

CODE

1



PART SYLLABUS TEST [PST-01]

TARGET : IIT-JEE 2016

CLASS : XII & DROPPER

Date : 3-01-2016

Duration : 3 Hours

Max. Marks : 210

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

PAPER - 1

JEE ADVANCED TEST SERIES

INSTRUCTIONS

A. General :

1. This Question Paper contains 60 questions.
2. The question paper CODE is printed on the left hand top corner on this sheet of the booklet.
3. No additional sheets will be provided for rough work.
4. Blank paper, clipboard, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are **not** allowed.
5. The answer sheet, a machine-gradable **Objective Response Sheet (ORS)**, is provided separately.
6. Do not Tamper / mutilate the **ORS** or this booklet.
7. Do not open the question-paper booklet before instructed to do so by the invigilators.
8. Write your **Name** and **Roll No.** in the space provided on the front page of this booklet.

B. Filling the bottom-half of the ORS :

9. Write your Roll No., Name and Class and sign with pen in appropriate places. **Do not write these anywhere else.**
10. Darken the appropriate bubbles below your roll number and paper code with HB **Pencil**.

C. Question Paper Format and Marking Scheme

The question paper consists of **three parts** (Physics, Chemistry and Mathematics). Each part consists of two sections.

11. For each question in **Section I**, you will be **awarded 4 marks** if you darken all the bubble(s) corresponding to the correct answer(s) and zero mark if no bubbles are darkened. In all other cases, **minus one (-1) mark** will be awarded.
12. For each question in **Section II**, you will be **awarded 3 marks** if you darken only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. **No negative** marks will be awarded for incorrect answer in this section.

STUDENT NAME : _____

Roll No. : _____

Address : R-24, Opp. Railway Track, Zone-II, M.P. Nagar, Bhopal (M.P.) Pin : 462011

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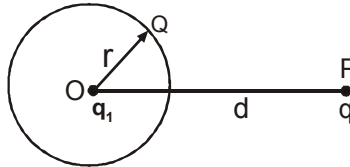
PART – I (PHYSICS)

SECTION - I

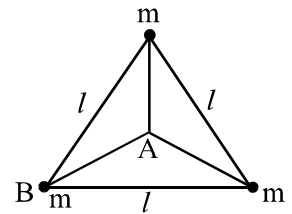
(One or More Than One Options Correct Type)

This section contains 10 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

1. A thin metallic spherical shell contains a charge Q on it. A point charge q_1 is placed at the centre O of the shell and another charge q is placed at P , at a distance d , ($d > r$) from the centre as shown in the figure. The **INCORRECT** option(s) is/are



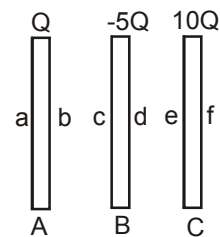
- (A) Force on q_1 due to the charge on shell [Q and induced charges] is towards right.
 (B) Force on q_1 due to all the charges [Q , q and the induced charges] is zero.
 (C) Force on q_1 due to q is towards left.
 (D) Force on q due to Q and q_1 is $\frac{kQq}{d^2} + \frac{kq_1Q}{(d-r)^2}$
2. Three equal masses m are rigidly connected to each other by massless rods of length l forming an equilateral triangle, as shown above. The assembly is to be given an angular velocity ω about an axis perpendicular to the triangle. For fixed ω , the ratio of the kinetic energy of the assembly for an axis through B compared with that for an axis through A is equal to



- (A) 3 (B) 2 (C) 1/2 (D) 1/3
3. The potential energy function associated with the force $\vec{F} = 4xy\hat{i} + 2x^2\hat{j}$ is :
- (A) $U = -2x^2y$ (B) $U = -2x^2y + \text{constant}$
 (C) $U = 2x^2y + \text{constant}$ (D) not defined

(SPACE FOR ROUGH WORK)

4. A uniform cylinder of mass m rests on two rough horizontal fixed planks. A thread is wound on the cylinder at the center on the curved part. The hanging end of the thread is pulled vertically down with a constant force F and the cylinder rolls without sliding on the planks. Choose the correct alternatives:
- (A) Since horizontal acceleration is provided by the friction acting on the cylinder, its translation kinetic energy ($\frac{1}{2}mv^2$) is equal to work done by this friction
- (B) Since torque about instantaneous axis of rotation is produced by force F , kinetic energy ($\frac{1}{2}I\omega^2$) is equal to work done by F where I is moment of inertia about the instantaneous axis of rotation and ω is the angular velocity
- (C) Since cylinder is moving, energy is lost against friction
- (D) Work done by F + work done by friction on cylinder = total KE of the cylinder
5. Which of the following statements are *correct* ?
- (A) There can be potential difference between two adjacent conductors that carry the same amount of positive charge.
- (B) Potential difference V is applied across a copper wire of diameter d and L . When the diameter of the wire is doubled keeping the other parameters same, the drift speed of the electrons remains unchanged.
- (C) 10 identical bulbs are connected in series. If one of the bulb gets fused and the remaining 9 bulbs are reconnected across the same supply in series then, light gets increased in the room.
- (D) If a charged conductor is earthed then, its net charge will become zero in any situation.
6. Three very large plates are given charges as shown in the figure. If the cross-sectional area of each plate is the same, then the final charge distribution on the surfaces a, b, c, d, e, f of the plates A, B & C is
- (A) $7Q$ on surface e and $3Q$ on surface f
- (B) $-2Q$ on surface b and $3Q$ on surface a
- (C) $-6Q$ on surface d and Q on surface c
- (D) the magnitude of charges at all surfaces b, c, d, e is equal



(SPACE FOR ROUGH WORK)

7. One end of an ideal spring (spring constant k) is attached to a rigid wall and other end to a block kept on a horizontal smooth surface. The spring is always horizontal. The block is released from rest when the spring is elongated by x .
- (A) The maximum work done by the spring on the block in the subsequent motion is $\frac{1}{2}kx^2$
 (B) The block is at rest when the spring is in its undeformed state
 (C) The spring always does positive work when the block moves away from the wall.
 (D) The spring does negative work whenever the block slows down.
8. A stone is projected from level ground at time $t = 0$. Let v_x and v_y are the horizontal and vertical components of velocity at any time t ; x and y are displacements along horizontal and vertical from the point of projection at any time t . Then
- (A) $v_y - t$ graph is a straight line
 (B) $x - t$ graph is a straight line passing through origin
 (C) $y - t$ graph is a straight line passing through origin
 (D) $v_x - t$ graph is a straight line with non zero slope
9. Two small spheres of mass m_1 and m_2 are moving towards each other with constant velocities \vec{u}_1 and \vec{u}_2 respectively and undergo head on inelastic collision. If the coefficient of restitution is e and $m_1\vec{u}_1 + m_2\vec{u}_2 = 0$, then pick up the correct statements.
- (A) During the collision, least kinetic energy of system of both spheres is zero.
 (B) Velocity of separation of both spheres after collision has magnitude $= e|\vec{u}_1 - \vec{u}_2|$
 (C) Velocity of sphere of mass m_1 after collision $= -e\vec{u}_1$
 (D) At the instant of maximum deformation during collision, speed of each sphere is zero.
10. Suppose a smooth tunnel is dug along a straight line joining two points on the surface of the earth and a particle is dropped from rest at its one end. Assume that mass of earth is uniformly distributed over its volume. Then, which of the following statements are **NOT CORRECT** ?
- (A) The particle will emerge from the other end with velocity $(GM_e)/(2R_e)$, where M_e and R_e are earth's mass and radius, respectively
 (B) The particle will come to rest at centre of the tunnel because at this position, particle is closest to earth's centre
 (C) Potential energy of the particle will be equal to zero at centre of the tunnel if it is along a diameter
 (D) Acceleration of the particle will be proportional to its distance from mid-point of the tunnel

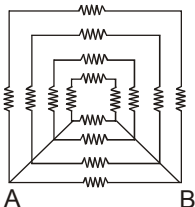
(SPACE FOR ROUGH WORK)

SECTION - II

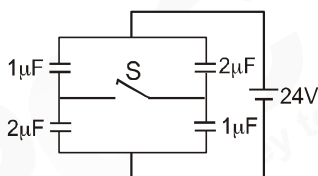
(One Integer Value Correct Type)

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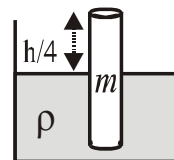
11. Sixteen resistors each of resistance $16\ \Omega$ are connected in the circuit as shown in figure. The net resistance between AB is _____



12. A solid conducting sphere of radius 10 cm is enclosed by a thin metallic shell of radius 20 cm. A charge $q = 20\ \mu\text{C}$ is given to the inner sphere. Find the heat generated (in Joule) in the process when the inner sphere is connected to the shell by a conducting wire.
13. Four uncharged capacitors are charged by 24V battery as shown in the figure. Charge flowing through S when it is closed is $n \times 4 \times 10^{-6}\ \text{C}$. Find 'n'.

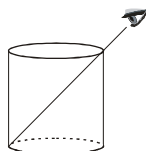


14. A particle is projected at 60° to the horizontal with a kinetic energy K . The kinetic energy at the highest point is $\frac{k}{n}$. What is the value of n ?
15. A solid cylinder of height h and mass m is floating in a liquid of density ρ as shown in figure. Find the upward acceleration (in m/s^2) of the vessel containing liquid for which the relative downward acceleration of the completely immersed cylinder w.r.t. vessel becomes equal to $(1/3)^{\text{rd}}$ of that of the vessel.

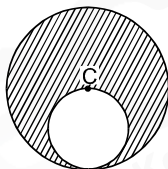


(SPACE FOR ROUGH WORK)

16. A 10 H.P. motor pumps out water and fills a water tank of volume 22380 litres at a height of 10m from the ground. The running time of the motor to fill the empty water tank is _____ minutes ($g = 10\text{ms}^{-2}$)
17. A glass beaker has diameter 4cm wide at the bottom. An observer observes the edge of bottom when beaker is empty as shown in figure. When the beaker is completely filled with liquid of refractive index $n = \sqrt{5/2}$, he can just see the centre of bottom, then the height (in cm) of glass beaker is



18. A solid sphere of radius 'R' is uniformly charged with charge density ρ in its volume. A spherical cavity of radius $\frac{R}{2}$ is made in the sphere as shown in the figure. It is given that $\frac{\rho R^2}{\epsilon_0} = 12$ Volts. Find the electric potential in volts at the centre C of the sphere.



19. A man of mass M stands at one end of a plank of length $L = 36$ m which lies at rest on a frictionless surface. The man walks to other end of the plank. If the mass of the plank is $\frac{M}{3}$, then find the distance (in m) that the man moves relative to ground.
20. A particle of mass $2m$ is projected at an angle of 45° with horizontal with a velocity of $20\sqrt{2}$ m/s. After 1 s explosion takes place and the particle is broken into two equal pieces. As a result of explosion one part comes to rest. If the maximum height attained from the ground by the other part is $5n$ meter, what is the value of n . Take $g = 10$ m/s².

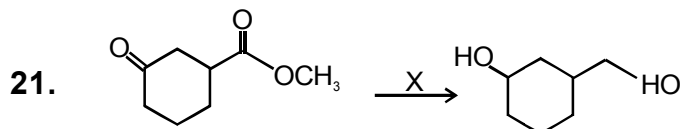
(SPACE FOR ROUGH WORK)

PART – II (CHEMISTRY)

SECTION - I

(One or More Than One Options Correct Type)

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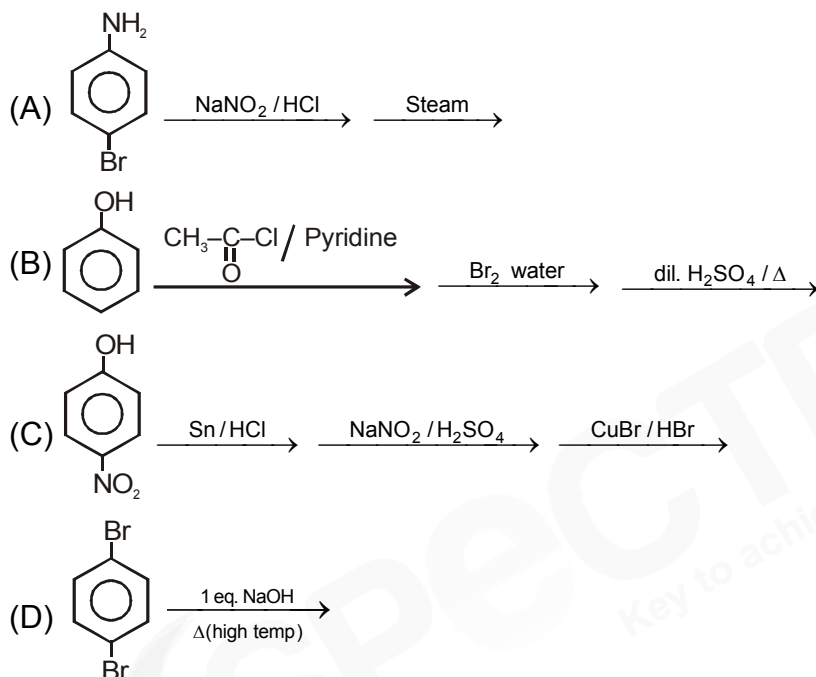
In the above transformation 'X' could be

- (A) $\text{NaBH}_4 | \text{C}_2\text{H}_5\text{OH} | \text{H}_3\text{O}^+$ (B) $\text{N}_2\text{H}_4 | \text{OH}^- | \text{glycol} | \Delta$
 (C) $\text{LiAlH}_4 | \text{Et}_2\text{O} | \text{H}_3\text{O}^+$ (D) DIBAL – H | THF | H_3O^+
22. Au and Pt dissolves in aqua regia forming the soluble compound X and Y respectively. The oxidation states and hybridisation of Au and Pt in X and Y are :
 (A) +1, +2 (B) $\text{dsp}^2, \text{d}^2\text{sp}^3$ (C) $\text{sp}^3, \text{sp}^3\text{d}^2$ (D) +3, +4
23. an aqueous solution of aniline of concentration 0.24 M is prepared. What concentration of sodium hydroxide is needed in this solution so that anilinium ion concentration remains at $1 \times 10^{-8} \text{ M}$? K_b for $\text{C}_6\text{H}_5\text{NH}_2 = 2.4 \times 10^{-5} \text{ M}$
 (A) $2 \times 10^{-2} \text{ M}$ (B) 10^{-4} M (C) 10^{-2} M (D) 10^{-3} M
24. Consider the 1st order reaction $\text{A} \xrightarrow{k} \text{product}$. Let α = degree of dissociation of A at time 't' and k = rate constant. The correct relation is
 (A) $\alpha = e^{-kt}$ (B) on increasing temperature α increases
 (C) $\alpha = 1 - e^{-kt}$ (D) on increasing temperature α is unaffactive
25. Xe when reacted with F_2 in 1 : 5 mole ratio at high temp and high pressure compound 'A' is formed. identify true statement(s) about 'A'
 (A) Central atom is in sp^3d^2 hybridisation
 (B) It's hydrolysis is disproportionation reaction
 (C) Xe(g) is one of the hydrolysis product
 (D) Central atom of A has one non-bonded e^- pair

(SPACE FOR ROUGH WORK)

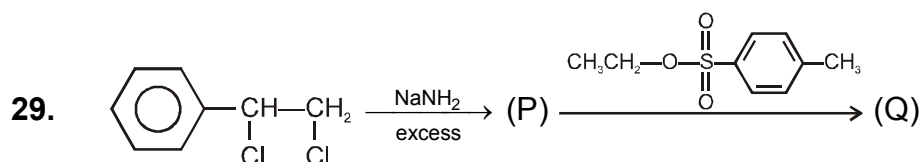
26. The qualitative order of Debroglie wavelength for electron, proton and α particle is
 $\lambda_e > \lambda_p > \lambda_\alpha$ if
 (A) If kinetic energy is same for all particles
 (B) If the accelerating potential difference ' V ' is same for all the particles (from rest)
 (C) If velocities are same for all particles
 (D) If velocities are different for all particles

27. Which of them yields Bromophenol as major product.



28. Mole fraction of CH_3OH in mixture containing CH_3OH and $\text{C}_2\text{H}_5\text{OH}$ is 0.5. Hence mass percentage of CH_3OH in the mixture is –
 (A) 41% (B) 59% (C) 50% (D) 25%

(SPACE FOR ROUGH WORK)



true statement about above reaction sequence is/are :

- (A) P to Q takes place by S_N2 mechanism (B) Q is 1-phenylbut-1-yne
 (C) P is anion of terminal alkyne (D) formation of P involves E^2 mechanism
30. Which of the following statements are correct ?
 (A) hydrolysis of sucrose with dilute acid yields an equimolar mixture of D-Glucose and D-fructose
 (B) Acidic hydrolysis of sucrose is accompanied by a change in optical reaction
 (C) In sucrose, the glycosidic linkage is between C – 1 glucose and C – 2 of fructose
 (D) In sucrose, the glycosidic linkage is between C – 1 glucose and C – 4 of fructose .

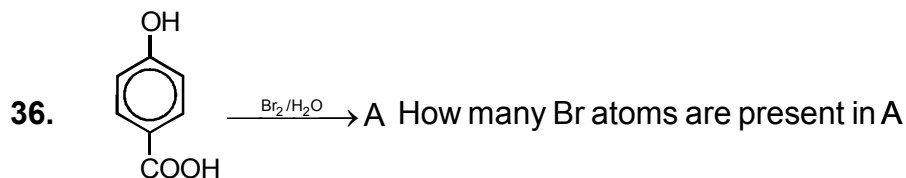
SECTION - II

(One Integer Value Correct Type)

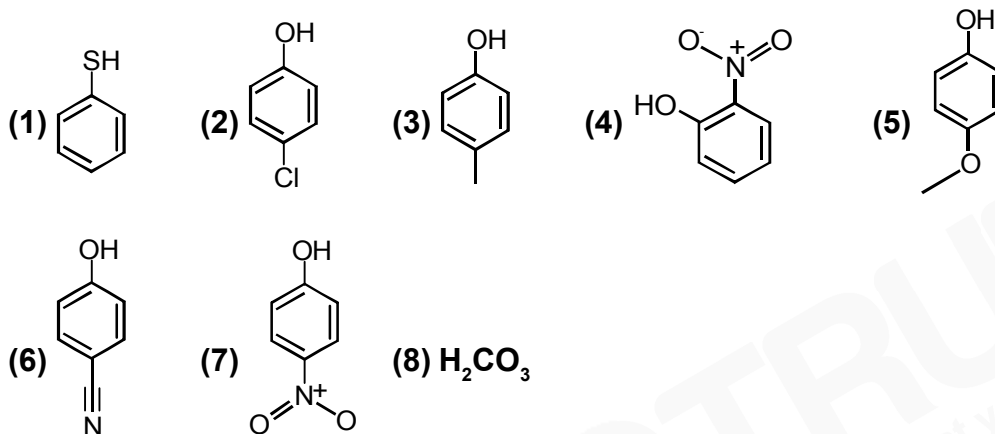
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31. Rate constant for reaction $P \rightarrow Q$ is $0.693 \text{ mole lit}^{-1} \text{ sec}^{-1}$. If initial concentration of P is 6.93 mol/lit . Half period of reaction (in seconds) is
32. 15 ml of 2.24 volume H_2O_2 solution is titrated by 0.4 M KMnO_4 in slightly basic medium then volume of KMnO_4 solution required is
33. During setting plaster of paris absorbs moisture then how many water molecules are present per formula unit of reformed product
34. find total dichloro isomers obtained by monochlorination of 2-chlorobutane
35. Specific gravity of a solution is 1.8 having 62% by weight of a solute, it is to be diluted to specific gravity of 1.2. If volume of H_2O added to 100 ml of this solution is 'V' ml then find the value of $(V/100)$ ($d_{\text{H}_2\text{O}} = 1 \text{ g/ml}$, assume volume to be additive)

(SPACE FOR ROUGH WORK)



37. How many of the following compounds are more acidic than phenol



38. When 2-ethyl anthroquinol is subjected to auto oxidation then how many o-atoms are present in organic product formed
39. In He^+ ion e^- is present in the state in which binding energy is equal to 6.04 eV then the degeneracy of electron for this state is
40. K_a of a substituted benzoic acid is 10^{-5} . If 20 ml of 0.2 M of this acid is titrated by 0.2 M NaOH solution then pH of the solution at the equivalence point is

(SPACE FOR ROUGH WORK)

PART- III (MATHEMATICS)**SECTION – I****(One or More Than One Options Correct Type)**

This section contains 10 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

41. Let R be the set of real numbers and $f : R \rightarrow R$, be a differentiable function such that $|f(x) - f(y)| \leq |x - y|^3 \forall x, y \in R$. If $f(10) = 100$, then the value of $f(20)$ is equal to
 (A) 0 (B) 10 (C) 20 (D) 100

42. For the equation $\frac{e^{-x}}{1+x} = p$, which of the following statement(s) is(are) correct ?
 (A) If $p \in (0, \infty)$ then equation has 2 real and distinct roots.
 (B) If $p \in (-\infty, -e^2)$ then equation has 2 real and distinct roots.
 (C) If $p \in (0, \infty)$ then equation has 1 real root.
 (D) If $p \in (-e, 0)$ then equation has no real root.

43. Let f be a differentiable function on R and satisfying the integral equation

$$\int_0^x f(t) dt + \int_0^x t \cdot f(x-t) dt = -1 + e^{-x}, \text{ for all } x \in R, \text{ then}$$

- (A) $f(2) = e^{-2}$ (B) $f(0) + f'(0) = 1$ (C) $f'(0) = 2$ (D) $f'(0) = 1$
44. Given two independent events, if the probability that exactly one of them occurs is $\frac{26}{49}$ and the probability that none of them occurs is $\frac{15}{49}$, then the probability of more probable of the two events is
 (A) $\frac{3}{7}$ (B) $\frac{4}{7}$ (C) $\frac{5}{7}$ (D) $\frac{6}{7}$

(SPACE FOR ROUGH WORK)

45. The solution of differential equation $e^{-x}(y+1)dy + (\cos^2 x - \sin 2x)y dx = 0$ subject to the condition $y = 1$ when $x = 0$, is
- (A) $(y+1) + e^x \cdot \cos^2 x = 3$ (B) $\ln(y+1) + e^x \cdot \cos^2 x = 1 + \ln 2$
 (C) $y + \ln y = e^x \cdot \cos^2 x$ (D) $y + \ln y + e^x \cdot \cos^2 x = 2$
46. Let $L = \lim_{x \rightarrow 0} \frac{3px + (p-2)\sin x}{(\sin^{-1} x)^3}$, where $p \in \mathbb{R}$. If L is finite then
- (A) $p = \frac{1}{2}$ (B) $L = \frac{1}{4}$ (C) $L = \frac{-1}{4}$ (D) $p = \frac{-1}{2}$
47. Let $f(x) = \operatorname{sgn}(\sin^2 x + 2\sin x - 3)$, $x \in \mathbb{R}$ and $g(x) = x^2 + (2m+6)x + 4m + 12$. If $g(x)$ is less than M for atleast one real x where M is the maximum value of $f(x)$. Then m can be
- (A) -4 (B) -3 (C) 2 (D) 3
48. If 4 elements are randomly selected from the collection $\{-2, 0, 1, 2, 0\}$ and 2×2 matrices are formed using each of the selected elements, then the chance that the selected 2×2 matrix is invertible, is
- (A) $\frac{2}{5}$ (B) $\frac{7}{15}$ (C) $\frac{1}{5}$ (D) $\frac{3}{5}$
49. $\int_0^{\pi/2} \frac{\sin^3 x}{(\cos^4 x + 3\cos^2 x + 1) \tan^{-1}(\sec x + \cos x)} dx$ is equal to
- (A) $\frac{\pi}{2} - \tan^{-1} 2$ (B) $\ln \frac{\pi}{2} - \ln(\tan^{-1} 2)$
 (C) $\ln(\tan^{-1} 2)$ (D) $\ln \frac{\pi}{2}$
50. Let $\alpha > -1$ and $\beta > -1$, then the value of $\lim_{n \rightarrow \infty} n^{\beta-\alpha} \left(\frac{1^\alpha + 2^\alpha + \dots + n^\alpha}{1^\beta + 2^\beta + \dots + n^\beta} \right)$ is
- (A) $\frac{\beta+1}{\alpha+1}$ (B) $\frac{\alpha+1}{\beta+1}$ (C) $\frac{\alpha+2}{\beta+2}$ (D) $\frac{\beta+2}{\alpha+2}$

(SPACE FOR ROUGH WORK)

SECTION – II
(One Integer Value Correct Type)

This section contains 10 questions. Each question, when worked out will result in an integer from 0 to 9 (both inclusive).

51. Graph of a function $y = f(x)$ is shown in the adjacent figure.

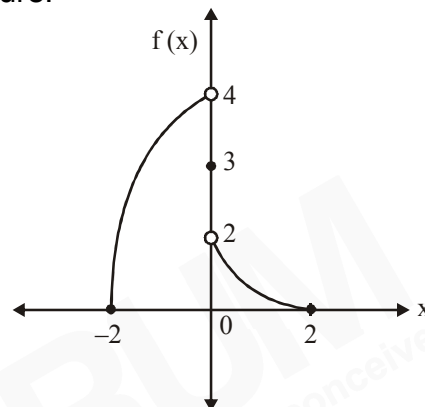
Four limits I_1, I_2, I_3 and I_4 are given as :

$$I_1 = \lim_{x \rightarrow 0^+} [f(x) - 2]$$

$$I_2 = \lim_{x \rightarrow 0^-} [f(x^2) + f(x)]$$

$$I_3 = \lim_{x \rightarrow 0^+} [\sin^{-1}(\sin(f(x))) + f(0)]$$

$$I_4 = \lim_{x \rightarrow 0^-} \left(\sin^{-1}(\sin(f(x)^2)) + \tan^{-1}(\tan(f(x))) \right)$$



then find the value of $(I_1 + I_2 + I_3 + I_4)$.

[Note : $[k]$ denotes greatest integer function less than or equal to k .]

52. Let $I_1 = \int_{\frac{1}{2}}^2 \frac{x^{2012} - 1}{x^{2014} + 1} dx$ and $I_2 = \int_2^4 \left(\log_x 2 - \frac{(\log_x 2)^2}{\ln 2} \right) dx$ then find $I_1 + I_2$.

53. A set of 3 numbers is chosen from the set of number $S = \{1, 2, 3, \dots, (2n + 1)\}$. If the probability that the number chosen are in A.P. is $\frac{4}{21}$, then find the value of n .

54. If equation of tangent to the graph of the function $y = f(x)$ at $x = 2$ is $4x - y - 3 = 0$ and at this point tangent cuts the graph also, then find $\lim_{x \rightarrow 2} \frac{f(x^2 - 2) - f(f(x) - 3)}{(x - 2)^2}$.

(SPACE FOR ROUGH WORK)

55. An urn contains 10 balls, 4 red and 6 blue. A second urn contains 16 red balls and unknown number of blue balls. A single ball is drawn from each urn. If the probability that both balls are of the same colour is 0.44, then find the number of blue balls in the second urn.
56. The function $f(x) = \frac{\sin 3x + A \sin 5x + B \sin x}{x^4 \tan^{-1} x}$, $x \neq 0$ and $f(0) = C$. If f is continuous at $x = 0$, then find the value of $\frac{4AB+C}{A}$.
57. If $\alpha + \frac{1}{\alpha}$ and $2 - \beta - \frac{1}{\beta}$ ($\alpha, \beta > 0$) are the roots of the quadratic equation $x^2 - 2(a+1)x + a - 3 = 0$ then find the sum of integral values of 'a'.
58. Let p_1 and p_2 be two values of p for which $f(x) = \begin{cases} x \cdot \frac{\ln(1+x) + \ln(1-x)}{\sec x - \cos x}, & x \in (-1, 0) \\ (p^2 - 3p - 1) \sin x + x^2, & x \in [0, \infty) \end{cases}$ is differentiable at $x = 0$, then find the value of $(p_1^2 + p_2^2)$.
59. Let f be a differentiable function on \mathbb{R} and satisfying $\int_0^x (e^{-x} - ae^{-t}) f(t) dt = 0$, where $a \neq 1$. Find the value of $f(e) + f(e^2)$.
60. Let $f(x) = x \cos x$, $x \in \left[\frac{3\pi}{2}, 2\pi\right]$ and g is the inverse function of f .
If $\int_0^{2\pi} g(x) dx = a\pi^2 + b\pi + c$, where $a, b, c \in \mathbb{R}$, then find the value of $2(a+b+c)$.

(SPACE FOR ROUGH WORK)

Space for Rough Work

SPECTRUM
Key to achieve, what you conceive

CODE

1



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5. The answer sheet, a machine-gradable **Objective Response Sheet (ORS)**, is provided separately.
6. Do not Tamper / mutilate the **ORS** or this booklet.
7. Do not open the question-paper booklet before instructed to do so by the invigilators.
8. Write your **Name** and **Roll No.** in the space provided on the front page of this booklet.

B. Filling the bottom-half of the ORS :

9. Write your Roll No., Name and Class and sign with pen in appropriate places. **Do not write these anywhere else.**
10. Darken the appropriate bubbles below your roll number and paper code with HB **Pencil**.

C. Question Paper Format and Marking Scheme

The question paper consists of **three parts** (Physics, Chemistry and Mathematics). Each part consists of three sections.

11. For each question in **Section I**, you will be **awarded 4 marks** if you darken all the bubble(s) corresponding to the correct answer(s) and zero mark if no bubbles are darkened. In all other cases, **minus one (-1) mark** will be awarded.
12. For each question in **Section II**, you will be **awarded 3 marks** if you darken all the bubble(s) corresponding to the correct answer(s) and zero mark if no bubbles are darkened. **No negative** marks will be awarded for incorrect answers in this section.
13. For each question in **Section-III** : you will be **awarded 2 marks** for each row in which you have darkened the bubble(s) corresponding to the correct answer. Thus, each question in this section carries a maximum of **8 marks**. There is **no negative marks** awarded for incorrect answer(s) in this Section.

STUDENT NAME : _____

Roll No. : _____

Address : R-24, Opp. Railway Track, Zone-II, M.P. Nagar, Bhopal (M.P.) Pin : 462011

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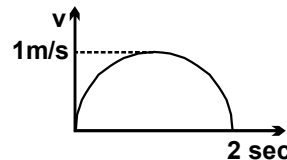
SECTION - I

(One or More Than One Options Correct Type)

This section contains 10 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

1. Velocity-time graph for a car moving in a straight line is a semicircle as shown here. Which of the following is correct :

- (A) distance and magnitude of displacement of car will be same.
 (B) Acceleration of car is never zero.
 (C) Mean speed of the particle is $\pi/4$ m/s.
 (D) The car makes a turn once during its motion.



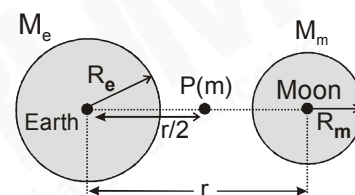
2. From figure, select the correct alternative (s)

- (A) In escaping condition total energy of particle (P) of mass 'm' is zero

- (B) Escape velocity of particle P is $v_e = \sqrt{\frac{4G}{r}(M_e + M_m)}$

- (C) Escape velocity is $v_e = \sqrt{\frac{2G}{r}(M_e + M_p)}$

- (D) In escaping condition T.E. (Total energy) of particle is negative



3. A parallel plate capacitor with plate area A and separation d has charge Q. A slab of dielectric constant k inserted in space between the plates almost completely fills the space. If E_0 and C_0 be the electric field and capacitance before inserting the slab, then

- (A) the electric field after inserting the slab is $\frac{E_0}{k}$.

- (B) the capacitance after inserting the slab is C_0

- (C) the induced charge on the slab is $Q \left(1 - \frac{1}{k} \right)$

- (D) the energy stored in the capacitor becomes $\frac{U_0}{k}$, U_0 being the energy of the capacitor before inserting the slab

(SPACE FOR ROUGH WORK)

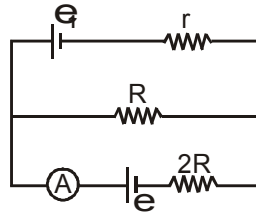
4. Identify the correct options according to the given circuit if the reading of ammeter is zero.

(A) The value of ε_1 will be $\frac{e(R+r)}{R}$

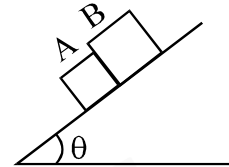
(B) Current in R is $\frac{e_1}{r+R}$

(C) Value of ε_1 will be ε

(D) Potential across $2R$ is zero



5. The two blocks A and B of equal mass are initially in contact when released from rest on the inclined plane. The coefficients of friction between the inclined plane A and B are μ_1 and μ_2 respectively.



(A) If $\mu_1 > \mu_2$, the blocks will always remain in contact.

(B) If $\mu_1 < \mu_2$, the blocks will slide down with different accelerations (if blocks slide) (C) If

$\mu_1 > \mu_2$, the blocks will have a common acceleration $\frac{1}{2}(\mu_1 + \mu_2)g \sin \theta$.

(D) If $\mu_1 < \mu_2$, the blocks will have a common acceleration $\frac{\mu_1 \mu_2 g}{\mu_1 + \mu_2} \sin \theta$.

6. A body of mass M is attached to the lower end of a metal wire, whose upper end is fixed. The elongation of the wire is l .

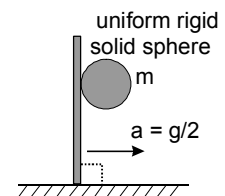
(A) Loss in gravitational potential energy of M is $Mg/$

(B) The elastic potential energy stored in the wire is $Mg/$

(C) The elastic potential energy stored in the wire is $1/2 Mg/$

(D) Heat produced is $1/2 Mg/$.

7. A uniform solid sphere rolls down on a vertical rigid surface without slipping. If the vertical surface moves with an acceleration $a = g/2$ in horizontal direction as shown then the possible value(s) of coefficient of friction between the sphere and vertical surface so as to prevent slipping is:



(A) 0.4

(B) 4/7

(C) 2/7

(D) 6/7

(SPACE FOR ROUGH WORK)

8. An electric dipole is placed in electric field whose direction is fixed but whose magnitude varies linearly with distance as we move in the direction of field. The *correct* option is
 (A) It may experiences no net force and no torque
 (B) It may experiences a net force but no torque
 (C) It may experiences a net force and a torque
 (D) It may experiences no net force but a torque
9. Which of the following statements is/are **INCORRECT** ?
 (A) When a lens ($n = 1.5$) is dipped in water ($n = 1.33$), magnitude of its focal length increases
 (B) When a lens ($n = 1.5$) is dipped in water ($n = 1.33$), magnitude of its focal length decreases
 (C) When a spherical mirror is dipped in water, magnitude of its focal length increases
 (D) When a lens ($n = 1.5$) is dipped in water ($n = 1.33$), magnitude of its focal length remains same
10. When an air bubble rises from the bottom of a deep lake to a point just below the water surface, the pressure of air inside the bubble
 (A) is greater than the pressure outside it (B) is less than the pressure outside it
 (C) increases as the bubble moves up (D) decreases as the bubble moves up

SECTION – II

Comprehension Type (Only One Option Correct)

This section contains 4 paragraphs. Each paragraph, 2 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 11 & 12

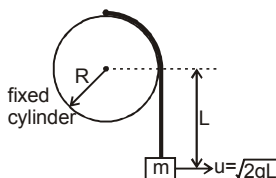
A particle initially (i.e. at time $t = 0$) moving with a velocity u is subjected to a retarding force. As a result of which it decelerates at a rate $a = -k\sqrt{v}$ where u is the instantaneous velocity and k is a positive constant.

11. The particle comes to rest in a time
 (A) $\frac{2\sqrt{u}}{k}$ (B) $\frac{\sqrt{u}}{k}$ (C) $2k\sqrt{u}$ (D) $k\sqrt{u}$
12. The distance covered by the particle before coming to rest is
 (A) $\frac{u^{3/2}}{k}$ (B) $\frac{2u^{3/2}}{k}$ (C) $\frac{3u^{3/2}}{2k}$ (D) $\frac{2u^{3/2}}{3k}$

(SPACE FOR ROUGH WORK)

Paragraph for Question Nos. 13 & 14

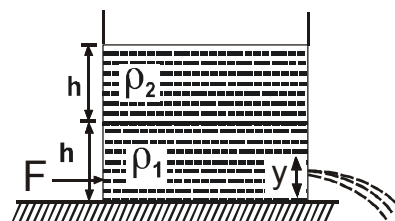
The cross-section of a fixed cylinder (not allowed to rotate and translate) with horizontal axis is as shown. One end of a light inelastic string is fixed at top of cylinder of radius R and a small block of mass m is tied to the other end of string. Initially the block is at rest with the portion of string not in contact with cylinder being vertical and having length L as shown. At the lowest position the block is given initial horizontal velocity $u = \sqrt{2gL}$ and the block moves in vertical plane. When the block reaches the highest point of its trajectory, the length of string not in contact with cylinder is $L + \frac{R\pi}{3}$. (where g is acceleration due to gravity).



13. The distance between block and centre of cylinder when block is at highest position will be:
- (A) $2R$ (B) $\sqrt{5} R$ (C) $3R$ (D) $\frac{2R}{\sqrt{3}}$
14. The least tension in string is:
- (A) $\frac{mg}{\sqrt{6}}$ (B) $\frac{mg}{\sqrt{5}}$ (C) $\frac{\sqrt{3}}{2} mg$ (D) $\frac{mg}{2}$

Paragraph for Questions Nos. 15 & 16

A cylindrical tank having cross-sectional area $A = 0.5 \text{ m}^2$ is filled with two liquids of density $\rho_1 = 900 \text{ kg m}^{-3}$ and $\rho_2 = 600 \text{ kg m}^{-3}$, to a height $h = 60 \text{ cm}$ each as shown in figure. A small hole having area $a = 5 \text{ cm}^2$ is made in right vertical wall at a height $y = 20 \text{ cm}$ from the bottom. A horizontal force F is applied on the tank to keep it in static equilibrium. The tank is lying on a horizontal surface. Neglect mass of cylindrical tank in comparison to mass of liquids. (take $g = 10 \text{ ms}^{-2}$)



(SPACE FOR ROUGH WORK)

15. The velocity of efflux
 (A) 10 ms^{-1} (B) 20 ms^{-1} (C) 4 ms^{-1} (D) 35 ms^{-1}
16. Minimum and maximum values of F to keep the cylinder in static equilibrium just after the water starts to spill through the hole. If the co-efficient of static friction between contact surfaces is 0.01.
 (A) 0, 40 N (B) 5.4 N, 52.2 N (C) 0, 70 N (D) 0, 52.2 N

Paragraph for Question Nos. 17 & 18

A block of mass m is initially at rest on a frictionless horizontal surface. A time-dependent force $F = at - bt^2$ acts on the body, where a and b are positive constants. Consider time in which force is positive.

17. The magnitude of the force is maximum at time t_1 given by
 (A) $\frac{a^2}{2b}$ (B) $\frac{a^2}{4b}$ (C) $\frac{2a^2}{b}$ (D) $\frac{4a^2}{b}$
18. The maximum velocity v_{\max} attained by the block is
 (A) $\frac{a^3}{4mb^2}$ (B) $\frac{a^3}{8mb^2}$ (C) $\frac{a^3}{6mb^2}$ (D) $\frac{a^3}{12mb^2}$

SECTION – III

Matrix – Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column-I** are labelled A, B, C and D, while the statements in **Column-II** are labelled p, q, r, s and t. Any given statement in **Column-I** can have correct matching with **ONE OR MORE** statement(s) in **Column-II**. The appropriate bubbles corresponding to the answers

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

to these questions have to be darkened as illustrated in the following example.

If the correct matches are A-p, s and t ; B-q and r ; C-p and q ; and D-s and t ; then the correct darkening of bubbles will look like the following

(SPACE FOR ROUGH WORK)

19. In the column-II some arrangements with light string, frictionless and light pulley are shown. In string AB, Tension may be written as $T = \eta mg$. Some values of η is given in column-I, match the values with arrangements of column-II. All the surfaces shown are smooth.

Column-I

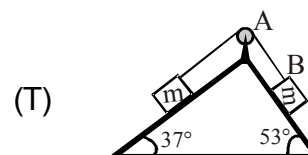
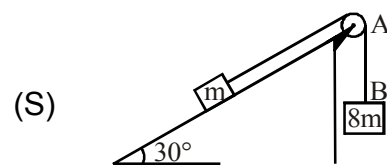
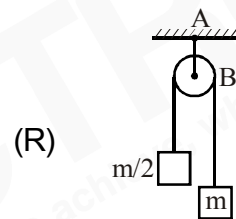
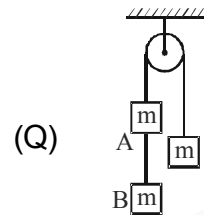
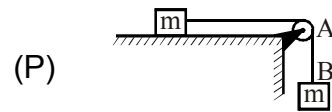
(A) $\eta = \frac{1}{2}$

(B) $\eta = \frac{2}{3}$

(C) $\eta = \frac{4}{3}$

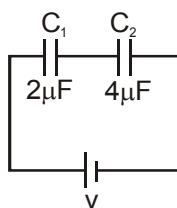
(D) $\eta = \frac{7}{10}$

Column-II



(SPACE FOR ROUGH WORK)

20. In the given figure, the separation between the plates of C_1 is slowly increased to double of its initial value, then

**Column – I**

- (A) The potential difference across C_1
 (B) The potential difference across C_2
 (C) The energy stored in C_1
 (D) The energy stored in C_2

Column – II

- (P) Increases
 (Q) decreases
 (R) increases by a factor of $6/5$
 (S) decreases by a factor of $18/25$
 (T) remains same

(SPACE FOR ROUGH WORK)

PART- II (CHEMISTRY)

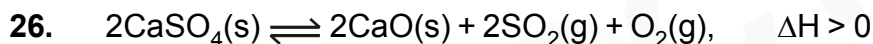
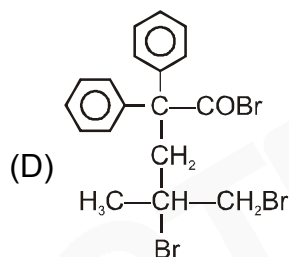
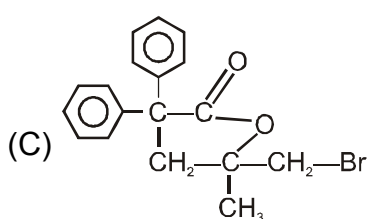
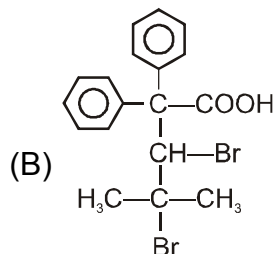
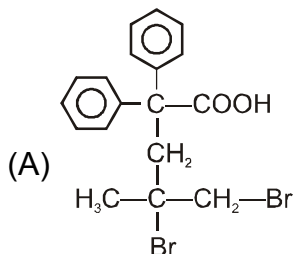
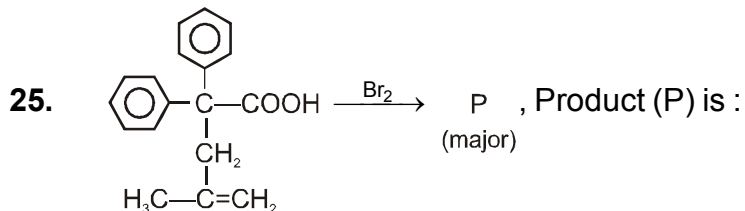
SECTION - I

(One or More Than One Options Correct Type)

This section contains 10 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

21. Which of the following is/are true for different allotropic forms of phosphorus
- (A) $(\Delta_f H^\circ) \text{P(white)} = 0$ (B) for $\text{P(white)} \rightarrow \text{P(red)}$, $\Delta H > 0$
 (C) for $\text{P(white)} \rightarrow \text{P(black)}$, $\Delta H < 0$ (D) for $\text{P(red)} \rightarrow \text{P(black)}$, $\Delta S < 0$
22. Identify the **correct** statement(s)
- (A) Molecularity of a reaction may include the number of product molecules taking part in the reaction.
 (B) Larger the value of E_a , greater is the effect on the value of k for a given temperature change.
 (C) At lower temperature, increase in temperature causes more change in the value of k than at higher temperature.
 (D) concentration of catalyst appears in rate law
23. The product(s) which is/are formed in the following reaction :
- $$\begin{array}{c} \text{CH}_3 \qquad \qquad \text{CH}_3 \\ | \qquad \qquad | \\ \text{Ph}-\text{C}-\text{CH}-\text{CH}-\text{CH}-\text{CH}_2\text{OH} \\ | \quad | \quad | \\ \text{OH} \quad \text{OH} \quad \text{OH} \end{array} \xrightarrow{\text{HIO}_4 \text{ (excess)}}$$
- (A) HCOOH (B) $\text{Ph}-\text{C}(=\text{O})-\text{CH}_3$ (C) $\text{OHC}-\overset{\text{CH}_3}{\underset{|}{\text{CH}}}-\text{CH}_2\text{OH}$ (D) $\text{OHC}-\overset{\text{CH}_3}{\underset{|}{\text{CH}}}-\text{CHO}$
24. Which of the following is a state function
- (A) Entropy (B) Reversible work (C) free energy (D) irreversible work

(SPACE FOR ROUGH WORK)

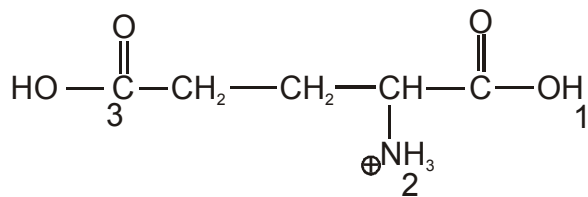


Above equilibrium is established by taking some amount of $\text{CaSO}_4(\text{s})$ in a closed container at 1600 K. Then which of the following may be correct option.

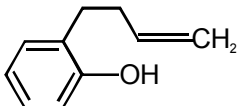
- (A) moles of $\text{CaO}(\text{s})$ will increase with the increase in temperature
- (B) If the volume of the container is doubled at equilibrium then the final partial pressure of $\text{SO}_2(\text{g})$ will be different from that of the old equilibrium.
- (C) If the volume of the container is halved partial pressure of $\text{O}_2(\text{g})$ at new equilibrium will remain same
- (D) If two moles of the He gas is added at constant pressure then the moles of $\text{CaO}(\text{s})$ will increase.

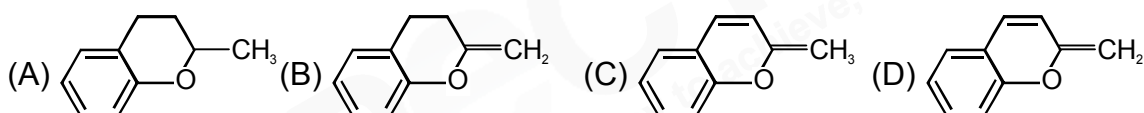
(SPACE FOR ROUGH WORK)

27. For the cationic form of amino acid identify true statements (if pK_a values are 2.2, 4.2 and 9.6)



- (A) K_a order is $1 > 2 > 3$ (B) K_a order is $1 > 3 > 2$
 (C) isoelectric point is at $\text{pH} = 3.2$ (D) isoelectric point is at $\text{pH} = 6.9$
28. When I_2 is added to excess of warm chlorine water solution then which is true about the reaction
- (A) It is a redox reaction
 (B) oxidation state of I_2 in the balanced reaction is +1
 (C) In the balanced reaction coefficient Cl_2 is 8
 (D) In the balanced reaction no molecules of water involved per molecule of I_2 is 9

29.  $\xrightarrow{\text{H}^+}$ major product of this reaction is



30. which of the following is true for terylene
- (A) It is a condensation polyester
 (B) It is condensation polyamide
 (C) one of its monomer has four oxygen atom in structure
 (D) one of its monomer has two oxygen atom in structure
 carboxylic acid

(SPACE FOR ROUGH WORK)

SECTION – II

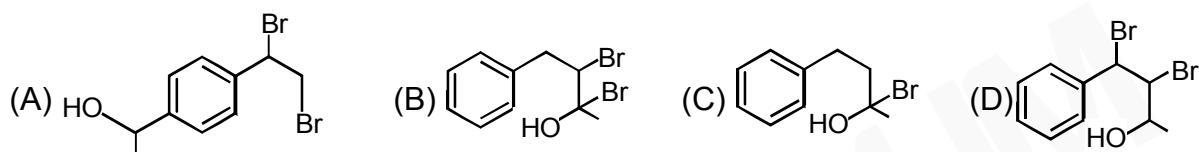
Comprehension Type (Only One Option Correct)

This section contains 4 paragraphs. Each paragraph, 2 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 31 & 32

Compounds (A), $C_{10}H_{12}O$ gives off hydrogen on treatment with sodium metal and decolorises Br_2 in CCl_4 to give (B). $C_{10}H_{12}OBr_2$. (A) on treatment with I_2 in NaOH gives iodoform and an acid (C) after acidification. Compound A when heated with concentrated acidified $KMnO_4$ solution then it forms monoaromatic carboxylic acid. Answer the following based on the above

31. Compound B is



32. Which of the following statements regarding A are **incorrect** ?
 (A) In the presence of acidic medium A form a 5 membered ring
 (B) A has 2 geometrical isomers.
 (C) A has diastereomers
 (D) A has 2 chiral centres

Paragraph for Question Nos. 33 & 34

An alkali metal 'A' gives red colour in oxidising flame. A on heating in air forms compound 'B' and 'B' on hydrolysis produces different compounds along with gas 'C'. When 'C' is heated with NH_3 in the presence of Pt forms gas 'D' and water. D on further reaction with air forms reddish brown gas 'E' which disproportionates in aqueous solution. Then answer the following questions.

33. A, B and C are respectively
 (A) Li, Li_3N , NH_3 (B) Rb, RbO_2 , O_2 (C) Rb, Rb_2O_2 , O_2 (D) K, KO_2 , O_2
34. Identify the correct statement regarding C, D and E ?
 (A) all are paramagnetic
 (B) D is also a brown coloured vapour
 (C) C and D are paramagnetic and B is diamagnetic
 (D) both D and E undergoes disproportionation in aqueous solution at room temperature

(SPACE FOR ROUGH WORK)

Paragraph for Questions 35 and 36

10 moles of an ideal diatomic gas ($\gamma = 1.4$) at 300 K and 6 atm is expanded irreversibly and adiabatically to a final pressure of 1.2 atm against a constant pressure of 1 atm.

(Given : $\ln 2 = 0.7$, $\ln 10 = 2.3$, R = gas constant)

35. ΔH for the process is
 (A) 0 (B) $-1500R$ (C) $-2100R$ (D) $-3000R$
36. For the process which is true
 (A) $(\Delta S)_{\text{system}} = 0$ (B) $(\Delta S)_{\text{surrounding}} = 0$
 (C) $(\Delta S)_{\text{universe}} = 0$ (D) None of these

Paragraph for Questions 37 and 38

Due to the presence of solubility of salt reduces considerably.

The common ion effect is also used for almost complete precipitation of a particular ion as its sparingly soluble salt, with very low value of solubility product for gravimetric estimation. solubility of Ag_2CrO_4 in 0.1 M AgNO_3 is found to be 10^{-10} M.

40 mL of 0.10 M AgNO_3 is mixed with 60 mL of 0.05 M K_2CrO_4 solution. Then

37. Approximate Ag^+ ion concentration in the solution is
 (A) 0.01 M (B) 10^{-6} M (C) 5×10^{-8} M (D) 10^{-5} M
38. Approximate CrO_4^{2-} ion concentration in the solution is
 (A) 0.03 M (B) 0.02 M (C) 0.01 M (D) 10^{-3} M

SECTION - III**Matrix - Match Type**

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column-I** are labelled A, B, C and D, while the statements in **Column-II** are labelled p, q, r, s and t. Any given statement in **Column-I** can have correct matching with **ONE OR MORE** statement(s) in **Column-II**. The appropriate bubbles corresponding to the answers

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

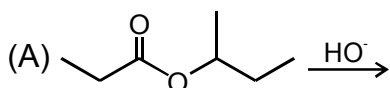
to these questions have to be darkened as illustrated in the following example.

If the correct matches are A-p, s and t ; B-q and r ; C-p and q ; and D-s and t ; then the correct darkening of bubbles will look like the following

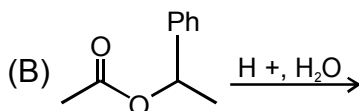
(SPACE FOR ROUGH WORK)

39. COLUMN -I

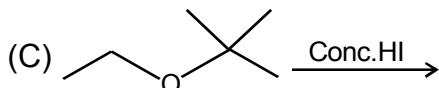
COLUMN-II



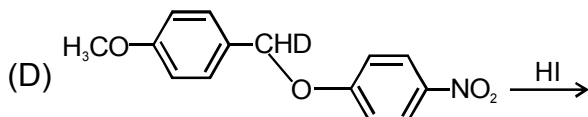
(p) Involves carbocation formation



(q) Acyl ($\text{C}=\text{O}$) cleavage



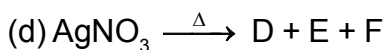
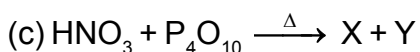
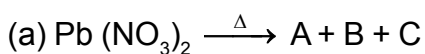
(r) Product involves Racemic mixture



(s) Product gives iodoform test

(t) One of the product is 3° halide

40. Match the following
Column I



Column II

(p) reddish - brown coloured gas is evolved

(q) paramagnetic gas(es) is/are evolved

(r) One of the product contains N - O - N linkage

(s) One of the product is a solid (metal) residue

(t) One of the product is paramagnetic with two unpaired electron

(SPACE FOR ROUGH WORK)

SECTION – I

(One or More Than One Options Correct Type)

This section contains 10 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

41. The number of ways in which 18 identical coins can be distributed among five children A, B, C, D and E so that everyone gets atleast one coin but not more than 8 coins, is
 (A) 2380 (B) 2150 (C) 1750 (D) 1650
42. Let $f(x)$ be a twice differentiable function such that $f''(x) > 0$ in $[0, 2]$. Then
 (A) $f(0) + f(2) = 2f(c)$, for atleast one $c \in [0, 2]$.
 (B) $f(0) + f(2) < 2f(1)$
 (C) $f(0) + f(2) > 2f(1)$
 (D) $2f(0) + f(2) > 3f\left(\frac{2}{3}\right)$
43. The value of $\lim_{x \rightarrow 0} \frac{\sin^3 x - x^3 \operatorname{sgn}\left(1 - \left\lfloor \frac{x}{\sin^{-1} x} \right\rfloor\right)}{x \tan^2 x \sin(\pi \cos x)}$ is equal to :
 [Note : $[k]$ denotes greatest integer less than or equal to k and $\operatorname{sgn}(k)$ denotes signum function of k .]
 (A) $\frac{1}{\pi}$ (B) $\frac{-1}{\pi}$ (C) $\frac{1}{6\pi}$ (D) $-\frac{1}{6\pi}$
44. The area bounded by the curves $f(x) = x^3 - 3x$ and $g(x) = 2x^2$ in the second quadrant is
 (A) $\frac{12}{23}$ (B) $\frac{7}{12}$ (C) $\frac{2}{3}$ (D) $\frac{3}{5}$

(SPACE FOR ROUGH WORK)

45. Let $L = \lim_{x \rightarrow 1} \frac{\sin(6 \cos^{-1} x)}{\sqrt{1-x^2}}$ and $M = \lim_{x \rightarrow 1} \frac{1 - \cos(6 \cos^{-1} x)}{1-x^2}$. Which of the following is/are correct ?

(A) $L + M = 24$ (B) $\frac{M}{L} = 3$ (C) $L - M = 12$ (D) $LM = 54$

46. If α is a real number for which $f(x) = \ln\left(3 \cos^{-1}\left(\frac{3x}{7}\right) - \pi\right)$ is defined, then the possible values of $[\alpha]$ can be

[Note: $[k]$ denotes greatest integer function less than or equal to k .]

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

47. A pair of dice is rolled. Two events E and F are defined as follows

E : occurrence of a doublet

F : occurrence of a total of 7

then the events E and F are

- (A) equally likely but not independent.
 (B) equally likely and mutually exclusive.
 (C) mutually exclusive but not exhaustive.
 (D) $P(E / F) = P(F / E)$

48. Let f be a strictly increasing continuous function defined on the set of real numbers.

If $f(1) = 2$ and $f(2) = 4$, then value of $\int_1^2 f(x) dx$ can be equal to

(A) $\frac{5}{2}$ (B) $\frac{11}{4}$ (C) $\frac{25}{8}$ (D) 4

(SPACE FOR ROUGH WORK)

49. The value of definite integral $\int_{\frac{1}{3}}^{\frac{2}{3}} \frac{\ln x}{\ln(x-x^2)} dx$ is equal to
- (A) $\frac{1}{3}$ (B) $\frac{1}{6}$ (C) $\frac{1}{9}$ (D) $\frac{1}{18}$
50. Let $f(x)$ be a continuous and periodic function such that $f(x) = f(x + T)$ for all $x \in \mathbb{R}$, $T > 0$. If $\int_{-2T}^{a+5T} f(x) dx = 19$ ($a > 0$) and $\int_0^T f(x) dx = 2$, then $\int_0^a f(x) dx$ is equal to
- (A) 3 (B) 5 (C) 7 (D) 9

SECTION – II

Comprehension Type (Only One Option Correct)

This section contains 4 paragraphs. Each paragraph, 2 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 51 & 52

Consider, $f(x) = \tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right)$ and $g(x) = \operatorname{cosec}^{-1}\left(\frac{\sqrt{1+x^2}}{x}\right)$, $x \neq 0$

51. The number of solution(s) of the equation

$$x^2 = |f(x) - g(x)| \text{ is}$$

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

52. If $f(x) + g(x) = \frac{\pi}{8}$ then x equals

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

(SPACE FOR ROUGH WORK)

Paragraph for Question Nos. 53 & 54

Let $f(x) = \lim_{n \rightarrow \infty} \left(1 - \sin x + \sqrt[n]{e} \sin x \right)^n$ $n \in \mathbb{N}$

$$a = \frac{2}{11} \lim_{x \rightarrow 0} \left(\left[\frac{\sin x}{x} \right] + \left[\frac{2 \sin x}{x} \right] + \left[\frac{3 \sin x}{x} \right] + \dots + \left[\frac{11 \sin x}{x} \right] \right); b = \lim_{x \rightarrow 0} \left(\frac{x^2}{\left[\frac{\tan x}{x} \right] - \cos x} \right)$$

[Note: $[k]$ denotes greatest integer function less than or equal to k .]

53. The value of $(a + b)$ is equal to
 (A) 2 (B) 6 (C) 10 (D) 12
54. Number of integral values of λ so that the equation $bx^2 - b^2x + \lambda = 0$ has roots α, β such that $1 < \alpha < 2$ and $2 < \beta < 3$ is
 (A) 0 (B) 1 (C) 2 (D) 3

Paragraph for Question Nos. 55 & 56

Consider, $f(x) = \cos 2x + 2x\lambda^2 + (2\lambda + 1)(\lambda - 1)x^2$, $\lambda \in \mathbb{R}$

55. For $\lambda = 1$, if $f(3x^2 - 2x + 1) < f(x^2 - 2x + 9)$ then number of integral values of x in $[-10, 10]$ is
 (A) 3 (B) 5 (C) 16 (D) 18
56. If $f(x)$ is increasing for all $x \in \mathbb{R}$ then number of values of λ is
 (A) 1 (B) 2 (C) 3 (D) infinite

Paragraph for Question Nos. 57 & 58

If $y = f_1(x)$ and $y = f_2(x)$ are two solutions of the equation $ydx + dy = -e^xy^2dy$ where $f_1(0) = 1$ and $f_2(0) = -1$.

57. The number of solutions(s) of the equation $f_1(x) \cdot f_2(x) + x^2 = 0$ is(are)
 (A) 0 (B) 1 (C) 2 (D) 3
58. If area enclosed by $y = f_1(x)$, $y = e^x$ and the x -axis is A_1 and $y = f_2(x)$, $y = -e^x$ and the x -axis is A_2 then $A_1 + A_2$ is equal to
 (A) $6 \ln 2$ (B) 3 (C) 6 (D) $3 \ln 2$

(SPACE FOR ROUGH WORK)

SECTION – III

Matrix - Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column-I** are labelled A, B, C and D, while the statements in **Column-II** are labelled p, q, r, s and t. Any given statement in **Column-I** can have correct matching with **ONE OR MORE** statement(s) in **Column-II**. The appropriate bubbles corresponding to the answers

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

to these questions have to be darkened as illustrated in the following example.

If the correct matches are A-p, s and t ; B-q and r ; C-p and q ; and D-s and t ; then the correct darkening of bubbles will look like the following

59.	Column – I	Column – II
(A)	If $\lim_{n \rightarrow \infty} \frac{(1^3 + 2^3 + 3^3 + \dots + n^3)(1^5 + 2^5 + 3^5 + \dots + n^5)}{(1^9 + 2^9 + 3^9 + \dots + n^9)} = \frac{p}{q}$ where $p, q \in \mathbb{N}$ then least value of $ p - q $ is	(P) 2
(B)	If $f(x) = \text{Max.}(\tan^{-1} x, \text{Min.}(\sin^{-1} x, \cos^{-1} x))$, then number of points where $f(x)$ is non-derivable is	(Q) 3
(C)	If an integer is randomly selected from the set $[-2\pi, 2\pi]$ then the probability that it lies in the domain of the function $f(x) = \sqrt{\log_2 \left(\frac{10x-4}{4-x^2} \right) - 1}$ is $\frac{a}{b}$ where a and b are relatively prime numbers then $(b - a)$ is equal to	(R) 7 (S) 8
(D)	If the function $f(x) = c x \cdot e^{-x} - \frac{x^2}{2} + x$ is decreasing for every $-\infty < x \leq 0$, then the least value of c^2 is equal to	(T) 1

(SPACE FOR ROUGH WORK)

60.

Column – I

Column – II

- (A) If $\lim_{x \rightarrow \frac{\pi}{2}} \frac{\left(1 - \tan \frac{x}{2}\right)(1 - \sin x)}{\left(1 + \tan \frac{x}{2}\right)(\pi - 2x)^3}$ is equal to $\frac{1}{k}$, (P) 9
then the value of k where $k \in \mathbb{N}$ is
- (B) If the range of the function $f(x) = 3 \sin \sqrt{\frac{\pi^2}{16} - x^2}$ is $[a, b]$, (Q) 12
then the value of $2(a^2 + b^2)$ is
- (C) If the sum of all possible values of $x \in (0, 2\pi)$ satisfying (R) 16
the equation $2\cos x \operatorname{cosec} x - 4\cos x - \operatorname{cosec} x = -2$
is equal to $\frac{k\pi}{4}$ ($k \in \mathbb{N}$), then the value of k is (S) 32
- (D) If $\ln((e-1)e^{xy} + x^2) = x^2 + y^2$, (T) 2
then $\frac{dy}{dx}$ at $(1, 0)$ is equal to

(SPACE FOR ROUGH WORK)

Space for Rough Work

