


CLASSROOM CONTACT PROGRAMME
**JEE(Advanced)
FULL SYLLABUS**
SAMPLE PAPER-5
PAPER-2
Time : 3 Hours
Maximum Marks : 198
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 **28** 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.

DO NOT BREAK THE SEALS WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR
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

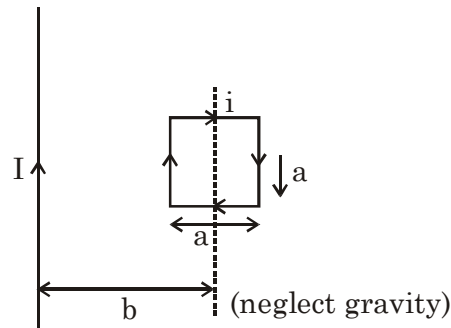
PART-1 : PHYSICS

SECTION-I : (Maximum Marks: 24)

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

Space for Rough Work

1. An infinite current carrying wire is placed at a distance b from a very small square loop of side a . The current in loop is i . Neglect any induced emf and assume these currents remain constant.



- (A) The loop is attracted to the wire by a force $F = \frac{\mu_0 I i}{2\pi b^2} a^2$.
- (B) The loop must be projected away from wire with a kinetic energy of $\frac{\mu_0 I i a^2}{3\pi b}$, so that it does not return back.
- (C) If the loop is projected into the plane with a kinetic energy of $\frac{\mu_0 I i a^2}{4\pi b}$, it moves in a circular path.
- (D) If the loop is projected into the plane with a kinetic energy of $\frac{\mu_0 I i a^2}{2\pi b}$, it moves in a circular path.

Space for Rough Work

2. A simple pendulum time period at night 12'O clock is 2 sec if it is on equator. In which of the following cases will it's time period be greater than 2 sec?
- (A) It is taken to poles.
(B) The temperature is increased.
(C) It is taken on a geostationary satellite.
(D) It is taken to a high hill on equator.
3. A, B and C are the mean positions of three particle in a line along which Simple harmonic waves of amplitude 10 units is travelling. At a certain instant particle A has a displacement of 8.66 decreasing, B has displacement of +5 increasing, and C has displacement of +8.66 decreasing. The distance $AB = 13$ cm and is less than one wavelength. BC is also less than one wavelength. Assume $y = A \sin (kx - \omega t)$.
- (A) The phase angles of A is $2\pi/3$ and that of B is $13 \pi/6$.
(B) The wavelength is 52 cm.
(C) The distance BC is 39 cm.
(D) The position of particles D and E in between them, for each of which the displacement is zero is $29/9$ cm, $169/18$ cm from A.
4. The rate at which energy is produced in mammals is proportional to their volume. Assume that mammals lose energy according to Newton's Law of cooling. Their body temperature are 27°C and surrounding is at 7°C . Assume that each mammal is curled up to form a sphere of different radius.
- (i) Mouse of radius 2 cm.
(ii) human being of radius 40 cm.
(iii) elephant of radius 2m.
- The energy intake/mass to maintain their temperature are E_1 , E_2 & E_3 respectively. Assume same emissivity and density.
- (A) $E_1 > E_2 > E_3$
(B) $E_3 > E_2 > E_1$
(C) rate of heat loss/area for all of them is same.
(D) rate of heat loss/area is largest for elephant.

Space for Rough Work

5. A car of mass 1200 kg started from rest and speeded up at an acceleration of 2 m/s^2 along a straight horizontal path of length 200 m. Its wheels did not slide. (The mass of the wheels can be neglected.)
- (A) The total frictional force exerted between the ground and the wheels was 2400 N.
(B) The final kinetic energy of the car is 480 kJ.
(C) Work done by the frictional force is 240 kJ.
(D) Final speed is 72 km/hr.
6. A shiny spoon is held in front of our eye at a distance of 25 cm such that the stem of the spoon is vertical. If the concave side of the spoon is observed, then an inverted image of our head can be seen, whilst if the convex part of the spoon is observed, then the image is upright. The radius of curvature of the vertical section of the spoon is 5 cm.
- (A) The upright image is shorter than the inverted image.
(B) The inverted image is shorter than the upright image.
(C) The inverted image is at a distance of $\frac{200}{9}$ cm from us.
(D) The upright image is at a distance of $\frac{250}{11}$ cm from us.

Space for Rough Work

SECTION-II : (Maximum Marks: 24)

- 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.

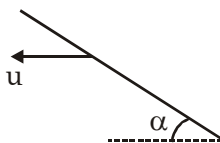
For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

+	●				
●	●	0	0	0	0
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

●	-				
●	●	●	0	0	●
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

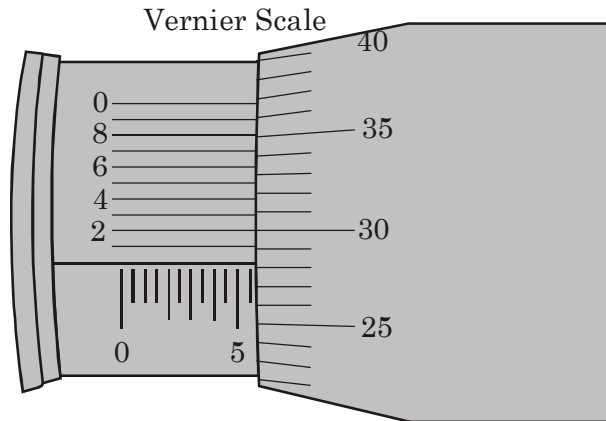
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If **ONLY** the correct numerical value is entered as answer.
Zero Marks : 0 In all other cases.

1. Consider a flat plate of area S moving horizontally through a medium having stationary particles of mass m each. The number of particles/volume in medium is n . The collision of particles with plate is elastic. If angle α is varied, the maximum force on the plate in the vertical direction is $kn\mu^2 S$. Find the value of k .



Space for Rough Work

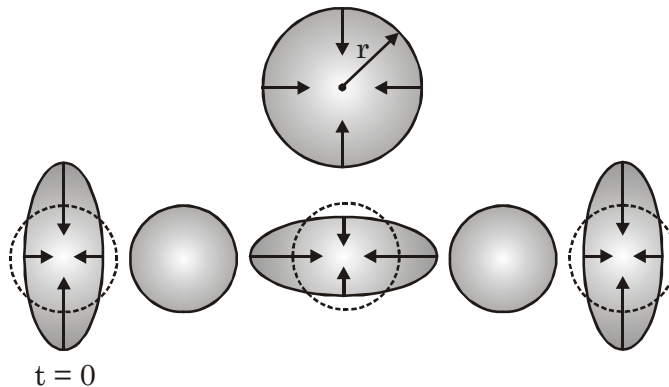
2. The picture shown below a picture of vernier screw gauge. Main scale or pitch is 0.5 mm. There are 50 divisions on circular scale. 9 circular scale divisions correspond to 10 vernier scale divisions. What is the reading R (in mm)? Fill 10R in the OMR.



3. An optical system contains a thin lens, $n = 1.4$, with positive curvature of radius $R_1 = 25$ cm for surface 1 and negative curvature of radius $R_2 = -25$ cm for surface 2. This lens collects light from the right side. To the left of the lens we want to keep a flat plate of thickness t of the same glass so that the light that radiates from a distant object is focused on a screen 35cm to the left of the lens. What is thickness t (in cm) ?

Space for Rough Work

4. A drop of liquid of radius r , density ρ and surface tension σ oscillates in gravity free space as shown in figure. If the time period of oscillation of this drop is 2 sec, what is the time period (in sec) of oscillation of a drop of radius $2r$. The second drop is made of same liquid as first.



5. Suppose that two electrons are in orbit around one proton (an H ion), both in an $n = 1$ level. Assuming standard reference for potential energy, find the modulus of mechanical energy of this system (in eV). Take energy of ionization of Bohr atom as 13.6 eV. Assume that the total angular momentum is quantized as in Bohr's theory.
6. On perfectly slippery ice, two identical boards lie in contact (figure). At the left edge a rough block is placed on the first board. When it was pushed, it reached the right edge of the second board and stayed on it. The final speed of second board is n times the final speed of first board. What is the value of n ? Weight and size of block is much less than mass and the length of the boards.

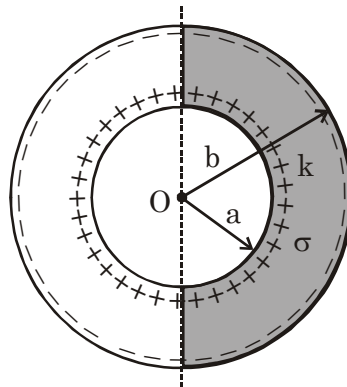


Space for Rough Work

SECTION-III : (Maximum Marks : 18)

- This section contains **SIX** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +3 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : -1 In all other cases

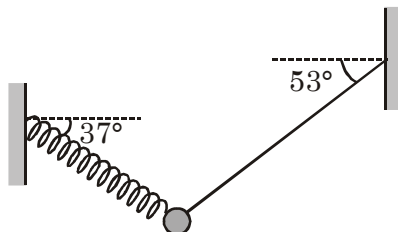
1. Half portion of a spherical capacitor is filled with a dielectric of dielectric constant $k = 2$ and conductivity σ . The charge given to spherical capacitor is Q_0 . Due to the conductivity of dielectric charge leaks and the time constant for the discharge circuit is x time of $\frac{\epsilon_0}{\sigma}$. Find the value of x .



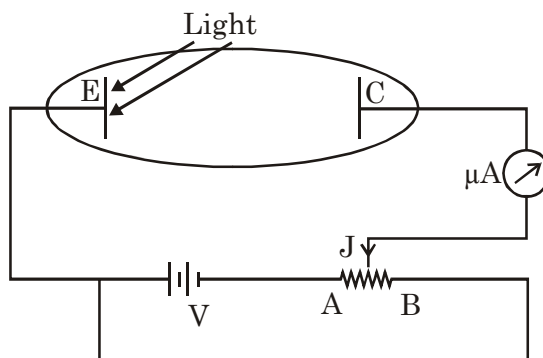
2. At low temperatures, the molar heat capacity of solids at constant pressure depends on the absolute temperature T according to the law $C_T = C_{T_0} \left(\frac{T}{T_0} \right)^3$. One mole (40 g) of solid argon at temperature 8K is brought into thermal contact with two kilograms of solid argon at a temperature of 1K and they insulated everything together. What will be the temperature (in K) of the substance when thermal equilibrium is established? Round off to nearest integer.

Space for Rough Work

3. A body of mass 1 kg is suspended by means of a spring and a thread between two walls as shown in the figure. The measure of both angles between the thread and the horizontal and the spring and the horizontal is shown in the figure. What is the initial acceleration (in m/s^2) of the object if the thread breaks ?

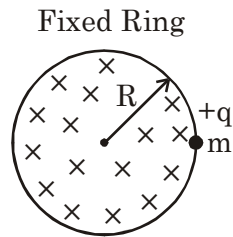


4. In a photoelectric experimental setup ultraviolet light of wavelength 350 nm is incident on emitter plate (E). The work function of the emitter plate is $\phi = 2.2$ eV. AB is a uniform wire resistor having length $L = 100$ cm. Resistance of the wire AB is 10Ω and the emf of the battery is $V = 10$ volt. The sliding contact J can be moved along the wire AB. When the sliding contact is placed at end B of the wire resistor the micro-ammeter shows a reading of $i = 6 \mu A$. Assume that photoelectric current is very small compared to the current through the cell. Find the reading of the ammeter (in μA) when the slider is moved to end A of the wire.



Space for Rough Work

5. In the manufacture of boiler filament we used a Nichrome wire of volume 10 cm^3 . What is the mass of water (in multiples of 10 gm/min) that can be heated every minute from the temperature of 10°C to a temperature of 100°C . The current density in it = 3 A/mm^2 . Boiler efficiency = 70% . Resistivity of nichrome is $1 \mu\Omega\text{m}$. $S_{\text{Water}} = 4200 \text{ J/kg}^\circ\text{C}$.
6. We have a fixed smooth insulating ring of radius R kept in a horizontal plane. A bead of mass m and charge $+q$ is threaded on the ring. A time varying magnetic field $B = B_0 + \alpha t$ is present. It is perpendicular to the plane of ring as shown. Find the force exerted (in 10^{-4}N) on the bead by the ring at $t = 5 \text{ sec}$. Take $B_0 = 0.01 \text{ T}$, $\alpha = 10^{-3} \text{ T/sec.}$, $R = 1\text{m}$, $q = 1 \text{ mC}$, $m = \frac{10^{-6}}{16} \text{ kg}$.



Space for Rough Work

PART-2 : CHEMISTRY

SECTION-I : (Maximum Marks: 24)

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

-
1. Consider the given electronic configuration of atom/ion :-
 $1s^0 2s^0 2p^0 3s^0 3p^0 3d^0 4s^1$
Select **INCORRECT** statement(s) :-
(A) Electron is in 3rd excited state of given atom/ion
(B) Degeneracy of energy level in which electron is present in given configuration = 32
(C) Total number of quantum number sets without changing energy of electron = 16
(D) Electron is present in an non directional orbital
2. p-Chloroaniline and anilinium hydrochloride can be distinguished by :-
(A) Sandmeyer reaction (B) NaHCO_3
(C) AgNO_3 (D) Carbylamine test
-

Space for Rough Work

3. Select the correct statement(s):
- (A) Heating is the transfer of energy that makes use of disorderly, apparently random, molecular motion in the surroundings.
 - (B) Work is the transfer of energy that makes use of organised motion of the molecules
 - (C) The internal energy of an isolated system is constant.
 - (D) A reversible change in thermodynamics is a change that can be reversed by an infinitesimal modification of a variable.
4. For an element $X_{(g)}$ value of negative electron gain enthalpy is second highest in periodic table elements. Select **CORRECT** statement(s) for element X.
- (A) Electronegativity of X is higher as compared to $Cl_{(g)}$ on Paulings scale.
 - (B) Negative electron gain enthalpy of $X_{(g)}^+$ is more than negative electron gain enthalpy of $O_{(g)}^+$.
 - (C) Negative electron gain enthalpy of $X_{(g)}$ is more than negative electron gain enthalpy of $Cl_{(g)}$.
 - (D) Ionisation energy of $X_{(g)}^-$ is less than ionisation of $Cl_{(g)}^-$

Space for Rough Work

5. Which of the following reaction are used to confirm presence of carbonyl group?
- (A) Reaction with hydroxylamine
 - (B) Reaction with hydrazine Sol
 - (C) Reaction with phenylhydrazine
 - (D) Reaction with semicarbazide hydrochloride
6. Identify the statement(s) which is/are **NOT CORRECT** with respect to the surface phenomenon.
- (A) If on adding electrolyte in an emulsion, the conductivity decreases, then it will be an oil in water type emulsion.
 - (B) Tyndall effect is observed when the refractive indices of the dispersed phase and dispersion medium differ largely.
 - (C) Macromolecular colloids are generally lyophobic in nature.
 - (D) Gases which can react with the adsorbents generally show chemisorption.
-

Space for Rough Work

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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

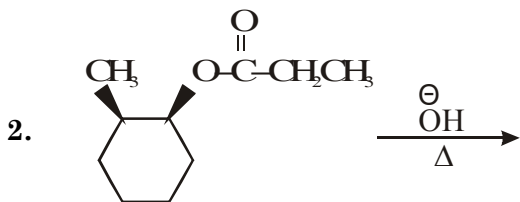
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1. XeF₆ is not stored in glass bottles due to the formation of P and Q compounds. Here P is a nonpolar molecule and Q is a polar molecule formed by reaction of two mole of XeF₆ and one mole of acidic oxide present in glass.

Find the value of (y-x)

Here x = number of similar bond angles in P molecule

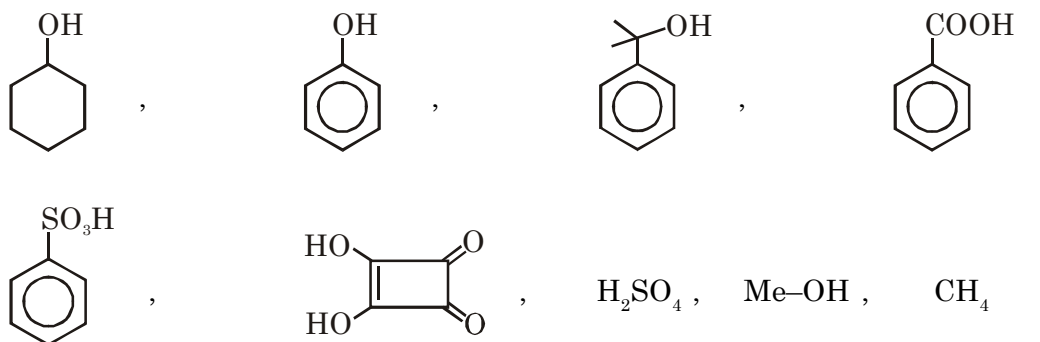
y = Number of d-orbitals used for bonding by central atom of Q



Number of α -Hydrogen atoms in Hydrocarbon formed as major product.

Space for Rough Work

5. Identify total number compounds which are soluble in aqueous NaOH as well as NaHCO₃?



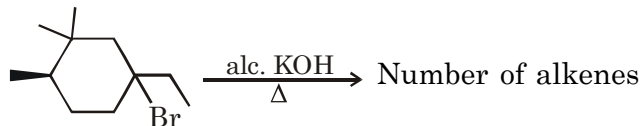
6. A solution contains 0.1M – Ba²⁺ and 0.2 M – Sr²⁺. If solid Na₂CrO₄ is added in this solution, what is the maximum percentage of Ba²⁺ precipitated as BaCrO₄, before any precipitation of SrCrO₄, is [K_{sp} (BaCrO₄) = 1.2 × 10⁻¹⁰; K_{sp} (SrCrO₄) = 4.0 × 10⁻⁹]

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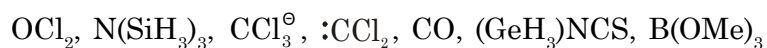
1. Find out the number of sets, in which first specie would be expected to have the higher C–O stretching frequency?
 (CO, CO₂),
 ([Ti(CO)₆]²⁺, [V(CO)₆]⁰)
 (Cr(CO)₆, [Mn(CO)₆]⁺)
 ([Co(CO)₄]⁰, [Ni(CO)₄])
 ([P(Cl)₃Mo(CO)₃], [(PMe₃)₃Mo(CO)₃])
2. How many alkenes are produced when following compound is heated with alc. KOH :



3. The density of crystalline sodium chloride is 2.167 gm/cm³. What would be the approximate side length (in cm) of cube containing one mole of NaCl ?

Space for Rough Work

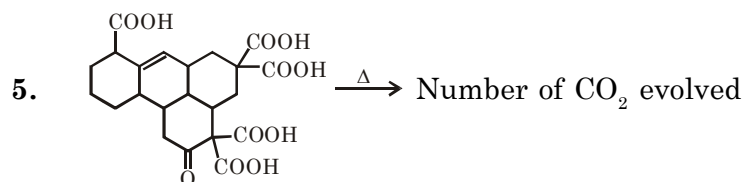
4. Consider the following species.



Find the product of **(x.y)** if

x = number of species in which $2p_\pi-3d_\pi$ back bond present

y = number of species in which direction of lone pair donation is from 2nd period element to 3rd period element



6. There are two vessels of same volume consisting same number of moles of two different gases at the same temperature. One of the gas is CH_4 and the other is unknown gas, G. Assuming that the molecules of G are under random motion whereas in CH_4 , except one, all are stationary.

The collision diameter is same for both the gases and the average speed of CH_4 is $\sqrt{\frac{48}{\pi}}$ times

the rms speed of G. If Z_1 represents the number of collisions made by one molecule with other molecules per unit time and the ratio of Z_1 for CH_4 and Z_1 for G is x : 1, the value of 'x' is

Space for Rough Work

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

- This section contains **SIX** 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.
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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 : -2 In all other cases.
 - **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.
-
1. If two real and distinct roots of $(x - 2019)(x - 2022) + \lambda(x - 2020)(x - 2021) = 0$ are x_1 and x_2 for some $\lambda \in \mathbb{R}^+$, then which of the following option(s) is/are correct -
- (A) 2020 will lie in (x_1, x_2)
(B) $x_1, x_2 \in (2019, 2021)$
(C) $x_1, x_2 \in (2019, 2022)$
(D) $x_1, x_2 \in (2019, 2020)$
2. A straight line $y = m(x - a)$, $m \neq 0$ meets a parabola $y^2 = 4ax$ at two points A and B. Then which of the following option(s) is/are correct
- (A) Length AB = 4a when $m = 1$
(B) Length AB = 8a when $m = 1$
(C) Angle between normals drawn at A and B is 45° when $m = 1$
(D) Angle between normals drawn at A and B is 90° when $m = 2$

Space for Rough Work

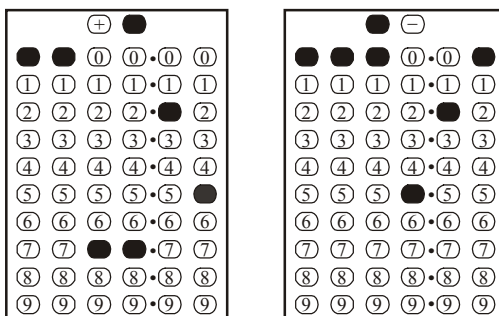
3. Let N be the number of ordered pairs of non-empty sets A and B . If A and B satisfy
(i) $A \cup B = \{1, 2, 3, \dots, 12\}$ (ii) $A \cap B = \phi$
(iii) (number of elements of A) $\notin A$ (iv) (number of elements of B) $\notin B$
then choose correct options
(A) N is a 3-digits number
(B) Sum of the digits of N is 11
(C) When N is divided by 10, remainder is 2
(D) N is an odd number
4. Let complex numbers Z_1 and $\frac{1}{\bar{Z}_1}$ lie on $|Z - Z_0| = 4R$ and $|Z - Z_0| = 16R$ respectively. If Z_0 satisfies $2|Z_0|^2 = R^2 + 2$ and $|Z_1|^2 = \frac{p}{q}$ where $p, q \in \mathbb{N}$ and H.C.F of p and q is 1, then choose the correct option(s)
(A) $p > q$ (B) $p < q$ (C) p is a prime (D) q is a prime
5. If $L_1 : \frac{x}{1} = \frac{y}{2} = \frac{z}{3}$, $P_1 : x + y + z = 0$, $L_2 : \frac{x}{a} = \frac{y}{b} = \frac{z}{c}$ and line L_2 is projection of line L_1 in plane P_1 , then which of the following option(s) is/are correct
(A) $a + c = 0$ (B) $a + b = 0$ (C) $b + c = 0$ (D) $a + b + c = 0$
6. Let $P(x)$ be a monic real polynomial of degree 3. $P(x)$ has maximum at $x = 0$ and $P'(x)$ has minimum at $x = 1$. If $P(1) = 0$, then choose correct option(s)
(A) $P(2)$ is negative (B) $P(-2)$ is negative
(C) $P(2)$ is positive (D) $P(-2)$ is positive

Space for Rough Work

SECTION-II : (Maximum Marks: 24)

- 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 : +4 If **ONLY** the correct numerical value is entered as answer.
Zero Marks : 0 In all other cases.

1. Let A, B and C be 3 square matrices of order 3×3 . If $A^3 - 6A^2 + 7A + B = 0$ and $(\text{adj}(\text{adj}B)) = C$,

where $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$, then $\left(\frac{\text{sum of the elements of C}}{10} \right)$ is

2. If the value of $\int_0^1 x \left\{ \frac{d^2}{dx^2} (1-x^2)^4 \right\} dx$ is N, then the value of $\frac{N}{2}$ is

3. Let $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = 3\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = \hat{i} + \hat{j} + \hat{k}$ be three vectors.

If $\vec{r} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{r} \cdot \vec{a} = 0$, then the value of $|\vec{r}|^2$ is

Space for Rough Work

4. Let A, B and C be the vertices of an equilateral triangle. Equation of side BC is $x + y = 0$ and co-ordinates of A are (α, β) . If exterior angle bisectors of angles at B and C are $y = (2 - \sqrt{3})x$ and $y - 1 = (x + 1)(2 + \sqrt{3})$ respectively, then the value of $(\alpha\beta)$ is
5. Two players A and B play a series of matches. In each match it is 2 to 1 in favour of the winner of the previous match. If A wins the first match, then the probability that A will win 3 matches of the next 4 matches, is - (Assume no match ends in draw)
6. Let T_n be the n^{th} term of a series for $n \geq 1$ and $T_1 = 1$, $T_{n+1} = 2T_n + 4^n$, $n \geq 1$. If $S_n =$ Sum of first n terms of the series and $S_n = \frac{a \cdot 4^n + b \cdot 2^n + 1}{3}$ where $a, b \in \mathbb{I}$, then the value of $\left| \frac{b}{a} \right|$ is

Space for Rough Work

SECTION-III : (Maximum Marks : 18)

- This section contains **SIX** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +3 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : -1 In all other cases

-
1. Let $x_0, y_0, z_0 \in \mathbb{R} - \{0\}$. If (x_0, y_0, z_0) be the solution of system of equations
 $x + y - 2z = 0$
 $2x - 3y + z = 0$
 $x - 5y + 4z = k, k \in \mathbb{R}$
then the value of $\frac{x_0 y_0 + y_0 z_0 + z_0 x_0}{x_0^2 + y_0^2 + z_0^2}$ is
 2. Let $f(x)$ be a polynomial function of degree n such that $2 + 2f(x) = f(x-1) + f(x+1), \forall x \in \mathbb{R}$. If $S =$ sum of all possible values of n , then the value of S is
 3. $ax^2 + 2hxy + by^2 + 2gx + 2fy = 0$ is a hyperbola whose center is at $(1,2)$ and the asymptotes of this hyperbola are parallel to lines $2x + 3y = 0$ and $x + 2y = 1$. If hyperbola passes through $(2,4)$, then the value of $\left[\frac{f}{g} \right]$ is (where $[.]$ represents greatest integer function)

Space for Rough Work

4. Let $f : [0, \pi] \rightarrow [0, \pi]$ and $g : [0, \pi] \rightarrow [0, \pi]$ be two functions defined by $f(x) = x + \sin x$ and g is inverse function of f . If A is the area of the region bounded by $y = f(x)$ and $y = g(x)$, then the value of A is
5. If the sum of the series $\sec^2 x + \frac{1}{2^2} \sec^2\left(\frac{x}{2}\right) + \frac{1}{2^4} \sec^2\left(\frac{x}{2^2}\right) + \dots + \frac{1}{2^{2n-2}} \sec^2\left(\frac{x}{2^{n-1}}\right)$ is equal to $a^2 \operatorname{cosec}^2 ax - \frac{4}{4^n} \operatorname{cosec}^2 \frac{x}{2^{n-1}}$, $a \in \mathbb{N}$, then the value of 'a' is
6. If $f : \mathbb{R} - \{0, 1\} \rightarrow \mathbb{R}$ be a function satisfying $f(x) + f\left(1 - \frac{1}{x}\right) = \tan^{-1} x$ and $N = f\left(\frac{1}{2}\right)$, then the value of $\left(\frac{8N}{\pi}\right)$ 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 three 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	One or more correct option(s)	6	+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	-2 In all other cases	24
II	Numerical Value Type (Up to second decimal place)	6	+4 If only the bubble corresponding to correct answer is darkened	—	0 In all other cases	—	24
III	Single digit Integer (0-9)	6	+3 If only the bubble corresponding to correct answer is darkened	—	0 If none of the bubbles is darkened	-1 In all other cases	18

NAME OF THE CANDIDATE FORM NO.	
I have read all the instructions and shall abide by them. _____ 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. _____ Signature of the Invigilator