



# CLASSROOM CONTACT PROGRAMME

JEE(Advanced)  
FULL SYLLABUS

## SAMPLE PAPER-1

## PAPER-2

Time : 3 Hours

Maximum Marks : 180

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

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

## 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**

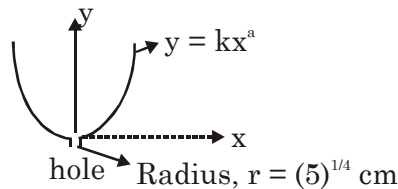
**BEWARE OF NEGATIVE MARKING**

**PART-1 : PHYSICS**

**SECTION-I(i) : (Maximum Marks: 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.

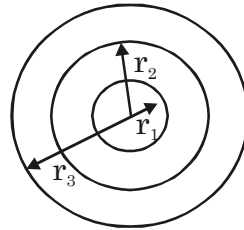
1. For the tank shown in figure, if time of emptying the tank from height of 16m to 4m is 't' then, choose the correct option(s) :



- (A) If  $k = 1, a = 4, t = 12000$  sec.                      (B) If  $k = 1, a = 2, t = 500$  sec  
 (C) If  $k = 4, a = 2, t = 125$  sec.                      (D) If  $k = 4, a = 4, t = 6000$  sec.

**Space for Rough Work**

2. A uniform ring of radius  $R$  lies on the  $x$ - $y$  plane with its centre at origin. Its moment of inertia about  $z$ -axis is equal to its moment of inertia about an axis along the line  $y = K_1x + K_2$ .
- (A)  $K_1 = 1, K_2 = +\frac{R}{\sqrt{2}}$  (B)  $K_1 = 1, K_2 = -R$  (C)  $K_1 = -1, K_2 = +R$  (D)  $K_1 = -1, K_2 = -\frac{R}{\sqrt{2}}$
3. Three highly conducting concentric spherical shells (acting as black body) of radii  $r_1, r_2$  and  $r_3$  are kept in vacuum. The region between the shells is evacuated and they can exchange energy only by radiation. Inside the innermost shell there is a heater of constant power  $P$ . In steady state, ( $\sigma =$  Stefan's constant)

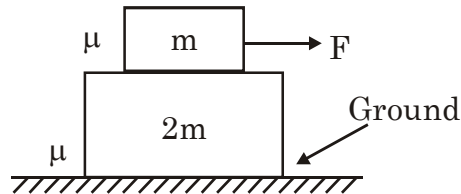


- (A) Temperature of outermost shell is  $\left(\frac{P}{4\pi\sigma r_3^2}\right)^{1/4}$
- (B) Temperature of middle shell is  $\left(\frac{P}{4\pi\sigma}\right)^{1/4} \left(\frac{1}{r_3^2} + \frac{1}{r_2^2}\right)^{1/4}$
- (C) Temperature of innermost shell is  $\left(\frac{P}{4\pi\sigma}\right)^{1/4} \left(\frac{1}{r_1^2} - \frac{1}{r_2^2}\right)^{1/4}$
- (D) If both outer and middle shell were removed, the temperature of innermost shell would decrease.

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**Space for Rough Work**

4. The system of two blocks is at rest as shown in the figure. A variable horizontal force is applied on the upper block. The coefficient of friction for both the contacts is  $\mu$ . Choose the correct option(s) :

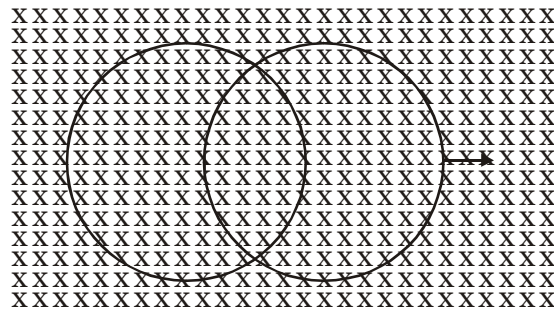


- (A) When acceleration of the upper block is  $2 \mu g$ , net force on the lower block by the ground is  $mg\sqrt{9 + \mu^2}$
- (B) When acceleration of the upper block is  $2 \mu g$ , acceleration of the lower block is zero
- (C) Net horizontal force on the lower block is always zero.
- (D) Unless the upper block moves, no frictional force exists between the ground and the lower block.

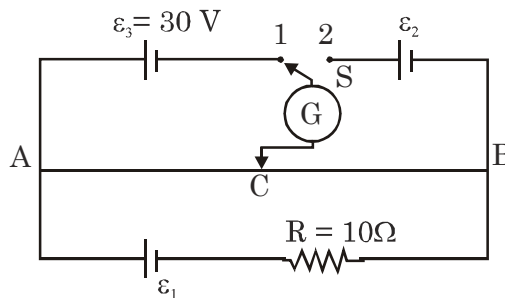
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**Space for Rough Work**

5. In the diagram shown, a uniform magnetic field is present perpendicular to the plane of the paper. Both the rings are identical and have a constant resistance per unit length. The left ring has been kept fixed at its position and the right ring is slide uniformly on the left ring towards the right hand side. Which of the following statements is/are true ?



- (A) The emf induced in the left ring is zero  
 (B) The emf induced in both the rings is non-zero  
 (C) The magnetic force acting on the right ring is zero  
 (D) The magnetic force acting on both the rings is non-zero
6. In the circuit shown in figure, AB is a uniform wire of length  $L = 5$  m. It has a resistance of  $2\Omega/\text{m}$ . When  $AC = 2.0$  m, it was found that the galvanometer shows zero reading when switch S is placed in either of the two positions 1 or 2. Then,



- (A)  $\epsilon_1 = 150\text{V}$       (B)  $\epsilon_1 = 600\text{V}$       (C)  $\epsilon_2 = 60\text{V}$       (D)  $\epsilon_2 = 45\text{V}$

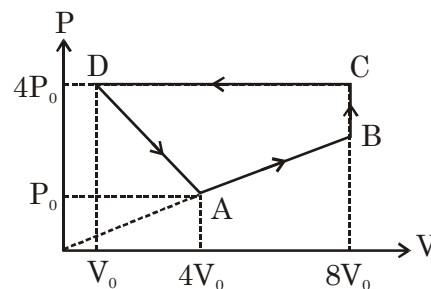
Space for Rough Work

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

- This section contains **FOUR** questions.
- **Each question has matching lists.** The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**
- For each question, marks will be awarded in one of the following categories :  
*Full Marks* : +3 If only the bubble corresponding to the correct option is darkened.  
*Zero Marks* : 0 If none of the bubbles is darkened.  
*Negative Marks* : -1 In all other cases

7. Answer the following by appropriately matching the lists based on the information given in the list.

$\frac{3}{25}$  moles of an ideal monatomic gas undergoes a process as shown in figure.  $\Delta U$ ,  $Q$  and  $W$  represents the change in internal energy, amount of heat exchange and pressure-volume work respectively for the gas either for single process or for complete cycle.  $\left( R = \frac{25}{3} \text{ SI unit} \right)$



- |  |  |
|--|--|
| <p><b>List-I</b></p> <p>(P) In process AB<br/>         (Q) In process DA<br/>         (R) In cyclic process ABCDA<br/>         (S) In process CD</p> | <p><b>List-II</b></p> <p>(1) <math>Q = 0</math> or <math>Q = +ve</math><br/>         (2) <math>\Delta U = 0</math> or <math>\Delta U = -ve</math><br/>         (3) <math>\Delta U = +ve</math><br/>         (4) <math>W = +ve</math> or <math>W = 0</math><br/>         (5) <math>W = -ve</math></p> |
|--|--|

Correctly match among the following is :

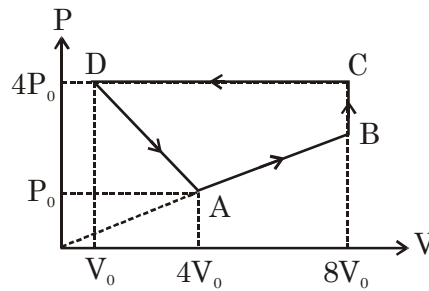
- (A) P → 1,4; Q → 1,2,4; R → 2,5; S → 3,5      (B) P → 1,3,4; Q → 1,2,4; R → 2,5; S → 2,5  
 (C) P → 1,3,4; Q → 1,2,5; R → 2,5; S → 2,5      (D) P → 1,3,4; Q → 1,2,4; R → 2,4; S → 2,5

Space for Rough Work

**ALLEN**

8. Answer the following by appropriately matching the lists based on the information given in the list.

$\frac{3}{25}$  moles of an ideal monatomic gas undergoes a process as shown in figure.  $\Delta U$ ,  $Q$  and  $W$  represents the change in internal energy, amount of heat exchange and pressure-volume work respectively for the gas either for single process or for complete cycle. If temperature at point A is 100K.  $\left( R = \frac{25}{3} \text{ SI unit} \right)$



- | List-I                                      | List-II (Numerical Value) |
|---|---------------------------|
| (P) Work done in process AB                 | (1) 450 J                 |
| (Q) Change in internal energy in process AB | (2) 2100 J                |
| (R) Work done in cyclic process ABCDA       | (3) 150 J                 |
| (S) Change in internal energy in process CD | (4) 1050 J                |
|   | (5) 362.5 J               |

Correctly match among the following is :

- |                                |                                |
|--------------------------------|--------------------------------|
| (A) P → 3; Q → 1; R → 5; S → 4 | (B) P → 3; Q → 2; R → 5; S → 4 |
| (C) P → 2; Q → 1; R → 5; S → 4 | (D) P → 3; Q → 1; R → 5; S → 2 |

**Space for Rough Work**



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

If potential energy interaction between electron & nucleus (infinite mass) is given by  $U = -\frac{ke^2}{3r^3}$  (Bohr's theory is valid), where n represents n<sup>th</sup> orbit. then :

**List-I**

**List-II**

- |  |                      |
|--|----------------------|
| (P) Electric current due to electron moving in a orbit | (1) $n^{-2}$         |
| (Q) Magnetic field due to electron at centre of atom   | (2) $n^7$            |
| (R) Angular momentum of n <sup>th</sup> orbit          | (3) $n^0$            |
| (S) Magnetic moment create due to revolving electron   | (4) $n^5$<br>(5) $n$ |

(A) P → 4; Q → 2; R → 5; S → 5

(B) P → 1; Q → 2; R → 5; S → 5

(C) P → 4; Q → 2; R → 5; S → 1

(D) P → 4; Q → 2; R → 1; S → 5

**Space for Rough Work**

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

If potential energy interaction between electron & nucleus (infinite mass) is given by

$$U = U_0 \ln \left( \frac{r}{r_0} \right) \text{ (Bohr's theory is valid), where } n \text{ represents } n^{\text{th}} \text{ orbit. then :}$$

**List-I**

**List-II**

- |   |   |
|---|---|
| <p>(P) Electric current due to electron moving in a orbit</p> <p>(Q) Magnetic field due to electron at centre of atom</p> <p>(R) Angular momentum of <math>n^{\text{th}}</math> orbit</p> <p>(S) Magnetic moment create due to revolving electron</p> | <p>(1) <math>n^{-2}</math></p> <p>(2) <math>n^{-1}</math></p> <p>(3) <math>n^0</math></p> <p>(4) <math>n^5</math></p> <p>(5) <math>n</math></p> |
|---|---|

- |   |   |
|---|---|
| <p>(A) P → 2; Q → 1; R → 2; S → 5</p> <p>(C) P → 2; Q → 1; R → 4; S → 5</p> | <p>(B) P → 2; Q → 1; R → 5; S → 5</p> <p>(D) P → 3; Q → 1; R → 2; S → 5</p> |
|---|---|

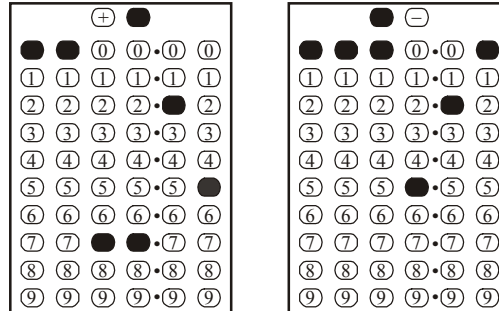
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**Space for Rough Work**

**SECTION-II : (Maximum Marks: 24)**

- This section contains **EIGHT** 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.

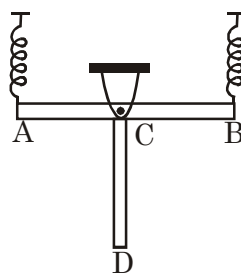
1. Two point masses of mass 4m and m respectively by a distance d are revolving under mutual

force of attraction. Ratio of their kinetic energy will be  $\left( \frac{K.E_{4m}}{K.E_m} \right)$

2. A body is made of two rods AB and CD rigidly joined together to form a T shape. Two springs are attached to this body and the body is free to rotate in a vertical plane about a horizontal axis passing through C as shown in the figure. Then, the angular frequency (in rad/s) of small

oscillation of this system is ? Mass of each rod is  $m = 6 \text{ kg}$  and their lengths are  $L = \frac{5}{52} \text{ m}$ .

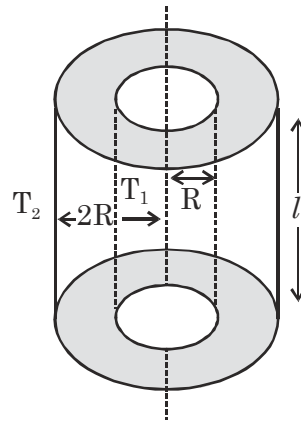
Spring constant for each spring is  $K = 96 \text{ N/m}$



**Space for Rough Work**

**ALLEN**

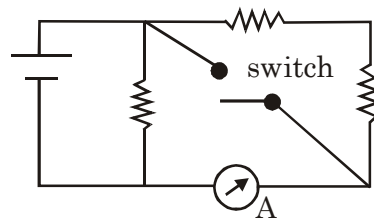
3. Inner surface of a cylindrical shell of length  $\ell$  and of material of thermal conductivity  $k$  is kept at constant temperature  $T_1$  and the outer surface of the cylinder is kept at constant temperature  $T_2$  such that ( $T_1 > T_2$ ) as shown in figure. Heat flows from inner surface to outer surface radially outward. Inner and outer radii of the shell are  $R$  and  $2R$  respectively. Due to lack of space this cylinder has to be replaced by a smaller cylinder of length  $\frac{\ell}{2}$  inner and outer radii  $\frac{R}{8}$  and  $R$  respectively and thermal conductivity of material  $nk$ . If rate of radially outward heat flow remains same for same temperature of inner and outer surface i.e.  $T_1$  and  $T_2$ , then find the value of  $n$ .



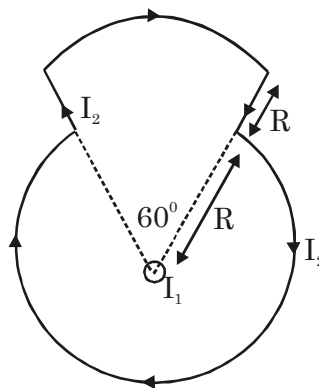

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Space for Rough Work

4. In the circuit shown, the reading of the Ammeter becomes four times of its initial value after the switch is closed. Each resistor has a resistance =  $2\Omega$  and the ideal cell has e.m.f. =  $10\text{ V}$ . Then the ammeter has a resistance (in  $\Omega$ ) equal to



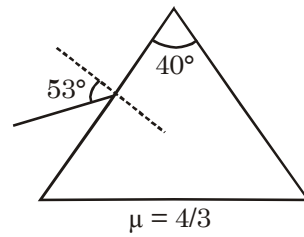
5. A long current carrying straight wire having current  $I_1 = 10^4$  ampere is placed at the centre of an another current carrying loop having current  $I_2 = 10^4$  ampere. Straight wire is perpendicular to the plane of the loop as shown in the figure. The torque (in N-m) acting on the loop about its center is  $10x$ . Find the value of  $x$ . (Radius  $R = 1\text{ m}$ )




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**Space for Rough Work**

6. Consider a uniformly charged nonconducting cube of volume charge density  $\rho$ . Potential of one of vertex is  $\frac{10}{3}$  volt, find the potential of centre of the cube (in volts).
7. If the length and breadth of a thin rectangular sheet are measured using a meter scale as 16.2 cm and 10.1 cm respectively, its surface area is  $164 \pm x \text{ cm}^2$ . Then value of 'x' is.
8. Find the deviation of light ray (in degree)




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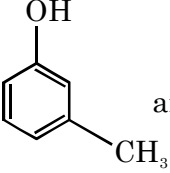
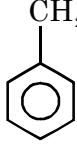
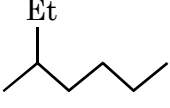
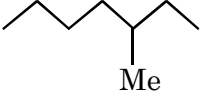
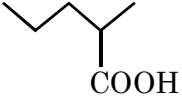
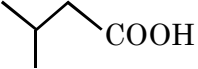
Space for Rough Work

**PART-2 : CHEMISTRY****SECTION-I(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.
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1. Which phenomenon occurs when an electric field is applied to a colloidal solution and electrophoresis is prevented by some suitable means ?  
(A) Reverse osmosis takes place.                      (B) Electrosmosis takes place  
(C) Dispersion medium begins to move              (D) Dispersion medium becomes stationary
  2. Which of the following can have same set of quantum numbers?  
(A) Unpaired electron of Cl and electron entered in Cl  
(B) Outermost electron of K and outermost electron of Cr .  
(C) Paired electron in 2p-orbital of O and electron required to remove to form O<sup>+</sup> from O  
(D) Outermost electron of Mg and outermost electron of Ca
- 

**Space for Rough Work**

3. Correctly matched among the following is/are :

Column-I (Compounds)	Column-II (Relationship)
(A) $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{CH}_2-\text{CH}_3$ and $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OCH}_3$	Position Isomers
(B)  and 	Functional Isomers
(C)  and 	Chain Isomers
(D)  and 	Chain Isomers

4. 80.0 gm salt of weak base and strong acid XY is dissolved in water and formed 2 litre of aqueous solution. The pH of the resultant solution was found to be 5 at 298 K. If XY forms CsCl type crystal having  $r_{X^+}$  (radius of  $X^+$ ) = 1.6 Å and  $r_{Y^-}$  (radius of  $Y^-$ ) = 1.864 Å then select correct statement(s).

(Given :  $K_b(\text{XOH}) = 4 \times 10^{-5}$ ;  $N_A = 6 \times 10^{23}$ ,  $\log 2 = 0.30$ )

- (A) Molar mass of salt is 100 g/mol                      (B) % Degree of hydrolysis of salt is 0.25  
 (C) Edge length of XY is 4Å                                      (D) Density of solid salt XY is 5 in gm/cc

**Space for Rough Work**



5. Which of the following statements are correct.
- (A) In modern periodic table each block contains a number of columns equal to the number of electrons that can occupy that sub-shell.
- (B) The greatest increase in ionization enthalpy is experienced on removal of electron from core noble gas configuration.
- (C) The size of the isoelectronic species is affected by electron-electron interaction in the outer orbitals.
- (D) Anything that influences the valence electrons will affect the chemistry of the element and the valence shell is not affected by nuclear mass.
6. Correct option among the following is/are :
- (A) Glycerol + Oxalic acid  $\xrightarrow[\text{(ii) H}^+/\text{HOH}]{\text{(i) 100-110}^\circ}$  Formic acid
- (B) Glycerol + Oxalic acid  $\xrightarrow{210^\circ}$  Allyl Alcohol
- (C) Glycol + Oxalic acid  $\xrightarrow{213^\circ\text{C}}$  Ethene
- (D) Glycerol + Formic acid  $\xrightarrow{260^\circ\text{C}}$  Allyl alcohol

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Space for Rough Work

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

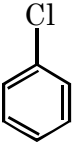
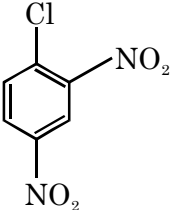
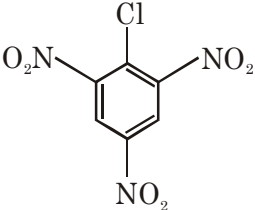
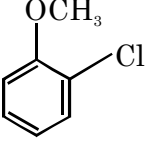
- This section contains **FOUR** questions.
- **Each question has matching lists.** The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**
- For each question, marks will be awarded in one of the following categories :

*Full Marks* : +3 If only the bubble corresponding to the correct option is darkened.

*Zero Marks* : 0 If none of the bubbles is darkened.

*Negative Marks* : -1 In all other cases

7. Answer the following by appropriately matching the lists based on the information given in the list.

List-I	List-II
<p>(P)  <math>\xrightarrow[623\text{k}, 300\text{atm}, \text{H}^+]{\text{NaOH}}</math></p>	<p>(1) Reaction involve Meisen Heimer Complex or anionic sigma complex</p>
<p>(Q)  <math>\xrightarrow{\text{aq. KOH}}</math></p>	<p>(2) Gives best rate of Ar SNAE amongst all</p>
<p>(R) </p>	<p>(3) Benzyne intermediate is involved</p>
<p>(S) </p>	<p>(4) Raschig's Process</p> <p>(5) -F instead of -Cl gives better rate of Ar SNAE</p>

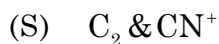
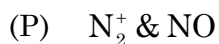
Correctly match among the following is :

- |                                      |  |
|--------------------------------------|--|
| (A) P → 4; Q → 2,5; R → 1,3,5; S → 1 | (B) P → 3; Q → 1,5; R → 1,2,5; S → 3   |
| (C) P → 1; Q → 1,4; R → 1,5; S → 4   | (D) P → 2,3; Q → 1; R → 2,4,5; S → 1,3 |

Space for Rough Work

8. Answer the following by appropriately matching the lists based on the information given in the list.

## List-I



## List-II

(1) Same bond order as that of  $B_2$ (2) Same magnetic property and bond order as that of  $NO^+$ (3) Same number of unpaired electron as that of  $S_2^-$ (4) Same bond order but not same magnetic property as that of  $O_2$ (5) The bond order is less than that observed in  $CO^+$ (6) Similar magnetic property as that of  $O_3$ 

Correctly match among the following is :

(A) P  $\rightarrow$  3,4,5; Q  $\rightarrow$  1,4,6; R  $\rightarrow$  5; S  $\rightarrow$  4,5,6(B) P  $\rightarrow$  3,5,6; Q  $\rightarrow$  1,4,5; R  $\rightarrow$  2; S  $\rightarrow$  5,6(C) P  $\rightarrow$  3,5; Q  $\rightarrow$  1,5,6; R  $\rightarrow$  2,5; S  $\rightarrow$  4,5,6(D) P  $\rightarrow$  3,4,5; Q  $\rightarrow$  1,5; R  $\rightarrow$  2,4,5; S  $\rightarrow$  4,6

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Space for Rough Work

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

**List-I**

- (P)  $\text{NH}_2\text{COONH}_4(\text{s}) \rightleftharpoons 2\text{NH}_3(\text{g}) + \text{CO}_2(\text{g}); \Delta H < 0$
- (Q)  $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g}); \Delta H > 0$
- (R)  $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g}); \Delta H > 0$
- (S)  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g}); \Delta H < 0$

**List-II**

- (1) High pressure and low temperature will favour formation of products.
- (2) Increases in the amount of any of the product will definitely favour backward reaction.
- (3) Increase in temperature and doubling the volume of reaction vessel will cause the equilibrium to shift in similar direction.
- (4) A decrease in temperature will cause decrease in the value of equilibrium constant.
- (5) Increase in concentration of reactant the equilibrium is achieved will make the equilibrium shift towards product side

Correctly match among the following is :

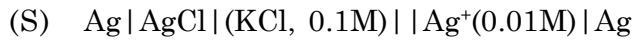
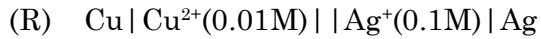
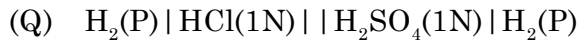
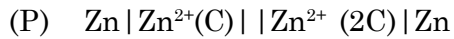
- (A) P → 3; Q → 3,5; R → 1,2,5; S → 3,4      (B) P → 2; Q → 3,4; R → 2,4,5; S → 1,2,3,5
- (C) P → 2; Q → 4,5; R → 1,2,4; S → 1,3,5      (D) P → 2; Q → 3,4,5; R → 1,4,5; S → 2,5

---

**Space for Rough Work**

**ALLEN**

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

**List-I****List-II**

(1) Spontaneous cell reaction

(2) Working galvanic cell representation

(3) Concentration of cation in cathodic compartment increases upto equilibrium

(4) Concentration cell

(5) Concentration of  $\text{Cl}^-$  in anodic compartment decreases

Correctly match among the following is :

(A)  $\text{P} \rightarrow 1,3; \text{Q} \rightarrow 3,4; \text{R} \rightarrow 1,2; \text{S} \rightarrow 1,2,3,4$  (B)  $\text{P} \rightarrow 1,2,4; \text{Q} \rightarrow 3,5; \text{R} \rightarrow 1,3; \text{S} \rightarrow 1,2,4$ (C)  $\text{P} \rightarrow 1,2,4; \text{Q} \rightarrow 4; \text{R} \rightarrow 1,2; \text{S} \rightarrow 1,2,5$  (D)  $\text{P} \rightarrow 1,2,3; \text{Q} \rightarrow 3,4; \text{R} \rightarrow 1,2,5; \text{S} \rightarrow 1,2,3,5$ 


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**Space for Rough Work**

**SECTION-II : (Maximum Marks: 24)**

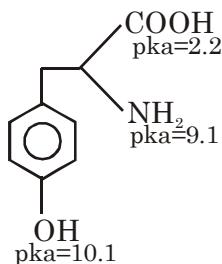
- This section contains **EIGHT** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... 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.



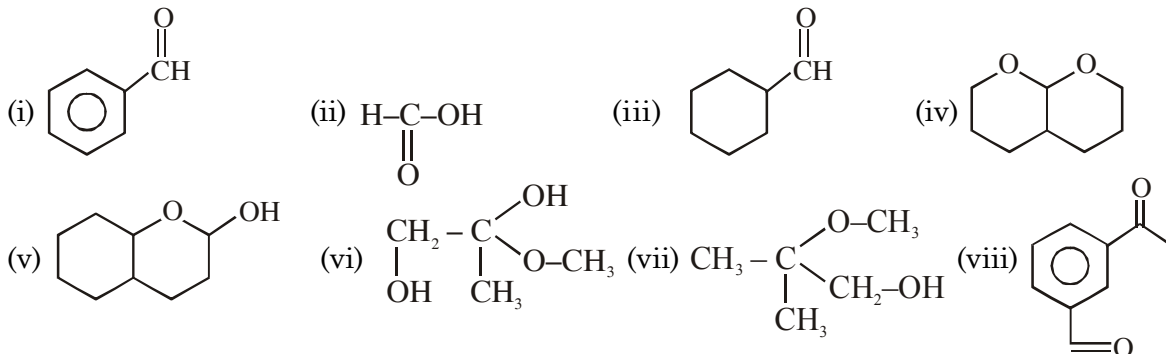
1. Find out Isoelectric value for Tyrosine.
2. Among the following complexes, how many have spin only magnetic moment of 2.83 B.M.  
 $[\text{Ni}(\text{CO})_4]$ ;  $[\text{Ni}(\text{NH}_3)_6]^{+2}$ ;  $[\text{NiCl}_2(\text{PPh}_3)_2]$ ;  $[\text{NiCl}_4]^{-2}$ ;  $[\text{NiF}_6]^{-2}$ ;  $[\text{Ni}(\text{H}_2\text{O})_6]^{+2}$ ;  $[\text{Ni}(\text{en})_3]^{+2}$ ;  $[\text{NiF}_6]^{-4}$ ;  $[\text{Ni}(\text{CN})_4]^{-2}$ ;  $[\text{PdCl}_4]^{-2}$ .
3. The graph of compressibility factor ( $Z$ ) vs  $P$  for one mole of a real gas is plotted at constant temperature 273 K. If the slope of graph at very high pressure  $\left(\frac{dZ}{dp}\right)$  is  $\frac{1}{10} \text{ atm}^{-1}$ , the volume of one molecule of real gas in  $\text{cm}^3$  is  $x \times 10^{-22}$ . Find 'x'. [Take  $N_A = 6 \times 10^{23}$ ].

**Space for Rough Work**

4. (a) Oxidation state of Zr in the compound formed by it in Van arkel process is  $k$   
 (b) Bond order of gas used in Mond's process is  $l$   
 (c) Number of ions formed on dissolution of a complex formed after reduction in MacArthur forrest process of extracting silver is  $m$ .

Report your answer as  $(k \times l \times m)$

5. Number of compounds which can be oxidised by Tollen's reagent.



6. Solution of  $\text{HNO}_3$  in pure  $\text{H}_2\text{SO}_4$  can be used for nitration of benzene. One such solution was made by adding 63 gm  $\text{HNO}_3$  in 9800 gm  $\text{H}_2\text{SO}_4$ . What should be the approx. molality of all particles in this solution if 30%  $\text{HNO}_3$  is dissociated ?

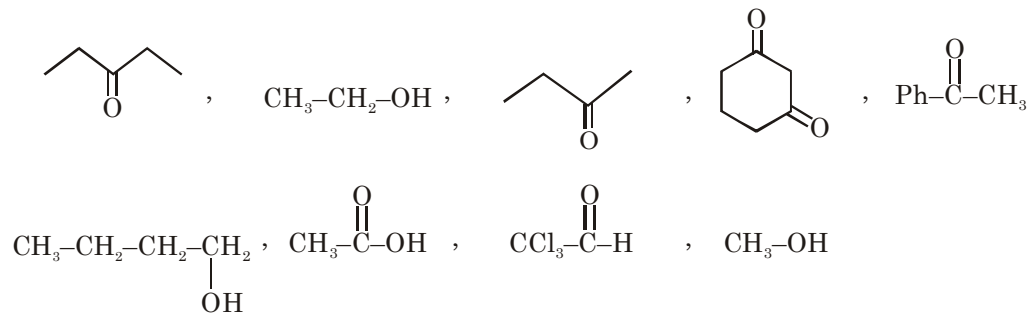
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**Space for Rough Work**

7. Amongst the following, the total number of compounds soluble in concentrated  $\text{NH}_3$  solution is

- (A)  $\text{Ag}_2\text{CrO}_4$       (B)  $\text{Cu}(\text{OH})_2 \cdot \text{CuSO}_4$       (C)  $\text{PbSO}_3$       (D)  $\text{Al}(\text{OH})_3$   
 (E)  $\text{Ni}(\text{OH})_2$       (F)  $\text{Zn}_3(\text{PO}_4)_2$       (G)  $\text{BaSO}_4$       (H)  $\text{Bi}(\text{OH})_2\text{NO}_3$   
 (I)  $\text{Mn}(\text{OH})_2$

8. How many compounds gives chloroform with  $\text{Cl}_2, \text{NaOH}$ ?




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**Space for Rough Work**



## PART-3 : MATHEMATICS

## SECTION-I(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.

- 
1. Let E-ABCD be a pyramid on square base ABCD where A is the origin and B and D are lying on positive x-axis and y-axis respectively. If E is (0, 2, 3) and  $\overline{DE} \cdot (\hat{i} + \hat{j}) = \vec{0}$ , then

(A) image of the point D in the plane ABE is  $\left(0, \frac{-10}{13}, \frac{24}{13}\right)$

(B) image of the point D in the plane ABE is  $\left(0, \frac{-6}{13}, \frac{30}{13}\right)$

(C) volume of the tetrahedron ABDE is 2 cubic units.

(D) perpendicular distance of the point D from the plane ABE is  $\frac{9}{\sqrt{13}}$

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Space for Rough Work

2. Let  $z_1, z_2, z_3 \in \mathbb{C}$  and satisfying  $z_1 \bar{z}_1 + (2 + 3i) \bar{z}_1 + (2 - 3i)z_1 = 3 = z_2 \bar{z}_2 + (2 + 3i) \bar{z}_2 + (2 - 3i)z_2$  and  $z_3 = 4 + 6i$ . If  $\arg(z_3 - z_1) = \arg(z_3 - z_2)$  then
- (A)  $|z_3 - z_1| |z_3 - z_2| = 101$   
 (B)  $|z_3 - z_1| |z_3 - z_2| = 117$   
 (C) If  $|z_1 - z_2|$  is maximum then  $|z_1 z_2| = 3$   
 (D) If  $|z_1 - z_2|$  is maximum then  $|z_1| + |z_2| = 8$
3. Let A be a non singular square matrix of order 3 such that  $\text{Tr.}(A^{-1}) = 3$  and  $\det(A^{-1}) = \frac{1}{5}$ .  
 If  $(A^{-1}BA) = 2(\text{adj } A)$  then  
 (A)  $\det(B) = 5000$       (B)  $\det(B) = 200$       (C)  $\text{Tr.}(B) = 30$       (D)  $\text{Tr.}(B) = 15$   
 [Note :  $\text{Tr.}(P)$  and  $\text{adj } P$  denote trace of square matrix P and adjoint matrix of square matrix P respectively.]
4. Two tangents  $2x + y = 2$  and  $x - 2y = 3$  to a parabola touching it at A(2, -2) and B(5, 1) respectively. If focus of parabola is S( $\alpha, \beta$ ) and latus rectum length is L then ( $\alpha, \beta \in \mathbb{R}$ )
- (A)  $\alpha - \beta = 3$       (B)  $\alpha - \beta = 4$       (C)  $L = \frac{27\sqrt{3}}{25}$       (D)  $L = \frac{27\sqrt{2}}{25}$

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**Space for Rough Work**

5. If  $I_1 = \frac{\int_0^{\pi/4} \left(x - \frac{\pi}{4}\right)^{50} \cdot \sec^2 x \, dx}{\int_0^{\pi/4} \left(x - \frac{\pi}{4}\right)^{49} \cdot \tan x \, dx}$

$I_2 = \frac{1}{100} \int_0^{\pi/4} \left(x - \frac{\pi}{4}\right)^{100} \cdot \sec^2 x \, dx - \int_0^{\pi/4} x^{99} \cdot \left(\frac{1 - \tan x}{1 + \tan x}\right) dx$  then

- (A)  $I_1 < I_2$                       (B)  $I_1 > I_2$                       (C)  $I_1 \cdot I_2 \geq 0$                       (D)  $I_1 \cdot I_2 < 0$

6. In a triangle ABC, which of the following is/are true ?

(A)  $\frac{\cos A}{a} = \frac{\cos B}{b} = \frac{\cos C}{c}$                       (B)  $\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c} = \frac{a^2 + b^2 + c^2}{2abc}$

(C)  $\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} = \frac{1}{r}$                       (D)  $\frac{\sin 2A}{a^2} = \frac{\sin 2B}{b^2} = \frac{\sin 2C}{c^2}$

(where symbols have their usual meaning in a triangle)

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**Space for Rough Work**

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

- This section contains **FOUR** questions.
- **Each question has matching lists.** The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**
- For each question, marks will be awarded in one of the following categories :  
*Full Marks* : +3 If only the bubble corresponding to the correct option is darkened.  
*Zero Marks* : 0 If none of the bubbles is darkened.  
*Negative Marks* : -1 In all other cases

7. **Answer the following by appropriately matching the lists based on the information given in the list.**

$$\text{Let } g(x) = \begin{cases} \frac{\pi}{2} - 2 \tan^{-1}(f(x)), & f(x) \in (-1, 1) \\ -\frac{\pi}{2} - 2 \tan^{-1}(f(x)), & f(x) \in (-\infty, -1) \\ \frac{3\pi}{2} - 2 \tan^{-1}(f(x)), & f(x) \in (1, \infty) \end{cases}, \text{ where } f(x) = \begin{cases} x + 1, & x \leq 0 \\ 1 - x^2, & 0 < x < 2. \\ x - 5, & x \geq 2 \end{cases}$$

**List-I**

**List-II**

- |  |     |    |
|--|-----|----|
| (P) Values of 'x' for which derivative of g(x) w.r.t. f(x) is $-\frac{1}{13}$ is / are | (1) | -6 |
| (Q) Values of 'x' for which f(x) has local maximum or local minimum                    | (2) | 1  |
| (R) Values of 'k' for which f(x) + k = 0 has 2 positive and one negative root is/are   | (3) | 2  |
| (S) Values of 'x' for which g'(x) < 0 is / are   | (4) | 10 |

Correctly match among the following is :

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

**Space for Rough Work**

8. Answer the following by appropriately matching the lists based on the information given in the list.

List-I	List-II
(P) The curve $y = f(x)$ satisfies $\frac{d^2y}{dx^2} = 6x - 4$ and $f(x)$ has a local minimum value 5 when $x = 1$ . Then $f(0)$ is equal to	(1) 1
(Q) The tangent to $y = ax^2 + bx + \frac{7}{2}$ at $(1, 2)$ is parallel to the normal at $(-2, 2)$ on the curve $y = x^2 + 6x + 8$ . Then the value of $\frac{a}{2} - b$ is	(2) 2
(R) Let A be the point where the curve $5\alpha^2x^3 + 10\alpha x^2 + x + 2y - 4 = 0$ ( $\alpha \in \mathbb{R}, \alpha \neq 0$ ) meets the y-axis, then the equation of tangent to the curve at the point where the normal at A meets the curve again is $y = ax + b$ , then the value of $a + b$ is	(3) 3
(S) If $f(x) = \frac{px}{e^x} - \frac{x^2}{2} + x$ is a decreasing function for every $x \leq 0$ . Then the least value of $p^2$ is	(4) 4
	(5) 5

Correctly match among the following is :

- |  |  |
|--|--|
| (A) $P \rightarrow 5, Q \rightarrow 3, R \rightarrow 4, S \rightarrow 2$ | (B) $P \rightarrow 5, Q \rightarrow 2, R \rightarrow 4, S \rightarrow 1$ |
| (C) $P \rightarrow 5, Q \rightarrow 3, R \rightarrow 4, S \rightarrow 1$ | (D) $P \rightarrow 4, Q \rightarrow 3, R \rightarrow 2, S \rightarrow 2$ |

Space for Rough Work

**ALLEN**

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

- | <b>List-I</b>  | <b>List-II</b> |
|--|----------------|
| (P) If $f(x) = \text{sgn}(\sin^2 x - \sin x - 1)$ has exactly 4 points of discontinuity for $x \in (0, n\pi)$ $n \in \mathbb{N}$ then $n$ can be   | (1) 0          |
| (Q) Let $f(x) = x^2 - x + k - 2$ and $g(x) = x^2 - x + 1$ . If the complete set of values of $k$ for which $y = \left[ \frac{f(x)}{g(x)} \right]$ (where $[.]$ denotes greatest integer function) is continuous $\forall x \in \mathbb{R}$ is $[a, b)$ then $\left( b - \frac{5a}{4} \right)$ equals | (2) 4          |
| (R) Let $f(x) = \begin{cases} \cos^{-1} x, & \frac{1}{2} \leq  x  \leq 1 \\ \frac{2 x }{3} + \frac{\pi}{3} - \frac{1}{3}, &  x  < \frac{1}{2} \end{cases}$ . Then the number of real points in the domain of $f(x)$ where it is non-differentiable is  | (3) 5          |
| (S) Number of points where $f(x) = \begin{cases} \max( x^2 - x - 2 , x^2 - 3x), & x \geq 0 \\ \max(\ln(-x), e^x), & x < 0 \end{cases}$ is non-differentiable is  | (4) 3          |
|  | (5) 2          |

Correctly match among the following is :

- |                                  |                                  |
|----------------------------------|----------------------------------|
| (A) P → 2,3; Q → 1; R → 3; S → 4 | (B) P → 2,3; Q → 1; R → 2; S → 4 |
| (C) P → 2,4; Q → 5; R → 2; S → 5 | (D) P → 2,4; Q → 5; R → 3; S → 5 |

**Space for Rough Work**

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

$$\text{Let } f(x) = \lim_{t \rightarrow \infty} \frac{(a + \sin \pi x)^t - 1}{(a + \sin \pi x)^t + 1}, x \in (0, 6), \text{ then}$$

**List-I**

- (P) If  $a = 1$ , then
- (Q) If  $a = 3$ , then
- (R) If  $a = 0.5$ , then
- (S) If  $a = 0$ , then

**List-II**

- (1)  $f(x)$  has no point of discontinuity
- (2)  $f(x)$  has 5 points of discontinuity
- (3)  $f(x)$  has infinite points of discontinuity
- (4)  $f(x)$  has 6 points of discontinuity
- (5)  $f(x)$  has 3 points of discontinuity

Correctly match among the following is :

- (A) P  $\rightarrow$  2; Q  $\rightarrow$  1; R  $\rightarrow$  4; S  $\rightarrow$  4
- (B) P  $\rightarrow$  4; Q  $\rightarrow$  1; R  $\rightarrow$  4; S  $\rightarrow$  3
- (C) P  $\rightarrow$  5; Q  $\rightarrow$  4; R  $\rightarrow$  5; S  $\rightarrow$  2
- (D) P  $\rightarrow$  2; Q  $\rightarrow$  4; R  $\rightarrow$  5; S  $\rightarrow$  4

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**Space for Rough Work**

**SECTION-II : (Maximum Marks: 24)**

- This section contains **EIGHT** 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 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 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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- 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. Let  $a_1, a_2, a_3, \dots$  be a sequence of positive integers in arithmetic progression with common difference 2. Also, let  $b_1, b_2, b_3, \dots$  be a sequence of positive integers in geometric progression with common ratio 2. If  $a_1 = b_1 = c$ , then the number of all possible values of  $c$ , for which the equality

$$2(a_1 + a_2 + \dots + a_n) = b_1 + b_2 + \dots + b_n$$

holds for some positive integer  $n$ , is \_\_\_\_\_

2. Consider the two circles  $C_1 : x^2 + y^2 + 4x + 4y - 1 = 0$   
 $C_2 : x^2 + y^2 + 6x + 2y - 7 = 0$

and the two lines  $L_1 : x + 2y + 3 = 0$   
 $L_2 : 2x + 3y + \lambda = 0$

If  $L_1$  intersects  $C_1$  at A and B and  $L_2$  intersects  $C_2$  at C and D, the value of  $\lambda$  so that A, B, C, D are concyclic is

**Space for Rough Work**



3. Consider the differential equation  $\sin y \, dy = 2 \cos x \cdot \cos y \, dx - \sin^2 x \cdot \cos x \, dx$  where  $y|_{x=0} = 0$ . If the solution of the differential equation is expressed in the form  $\cos y = A \sin^2 x + B \sin x + C + D e^{-2 \sin x}$  where A, B, C, D are constants. Find  $(A + B + C + D)$ .
4. A box contains  $n$  coins of which atleast one is biased. Let  $E_k$  denote the event that exactly  $k$  out of the  $n$  coins are biased. Also Let  $P(E_k)$  be directly proportional to  $k(k + 1)$  for  $1 \leq k \leq n$ . If a coin selected at random is found to be biased, then the probability that it is the only biased coin in the box is  $F(n)$ . Find  $\lim_{k \rightarrow \infty} \sum_{r=1}^k F(r) \cdot (3r + 1)$ .
5. Let  $a_1, a_2, a_3, \dots, a_9$  be in H.P. where  $a_4 = 5$  and  $a_5 = 4$ .

$$\text{If } D = \begin{vmatrix} a_1 & a_2 & a_3 \\ 5 & 4 & a_6 \\ a_7 & a_8 & a_9 \end{vmatrix} \text{ and } A = \begin{bmatrix} 1 & 1/2 & 1/3 \\ 1/4 & 1/5 & 1/6 \\ 1/7 & 1/8 & 1/9 \end{bmatrix} \text{ then } \frac{D}{1000|A|} \text{ is equal to}$$

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**Space for Rough Work**

6. Let matrix  $A = \begin{vmatrix} x & y & -z \\ 1 & 2 & 3 \\ 1 & 1 & 2 \end{vmatrix}$ , where  $x, y, z \in \mathbb{N}$ . If  $|\text{adj}(\text{adj}(\text{adj}(\text{adj} A)))| = 4^8 \cdot 5^{16}$ , then the value of

$(x + y + z)$  equals

7. If  $a_1, a_2, a_3, \dots, a_n$  be in A.P. Let  $(1 + \sin 2\theta)$  is the A.M. of  $a_1, a_n$ . Let  $(1 - \tan \theta)$  is the A.M. of  $\frac{1}{a_1 a_n}, \frac{1}{a_2 a_{n-1}}, \dots, \frac{1}{a_n a_1}$ . Let  $(1 + \tan \theta)$  is the A.M. of  $\frac{1}{a_1}, \frac{1}{a_2}, \frac{1}{a_3}, \dots, \frac{1}{a_n}$ . Then the sum of values of  $\theta \in (0, 2\pi]$  is  $k\pi$ . Find  $k$ .

8. Let  $t_{100} = \sum_{r=0}^{100} \frac{1}{\binom{100}{r}^5}$  and  $S_{100} = \sum_{r=0}^{100} \frac{r}{\binom{100}{r}^5}$ , then the value of  $\frac{S_{100}}{5t_{100}}$  equals

**Space for Rough Work**

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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)	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
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)	8	+3 If only the bubble corresponding to correct answer is darkened	—	0 In all other cases	—	24

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