

FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
OPEN TEST – I
PAPER –1
TEST DATE: 09-02-2025

Time Allotted: 3 Hours

Maximum Marks: 180

General Instructions:

- The test consists of total 51 questions.
- Each subject (PCM) has 17 questions.
- This question paper contains **Three Parts**.
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **Two Sections: Section-A & Section-B**.

Section – A (01 – 04, 18 – 21, 35 – 38): This section contains **TWELVE (12)** questions. Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.

Section – A (05 –07, 22 – 24, 39 – 41): This section contains **NINE (9)** questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).

Section – A (08 – 11, 25 – 28, 42 – 45): This section contains **TWELVE (12)** Matching List Type Questions. Each question has **FOUR** statements in **List-I** entries (P), (Q), (R) and (S) and **FIVE** statements in **List-II** entries (1), (2), (3), (4) and (5). The codes for lists have choices (A), (B), (C), (D) out of which, **ONLY ONE** of these four options is correct answer.

Section – B (12 – 17, 29 – 34, 46 – 51): This section contains **EIGHTEEN (18)** numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.

MARKING SCHEME

Section – A (Single Correct): Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+3	If ONLY the correct option is chosen.
Zero Marks	:	0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	-1	In all other cases.

Section – A (One or More than One Correct): Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+4	If only (all) the correct option(s) is (are) chosen;
Partial Marks	:	+3	If all the four options are correct but ONLY three options are chosen;
Partial marks	:	+2	If three or more options are correct but ONLY two options are chosen and both of which are correct;
Partial Marks	:	+1	If two or more options are correct but ONLY one option is chosen and it is a correct option;
Zero Marks	:	0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	-2	In all other cases.

Section – B: Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+4	If ONLY the correct numerical value is entered at the designated place;
Zero Marks	:	0	In all other cases.

Physics

PART – I

SECTION – A

(One Options Correct Type)

This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

1. A meteorite of mass m collides with a satellite perpendicular to the satellite velocity in its plane which was orbiting around a planet in a circular path of radius R . Due to collision, the meteorite sticks to the satellite (mass = $10m$) and the satellite is seen to have gone into an orbit whose minimum distance from the planet is $R/2$. Determine the velocity u of the meteorite before collision, Mass of the planet is M .

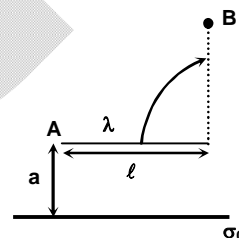
(A) $\sqrt{\frac{49GM}{5R}}$

(B) $\sqrt{\frac{11GM}{242R}}$

(C) $\sqrt{\frac{58GM}{R}}$

(D) $\sqrt{\frac{11GM}{5R}}$

2. A rod of length ℓ having linear charge density λ lies parallel to an infinite sheet of surface charge density σ_0 . The line charge is rotated slowly, such that it becomes vertical as shown in the figure. Neglect gravity throughout the question. Choose the correct option(s). (Assume that there is no change in charge density of sheet during the process)



(A) Work done to rotate the line charge is $\frac{\lambda\sigma_0\ell^2}{4\epsilon_0}$.

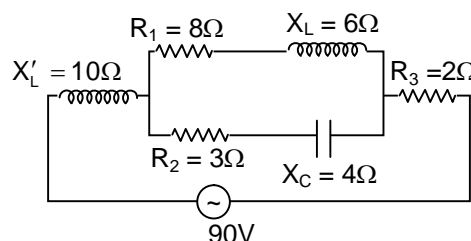
(B) Work done to rotate the line charge is $-\frac{\lambda\sigma_0\ell^2}{4\epsilon_0}$.

(C) Work done to rotate the line charge is $\frac{\lambda\sigma_0\ell^2}{2\epsilon_0}$.

(D) $V_B - V_A = \frac{\sigma\ell}{2\epsilon_0}$, where V stands for potential at a point.

3. Consider the circuit shown in the figure. The current supplied by the ac voltage source is

- (A) 4 amp
(B) 9 amp
(C) 10 amp
(D) 16 amp



4. A metallic surface is illuminated alternatively with electromagnetic radiations of wavelengths 3100\AA and 4000\AA . It is observed that the maximum speeds of the photoelectrons under these illuminations are in the ratio 2 : 1. The work function of the metal is

- (A) 2 eV
(B) 2.4 eV
(C) 2.8 eV
(D) 3 eV

SECTION – A**(One or More than one correct type)**

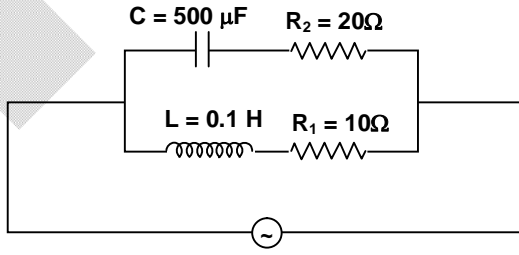
This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

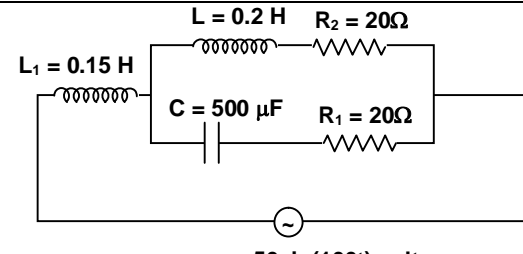
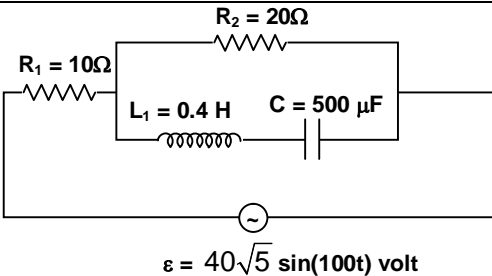
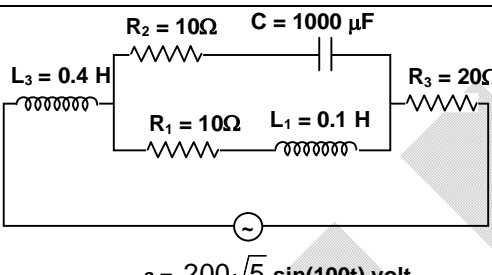
5. Pressure variation inside a organ pipe is given as $\Delta P = P_0 \cos \frac{3\pi x}{2} \sin(200t + \phi)$, where x is in meter and t is in second. Then (take x = 0 at one of the ends of pipe)
- (A) Organ pipe is closed at one end and open at other end if length of organ pipe is 3m.
 - (B) Organ pipe is open at both ends if length of organ pipe 2m for some value of ϕ .
 - (C) Organ pipe is closed at both ends if length of organ pipe 2m for any value of ϕ
 - (D) Distance between two consecutive node and antinode is $\frac{1}{3}$ m.
6. The pitch of screw gauge is 1 mm and its circular scale is divided into 100 divisions. When nothing is put between the studs the zero of main scale is not seen but when circular scale is rotated by 450° the zero of the main scale is just visible and the zero of main scale coincides with the zero of the circular scale. When a glass plate is placed between the studs the circular scale lies between 18^{th} and 19^{th} division of main scale and circular scale reads 34 divisions. Then
- (A) There is negative zero error and its magnitude is 1.25 mm
 - (B) There is positive zero error and its magnitude is 1.25 mm
 - (C) Thickness of the glass plate is 19.59 mm
 - (D) Thickness of the glass plate is 17.09 mm
7. A tube of certain diameter of length 97 cm is open at both ends. Its fundamental frequency of resonance is found to be 160 Hz. The velocity of sound in air is 320 m/s. Then choose the correct statement (s)
- (A) Diameter of the tube is 5 cm
 - (B) When one end of the tube is closed, the lowest frequency of resonance for the tube is 81.22 Hz (approximately upto two decimal)
 - (C) When one end of the tube is closed the frequency of 3^{rd} harmonic is 243.65 Hz (approximately upto two decimal)
 - (D) When both end are open the frequency of 5^{th} harmonic is 800 Hz

SECTION – A**(Matching List Type)**

This section contains **FOUR (04)** Matching List Type Questions. Each question has **FOUR** statements in **List-I** entries (P), (Q), (R) and (S) and **FIVE** statements in **List-II** entries (1), (2), (3), (4) and (5). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.

8. List –I contains four different AC circuits with AC sources as shown in the figure. List-II contains the rms currents through the different AC sources of the circuits.

List –I		List –II	
(P)	 <p>$\varepsilon = 80\sin(100t)$ volt</p>	(1)	$\sqrt{2}$ Amp

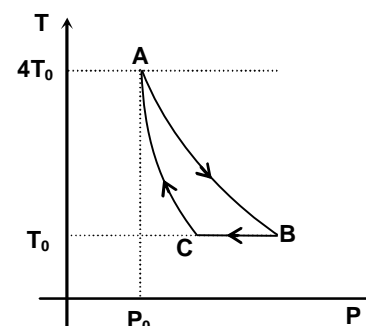
(Q)	 <p>$\varepsilon = 50\sin(100t)$ volt</p>	(2)	$4\sqrt{10}$ Amp
(R)	 <p>$\varepsilon = 40\sqrt{5} \sin(100t)$ volt</p>	(3)	$2\sqrt{10}$ Amp
(S)	 <p>$\varepsilon = 200\sqrt{5} \sin(100t)$ volt</p>	(4)	$2\sqrt{5}$ Amp
		(5)	$2\sqrt{2}$ Amp

The correct option is:

- (A) (P) → (4) (Q) → (1) (R) → (5) (S) → (3)
 (B) (P) → (4) (Q) → (2) (R) → (5) (S) → (4)
 (C) (P) → (1) (Q) → (3) (R) → (4) (S) → (2)
 (D) (P) → (2) (Q) → (5) (R) → (1) (S) → (3)

9.

One mole of an ideal diatomic gas undergoes a cyclic process as shown in Temperature-Pressure graph. Temperature and pressure of gas at 'A' is $4T_0$ and P_0 respectively and temperature in process BC is T_0 . The process AB is given by $TP^2 = \text{constant}$ and the process CA is given by $TP^4 = \text{constant}$.



List –I describe the name of thermodynamics process involve in the cyclic process and List-II gives work done by gas in the process, change in internal energy of the gas in the process and heat given to the gas in the process.

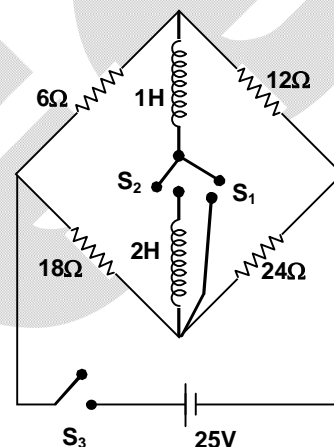
List –I		List –II	
(P)	In the thermodynamics process A → B	(1)	Work done by gas and heat given to gas is negative
(Q)	In the thermodynamics process B → C	(2)	Work done by gas is negative but heat given to gas is positive

(R)	In the thermodynamics process $C \rightarrow A$	(3)	Work done by gas is positive but heat given to gas negative
(S)	In the cyclic process	(4)	Work done by gas and heat given to gas is positive
		(5)	Work done by gas is positive and change in internal energy of gas is negative

The correct option is:

- (A) (P) \rightarrow (3) (Q) \rightarrow (2) (R) \rightarrow (2) (S) \rightarrow (4)
 (B) (P) \rightarrow (3) (Q) \rightarrow (2) (R) \rightarrow (5) (S) \rightarrow (4)
 (C) (P) \rightarrow (2) (Q) \rightarrow (2) (R) \rightarrow (1) (S) \rightarrow (3)
 (D) (P) \rightarrow (1) (Q) \rightarrow (4) (R) \rightarrow (4) (S) \rightarrow (1)

10. Four resistors 6Ω , 12Ω , 18Ω and 24Ω , two ideal inductors $1H$ and $2H$ and a battery of $25V$ are arranged in the given circuit with the help of three switches S_1 , S_2 and S_3 as shown in the figure. ($e^{-1} = 0.37$).



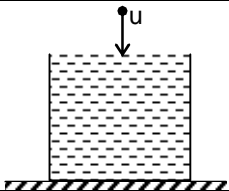
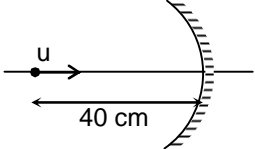
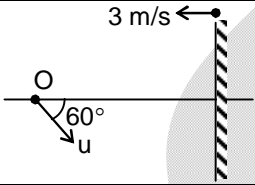
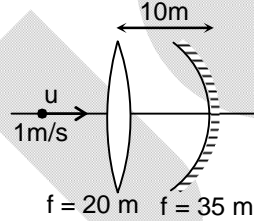
List -I describes statement regarding the given circuit and List-II gives their values. (either exactly or as a close approximation).

List -I		List -II	
(P)	When switch S_1 and S_3 closed simultaneously and S_2 remain opened. Then time constant of circuit in second.	(1)	1.35
(Q)	When switch S_1 and S_3 remain closed for long time and S_2 remain opened then current through inductor in ampere at one time constant.	(2)	0.07
(R)	When switch S_1 and S_3 remain closed for long time and S_2 remain opened then current in 12Ω resistance at one time constant.	(3)	0.056
(S)	If S_1 and S_3 remain closed for long time and then S_1 is opened, S_2 is closed and S_3 remain closed then find current in the branch of inductor immediately after switching.	(4)	0.105
		(5)	0.167

The correct option is:

- (A) (P) \rightarrow (3) (Q) \rightarrow (2) (R) \rightarrow (2) (S) \rightarrow (4)
 (B) (P) \rightarrow (2) (Q) \rightarrow (4) (R) \rightarrow (1) (S) \rightarrow (3)
 (C) (P) \rightarrow (2) (Q) \rightarrow (2) (R) \rightarrow (1) (S) \rightarrow (3)
 (D) (P) \rightarrow (2) (Q) \rightarrow (5) (R) \rightarrow (1) (S) \rightarrow (3)

11. In List-I motion of a particle is shown and in List-II relative speed between object and its image is given.

List -I			List -II	
(P)	Object is moving towards water with velocity 3 m/s. Refractive index of water is $\frac{4}{3}$		(1)	10 m/s
(Q)	Object O is moving towards concave mirror focal length 10 cm with velocity $u = 9$ m/s		(2)	1 m/s
(R)	Object is moving towards plane mirror with velocity $u = 2$ m/s and mirror is also moving with velocity 3 m/s as shown in the figure.		(3)	0
(S)	Observer O is moving toward lens with speed 1 m/s, which is at 15 m away from it. The separation between lens ($f = 20$ m) and mirror ($f = 35$ m) is 10 m.		(4)	8 m/s
			(5)	15 m

The correct option is:

- (A) (P) \rightarrow (3) (Q) \rightarrow (2) (R) \rightarrow (2) (S) \rightarrow (4)
 (B) (P) \rightarrow (3) (Q) \rightarrow (2) (R) \rightarrow (5) (S) \rightarrow (4)
 (C) (P) \rightarrow (2) (Q) \rightarrow (1) (R) \rightarrow (4) (S) \rightarrow (3)
 (D) (P) \rightarrow (2) (Q) \rightarrow (5) (R) \rightarrow (1) (S) \rightarrow (3)

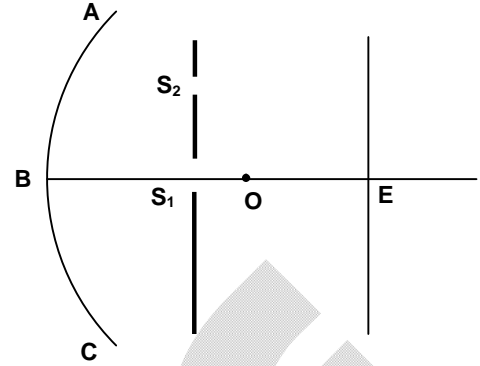
SECTION – B

(Numerical Answer Type)

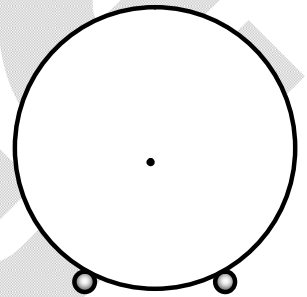
This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.

12. When a soap bubble of radius r is charged to a uniform density σ , its radius increases to triple value. Assume temperature remains constant during expansion and atmospheric pressure as P_0 . The pressure inside the initially uncharged bubble of radius r is $P = \left(\frac{\sigma^2}{X\epsilon_0} - \frac{Y}{4} P_0 \right)$. Find the value of $(X - 5Y)$. [Charge resides only on the outer surface of the bubble]

13. ABC is a spherical wavefront centered at O is incident on slits S_1 and S_2 . $BS_1 = 3\lambda$, $S_1S_2 = 4\lambda$, $BO = 6\lambda$, $S_1E = 128\lambda$, here λ is the wavelength of incident wave. A mica sheet of refractive index 1.5 is pasted on S_2 . If the minimum value of thickness of mica sheet for which central maxima is formed at E is $\frac{31\lambda}{N}$. Find the value of N.



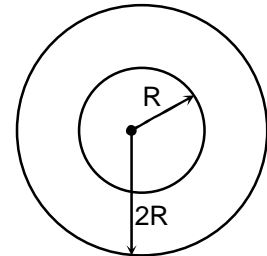
14. A sphere of radius r is rolling horizontally without slipping on two parallel rails placed a distance $r/2$ apart (in the diagram the sphere is rolling perpendicular to the plane of the page). If the centre of mass of the sphere has a speed v , the maximum velocity among all points of the sphere is $v_{\max} = \left(\frac{3k + 4\sqrt{15}}{15} \right) v$. Find the value of k .



15. A small body starts falling on to the sun from a distance equal to the radius of the earth's orbit around the sun. The initial velocity of the body is zero relative to the heliocentric reference frame. If the time period of revolution of earth around the sun is T_0 and the time taken by the body to fall on the surface of sun is $\left(\frac{nT_0}{16\sqrt{2}} \right)$. Find the value of n .

16. In the process of nuclear fission of 3g uranium, the mass lost is 1.5 mg. The efficiency of power house run by the fission reactor is 20%. To obtain 1200 megawatt power from the power house, how much uranium (in gram) will be required per hour?

17. Two bubbles contain same ideal gas such that one is trapped inside other. System is kept in vacuum. Ratio of densities of inner and middle gas is x and the ratio of number of moles is y then value of $\frac{x}{y}$ is (Assume temperature of both regions are same)



Chemistry

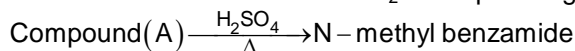
PART – II

SECTION – A

(One Options Correct Type)

This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

18. Ketone 'P' on treatment with NH_2OH at $\text{pH} = 5$ gives compound (A).

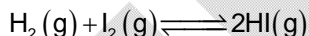


(Major)

So, correct structure of 'A' is:

- (A) $\begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{C}=\text{N}-\text{OH} \\ | \\ \text{Ph} \end{array}$
- (B) $\begin{array}{c} \text{Ph} \\ | \\ \text{C}=\text{N}-\text{OH} \\ | \\ \text{H}_3\text{C} \end{array}$
- (C) $\begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{C}=\text{N}-\text{OH} \\ | \\ \text{H}_3\text{C} \end{array}$
- (D) $\begin{array}{c} \text{Ph} \\ | \\ \text{C}=\text{N}-\text{OH} \\ | \\ \text{Ph} \end{array}$

19. 1 mole of $\text{H}_2(\text{g})$ and 1 mole of $\text{I}_2(\text{g})$ are taken in a container at 400 K and the following equilibrium is allowed to establish:



The equilibrium mixture required 100 mL of 10 M hypo solution up to starch end point (i.e. blue colour of starch indicator is disappeared). So, the dissociation constant per mole of HI at 400 K will be:

- (A) 0.25 (B) 0.50
(C) 4 (D) 2
20. Identify the compound which differ in its colour from rest of the three:
(A) Potassium hexanitritocobaltate(III)
(B) Tetraamminecopper(II) sulphate
(C) Ferric ferrocyanide
(D) Hexaamminenickel(II) chloride

21. In a sample of H-atoms, all atoms are initially in their 4th excited state and now these atoms are allowed to de-excite to the ground state. Now, choose the only INCORRECT statement of the following: (Assume multiple excitation of atoms is not allowed)
(A) If the sample contains only two H-atoms, then a maximum of six distinct spectral lines can be observed in its emissions spectrum.
(B) Minimum five hydrogen atoms, the sample should contain in order to show all possible spectral lines in its emission spectrum

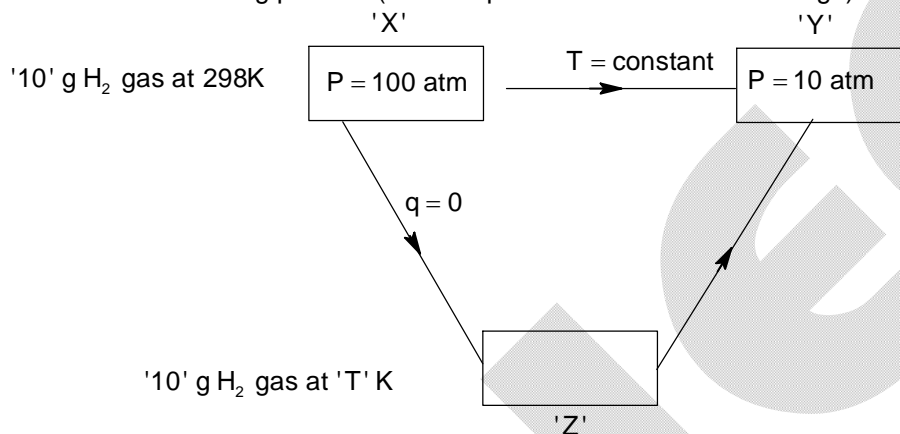
- (C) If the sample contains 8 H-atoms, then maximum number of 10 spectral lines can be observed, in its emission spectrum
- (D) If the sample contains minimum 6 H-atoms, then a maximum of 10 spectral lines can be observed in its emission spectrum.

SECTION – A

(One or More than one correct type)

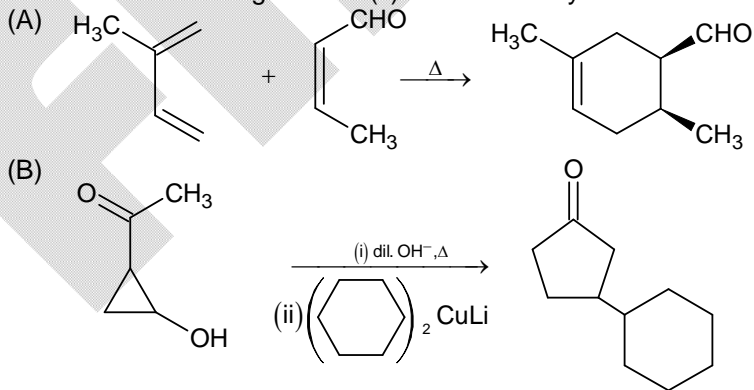
This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

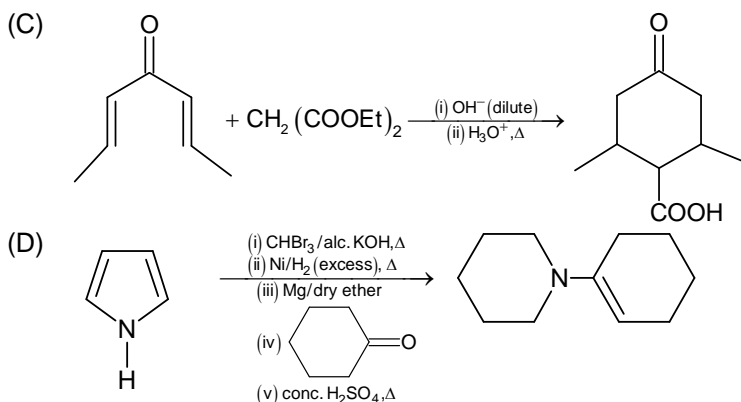
22. Consider the following process (each step involves a reversible change)



Select the correct choice(s):

- (A) $\Delta S_{X \rightarrow Z} = 0$
- (B) $\Delta S_{X \rightarrow Z \rightarrow Y} = 0$
- (C) $\Delta S_{X \rightarrow Y} = 95.7 \text{ JK}^{-1}$
- (D) $\Delta S_{X \rightarrow Y} = \Delta S_{Z \rightarrow Y} = 95.7 \text{ JK}^{-1}$
23. 100 ml of 0.1 M aqueous solution of sodium phosphate is titrated using 0.1 M HCl. Now, choose the correct statement(s) of the following: (For H₃PO₄ : $K_{a_1} = 10^{-3}$, $K_{a_2} = 10^{-8}$ and $K_{a_3} = 10^{-13}$ at 25°C)
- (A) The pH of the solution is 13 at 25°C, when the titre value is 50 mL.
- (B) pH of the solution is 10.5 at 25°C, when the titre value is 100 mL.
- (C) pH of the solution is 8 at 25°C, when the titre value is 150 mL.
- (D) pH of the solution is 3 at 25°C, when the titre value is 200 mL.
24. Which of the following reaction(s) is/are correctly matched with their major product?





SECTION – A (Matching List Type)

This section contains **FOUR (04)** Matching List Type Questions. Each question has **FOUR** statements in **List-I** entries (P), (Q), (R) and (S) and **FIVE** statements in **List-II** entries (1), (2), (3), (4) and (5). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.

25. Some reactions are given in List-I. The product of each reaction (in List-I) containing the underlined element is treated with excess of PCl_5 to form one or more product(s) given in List-II. Now match List-I with List-II and choose the correct option from the codes given below:

List – I		List – II	
(P)	$\underline{\text{P}}_4$ (White) + O_2 (Excess) \longrightarrow	(1)	POCl_3
(Q)	$\underline{\text{P}}_4$ (White excess) + O_2 \longrightarrow	(2)	PCl_3
(R)	$\underline{\text{P}}_4$ (White) + Conc. HNO_3 \longrightarrow	(3)	SOCl_2
(S)	P_4 (White) + $\underline{\text{S}}\text{O}_2\text{Cl}_2$ \longrightarrow	(4)	HCl
		(5)	1 mole of the product containing underlined element (in list-I) requires at least three moles of PCl_5 to react completely

Codes:

- (A) $\text{P} \rightarrow 1, 5$; $\text{Q} \rightarrow 2, 5$; $\text{R} \rightarrow 1, 4$; $\text{S} \rightarrow 3, 5$
 (B) $\text{P} \rightarrow 1, 5$; $\text{Q} \rightarrow 1, 2, 5$; $\text{R} \rightarrow 1, 4, 5$; $\text{S} \rightarrow 1, 3$
 (C) $\text{P} \rightarrow 1, 2, 5$; $\text{Q} \rightarrow 1, 5$; $\text{R} \rightarrow 4, 5$; $\text{S} \rightarrow 1, 2, 3$
 (D) $\text{P} \rightarrow 1, 2, 5$; $\text{Q} \rightarrow 1, 2, 5$; $\text{R} \rightarrow 1, 4, 5$; $\text{S} \rightarrow 3$
26. Match the complex formed as a result of reactions given in List – I with their characteristics given in List II and choose the correct option, from the codes given below:

List – I		List – II	
(P)	$\text{CuSO}_4 + \text{NH}_3$ (aq.) $\xrightarrow{\text{(excess)}}$	(1)	Colour of the complex is blue
(Q)	$\text{CoCl}_2 + \text{KNO}_2 \xrightarrow{\text{CH}_3\text{COOH}}$	(2)	Hybridization of central metal ion is sp^3
(R)	$\text{CoCl}_2 + \text{NH}_4\text{SCN} \longrightarrow$	(3)	Complex is paramagnetic
(S)	$\text{CuSO}_4 + \text{KCN} \xrightarrow{\text{(excess)}}$	(4)	Colour of the complex is yellow
		(5)	Spin only magnetic moment of the complex = 3.87 BM

Codes:

- (A) $\text{P} \rightarrow 1, 3$; $\text{Q} \rightarrow 4, 5$; $\text{R} \rightarrow 1, 2, 3, 5$; $\text{S} \rightarrow 2, 3$
 (B) $\text{P} \rightarrow 1, 3, 5$; $\text{Q} \rightarrow 4$; $\text{R} \rightarrow 1, 2, 3$; $\text{S} \rightarrow 2$
 (C) $\text{P} \rightarrow 1, 3$; $\text{Q} \rightarrow 4$; $\text{R} \rightarrow 1, 2, 3, 5$; $\text{S} \rightarrow 2$
 (D) $\text{P} \rightarrow 3, 4$; $\text{Q} \rightarrow 1, 3$; $\text{R} \rightarrow 2, 3, 5$; $\text{S} \rightarrow 2, 4$

27. Match the major organic product of reactions given in List I with their characteristics given in List II and choose the correct option from the codes given below:

List – I		List – II	
(P)	Hepta – 2,5 – dien – 4 – one $\xrightarrow[\text{(iii) } \Delta]{\text{(i) diethyl malonate/OH}^{\ominus} \text{ (excess)}}$	(1)	It gives positive BRADY'S test
(Q)	Hexan – 2,5 – dione $\xrightarrow[\text{(ii) } \text{CHBr}_3/\text{t-BuOK}, \Delta]{\text{(i) } (\text{NH}_4)_2\text{CO}_3/\Delta}$	(2)	It is cyclic
(R)	Cyclohexan – 1,3 – dione $\xrightarrow{\text{But-3-en-2-one/dil. NaOH(excess), } \Delta}$	(3)	It is aromatic
(S)	Pent – 4 – enoic acid $\xrightarrow{\text{I}_2/\text{NaHCO}_3}$	(4)	It contains at least one six-membered ring
		(5)	Degree of unsaturation is ≥ 3

Codes:

- (A) P \rightarrow 1, 2, 4, 5; Q \rightarrow 2, 3, 4, 5; R \rightarrow 1, 2, 4, 5; S \rightarrow 2, 4
 (B) P \rightarrow 1, 3, 4, 5; Q \rightarrow 2, 4, 5; R \rightarrow 2, 4; S \rightarrow 1, 2, 4, 5
 (C) P \rightarrow 1, 2, 3, 4; Q \rightarrow 2, 3, 5; R \rightarrow 1, 2, 4, 5; S \rightarrow 2, 3, 5
 (D) P \rightarrow 1, 2, 4; Q \rightarrow 2, 3, 4, 5; R \rightarrow 1, 2, 4, 5; S \rightarrow 2, 4
28. Match the reactions given in List I with characteristics of their products given in List II and choose the correct option from the codes given below:

List – I		List – II	
(P)	$\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O}_2 + \text{KOH} \longrightarrow$	(1)	Red-brown solid is formed
(Q)	$\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O}_2 + \text{H}_2\text{SO}_4 \longrightarrow$	(2)	Green oily liquid is formed
(R)	$\text{K}_4[\text{Fe}(\text{CN})_6] + \text{dil. H}_2\text{SO}_4 \xrightarrow{\Delta}$	(3)	Blue coloured solution is obtained
(S)	$\text{KMnO}_4 + \text{Conc. H}_2\text{SO}_4 \text{ (cold)} \longrightarrow$	(4)	Contains at least one peroxide linkage
		(5)	A linear triatomic gas is formed as one of the product

- (A) P \rightarrow 1, 5; Q \rightarrow 2, 5; R \rightarrow 5; S \rightarrow 2
 (B) P \rightarrow 1, 4; Q \rightarrow 3, 4; R \rightarrow 5; S \rightarrow 2
 (C) P \rightarrow 3; Q \rightarrow 2; R \rightarrow 3; S \rightarrow 5
 (D) P \rightarrow 2, 4; Q \rightarrow 3, 5; R \rightarrow 3; S \rightarrow 3, 4

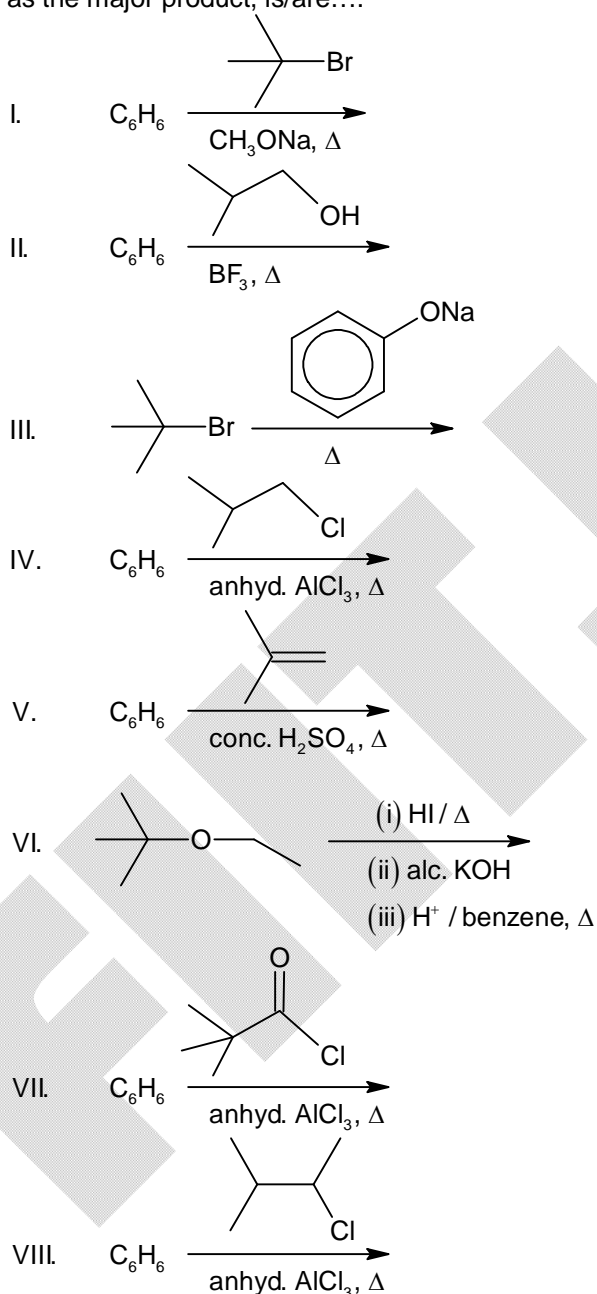
SECTION – B

(Numerical Answer Type)

This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.

29. Total number of isomers of a compound having molecular formula, $\text{K}_3\text{Fe}(\text{C}_6\text{N}_6)_3$ is:
30. The ratio of the sum of number of resonating structures and number of plane of symmetry in the anionic moiety of gypsum to the number of resonating structures in the anionic moiety of calcium phosphate is...
31. Consider the following species:
- | | | | | |
|------------------------------|----------------------------|------------------------|--------------------------------------|-----------------|
| $[\text{VO}(\text{acac})_2]$ | $[\text{Fe}(\text{CO})_5]$ | $[\text{PtCl}_4]^{2-}$ | $\text{K}_4[\text{Fe}(\text{CN})_6]$ | $[\text{IF}_7]$ |
| (I) | (II) | (III) | (IV) | (V) |
- [Where acac : acetyl acetonate ion]
 If, the sum of axial d-orbitals having conical nodal surfaces in all the species be 'x'
 The sum of axial d-orbitals having two nodal planes in all species be 'y' and the sum of non-axial d-orbitals in all species be 'z' then find the value of $(x + z - y)^2$.

32. Total number of moles of ethanoyl chloride required to completely acetylate one mole of Lactose is.....
33. 1 L hard water (density = 1.5 g/cm^3) after passing through acidic resin (RH_2) has pH = 3.52 at 25°C . Assume that Ca^{2+} ions are the only cations present in hard water sample, if the degree of hardness of this sample of hard water in parts per million (ppm) of CaCO_3 is found to be $2x$, then find the value of x . [$\log_{10} 3 = 0.48$]
34. Some reactions are given below. The number of reaction(s) in which tert-butyl benzene is formed as the major product, is/are....



Mathematics

PART – III

SECTION – A

(One Options Correct Type)

This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

35. Let $A = \begin{bmatrix} 2 & 1 \\ 0 & 3 \end{bmatrix}$ be a matrix. If $A^{14} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $a + d$ is divisible by
 (A) 10 (B) 11
 (C) 12 (D) 13
36. Let $f(x)$ is twice differentiable function such that $\frac{d^2}{dx^2}(e^{-x^2}f(x)) < 0$, $f(0) = 0$, $f(1) = 1$, then which of the following is true?
 (A) $f(x) < xe^{(x^2-1)} \forall x \in (0, 1)$ (B) $f(x) > xe^{(x^2-1)} \forall x \in (0, 1)$
 (C) $f\left(\frac{1}{2}\right) < \frac{1}{2e}$ (D) none of these
37. Given the sequence of numbers $a_1, a_2, \dots, a_{1013}$ which satisfy $\frac{a_1}{a_1+1} = \frac{a_2}{a_2+3} = \frac{a_3}{a_3+5} = \dots = \frac{a_{1013}}{a_{1013}+2025}$ also $a_1 + a_2 + \dots + a_{1013} = 2026$, then 41th term of the sequence is equal to
 (A) $\frac{166}{1013}$ (B) $\frac{162}{1013}$
 (C) $\frac{160}{1013}$ (D) $\frac{157}{1013}$
38. Let $f(x)$ and $g(x)$ are two quadratic polynomial having leading coefficient one, it is known that $f(21) + f(5) + f(78) = g(21) + g(5) + g(78)$ the real value of x satisfy the equation $f(x) = g(x)$ is
 (A) $\frac{102}{3}$ (B) 102
 (C) $\frac{104}{3}$ (D) 104

SECTION – A

(One or More than one correct type)

This section contains **THREE (03)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

39. Let $f(x) = [x] + 2\left[\frac{x}{2}\right] + 4\left[\frac{x}{4}\right] + \dots \forall x \geq 0$, (where $[.]$ represents greatest integer function), then
 (A) $\int_0^{16} f(x) dx = 2^3 + 2^7 + 2^8$ (B) $\int_0^{32} f(x) dx = 2^4 + 2^{11}$
 (C) $\int_0^{64} f(x) dx = 2^5 + 2^{11} + 2^{13}$ (D) $\int_0^{128} f(x) dx = 2^6 + 2^{14} + 2^{15}$

40. Let all roots of the polynomial $p(x) = a_{2024}(x)^{2024} + a_{2023}(x)^{2023} + \dots + a_1x + a_0$ are real and smaller than 1, for any such polynomial, consider the function
- $$f(x) = a_{2024} \frac{e^{2024x}}{2024} + a_{2023} \frac{e^{2023x}}{2023} + \dots + a_1 e^x + a_0 x$$
- , then which of the following is INCORRECT?
- (A) $f'(x)$ has 2024 real roots in $(-\infty, 0)$ (B) f is increasing in $(0, \infty)$
 (C) f is decreasing in $(0, \infty)$ (D) f'' has no real roots in $(0, \infty)$
41. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ given by $f(\alpha) = \alpha - \int_0^1 g(\alpha) d\alpha$ and $g : \mathbb{R} \rightarrow \mathbb{R}$ given by $g(t) = 1 + \frac{t^3}{2} - t \int_0^t f(x) dx$, $x, \alpha, t \in \mathbb{R}$, then which of the following is TRUE?
- (A) $g(x)$ is not bounded function
 (B) $g(x)$ has one point of minima
 (C) for function $f(x) + g(x)$ minima exist at $x = -\frac{1}{3}$
 (D) function $f(x) + g(x)$ is strictly increasing in $\left(\frac{3}{2}, \infty\right)$

SECTION – A (Matching List Type)

This section contains **FOUR (04)** Matching List Type Questions. Each question has **FOUR** statements in **List-I** entries (P), (Q), (R) and (S) and **FIVE** statements in **List-II** entries (1), (2), (3), (4) and (5). The codes for lists have choices (A), (B), (C), (D) out of which **ONLY ONE** of these four options is correct answer.

42. Match entry in List-I to the correct entry in List-II

List – I		List – II	
(P)	If $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$, then trace of (A^{2024}) is	(1)	1
(Q)	If the system of equations $x + 4y - z = \alpha$, $7x + 9y + \beta z = -3$ and $5x + y + 2z = -1$ has infinitely many solution, then $4\beta - 3\alpha$ is	(2)	2
(R)	If $\cos A \hat{i} + \hat{j} + \hat{k}$, $\hat{i} + \cos B \hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + \cos C \hat{k}$ ($A \neq B \neq C \neq 2n\pi$) are coplanar vectors, then the value of $\left \cot^2 \frac{A}{2} + \cot^2 \frac{B}{2} + \cot^2 \frac{C}{2} \right $ is	(3)	3
(S)	The plane $x + y + z + 1 = 0$ is rotated through right angle about its line of intersection with the plane $2y + z - 4 = 0$, the equation of the plane in new position is $x - y + k = 0$, then k is	(4)	4
		(5)	5

The correct option is:

- (A) (P) \rightarrow (2); (Q) \rightarrow (3); (R) \rightarrow (4); (S) \rightarrow (5)
 (B) (P) \rightarrow (3); (Q) \rightarrow (1); (R) \rightarrow (5); (S) \rightarrow (4)
 (C) (P) \rightarrow (3); (Q) \rightarrow (5); (R) \rightarrow (1); (S) \rightarrow (4)
 (D) (P) \rightarrow (2); (Q) \rightarrow (3); (R) \rightarrow (1); (S) \rightarrow (5)

43. An ellipse E has its centre C(1, 3), focus at S(6, 3) and passing through the point P(4, 7), then

List – I		List – II	
(P)	If a and b is length of semi-major axis and semi minor axis of ellipse E, then $a^2 - b^2$ is	(1)	5
(Q)	The product of the length of perpendicular segments from the foci on tangent at P is	(2)	10
(R)	If the point of intersection of lines joining each focus to the foot of perpendicular from the other focus upon the tangent at point P is (α, β) , then $3\alpha + \beta$ is	(3)	15
(S)	If the normal at a variable point on the ellipse meet its axes in Q and R, then the locus of mid-point of QR is a conic with an eccentricity (e), then $18(e)^2$ is	(4)	20
		(5)	25

The correct option is:

- (A) (P) \rightarrow (3); (Q) \rightarrow (5); (R) \rightarrow (2); (S) \rightarrow (4)
 (B) (P) \rightarrow (5); (Q) \rightarrow (4); (R) \rightarrow (3); (S) \rightarrow (2)
 (C) (P) \rightarrow (3); (Q) \rightarrow (5); (R) \rightarrow (1); (S) \rightarrow (4)
 (D) (P) \rightarrow (5); (Q) \rightarrow (4); (R) \rightarrow (1); (S) \rightarrow (2)
44. Let $[.]$ and $\{.\}$ denotes the greatest integer function and the fractional part function respectively, then

List – I		List – II	
(P)	$\left[444 \int_{-1}^1 \frac{3x^{443} + x^{1331} + 8x^{884} \sin x^{871}}{1 + x^{888}} dx \right]$ is	(1)	0
(Q)	$\int_0^{2024} x \cos(2\pi\{x\}) dx$ is	(2)	4
(R)	$\left[\frac{9(\sqrt{1} + \sqrt{2} + \sqrt{3} + \dots + \sqrt{10000})}{10^8} \right]$ is	(3)	5
(S)	If $y = \int_x^{x^2} \frac{dt}{t + \sqrt{t}}$, then least value of $\frac{e^y}{(\sqrt{2}-1)^2}$ is	(4)	6
		(5)	7

The correct option is:

- (A) (P) \rightarrow (1); (Q) \rightarrow (5); (R) \rightarrow (2); (S) \rightarrow (4)
 (B) (P) \rightarrow (3); (Q) \rightarrow (1); (R) \rightarrow (5); (S) \rightarrow (4)
 (C) (P) \rightarrow (3); (Q) \rightarrow (1); (R) \rightarrow (4); (S) \rightarrow (2)
 (D) (P) \rightarrow (1); (Q) \rightarrow (5); (R) \rightarrow (3); (S) \rightarrow (2)

45. Match entry in List-I to the correct entry in List-II

List – I		List – II	
(P)	A and B are acute angles which satisfy $3 \sin^2 A + 2 \sin^2 B = 1$ and $3 \sin 2A - 2 \sin 2B = 0$ let $A + 2B = \lambda \cdot \frac{\pi}{4}$, then λ is	(1)	2
(Q)	For some positive integer λ and μ if $\frac{\cos 3x}{\sin 5x} - \frac{\sin 3x}{\cos 5x} = \lambda (\sin 2x + \cos 2x \cdot \cot \mu x)$ where $x \in \left(0, \frac{\pi}{20}\right)$, then value of $\frac{\mu}{\lambda}$ is	(2)	3
(R)	If $f(x) = \cos^{-1}(4x^3 - 3x)$ and $\lim_{x \rightarrow \frac{1}{2}^+} f'(x) = \lambda$ and $\lim_{x \rightarrow \frac{1}{2}^-} f'(x) = \mu$, then $\lambda + \mu + 3$ is	(3)	5
(S)	If ABC be a triangle and BE and CF be the angle bisector of $\angle B$ and $\angle C$ with E on AC and F on AB. Let P and Q be the foot of perpendicular from A to BE and CF respectively. Let R is the point at which the incircle of $\triangle ABC$ touches AB. If $\frac{AR}{PQ} = \frac{\lambda}{\mu}$ (λ and μ are coprime), then $\lambda + \mu$ is	(4)	7
		(5)	8

The correct option is:

- (A) (P) \rightarrow (5); (Q) \rightarrow (2); (R) \rightarrow (4); (S) \rightarrow (1)
 (B) (P) \rightarrow (3); (Q) \rightarrow (1); (R) \rightarrow (5); (S) \rightarrow (4)
 (C) (P) \rightarrow (3); (Q) \rightarrow (5); (R) \rightarrow (1); (S) \rightarrow (4)
 (D) (P) \rightarrow (1); (Q) \rightarrow (3); (R) \rightarrow (2); (S) \rightarrow (1)

SECTION – B

(Numerical Answer Type)

This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.

46. Let x be a real number for which $\left[x + \frac{19}{100}\right] + \left[x + \frac{20}{100}\right] + \left[x + \frac{21}{100}\right] + \dots + \left[x + \frac{91}{100}\right] = 546$, then find $[100x]$
47. For all real number x , let $f(x) = \frac{1}{\sqrt[2011]{1-x^{2011}}}$. Find the number of real root of the equation $f(f(\dots(f(x))\dots)) = \{-x\}$, where f is applied 2025 times (Where $\{.\}$ represent fractional part function)
48. $\lim_{n \rightarrow \infty} \left(((2025)^{2026})^n + ((2026)^{2025})^n \right)^{\frac{1}{n}}$ is equal to a^b , where $a, b \in \mathbb{N}$, then $|a - b|$ is equal to
49. n biased coins, with m^{th} coin having probability of throwing tail equal to $\frac{1}{2m+1}$ ($m = 1, 2, \dots, n$) are tossed once. The probability an odd number of tails, if results for each coin are independent, is $\frac{xn}{yn+z}$, where $x, z \in \mathbb{N}$ and y is a prime number, then the value of $2x + y + z$ is

50. Consider f be a injective function from set $A\{-2, 1, 0\}$ to set $B\{1, 2, 3\}$ such that exactly one of the following statement is true : $f(-2) = 1$, $f(1) \neq 1$, $f(0) \neq 2$ and the remaining two are false. If the area of the triangle formed by $(-2, 1, 0)$, $(f(-2), f(1), f(0))$ and origin is given by $\frac{\sqrt{k}}{2}$, then k is
51. The internal angle bisector of the $\triangle ABC$ meet the opposite sides in D, E, F respectively. (Where $AB = 2$, $BC = 3$, $AC = 4$ units), such that the area of $\triangle ABC = k$ (area of $\triangle DEF$), then integral part of k is equal to