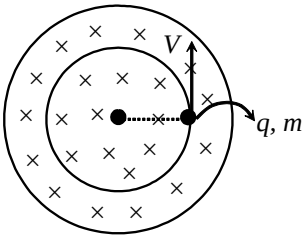
(C) Brightness of C suddenly increases but that of A and B remains unchanged.

(D) Brightness of all the bulbs suddenly increases equally.

space for rough work

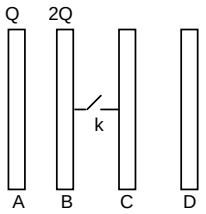
PART – B
(*Matrix Match Type*)

1. The central cross-section of a long cylindrical region containing uniform but time varying magnetic field *B* is shown. A particle of constant mass and variable positive charge moves in a circle in the plane, so that the radius of the circle remains constant.



Column-I		Column-II	
(A)	If the magnetic field is increased by 2%, the speed of the particle will	(P)	decrease
(B)	If the magnetic field is decreased by 4%, the speed of the particle will	(Q)	increase
(C)	If the magnetic field is increased by 2%, the charge of the particle will	(R)	change by 1%
(D)	If the magnetic field is decreased by 4%, the charge of the particle will	(S)	change by 2%

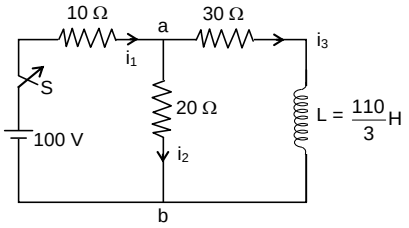
2. Read the following and write the correct pairs.
Initially, the two plates (A and B) are given charges as shown. Find the final charges on the plates after the key k is closed. All plates are conducting, parallel and of infinite length and breadth.



Column-I		Column-II	
(A)	Final charge on plate A	(P)	Q/2
(B)	Final charge on plate B	(Q)	Q
(C)	Final charge on plate C	(R)	0
(D)	Final charge on plate D	(S)	3Q/2

space for rough work

3. At t = 0 switch S is closed. Then for current i_1, i_2 and i_3 match the column as mentioned in different conditions.



Column-I		Column-II	
(A)	At t = 0 switch closed	(P)	$i_1 = \frac{50}{11}A,\ i_2 = \frac{30}{11}A,\ i_3 = \frac{20}{11}A$
(B)	At $t \to \infty$ switch remains closed	(Q)	$i_1 = 0,\ i_2 = \frac{20}{11}A,\ i_3 = \frac{20}{11}A$
(C)	At $t \to \infty$ when switch just reopened	(R)	$i_1 = i_2 = \frac{10}{3},\ i_3 = 0$
(D)	At t = ln 2 switch remains closed.	(S)	$i_1 = \frac{130}{33},\ i_2 = \frac{100}{33}A,\ i_3 = \frac{10}{11}A$

4. A wheel of radius R is rolling without slipping on a rough horizontal surface whose velocity of centre is V towards right and remains constant. Column-I indicates the magnitude of the acceleration of particles of the wheel and Column-II indicates the particle and reference.

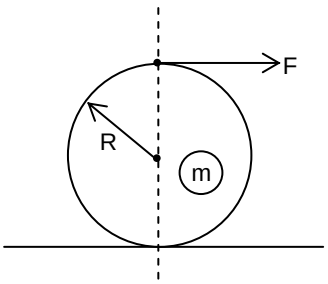
Column-I		Column-II	
(A)	$\frac{V^2}{R}$	(P)	Any point on the outer periphery.
(B)	$\frac{2V^2}{R}$	(Q)	Centre of the wheel.
(C)	$\sqrt{2}\frac{V^2}{R}$	(R)	Left most point with respect to the lowest point.
(D)	Zero	(S)	Right most point with respect to the lowest point.
		(T)	Top most point with respect to the lowest point.

PART – C

(Numerical Based)

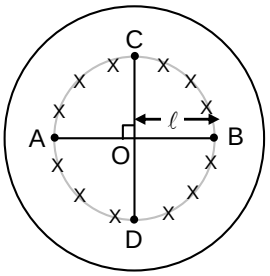
This section contains 06 **multiple choice questions**. The answer to each question is a single digit integer, ranging from 0 to 9 (both inclusive)

1. A tangential force F acts at the top of a thin spherical shell of mass m and radius R. If it rolls without slipping then acceleration is given by $a = \frac{xF}{5m}$. What is the value of x?

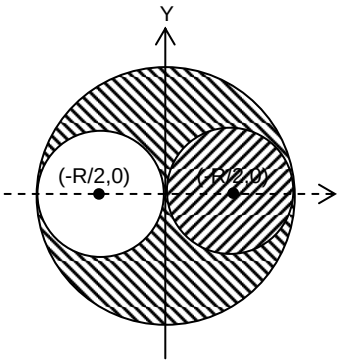


space for rough work

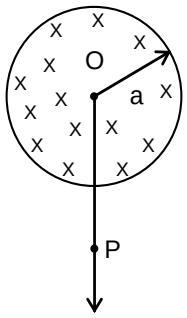
2. A massless non-conducting rod AB of length 2ℓ is placed n uniform time varying magnetic field confined in a cylindrical region of radius R > ℓ as shown. The centre of the rod coincides with the centre of the cylindrical region. The rod can freely rotate in the plane of the figure about an axis coinciding with the axis of the cylinder. Two particles each of mass M and charge q are attached to the ends A and B of the rod. The time varying magnetic field in this cylindrical region is given by $B = B_0\left[1-\frac{t}{2}\right]$ where B_0 is a constant. The field is switched on at time t = 0 consider B_0 = 100 T, ℓ = 4 cm, $\frac{q}{m}=\frac{4\pi}{100}$ c / kg. Calculate the time in which the rod will reach position CD shown in figure for the first time.



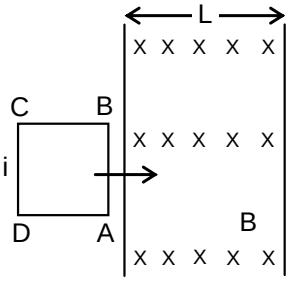
3. Figure shows a uniform disc of radius R from which a hole of radius R/2 has been cut out from left of the centre and is placed on right of the centre of disc. The centre of mass of resulting disc is at a distance R/n from centre of uniform disc. Find the value of n



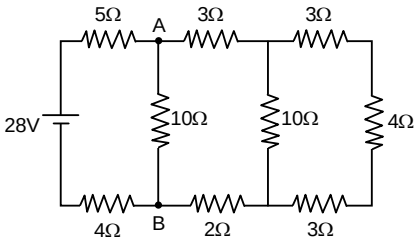
4. There exists a uniform magnetic field perpendicular to the plane of the figure in a cylindrical region of radius a. The magnetic field is increasing at a constant rate of α T/s. A particle having charge q is at a point P outside the field region. The particle is slowly moved to infinity. Calculate work done by the external agent on the particle if the particle is moved in radial direction OP.



5. A region of width L contains a uniform magnetic field B directed into the plane of the figure. A square conducting loop of side length ℓ(<L) is kept with it's side AB at the boundary of the field region. The loop is pushed into the field region with a speed such that it just manages to exit the field region calculate the time needed for the entire loop to enter the field region after it is pushed. Mass and resistance of the loop is M & R respectively. (it is given that $B^2\ell^2$ = MR ln2)



6. Consider the circuit shown in the figure. Find the current (in A) in the 5Ω resistor.



space for rough work