From Long Term Classroom Programs and Medium / Short Classroom Program 4 in Top 10, 10 in Top 20, 43 in Top 100, 75 in Top 200, 159 in Top 500 Ranks & 3542 total selections in IIT-JEE 2012

ALL INDIA TEST SERIES

FIITJEE

JEE (Advanced), 2013

CONCEPT RECAPITULATION TEST
(Set – I)

Paper 1

Time Allotted: 3 Hours **Maximum Marks: 243**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into two sections: **Section-A & Section-B**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with black pen for each character of your Enrolment No. and write your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

(i) **Section-A (01 to 09)** contains 09 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (10 – 13) contains 4 Assertion-Reasoning (multiple choice questions) which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (14 – 19) contains 2 paragraphs. Based upon paragraph, 3 multiple choice questions have to be answered. Each question has only one correct answer and carries **+4 marks** for correct answer and **– 1 mark** for wrong answer.

(ii) **Section-B (1 – 03)** contains 3 Matrix Match Type (4 × 4 Matrix) questions containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+6 marks** for all correct answer. There is no negative marking.

Name of the Candidate	
Enrolment No.	

Useful Data

PHYSICS

Acceleration due to gravity	$g = 10\ m/s^2$
Planck constant	$h = 6.6 \times 10^{-34}$ J-s
Charge of electron	$e = 1.6 \times 10^{-19}$ C
Mass of electron	$m_e = 9.1 \times 10^{-31}$ kg
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2$
Density of water	$\rho_{water} = 10^3\ kg/m^3$
Atmospheric pressure	$P_a = 10^5\ N/m^2$
Gas constant	$R = 8.314\ J\ K^{-1}\ mol^{-1}$

CHEMISTRY

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	0.0821 Lit atm $K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2$ Cal $K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's constant	h	=	6.625×10^{-34} J·s
		=	6.625×10^{-27} erg·s
1 Faraday		=	96500 coulomb
1 calorie		=	4.2 joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No: H=1, He = 2, Li=3, Be=4, B=5, C=6, N=7, O=8, N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16, Cl=17, Ar=18, K =19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33, Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56, Pb=82, U=92.

Atomic masses: H=1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16, F=19, Na=23, Mg=24, Al = 27, Si=28, P=31, S=32, Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59, Ni=58.7, Cu=63.5, Zn=65.4, As=75, Br=80, Ag=108, Sn=118.7, I=127, Xe=131, Ba=137, Pb=207, U=238.

Physics

PART – I

SECTION – A
Single Correct Choice Type

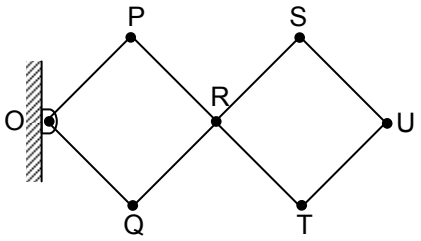
This section contains **9 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. The end of a chain of length L and mass per unit length ρ, which is piled up on a horizontal platform is lifted vertically with a constant velocity u by a variable force F. Find F as a function of height x of the end above platform.

(A) $\rho\left(gx + 2u^2\right)$ (B) $\rho\left(2gx + \rho u^2\right)$

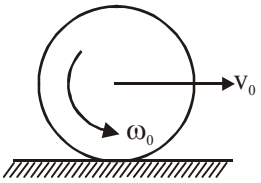
(C) $\rho\left(gx + u^2\right)$ (D) $\rho\left(u^2 - gx\right)$

2. In the arrangement of rigid links of equal length l, they can freely rotate about the joined ends as shown in the figure. If the end U is pulled horizontally with constant speed 20 m/s, find the approx. speed of end P when the angle SUT is 90^o.



(A) 5 m/s
(B) 10 m/s
(C) 7.1 m/s
(D) 14.12 m/s

3. A disc of radius R is spun to an angular speed ω_0 about its axis and then imparted a horizontal velocity of magnitude $\frac{\omega_0 R}{4}$ (at t = 0) with its plane remaining vertical. The coefficient of friction between the disc and the plane is μ. The sense of rotation and direction of its linear speed are shown in the figure. Choose the correct statement. The disc will return to its initial position

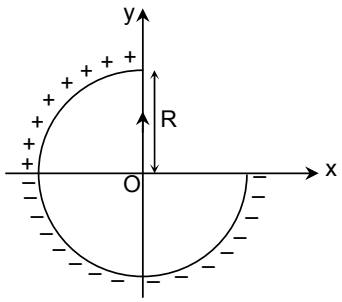


(A) if the value of $\mu < 0.5$. (B) irrespective of the value of μ ($\mu > 0$).

(C) if the value of $0.5 < \mu < 1$. (D) if $\mu > 1$.

Rough work

4. A conductor having uniform linear charge density λ is placed in circular form in 3 quadrants with different polarities as shown in the figure. Let E_0 be the electric field at O. Then the angle made E_0 with the line along y-axis.



(A) $\tan^{-1}\left(\frac{1}{2}\right)$ (B) $\tan^{-1}(1)$

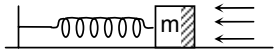
(C) $\tan^{-1}\left(\frac{1}{3}\right)$ (D) None

5. A neutral metallic finite block is placed at large but finite distance from a large charged sheet in the middle space in front of sheet. Then the block will be

(A) Attracted towards the sheet (B) Repelled away from the sheet

(C) Depend on nature of charge on the sheet (D) Zero force on the block

6. A spring block system with mass of block m and spring constant K (all the surfaces of block are perfectly reflecting and smooth) is placed on a smooth horizontal plane as shown in the diagram. A light beam of intensity I is switched on from rightwards. Find the amplitude of oscillations of the block. (face area of block is A)



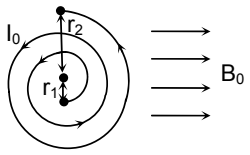
(A) $\frac{I}{KC}A$ (B) $\frac{2I}{KC}A$

(C) $\frac{4I}{KC}A$ (D) Zero

Rough work

7. A rod of mass M and length L is placed on a smooth horizontal table and is hit by a ball moving horizontally and perpendicular to length of rod and sticks to it. Then conservation of angular momentum can be applied
(A) About any point on the rod
(B) About a point at the centre of the rod
(C) About end point of the rod
(D) None

8. Magnetic force on a spiral carrying current I_0 and placed in magnetic field B_0 parallel to the plane of spiral as shown in diagram, will be nearly (initial point, final point and centre lie on a line)



(A) Zero
(B) $I_0B_0(r_2 - r_1)$
(C) $I_0B_0(r_2 + r_1)$
(D) $\frac{I_0B_0r_2}{r_1}$

9. A horizontal spring mass system of mass M performs simple harmonic motion of amplitude a_0 and time period T_0. When the mass M passes through mean position, another stationary mass M sticks to it and both move together. If a and T be new amplitude and time period, then
(A) $a = \frac{a_0}{\sqrt{2}}$
(B) $a = a_0\sqrt{2}$
(C) $T = \frac{T_0}{\sqrt{2}}$
(D) None

Rough work

Assertion - Reasoning Type

This section contains 4 questions numbered 10 to 13. Each question contains **STATEMENT-1 (Assertion)** and **STATEMENT-2 (Reason)**. Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

10. STATEMENT-1: A person is standing on a horizontal ground which is perfectly smooth. Normal reaction force on the person is the reaction force of the weight of the person

and

STATEMENT-2: According to Newton's third law for every force of action, there exists an equal & opposite force of reaction.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement -2 is False.
(D) Statement-1 is False, Statement-2 is True.

11. STATEMENT-1: A uniform circular motion is essentially uniformly accelerated.

and

STATEMENT-2: In uniform circular motion, acceleration is always directed towards centre.

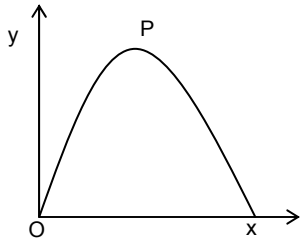
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement -2 is False.
(D) Statement-1 is False, Statement-2 is True.

Rough work

12. STATEMENT-1: In a projectile motion, (see figure) radius of curvature decreases along the trajectory as one goes from point of projection to the highest point on trajectory.

and

STATEMENT-2: As the projectile moves from O to P, its speed decreases while acceleration increases.



(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement -2 is False.
(D) Statement-1 is False, Statement-2 is True.

13. STATEMENT-1: The electrostatic force on a charged particle located on an equi-potential surface is always zero.

and

STATEMENT-2: Work done by external agent in slowly moving a point charge over equipotential surface is zero.

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement -2 is False.
(D) Statement-1 is False, Statement-2 is True.

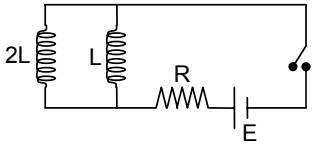
Rough work

Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice question based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 14 to 16

For the circuit shown in the figure, the switch S is closed at t = 0. All the inductors are ideal and cell is having zero internal resistance. Based on above information, answer the following questions.



14. The current in inductor of inductance 2L as a function of time is

(A) $\frac{E}{3R}\left[1-e^{\frac{-Rt}{L}}\right]$ (B) $\frac{E}{3R}\left[1-e^{\frac{-3Rt}{2L}}\right]$

(C) $\frac{2E}{3R}\left[1-e^{\frac{-Rt}{L}}\right]$ (D) $\frac{E}{R}\left[1-e^{\frac{-3Rt}{2L}}\right]$

15. The magnetic energy stored in inductor of inductance L at $t = t_0$ is

(A) $\frac{E^2L}{18R^2}\left[1-e^{\frac{-Rt_0}{L}}\right]^2$ (B) $\frac{E^2L}{18R^2}\left[1-e^{\frac{-3Rt_0}{2L}}\right]^2$

(C) $\frac{2E^2L}{9R^2}\left[1-e^{\frac{-3Rt_0}{2L}}\right]^2$ (D) $\frac{E^2L}{2R^2}\left[1-e^{\frac{-3Rt_0}{2L}}\right]^2$

16. After being closed for a long time, the switch is opened at t = 0. Then current through L for t > 0 is

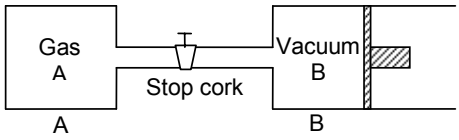
(A) Zero (B) $\frac{E}{R}\left[1-e^{\frac{-Rt}{L}}\right]$

(C) $\frac{2E}{3R}e^{\left[\frac{-3Rt}{2L}\right]}$ (D) $\frac{2E}{3R}e^{\left[\frac{-Rt}{2L}\right]}$

Rough work

Paragraph for Question Nos. 17 to 19

An ideal diatomic gas is confined in a cylinder A of volume V_0. Then, cylinder is connected to another cylinder B with the help of tube of a negligible volume. The cylinder B is fitted with a movable piston, which can be adjusted from outside. Initially, piston is adjusted so that the volume of B is same as volume of A, i.e., V_0. B is evacuated and stop cork is opened so that gas expands and occupies the volume $2V_0$.



Answer the following questions based on above information.

17. During this free expansion, the internal energy of this system
(A) Increases (B) Decreases
(C) Remains constant (D) Nothing can be said

18. With open stop cork, the piston is slowly moved to compress the gas back to cylinder A at temperature T. Then, for n moles of gas, work done on the gas is
(A) $nRT\ln 2$ (B) $-nRT\ln 2$
(C) nRT (D) $-nRT$

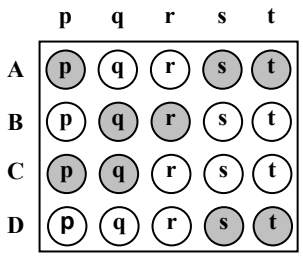
19. The heat absorbed by the gas in the above process is
(A) $nRT\ln 2$ (B) $-nRT\ln 2$
(C) nRT (D) $-nRT$

Rough work

SECTION - B

Matrix – Match Type

*This section contains 3 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 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:

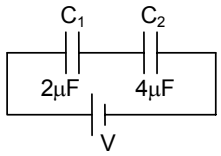


1. Column–B shows the optical phenomenon that can be associated with optical components given in Column–A. Note the Column–I may have more than one matching options in Column–B.

Column A		Column B	
(A)	Convex mirror.	(p)	Dispersion.
(B)	Converging lens.	(q)	Deviation.
(C)	Thin prism.	(r)	Real image of real object.
(D)	Glass slab.	(s)	Virtual image of real object.

Rough work

2. In the given figure, the separation between the plates of C_1 is slowly increased to double of its initial value. Then:



Column I		Column II	
(A)	The potential difference across C_1	(p)	Increases
(B)	The potential difference across C_2	(q)	Decreases
(C)	The energy stored in C_1	(r)	Increases by a factor of $\frac{6}{5}$
(D)	The energy stored in C_2	(s)	Decreases by a factor of $\frac{18}{25}$
		(t)	Remain constant

3. A charged particle with some initial velocity is projected in a region, where non-zero, non varying and uniform electric and/or magnetic fields are present. In Column I, information about existence of electric field and/or magnetic field and direction of initial velocity of charged particle are given while in Column II, the probable path of charged particle is mentioned. Match the entries of Column I with entries of Column II: (consider gravity free space)

Column I		Column II	
(A)	$\vec{E} = 0,\ \vec{B} \neq 0$ and initial velocity is at an unknown angle with $\vec{B}$	(p)	Straight line
(B)	$\vec{E} \neq 0,\ \vec{B} = 0$ and initial velocity is at unknown angle with $\vec{E}$	(q)	Parabola
(C)	$\vec{E} \neq 0,\ \vec{B} \neq 0,\ \vec{E} \parallel \vec{B}$ and initial velocity is perpendicular to $\vec{E}$	(r)	Circular
(D)	$\vec{E} \neq 0,\ \vec{B} \neq 0,\ \vec{E}$ perpendicular to $\vec{B}$ and initial velocity is perpendicular to both $\vec{E}$ and $\vec{B}$	(s)	Helical path with non uniform pitch
		(t)	Cycloid

Rough work

Chemistry

PART – II

SECTION – A
Single Correct Choice Type

This section contains **9 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. If an electron is ejected from 1st excited state of H-atom by the radiation corresponding to second line of "Balmer Series" of Li^{2+} ion then calculate kinetic energy of ejected electron.
   (A) 4.35 eV (B) 6.25 eV
   (C) 11.25 eV (D) 19.55 eV

2. A cation M^{+x} forms violet colouraiton $[M(H_2O)_6]^{+x}$ in aqueous medium.
   M^{+x} +NH_3 solution $\rightarrow$ grey – blue gelatanious precipitate
   Soluble in excess of precipitant
   $M^{+x} + S_2O_8^{-2} \xrightarrow{H^+}$ yellow solution in presence of one drop of dilute $AgNO_3$, which turns blue when the solution is acidified and 3ml of ether added followed by the addition of H_2O_2 is done.
   M^{+x} in the above analysis can be :
   (A) Fe^{+3} (B) Cr^{+3}
   (C) Al^{+3} (D) Cr^{+2}

3. The density of pure substance (X) whose atoms pack in cubic close pack arrangement is 1 g/cc. If 'Y' atoms can occupy tetrahedral void and if all tetrahedral voids are occupied by 'Y' atoms. What is the density of resulting solid in g/cc..(Atomic mass (X) = 30 gm/mol, (Y) = 50 gm/mol)
   (A) 3.37 (B) 4.33 gm/cc
   (C) 1.33 (D) 5.37

4. Select the reaction which does not occur in Bessemen's converter
   (A) $2Cu_2S + 5O_2 \longrightarrow 2CuSO_4 + 2CuO$
   (B) $2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$
   (C) $FeO + SiO_2 \longrightarrow FeSiO_3$
   (D) $2CuFeS_2 + O_2 \longrightarrow Cu_2S + 2FeS + SO_2$

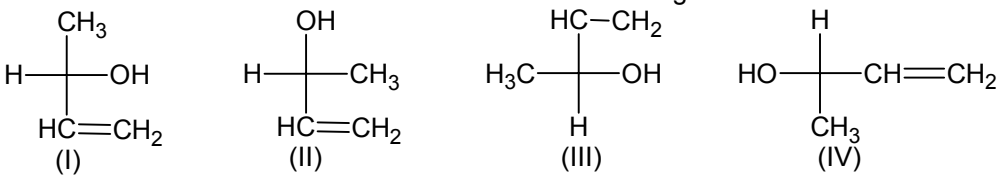
Rough work

5. Select the incorrect reaction

(A) $I_4O_9 \rightleftharpoons I^{3+} + \left(IO_3^-\right)_3$ (B) $I_2O_4 \rightleftharpoons IO^+ + IO_3^-$

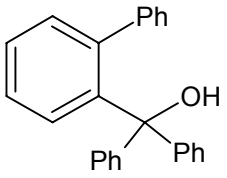
(C) $CsBr_3 \rightleftharpoons Cs^+ + Br_3^-$ (D) None of these

6. Select the combinations which have same absolute configuration

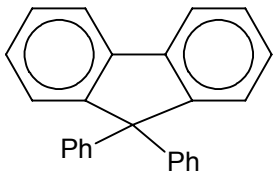


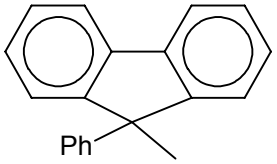
(A) II and III (B) I and IV

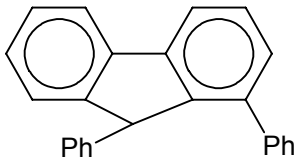
(C) II and IV (D) III and IV

7. 

$\xrightarrow{\text{Conc. } H_2SO_4}$ A(Major product). The A is :

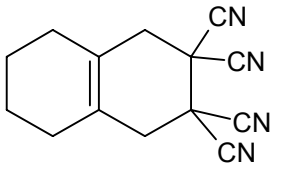
(A) 

(B) 

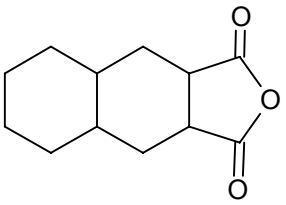
(C) 

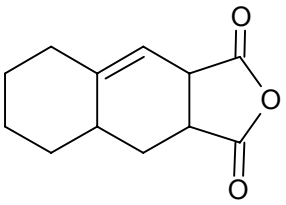
(D) None of these

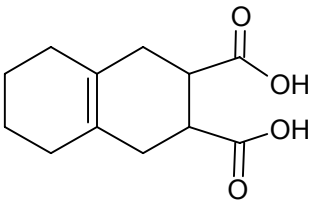
Rough work

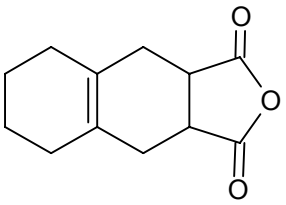
8. 

$\xrightarrow{H_3O^+/\Delta}$ (X); the product (A)

(A) 

(B) 

(C) 

(D) 

9. 0.05 mL solution contains 6×10^{-7} mol of H^+ of the rate of disappearance of H^+ IS 6×10^5 mol L^{-1}, how long will it take for the H^+ in solution 10 disappear?
(A) 8×10^{-8} s (B) 2×10^{-8} s
(C) 6×10^{-6} s (D) 2×10^{-2} s

Rough work

Reasoning Type

This section contains 4 questions numbered 10 to 13. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

10. STATEMENT-1: C_3O_2 is a bent molecule.
and
STATEMENT-2: Each carbon atom in C_3O_2 lies in sp hybrid state.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement -2 is False.
(D) Statement-1 is False, Statement-2 is True.

11. STATEMENT-1: Basic radicals of V group are precipitated as their sulphides in presence of NH_4Cl.
and
STATEMENT-2: NH_4OH maintains the pH of the solution basic during precipitation of group V.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement -2 is False.
(D) Statement-1 is False, Statement-2 is True.

Rough work

12. STATEMENT-1: Energy is released if two lighter nuclei combine to give a nucleous having mass number A < 50.
and
STATEMENT-2: The binding energy per nucleon in the light nuclei is greater than 9 MeV.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement -2 is False.
(D) Statement-1 is False, Statement-2 is True.

13. STATEMENT-1: N,N,2,6-tetramethylaniline has more base strength than N, N-dimethylaniline.
and
STATEMENT-2: The steric inhibition of o,o-disubstituted anilines increases the base strength of amines.
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement -2 is False.
(D) Statement-1 is False, Statement-2 is True.

Rough work

Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice question based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

Paragraph for Question Nos. 14 to 16

MnO_2 is most important oxide of Mn. MnO_2 occurs naturally as the black coloured mineral pyrolusite. It is an oxidizing agent and decomposes to Mn_3O_4 on heating to 530^oC. It is used to prepare the $KMnO_4$ and production of Cl_2 gas. Over half million tonnes per year of MnO_2 is used to dry batteries.

14. In lab, MnO_2 is made by
    (A) Heating Mn in O_2
    (B) Oxidising Mn^{+2} in air
    (C) Electrolytic oxidation of $MnSO_4$
    (D) Precipitating in alkaline medium

15. When MnO_2 is fused with KOH in presence of air, the product formed is:
    (A) Purple colour $KMnO_4$
    (B) Green colour K_2MnO_4
    (C) colourless MnO_4^-
    (D) Purple colour of K_2MnO_4

16. MnO_2 dissolves in conc. HCl to form
    (A) Mn^{4+} ion and Cl_2
    (B) Mn^{2+} ion and Cl_2
    (C) $[MnCl_4]^{2-}$ and Cl_2
    (D) Only $[MnCl_2]^{2-}$

Rough work

Paragraph for Question Nos. 17 to 19

Three moles of CO_2 gas expands isothermally reversibly (in thermal contact with the surroundings; temp = 15°C) against a fixed external pressure of 1 bar the initial and final volumes of the gas are 10 L to 30 L, respectively. (In this problem we consider the thermodynamics of ideal gas, phase transition, and chemical equilibrium)

17. Which is the correct statement

(A) $\Delta S_{system} > 0, \Delta S_{surr} = 0$ (B) $\Delta S_{system} > 0, \Delta S_{surr} < 0$

(C) $\Delta S_{system} < 0, \Delta S_{surr} > 0$ (D) $\Delta S_{system} < 0, \Delta S_{surr} = 0$

18. Calculate ΔS_{sys} (Assuming CO_2 to be an ideal gas)

(A) 27.4 JK^{-1} (B) 9.1 JK^{-1}

(C) - 27.4 JK^{-1} (D) - 9.1 JK^{-1}

19. $\Delta S_{uni}\left(\text{in } JK^{-1}\right)$ will be:

(A) 27.4 (B) 6.94

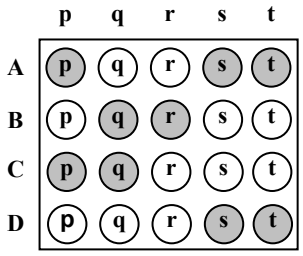
(C) - 6. 94 (D) 0

Rough work

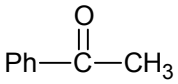
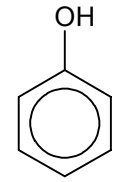
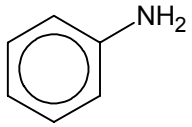
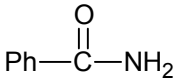
SECTION-B
(Matrix Type)

This section contains 3 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 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:



1. Match the following:

Column – I	Column – II
(A) 	(p) 2,4-DNP test
(B) 	(q) Hoffmann bromamide test
(C) 	(r) Positive carbylamine test
(D) 	(s) Undergo Reimen-Tiemann reaction
	(t) Coupling reaction with benzene diazonium cation

Rough work

2. Match the following:

Column – I		Column – II	
(A)	Zn + dil. HNO_3	(p)	H_2
(B)	Mg + very dil. HNO_3	(q)	NO
(C)	Sn + dil. HNO_3	(r)	NH_4NO_3
(D)	Pb + dil. HNO_3	(s)	N_2O
		(t)	N_2

3. Match the following:

Column – I		Column – II	
(A)	The d-orbital which has two angular nodes	(p)	$3d_{x^2-y^2}$
(B)	The d-orbital with two nodal surfaces formed cones	(q)	$3d_{z^2}$
(C)	The orbital without angular node	(r)	4f
(D)	The orbital which has three angular nodes	(s)	3s

Rough work

Mathematics

PART – III

SECTION – A
Straight Objective Type

This section contains **9 multiple choice questions** numbered 1 to 9. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. If $I_1 = \int_{-100}^{101} \frac{dx}{(5+2x-2x^2)(1+e^{2-4x})}$ and $I_2 = \int_{-100}^{101} \frac{dx}{5+2x-2x^2}$, then $\frac{I_1}{I_2}$ is

   (A) $\frac{1}{2}$ (B) 2

   (C) 0 (D) none of these

2. A ray of light is sent along the line x + y = 1, after being reflected from the line y – x = 1 it is again reflected from the line y = 0, then the equation of the line representing the ray after second reflection may be given as

   (A) x + y = 1 (B) x – y = 1

   (C) y – x = 1 (D) none of these

3. Find the value of λ so that the points P, Q, R and S on the sides OA, OB, OC and AB of a regular tetrahedron OABC are coplanar. You are given that $\frac{OP}{OA} = \frac{1}{3}$; $\frac{OQ}{OB} = \frac{1}{2}$, $\frac{OR}{OC} = \frac{1}{3}$ and $\frac{OS}{AB} = \lambda$.

   (A) λ = 1/2 (B) $\lambda = -1$

   (C) λ = 0 (D) for no value of λ

4. If two numbers are selected from numbers 1 to 25, then the number of ways that their difference does not exceed 10 is

   (A) 105 (B) 195

   (C) $^{15}C_2$ (D) none of these

Rough work

5. Let f(x) be a function satisfying f ′(x) = f(x) and f(0) = 1 and g be a function satisfying f(x) + g(x) = x^2. The value of $\int_0^1 f(x)\,g(x)\,dx$ is

(A) $\frac{1}{4}(e-7)$ (B) $\frac{1}{4}(e-2)$

(C) $\frac{1}{5}(e-3)$ (D) $e-\frac{e^2}{2}-\frac{3}{2}$

6. If n is a positive integer and $(3\sqrt{3}+5)^{2n+1} = \alpha + \beta$
Where α is an integer and $0 < \beta < 1$, then
(A) α is an even integer (B) $(\alpha+\beta)^2$ is divisible by 2^{2n+1}
(C) α is an odd integer (D) none of these

7. If tan α is an integral solution of the inequation $4x^2 - 16x + 15 < 0$ and cos β is the slope of the bisector of the angle in the first quadrant between the x and y axis, then the value of $\sin(\alpha+\beta) \times \sin(\alpha-\beta)$ is

(A) $\frac{1}{5}$ (B) $\frac{2}{5}$

(C) $\frac{4}{5}$ (D) none of these

8. The radius of the circle passing through the centre of the in-circle of ΔABC and through the end points of BC is given by

(A) $\frac{a}{2}\cos A$ (B) $\frac{a}{2}\sec A/2$

(C) $\frac{a}{2}\sin A$ (D) a sec A/2

9. If n is an even integer and a, b, c are distinct numbers, then the number of distinct terms in the expansion of $(a+b+c)^n + (a+b-c)^n$ is

(A) $\left(\frac{n+2}{2}\right)^2$ (B) n + 2

(C) $\frac{n+4}{2}$ (D) none of these

Rough work

Reasoning Type

This section contains 4 questions numbered 10 to 13. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

10. STATEMENT 1: For $n > 1$, $n^4 + 4^n$ can't be a prime number.
STATEMENT 2: $x^2 + y^2$ can only be factorized in real factors if $2xy$ is also a square.
(A) Both the statements are true and Statement 2 is correct explanation of Statement 1
(B) Both the Statements are true and Statement 2 is not the correct explanation of Statement 1
(C) Statement 1 is true and Statement 2 is false
(D) Statement 1 is false and Statement 2 is true

11. STATEMENT 1: If $p < q$ and $px^2 + 4\mu xy + qy^2 + 4a(x + y + 1) = 0$ represents pair of straight lines for some $\mu \in R$ and $a \neq 0$, then $a \leq p$ or $a \geq q$.
STATEMENT 2: The given equation has non-zero linear terms.
(A) Both the statements are true and Statement 2 is correct explanation of Statement 1
(B) Both the Statements are true and Statement 2 is not the correct explanation of Statement 1
(C) Statement 1 is true and Statement 2 is false
(D) Statement 1 is false and Statement 2 is true

12. STATEMENT 1: If $2f(x) + f(-x) = \frac{1}{x}\sin\left(x - \frac{1}{x}\right)$ then value of $I = \int_{1/e}^{e} f(x)dx = 0$.
STATEMENT 2: If $f(2a - x) = -f(x)$, then $\int_{0}^{2a} f(x)dx = 0$.
(A) Both the statements are true and Statement 2 is correct explanation of Statement 1
(B) Both the Statements are true and Statement 2 is not the correct explanation of Statement 1
(C) Statement 1 is true and Statement 2 is false
(D) Statement 1 is false and Statement 2 is true

13. STATEMENT 1: Number of integral points lying in the smaller region bounded by the parabola $y^2 = 8x$ and circle $x^2 + y^2 = 16$ is 17. (Integral point is a point whose both coordinate are integer)
STATEMENT 2: For a point to lie inside the common smaller region $x \in (0, 4)$.
(A) Both the statements are true and Statement 2 is correct explanation of Statement 1
(B) Both the Statements are true and Statement 2 is not the correct explanation of Statement 1
(C) Statement 1 is true and Statement 2 is false
(D) Statement 1 is false and Statement 2 is true

Rough work

Comprehension Type

This section contains **2 paragraphs**. Based upon paragraphs **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of **which ONLY ONE** is correct.

Paragraph for Question Nos. 14 to 16

Read the following write up carefully and answer the following questions:

Consider function f(x) = $\sqrt{4-x^2}$, g(x) = |x – 2| and h(x) = $\sqrt{x-2}$, for x $\in$ R a function is defined as F(x) = max or min{f(x), g(x), h(x)} then

14. Area of F(x) = min{f(x), g(x), h(x)} between the co-ordinate axes for x < 0 is
(A) 2π sq. units (B) π sq. units
(C) 4π sq. units (D) none of these

15. Area enclosed by F(x) = min{f(x), g(x), h(x)} and G(x) = max{f(x), g(x), h(x)} for x $\in$ [0, 2] is
(A) π sq. units (B) $(\pi + 2)$ sq. units
(C) $(\pi - 2)$ sq. units (D) $(\pi - 1)$ sq. units

16. Area between the curves F(x) = min{f(x), g(x), h(x)}, x = 2, y = 0 and x = 3
(A) $\frac{3}{2}$ sq. units (B) $\frac{1}{2}$ sq. units
(C) 1 sq. units (D) none of these

Rough work

Paragraph for Question Nos. 17 to 19

Read the following write up carefully and answer the following questions:
f: R $\rightarrow$ R, f (x) is a differentiable function such that all its successive derivatives exist. f′(x) can be zero at discrete points only and f(x) f″(x) $\leq 0 \ \forall \ x \in R$.

17. If f (a) = 0, then which of the following is correct
(A) f(a + h) f″(a – h) < 0 (B) f (a + h) f″ (a – h) > 0
(C) f′(a + h) f″ (a – h) < 0 (D) f′ (a + h) f″ (a – h) < 0

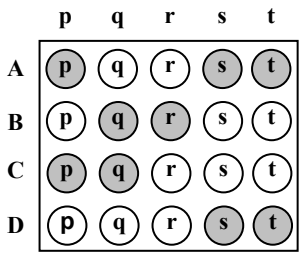
18. If α and β are two consecutive roots of f (x) = 0, then
(A) f″(γ) = 0 $\gamma \in (\alpha, \beta)$ (B) f′″(γ) = 0 $\gamma \in (\alpha, \beta)$
(C) f″″(γ) = 0 $\gamma \in (\alpha, \beta)$ (D) f″″′(γ) = 0 $\gamma \in (\alpha, \beta)$

19. If f′(x) $\neq$ 0, then maximum number of real roots of f″(x) = 0 is/are
(A) no real root (B) one
(C) two (D) three

Rough work

SECTION – B
Matrix – Match Type

This section contains 3 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 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:



1. Match the following:

Column – I		Column – II	
(A)	$\frac{\sin 1}{\sin 2} - \frac{\sin 5}{\sin 6}$	(p)	positive
(B)	$\tan\frac{3}{2} - \frac{9}{4}$	(q)	negative
(C)	$\lim_{x\to 0}\left[\frac{e^x - 1}{x}\right]$ (where [.] denotes the greatest integer function)	(r)	0
(D)	If $f'(\alpha) = 0$ and $f'(x) > 0\ \forall\ x \in R - \{\alpha\}$, then $f''(\alpha)$ is	(s)	does not exist

Rough work

2. Match the following:

	Column – I		Column – II
(A)	If $f^2(x)$ is even then f(x)	(p)	is even
(B)	If $f(x) = x[x^2] + \frac{1}{\sqrt{1-x^2}}$ (where [.] denotes the greatest integer function)	(q)	is odd
(C)	$e^{\frac{x^3-x^2}{x-1}} + e^{\frac{2x^2-x^3}{x-2}}$	(r)	may be even or odd
(D)	If $2xf(x) = f(2x^2 - 1)$, then f(x) (f(x) is not identically zero)	(s)	is neither even nor odd

3. Match the following:

	Column – I		Column – II
(A)	If the quadratic equations $3x^2 + ax + 1 = 0$ and $2x^2 + bx + 1 = 0$ have a common root, then the value of $5ab - 2a^2 - 3b^2$, where $a, b \in R$ is equal to	(p)	2
(B)	Total number of values of 'a' so that $x^2 - x - a = 0$ has integral roots, where $a \in N$ and $6 \le a \le 100$ is equal to	(q)	1
(C)	Number of real values of x, such that x, [x], {x} are in A.P., where [.] denotes greatest integer function and [.] denotes fractional part is equal to	(r)	4
(D)	If $z = x + iy$, $z^{1/3} = a - ib$, and $\frac{x}{a} - \frac{y}{b} = \lambda(a^2 - b^2)$, then λ Is equal to	(s)	8

Rough work