FIITJEE **JEE (Advanced)-2018**

ALL INDIA TEST SERIES

FULL TEST – VIII

Paper 2

Time Allotted: 3 Hours **Maximum Marks: 231**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into three sections: **Section-A, Section-C & Section-D**.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with black pen for each character of your Enrolment No. and write your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.

1. ***Section-A (01 – 03, 24 – 26, 47 – 49)*** *contains 9 multiple choice questions which have* ***only one correct answer****. Each question carries* ***+3 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*
   Section-A (04 – 08, 27 – 31, 50 – 54) *contains 15 multiple choice questions which have* ***one or more than one correct*** *answer. Each question carries* ***+4 marks*** *for correct answer and* ***–2 marks*** *for wrong answer.*
   Partial Marks **+1** for each correct option provided no incorrect options is selected.
   Section-A (09 – 10, 32 – 33, 55 – 56) *contains 3 paragraphs. Based upon paragraph, 2 multiple choice questions have to be answered. Each question has* ***only one correct*** *answer and carries* ***+3 marks*** *for correct answer. There is no negative marking.*
2. ***Section-C (11 – 20, 34 – 43, 57 – 66)*** *contains 30 Numerical based questions with answer as numerical value from* ***0 to 9*** *and each question carries* ***+3 marks*** *for correct answer. There is no negative marking.*
3. ***Section-D (21 – 23, 44 – 46, 67 – 69)*** *contains 9 Numerical answer type questions with answer XXXXX.XX and each question carries* ***+4 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*

Name of the Candidate	
Enrolment No.	

Useful Data

PHYSICS

Acceleration due to gravity	$g = 10\ m/s^2$
Planck constant	$h = 6.6 \times 10^{-34}$ J-s
Charge of electron	$e = 1.6 \times 10^{-19}$ C
Mass of electron	$m_e = 9.1 \times 10^{-31}$ kg
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2$
Density of water	$\rho_{water} = 10^3\ kg/m^3$
Atmospheric pressure	$P_a = 10^5\ N/m^2$
Gas constant	$R = 8.314\ J\ K^{-1}\ mol^{-1}$

CHEMISTRY

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	0.0821 Lit atm $K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2$ Cal $K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's constant	h	=	6.625×10^{-34} J·s
		=	6.625×10^{-27} erg·s
1 Faraday		=	96500 coulomb
1 calorie		=	4.2 joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No: H=1, He = 2, Li=3, Be=4, B=5, C=6, N=7, O=8, N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16, Cl=17, Ar=18, K =19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33, Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56, Pb=82, U=92.

Atomic masses: H=1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16, F=19, Na=23, Mg=24, Al = 27, Si=28, P=31, S=32, Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59, Ni=58.7, Cu=63.5, Zn=65.4, As=75, Br=80, Ag=108, Sn=118.7, I=127, Xe=131, Ba=137, Pb=207, U=238.

PART – I (Physics), PART – II (Chemistry), PART – III (Mathematics):
(SECTION – D)

For questions **21 to 23, 44 to 46, 67 to 69.**
Numerical answer type questions with answer XXXXX. XX

If answer is 348.4 / 251.37 / 213

Correct Method :

0	0	3	4	8	.	4	0
0	0	2	5	1	.	3	7
0	0	2	1	3	.	0	0

Wrong Method :

	3	4	8		.	4	
3	4	8			.		4
		3	4	8	.		4
	3		4	8	.	4	
	2		5	1	.	3	7
		2	1	3	.		
		2	1	3	.	0	
		2	1	3	.		0
		3	4	8	.	4	0
		2	5	1	.	3	7
		2	1	3	.	0	0

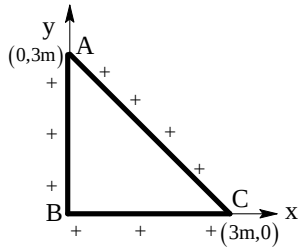
Physics

PART – I

SECTION – A
(One Options Correct Type)

This section contains **3 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

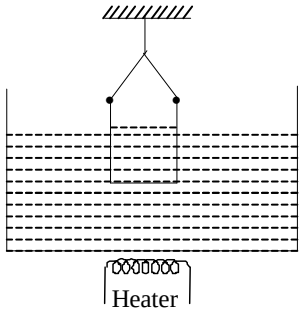
1. An isosceles triangular frame is made by three non conducting rods carrying charge of uniform charge density as shown in the figure. The co-ordinate of the point where electric field is zero is



(A) $\left(\frac{3}{2+\sqrt{2}}\text{m}, \frac{3}{2+\sqrt{2}}\text{m}\right)$ (B) $\left(\frac{3}{2-\sqrt{2}}\text{m}, \frac{3}{2-\sqrt{2}}\text{m}\right)$

(C) $\left(\frac{3}{2}\text{m}, \frac{3}{2}\text{m}\right)$ (D) $\left(\frac{5}{2}\text{m}, \frac{5}{2}\text{m}\right)$

2. Water is boiling in a large vessel as shown in the figure. Another open vessel containing water which is below $100°C$ is dipped in the bigger vessel by the help of string as shown in figure. Choose the correct option regarding the situation.



(A) The temperature of water in the smaller vessel will gradually increase and it will start boiling below $100°C$.

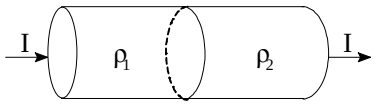
(B) The temperature of water in the smaller vessel will gradually increase and it will start boiling above $100°C$.

(C) The temperature of water in the smaller vessel will gradually increase upto $100°C$ and it will not boil.

(D) The temperature of water in the smaller vessel will gradually increase and it will start boiling at $100°C$.

Space for Rough work

3. Two long straight cylindrical conductors with resistivities ρ_1 *and* ρ_2 respectively are joined together as shown in figure. If a current I flows uniformly through the cross section, then magnitude of the charge accumulated at the interface of the two conductors is



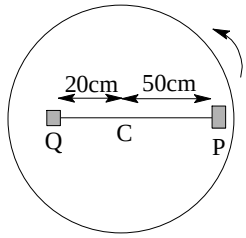
(A) $\frac{(\rho_1-\rho_2)I\in_0}{2}$ (B) $\in_0 I|\rho_1-\rho_2|$

(C) $\in_0 I|\rho_1+\rho_2|$ (D) 0

(One or More than one correct type)

This section contains **FIVE** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

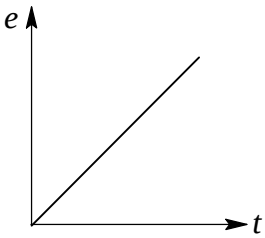
4. Two blocks P of mass 20kg and Q of mass 10kg are placed on a rough horizontal disk ($\mu = 2/3$) and are connected with a string which is along the diameter of disk as shown in the figure. Then
(Here C is centre of the disc)

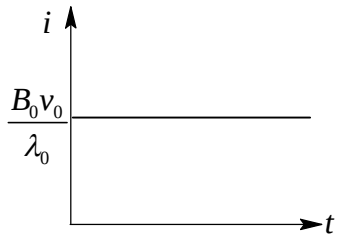


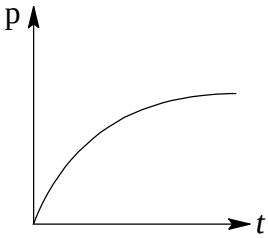
(A) The tension in the string when angular velocity of disc is 4 rad/second is 80/3 N.
(B) Friction on 10kg block is 16/3 N when angular velocity of disc is 4 rad/second.
(C) Friction on 20 kg block is 40/3 N when angular velocity of disc is 4 rad/second.
(D) Maximum angular velocity of disc for no slipping of block is 5 rad/second.

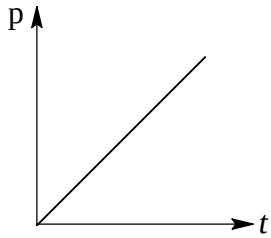
Space for Rough work

5. A long straight slider is moved with constant velocity $\vec{v} = v_0\hat{i}$ parallel to earth surface in the x-y plane in a uniform magnetic field $\vec{B} = B_0\hat{k}$ on a resistanceless rails in the form of curve $y^2=4x$. Here emf induced in the loop, current, power, resistance of slider per unit length and time are represented by e, i, p, λ_0 and t respectively. If at t = 0 slider starts from x = 0. Then which of the following option(s) is/are correct.

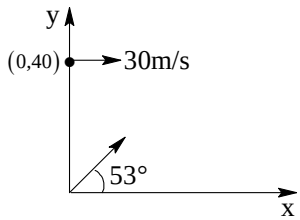
(A) 

(B) 

(C) 

(D) 

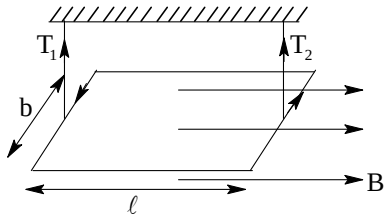
6. As soon as a monkey jumps horizontally with speed $30\,\text{m/s}$ from height 40m of a tree, an arrow is projected from the bottom of tree at an angle of $53°$ with the horizontal in the same plane. If the arrow hits the monkey. Then



(A) The angle at which arrow is approaching monkey with the horizontal with respect to monkey is $90°$.
(B) The angle at which arrow is approaching monkey with the horizontal with respect to monkey is $60°$.
(C) The time after which arrow hits the monkey is 1second.
(D) The time after which arrow hits the monkey is 2second.

Space for Rough work

7. A uniform conducting rectangular loop of sides ℓ, b and mass m carrying current i is hanging horizontally with the help of two vertical non conducting strings. There exists a uniform horizontal magnetic field B which is parallel to the longer side of loop. Choose the **CORRECT** option(s)



(A) The value of $T_1 = T_2 = \frac{mg}{2}$ (B) The value of $T_1 = \frac{mg - 2ibB}{2}$

(C) The value of $T_2 = \frac{mg + 2ibB}{2}$ (D) The value of $T_1 <$ value of T_2

8. A bob of mass M is rotating on smooth horizontal table with constant angular speed ω on a circular path with the help of an elastic wire of mass m $(m << M)$, length ℓ, specific heat s, area of cross-section A and young's modulus Y. Then:

(A) The increase in length of wire $\frac{\ell}{\left(\frac{YA}{M\ell\omega^2} - 1\right)}$

(B) The increase in length of wire $\frac{\ell}{\left(\frac{YA}{2M\ell\omega^2} - 1\right)}$

(C) If the bob snaps then the rise in temperature of wire is more than $\frac{YA\ell}{2ms}\left(\frac{1}{\frac{YA}{2M\ell\omega^2} - 1}\right)^2$ (ignore radiation loses)

(D) If the bob snaps then the rise in temperature of wire is less than $\frac{YA\ell}{2ms}\left(\frac{1}{\frac{YA}{M\ell\omega^2} - 1}\right)^2$ (ignore radiation loses)

Space for Rough work

(Paragraph Type)

This section contains **ONE** paragraph. Based on the paragraph, there are **TWO** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.

Paragraph for Question Nos. 9 and 10

Thick lenses are used in cameras whose focal length is defined as $\frac{1}{f}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}+\frac{(\mu-1)d}{\mu R_1 R_2}\right)$ where R_1 and R_2 are radius of curvature, d is the thickness of lens and μ is refractive index of the material of lens.

9. Focal length of a convex lens having $R_1=20\text{cm}$, $R_2=40\text{cm}$, $d=1\text{cm}$ and $\mu=3/2$

(A) 26.67cm (B) 26.7cm

(C) 26.8cm (D) 26.9cm

10. Focal length of a sphere of radius 30cm and having $\mu=3/2$

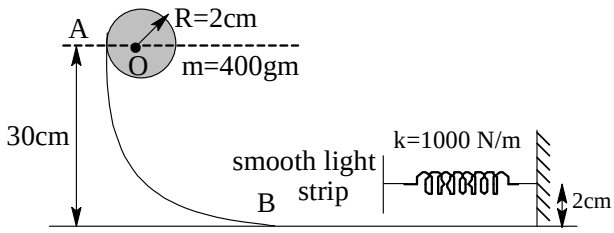
(A) 36cm (B) 45cm

(C) 60cm (D) 90cm

SECTION – C
(Single digit integer type)

This section contains **TEN** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

11. A uniform solid sphere of mass m=400gm and radius R=2cm is released from rest from a point A of a sufficiently rough slide AB. Initially, the centre O of the sphere is at the horizontal level of A. At the lower end B, the slide passes to smooth horizontal plane. A spring is attached to a wall on the horizontal plane. Find the maximum compression (in cm) of the spring in the process of motion of the sphere. (Take $g=10\text{m/s}^2$)

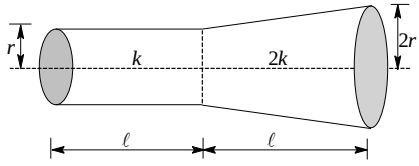


Space for Rough work

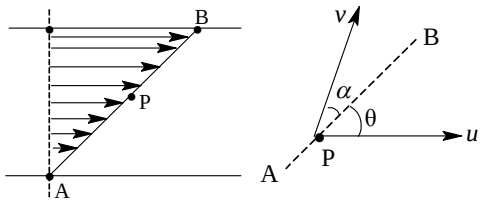
12. A conductor has a temperature independent resistance R & a total heat capacity 4 unit. At the moment $t=0$ it is connected to a $D.C.$ voltage V. If time dependence of the conductor's temperature assuming the thermal power dissipated in surrounding varies as $q=4(T-T_0)$ equal to $T=T_0+\frac{V^2}{4R}\left(1-e^{-Nt}\right)$ find value of N where T_0 is surrounding temperature equal to initial temperature of conductor.

13. A circular ring of radius R & mass m made by a uniform wire of cross-sectional area A is rotated about a stationary vertical axis passing through its centre & perpendicular to the plane of the ring. If young's modulus of material of ring is Y & increment in radius of ring equals to $\frac{mR^2\omega^2}{N\pi AY}$ without breaking find value of N. If breaking stress of ring is σ.

14. A composite object is formed by combining a uniform rod of circular cross-section with thermal conductivity k and a frustum with thermal conductivity $2k$ as shown in the figure. The equivalent thermal conductivity of the object is given as $\frac{Nk}{5}$, find $'N'$.

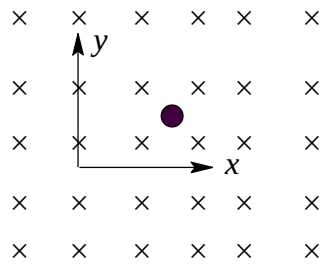


15. A river is flowing horizontally with a constant velocity gradient along its width. Its velocity from one bank to another varies from zero to u. A swimmer swims with a constant speed v w.r.t water such that he is always heading along the line AB w.r.t ground as shown. If the angle made by velocity of swimmer in still water varies from 45° to 75° with the river flow while going from A to B, if this angle is $\sin^{-1}\left(\frac{1}{N}\right)$ with line AB at the mid-point of the river, find $'N'$.

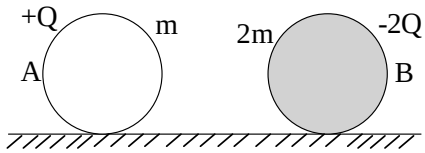


Space for Rough work

16. A neutral particle at rest in a uniform magnetic field B as shown in figure. The particle then spontaneously decays into two fragments, one with a positive charge $+q$ and mass $3m$ and other with a negative charge $-q$ and mass m. Neglecting the interaction between two charge particles and assuming speed is very much less than speed of light. The time $(in\,\mu s)$ after the decay at which two fragments meet(for first time) is $250\times N$. Find the value of N : (Neglect gravity) $\left(q=1\mu c, B=2\pi\mu T, m=10^{-15}kg\right)$. Both charges have velocity in xy plane



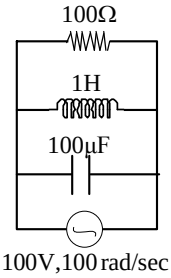
17. A hollow non conducting sphere A and a solid non conducting sphere B of equal radii R and masses m and $2m$ are kept at a large distance apart on a rough horizontal non conducting surface. Charges at A and B are Q and $-2Q$ respectively. Charges are uniformly distributed and remain constant and uniform as sphere come closer. Friction is sufficient to support pure rolling. Kinetic energy of the two spheres just before collision is K_A and K_B. Find $\left(\frac{K_B}{K_A}\times\frac{42}{5}\right)$.



18. The nozzle at the end of pipe has holes of equal area from which water ejects in all possible direction with speed $50\,m/s$. If in a park the nozzle is at a height of 8 meter above the ground. The maximum area (in km^2) which will get wet is nearly $\frac{N}{10}$. Find N.

Space for Rough work

19. An alternating current source is connected with three circuit elements as shown in the figure. Find the current (in Ampere) passing through the AC source?

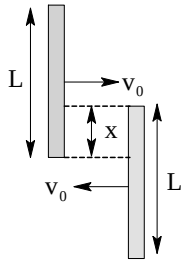


20. A charge particle having specific charge 1C/kg is projected parallel to x-axis from a point $(0,5)$ meters on the y-axis in the x-y plane with velocity $8\hat{i}\ m/s$ in a magnetic field which varies along x-axis as $\vec{B} = B_0\, x\hat{k}$ where $B_0 = 1$ tesla/meter. Find the maximum value of x (in meter) (neglect gravity).

SECTION – D
(Numerical Based XXXXX.XX answer Type)

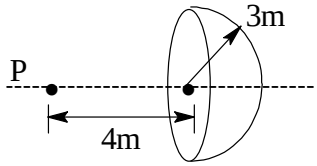
This section contains **3 questions**. Each question, when worked out will result in numerical answer Type with answer xxxxx.xx.

21. Two identical rigid rods, each of mass 1kg & length $\sqrt{3}\text{m}$, are moving opposite to each other without rotation on a smooth horizontal table as shown. For what maximum value of 'x' (after rounding off), the direction of motion of each rod would not change after collision, irrespective of the type of collision. Assume no sticking.

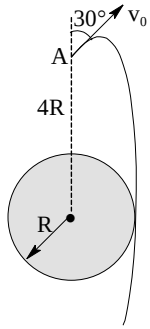


Space for Rough work

22. A point source of power 'P' is placed on the axis of a thin hemispherical shell as shown. The shell has a radius of 3m and behaves like a perfect black body. If the steady state temperature of shell is T. Find T^4 (after rounding off). (Take $P=2400\pi\sigma$ W, σ=stefan's const.).



23. A particle is projected from point 'A', that is at a distance $4R$ from the centre of the Earth, with speed v_0 as shown. If the particle passes grazing the earth's surface, then it is found that $v_0=100\times N$. Find the value of N (after rounding off). [Take $\frac{GM}{R}=6.4\times10^7\ m^2/s^2$, $\sqrt{2}=1.414$]



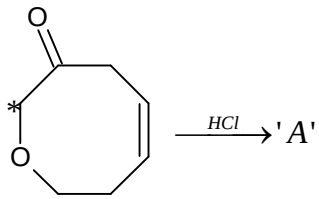
Space for Rough work

Chemistry

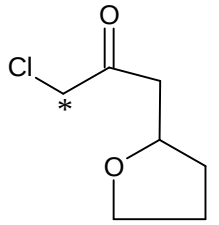
PART – II

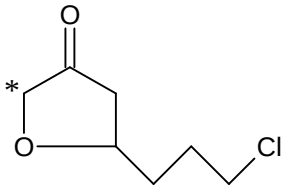
SECTION – A
(One Options Correct Type)

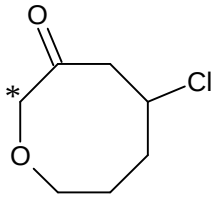
This section contains **3 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

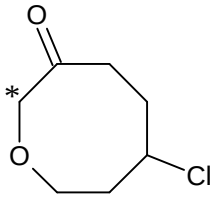
24. 

Which of the following is the correct structure of compound 'A' as major product?

(A) 

(B) 

(C) 

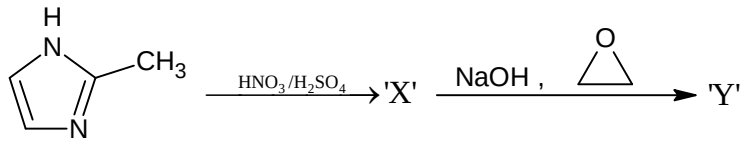
(D) 

25. Which of the following solution will show positive deviation from ideal behaviour (Raoult's law)

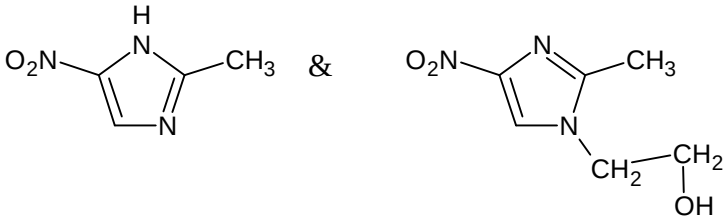
(A) Acetone+CS_2 (B) Benzene+toluene

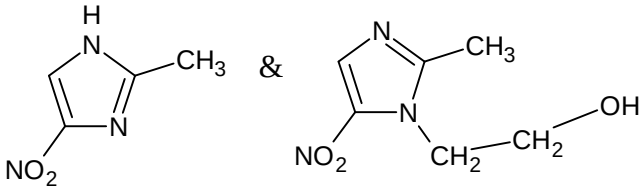
(C) Acetone+chloroform (D) Octanol+water

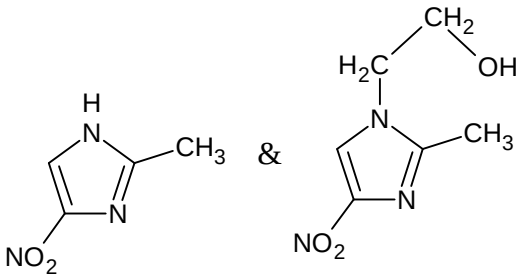
Space for Rough work

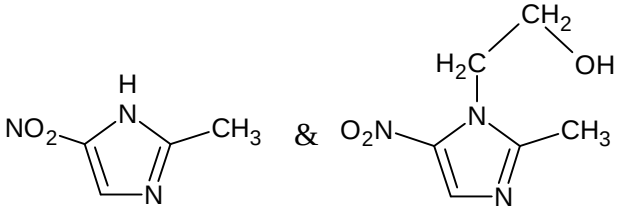
26. 

The respective structure of X & Y are?

(A) 

(B) 

(C) 

(D) 

Space for Rough work

(One or More than one correct type)

This section contains **FIVE** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

27. Which of the following statements are correct about nitrogen oxides and oxyions?

(A) Colourless, diamagnetic N_2O_4 has a weak $N\text{-}N$ bond that can readily dissociate to give the brown, paramagnetic NO_2

(B) N_2O_5 has $N\text{-}O\text{-}N$ bent bond in gaseous state and consists of NO_2^+ and NO_3^- ions in the solid state.

(C) Nitric oxide is formed by the action of lightening on atmospheric N_2 and O_2. In atmosphere, NO is oxidised to NO_2. These gases, often collectively designated as NO_x, contribute to the problem of acid rain, primarily because $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$.

(D) Ammonia is reacted with oxygen using a Platinum-Rhodium gauze catalyst to form nitric oxide, however in absence of catalyst NH_3 can be oxidised to form N_2, as $4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$

28. The correct statements about some of the ions of 3d-series in aqueous solution

(A) Cr^{2+} is better reducing agent than Fe^{3+}

(B) Co^{3+} is better oxidising agent than Fe^{3+}.

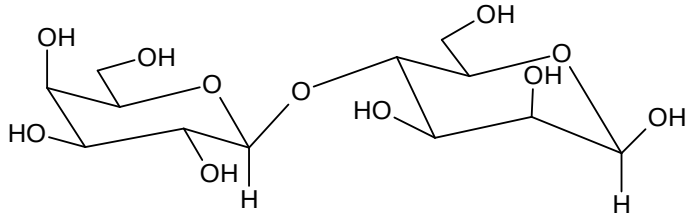
(C) When Fe^{3+} is used as oxidising agent, it attains $3d^7$ electronic configuration

(D) Cu is the only metal in 3d series, which is not having ability to displace hydrogen as H_2 from acidic solution (consider thermodynamic aspects).

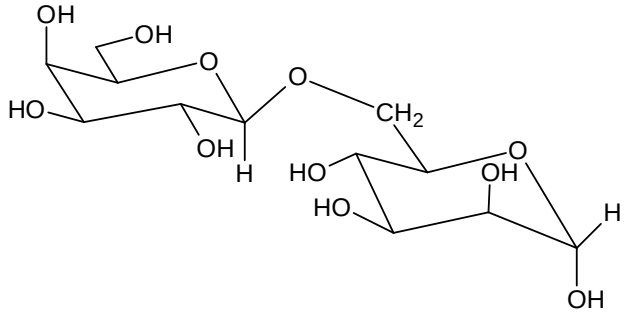
Space for Rough work

29. An unknown carbohydrate, formula $C_{12}H_{22}O_{11}$ reacts with Tollen's reagent to form a silver mirror. An α- glycosidase has no effect on the carbohydrate but a $\beta-$ galactosidase hydrolyzes it to D-galactose (C_4-epimers of D-glucose) and D-mannose (C_2-epimers of D-glucose). When the carbohydrate is methylated (using methyl iodide and silver oxide) and then hydrolyzed with dilute HCl, the products are 2,3,4,6-tetra-O-methyl galactose and 2,3,4 tri-O-methyl mannose. Which of the following is not correct structure of unknown carbohydrate?

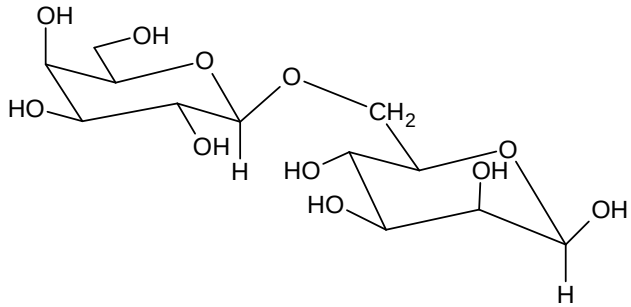
(A)



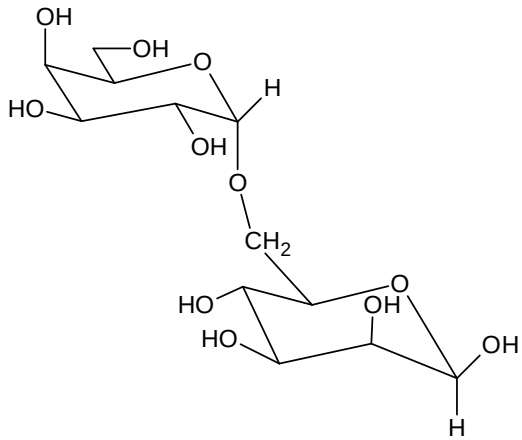
(B)



(C)



(D)



Space for Rough work

30. Step-I: 0.5ltr of saturated $Mg(OH)_2(aq.)$ is in contact with $Mg(OH)_2(s)$

Step-II: 0.5ltr of H_2O is added to 0.5ltr of solution in step (I) and the solution is vigorously stirred, undissolved $Mg(OH)_2(s)$ remains.

Step-III: 100ml of the clear solution in step (II) is removed and added to 0.5ltr of $0.1M\ HCl(aq.)$

Step-IV: 25ml of the clear solution in step (II) is removed and added to 225ml of $0.060M\ MgCl_2(aq.)$ ($K_{SP}, Mg(OH)_2 = 3.2\times10^{-11}$)

Which of the following are correct choices about above steps:

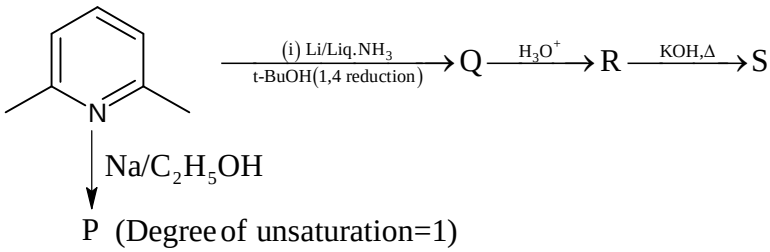
(A) Concentration of $Mg^{2+}(aq.)$ in step (II) is $2\times10^{-4}M$

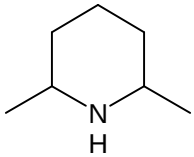
(B) Concentration of $Mg^{2+}(aq.)$ in step (III) is $3.33\times10^{-5}M$

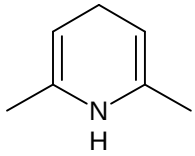
(C) Concentration of $Mg^{2+}(aq.)$ in step (IV) is nearly equal to $0.054M$

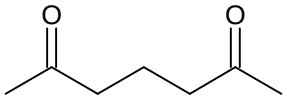
(D) Precipitation of $Mg(OH)_2(s)$ will occurs in step (III)

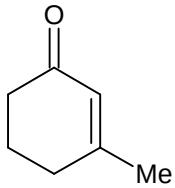
31. Which of the following are the correct statement(s) about the reaction given?



(A) 'P' is 

(B) 'Q' is 

(C) 'R' is 

(D) 'S' is 

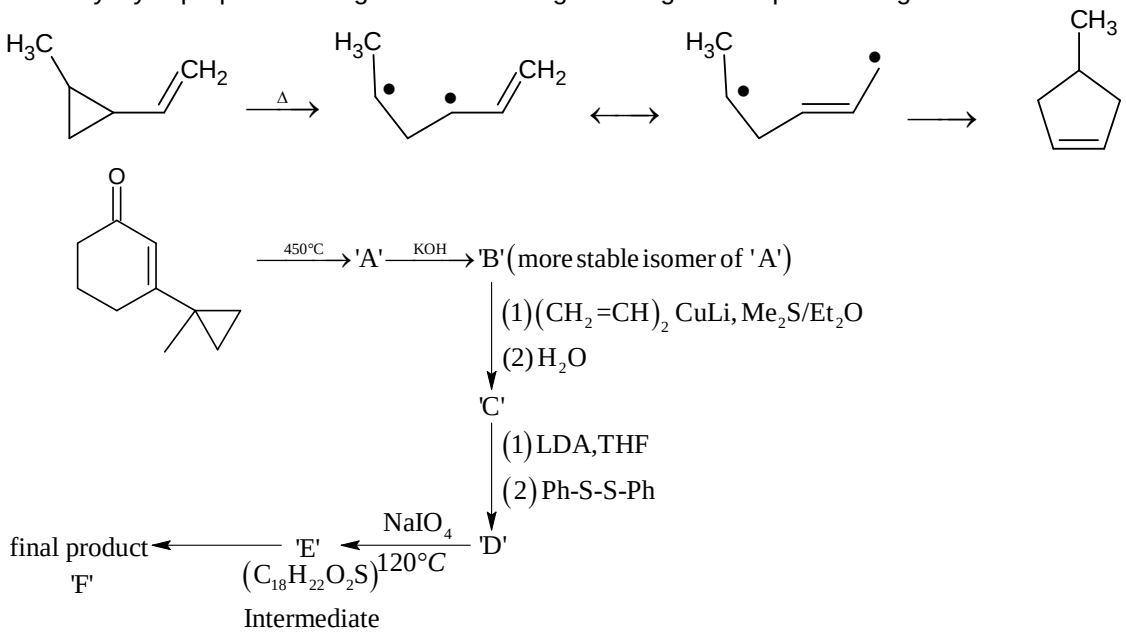
Space for Rough work

(Paragraph Type)

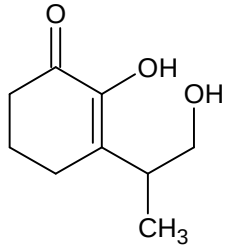
This section contains **ONE** paragraph. Based on the paragraph, there are **TWO** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.

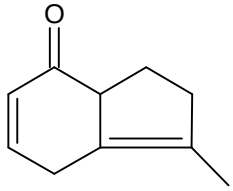
Paragraph for Question Nos. 32 and 33

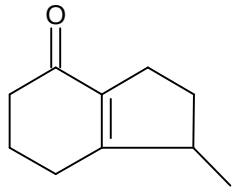
The vinyl cyclopropane undergoes the following rearrangement upon heating

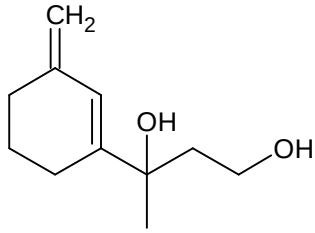


32. The compound 'B' will be:

(A)


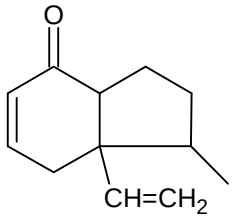
(B)


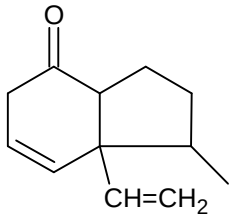
(C)


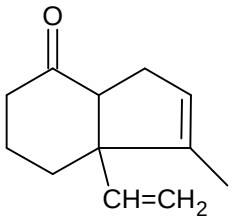
(D)


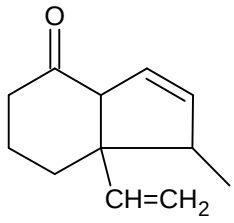
Space for Rough work

33. Compound 'F' will be:

(A) 

(B) 

(C) 

(D) 

SECTION – C
(Single digit integer type)

This section contains **TEN** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

34. CH_3COOH and CF_3COOH in their aqueous solution ionises as:

(I) $CH_3COOH+H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

$K_{a_1}, \Delta G_1^\circ, \Delta S_1^\circ$ are acid dissociation constant, standard free energy change & standard entropy change respectively, for dissociation of acetic acid

(II) $CF_3COOH + H_2O \rightleftharpoons CF_3COO^- + H_3O^+$

$K_{a_2}, \Delta G_2^\circ, \Delta S_2^\circ$ are acid dissociation constant, standard free energy change & standard entropy change respectively, for dissociation of trifluoroacetic acid . If both solutions are $1M$ each then the number of correct statements amongst the following are? (enthalpy change for both reactions are almost same.)

(i) $K_{a_1} < K_{a_2}$

(ii) $\Delta G_1^\circ > \Delta G_2^\circ$

(iii) $\Delta G_1^\circ < \Delta G_2^\circ$

(iv) $\Delta S_1^\circ > \Delta S_2^\circ$

(v) $\Delta S_1^\circ = \Delta S_2^\circ$

(vi) ΔS_1° & ΔS_2° are both positive

(vii) ΔS_1° & ΔS_2° are both negative

(viii) $\Delta S_2^\circ > \Delta S_1^\circ$

Space for Rough work

35. 16 moles of H_2 and 4 moles of N_2 are sealed in one litre vessel. The vessel is heated at constant temperature until the equilibrium $N_2(g)+3H_2(g)\rightleftharpoons 2NH_3(g)$ is established; it is found that the pressure in the vessel has fallen to $\frac{9}{10}$th of its original value $(P\,\text{atms})$. Now 'x' moles of an inert gas is added to the equilibrium mixture till the original pressure $(P\,\text{atms})$ is attained. The value of 'x' is?

36. The CFSE $\left(E_{\text{in octahedral field}}-E_{\text{symmetric field}}\right)$ for octahedral complex for d^7 electronic configuration is $'x'\,\text{kJ/mol}$, the value of $\left|\frac{x}{10}\right|$

$[\Delta_0=87.5\,\text{kJ/mole, Pairing energy}=90\,\text{kJ/mole}]$

37. Molar conductivity of 0.0625M KCl is $120\,S\,cm^2\,mol^{-1}$. The molar conductivity of $\left(\frac{x}{100}\right)$ molar NaCl is $90\,S\,cm^2\,mol^{-1}$. The value of 'x' will be:

$[\Lambda^0_{Na^+}=50 Scm^2mol^{-1},\ \Lambda^0_{Cl^-}=76 Scm^2mol^{-1},\ \Lambda^0_{K^+}=74 Scm^2mol^{-1}]$

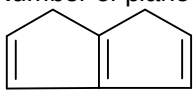
38. How many of the following chemical compound (s) / ion (s) has lone pair(s) at equatorial position of central atom?

$ClF_3, XeF_2, SF_4, IF_5, [SbF_4]^-, [SF_5]^-, IOF_4^-, SOF_4, XeOF_2$

39. The degeneracy of 2nd excited state $(n=3)$ of H atom is 18 then the degeneracy of first excited state of H^- ion is?

Space for Rough work

40. Number of plane (s) of symmetry in the product B is/are



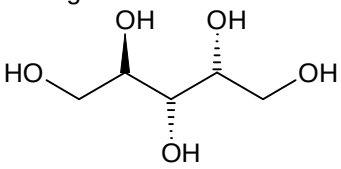
$\xrightarrow{CHCl_3(1eq.)+KOH} (A) \xrightarrow{CHCl_3(1eq.),KOH} (B)$

41. The total number of compounds whose aqueous solution turns Red litmus paper blue is:

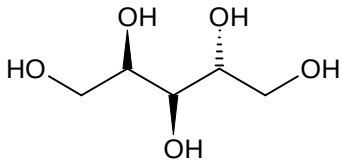
$LiCN, NH_4Cl, KCl, Na_2CO_3, (NH_4)_2C_2O_4, AgNO_3, NaHSO_4, NaHCO_3$

42. How many of the following are carbonates or sulphides ores:
Chalcocite, Argentite, Horn silver, Siderite, Azurite, Limestone, Magnesite, Kieserite

43. The specific rotation of 'A' is $+60^0$. A sample made up of 1gm of 'A' and 0.5gm of 'B' present in 10 ml of solution and placed in 10 cm cell of the polarimeter. The observed rotation of this sample 'x 'degree. The value of 'x':



(A)



(B)

Space for Rough work

SECTION – D
(Numerical Based XXXXX.XX answer Type)

This section contains **3 questions**. Each question, when worked out will result in numerical answer Type with answer xxxxx.xx.

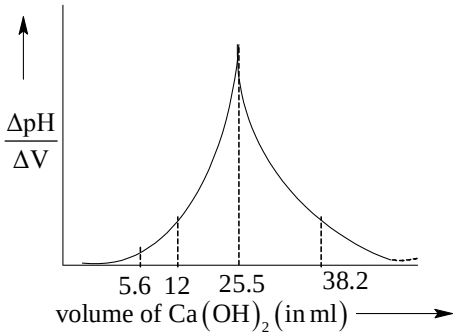
44. A pellet of naphthalene of mass 1.28 g is burnt in a bomb calorimeter with heat capacity 14000 J/K. If the initial temperature is 300K and final temperature is 302K.

The $\left|\Delta H_{\text{reaction}}\right|$ for 1 mole of Napthalene at 300 K in KJ/mole (consider reactant & products at 300K).

[At. wt. of C=12, $C_{V,\,CO_2(g)}=35 J mol^{-1}K^{-1}$ and $R=8.3 J mol^{-1}K^{-1}$

At. wt. of H=1, $C_{V,\,H_2O(l)}=75 J mol^{-1}K^{-1}$, heat capacity of $CO_2(g)$ & $H_2O(\ell)$ are taken as constant in this temperature range].

45. A schematic graph of the first derivative of the pH curve is plotted for the titration of 10ml of unknown HCl solution by using $0.2M\ Ca(OH)_2$, as shown:



The concentration of HCl solution will be _____M .

46. Calcium crystallizes in FCC with unit cell length of $(0.18)^{1/3}$ nm. This sample of calcium is having 0.1% Schottky defect. The density of the crystal is _____ gm/cm^3.

[Atomic weight of Ca=40, $N_A=6\times10^{23}$]

Space for Rough work

Mathematics

PART – III

SECTION – A
(One Options Correct Type)

This section contains **3 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

47. The number of solution(s) of the equation $2\tan^{-1}\left(\sec^2 \pi x\right) = \sin^{-1}\left(x^3 - x^2 + x + 2\right)$ is:

(A) 0 (B) 1

(C) 2 (D) 3

48. If $W = 2^4.3^2.5$ then number of factors of W^2 which are less than W but are not factors of W is:

(A) 36 (B) 132

(C) 66 (D) 38

49. Let S_1 be the locus of the point $'P'$ which moves such that $OP=1$ unit. The plane $x+y+z=1$ cuts the curve S_1 in another curve S_2. Find the volume of solid formed by joining the point O with every point on the curve S_2. (O is origin)

(A) $\frac{2\pi}{27}\sqrt{3}$ (B) $\frac{3\pi}{\sqrt{2}}$

(C) 4π (D) $\frac{4\sqrt{3}\pi}{7}$

Space for Rough work

(One or More than one correct type)

This section contains **FIVE** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

50. Let $f:\mathbb{R}\to\mathbb{R}$ *and* $g:\mathbb{R}\to\mathbb{R}$ be two functions,
$f(x)=|x|\left[x^2-1\right]$ & $g(x)=|x|+\left[x^2-1\right]$ then (where $[.]$ denotes G.I.F.)

(A) f is discontinuous exactly at five points in $[-1,2]$

(B) g is discontinuous exactly at five points in $[-1,2]$

(C) $\int_{-\frac{1}{2}}^{\frac{1}{2}}\left(f(x)-g(x)\right)dx=\frac{1}{2}$

(D) $\int_{-\frac{1}{2}}^{\frac{1}{2}}\left(f(x)-g(x)\right)dx=1$

51. Let A be a subset of set $S, S=\{1,2,.....7n\}$ having maximum possible elements, say m, such that sum of no two elements of it is divisible by 7. Which of the following option is/are correct?

(A) $\frac{m}{n}=3$

(B) $m-3n=1$

(C) The total number of ways in which A can be constructed is 8.

(D) The total number of ways in which A can be constructed is 8n

52. $P(x)\&Q(x)$ are two quadratic expressions with leading coefficients being one, such that $P(x)Q(x)=Q(P(x))\forall x\in R$ then.

(A) $Q(0)=0$ (B) $P(1)=1$

(C) $Q(x)=P(x)+Q'(0)$ (D) $P(1)=2$

Space for Rough work

53. Two triangles ΔABC & ΔDEF are non congruent but have 5 elements equal (out of 3 side lengths & 3 angles). Which of the following statements are true?
(A) Side length of given triangles are in G.P
(B) It is possible to construct ΔABC with side lengths $1 \& 9$
(C) It is possible to construct ΔDEF with side lengths $1 \& \sqrt{2}$
(D) It is not possible to have triangle ΔABC such that its sides are in A.P.

54. Let $\int_0^{\pi} \left(8\sin^2 x \cos x - f(x)\right) f(x)\,dx = \pi$, then which of the options are correct.

(A) $\int_0^{\pi/2} f(x)\,dx = \frac{4}{3}$ (B) $f(x)$ is periodic function with period 2π

(C) $f(x)$ is even function (D) $\int_0^{\pi} f(x)\,dx = 0$

(Paragraph Type)

This section contains **ONE** paragraph. Based on the paragraph, there are **TWO** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.

Paragraph for Question Nos. 55 and 56

Let C be a variable point in the first quadrant on the line $x + y = 1$ which intersects X and Y axes at A and B respectively. D and E are foot of perpendiculars from C on X and Y axes respectively. Let P be a point on the line segment joining D and E.

55. For all its possible positions, P will satisfy the inequality:
(A) $xy \geq \frac{1}{16}$ (B) $xy \leq \frac{1}{16}$
(C) $xy \geq \frac{1}{32}$ (D) $xy \leq \frac{1}{32}$

56. The area of the region traced by the point P, is:
(A) $\frac{1}{16}\ln 2$ (B) $\frac{1}{2}$
(C) $\frac{1}{4}$ (D) $\frac{1}{6}$

Space for Rough work

SECTION – C
(Single digit integer type)

This section contains **TEN** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

57. Let α_i be the solution of equation $\sin 2x = e^{-x}, \alpha_i \in [0, 2\pi]$ & $i = 1, 2, 3, 4$ also $f(x) = (x + \ln\sin 2\alpha_1)(x + \ln\sin 2\alpha_2)(x + \ln\sin 2\alpha_3)(x + \ln\sin 2\alpha_4) + \tan x$. The value of $\sum_{i=1}^{4} e^{-\alpha_i}\left(f(\alpha_i) + \frac{1}{f(\alpha_i)} \right)$ is.

58. The ordered triplet (α, β, γ) satisfies following equations
$x + y + 3z = 1, x - y + z = 1, ax + (a+b)y + 6z = 1, (a, b \in R)$
If $\alpha^2 + \beta^2 + \gamma^2$ is minimum, then minimum value of $a^2 + b^2$ is:

59. The value of $\frac{1}{3}\left(\sum_{k=0}^{14} (-1)^k (15-k)\ {}^{17}C_k \right)$ is.

60. If $r^{th}, (r+2)^{th}, (r+6)^{th}$ terms of an increasing A.P are last three terms of a G.P. and there lies exactly $2p+1$ number of terms of that G.P in the interval $(p,\ 2018p)(p \in N)$ then maximum value of p is____

61. $f : R \to R$ $f(x) = x^4 - x^2 + 1$. The number of values of x for which $f(f(f(x))) \le x^8$ is.

Space for Rough work

62. Consider, $f(t)=\frac{1}{4}t^2|\sin x|-t\sin x+4,\ t,x\in R$.

If $I_1=\int_0^{\pi/2}\left(\min\{f(t)\}\right)dx$ and $I_2=\min\left\{\int_0^{\pi/2}f(t)dx\right\}$ then $|I_1-I_2|$

[Note: $\min(g(t))$ denotes minimum value of $g(t)$ for $t\in R$]

63. The number of integral values of x for which $2x^2+x-6$ is a positive integral power of a positive prime is

64. If a,b,c are real numbers such that $a+b+c=0$, then value of

$$\frac{(ab)^2}{(a^2-bc)(b^2-ca)}+\frac{(bc)^2}{(b^2-ca)(c^2-ab)}+\frac{(ac)^2}{(a^2-bc)(c^2-ab)}$$ is:

65. Let $f:R\to R$ be a real function such that $f(x+1)+f(x-1)=\sqrt{3}f(x)\ \forall x\in R$ and $f(2)=4$. If $f(x)=\lambda\cos\left(\frac{\pi x}{k}\right)$ then find $\lambda-k$ (where k is the positive integer)

66. Let two lattice points are chosen at random from the set of $S=\{(x,y):0\le x,y\le 7,x,y\in I\}$ with replacement. If P is the probability that area of triangle formed by these two chosen points and $(0,0)$ is an integer, possibly zero, then the value of $8P$ is:

Space for Rough work

SECTION – D
(Numerical Based XXXXX.XX answer Type)

This section contains **3 questions**. Each question, when worked out will result in numerical answer Type with answer xxxxx.xx.

67. Cylinderical beaker of radius 11.5 cm is filled with water upto height of 15.7 cm. A solid cuboid of height 15.7 cm & square base of length 10.1 cm is dipped in it. Water evaporates at the rate proportional to area of water exposed to air (Proportionality constant, $\mu\, cm/\sec, \mu > 0$). Where solid cuboid sublimate at the constant rate of $\lambda\, cm^3/\sec$. If both water & solid vanishes at the same time, then $\frac{\lambda}{\mu}$ is

68. if $|z_i| = 12, i = 1,2,3,4,5 \,\&\, \sum_{i=1}^{5} z_i = \sum_{i=1}^{3} z_i = 0$ then, maximum value of $\sum_{1 \le i < j \le 5} \sum \left|z_i - z_j\right|^2$ is equal to

69. Three coloured boxes, i.e. **Red(R)**, **Blue(B)**, **Green(G)**, contains 3 balls each, of the same colours as that of the box. A ball is chosen from the **'R'** box and put in one of other two boxes. Again a ball is chosen randomly from the box '**B'** and put in one of other boxes. Same process is repeated with box '**G'**. If given that each box have equal number of balls after this process and P is the probability that composition of balls is not exactly same as in the beginning of random experiment, then value of $8P$ is:

Space for Rough work

FIITJEE

JEE(Advanced)-2018

ALL INDIA TEST SERIES

ANSWERS, HINTS & SOLUTIONS

FULL TEST – VIII
PAPER-2

Q. No.	PHYSICS	Q. No.	CHEMISTRY	Q. No.	MATHEMATICS
1.	**A**	24.	**B**	47.	**A**
2.	**C**	25.	**A**	48.	**D**
3.	**B**	26.	**D**	49.	**A**
4.	**ABD**	27.	**ABCD**	50.	**ABC**
5.	**BC**	28.	**ABD**	51.	**BD**
6.	**AC**	29.	**AD**	52.	**ABC**
7.	**BCD**	30.	**ABC**	53.	**ACD**
8.	**AD**	31.	**ABCD**	54.	**ABCD**
9.	**C**	32.	**C**	55.	**B**
10.	**B**	33.	**A**	56.	**D**
11.	**4**	34.	**4**	57.	**8**
12.	**1**	35.	**2**	58.	**9**
13.	**2**	36.	**7**	59.	**5**
14.	**6**	37.	**9**	60.	**5**
15.	**4**	38.	**5**	61.	**2**
16.	**3**	39.	**4**	62.	**0**
17.	**5**	40.	**2**	63.	**3**
18.	**2**	41.	**3**	64.	**1**
19.	**1**	42.	**6**	65.	**2**
20.	**4**	43.	**9**	66.	**5**
21.	**00000.73**	44.	**02806.28**	67.	**00102.01**
22.	**00008.89**	45.	**00001.02**	68.	**03600.00**
23.	**00056.56**	46.	**00001.48**	69.	**00007.75**

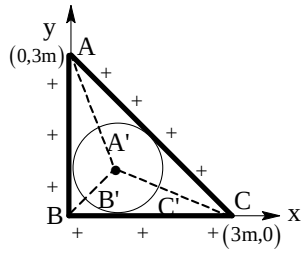
Physics

PART – I

SECTION – A

1. A

Field due to arc A'B' is equal to field due to side AB at the centre of arc. Similarly it will hold for other pairs also. So the field at the incentre is zero.



$$x=\frac{ax_1+bx_2+cx_3}{a+b+c} \Rightarrow y=\frac{ay_1+by_2+cy_3}{a+b+c}$$

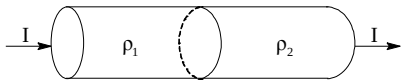
$$x=\frac{3}{2+\sqrt{2}}\,m\ ,\ y=\frac{3}{2+\sqrt{2}}\,m$$

2. C

Since water in the smaller vessel is taking heat from the water in the large vessel. It can reach to a temperature $100°C$. Since the temperature of water in the large vessel cannot go beyond $100°C$ before boiling completely. Hence water in the smaller vessel will not take heat from the water outside, it will not boil.

3. B

Magnitude of flux



$$=\left|E_2-E_1\right|A=\left|\rho_2-\rho_1\right|\ I=\frac{q}{\in_0}$$

$$q=\in_0\ I\left|\rho_1-\rho_2\right|$$

4. ABD

$$T+\frac{2}{3}(200)=20\left(\frac{1}{2}\right)16\Rightarrow T=80/3N \text{ and } \frac{80}{3}+f=10\left(\frac{1}{5}\right)4^2\Rightarrow f=\frac{16}{3}N$$

For maximum value

$$\text{of}\ \omega\Rightarrow T+400/3=20\left(\frac{1}{2}\right)\omega^2\ \&\ T-\frac{2}{3}\times100=10\left(\frac{1}{5}\right)\omega^2\Rightarrow\omega=5\text{rad/sec}$$

5. BC

$$e=B_0v_0(2y)=4B_0v_0^{3/2}\sqrt{t}$$

$$i=\frac{e}{\lambda(2y)}=\frac{Bv_0}{\lambda}\qquad where\Rightarrow y=\sqrt{4v_0t}$$

$$F=\left(\frac{B_0v_0}{\lambda}\right)(2y)B_0=\frac{2B_0^2v_0y}{\lambda}=\frac{4B_0^2v_0^{3/2}}{\lambda}\sqrt{t}$$

$$p=\vec{F}.\vec{v}=\frac{2B_0^2v_0^2y}{\lambda}=\frac{4B_0^2v_0^{5/2}}{\lambda}\sqrt{t}$$

6. AC

From monkey frame

$$\vec{v}_{am}=\vec{v}_a-\vec{v}_m=40\hat{j}\,m/s$$

$$\text{time}=\frac{40}{40}=1\text{sec}$$

7. BCD

Taking torque about R.H. side of loop

$$\text{mg}\frac{\ell}{2}\text{-T}_1\ell-\text{ibB}=0$$

$$=\text{-}\pi\text{nir}^2\text{B}\hat{\text{k}}$$

8. AD

$$Y=\frac{T/A}{x/\ell} \text{ where } T=M\left(\ell+x\right)\omega^2 \Rightarrow x=\frac{\ell}{\left(\frac{YA}{M\ell\omega^2}-1\right)}$$

And $ms\Delta\theta=\Delta U$

$$\Delta\theta=\frac{YA\ell}{2ms}\left(\frac{1}{\frac{YA}{M\ell\omega^2}-1}\right)^2$$

9. C

10. B

SECTION – C

11. 4

Sol: For solid sphere under pure rolling motion

$$\text{KE}_{\text{translation}}=\frac{5}{7}\text{KE}_{\text{total}}=\frac{1}{2}\text{KX}_{\text{max}}^2$$

$$\therefore \text{X}_{\text{max}}=4\text{cm}$$

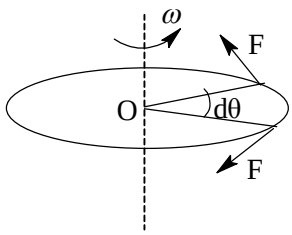
12. 1

$$\frac{\text{V}^2}{\text{R}}=4\left(\text{T-T}_0\right)+4\left(\frac{\text{dT}}{\text{dt}}\right)$$

$$\int_{T_0}^{T}\frac{dT}{\frac{V^2}{R}-4\left(T-T_0\right)}=\int_0^t\frac{dt}{C}\Rightarrow T=T_0+\frac{V^2}{4R}\left(1-e^{-t}\right)\Rightarrow N=1$$

13. 2

Sol.



Hence $dm = \frac{1}{2\pi} d\theta$

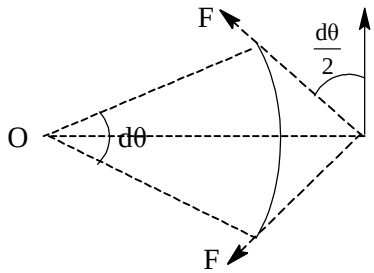
Hence radial component of tension,

$= 2F \sin\frac{d\theta}{2} \simeq Fd\theta$

$Fd\theta = \frac{nd\theta}{2\pi}\omega^2 R \Rightarrow F = \frac{m\omega^2 R}{2\pi}$

increment in radius is ΔR so elongation in length of ring

$\sigma = 2\pi\left(R + \Delta R\right) - 2\pi R = 2\pi\Delta R$



Strain $= \frac{\sigma}{2\pi R} = \frac{\Delta R}{R} \Rightarrow Y = \frac{\sigma}{\text{strain}} \Rightarrow \text{strain} = \frac{\sigma}{Y}$

$\frac{\Delta R}{R} = \frac{\sigma}{Y} \Rightarrow \Delta R = \frac{m\omega^2 R^2}{2\pi AY} = N = 2$

14. 6

Consider the object as two portion 'A uniform rod' and 'A frustum' with thermal resistance R_1 and R_2 respectively then

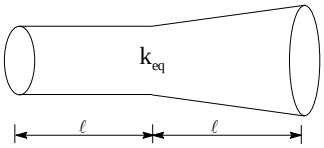
$\mathrm{R}_1 = \frac{\ell_1}{k_1 A_1} = \frac{\ell}{k\pi r^2}$

And $R_2 = \frac{\ell_2}{k_2 A_2} = \frac{\ell}{(2k)(\pi r_1 r_2)} = \frac{\ell}{4k\pi r^2}$

$\therefore$ Equivalent thermal resistance $R_{eq} = R_1 + R_2$

$\Rightarrow R_{eq} = \frac{5\ell}{4k\pi r^2} \ldots\ldots\ldots\ldots\ldots\ldots (1)$

Now if we consider the same lamina with equivalent thermal conductivity K_{eq}, then



$R_{eq} = R_1 + R_2 = \frac{\ell}{k_{eq}\pi r^2} + \frac{\ell}{k_{eq}\left(2\pi r^2\right)} = \frac{3\ell}{2k_{eq}\pi r^2} \ldots\ldots (2)$

By equating the terms of R_{eq} from eqn. (1) & (2), we get

$\frac{5\ell}{4k\pi r^2} = \frac{3\ell}{2k_{eq}\pi r^2}$

$k_{eq} = \frac{6k}{5}$

$\therefore N = 6$

15. 4

As initial angle of approach with horizontal is 45° whereas the river velocity is zero then θ=45°

At point B, $\mathrm{v}_{S/G}$ along the perpendicular to line AB is zero

and $\alpha = 75° - 45° = 30°$

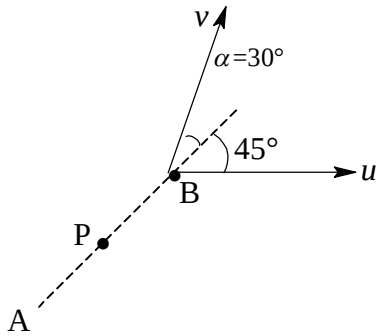
$\therefore v\sin 30° = u\sin 45° \Rightarrow \frac{u}{v} = \frac{1}{\sqrt{2}}$

Also at midpoint P, $v_{river} = \frac{u}{2}$

$\therefore \ v\sin\alpha = \frac{u}{2}\sin\theta \Rightarrow \sin\alpha = \frac{u}{2v}\sin 45° = \frac{1}{4}$

$\alpha = \sin^{-1}\left(\frac{1}{4}\right)$

$\therefore N = 4$

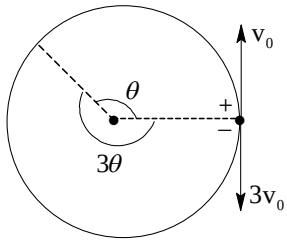


16. 3

$r = \frac{p}{qB} = same\ T_+ = \frac{2\pi\ m_+}{qB} T_- = \frac{2\pi\, m_-}{qB}$

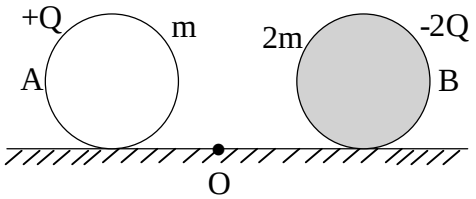
As $T_+ = 3T_-$ they will meet at $\theta = \pi/2$

Time is $\frac{T_+}{4} = \frac{6\pi m}{4qB} = (750\mu s) = 250\times 3\mu s$



17. 5

Let v_1 and v_2 the speed just before collision. Using COAM about point O on the ground



$0 = mv_1R + \frac{2}{3}mR^2\frac{v_1}{R} - 2mv_2R - \frac{2}{5}2mR^2\left(\frac{v_2}{R}\right) \Rightarrow v_1 = \frac{42}{25}v_2$

$K_A = \frac{1}{2}mv_1^2 + \frac{1}{2}\frac{2}{3}mR^2\frac{v_1^2}{R^2} = \frac{1}{2}.mv_1^2\times\frac{5}{3}$

$K_B = \frac{1}{2}2mv_2^2\left(1+\frac{2}{5}\right) = \frac{1}{2}mv_2^2\frac{14}{5}$

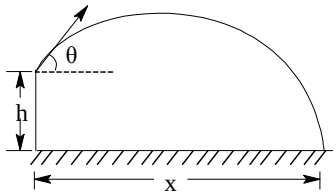
$\frac{K_B}{K_A} = \frac{42}{25}\left(\frac{v_2^2}{v_1^2}\right) = \frac{25}{42}$

18. 2

$x = u_x t - - - - - (1)$

$-h = u_y t - \frac{1}{2}gt^2 - - - - (2)$

Eliminating t and using $\sin\theta = \frac{u_y}{u}$ and $\cos\theta = \frac{u_x}{u}$ and substituting in equation (1) and (2)



$$h\left(1+\cos 2\theta\right) = \frac{gx^2}{u^2} - x\sin 2\theta$$

Differentiating w.r.t.

θ for maximum value of x $\Rightarrow \tan 2\theta = \frac{x}{h} \Rightarrow x = \sqrt{\frac{2u^2}{g}\left(h + \frac{u^2}{2g}\right)}$

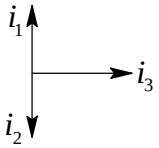
So maximum Area = $\pi x^2 = 209000m^2 \approx 0.2km^2$

19. 1

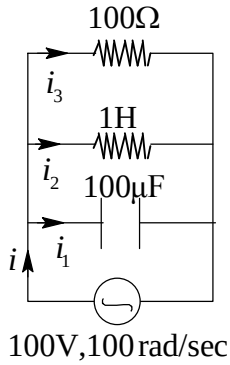
$$\mathrm{X}_L = wL = 100\Omega \Rightarrow X_C = \frac{1}{wc} = 100\Omega$$

$$\mathrm{i}_1 = \frac{100}{100} = 1\mathrm{A} \Rightarrow \mathrm{i}_2 = \frac{100}{100} = 1\mathrm{A} \Rightarrow \mathrm{i}_3 = \frac{100}{100} = 1\mathrm{A}$$

From phasor diagram



So $i = i_3 = 1\mathrm{A}$



20. 4

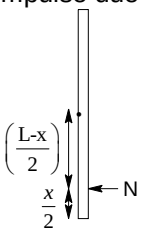
Using WET from a frame moving with velocity $8\left(-\hat{j}\right)m/s$

$$\int_0^{X_{\max}} qv_0B_0x\,dx\cos 180° = -\frac{1}{2}m\left(v_0\sqrt{2}\right)^2 \Rightarrow X_{\max} = 4\,meter$$

SECTION – D

21. 00000.73

Impulse due to 'N' would act at the centre of the colliding parts



Applying Impulse momentum theorem

$$-\int N.dt = M\left(v - v_0\right) \qquad ---(1)$$

& Applying Angular impulse, angular momentum theorem

$$\int N\left(\frac{L-x}{2}\right).dt = \frac{ML^2}{12}\omega \qquad ---(2)$$

Also $e = \dfrac{\omega\left(\dfrac{L-x}{2}\right) - v}{v_0}$ $\quad ---(3)$

From (1), (2) & (3)

$$v\left[1+3\left(\frac{L-x}{2}\right)^2\right] = v_0\left[3\frac{(L-x)^2}{L^2} - e\right]$$

$\therefore$ *for* $v > 0$

$$x < L\left[1-\sqrt{\frac{e}{3}}\right]$$

For inequality to hold true for all 'e'

$$x < L\left[1-\frac{1}{\sqrt{3}}\right]$$

$$or\ x < \left(\sqrt{3}-1\right),\ \therefore x_{\max} = 0.732$$

22. 00008.89

Power absorbed by shell

$$\Rightarrow \frac{\mathrm{P}\times 2\pi\left(1-\cos 37\right)}{4\pi}$$

$$\Rightarrow \frac{\mathrm{P}}{10}$$

For equilibrium

$$\Rightarrow \frac{P}{10} = 3\pi R^2\sigma T^4$$

$$\therefore T^4 = \frac{P}{30\pi R^2\sigma} = \frac{2400\sigma\pi}{30\pi\times 9\times\sigma} \Rightarrow 8.89$$

23. 00056.56

Applying conservation of angular momentum w. r. t. the centre of earth,

$4R\times mv_0\sin 30 = mvR, v = 2v_0$

Applying energy conservation

$$\frac{1}{2}m\left(2v_0\right)^2 - \frac{GMm}{R} = -\frac{GMm}{4R} + \frac{1}{2}mv_0^2$$

$$\therefore v_0 \Rightarrow \sqrt{\frac{GM}{2R}} \Rightarrow \sqrt{\frac{64\times 10^6}{2}} = 40\sqrt{2}\times 100 m/s$$

$$\therefore x = 40\sqrt{2} \Rightarrow 56.56$$

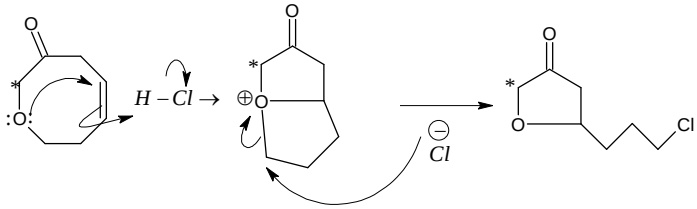
Chemistry

PART – II

SECTION – A

24. B

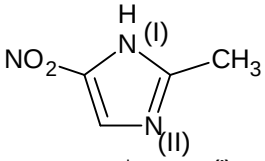
Sol.



25. A

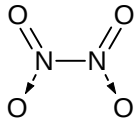
Octanol and water are insoluble.

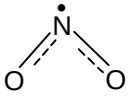
26. D

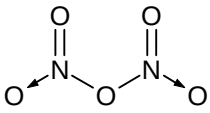
'X' = 

First step is EAS and in 2nd step $N^{(I)}$ is better nucleophile than other $N^{(II)}$.

27. ABCD

 diamagnetic because no unpaired electron

 paramagnetic due to presence of unpaired electron.



HNO_3, H_2SO_4 etc. are responsible for acid rain

28. ABD

$E^0_{Cr^{3+}/Cr^{2+}} < E^0_{Fe^{3+}/Fe^{2+}} < E^0_{Co^{3+}/Co^{2+}}$

29. AD

Hydrolysis requires a $\beta-$ galactosidase, showing that galactose and mannose are linked by a $\beta-$ galactosidic linkage. For sugar to be reducing, one of the hexoses must have free hemiacetal form.

The methylation /hydrolysis procedure shows the point of attachment of the glycosidic bond to mannose. C_1 is anomeric carbon on mannose ring and both $\alpha-\beta$ forms satisfy the above conditions.

30. ABC

Step-I: $\left[Mg^{2+}\right]=\sqrt[3]{\frac{3.2\times10^{-11}}{4}}=2\times10^{-4}M$

Step-II: $\left[Mg^{2+}\right]=2\times10^{-4}M$

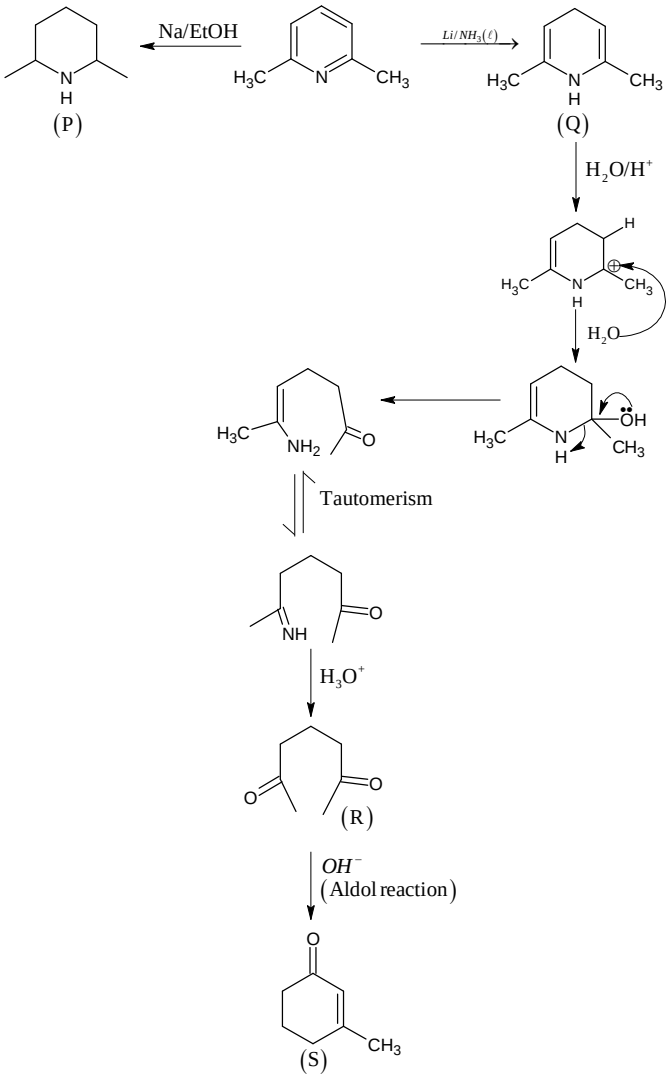
Step-III: $\left[Mg^{2+}\right]=2\times10^{-4}\times\frac{100}{(100+500)}=3.33\times10^{-5}M$

Step-IV:

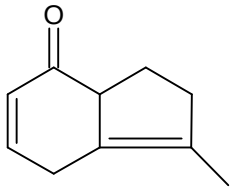
$Mg(OH)_2$ (25ml of 2×10^{-4}M or 0.005 mmole) is mixed with $MgCl_2$ (225ml of 0.06M or 13.5 mmole)

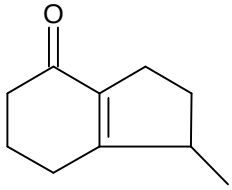
so $\left[Mg^{2+}\right]_{\text{mainly from } MgCl_2}\simeq\frac{13.5}{250}M$

31. ABCD

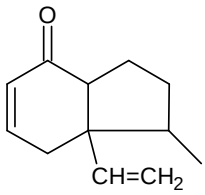


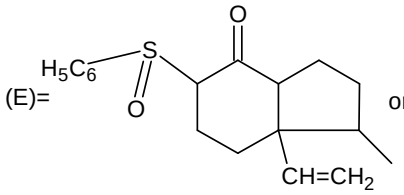
32. C

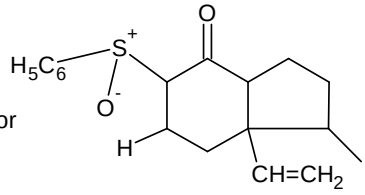
A= 

B= 

33. A

F= 

(E)= 

or 

SECTION – C

34. 4

$K_{a_2} > K_{a_1}$

$\Delta G° = -RT \ln K_a$

$\Delta G_1^\circ > \Delta G_2^\circ$, ΔG_1° and ΔG_2° are both +ve due to $K_a < 1$

$\Delta G_1^0 = \Delta H_1^0 - T\Delta S_1^0$ and $\Delta G_2^0 = \Delta H_2^0 - T\Delta S_2^0$

$\Delta H_1^0 \simeq \Delta H_2^0$

$\Rightarrow \Delta S_1^0$ is more negative than ΔS_2^0.

ΔS_1^0 and ΔS_2^0 both are negative because water is more organised due to hydration.

35. 2

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

$t = 0$ 4 16 –

$t = t_{eq.}$ $4-a$ $16-3a$ $2a$

$P \times 1 = 20 \times R \times T$

$\frac{9}{10} P \times 1 = (20 - 2a) \times R \times T \Rightarrow a = 1$

On adding 'x' moles of inert gas at constant volume, equilibrium composition does not change

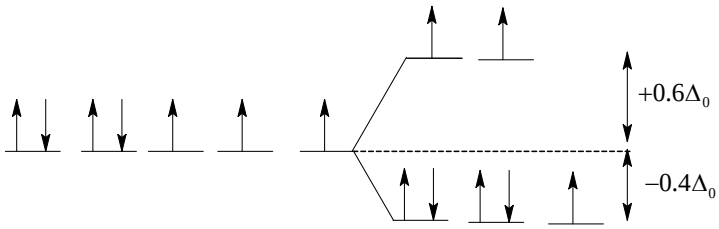
$\frac{9}{10} \times P \times 1 = 18 \times R \times T$

$P \times 1 = (18 + x) RT$

$x = 2$

36. 7

$\text{CFSE} = E_{\text{ligand field}} - E_{\text{symmetric field}}$



$$=\left[5\times\left(\frac{-2}{5}\Delta_0\right)+\left(2\times\frac{3}{5}\Delta_0\right)+2P\right]-2P$$

$$=\frac{-4}{5}\Delta_0$$

$$=\frac{-4}{5}\times 87.5=x=-70$$

$$\Rightarrow\left|\frac{x}{10}\right|=7$$

37. 9

$\Lambda_m=\Lambda_m^0-A\sqrt{C}$

For KCl

$120=150-A\sqrt{0.0625}$

$A=120$

'A' will remains same for KCl and NaCl (1:1 electrolyte)

For NaCl

$$90=126-120\sqrt{\frac{x}{100}}$$

$x=9$

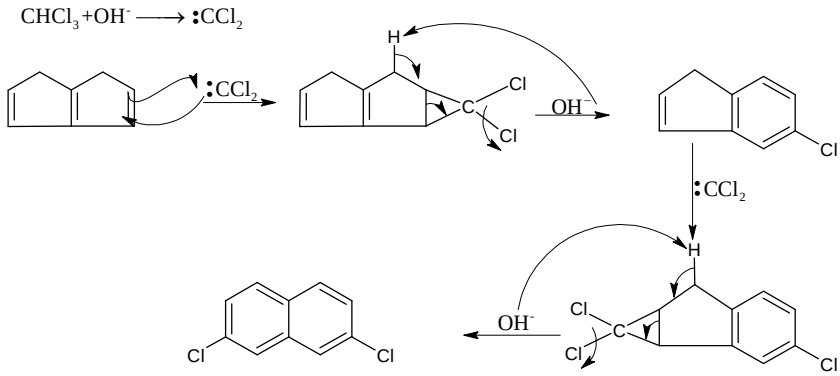
38. 5

$ClF_3, XeF_2, SF_4, [SbF_4]^-$, $XeOF_2$ are having lone pairs at equitorial position.

39. 4

degenerate states are

40. 2



It has two plane of symmetry

41. 3

$LiCN, Na_2CO_3, NaHCO_3$

42. 6

Chalcocite Cu_2S, Argentite Ag_2S, Horn silver AgCl, Siderite $FeCO_3$, Azurite $2CuCO_3.Cu(OH)_2$, Limestone $CaCO_3$. $MgCO_3$, Magnesite $MgCO_3$, Kieserite $MgSO_4.H_2O$

43. 9

A and B are same

$$[\alpha]_{sp.rot.} = \frac{\alpha_{obs.}}{c(g/ml)\times l(dm)}$$

$$60 = \frac{\alpha_{obs.}}{\frac{1.5}{10}\times 1}$$

$$\alpha_{obs.} = 9^0$$

SECTION – D

44. 02806.28

$$C_{10}H_8(s) + 12O_2(g) \longrightarrow 10CO_2(g) + 4H_2O(\ell)$$

For 1 mole Napthalene, heat liberated = $\frac{14000\times 2}{0.01} = 28\times 10^5 J/mole$

$\Delta U = -28\times 10^5 J/mol$

$\Delta U_{at\,300K} = -28\times 10^5 - [10\times 2\times 35 + 4\times 75\times 2]$

(but here product and reactant both are at 300K)

$$= (-28\times 10^5 - 1300)J$$

$$= (-2800 - 1.3)kJ = -2801.3kJ$$

$$\Delta H = \Delta U + (\Delta n)_g RT$$

$$= -2801.3 + (-2)8.3\times 300\times 10^{-3}$$

$= -2801.3 - 4.98$

$= -2806.28$ KJ/mol

45. 00001.02

The rate of change of pH with the volume of alkali added is maximum at equivalence point.

So volume required to neutralisation = 25.5ml

$25.5 \times 2 \times 0.2 = M \times 1 \times 10$

So, $M = 1.02$

46. 00001.48

$Z = 4 \times 0.999$

$$d = \frac{4 \times 0.999 \times 40}{6 \times 10^{23}\left[(0.18)^{1/3} \times 10^{-7}\right]^3} \text{ gm/cm}^3$$

$= 1.48 \text{ g/cm}^3$

Mathematics

PART – III

SECTION – A

47. A

$2\tan^{-1}\left(\sec^2 \pi x\right) \geq \frac{\pi}{2}$ & $\sin^{-1}\left(x^3 - x^2 + x + 2\right) \leq \frac{\pi}{2}$

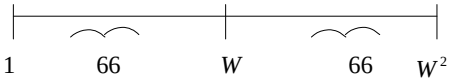
Equality holds if $x^3 - x^2 + x + 2 = 1$ & $\sec^2 \pi x = 1$

$\Rightarrow x^3 - x^2 + x + 1 = 0, \quad x = n, n \in N$ but equation has no integral roots.

48. D

Sol. Factor of $W = 2^4.3^2.5^1 = 5 \times 3 \times 2 = 30$

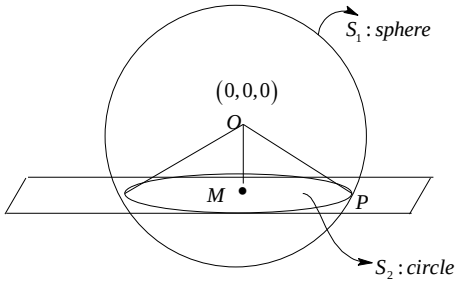
Factor of $W^2 = 2^8.3^4.5^2 = 9 \times 5 \times 3 = 135$



Hence $66 - 28 = 38$

49. A

Sol.



Plane: $x + y + z = 1$

Let OM be $\perp$ distance from 'O' to plane

$\Rightarrow OM = \frac{1}{\sqrt{1^2 + 1^2 + 1^2}} = \frac{1}{\sqrt{3}}$

$OP = 1(given)$

ΔOMP is a right angled triangle

$\therefore MP = \sqrt{1 - \frac{1}{3}} = \sqrt{\frac{2}{3}}$

The required curve is the cone with S_2 as circular base and vertex at $O(0,0,0)$

$V = \frac{1}{3}\pi r^2 h = \frac{1}{3} \times \pi \times \left(\sqrt{\frac{2}{3}}\right)^2 \times \frac{1}{\sqrt{3}}$

$= \frac{2}{9\sqrt{3}}\pi = \frac{2\sqrt{3}}{27}\pi$

50. ABC

Sol.

$$\left[x^2-1\right]=\begin{cases}0 & x=-1\\ -1 & -1<x<1\\ 0 & 1\le x<\sqrt{2}\\ 1 & \sqrt{2}\le x<\sqrt{3}\\ 2 & \sqrt{3}\le x<2\\ 3 & x=2\end{cases}$$

$$|x|\left[x^2-1\right]=\begin{cases}0 & x=-1\\ x & -1<x<0\\ -x & 0\le x<1\\ 0 & 1\le x<\sqrt{2}\\ x & \sqrt{2}\le x<\sqrt{3}\\ 2x & \sqrt{3}\le x<2\\ 3x & x=2\end{cases}$$

$$|x|+\left[x^2-1\right]=\begin{cases}-x & x=-1\\ -x-1 & -1<x<0\\ x-1 & 0\le x<1\\ x & 1\le x<\sqrt{2}\\ x+1 & \sqrt{2}\le x<\sqrt{3}\\ x+2 & \sqrt{3}\le x<2\\ x+3 & x=2\end{cases}$$

$$\int_{-1/2}^{1/2}\left(f(x)-g(x)\right)dx=\int_{-1/2}^{0}(2x+1)\,dx+\int_{0}^{1/2}(-2x+1)\,dx=\frac{1}{2}$$

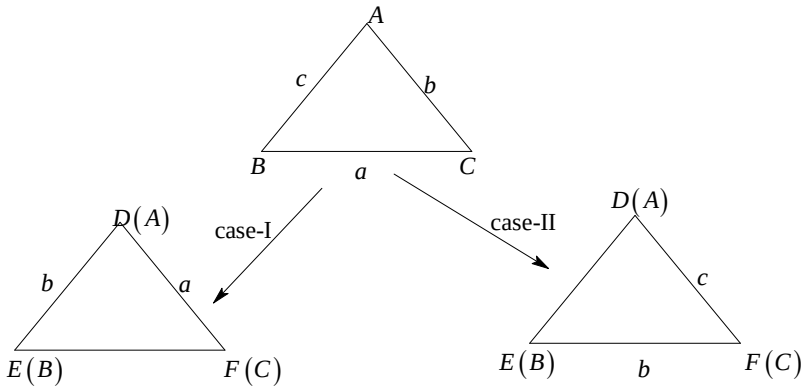
51. BD

Sol. Divide S in 7 partition of form $7k+r\left(r=0,.....,6\right)$ we can choose a element from partition of form $7k+r$. We cannot use $7(k+1)-r.\{r=1,.....,6\}$ and we can select 1 element from partition of form $7k$.

52. ABC

Let $Q(x)=x^2+bx+c, Q\left(P(x)\right)=\left(P(x)\right)^2+bP(x)+c$ as $P(x)\,|\,Q\left(P(x)\right)\Rightarrow c=0$ and $Q(x)=P(x)+b$

53. ACD



case-I

Let $a > b > c$, $\dfrac{\sin C}{\sin B} = \dfrac{c}{b} = \dfrac{b}{a} \Rightarrow b^2 = ac$

case-II

Let $a > b > c$, $\dfrac{\sin A}{\sin B} = \dfrac{b}{c} = \dfrac{a}{b} \Rightarrow b^2 = ac$

Let $(a,b,c) \equiv (c\lambda^2, c\lambda, c)$ as triangle is

formed $b + c > a \Rightarrow \lambda^2 - \lambda - 1 < 0 \Rightarrow \dfrac{2}{1+\sqrt{5}} < \lambda < \dfrac{1+\sqrt{5}}{2}$

54. ABCD

$$\int_0^{\pi} 16\sin^4 x \cos^2 x - \left(f(x) - 4\sin^2 x \cos x \right)^2 dx$$

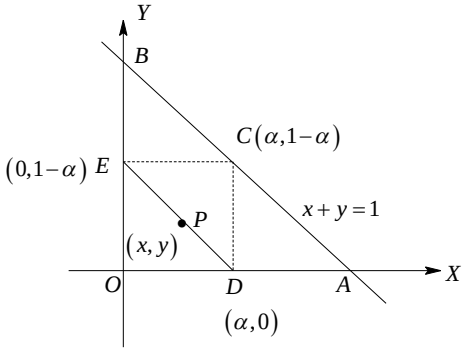
$$= \pi - \int_0^{\pi} \left(f(x) - 4\sin^2 x \cos x \right)^2 = \pi$$

$$f(x) = 4\sin^2 x \cos x$$

55. B

56. D

Sol. (55 – 56)



$$\frac{x}{\alpha}+\frac{y}{1-\alpha}=1$$

$AM \geq GM$

$$\frac{\frac{x}{\alpha}+\frac{y}{1-\alpha}}{2} \geq \sqrt{\frac{xy}{\alpha(1-\alpha)}}$$

$$\Rightarrow xy \leq \frac{\alpha(1-\alpha)}{4}$$

$$xy \leq \frac{1}{16}$$

Region traced by point P is $(y-x-1)^2 \geq 4x$

$$\therefore Area = \int_0^1 \left(x+1-2\sqrt{x}\right)dx = \frac{1}{6}$$

SECTION – C

57. 8

Sol. $f(\alpha_i)=\tan\alpha_i \quad e^{-\alpha_i}\left(f(\alpha_i)+\frac{1}{f(\alpha_i)}\right)=\frac{2e^{-\alpha_i}}{\sin 2\alpha_i}=2$

$$\sum_{i=1}^{4} e^{-\alpha_i}\left(f(\alpha_i)+\frac{1}{f(\alpha_i)}\right)=8$$

58. 9

Sol. $(2\lambda+1,\lambda,-\lambda)$ is the ordered triplet which satisfy first two equations so it must satisfy third equation & $(2\lambda+1)^2+\lambda^2+\lambda^2$ must be minimum which happens at $\lambda=-\frac{1}{3}$ so $(\alpha,\beta,\gamma)\equiv\left(\frac{1}{3},-\frac{1}{3},\frac{1}{3}\right)$ which satisfies third equation, i.e.

$$a\times\frac{1}{3}+(a+b)\left(-\frac{1}{3}\right)+6\times\frac{1}{3}=1$$

$b=3 \,\&\, a\in R$

59. 5

Sol. Coeff. of x^{14} in $(1-x)^{17}\left(1+2x+3x^2+.....+15x^{14}+.....\right)$ is $\sum_{k=0}^{14}(-1)^k(15-k)\ {}^{17}C_k$.

Which is same as coeff. of x^{14} in $(1-x)^{15}$ $={}^{15}C_{14}=15$

60. 5

Sol. Let $r^{th},(r+2)^{th},(r+6)^{th}$ terms be $a, a+2d, a+6d$ respectively.

$\Rightarrow (a+2d)^2=a(a+6d)\Rightarrow a=2d.$

Terms are $(2d, 4d, 8d)$ so common ratio of G.P is $\frac{1}{2}$.

Let $u, \frac{u}{2}, \frac{u}{2^2}, \ldots\ldots \frac{u}{2^{2p}}$ are $2p+1$ terms in $(p, 2018p)$

i.e.

$u < 2018p \;\&\; \frac{u}{2^{2p}} > p$

$p.2^{2p} < u < 2018p$

$4^p < 2018$

$p \le 5$

61. 2

Sol. $f(x) > x^2 \;\; \forall x \in R - \{\pm 1\}$

$f(f(x)) > f^2(x) \;\; \forall x \in R - \{\pm 1, 0\}$

$f(f(x)) > f^2(x) > (x^2)^2 \quad \forall x \in R - \{\pm 1, 0\}$

$f(f(f(x))) > f^2(f(x)) > f^4(x) > x^8 \quad \forall x \in R - \{\pm 1\}$

$f(f(f(x))) \le x^8$ has solution only at $x = \pm 1$

62. 0

Sol. $\min(f(t)) = -\left(\frac{\sin^2 x - 4 \cdot \frac{1}{4}|\sin x| \cdot 4}{4 \cdot \frac{1}{4}|\sin x|}\right)$

$= 4 - |\sin x|$

$\therefore I_1 = \int_0^{\pi/2} (4 - |\sin x|)\, dx = [4x + \cos x]_0^{\pi/2}$

$I_1 = 2\pi - 1$

$I_2 = \min\left(\int_0^{\pi/2} \left(\frac{1}{4}t^2 |\sin x| - t \sin x + 4\right) dx\right)$

$= \min\left(\left[-\frac{1}{4}t^2 \cos x + t \cos x + 4x\right]_0^{\pi/2}\right)$

$= \min\left(2\pi + \frac{1}{4}t^2 - t\right)$

$= \min\left(2\pi + \frac{1}{4}(t-2)^2 - 1\right)$

$I_2 = 2\pi - 1$

$\therefore |I_1 - I_2| = 0$

63. 3

$(x+2)(2x-3)=p^n$

Case 1: One of the factors is ± 1 which is possible only when $x=2,-3$

Case 2: Let $x+2=p^r$ & $2x-3=p^s$

$\Rightarrow p^s\left(2p^{r-s}-1\right)=7$

$\Rightarrow p=7 \& x=5$

64. 1

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

So given expression reduces to

$$\frac{(ab)^2+(bc)^2+(ca)^2}{(ab+bc+ca)^2}=\frac{(ab+bc+ca)^2-2abc(a+b+c)}{(ab+bc+ca)^2}$$

$=1$

65. 2

$$\frac{\cos\pi(x+1)}{k}+\frac{\cos\pi(x-1)}{k}=\sqrt{3}\frac{\cos\pi(x)}{k}$$

$$\Rightarrow \frac{\cos\pi(x)}{k}\left(2\frac{\cos\pi}{k}-\sqrt{3}\right)=0$$

$$\Rightarrow \frac{\pi}{k}=\frac{\pi}{6}\Rightarrow k=6$$

$$\lambda\cos\frac{\pi}{3}=4\Rightarrow\lambda=8$$

66. 5

Let chosen points be $(\alpha_1,\beta_1)\&(\alpha_2,\beta_2)$. The area of the triangle $\frac{1}{2}\left|\alpha_1\beta_2-\alpha_2\beta_1\right|$ must be integer.

$\Rightarrow \alpha_1\beta_2-\alpha_2\beta_1$ is even integer. Total probability $=\left(1-\frac{2(64-16).16}{64\times 64}\right)=\frac{5}{8}$

SECTION – D

67. 00102.01

$$\frac{dv}{dt}=-\mu A\Rightarrow\frac{Adh}{dt}=-\mu A$$

$$\int_{15.7}^{0} dh=\int_{0}^{t}-\mu dt \qquad \Rightarrow 15.7=\mu t$$

$$\frac{dv}{dt}=-\lambda \Rightarrow (10.1)^2\frac{dh}{dt}=-\lambda$$

$$\int_{15.7}^{0}(10.1)^2\,dh=\int_{0}^{t}-\lambda dt$$

$$\lambda t=(10.1)^2(15.7)$$

As t is same in both case $\frac{(10.1)^2(15.7)}{\lambda}=\frac{(15.7)}{\mu}\Rightarrow\frac{\lambda}{\mu}=(10.1)^2$

68. 03600.00

As $z_1+z_2+z_3=0\Rightarrow z_1,z_2,z_3$ are vertices of an equilateral triangle and z_4,z_5 are end points of diameter. So $|z_i-z_j|^2=3r^2$ if $i,j\in\{1,2,3\}$; $|z_i-z_j|^2=4r^2$ if $i\in\{1,2,3\}$ & $j\in\{4,5\}$ & $|z_4-z_5|^2=4r^2$

$$\Rightarrow\sum_{1\le i<j\le 5}\sum|z_i-z_j|^2=25r^2=3600$$

69. 00007.75

Let A denotes the probability that every box have three balls each. B is the probability that each box has balls of the colour as that of the box.

Required probability $=P(\bar{B}/A)=1-P(B/A)$

Cases: $R\to B,B\to G,G\to R$ or $R\to G,B\to R,G\to B$

$$P(A)=\frac{1}{2}.\frac{1}{2}.\frac{1}{2}+\frac{1}{2}.\frac{1}{2}.\frac{1}{2}$$

$$P(A\cap B)=\frac{1}{2}.\left(\frac{1}{2}.\frac{1}{4}\right).\left(\frac{1}{2}.\frac{1}{4}\right)$$

So $$P(B/A)=\frac{\frac{1}{8}.\frac{1}{16}}{\frac{1}{8}+\frac{1}{8}}=\frac{1}{32}$$

$$P(\bar{B}/A)=\frac{31}{32}$$