



NARAYANA
IIT ACADEMY
INDIA

41
YEARS
OF EXCELLENCE

JEE ADVANCED GRAND TEST SERIES



NARAYANA
IIT ACADEMY
INDIA

45
YEARS
OF EXCELLENCE

Sec: OSR.IIT_*CO-SC
Time: 3HRS

Date: 10-04-25
Max. Marks: 180

Name of the Student: _____

H.T. NO:

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10-04-25_OS.RSTAR CO-SUPER CHAINA_JEE-ADV_OGTA-3(P1)_SYLLABUS

PHYSICS: TOTAL SYLLABUS

CHEMISTRY: TOTAL SYLLABUS

MATHEMATICS: TOTAL SYLLABUS

TIME:3hrs**IMPORTANT INSTRUCTIONS****Max Marks: 180****MATHEMATICS**

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I (Q.N : 1 – 3)	Questions with Multiple Correct Choice (partial marking scheme) (+1,0)	+4	-2	3	12
Sec – II (Q.N : 4 – 7)	Questions with Single Correct Options	+3	-1	4	12
Sec – III (Q.N : 8 – 13)	Questions with Non-Negative Integer type	+4	0	6	24
Sec – IV (Q.N : 14 – 17)	Questions with MATRIX MATCH	+3	-1	4	12
Total				17	60

PHYSICS

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I (Q.N : 18 – 20)	Questions with Multiple Correct Choice (partial marking scheme) (+1,0)	+4	-2	3	12
Sec – II (Q.N : 21 – 24)	Questions with Single Correct Options	+3	-1	4	12
Sec – III (Q.N : 25 – 30)	Questions with Non-Negative Integer type	+4	0	6	24
Sec – IV (Q.N : 31 – 34)	Questions with MATRIX MATCH	+3	-1	4	12
Total				17	60

CHEMISTRY

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I (Q.N : 35 – 37)	Questions with Multiple Correct Choice (partial marking scheme) (+1,0)	+4	-2	3	12
Sec – II (Q.N : 38 – 41)	Questions with Single Correct Options	+3	-1	4	12
Sec – III (Q.N : 42 – 47)	Questions with Non-Negative Integer type	+4	0	6	24
Sec – IV (Q.N : 48 – 51)	Questions with MATRIX MATCH	+3	-1	4	12
Total				17	60

THE NARAYANA GROUP

MATHEMATICS**MAX.MARKS: 60****SECTION - I (Maximum Marks : 12)**

This section contains **THREE (03)** 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.

1. Let $f(x) = \sin x + px + q$. Then $f(x) = 0$ has :

A) Only one real root which is positive if $p > 1, q < 0$

B) Only one real root which is negative if $p < -1, q < 0$

C) Only one real root which is negative if $p > 1, q > 0$

D) Only one real root which is positive if $p < -1, q < 0$

2. Let $\vec{u} = \cos\alpha\hat{i} + \sin\alpha\hat{j}$, $\vec{v} = \cos\beta\hat{i} + \sin\beta\hat{j}$, $\vec{w} = \cos\gamma\hat{i} + \sin\gamma\hat{j}$, $0 \leq \alpha, \beta, \gamma < 2\pi$.

If $\vec{u} \cdot \vec{w} = \vec{v} \cdot \vec{w} = -\sqrt{3}\vec{u} \cdot \vec{v}$ then $(2\vec{u} \cdot \vec{v})^3$ can be equal to :

A) $\frac{-8}{27}$

B) $\frac{-1}{8}$

C) 1

D) $\frac{1}{9}$

3. P is a non-singular matrix of order $n \times n$ such that $3PQP^{-1} + P = 2P^{-1}QP$ then

A) P & Q both are identity matrices

B) $\det.(P + Q) = 0$

C) $PQP^{-1} - P^{-1}QP$ is a singular matrix

D) $P + Q$ is non - invertible matrix

SECTION-II (Maximum Marks: 12)

This section contains **FOUR (04)** questions.

Each question has FOUR options for correct answer(s). **ONLY ONE** of these four option is the correct answer. For each question, choose the correct option corresponding to the correct answer.

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If only the correct option is chosen.

Zero Marks: 0 If none of the option is chosen.(i.e the question is un answered)

Negative Marks: -1 In all other cases.

4. A ray of light travelling along the line OP (O being origin) is reflected by the line mirror $2x - 3y + 1 = 0$, the point of incidence being P(1,1). The reflected ray, travelling along PQ is again reflected by the line mirror $2x - 3y - 1 = 0$, the point of incidence being Q. From Q, ray move along QR, where R lies on the line $2x - 3y + 1 = 0$. Then sum of ordinate of point R and abscissa of point Q is :

A) $\frac{100}{13}$ B) $\frac{73}{13}$ C) $\frac{53}{13}$ D) $\frac{23}{13}$

5. Number of integers in the range of ' m ' for which point (m,1) which satisfy $x^2 + y^2 - 3x + 1 \leq 0$ and $2x - y < 2$ is-

A) 0 B) 1 C) 2 D) 3

6. Let $g(x) = \int_{x^2}^{x^3} \frac{dt}{\ln t}$ for $x > 1$ and $h(x) = \int_1^x (2t^2 - \ln t) g(t) dt$, ($x > 1$), then :

A) h is increasing on $(1, \infty)$

B) h is decreasing on $(1, 2)$ and increasing on $(2, \infty)$

C) h is decreasing on $(1, \infty)$

D) h is increasing on $(1, 2)$ and decreasing on $(2, \infty)$

7. The tangent at (x', y') to the curve $x^3 + y^3 = a^3$ meets the curve again at (x_1, y_1) , then

$$\left| \frac{x_1}{x'} + \frac{y_1}{y'} \right|^2 =$$

A) 4 B) 1 C) a D) a^2

SECTION-III (Maximum Marks : 24)

This section contains **SIX (06)** questions. The answer to each question is a **NON-NEGATIVE INTEGER**

For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter answer.

Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +4 If ONLY the correct numerical value is entered as answer.

Zero Marks: 0 In all other cases.

8. The solution of the equation $(2x^2 + 3y^2 - 7)xdx - (3x^2 + 2y^2 - 8)ydy = 0$ is given by $(x^2 + y^2 + \gamma) = C(x^2 - y^2 + \delta)^\beta$. Where C is arbitrary constant, then $(\beta + \gamma + \delta)$ equals
9. If z is a complex number satisfying the condition $\left|z - \frac{5}{z}\right| = 4$, then sum of greatest and least value of $|z|$ is
10. The term which is independent of ' x ' in the expansion of $\left(\frac{x^4 + x^2 + 1}{x^2 - x + 1} - \frac{x^2 + x + 1}{x}\right)^{12}$ is
11. In a drawer Mr. X has 5 pairs of socks, each pair a different color. On Monday, he selects two individual socks at random from the 10 socks in the drawer. On Tuesday, he selects 2 of the remaining 8 socks at random and on Wednesday, two of the remaining 6 socks at random. If the probability that Wednesday is the first day he selects matching socks is $\frac{m}{n}$, where m and n are relatively prime positive integers, then the value of $\frac{m+n}{11}$ is equal to
12. A 3×3 matrix has entries either 1 or -1. Let S be the set of all matrices such that the product of elements of any row or column is -1. For example $\begin{pmatrix} 1 & -1 & 1 \\ 1 & 1 & -1 \\ -1 & 1 & 1 \end{pmatrix}$ is an element of S and number of elements in S is m . Let $P = \begin{pmatrix} 3 & -2 & 3 \\ 2 & -2 & 3 \\ 0 & -1 & 1 \end{pmatrix}$ and trace of the matrix $\text{adj}(\text{adj } P)$ is n then the value of $\frac{m}{n}$ is

13. Let the area of given triangle ABC be Δ . Points A_1 , B_1 and C_1 are the mid points of the BC , CA and AB respectively. Point A_2 is the mid point of CA_1 . Lines C_1A_1 and AA_2 meet the median BB_1 at points E and D respectively. If Δ_1 be the area of the quadrilateral A_1A_2DE . If the value of $\frac{\Delta_1}{\Delta} = \frac{m}{n}$ (where m and n are coprime), then $n - 3m =$ _____

SECTION-IV (Maximum Marks : 12)

SECTION 4 (Maximum Marks: 12)

This section contains **FOUR (04)** Matching List Sets. Each set has ONE Multiple Choice Question. Each set has TWO lists: List-I and List-II. List-I has Four entries (P), (Q), (R) and (S) and List-II has Five entries (1), (2), (3), (4) and (5).

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 ONLY if 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.

14. Matching the following statement

List-I		List-II	
P)	If $\frac{dy}{dx} \left(\frac{1 + \cos x}{y} \right) = -\sin x$ and $f\left(\frac{\pi}{2}\right) = -1$ then $f(0)$ is	1)	5
Q)	The number of points of non-derivability of the function $f(x) = \left[\frac{2x}{\pi} \right] \text{sgn}(\{x\})$ in $(-2, 2)$ is (where $[P]$, $\{P\}$ & $\text{sgn}(P)$ denotes greater integer $\leq P$, fractional part of P & signum function of P respectively)	2)	-2
R)	The area bounded by $e^{\ln x+1 } \geq y , x \leq 1$ is	3)	4
S)	Number of real values of x which satisfy the equation $\frac{(\sec^{-1}x)^3 + (\text{cosec}^{-1}x)^3}{(\tan^{-1}x + \cot^{-1}x)^3} = 7$ is:	4)	1
		5)	7

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

B) $P \rightarrow 2; Q \rightarrow 3; R \rightarrow 3; S \rightarrow 4$

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

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

15. Matching the following statement

List-I		List-II	
P)	If $\sin^2 A = x$ and $\sin A \cdot \sin 2A \sin 3A \cdot \sin 4A = ax^2 + bx^3 + cx^4 + dx^5$, then the value of $a + b + c + d + 5$ is	1)	1
Q)	The values of x between 0 and 2π which satisfy the equation $\sin x \sqrt{8\cos^2 x} = 1$ are in A.P. with common difference d , then $\frac{4d}{\pi}$ is	2)	2
R)	The least difference between the roots, in the first quadrant $\left(0 \leq x \leq \frac{\pi}{2}\right)$, of the equation $4\cos x(2 - 3\sin^2 x) + (\cos 2x + 1) = 0$ is $\frac{\pi}{k}$, then $k =$	3)	6
S)	Let $f(x) = \sqrt{\sin^4 x + 4\cos^2 x} - \sqrt{\cos^4 x + 4\sin^2 x}$ and $g(\sin 2t) = \sin t + \cos t \forall t \in \left[-\frac{\pi}{4}, \frac{\pi}{4}\right]$. If the range of $g(f(x))$ is $[a, b]$, then the value of $a^2 + b^2$ is.	4)	5
		5)	4

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

16. Matching the following statement

List-I		List-II	
P)	If $\lim_{h \rightarrow 0^+} \int_{-1}^1 \frac{h dx}{h^2 + x^2} = k\pi$ Then k equals	1)	5
Q)	The area of the region defined by $1 \leq x - 2 + y + 1 \leq 2$ is	2)	3
R)	$\int_0^{10\pi} [\sin x + \cos x] dx = -11k\pi$ then k equal to (where $[.]$ denotes greatest integer function)	3)	1
S)	If distance between two focii of ellipse $(x - 2y + 3)^2 + (8x + 4y + 4)^2 = 20$ is k then $\frac{k^2}{5}$ equals to	4)	6
		5)	9

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

17. Match the following

List-I		List-II	
P)	If $\sqrt{x^2 + y^2} + \sqrt{(x+3)^2 + (y+4)^2} = 9 - a^2$ represent an ellipse then number of integral value of a is	1)	7
Q)	If $a, b, c > 0$ & $a^2 = bc$ & $a + b + c = abc$ then the least possible value of a^2 is	2)	5
R)	The minimum value of $n \in N$ so that the sum of coefficient of terms in the expansion of $(a + b + c - d)^n$ is more than the number of terms is:-	3)	3
S)	If $\lim_{x \rightarrow \infty} (8x^3 + ax^2)^{\frac{1}{3}} - bx$ exists & is equal to 1, then value of $a - 3b$ is equals to	4)	6
		5)	2

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

THE NARAYANA GROUP

PHYSICS**MAX.MARKS: 60****SECTION - I (Maximum Marks : 12)**

This section contains **THREE (03)** 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:

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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.

18. The current density in a wire of radius a varies with radial distance r as $J = kr^2$, where k is a constant.

A) Total current passing through the cross section of the wire is $I = \frac{\pi ka^4}{2}$.

B) Total current passing through the cross section of the wire is $I = \frac{3\pi ka^3}{2}$.

C) The magnetic field at a distance $r > a$ is $B = \frac{\mu_0 ka^4}{4r}$.

D) The magnetic field at a distance $r < a$ is $B = \frac{\mu_0 kr^3}{4}$.

19. When the number of electrons striking the target material in Coolidge's tube (i.e., X-ray tube) is increased keeping the potential difference same, then :-

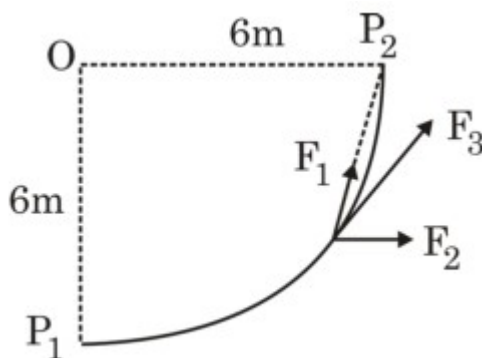
A) intensity of X-rays increases

B) wavelength of X-ray photons increases

C) frequency of cut off X-ray photons remains same.

D) energy of each of the most energetic X-ray photons increases.

20. A smooth track in the form of a quarter circle of radius 6m lies in the vertical plane. A particle moves from P_1 to P_2 under the action of forces \vec{F}_1, \vec{F}_2 and \vec{F}_3 . Force \vec{F}_1 is always toward P_2 and always 20 N in magnitude. Force \vec{F}_2 is always acts horizontally and is always 30 N in magnitude. Force \vec{F}_3 always acts tangentially to the track and is of magnitude 15 N. Select the correct alternative (s) :



- A) Work done by \vec{F}_1 is 120 J B) Work done by \vec{F}_2 is 180 J
C) Work done by \vec{F}_3 is 45π J D) \vec{F}_1 is conservative in nature

SECTION-II (Maximum Marks: 12)

This section contains **FOUR (04)** questions.

Each question has FOUR options for correct answer(s). **ONLY ONE** of these four option is the correct answer. For each question, choose the correct option corresponding to the correct answer.

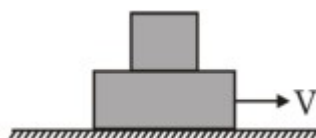
Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If only the correct option is chosen.

Zero Marks: 0 If none of the option is chosen.(i.e the question is un answered)

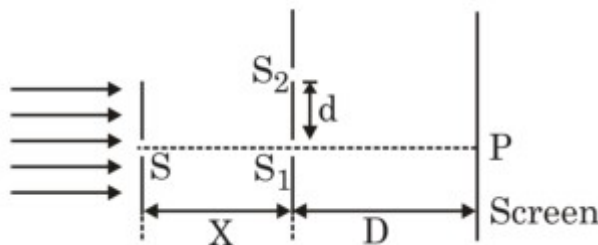
Negative Marks: -1 In all other cases.

21. A block is resting on a horizontal plate in the XY plane and co-efficient of friction between block and the plate is μ . The plate begins to move with velocity $v = bt^2$ in X-direction. At what time will the block starts sliding from plate ?

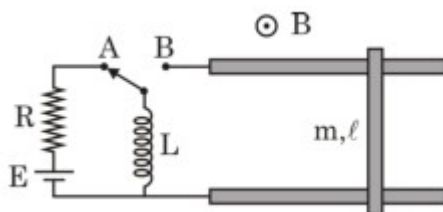


- A) $\frac{\mu b}{g}$ B) $\frac{\mu b g}{2}$ C) $\frac{\mu g}{b}$ D) $\frac{\mu g}{2 b}$

22. Monochromatic light of wavelength λ emerging from slit S illuminates slits S_1 and S_2 which are placed with respect to S as shown in figure. The distances x and D are large compared to the separation d between the slits. If $x = D/2$, the minimum value of d so that there is a dark fringe at the centre P of the screen is :-



- A) $\sqrt{\frac{\lambda D}{3}}$ B) $\sqrt{\frac{2\lambda D}{3}}$ C) $\sqrt{\lambda D}$ D) $2\sqrt{\frac{\lambda D}{3}}$
23. An electromagnetic wave of frequency $f = 3.0\text{MHz}$ passes from vacuum into a non-magnetic dielectric medium with relative permittivity $\epsilon = 4.0$. Then :-
- A) wavelength is doubled and the frequency remains unchanged
- B) wavelength is doubled and frequency becomes half.
- C) wavelength is halved and frequency remains unchanged.
- D) wavelength and frequency both remain unchanged.
24. Switch is in position A for a long time. It is suddenly switched to the side B. Mass of rod is m and length is ℓ . Maximum speed of rod will be :- (uniform magnetic field B exists in the region of conducting rails and rod)



- A) $\left(\frac{E}{R}\right)\sqrt{\frac{L}{m}}$ B) $\left(\frac{E}{R}\right)\sqrt{\frac{m}{L}}$ C) $2\left(\frac{E}{R}\right)\sqrt{\frac{L}{m}}$ D) $2\left(\frac{E}{R}\right)\sqrt{\frac{m}{L}}$

SECTION-III (Maximum Marks : 24)

This section contains **SIX (06)** questions. The answer to each question is a **NON-NEGATIVE INTEGER**

For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter answer.

Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +4 If ONLY the correct numerical value is entered as answer.

Zero Marks: 0 In all other cases.

25. An ammeter and a voltmeter are connected in series to a battery with an emf $E = 6 \text{ V}$.

When a certain resistance is connected in parallel with the voltmeter, the reading of the latter decreases two times, whereas the reading of the ammeter increases the same number of times. Find the voltmeter reading, in volt, after the connection of the resistance.

26. An ideal gas having initial pressure p , volume V and temperature T is allowed to

expand adiabatically until its volume becomes $5.66 V$ while its temperature falls to $\frac{T}{2}$.

Calculate the degrees of freedom of the gas molecules. Given

$$\log_e(5.66) \cong 1.75, \log_e(2) = 0.70$$

27. The peak emission from a black body at a certain temperature occurs at a wavelength of

6000 \AA . On increasing its temperature, the total radiation emitted is increased 16 times.

These radiations are allowed to fall on a metal surface. Photoelectrons emitted by the

peak radiation at higher temperature can be brought to rest by applying a potential

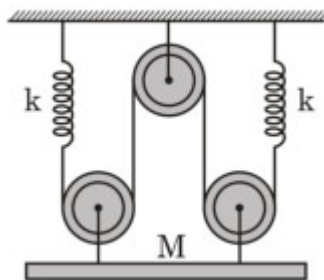
equivalent to the excitation potential corresponding to the transition for the level $n = 4$

to $n = 2$ in the Bohr's hydrogen atom. The work function of the metal is given by

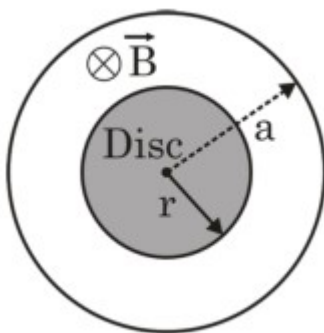
$\frac{\alpha}{100} \text{ eV}$ where α is the numerical constant. The value of α is found $53 \times x$, find x .

[Take : $hc = 12420 \text{ eV} \cdot \text{\AA}$ and $1 \text{ Rydberg} = 13.6 \text{ eV}$]

28. The natural frequency of the system shown in figure is $f = \frac{1}{\pi} \sqrt{\frac{xk}{M}}$. The pulleys are smooth and massless. Find x .



29. A road passes at some distance from a standing man. A truck is coming on the road with some acceleration. The truck driver blows a whistle of frequency 500 Hz when the line joining the truck and the man makes an angle of θ with the road. The man hears a note having a frequency of 600 Hz when the truck is closest to him. Also, the speed of truck has got doubled during this time. Find the value of θ , in degree.
30. A uniform disc of radius r and mass m is charged uniformly with the charge q . This disc is placed flat on a rough horizontal surface having coefficient of friction μ . A uniform magnetic field is present in the complete circular region of radius ' a ' ($a > r$) but varying as kt^3 as shown in Figure. Find the time, in second after which the disc begins to rotate. (Given $r = 1$ m, $m = 18$ kg, $q = 1$ C, $\mu = 0.1$, $K = 4$, $g = 10$ ms $^{-2}$)



SECTION-IV (Maximum Marks : 12)**SECTION 4 (Maximum Marks: 12)**

This section contains **FOUR (04)** Matching List Sets. Each set has ONE Multiple Choice Question. Each set has TWO lists: List-I and List-II. List-I has Four entries (P), (Q), (R) and (S) and List-II has Five entries (1), (2), (3), (4) and (5).

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.

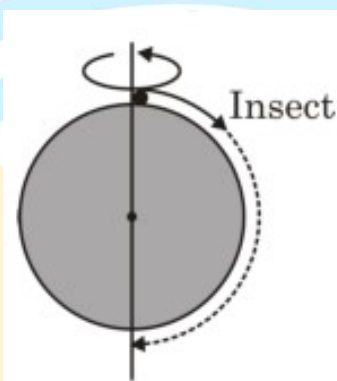
Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +3 ONLY if 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.

31. A solid sphere is freely rotating about an axis as shown in Figure. An insect follows the dotted path on the circumference of sphere as shown. Match the following as insect moves from top to bottom for the system of insect and sphere



List-I		List-II	
P)	Moment of inertia	1)	will remain constant
Q)	Angular velocity	2)	will first increase then decrease
R)	Angular momentum	3)	will first decrease then increases
S)	Rotational kinetic energy	4)	will continuously decrease
		5)	will continuously increase

A) $P \rightarrow 2; Q \rightarrow 3; R \rightarrow 1; S \rightarrow 3$

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

C) $P \rightarrow 5; Q \rightarrow 2; R \rightarrow 3; S \rightarrow 1$

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

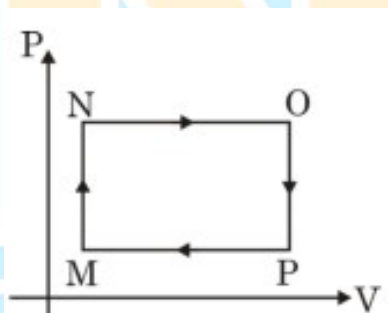
32. Match the following based on the dimensions (the symbols have their usual meaning)
(R-Resistance, C-Capacitance, L-Inductance, E-Electric field, B-Magnetic field)

List-I		List-II	
P)	$\frac{R}{L}$	1)	Time
Q)	CR	2)	Frequency
R)	$\frac{E}{B}$	3)	Speed
S)	$\frac{1}{\mu_0 \epsilon_0}$	4)	Kinetic energy
		5)	Kinetic energy per unit mass

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

33. With reference to the following P – V diagram, match the following quantities.

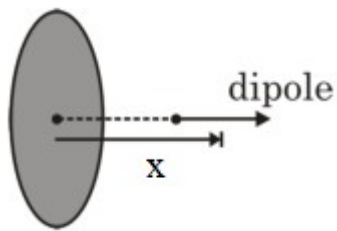
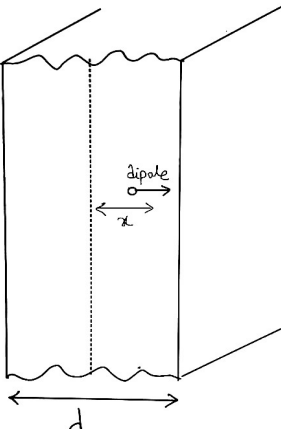
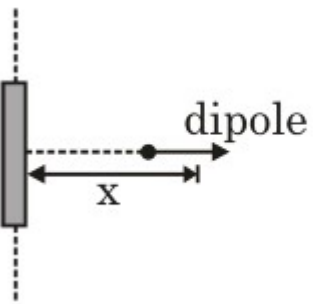
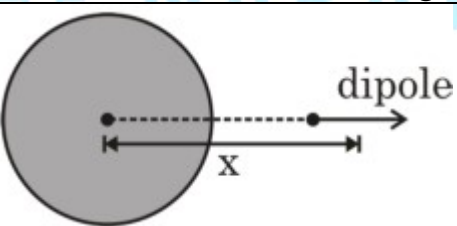
[W : work done by gas ; ΔU : change in internal energy of gas]



List-I		List-II	
P)	Process MN	1)	$W = 0$
Q)	Process NO	2)	$W < 0$
R)	Process OP	3)	$W > 0$
S)	Process PM	4)	$\Delta u > 0$
		5)	$\Delta u < 0$

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

34. List-I shows different charge distributions and short electric dipole at a distance x from the charge distributions. List-II gives the dependence of force acting on the dipole as of function of x .

	LIST-I		LIST-II
P)	 <p>Uniformly charged thin disc of radius R (x is comparable to R)</p>	1)	x^{-2}
Q)	 <p>Uniformly charged thick infinite sheet. Dipole is placed well inside the sheet at a distance x from central plane of sheet.</p>	2)	x^{-5}
R)	 <p>Uniform infinite line of charge.</p>	3)	x^0
S)	 <p>Uniformly charged sphere. Dipole is placed outside the sphere.</p>	4)	None of these
		5)	x^{-3}

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

CHEMISTRY**MAX.MARKS: 60****SECTION - I (Maximum Marks : 12)**

This section contains **THREE (03)** 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.

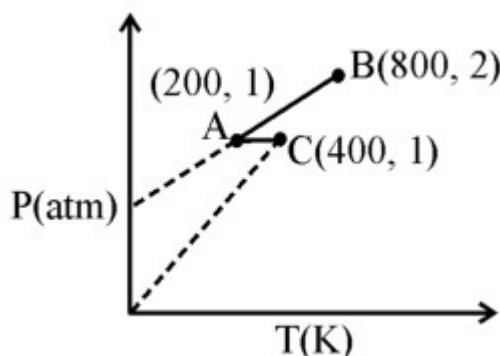
Partial Marks : +1 If two or more options are correct but ONLY one option is chosen and it is a correct option.

Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).

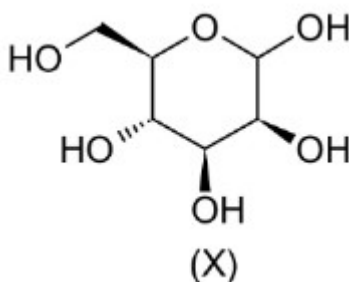
Negative Marks: -2 In all other cases.

35. One mole of a diatomic ideal gas is subjected to a reversible process that involves two steps AB and AC. The pressure at A and C is same. Consider the graph and choose correct statements.

[Given : $\ln 2 = 0.70$, $\ln 3 = 1.1$, $R = 0.082 \text{ L - atm / K - mol}$]



- A) Entropy change for process AC is 0.2 kJ K^{-1}
 B) In Path AB work done is -22.3 J
 C) Volume of gas at B = $2 \times$ Volume of gas at A
 D) Volume of gas at C is 32.8 lit.
36. The correct statement/s about the pyranose form of a sugar (X) given below is/are:



- A) It exists in two anomeric pyranose forms
- B) It reacts with Tollen's reagent to give a silver mirror
- C) The penta-O-methyl derivative of (X) is non reducing
- D) It resists reduction with aqueous sodium borohydride

37. The correct statement(s) related to oxoacids of phosphorous is(are) :

- A) Upon heating, H_3PO_3 undergoes disproportionation reaction to produce H_3PO_4 and PH_3 .
- B) While H_3PO_3 can act as reducing agent, H_3PO_4 cannot.
- C) H_3PO_3 is a monobasic acid.
- D) The H atom of P – H bond in H_3PO_3 is not ionizable in water.

SECTION–II (Maximum Marks: 12)

This section contains **FOUR (04)** questions.

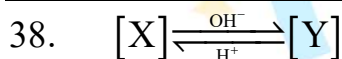
Each question has FOUR options for correct answer(s). **ONLY ONE** of these four option is the correct answer. For each question, choose the correct option corresponding to the correct answer.

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If only the correct option is chosen.

Zero Marks: 0 If none of the option is chosen.(i.e the question is un answered)

Negative Marks: -1 In all other cases.



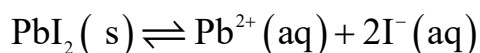
Both [X] and [Y] produce ink blue solution with H_2O_2 in presence of organic solvents and H_2SO_4 , [X] & [Y] respectively

- A) MnO_4^- , MnO_4^{2-} B) $\text{Cr}_2\text{O}_7^{2-}$, CrO_4^{2-} C) CrO_4^{2-} , $\text{Cr}_2\text{O}_7^{2-}$ D) SO_3^{2-} , SO_4^{2-}

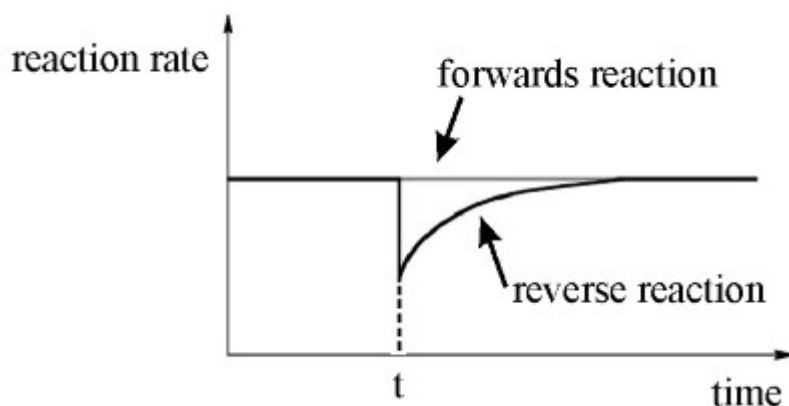
39. Which of the following set contains, all tetrahedral geometries with respect to central metal atom or ion ?

- A) FeCl_4^{2-} , $\text{Cu}(\text{CN})_4^{3-}$, PdCl_4^{2-} B) $\text{NiCl}_2(\text{PPh}_3)_2$, $\text{Pt}(\text{CN})_4^{2-}$, $\text{RhCl}(\text{PPh}_3)_3$
- C) $\text{Ni}(\text{CO})_4$, $\text{Fe}(\text{CO})_4^{2-}$, $\text{Cu}(\text{CN})_4^{3-}$ D) $\text{Fe}(\text{CO})_5$, $\text{Co}(\text{CO})_4^-$, $[\text{NiCl}_4]^{2-}$

40. A small amount of solid lead iodide was added to a beaker of water, which was stirred. Most of the solid settled at the bottom of the beaker, but a little dissolved, establishing the equilibrium

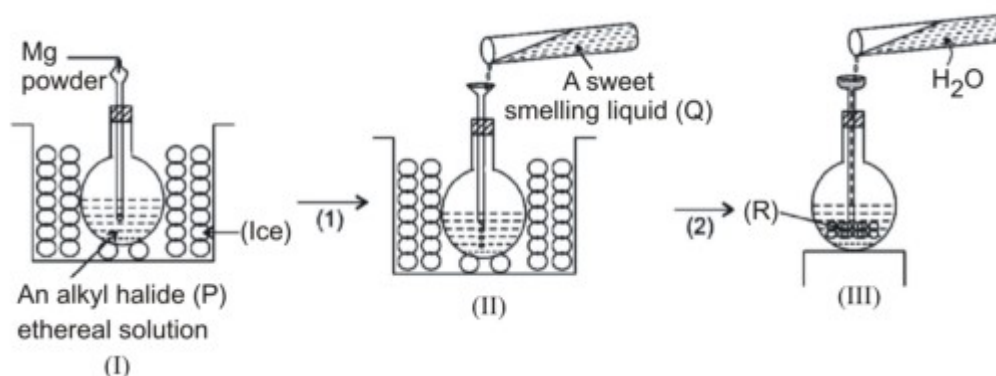


The rates of the forward and reverse reactions were monitored over time, producing the graph shown below:

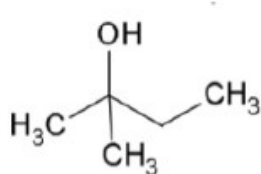


What happened at time t ?

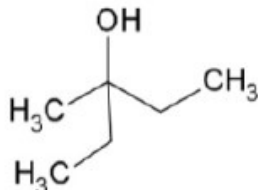
- A) The beaker was cooled in an ice-bath.
 - B) A small amount of solid KI was added to the beaker.
 - C) A small amount of solid PbI_2 was removed from the beaker.
 - D) A small amount of water was added to the beaker.
41. Consider the following scheme:



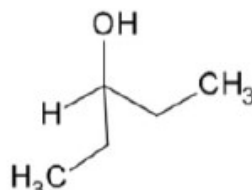
If P is ethyl chloride, R can be



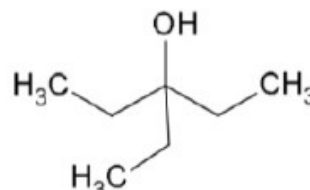
I



II



III



IV

A) I, II, III, IV

B) II, III, IV only

C) IV only

D) II, IV only

SECTION-III (Maximum Marks : 24)

This section contains **SIX (06)** questions. The answer to each question is a **NON-NEGATIVE INTEGER**

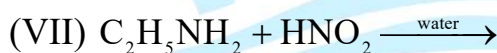
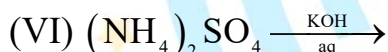
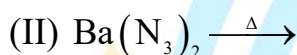
For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter answer.

Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +4 If **ONLY** the correct numerical value is entered as answer.

Zero Marks: 0 In all other cases.

42. Find the number of reactions, which give N_2 .

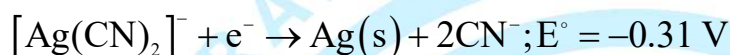
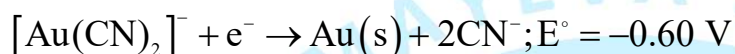
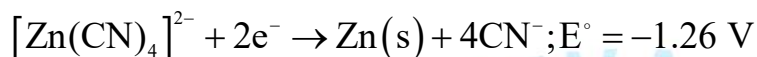


43. If 'x' is the total number of $p\pi - d\pi$ bonds and 'y' is the total number of lone pair(s) on non terminal atoms per molecule in trimer of SO_3 , the value of $(x + y)$ is :-

44. One gram of commercial $AgNO_3$ is dissolved in 50 mL of water. It is treated with 50 mL of a KI solution. The silver iodide thus precipitated is filtered off. Excess of KI in the filtrate is titrated with $M/10KIO_3$ solution in presence of 6M HCl till all I^- ions are converted into ICl . It requires 50 mL of $M/10KIO_3$ solution. Twenty milliliters of the same stock solution of KI requires 30 mL of $M/10KIO_3$ under similar conditions. The percentage of $AgNO_3$ in the sample is (Atomic weight of silver = 108)

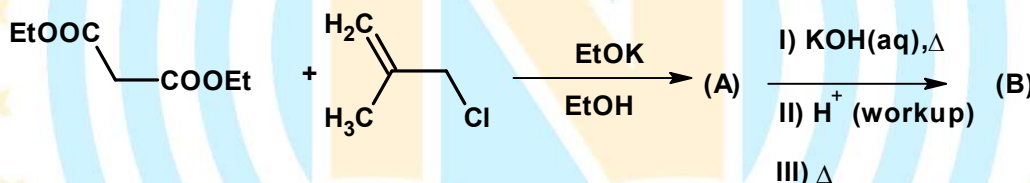
45. Both gold and silver are extracted by cyanide process. Gold in nature is frequently alloyed with silver, which is also oxidized by aerated NaCN solution, similar to gold. 1000 L of a solution of $0.002\text{M} [\text{Au}(\text{CN})_2]^-$ and $0.003\text{M} [\text{Ag}(\text{CN})_2]^-$ was evaporated to half of the original volume and treated with 78 g zinc (atomic mass = 65).

Assume that elevation from standard conditions is unimportant and that the redox reactions go to completion. Given:



If the concentration of $[\text{Au}(\text{CN})_2]^-$ in the solution after addition of zinc in it, be x mol/lit. The value of $(x \times 10^5)$ is.

46. Consider the following reactions



Amount (in mg) of B reacts completely with 100ml of 0.1MNaHCO_3 solution.

47. The correct order of the given reagents to convert benzene to m-Chlorobromobenzene is

- (1) Sulfuric acid (conc.) and heat
- (2) $\text{Cl}_2 + \text{FeCl}_3$ and heat
- (3) $\text{NaNO}_3 + \text{H}_3\text{O}^+, 0^\circ\text{C}$
- (4) H_2 / Pt catalyst
- (5) Mg in ether
- (6) PBr_3

(7) H_3PO_2 (aqueous)(8) HNO_3 (conc.) + H_2SO_4 (conc.) and heat(9) $\text{Cu}_2\text{Br}_2 + \text{HBr}$ (10) $(\text{CH}_3\text{CO})_2\text{O} + \text{pyridine}$

Write the correct order in form of their number and express last two digits as answer.

[For, e.g. If order is 1357, then your answer will be 57]

SECTION-IV (Maximum Marks : 12)**SECTION 4 (Maximum Marks: 12)**

This section contains **FOUR (04)** Matching List Sets. Each set has ONE Multiple Choice Question. Each set has TWO lists: List-I and List-II. List-I has Four entries (P), (Q), (R) and (S) and List-II has Five entries (1), (2), (3), (4) and (5).

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.

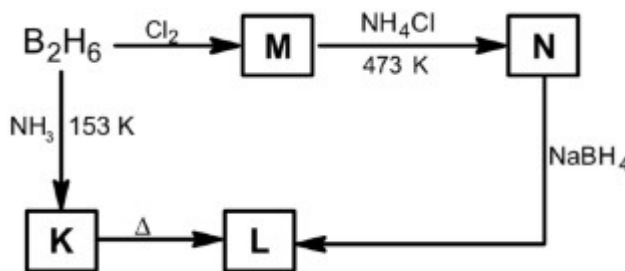
Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +3 ONLY if 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.

48. Study the sequence of reactions of diborane (B_2H_6) given below and match the products K, L, M and N with products mention in List-II (shown reagents are taken in excess)



List-I		List-II	
P)	K	1)	$[\text{BH}_2(\text{NH}_3)_2][\text{BH}_4]$
Q)	L	2)	$\text{B}_2\text{H}_5\text{Cl}$
R)	M	3)	BCl_3
S)	N	4)	$\text{B}_3\text{N}_3\text{H}_3\text{Cl}_3$
		5)	$\text{B}_3\text{N}_3\text{H}_6$

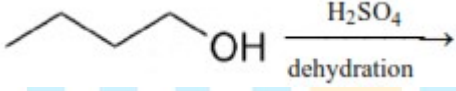
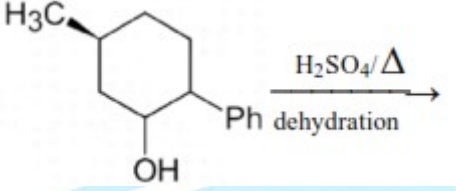
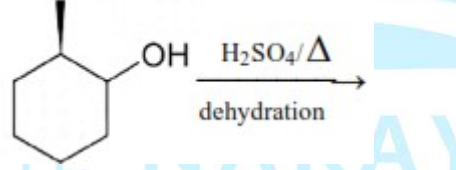
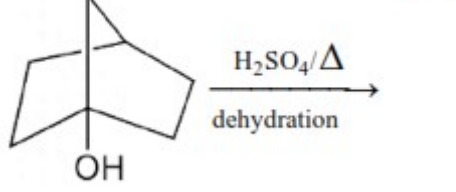
A) $\text{P} \rightarrow 5; \text{Q} \rightarrow 1; \text{R} \rightarrow 3; \text{S} \rightarrow 2$ B) $\text{P} \rightarrow 5; \text{Q} \rightarrow 1; \text{R} \rightarrow 2; \text{S} \rightarrow 4$ C) $\text{P} \rightarrow 1; \text{Q} \rightarrow 5; \text{R} \rightarrow 2; \text{S} \rightarrow 4$ D)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

49. Match the half-life of the reaction in List-I with the integrated rate equation in List-II (a = initial concentration of reactant and $a - x$ = concentration of reactant at time ' t '.)

List-I		List-II	
P)	$t_{1/2} = \frac{0.586}{k} \sqrt{a}$	1)	$k = \frac{x}{t}$
Q)	$t_{1/2} = \frac{0.693}{k}$	2)	$k = \frac{1}{t} \left[\frac{1}{a-x} - \frac{1}{a} \right]$
R)	$t_{1/2} = \frac{a}{2k}$	3)	$k = \frac{2}{t} [\sqrt{a} - \sqrt{a-x}]$
S)	$t_{1/2} = \frac{1}{ka}$	4)	$k = \frac{2.303}{t} \log \frac{a}{a-x}$
		5)	$k = \frac{2}{t} \left[\frac{1}{\sqrt{a-x}} - \frac{1}{\sqrt{a}} \right]$

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

50. Match each species in List - I with appropriate statement (s) of List - II and choose correct option

	LIST-I		LIST-II
P)		1)	At least one of the product shows optical isomerism.
Q)		2)	Major product contains even number of α - hydrogen's (Hydrogen's which can involve in hyper conjugation).
R)		3)	One of the product shows geometrical isomerism.
S)		4)	Reactant can turn acidified dichromate to green.
		5)	Will not undergo dehydration.

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

51. Match the following

List-I		List-II	
P)	A compound that liberates ammonia on treatment with Hot aqueous KOH	1)	$\text{CH}_3 - \text{CH}_2 - \text{CN}$
Q)	A compound that gives CO_2 , NH_4^+ and acetic acid after boiling in concentrated, aqueous HCl	2)	$\text{CH}_3 - \text{CH}_2 - \text{CONH}_2$
R)	A compound that gives NH_4^+ and mono carboxylic acid after treatment with concentrated aqueous HCl.	3)	$\text{NC} - \text{CH}_2 - \text{CN}$
S)	A compound that gives product A with MeMgI followed by hydrolysis, which on further treatment with MeMgI excess followed by acidification gives 2-methyl-2-butanol	4)	$\text{CH}_3\text{COONH}_4$
		5)	PhCOONH_4

The correct option is

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

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