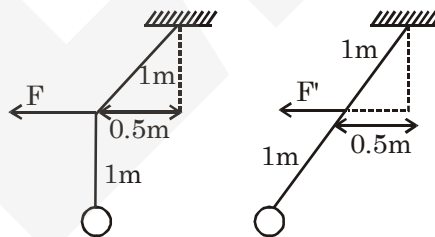


HAVE CONTROL → HAVE PATIENCE → HAVE CONFIDENCE ⇒ 100% SUCCESS

BEWARE OF NEGATIVE MARKING
PART-1 : PHYSICS
SECTION-1 : (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.

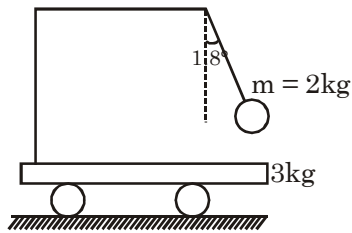
1. A bob of mass 1kg is hanging from an inextensible massless string of length 2m. The string is pulled slowly at the midpoint to the left so that both portions of string are taut. The midpoint is now held at 0.5 m away from the original vertical position by a horizontal force. The same experiment is repeated, but with a hinged massless rod replacing the string :-



- (A) The force required to hold the midpoint is same in both cases.
- (B) The force required to hold the midpoint is larger in second case.
- (C) The tension in the string between the midpoint and the hinge is less than the tension in the rod between the midpoint and the hinge.
- (D) The tension in the string between the midpoint and the bob is more than the tension in the rod between the midpoint and the bob.

Space for Rough Work

2. A simple pendulum of length $\ell = 30$ cm and mass $m = 2$ kg is attached to a cart of mass 3 kg. The cart can move frictionlessly on level ground. The bob is released from rest when string makes an angle of 1.8° with the horizontal :-



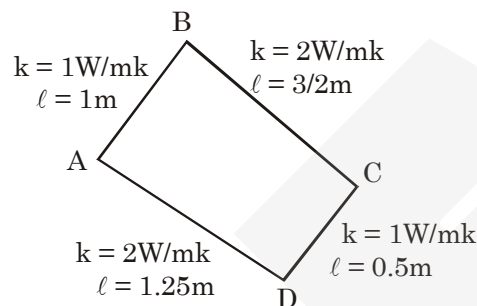
- (A) The amplitude of oscillation of cart is $\frac{\pi}{5}$ cm .
- (B) The time period of oscillation is $\frac{\pi}{5}$ sec
- (C) The cart and bob oscillate with phase difference of π .
- (D) The time period of oscillation is $\frac{\pi\sqrt{3}}{5}$ sec .

Space for Rough Work

3. Consider the potential energy given by

$$U = \frac{x^4}{4} - \frac{x^3}{3} - 3x^2$$

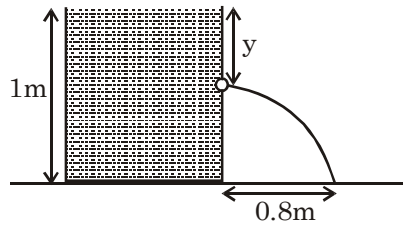
- (A) $x = 0$ is position of stable equilibrium.
 (B) $x = 3$ is position of stable equilibrium.
 (C) If body starts from $x = -2$, it can go to $x = 3$ if its kinetic energy is greater than $\frac{16}{3} \text{ J}$.
 (D) If body starts from $x = -2$, it can go to $x = 3$ even if its initial kinetic energy is zero.
4. Consider 4 well lagged rods as shown. Point A is maintained at 100°C and C at 0°C . All rods have same cross sectional area :-



- (A) Temperature of junction D = $\frac{400}{7}^\circ\text{C}$
 (B) Temperature of junction B = $\frac{300}{7}^\circ\text{C}$.
 (C) Rate of heat flowing through AB is less than heat flowing through AD.
 (D) Rate of heat flowing through AB is more than rate of heat flowing through AD.

Space for Rough Work

5. In a tank filled with water, a small hole is made on the side. The emerging water jet falls to a distance of 0.8 m from the base as shown :-



- (A) As the level falls, the range decreases.
(B) As the level falls, the time of flight for water jet remains the same.
(C) y can be 0.8 m.
(D) y can be 0.2 m.
6. In a standard YDSE setup, the fringe width on the screen is 1.5 mm. When a thin glass film is pasted in front of the upper slit, the fringe pattern shifts up. But it is seen that at a point P above central maxima where intensity was one fourth the intensity at central maxima, intensity remains the same. There were no maxima between central maxima and point P before film was introduced. What can be the thickness of the film ? Take $\mu = 1.5$, $\lambda = 450$ nm :-
(A) 3×10^{-7} m (B) 5×10^{-7} m (C) 9×10^{-7} m (D) 1.4×10^{-6} m

Space for Rough Work

SECTION-2 : (Maximum Marks : 12)

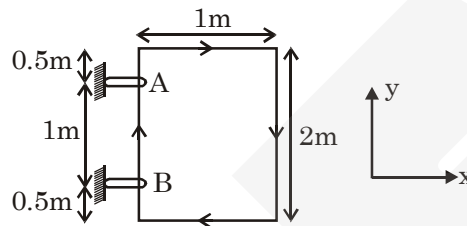
- This section contains **FOUR** questions.
- **Each question has matching lists.** The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**
- For each question, marks will be awarded in one of the following categories :

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

1. A rigid uniform wire frame of mass 1kg has dimension as shown. It is free to rotate about vertical axis supported by two hinges as shown. A current of 1A flows in the frame. A magnetic field \vec{B} is on. Assume that the current in the frame remains unchanged and frame is initially at rest.



List-I

- (P) $\vec{B} = 4\hat{i}$ tesla
 (Q) $\vec{B} = -4\hat{i}$ tesla
 (R) $\vec{B} = 3\hat{j}$ tesla
 (S) $\vec{B} = 6\hat{k}$ tesla.

List-II

- (1) The frame starts rotating in anticlockwise direction as seen from above (along y-axis).
 (2) The frame starts rotating in clockwise direction as seen from above (along y-axis).
 (3) Hinge A exerts a non zero force in +ve z direction.
 (4) Hinge B exerts a non zero force in +ve z direction.
 (5) Hinge A exerts a non zero force in +ve x direction.
 (6) Hinge B exerts a non zero force in +ve x direction.

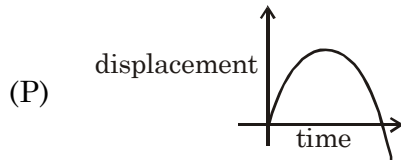
- (A) P → 2,3,4,6; Q → 1,5; R → 4,6; S → 6
 (B) P → 1,3,4; Q → 2,5; R → 2,4,6; S → 1,6
 (C) P → 2,3,4; Q → 1,3,6; R → 1,4,6; S → 2,6
 (D) P → 1,3; Q → 2,5,6; R → 4,6; S → 1,3,5

Space for Rough Work

2. In the list-I, there are certain situations depicted and list-II gives the description of speed and acceleration of particle. Match them. Neglect air resistance and assume uniform gravitational field wherever applicable. Consider time before it hits the ground.

List-I

List-II



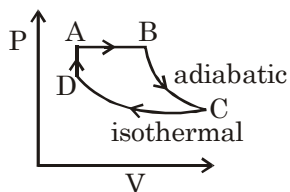
Particle moving in 1 dimension

- (Q) $x = t^2 + 3t$
 (R) A projectile thrown on level ground at an angle to the horizontal
 (S) A ball thrown vertically down from a cliff.
- (A) P → 1,5; Q → 2,6; R → 4; S → 2,5
 (B) P → 2, 5; Q → 3, 6; R → 2; S → 3, 6
 (C) P → 1,5; Q → 4,6; R → 1,6; S → 2,5
 (D) P → 2,6; Q → 2; R → 3,6; S → 3,6

- (1) speed increases & then decreases
 (2) speed decreases & then increases
 (3) speed increases continuously.
 (4) speed decreases continuously
 (5) acceleration is initially opposite to velocity.
 (6) acceleration is initially in the same direction as the velocity

Space for Rough Work

3. The P–V diagram shows a cyclic process on a monoatomic gas.



List-I

- (P) A → B
(Q) B → C
(R) C → D
(S) D → A

List-II

- (1) $\Delta U = +ve$
(2) $\Delta U = -ve$
(3) $W_{\text{by gas}} = +ve$
(4) $W_{\text{by gas}} = -ve$
(5) heat is given to gas
(6) heat is extracted from gas.

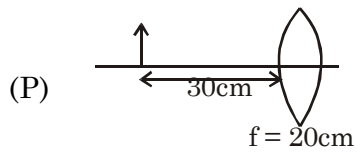
- (A) P → 2,3,5; Q → 2,3; R → 2,5; S → 1,5
(B) P → 1,5; Q → 2; R → 4; S → 1,3
(C) P → 1, 3, 5; Q → 2, 3; R → 4, 6; S → 1, 5
(D) P → 1,3,6; Q → 2,4,5; R → 1,5; S → 4,6

Space for Rough Work

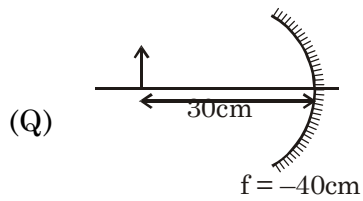
4. Match the list-I with nature of image in list-II

List-I

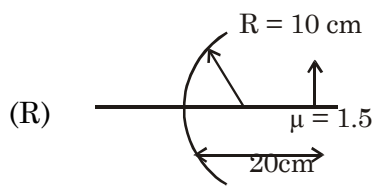
List-II



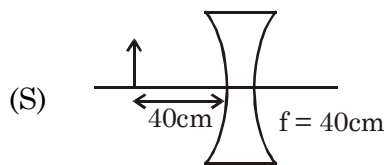
(1) Erect image



(2) Inverted image



(3) magnified image



(4) diminished image

(5) real image

(6) virtual image

(A) P → 2,3,5; Q → 1,4,6; R → 1,3,6; S → 2,3,5

(B) P → 1,4; Q → 2,3,5; R → 1,4,6; S → 1,3,6

(C) P → 1,4,6; Q → 1,3,6; R → 2,3,5; S → 1,4

(D) P → 2,3,5; Q → 1,3,6; R → ;1,3,6; S → 1,4,6

Space for Rough Work

SECTION-3 : (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

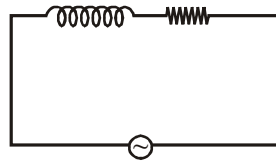
●	-				
●	●	●	○	○	●
①	①	①	①	①	①
②	②	②	②	●	②
③	③	③	③	③	③
④	④	④	④	④	④
⑤	⑤	⑤	●	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨

- 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.

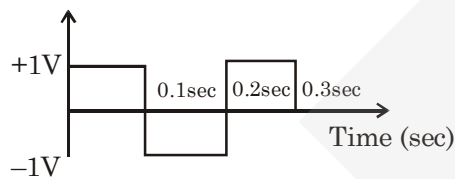
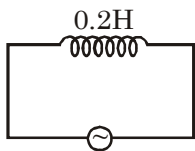
1. What is the force/length between two long parallel current carrying wires carrying current of 186 A and 24 A at a distance of 0.1 mm from each other. Give the answer correct to significant digits (in N/m).
2. A point charge is kept on the axis of a circular non conducting disc. The distance is such that $\frac{1}{4}$ th of the total electric flux coming from the charge passes through the disc. By what distance (in cm) should the charge be moved along the axis so that $\frac{1}{5}$ th of the total electric flux coming from the charge passes through the disc ? The radius of disc is 30 cm.

Space for Rough Work

3. In a series LR circuit connected to an alternating voltage source, it is observed that at the instant voltage across the source is maximum, voltage across the inductor is 3V and voltage across the resistance is 4V. If resistance is 2Ω , what is reactance (in Ω) of the inductor ?



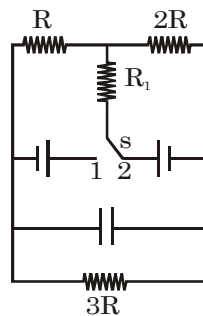
4. The de-broglie wavelength of electrons striking the cathode to produce x rays is equal $\frac{1}{100}$ of minimum wavelength of x ray produced. What is the voltage across x ray tube (in volt).
5. An AC source has voltage given by



The circuit is connected at $t = 0$ sec. The current in the inductor (in ampere) at $t = 0.25$ sec is.

Space for Rough Work

6. When switch is shifted from 1 to 2 current through R_1 remains same in direction but becomes 5 times. The initial charge on capacitor was Q . Final charge on capacitor is Q' . Find $\frac{Q}{Q'}$. (consider only the charge and currents in steady state)



7. A sample of β active nuclei has a half life of 100 min. Initially, there are 10^{13} β active nuclei. Assume that all β particles emitted leave the sample. What is the charge acquired (in μC) by the sample in 200 min?
8. A cube is immersed in kerosene and water at rest without any external force as shown. To keep it completely submerged in water, we need to apply an extra force of 4 N. If it was initially submerged to depth of $\frac{a}{4}$ in kerosene, what is the length 'a' of the side of cube (in cm) ?



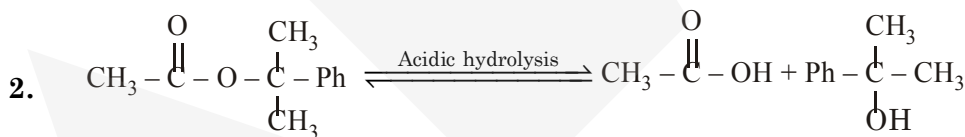
Space for Rough Work

PART-2 : CHEMISTRY
SECTION-1 : (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. Which statement(s) is/are correct -

- (A) If 0.1M CH_3COOH aqueous solution ($K_a = 1.8 \times 10^{-5}$) is diluted at 25°C , then $[\text{H}^+]$ will increase.
- (B) On heating a sample of pure water $[\text{H}^+]$ and $[\text{OH}^-]$ increases but the sample still remains neutral
- (C) 10^{-4}M HCl solution is less acidic than 0.1M HCN ($K_{a \text{ HCN}} = 10^{-5}$) solution
- (D) 10^{-8}M HCl aqueous solution will have pH exactly equal to 8

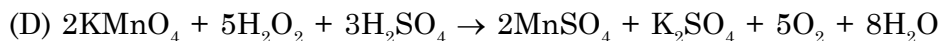
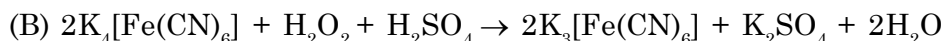
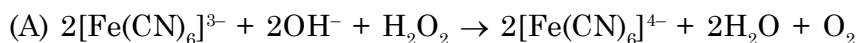


correct statements regarding the above reaction is/are :

- (A) Free carbocation is involved in the reaction as an intermediate
- (B) Alkyl-oxygen bond cleavage takes place
- (C) Acyl-oxygen bond cleavage takes place
- (D) Alcohol formed in the reaction will give immediate turbidity with Lucas reagent

Space for Rough Work

3. Which of the following reaction is/are feasible?



4. Select the correct statement(s)?

(A) Addition of HgI_2 to aqueous solution of KI increases the freezing point since a complex $\text{K}_2[\text{HgI}_4]$ is formed

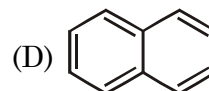
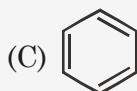
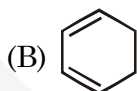
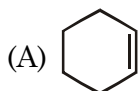
(B) Three aqueous solutions of ammonia labelled as A, B and C with concentrations 0.1 M, 0.01 M and 0.001 M respectively, then value of Van't Hoff factor for these solution will be in order :- $i_A < i_B < i_C$ (consider degree of dilution)

(C) Vapour density of $\text{PCl}_5(\text{g})$ dissociating into $\text{PCl}_3(\text{g})$ and $\text{Cl}_2(\text{g})$ is 100. % dissociation of PCl_5 is 4.25% [Given : atomic mass of P = 31, Cl = 35.5]

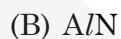
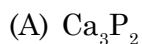
(D) If pH of 0.1 M monobasic acid is found to be 2, its osmotic pressure at a given temperature T K is 0.11 RT

5. Compounds having heat of hydrogenation lesser than that of cyclohexa-1, 4-diene i.e. 

[Hint resonance energy of benzene is 36 Kcal]



6. Which of the following compound/s does not liberate acidic gas during its hydrolysis.



Space for Rough Work

SECTION-2 : (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

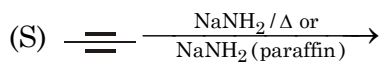
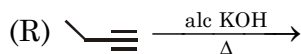
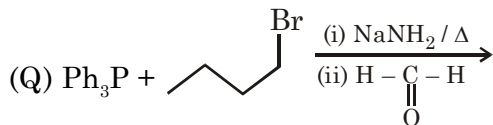
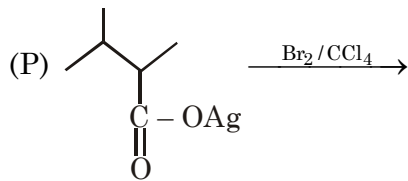
1.	List-I	List-II
	(Electrolysis using inert electrode)	(Product at anode or cathode.)
	(P) Aqueous solution of sodium acetate	(1) H_2
	(Q) Aqueous solution of sodium formate	(2) CO_2
	(R) Concentrated aqueous solution of NaCl	(3) Cl_2
	(S) Dilute aqueous solution of HCl	(4) C_2H_6
		(5) O_2

The correct option is

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

Space for Rough Work

2. Match the list

List-I

List-II

(1) Ionic organometallic product is formed

(2) Product can show electrophilic addition reaction with HBr (1 eq.)

(3) Reaction involve free radical as an intermediate

(4) Number of carbon in parent chain of product is 4

 Select **CORRECT** code for your answer :

 (A) P \rightarrow 3, 4; Q \rightarrow 2; R \rightarrow 2, 4; S \rightarrow 1, 4

 (B) P \rightarrow 3, 4; Q \rightarrow 2; R \rightarrow 2, 4; S \rightarrow 1, 3

 (C) P \rightarrow 3, 4; Q \rightarrow 1, 2; R \rightarrow 2, 4; S \rightarrow 1, 4

 (D) P \rightarrow 2, 3; Q \rightarrow 2; R \rightarrow 2, 4; S \rightarrow 1, 4

Space for Rough Work

3. Match the list:

List- I (Complex Compounds)	List- II (Properties)
(P) $[\text{CoF}_6]^{3-}$	(1) Diamagnetic and low spin complex
(Q) $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$	(2) Paramagnetic and outer orbital complex
(R) $[\text{AuCl}_4]^-$	(3) Paramagnetic and inner orbital complex
(S) $[\text{Fe}(\text{CN})_6]^{3-}$	(4) Paramagnetic and low spin complex

The **CORRECT** option is

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

4. Match the list:

List- I Complex Compound	List- II Properties
(P) $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$	(1) d^2sp^3 hybridisation
(Q) $[\text{Co}(\text{CN})_2(\text{NH}_3)_4]\text{OC}_2\text{H}_5$	(2) Ionisation isomerism
(R) $[\text{IrCl}_6]^{3-}$	(3) $\mu = 2.83$ B.M.
(S) $[\text{PtCl}_2(\text{NH}_3)_4]\text{Br}_2$	(4) $\Delta_0 < P$
	(5) sp^3d^2 hybridisation

The **CORRECT** option is

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

Space for Rough Work

SECTION-3 : (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 darken the corresponding bubbles in the ORS.

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

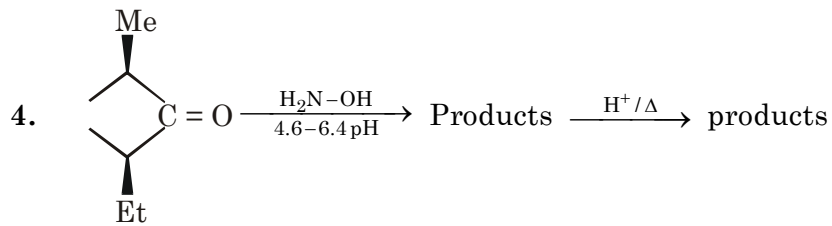
+									
●	●	○	○	○	○	○	○	○	○
①	①	①	①	①	①	①	①	①	①
②	②	②	②	●	●	②	②	②	②
③	③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	●	●	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	●	●	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

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

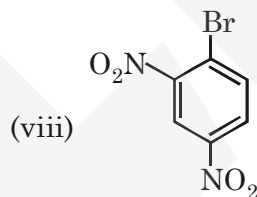
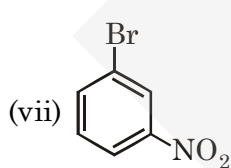
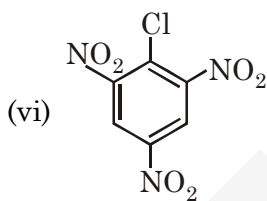
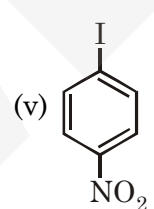
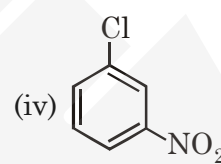
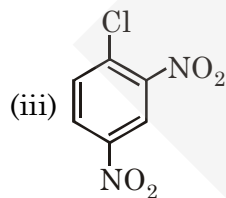
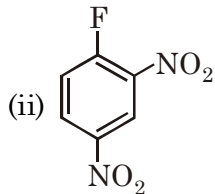
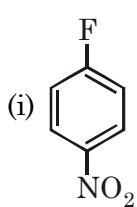
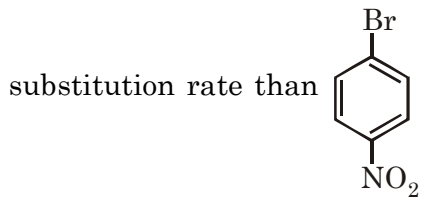
1. For the first order reaction $A(g) \rightarrow 2B(g) + C(g)$ the half life for decomposition of A is 3 minute at 300K. Calculate the time (in minute) in which partial pressure of A(g) will drop from 2 bar to 0.5 bar at 400K. Given activation energy of reaction is 840 R. (Take $\ln 2 = 0.7$)
2. 2 moles of methane gas are compressed from (1 bar, 2L) to 2 bar isothermally against constant external pressure. Calculate work done in Joules.
3. For 10 minutes each, at 0°C , from two identical holes nitrogen and an unknown gas are leaked into a common vessel of 4 litre capacity. The resulting pressure in vessel is 2.8 atm and the mixture contains 0.4 mole of nitrogen. What is the molar mass of unknown gas? (Take $R = 0.0821 \text{ L-atm} \cdot \text{mol}^{-1} \text{ K}^{-1}$)

Space for Rough Work



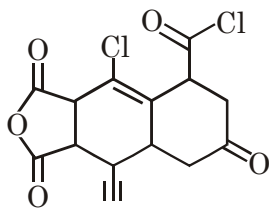
Find out total number of final products?

5. How many of the following compounds given below have faster aromatic nucleophilic



Space for Rough Work

6. Find out total number of moles of Grignard reagent RMgX consumed when treated it with 1 mole of 'X'



7. Find the number of electrons having $|m| \leq 1$, $\ell = 2$, $m_s = -\frac{1}{2}$ in Pd ($Z = 46$).
8. During extraction of iron, CO is the chief reducing agent. If 72 Kg of carbon is available and produced CO is completely used to reduce Haematite (present in excess amount) then calculate how much Kg of Iron is obtained after reduction.
(Given : atomic weight of C–12 g/mol, O–16 g/mol, Fe–55.85 g/mol)

Space for Rough Work

PART-3 : MATHEMATICS
SECTION-1 : (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. If e_1 is eccentricity of $9x^2 + 4y^2 = 36$ and e_2 is eccentricity of $9x^2 - 4y^2 = 36$ then
 - (A) $e_1^2 + e_2^2 < 3$
 - (B) $e_1^2 + e_2^2 > 3$
 - (C) $e_1^2 + e_2^2 < 4$
 - (D) $e_1^2 + e_2^2 > 4$
2. Let $f : [0, 1] \rightarrow [0, \infty)$ be a differentiable function so that $f'(x)$ is decreasing function ; $f(0) = 0$,

$f'(0) > 0$ and $I = \int_0^1 \frac{dx}{1+f^2(x)}$ then which of the following is **INCORRECT** ?

- (A) $I \leq \frac{f(1)}{f'(1)}$
- (B) $I < \frac{f(1)}{f'(1)}$
- (C) $I \geq \frac{f(1)}{f'(1)}$
- (D) $I > \frac{f(1)}{f'(1)}$

Space for Rough Work

3. The coordinates of four angular points of a tetrahedron OABC are (0,0,0), (0,0,2), (0,4,0) and (6,0,0) respectively. A point P inside the tetrahedron is at the same distance r from the four plane faces of tetrahedron. Which of following **CANNOT** be the value of r ?

(A) $\frac{2}{3}$ (B) $\frac{2}{5}$ (C) 2 (D) 3

4. Let $C_k = {}^n C_k$ for $0 \leq k \leq n$ and $A_k = \begin{bmatrix} C_{k-1} & 0 \\ 0 & C_k \end{bmatrix}$ for $k \geq 1$ and

$$A_1 A_2 + A_2 A_3 + A_3 A_4 + \dots + A_{n-1} A_n = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix} \text{ then}$$

(A) $a = b$ (B) $a + b = 2({}^{2n}C_{n-1} - n)$
 (C) $a = 2b$ (D) $a + b = 0$

5. Probability that the length of a randomly chosen chord of a circle lies between $\frac{1}{2}$ and $\frac{3}{4}$ of its diameter is $\frac{p}{q}$ where p and q are coprime number, then

(A) $p + q = 21$ (B) $q - p = 11$ (C) $p + q = 20$ (D) $q - p = 10$

6. For two complex numbers z_1 and z_2 ; $(az_1 + b\bar{z}_1)(cz_2 + d\bar{z}_2) = (cz_1 + d\bar{z}_1)(az_2 + b\bar{z}_2)$ if

(A) $\frac{a}{b} = \frac{c}{d}$ (B) $\frac{a}{d} = \frac{b}{c}$ (C) $|z_1| = |z_2|$ (D) $\arg(z_1) = \arg(z_2)$

Space for Rough Work

SECTION-2 : (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

1. Let $\phi(x) = 3f\left(\frac{x^2}{3}\right) + f(3-x^2) \quad \forall x \in (-3, 4)$ where $f''(x) > 0 \quad \forall x \in (-3, 4)$,

$$g(x) = (a^2 - 3a + 2)\left(\cos^2 \frac{x}{4} - \sin^2 \frac{x}{4}\right) + (a-1)x + \sin 1$$

Match List-I with List-II and select the correct answer using the code given below the list.

List-I

- (P) $\phi(x)$ is increasing in
- (Q) $\phi(x)$ is decreasing in
- (R) The set of values of a for which $g(x)$ does not possess critical point is
- (S) The set of values of a for which $g(x)$ possess critical point is

List-II

- (1) $(0, 1) \cup (1, 4)$
- (2) $\left[-\frac{3}{2}, 0\right]; \left[\frac{3}{2}, 4\right)$
- (3) $\left(-3, -\frac{3}{2}\right]; \left[0, \frac{3}{2}\right]$
- (4) $(-\infty, 0] \cup \{1\} \cup [4, \infty)$
- (A) P \rightarrow 2; Q \rightarrow 3; R \rightarrow 1; S \rightarrow 4 (B) P \rightarrow 2; Q \rightarrow 3; R \rightarrow 4; S \rightarrow 1
- (C) P \rightarrow 3; Q \rightarrow 2; R \rightarrow 1; S \rightarrow 4 (D) P \rightarrow 3; Q \rightarrow 2; R \rightarrow 4; S \rightarrow 1

Space for Rough Work

2. $S \equiv x^2 + y^2 - 2x - 4y + 1 = 0$ and $S' \equiv x^2 + y^2 - 4x - 2y + 1 = 0$ are equations of two circles.

Match List-I with List-II and select the correct answer using the code given below the list.

List-I
List-II

- | | |
|---|--|
| (P) Sum of number of tangents from (1, 3) to S and number of tangents from (1,3) to S' is | (1) 1 |
| (Q) If r is radius of circle passes through point of intersection of S and S' and whose normal is the straight line $2x + y - 6 = 0$, then the value of $\frac{r^2}{4}$ is | (2) 2 |
| (R) If m is slope of common tangent of $S = 0$ and $S' = 0$ then $ m $ is | (3) 3 |
| (S) If ℓ is length of common tangent of S and S' then the value of $2\ell^2$ is | (4) 4 |
| (A) P \rightarrow 2; Q \rightarrow 1; R \rightarrow 2; S \rightarrow 3 | (B) P \rightarrow 2; Q \rightarrow 2; R \rightarrow 1; S \rightarrow 4 |
| (C) P \rightarrow 2; Q \rightarrow 2; R \rightarrow 4; S \rightarrow 1 | (D) P \rightarrow 1; Q \rightarrow 1; R \rightarrow 4; S \rightarrow 2 |

Space for Rough Work

3. (1) The sum of all the values of r satisfying ${}^{39}C_{3r-1} - {}^{39}C_{r^2} = {}^{39}C_{r^2-1} - {}^{39}C_{3r}$ is α_1 .
- (2) If ${}^{2n+3}C_{2n} - {}^{2n+2}C_{2n-1} = 15(2n+1)$ then the value of n is α_2
- (3) If ${}^{56}P_{r+6} : {}^{54}P_{r+3} = 30800 : 1$ then the value of r is α_3
- (4) ${}^{n+2}C_8 : {}^{n-2}P_4 = 57 : 16$ then the value of n is α_4

Match List-I with List-II and select the correct answer using the code given below the list.

List-I

- (P) The value of α_1 is
- (Q) The value of α_2 is
- (R) The value of α_3 is
- (S) The value of α_4 is
- (A) $P \rightarrow 2; Q \rightarrow 3; R \rightarrow 1; S \rightarrow 4$
- (C) $P \rightarrow 2; Q \rightarrow 1; R \rightarrow 3; S \rightarrow 4$

List-II

- (1) 41
- (2) 8
- (3) 14
- (4) 19
- (B) $P \rightarrow 2; Q \rightarrow 3; R \rightarrow 4; S \rightarrow 1$
- (D) $P \rightarrow 3; Q \rightarrow 2; R \rightarrow 1; S \rightarrow 4$

Space for Rough Work

4. (i) Let harmonic mean, arithmetic mean and geometric mean of two positive numbers a and b respectively be 4 , A and G . If $2A + G^2 = 27$ then $a^2 + b^2 = \alpha_1$
- (ii) If the value of $x + y + z = 15$ where a, x, y, z, b are in arithmetic progression while the value of $\frac{1}{x} + \frac{1}{y} + \frac{1}{z}$ is $\frac{5}{8}$ where a, x, y, z, b are in harmonic progression, then the value of $a^2 + b^2$ is α_2
- (iii) The value of $\sum_{r=1}^{16} \left(\frac{1^3 + 2^3 + \dots + r^3}{1 + 3 + \dots + (2r-1)} \right)$ is α_3
- (iv) If the geometric mean and harmonic mean of two positive numbers x_1 and x_2 are 18 and $\frac{216}{13}$ respectively then the value of $|x_1 - x_2|$ is α_4 .

Match List-I with List-II and select the correct answer using the code given below the list.

List-I

- (P) The value of α_1 is
- (Q) The value of α_2 is
- (R) The value of α_3 is
- (S) The value of α_4 is
- (A) $P \rightarrow 2; Q \rightarrow 1; R \rightarrow 2; S \rightarrow 3$
- (C) $P \rightarrow 2; Q \rightarrow 1; R \rightarrow 3; S \rightarrow 4$

List-II

- (1) 52
- (2) 45
- (3) 446
- (4) 15
- (B) $P \rightarrow 2; Q \rightarrow 2; R \rightarrow 1; S \rightarrow 4$
- (D) $P \rightarrow 1; Q \rightarrow 1; R \rightarrow 4; S \rightarrow 2$

Space for Rough Work

SECTION-3 : (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 darken 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	②	②	②	②
③	③	③	③	③	③	③	③	③	③
④	④	④	④	④	④	④	④	④	④
⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	●	●	⑦	⑦	⑦	⑦	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨

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

- In a triangle ABC (with usual notations), $a = 5$, $b = 4$ and $A - B = \cos^{-1}\left(\frac{31}{32}\right)$ then the value of $\frac{c}{5}$ is
- In the expansion of $(1 - x)^{30}(1 + x + x^2)^{31}$ the coefficient of x^{47} is $(-^{30}C_r)$ then the value of $\left|\frac{r}{2}\right|$ is
- In the equation $x^5 - 5x^4 + 9x^3 - 9x^2 + 5x - 1 = 0$ if p is the sum of real roots and q is the product of real roots then the value of $\frac{q}{p}$ is

Space for Rough Work

4. Let $f : (0, \infty) \rightarrow (0, \infty)$ be a function differentiable at 3 and satisfying $f(3) = 3f'(3)$. If the value

of $\lim_{x \rightarrow \infty} \left(\frac{f\left(3 + \frac{3}{x}\right)}{f(3)} \right)^x$ is L then $\frac{[L]}{5}$ is (where $[.]$ is greatest integer function)

5. The value of $\int_{\frac{\pi}{4}}^{\frac{3\pi}{4}} \frac{\cos x}{1 - \cos x} dx$ is equal to (use $\pi = \frac{22}{7}$)

6. Let $f(x) = \begin{vmatrix} \sec x & \cos x & \sec^2 x + \cot x \cos \operatorname{ec} x + \cos x \\ \cos^2 x & \cos^2 x & \operatorname{cosec}^2 x + \cos^4 x \\ 1 & \cos^2 x & \cos^2 x \end{vmatrix}$ then the value $\left| \int_0^{\pi/2} f(x) dx \right|$ is (use $\pi = \frac{22}{7}$)

Space for Rough Work

7. If $y = 2x - 3$ is a tangent to the parabola $y^2 = 4a\left(x - \frac{1}{3}\right)$ then the value of $|a|$ is
8. OA, OB, OC are the sides of a rectangular parallelepiped whose diagonals are OO', AA', BB' and CC'. D is the centre of rectangle AC'O'B' and D' is centre of rectangle O'A'CB'. If sides OA, OB, OC are in ratio 1 : 2 : 3 and $\angle DOD' = \alpha$ then $\frac{697 \cos^2 \alpha}{128}$ is
(Centre of rectangle is mid point of diagonal)
-

Space for Rough Work