

Advanced Practice Test-5

TIME : 3 hrs	M.M. : 225
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Read the following Instructions very carefully before you proceed.

- The question paper consists of 3 parts (Subject I : Chemistry, Part II : Physics, Part III : Mathematics). Each Subject has 2 sections (Section I & Section II).
- Section I** contains 3 types of questions [**Type 1, Type 2 & Type 3**]

Type 1 contains **5 Single Correct Answer Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.

➤ *Marking scheme [3 Marks for Correct answer & **-1 NEGATIVE MARKING** for wrong answer]*

Type 2 contains **5 Multiple Correct Answer Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE CHOICES** may be correct.

➤ *Marking scheme [5 Marks for All Correct answers & **-2 NEGATIVE MARKING** for wrong answer]*

Type 3 contains **5 Match the following Objective type Questions**. Each question contains statements given in 2 lists. Statements in the first list have to be matched with statements in the second list and then option with the appropriate code is to be marked in the answer sheet. **The options for the correct match are provided as (A), (B), (C) and (D) out of which ONLY ONE Choice is Correct.**

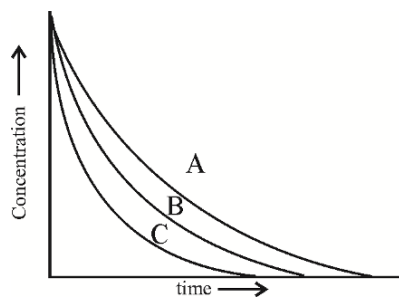
➤ *Marking scheme [3 Marks for All Correct answers & **-1 NEGATIVE MARKING** for wrong answer]*
- Section II** contains **5 Single Integer Value Type Questions**. The answer to each of the questions is a single-digit integer, ranging from 0 to 9 (both inclusive).
- *Marking scheme [4 Marks for Correct answer & **NO NEGATIVE MARKING** for wrong answer]*
- For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.
- No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.
- On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
- No one will be permitted to leave the test room before the end of the test.**

SECTION-I/TYPE-1

SINGLE CORRECT ANSWER

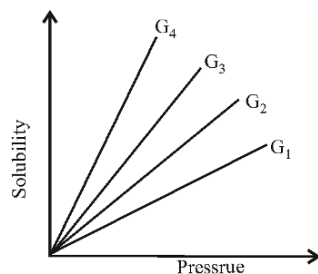
This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct:

1. The decay profiles of three radioactive species A, B and C are given below:



These profiles imply that the decay constants λ_A, λ_B and λ_C follow the order

- (A) $\lambda_A > \lambda_B > \lambda_C$ (B) $\lambda_A > \lambda_C > \lambda_B$ (C) $\lambda_B > \lambda_A > \lambda_C$ (D) $\lambda_C > \lambda_B > \lambda_A$
2. The variation of solubility of four different gases (G_1, G_2, \dots etc) in a given solvent with pressure at a constant temperature is shown in the plot.



The gas with the highest value of Henry's Law constant is :

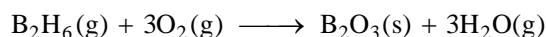
- (A) G_4 (B) G_2 (C) G_3 (D) G_1
3. Identify the correct statement for a gas that obeys the equation of state $P(V - nb) = nRT$?
- (A) Gas behave as an ideal gas (B) Gas can be easily liquefied
(C) Intermolecular forces between gas molecules are negligible
(D) Gas shows negative deviation from ideal behavior

4. A container of volume 2L is separated into equal compartments. In one compartment one mole of an ideal monatomic gas is filled at 1 bar pressure and the other compartment is completely evacuated. A pinhole is made in the separator so gas expands to occupy full 2L and heat is supplied to gas so that finally pressure of gas equals 1 bar. Then :

Vacuum	1 L
1 bar	1 L

- (A) $\Delta U = \Delta H = 150 \text{ J}$ (B) $\Delta H = 250 \text{ J}$
(C) $\Delta U = 100 \text{ J}$ (D) $\Delta U = \Delta H = 0$

5. Diborane reacts with O_2 to give boric oxide and water vapour.



If we mix B_2H_6 and O_2 in the correct stoichiometric ratio, and the total pressure of the mixture before the reaction is 200 mm Hg, the partial pressure of the gases should be :

- (A) $p(B_2H_6) = 50$ mm Hg, and $p(O_2) = 150$ mm Hg
 (B) $p(B_2H_6) = 150$ mm Hg, and $p(O_2) = 50$ mm Hg
 (C) $p(B_2H_6) = 100$ mm Hg, and $p(O_2) = 100$ mm Hg
 (D) $p(B_2H_6) = 75$ mm Hg, and $p(O_2) = 125$ mm Hg

SECTION-I/TYPE-2

MULTIPLE CORRECT ANSWERS

This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct :

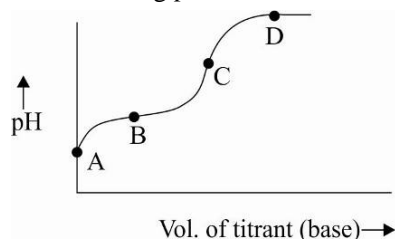
6. Select the correct statement(s) with respect to the salts of alkaline earth metals.
- (A) Solubility of hydroxides increases down the group.
 (B) Basic character of oxides increase down the group.
 (C) Bicarbonates exist in solid state as well as in solutions.
 (D) $CaSO_4 \cdot \frac{1}{2}H_2O$ is called as plaster of pairs.
7. Which of the following molecules will have different values of standard molar enthalpy of formation, one calculated using bond energies and other calculated calorimetrically ?
- (A) $C_2H_6(g)$ (B) 1, 3-Butadiene
 (C) 1, 4-Cyclohexadiene (D) 1, 3-Pentadiene
8. Which of the following statement(s) regarding entropy change, when a system undergo change of state, is(are) correct ?
- (A) The equation for entropy change can also be written as ; $\Delta S_{\text{sys}} = nC_v \ln \frac{T_2}{T_1} + nR \ln \frac{P_1}{P_2}$
 (B) In an irreversible change, $\Delta S_{\text{univ.}} > 0$
 (C) In an adiabatic process, $\Delta S_{\text{sys.}}$ is always zero
 (D) In an isochoric process, $\Delta S_{\text{sys.}} = n C_v \ln \left(\frac{T_2}{T_1} \right)$
9. In which of the following, hybridization of central atom changes ?
- (A) $SO_3 \longrightarrow SO_3^{2-}$ (B) $CO_2 \longrightarrow CO_3^{2-}$
 (C) $N_2O_4 \longrightarrow NO_2^-$ (D) $AlCl_3 \longrightarrow Al_2Cl_6$
10. Which of the following organic names is(are) **INCORRECT** (DO NOT bother hyphens or spaces)?
- (A) 2,3 - Dihydroxy propanamine (B) 2, 3-Diamino 3-hydroxy butanoic acid
 (C) Pent-2-en-4-yne (D) 3-Hydroxy 2-iodo propanal

SECTION-I/TYPE-3
MATRIX MATCH TYPE

This section contains 5 Single Choice Questions. Each question has matching lists. The codes for the lists have 4 choices (A), (B), (C) and (D) out of which ONLY ONE Choice is Correct.

11. MATCH THE FOLLOWING COLUMN:

Observe the following pH curve for titration of a weak acid with a strong base and do the correct matching :



where $[A_0]$ = Initial concentration of weak acid

	List 1 [Stages of titration]		List 1 [pH of solution]
(P)	A	1.	$\text{pH} = \frac{1}{2} \text{pK}_a + \frac{1}{2} \text{pK}_w + \frac{1}{2} \log [\text{Salt}]$
(Q)	B	2.	$\text{pH} = \frac{1}{2} \text{pK}_a - \frac{1}{2} \log [A_0]$
(R)	C	3.	$\text{pH} = \text{pK}_w + \log [\text{Base}]$
(S)	D	4.	$\text{pH} = \text{pK}_a - \log \frac{[\text{weak acid}]}{[\text{salt}]}$

Codes :

	P	Q	R	S		P	Q	R	S
(A)	2	3	4	1	(B)	2	4	1	3
(C)	1	2	3	4	(D)	2	4	3	1

12. Match the molecular species in List 1 with their structural characteristics in List 2.

	List 1		List 2
(P)	XeF_2	1.	sp^2 hybridized central atom, bent
(Q)	SF_2	2.	sp hybridized central atom, linear
(R)	CN_2^{2-}	3.	sp^3 hybridized central atom, bent
(S)	SO_2	4.	sp^3d hybridized central atom, linear

Codes :

	P	Q	R	S		P	Q	R	S
(A)	1	2	3	4	(B)	2	1	4	3
(C)	3	2	1	4	(D)	4	3	2	1

13. MATCH THE FOLLOWING LISTS :

	List 1 [Electrode]		List 2 [Half-cell]
(P)	Primary reference electrode	1.	$\text{Ag}_{(s)} \text{AgCl}_{(s)} \text{KCl}_{(aq)}$
(Q)	$E_{\text{M}^+/\text{M}} = E_{\text{X}^-/\text{MX}/\text{M}}$ [M = Metal] [MX = metal insoluble salt]	2.	$\text{Pt}_{(s)} \text{H}_{2(g)} \text{HCl}_{(aq)}$ 1atm 1M
(R)	Calomel electrode	3.	$\text{Hg}_{(s)} \text{Hg}_2\text{Cl}_{2(s)} \text{KCl}_{(aq)}$
(S)	Electrode of lead storage battery	4.	$\text{Pb}_{(s)} \text{PbSO}_{4(s)} \text{H}_2\text{SO}_{4(aq)}$

Codes :

	P	Q	R	S		P	Q	R	S
(A)	1	2	3	4	(B)	2	3	1	4
(C)	3	2	1	4	(D)	2	1	3	4

14. MATCH THE FOLLOWING LISTS :

	List 1 [Reaction]		List 2 [Product]
(P)	$\begin{array}{c} \text{CH}_2 - \text{OH} \\ \\ \text{CH} - \text{OH} \xrightarrow[\Delta]{\text{KHSO}_4} \\ \\ \text{CH}_2 - \text{OH} \end{array}$	1.	Unsaturated aldehyde
(Q)	$\begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \quad \\ \text{CH}_3 - \text{C} - \text{C} - \text{CH}_3 \\ \quad \\ \text{OH} \quad \text{OH} \end{array} \xrightarrow{\text{H}_2\text{SO}_4 (\text{conc.})}$	2.	Saturated alcohol
(R)	$\begin{array}{c} \text{CH}_3 \quad \text{Ph} \\ \diagdown \quad / \\ \text{C} \\ \\ \text{O} \end{array} \xrightarrow[\text{H}_2\text{O}]{\text{NaBH}_4}$	3.	Methyl ketone
(S)	$\text{CH}_2 = \text{CH} - \text{CHO} \xrightarrow[\text{Pt}, \Delta]{\text{H}_2}$	4.	Racemic mixture

Codes :

	P	Q	R	S		P	Q	R	S
(A)	1	4	3	2	(B)	3	1	4	2
(C)	1	3	4	2	(D)	2	3	4	1

15. MATCH THE FOLLOWING LISTS :

	List 1 [Reaction]		List 2 [Types of reaction]
(P)	$\text{Ph} - \overset{\text{CH}_3}{\underset{\text{Cl}}{\text{C}}} - \text{CH}_3 \xrightarrow{\text{NaOH}_{(\text{aq})}}$	1.	Electrophilic addition reaction
(Q)	$\text{Ph} - \overset{\text{CH}_3}{\text{C}} = \text{CH}_2 \xrightarrow[\text{Peroxide}]{\text{HBr}}$	2.	Nucleophilic substitution reaction
(R)	$\text{Ph} - \overset{\text{CH}_3}{\text{C}} = \text{CH}_2 \xrightarrow{\text{HCl}}$	3.	Free radical addition reaction
(S)	$\text{Ph} - \overset{\text{CH}_3}{\text{C}}\text{H} - \text{CH}_3 \xrightarrow[\text{AlCl}_3]{\text{Cl}_2}$	4.	Electrophilic substitution reaction

Codes :

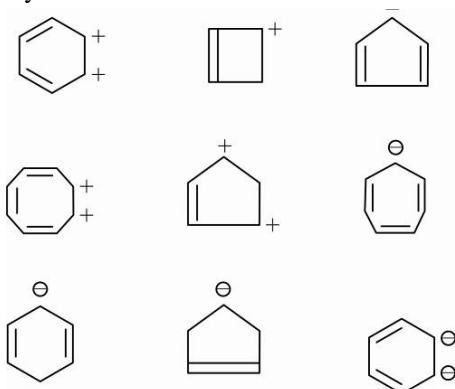
	P	Q	R	S		P	Q	R	S
(A)	4	3	1	2	(B)	2	3	1	4
(C)	4	3	2	1	(D)	2	1	3	4

SECTION - II

SINGLE INTEGER VALUE CORRECT TYPE

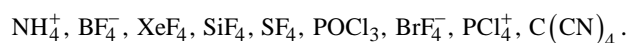
This section contains 5 single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

1. How many of them are aromatic :

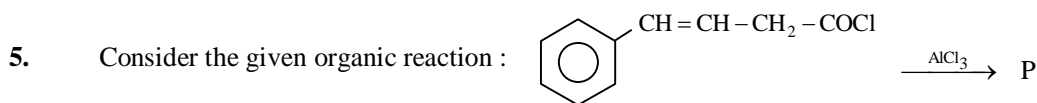


2. Photons of energy 7eV are incident on two metals A and B with work functions 6 eV and 3eV respectively. The minimum de-Broglie wavelengths of the emitted photoelectrons with maximum energies are λ_A and λ_B , respectively where $\frac{\lambda_A}{\lambda_B}$ is nearly equal to _____.

3. How many of the following molecular species are regular tetrahedral in shape?



4. If equilibrium concentration of both benzene and acetylene for reversible reaction $3\text{C}_2\text{H}_2(\text{g}) \rightleftharpoons \text{C}_6\text{H}_6(\text{g})$ is 0.5 mol lit^{-1} then find the value of equilibrium constant K_c for the reaction.



Find the degree of unsaturation (DU) in the product P.

SUBJECT - II (PHYSICS)

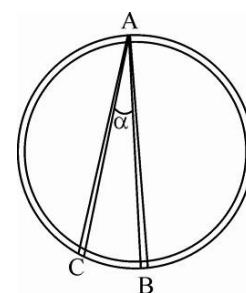
75 MARKS

SECTION-I/TYPE-1

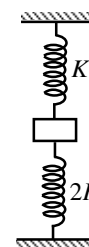
SINGLE CORRECT ANSWER

This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which **ONLY ONE Choice is Correct**:

1. In a vertical disc two grooves are made as shown in figure. AB is a diameter. Two balls are dropped at A one in each groove, simultaneously. Then :
- (A) Time to each at C is less than that to reach at B
 (B) Time to reach at C is greater than that to reach at B
 (C) Time to reach at C is equal to that to reach at B
 (D) The difference in time to reach at C and to reach at B may be positive, negative or zero depending on α

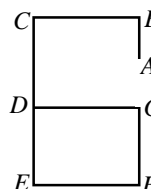


2. A block of mass m is connected two springs of spring constant $2k$ and k respectively as shown in vertical plane. At equilibrium both spring are compressed by same length. If suddenly lower spring is cut then acceleration of block just after spring cut, is :
- (A) $2g$ downward
 (B) g downward
 (C) g upward
 (D) None of these



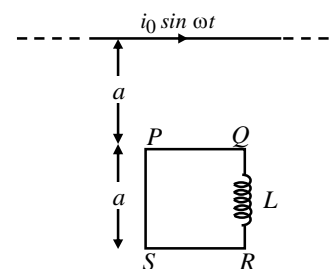
3. The frame is made by seven wires, each has conductivity K . length of each segment is ℓ except AB . AB is equal to $\ell/2$. The temperature of points F and A are maintained at 200°C and 100°C then temperature of D is :

- (A) $1600/9^\circ\text{C}$
 (B) 124°C
 (C) $1200/7^\circ\text{C}$
 (D) 112°C

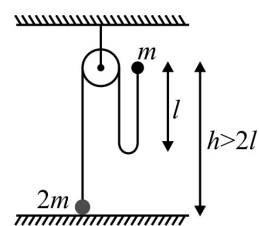


4. A conducting square loop $PQRS$ of zero resistance but containing an inductor of inductance L is placed near a long wire carrying current $i_0 \sin \omega t$, as shown in the figure. The peak value of induced current in the loop is:

- (A) $\frac{\mu_0 a i_0 (\ln 2)}{\omega L}$
 (B) $\frac{\mu_0 a i_0 (\ln 2)}{2\pi L}$
 (C) $\frac{\mu_0 a i_0 (\ln 2)}{2\pi \omega L}$
 (D) $\frac{2\mu_0 i_0 (\ln 2)}{\pi L}$



5. In figure, a heavy ball of mass $2m$ rests on the horizontal surface and the lighter ball of mass m is dropped from a height $h > 2l$. At the instant the string gets taut, the upward velocity of the heavy ball will be :



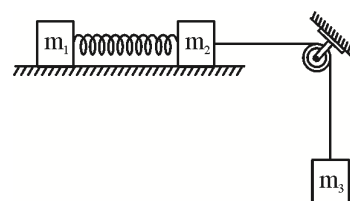
- (A) $\frac{2}{3}\sqrt{gl}$ (B) $\frac{4}{3}\sqrt{gl}$
 (C) $\frac{1}{3}\sqrt{gl}$ (D) $\frac{1}{2}\sqrt{gl}$

SECTION-I/TYPE-2

MULTIPLE CORRECT ANSWERS

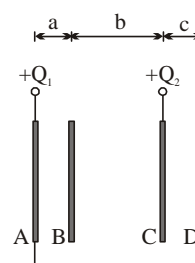
This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct :

6. A block of mass m_1 is connected with another block of mass m_2 by a light spring. m_2 is connected with a hanging mass m_3 by an inextensible light string. At the time of release of block m_3 :



- (A) tension in the string is $\frac{m_2 m_3}{m_2 + m_3} g$ (B) acceleration of m_1 is zero
 (C) acceleration of m_3 is $\frac{m_3 g}{m_1 + m_2 + m_3}$ (D) acceleration of m_3 is $\frac{(m_3 - m_2)}{m_3 + m_2} g$

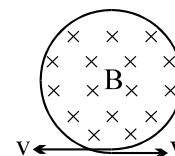
7. Figure shows an arrangement of four identical rectangular plates A, B, C and D each of area S . Plates A and C are given charges as shown. Ignore the separation between the plates in comparison to the plate dimensions. Choose the correct option(s) :



- (A) Potential difference between plates A & B is independent of Q_1
 (B) Potential difference between plates C & D is independent of Q_1
 (C) Potential difference between plates A & B is independent of Q_2
 (D) Potential difference between plates C & D is independent of Q_2

8. A circular conducting loop of radius r_0 and having resistance per unit length λ as shown in the figure is placed in a magnetic field B which is constant in space and time.

The ends of the loop are crossed and pulled in opposite directions with a velocity v such that the loop always remains circular and the radius of the loop goes on decreasing, then :

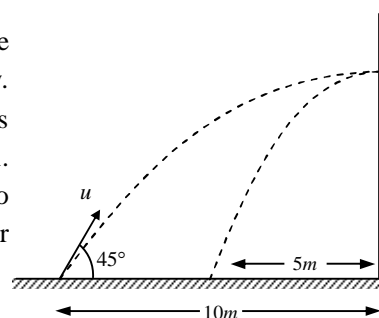


- (A) Radius of the loop changes with r as $r = r_0 - vt/\pi$
 (B) EMF induced in the loop as a function of time is $e = 2Bv[r_0 - vt/\pi]$
 (C) Current induced in the loop is $I = \frac{Bv}{2\pi\lambda}$ (D) Current induced in the loop is $I = \frac{Bv}{\pi\lambda}$

9. A block starts moving on a horizontal plane under the influence of horizontal acceleration a . After t_0 sec, the acceleration remains the same in magnitude but reverses in direction. At what time does it come back to the initial point?

- (A) $\sqrt{2}t_0$ (B) $2t_0$ (C) $(2 - \sqrt{2})t_0$ (D) $(2 + \sqrt{2})t_0$

10. A ball of mass 20 gm is projected with velocity $u\text{ m/s}$ at an angle of 45° with horizontal and it hits a vertical wall perpendicularly. The wall is 10 m away from the point of projection. It rebounds perpendicularly from the wall and falls 5 m away from the wall. The entire motion is in the same vertical plane perpendicular to ground and the wall. The ball remained in contact with the wall for 0.01 seconds .
- (A) Average force exerted by wall on the ball is 30 N
 (B) Average force exerted by ball on the wall is 70 N
 (C) Time taken by particle from ground to wall is 1 sec
 (D) Time taken by particle from wall to ground is 0.5 sec



SECTION-I/TYPE-3
MATRIX MATCH TYPE

This section contains 5 Single Choice Questions. Each question has matching lists. The codes for the lists have 4 choices (A), (B), (C) and (D) out of which ONLY ONE Choice is Correct.

11. In the $s-t$ equation ($s = 10 + 20t - 5t^2$). MATCH THE FOLLOWING LISTS :

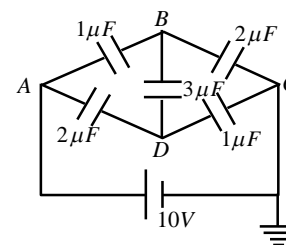
	List 1		List 2
(P)	Distance travelled in $3s$	1.	-20 unit
(Q)	Displacement in $1s$	2.	15 unit
(R)	Initial acceleration	3.	25 unit
(S)	Velocity at $4s$	4.	-10 unit

Codes :

	P	Q	R	S		P	Q	R	S
(A)	4	1	3	2	(B)	3	2	1	4
(C)	4	1	2	3	(D)	3	2	4	1

12. Consider the capacitor circuit shown in the figure.
 Match List 1 with List 2:

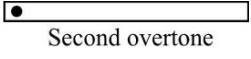
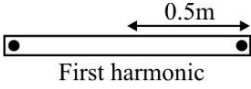
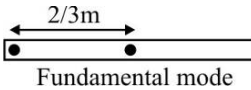
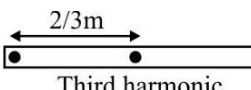
	List 1		List 2
(P)	Potential of D in V	1.	$20/9$
(Q)	Potential of B in V	2.	$40/9$
(R)	Charge on $1\mu F$ capacitor in μC	3.	$10/3$
(S)	Charge on $3\mu F$ capacitor in μC	4.	$50/9$



Codes :

	P	Q	R	S		P	Q	R	S
(A)	2	2	3	4	(B)	4	2	4	3
(C)	4	2	1	3	(D)	3	2	1	4

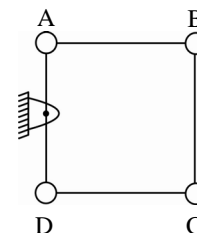
13. Longitudinal waves are produced in five identical rods in different situations. Their mode of vibration and fixed points (with bold point) are shown in the List 2, and their frequencies are given in the List 1, match the frequency in the List 1 with the appropriate situations in the List 2. Each of the rods has length 1 m young's modulus of elasticity $2 \times 10^{12}\text{ N/m}^2$ and density $5 \times 10^3\text{ kg/m}^3$.

	List 1		List 2
(P)	10 KHz	1.	 Second overtone
(Q)	15 KHz	2.	 First harmonic
(R)	25 KHz	3.	 Fundamental mode
(S)	45 KHz	4.	 Third harmonic

Codes :

	P	Q	R	S		P	Q	R	S
(A)	2	3	1	4	(B)	2	3	4	1
(C)	3	2	1	4	(D)	4	2	3	1

14. Four massless rods of length l are used to make a rigid structure. At each corner we attach a point particle of mass m . Rod AD is hinged at its mid point. If the system is released from position shown (in vertical plane). Match the List 1 with List 2 just after release. (Take $m = 1.5\text{ kg}$ $l = 1\text{ m}$ and $g = 10\text{ m/s}^2$).

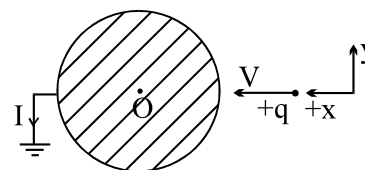


	List 1		List 2
(P)	Angular acceleration of structure (in rad/s^2)	1.	40
(Q)	Acceleration of mass at corner A (in m/s^2)	2.	$10\sqrt{5}/3$
(R)	Acceleration of mass at corner B (in m/s^2)	3.	$20/3$
(S)	Force exerted by hinge (in N)	4.	$10/3$

Codes :

	P	Q	R	S		P	Q	R	S
(A)	3	2	2	4	(B)	4	3	1	2
(C)	3	4	1	2	(D)	3	4	2	1

15. The figure shows a fixed conducting earthed sphere. A point charge $+q$ is projected towards the conducting sphere from very large distance shown in figure. (Neglect gravity). As the point charge progresses towards sphere.



	List 1		List 2
(P)	Charge on sphere will be	1.	-ve
(Q)	Electric field at 'O' due to charge on sphere	2.	increases
(R)	Acceleration of point charge 'q'	3.	decreases
(S)	Current I (shown in figure) in the wire connecting the sphere with earth	4.	+ve

Codes :

	P	Q	R	S		P	Q	R	S
(A)	1, 2	1, 2	2, 4	2, 4	(B)	1, 2	1, 2	1, 3	2, 4
(C)	1, 2	1, 3	2, 4	2, 4	(D)	1, 3	1, 2	2, 3	2, 4

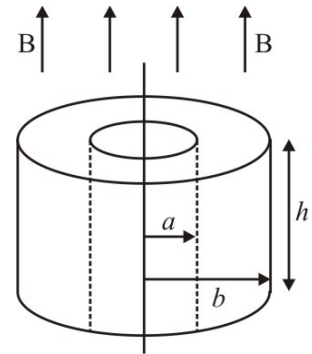
SECTION - II
SINGLE INTEGER VALUE CORRECT TYPE

This section contains 5 single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

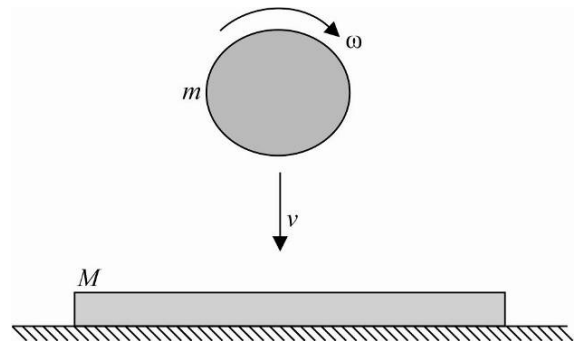
1. The filament of an incandescent lamp of power 64 W is made of Tungsten. The operation temperature of the lamp is 2000K. Consider the filament a black body and find its radius (in mm).

[Given : $\sigma = 6 \times 10^{-8} \text{ W/m}^2$ and length of filament is $\frac{10}{3\pi} \text{ cm}$]

2. A conducting ring of circular cross section with inner and outer radii 'a' and 'b' is made of a material of resistivity 'ρ'. The thickness of ring is h. It is placed coaxially in a vertically cylindrical region of large radius of a magnetic field $B = krt$, where k is a positive constant, r is the distance from axis t is the time. If current through the ring is $I = (kh/\alpha\rho)[b^3 - a^3]$, then find the value of 'α'.



3. A solid ball of mass m and radius R spinning with angular velocity ω falls on a horizontal slab of mass M with rough upper surface (coefficient of friction μ) and smooth lower surface. Immediately after collision the normal component of velocity of the ball remains half of its value just before collision and it stops spinning. Find the velocity of the sphere in horizontal direction immediately after the impact (Given: $R\omega = 5$).



4. A plane flies horizontally at a height of 2 km at a constant speed of 112 m/s. From the airplane we want to drop a cargo on a ship moving on a parallel path on the surface of water with speed of 40 m/s. The path of plane and the ship are in the same vertical plane. If the horizontal distance from the ship so that cargo falls on ship is S(in m) then the value of S/288 is _____.
5. A moving coil galvanometer of resistance 72Ω is to be used as an ammeter of expanded range. What should be the value (in Ω) of the shunt used, so that deflection falls from 100 divisions to 10 divisions for same current?

SUBJECT - III (MATHEMATICS)

75 MARKS

SECTION-I/TYPE-1

SINGLE CORRECT ANSWER

This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct:

1. Consider function $f(x) = \sqrt{4-x^2}$, $g(x) = |x-2|$ and $h(x) = \sqrt{x-2}$, for $x \in R$ a function is defined as $F(x) = \min \{f(x), g(x), h(x)\}$ between the coordinate axes for $x < 0$, then the Area of $F(x)$ between the coordinate axes for $x = 0$ is :
- (A) $2\pi sq$ unit (B) πsq unit (C) $4\pi sq$ unit (D) None of these
2. Let z be a complex number satisfying $|z+4-5i|=9$. Let $a = \max|z+2-3i|$ and $b = \min|z+2-3i|$, then $a^2 + b^2 =$
- (A) 278 (B) 178 (C) 118 (D) 148
3. Let $a = \cos^{-1} \cos 20$, $b = \cos^{-1} \cos 30$ and $c = \sin^{-1} \sin(a+b)$ then the maximum value of $\sin(2(a+b+c)x) + \cos^2((a+b+c)x)$ is :
- (A) $\frac{\sqrt{5}+1}{2}$ (B) $\frac{\sqrt{5}-1}{2}$ (C) $\frac{\sqrt{3}-1}{2}$ (D) $\frac{\sqrt{3}+1}{2}$
4. If the primitive of the function $f(x) = \frac{x^{2009}}{(1+x^2)^{1006}}$ w.r.t x is equal to $\frac{1}{n} \left(\frac{x^2}{1+x^2} \right)^m + C$
Then find $(m+n)$ (where $m, n \in N$)
- (A) 2015 (B) 3015 (C) 725 (D) None of these
5. If $P = \int_0^\infty \frac{x^2}{x^4+1} dx$, $Q = \int_0^\infty \frac{x dx}{x^4+1}$ and $R = \int_0^\infty \frac{dx}{x^4+1}$, then the value of $P - \sqrt{2}Q + R$ is :
- (A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2\sqrt{2}}$ (C) $\frac{\pi}{\sqrt{2}}$ (D) $\frac{\pi}{3\sqrt{2}}$

SECTION-I/TYPE-2
MULTIPLE CORRECT ANSWERS

This section contains 5 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct :

6. If $I = \int \frac{\sin x + \sin^3 x}{\cos 2x} dx = A \cos x + B \ln|f(x)| + C$, then :

(A) $A = 1/4, B = -\frac{1}{\sqrt{2}}, f(x) = \frac{\sqrt{2} \cos x - 1}{\sqrt{2} \cos x + 1}$ (B) $A = 1/2, B = -\frac{3}{4\sqrt{2}}, f(x) = \frac{\sqrt{2} \cos x - 1}{\sqrt{2} \cos x + 1}$

(C) $A = -1/2, B = \frac{3}{\sqrt{2}}, f(x) = \frac{\sqrt{2} \cos x + 1}{\sqrt{2} \cos x - 1}$ (D) $A = 1/2, B = \frac{3}{4\sqrt{2}}, f(x) = \frac{\sqrt{2} \cos x + 1}{\sqrt{2} \cos x - 1}$

7. Let $f(x) = \frac{(\ln(1+x) - \ln 2)(3 \cdot 4^{x-1} - 3x)}{\{(7+x)^{1/3} - (1+3x)^{1/2}\} \sin \pi x}, x \neq 1$. The value of $f(1)$ so that f is continuous at $x = 1$ is :

(A) an algebraic number (B) a rational number

(C) a transcendental number (D) $\frac{9}{4\pi} \ln\left(\frac{4}{e}\right)$

8. Suppose $f'(x)$ exists for each x and $h(x) = f(x) - (f(x))^2 + (f(x))^3$ for every real number x . Then :

(A) h is increasing whenever f is increasing (B) h is increasing whenever f is decreasing

(C) h is decreasing whenever f is decreasing (D) Nothing can be said in general

9. Let A, B, C be three sets of complex numbers as defined below

$$A = \{z : |z| \leq 2\sqrt{3}\} ; B = \{z : (\operatorname{Im}(z))^2 = 4\operatorname{Re}(z)\} ; C = \{z : |\arg z| = \tan^{-1} \sqrt{2}\}$$

Then set $A \cap B \cap C$ contains the complex number(s)

(A) $2 + i\sqrt{2}$ (B) $2 + i2\sqrt{2}$ (C) $2 - i2\sqrt{2}$ (D) $0 + i0$

10. Which of the following sets can be the subset of the general solution of the equation $1 + \cos 3x = 2 \cos 2x$?

(A) $n\pi + \frac{\pi}{3}$ (B) $n\pi + \frac{\pi}{6}$ (C) $n\pi - \frac{\pi}{6}$ (D) $2n\pi$

SECTION-I/TYPE-3
MATRIX MATCH TYPE

This section contains 5 Single Choice Questions. Each question has matching lists. The codes for the lists have 4 choices (A), (B), (C) and (D) out of which ONLY ONE Choice is Correct.

11. 5 balls are placed in 3 boxes. Each box can hold all 5 balls. Number of ways in which the balls can be placed if :

	List 1		List 2
(P)	Balls are identical but boxes are different and no box remains empty	1.	2
(Q)	Balls are different but boxes are identical and no box remains empty	2.	25
(R)	Balls as well as boxes are identical and no box remains empty	3.	243
(S)	Balls are different and boxes are different and boxes can remain empty	4.	6

Codes :

	P	Q	R	S		P	Q	R	S
(A)	2	4	3	1	(B)	4	2	1	3
(C)	1	2	3	4	(D)	2	3	4	1

12. MATCH THE FOLLOWING LISTS :

	List 1		List 2
(P)	The distance between the lines $(x + 7y)^2 + 4\sqrt{2}(x + 7y) - 42 = 0$ is	1.	2
(Q)	If the sum of the distances of a point from two perpendicular lines in a plane is 1, then its locus is $ x + y = k$, where k is	2.	7
(R)	If $6x + 6y + m = 0$ is acute angle bisector of line $x + 2y + 4 = 0$ and $4x + 2y - 1 = 0$, then m is equal to	3.	3
(S)	Area of the triangle formed by the lines $y^2 - 9xy + 18x^2 = 0$ and $y = 6$ is	4.	1

Codes :

	P	Q	R	S		P	Q	R	S
(A)	1	4	3	2	(B)	2	3	4	1
(C)	1	4	2	3	(D)	3	4	2	1

13. MATCH THE COLUMN :

List 1		List 2	
(P)	In a ΔABC , let $\angle C = \frac{\pi}{2}$, $r =$ in radius $R =$ circum radius then $2(r + R)$ is equal to	1.	$a + b + c$
(Q)	If ℓ, m, n are perpendicular drawn from the vertices of triangle having sides a, b and c then $\sqrt{2R\left(\frac{b\ell}{c} + \frac{cm}{a} + \frac{an}{b}\right) + 2ab + 2bc + 2ca}$	2.	$a - b$
(R)	In a ΔABC , $R(b^2 \sin 2C + c^2 \sin 2B)$ equals	3.	$a + b$
(S)	In a right angle triangle ABC $\angle C = \frac{\pi}{2}$, then $4R \sin \frac{A+B}{2} \cdot \sin \frac{A-B}{2}$	4.	abc

Codes :

	P	Q	R	S		P	Q	R	S
(A)	1	2	3	4	(B)	4	2	1	1
(C)	2	1	4	3	(D)	3	1	4	2

14. MATCH THE FOLLOWING LISTS :

List 1		List 2	
(P)	The value of $\int_{\alpha}^{\frac{\pi}{2}-\alpha} \frac{d\theta}{1 + \cot^n \theta} = A - \alpha$, then the value of 'A' is [where, $0 < \alpha < \frac{\pi}{2}$, $n > 0$]	1.	$\frac{\pi}{2}$
(Q)	The value of $\int_{-\pi}^{\pi} \frac{\sin^2 x}{1 + \alpha^x} dx$, $\alpha > 0$	2.	$\frac{\pi}{4}$
(R)	The value of $\int_{\alpha}^{2\pi-\alpha} \frac{x \sin^{2n} x}{\sin^{2n} x + \cos^{2n} x} dx$ is	3.	$\frac{\pi}{4} - \tan^{-1} \alpha$
(S)	$\int_{\tan^{-1} \alpha}^{\cot^{-1} \alpha} \frac{\tan x}{\tan x + \cot x} dx$	4.	Depends on α

Codes :

	P	Q	R	S		P	Q	R	S
(A)	4	1	2	3	(B)	2	1	4	3
(C)	1	4	2	3	(D)	3	1	2	4

15. For $a \neq 0$ the equation $ax^2 + b|x| + c = 0$ has exactly k real roots. Based on this information, match the following lists :

	List 1		List 2
(P)	If $k = 1$, then there must be	1.	$ab < 0$
(Q)	If $k = 2$, then there must be	2.	$ab > 0$
(R)	If $k = 3$, then there must be	3.	$ac < 0$
(S)	If $k = 4$, then there must be	4.	$ac > 0$

Codes:

	P	Q	R	S		P	Q	R	S
(A)	2	3	1	4	(B)	3	2	4	1
(C)	2	1	3	4	(D)	3	4	2	1

SECTION - II

SINGLE INTEGER VALUE CORRECT TYPE

This section contains 5 single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

- A circle is inscribed in the ellipse $\frac{x^2}{16} + \frac{y^2}{25} = 1$, where centre is one of the foci. If circle is touching the ellipse, then the radius of the circle is _____.
- A differentiable function f satisfying a relation $f(x+y) = f(x) + f(y) + 2xy(x+y) - \frac{1}{3}; \forall x, y \in R$ and $\lim_{h \rightarrow 0} \frac{3f(h) - 1}{6h} = \frac{2}{3}$. The value of definite integral $\int_{-3}^3 f(x) dx$ is _____.
- If $f(x) = \tan^{-1}\left(\frac{1}{\sin^2 x + \sin x + 1}\right) + \tan^{-1}\left(\frac{1}{\sin^2 x + 3 \sin x + 3}\right) + \tan^{-1}\left(\frac{1}{\sin^2 x + 5 \sin x + 7}\right) + \tan^{-1}\left(\frac{1}{\sin^2 x + 7 \sin x + 13}\right) + \dots$ upto n terms, then $f'(x)$ in simplified form is $\frac{A}{1+(B+n)^2} - \frac{A}{1+B^2}$. The value of $A^2 + B^2$ is _____.
- Out of 20 consecutive numbers two are chosen at random then the probability that their sum is odd but not divisible by 3 is $\frac{k_1}{k_2}$ (there is no common factor in k_1 and k_2) where k_i is two digit number, then $\left[\frac{k_1 + k_2}{21}\right]$ is _____. (where $[.]$ is greatest integer function)
- If r^{th} and $(r+1)^{\text{th}}$ term is greatest term in the expansion of $(1+x)^{\frac{25}{2}}$ when $x = \frac{4}{5}$ then r will be _____.