

CAREER POINT

MOCK TEST PAPER for IIT JEE (Advanced)

PAPER-2

Physics, Chemistry & Mathematics

Time : 3 Hours

Maximum Marks : 180

IMPORTANT INSTRUCTIONS

A. GENERAL :

1. Please read the instructions given for each question carefully and mark the correct answers against the question numbers on the answer sheet in the respective subjects.
2. The answer sheet, a machine readable Optical Mark Recognition (OMR) is provided separately.
3. Do not break the seal of the question-paper booklet before being instructed to do so by the invigilators.

B. MARKING SCHEME :

Each subject in this paper consists of following types of questions:-

SECTION - I

4. Multiple choice questions with single correct option. **3 marks** will be awarded for each correct answer and **-1 mark** for each wrong answer.
5. Passage based multiple choice questions with single correct option. **3 marks** will be awarded for each correct answer and **-1 mark** for each wrong answer.
6. Column matching type questions (**Single Correct Answer type**). **3 marks** will be awarded for the correct answer and **-1 mark** for wrong answer.

This paper does not consist of **Section-II** and **Section-III**.

C. FILLING THE OMR :

7. Fill your Name, Roll No., Batch, Course and Centre of Examination in the blocks of OMR sheet and darken circle properly.
8. Use only HB pencil or blue/black pen (avoid gel pen) for darkening the bubbles.
9. While filling the bubbles please be careful about **SECTIONS** [i.e. **Section-I** (include single correct, reason type, multiple correct answers), **Section -II** (column matching type), **Section-III** (include integer answer type)]

For example if only 'A' choice is correct then, the correct method for filling the bubbles is

A B C D
● ○ ○ ○

For example if only 'A & C' choices are correct then, the correct method for filling the bubbles is

A B C D
● ○ ● ○

the wrong method for filling the bubble are

☑ ⊗ ● ●

SEAL

PHYSICS

Section – I [Q.1 to Q.20]

Questions 1 to 10 are multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE is correct. Mark your response in OMR sheet against the question number of that question. + 3 marks will be given for each correct answer and – 1 mark for each wrong answer.

Q.1 A plastic disc of radius R has a charge q uniformly distributed over its surface. If the disc is rotated with a frequency f about its axis, then the magnetic induction at the centre of the disc is given by:

- (A) $(\mu_0 f q / R)$ (B) $(\mu_0 f q / 2 \pi R)$
 (C) $(\mu_0 q / f R)$ (D) $(\mu_0 f / q R)$

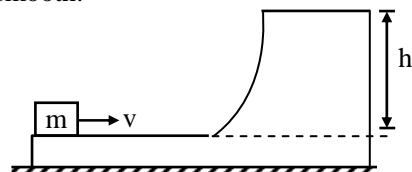
Q.2 In an L-C-R series AC circuit the voltage across L, C and R is 10 V each. If the inductor is short circuited, the voltage across the capacitor would become -

- (A) 10 V (B) $\frac{20}{\sqrt{2}}$ V
 (C) $20\sqrt{2}$ V (D) $\frac{10}{\sqrt{2}}$ V

Q.3 Assuming that about 200 MeV of energy is released per fission of U^{235} nuclei, then mass of U^{235} consumed per day in a fission reactor of power 1 megawatt will be approximately -

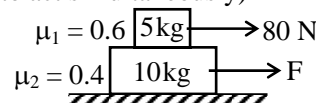
- (A) 10^{-2} gm (B) 1 gm
 (C) 100 gm (D) 10000 gm

Q.4 A block of mass m is given a velocity v . Find to what height the block will rise after breaking off from mass M . Assume all surface to be smooth.



- (A) $\frac{mv^2}{2g(m+M)}$ (B) $\frac{mv^2}{2gM}$
 (C) $\frac{v^2}{2g}$ (D) $\frac{Mv^2}{2g(m+M)}$

Q.5 A system of two blocks is shown in figure. Friction coefficient between 5 kg and 10 kg block is $\mu = 0.6$ and between 10 kg and ground is $\mu = 0.4$. What will be the maximum value of force F applied at the lower block so that 5 kg block does not slip w.r.t. 10 kg. ($g = 10 \text{ m/sec}^2$). The force applied at the upper block is having fixed magnitude of 80 N (both forces start to act simultaneously)



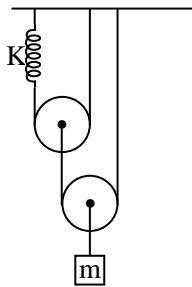
- (A) 160 N (B) 250 N
 (C) 210 N (D) 310 N

Space for rough work

Q.6 The horizontal range and maximum height attained by a projectile are R and H respectively. If a constant horizontal acceleration $a = g/4$ is imparted to the projectile due to wind, then its horizontal range and maximum height will be -

- (A) $(R + H), \frac{H}{2}$ (B) $\left(R + \frac{H}{2}\right), 2H$
 (C) $(R + 2H), H$ (D) $(R + H), H$

Q.7 What is the period of small oscillations of the block of mass m if the springs are ideal and pulleys are massless ?

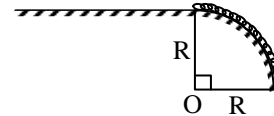


- (A) $\frac{\pi}{2} \sqrt{\frac{m}{k}}$ (B) $\frac{\pi}{2} \sqrt{\frac{m}{2k}}$
 (C) $\frac{\pi}{2} \sqrt{\frac{2m}{k}}$ (D) $\pi \sqrt{\frac{m}{2k}}$

Q.8 Two spheres of different materials one with double the radius and one-fourth wall thickness of the other, are filled with ice. If the time taken for complete melting of ice in the large sphere is 25 minutes and that for smaller one is 16 minutes, the ratio of thermal conductivities of the materials of larger sphere to that of smaller sphere is -

- (A) 4 : 5 (B) 5 : 4 (C) 25 : 8 (D) 8 : 25

Q.9 A chain of length $\ell < \frac{\pi R}{2}$ is placed on a smooth surface whose some part is horizontal and some part is quarter circular of radius r in the vertical plane as shown. Initially the whole part of chain lies in the circular part with one end at topmost point of circular surface. If the mass of chain is m , then work required to pull very slowly the whole chain on horizontal part is -



- (A) $\frac{m}{\ell} gR^2 \left[\sin\left(\frac{\ell}{R}\right) \right]$
 (B) $\frac{m}{\ell} gR^2 \left[\cos\left(\frac{\ell}{R}\right) \right]$
 (C) $\frac{m}{\ell} gR^2 \left[\left(\frac{\ell}{R}\right) - \sin\left(\frac{\ell}{R}\right) \right]$
 (D) $\frac{m}{\ell} gR^2 \left[\left(\frac{\ell}{R}\right) - \cos\left(\frac{\ell}{R}\right) \right]$

Space for rough work

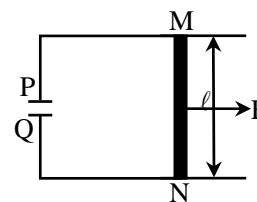
Q.10 A coaxial cylinder made of glass is immersed in liquid of surface tension 'S'. Radius of inner and outer surface of cylinder are R_1 and R_2 respectively. Height upto which liquid will rise is (Density of liquid is ρ) -

- (A) $\frac{2S}{R_2\rho g}$ (B) $\frac{2S}{R_1\rho g}$
 (C) $\frac{S}{(R_2 - R_1)\rho g}$ (D) $\frac{2S}{(R_2 - R_1)\rho g}$

Question 11 to 16 are based on paragraph. There are 3 paragraphs; each has 2 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Mark your response in OMR sheet against the question number of that question. +3 marks will be given for each correct answer and – 1 mark for each wrong answer.

Passage # 1 (Ques. 11 & 12)

A parallel plate capacitor of capacitance C is connected between two horizontal metallic rails where uniform magnetic field B is available. A metallic rod of length ℓ which can slide freely on the rails has a mass m. The distance between the rails is ℓ . A constant horizontal force F acts on the rod. Magnetic field B is acting into the plane. Neglecting the resistance of system answer following questions.



- Q.11** During the motion of rod
 (A) Current goes on increasing
 (B) Current remains constant
 (C) No current flows through the rod
 (D) Current goes on decreasing

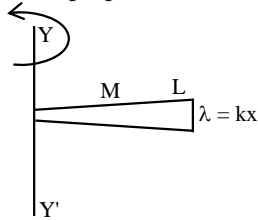
- Q.12** During the motion of rod
 (A) The rod at one instant can attain terminal velocity
 (B) The velocity of rod goes on increasing
 (C) The velocity of rod goes on decreasing
 (D) The velocity of rod fluctuates.

Passage # 2 (Ques. 13 & 14)

Moment of inertia is a physical term which oppose the change in rotational motion. Moment of inertia depends on distribution of mass, shape of the body as well as distance from the rotational axis. Moment of linear momentum is called angular momentum. If no external torque act on the system then angular momentum of the system remains conserved. Geometrical meaning of angular momentum relates to the areal velocity.

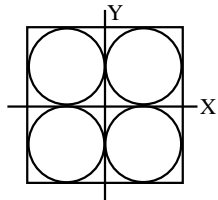
Space for rough work

- Q.13** Mass M is distributed over the rod of length L . If linear mass density (λ) linearly increases with length as $\lambda = Kx$. The M.I. of the rod about one end perpendicular to rod i.e. (YY') –



- (A) $\frac{ML^2}{3}$ (B) $\frac{ML^2}{12}$
 (C) $\frac{2}{3}ML^2$ (D) $\frac{KL^4}{4}$

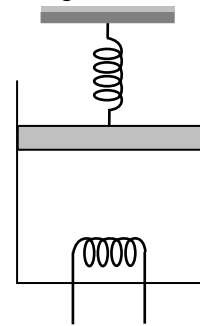
- Q.14** Four holes of radius R are cut from a thin square plate of side $4R$ and mass M . The moment of inertia of the remaining portion about z -axis is –



- (A) $\frac{\pi}{12}MR^2$ (B) $\left(\frac{4}{3} - \frac{\pi}{4}\right)MR^2$
 (C) $\left(\frac{4}{3} - \frac{\pi}{6}\right)MR^2$ (D) $\left(\frac{8}{3} - \frac{10\pi}{16}\right)MR^2$

Passage # 3 (Ques. 15 & 16)

Two moles of a monoatomic ideal gas $\left[U = \frac{3}{2}nRT\right]$ is enclosed in an adiabatic, vertical cylinder fitted with a smooth, light adiabatic piston. The piston is connected to a vertical spring of spring constant 200 N/m as shown in figure. The area of cross-section of the cylinder is 20.0 cm^2 . Initially, the spring is at its natural length and temperature of the gas is 300K . The atmospheric pressure is 100 kPa . The gas is heated slowly for some time by means of an electric heater so as to move the piston up through 10 cm .



- Q.15** The work done by the gas in the whole process is -
 (A) 21 J (B) 12 J
 (C) 2.1 J (D) 1.2 J

Space for rough work

- Q.16** The final temperature of the gas is approximately equal to :
 (A) 131 K (B) 231 K
 (C) 331 K (D) 431 K

Each Question from 17 to 20 has matching lists. The codes for the lists have choices (A, B, C and D) out of which ONLY ONE is correct. Match List-I with List-II and select the correct answer using the code given below the lists. + 3 marks for the SINGLE CORRECT ANSWER and -1 for the INCORRECT ANSWER.

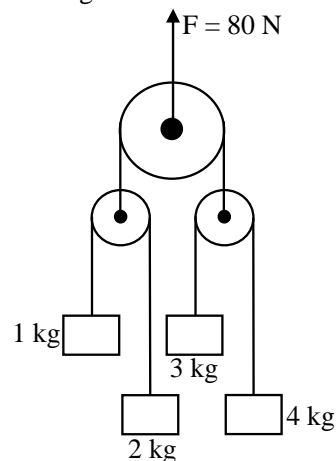
- Q.17** Two point charges $+1\mu\text{C}$ and $+4\mu\text{C}$ are placed at points (0, 0) and (30, 0). Then as we move along x-axis match the following.

List-I	List-II
(P) Magnitude of net electric field increases	(1) $x = 10$ to $x = 30$
(Q) Magnitude of net electric field decreases	(2) $x = 0$ to $x = -20$
(R) Potential increases	(3) $x = 0$ to $x = 10$
(S) Potential first decreases and then increases	(4) $x = 0$ to $x = 30$

Codes :

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

- Q.18** In the diagram shown in figure, all pulleys are smooth and massless and strings are light. Match the following:



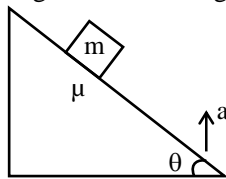
List-I	List-II
(P) 1 kg block	(1) will remain stationary
(Q) 2 kg block	(2) will move down
(R) 3 kg block	(3) will move up
(S) 4 kg block	(4) 5 m/s^2

Codes :

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

Space for rough work

Q.19 A block of mass $m = 1 \text{ kg}$ is at rest with respect to a rough wedge as shown in figure.



The wedge starts moving up from rest with an acceleration of $a = 2 \text{ m/s}^2$ and the block remains at rest with respect to wedge then in 4 sec. of motion of wedge work done on block (assume angle of inclination of wedge is $\theta = 30^\circ$ and $g = 10 \text{ m/s}^2$) –

List-I

List-II

- (P) By gravity (in magnitude) (1) 144 J
 (Q) By normal reaction (2) 32 J
 (R) By friction (3) 160 J
 (S) By all the forces (4) 48 J

Codes :

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

Q.20 Match the following :-

List-I

List-II

- | | |
|--|---|
| (P) Final temperature is 2.5°C | (1) 10 gm water at 30° is mixed with 10 gm of water at 70°C |
| (Q) Final mixture contain ice & water | (2) 10 gm of ice at 0°C is mixed with 10 gm of water at 85°C |
| (R) Final mixture contains water & steam | (3) 10 gm of ice at 0°C is mixed with 10 gm of water at 50°C |
| (S) Final temperature is 50°C | (4) 10 gm of ice at 0°C is mixed with 10 gm of steam at 100°C |

Codes :

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

Space for rough work

CHEMISTRY

Section – I [Q.1 to Q.20]

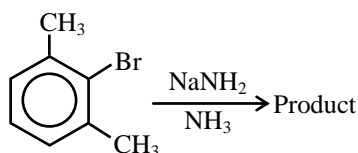
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Q.1 Maximum enolisation takes place in :

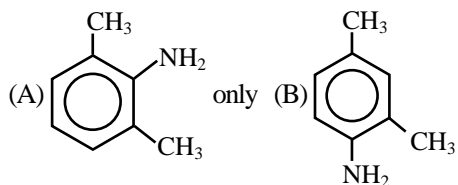
- (A) CH_3COCH_3
 (B) $\text{CH}_3\text{COCH}_2\text{CHO}$
 (C) $\text{CH}_3\text{COCH}_2\text{COCH}_3$



Q.2



Here the product is -

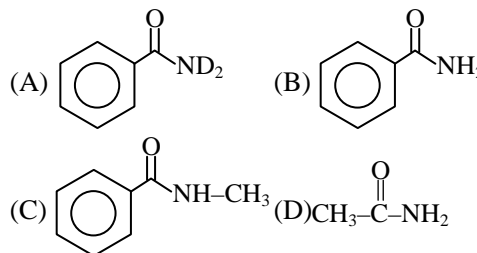


- (C) Equimolar mixture of (A) and (B)
 (D) No reaction

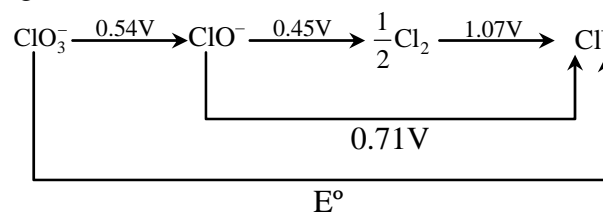
Q.3 Number of hydroxyl groups after interaction in pentose sugars and hexose sugar is -

- (A) Increases
 (B) Decreases
 (C) Remains constant
 (D) Depend upon medium

Q.4 Which of the following will not undergo Hoffmann bromamide reaction ?



Q.5



The E° in the given diagram is-

- (A) 0.5 (B) 0.6
 (C) 0.7 (D) 0.8

Space for rough work

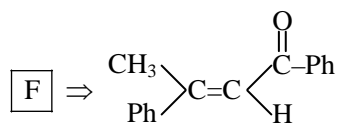
- Q.6** Equal volume of two solution having pH = 2 and pH = 10 are mixed together at 90°C. Then pH of resulting solution is : (Take K_w at 90°C = 10^{-12})
 (A) $2 + \log 2$ (B) $10 - \log 2$
 (C) 7 (D) 6
- Q.7** Three solutions are prepared by adding 'w' gm of 'A' into 1kg of water, 'w' gm of 'B' into another 1 kg of water and 'w' gm of 'C' in another 1 kg of water (A, B, C are non electrolytic). Dry air is passed from these solutions in sequence (A → B → C). The loss in weight of solution A was found to be 2 gm while solution B gained 0.5 gm and solution C lost 1gm. Then the relation between molar masses of A, B and C is
 (A) $M_A : M_B : M_C = 4 : 3 : 5$
 (B) $M_A : M_B : M_C = \frac{1}{4} : \frac{1}{3} : \frac{1}{5}$
 (C) $M_C > M_A > M_B$
 (D) $M_B > M_A > M_C$
- Q.8** The elementary reaction $A + B \rightarrow$ products has $k = 2 \times 10^{-5} \text{ M}^{-1} \text{ S}^{-1}$ at a temperature of 27°C. Several experimental runs are carried out using stoichiometric proportion. The reaction has a temperature coefficient value of 2.0. At what temperature should the reaction be carried out if on halving the concentrations, the rate of reaction is desired to be 50% higher than a previous run. (Given, $\frac{\ln 6}{\ln 2} = 2.585$).
 (A) 47°C (B) 53°C
 (C) 57°C (D) 37°C
- Q.9** A reaction at 300 K with $\Delta G^\circ = -1743 \text{ J/mol}$ consists of 3 mole of A (g), 6 mole of B (g) and 3 mole of C (g). If A, B and C are in equilibrium in 1 litre container then the reaction may be [Given: $2 = e^{0.7}$, $R = 8.3 \text{ J/K-mol}$]
 (A) $A + B \rightarrow C$ (B) $A \rightarrow B + 2C$
 (C) $2A \rightarrow B + C$ (D) $A + B \rightarrow 2C$
- Q.10** According to Molecular orbital theory which of the following statement is incorrect?
 (A) LUMO level for C_2 molecule is $\sigma 2p_x$ orbital.
 (B) In C_2 molecules both the bonds π are bonds
 (C) C_2 is paramagnetic but C_2^{2-} is diamagnetic.
 (D) In C_2^{2-} ion there is one σ and two π bonds

Space for rough work

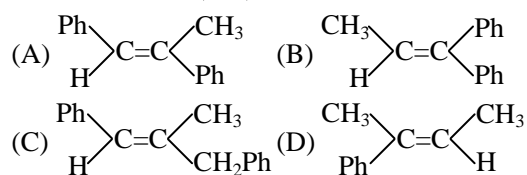
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Passage # 1 (Ques. 11 & 12)

A tertiary alcohol [A] on acid catalysed dehydration gives a product [B]. Ozonolysis of [B] leads to compounds [C] and [D]. Compound [C] upon reaction with KOH gives benzyl alcohol and a compound [E]; whereas [D] on reaction with KOH high temperature gives only [F].



Q.11 The structure of [B] is



Q.12 The structures [C], [D] and [E] respectively are -
 (A) PhCHO, PhCOCH₃, PhCOOK
 (B) PhCHO, PhCH₂CHO, PhCH₂COOK
 (C) PhCOCH₃, PhCH₂CHO, PhCOOK
 (D) PhCOCH₃, PhCH₂CHO, PhCH₂COOK

Passage # 2 (Ques. 13 & 14)

A solution that is relatively resistance to change in pH is called a buffer solution. We can also say that the solution is buffered the simplest way to achieve substantial concentration of both acid and base in the same solution to use a conjugate acid-base pair. The most common form of buffer solution contains a weak acid and its conjugate base or a weak base and its conjugate acid.

By using buffer concept. A student prepare 2L buffer solution of 0.33M NaH₂PO₄ and 0.33M Na₂HPO₄. The solution is divided in half between the two compartment (each containing 1L buffer) of an electrolysis is carried out for 212 min with a constant current of 1.25A. [Assumes that pK_a(H₂PO₄⁻) = 7.2]

Space for rough work

- Q.13** The concentration of $[H^+]$ consumed by HPO_4^{2-} at anode is:
 (A) 0.165 M (B) 0.330 M
 (C) 1.00 M (D) 0.0825 M

- Q.14** pH in 2nd compartment cell (at cathode) is:
 (A) 7.2 (B) 6.72 (C) 7.67 (D) 7.0

Passage # 3 (Ques. 15 & 16)

A radioactive substance 'A' converts to stable nuclei D by following series of reaction :

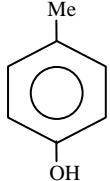
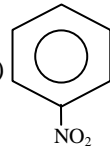
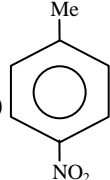
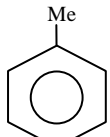


Given : $t_{1/2}$ for 'A' = 0.0693 days
 $t_{1/2}$ for 'B' = 6930 days
 $t_{1/2}$ for 'C' = 6.93 days

- Q.15** Number of nuclei of 'C' formed in the first 10 days are, if initially 10^{20} nuclei of A is taken
 (A) 10^{18} (B) 10^{16} (C) 10^{17} (D) 10^{19}

- Q.16** Number of nuclei of 'D' present after 6930 days are, if initially 10^{20} nuclei of A is taken-
 (A) 10^{10} (B) $\frac{1}{2} \times 10^{20}$
 (C) $\frac{1}{2} \times 10^{17}$ (D) 10^9

Each Question from 17 to 20 has matching lists. The codes for the lists have choices (A, B, C and D) out of which ONLY ONE is correct. Match List-I with List-II and select the correct answer using the code given below the lists. + 3 marks for the SINGLE CORRECT ANSWER and -1 for the INCORRECT ANSWER.

Q.17	List-I (Compounds)	List-II (Dipole Moment)
(P)		(1) 0.43 D
(Q)		(2) 1.57 D
(R)		(3) 3.93 D
(S)		(4) 4.39 D

Space for rough work

Codes :

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

Q.18 Match the following -

List- I

- (P) Phenol + Neutral FeCl_3
(Q) Phenol + Br_2 (aq.)
(R) Phenol + NaHCO_3
(S) Picric acid + NaHCO_3

List- II

- (1) No reaction
(2) Violet colour
(3) White ppt.
(4) CO_2 gas is evolved

Codes :

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

Q.19 Assume inert electrolyte used and salt bridge in all the given cells is KCl . (K_a of $\text{HCOOH} = 2 \times 10^{-4}$)

List- I

- (P) $\text{Zn} | \text{ZnSO}_4(1\text{M}) || \text{ZnSO}_4(2\text{M}) | \text{Zn}$
(Q) $\text{Cu} | \text{CuCl}_2(1\text{M}) || \text{CuSO}_4(2\text{M}) | \text{Cu}$
(R) $\text{Ag} | \text{AgCl}(\text{sat. sol.}) || \text{AgNO}_3(1\text{M}) | \text{Ag}$
(S) $\text{Pt} | \text{H}_2 | \text{HCOOH} (1\text{M}) || \text{HCl} (1\text{M}) | \text{H}_2 | \text{Pt}$

List- II

- (1) Spontaneous cell reaction.
(2) Osmotic pressure of cathodic solution is greater than that of anodic solution .
(3) At equilibrium condition of the cell, freezing point of anodic solution is higher than of cathodic solution
(4) At equilibrium condition of the cell, boiling point of cathodic solution is higher than that of anodic solution

Codes :

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

Space for rough work

Q.20 Match the following :

If k_a of HCN = 5×10^{-10} , k_a of HOCN = 3.2×10^{-4} ,

k_b of NH_3 = 1.8×10^{-5} , k_a of CH_3COOH = 1.8×10^{-5}

List- I

List- II

(P) 10^{-2} M NaCN

(1) pH > 7

(Q) 100 ml of 10^{-1} M NaCl + 100 ml of
 10^{-1} M HCl + 300 ml of 10^{-1} M NaOH

(2) pH # 7

(R) 10^{-1} M HCl + 10^{-1} M HCN

(3) pH < 7

(S) 10^{-1} M NH_4OCN

(4) pH = 7

Codes :

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

Space for rough work

MATHEMATICS

Section – I [Q.1 to Q.20]

Questions 1 to 10 are multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE is correct. Mark your response in OMR sheet against the question number of that question. + 3 marks will be given for each correct answer and – 1 mark for each wrong answer.

- Q.1** If the equations $ax^2 + bx + c = 0$ and $5x^2 + 12x + 13 = 0$ have a common root, where a, b and c are the sides of a triangle ABC, then
(A) ΔABC is acute angled
(B) ΔABC is right angled
(C) ΔABC is isosceles
(D) ΔABC is right angled isosceles
- Q.2** The system of equations $x + ky + 3z = 0$, $3x + ky - 2z = 0$, $2x + 3y - 4z = 0$ possess a non-trivial solution over the set of rationals then $2k$ is on integral element of the interval
(A) [10, 20] (B) (20, 30)
(C) [30, 40] (D) (40, 50)

- Q.3** If $z = x + 3i$ then value of $\int_2^4 \left[\arg \left| \frac{z-i}{z+i} \right| \right] dx$
(where $[.]$ denotes greatest integer function and $i = \sqrt{-1}$)
(A) $3\sqrt{2}$ (B) $6\sqrt{3}$
(C) $\sqrt{6}$ (D) 0

- Q.4** **S₁** : No. of solution of the equation $\sin^{-1}x - \cos^{-1}(-x) = \frac{\pi}{2}$ is one
S₂ : Solution set of the equation $\sin^{-1}(x^2 + 4x + 3) + \cos^{-1}(x^2 + 6x + 8) = \frac{\pi}{2}$ is $\left\{ -\frac{5}{2} \right\}$
S₃ : $\sin^{-1}(\cos(\sin^{-1}x)) + \cos^{-1}(\sin(\cos^{-1}x))$ is equal to π
S₄ : $2[\tan^{-1}1 + \tan^{-1}2 + \tan^{-1}3]$ is equal to 2π
(A) FTFT (B) FTTF
(C) FTTF (D) FFTT

Space for rough work

Q.5 Which of the following statements are true/false-

S₁ : If $A = [a_{ij}]$ is a square matrix of even order such that $a_{ij} = i^2 - j^2$ then A is skew symmetric matrix.

S₂ : Area enclosed by $|x| + |y| = 1$ is 1.

S₃ : Smaller area enclosed by $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and

$$\frac{x}{a} + \frac{y}{b} = 1 \text{ is } \frac{\pi ab}{4} - \frac{ab}{2}$$

S₄ : Area enclosed by $y = [x]$ and $y = \{x\}$ is 1. (where $[.]$ is greatest integer and $\{.\}$ is fractional part functions)

- (A) TFFT (B) TTTT
(C) TFTF (D) FFTT

Q.6 Consider the following statements :

S₁ : Number of solutions of $[\sin^{-1} x] = \{1 + x^2\}$ is two. (where $[.]$ is greatest integer and $\{.\}$ is fractional part functions)

S₂ : $f(x) = x^3 + \tan x$ is surjective function

S₃ : All basic inverse trigonometric function are periodic

S₄ : Domain of

$$f(x) = \sqrt{(x^2 - 3x - 10) \ln^2(x - 3)}$$
 is $[5, \infty)$.

State, in order, whether S_1, S_2, S_3, S_4 are true or false.

- (A) FTFF (B) TTFF
(C) TFFT (D) TTTT

Q.7 **S₁** : Length of the latus rectum of the ellipse $x^2 + 4y^2 - 2x - 16y + 13 = 0$ is 1.

S₂ : Distance between foci of the ellipse $x^2 + 4y^2 - 2x - 16y + 13 = 0$ is $4\sqrt{3}$.

S₃ : Sum of the focal distances of a point $P(x, y)$ on the ellipse $x^2 + 4y^2 - 2x - 16y + 13 = 0$ is 4.

S₄ : $y = 3$ meet the tangent drawn at the vertices of the ellipse $x^2 + 4y^2 - 2x - 16y + 13 = 0$ at points P & Q then PQ subtends a right angle at any of its foci.

- (A) TFFT (B) TTTT
(C) TFFT (D) TFTF

Q.8 If $x^2(f(x) - 1) - x(7f(x) + 5) + 10f(x) + 14 = 0$ $\forall x \in \mathbb{R}$, and $f(x)$ be a continuous function $\forall x \in \mathbb{R} - \{5\}$, then $f(2)$ is-

- (A) $\frac{7}{3}$ (B) $-\frac{7}{3}$ (C) 3 (D) -3

Q.9 Let $\lambda = \int_0^1 \frac{dx}{1+x^3}$, $p = \lim_{n \rightarrow \infty} \left[\frac{\prod_{r=1}^n (n^3 + r^3)}{n^{3n}} \right]^{1/n}$,

then $\ln p$ is equal to -

- (A) $\ln 2 - 1 + \lambda$ (B) $\ln 2 - 3 + 3\lambda$
(C) $2 \ln 2 - \lambda$ (D) $\ln 4 - 3 + 3\lambda$

Space for rough work

- Q.10** If $|z - 4 + 3i| \leq 1$ and α and β be the least and greatest values of $|z|$ and k be the least value of $\frac{x^4 + x^2 + 4}{x}$ on the interval $(0, \infty)$, then k is equal to-
- (A) α (B) β
 (C) $\alpha + \beta$ (D) None of these

Question 11 to 16 are based on paragraph. There are 3 paragraphs; each has 2 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Mark your response in OMR sheet against the question number of that question. +3 marks will be given for each correct answer and – 1 mark for each wrong answer.

Passage # 1 (Ques. 11 & 12)

Let $f(xy) = xf(y) + yf(x) \forall x, y \in \mathbb{R}$ and $f(x)$ be differentiable in $(0, \infty)$ and $f'(1) = 1$

- Q.11** $\lim_{x \rightarrow 0^+} (1 + f(x))^{1/x}$ equals to
- (A) 1 (B) 2
 (C) 0 (D) ∞

- Q.12** Which of following is incorrect ?
- (A) $f(x)$ increases in $\left(\frac{1}{e}, \infty\right)$
 (B) $f(x)$ decreases in $\left(0, \frac{1}{e}\right)$
 (C) $f(x)$ attains minimum value at $x = 1/e$
 (D) minimum value of $f(x)$ is $1/e$

Passage # 2 (Ques. 13 & 14)

$y = f(x)$ is a parabola of the form $y = x^2 + ax + 1$, its tangent at the point of intersection of y-axis and parabola also touches the circle $x^2 + y^2 = r^2$. It is known that no point of the parabola is below x-axis.

- Q.13** The radius of circle when a attains its maximum value
- (A) $\frac{1}{\sqrt{10}}$ (B) $\frac{1}{\sqrt{5}}$
 (C) 1 (D) $\sqrt{5}$
- Q.14** The slope of the tangent when radius of the circle is maximum
- (A) 0 (B) 1
 (C) -1 (D) Not defined

Space for rough work

Passage # 3 (Ques. 15 & 16)

A curve $y = f(x)$ passes through $(2, 0)$ and slope of tangent at any point $P(x, y)$ on the curve is

$$\frac{(x+1)^2 + y - 3}{x+1} \text{ then}$$

Q.15 The curve is

- (A) a parabola (B) a circle
(C) an ellipse (D) a hyperbola

Q.16 Area bounded between $y = |f(x)|$, x-axis and $|x| = 3$ is

- (A) 20 (B) 21
(C) $\frac{62}{3}$ (D) $\frac{52}{3}$

Each Question from 17 to 20 has matching lists. The codes for the lists have choices (A, B, C and D) out of which ONLY ONE is correct. Match List-I with List-II and select the correct answer using the code given below the lists. + 3 marks for the SINGLE CORRECT ANSWER and -1 for the INCORRECT ANSWER.

Q.17 Match the list

List - I

List -II

- (P) The length of the common chord of two circles of radii 3 and 4 units which intersect orthogonally is $\frac{k}{5}$, then k equals to (1) 1
- (Q) The circumference of the circle $x^2 + y^2 + 4x + 12y + p = 0$ is bisected by the circle $x^2 + y^2 - 2x + 8y - q = 0$, then $p + q$ is equal to : (2) 24
- (R) Number of distinct chords of the circle $2x(x - \sqrt{2}) + y(2y - 1) = 0$; chords are passing through the point $(\sqrt{2}, \frac{1}{2})$ and are bisected on x-axis is (3) 32
- (S) One of the diameters of the circle circumscribing the rectangle ABCD is $4y = x + 7$. If A and B are the points $(-3, 4)$ and $(5, 4)$ respectively, then the area of the rectangle is (4) 36

Codes :

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

Space for rough work

Q.18 Match the list :

- | | List-I | List-II |
|-----|--|----------------|
| (P) | Natural numbers less than the fundamental period of $f(x) = \sin x + \cos x $ is | (1) 3 |
| (Q) | If \vec{a}, \vec{b} and \vec{c} are three non coplanar vectors such that $\vec{p} = (\vec{a} \times \vec{b}) \times (\vec{b} \times \vec{c})$, $\vec{q} = (\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a})$, $\vec{r} = (\vec{c} \times \vec{a}) \times (\vec{a} \times \vec{b})$ and $[\vec{p}\vec{q}\vec{r}] = [\vec{a}\vec{b}\vec{c}]^n$, then 'n' must be | (2) 1 |
| (R) | If there are exactly two points on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ whose distance from centre is same and is equal to $\sqrt{\frac{a^2 + 2b^2}{2}}$, then eccentricity of the ellipse is $\frac{1}{\sqrt{k}}$, where k is equal to | (3) 4 |
| (S) | In an acute angled triangle ABC, $\tan A, \tan B$ & $\tan C$ are in H.P. then the minimum value of $\cot B$ is $\frac{1}{\sqrt{k}}$, where k is equal to | (4) 2 |

Codes :

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

Q.19 Match the list :

- | | List-I | List-II |
|-----|--|----------------|
| (P) | $\lim_{n \rightarrow \infty} \sum_{n=1}^n \frac{{}^n C_2}{2^n}$ equals | (1) 0 |
| (Q) | Let the roots of $f(x) = 0$ are 2, 3, 5, 7 and 9 and the roots of $g(x) = 0$ are -1, 3, 5, 7 and 8. Number of solutions of the equation $\frac{f(x)}{g(x)} = 0$ is | (2) 1 |
| (R) | Let $y = \frac{\sin^3 x}{\cos x} + \frac{\cos^3 x}{\sin x}$ where $0 < x < \pi/2$, then the minimum value of y is | (3) 3/2 |
| (S) | A circle passes through vertex D of the square ABCD, and is tangent to the sides AB and BC. If $AB = 1$, the radius of the circle can be expressed as $p + q\sqrt{2}$, then $p + q$ has the value equal to | (4) 2 |

Codes :

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

Space for rough work

Q.20 Match the list

List-I

List-II

- (P) $(x - 2)$ is a common factor of expression $x^2 + ax + b$ and $x^2 + cx + d$ where $a \neq c, b \neq d$ then $\frac{b-d}{c-a}$ is equal to (1) 4
- (Q) If number of ways of arranging letter of word CHEEKU is $3(k!)$ then k equals (2) 5
- (R) Last non zero digit in $21!$ is (3) 2
- (S) If $n \in \mathbb{N}$ then remainder when $(37)^{n+2} + (16)^{n+1} + (30)^n$ is divided by 7 is (4) 0

Codes :

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

Space for rough work

SEAL