



JEE(Advanced) : MOCK TEST-02

PAPER-1

HAVE CONTROL → HAVE PATIENCE → HAVE CONFIDENCE ⇒ 100% SUCCESS

BEWARE OF NEGATIVE MARKING

PART-1 : PHYSICS

SECTION-I (i) : (Maximum Marks: 24)

- This section contains **SIX (06)** questions.
- Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s)
- 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.

- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

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1. A variable capacitor with initial capacitance C_0 is charged to a voltage V_0 and is short circuited through a resistance R . If current remains constant during discharging (an external agent is pulling the plates apart) then choose correct option(s).

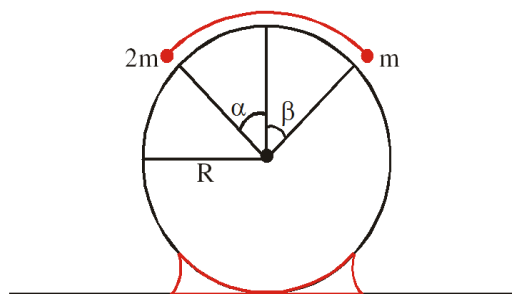
(A) Variation of capacitance with time is given by $C = C_0 \left(1 - \frac{t}{RC_0} \right)$.

(B) Time taken to discharge the capacitor is given by $t = RC_0$.

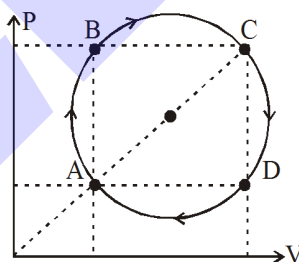
(C) Total heat produced in the resistor is $C_0 V_0^2$.

(D) Initial energy stored in the capacitor is $\frac{1}{2} C_0 V_0^2$.

2. A cylindrical body of radius R is fixed in a horizontal position. A piece of ideal thread of length ℓ was laid on its slippery surface. On one end of thread a point like body of mass m is attached, while to the other end another point like body of mass $2m$ is attached. Choose correct statement(s). The system is in equilibrium.



- (A) $2 \sin \alpha = \sin \beta$
 (B) $2 \sin \beta = \sin \alpha$
 (C) Maximum possible length of string is $\ell_{\max} = 2\pi R/3$.
 (D) Maximum possible length of string is $\ell_{\max} = 2R$.
3. By properly combining two prisms made of different materials, it is possible to :-
 (A) have dispersion without average deviation.
 (B) have deviation without dispersion.
 (C) have both dispersion and average deviation.
 (D) have neither dispersion nor average deviation.
4. A sample of ideal gas of some mass is taken through the cyclic process shown in the figure. The temperature of the gas at state A is $T_A = 200$ K, and at state C is $T_C = 1800$ K. Choose the correct option(s) :-



- (A) $\frac{V_A}{V_C} = \frac{1}{3}$ (B) $\frac{V_A}{V_B} = \frac{1}{9}$ (C) $\frac{P_A V_A}{P_C V_C} = \frac{1}{3}$ (D) $\frac{P_A V_A}{P_C V_C} = \frac{1}{9}$

5. X-ray from a tube with a target A of atomic number Z shows strong K lines for target A and weak K lines for impurities. The wavelength of K_{α} lines is λ_z for target A and λ_1 and λ_2 for two impurities. If $\frac{\lambda_z}{\lambda_1} = 4$ and $\frac{\lambda_z}{\lambda_2} = \frac{1}{4}$. Screening constant of K_{α} lines to be unity. Select the correct statement(s).
- (A) The atomic number of first impurity is $2Z - 1$.
- (B) The atomic number of first impurity is $2Z + 1$.
- (C) The atomic number of second impurity is $\frac{(Z + 1)}{2}$.
- (D) The atomic number of second impurity is $\frac{Z}{2} + 1$.
6. A man is sitting in a boat floating in water. There are heavy stones placed in the boat.
- (A) When the man throws the stones in water, the level of boat goes down.
- (B) When the man throws the stones in water, the level of boat rises up.
- (C) When the man drinks some water, the level of boat goes down
- (D) When the man drinks some water, the level of boat remains unchanged.

SECTION-I (ii) : (Maximum Marks: 12)

- This section contains **FOUR (04)** questions.
- Each **question has matching lists**. The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3 If ONLY the correct option is chosen.

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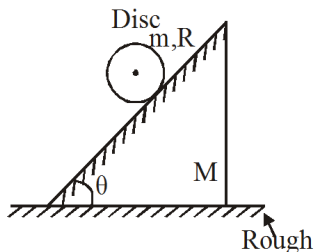
Negative Marks : -1 In all other cases

7. A block of mass 1.0 kg is pulled up on a rough slope of inclination 37° with the horizontal. The coefficient of kinetic friction between the block and the slope is 0.25. The block moves with acceleration 2.0 m/s^2 . After 5.0 s from the instant the block starts, which of the following statements is/are true ? (Power of any force is given by $P = \vec{F} \cdot \vec{V}$)

	List-I		List-II
(I)	Power delivered by the pulling force	(P)	20 W
(II)	Power delivered by the weight of the block	(Q)	-20 W
(III)	Power delivered by the friction between the slope and the block	(R)	-60 W
(IV)	Power delivered by the contact force between the slope and the block	(S)	100 W
		(T)	80 W

- (A) I \rightarrow P; II \rightarrow R; III \rightarrow Q; IV \rightarrow S
 (B) I \rightarrow S; II \rightarrow R; III \rightarrow Q; IV \rightarrow Q
 (C) I \rightarrow P; II \rightarrow Q; III \rightarrow R; IV \rightarrow S
 (D) I \rightarrow Q; II \rightarrow S; III \rightarrow T; IV \rightarrow P

8. A disc of mass m and radius R is performing pure rolling on the inclined surface of a wedge of mass M . Wedge is placed on a rough horizontal surface. If wedge does not move on the horizontal surface then match the followings.



	List-I		List-II
(I)	Frictional force acting on disc	(P)	$\frac{mg \sin \theta}{3}$
(II)	Vertical component of net frictional force acting on wedge	(Q)	$\frac{mg \sin^2 \theta}{3}$
(III)	Normal reaction acting on disc	(R)	$mg \cos \theta$
(IV)	Normal reaction acting on wedge by the ground	(S)	$\left(m \cos^2 \theta + \frac{m}{3} \sin^2 \theta + M \right) g$
		(T)	$\left(m \sin^2 \theta + \frac{m}{3} \cos^2 \theta + M \right) g$

- (A) $I \rightarrow P; II \rightarrow Q; III \rightarrow S; IV \rightarrow T$
 (B) $I \rightarrow P; II \rightarrow Q; III \rightarrow T; IV \rightarrow S$
 (C) $I \rightarrow P; II \rightarrow Q; III \rightarrow R; IV \rightarrow S$
 (D) $I \rightarrow S; II \rightarrow T; III \rightarrow P; IV \rightarrow Q$

9. Match the following lists.

	List-I		List-II
(I)	Nearby objects appear moving past faster than distant objects.	(P)	Human eye sense the direction from which light enters it.
(II)	Extremely distant objects appear moving among with us	(Q)	It cannot resolve two points if they subtend an angle less than one minute.
(III)	Many people believe that they can read better in bright light than in dim light	(R)	Persistence of human eye is 0.1 s
(IV)	The colors of the surface of bodies that can be impregnated with water appear richer after moistening the surface.	(S)	Contraction of the pupil in bright light reduces spherical aberration.
		(T)	Due to moistening, surface irregularities are covered with water film, which reduces diffuse reflection of light

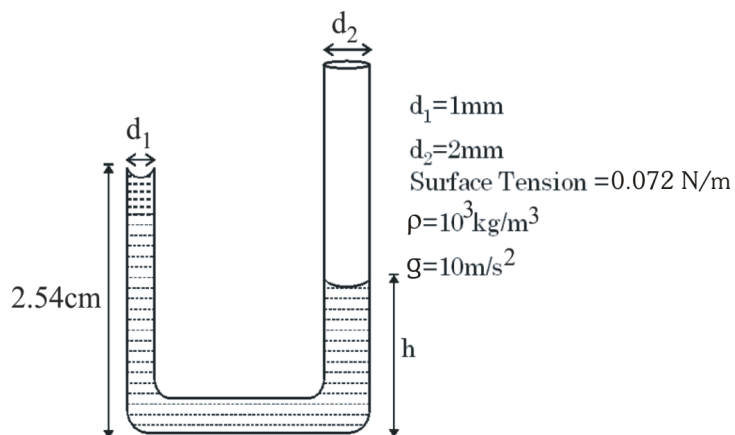
(A) I → P; II → Q; III → R; IV → S

(B) I → P; II → T; III → R; IV → Q

(C) I → P; II → S; III → R; IV → P

(D) I → P; II → P; III → S; IV → T

10.



The right limb is long enough and its radius is twice that of left limb. Water is slowly poured into the right limb. Considering water wets completely and the left limb is fully filled. List I corresponds to height of liquid in right limb and list II corresponds to radius of meniscus (R) and its shape in left limb.

	List-I		List-II
(P)	$h = 1.1 \text{ cm}$	(1)	Concave upward
(Q)	$h = 2 \text{ cm}$	(2)	Flat
(R)	$h = 2.54 \text{ cm}$	(3)	Convex upward
(S)	$h = 6.86 \text{ cm}$	(4)	$R = 1 \text{ mm}$
		(5)	$R = 0.5 \text{ mm}$

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

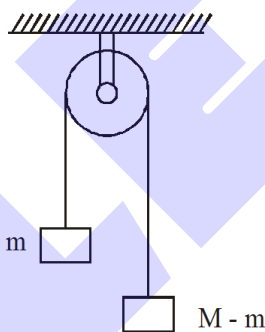
SECTION-II : (Maximum Marks: 24)

- This section contains **EIGHT (08)** questions. The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **Two** decimal places; e.g. 6.25, 7.00, -0.33, -0.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct)
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If ONLY the correct numerical value is entered.

Zero Marks : 0 In all other cases.

1. In a long cylindrical metal wire of radius r and of resistivity ρ , a current of strength I flows in uniform distribution. The wire has constant surface temperature T_0 . The temperature of the wire on its axis of symmetry is given by $T = T_0 + \frac{I^2 \rho}{\pi^2 r^2 K} \times \lambda$. Here K is thermal conductivity of wire. Find λ .
2. A certain amount of water is heated from 20°C to 40°C using an 800 Watt immersion heater. We expect to heat water in 210 seconds, but instead it takes 230 seconds. Determine the heat capacity of vessel in S.I. units. Ignore other heat losses.
3. A mass M is divided in two parts m and $M-m$. Now two parts are connected by an ideal string passing over a pulley as shown in diagram. Find value of m/M such that tension in string is maximum.



4. A cell of emf 1.5 V and internal resistance 0.5Ω is connected to a nonlinear conductor in which current varies with voltage as $V^2 = I$. Calculate the current drawn from cell (in ampere).
5. A coil with inductance L and resistance R is connected to an alternating source. The capacity of a capacitor that can be connected in series later with the coil such that active power of circuit does not change is given by $C = \frac{n}{\omega^2 L}$. Find value of n .

6. Consider a spherical homogeneous cloud of mass M made by an explosion. Due to energy received from the explosion, it is expanding and the expansion is spherically symmetric. At an instant its radius is R_0 and the particles on the surface are moving away from its center with velocity V_0 . Its radius when expansion ceases is given by $\frac{nGM R_0}{2GM - R_0 V_0^2}$. Find n .
7. The electrostatic flux through a rectangular area of $\frac{7}{188} \text{ m}^2$ is lying in a plane $2x + 3y + 6z = 10$ due to an electric field $(8\hat{i} + 6\hat{j} + 10\hat{k}) \text{ V/m}$ will be in (V-m)
8. A parallel beam of light of all wavelength greater than 3000 \AA falls on a double slit in a Young's double slit experiment. It is observed that the wavelengths 3600 \AA and 6000 \AA are absent at a distance of 31.5 mm from the position of the central maximum, and the orders of the minima at this point for the two wavelengths differ by 7. If the distance between the slits and the screen is 1 m , the separation between the two slits (in mm) is :

PART-2 : CHEMISTRY
SECTION-I (i) : (Maximum Marks: 24)

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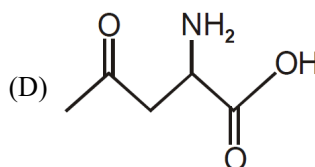
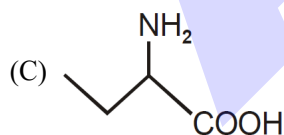
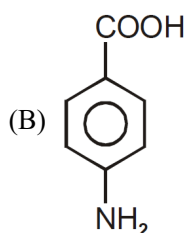
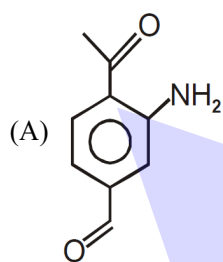
Partial Marks : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.

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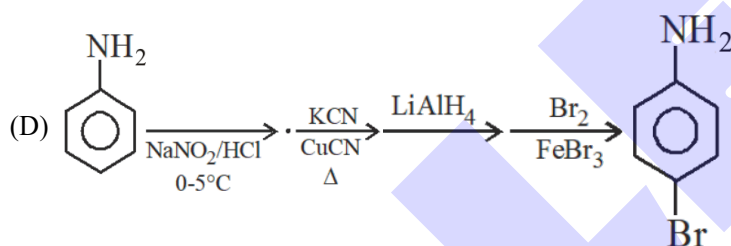
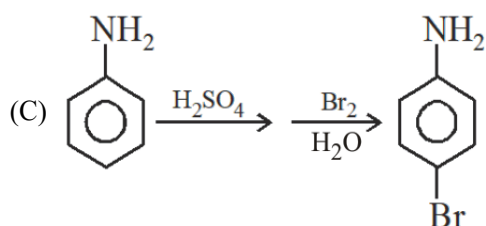
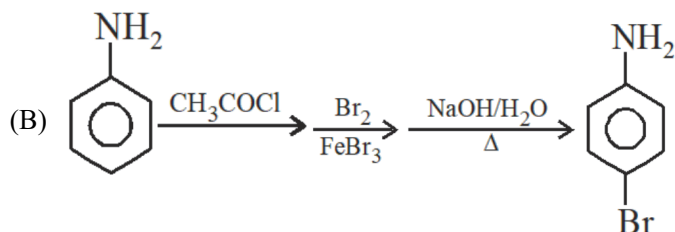
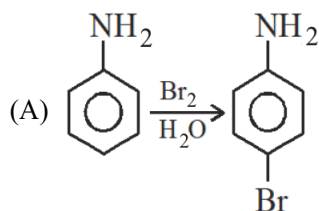
Negative Marks : -2 In all other cases.

- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

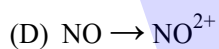
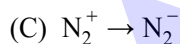
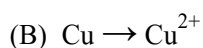
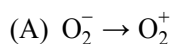
1. A compound '**X**' evolves CO_2 when treated with NaHCO_3 but gives negative test with tollens's reagent and fehling's solution. On treatment with CHCl_3 , KOH , a foul smelling organic compound is formed. If '**X**' do not give positive iodoform test, which of the following satisfy the conditions to be '**X**'.



2. Which of the following method(s) is/are not used to prepare p-bromo aniline as major product :



3. In which of the following process(es) electrons are removed from different type of orbitals?



4. Which of the following statements are incorrect from following options?

(A) Zone refining is carried out in presence of noble gas environment.

(B) Fe is the 2nd most abundant metal in the earth crust.

(C) Sapphire consists of Al_2O_3 and Co (as impurity).

(D) Formula of Bauxite : $AlO_{3-2x}(OH)_x$, where $0 < x < 1$.

5. Which of following is/are incorrect statement(s) for a sample of ideal gas ?
- (A) Temperature of gas remains constant during its adiabatic free expansion
- (B) During compression of the gas at constant pressure, temperature of gas increases.
- (C) Molar heat capacity of the gas is zero during an isothermal process
- (D) At 300 K temperature molar internal energy change of $\text{SO}_2(\text{g})$ is greater than molar internal energy change of $\text{CO}_2(\text{g})$ when temperature of both gases is increased by 20 K.
6. Select the correct statement(s) about FCC(ABCABC...) structure,
[Given : a = Edge length of FCC unit cell]
- (A) Distance between nearest octahedral void and tetrahedral void is $\frac{\sqrt{3}a}{4}$
- (B) Distance between two nearest octahedral voids is $\frac{a}{\sqrt{2}}$
- (C) Distance between two nearest tetrahedral voids is $\frac{\sqrt{3}a}{2}$
- (D) Distance between close-packed layers A and B is $2r\sqrt{\frac{2}{3}}$ [r = radius of atom]

SECTION-I (ii) : (Maximum Marks: 12)

- This section contains **FOUR (04)** questions.
- Each **question has matching lists**. The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3 If ONLY the correct option is chosen.

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Negative Marks : -1 In all other cases

List-I (Compound)		List-II (Can be distinguish by)	
(P)	$\text{CH}_3\text{-CHO}$ & Ph-CHO	(1)	$\text{Br}_2 / \text{H}_2\text{O}$ test
(Q)	$\text{CH}_3\text{-CH}_3$ & $\text{HC}\equiv\text{CH}$	(2)	Ammonical Aq. NO_3
(R)	$\text{CH}_3\text{-C}\equiv\text{CH}$ & $\text{CH}_3\text{-}\overset{\text{O}}{\parallel}\text{C}\text{-CH}_3$	(3)	Iodoform test
(S)	$\text{CH}_3\text{-CHO}$ & $\text{CH}_3\text{-}\overset{\text{O}}{\parallel}\text{C}\text{-CH}_3$	(4)	NaHSO_4 test
		(5)	Fehling test

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

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

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

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

8. List-I contains co-ordination compounds and List-II contains their properties:

List-I	List-II
(P) $[\text{NiCl}_4]^{2-}$	(1) Diamagnetic species
(Q) $[\text{Cr}(\text{H}_2\text{O})_3\text{F}_3]$	(2) Low spin octahedral complex
(R) $[\text{PtCl}_4]^{2-}$	(3) Contains unpaired electrons
(S) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$	(4) d^8 configuration of metal ion
	(5) Exhibits geometrical isomerism

[Given atomic no. Ni = 28, Cr = 24, Pt = 78, Co = 27]

Match each species in List-I with their properties in List-II and choose the correct option:

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

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

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

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

9. Boyle's temperature (T_B): T_B of $\text{CO}_2 = 350^\circ\text{C}$, T_B of $\text{CH}_4 = 60^\circ\text{C}$ and T_C of $\text{H}_2 = -240^\circ\text{C}$

List-I		List-II	
(P)	CO_2 gas in low pressure region & temperature 573 K.	(1)	$PV = nRT$
(Q)	CO_2 gas in very high pressure region & temperature 623 K	(2)	Gas is more compressible with respect to an ideal gas.
(R)	CH_4 gas at 333 K & in low pressure region.	(3)	Gas cannot be liquefied at any pressure at given temperature.
(S)	H_2 gas in low pressure region & temperature 20 K.	(4)	Molar volume of gas is lesser than that of ideal gas at same pressure and temperature.
		(5)	Repulsive forces dominate

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

10. Match the following

List - I		List - II	
(P)	A saturated aqueous solution of $\text{Mg}(\text{OH})_2$ [$K_{\text{sp}} = 4 \times 10^{-12}$]	(1)	$\text{pH} = 7$
(Q)	300 ml of 0.1 M BOH + 100 ml. of 0.1M HCl [$K_{\text{b}}(\text{BOH}) = 10^{-4}$]	(2)	$\text{pH} = \frac{\text{p}K_{\text{a}_2} + \text{p}K_{\text{a}_3}}{2}$
(R)	300 ml. of 0.1 M BOH + 300 ml. of 0.1 M HA [$K_{\text{a}} = K_{\text{b}} = 10^{-4}$]	(3)	$\text{pH} = 10 + \log 2$
(S)	0.01 M aqueous solution Na_2HPO_4 [Given that: $\text{p}K_{\text{a}_1}(\text{H}_3\text{PO}_4) = 4.3$; $\text{p}K_{\text{a}_2}(\text{H}_3\text{PO}_4) = 8.102$; $\text{p}K_{\text{a}_3}(\text{H}_3\text{PO}_4) = 12.5$;	(4)	$\text{pH} = \frac{1}{2}\text{p}K_{\text{w}} + \frac{1}{2}\text{p}K_{\text{a}} - \frac{1}{2}\text{p}K_{\text{b}}$
		(5)	Buffer solution

(A) $\text{P} \rightarrow 3; \text{Q} \rightarrow 3; \text{R} \rightarrow 2; \text{S} \rightarrow 3$

(B) $\text{P} \rightarrow 1; \text{Q} \rightarrow 3; \text{R} \rightarrow 1; \text{S} \rightarrow 4$

(C) $\text{P} \rightarrow 3; \text{Q} \rightarrow 1; \text{R} \rightarrow 4; \text{S} \rightarrow 3$

(D) $\text{P} \rightarrow 3; \text{Q} \rightarrow 3; \text{R} \rightarrow 5; \text{S} \rightarrow 2$

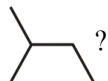
SECTION-II : (Maximum Marks: 24)

- This section contains **EIGHT (08)** questions. The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **Two** decimal places; e.g. 6.25, 7.00, -0.33, -0.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct)
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If ONLY the correct numerical value is entered.

Zero Marks : 0 In all other cases.

1. Total number of fractions obtained on fractional distillation of all monochloro derivatives product(s) of



2. (A) (B) (C) (D) (E) (F) (G) (H)

Calculate the number of reducing sugar = x

Calculate the number of sugar in which molecular weight increases by 210, whenever it undergo acetylation reaction with acetic anhydride = y

So $x - y =$

3. Organic compound [M] has the following data :
- Molecular weight is 149, it contains only 3 different elements.
 - It can rotate plane polarized light (chiral carbon).
 - [M] on oxidation with hot alkaline KMnO_4 produces benzoic acid.
 - [M] can be prepared by treating carbonyl compound with methyl amine followed by NaBH_4 .
- Write the number of possible structures for [M] (excluding stereo isomers).

4. A mixture of Potash alum, Chrome alum and Mohr's salt is taken in water and H_2O_2 is added in strongly alkaline medium and finally filtered.

If atomic mass/molecular mass of cation in residue is 'a' and the number of type of ions from the salt mixture passed into the filtrate is 'b'. Then find the value of a/b.

(Atomic mass : Cr = 52 , Fe = 56 , S = 32 , O = 16 , N = 14 , C = 12 , B = 11 , H = 1 , K^+ = 39 , Na^+ = 23 , Ni = 58 , Cu = 29 , Zn = 65 , Cl = 35.5 , Br = 80 , F = 19)

5. (a) Fullerene has no dangling bonds.
 (b) Ni + excess NH_3 solution \rightarrow deep blue solution
 (c) PH_3 can be absorbed by $\text{HgCl}_2(\text{aq.})$
 (d) Bleaching powder available in market is completely soluble in water.
 (e) Na can be safely stored in ethanol.
 (f) $\text{Na}_2\text{S}_2\text{O}_3 + \text{Cl}_2$ -water (excess) produces NaHSO_4 and HCl .
 (g) Higher concentration of SO_2 damages the leaves of plant and retard the rate of photosynthesis.

If x = number of correct statements.

y = number of incorrect statements.

then find the value of x/y.

6. Let 'A' and 'B' are two completely miscible liquids. $P_A^\circ = 90$ torr and $P_B^\circ = 40$ torr. In a flask 8 moles of 'A' is mixed with 4 moles of 'B'. However as soon as B is added 'A' starts dissociating as two different liquids 'C' and 'D' as $A \rightarrow C + D$.

Both 'C' and 'D' are also completely miscible with each other and with 'A' and 'B'. Given $P_C^\circ = 50$ torr and $P_D^\circ = 40$ torr.

Assume dissociation of 'A' follows 1st order kinetics with half life equal to 50 min. After 100 min 2 moles of a non-volatile non-electrolyte solute 'S' is added in solution which immediately arrests the dissociation of A completely.

Calculate final vapour pressure of the solution in torr.

7. Fixed amount of an ideal gas contained in a sealed rigid vessel of volume 24.6 litres at 1.0 bar is heated reversibly from 27°C to 127°C . The entropy of gas is $S = 10 + 10^{-2} T$ (J/K). Then what is the enthalpy change (in J) during the process.

8. $\text{NO}_3^- \rightarrow \text{NO}_2$ (acid medium), $E^\circ = 0.790\text{V}$
 $\text{NO}_3^- \rightarrow \text{NH}_3\text{OH}^+$ (acid medium) $E^\circ = 0.731\text{V}$.

At what pH. the above two electrodes will have same electrode potential value?

Assume that activity of all other species to be unity except $[\text{H}^+]$ ions ? $\left(\frac{2.303 RT}{F} = 0.059 \right)$

PART-3 : MATHEMATICS
SECTION-I (i) : (Maximum Marks: 24)

- This section contains **SIX (06)** questions.
- Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s)
- 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.

- **For Example :** If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

- Let the equation $ax^2 - bx + c = 0$ has 2 distinct roots in the interval (0,1) where $a, b, c \in \mathbb{N}$. If $\lambda < \log_5(abc)$ for all choices of natural numbers a, b, c then non-negative integral values of λ can be :
 (A) 0 (B) 1
 (C) 2 (D) 3
- Event 'A' is independent of event B, $B \cup C$ and $B \cap C$. If $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{3}$ and $P(C) = \frac{1}{4}$. Then :
 (Where $P(x)$ denotes probability of event x)
 (A) $P\left(\frac{A}{C}\right) = \frac{1}{2}$
 (B) $P\left(\frac{\bar{B} \cup \bar{C}}{A}\right) = \frac{11}{12}$ (where B and C independent events)
 (C) $P\left(\frac{\bar{A}}{B \cap C}\right) = \frac{1}{2}$
 (D) A and C are not independent events

3. An ellipse with eccentricity $\frac{1}{2}$ passes through $P(3,4)$ whose nearer focus is $S(0,0)$ and equation of tangent at P on ellipse is $3x + 4y - 25 = 0$. If a chord through S parallel to tangent at P intersects the ellipse at A and B then :
- (A) length of AB is 15
 (B) length of latus rectum of ellipse is 15
 (C) focal length of ellipse is 10
 (D) centre of ellipse is $(-3, -4)$
4. Let $\langle T_n \rangle$ be a sequence such that $T_n^3 + 2T_n = T_{n+1} \forall n \in \mathbb{N}$, and $T_1 = 1$, then :
- (A) $\sum_{n=1}^{100} (T_n^3 + T_n + 1) = T_{101} + 99$
 (B) $\sum_{n=1}^{100} (T_n^3 + T_n + 1) = T_{101} + 100$
 (C) $\prod_{n=1}^{100} (T_n^2 + 2) = T_{100}$
 (D) $\prod_{n=1}^{100} \left(\frac{T_{n+1}}{T_n} - T_n^2 \right) = 2^{100}$
5. Let $f : (0, \infty) \rightarrow \mathbb{R}$ be a differentiable function satisfying the equation $f(xy) = e^{xy-x-y}(e^y f(x) + e^x f(y)) \forall x, y > 0$. If $f'(1) = e$, then
 (Note : where 'e' is nepier's constant)
- (A) $\lim_{x \rightarrow e} \left[\frac{f(x) - e^x}{x - e} \right] = e^{(e-1)}$
 (B) number of roots of the equation $f(x) = xe^x$ in $(0, \infty)$ is 2.
 (C) $\int_1^e f(x) dx < e^e (e - 1)$
 (D) $f(x)$ is strictly increasing function in $(0, \infty)$.
6. If three planes $P_1 \equiv 2x + y + z - 1 = 0$, $P_2 \equiv x - y + z - 2 = 0$ and $P_3 \equiv \alpha x - y + 3z - 5 = 0$ intersects each other at point P on XOY plane and at point Q on YOZ plane, where O is the origin then identify the correct statement(s) ?
- (A) The value of α is 4.
 (B) Straight line perpendicular to plane P_3 and passing through P is $\frac{x-1}{4} = \frac{y+1}{-1} = \frac{z}{3}$.
 (C) The length of projection of \overrightarrow{PQ} on x -axis is 1.
 (D) Centroid of the triangle OPQ is $\left(\frac{1}{3}, \frac{-1}{2}, \frac{1}{2} \right)$

SECTION-I (ii) : (Maximum Marks: 12)

- This section contains **FOUR (04)** questions.
- Each **question has matching lists**. The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**
- For each question, marks will be awarded in one of the following categories :

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

7. Match the following List-I with List-II

	List-I		List-II
(I)	The number of all triples (a,b,c) such that all three term a,b,c are in harmonic progression in which $a = 20$ and b divides c (where a,b,c are strictly increasing positive integers)	(P)	66
(II)	The number of solutions of $m + n + p = 10$, (m,n,p are non-negative integers)	(Q)	20
(III)	The number of ordered pair (a,b) satisfying the equation $ab + b - a + 1 = 0$ are where $a,b \in \mathbb{I}$	(R)	4
(IV)	The number of ordered pairs (x,y) of real numbers such that $(x + iy)^{20} = x - iy$ is (where $i = \sqrt{-1}$)	(S)	5
		(T)	22

- (A) $I \rightarrow S; II \rightarrow P; III \rightarrow R; IV \rightarrow T$
- (B) $I \rightarrow T; II \rightarrow Q; III \rightarrow S; IV \rightarrow P$
- (C) $I \rightarrow Q; II \rightarrow P; III \rightarrow R; IV \rightarrow T$
- (D) $I \rightarrow R; II \rightarrow S; III \rightarrow Q; IV \rightarrow P$

8. Match the following List-I with List-II

	List-I		List-II
(I)	Let $f(x) = x^4 + ax^3 + bx^2 + cx + d$ (where a, b, c, d are real coefficient) and $f(x) = 0$ has real roots, If $ f(i) = 1$ and $a = b = c = d = k$ then k can be (where $i = \sqrt{-1}$)	(P)	0
(II)	If $x^5 = 1$ ($x \neq 1$) then $\frac{x}{1+x^2} + \frac{x^2}{1+x^4} + \frac{x^3}{1+x} + \frac{x^4}{1+x^3}$ equals	(Q)	1
(III)	Let $f(x) = \ell n \left[\cos x + \frac{1}{2} \right]$ (where $[\cdot]$ denotes the greatest integer function), then $\int_{x_1}^{x_2} \left(\lim_{n \rightarrow \infty} \left(\frac{(f(x))^n}{x^2 + \tan^2 x} \right) \right) dx$ is (where $x_1, x_2 \in \left[-\frac{\pi}{6}, \frac{\pi}{6} \right]$)	(R)	2
(IV)	Let ABCD be a cyclic quadrilateral inscribed in a circle of radius 2, such that $BD = 2\sqrt{3}$, $AB = 1$. If $\angle BAD$ is acute and $AD = a + b\sqrt{5}$, then the value of $a + b$ is equal to	(S)	3
		(T)	4

(A) $I \rightarrow Q; II \rightarrow P; III \rightarrow R; IV \rightarrow T$

(B) $I \rightarrow P; II \rightarrow R; III \rightarrow P; IV \rightarrow R$

(C) $I \rightarrow T; II \rightarrow R; III \rightarrow Q; IV \rightarrow S$

(D) $I \rightarrow S; II \rightarrow P; III \rightarrow R; IV \rightarrow Q$

9. Match the following List-I with List-II

	List-I		List-II
(I)	If $f(x) + f''(x) = -x g(x)f'(x)$ and $g(x) > 0 \forall x \in \mathbb{R}$ then $(f(x))^2 + [f'(x)]^2$ has k as its maxima. Then k is	(P)	0
(II)	If $f^2(x) + f(x) = g(x)$ and $g(x)$ is always increasing then the minimum value that $f(x)$ can attain so that $f(x)$ also increasing is k . Then $(2(k+1))$ is	(Q)	1
(III)	If $g(x) = f(x) \int_0^x f(t) dt$ is non-increasing function and $f(x)$ is continuous in \mathbb{R} then $f(1)$ is	(R)	2
(IV)	If $f(x)$ is differentiable function and $f(x) = x^2 + \int_0^x e^{-t} f(x-t) dt$ then $f(-1) = \frac{k}{3}$ then k is	(S)	-1
		(T)	3

(A) $I \rightarrow P; II \rightarrow Q; III \rightarrow P; IV \rightarrow R$

(B) $I \rightarrow Q; II \rightarrow T; III \rightarrow P; IV \rightarrow R$

(C) $I \rightarrow S; II \rightarrow Q; III \rightarrow T; IV \rightarrow S$

(D) $I \rightarrow R; II \rightarrow T; III \rightarrow P; IV \rightarrow Q$

10. Let $H : \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, where $a, b > 0$ be a hyperbola in the xy -plane whose centre is C , one of the foci is F_1 . Foot of perpendicular from F_1 upon line $L : bx - ay = 0$ is P . Triangle CF_1P is isosceles triangle whose area is 8 sq. units.

Match List-I with List-II and select the correct answer using the code given below the list.

	List-I		List-II
(I)	The length of transverse axis of H is	(P)	$4\sqrt{2}$
(II)	The eccentricity of H is	(Q)	1
(III)	The slope of L is	(R)	4
(IV)	The distance between directrices of H is	(S)	$\sqrt{2}$
		(T)	8

(A) $I \rightarrow S; II \rightarrow T; III \rightarrow Q; IV \rightarrow P$

(B) $I \rightarrow T; II \rightarrow S; III \rightarrow Q; IV \rightarrow P$

(C) $I \rightarrow T; II \rightarrow S; III \rightarrow Q; IV \rightarrow R$

(D) $I \rightarrow T; II \rightarrow R; III \rightarrow Q; IV \rightarrow P$

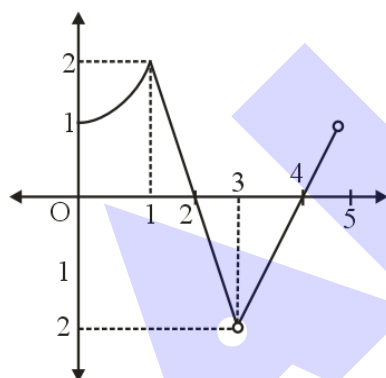
SECTION-II : (Maximum Marks: 24)

- This section contains **EIGHT (08)** questions. The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/round-off** the value to **Two** decimal places; e.g. 6.25, 7.00, -0.33, -30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct)
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If ONLY the correct numerical value is entered.

Zero Marks : 0 In all other cases.

- Suppose f and g are differentiable function such that $xg(f(x))f'(g(x))g'(x) = f(g(x))g'(f(x))f'(x)$ for all real x . Also f is non negative and g is positive. If $\int_0^a f(g(x)) dx = \frac{1}{2} - \frac{e^{-2a}}{2}$ for all reals a and $g(f(0)) = 1$ then the value of $g(f(4))$ is equal to $e^{-\lambda}$ where $\lambda \in \mathbb{N}$, then the value of $\frac{\lambda}{10}$ is
Note : (where 'e' is napier's constant)
- Let z satisfies $\bar{z}\bar{z} + (-4 + 5i)\bar{z} + (-4 - 5i)z - 40 = 0$. If $a = \max|z + 2 - 3i|$ and $b = \min|z + 2 - 3i|$, then value of $\left(\frac{a-b}{8}\right)$ is ?
- Let $f(1) + g(1) = 9e$; $f(x) = -x^2g'(x)$; $g(x) = -x^2f'(x)$. If $\int_1^4 \frac{f(x) + g(x)}{x^2} dx = k \left(e - e^{\frac{1}{4}}\right)$, then the value of $\frac{k}{4}$ is
(Note : where e is napier's constant)
- Graph of a function $y = f(x)$ is shown as



If $g(x) = |f(|x|)|$, then find number of solution(s) of the equation

$$g(g(x)) = \operatorname{sgn}(x^2 - (k+1)x + (k^2+1)), k \in \mathbb{R}.$$

[Note : $\operatorname{sgn}(y)$ denotes the signum function of y .]

5. Let $D = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ and $P = \begin{bmatrix} 7 & 0 & 2 \\ 0 & 1 & 0 \\ 2 & 0 & 5 \end{bmatrix}$. Consider $A = P^{-1}DP$ then $\frac{\det. (A^2 + A)}{10}$ is
6. Let $A_r, r = 1, 2, \dots, 29$ be arithmetic means between 303 and -57 where $A_r > A_{r+1} \forall r = 1, 2, \dots, 28$. If S be the sum of these means, then the value of $\left(\frac{S}{(A_{14} - 12) |A_r|_{\min}} \right)$
 [Note : $|A_r|_{\min}$ denotes the minimum value of $|A_r|$]
7. If $\left(x - 2 + \frac{1}{x} \right)^{30} = n_0 x^{30} + n_1 x^{29} + \dots + n_{29} x + n_{30} + n_{31} x^{-1} + \dots + n_{60} x^{-30}$ and $C = n_0 + n_1 + n_2 + \dots + n_{60}$. Find the value of a if $n_{30} - C = \binom{60}{a}$.
 [Note : $\binom{n}{r}$ denotes nC_r]
8. Let $E - ABCD$ be a pyramid on square base $ABCD$ where A is the origin and B and D are lying on positive x -axis and y -axis respectively. If E is $(0, 2, 3)$ and $\overrightarrow{DE} \cdot (\hat{i} + \hat{j}) = \vec{0}$, then volume of the tetrahedron $ABDE$ is