



CLASSROOM CONTACT PROGRAMME

JEE(Advanced)
FULL SYLLABUS

SAMPLE PAPER-2

PAPER-2

Time : 3 Hours

Maximum Marks : 186

READ THE INSTRUCTIONS CAREFULLY

GENERAL :

1. This sealed booklet is your Question Paper. Do not break the seal till you are told to do so.
2. Use the Optical Response sheet (ORS) provided separately for answering the questions.
3. Blank spaces are provided within this booklet for rough work.
4. Write your name, form number and sign in the space provided on the back cover of this booklet.
5. After breaking the seal of the booklet, verify that the booklet contains **36** pages and that all the **18** questions in each subject and along with the options are legible. If not, contact the invigilator for replacement of the booklet.
6. You are allowed to take away the Question Paper at the end of the examination.

OPTICAL RESPONSE SHEET :

7. The ORS will be collected by the invigilator at the end of the examination.
8. Do not tamper with or mutilate the ORS. **Do not use the ORS for rough work.**
9. Write your name, form number and sign with pen in the space provided for this purpose on the ORS. **Do not write any of these details anywhere else on the ORS.** Darken the appropriate bubble under each digit of your form number.

DARKENING THE BUBBLES ON THE ORS :

10. Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.
11. Darken the bubble **COMPLETELY.**
12. The correct way of darkening a bubble is as :
13. The ORS is machine-gradable. Ensure that the bubbles are darkened in the correct way.
14. Darken the bubbles **ONLY IF** you are sure of the answer. There is **NO WAY** to erase or "un-darken" a darkened bubble.
15. Take **$g = 10 \text{ m/s}^2$** unless otherwise stated.

Please see the last page of this booklet for rest of the instructions

SOME USEFUL CONSTANTS

Atomic No. : H = 1, B = 5, C = 6, N = 7, O = 8, F = 9, Al = 13, P = 15, S = 16,
Cl = 17, Br = 35, Xe = 54, Ce = 58

Atomic masses : H = 1, Li = 7, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24,
Al = 27, P = 31, S = 32, Cl = 35.5, Ca = 40, Fe = 56, Br = 80, I = 127,
Xe = 131, Ba = 137, Ce = 140,

- | | |
|------------------------------------|--|
| • Boltzmann constant | $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$ |
| • Coulomb's law constant | $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ |
| • Universal gravitational constant | $G = 6.67259 \times 10^{-11} \text{ N-m}^2 \text{ kg}^{-2}$ |
| • Speed of light in vacuum | $c = 3 \times 10^8 \text{ ms}^{-1}$ |
| • Stefan-Boltzmann constant | $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{-K}^{-4}$ |
| • Wien's displacement law constant | $b = 2.89 \times 10^{-3} \text{ m-K}$ |
| • Permeability of vacuum | $\mu_0 = 4\pi \times 10^{-7} \text{ NA}^{-2}$ |
| • Permittivity of vacuum | $\epsilon_0 = \frac{1}{\mu_0 c^2}$ |
| • Planck constant | $h = 6.63 \times 10^{-34} \text{ J-s}$ |

Space for Rough Work

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

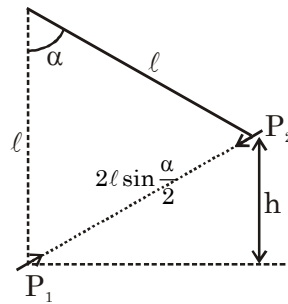
BEWARE OF NEGATIVE MARKING

PART-1 : PHYSICS

SECTION-I(i) : (Maximum Marks: 32)

- This section contains **EIGHT** questions.
 - Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
 - For each question, choose the correct option(s) to answer the question.
 - Answer to each question will be evaluated according to the following marking scheme:
 - Full Marks* : +4 If only (all) the correct option(s) is (are) chosen.
 - Partial Marks* : +3 If all the four options are correct but **ONLY** three options are chosen.
 - Partial Marks* : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
 - Partial Marks* : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
 - Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered).
 - Negative Marks* : -1 In all other cases.
 - **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -1 marks.
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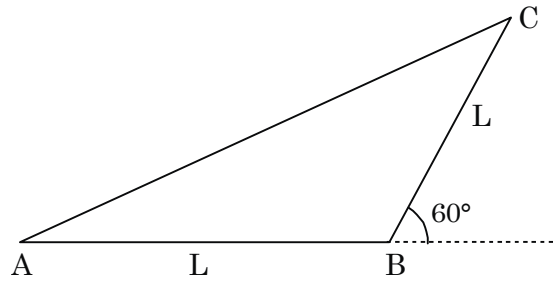
1. A small dipole of dipole moment \vec{P}_2 of mass m is suspended vertically by a string of length ℓ . A small dipole of dipole moment \vec{P}_1 is now brought towards \vec{P}_2 from infinity so that the P_2 moves away and gravitational potential energy of diopole P_1 does not change. The final equilibrium position of the system including the direction of dipole, the angles and distance is shown in figure (where g is the acceleration due to gravity).
Choose the correct statement(s) :



- (A) The work done in bringing the dipole to this position is $\frac{4mgh}{3}$
- (B) The work done in bringing the dipole to this position is $\frac{5mgh}{3}$
- (C) Change in electrostatic potential energy of dipole is $\frac{mgh}{3}$
- (D) Change in electrostatic potential energy of dipole is $\frac{2mgh}{3}$

Space for Rough Work

2. A triangular rod frame ABC having equal mass 'M' of all three sides. Rod AB and BC are of length = L. Then the moment of inertia of triangular frame about :



- (A) An axis perpendicular to AB and passing through B and in the plane of triangle is $\frac{2}{3}Ml^2$
- (B) An axis perpendicular to AB and passing through B and in the plane of triangle is $\frac{3}{4}Ml^2$
- (C) An axis perpendicular to AB and passing through A and in the plane of triangle is $\frac{8}{3}Ml^2$
- (D) An axis perpendicular to AB and passing through A and in the plane of triangle is $\frac{10}{3}Ml^2$
3. The filament of a light bulb has surface area 64 mm^2 . The filament can be considered as a black body at temperature 2500 K emitting radiation like a point source. At night the light bulb is observed from a distance of 10 m . Assume light detector to be circular with radius $r = 10\sqrt{3} \text{ m}$. Then (Take $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{K}^4$, Wien's displacement constant = $2.90 \times 10^{-3} \text{ m-K}$, Planck' constant = $6.63 \times 10^{-34} \text{ Js}$, speed of light in vacuum = $3.00 \times 10^8 \text{ m/s}$, assume detector absorbs all the radiation incident on it and point source (filament) lie on the axis of detector) :
- (A) Power radiated by the filament is in the range 642 W to 645 W
- (B) Radiated power entering into detector is in the range of 34.42 W to 34.52 W .
- (C) The wavelength corresponding to the maximum intensity of light is 1160 nm .
- (D) Taking the average wavelength of emitted radiation to be 1740 nm , the total number of photons entering per second into detector is in the range 3.1×10^{20} to 3.2×10^{20} .

Space for Rough Work

4. A point particle of mass m moving on circular orbit under the action of constant force (in magnitude) = F always towards origin. If energies are calculated by using Bohr's model and R_n , v_n and E_n are the radius of n^{th} orbit, speed in n^{th} orbit and energy associated in n^{th} orbit, (h = plank constant) then

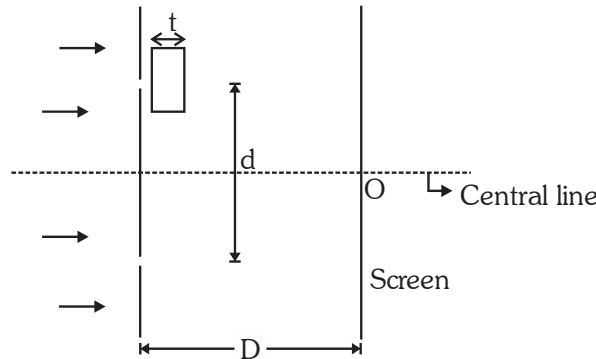
(A) $\frac{R_{8^{\text{th}}}}{R_{1^{\text{st}}}} = 4$

(B) $\frac{v_{8^{\text{th}}}}{v_{1^{\text{st}}}} = 4$

(C) Total energy of particle increases by $\frac{9}{2} \left[\frac{h^2 F^2}{4\pi^2 m} \right]^{1/3}$ if particle moves from $n = 1$ to $n = 8$

(D) Total kinetic energy of particle increases by $\frac{3}{2} \left[\frac{h^2 F^2}{4\pi^2 m} \right]^{1/3}$ if particle moves from $n = 1$ to $n = 8$

5. In Young's double slit experiment a transparent sheet of thickness t and refractive index μ is placed in front of one of the slits and the central fringe moves away from the central line. It was found that when temperature was raised by $\Delta\theta$ the central fringe was back on the central line (at O). It is known that temperature coefficient of linear expansion of the material of the transparent sheet is α . A young scientist modeled that the refractive index of the material changes with temperature as $\Delta\mu = -\gamma\Delta\theta$. Then [D and d are given and have usual meaning].



(A) $\Delta\theta$ in terms of other given quantities is $\frac{(\mu - 1)}{-(\mu - 1)\alpha + \gamma}$

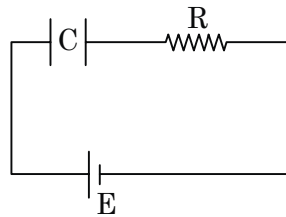
(B) $\Delta\theta$ in terms of other given quantities is $\frac{(\mu - 1)}{(\mu - 1)\alpha + \gamma}$

(C) If setup is placed in medium other than air, then $\Delta\theta$ will increase [If $\Delta\theta$ is positive]

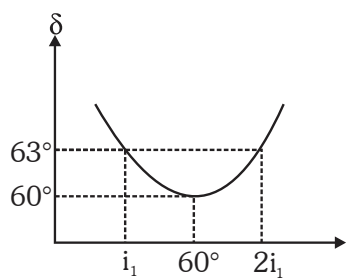
(D) If setup is placed in medium other than air, then $\Delta\theta$ will decrease [If $\Delta\theta$ is positive]

Space for Rough Work

6. A circuit consists of a permanent source of e.m.f. E , a resistor R and a capacitor C connected in series. The internal resistance of the source is negligibly small. At the moment $t = 0$, the capacitance of the capacitor was abruptly (jumpwise) decreased by a factor η . Then



- (A) the current in the circuit as a function of time is $\frac{(\eta - 1)E}{R} e^{-\eta t/RC}$
- (B) the current in the circuit as a function of time is $\frac{(\eta + 1)E}{R} e^{-\eta t/RC}$
- (C) the current in the circuit just after the capacitance changes is $\frac{(\eta - 1)E}{R}$
- (D) the current in the circuit just after the capacitance changes is $\frac{(\eta + 1)E}{R}$
7. Consider two particles A and B of masses m and $2m$ at rest in an inertial frame. Each of them are acted upon by net forces of equal magnitudes F in the positive x -direction for equal amounts of time t . Momenta of the particles A and B in centre of mass frame are \vec{P}_1 and \vec{P}_2 respectively. Then
- (A) $\vec{P}_1 = \frac{F}{3} t \hat{i}$ (B) $\vec{P}_1 = \frac{2F}{3} t \hat{i}$ (C) $\vec{P}_2 = -\frac{F}{3} t \hat{i}$ (D) $\vec{P}_2 = -\frac{2F}{3} t \hat{i}$
8. For a glass prism the plot of deviation (δ) vs angle of incidence (i) is as shown. If the refractive index of the glass is μ and value of angle is i_1 . Then



- (A) $\mu = 2$ (B) $\mu = \sqrt{3}$ (C) $i_1 = 30^\circ$ (D) $i_1 = 41^\circ$

Space for Rough Work

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

- This section contains **TWO** List-Match sets.
- Each List-Match set has **Two** Multiple Choice Questions.
- Each List-Match set has two lists : **List-I** and **List-II**
- **List-I** has **Four** entries (I), (II), (III) and (IV) and **List-II** has **Six** entries (P), (Q), (R), (S), (T) and (U)
- **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated according to the following marking scheme :
Full Marks : +3 If **ONLY** the option corresponding to the correct combination is chosen.
Zero Marks : 0 If none of the options is chosen (i.e., the question is unanswered);
Negative Marks : -1 In all other cases

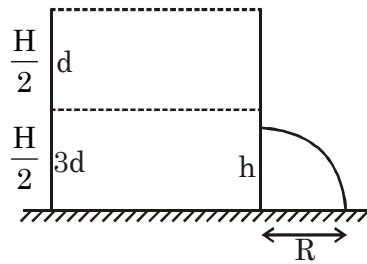
9. Answer the following by appropriately matching the lists based on the information given in the paragraph.

A container of large uniform cross-sectional area A hold two immisible non-viscous and incompressible liquids of density d and $3d$, each of height $\frac{H}{2}$. The lower density liquid is open to the atmosphere having pressure P_0 . A tiny hole of area a ($a \ll A$) is punched on the vertical side of the lower container at a height h $\left[0 < h < \frac{H}{2} \right]$ for which range 'R' is maximum.

- | List | List |
|--|--------------------------------|
| (I) h will be | (P) $\frac{2H}{3}$ |
| (II) R will be | (Q) $\frac{H}{12}$ |
| (III) V (velocity of efflux) will be | (R) $\sqrt{\frac{gH}{3}}$ |
| (IV) Force on the vessel due to liquid flowing out will be | (S) $\frac{7}{2} \text{ dagH}$ |
| | (T) 2 dagH |
| | (U) None |

Space for Rough Work

If container is resting on the ground (horizontal surface), then :



- (A) I → P, II → Q, III → U, IV → U
- (B) I → Q, II → P, III → R, IV → T
- (C) I → U, II → P, III → U, IV → T
- (D) I → Q, II → P, III → R, IV → U

Space for Rough Work

10. Answer the following by appropriately matching the lists based on the information given in the paragraph.

A container of large uniform cross-sectional area A hold two immisible non-viscous and incompressible liquids of density d and $3d$, each of height $\frac{H}{2}$. The lower density liquid is open to the atmosphere having pressure P_0 . A tiny hole of area a ($a \ll A$) is punched on the vertical side of the lower container at a height h $\left[0 < h < \frac{H}{2}\right]$ for which range 'R' is maximum.

List

(I) h will be

(II) R will be

(III) V (velocity of efflux) will be

(IV) Force on the vessel due to liquid flowing out will be

List

(P) $\frac{2H}{3}$

(Q) $\frac{H}{12}$

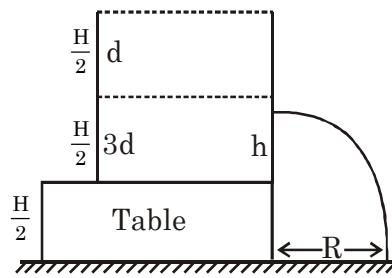
(R) $\sqrt{\frac{gH}{3}}$

(S) $\frac{7}{2} \text{ dagH}$

(T) 2 dagH

(U) None

If container is placed on the top of table at height $\frac{H}{2}$, then :



(A) I \rightarrow Q, II \rightarrow U, III \rightarrow U, IV \rightarrow S

(B) I \rightarrow P, II \rightarrow Q, III \rightarrow U, IV \rightarrow S

(C) I \rightarrow U, II \rightarrow U, III \rightarrow U, IV \rightarrow U

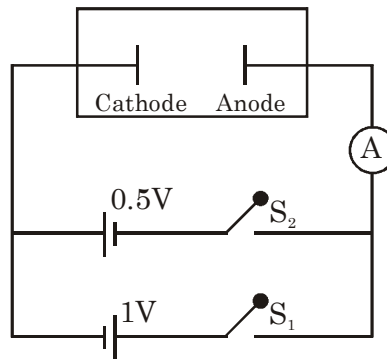
(D) I \rightarrow Q, II \rightarrow P, III \rightarrow U, IV \rightarrow U

Space for Rough Work

ALLEN

11. Answer the following by appropriately matching the lists based on the information given in the paragraph.

A photo electric cell is shown in the figure. The emitter plate (cathode) is made of copper ($\phi = 4.7 \text{ eV}$) and emitter is illuminated by a source of monochromatic light of wavelength 200 nm . Saturation current is observed when potential difference between cathode and anode is 1 V and anode at higher potential. [Range of ammeter is large] [Take $hc = 1240 \text{ (eV)nm}$]

**List-I**

- (I) Minimum kinetic energy of photoelectrons reaching the collector is
 (II) Maximum kinetic energy of photoelectrons reaching the collector is
 (III) If wavelength of incident light is decreased (no. of incident photon same), then reading of current as shown by ammeter will
 (IV) If number of incident photons increases, then reading of current as shown by ammeter will

List-II

- (P) 2.5 eV
 (Q) Remain same
 (R) 1 eV
 (S) Increase
 (T) 0
 (U) Decrease

If only S_1 is closed, then :

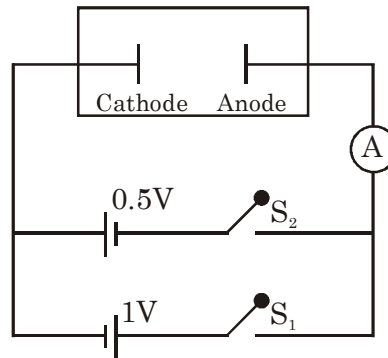
- (A) I \rightarrow S, II \rightarrow R, III \rightarrow Q, IV \rightarrow S
 (B) I \rightarrow P, II \rightarrow T, III \rightarrow R, IV \rightarrow S
 (C) I \rightarrow T, II \rightarrow P, III \rightarrow S, IV \rightarrow U
 (D) I \rightarrow R, II \rightarrow P, III \rightarrow Q, IV \rightarrow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

Space for Rough Work

ALLEN

12. Answer the following by appropriately matching the lists based on the information given in the paragraph.

A photo electric cell is shown in the figure. The emitter plate (cathode) is made of copper ($\phi = 4.7 \text{ eV}$) and emitter is illuminated by a source of monochromatic light of wavelength 200 nm . Saturation current is observed when potential difference between cathode and anode is 1 V and anode at higher potential. [Range of ammeter is large][Take $hc = 1240 \text{ (eV)nm}$]

**List-I**

- (I) Minimum kinetic energy of photoelectrons reaching the collector is
- (II) Maximum kinetic energy of photoelectrons reaching the collector is
- (III) If wavelength of incident light is decreased (no. of incident photon same), then reading of current as shown by ammeter will
- (IV) If number of incident photons increases, then reading of current as shown by ammeter will

List-II

- (P) 2.5 eV
- (Q) Remain same
- (R) 1 eV
- (S) Increase
- (T) 0
- (U) Decrease

If only S_2 is closed, then :

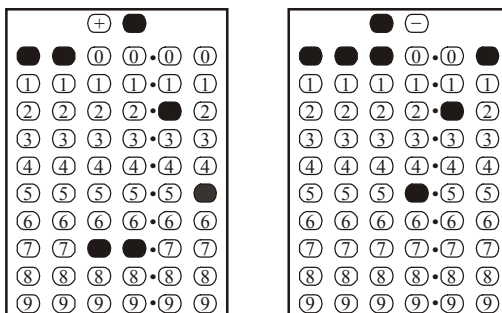
- (A) I \rightarrow P, II \rightarrow Q, III \rightarrow S, IV \rightarrow Q
- (C) I \rightarrow S, II \rightarrow T, III \rightarrow P, IV \rightarrow U

- (B) I \rightarrow T, II \rightarrow R, III \rightarrow Q, IV \rightarrow S
- (D) I \rightarrow T, II \rightarrow T, III \rightarrow S, IV \rightarrow Q

Space for Rough Work

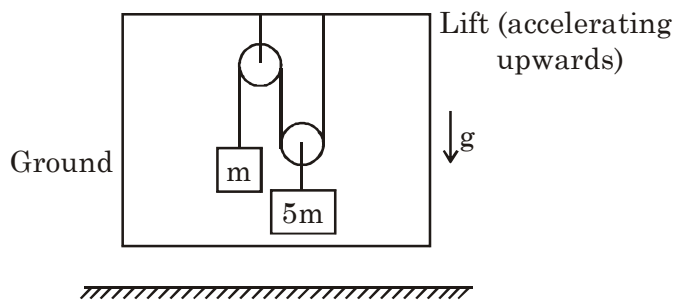
SECTION-II : (Maximum Marks: 18)

- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS. **For Example** : If answer is -77.25, 5.2 then fill the bubbles as follows.



- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 If **ONLY** the correct numerical value is entered as answer.
Zero Marks : 0 In all other cases.

1. A point moves along a circle such that distance travelled $S = at^2$ [where $a = \frac{1}{2} \text{ m/s}^2$] and t is time in second. Find the total acceleration of the point at the moment when it covered the n^{th} ($n = 0.10$) fraction of the circle after the beginning of the motion. [Take $\pi^2 = 10$]
2. A pulley block system inside lift is shown in figure. The pulleys and the threads are ideal and masses of the blocks are m and $5m$. Find the minimum acceleration (in m/s^2) of the lift along vertically upwards direction for which the threads remain taut and both the blocks accelerate in the same direction relative to the ground. [Take $g = 9.80 \text{ m/s}^2$]



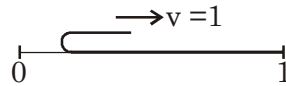
Space for Rough Work

ALLEN

3. 3 identical point particles of mass M move in such a way that distance between particles is 'd' which remain constant. Only force is the gravitational force between particles. Then magnitude of relative velocity (in m/s) of one particle with respect to other particle will be :

[Take $\sqrt{\frac{GM}{d}} = \sqrt{3}$ m/s]

4. A long, thin, pliable carpet is laid on the floor. One end of the carpet is bent back and then pulled backwards with constant unit velocity, just above the part of the carpet which is still at rest on the floor. What is the minimum force needed to pull the moving part, if the carpet has unit length and unit mass ?



Space for Rough Work

ALLEN

5. Consider a uniformly charged solid cylinder of large length and radius R . Now consider a cylindrical surface of radius $2R$ and length $2R$ coaxial with cylinder and electric flux through cylindrical surface is ϕ_0 . Now consider a spherical surface of radius $2R$ and one of the diameter along axis of cylinder and electric flux through spherical surface is ϕ . Find $\frac{\phi}{\phi_0}$.
6. A spherical bubble inside water has radius R . Take the pressure inside the bubble and the water pressure to be P_0 . The bubble now gets compressed radially in an isothermal manner so that its radius become $(R - a)$. For $a \ll R$, the magnitude of work done in the process is given by $(4\pi P_0 R a^2)x$ where x is a constant. Find x .

Space for Rough Work

PART-2 : CHEMISTRY

SECTION-I(i) : (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Partial Marks : +3 If all the four options are correct but **ONLY** three options are chosen.
Partial Marks : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
Partial Marks : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -1 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -1 marks.

1. Which of the following reagents is/are used for softening process of permanent hardness in water ?

- (A) $\text{Na}_6\text{P}_6\text{O}_{18}$ (B) Na_2CO_3 (C) Zeolite (D) $\text{Ca}(\text{OH})_2$

2. IE_1 (kJ/mole) of 2nd period elements are mentioned below with some blank/vacant data spaces:

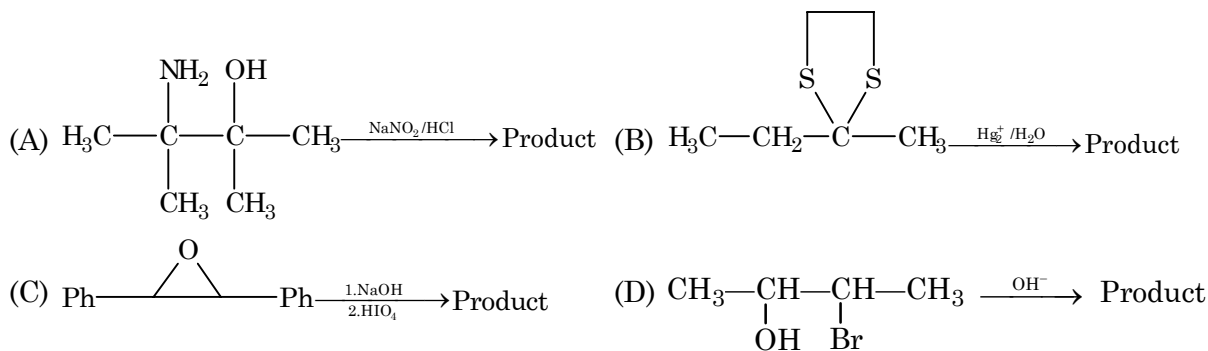
Li	Be	B	C	N	O	F	Ne
520	<u>"P"</u>	800	<u>"Q"</u>	1402	1314	<u>"R"</u>	2080

Select **CORRECT** number of statement(s) regarding above data table. (Consider all processes are gas phased).

- (A) $|EA|$ of N^+ is more than 1402 kJ/mol
 (B) Value of "R" is more than 1402 kJ/mol
 (C) Value of "P" is more than $|EA|$ of C^+
 (D) $Q > 800$ kJ/mol

Space for Rough Work

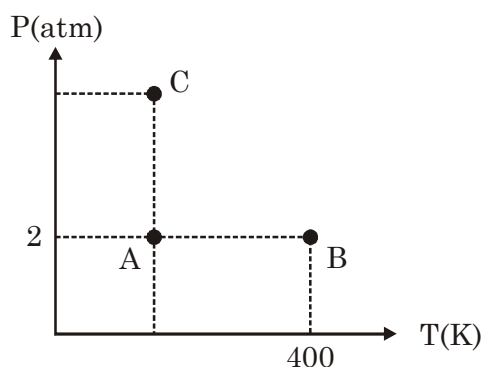
3. In which reaction the product will react with 2, 4 dinitrophenylhydrazine.



4. $\frac{V_{\text{final}}}{V_{\text{initial}}} = 2$ is achieved for each of the three different reversible processes as mentioned below.

(1 mole of ideal gas with $\gamma = 1.5$ for all processes)

- (x) Isothermal process ending at state - A
- (y) Isobaric process starting from state - A
- (z) Reversible adiabatic process ending at state - B

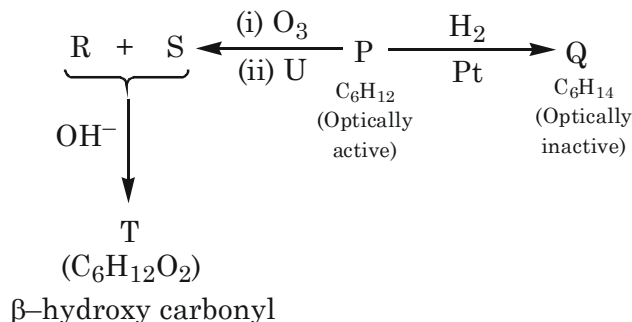


Which of the following statements is/are correct ?

- (A) Temperature of gas increases in two of the processes.
- (B) Maximum temperature observed during any of the processes is 400 K.
- (C) If "C" is initial state of isothermal process then $P_C = 4 \text{ atm}$.
- (D) Initial pressure of adiabatic process is more than initial pressure of isothermal process.

Space for Rough Work

5. Intramolecular hydrogen bonding is **NOT** present in:
 (A) crystalline orthoboric acid, $B(OH)_3$ (B) Acetic acid in benzene solvent
 (C) crystals of ice (D) para-nitrophenol
6. Select correct options on basis of following separation of reactions.



- (A) "Q" does not have any 4° carbon.
 (B) Formation of T from "R" and "S" involve nucleophilic addition
 (C) "T" compound is optically inactive.
 (D) Reagent "U" can be dimethyl sulphide.
7. Identify the incorrect statements when a fixed amount of ideal gas is heated in a container fitted with a movable piston always operating at constant pressure.
- (A) Average distance travelled between successive collisions will decreases.
 (B) Collisions frequency increases since speed of the molecules increases with increases in temperature.
 (C) Average relative speed of approach remains unaffected.
 (D) Average angle of approach remains unaffected.
8. Choose the **CORRECT** statement(s) among the following.
- (A) $[Pd(Cl)_4]^{2-}$ is tetrahedral geometry & paramagnetic.
 (B) $[Cr(NH_3)_3(Cl)_3]$ has 2 geometrical isomers & 2 optical isomers.
 (C) $[Co(H_2O)_6]^{3+}$ is low spin while $[CoF_6]^{3-}$ is a high spin complex & both cant show G.I.
 (D) $[Fe(H_2O)_5(NO)]SO_4$ has sp^3d^2 hybridisation and can't show optical isomers.

Space for Rough Work

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

- This section contains **TWO** List-Match sets.
- Each List-Match set has **Two** Multiple Choice Questions.
- Each List-Match set has two lists : **List-I** and **List-II**
- **List-I** has **Four** entries (I), (II), (III) and (IV) and **List-II** has **Six** entries (P), (Q), (R), (S), (T) and (U)
- **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated according to the following marking scheme :
Full Marks : +3 If **ONLY** the option corresponding to the correct combination is chosen.
Zero Marks : 0 If none of the options is chosen (i.e., the question is unanswered);
Negative Marks : -1 In all other cases

9. Answer the following by appropriately matching the lists based on the information given in the paragraph.

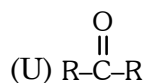
Match the following.

List - I

- (I) LiAlH_4
- (II) NaBH_4
- (III) H_2/Pd
- (IV) B_2H_6

List - II

- (P) RCH=NOH
- (Q) RCOOH
- (R) R-CH=NH
- (S) RCOCl
- (T) $\text{R-C}\equiv\text{N}$



Which of the following combination is incorrect to produce amine.

- (A) (II) - (R) (B) (I) - (P) (C) (III) - (T) (D) (II) - (S)

Space for Rough Work

10. Answer the following by appropriately matching the lists based on the information given in the paragraph.

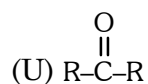
Match the following.

List - I

- (I) LiAlH_4
- (II) NaBH_4
- (III) H_2/Pd
- (IV) B_2H_6

List - II

- (P) RCH=NOH
- (Q) RCOOH
- (R) R-CH=NH
- (S) RCOCl
- (T) $\text{R-C}\equiv\text{N}$



Which of the following combination is incorrect to produce alcohol.

- (A) (III) - (U) (B) (II) - (S) (C) (IV) - (S) (D) (IV) - (Q)

Space for Rough Work

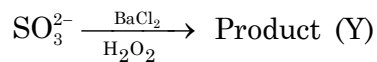
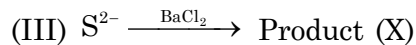
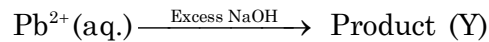
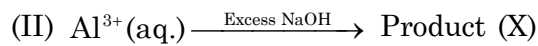
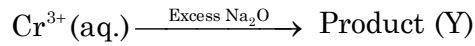
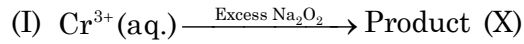
ALLEN

11. Answer the following by appropriately matching the lists based on the information given in the paragraph.

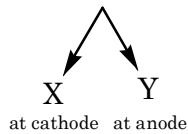
Match the Matrix.

List - I

(Pairs of reaction)



(IV) Electrolysis of molten Al_2O_3 along with Na_3AlF_6 & CaF_2



List - II

(Related observation in each pair of reaction)

(P) X is soluble but Y is precipitate

(Q) X and Y both are soluble

(R) Element X forms amphoteric oxide & Y is a mixture of colourless gases

(S) Y is soluble but X is precipitate

(T) X is yellow solution, Y is green solution

(U) X is a metal, Y is yellow gas

Which combination will give X & Y as colourless solution.

(A) (I) - (T)

(B) (II) - (Q)

(C) (III) - (P)

(D) (IV) - (U)

Space for Rough Work

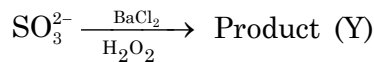
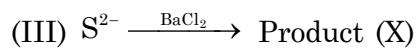
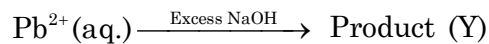
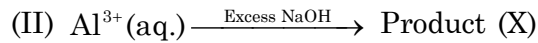
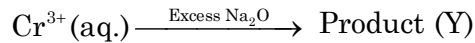
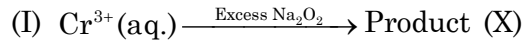
ALLEN

12. Answer the following by appropriately matching the lists based on the information given in the paragraph.

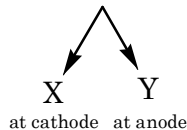
Match the Matrix.

List - I

(Pairs of reaction)



(IV) Electrolysis of molten Al_2O_3 along with Na_3AlF_6 & CaF_2



List - II

(Related observation in each pair of reaction)

(P) X is soluble but Y is precipitate

(Q) X and Y both are soluble

(R) Element X forms amphoteric oxide & Y is a mixture of colourless gases

(S) Y is soluble but X is precipitate

(T) X is yellow solution, Y is green solution

(U) X is a metal, Y is yellow gas

Select **INCORRECT** combination

(A) (I) - (T)

(B) (III) - (S)

(C) (I) - (Q)

(D) (IV) - (R)

Space for Rough Work

SECTION-II : (Maximum Marks: 18)

- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

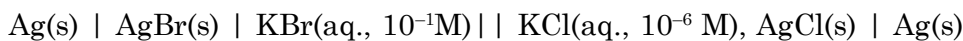
<p style="text-align: center;">+</p> <p>● ● 0 0 0 0</p> <p>① ① ① ① ① ①</p> <p>② ② ② ② ● ②</p> <p>③ ③ ③ ③ ③ ③</p> <p>④ ④ ④ ④ ④ ④</p> <p>⑤ ⑤ ⑤ ⑤ ⑤ ●</p> <p>⑥ ⑥ ⑥ ⑥ ⑥ ⑥</p> <p>⑦ ⑦ ● ● ⑦ ⑦</p> <p>⑧ ⑧ ⑧ ⑧ ⑧ ⑧</p> <p>⑨ ⑨ ⑨ ⑨ ⑨ ⑨</p>	<p style="text-align: center;">-</p> <p>● ● ● 0 0 ●</p> <p>① ① ① ① ① ①</p> <p>② ② ② ② ● ②</p> <p>③ ③ ③ ③ ③ ③</p> <p>④ ④ ④ ④ ④ ④</p> <p>⑤ ⑤ ⑤ ● ⑤ ⑤</p> <p>⑥ ⑥ ⑥ ⑥ ⑥ ⑥</p> <p>⑦ ⑦ ⑦ ⑦ ⑦ ⑦</p> <p>⑧ ⑧ ⑧ ⑧ ⑧ ⑧</p> <p>⑨ ⑨ ⑨ ⑨ ⑨ ⑨</p>
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- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 If **ONLY** the correct numerical value is entered as answer.
Zero Marks : 0 In all other cases.

1. Silver ion forms a complex ion with thiosulphate ion. $[Ag(S_2O_3)_2]^{3-}$, with $K_f = 2.8 \times 10^{13}$. How much AgBr ($K_{sp} = 5.4 \times 10^{-13}$), in mole, will dissolve in 1 litre of 0.20 M $Na_2S_2O_3$ solution.

(Report your answer till two places after decimal) ($\sqrt{15.12} = 3.88$)

2. Find E_{cell} (volts) for



Given, $K_{sp} (AgCl) = 10^{-10} M^2$.

$K_{sp} (AgBr) = 10^{-15} M^2$.

3. Total number of compounds which are soluble in hot aqueous NaOH are:

- | | |
|----------------------------|--------------------|
| (i) Salicyclic acid | (ii) Aspirin |
| (iii) Formic acid | (iv) Acetic acid |
| (v) Succinic anhydride | (vi) Cyclohexanone |
| (vii) Benzene sulphonamide | (viii) Cyclohexene |

Space for Rough Work

PART-3 : MATHEMATICS

SECTION-I(i) : (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Partial Marks : +3 If all the four options are correct but **ONLY** three options are chosen.
Partial Marks : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
Partial Marks : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -1 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -1 marks.

1. If the centre of the arc represented by $\arg \left[\frac{(z - 3i)}{(z - 2i + 4)} \right] = \frac{\pi}{4}$ is $\alpha + i\beta$, then

(A) $\beta = \frac{9}{2}$

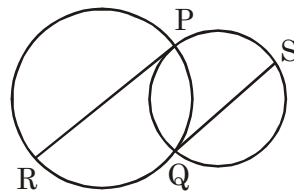
(B) $\beta = \frac{7}{2}$

(C) $\alpha = \frac{-5}{4}$

(D) $\alpha = \frac{-5}{2}$

Space for Rough Work

2. There are three bags B_1 , B_2 and B_3 . The bag B_1 contains 4 red and 4 black marbles, B_2 contains 3 red and 4 black marbles, B_3 contains 4 red and 3 black marbles, Bags B_1 , B_2 and B_3 have probabilities $\frac{1}{6}$, $\frac{1}{3}$ and $\frac{1}{2}$ respectively of being chosen. A bag is selected at random and a marble is chosen at random from the bag. Then which of the following options is/are correct ?
- (A) Probability that the selected bag is B_2 and the chosen marble is black equals $\frac{4}{21}$.
- (B) Probability that chosen marble is red equals $\frac{43}{84}$.
- (C) Probability that chosen marble is red, given that selected bag is B_1 equals $\frac{1}{2}$.
- (D) Probability that the selected bag is B_2 given that chosen marble is red equals $\frac{12}{43}$.
3. Two circles $x^2 + y^2 + 2ax - c^2 = 0$ and $x^2 + y^2 + 2bx - c^2 = 0$ meet in points P and Q. Parallel lines are drawn through P and Q to meet the circles in R and S as shown in figure. If locus of mid point of RS is $x^2 + y^2 + \lambda(a + b)x = 0$, then the value of λ is smaller than



(A) 1

(B) 2

(C) 3

(D) 4

Space for Rough Work

4. If matrix $A = \begin{bmatrix} a & b \\ c & a \end{bmatrix}$ satisfies $A^{-1} = A$, then possible values of real number x such that $A - xI$ is not invertible is/are
 (A) 3 (B) 1 (C) -1 (D) 4

5. If $f(x) = \begin{cases} |x| - 3 & x < 1 \\ |x - 2| + a & x \geq 1 \end{cases}$ and $g(x) = \begin{cases} 2 - |x| & x < 2 \\ \text{sgn}(x) - b & x \geq 2 \end{cases}$
 and $h(x) = f(x) + g(x)$ is continuous $\forall x \in \mathbb{R}$ then which of the following options is/are incorrect
 (A) Value of 'a - b' is 4 (B) Value of 'a - b' is -3
 (C) Value of 'a + b' is 2 (D) Value of 'a + b' is -2

6. The value of $\lim_{x \rightarrow \frac{\pi}{2}} \left(12 \tan^2 x \left(\sqrt{6 + 3 \sin x - 2 \cos^2 x} - \sqrt{3 + 6 \sin x - \cos^2 x} \right) \right)$ is less than :
 (A) 0 (B) 1 (C) 2 (D) 3

Space for Rough Work

7. Let M be a 3×3 invertible matrix with real entries and let I denote the 3×3 identity matrix. If $M^{-1} = \text{adj}(\text{adj } M)$, then which of the following statement is/are ALWAYS TRUE ?
- (A) $M = I$ (B) $\det M = 1$ (C) $M^2 = I$ (D) $(\text{adj } M)^2 = I$
8. A normal to the hyperbola $\frac{x^2}{4} - \frac{y^2}{1} = 1$ at point P in Ist quadrant has equal intercepts on the positive x and y -axis at point A and B respectively. The tangent at point ' P ' cut x -axis at point C . The normal at point ' P ' also touches the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. If $\Delta_1 = \text{Area of } \Delta PAC$ and $\Delta_2 = \text{area of } \Delta PBC$, then
- (A) The value of $a^2 + b^2$ is $\frac{25}{3}$ (B) The value of $a^2 + b^2$ is $\frac{50}{3}$
- (C) $\frac{\Delta_1}{\Delta_2} = \frac{1}{4}$ (D) $\frac{\Delta_1}{\Delta_2} = \frac{1}{\sqrt{2}}$

Space for Rough Work

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

- This section contains **TWO** List-Match sets.
- Each List-Match set has **Two** Multiple Choice Questions.
- Each List-Match set has two lists : **List-I** and **List-II**
- **List-I** has **Four** entries (I), (II), (III) and (IV) and **List-II** has **Six** entries (P), (Q), (R), (S), (T) and (U)
- **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated according to the following marking scheme :
Full Marks : +3 If **ONLY** the option corresponding to the correct combination is chosen.
Zero Marks : 0 If none of the options is chosen (i.e., the question is unanswered);
Negative Marks : -1 In all other cases

9. Answer the following by appropriately matching the lists based on the information given in the paragraph.

Given the continuous function

$$y = f(x) = \begin{cases} x^2 + 10x + 8 & x \leq -2 \\ ax^2 + bx + c & -2 < x < 0 \quad a \neq 0 \\ x^2 + 2x & x \geq 0 \end{cases}$$

Line L touches the graph of $y = f(x)$ at 3 points.

There are some expression given in the List-I whose values are given in List-II below :

List-I	List-II
(I) Slope of line L is	(P) 2
(II) The value of $a + b + c$ is	(Q) 3
(III) The value of $a^2 + b - c$ is	(R) 4
(IV) The value of $a \times b - c$ is	(S) 5
	(T) 6
	(U) 7

Which of the following is only correct combination.

- (A) (I)→(P) (B) (I)→(Q) (C) (II)→(U) (D) (II)→(T)

Space for Rough Work

ALLEN

10. Answer the following by appropriately matching the lists based on the information given in the paragraph.

Given the continuous function

$$y = f(x) = \begin{cases} x^2 + 10x + 8 & x \leq -2 \\ ax^2 + bx + c & -2 < x < 0 \quad a \neq 0 \\ x^2 + 2x & x \geq 0 \end{cases}$$

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(III) The value of $a^2 + b - c$ is	(R) 4
(IV) The value of $a \times b - c$ is	(S) 5
	(T) 6
	(U) 7

Which of the following is only Incorrect combination.

- (A) (I)→(R) (B) (III)→(Q) (C) (III)→(U) (D) (IV)→(T)

Space for Rough Work

ALLEN

11. Answer the following by appropriately matching the lists based on the information given in the paragraph.

Consider a triangular pyramid ABCD, the position vectors of whose angular points are A (3, 0, 1), B(-1, 4, 1), C(5, 2, 3) and D(0, -5, 4). Let G be the point of intersection of the medians of triangle BCD.

There are some expression given in the List-I whose values are given in List-II below :

List-I	List-II
(I) The length of vector \overline{AG} is	(P) $\frac{14}{\sqrt{6}}$
(II) Area of ΔABC is	(Q) $\frac{4}{\sqrt{6}}$
(III) Length of perpendicular from vextex D on opposite face is	(R) $4\sqrt{6}$
(IV) Area of ΔABD is	(S) $\frac{\sqrt{51}}{3}$
	(T) $2\sqrt{82}$
	(U) $\sqrt{82}$

Which of the following is the only correct combination :

- (A) (I)→(S) (B) (III)→(Q) (C) (IV)→(R) (D) (IV)→(Q)

Space for Rough Work

ALLEN

12. Answer the following by appropriately matching the lists based on the information given in the paragraph.

Consider a triangular pyramid ABCD, the position vectors of whose angular points are $A(3, 0, 1)$, $B(-1, 4, 1)$, $C(5, 2, 3)$ and $D(0, -5, 4)$. Let G be the point of intersection of the medians of triangle BCD.

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(III) Length of perpendicular from vextex D on opposite face is	(R) $4\sqrt{6}$
(IV) Area of ΔABD is	(S) $\frac{\sqrt{51}}{3}$
	(T) $2\sqrt{82}$
	(U) $\sqrt{82}$

Which of the following is only Incorrect combination :

- (A) (IV)→(T) (B) (II)→(R) (C) (III)→(P) (D) (II)→(P)

Space for Rough Work

SECTION-II : (Maximum Marks: 18)

- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

+	●				
●	●	○	○	○	○
①	①	①	①	①	①
②	②	②	②	●	②
③	③	③	③	③	③
④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	●
⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	●	●	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨

-	○				
●	●	●	○	○	●
①	①	①	①	①	①
②	②	②	②	●	②
③	③	③	③	③	③
④	④	④	④	④	④
⑤	⑤	⑤	●	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨

- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 If **ONLY** the correct numerical value is entered as answer.
Zero Marks : 0 In all other cases.

1. A sports person wants to practice for exactly 5 days during coming 20 days, but he doesn't want to tire himself. So he decided to have at least 2 days of rest between two practice sessions. Find the no of ways in which he can do so.
2. Total number of onto functions
 $f : \{1, 2, 3, 4, 5\} \rightarrow \{3, 4, 5, 6, 7\}$ such that $f(i) \neq i + 2$ is
3. Two fair dice are rolled together and the sum of the numbers on the faces is observed. If p is the probability of getting sum as prime number before the sum is obtained as perfect square, then the value of 88p.

Space for Rough Work

ALLEN

4. Let d_n be the distance travelled by the fighter plane is n^{th} hour. $d_{n+1} = 2d_n + n(1+2^n)$, $\forall n = 1, 2, 3, 4, \dots$ where $d_1 = 1$. If $d_n = (n^2 - 2n + 13)2^{n-2} - (n + 1)$ for some particular n , then value of n is :

5. $\int_{-3}^3 x^{16} \{x^{17}\} dx$ is equal to $\frac{3^\lambda}{\mu}$. ($\{ \}$ is fractional part) then the smallest value of $\lambda + \mu$ is equal to

(where $\lambda, \mu \in \mathbb{N}$)

6. If $x + 4y$ is a normal to the curve $y^2 = \alpha x^3 - \beta$ at $(2, 3)$, then the value of $\alpha + \beta$ is

Space for Rough Work

Space for Rough Work

QUESTION PAPER FORMAT AND MARKING SCHEME :

16. The question paper has three parts : Physics, Chemistry and Mathematics.
 17. Each part has two sections as detailed in the following table.

Section	Que. Type	No. of Que.	Category-wise Marks for Each Question				Maximum Marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
I(i)	One or more correct option(s)	8	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	+1 For darkening a bubble corresponding to each correct option, provided NO incorrect option darkened	0 If none of the bubbles is darkened	-1 In all other cases	32
I(ii)	Matching Lists Type (Single correct option)	4	+3 If only the bubble corresponding to the correct option is darkened	—	0 If none of the bubbles is darkened	-1 In all other cases	12
II	Numerical Value Type (Up to second decimal place)	6	+3 If only the bubble corresponding to correct answer is darkened	—	0 In all other cases	—	18

NAME OF THE CANDIDATE	
FORM NO.	
I have read all the instructions and shall abide by them. <hr style="width: 80%; margin-left: auto; margin-right: auto;"/> Signature of the Candidate	I have verified the identity, name and Form number of the candidate, and that question paper and ORS codes are the same. <hr style="width: 80%; margin-left: auto; margin-right: auto;"/> Signature of the Invigilator