FIITJEE

ALL INDIA INTERNAL TEST SERIES

CHEMISTRY, MATHEMATICS & PHYSICS

SET – A

APT - 3 | **113240** | **Ai²TS-3**

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. Consider the following cases
   I. 2 M CH_3COOH solution is benzene at 27^oC where there is dimer formation to the extent of 100%.
   II. 0.5 M KCl aq. solution at 27^oC which ionizes 100%.
   Which is/are true statement(s)
   (A) both are isotonic (B) I is hypertonic
   (C) II is hypotonic (D) None is correct

2. The heat of dissociation for acetic acid, using the data
   $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O \quad \Delta H = -13.2 KCal$
   $H^+ + OH^- \longrightarrow H_2O \quad \Delta H = -13.7 KCal$
   Is $q \times 10^{-1}$. The value of q is
   (A) 3 (B) 4
   (C) 5 (D) 6

3. Which of the following metal chloride does not perform the chromyl chloride test?
   (A) NH_4Cl (B) $FeCl_3$
   (C) $BaCl_2$ (D) $HgCl_2$

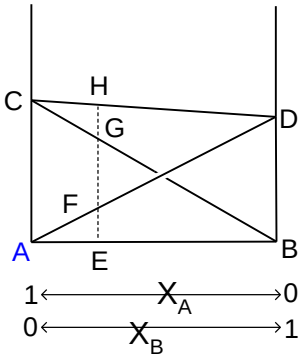
4. Which stoichiometric defect is shown by AgBr?
   (A) Schottky defect (B) Frenkel defect
   (C) Both A & B (D) None of these

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. Based on the given diagram, which of the following statements regarding the solutions of two miscible volatile liquids are correct?



(A) Plots AD and BC show the Raoult's law is obeyed for the solution in which B is a solvent and A is solute and as well as for that in which A is solvent and B is solute.
(B) Plots CD shows that Dalton's law of partial pressure is obeyed by the binary solutions of components A and B.
(C) RF + EG = EH and AC and BD corresponds to the vapour pressure of pure solvent A and B respectively
(D) As B is added to the components A, vapour pressure of A as well as of B changes

6. Select the correct statements about Ag^+/Ag electrodes.
(A) $E_{Ag^+/Ag} = E^0_{Ag^+/Ag} + \frac{0.0591}{n}\log\left[Ag^+\right]$
(B) Addition of CN^- in Ag^+/Ag electrode shows a decrease in the value of $E_{Ag^+/Ag}$
(C) Addition of CN^- in Ag^+/Ag electrode shows an increase in the value of $E_{Ag^+/Ag}$
(D) Addition of CN^- in Ag^+/Ag electrode shows a decrease in E^0_{Ag/Ag^+} and an increase in $E^0_{Ag^+/Ag}$

7. In hcp system of crystals if 'r' is the radius of each sphere, there which are correct?
(A) The number of atoms in this hcp unit cell is 6
(B) The area of the base of this hcp unit cell is $6\sqrt{3}r^2$
(C) The volume of this hcp unit cell is $24\sqrt{2}\,r^3$
(D) The height of this hcp unit cell is $\sqrt{\frac{32}{3}}\,r$

8. Which are buffer mixtures?
(A) H_3BO_3 and borax
(B) NaOH and $NaNO_3$
(C) CH_3COONa and CH_3COOH
(D) NH_4OH and NH_4Cl

9. $HgCl_2$ is prepared by reaction between
(A) HgS and aqua regia
(B) Hg and heated chlorine
(C) Hg_2Cl_2 and heated Hg
(D) Hg_2Cl_2 and dil. HCl

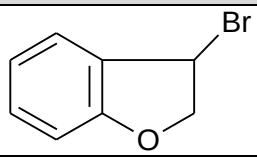
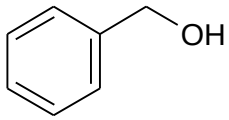
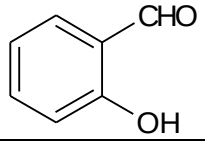
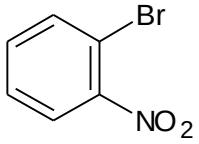
10. $(SiH_3)_3N$ is a weaker base than $(CH_3)_3N$ because
(A) in $(SiH_3)_3N$, lone pair of electrons and nitrogen is involved in $d\pi$-$p\pi$ bonding
(B) in $(CH_3)_3\ddot{N}$, steric effect of three alkyl groups make is least basic
(C) lack of d-orbitals over C in CH_3
(D) All the above

Space for rough work

PART – B

(*Matrix Match Type*)

1. Match the Columns

Column – I		Column – II	
(A)		(P)	Nucleophilic substitution
(B)		(Q)	Elimination
(C)		(R)	Nucleophilic addition
(D)		(S)	Esterification with acetic anhydride
		(T)	Dehydrogenation

2. Match the Columns

Column – I		Column – II	
(A)	Isothermal process(reversible)	(P)	$W = 2.303\ nRT \log \frac{P_1}{P_2}$
(B)	Adiabatic process	(Q)	PV^{γ} = constant
(C)	$W = \frac{nR}{\gamma - 1}(T_2 - T_1)$	(R)	$W = 2.303\ nRT \log \frac{V_2}{V_1}$
(D)	Irreversible isothermal process	(S)	$W = -P_{ex}(V_2 - V_1)$

Space for rough work

3. Match the Columns

Column – I		Column – II (ΔT_b in terms of K_b)	
(A)	1 molal KCl solution with 100% ionization	(P)	1.5 Kb
(B)	1 molal K_2SO_4 with 95% ionization	(Q)	2.0 Kb
(C)	1 molal $K_4[Fe(CN)_6]$ solution with 50% ionization	(R)	2.5 Kb
(D)	1 molal iron(III) sulphate solution with 25% ionisation	(S)	3.0 Kb

4. Match the Columns

Column – I		Column – II	
(A)	Fe^{3+}, Zn^{2+}, Cu^{2+} can be separated by	(P)	KI solution
(B)	PbS, CuS and CdS dissolve in	(Q)	Alkaline Na_2SnO_2
(C)	Pb^{2+} gives yellow ppt with	(R)	50% HNO_3
(D)	Bi^{3+} gives a black ppt with	(S)	K_2CrO_4 solution
		(T)	Aqueous NH_3

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. One mole of an ideal gas is expanded isothermally and reversibly at 298 K until its volume is quadrupled. What is the entropy change of the universe?

2. For an electrochemical cell
Pt | H_2(1 atm) | BOH(0.1 M) || Ha (0.1 M) | H_2(1 atm) | Pt
E_{Cell} is 0.48 V at 25°C
[Given K_B(BOH) = 10^{-5} K_a Ha = 10^{-x} K_W = 10^{-14}]
What is the numerical value of x?

3. Among PbS, CuS, HgS, Ag_2S, CoS, NiS, Bi_2S_3 and SnS_2, the total number of black coloured sulphide is

4. The ratio of coordination no. of Al and no. of Al atoms per unit cell in fcc lattice is

5. How many of the following are co-polymers
Buna-S, Nylon-6, Polystyrene, Nylon-2-Nylon-6, Bakelite, PVC, Teflon, Neoprene

6. A 0.1 M monobasic acid has osmotic pressure equal to 2.69 atm at 25°C. What will be its pH.

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. The mirror image of the parabola $y^2 = 4x$ in the tangent to the parabola at the point (1, 2) is:

(A) $(x-1)^2 = 4(y+1)$ (B) $(x+1)^2 = 4(y+1)$

(C) $(x+1)^2 = 4(y-1)$ (D) $(x-1)^2 = 4(y-1)$

2. If $\Delta(x) = \begin{vmatrix} x & 1+x^2 & x^3 \\ \log(1+x^2) & e^x & \sin x \\ \cos x & \tan x & \sin^2 x \end{vmatrix}$, then:

(A) $\Delta(x)$ is divisible by x (B) $\Delta(x) = 0$

(C) $\Delta'(x) = 0$ (D) none of these

3. If A is a square matrix, then $\text{adj}\,A^T - (\text{adj}\,A)^T$ is equal to:

(A) $2|A|$ (B) $2|A|I$

(C) null matrix (D) unit matrix

4. $f(x) = \int_0^x (e^t - 1)(t-1)(\sin t - \cos t)\sin t\,dt, \forall x \in \left(-\frac{\pi}{2}, 2\pi\right)$, then $f(x)$ is decreasing in:

(A) $\left(-\frac{\pi}{2}, 0\right) \cup \left(\frac{\pi}{4}, 1\right) \cup \left(\pi, \frac{\pi}{4}\right)$ (B) $\left(-\frac{\pi}{2}, \frac{\pi}{4}\right) \cup (1, \pi) \cup \left(\frac{5\pi}{4}, 2\pi\right)$

(C) $\left(\frac{\pi}{4}, 1\right) \cup \left(\pi, \frac{5\pi}{4}\right)$ (D) $\left(0, \frac{\pi}{4}\right) \cup (1, \pi) \cup \left(\frac{5\pi}{4}, 2\pi\right)$

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. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be vectors forming right hand triad. Let $\vec{p}=\frac{\vec{b}\times\vec{c}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}$, $\vec{q}=\frac{\vec{c}\times\vec{a}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}$ and $\vec{r}=\frac{\vec{a}\times\vec{b}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}$. If $x\in R^+$, then

(A) $x\left[\vec{a}\ \vec{b}\ \vec{c}\right]+\frac{\left[\vec{p}\ \vec{q}\ \vec{r}\right]}{x}$ has least value 2

(B) $x^4\left[\vec{a}\ \vec{b}\ \vec{c}\right]^2+\frac{\left[\vec{p}\ \vec{q}\ \vec{r}\right]}{x^2}$ has least value $\left(\frac{3}{2^{\frac{2}{3}}}\right)$

(C) $\left[\vec{p}\ \vec{q}\ \vec{r}\right]>0$

(D) none of the above

6. If $ax^2+(b-c)x+a-b-c=0$ has unequal real roots for all $c\in R$, then:

(A) $b<0<a$ (B) $a<0<b$

(C) $b<a<0$ (D) $b>a>0$

7. If $2\cos\theta=x+\frac{1}{x}$ and $2\cos\phi=y+\frac{1}{y}$, then:

(A) $\frac{x}{y}+\frac{y}{x}=2\cos(\theta-\phi)$ (B) $x^my^n+\frac{1}{x^my^n}=2\cos(m\theta+n\phi)$

(C) $\frac{x^m}{y^n}+\frac{y^n}{x^m}=2\cos(m\theta-n\phi)$ (D) $xy+\frac{1}{xy}=2\cos(\theta+\phi)$

8. The value of the determinant $\begin{vmatrix}\sqrt{6} & 2i & 3+\sqrt{6}\\ \sqrt{12} & \sqrt{3}+\sqrt{8}\,i & 3\sqrt{2}+\sqrt{6}\,i\\ \sqrt{18} & \sqrt{2}+\sqrt{12}\,i & \sqrt{27}+2i\end{vmatrix}$, where $i=\sqrt{-1}$, is

(A) complex (B) real

(C) irrational (D) rational

9. If $\lim\limits_{x\to1}\left(2-x+a[x-1]+b[1+x]\right)$ exists, then a and b can take the values (where [.] denotes the greatest integer function):

(A) $a=\frac{1}{3}, b=1$ (B) $a=1, b=-1$

(C) $a=9, b=-9$ (D) $a=2, b=\frac{2}{3}$

10. Suppose p, q, r, s $\in N$ and $p\ge q\ge r$. If $5^{\log_5(2^p)}+7^{\log_7(2^q)}+11^{\log_{11}(2^r)}=2^s$ then

(A) $q=p-1$ (B) $r=p-1$

(C) $s=p+1$ (D) $s=q+r$

Space for rough work

PART – B

(*Matrix Match Type*)

1. Let $F(x)=\int_0^x (t-1)(t-2)^2\,dt$

Column-I		Column-II	
(A)	The point of minimum of F lie in	(P)	$(0,\infty)$
(B)	F increases on	(Q)	(0, 2)
(C)	F decreases on	(R)	$[1,\infty)$
(D)	If $F(x)\geq K$ for all x for some K, then K lies in	(S)	(–4, –1)

2. Let $y=f(x)$ be the solution of $\frac{dy}{dx}=\frac{y}{x}+\tan\frac{y}{x}$, $y(1)=\frac{\pi}{2}$, then

Column-I		Column-II	
(A)	f is defined on	(P)	$\left[-\frac{1}{2},\frac{1}{2}\right]$
(B)	The range of f contains	(Q)	$[-1,1]$
(C)	f is continuous on	(R)	$\left[-\frac{\pi}{2},\frac{\pi}{2}\right]$
(D)	$f<2$ on	(S)	[0, 1]

Space for rough work

3. Match the following

Column-I		Column-II	
(A)	If $\left\|\vec{a}+\vec{b}\right\|=\left\|\vec{a}+2\vec{b}\right\|$, then angle between $\vec{a}$ and $\vec{b}$ is	(P)	90^o
(B)	If $\left\|\vec{a}+\vec{b}\right\|=\left\|\vec{a}-2\vec{b}\right\|$, then angle between $\vec{a}$ and $\vec{b}$ is	(Q)	obtuse
(C)	If $\left\|\vec{a}+\vec{b}\right\|=\left\|\vec{a}-\vec{b}\right\|$, then angle between $\vec{a}$ and $\vec{b}$ is	(R)	0^o
(D)	Angle between $\vec{a}\times\vec{b}$ and a vector perpendicular to the vector $\vec{c}\times\left(\vec{a}\times\vec{b}\right)$ is	(S)	acute

4. A man takes a step forward with probability 0.4 and backward with probability 0.6. Suppose the man takes 11 steps and p_r denotes the probability that the man is r steps away from his initial position, then value of:

Column-I		Column-II	
(A)	p_1	(P)	0
(B)	p_3	(Q)	${}^{11}C_5(0.24)^5$
(C)	p_{10}	(R)	$(0.4)^{11}+(0.6)^{11}$
(D)	p_{11}	(S)	${}^{11}C_4(0.24)^4(0.28)$

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 $\frac{3iz_2}{5z_1}$ is purely real, then $5\left|\frac{3z_1+7z_2}{3z_1-7z_2}\right|$ is _____

2. The number of integral values of α for which the point $(\alpha-1, \alpha+1)$ lies in the larger segment of the circle $x^2+y^2-x-y-6=0$ made by chord whose equation is $x+y-2=0$ is ____

3. The least possible positive value of a for which $\frac{x^3-6x^2+11x-6}{x^3+x^2-10x+8}+\frac{a}{30}=0$ does not have a real solution is

4. If $\int\frac{5x^4+4x^5}{\left(x^5+x+1\right)^2}dx=f(x)+C$, then the value of $\frac{1}{f(1)}$ is _____

5. Find the area bounded by the x – axis, part of the curve $y=1+\left(\frac{8}{x^2}\right)$ and the ordinates at $x=2$ and $x=4$. If the ordinates at x = a divides the area into two equal parts, then the value of a^2 is _____

6. The points with position vectors $10\hat{i}+3\hat{j}, 12\hat{i}-5\hat{j}$ and $a\hat{i}+11\hat{j}$ are collinear if a equals ____

space for rough work

Section – III (PHYSICS)

PART – A

(Single Correct Choice Type)

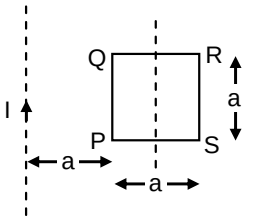
This section contains 4 **multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. A metal disc of radius a rotates with a constant angular velocity ω about its axis. The potential difference between the centre and rim of the disc is (m = mass of electron, e = charge on electron)

(A) $\frac{m\omega^2a^2}{e}$ (B) $\frac{1}{2}\frac{m\omega^2a^2}{e}$

(C) $\frac{e\,\omega^2a^2}{2m}$ (D) $\frac{e\,\omega^2a^2}{m}$

2. In the figure shown a square loop PQRS of side a and resistance r is placed near an infinitely long wire carrying a constant current I. The sides PQ and RS are parallel to the wire. The wire and the loop are in the same plane. The loop is rotated by 180° about an axis parallel to the long wire and passing through the mid points of the side QR and PS. The total amount of charge which passes through any point of the loop during rotation is



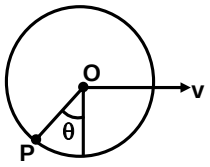
(A) $\frac{\mu_o Ia}{2\pi r}\ln 2$

(B) $\frac{\mu_o Ia}{\pi r}\ln 2$

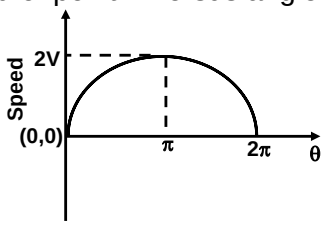
(C) $\frac{\mu_o Ia^2}{2\pi r}$

(D) cannot be found because time of rotation not given.

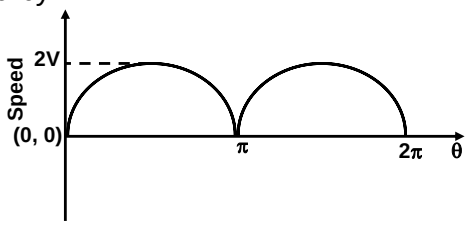
3. A ring is rolling without slipping on a horizontal surface. The velocity of centre of mass is V. A point P on the circumference of the ring makes an angle θ with the downward vertical as represented in the figure. The speed of point P versus angle θ is best represented by



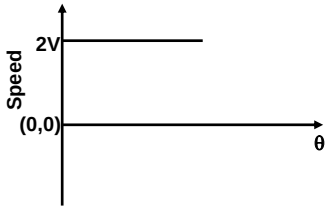
(A)



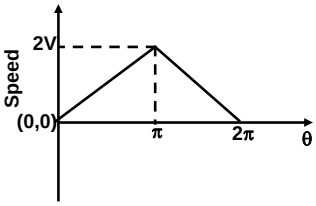
(B)



(C)

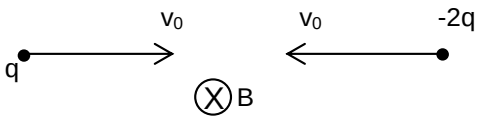


(D)



Space for rough work

4. A charge particle q of mass m is placed at a distance d from another charge particle – 2q of mass 2m in a uniform magnetic field B as shown. If particles are projected towards each other with equal speed v_0, so that the two particles touches each other without collision during its motion. (Assume only force due to magnetic field acts on the particle) find v_o



(A) $\frac{qBd}{m}$ (B) $\frac{qBd}{2m}$

(C) $\frac{2qBd}{m}$ (D) $\frac{3qBd}{2m}$

(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 horizontal disc rotates freely about a vertical axis through its centre. A ring, having the same mass and radius as the disc, is now gently placed on the disc. After some time, they rotate with a common angular speed.

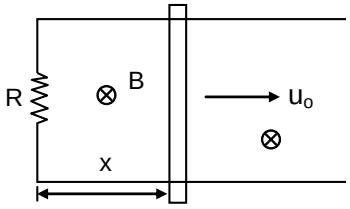
(A) some friction exists between the disc and the ring.

(B) the angular momentum of the disc plus ring is conserved.

(C) the final common angular speed is $\frac{2}{3}$ rd of the initial angular velocity of the disc.

(D) $\frac{2}{3}$ rd of the initial kinetic energy changes to heat.

6. 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.

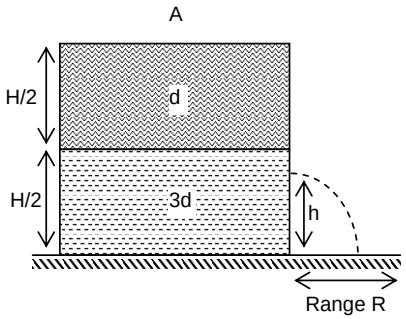
(B) If applied external force is doubled then a part of external power increase the velocity of rod.

(C) Lenz's law is not satisfied for direction of current in loop.

(D) If resistance R is doubled then power required to maintain the constant velocity v_0 becomes half.

Space for rough work

7. A container of large uniform cross sectional area A resting on a horizontal surface holds two immiscible non viscous and incompressible liquids of density d and 3d, each of height H/2. The lower density liquid is open to the atmosphere having pressure P_0. A tiny hole of area a(a<<A) is punched to the vertical side of lower container at a height h (0<h<H/2) for which range is maximum.



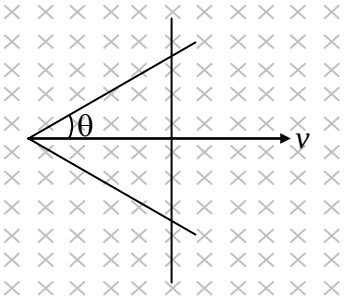
(A) h = H /3

(B) Range R = $\frac{2H}{3}$

(C) Range R = $\frac{3H}{2}$

(D) Velocity of efflux $v = \sqrt{\frac{2}{3}gH}$

8. Two straight conducting rails form a right angle where their ends are joined. A conducting bar in contact with the rails start at the vertex at $t = 0$ and moves with a constant velocity v along them as shown. A magnetic field B is directed into the page. The induced emf in the circuit at any time t is proportional to



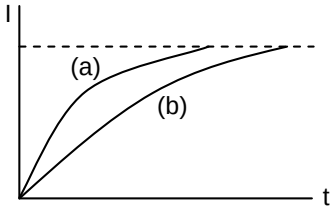
(A) t^0

(B) t

(C) v

(D) v^2

9. A circuit consisting of a constant emf 'E', a self-inductance 'L' and a resistance 'R'. Graph of current with time t is as shown by curve 'a' in the figure. When one or more of parameters E, R and L are changed, the curve 'b' is obtained. The steady state current is same in both the cases. Then, it is possible that



(A) E & R are kept constant and L is increased.
(B) E & R are kept constant and L is decreased.
(C) E & R are both halved and L is kept constant.
(D) E & R are doubled and L is constant.

10. A positive charge is passing through an electromagnetic field in which $\vec{E}$ & $\vec{B}$ are directed towards y-axis & z-axis respectively. If a charge particle passes through the region undeviated, then its velocity is/are represented by (here a, b & c are constant)

(A) $\vec{v} = \frac{E}{B}\hat{i} + a\hat{j}$

(B) $\vec{v} = \frac{E}{B}\hat{i} + b\hat{k}$

(C) $\vec{v} = \frac{E}{B}\hat{i} + c\hat{i}$

(D) $\vec{v} = \frac{E}{B}\hat{i}$

Space for rough work

PART – B

(*Matrix Match Type*)

1. Which of the effect (s) given in column -II will be produced by a loop mentioned in column -I

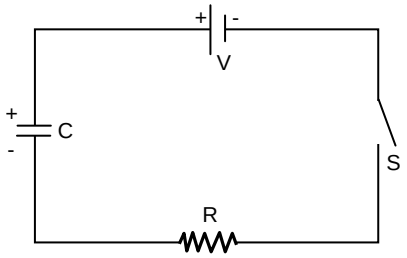
Column-I		**Column-II**	
(A)	Stationary dielectric ring having uniform charge	(P)	electric field
(B)	Dielectric ring having uniform charge is rotating with constant angular velocity	(Q)	magnetostatic field
(C)	A constant current I_0 in the loop	(R)	time dependent induced electric field outside the loop
(D)	Time varying sinusoidal current in the loop $I = I_0 \cos \omega t$	(S)	magnetic moment in the loop

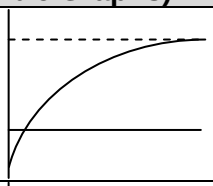
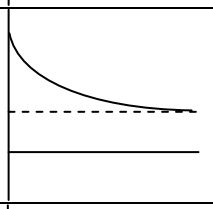
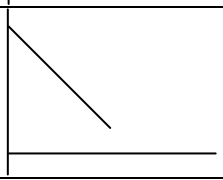
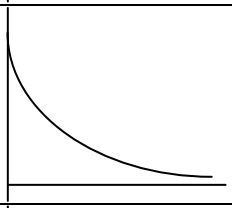
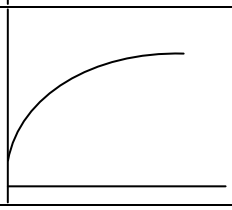
2. Column – I gives situations involving a charged particle which may be realized under the conditions given in Column – II. Match the situations in Column – I with the condition in Column – II.

Column – I		**Column – II**	
(A)	Increase in speed of a charged particle.	(P)	Electric filed uniform in space and constant in time.
(B)	Exert a force on an electron initially at rest.	(Q)	Magnetic field uniform in space and constant in time.
(C)	Move a charged particle in circle with uniform speed	(R)	Magnetic field uniform is space but varying with time.
(D)	Accelerate a moving charged particle	(S)	Magnetic field non-uniform in space but constant with time insufficient in formation decide.

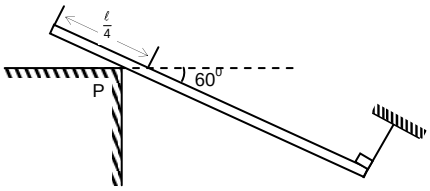
Space for rough work

3. In the circuit shown, initially capacitor C has some charge q_0 (less than CV), the switch S is closed at t = 0. Match the variables given in column – I with possible graph shown in column – II



Column – I (Variables)		Column – II (Possible Graphs)	
(A)	Charge versus time	(P)	
(B)	Current versus time	(Q)	
(C)	Charge versus current	(R)	
(D)	Energy stored in capacitor versus time	(S)	
		(T)	

4. A uniform rod of mass m and length ℓ is in equilibrium under the action of contact forces, gravity and tension in string as shown in the figure.



Column – I		Column – II	
(A)	The tension is the sting is	(P)	$\frac{2mg}{7}$
(B)	The frictional force acting on the rod is	(Q)	$\frac{mg}{3}$
(C)	If the string is cut, then just after it normal reaction on the rod is	(R)	$\frac{mg}{6}$
(D)	Just before the string is cut, the normal reaction on the rod is	(S)	$\frac{\sqrt{3}\,mg}{2}$

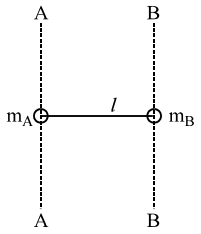
Space for rough work

PART – C

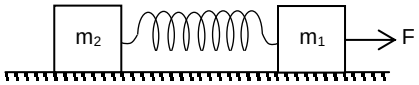
(Numerical Based)

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

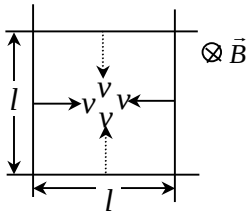
1. A point mass m_A is connected to a point mass m_B by a massless rod of length *l* as shown in the figure. It is observed that the ratio of the moment of inertia of the system about the two axes BB and AA, which is parallel to each other and perpendicular to the rod is $\frac{I_{BB}}{I_{AA}} = 3$. The distance of the centre of mass of the system from the mass A is l/K. find K.



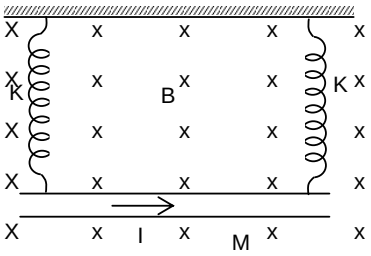
2. Two blocks of masses m_1 = 1kg and m_2 = 2kg are connected by a non deformed light spring. They are lying on a rough horizontal surface. The coefficient of friction between the blocks and the surface is 0.4, what minimum constant force F (In N) has to be applied in horizontal direction to the block of mass m_1 in order to shift the other block? (g = 10 m/s^2)



3. In the figure shown the four rods have λ = 0.5 Ω/m resistance per unit length. The arrangement is kept in a magnetic field of constant magnitude B = 2T and directed perpendicular to the plane of the figure and directed inwards. Initially the rods form a square of side length l = 15m as shown. Now each wire starts moving with constant velocity v = 5 m/s towards opposite wire. The force required in newton on each wire to keep its velocity constant at t = 1 sec is 100 K. The value of 'K' is

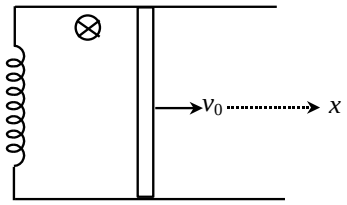


4. A metal rod of mass 10gm and length 25 cm is suspended on two springs as shown in figure. The springs are extended by 4 cm. When a 20 ampere current passes through the rod it rises by 1 cm. The magnetic field is x × 10^{-2} T (g = 10 m/s^2). Find the value of 2x.



5. A uniform disc of radius R having charge Q distributed uniformly all over its surface is placed on a smooth horizontal surface. A magnetic field, B = kxt^2, where k is a constant, x is the distance (in metre) from the centre of the disc and t is the time (in second), is switched on perpendicular to the plane of the disc. Find the torque (in N-m) acting on the disc after 15 sec. (Take 4kQ = 1 S.I. unit and R=1 m)

6. A loop is formed by two parallel conductors connected by a solenoid with inductance L = 2H and a conducting rod of mass m = 8kg which can freely (without friction) slide over the conductors. The conductors are located in a horizontal plane and in a uniform vertical magnetic field B= πT. The distance between the conductors is l = 2m. At the moment t = 0, the rod is imparted on initial velocity v0 = 2m/s directed to the right. Find the time period of oscillation of rod in sec if the resistance of loop is negligible.



Space for rough work