VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced Home Practice Test -8 | Paper -2 | JEE 2024

Date: 13/05/2024 **Maximum Marks: 186**

Duration : 3.0 Hours

General Instructions

1. The question paper consists of 3 Subject (Subjects I: **Physics**, Subject II: **Chemistry**, Subject III: **Mathematics**). Each Part has **Three** sections (Section 1, Section 2 and Section 3).
2. **Section 1** contains **8 Multiple Correct Answer Type Questions.** Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
3. **Section 2** contains **6 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.
4. **Section 3** contains **2 List-Match sets.** Each List-Match set has **2 Multiple Choice Questions.** List I has Four entries (I), (II), (III) and (IV) and List II has Six entries (P), (Q), (R), (S), (T), (U), (V) and (W).
   FOUR options are given in each Multiple Choice Question based on List I and List II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.
5. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ **Invigilator's Signature** _____

MARKING SCHEME

SECTION-1 | (Maximum Marks: 32)

- This section consists of **Eight (08)** Questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- 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 and both of which are correct.
Partial Marks	**:**	+1 If two or more options are correct but ONLY one option is chosen, and it is a correct option.
Zero Mark	**:**	0 if none of the options is chosen (i.e. the question is unanswered).
Negative Marks	**:**	–1 In all other cases.

SECTION-2 | (Maximum Marks: 18)

- This section contains **Six (06) Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	**:**	+3 **ONLY** if the correct numerical value is entered.
Zero Mark	**:**	0 In all other cases.

SECTION-3 | (Maximum Marks: 12)

- This section **Two (02)** List-Match sets.
- Each List-Match set has **Two (02)** Multiple Choice Questions.
- Each List-Match set has two lists : List I and List II.
- List I has Four entries (I), (II), (III) and (IV) and List II has Six entries (P), (Q), (R), (S), (T), (U), (V) and (W).
- FOUR options are given in each Multiple Choice Question based on List I and List II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated according to the following marking scheme :

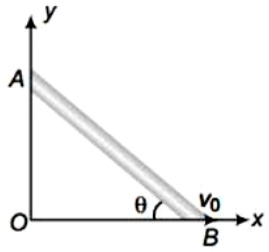
Full Marks	:	+3 If ONLY the option corresponding to the correct combination is chosen.
Zero Marks	:	0 If none of the options is chosen (i.e., the question is unanswered)
Negative Marks	:	–1 In all other cases.

SUBJECT I : PHYSICS 62 MARKS

Section-1 | Multiple Choice Type

This Section contains **8 Multiple Correct Answer Type Questions.** Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

1. The end B of the rod AB which makes angle θ with the floor is being pulled with a constant velocity v_0 as shown. The length of the rod is l. Which of the following statement(s) is(are) correct?



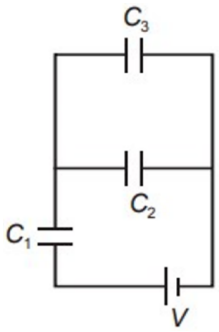
(A) At $\theta = 37°$ velocity of end A is $\frac{4}{3}v_0$ downwards

(B) At $\theta = 37°$ angular velocity of rod is $\frac{5}{3l}v_0$

(C) Angular velocity of rod is constant

(D) Velocity of end A is constant

2. In the arrangement shown in figure, if a dielectric slab is inserted into capacitor C_3 then:



(A) Change on C_1 increases **(B)** Change on C_1 decreases

(C) Change on C_2 increases **(D)** Change on C_2 decreases

3. Two identical small balls A and B each of mass m connected by a light inextensible cord of length l are placed on a frictionless horizontal floor. If ball B is given initial velocity u in vertical direction, for the situation given, which of the following option(s) is/are correct?

[$u_{\min}$ is minimum velocity for which A leaves the table]

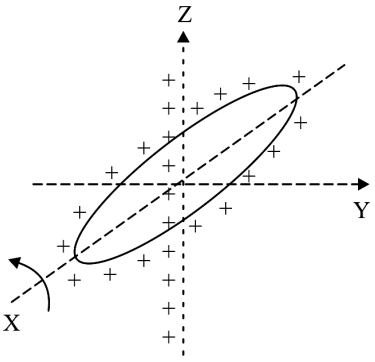
(A) For a sufficient initial velocity u, ball A may leave the table. The minimum velocity $u_{\min}$ equals $\sqrt{3gl}$

(B) For $u > u_{\min}$, till A does not leave the table, acceleration of center of mass of (A + B) system is always in vertical direction

(C) For $u = \sqrt{4gl}$, ball A will leave the table at $\theta = 90°$ (θ is angle between cord and horizontal)

(D) For $u = \sqrt{2gl}$, rope will slack in between the first quarter of motion

4. An infinitely charged wire of charge $+\lambda_1\ coulomb/meter$ is placed along *z*-axis. A charged ring having charge $+\lambda_2\ coulomb/meter$ and of radius *R,* initially placed on *xy*-plane, centered at origin. If ring is rotated anticlockwise (seeing from +*x*-axis) by angle α about *x*-axis. For the case given, which of the following statement(s) is/are correct? [ignore gravity]



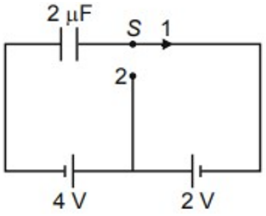
(A) When ring is rotated by angle α about x-axis, and released, net force on ring due to charged wire is zero

(B) For $\alpha = 90°$ magnitude of torque on ring is very large

(C) Net torque on ring is proportional to $-\tan\left(\frac{\alpha}{2}\right)$ for angle α

(D) Ring does simple harmonic motion for small angle α, about $\alpha = 0$

5. In the circuit shown, the switch *S* is initially at position-1 and then it is shifted to position-2. Then after shifting the switch.



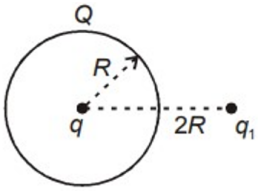
(A) Work done by the battery of 4 *V* is $16\,\mu J$

(B) Work done by the battery of 4 *V* is $8\,\mu J$

(C) Heat dissipated to surrounding is $4\,\mu J$

(D) Heat dissipated to surrounding is $8\,\mu J$

6. A thin metallic spherical shell contains a change *Q* on it. A point charge *q* is placed at the centre of shell and another charge q_1 is placed outside it as shown in figure. All the three charges are +*ve*. Then:



(A) Force on the charge *q* at centre is zero

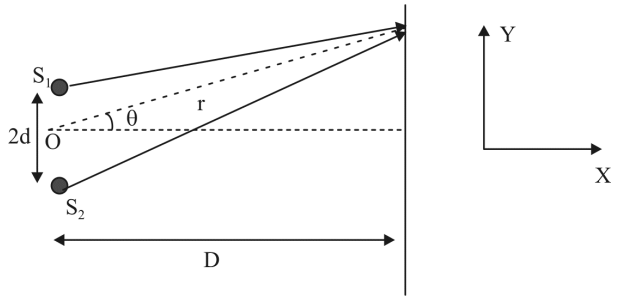
(B) Force on charge q_1 is $\frac{(Q+q)q_1}{16\pi\varepsilon_0 R^2}$

(C) Charge on outer surface of shell is $(Q+q)$

(D) Charge on inner surface of shell is zero

7. Two identical monochromatic coherent point sources of light with zero phase difference and optical power *P*, emit waves of wavelength λ. The separation between sources is equal to $2d$, such that $d = 100\lambda$. If the screen distance $D >> d$, and intensity of light at centre of screen equals $I(\theta = 0°) = I_0$, then for the situation given, which of the following options is/are correct?

[Intensity is measured along *y*-axis and detector can detect faintest maxima]



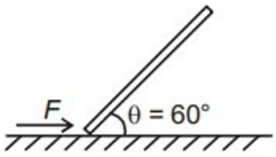
(A) For $-90° \le \theta \le 90°$, when screen is flat, the no of maximas on whole screen is 399

(B) For $-90° \le \theta \le 90°$, when screen is flat, the location of faintest maxima are $\theta = \pm \sin^{-1}\left(\frac{199}{200}\right)$

(C) If screen is curved with radius *D*, centered at '*O*', then for $-90° \le \theta \le 90°$, the $\frac{d}{d\theta}(I_\theta) = 0$

(D) If screen is curved with radius *D*, centered at '*O*', then for $-90° \le \theta \le 90°$, number of maxima on screen equals 401

8. A homogeneous rod is pushed along a smooth horizontal surface with a force $F = 10\sqrt{3}N$. The rod has a purely translational motion at $\theta = 60°$. If mass of rod is *m*, then:



(A) $m = 3\ kg$ **(B)** $m = 1\ kg$

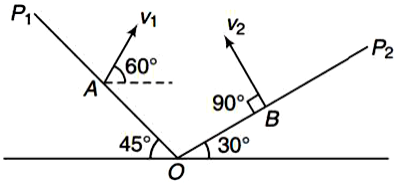
(C) Acceleration of rod if $\frac{10}{\sqrt{3}} m/s^2$ **(D)** Acceleration of rod if $10\sqrt{3}\, m/s^2$

SPACE FOR ROUGH WORK

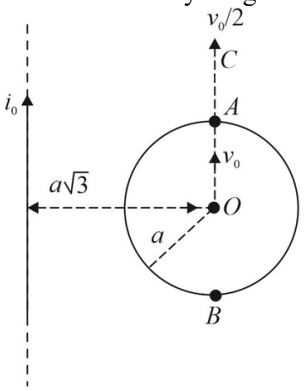
Section-2 | Numerical Value Type

This Section contains **6 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

9. A particle is projected from an inclined plane OP_1 from A with velocity $v_1 = 8\,ms^{-1}$ at an angle 60° with horizontal. Another particle is projected at the same instant from B with velocity $v_2 = 16\,ms^{-1}$ and perpendicular to the plane OP_2 as shown in figure. After time $10\sqrt{3}\,s$, their separation was minimum and found to be 70 m. Then find distance AB.

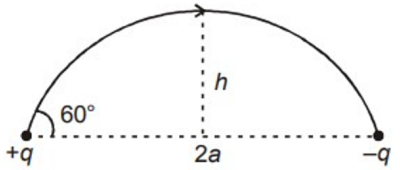


10. A conducting circular loop of radius a and resistance per unit length R is moving with a constant velocity v_0, parallel to an infinite conducting wire carrying current i_0. A conducting rod of length $2a$ is moving with a constant velocity $\frac{v_0}{2}$ such that its centre is moving in the same line as the centre of loop. At the instant $t = 0$, the rod comes in contact with the loop at A and starts sliding on the loop with the constant velocity. Neglect the resistance of the rod and the self-inductance of the circuit.



If the force required to maintain the velocity of rod, when it is at distance $\frac{a}{2}$ from point A of the loop, equals $F = N\frac{\mu_0^2 i_0^2 v_0}{aR\pi^3}$, then N equals _____. [Take $\log_e 3 = 1.1$]

11. Two change particles are arranged as shown in figure. The height of electric field line at midpoint is given by $h = \frac{\sqrt{n}}{3}a$. Find the value of n _____.



12. In an experiment on photoelectric effect light of wavelength 400 *nm* is incident on a metal plate at the rate of $5W$. The potential of the collector plate is made sufficiently positive with respect to emitter so that the current reaches the saturation value. Assuming that on the average one out of every 10^6 photons is able to eject a photoelectron, find the photocurrent in the circuit (in μA).

[Given that $\left(\frac{hc}{\lambda} = 12400\, eV\,\text{Å}\right)$]

13. The density of a rod hanging vertically from the ceiling is changing linearly with distance x from the free end as $\lambda = \lambda_0\left(1+\frac{x}{\ell}\right)$. If the Young's modulus of wise is Y and area of cross section is A then elastic potential energy stored is $\frac{19\lambda_0^2 g^2 \ell^3}{NAY}$. Find N_____.

14. A man of height 2.0 *m* is standing on a level road where because of temperature variation the refractive index of air is varying as $\mu = \sqrt{1+\alpha y}$, where y is height from road. If $\alpha = 2.0\times10^{-6} m^{-1}$. Find the distance (in *km*) of furthest point that he can see on the road.

SPACE FOR ROUGH WORK

Section-3 | Matching List Type

This **Section** contains **2 List-Match sets.** Each List-Match set has **2 Multiple Choice Questions.** List I has Four entries (I), (II), (III) and (IV) and List II has Six entries (P), (Q), (R), (S), (T), (U) and (V).
FOUR options are given in each Multiple Choice Question based on List I and List II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

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

Paragraph for Q. 15 to 16

A musical instrument is made using four different metal strings 1, 2, 3 and 4 with mass per unit length μ, 4μ, 9μ and 16μ respectively. The instrument is played by vibrating the strings by varying free length in between the range l_0 and $12l_0$. It is found that in string-1 at free length l_0 and tension T_0, the fundamental mode frequency is f_0. List-2 gives the above four strings while List –II the magnitude of some quantity, as multiple of f_0.

List-1		List-2	
(I)	String-1	**(P)**	1
(II)	String-2	**(Q)**	1/2
(III)	String-3	**(R)**	1/3
(IV)	String-4	**(S)**	1/4
		(T)	1/6
		(U)	1/8

15. If the tension in each string is T_0, the correct match for highest fundamental frequency in f_0 units will be:

(A) $(I) \to P, (II) - T, (III) \to R, (IV) \to S$

(B) $(I) \to P, (II) - R, (III) \to V, (IV) \to Q$

(C) $(I) \to P, (II) \to Q, (III) \to R, (IV) \to S$

(D) $(I) \to Q, (II) \to S, (III) \to P, (IV) \to T$

16. The length of strings 1, 2, 3 and 4 are kept fixed at l_0, $2l_0$, $12l_0$, $8l_0$ respectively. Strings 1, 2, 3 and 4 are vibrated at their 1st, 2nd, 6th and 4th harmonics respectively such that tension in each string remains T_0. Frequencies of vibration in four strings.

(A) $(I) \to Q, (II) \to S, (III) \to P, (IV) \to U$

(B) $(I) \to P, (II) \to S, (III) \to T, (IV) \to Q$

(C) $(I) \to R, (II) \to T, (III) \to S, (IV) \to Q$

(D) $(I) \to P, (II) \to Q, (III) \to T, (IV) \to U$

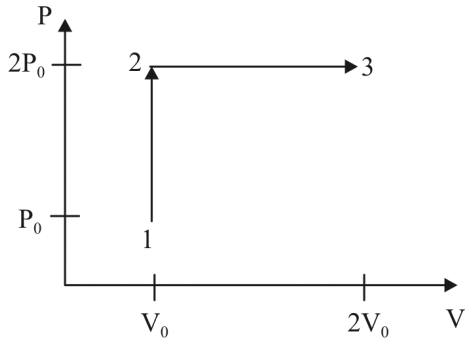
Paragraph for Q. 17 to 18

In a thermodynmic process on an ideal di-atomic gas, the infinitesimal heat absorbed by the gas is given by $T\Delta S$, where T is temperature of system and ΔS is the small change in quantity S of systems. For a mole of di-atomic gas $S = \frac{5}{2}R\log_e T + R\log_e V + S_0$.

Where R is gas constant, S_0 is reference value of quantity S. List L gives some quantities involved in a process and List-2 gives some possible values of quantities.

List-1		List-2	
I.	Work done by the system in process $1 \to 2 \to 3$	**(P)**	$\frac{19}{2}RT_0$
II.	Change in internal energy in process $1 \to 2 \to 3$	**(Q)**	$\frac{5}{2}RT_0$
III.	Heat absorbed by system in process $1 \to 2 \to 3$	**(R)**	$-RT_0(\ln 4 - 1)$
IV.	Heat absorbed by system in process $1 \to 2$	**(S)**	$2RT_0$
		(T)	$RT_0\left(\frac{7}{4} - \ln 4\right)$
		(U)	$\frac{15}{2}RT_0$
		(V)	$\frac{7}{2}RT_0$

17. If the process carried out on one mole of di-atomic gas is stated on pv-diagram with $P_0V_0 = RT_0$, then the correct match is:



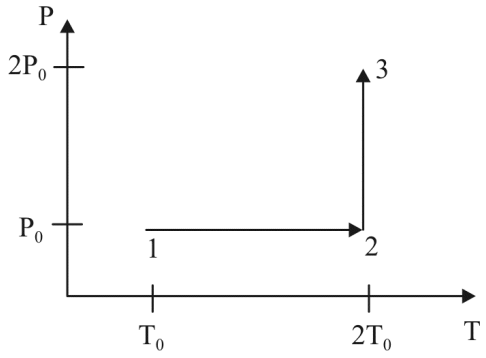
(A) $(I) \to (S), (II) \to (R), (III) \to (P), (IV) \to (T)$

(B) $(I) \to (R), (II) \to (U), (III) \to (Q), (IV) \to (S)$

(C) $(I) \to (S), (II) \to (U), (III) \to (P), (IV) \to (Q)$

(D) $(I) \to (S), (II) \to (P), (III) \to (Q), (IV) \to (T)$

18. If one mole of di-atomic gas undergoes the process as shown on P – T graph with P_0V_0 equals RT_0, then the correct match is:



(A) $(I) \rightarrow (R), (II) \rightarrow (V), (III) \rightarrow (R), (IV) \rightarrow (Q)$

(B) $(I) \rightarrow (T), (II) \rightarrow (U), (III) \rightarrow (R), (IV) \rightarrow (V)$

(C) $(I) \rightarrow (R), (II) \rightarrow (Q), (III) \rightarrow (T), (IV) \rightarrow (Q)$

(D) $(I) \rightarrow (R), (II) \rightarrow (Q), (III) \rightarrow (T), (IV) \rightarrow (V)$

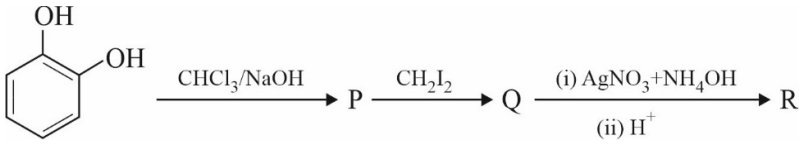
SPACE FOR ROUGH WORK

SUBJECT II : CHEMISTRY 62 MARKS

Section-1 | Multiple Choice Type

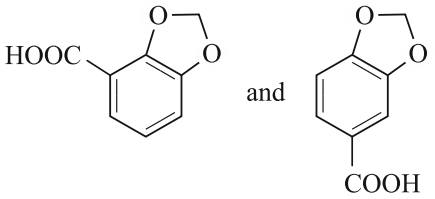
This Section contains **8 Multiple Correct Answer Type Questions.** Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

1. For the given sequence of reactions.

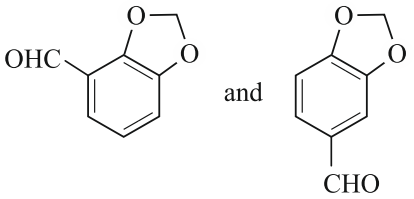


Choose the correct options:

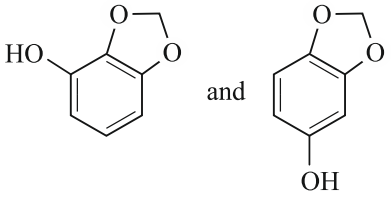
(A) R can be



(B) Q can be



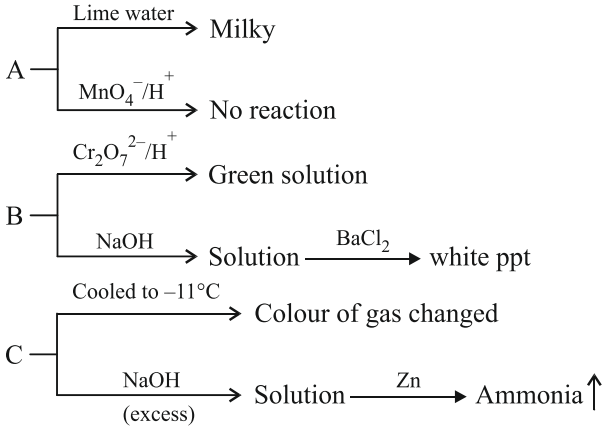
(C) Q can be



(D) The electrophile generated during the formation of 'P' has incomplete octet

SPACE FOR ROUGH WORK

2. Consider the three dioxide gases, A, B and C.



Choose the correct statement(s):

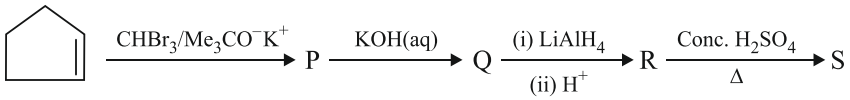
(A) Gas C is polar and paramagnetic

(B) Gas B is CO_2

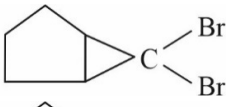
(C) Gas B is reducing in nature

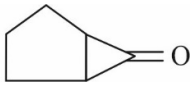
(D) Gas A is polar and paramagnetic

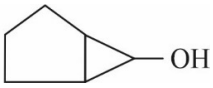
3. For the given below sequence of reactions.



Select the correct option(s):

(A) P = 

(B) Q = 

(C) R = 

(D) S = 

SPACE FOR ROUGH WORK

4. Which of the following is/are correct?

(A) Proteins which perform the role of biological catalysts in the body are called enzymes

(B) Proteins which are crucial to communication system in the body are called receptors

(C) Carrier proteins carry nonpolar molecules across the cell membrane

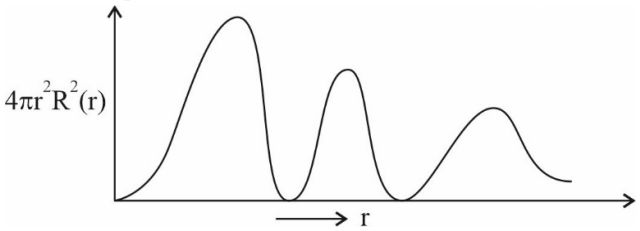
(D) Nucleic acids have coded genetic information for the cell

5. For H-atom : $R_{n,\ell} = \frac{1}{9\sqrt{3}}\left(\frac{1}{a_0}\right)^{3/2}(6-6\sigma+\sigma^2)e^{-\sigma/2}$. Where, $\sigma = \frac{2Zr}{3a_0}$, $a_0 = 0529Å$.

Select the correct statement(s) for the given orbital.

(A) Orbital is 3s

(B) The radial probability distribution curve for the given orbital is



(C) Distance between radial nodes is equal to $3\sqrt{3}a_0$

(D) It has 2 radial nodes

6. P, Q, R and S in the following processes are:

(I) $P_2O_5 + P \xrightarrow{\Delta} \text{slag}$

(II) $2Cu_2O + Cu_2S \xrightarrow{\Delta} Q + \text{Gas(S)}\uparrow$

(III) $Fe_2O_3 + 3CO \xrightarrow{\Delta} R + CO_2\uparrow$

Select which is correct?

(A) P = Quick lime **(B)** Q = Copper matte

(C) R = Metallic iron **(D)** S = SO_2

SPACE FOR ROUGH WORK

7. Read the following statements:

(I) Superoxide ion is larger than peroxide ion, so, KO_2 is more stable than NaO_2.

(II) Products in reaction of metal and nitric acid is independent of concentration of nitric acid.

(III) P_4 disproportionates in NaOH to give Phosgene and NaH_2PO_2.

(IV) $(NH_4)_2Cr_2O_7$ produces an orange-coloured compound on heating.

Choose the incorrect statement(s).

(A) (I) **(B)** (II) **(C)** (III) **(D)** (IV)

8. Choose the correct option(s) for the following reaction sequence.

$$[A] \xrightarrow[350°C]{Al_2O_3} [B] \xrightarrow[(ii)\,AgOH]{(i)\,HI} [C] \xrightarrow[350°C]{Al_2O_3} [B] \xrightarrow[(ii)\ H_2O_2,OH^-]{(i)\,B_2H_6} [A]$$

In the above reaction sequence (A) and (C) are isomers. Molecular formula of B is C_5H_{10}, which can also be obtained from the product of the reaction of CH_3CH_2MgBr with acetone followed by acidification and heat.

(A) $A = CH_3-CH_2-CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$, $B = (CH_3)_2C=CHCH_3$

(B) $A = (CH_3)_2CHCHOHCH_3$, $B = (CH_3)_2C=CHCH_3$

(C) $A = CH_3-CH_2-CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$, $B = CH_3-\overset{\displaystyle CH_3}{\overset{|}{CH}}-CH=CH_2$

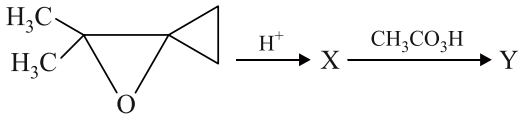
(D) $A = (CH_3)_2CHCHOHCH_3$, $C = CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle OH}{\overset{|}{\underset{|}{C}}}}-CH_2CH_3$

SPACE FOR ROUGH WORK

Section-2 | Numerical Value Type

This Section contains **6 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

9. For the reaction,



Number of atoms forming the ring in product 'Y' are:

10. Equal volumes of 1 M NaOH, 10% w/v NaOH and 2 M NaOH are mixed, then the molarity of final resultant solution is $x \times 10^{-2}$ M. Find the value of x.

11. **(i)** The number of Fe – C bonds in acetylchloridodicarbonylbis(trimethylphosphine)iron(II) is X.

(ii) The number of geometrical isomers of $\left[M(XY)(CD)(AB)\right]^{n+}$ is Y. [XY, CD and AB are unsymmetrical bidentate ligands]

Then X + Y is _____.

12. **(I)** 'A' is the change in oxidation number of nitrogen when dil. HNO_3 reacts with Zn metal.

(II) 'B' is the number of moles of phosphine gas produced by the reaction of 2 mole of calcium phosphide with excess water.

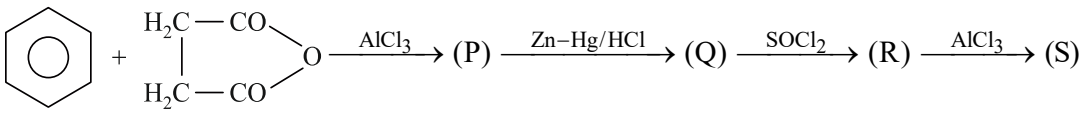
Then $A \times B =$ _____.

13. Compound X dissociates by two parallel first order paths at particular temperature as follows:

$X(g) \xrightarrow{k_1} Y(g)$ $\quad k_1 = 6.93 \times 10^{-4}\ min^{-1}$

$X(g) \xrightarrow{k_2} Z(g)$ $\quad k_2 = 6.93 \times 10^{-4}\ min^{-1}$

The time required to consume 50% x in seconds is _____ $\times 10^3$.

14. 

The molecular mass of the product 'S' is _____ $g\,mol^{-1}$.

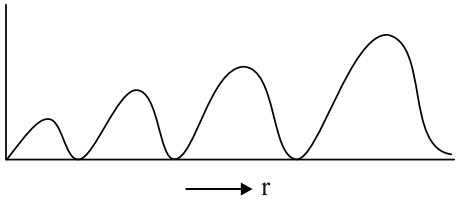
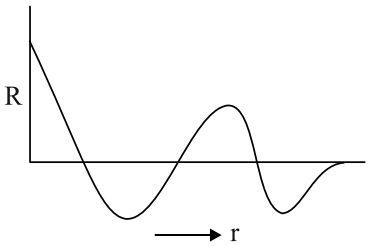
SPACE FOR ROUGH WORK

Section-3 | Matching List Type

This **Section** contains **2 List-Match sets.** Each List-Match set has **2 Multiple Choice Questions.** List I has Four entries (I), (II), (III) and (IV) and List II has Six entries (P), (Q), (R), (S) and (T).
FOUR options are given in each Multiple Choice Question based on List I and List II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

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

15. Match the Column.

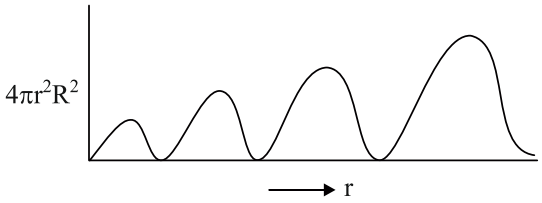
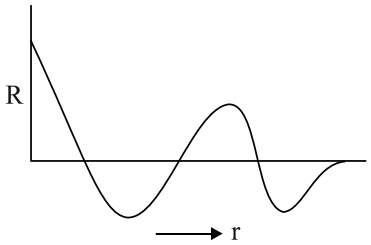
List-I		List-II	
(I)	$4\pi r^2R^2$ 	**(P)**	4s
(II)		**(Q)**	$5p_y$
(III)	Angular probability depends upon θ and ϕ	**(R)**	3s
(IV)	Atleast one angular node is present	**(S)**	$6d_{xy}$

Which of the following options has the correct combination considering List-I and List-II.

(A) (I) $\rightarrow$ P, Q, S **(B)** (II) $\rightarrow$ S, R **(C)** (III) $\rightarrow$ P, R **(D)** (IV) $\rightarrow$ P

SPACE FOR ROUGH WORK

16. Match the Column.

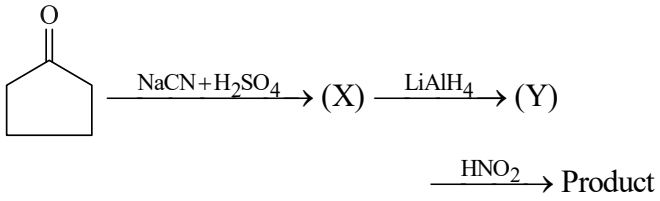
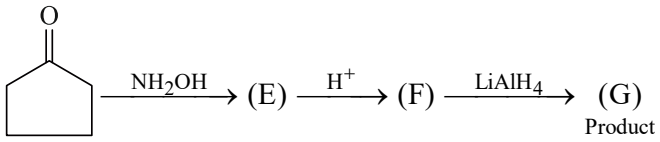
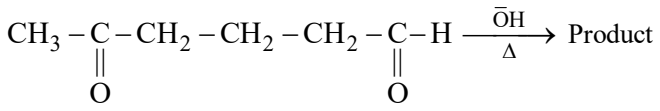
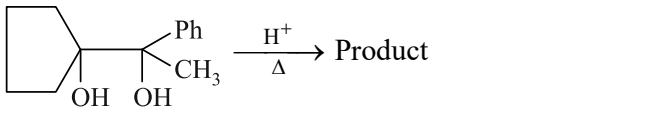
List-I		List-II	
(I)		**(P)**	4s
(II)		**(Q)**	$5p_y$
(III)	Angular probability depends upon θ and ϕ	**(R)**	3s
(IV)	Atleast one angular node is present	**(S)**	$6d_{xy}$

Which of the following options has the correct combination considering List-I and List-II.

(A) (I) $\rightarrow$ Q, R **(B)** (II) $\rightarrow$ R, S **(C)** (III) $\rightarrow$ S, P **(D)** (IV) $\rightarrow$ Q, S

SPACE FOR ROUGH WORK

17. Match the Column.

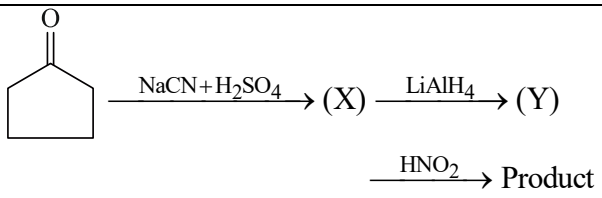
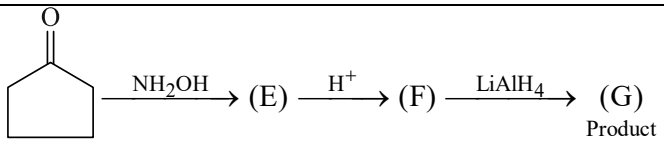
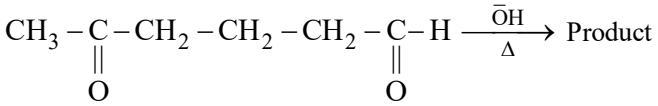
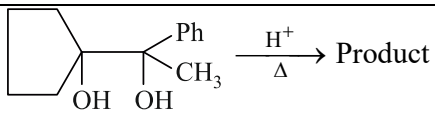
List-I		List-II	
(I)		**(P)**	Formation of six-member ring takes place in final product
(II)		**(Q)**	Final product is ketone
(III)		**(R)**	Final product react with 2, 4-DNP
(IV)		**(S)**	Final product formed will give positive Tollen's test
		(T)	Final product have 5-membered ring

Which of the following options has the correct combination considering List-I and List-II.

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

SPACE FOR ROUGH WORK

18. Match the Column.

List-I		List-II	
(I)		**(P)**	Formation of six-member ring take plane
(II)		**(Q)**	Final product is ketone
(III)		**(R)**	Final product react with 2, 4-DNP
(IV)		**(S)**	Final product formed will give positive Tollen's test
		(T)	Final product have 5-membered ring

Which of the following options has the correct combination considering List-I and List-II.

(A) (I) $\rightarrow$ S, T **(B)** (II) $\rightarrow$ P **(C)** (III) $\rightarrow$ S, T **(D)** (IV) $\rightarrow$ Q, S

SPACE FOR ROUGH WORK

SUBJECT III : MATHEMATICS 62 MARKS

Section-1 | Multiple Choice Type

This Section contains **8 Multiple Correct Answer Type Questions.** Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

1. Let $A=\begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$ and $B=\begin{bmatrix} bc-a^2 & ca-b^2 & ab-c^2 \\ ca-b^2 & ab-c^2 & bc-a^2 \\ ab-c^2 & bc-a^2 & ac-b^2 \end{bmatrix}$ be two non-singular matrices such that $(A^2-2I)B=0$ where $a>b>c>0,$ then which of the following statements is (are) correct?

(A) $Tr(AB)=6\sqrt{2}$ **(B)** $Tr(AB)=-6\sqrt{2}$

(C) $\det.(A-\sqrt{2}B)=54\sqrt{2}$ **(D)** $\det.(A-\sqrt{2}B)=-54\sqrt{2}$

2. Let $P=\begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$ and Q be an orthogonal matrix of order 3×3. Let $A=P^{2018}$, $B=QPQ^T$, then which of the following is/are correct?

(A) Trace of matrix A is 3 **(B)** $Q^TB^{2018}Q=A$

(C) $\det(B^5)=1$ **(D)** $\det\left(adj(A)\right)=\det\left(adj(B)\right)$

3. The value of $\sum_{k=1}^{\infty}\frac{6^k}{\left(3^k-2^k\right)\left(3^{k+1}-2^{k+1}\right)}$ is equal to:

(A) $\lim\limits_{x\to 0}\dfrac{1-\cos 2x}{x^2}$

(B) $\lim\limits_{n\to\infty}\left(\sin\dfrac{\pi}{2n}\times\sin\dfrac{2\pi}{2n}\times\sin\dfrac{3\pi}{2n}....\sin\dfrac{(n-1)\pi}{n}\right)^{\frac{1}{n}}$

(C) $\dfrac{\pi\ln 2}{\int\limits_{\pi/2}^{0}\ln\left|\cos 2x\right|dx}$

(D) $\dfrac{2}{\pi\ln 2}\int\limits_{0}^{\pi/4}\ln\left(1+\tan x\right)dx$

4. Let $f(x)=\dfrac{\cos^{-1}(1-\{x\})\sin^{-1}(1-\{x\})}{\sqrt{2\{x\}}(1-\{x\})},$ then which of the following is/are correct?

[Note : $\{x\}$ denotes fractional part function of x]

(A) $\lim\limits_{x\to 0^+}f\left(x\right)=\sqrt{2}\lim\limits_{x\to 0^-}f\left(x\right)$ **(B)** $\lim\limits_{x\to 0^-}f\left(x\right)=\sqrt{2}\lim\limits_{x\to 0^+}f\left(x\right)$

(C) $\lim\limits_{x\to 0^-}f(x)=\dfrac{\pi}{2\sqrt{2}}$ **(D)** $\lim\limits_{x\to 0^-}f(x)=\sqrt{2}\pi$

5. Let $y = f(x)$ be a differentiable function such that $f(3-x) = f(3+x) \forall x \in R$ and the equation $f(x) = 0$ has exactly 5 distinct real solutions x_1, x_2, x_3, x_4 and x_5. If $x_1 < x_2 < x_3 < x_4 < x_5$, then which of the following is/are must be correct?

(A) $x_1 + x_2 + x_3 + x_4 + x_5 = 15$

(B) $f'(x_3) = 0$

(C) $y = f'(x)$ has minimum 5 real roots

(D) $y = |f(x)|$ is a differentiable function

6. If $f(\theta) = \lim\limits_{n\to\infty} \sum\limits_{r=0}^{n\theta} \dfrac{2r}{n\sqrt{(3\theta n - 2r)(n\theta + 2r)}}$ then:

(A) $f(1) = \dfrac{\pi}{6}$

(B) $f(\theta) = \dfrac{\theta}{2}\displaystyle\int_0^{\theta} \dfrac{dx}{\sqrt{\theta^2 - \left(x - \frac{\theta}{2}\right)^2}}$

(C) $f(\theta)$ is a constant function

(D) $y = f(\theta)$ is invertible

7. The coefficients of the quadratic function $f(x)$ including the constant term, are all rational. $f(x)$ has local maximum at $x = 0$. If $g(x) = |f'(x)|e^{f(x)}$ has maximum value $4\sqrt{e}$, then:

(A) $\displaystyle\int_{-1}^{0} g(x)\,dx = e - \frac{1}{e^7}$

(B) The value of $\operatorname{sgn}\left(f(0)\right) = -1$

(C) $g(x)$ is non derivable at one value of x,

(D) The value of $g\left(\tan\dfrac{\pi}{4}\right) = \dfrac{2}{e^7}$

8. If three planes $P_1 = 2x + y + z - 1 = 0$, $P_2 = x - y + z - 2 = 0$ and $P_3 = \alpha x - y + 3z - 5 = 0$ intersect each other at point P on XOY plane and at point Q on YOZ plane, where O is the origin then identify the correct statement(s)?

(A) The value of α is 4

(B) Straight line perpendicular to plane P_3 and passing through P is $\dfrac{x-1}{4} = \dfrac{y+1}{-1} = \dfrac{z}{3}$

(C) The length of projection of $\overrightarrow{PQ}$ on x-axis is 1

(D) Centroid of the triangle OPQ is $\left(\dfrac{1}{3}, -\dfrac{1}{2}, \dfrac{1}{2}\right)$

SPACE FOR ROUGH WORK

Section-2 | Numerical Value Type

This Section contains **6 Numerical Value Type Questions**. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

9. Let $D=\begin{bmatrix}1&0&0\\0&2&0\\0&0&3\end{bmatrix}$ and $P=\begin{bmatrix}7&0&2\\0&1&0\\2&0&5\end{bmatrix}$. Consider $A=P^{-1}DP$. Find $\det.(A^2+A)$.

10. Let n be the number of ways in which 5 boys and 5 girls can stand in a queue in such a way that all the girls stand consecutively in the queue. Let m be the number of ways in which 5 boys and 5 girls can stand in a queue in such a way that exactly four girls stand consecutively in the queue. Then the value of $\frac{m}{n}$ is _____.

11. Let E_1, E_2, E_3 be three independent events associated with a random experiment such that $3P(E_1\cap\overline{E}_2\cap\overline{E}_3)=P(\overline{E}_1\cap E_2\cap\overline{E}_3)=9P(\overline{E}_1\cap\overline{E}_2\cap E_3)=3-3P(E_1\cup E_2\cup E_3)$.
Where $P(E_1), P(E_2), P(E_3)\neq 1$ and $P(A)$ denotes probability of event A. If absolute value of $\begin{vmatrix}P(E_1)&P(E_2)&P(E_3)\\P(E_2)&P(E_3)&P(E_1)\\P(E_3)&P(E_1)&P(E_2)\end{vmatrix}=\frac{a}{b}$, where a and b are co-prime natural numbers, then find the value of $(a+b)$.

12. If $\sum_{r=1}^{100}\sin^{-1}\left(\frac{1}{\sqrt{r^2+1}\sqrt{r^2+2r+2}}\right)$ is equal to $\tan^{-1}\left(\frac{p}{q}\right)$ where p and q are co-prime natural numbers, then the value of $(p+q)$ is equal to _____.

13. Let $I=\int_{-\frac{\sqrt{3}}{2}}^{\frac{\sqrt{3}}{2}}\sqrt{\frac{1-x}{1+x}}\sin^{-1}x\,dx$. If $I=\frac{\pi}{M}-\sqrt{N}$, where M and N are natural numbers, then find the value of $(M+N)$.

14. If p_1, p_2 are respectively the perpendicular distances of the points with position vectors $\vec{a}=3\hat{i}-5\hat{j}+8\hat{k}$ and $\vec{b}=2\hat{i}-41\hat{j}+21\hat{k}$ from the plane $\vec{r}\cdot(2\hat{i}+2\hat{j}-\hat{k})=12$, then p_2-4p_1 is equal to _____.

SPACE FOR ROUGH WORK

Section-3 | Matching List Type

This **Section** contains **2 List-Match sets.** Each List-Match set has **2 Multiple Choice Questions.** List I has Four entries (I), (II), (III) and (IV) and List II has Six entries (P), (Q), (R), (S), (T), (U), (V) and (W).
FOUR options are given in each Multiple Choice Question based on List I and List II and ONLY ONE of these four options satisfies the condition asked in the Multiple Choice Question.

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

Paragraph for Q. 15 to 16

Consider, E: $\frac{(x-1)^2}{16}+\frac{(y-2)^2}{9}=1$ and $H=(x-1)^2-(y-2)^2=\frac{7}{2}$

List-I : Contains equations of straight lines.
List-II : Contains image of focus (whose abscissa is greater than 1) of the conic about the line in List-I and contains area (in sq. units) of the triangle formed by joining the focus of conic, its image about the line in List-I and centre of the conic.

List-I		List-II	
(I)	$y=x+6$	**(P)**	Image of focus in line $(1, \sqrt{7}+2)$
(II)	$y=x+1$	**(Q)**	Image of focus in line $(-4, \sqrt{7}+7)$
(III)	$x+y=3$	**(R)**	Image of focus in line $(6, \sqrt{7}-3)$
(IV)	$x-y-4=0$	**(S)**	Image of focus in line $(1, 2-\sqrt{7})$
		(T)	Area $\frac{7}{2}$
		(U)	Area $\frac{(5\sqrt{7}+7)}{2}$
		(V)	Area $\frac{7}{4}$
		(W)	Area $\frac{(5\sqrt{7}-7)}{2}$

15. Which of the following options is the only correct combination?
(A) (I)-(Q), (U) **(B)** (II)-(P), (V) **(C)** (III)-(R), (W) **(D)** (IV)-(R), (V)

16. Which of the following options is the only incorrect combination?
(A) (III)-(S), (T) **(B)** (IV)-(Q), (V) **(C)** (II)-(P), (T) **(D)** (I)-(Q), (U)

SPACE FOR ROUGH WORK

Paragraph for Q. 17 to 18

Let $f(x)$ is defined as $f(x)=\begin{vmatrix}\sin(x+\alpha) & \sin(x+\beta) & \sin(x+\gamma)\\ \cos(x+\alpha) & \cos(x+\beta) & \cos(x+\gamma)\\ \cos(\beta-\gamma) & \cos(\gamma-\alpha) & \cos(\alpha-\beta)\end{vmatrix}$ and $P=\begin{bmatrix}\cos(\pi/9) & \sin(\pi/9)\\ -\sin(\pi/9) & \cos(\pi/9)\end{bmatrix}$,

where α, β and γ be non-zero numbers such that $(\alpha P^6+\beta P^3+\gamma I)$ is the zero matrix and where I is an identity matrix of order 2.

List-I		List-II	
(I)	The value of $\sum_{k=1}^{9} f(k)$ equals	**(P)**	1
(II)	The absolute value of $\frac{\alpha}{\beta}$ is equal to	**(Q)**	2
(III)	The value of $(\alpha^2+\beta^2+\gamma^2)^{(\alpha-\beta)(\beta-\gamma)(\gamma-\alpha)}$, is	**(R)**	–9
(IV)	The absolute value of $\frac{2\beta}{\gamma}$ is equal to	**(S)**	0
		(T)	9

17. Which of the following options has the correct combination considering List-I and List-II?

(A) (IV)-(P) **(B)** (III)-(Q) **(C)** (II)-(R) **(D)** (I)-(S)

18. Which of the following options has the **incorrect** combination considering List-I and List-II?

(A) (II)-(P) **(B)** (I)-(R) **(C)** (III)-(P) **(D)** (IV)-(Q)

SPACE FOR ROUGH WORK