



# CLASSROOM CONTACT PROGRAMME

JEE(Advanced)  
FULL SYLLABUS

## SAMPLE PAPER-4

### PAPER-1

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 **32** 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

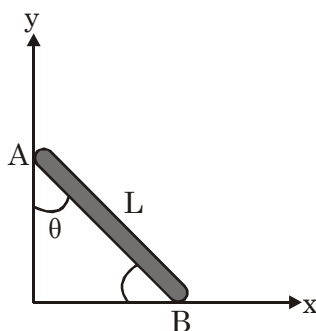
BEWARE OF NEGATIVE MARKING

## PART-1 : PHYSICS

## SECTION-I(i) : (Maximum Marks : 12)

- This section contains **FOUR** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option 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 option is darkened.  
*Zero Marks* : 0 If none of the bubbles is darkened.  
*Negative Marks* : -1 In all other cases

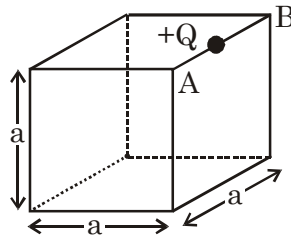
1. A rod AB of length L slides in the xy-plane. If an instant angle  $\theta$  with the vertical, the angular velocity of the rod will be at that instant :



- (A) Dependent upon the length of the rod, the angle  $\theta$  and also on the linear velocity of the end of A of the rod at that instant.
- (B) Independent of the length of the rod but will depend on the angle  $\theta$ .
- (C) Independent of  $\theta$  but will depend on the length of the rod and linear velocity of the end A at that instant.
- (D) Directly proportional to the length of the rod and the linear velocity of the end A at that instant.

Space for Rough Work

2. In two experiments with a continuous flow calorimeter to determine the specific heat capacity of a liquid, an input power of 30 W produces a rise of 10 K in the liquid. When the power was tripled, the same temperature rise was achieved by making the rate of flow of liquid four times faster. The power lost to the surrounding in each case is :  
 (A) 20 W                      (B) 30 W                      (C) 40 W                      (D) 10 W
3. +Q charge is placed at midpoint of AB as shown in figure. Then electric flux through cube due to +Q charge is :



- (A)  $\frac{+Q}{\epsilon_0}$                       (B)  $\frac{+Q}{2\epsilon_0}$                       (C)  $\frac{+Q}{4\epsilon_0}$                       (D)  $\frac{+Q}{8\epsilon_0}$
4. In a double slit experiment, instead of taking slits of equal widths, one slit is made twice as wide as the other. Then in the interference pattern  
 (A) the intensities of both the maxima and the minima increases.  
 (B) the intensity of both the maxima and minima decreases.  
 (C) the intensity of maxima decreases and that of the minima increases.  
 (D) the intensity of maxima increases and that of the minima decreases.

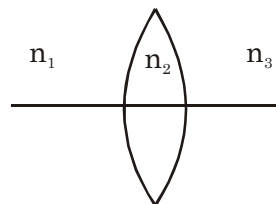
---

**Space for Rough Work**

## SECTION-I(ii) : (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.

5. An equiconvex lens of refractive index  $n_2$  is placed such that the refractive index of the surrounding media is as shown. Then the lens :-

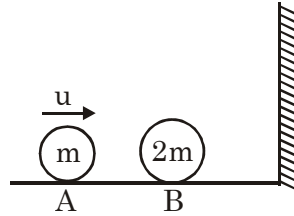


- (A) must be diverging if  $n_2$  is more than the arithmetic mean of  $n_1$  and  $n_3$ .
- (B) must be converging if  $n_2$  is greater than the arithmetic mean of  $n_1$  and  $n_3$ .
- (C) must be diverging if  $n_2$  is less than the arithmetic mean of  $n_1$  and  $n_3$ .
- (D) will neither be diverging nor converging if  $n_2$  is equal to arithmetic mean of  $n_1$  and  $n_3$ .

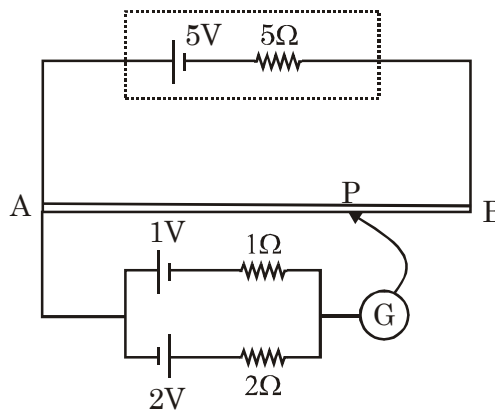
---

**Space for Rough Work**

6. The two balls A and B as shown in figure are of masses  $m$  and  $2m$ , respectively. Ball A moves with velocity  $u$  toward right while B is at rest. The wall at extreme right is fixed. Coefficient of restitution for collision between two balls is  $\frac{1}{2}$  and between ball and wall is 1. Then speed of A and B after all possible collisions are :-



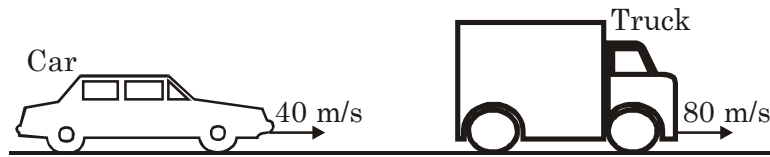
- (A)  $v_A = \frac{u}{2}$       (B)  $v_A = \frac{u}{4}$       (C)  $v_B = \frac{u}{8}$       (D)  $v_B = \frac{u}{4}$
7. A battery of emf  $E_0 = 5V$  and internal resistance  $5\Omega$  is connected across a long uniform wire AB of length 1 m and resistance per unit length  $5\Omega \text{ m}^{-1}$ . Two cells of  $E_1 = 1V$  and  $E_2 = 2V$  are connected as shown in figure.



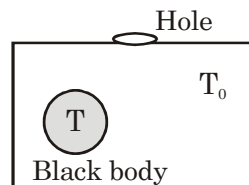
- (A) The null point is between A and B.  
 (B) If jockey is touched to point B, the current in the galvanometer will be going towards B.  
 (C) When jockey is connected to point A, no current is flowing through 1 V battery.  
 (D) The null point is point A.

**Space for Rough Work**

8. A car is chasing truck as shown in figure. If car sounds horn, then choose the **CORRECT** options.



- (A) Apparent frequency of sound for truck driver is more than actual frequency of sound.  
 (B) Apparent wavelength of sound for truck driver is more than actual wavelength of sound.  
 (C) Apparent wavelength of sound for truck driver is less than actual wavelength of sound.  
 (D) Speed of sound observed by truck driver is lesser than actual speed of sound in still air.
9. A black body of temperature  $T$  is inside the chamber of temperature  $T_0$  initially. Sun rays are allowed to fall from a hole from the top of chamber. If the temperature of black body ( $T$ ) and chamber ( $T_0$ ) remains constant, then :-

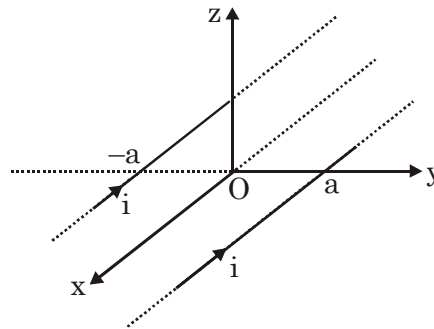


- (A) Black body will absorb more radiation than before sun rays fall on it.  
 (B) Black body will absorb less radiation than before sun rays fall on it.  
 (C) Black body emits more energy than energy absorbed by it after sun rays fall on it.  
 (D) Black body emits energy equal to energy absorbed by it after sun rays fall on it.

---

**Space for Rough Work**

10. Two long thin, parallel conductors carrying equal currents in the same direction are fixed parallel to the x-axis, one passing through  $y = a$  and the other through  $y = -a$ . The resultant magnetic field due to the two conductors at any point is  $B$ . Which of the following are **CORRECT**?



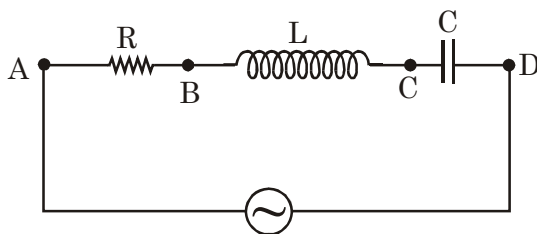
- (A)  $B = 0$  for all points on the x-axis.
- (B) At all points on the y-axis, excluding the origin,  $B$  has only a z-component.
- (C) At all points on the z-axis, excluding the origin,  $B$  has only a y-component.
- (D)  $B$  cannot have an x-component at any point in space.

---

**Space for Rough Work**



11. When a hydrogen atom is excited from ground state to first excited state then
- (A) Its kinetic energy increases by 10.2 eV.
  - (B) Its kinetic energy decreases by 10.2 eV.
  - (C) Its potential energy increases by 20.4 eV.
  - (D) Its angular momentum decreases by  $1.05 \times 10^{-34}$  J-s.
12. An alternating voltage source is applied to series RLC circuit as shown in the figure. Which of the following(s) is/are possible for the circuit at some instant of time?



- (A) Voltage across AD is zero and current through it is non-zero.
- (B) Voltage across AD is zero and current through it is also zero.
- (C) Voltage across AC is zero and current through it is non-zero.
- (D) Voltage across BD is zero and current through it is non-zero.

---

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.

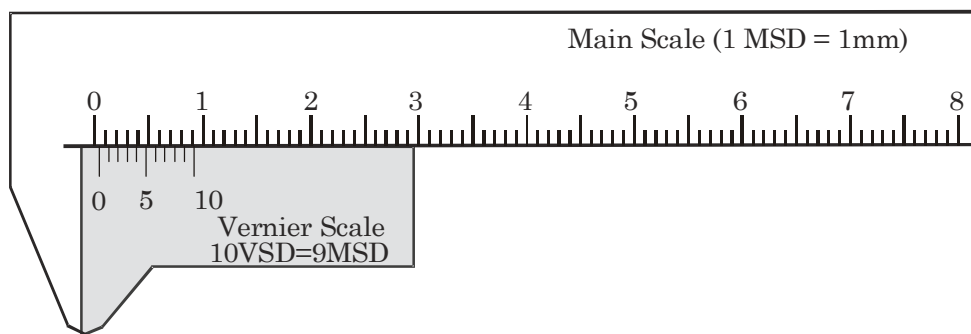
**For Example :** If answer is -77.25, 5.2 then fill the bubbles as follows.

+	●				
●	●	○	○	○	○
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.

- The jaws of the Vernier callipers shown in figure are in contact with each other. Then the zero error (in mm) of this Vernier callipers is :

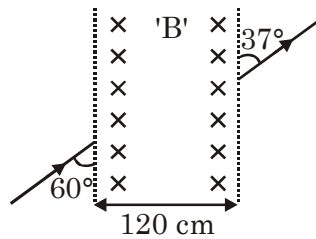


Space for Rough Work

2. The minimum and maximum distances of a satellite from the centre of the earth are  $2R$  and  $4R$  respectively, where  $R$  is the radius of earth and  $M$  is the mass of the earth. The minimum

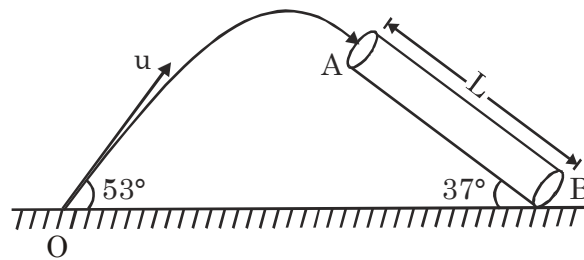
speed of the satellite is  $\sqrt{\frac{4GM}{xR}}$  then value of  $x$  is :-

3. A nucleus with mass number 224 initially at rest emits an  $\alpha$  particle. If the  $Q$  value of the reaction is 8 MeV and only one photon of energy 2.00 MeV is subsequently emitted after the emission of the  $\alpha$  particle, the kinetic energy (in MeV) of the  $\alpha$  particle is :
4. A positive charge particle enters and comes out from a uniform magnetic field which exists with direction inside the paper in a finite space of width 120 cm as shown in the figure. Find the radius of the circular path of charge particle (in meter) when it is inside the magnetic field.



**Space for Rough Work**

5. The ratio of translational and rotational kinetic energies for 1 mole gas at 200 K temperature is 3 : 2. The internal energy of one mole gas at that temperature is  $x \times 10^2$  J. Then value of x is [R = 8.3 J/mol · K]
6. In the given figure AB is a pipe fixed to the ground at an inclination of  $37^\circ$ . A ball is projected from point O at a speed of  $u = 20$  m/s at angle of  $53^\circ$  to the horizontal and it smoothly enter the pipe with its velocity parallel to the axis of the pipe. Then length of pipe (in metre) is : [Take  $g = 10 \text{ ms}^{-2}$ ]




---

**Space for Rough Work**

## PART-2 : CHEMISTRY

## SECTION-I(i) : (Maximum Marks : 12)

- This section contains **FOUR** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option 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 option is darkened.  
*Zero Marks* : 0 If none of the bubbles is darkened.  
*Negative Marks* : -1 In all other cases

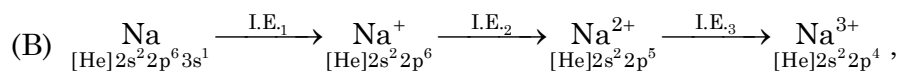
- 
1. During the electrolysis of 0.1 M  $\text{CuSO}_4$  solution using copper electrodes, a depletion of  $[\text{Cu}^{++}]$  occurs near the cathode with a corresponding excess near the anode, owing to inefficient stirring of the solution. If the local concentrations of  $[\text{Cu}^{++}]$  near the anode and cathode are respectively 0.12 M and 0.08 M, calculate the back e.m.f. developed. Temperature = 298 K  
[ $\log 2 = 0.301$ ,  $\log 3 = 0.477$ ]
- (A) 22 mV                      (B) 5.2 mV                      (C) 29 mV                      (D) 59 mV
2. Incorrect statement out of the following is :
- (A) Beilstein Test is used as qualitative test for Organic halides
- (B) Xanthoproteic test is used to detect presence of amino acid carrying aromatic groups (Benzene ring)
- (C) Barfoed Test is used to detect the presence of Monosaccharides.
- (D)  $\text{NaHSO}_3$  is used to identify  $\text{C}_2\text{H}_5 - \overset{\text{O}}{\parallel}{\text{C}} - \text{C}_2\text{H}_5$ .

---

Space for Rough Work

3. Select the **CORRECT** statement(s) / order(s) :

(A) A d-orbital can accommodate 10 electrons



order of successive I.E. is  $\text{I.E.}_1 < \text{I.E.}_2 > \text{I.E.}_3$

(C) Number of unpaired electrons in  $\text{Co}^{2+}$  cation > Number of unpaired electrons in  $\text{Co}^{3+}$  cation

(D) First ionisation energy of Zn is greater than that of Cu

4. The **INCORRECT** order is :

(A) Covalent character :  $\text{MgCl}_2 > \text{CaCl}_2 > \text{SrCl}_2 > \text{BaCl}_2$

(B) Thermal stability :  $\text{PbF}_4 > \text{PbCl}_4 > \text{PbBr}_4 > \text{PbI}_4$

(C) Melting point :  $\text{KF} > \text{KCl} > \text{KBr} > \text{KI}$

(D) Boiling point :  $\text{He} > \text{Ne} > \text{Ar} > \text{Kr} > \text{Xe}$

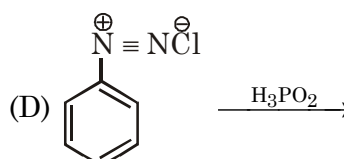
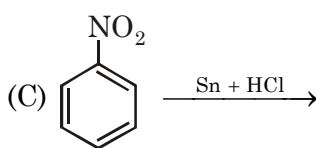
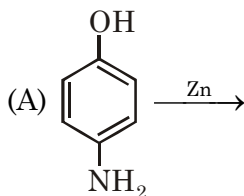
---

**Space for Rough Work**

## SECTION-I(ii) : (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.

5. Which of the following reactions will produce benzene?



Space for Rough Work

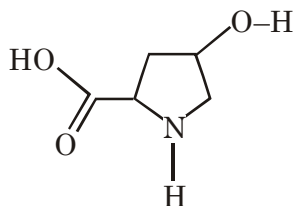
6. Incorrectly match options out of the following is/are.

**List-I**

(A) Maltose

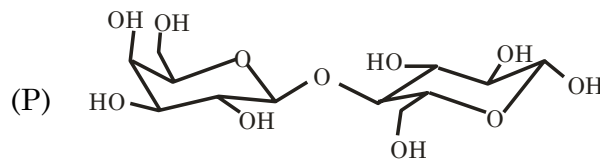
(B) Amylopectin

(C) 4 Hydroxy proline



(D) Thymine (Nitrogenous Base)

**List-II**



(Q) Presence of  $\beta$ -1,4-glycosidic and 1,6-glycosidic linkage

(R) Will give -ve test with  $\text{NaNO}_2 + \text{HCl}$

(S) Presence of imidazole ring

7. A reaction can take place by two paths.  $k_1$  and  $k_2$  are rate constants for the two paths and  $E_1$  and  $E_2$  are their respective activation energies.

At temperature  $T_a$  :  $k_1 > k_2$ ,  $E_1 < E_2$ .

if temperature is raised to  $T_b$ , the rate constants change to  $k'_1$  and  $k'_2$ . Which relation is not correct between  $k_1$  and  $k_2$ ,  $k'_1$  and  $k'_2$  (considering activation energy does not change with temperature).

(A)  $\frac{k'_1}{k_1} > \frac{k'_2}{k_2}$

(B)  $\frac{k'_1}{k_1} = \frac{k'_2}{k_2}$

(C)  $\frac{k'_1}{k_1} < \frac{k'_2}{k_2}$

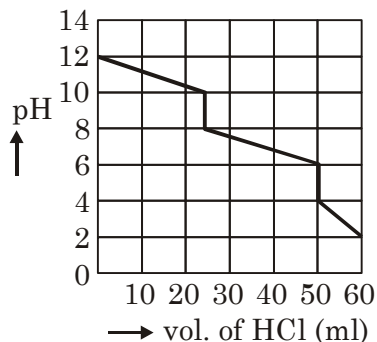
(D)  $\frac{k'_1}{k'_2} > \frac{k_1}{k_2}$

**Space for Rough Work**



8. The variation of pH during the titration of 0.5 N Na<sub>2</sub>CO<sub>3</sub> with 0.5 N HCl is shown in the given graph. The following table indicates the colour and pH (ranges of different indicators):

Indicator	Range of Colour change	Colour in acid	Colour in base
Thymol blue	1.2 to 2.8	Red	Yellow
Bromocresol red	4.2 to 6.3	Red	Yellow
Bromothymol blue	6.0 to 7.6	Yellow	Blue
Cresolphthalein	8.2 to 9.8	Colourless	Red

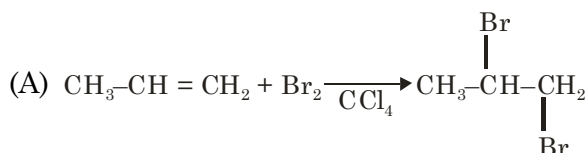


Based on the graph and the table, which of the following statements are true ?

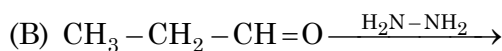
- (A) The first equivalence point can be detected by cresolphthalein.
  - (B) The complete neutralisation can be detected by bromothymol blue.
  - (C) The second equivalence point can be detected by bromocresol red.
  - (D) The volume of HCl required for the first equivalence point is half the volume of HCl required to reach upto second equivalence point
9. Xenon tetrafluoride, XeF<sub>4</sub> is/are :
- (A) tetrahedral and act as a fluoride donor with SbF<sub>5</sub>
  - (B) square planar and acts as a fluoride donor with PF<sub>5</sub>
  - (C) square planar and acts as fluoride donor with NaF
  - (D) see-saw shape and acts as a fluoride donor with AsF<sub>5</sub>

**Space for Rough Work**

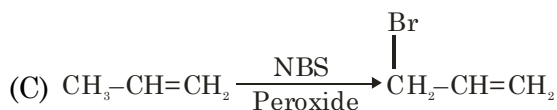
10. Which of the following statements are **CORRECT**?
- (A) S-S bond is present in  $H_2S_2O_6$
  - (B) In peroxomonosulphuric acid ( $H_2SO_5$ ) sulphur is in +6 oxidation state
  - (C) Iron powder along with  $Al_2O_3$  and  $K_2O$  is used as a catalyst in the preparation of  $NH_3$  by Haber's process
  - (D) Changes in enthalpy is positive for the preparation of  $SO_3$  by catalytic oxidation of  $SO_2$
11. Which of the following orders are **CORRECT** ?
- (A)  $TiH_2 < BeH_2 < CaH_2$  - Electrical conductance
  - (B)  $LiH < NaH < KH$  - Ionic character
  - (C)  $F-F < H-H < D-D$  - Bond dissociation enthalpy
  - (D)  $H_2O < MgH_2 < NaH$  - Reducing character
12. Correctly matched with their products out of the following is/are.



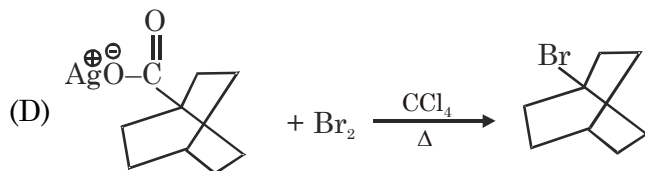
(Ionic addition involving cyclo bromonium ion intermediate)



Nucleophilic addition to  $C=O$  system



(Free Radical Allylic substitution)



**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.

+	●				
●	●	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* : +3 If **ONLY** the correct numerical value is entered as answer.  
*Zero Marks* : 0 In all other cases.

1. Calculate the pH at which the following conversion (reaction) will be at equilibrium in basic medium  $I_2(s) \rightleftharpoons I^-(aq) + IO_3^-(aq)$  when the equilibrium concentration at 300 K are  $(I^-) = 0.10$  M and  $[IO_3^-] = 0.10$  M.

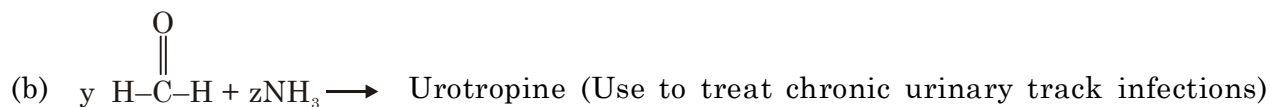
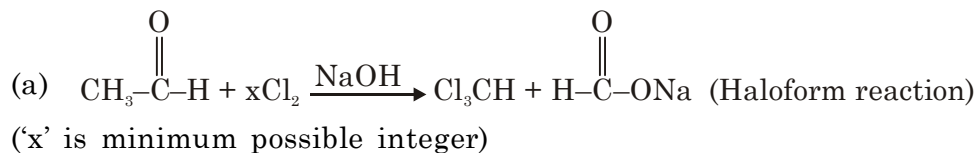
{Given that  $\Delta G_f^0(I^-, aq) = -50$  kJ/mole,  $\Delta G_f^0(IO_3^-, aq) = -123.5$  kJ/mole,  $\Delta G_f^0(H_2O, \ell) = -233$  kJ/mole,

$\Delta G_f^0(OH^-, aq) = -150$  kJ/mol, ideal gas constant =  $R = \frac{25}{3}$  J mole<sup>-1</sup>K<sup>-1</sup>,  $\log_e 10 = 2.3$ }

**Space for Rough Work**

2. How many of the following statements are correct ?
- (1) In CCP distance between two nearest octahedral voids is  $2R$
  - (2) In CCP distance between nearest tetrahedral and octahedral voids is  $2\sqrt{3}R$
  - (3) In CCP distance between two nearest voids is  $\sqrt{2}R$
  - (4) In CCP distance between next nearest tetrahedral void and farthest octahedral voids is  $\sqrt{5}R$
  - (5) In HCP along every edge, centres of two tetrahedral voids and one octahedral void is located
  - (6) In HCP, if a plane is passed parallel to top face but at  $\frac{3h}{4}$ , from bottom it pass through centres of octahedral voids. (h is the height of ionic unit cell)
  - (7) In HCP, top plane pass through centres of both tetrahedral and octahedral voids.

3. From the following reaction.

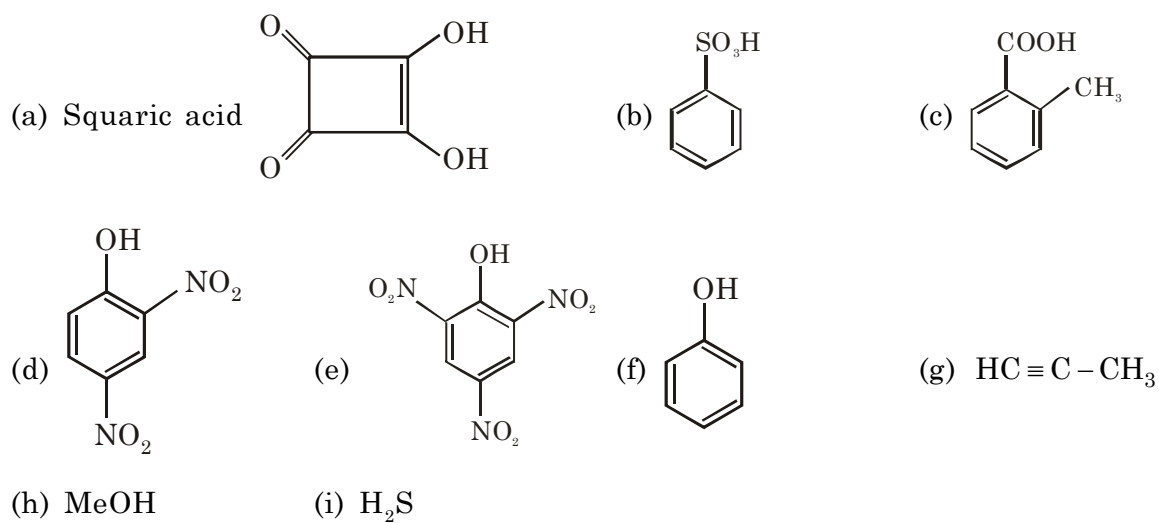


Find out  $\frac{x+y}{z}$ .

---

**Space for Rough Work**

4. How many of the following species/compounds are more acidic than carbonic acid?




---

Space for Rough Work

5. 50 ml of water sample containing temporary hardness only, required 0.1 ml of M/50 HCl for complete neutralisation. Calculate the temporary hardness of water in ppm.
6. If x and y are total number of metal electrons which are present in non-axial and axial set of d-orbitals respectively in Ni cation of  $[\text{Ni}(\text{DMG})_2]$ , then calculate value of  $\frac{x^2 + y^2}{x^2 - y^2}$ .

---

**Space for Rough Work**

## PART-3 : MATHEMATICS

## SECTION-I(i) : (Maximum Marks : 12)

- This section contains **FOUR** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option 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 option is darkened.  
*Zero Marks* : 0 If none of the bubbles is darkened.  
*Negative Marks* : -1 In all other cases

1. A box contains 2 fifty paise coins, 5 twenty-five paise coins and a certain number  $N (\geq 2)$  of ten and five paise coins. Five coins are taken out of the box at random. The probability that the total value of these coins is less than one rupee and fifty paise is

(A)  $\frac{10(N+2)}{(N+7)C_5}$       (B)  $1 - \frac{10(N+2)}{(N+7)C_5}$       (C)  $1 - \frac{5(N+2)}{(N+7)C_5}$       (D) None of these

2. If  $\alpha$  and  $\beta^2$  are the roots  $8x^2 - 10x + 3 = 0$  then the equation whose roots are  $(\alpha + i\beta)^{100}$  and  $(\alpha - i\beta)^{100}$  can be

(A)  $x^2 + x + 1 = 0$       (B)  $x^2 - x + 1 = 0$   
(C)  $x^3 + 1 = 0$       (D)  $2x^2 + x + 1 = 0$

---

**Space for Rough Work**

3. If  $(1 + ax + bx^2)^4 = a_0 + a_1x + a_2x^2 + \dots + a_8x^8$  where  $a, b, a_0, a_1, \dots, a_8 \in \mathbb{R}$  and  $a_0 + a_1 +$

$a_2 \neq 0$  and  $\begin{vmatrix} a_0 & a_1 & a_2 \\ a_1 & a_2 & a_0 \\ a_2 & a_0 & a_1 \end{vmatrix} = 0$  the value of  $5\left(\frac{a}{b}\right)$  is equal to

- (A) 5                                      (B) 6                                      (C) 7                                      (D) 8

4. Let  $g(x) = \int_{1-x}^{1+x} t |f'(t)| dt$ , where  $f(x)$  is not a constant function in any interval  $(a, b)$  and

the graph of  $y = f(x)$  is symmetric about the line  $x = 1$ . Then

- (A)  $g(x)$  is increasing  $\forall x \in \mathbb{R}$
- (B)  $g(x)$  is increasing only if  $x < 1$
- (C)  $g(x)$  is increasing if  $f$  is increasing
- (D)  $g(x)$  is decreasing  $\forall x \in \mathbb{R}$

**Space for Rough Work**





7. If the solution of differential equation  $(3 \tan x + 4 \cot y - 7)\sin^2 y \, dx - (4 \tan x + 7 \cot y - 5)$

$$\cos^2 x \, dy = 0 \text{ is } 3 \frac{\tan^2 x}{2} - a \tan x + 7 \frac{\cot^2 y}{2} - b \cot y + d(\cot y \tan x) = c, \text{ (c is arbitrary constant)}$$

then identify the correct options :

- (A)  $a + b + d = 16$  (B)  $a + b - d = 8$   
 (C)  $a - b + d = 8$  (D)  $a \cdot d = 28$

8. Let the unit vectors **a** and **b** be perpendicular and the unit vector **c** be inclined at an angle  $\theta$  to both **a** and **b**. If  $\mathbf{c} = \alpha \mathbf{a} + \beta \mathbf{b} + \gamma(\mathbf{a} \times \mathbf{b})$ , ( $\alpha, \beta, \gamma$  are scalars) then

- (A)  $\alpha = \beta = \cos \theta$  (B)  $\alpha = \cos \theta, \beta = \sin \theta$   
 (C)  $\gamma^2 = \cos 2\theta$  (D)  $\gamma^2 = -\cos 2\theta$

9. A point is moving on the circle  $(x - 4)^2 + (y - 8)^2 = 20$ , gets broken away from it and moving along a tangent to the circle cuts the x-axis at point  $(-2, 0)$ . The coordinates of the point on the circle at which the moving point broke away can be

- (A)  $\left(\frac{42}{5}, \frac{36}{5}\right)$  (B)  $\left(-\frac{2}{5}, \frac{44}{5}\right)$  (C)  $(6, 4)$  (D)  $(2, 4)$

**Space for Rough Work**





3. Two  $n \times n$  square matrices A and B are said to be equivalent if there exists a non-singular matrix P such that  $P^{-1}BP = A$ . If A and B are equivalent matrices such that  $|A| = |\text{adj}(\text{adj}(Q))|$ ,

where  $Q = \begin{bmatrix} 1 & 1 & 0 \\ -2 & 1 & -1 \\ 1 & 2 & 3 \end{bmatrix}$ , then sum of determinant values of A and B is equal to  $a \times 10^b$  (where

'a' is smallest positive integer) then  $\frac{b}{a}$  is equal to -

4. Let  $f(x) = ax - bx^3$  has four extrema on  $[-1, 1]$  at each of which  $|f(x)| = 1$ , where 'a' and 'b' are the positive integers then the value of  $\frac{a}{b}$  is

---

**Space for Rough Work**

5. Let  $h(x) = (x^2 + x + 1)^{-1}$ . The 36<sup>th</sup> derivative of  $h(x)$  with respect to  $x$  computed at  $x = 0$  is  $k!$ , then number of positive divisors of  $k$  is equal to
6. Area enclosed within the curve  $[y] = 2^{[x]}$ ,  $x \in [0, 9)$  (where  $[ \cdot ]$  denotes the greatest integer function) is equal to
- 

**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)	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
I(ii)	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
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: 0 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: 0 auto;"/> Signature of the Invigilator