JEE-ADVANCED PAPER-II

Time: 2.00 PM to 5.00 PM **IMPORTANT INSTRUCTIONS** **Max Marks: 180**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 10)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 11 – 16)	Questions with Comprehension Type (3 Comprehensions – 2 +2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 17 – 20)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 21 – 30)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 31 – 36)	Questions with Comprehension Type (3 Comprehensions – 2 +2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 37 – 40)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 41 – 50)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 51 – 56)	Questions with Comprehension Type (3 Comprehensions – 2 +2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 57 – 60)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

PART-I_PHYSICS **Max Marks : 60**

Section-1

(Only one Option correct Type)

This section contains 10 Multiple Choice questions. Each Question has Four choices (A), (B), (C) and (D). Out of Which Only One is correct

1. The length of a cylinder is measured with a metre rod having least count 0.1cm. Its diameter is measured with vernier calipers having least count 0.01cm. Given that length is 5.0 cm and radius is 2.0cm. The percentage error in the calculated value of the volume will be

   A) 1% B) 2% C) 3% D) 4%

2. A car is fitted with a device which transmits sound 60 times per minute. There is no wind and speed of sound in still air is 345 m/s. If you hear the sound 68 times per minute, when you are moving towards the car with a speed of 12m/s , the speed of the car must be

   A) 20.0 m/s towards you B) 30.0 m/s towards you

   C)10.0 m/s away from you D) 10.0 m/s towards you

3. In a regular polygon with11 sides each cornet is at a distance 'a' from centre. Identical charges are placed at 10 corners. At the centre the intensity is E and the potential is V. The ratio of $\frac{V}{E}$ has magnitude

   A) $11a$ B) $\frac{10}{a}$ C) $\frac{10}{11}a$ D) $10a$

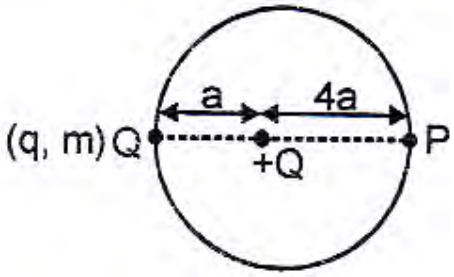
4. A micrometer screw gauge with pitch of 0.5cm and 50 divisions on circular scale is used to measure the diameter of a thin wire. Initially when the gap is closed the line of fourth division coincides with the reference line. Three reading shows 46^{th}, 48th and 44^{th} division coinciding with the reference line which is beyond 0.5 mm of the main scale. The (best) measured value is

   A) 0.46 mm B) 0.94 mm C) 0.92 mm D) 1.00 mm

5. How much heat must be supplied to convert 1 kg ice at -10^0C to steam at 100^0C (Take specific heat of ice $S_i = 0.5cal/gm^0C$)

   A) 725 kcal B) 720 kcal C) 730 kcal D) 735 kcal

6. The diagram shows a small bead carrying charge q. The bead can freely move on smooth fixed ring placed on a smooth horizontal plane. Potential due to $+Q$ at P is V. If bead is given a very small velocity tangential from Q. Velocity of bead when it reaches at P .



A) $\sqrt{\frac{6qV}{m}}$ B) $\sqrt{\frac{qV}{m}}$ C) $\sqrt{\frac{3qV}{m}}$ D) Zero

7. An electron (mass m, charge e) orbiting around a nucleus has angular momentum L. the magnetic field produced by the electron at the centre of the orbit can be expressed as

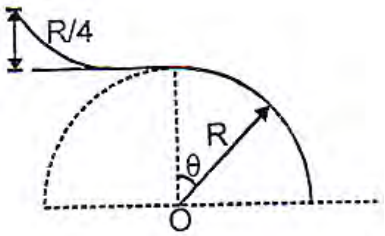
A) $B=\left(\mu_0 e/8\pi mr^3\right)L$ B) $B=\left(\mu_0 e/4\pi mr^3\right)L$

C) $B=\left(\mu_0 e/\pi mr^3\right)L$ D) $B=\left(e/4\pi\mu_0 mr^3\right)L$

8. A bowl of water, initially at $10^0 C$ is brought to boiling after being 9 minutes at the stove top. If it remains on the stove top, how long will it further take for all the water to evaporate? Neglect heat losses and the heat capacity of the bowl.

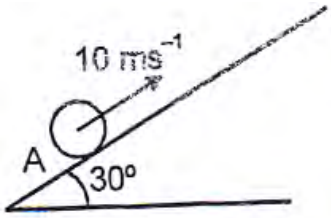
A) 18 min B) 36 min C) 54 min D) 15 min

9. A skier plans to ski a hemisphere of radius R . He starts from rest a curve surface of height (R/4) . The angle θ at which he leaves the hemisphere is



A) $\cos^{-1}\left(\frac{2}{3}\right)$ B) $\cos^{-1}\left(\frac{5}{\sqrt{3}}\right)$ C) $\cos^{-1}\left(\frac{5}{6}\right)$ D) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

10. A cylinder of mass 2kg is rolling up the place without slipping instantaneous velocity of centre of gravity at point A is $10ms^{-1}$. The distance traveled by the cylinder before coming to rest in metre is



A) 15 m B) $\frac{30}{4}m$ C) $\frac{30}{6}m$ D) $\frac{15}{6}m$

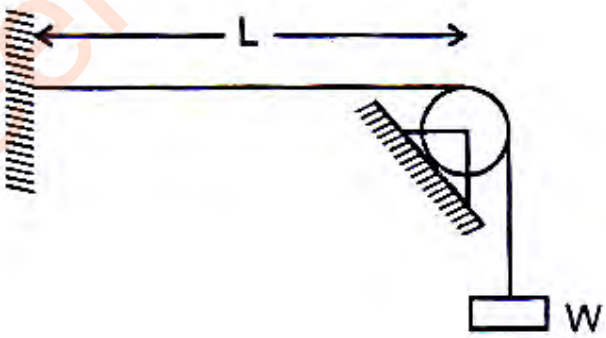
Section-2

(Paragraph Type)

This section contains 3 paragraphs each describing theory, experiment, data etc. Six questions relate to three paragraphs with two questions on each paragraph. Each question pertaining to a particular paragraph should have only one correct answer among the four choices A, B, C and D.

Paragraph- I For Question No.s 11 to 12 :

Standing transverse waves can be set up in a string clamped at both ends and under tension. For Example an arrangement such as one shown in the figure can set up such standing waves. The weight W provides the necessary tension. In one such arrangement a wire of length L , is in resonance in fundamental mode with a tuning fork.



11. If the weight is immersed in water and the length L is altered to L_1 , there is again resonance with the same tuning fork in fundamental mode. What can you say about L and L_1 ?

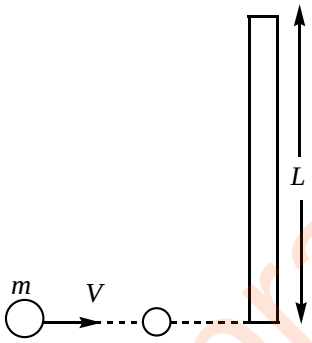
A) $L = L_1$ B) $L > L_1$ C) $L < L_1$ D) Data Insufficient

12. Now the weight is immersed in a liquid and for length L , the wire in resonance with the same tuning fork but in the first overtone. What is the ratio of densities of block and liquid?

A) 4/3 B) 2/3 C) 5/3 D) 3/4

Paragraph- II For Question No.s 13 to 14 :

A small disc and a thin uniform rod of length L , whose mass is η times greater than the mass of the disc, lie on a smooth horizontal plane. The disc is set in motion , in horizontal direction and perpendicular to the rod with velocity V , after which it elastically collides with the end of the rod.



13. The velocity of the disc after collision is

A) $\frac{(4+\eta)V}{4-\eta}$ B) ηV C) $\left(\frac{4-\eta}{4+\eta}\right)V$ D) $\left(\frac{\eta}{2}\right)V$

14. Angular velocity of the rod after the collision is

A) $\frac{2V}{L}$ B) $\frac{\eta V}{L}$ C) $\left(\frac{4+V}{4-\eta}\right)$ D) $\frac{12V}{(4+\eta)L}$

Paragraph -III For Question No.s 15 to 16:

A non-conducting disc of radius r and uniform positive surface charge density σ is placed on the ground, with its axis vertical. A Particle of mass m and charge q is dropped along the axis of the disc from a height h with zero initial velocity. The ratio of charge to mass of the particle is given by $\frac{q}{m}=\frac{4\in_0 g}{\sigma}$

15. What is the value of h if the particle just reaches the disc?

A) $\frac{4r}{3}$ B) $2r$ C) $\frac{3r}{2}$ D) $\frac{2r}{5}$

16. At what position z (from the ground) will the particle attain equilibrium position?

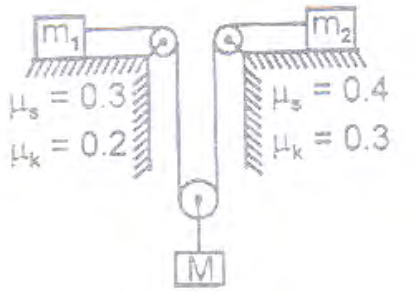
A) $z=\frac{r}{3}$ B) $z=\frac{r}{\sqrt{3}}$ C) $z=\frac{r}{\sqrt{2}}$ D) $z=\frac{r}{2}$

Section-3

(Matching List Type)

This section contains four questions, each having two matching lists (List-1 & List-II). The options for the correct match are provided as (A), (B),(C) and (D) out of which ONLY ONE is correct.

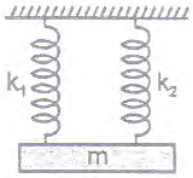
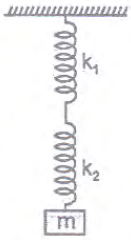
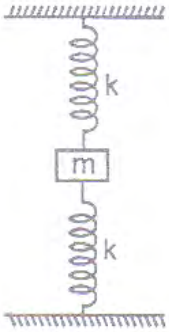
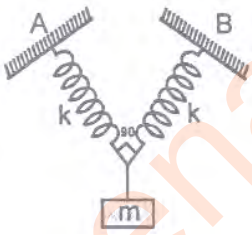
17. In the first column m_1, m_2 and M and situation is indicated. Match the description in column-II



List-I	List-II
P) M=3 kg, $m_1 = 6kg$, $m_2 = 4kg$. System is released from rest	1) Friction m_1 is static
Q) M=3 kg, $m_1 = 2kg$, $m_2 = 6kg$. System is released from rest	2) Friction m_2 is static
R) M=3 kg, $m_1 = 7kg$, $m_2 = 3kg$. System is released from rest	3) Friction m_1 is kinetic
S) M=3 kg, $m_1 = 1kg$, $m_2 = 3kg$. System is released from rest	4) Friction m_2 is kinetic

	P	Q	R	S
A)	2,3	1,2	1,4	1,4
B)	1,2	2,3	1,4	2,3
C)	2,3	1,2	2,3	1,4
D)	1,2	2,3	2,4	1,2

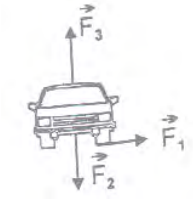
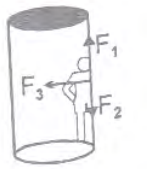
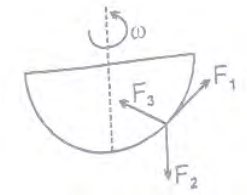
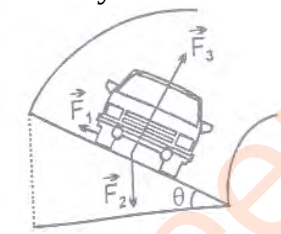
18. Match List(I) with List (II) and select the correct answer using given below the Lists .

List I		List II	
P)		1)	$T = 2\pi\sqrt{\frac{m(k_1+k_2)}{k_1k_2}}$
Q)		2)	$T = 2\pi\sqrt{\frac{m}{(k_1+k_2)}}$
R)		3)	$T = 2\pi\sqrt{\frac{m}{k}}$
S)		4)	$T = 2\pi\sqrt{\frac{m}{2k}}$

Codes:

	P	Q	R	S
A)	3	2	1	4
B)	4	3	2	1
C)	2	1	4	3
D)	1	2	3	4

19. Column-I shows certain situations and Column-II shows information about forces

List-I	List-II
P) Situation  Front view of a car rounding a curve with constant speed	1) $\vec{F}_1 + \vec{F}_2 = 0$
Q)  Passengers in a rotor not sliding relative to rotor wall cylindrical rotor is rotating with constant angular velocity about its symmetry axis	2) $\vec{F}_1 + \vec{F}_2 + \vec{F}_3$ is centripetal force
R)  Particle kept on rough surface of a bowl , no relative motion of particle in bowl , bowl has constant angular velocity	3) $\vec{F}_1$ is static friction
S)  Car parked on a banker road with no sideways skidding	4) $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 0$

Codes:

	P	Q	R	S		P	Q	R	S
A)	2,3	1,2,3	2,3	3,4	B)	1,2,3	2,3	2,3	3,4
C)	1,2	1,2	1,2,3	4	D)	1,2,3	1,2	2,3	2,3

20. Match List (1) with List(II) and select the correct answer using codes given below the lists. A proton and an α-particle have their kinetic energies in ratio 1:8

List I		List II	
P)	Ratio of their masses	1)	$1/\sqrt{2}$
Q)	Ratio of their velocities	2)	(1/4)
R)	Ratio of their charges	3)	1/2
S)	Ratio of their De-Broglie wavelength	4)	$4\sqrt{2}$

Codes :

	P	Q	R	S		P	Q	R	S
A)	2	4	3	1	B)	3	4	2	1
C)	3	1	2	4	D)	2	1	3	4

PART-II_CHEMISTRY **Max Marks : 60**

Section-1

(One or more options correct type)

This section contains 10 Multiple Choice questions. Each Question has Four choices (A), (B), (C) and (D). Out of Which Only One is correct

21. Phosphine gas is not prepared by

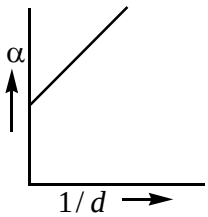
A) $Ca_3P_2 + dil.HCl$ B) $PH_4I + KOH$ soln

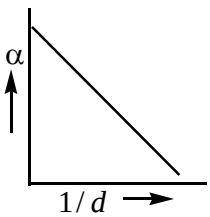
C) Red phosphorus + NaOH soln $\xrightarrow{\Delta}$ D) $P_4 + NaOH\text{soln} \xrightarrow{\Delta}$

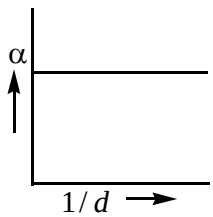
22. Given : $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

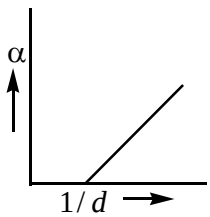
α = Degree of dissociation of N_2O_4

d = Vapour density of equilibrium mixture. Which is correct graph?

A) 

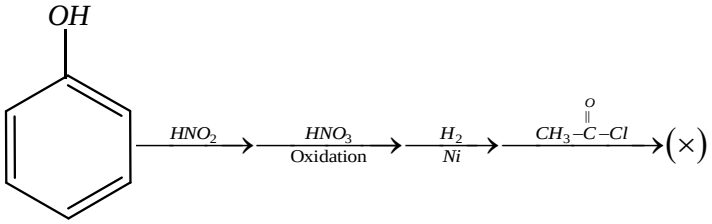
B) 

C) 

D) 

23. Potential difference of electrical double layer formed in a colloidal solution is called.

A) Zeta potential B) Brownian potential
C) Dorn potential D) Nernst potential

24. 

products (x) is

A) Aspirin B) Paracetamol C) Phenophthaline D) Phenylalanine

25. Which of the following co-ordination compound has three stereoisomers

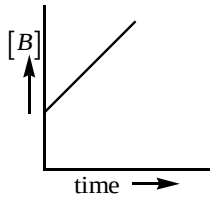
A) $\left[Cd(gly)(H_2O)(NH_3)\right]^+$ B) $\left[Pt\,Br_2(H_2O)_2\right]$

C) $\left[Cr(en)_3\right]^{3+}$ D) $\left[Co\,Br(NO_2)(en)_2\right]^+$

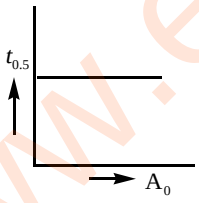
26. What is the approximate average number of glucose units in an aqueous solution of 10 g/L of starch has an osmotic pressure $\pi = 5\times10^{-3}\,atm$ at $25°C$?

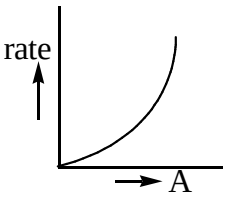
A) 300 units B) 100 units C) 450 units D) 1000 units

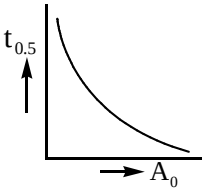
27. For the reaction $(A \rightarrow B)$ following graph is given:

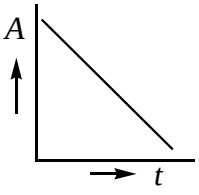


The correct graph for the given reaction is

A) 

B) 

C) 

D) 

28. $PCl_5(g) + Ag \xrightarrow{\Delta} x + y$

Where product x is water insoluble but y reacts with water, then product x is insoluble in solution of :

A) KCN B) $Na_2S_2O_3$ C) $dil.HNO_3$ D) NH_3

29. Which of the following co-ordination ion/compound does not exhibit structural isomerism.

A) $\left[PtBrCl\left(H_2O\right)_4\right]SO_4$ B) $\left[CoBr\left(NH_3\right)_5\right]\left[Cd\left(CN\right)_4\right]$

C) $\left[Co\left(ox\right)\left(H_2O\right)_4\right]Br$ D) $\left[Ir\left(ONO\right)_3\left(H_2O\right)_3\right]$

30. The energy of separation of an electron moving in He^+ is 13.6 eV. Which is correct statement?

A) kinetic energy associated with electron is 13.6 eV

B) Velocity associated with electron is $1.09\times10^6 m\sec^{-1}$

C) orbit angular momentum of electron is $\frac{h}{2\pi}$

D) none of these

Section-2

(Paragraph Type)

This section contains 3 paragraphs each describing theory, experiment, data etc. Six questions relate to three paragraphs with two questions on each paragraph. Each question pertaining to a particular paragraph should have only one correct answer among the four choices A, B, C and D.

Paragraph For Questions 31 & 32

$$\underbrace{X}_{\text{Water soluble salt}} \xrightarrow{\text{Excess KI}} Y\downarrow + \underbrace{Z}_{\text{Coloured (solution)}} \xrightarrow{Na_2S_2O_3} \underbrace{Y\downarrow}_{white} + \text{Colourless products}$$

31. Salt 'X' is

A) $Fe_2\left(SO_4\right)_3$ B) $CuSO_4.5H_2O$ C) KNO_2 D) $Hg\left(NO_3\right)_2$

32. Salt 'X' does not produce precipitate with solution of

A) $K_4\left[Fe\left(CN\right)_6\right]$ B) $BaCl_2$ C)NaOH D) Excess NH_4OH

Paragraph For Questions 33 & 34

500 ml 0.2M XOH $\left(K_b=10^{-7}\right)$ and 500 ml $0.16M$ $YOH\left(K_b=10^{-6}\right)$ are mixed together.

Given: log 3 = 0.48

33. pH of final solution is

A) 3.52 B) 6.52 C) 10.48 D) 7.48

34. The degree of dissociation of XOH in final solution is

A) $\frac{10^{-3}}{3}$ B) $\frac{10^{-4}}{3}$ C) $\frac{10^{-4}}{\sqrt{2}}$ D) 1.8×10^{-7}

Paragraph For Questions 35 & 36

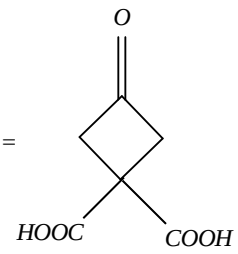
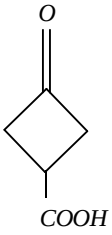
The neutralization Equivalent is Eq.wt $\left(\frac{g}{eq}\right)$ of an acid as determined by titration with standard $NaOH$. The number of ionisable (H) of an acid is the number of equivalents per mole and is equal to $\frac{mw}{NE}$.

(Gemdicarboxyllic acids on heating loses CO_2

35. Which carboxylic acid (A) , NE=52g/eq , loses CO_2 when heated to given an acid $(B), NE = 60g/eq$. Where $NE = \frac{molecular\ \text{mass}}{Number\ of\ ionisable\ H}$)

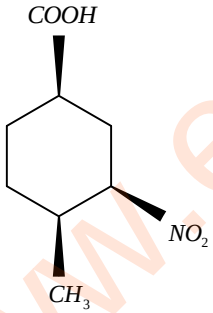
A) $A = CH_2(COOH)_2 ; B = CH_3COOH$

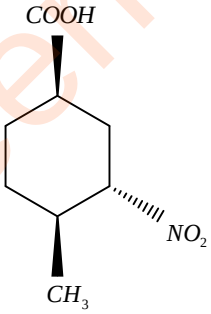
B) $A = \begin{matrix} CH_2COOH \\ | \\ CH_2COOH \end{matrix} ; B = CH_3COOH$

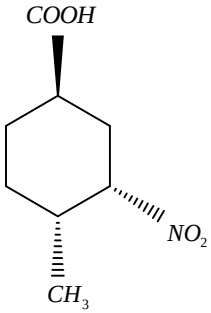
C) $A =$  ; $B =$ 

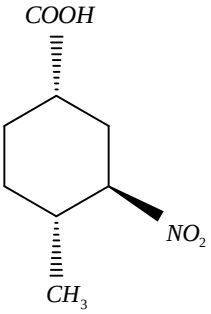
D) $A = CH_3 - CH\begin{matrix} COOH \\ \diagdown \\ \diagup \\ COOH \end{matrix} ; B = CH_3 - CH_2 - COOH$

36. Which of the following acid have higher pKa ?

A) 

B) 

C) 

D) 

Section-3

(Matching List Type)

This section contains four questions, each having two matching lists (List-1 & List-II). The options for the correct match are provided as (A), (B),(C) and (D) out of which ONLY ONE is correct.

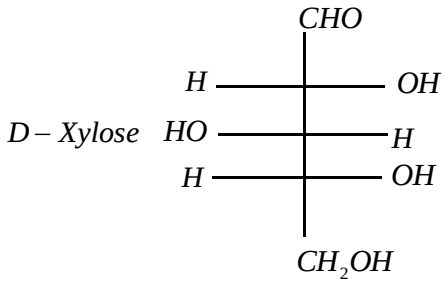
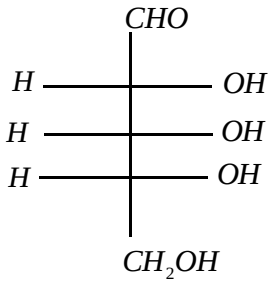
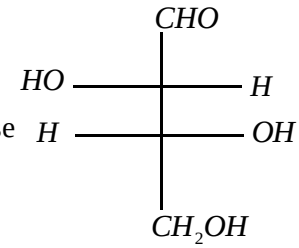
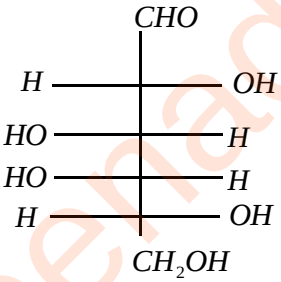
37.

	List-I (Conc.cell)	List-II (Condition for working of cell)
P)	$\underset{1bar}{Pt,H_2(g)\mid H^+(pH=x)\parallel H^+(pH=y)\mid \underset{1bar}{H_2(g),Pt}}$	1) $y > x$
Q)	$\underset{P_1}{Pt,H_2(g)\mid HCl(aq)\mid \underset{P_2}{H_2(g),Pt}}$	2) $P_1 > P_2$
R)	$\underset{1bar}{Pt,Cl_2(g)\mid Cl^-(y)\parallel Cl^-(x)\mid \underset{1bar}{Cl_2(g),Pt}}$	3) $x > y$
S)	$\underset{P_1}{Pt,Cl_2(g)\mid KCl(aq)\parallel \underset{P_2}{Cl_2(g),Pt}}$	4) $P_2 > P_1$

Codes :

	P	Q	R	S
A)	2	3	1	4
B)	3	2	4	1
C)	3	2	1	4
D)	2	3	4	1

38.

List--I		List-II
P)		1) On oxidation give meso
Q)	D-Ribose 	2) Give the same osazone as D-arabinose
R)	D-Threose 	3) Smallest aldose able to form cyclic hemiacetal
S)	D-galactose 	4) C-4 epimer of D-glucose

Codes :

	P	Q	R	S
A)	3	2	1	4
B)	4	3	2	1
C)	2	1	4	3
D)	1	2	3	4

39.

List—I (Reactions)		List-II (One of the product)	
P)	$Co\left(NO_3\right)_2 + Al_2O_3 \xrightarrow{\Delta} ....$	1)	NH_3
Q)	$NO_2(g) + NO(g) \xrightarrow{cool} ....$	2)	$NO_2(g)$
R)	$\left(NH_4\right)_2 Cr_2O_7(s) \xrightarrow{\Delta} ....$	3)	$N_2(g)$
S)	$Na\left(NH_4\right)HPO_4 + CuSO_4 \xrightarrow{\Delta}$	4)	Coloured substance

Codes :

	P	Q	R	S
A)	4	2	3	1
B)	4	1	3	2
C)	2	3	1	4
D)	2	4	3	1

40.

List--I		List-II	
P)	Pyruvic acid	1)	2,4 DNP Test
Q)	Aspirine	2)	Decolourises Br_2 / CCl_4
R)	Acrylic acid	3)	Evolve $H_2(g)$ with Na metal
S)	Benzyl alcohol	4)	Give $CO_2(g)$ with $NaHCO_3$

Codes :

	P	Q	R	S
A)	3	2	1	4
B)	4	3	2	1
C)	1	4	2	3
D)	1	2	3	4

Section-1

(Only one Option correct Type)

This section contains 10 Multiple Choice questions. Each Question has Four choices (A), (B), (C) and (D). Out of Which Only One is correct

41. Let $\frac{x-1}{2}=\frac{y-1}{3}=\frac{z+3}{2}$ and $\frac{x-k}{1}=\frac{y+1}{5}=\frac{z}{-1}$ be two lines intersect at (α,β,γ) then $\alpha+\beta+\gamma-k$ equals

A) 1 B)4 C)6 D)9

42. Let $A=\{1,2,3,4,5,6,7,8\}$ be a set Let $f:A\to A$ be a function such that $f(X)\neq X$,$\forall X\in A, f(X)$ is even when ever X is even and $f(X)$ is odd when ever X is odd. Then total number of on-to functions satisfying these conditions will be

A)36 B) 49 C) 64 D) 81

43. Let A be square matrix of order n and I_n be an identity matrix of order $n.A\neq 0$ and $A^3=0$. Let $M=\frac{1}{2}A^2+A+I_n$ and $N=\frac{1}{2}A^2-A+I_n$ be two matrices . Then which of the following must be correct ?

A) $M^{-1}=N$ B) $\det(M)=0$ C) $M^T=N$ D) $\det(MN)\neq 1$

44. $\lim\limits_{x\to 0}\dfrac{\int_{1-x}^{1+x}\left(t^3-3t^2+3t+3\right)\sin(t-1)\,dt}{x^3\sin x.\sin 2x}$ equals :

A) $\frac{1}{10}$ B) $\frac{1}{5}$ C) $\frac{2}{5}$ D) None of these

45. Let $Z=x+iy(x,y\in R)$ be a complex number such that $|Z-(2+3i)|=2$ and $|Z-(5-i)|=3$ then $|Z|$ is equal to

A) $\sqrt{31}$ B) $\sqrt{\frac{61}{5}}$ C) $\sqrt{\frac{31}{5}}$ D) 5

46. Let $S_n=\sum\limits_{k=1}^{n}\dfrac{k}{(k-1)^{\frac{4}{3}}+\left(k^2-1\right)^{\frac{2}{3}}+(k+1)^{\frac{4}{3}}}$ then $\underset{n\to\infty}{Lim}\dfrac{S_n}{n^{2/3}}$ equals

A) 0 B) $\frac{1}{4}$ C) $\frac{1}{2}$ D) 1

47. $\int_1^{\infty} \frac{1}{x^2} ln\left(\frac{x^2}{x-1}\right) dx$ equals

A) 0 B)1 C) 2 D) None of these

48. The line $y = mx + 1$ cuts the parabola $y^2 = 4ax$ at two points P and Q if equation of circle with one diameter PQ is $x^2 + y^2 + 18x + 4y + 5 = 0$ then $a + m$ equals

A) 0 B) 3 C) 5 D) None of these

49. Let A,B,C and D be four points in space satisfying $x^4 + y^4 + z^4 + 1 = 4xyz$ then the volume of tetrahedron $A - BCD$ is

A) 16 B) $\frac{16}{3}$ C) $\frac{8}{3}$ D) None of these

50. Let $(0,0)$ be the focus of a parabola which is passing through the point $(1,1)$. If the line $2x + y = 3$ is tangent to the parabola at $(1,1)$ then the length of latus-rectum of the parabola is

A) $\frac{36\sqrt{2}}{5}$ B) $\frac{18\sqrt{2}}{5}$ C) $\frac{9\sqrt{2}}{5}$ D) $9\sqrt{2}$

Section-2

(Paragraph Type)

This section contains 3 paragraphs each describing theory, experiment, data etc. Six questions relate to three paragraphs with two questions on each paragraph. Each question pertaining to a particular paragraph should have only one correct answer among the four choices A, B, C and D.

Paragraph for Questions 51 & 52

Let a, b and c be three non-negative numbers such that

$a^3 - a^2 + a = b$

$b^3 - b^2 + b = c$

$c^3 - c^2 + c = a$

51. Number of possible triplets of type (a,b,c) is /are

A) 0 B)1 C)2 D) More than 2

52. If at least one among a,b and c is different from other two then number of possible triples of type (a,b,c) is /are

A)0 B)1 C)2 D) More than 2

Paragraph For Questions 53 & 54

In $\Delta ABC, AB = AC$. Points D and E lie on BC such that $BD = DC$ and $BE > CE$. $\tan\angle EAC$, $\tan\angle EAD$ and $\tan\angle EAB$ are in G.P.

53. $\angle EAD$ is equal to

A) $\frac{\pi}{6}$ B) $\frac{\pi}{4}$ C) $\frac{\pi}{3}$ D) $\tan^{-1}\frac{3}{4}$

54. If $AE = 10$ then AD equals

A) $5\sqrt{2}$ B) $5\sqrt{3}$ C) 5 D) 6

Paragraph For Questions 55 & 56

Let $y = f(x)$ be a polynomial such that $\int_{x+\sqrt{2}}^{x+\sqrt{5}} f(x)dx = ax + b, \forall x \in R(a \neq 0)$ and $(a,b \in R)$

$f(0) = 3$ and $f(1) = 5$

55. The function $y = f(x)$ is

A) one-one and on-to B) on-to but not one-one

C) one-one but on-to D) Neither one-one nor on-to

56. Area bounded by the curve $y = f(x)$, between the ordinates $x = 0$ and $x = 2$ and the x-axis is

A) 3 B) 7 C) 9 D) 10

Section-3

(Matching List Type)

This section contains four questions, each having two matching lists (List-1 & List-II). The options for the correct match are provided as (A), (B),(C) and (D) out of which ONLY ONE is correct.

57.

List--I		List-II	
P)	Number of real roots of $(2013)^x + (2014)^x = (2015)^x$	1)	1
Q)	If $x^4 - 10x^3 + 26x^2 - 10x + 1 = 0$ has n distinct real roots than $n =$	2)	2
R)	Let a,b,c and d be four positive real numbers such that $abcd = 1$. If n is the least value of $(1+a)(1+b)(1+c)(1+d)$ then positive integral factors of n which are not a perfect square are	3)	3
S)	$\left[\underset{x\to 0}{Lim}\dfrac{\sin\left(\pi\cos^2(\sin x)\right)}{x^2}\right]$ equals $([.]GIF)$	4)	4

Codes :

	P	Q	R	S
A)	3	2	1	4
B)	4	3	2	1
C)	2	1	4	3
D)	1	4	2	3

58. Let $y^2 = 10x$ be a parabola, From $\left(\frac{15}{2}, 0\right)$ three normals are drawn to the parabola . A, B and C are co-normal points .

List--I		List-II	
P)	Area of ΔABC is	1)	$\frac{25}{2}$
Q)	Radius of circumcircle of ΔABC	2)	$\frac{25}{4}$
R)	Centroid of ΔABC	3)	$\left(\frac{5}{3}, 0\right)$
S)	Circumcentre of ΔABC	4)	$\left(\frac{25}{4}, 0\right)$

Codes:

	P	Q	R	S
A)	3	2	1	4
B)	4	3	2	1
C)	2	1	4	3
D)	1	2	3	4

59. Let a, b and c be three distinct real numbers such that $\frac{2-a^3}{a} = \frac{2-b^3}{b} = \frac{2-c^3}{c} = -3$

List--I		List-II	
P)	$a+b+c$	1)	6
Q)	$a^3+b^3+c^3$	2)	12
R)	$ab+bc+ca$	3)	0
S)	$2\left(a^2+b^2+c^2\right)$	4)	-3

Codes:

	P	Q	R	S
A)	3	1	4	2
B)	4	3	2	1
C)	2	1	4	3
D)	1	2	3	4

60.

List--I		List-II	
P)	$\int_{-2}^{0}(x-1)x(x+1)(x+2)(x+3)\,dx$ is equal to	1)	1
Q)	If $x^5+ax^4+bx^3+cx^2+dx+e=0$ has exactly 3 distinct real root, then minimum number of points where $f(x)=\lvert x^5+ax^4+bx^3+cx^2+dx+e\rvert$ is not differentiable is $(a,b,c,d,e\in R)$	2)	0
R)	$\lim_{x\to 1}\left(\frac{8}{1-x^8}-\frac{4}{1-x^4}\right)$ equals	3)	3
S)	If the roots of the equation $x^4+ax^3+bx^2+cx+60=0$ are natural numbers other than 1. If $a+b+c+61=2^n$ then n equals $(a,b,c\in R)$	4)	2

Codes:

	P	Q	R	S
A)	3	2	1	4
B)	4	3	2	1
C)	2	1	4	3
D)	1	2	3	4

Solutions

PHYSICS

Single correct choice Type

1. (C)

Sol: $l = 5 \pm 0.1cm$

$r = 2 \pm 0.01cm$

$V = \pi r^2 l$

$\therefore$ % error in volume= $\left(\frac{2\Delta r}{r} + \frac{\Delta l}{l}\right) \times 100 = \left(\frac{2 \times 0.01}{2} + \frac{0.1}{5}\right) \times 100 = 3\%$

2. (B)

Sol: $f_{app} = \left(\frac{V + V_0}{V - V_0}\right) f_0$, assuming car moving towards us .

$\therefore 68 = \left(\frac{345 + 12}{345 - V_c}\right) 60 = V_C = 30m/s$

3. (D)

Sol: $E = \frac{kq}{a^2}, V = \frac{10kq}{a}$

$\therefore \frac{V}{E} = 10a$

4. (C)

Sol: $L.C = \frac{Pitch}{C.S.D} = \frac{0.5}{50} = 0.01mm$

Zero error is positive

$\therefore$ Reading $X = M.S.R. + (C.S.R - Zero\ Error) \times L.C$

$\therefore X_1 = 0.5 + (46 - 4)0.01 = 0.92mm$

$X_2 = 0.5 + (48 - 4)0.01 = 0.94mm$

$X_3 = 0.5 + (44 - 4)0.01 = 0.90mm$

$\therefore$ Best reading= $X_{mean} = 0.92mm$

5. (A)

Sol: $Q_{total} = mS_i(10) + mL_f + mS_w(100) + mL_v$

Putting $m = 1kg, S_1 = 0.5, S_w = 1, L_V = 540, L_f = 80$

6. (A)

Sol: $U_i + K.E_i = U_f + K.E_f \Rightarrow \frac{kQq}{4a} + 0 = \frac{kQq}{4a} + \frac{1}{2}mv^2$

Given $\frac{kQ}{4a} = V \Rightarrow v = \sqrt{\frac{6qV}{m}}$

7. (B)

Sol: $B = \frac{\mu_0 i}{2r}$ ....(1)

Where $i = \frac{e}{T} = \frac{e\omega}{2\pi}$.

Also $L = I\omega = mr^2\omega$

$\omega = \frac{L}{mr^2}$

Putting values in (1) , $B = \left(\frac{\mu_0 e}{4\pi mr^3}\right)L$

8. (C)

Sol: Let rate of heat supply = P

$\therefore$ Heat to boil $Q_1 = P(9\text{ min}) = mS_w(100-10) = 90m$

Heat to evaporate $Q_2 = Pt = mL_v = 540m$

$\therefore \frac{t}{9} = \frac{540}{90} \Rightarrow t = 54\text{min}$

9. (C)

Sol: At point of leaving contact

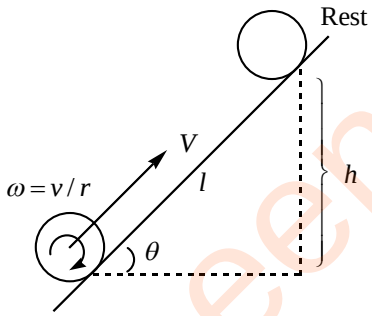
$v^2 = 2gh = 2g\left[\frac{R}{4} + R(1-\cos\theta)\right]$

And $Mg\cos\theta = \frac{mv^2}{R}(\because N = 0)$

$\Rightarrow \cos\theta = \frac{v^2}{Rg} \Rightarrow \cos\theta = \frac{5}{6}$

10. (A)

Sol:



$\therefore \frac{1}{2}MV^2 + \frac{1}{2}I\omega^2 = Mgh$

$\Rightarrow \frac{1}{2}MV^2 + \frac{MR^2}{2\times 2}\left(\frac{v^2}{R^2}\right) = Mgl\sin\theta$

Putting $\theta = 30^0$ and $v = 10m/s$ $l = 15m$

Section-II
Comprehension Type

Paragraph for Questions No.s 11 to 12

11. (B)

12. (A)

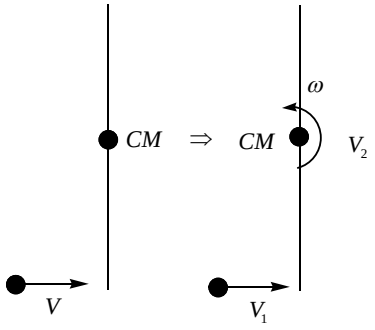
Sol: $V_{new} = \frac{V}{2}; T_{New} = \frac{T}{4} \Rightarrow \frac{3T}{4} = F_b = plVg$

$T = \rho_0 Vg$

$$\frac{\rho l}{\rho_0}=\frac{3}{4}\Rightarrow\frac{\rho_0}{\rho l}=\frac{4}{3}$$

Paragraph for Questions No.s 13 to 14

13. (C)
14. (D)



Sol: $L_i = L_f$ about CM of rod

$$\Rightarrow mV\frac{L}{2}=mV_1\frac{L}{2}+\frac{\eta ML^2}{12}\omega \qquad .....(1)$$

$$\rho_i=\rho_f\Rightarrow mV=mV_1+\eta mV_2 \qquad .....(2)$$

$$E_i=E_f\Rightarrow\frac{1}{2}mV^2=\frac{1}{2}mV_1^2+\frac{1}{2}\eta mV_2^2+\frac{1}{2}\left(\frac{\eta mL^2}{12}\right)\omega^2 \qquad .....(3)$$

Solving the equations

$$V_1=\left(\frac{4-\eta}{4+\eta}\right)V \text{ and } \omega=\frac{12V}{(4+\eta)L}$$

15. (A)
16. (B)

Sol: $$V=\frac{\sigma}{2\varepsilon_0}\left(\sqrt{R^2+X^2}-X\right);X=0\Rightarrow V_c=\frac{\sigma}{2\varepsilon_0}(R);V_h=\frac{\sigma}{2\varepsilon_0}\left(\sqrt{R^2+h^2}-h\right)$$

$$mgh+\frac{q\sigma}{2\varepsilon_0}\left(\sqrt{R^2+h^2}-h\right)=\frac{q\sigma}{2\varepsilon_0}R+0;\frac{q\sigma}{\varepsilon_0}=4mg\Rightarrow\frac{q\sigma}{2\varepsilon_0}=2mg$$

$$mgh+2mg\left(\sqrt{R^2+h^2}-h\right)=2mgR;h+2\left(\sqrt{R^2+h^2}-h\right)=2R$$

$$2\left(\sqrt{R^2+h^2}\right)=(2R+h);4\left(R^2+h^2\right)=4R^2+h^2+4Rh;4h^2=h^2+4Rh;3h^2=4Rh\Rightarrow h=\frac{4R}{3}$$

For equilibrium $F_{Net}=0$ $$mg=\frac{q\sigma}{2\varepsilon_0}\left(1-\frac{x}{\sqrt{R^2+X^2}}\right);mg=2mg\left(1-\frac{x}{\sqrt{R^2+X^2}}\right)$$

$$\frac{1}{2}=1-\frac{x}{\sqrt{R^2+X^2}}$$

$$\frac{x}{\sqrt{R^2+X^2}}=\frac{1}{2}\Rightarrow 4X^2=R^2+X^2;3X^2=R^2\Rightarrow X=\pm\frac{R}{\sqrt{3}}$$

Section-III

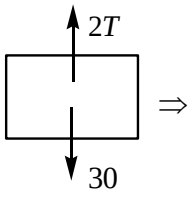
17. (B)

m_1 m_2

Sol :

	$f_{s\max_1}$	f_{k_1}	$f_{s\max_2}$	f_{k_2}	
$m_1 = 6kg$	18	12	16	12	$m_2 = 4$
$m_1 = 2kg$	6	4	24	18	$m_2 = 6$
$m_1 = 7kg$	21	14	12	9	$m_2 = 3$
$m_1 = 1kg$	3	2			

If all three stationary T=15N



For Case –I :

In $P \to F_{s\max_1}$ & $f_{s\max_2} > 15 \Rightarrow$ Both static : $P \to 1,2$

In $R \to f_1$ static f_2 kinetic : $R \to 1,4$

In $Q \to f_2$ static , f_1 kinetic : $Q \to 2,3$

(Check option)

18. (C)

19. A

(P) speed constant & moving in circle $\Rightarrow \vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \frac{mv^2}{R} = \vec{f}_c \,\&\, \vec{F}_3 + \vec{F}_2 = 0$

(for equilibrium in vertical) & $\vec{F}_1$ must be static friction.

(Q) $F_1 \,\&\, F_2$ will cancel each other.

$F_1 =$ friction (static) & $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \vec{F}_c$ (as circular motion)

(R) $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \vec{F}_c$

$F_1 =$ static friction

(S) Car at rest $\Rightarrow F_1 + F_2 + F_3 = 0$

20. D

$$\frac{K_p}{K_\alpha} = \frac{1}{8} \qquad P-2 \qquad \frac{mP}{m_\alpha}\frac{V_p^2}{V_\alpha^2} = \frac{1}{8}; \frac{1}{4}\frac{V_p^2}{V_\alpha^2} = \frac{1}{8} \Rightarrow \frac{V_p}{V_\alpha} = \frac{1}{\sqrt{2}}; \frac{P_p^2}{2m_p \frac{P_\alpha^2}{2m\alpha}} = \frac{1}{8}$$

$$\left(\frac{P_p^2}{P_\alpha}\right) = \frac{m_p}{m_\alpha} \times \frac{1}{8}; \left(\frac{P_p}{P_\alpha}\right) = \left(\frac{1}{4} \times \frac{1}{8}\right)^{1/2}; \frac{\lambda_\alpha}{\lambda_p} = \frac{P_p}{P_\alpha} = \frac{1}{4\sqrt{2}}; \frac{\lambda_p}{\lambda_\alpha} = 4\sqrt{2}$$

CHEMISTRY

21. C

$Ca_3P_2 + 6HCl \rightarrow 3CaCl_2 + 2PH_3\uparrow$

$PH_4I + KOH \rightarrow PH_3\uparrow + KI + H_2O$

$P_4 + 3NaOH + 3H_2O \rightarrow PH_3\uparrow + 3NaH_2PO_2$

Red phosphorus + NaOH soln. $\xrightarrow{\Delta}$ no reaction

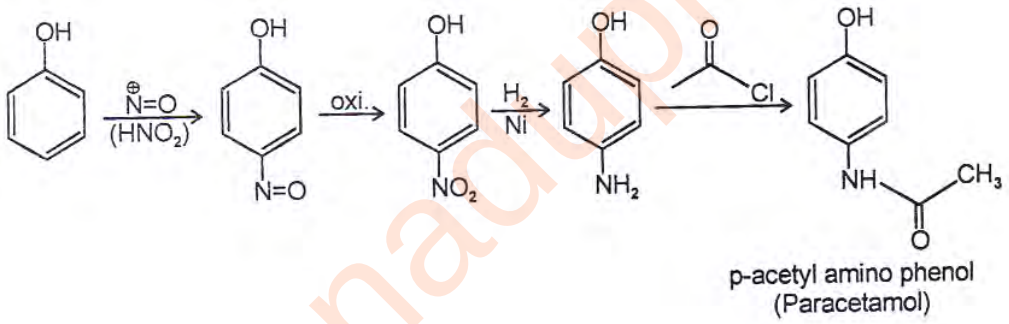
22. D

$\frac{D}{d} = 1 + (2-1)\alpha \Rightarrow \alpha = \frac{46}{d} - 1$

23. A

Potential difference of electrical double layer formed in a colloidal solution is called Zeta potential.

24. B



25. D

	Complexes	Hyd. Of central Metal cation	No. of stereoisomers
(A)	$\left[Cd(gly)(H_2O)(NH_3)\right]^+$	sp^3	2
(B)	$\left[Pt\,Br_2(H_2O)_2\right]$	dsp^2	2
(C)	$\left[Cr(en)_3\right]^{3+}$	d^2sp^3	2
(D)	$\left[Co\,Br(NO_2)(en)_2\right]^+$	d^2sp^3	3

26. A

$\pi = mRT$ (m = molarity, R = 0.082 L atm/mol. K, $T = 25°C = 298K$)

$$M = m = \frac{\pi}{RT} = \frac{5\times10^{-3}}{0.082\times298} = 2\times10^{-4}$$

$$M = \frac{w}{m\times V}$$

$$m = \frac{w}{M\times V}$$

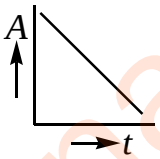
$$m = \frac{10}{2\times10^{-4}} = 5\times10^{4}$$

Each glucose unit (mw = 180)

Bonded to the starch chain with bss of $1H_2O(mm=18)$ giving a effective molecular mass $=180-18=162$

So approximate average number of glucose $= \frac{5\times10^{4}}{162} = 309 \cong 300$

27. D

Reaction is zero order 

28. C

$PCl_5 + Ag \rightarrow AgCl + PCl_3$

PCl_3 is water soluble while AgCl is insoluble in dil HNO_3.

29. C

A) Ionization isomerism B) Co-ordination isomerism

C) No isomerism D) Linkage isomerism

30. A

$$E_{sep} = \frac{13.6z^2}{n^2} = 13.6 \quad \Rightarrow \quad n=2 \quad z=2$$

$$KE = -E_n = -\left(-\frac{13.6\times2^2}{2^2}\right) = 13.6eV$$

$$V = 2.18\times10^{8}\times\frac{2}{2} = 2.18\times10^{6}\, m/s$$

$$J = n\frac{h}{2\pi} = \frac{2h}{2\pi} = \frac{h}{\pi}$$

31. B

Cu^{2+} give ppt with excess of KI

$$Cu^{2+} + KI(\text{excess}) \rightarrow CuI\downarrow + KI_3(\text{brown})$$

32. D

Cu^{2+} gives deep blue colour solution in excess of NH_3.

33. C

$$[OH]^{-} = \sqrt{0.1\times10^{-7} + 0.08\times10^{-6}}$$

$$= \sqrt{0.1+10^{-7} + 0.08\times10^{-7}}$$

$$= \sqrt{9\times10^{-8}}$$

$$= 3\times10^{-4}$$

$$pOH = 4 - \log 3$$

34. A

$$\alpha_{XOH} = \frac{10^{-7}\times0.1}{0.1\times3\times10^{-4}} = \frac{10^{-3}}{3}$$

35. A

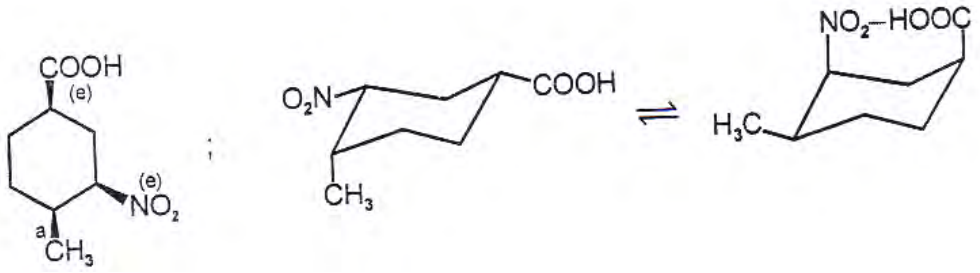
$$\text{NE} = \frac{\text{mol.mass}}{\text{H}^{+}}$$

Assume B is monocarboxylic aid and NE = MW the –COOH accounts for 45 g/ml of molecular wt, leav $60-45=15\, g/mol$ for the remainder $\left(\text{due to } CH_{3^{-}}\right)$ so "b" is CH_3COOH

"A" has a second $-COOH$ replacing an H of CH_3COOH, it is malonic acid

$$CH_2\begin{matrix}COOH\\COOH\end{matrix} = \frac{104}{2} = 52\, g/mol$$

36. A



Due to H-bonding it is weak acid & have higher pKa.

37. C

P: $E_{cell} = \frac{0.0591}{1}\left(pH_{anode} - pH_{cathode}\right)$

$E_{cell} = 0.059\left(x - y\right)$

$E_{cell} = +ve; \left(x > y\right)$

Q: $E_{cell} = \frac{0.0591}{2} \times \log \frac{P_1}{P_2}$

$E_{cell} = +ve \quad P_1 > P_2$

R: $E_{cell} = \frac{0.0591}{1} \times \log \frac{y}{x}$

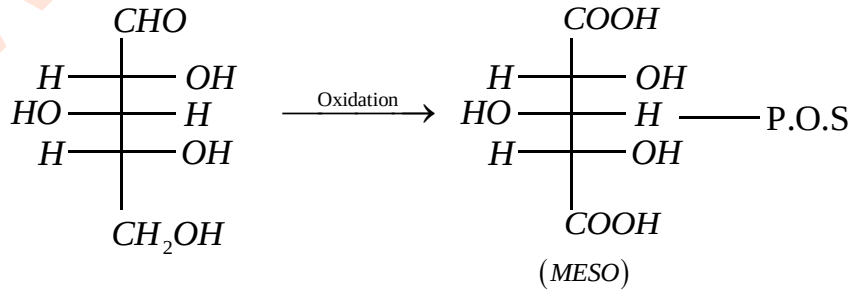
$E_{cell} = +ve, y > x$

S: $E_{cell} = \frac{0.0591}{2} \times \log \frac{P_2}{P_1}$

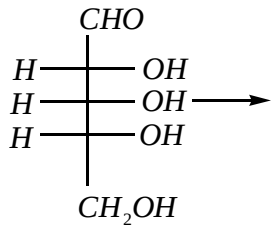
$E_{cell} = +ve \quad P_2 > P_1$

38. D

(P) D-xylose

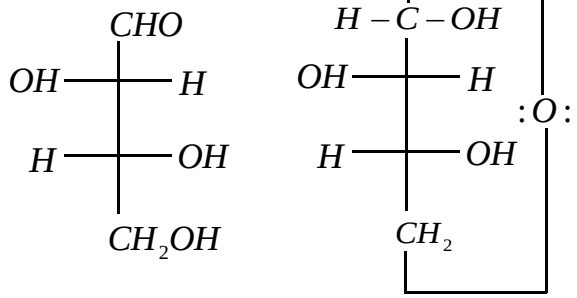


(Q) D-Ribose



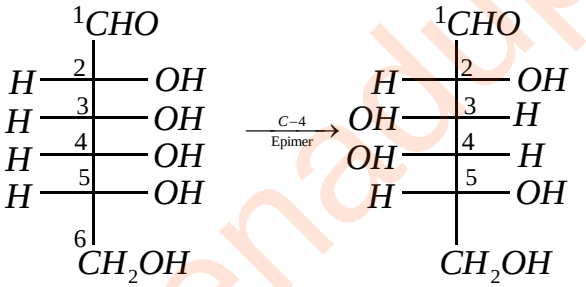
→ C_2 – epimer of D-Arabinose, give same osazone as D-arabinose

(R) D-threose



Smallest aldose (4C) able to form cyclic hemiacetal.

(S) D-galactose = it is C-4 epimer of D-glucose



(D-glucose) (D-galactose)

39. (D)

$Co(NO_3)_2 + Al_2O_3 \xrightarrow{\Delta} CoO + NO_2(g) + O_2(g)$

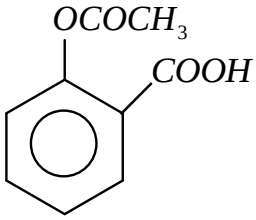
$NO_2(g) + NO(g) \xrightarrow{Cool} N_2O_3(s)$

$(NH_4)_2 Cr_2O_7(s) \xrightarrow{\Delta} N_2(g) + Cr_2O_3(s) + H_2O(g)$

$Na(NH_4)HPO_4 + CuSO_4 \xrightarrow{\Delta} NaPO_3 + NH_3(g) + H_2O(g)$

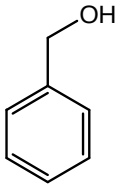
40. C

(P) Pyrcuric acid $= \left(CH_3 - \overset{O}{\overset{\|}{C}} - COOH \right)$ have carbonyl group i.e. show 2, 4 DNP test.

(Q) Aspirine is  & give CO_2 gas with $NaHCO_3$

(R) Acrylic acid $= \left(CH_3 - CH = CH - COOH \right)$

Due to $\pi - bond$, it declourise Br_2 / CCl_4 (Unsaturation test).

(S) Benzyl alcohol is  & react with Na metal evolve H_2 gas.

MATHEMATICS

Single correct choice Type

41. (B)

Sol: Let $(1+2p, 1+3p, -3+2p)$ be a point on the first line and $(k+q, -1+5q, -q)$ be a point on the line. If they are co-ordinates of point of intersection then

$-3+2p = -q$ and $1+3p = -1+5q$

$1+2p = k+q$

$\Rightarrow p = q = 1$ and $k = 2$

Point of intersection will be $(3, 4, -1)$

42. (D)

Sol: From given condition odd elements of the domain can associate with unequal odd elements of the co-domain and even elements of the domain can associate with unequal even number of the co-domain

Number of ways if X is odd = $4!\left(1-\frac{1}{1!}+\frac{1}{2!}-\frac{1}{3!}+\frac{1}{4!}\right)=9$

Number of ways if X is even = $4!\left(1-\frac{1}{1!}+\frac{1}{2!}-\frac{1}{3!}+\frac{1}{4!}\right)=9$

43. (A)

Sol: $M=\frac{1}{2}A^2+A+I_n\ ;\ N=\frac{1}{2}A^2-A+I_n$

$$M.N=\frac{1}{4}A^4+I_n=\frac{1}{4}A\left(A^3\right)+I_n$$

$$=I_n \quad \left(A^3=0\right)$$

$$\Rightarrow M^{-1}=N$$

44. (B)

Sol: $\int_{1-x}^{1+x}\left(t^3-3t^2+3t+3\right)\sin\left(t-1\right)dt=\int_{1-x}^{1+x}\left(\left(t-1\right)^3+4\right)\sin\left(t-1\right)dt=\int_{-x}^{x}\left(t^3+4\right)\sin t dt=2\int_0^{\alpha}t^3\sin t dt$

$$\Rightarrow \lim_{x\to 0}\frac{\int_{1-x}^{1+x}\left(t^3-3t^2+3t+3\right)\sin\left(t-1\right)dt}{x^3\sin x\sin 2x}$$

$$=\lim_{x\to 0}\frac{2\int_0^x t^3\sin t dt}{x}\cdot\frac{x}{\sin x}\cdot\frac{x}{\sin 2x}=\lim_{x\to 0}\frac{x^3\sin x}{5x^4}\cdot\frac{x}{\sin x}\cdot\frac{2x}{\sin 2x}=\frac{1}{5}$$

45. (B)

Sol: $\left|z-\left(2+3i\right)\right|=2$ is a circle and $\left|z-\left(5-i\right)\right|=3$ is another circle

The distance between their centres is equal to sum of their radii that's why 'Z' will be their point of contact .

$$\Rightarrow Z=\frac{16}{5}+i\frac{7}{5}\Rightarrow\left|Z\right|=\sqrt{\frac{61}{5}}$$

46. (C)

Sol: $T_k = \dfrac{k}{(k-1)^{\frac{4}{3}} + (k-1)^{\frac{2}{3}}.(k+1)^{\frac{2}{3}} + (k+1)^{\frac{4}{3}}}$

$$= \frac{k\left[(k+1)^{\frac{2}{3}} - (k-1)^{\frac{2}{3}}\right]}{\left[(k+1)^{\frac{2}{3}}\right]^3 - \left[(k-1)^{\frac{2}{3}}\right]^3} = \frac{1}{4}\left[(k+1)^{\frac{2}{3}} - (k-1)^{\frac{2}{3}}\right]$$

$$S_n = \frac{1}{4}\left[(n+1)^{\frac{2}{3}} + n^{\frac{2}{3}} - 1 - 0\right] = \frac{1}{4}\left[(n+1)^{\frac{2}{3}} + n^{\frac{2}{3}} - 1\right]$$

$$\frac{S_n}{n^{2/3}} = \frac{1}{4}\left[\left(1+\frac{1}{n}\right)^{\frac{2}{3}} + 1 - \frac{1}{n^{\frac{2}{3}}}\right] \Rightarrow \underset{x\to\infty}{Lim}\frac{S_n}{n^{2/3}} = \frac{1}{2}$$

47. (C)

Sol: $I = \int_{-1}^{\infty} \frac{1}{x^2} ln\left(\frac{x^2}{x-1}\right)dx$

Put $x = \frac{1}{t}$ $\quad dx = -\frac{dt}{t^2}$

$$I = \int_1^0 ln\frac{1}{t(1-t)}dt = -\int_0^1 lnt(1-t)dt = -\int_0^1 lntdt - \int_0^1 ln(1-t)dt = -2\int_0^1 lntdt = 2$$

48. (A)

Sol: Let $P(x_1, y_1)$ & $Q(x_2, y_2)$ then the roots of the equation $(mx+1)^2 - 4ax = 0$

$x^2 + \left(\frac{2m-4a}{m^2}\right)x + \frac{1}{m^2} = 0$ are x_1 and x_2

And the roots of the equation $y^2 = 4a\left(\frac{y-1}{m}\right) = y^2 - \frac{4a}{m}y + \frac{4a}{m} = 0$ and y_1 and y_2

Required circle is

$$x^2 + y^2 + \left(\frac{2m-4a}{m^2}\right)X + \left(-\frac{4a}{m}\right)y + \frac{1}{m^2} + \frac{4a}{m} = 0 \text{.........}(1)$$

$$x^2 + y^2 + 18x + 4y + 5 = 0 \text{...}(2)$$

From (1) and (2)

$$\frac{-4a}{m} = 4, \frac{1}{m^2} + \frac{4a}{m} = 5 \text{ and } \frac{2m-4a}{m^2} = 10 \quad \Rightarrow m = \frac{1}{3} \text{ and } a = -\frac{1}{3}$$

49. (C)

Sol: $x^4+y^4+z^4+1-4xyz=0$

$\Rightarrow x^4+y^4-2x^2y^2+z^4+1-2z^2+2x^2y^2+2z^2-4xyz=0$

$\Rightarrow \left(x^2-y^2\right)^2+\left(z^2-1\right)^2+2\left(xy-z\right)^2=0$

$\Rightarrow z^2=1 \qquad xy=z$ and $x^2=y^2$

$z=1 \Rightarrow x=1 \qquad y=1$

$x=-1 \qquad y=-1$

$z=-1 \Rightarrow x=-1 \qquad y=1$

$x=1 \qquad y=-1$

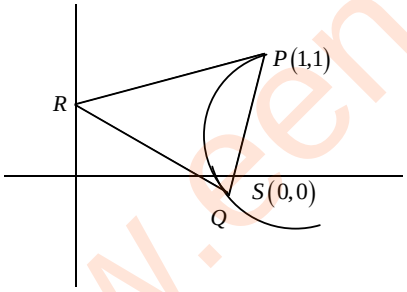
$A(1,1,1) \qquad B(-1,-1,1) \quad C(-1,1,-1) \quad and \quad D(1,-1,-1)$

$\overrightarrow{AB}=-2\hat{i}-2\hat{j} \qquad \overrightarrow{AC}=-2\hat{i}-2\hat{k} \qquad \overrightarrow{AD}=-2\hat{j}-2\hat{k}$

$$Volume=\left|\frac{1}{6}\begin{vmatrix}-2 & -2 & 0\\ -2 & 0 & -2\\ 0 & -2 & -2\end{vmatrix}\right|=\frac{1}{6}(8+8)=\frac{8}{3}$$

50. (B)

Sol:



From properties of parabola

$RS \perp PS$ and $RQ \perp PR$

$\Rightarrow PR: 2x+y=3$

$RS=x+y=0 \qquad \Rightarrow R(3,-3)$

Now: $RQ: x-2y=9$

$PQ=x=y \qquad \Rightarrow \qquad Q(-9,-9)$

$PS=l_1=\sqrt{2}$

$QS = l_2 = 9\sqrt{2}$

Length of latus-rectum= $= \frac{4l_1l_2}{l_1+l_2} = \frac{4\times 9\sqrt{2}\times\sqrt{2}}{9\sqrt{2}+\sqrt{2}} = \frac{36\sqrt{2}}{10} = \frac{18\sqrt{2}}{5}$

Section-II

Comprehension Type

Paragraph for question Nos : 51-52

51. (C)

52. (A)

Sol: Consider the function $f(x) = x^3 - x^2 + x$

$f(x)$ is an increasing function such that

$f(x) - x < 0 \qquad \forall x \in (0,1)$

And $f(x) - x > 0 \qquad \forall x > 1$

Now , if $a,b,c \in (0,1)$

$b < a, c < b$ and $a < c$ (not possible)

If $a,b,c \in (1,\infty)$

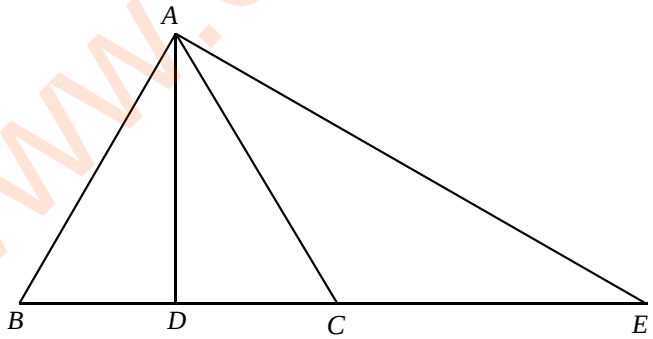
$b > a, c > b$ and $a > c$ (not possible)

$\Rightarrow a = b = c = 1$ ir $\Rightarrow a = b = c = 0$

Paragraph for question Nos : 53-54

53. (B)

54. (A)



Sol: $\angle EAD = \alpha$ and $\angle CAD = \beta$

$\tan(\alpha-\beta), \tan\alpha$ and $\tan(\alpha+\beta)$ are in GP ,

$$\Rightarrow \tan^2\alpha = \frac{\sin(\alpha-\beta)\sin(\alpha+\beta)}{\cos(\alpha-\beta)\cos(\alpha+\beta)} = \frac{\sin^2\alpha-\sin^2\beta}{\cos^2\alpha-\sin^2\beta}$$

$$\Rightarrow \sin^2\alpha\cos^2\alpha-\sin^2\alpha\sin^2\beta = \cos^2\alpha\sin^2\alpha-\cos^2\alpha\sin^2\beta$$

$$\Rightarrow \sin^2\beta = 0 \text{ or } \tan^2\alpha = 1$$

$$\Rightarrow \alpha = \frac{\pi}{4}(\beta \neq 0)$$

$$\Rightarrow AD = AE\cos\frac{\pi}{4} = 5\sqrt{2}$$

Paragraph for question Nos : 55-56

55. (A)

56. (D)

Sol: $\int_{x+\sqrt{2}}^{x+\sqrt{5}} f(x)dx = ax+b \qquad \forall x \in R$

$$\Rightarrow f\left(x+\sqrt{5}\right) - f\left(x+\sqrt{2}\right) = a \qquad \forall x \in R$$

$$\Rightarrow f'\left(x+\sqrt{5}\right) = f'\left(x+\sqrt{2}\right) = a \qquad \forall x \in R$$

$\Rightarrow f'x$ is a periodic function but $f(x)$ is polynomial $\Rightarrow f'(x)$ is a polynomial

$$\Rightarrow f'(x) = k \text{ (a constant)}$$

$$\Rightarrow f'(x) = kx+c$$

Now $f(0)=3$ and $f(1)=5$

$$\Rightarrow f(x) = 2x+3$$

Section-III

Matching List Type

57. (D)

58. (D)

Sol: The co-normal points will be $(0,0)$ $\left(\frac{5}{2},5\right)$ and $\left(\frac{5}{2},-5\right)$ centroid $\left(\frac{5}{3},0\right)$

Circumcenter $\left(\frac{25}{4},0\right)$; Radius = $\frac{25}{4}$; Area of $\Delta ABC = \frac{25}{2}$

59. (A)

Sol: $\frac{2-a^3}{a}=\frac{2-b^3}{b}=\frac{2-c^3}{c}=-3$

Let $\frac{2-x^3}{x}=-3 \qquad (x=a,b,c)$

$\Rightarrow x^3-3x-2=0$

$a+b+c=0, ab+bc+ca=-3$ and $abc=2$

$a^3+b^3+c^3-3abc=0 \Rightarrow a^3+b^3+c^3=6$

$a^2+b^2+c^2=-2(ab+bc+ca)=6$

60. (C)

Sol: (A) $\int_{-2}^{0}(x-1)x(x+1)(x+2)(x+3)dx=\int_{-1}^{1}(x-2)(x-1)x(x+1)(x+2)dx=0$

(B) If $f(x)=0$ has two pairs of equal roots than $y=f(x)$ has 1 point where it is not differentiable .

(C) $L=\lim_{x\to 1}\frac{8}{1-x^8}-\frac{4}{1-x^4}$ .....(1)

$L=\lim_{x\to 1}\frac{-8x^8}{1-x^8}+\frac{4x^4}{1-x^4}$ .....(2)

$(1)+(2)$

$2L=8-4=4 \Rightarrow L=2$

(D) $60=2.2.3.5 \Rightarrow x^4+ax^3+bx^2+cx+60=(x-2)(x-2)(x-3)(x-5)$

$\Rightarrow 1+a+b+c+60=8=2^3$

JEE-ADVANCED : KEY : PAPER-II

PHYSICS	KEY	CHEMISTRY	KEY	MATHEMATICS	KEY
1	C	21	C	41	B
2	B	22	D	42	D
3	D	23	A	43	A
4	C	24	B	44	B
5	A	25	D	45	B
6	A	26	A	46	C
7	B	27	D	47	C
8	C	28	C	48	A
9	C	29	C	49	C
10	A	30	A	50	B
11	B	31	B	51	C
12	A	32	D	52	A
13	C	33	C	53	B
14	D	34	A	54	A
15	A	35	A	55	A
16	B	36	A	56	D
17	B	37	C	57	D
18	C	38	D	58	D
19	A	39	D	59	A
20	D	40	C	60	C