BATCH – AII 1820

PHYSICS, CHEMISTRY & MATHEMATICS

CPT2 | **CODE:** | **PAPER - 1**

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

- 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.

INSTRUCTIONS

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

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Sections.
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. Each section is further divided into three parts: **Part-A, B & C**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. 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 ***Blue/Black Ball Point Pen*** 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 **– 2 mark** for wrong answer.

(ii) **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.

(iii) **Part-B (01 - 04)** contains 4 Matrix Match Type question containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+8 marks** for all correct answer. For each correct row **+2 mark** will be awarded. There may be one or more than one correct choice. No marks will be given for any wrong match in any question. There is no negative marking

(iv) **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 the Candidate :_____

Batch :_____ **Date of Examination :**_____

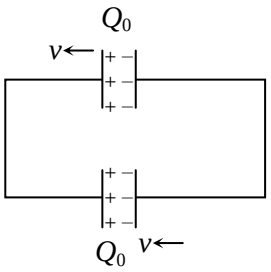
Enrolment Number :_____

SECTION-I: PHYSICS

Part-A: Only One Option Correct Type

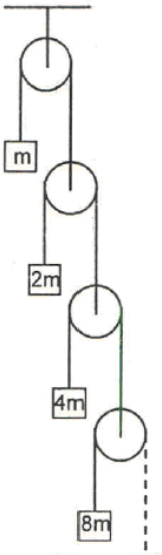
This section contains **4 Multiple Choice Questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **Only One Option is correct.**

1. Two identical capacitor connected as shown and having initial charge Q_0 each. Separation between plates of capacitor is d. Suddenly the left plate of upper capacitor and right plate of lower capacitor start moving with speed v towards left while other plate of capacitor remains fixed. The current in the circuit is



(A) $\frac{Q_0 v}{2d}$ (B) $\frac{Q_0 v}{d}$ (C) $\frac{Q_0 vt}{2d}$ (D) zero

2. Consider a system of infinite pulleys and blocks as shown. Every next block is twice heavier than the previous one. All pulleys and strings involved are ideal. System is released from rest. The acceleration of block of mass m is



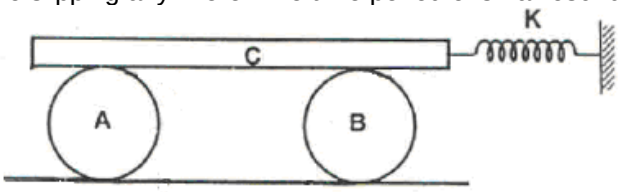
(A) $\frac{3g}{2}$

(B) $\frac{g}{2}$

(C) g

(D) $\frac{3g}{4}$

3. A is uniform solid cylinder, B is uniform thin hollow cylinder. Both have same mass and same radius. C is a uniform plank. A, B and C each have same mass equal to m. Friction is sufficient so that there is no slipping anywhere. The time period of small oscillations of the above system is



(A) $T = 2\pi\sqrt{\frac{15m}{8K}}$ (B) $T = 2\pi\sqrt{\frac{15m}{4K}}$ (C) $T = 2\pi\sqrt{\frac{5m}{K}}$ (D) $T = 2\pi\sqrt{\frac{5m}{8K}}$

space for rough work

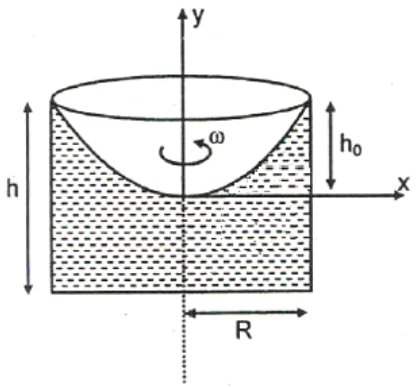
4. On heating water, bubbles being formed at the bottom of the vessel detach and rise. Take the bubbles to be spheres of radius R and making a circular contact of radius r with the bottom of the vessel. If r << R and the surface tension of the water is T, value of r just before bubbles detach is (density of water is ρ)

(A) $R^2\sqrt{\frac{\rho g}{3T}}$ (B) $R^2\sqrt{\frac{\rho g}{6T}}$ (C) $R^2\sqrt{\frac{2\rho g}{3T}}$ (D) $R^2\sqrt{\frac{3\rho g}{T}}$

Part-A: One or More Than One Options Correct Type

This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. Ideal liquid of density ρ is filled in a cylindrical container upto $(3/4)^{th}$ height. Now the liquid is being rotated about vertical axis passing through its axis of symmetry with constant angular velocity ω, such that liquid is on the verge of falling out of the container and free surface of liquid forms a paraboloid. Whole situation is shown in the figure. Choose the correct option(s).

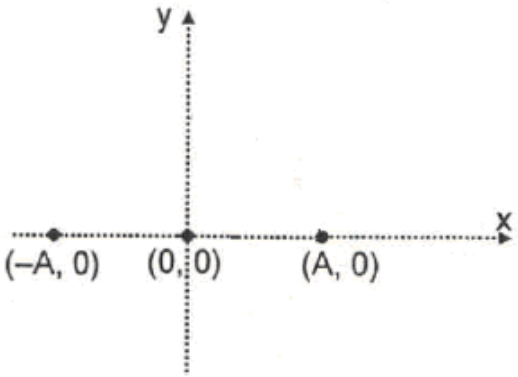


(A) $h_o = \frac{h}{2}$ (B) $\omega = \sqrt{\frac{gh}{R^2}}$ (C) $\frac{dp}{dx} = \rho\omega^2 x$ (D) $\frac{dp}{dy} = \rho g$

6. A charged particle (+q) is moving simple harmonically on the x-axis with its mean position at origin. Amplitude of the particle is A and its angular frequency is ω. Then choose the correct option(s).

(A) The magnitude of magnetic field at (2A, 0) will change periodically with period $2\pi/\omega$.

(B) The maximum magnitude of the magnetic field at (0, A) is $\frac{\mu_0}{4\pi}, \frac{q\omega}{A}$



(C) The magnetic field at (A, A) at the moment the particle passes through $\left(\frac{A}{2}, 0\right)$, will be $\frac{\sqrt{3}\cdot\mu_0 q\omega}{5\sqrt{5}\,\pi A}$

(D) The magnitudes of magnetic field at (0, A) and (0, –A) will be same at any time.

space for rough work

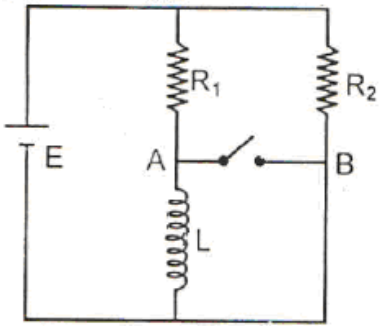
7. In a radioactive decay reaction:

$$A \xrightarrow[2\lambda]{} B \xrightarrow[9\lambda]{} C$$

Select correct alternative/s at the instant the number of particles of B is maximum:

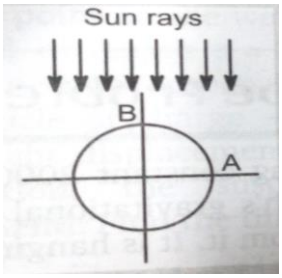
(A) activity of A is equal to activity of B
(B) no. of atoms of A is 4.5 times of B
(C) activity of A is more than activity of B
(D) activity of A is minimum

8. In the circuit shown below the switch between A & B is closed at t = 0, then choose the correct option(s). (Consider circuit to be in steady) state at t < 0)



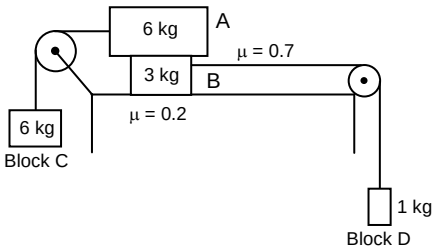
(A) Current through R_1 and R_2 will not change just after the switch is closed.
(B) Current through R_1 and R_2 will change just after switch is closed.
(C) Current through L will be different at both instants, i.e., just after switch is closed and after long time
(D) Current through R_2 will be same at $t < 0$ and $t \to \infty$

9. A particle B is moving in a vertical circle of radius a in anticlockwise direction with constant time period T. Another particle A is undergoing SHM on it's horizontal diameter with amplitude a and same time period T. A is initially at it's right extreme and B is at topmost point as shown. Sun is directly overhead. The shadow of B first fall on A at time t_1 and the acceleration of B first point directly towards A at time t_2. The value of t_1 and t_2 are respectively



(A) $t_1 = \frac{7T}{8}$ (B) $t_2 = \frac{T}{4}$ (C) $t_1 = \frac{5T}{8}$ (D) $t_2 = T$

10. An arrangement of the masses and pulleys is shown in the figure. Strings connecting masses A and B with pulleys are horizontal and all pulleys and strings are light. Friction coefficient between the surface and the block B is 0.2 and between blocks A and B is 0.7. If the system is released form rest (use g = 10 m/s^2)

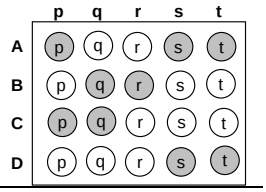


(A) magnitude of acceleration of the system is 2 m/s^2 and there is no slipping between block A and Block B.
(B) magnitude of friction force between block A and block B is 42 N.
(C) acceleration of block C is 1 m/s^2 downwards.
(D) tension in the string connecting block B and block D is 12 N.

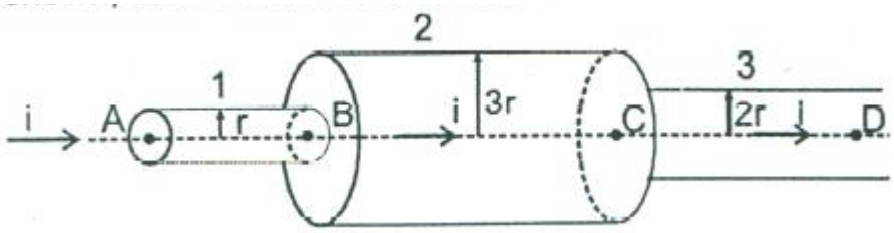
space for rough work

Part-B: Matrix-Match Type Questions

This Section contains **4 Matrix Match Type Questions.** Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.



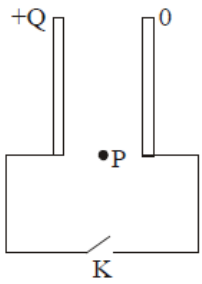
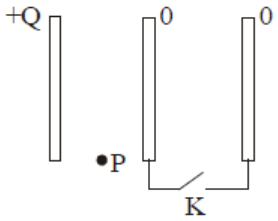
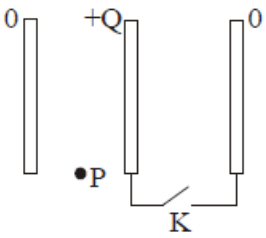
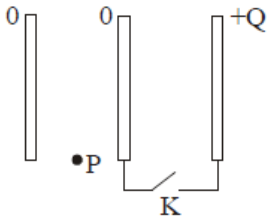
1. Three metallic bars 1, 2, 3 are arranged as shown in figure, with number of free charge carriers in ratio $N_1 : N_2 : N_3 = 1 : 3 : 2$; resistivity ratio $p_1 : p_2 : p_3 = 2 : 1 : 3$; lengths in ratio $\ell_1 : \ell_2 : \ell_3 = 2 : 2 : 3$ for 1, 2 and 3 bars respectively (radius of cross-section shown in figure), carry current I as shown, then match the columns:



Column - I		Column – II	
(A)	If P_1, P_2 and P_3 are power dissipated across AB, BC and CD then $\frac{P_2P_3}{P_1^2}$	(P)	$\frac{81}{32}$
(B)	If E_1, E_2 and E_3 are magnitude of Electric-fields across AB, BC and CD then $\frac{E_3^2}{E_1 \cdot E_2}$	(Q)	$\frac{1}{32}$
(C)	If v_{d_1}, v_{d_2} and v_{d_3} are drift speeds in bar AB, BC and CD respectively. Then $\frac{v_{d_2} v_{d_3}}{v_{d_1}}$ equals	(R)	$\frac{1}{4}$
(D)	If V_1, V_2, V_3 are potential differences across AB, BC and CD. Then $\frac{V_2 \cdot V_3}{V_1^2}$	(S)	< 1
		(T)	$\frac{5}{32}$

space for rough work

2. At t = 0, key k is closed, then match the following:

Column-I		Column-II	
(A)		(P)	Charge of magnitude of Q shall pass through key k
(B)		(Q)	Charge of magnitude Q/2 shall pass through key k
(C)		(R)	After key is closed, electric field at P becomes zero.
(D)		(S)	After key is closed, electric field at P is same as before key is closed.
		(T)	No charge flows

space for rough work

3. Match the statements in **Column – I** with the results in **Column – II**

	Column – I		**Column – II**
(A)	A variable resistor is connected across a non ideal cell. As the resistance of the variable resistor is continuously increased from zero to a very large value, the electric power consumed by the variable resistor	(P)	First increases for some time and then decrease
(B)	A circular ring lies in space having uniform and constant magnetic field. Initially the direction of magnetic field is parallel to plane of the ring. Keeping the centre of ring fixed the ring is rotated by 180^0 about one of its diameter with constant angular speed. For the duration the ring rotates, the magnitude of induced emf in the ring.	(Q)	First decreases for some time and then increases
(C)	A thin rod of length 1 cm lies along principal axis of a convex lens of focal length 5 cm near end of rod is at a distance 10 cm from optical centre of the lens. The convex lens is moved (without rotation) perpendicular to initial principal axis by 5 mm and brought back to its initial position. The length of the image of the rod	(R)	Is always constant
(D)	A bulb (of negligible inductance) and a capacitor in series are connected across an ideal ac source of constant peak voltage and variable frequency. As frequency of ac source is continuously increased, the brightness of bulb.	(S)	Increases or may increase over some time interval

4. Ionization energy from first excited state of hydrogen atom is E. Match the following two columns for He^+ atom.

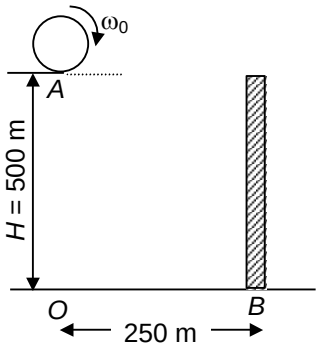
	Column–I		**Column–II**
(A)	Ionization energy from ground state	(P)	4 E
(B)	Electrostatic potential energy in first excited state	(Q)	– 16 E
(C)	Kinetic energy of electron in ground state	(R)	– 8 E
(D)	Ionization energy from first excited state	(S)	16 E

space for rough work

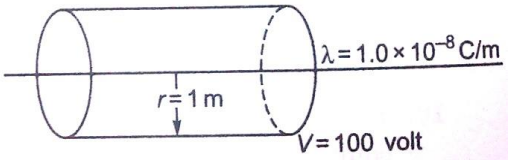
Part –C: Single digit integer

This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

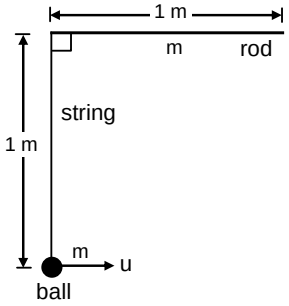
1. A ball of mass 1 kg and radius 10 cm is given an angular velocity 100 rad/s and is then dropped from a height H = 500m from a point A above the ground. The coefficient of restitution for the collision between the ball and the floor is 0.5 and coefficient of friction between the ball and the floor is 1/3. There is a smooth wall at a distance of 250 m from point O (which is vertically below A). The collision between the ball and wall is perfectly elastic. If the height at which the ball hits the wall is $\frac{250}{x}$ find the value 'x'.



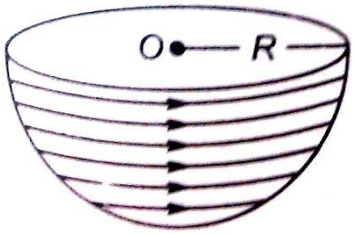
2. A long straight wire carries a charge of 1.0×1.0^{-8} C/m (figure). A coaxial cylindrical equipotential surface, radius 1.0 m, has a potential of 100 V. The radius of the 1000 V equipotential cylinder is e^{-n}. Find the value of n.



3. As situation shown in figure the ball has been given a velocity u. Find the ratio of magnitude of the acceleration of left end of the rod to the magnitude of acceleration of the ball.



4. A wire is wrapped over a hemi-spherical cone of radius R. If N = number of turns and I = current per turn and the induction at O is $\frac{\mu_o Ni}{nR}$, the value of 'n' is



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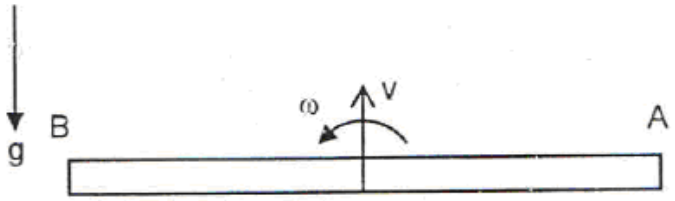
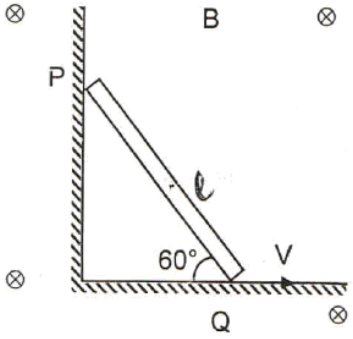
5. Uniform rod mass m and length ℓ initially horizontal, is set in motion such that COM of the rod gets velocity v vertically upward and angular velocity ω such that $\frac{v}{g} = (2n\pi + \pi/2)\frac{1}{\omega}$, where n is an integer. The whole situation is shown in the figure.



Radius of curvature of the path of particle situated at end A when it is at highest point of its path is $R = \frac{\omega^2\ell^2}{\alpha(2g + \omega^2\ell)}$. Here α is an integer. Find α.

6. Consider a conducting rod PQ of length ℓ resting against two perpendicular smooth non conducting walls. Initially rod make angle 60° with horizontal surface. There exist uniform magnetic field directed into the plane of the paper. Now at t = 0 we start pulling end Q of the rod with constant velocity V along horizontal surface. Whole situation is shown in figure. (at t = 0).



At time $t_0 = \frac{\ell}{\alpha V}\left(\sqrt{\alpha} - 1\right)$ emf induced between the ends of the rod PQ is found to be zero. Here α is an integer. Find α.

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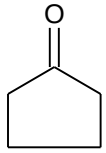
SECTION-II: CHEMISTRY

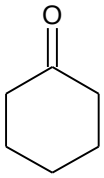
Part-A: Only One Option Correct Type

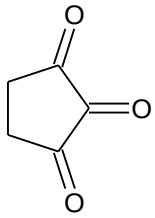
This section contains **4 Multiple Choice Questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **Only One Option is correct.**

1. $nH_2N(CH_2)_6NH_2 + (X) \xrightarrow{\Delta} \text{Nylon } 6,6$

What product is obtained on heating compound(X)

(A) 

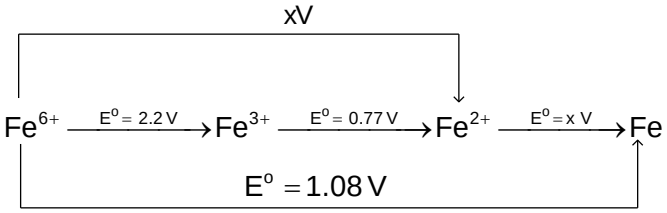
(B) 

(C) 

(D) None of these

2. Lassaigne's test is not used for the detection of the following element

(A) O (B) N (C) S (D) Cl

3. 

What is the value of y and x respectively

(A) 2.77V and –1.89V (B) –1.89V and 2.77V

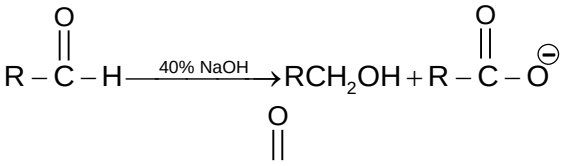
(C) 1.84V and –0.445V (D) –0.445V and 1.84V

4. Glucose and Fructose can be distinguished by

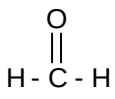
(A) Tollen's reagent (B) HOBr (C) dil HNO_3 (D) All of these

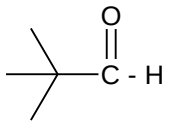
Part-A: One or More Than One Options Correct Type

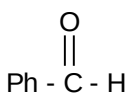
This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

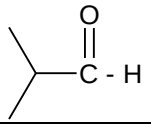
5. 

In the above case $\overset{O}{\overset{\|}{R - C - H}}$ can be

(A) 

(B) 

(C) 

(D) 

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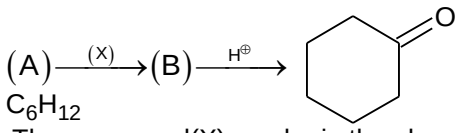
6. 

The compound(X) can be in the above transformation.

(A) Bayer's reagent (B) $OsO_4/NaHSO_3$

(C) $CH_3COOH/H^{\oplus}$ (D) mCPBA, $\overset{\ominus}{O}H$

7. Which of the following compounds are more reactive than $R-\overset{O}{\overset{\|}{C}}-OH$ towards attack of nucleophile?

(A) $R-\overset{O}{\overset{\|}{C}}-Cl$ (B) $R-\overset{O}{\overset{\|}{C}}-CN$

(C) $R-\overset{O}{\overset{\|}{C}}-NH_2$ (D) $R-\overset{O}{\overset{\|}{C}}-H$

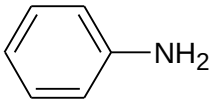
8. Which of the following complexes are outer orbit complexes?

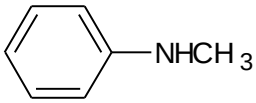
(A) $[Ni(CN)_4]^{2-}$ (B) $[NiCl_4]^{2-}$ (C) $[Ni(CO)_4]$ (D) $[Ni(CN)_6]^{4-}$

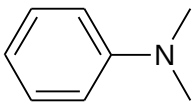
9. Which of the following aqueous solutions will have same nature(acidic, basic or neutral) after electrolysis using inert electrodes as water has at 60°C.

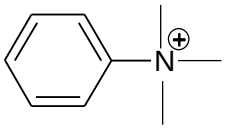
(A) 0.1 M $CuSO_4$ (B) 0.1 M Ag_2SO_4 (C) 0.1 M AgCl (D) 0.1 M Na_2SO_4

10. In which of the following N, N diazo coupling can take place.

(A) 

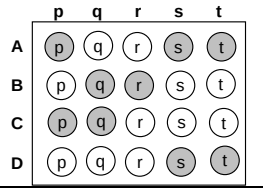
(B) 

(C) 

(D) 

Part-B : Matrix-Match Type Questions

This Section contains **4 Matrix Match Type Questions.** Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.



1. Match the following:

Column – I		Column – II	
(A)	$Na_4[Fe(CN)_5NOS]$	(P)	Phenolic group detection
(B)	$[Fe(H_2O)_5NO]SO_4$	(Q)	Aniline detection
(C)	Neutral $FeCl_3$	(R)	S-detection
(D)	Alkaline β-naphthol	(S)	Brown colour

space for rough work

2. Match the following:

Column – I Compounds		Column – II Properties	
(A)	H_2S	(P)	Oxidation agent
(B)	H_2O_2	(Q)	Reducing agent
(C)	O_3	(R)	Bleaching action due to oxidizing behaviour
(D)	H_2SO_3	(S)	Bleaching action due to reducing behaviour

3. Match the following:

Column – I Compounds		Column – II Properties	
(A)	Aq. Borax	(P)	pH es dilution dependent
(B)	NaH_2PO_4	(Q)	pH es temperature dependent
(C)	Na_2HPO_4	(R)	pH es conc. dependent
(D)	Na_3PO_4	(S)	Act as a Buffer solution

4. Match the following:

Column – I Type of silicates		Column – II Formula	
(A)	3-D	(P)	$\left(SiO_3\right)_n^{2n^-}$
(B)	Soro	(Q)	$\left(Si_2O_5\right)_n^{2n^-}$
(C)	Cyclic	(R)	$(Si_2O_7)^{6-}$
(D)	Phyllo	(S)	$(SiO_2)_n$

Part –C: Single digit integer

This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

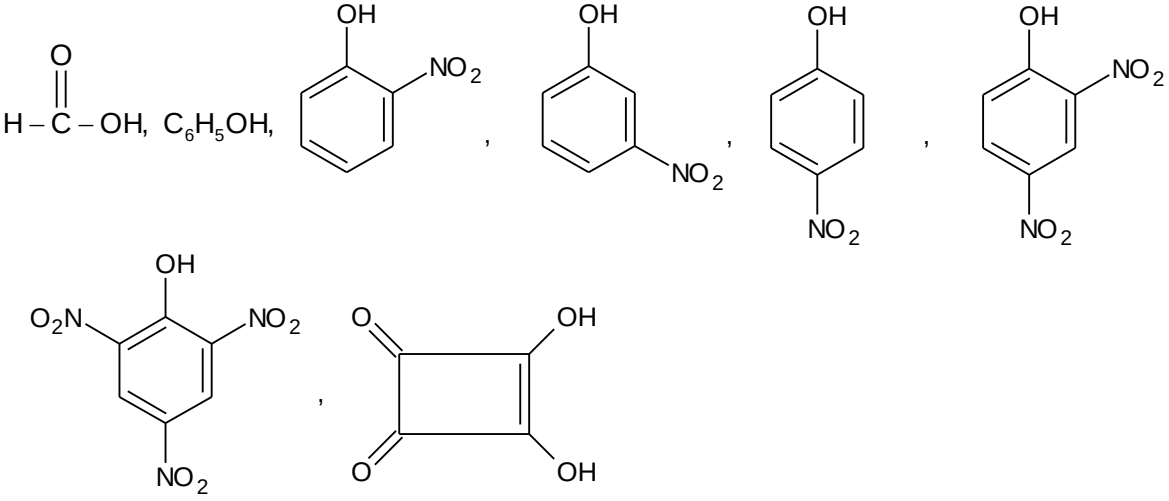
1. Determine the pH of 0.1 NaHS at 25°C

Given $K_{a_1}\left(H_2S\right)=10^{-5}$ at 25°C

$K_{a_2}\left(H_2S\right)=10^{-9}$

space for rough work

2. Total how many compounds can release CO_2 on treating with $NaHCO_3$ solution?



3. Total how many mole gaseous products are formed on heating NH_4ClO_4 at 100°C

4. Among the following radicals how many reacts with $K_4[Fe(CN)_6]$ to form a white ppt.
Ca^{2+}, Fe^{3+}, Fe^{2+}, Zn^{2+}, Cu^{2+}

5. Among all the natural amino acids how many will respond to Lucas test at room temperature.

6. Total how many unpaired electrons are present on central metal atom as well as on ligand in the Brown complex which is formed in ring test.

SECTION-III: MATHEMATICS

Part-A: Only One Option Correct Type

This section contains **4 Multiple Choice Questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **Only One Option is correct.**

1. Let I be the purchase value of an equipment and V (t) be the value after it has been used for t years. The value V (t) depreciates at a rate given by differential equation $\frac{dV(t)}{dt} = -k(T-t)$, where k > 0 is a constant and T is the total life in years of the equipment. Then the scrap value V(T) of the equipment is

(A) $I - \frac{kT^2}{2}$ (B) $I - \frac{k(T-t)^2}{2}$ (C) e^{-kT} (D) $T^2 - \frac{1}{k}$

2. Let x, y be such that $(x-y) \in (\pi, 3\pi)$. If $\sin x + \sin y = \frac{-21}{65}$ and $\cos x + \cos y = \frac{-27}{65}$, then $\cos\left(\frac{x-y}{2}\right)$ is equal to

(A) $\frac{-3}{\sqrt{130}}$ (B) $\frac{3}{\sqrt{130}}$ (C) $\frac{6}{65}$ (D) $\frac{-6}{65}$

space for rough work

3. If $f(x)=x^2-\left[\frac{1}{2}|\sin x|+\left[\frac{3}{x^2+4}\right]\right]$ where [k] denote greatest integer less than or equal to k, then number of points in $[0,2\pi]$ where f (x) is discontinuous is (are)

(A) 0 (B) 1 (C) 2 (D) 3

4. If two mutually perpendicular lines meets the curve $C: y^2=4(x+y)$ at P and Q orthogonally, then locus of point of intersection of tangents to the curve C at P and Q is

(A) $x+1=0$ (B) $x+2=0$ (C) $x^2+y^2+4x=0$ (D) $x^2+y^2+4y=0$

Part-A: One or More Than One Options Correct Type

This section contains **6 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONE** or **MORE THAN ONE is correct.**

5. If $f(x)=\int_{x^2}^{x^3}\ell n\,t\,dt,(x>0)$ and $f'\left(\frac{4}{9}\right)=f'(k)$ then value of k can be

(A) 0 (B) $\frac{2}{3}$ (C) 1 (D) $\frac{4}{9}$

6. If M_1 and M_2 are the feet of perpendicular from foci F_1 and F_2 of the ellipse $\frac{x^2}{64}+\frac{y^2}{25}=1$ on the tangent at any point P of the ellipse then

(A) $\left(F_1M_1^2+F_2M_2^2\right)_{min}=50$ (B) $\left(F_1M_1+F_2M_2\right)_{max}=25$

(C) $\left(F_1M_1+F_2M_2\right)_{min}=10$ (D) $\left(F_1M_1+F_2M_2\right)_{min}=50$

7. Consider a 3×3 matrix A with entries (equally likely) from the set {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}. M and N are two events defined as follows:

$M:\{a_{ij}=0\forall\ i<j\}$

$N:\{|A|\neq0\}$

then which of the following hold(s) good?

(A) $P(M)=\frac{1}{10}$ (B) $P(M)=\frac{1}{1000}$ (C) $P\left(\frac{N}{M}\right)=\frac{9}{10}$ (D) $P\left(\frac{N}{M}\right)=\frac{729}{1000}$

8. Consider $f:(-\infty,0)\cup\left(\frac{1}{3e},\infty\right)\to R,$ defined by $f(x)=\frac{3x}{2}\ell n\left(e-\frac{1}{3x}\right)$ then

(A) $f(x)$ has no point of inflection (B) f (x) is surjective but not injective

(C) $f(x)$ is bijective function (D) $f(x)=\frac{-1}{2e}$ has two distinct solutions.

[Note : e denotes Napier's constant]

space for rough work

9. Let P be the point (1, 0) and Q is any point or parabola $y^2 = 8x$. The locus of midpoint of PQ is another parabola whose

(A) focus is $\left(\frac{1}{2}, 0\right)$ (B) length of latus – rectum is 2

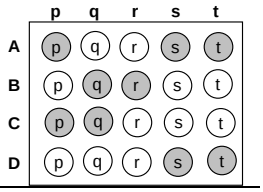
(C) equation of director circle is $2x+1=0$ (D) equation of tangent at vertex is $2x-1=0$

10. Let A and B be two events such that $P\left(\overline{A \cup B}\right) = \frac{1}{6}$, $P\left(A \cap B\right) = \frac{1}{4}$ and $P\left(\overline{A}\right) = \frac{1}{4}$, where $\left(\overline{A}\right)$ stands for complement of event A, then which of the following statement(s) is (are) **incorrect**?

(A) Events A and B are equally likely and mutually exclusive
(B) Events A and B are equally likely but not mutually exclusive
(C) Events A and B are independent but not equally likely
(D) Events A and B are mutually exclusive and independent

Part-B : Matrix-Match Type Questions

This Section contains **4 Matrix Match Type Questions.** Each question has **four statements** (A, B, C and D) given in **Column I** and **five statements** (p, q, r, s and t) in **Column II.** Any given statement in Column I can have correct matching with **ONE** or **MORE** statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS.



1. Right triangle ABC with right angle A has an area equal to its perimeter. The incentre of the triangle ABC is I and $IB = \sqrt{13}$, Match List – 1 with List – II and select the correct answer using the code given below the lists:

[Note: All symbols used have usually meaning in triangle ABC]

List – I		List - II	
(A)	$(s-b)$	(P)	$\frac{12}{5}$
(B)	$\Delta =$	(Q)	$\frac{13}{2}$
(C)	R =	(R)	3
(D)	tan B =	(S)	30

2. Match the following

List – I		List - II	
(A)	The value of definite integral $\int_1^{\sqrt{3}} \left(x^{2x^2+1} + \ell n\left(x^{\left(2x^{2x^2+1}\right)} \right) \right) dx$ is equal to	(P)	2
(B)	If $\lim_{x\to 0} \frac{f(x)}{\sin^2 x} = 8$, $\lim_{x\to 0} \frac{g(x)}{2\cos(x) - xe^x + x^3 + x - 2} = \lambda$ and $\lim_{x\to 0} (1+2f(x))^{\frac{1}{g(x)}} = \frac{1}{e}$, then λ is equal to (where f and g are continuous function on R)	(Q)	3
(C)	The tangent to $y = ax^2 + bx + \frac{7}{2}$ at M (1, 2) is parallel to the normal at N (–2, 2) on the curve $y = x^2 + 6x + 10$. Then $\left(\frac{a}{2} - b\right)$ is equal to	(R)	8
(D)	Number of values of θ lying in (–6, 3) and satisfying $\cot\frac{\theta}{2} = 1 + \cot\theta$, is	(S)	13

3. Match the following

Column-I		Column-II	
(A)	If the roots of the equation $x^5 - 40x^4 + px^3 + qx^2 + rx + s = 0$ are in geometric progression and the sum of their reciprocals is 10, then the value of $\log_2 \lvert s \rvert$ is	(P)	2
(B)	The value of expression $\frac{\cos 25^\circ}{\sin 70^\circ \sin 85^\circ} + \frac{\cos 70^\circ}{\sin 25^\circ \sin 85^\circ} + \frac{\cos 85^\circ}{\sin 25^\circ \sin 70^\circ}$ is equal to	(Q)	3
(C)	The graph of the function g is the reflection of the graph of $f(x) = x + e^x$ defined for all real x about the line $y = x$. If the value of $g'(1)$ is equal to $\frac{p}{q}$ (where p and q are coprime), then (p + q) equals	(R)	4
(D)	The value of a for which $f(x) = x^3 + x^2 + a\cos x$ is injective is/are	(S)	5

4. Match the column

Column-I		Column-II	
(A)	If the value of $\lim\limits_{x \to \frac{\pi}{2}} \left(\frac{\int_{\frac{\pi}{2}}^{x} \left(1 - \tan\frac{t}{2}\right)(1 - \sin t)\,dt}{\int_{\frac{\pi}{2}}^{x} \left(1 + \tan\frac{t}{2}\right)(\pi - 2t)^3\,dt} \right)$ is equal to $\frac{1}{L}$ then L is divisible by	(P)	1
(B)	Number of real solutions of the equation $x^7 + 14x^5 + 16x^3 + 30x - 420 = 0$ is equal to	(Q)	2
(C)	If $\frac{dy}{dx} = y + 3 > 0$ and $y(0) = 2$ then $y(\ell n 2)$ is equal to	(R)	4
(D)	The number of values of $\theta \in [0, 3\pi]$ satisfying simultaneously the equations $2\cos^2\theta - (2 + \sqrt{3})\cos\theta + \sqrt{3} = 0$ and $2\sin^2\theta + 5\sin\theta = 3$ is equal to	(S)	5
		(T)	7

space for rough work

Part –C: Single digit integer

This section contains **6 questions.** The answer to each question is a single digit integer ranging from 0 to 9 (both inclusive).

1. If $\lim\limits_{x\to 0}\dfrac{1+3a\cos(2x)+5b\cos(4x)}{x^4}$ exists for all $x\in R$ and has value 'c' then find the value of $[a-b+c]$.
   [Note : [y] denotes greatest integer function less than or equal to y]

2. In an increasing G.P. the sum of the first and the last term is 66, the product of the second and the second last term is 128, and the sum of all the terms is 126. How many terms are there in the progression?

3. A normal is drawn at a point P (x, y) on a curve. It meets the x – axis and y – axis at A and B respectively such that (x – intercept)$^{-1}$ + (y – intercept)$^{-1}$ = 1, where O is origin, then find radius of the director circle of the curve passing through (3, 3).

4. The target may be either at point A with probability $\dfrac{8}{9}$ or at point B with probability $\dfrac{1}{9}$. There are 55 shots, each of which can be fired at point A of B. Each shot may hit the target, independent of the other with probability $\dfrac{1}{2}$.If number of shots must be fired at point A to hit the target with maximum probability is n then unit digit of n is equal to

5. If the value of the integral $\int_0^{\frac{\pi}{2}}(\cos x)^{2011}(\sin 2013x)\,dx$ is $\dfrac{a}{b}$ where a and b are co – prime then find the value of (b – 2010a).

6. Let z_1, z_2, z_3 be complex numbers such that $z_1^2+z_2^2+z_3^2=z_1z_2+z_2z_3+z_3z_1$ and $|z_1+z_2+z_3|=21$. Given that $|z_1-z_2|=2\sqrt{3}$, $|z_1|=3\sqrt{3}$. Compute $\dfrac{|z_2|^2+|z_3|^2}{44}$

space for rough work