FIITJEE **JEE (Advanced)-2018**

ALL INDIA TEST SERIES

FULL TEST – VII

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

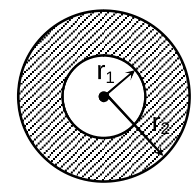
Physics

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. In given diagram, their is a conducting sphere of radius r_1 which is surrounded by dielectric ($\in_r$). If conducting sphere is given charge 'q' then surface density of polarization charges on outer surface of dielectric layer is



(A) $\frac{\in_r q}{4\pi r_2^2}$ (B) $\frac{q}{4\pi \in_r r_2^2}$

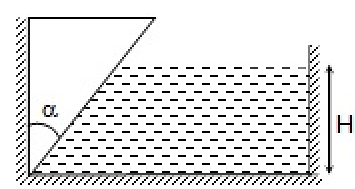
(C) $\frac{(\in_r - 1)q}{4\pi r_2^2}$ (D) $\frac{(\in_r - 1)q}{4\pi \in_r r_2^2}$

2. A parallel plate capacitor (plate Area : A) connected to battery of emf 'V' and negligible internal resistance, so that one of the plate is made to oscillate and distance between plate varies as $d = d_0 + a\cos(\omega t)$, $a << d_0$. If maximum current observed in circuit is I_0, then maximum possible amplitude of vibration (a) is

(A) $\frac{a^2 I_0}{VA\omega \in_0}$ (B) $\frac{I_0 d_0}{V\sqrt{A}\omega \in_0}$

(C) $\frac{I_0 {d_0}^2}{VA\omega \in_0}$ (D) $\frac{I_0 d_0}{VA\omega \in_0}$

3. A slit is cut along the left bottom edge of a rectangular tank. The slit is closed by a wooden wedge mass 'M' and apex angle 'α' as shown in diagram. The vertical plane surface of the wedge is in the contact with the left vertical wall of the tank. Coefficient of static friction between these surfaces in contact is 'μ'. To what maximum height, can water be filled in tank without any leakage through the slit? The width of tank is 'b' and density of water is 'ρ'.



(A) $\sqrt{\frac{2M}{\rho b(\tan\alpha - \mu)}}$ (B) $\sqrt{\frac{4M}{\rho b(\tan\alpha - \mu)}}$

(C) $\sqrt{\frac{2M}{\rho b(\sin\alpha - \mu\cos\alpha)}}$ (D) $\sqrt{\frac{2M\cos\alpha}{\rho b(\tan\alpha - \mu\cos\alpha)}}$

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.

4. A narrow beam of monochromatic light of wavelength 'λ' emitted by source of power 'P', propagating in x-direction gets reflected from perfectly reflecting plane mirror, having area vector $\vec{A} = A(-\hat{i} + \hat{j})$. The beam after reflection falls on metal plate of area A (placed in x-z plane), having work function ϕ and photo electric efficiency 'η'. If photoelectrons emitted are immediately removed from vicinity then (velocity of light is c)
(A) Magnitude of change in momentum of photon after reflection from mirror depends only on 'λ'
(B) Magnitude of change in momentum of photon after reflection from mirror depends on 'λ'
(C) Magnitude of force exerted by light beam on mirror depends only on 'P' & 'c'.
(D) Force exerted by light beam on mirror depends only on 'P' & 'c'.

5. A metallic ring of radius 'r', charged to potential $-V_0$ placed in free space is continuously irradiated by UV of wavelength (λ) [assume potential at infinity is zero] then, given : threshold wavelength is λ_0, C : speed of light, 'h' : planck's constant, m : mass of electron
(A) Maximum speed of photoelectron immediately after emission is $\sqrt{\frac{2hc}{m}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)}$
(B) Maximum speed of photoelectron at great distance from ring is $\sqrt{\frac{2hc}{m}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right) + \frac{eV_0}{2m}}$
(C) Potential of ring after prolonged irradiation is $\frac{2hc}{e}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$
(D) Total number of photoelectrons emitted from ring is $\frac{4\pi \in_0 r}{e}\left\{\frac{hc}{e}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right) + V_0\right\}$

Space for Rough work

6. If electric force $(\vec{F})$ on a point charge 'q' due to another charge 'Q' obeys following law

$$\vec{F} = \frac{Qq(1-\sqrt{\alpha r})\vec{r}}{4\pi \epsilon_0 r^3}$$

Where α: positive constant, $\vec{r}$ is position vector of charge 'q' relative to 'Q'.

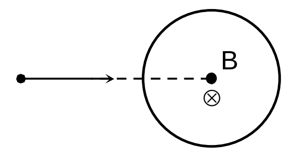
(A) Electric field to point charge Q is $\vec{E} = \frac{Q(1-\sqrt{\alpha r})}{4\pi \epsilon_0 r^3}\vec{r}$

(B) $\oint \vec{E}.\vec{dl}$ over a closed path will be equal to zero.

(C) Gauss's law $\oint \vec{E}.\vec{ds} = \frac{q_{enclosed}}{\epsilon_0}$ holds true

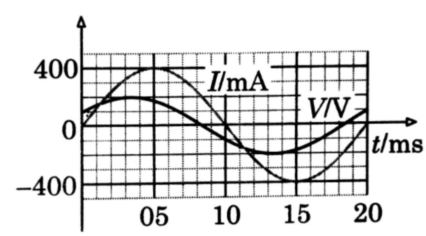
(D) All statements are correct.

7. Uniform magnetic field is confined into a cylindrical region, if α-particles with different speeds enter the region radially, then



(A) Faster the particle, lesser is the time spent in region
(B) Slower the particle, lesser is the time spent in region
(C) Slower the particle, greater is the time spent in region
(D) Time will be same for all particles

8. The graph shows variation of source voltage (V) and steady state current (I) drawn by a series RLC circuit. Identify correct statement(s).



(A) Current lags the voltage
(B) Resistance in circuit is $250\sqrt{3}\Omega$
(C) If capacitive reactance is 74Ω, then inductive reactance will be 324 Ω.
(D) Average power dissipated in circuit will be $20\sqrt{3}$W.

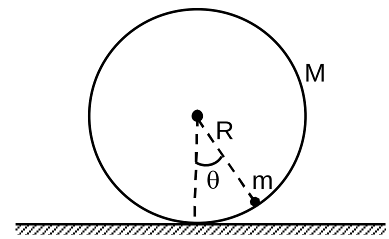
Space for Rough work

(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

A particle of mass 'm' slides without friction inside a hoop of radius 'R' and mass 'M'. The hoop rolls without slipping on a rough horizontal surface. Initially the particle is given small displacement (w.r.t. ring), the system performs SHM.



Now answer the following questions:

9. Angular frequency of small oscillations is

(A) $\sqrt{\frac{g}{R}\left(1+\frac{m}{M}\right)}$ (B) $\sqrt{\frac{g}{R}\left(1+\frac{m}{2M}\right)}$

(C) $\sqrt{\frac{g}{R}\left(1+\frac{2m}{M}\right)}$ (D) $\sqrt{\frac{mg}{2MR}}$

10. If the angular amplitude of oscillation of particle w.r.t. ring is 'θ', then the amplitude of oscillation of the centre of ring is

(A) $\frac{MR\theta}{M+m}$ (B) $\frac{MR\theta}{2M+m}$

(C) $\frac{mR\theta}{2M+m}$ (D) $\frac{mR\theta}{m+M}$

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.

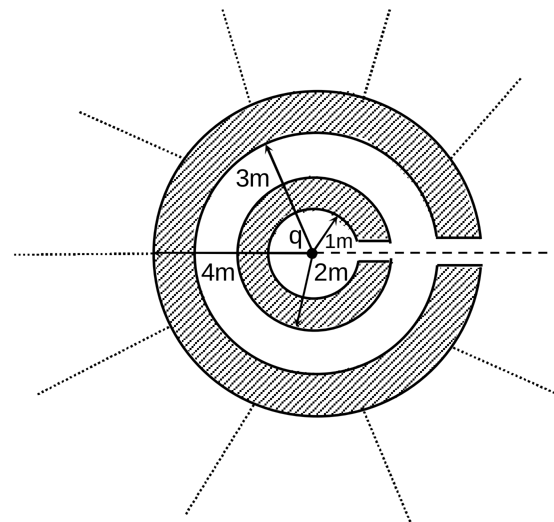
11. A liquid droplet of surface tension 4 N/m is introduced between two heavy plates of mass 1 kg and area 0.2 m^2. If the distance between these plates (which are put horizontally) is 2 cm, and angle of contact is 0°, the net normal force between the plates is found to be 10 n. Find 'n'. (take g = 10 m/s^2)

Space for Rough work

12. A particle of mass 1 kg and charge 0.5 C, is projected in a magnetic field of magnitude 2T, with a velocity 3 m/s making at angle of 30° with the field. Find radius of curvature of path traced out by the particle (in metres) [neglect gravity].

13. A battery of internal resistance 5Ω is connected across a capacitor of face area 0.1 m^2, distance between the plates as 1 cm and containing dielectric of relative permittivity 3 and resistivity 100 Ωm, fully inserted into it. The time constant of charging of capacitor is found to be $10n \in_0$. Then find the value of 'n'.

14. A charge 'q' is placed at the origin of an infinite chain of thick spherical conductors, whose inner and outer radii vary as (1m, 2m); (3m, 4m); (5m, 6m) and so on. The work needed to take the charge 'q' from centre of the system to infinite separation, through the orifice, is found to be $kq^2 \ell n\sqrt{n-4}$. Find 'n'.

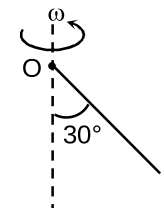


15. A tightly wound toroid (10,000 turns) has rectangular cross-section of thickness 2 cm and ratio of inner and outer radii as e^2. The self inductance of this toroid is x/10 H. Find x.

16. One mole of a monoatomic gas is supplied heat such that its molar heat capacity during the process is 2R. (R gas constant). If during heating, its volume gets doubled, by what factor does its temperature change?

Space for Rough work

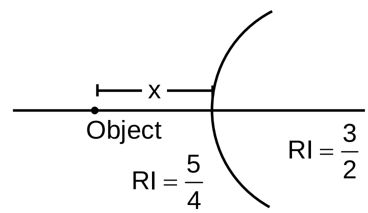
17. A rod of mass 6 kg and length 2 m, is rotating with an angular speed 1 rad/s about a point 'O' such that, the rod always makes an angle of 30° with vertical. What is the angular momentum of rod about 'O' [in SI units]?



18. Three sources of frequency 400 Hz, 401 Hz and 405 Hz respectively are emitting sound continuously is space. How many beats will be heard per second?

19. Atoms (may be in excited state) in a material ${}^{A}_{Z}X$ absorbs photons of energy 47.25 eV. We get 3 different photons in emission spectrum having energy greater than or equal to 47.25 eV. Find Z.

20. Radius of curvature of surface separating two media is 2m. To form real image of object, its distance from surface must be greater than x. Find $\frac{x}{2}$.

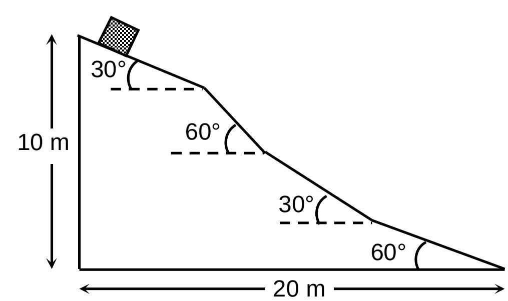


SECTION – D
(Numerical Based XXXXX.XX answer Type)

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

21. Plate 1 of a capacitor having capacitance 1.5 μF is given a charge of 30 μc while the other plate is uncharged. The capacitor is now connected with a battery of potential 40 V with plate 1 connected to the positive terminal. Work done by battery is ___________ μJ.

22. A block of mass 18 kg is released from the top of the wedge as shown in the diagram. Coefficient of friction between block and surface of the wedge is μ = 0.2. Magnitude of work done by friction when the block reaches bottom of the wedge is .... (Assume that the block makes smooth transitions at all corners so that it never looses contact, g = 10 m/s^2)



23. One mole of an ideal gas undergoes a thermodynamic process whose molar specific heat is given by the equation $C = C_V + 4R$. Equation of such a process is given by VT^{-n}, value of n is

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. Two liquids A and B are mixed at temperature T in a certain ratio to form an ideal solution. It is found that the partial pressure of A, i.e., P_A is equal to P_B, the pressure of B for liquid mixture. What is the total pressure of the liquid mixture in terms of P_A^0 and P_B^0?

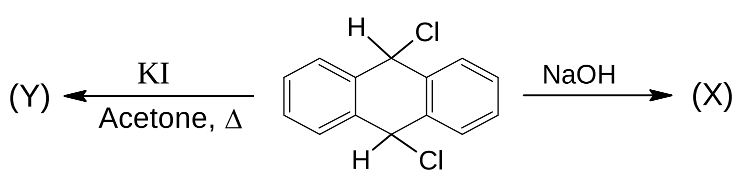
(A) $\dfrac{P_A^0 P_B^0}{P_A^0+P_B^0}$

(B) $\dfrac{2P_A^0 P_B^0}{P_A^0+P_B^0}$

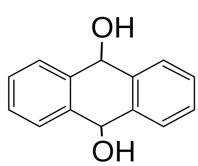
(C) $\dfrac{2P_A^0}{P_A^0+P_B^0}$

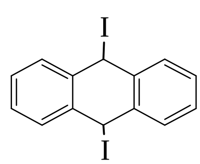
(D) $\dfrac{2P_B^0}{P_A^0+P_B^0}$

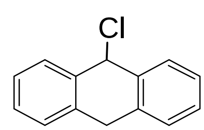
25.

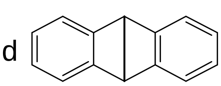


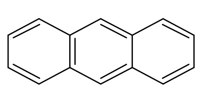
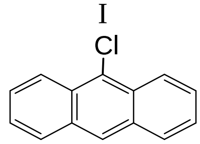
X and Y are, respectively.

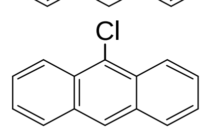
(A) 

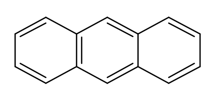
and 

(B) 

and 

(C)  and 

(D) 

and 

Space for Rough work

26. Extraction of copper from copper pyrite $(CuFeS_2)$ does not involve:
(A) crushing followed by concentration of the ore by froth-floatation.
(B) removal of iron as slag
(C) self-reduction step to produce 'blister copper' following evolution of SO_2.
(D) refining of 'blister copper' by carbon reduction

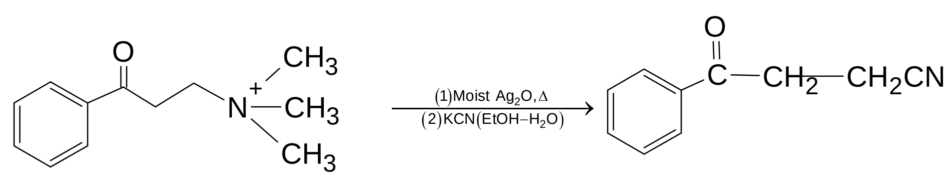
(One or More than one correct type)

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. Titration of 664 mg of a pure organic carboxylic acid, H_2A, showed a rapid change in pH at 40 ml. and at 80 ml of 0.1 M NaOH titrant. When 40 ml. of NaOH was added, the pH was 5.85 and at 60 ml of NaOH the pH was 8.08. Which of the following statements are correct
(A) the molecular weight of acid is 166
(B) the molecular weight of acid 664
(C) the pka$_1$ of acid is 3.62
(D) the pka1 of acid is 5.85

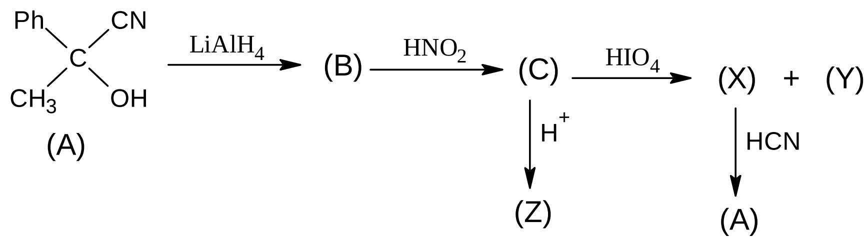
28. $D(-)\text{Glyceraldehyde} \xrightarrow[HCl]{Me_2CO} A \xrightarrow[(ii)H_2O]{(i)CH_2=CHMgCl} B \xrightarrow[(ii)Me_2S,\ (iii)H^+/H_2O]{(i)O_3} C$

Which of the following statements are correct?
(A) C is CHO–(CHOH)$_2$–CH_2OH
(B) A contains carbonyl group as well as C–O–C linkage
(C) B can decolorize Br_2/H_2O
(D) three moles of HIO_4 will be consumed with C

29.


Choose the correct statement (s)
(A) The reaction involves S_N2 attack followed by conjugate addition.
(B) the reaction involves $E_{CB}1$ path.
(C) It involves 1, 4-addition in α, β-unsaturated carbonyl compound.
(D) It involves nucleophilic attack on carbonyl carbon initially.

Space for Rough work

30. 

Correct statements are
(A) X gives yellow precipitate with I_2 in presence of NaOH.
(B) Y is reduced by Fehling solution
(C) Z gives silver mirror with $[Ag(NH_3)_2]^+$
(D) X reduces Tollen's reagent

31. Select the correct statement (s) for positron emission by unstable nucleus
(A) X-ray emission takes place
(B) A neutron is formed
(C) $\frac{n}{p}$ of daughter nucleus increases
(D) A neutron is consumed

(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

An inorganic salt (A) on heating upto 230^0C loses its colour and forms (B), the loss of water from salt (A) is 36.07% by weight. Small amount of salt (B) is dissolved in 1L of water. Assuming no volume change after the dissolution. 100mL of the solution is treated with excess KI solution, results a precipitate (C) with the evolution of I_2. The liberated I_2 requires 20 mL of 0.25 M sodium thiosulphate solution. [mol. wt. Cu = 63.5, Zn = 65.5, Fe = 56, Mg = 24]

32. Molecular formula of inorganic slat (A) is
(A) $FeSO_4 . 7H_2O$ (B) $ZnSO_4.7H_2O$
(C) $CuSO_4 .5H_2O$ (D) $MgSO_4.7H_2O$

33. What amount of salt (B) is dissolved in 1 L of water
(A) 0.199 gm (B) 7.97 gm
(C) 0.235 gm (D) 9.4 gm

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.

34. A 50 ml 1.92% (w/v) solution of a metal ion M^{n+} (at. wt. = 60) was treated with 5.332 g hydrazinehydrate $(N_2H_4.H_2O)$ (90%pure) and the mixture was saturated with CO_2 gas when entire metal gets precipitated as a complex $[M(NH_2-NHCOO)_n]$ the complex was filtered of and the filtrate was titrated with M/10 KIO_3 in the presence of conc. HCl according to the following equation $N_2H_4 + IO_3^- + 2H^+ + Cl^- \rightarrow ICl + 3H_2O + N_2\uparrow$
The volume of M/10 KIO_3 solution needed for end point to arrive was 480 ml. Find the value of n.

35. Among the followings, total number of cations that tends to form soluble complex with excess of $NH_4OH(aq.)$ and NaCN(aq.)
Pb^{+2}, Cd^{+2}, Hg^{+2}, Bi^{+3}, Cu^{+2}, Ag^{+}

36. When a liquid (molecular mass = 378) that is immiscible with water was steam distilled at 95^0C at a total pressure of 750 torr, the distillate contained **x** gm of liquid per gm of water. Calculate the value of **x**. Where vapour pressure of water is 630 torr at 95^0C.

37. The vapour pressure of a solution containing 66. 9 gm of $M(NO_3)_n$ dissolved in 100 gm of water is 747 torr at 373 K. The degree of dissociation of the salt is 0.565. Molar mass of $M(NO_3)_n$ = 148.3 g/mol. Then n is.

38. $CH_3CH=CHCHO \xrightarrow[\text{dil}]{OH^-} A(C_8H_{12}O_2) \xrightarrow[H^+]{\Delta} B \xrightarrow[HCl]{Zn/Hg} C(C_8H_{12})$
No. of stereo isomers possible for compound (C) are

39. Find the number of acid(s) from the following in which X – H bond is/are present, Given X is central atom:
$H_3PO_2, H_4P_2O_7, H_4P_2O_5, H_2S_2O_6, H_3PO_3, H_3BO_3, H_4P_2O_6$

40. Diethyl oxalate is condensed with Diethyl pentan-1, 5-oate in the presence of sodium ethoxide to form a product (A), which on acidic hydrolysis followed by heating gives another product (B). Now (B) is treated with sodium in liquid ammonia to give (C). Find the degree of unsaturation in (C).

Space for Rough work

41. The rate of decomposition of $NH_3(g)$ takes place at 10 atm on platinum surface. What is rate of formation (in M min^{-1}) of $H_2(g)$. If rate constant of reaction $2NH_3(g) \longrightarrow N_2(g) + 3H_2(g)$ is 2.0 $M\,min^{-1}$?

42. How many molecules in which dz^2 orbital involved in their hybridization of central atom?
$XeF_2, XeOF_4, BrCl_3, \left[Ni(CN)_4\right]^{2-}, [NiCl_4]^{-2}, \left[Fe(CN)_6\right]^{-4}$

43. (i) HgS, PbS, CuS, CdS, SnS, Bi_2S_3 among the given sulphides, the number of sulphides which are more soluble in water than MnS is x
(ii) $Pb(OH)_2$, $Ba(OH)_2$, $Zn(OH)_2$, $Ca(OH)_2$, $Cu(OH)_2$, $Fe(OH)_2$. Among the given hydroxides, the no. of hydroxides which are less soluble in water than $Mg(OH)_2$ is y.
Then calculate x + y

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. For the following cell
Pt, H_2 | H_2A || KCl, Hg_2Cl_2 | Hg ,
1atm (0.1 M, 100 mL) (1M)
what volume (mL) of 2. 5 M NaOH is required to be added to left hand half cell in order to maintain the emf of the cell 0.5164 volts.
Given K_{sp} $Hg_2Cl_2 = 4.2 \times 10^{-18}$; $E^0_{Cl^-, Hg_2Cl_2(s)|Hg(l)} = 0.28V$
For H_2A ($pK_1 = 2.8$, $pK_2 = 5.2$)

45. A compound [A] $C_xH_yO_z$ on catalytic hydrogenations gives [B] $C_xH_{14}O$. [A] on reaction with hot alk. $KMnO_4$ followed by acidification gives tricarboxylic acid [C], which on heating with sodalime gives cyclopentane. Acid [C] can also be obtained by oxidizing 1, 2, 4-cyclopentane tricarbaldehyde, find the value of $\frac{x+z}{2}$

46. An ideal gas having initial pressure P, volume V and temperature T is allowed to expand adiabatically until its volume becomes 5.66 V, while its temperature decreases to T/2. Work done by the gas during expansion is given by W = **X** PV. Find the value of **X**. (given $(5.66)^{0.4} = 2$)

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. A function is defined for all real numbers and satisfies $f(2+x)=f(2-x)$ and $f(7+x)=f(7-x)$ for all real x. If x = 0 is root of f(x) = 0, what is the least numbers of root f(x) = 0 must have in the interval $-1000 \le x \le 1000$

(A) 402
(B) 401
(C) 200
(D) 201

48. In $\{a_n\}$, $a_1 = 2$ $a_{n+1} = 1-\frac{1}{a_n}$ for $n \ge 1$

Let P_n be the product of its first n terms, then the value of P_{2009} is

(A) $-\frac{1}{2}$
(B) –1
(C) $\frac{1}{2}$
(D) 1

49. In ΔABC, $\tan\angle CAB = \frac{22}{7}$ and the altitude from A divided BC into segment of length 3 and 17, the area of ABC is

(A) 110
(B) 112
(C) 95
(D) None of these

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 $f(x)$ is a real valued function defined by :

$$f(x) = x^2 + x^2\int_{-1}^{1} t.f(t)dt + x^3\int_{-1}^{1} f(t)dt$$

Then which of the following holds good ?

(A) $\int_{-1}^{1} t.f(t) = \frac{10}{11}$ (B) $f(1) + f(-1) = \frac{30}{11}$

(C) $\int_{-1}^{1} t.f(t)dt > \int_{-1}^{1} f(t)dt$ (D) $f(1) - f(-1) = \frac{20}{11}$

51. Let A, B, C be n $\times$n real matrices and are pairwise commutative and ABC = O_n and if λ = det $(A^3 + B^3 + C^3)$. det(A + B + C) then

(A) $\lambda > 0$ (B) $\lambda < 0$

(C) $\lambda = 0$ (D) $\lambda \in (-\infty, \infty) - \{0\}$

52. If variable line $x(3+\lambda) + 2y(2-\lambda) - (7-\lambda) = 0$ always passes through a fixed point (a, b) where λ is parameter and $l = \lim_{x\to(a-b)^-} \frac{[(\sin x) - 2] + \{\cos x\}}{x - [x] - 1}$ where [y] and {y} denotes greatest integer $\leq$ y and fractional part of y respectively, then:

(A) $a + 2b = 3$ (B) $a - b + 2l = 2$

(C) $l = 1$ (D) l does not exist

53. If f: N $\to$N, and for $x_2 > x_1$, $f(x_2) > f(x_1)$ $\forall$ $x_1, x_2 \in$ N and f(f(n)) = 3n, $\forall$ n $\in$N then

(A) f(1) = 2 (B) f(2) = 3

(C) f(1) = 3 (D) f(2) = 4

Space for Rough work

54. Let first and second row vectors of matrix A be $\vec{r}_1 = [1\,1\,3]$ and $\vec{r}_2 = [2\,1\,1]$ let the third row vector be in the plane of $\vec{r}_1$ and $\vec{r}_2$ perpendicular to $\vec{r}_2$ with magnitude $\sqrt{5}$, then which of the following is/are true?
(A) Tr. (A) = 3
(B) Volume of parallelepiped formed by $\vec{r}_2, \vec{r}_3$ and $\vec{r}_2 \times \vec{r}_3$ equals 30
(C) Row vectors are linearly dependent
(D) $\left[\vec{r}_1 \times \vec{r}_2 \;\; \vec{r}_2 \times \vec{r}_3 \;\; \vec{r}_3 \times \vec{r}_1\right] = 0$

(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

A parabola passes through the points A and B, the ends of a diameter of a given circle of radius ‘a’. A tangent to the concentric circle of radius ‘b’ is the directrix of the parabola.

55. If AB and a perpendicular diameter are taken as coordinate axes, the locus of the focus of the parabola is
(A) $\frac{x^2}{a^2} + \frac{y^2}{b^2 - a^2} = 1$
(B) $\frac{x^2}{a^2} - \frac{y^2}{b^2 - a^2} = 1$
(C) $\frac{x^2}{b^2} + \frac{y^2}{b^2 - a^2} = 1$
(D) none of these

56. The length of the latus rectum of the locus of the focus of the parabola for a = 4 and b = 3 is
(A) $\frac{14}{3}$
(B) $\frac{7}{2}$
(C) $\frac{7}{3}$
(D) $\frac{7}{\sqrt{2}}$

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 L denotes the number of subjective functions $f: A \to B$, where set A contains 4 elements and set B contains 3 elements.
M denotes number of elements in the range of the function.
$f(x) = \sec^{-1}(\operatorname{sgn} x) + \operatorname{cosec}^{-1}(\operatorname{sgn} x)$ where $\operatorname{sgn} x$ denotes signum function of x.
And N denotes coefficient of t^5 in $(1+t^2)^5(1+t^3)^8$.
The value of $(LM+N)$ is λ, then the value of $\frac{\lambda}{19}$ is.

58. Let $L = \prod_{n=3}^{\infty}\left(1-\frac{4}{n^2}\right); M = \prod_{n=2}^{\infty}\left(\frac{n^3-1}{n^3+1}\right)$ and $N = \prod_{n=3}^{\infty}\frac{(1+n^{-1})^2}{1+2n^{-1}}$,
Then find the value of $L^{-1} + M^{-1} + N^{-1}$.

59. If $P = \frac{\sum_{n=1}^{99}\sqrt{10+\sqrt{n}}}{\sum_{n=1}^{99}\sqrt{10-\sqrt{n}}}$, then [P] is {where [.] is GIF}

60. For any non empty finite set A of real numbers, Let S(A) be the sum of the elements in A. There are exactly 61 of 3-element subsets A of {1,2 .....23} with S(A) = 36. The number of 3-element subsets of {1, 2, 3, ...23} with S(A) < 36 is m, then the value of $\frac{m}{171}$ is

61. The function $f: R \to R$ satisfies $f(x^2).f''(x) = f'(x).f'(x^2)$ for all real x. Given that $f(1) = 1$ and $f'''(1) = 8$, then the value of $f'(1) + f''(1)$ is.

62. The value of a, if a and b are integers such the $x^2 - x - 1$ is a factor of $ax^{17} + bx^{16} + 1$ is P, then the value of $\frac{P}{329}$.

Space for Rough work

63. Let $I = \int_0^1 (1-x^{50})^{99} x^{100} dx$ and

$J = \int_0^1 (1-x^{50})^{100} x^{100} dx$

If $\frac{I}{J}$ is equal to $\frac{m}{n}$ where m and n are co-prime then find the value of $\left(\frac{m-n-1}{20}\right)$.

64. Let M_n be the $n \times n$ matrix with entries as follow: for $1 \le i \le n$ $m_{i,i} = 10$; for $1 \le i \le n-1$ $m_{i+1,i} = m_{i,i+1} = 3$ all other enteriesin M_n are zero, Let D_n be the determinant of matrix M_n, then $\sum_{n=1}^{\infty} \frac{1}{8D_n + 1}$ can be represented as $\frac{p}{q}$, where p and q are relatively prime integers, the value of p + q is M, then value of $\frac{M}{73}$ is.

65. Let A, B, C, D be the vertices of a regular tetrahedron each of whose edges measures 1 meter. A bug, starting from vertex A, observes, the following rules, at each vertex it chooses one of the three edges meeting at that vertex, each edge being equally likely to be chosen, and crawls along that edge to the vertex at its opposite end. Let $p = \frac{n}{729}$ be the probability that the bug is at vertex A when it has crawled exactly 7 meters. The value of n is z, then the value of $\frac{z}{91}$ is.

66. The equation $z^6 + z^3 + 1 = 0$ has complex roots with argument between 90º and 180º in the complex plane, determine the degree measure of θ is p, then the value of $\frac{p}{40}$

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. For nonnegative integers a and b with $a+b \le 6$, let $T(a,b) = \binom{6}{a}\binom{6}{b}\binom{6}{a+b}$. {where $\binom{n}{r} = {}^{n}C_{r}$ }

Let S denote the sum of all T(a, b), where a and b are nonnegative Integers with $a+b \le 6$. Then the value of S is.

68. A circle is circumscribed around an isosceles triangle whose two congruent angles have degree measure x. Two points are chosen independently and uniformly at random on the circle, and a chord is drawn between them. The probability that the chord intersects the triangle is $\frac{14}{25}$. The difference between the largest and smallest possible values of x is.

69. The number of integer values of k in the closed interval [-500, 500] for which the equation $\log(kx) = 2\log(x+2)$ has exactly one real solution.

Space for Rough work

FIITJEE **JEE(Advanced)-2018**

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ANSWERS, HINTS & SOLUTIONS

FULL TEST – VII
PAPER-2

Q. No.	PHYSICS	Q. No.	CHEMISTRY	Q. No.	MATHEMATICS
1.	**D**	24.	**B**	47.	**B**
2.	**C**	25.	**D**	48.	**B**
3.	**A**	26.	**D**	49.	**A**
4.	**A, C**	27.	**A, C**	50.	**B, D**
5.	**A, D**	28.	**A, B, C, D**	51.	**A, C**
6.	**A, B**	29.	**B, C**	52.	**A, D**
7.	**A, C**	30.	**A, C**	53.	**A, B**
8.	**A, B, C, D**	31.	**B, C**	54.	**B, C, D**
9.	**B**	32.	**C**	55.	**C**
10.	**C**	33.	**B**	56.	**A**
11.	**9**	34.	**3**	57.	**4**
12.	**6**	35.	**3**	58.	**8**
13.	**2**	36.	**4**	59.	**2**
14.	**6**	37.	**2**	60.	**5**
15.	**8**	38.	**6**	61.	**6**
16.	**4**	39.	**3**	62.	**3**
17.	**4**	40.	**2**	63.	**5**
18.	**8**	41.	**6**	64.	**1**
19.	**5**	42.	**4**	65.	**2**
20.	**5**	43.	**4**	66.	**4**
21.	**01800.00**	44.	**00004.00**	67.	**18564.00**
22.	**00720.00**	45.	**00004.50**	68.	**00038.00**
23.	**00004.00**	46.	**00001.25**	69.	**00501.00**

Physics

PART – I

SECTION – A

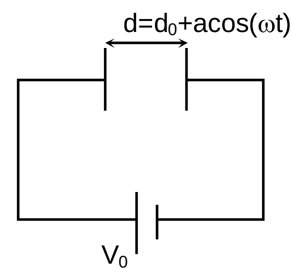
1. D

Induced charge $= q\left(1-\frac{1}{\epsilon_r}\right)$

Surface density $= \frac{q\left(1-\frac{1}{\epsilon_r}\right)}{4\pi r_2^2} = \frac{q(\epsilon_r - 1)}{4\pi \epsilon_r r_2^2}$

2. C

$I = \frac{d}{dt}Q = \frac{d}{dt}(CV) = V\frac{d}{dt}\left(\frac{\epsilon_0 A}{d_0 + a\cos\omega t}\right)$



$I = \frac{V \epsilon_0 A[a\omega \sin\omega t]}{(d_0 + a\cos\omega t)^2}$

$= \frac{V \epsilon_0 A[a\omega \sin\omega t]}{[d_0 + a\cos\omega t]^2}$

When $\sin\omega t = 1, \cos\omega t = 0$, 'I' becomes maximum

$\therefore\ I_0 = \frac{V \epsilon_0 A\omega a}{d_0^2}$

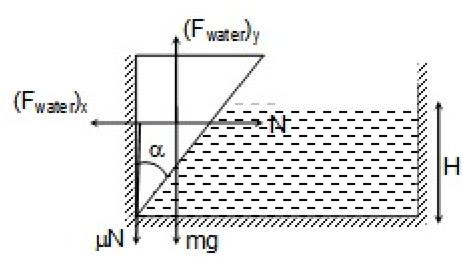
$a = \frac{I_0 {d_0}^2}{V \epsilon_0 A\omega}$

3. A

$(F_{water})_y = \frac{H}{2}(H\tan\alpha)b\rho g$

$(F_{water})_x = \frac{H}{2}(\rho g)(Hb)$

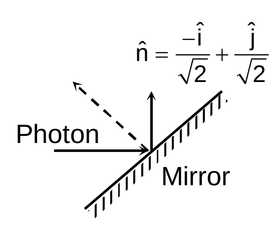
When 'H' is max friction will be maximum.
Use condition of equilibrium.



4. A, C

Change in momentum of each photon $= \frac{h}{\lambda}\left(-\hat{i} + \hat{j}\right)$

Force exerted by light beam on mirror $= \frac{P}{C}\left(\hat{i} - \hat{j}\right)$



5. A, D

Ring is at (–)ve potential and V(∞) = 0, electric field due to this potential difference will accelerate electron away from ring for maximum speed of photoelectron immediately after emission

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + \frac{1}{2}mV_{max}^2 \quad \Rightarrow \quad V_{max} = \sqrt{\frac{2hc}{m}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)}$$

For maximum speed of photoelectron at '∞'

$$\frac{hc}{\lambda} + eV_0 = \frac{hc}{\lambda_0} + \frac{1}{2}mV'^2_{max}$$

$$V'_{max} = \sqrt{\frac{2hc}{m}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right) + \frac{2eV_0}{m}}$$

After prolong irradiation, potential of ring will change

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + eV_{ring} \quad \Rightarrow \quad V_{ring} = \frac{hc}{e}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

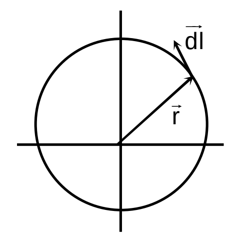
'n' : Total no. of photo electrons emitted then

$$\frac{K(ne)}{r} = \frac{hc}{e}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right) - (V_0) \Rightarrow (D)$$

6. A, B

$$\vec{E} = \frac{\vec{F}}{q} \Rightarrow (A)$$

Assume Q is at origin, consider a circular loop of radius 'r', $\vec{r}$ will be perpendicular to $\vec{dl}$



As $\vec{E}$ is along $\vec{r}$

So $\int \vec{E}.\vec{dl} = 0$

Consider sphere of radius 'r', $\vec{E}$ will be along $\vec{ds}$ at any position

$$\oint \vec{E}.\vec{ds} = \phi(E)(ds) = E\oint ds = \frac{Q(1-\sqrt{\alpha r})}{4\pi \in_0 r^2}(4\pi r^2) = \frac{Q}{\in_0}(1-\sqrt{\alpha r})$$

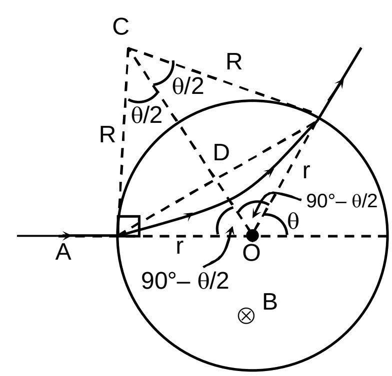
7. A, C

$$AD = R\sin\frac{\theta}{2} = r\sin\left(90° - \frac{\theta}{2}\right)$$

$$\Rightarrow \quad \tan\frac{\theta}{2} = \frac{r}{R}$$

Also, $R = \frac{mv}{qB}$

$$\Rightarrow \quad \tan\frac{\theta}{2} = \frac{rqB}{mv}$$



Angular velocity, $\omega = \frac{v}{R} = \frac{qB}{m} \rightarrow$ constant for all α-particles

So, time period will higher for the particle whose. 'θ' is higher, i.e., velocity is lower.

8. A, B, C, D

Voltage leads current (see at t = 0)

If I = 400 sin ωt	$[I_0 = 400]$	(in mA)
Then V = 200 sin (ωt + φ)	$[V_0 = 200]$	(in volt.)

At t = 0, V = 100 $\quad \Rightarrow \quad \phi = \frac{\pi}{6}$

$$Z = \frac{V_{rms}}{I_{rms}} = \frac{200/\sqrt{2}}{4\sqrt{2}} = 500\Omega$$

Also, $\frac{R}{Z} = \cos\phi \quad \Rightarrow \quad R = 250\sqrt{3}\Omega$

$R^2 + (X_L - X_C)^2 = Z^2 \Rightarrow X_L = 324\ \Omega$

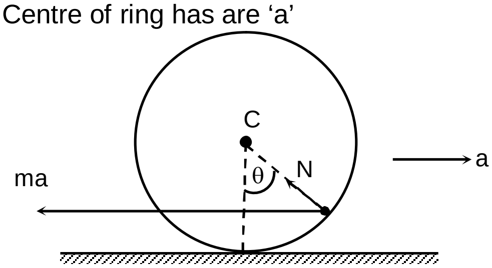
Average power = $I_{rms} V_{rms} \cos\phi$

$= 20\sqrt{3}W$

9. B
10. C

Sol. Centre of ring has are 'a'

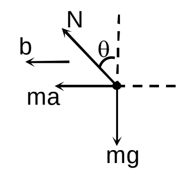
a : acceleration ring w.r.t. ground
b : acceleration of particles w.r.t. ring



Hence w.r.t. 'C', for the particle

$N\cos\theta = mg$ ....(i)

$N\sin\theta + ma = mb$ ....(ii)



And for the ring

$\Rightarrow$ $N\sin\theta - f = Ma$ ....(iii)

$f.R = MR^2 .a/R$

$\Rightarrow$ $f = Ma$ ....(iv)

$\Rightarrow$ $N\sin\theta = 2Ma$

$N = mg$

$mg.\theta = 2\,Ma$

$\Rightarrow$ $a = \frac{mg}{2M}\theta$

From (ii)

$N\sin\theta + ma = mb$

$\Rightarrow$ $2Ma + ma = mb \Rightarrow a(2M + m) = mb$

$\Rightarrow$ $\frac{mg}{2M}(2M+m)\theta = m.b$

Put $\theta = \frac{x}{R}$ [x: displacement of particle w.r.t. ring]

$\Rightarrow$ $\frac{g}{2M}(2M+m)\frac{x}{R} = b \quad \Rightarrow \quad b = \frac{g}{R}\left(1+\frac{m}{2M}\right).x$

$\omega = \sqrt{\frac{g}{R}\left(1+\frac{m}{2m}\right)}$

Part – 2

$a = mb/(m + 2M)$

$\Rightarrow$ $y = \frac{mx}{m+2M}$

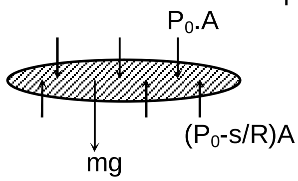
[y: displacement of ring w.r.t. ground]

$\Rightarrow$ $y = \frac{mR\theta}{m+2M}$

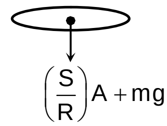
SECTION – C

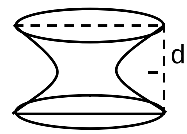
11. 9

If we draw the FBD of upper plate, we see



i.e.





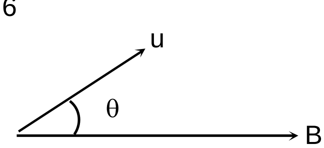
R=d/2

This force "(S/R) A + mg" must be balanced by normal reaction at same points from concern plate.

Hence N = (S/R)A + mg $\Rightarrow$ N = 90

Hence n = 9

12. 6

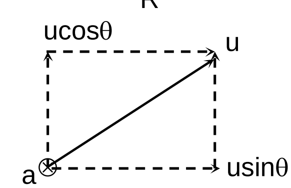


$$R = \frac{m(\sin\theta)}{qB}$$

Acceleration of particle w.r.t. an observer moving with u cos θ (along $\vec{B}$) is

$$a = \frac{(u\sin\theta)^2}{R}$$

Since this observer is not accelerated, hence net acceleration of particle is also $\frac{(u\sin\theta)^2}{R}$, which is perpendicular to its net speed 'v'.

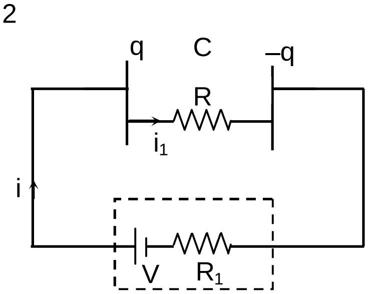


Hence ROC $= \frac{u^2}{a}$

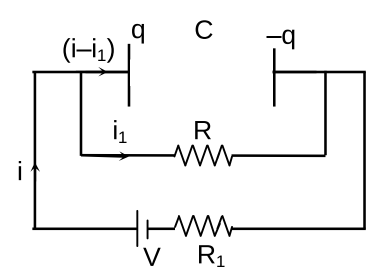
$$= \frac{R}{\sin^2\theta} = \frac{\frac{mu\sin\theta}{qB}}{\sin^2\theta} = \frac{mu}{qB\sin\theta}$$

Putting values, we get ROC as 6 m.

13. 2



$\Rightarrow$



Both the circuits are equivalent, since

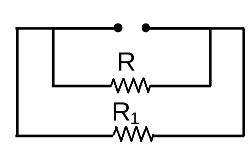
$q/c = i_1R$ (i) and $i - i_1 = dq/dt$ (ii)

Satisfies both

Hence, time constant of circuit will be

τ = Reff. C

Where Reff = $R.R_1 / R + R_1$



Thus $\tau = \left(\frac{RR_1}{R+R_1}\right)C$

Putting $C = \frac{\epsilon_0 \epsilon_r A}{d}$ and $R = \frac{\rho d}{A}$

We get $\tau = 100 \epsilon_0$

$\Rightarrow$ n = 2

14. 6

Electrical energy is present everywhere except the space occupied by conductors. When the charge is taken to infinity, energy will be present in the entire space surrounding it. Hence work done by external will be equal to the energy in the missing space.

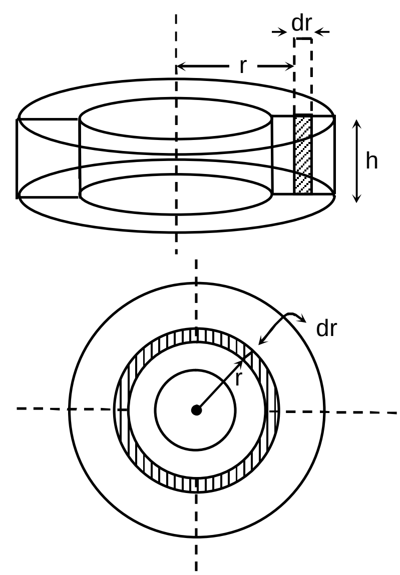
$$W_{ext} = \frac{kq^2}{2}\left(\frac{1}{1}-\frac{1}{2}\right)+\frac{kq^2}{2}\left(\frac{1}{3}-\frac{1}{4}\right)+.........$$

$$= \frac{kq^2}{2}\left(1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+......\right) = \frac{kq^2}{2}\ell n2$$

$$= kq^2 \ell n\sqrt{2}$$

Hence n = 6.

15. 8



$B \times 2\pi r = \mu_0 NI$

$\Rightarrow B = \frac{\mu_0 NI}{2\pi r}$

Flux through small element = $\frac{\mu_0 NI}{2\pi r}.hdr$

$\Rightarrow$ Flux through a cross-section $= \frac{\mu_0 NIh}{2\pi}\int_a^b \frac{dr}{r}$

$$= \frac{\mu_0 NIh}{2\pi}\ell n\left(\frac{b}{a}\right)$$

$\Rightarrow$ Flux through 'N' turns $= \frac{\mu_0 N^2 Ih}{2\pi}\ell n\left(\frac{b}{a}\right)$

$\Rightarrow L = \frac{\phi}{I} = \frac{\mu_0 N^2 h}{2\pi}\ell n\left(\frac{b}{a}\right)$

Putting values, we get L = 0.8

Hence n = 8

16. 4

$dQ = dU + dW$

$\Rightarrow$ $ncdT = nc_v dT + Pdv$

$\Rightarrow$ $n.2RdT = n.\frac{3}{2}RdT + \frac{nRT}{V}dv$

$\Rightarrow$ $\int \frac{dv}{v} = \int \frac{dT}{2T}$

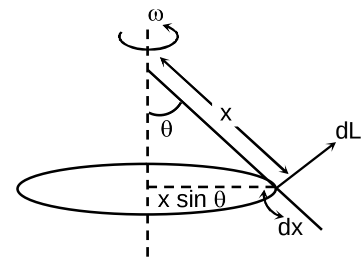
$\Rightarrow$ $\frac{v^2}{T} = \text{constt.}$

Thus, on doubling volume, temperature changes 4 times.

17. 4

$dL = (dm)(\omega . x \sin\theta)x$

$$= \frac{m}{\ell} dx . \omega x^2 \sin\theta$$



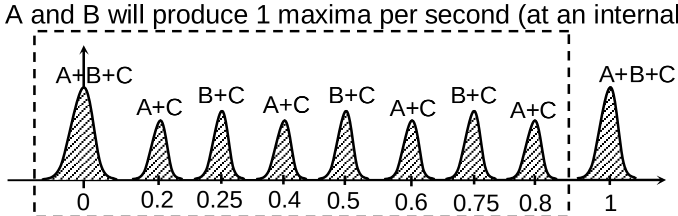
$\Rightarrow \quad dL = \frac{m\omega \sin\theta}{\ell} \int_0^{\ell} x^2 dx$

$\Rightarrow \quad L = \frac{m\ell^2 \omega \sin\theta}{3}$

Putting values, we get L = 4.

18. 8

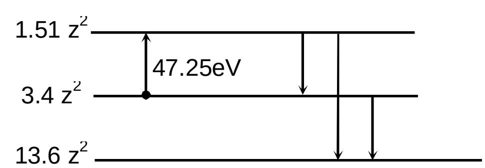
A and C will produce 5 maxima per second (at an internal of 0.2 sec)
B and C will produce 4 maxima per second (at an internal 0.25 sec)
A and B will produce 1 maxima per second (at an internal 1 sec)



Total no. of maxima in 1 sec is 7 secondary + 1 primary = 8 maxima

19. 5

As we are getting 3 different photons so transition must be from n = 3 to n = 1 and energies of these photons are more than or equal to 47.25 so initially electrons must be in n = 2



$3.4 z^2 - 1.51z^2 = 47.25$

$\Rightarrow \quad z = 5$

20. 5

$\frac{n_2}{V} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$

$\frac{n_2}{V} = \frac{n_2 - n_1}{R} + \frac{n_1}{u}$

$u = -x \quad \Rightarrow \quad \frac{n_2}{v} = \frac{n_2 - n_1}{R} - \frac{n_1}{x}$

For real image V must be +ve

$\frac{n_2 - n_1}{R} - \frac{n_1}{x} > 0$

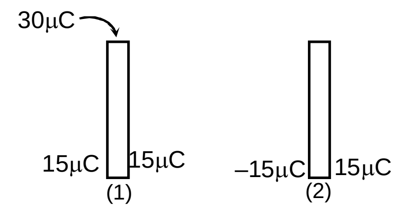
$\Rightarrow \quad x > \frac{n_1 R}{n_2 - n_1}$

SECTION – D

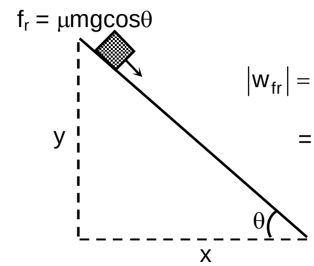
21. 01800.00

Charge is initially distributed as shown in figure. Now after connecting the battery, potential difference across the plates of the capacitor should also become 40 V in steady state.

Hence, $Q_f = CV$
= (1.5) (40) μC
= 60 μC (Charge on inner surface)
Hence, charge supplied by battery is 45μC
So, work done by battery, W = (Q) (V)
= (45μC) (40V)
= 1800 μJ
So, answer is 1800.



22. 00720.00
Hence, work done by friction is independent of angle of inclination. It only depends upon horizontal displacement.
So, (W_{fr}) = (0.2) (18) (10) (20)
= 720 J



$$|w_{fr}| = (\mu mg\cos\theta)\left(\frac{x}{\cos\theta}\right)$$
$$= \mu mg\ x$$

23. 00004.00
Given that $C = C_V + 4R$ .....(1)
Compare with dQ = dU + PdV
$CdT = C_V d_T + Pd_V$
$$C = C_V + P\frac{dV}{dT} \quad .....(2)$$
We get, $4R = \dfrac{PdV}{dT}$
$$4R = \frac{RT}{V}\frac{dv}{dT}$$
$$4\int\frac{dT}{T} = \int\frac{dv}{v}$$
$$\ell nT^4 = \ell nV$$
$$VT^{-4} = \text{const}$$
Hence, n = 4

Chemistry

PART – II

SECTION – A

24. B

$P_A = P_B$

$X_A . P_A^0 = X_B . P_B^0$

$$\frac{X_A}{X_B} = \frac{P_B^0}{P_A^0}$$

$$1 + \frac{X_A}{X_B} = 1 + \frac{P_B^0}{P_A^0}$$

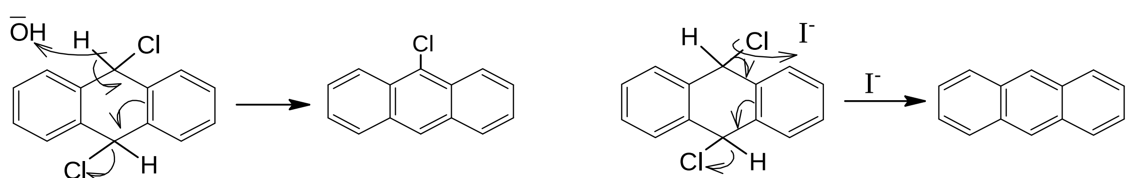
$$\frac{1}{X_B} = \frac{P_A^0 + P_B^0}{P_A^0}$$

$$X_B = \frac{P_A^0}{P_A^0 + P_B^0}$$

Similarly, $X_A = \dfrac{P_B^0}{P_A^0 + P_B^0}$

$$P_T = P_A^0 . X_A + P_B^0 . X_B = \frac{2P_A^0 . P_B^0}{P_A^0 . P_B^0}$$

25. D



(X) (Y)

26. D

27. AC

Since 4 milli mole of NaOH was required to reach first equivalence point, the molecular wt. was

$$\frac{664\,mg}{4\,m\,mol} = 166$$

60 ml of NaOH is represented by a point midway to second equivalence point, at which

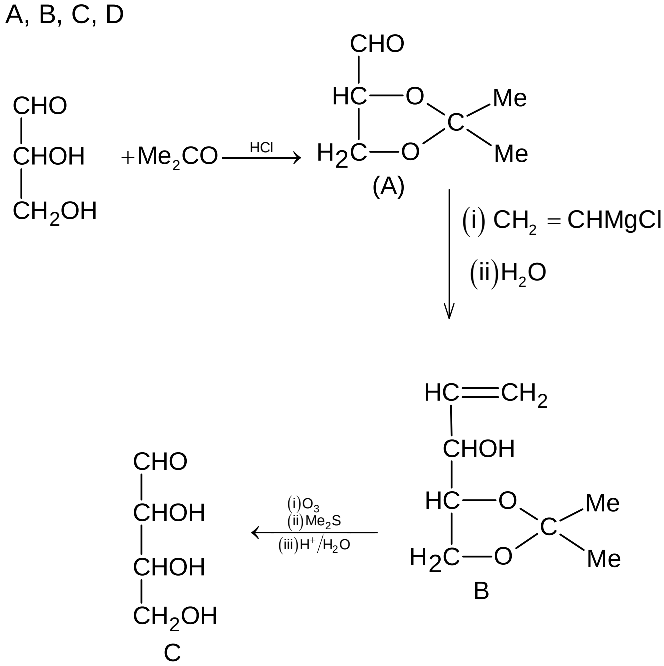
pH = Pka_2 = 8.08

At the first equivalence point,

pH = 5.85 = $\dfrac{Pka_1 + Pka_2}{2}$

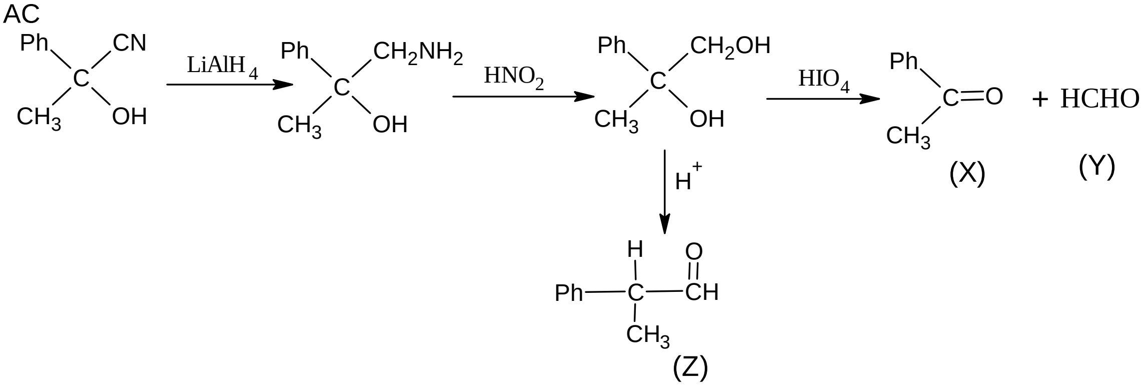
$\therefore$ Pka_1 = 3.62

28. A, B, C, D



29. B C

30. AC



31. BC
32. C
33. B

Sol. (for 32–33)

$CuSO_4.5H_2O\,(s) \xrightarrow{\Delta} CuSO_4(s)$
(A) Blue (B) white

$2CuSO_4 + 4KI \longrightarrow Cu_2I_2\downarrow + I_2\uparrow + 2K_2SO_4$
ppt

$I_2 + 2S_2O_3^{2-} \longrightarrow 2I^- + S_4O_6^{2-}$

millimoles of thiosulphate required = $0.25 \times 20 = 5$

$\therefore$ millimoles of I_2 used = 5/2

$\therefore$ millimoles of $CuSO_4$ dissolved = $\frac{5}{2} \times 2 = 5$

$\therefore\ (wt)_{CuSO_4}$ = 5 × 10^{-3} × 159.5 = 0.797 gm in 100 mL of solution.
Hence in 1 L solution (wt.) of $CuSO_4$ dissolved = 7.97 gm

SECTION – C

34. 3

$$n_{M^{n+}} = \frac{1.92}{2\times 60} mol = 0.016\, mol$$

$$nhydrazinehydrate = \frac{0.9\times 5.332}{50} mol = 0.096 mol$$

n_{eq}. KIO_3 = $4\times\frac{1}{10}N\times 0.48L$ = 0.192 eq. = $n_{eq.}$ hydrazine reacted with KIO_3

$\therefore$ n hydrazine left after reaction with M^{n+} = $\frac{0.192}{4} mol = 0.048 mol$

$\therefore$ n hydrazine hydrate reacted with M^{n+} = (0.096 – 0.048) mol = 0.048 mol

M^{n+} + n $H_2NNHCOO^-$ $\rightarrow$ [M $(H_2NNHCOO)_n$]

$$\frac{n_{M^{n+}}}{n_{hydrazine}} = \frac{1}{n} = \frac{0.016}{0.048} = \frac{1}{3}$$

$\therefore$ n = 3

35. 3

Cu^{+2}, Cd^{+2}, Ag^{+}

36. 4

$$\frac{y_A}{y_B} = \frac{P_A^\circ}{P_B^\circ}$$

$$\frac{n_A}{n_B} = \frac{P_A^\circ}{P_B^\circ}$$

$$\frac{\frac{x}{378}}{\frac{1}{18}} = \frac{120}{630}$$

Hence $x = \frac{378\times 4}{21\times 18} = 4$

37. 2

Mole fraction of solute (x) = $\frac{\left(\frac{66.9}{148.3}\right)}{\left(\frac{66.9}{148.3}\right)+\left(\frac{100}{18}\right)} = 8.03\times 10^{-3}$

Relative lowering of vapour pressure

$$\frac{P^0 - P_s}{P^0} = (x\times i) \Rightarrow \frac{\Delta P}{P^0} = x\times i$$

$$= \frac{760-747}{760} = 8.03\times 10^{-3}\times i$$

$M(NO_3)_n$ $\rightarrow$ M^{n+} + n NO_3^-

$1-\alpha$ $\quad\quad\quad$ α $\quad\quad$ $n\alpha$

Van't Hoff Factor $i = (1 + n\alpha) = [1 + 0.565n]$

$$i = \frac{13}{760 \times 8.03 \times 10^{-3}} \simeq 2.13$$

$\therefore$ $1 + 0.565\,n = 2.13$

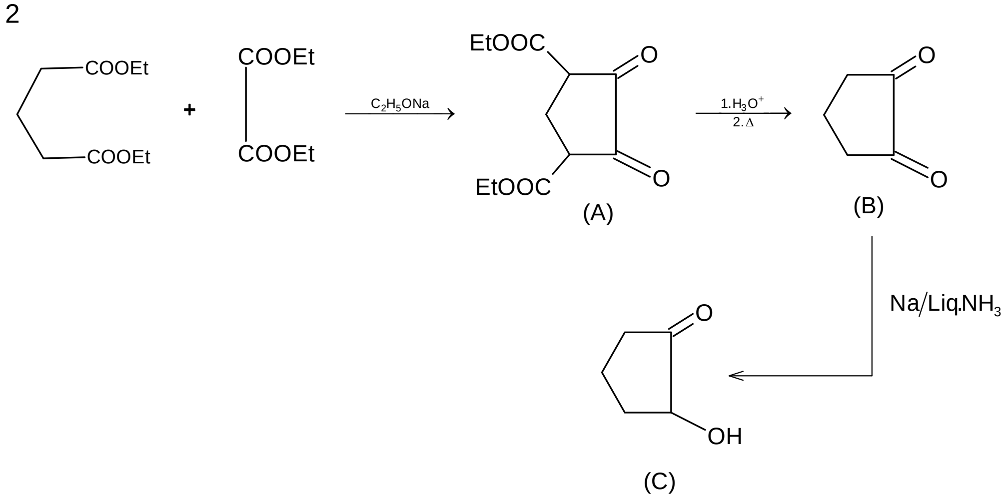
$\therefore$ $n = 2$

38. 6

39. 3

H_3PO_2, $H_4P_2O_5$, H_3PO_3

40. 2



41. 6

$$\frac{1}{3}\frac{d(H_2)}{dt} = k[NH_3]^0$$

$$\frac{d(H_2)}{dt} = 3 \times 2 = 6\,M\,min^{-1}$$

42. 4

$XeF_2, XeOF_4, BrCl_3, \left[Fe(CN)_6\right]^{-4}$

43. 4

(i) all given sulphides are less soluble than MnS, hence x = 0

(ii) $Pb(OH)_2$, $Zn(OH)_2$, $Cu(OH)_2$, $Fe(OH)_2$, are less soluble than $Mg(OH)_2$, y = 4

Hence ; x + y = 0+4 = 4

SECTION – D

44. 00004.00

Anode half cell $\quad H_2 \rightarrow \quad 2H^+ + 2e^-$

cathode half cell $\quad \underline{Hg_2Cl_{2\,(s)} + 2e^- \rightarrow Hg(l) + 2Cl^-}$

Net cell reaction $\quad Hg_2Cl_{2(s)} + H_2 \rightarrow 2H^+ + Hg(l) + 2Cl^-$

$$\therefore\ E_{cell} = E^0_{cell} - \frac{0.0591}{2}\log\frac{\left[H^+\right]^2 \times \left[Cl^-\right]^2}{P_{H_2}}$$

$$0.5164 \quad = 0.28 - \frac{0.0591}{2}\log\left[H^+\right]^2; \quad P_{H_2} = 1atm, \quad Cl^- = 1M$$

$0.2364 = -0.0591 \log[H^+]$

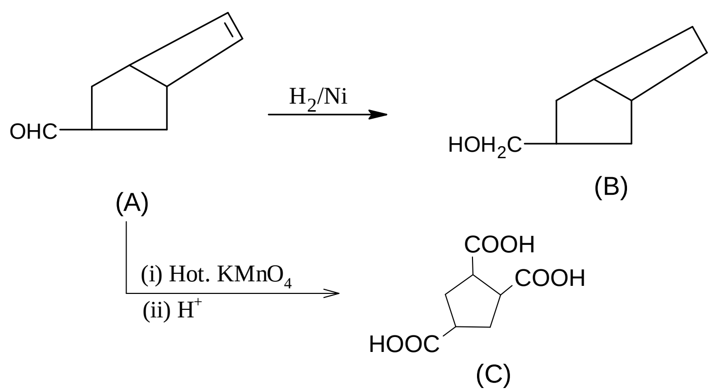
$$pH = \frac{0.2364}{0.0591} \simeq 4 = \frac{pk_1 + pk_2}{2}$$

In order to maintain the pH of left hand half cell the vol. of NaOH required

$\therefore$ $0.1 \times 100 = 2.5 \times V$ (1^{st} equivalence point)

$$V = \frac{10}{2.5} = 4mL$$

45. 00004.50



$\therefore$ A is $C_8H_{10}O$

$\therefore$ x = 8, y = 10 and z = 1

46. 00001.25

For an adiabatic process,

$TV^{\gamma-1}$ = constant

$$\therefore\ T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1} = \frac{T_1}{2}(5.66V_1)^{\gamma-1}$$

Hence, $2 = (5.66)^{\gamma - 1}$

or $\log 2 = (\gamma - 1) \log 5.66$

$\therefore$ $\gamma = 1.4$

The gas is, therefore a diatomic gas and have five degrees of freedom.

The work done by a gas during an adiabatic process is

$$W = \frac{P_2V_2 - P_1V_1}{\gamma - 1}$$

Since $P_1V_1^{\gamma} = P_2V_2^{\gamma} = P_2(5.66V_1)^{\gamma}$

$$P_2 = \frac{P_1}{(5.66)^{\gamma}}$$

$$\therefore\ W = \left[\frac{P_1(5.66V_1)}{(5.66)^{\gamma}} - P_1V_1\right]\frac{1}{0.4} = 1.25\ P_1V_1$$

or W = 1.25 PV

Hence; x = 1.25

Mathematics

PART – III

SECTION – A

47. B

Sol. f(x) = f(4-x), f(x) = f(x+10), f(x) = f(14-x). There are 201 multiple of 10 and 200 numbers that remainders have 4 divided by 10.

48. B

Sol. $a_{n+2} = 1 - \frac{1}{a_{n+1}} = 1 - \frac{a_n}{a_n - 1} = \frac{1}{1 - a_n}$

$a_{n+3} = 1 - \frac{1}{a_{n+2}} = 1 + (a_n - 1) = a_n$

So, $\{a_n\}$ is periodic sequence with period 3

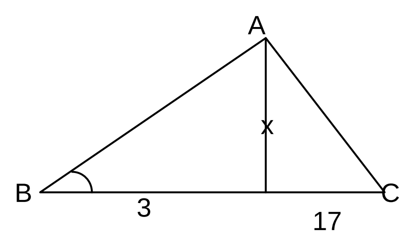
$a_1 = 2 \; a_2 = \frac{1}{2} \; a_3 = -1$

$p_3 = -1$

$P_{2009} = (P_3)^{669}.P_2 = (-1)^{669} = -1$

49. A

Sol. $\tan^{-1}\left(\frac{22}{7}\right) = \tan^{-1}\frac{3}{x} + \tan^{-1}\frac{17}{x}$



$\frac{22}{7} = \frac{\frac{3}{x} + \frac{17}{x}}{1 - \left(\frac{3}{x}\right).\left(\frac{17}{x}\right)}$

$11x^2 - 70x - 56 = (x - 11)(11x + 51) = 0$

$\Rightarrow x = 11$

$\Delta = \frac{1}{2}(3 + 17)(11) = 110$

50. B, D

Sol. We have $f(x) = x^2 + ax^2 + bx^3$

Where $a = \int_{-1}^{1} t.f(t)dt$ and $b = \int_{-1}^{1} f(t)\,dt$

Now, $a = \int_{-1}^{1} t\left[(a+1)t^2 + bt^3\right]dt$

$a = 2b\int_0^1 t^4 dt = \frac{2b}{5}$ ...(1)

Again $b = \int_{-1}^{1} f(t)\,dt = \int_{-1}^{1}\left[(a+1)t^2 + bt^3\right]dt$

$= 2\int_0^1 (a+1)t^2\,dt$

$b = \dfrac{2(a+1)}{3}$ ...(ii)

From equations (1) and (ii)

$\dfrac{5a}{2} = \dfrac{2(a+1)}{3}$

$\left(\dfrac{5}{2} - \dfrac{2}{3}\right)a = \dfrac{2}{3}$

$\dfrac{11}{6}a = \dfrac{2}{3}$

$a = \dfrac{4}{11}$ and $b = \dfrac{10}{11}$

Hence $\int_{-1}^{1} t.f(t)\,dt = \dfrac{4}{11}$ and $\int_{-1}^{1} f(t)\,dt = \dfrac{10}{11}$

$\therefore f(x) = (a+1)x^2 + bx^3$

$\left.\begin{array}{l} f(1) = (a+1) + b \\ f(-1) = (a+1) - b \end{array}\right]$

$f(1) + f(-1) = 2(a+1) = \dfrac{30}{11}$

And $f(1) - f(-1) - 2b = \dfrac{20}{11}$

51. A, C

Sol. $A^3 + B^3 + C^3 = A^3 + B^3 + C^3 - 3ABC$

$= (A + B + C)(A^2 + B^2 + C^2 - AB - BC - CA)$

$= (A + B + C)(A + \omega B + \omega^2 C)(A + \omega^2 B + \omega C)$ {ω = cube root of unity}

$= (A + B + C)(A + \omega B + \omega^2 C)\left(\overline{A + \omega B + \omega^2 C}\right)$

then $\det(A^3 + B^3 + C^3) . \det(A + B + C) = \det(A + B + C)^2 . \det(A + \omega B + \omega^2 C)\,\overline{\det\left(A + \omega B + \omega^2 C\right)}$

$= (\det(A + B + C))^2 . |\det(A + \omega B + \omega^2 C)|^2 \geq 0.$

52. A, D

Sol. The given variable line can be expressed as

$\Rightarrow 3x + 4y - 7 + \lambda(x - 2y + 1) = 0$

$\Rightarrow L_1 + \lambda L_2 = 0$

$L_1 \equiv 3x + 4y - 7 = 0, L_2 \equiv x - 2y + 1 = 0$

Point of intersection of $L_1 = 0$ and $L_2 = 0$ is (1, 1)

$\therefore$ a = b = 1 $\Rightarrow a + 2b = 3$

Now, $l = \lim\limits_{x\to 0^-} \dfrac{[\sin x] - 2 + \{\cos x\}}{\{x\} - 1}$

$= \lim\limits_{h\to 0} \dfrac{[\sin(0-h)] - 2 + \{\cos(0-h)\}}{\{0-h\} - 1}$

$= \dfrac{-1-2+1}{1-1} = \dfrac{-2}{0}$

Hence l does not exist

53. A, B

Sol. f(3n) = f(f(f(n))) = 3f(n), $\forall$ n $\in$ N

put n = 1, f(3) = 3f(1)

f(1) $\neq$ 1 as if f(1) = 1, then

f(f(1)) = 3 . 1 = 3 = f(1) = 1 which is incorrect, thus f(1) > 1 and f(f(1)) > f(1)
3 = f(f(1)) > f(1) > 1
so f(1) = 2
f(2) = f(f(1)) = 3.

54. B, C, D

Sol. As, $\vec{r}_3 = (\vec{r}_1 \times \vec{r}_2) \times \vec{r}_2 = (\vec{r}_1.\vec{r}_2)\vec{r}_2 - (\vec{r}_2.\vec{r}_2)\vec{r}_1$

$= 6(2\hat{i} + \hat{j} + \hat{k}) - 6(\hat{i} + \hat{j} + 3\hat{k}) = (6\hat{i} - 12\hat{k})$

$\therefore$ Row 3 vector $\pm\dfrac{6(\hat{i} - 2\hat{k})}{6\sqrt{5}}.\sqrt{5} = \hat{i} - 2\hat{k}$ or $-\hat{i} + 2\hat{k}$

$$A = \begin{bmatrix} 1 & 1 & 3 \\ 2 & 1 & 1 \\ 1 & 0 & -2 \end{bmatrix} \text{ or } \begin{bmatrix} 1 & 1 & 3 \\ 2 & 1 & 1 \\ -1 & 0 & 2 \end{bmatrix} = \text{Tr.}(A) = 0, 4.$$

Also, $[\vec{r}_2\ \vec{r}_3 \vec{r}_2 \times \vec{r}_3] = |\vec{r}_2||\vec{r}_3||\vec{r}_2 \times \vec{r}_3|$

$= \sqrt{6}.\sqrt{5}.\sqrt{6}.\sqrt{5} = 30$

Since $\vec{r}_1, \vec{r}_2$ and $\vec{r}_3$ are coplanar

$\Rightarrow$ they are linearly dependent

$\therefore \left[\vec{r}_1 \times \vec{r}_2\ \vec{r}_2 \times \vec{r}_3 \vec{r}_3 \times \vec{r}_1\right] = \left[\vec{r}_1\ \vec{r}_2\ \vec{r}_3\right]^2 = 0$

55. C

Let $A \equiv (-a, 0), B \equiv (a, 0)$, the equations of the circles are $x^2 + y^2 = a^2$ and $x^2 + y^2 = b^2$ ......(1)

Any tangent to (1) is $y = mx + b\sqrt{1+m^2}$

Let (h, k) be the coordinates of the focus, A and B lie on the parabola.

$\therefore \sqrt{1+m^2}\sqrt{(h+a)^2 + k^2} = -ma + b\sqrt{1+m^2}$

And $\sqrt{1+m^2}\sqrt{(h-a)^2 + k^2} = ma + b\sqrt{1+m^2}$

Eliminating m from the above equations, we get the locus as $\dfrac{x^2}{b^2} + \dfrac{y^2}{b^2 - a^2} = 1$

56. A

For $a = 4, b = 3$, the curve becomes $\dfrac{x^2}{9} - \dfrac{y^2}{7} = 1$

The length of LR = $\dfrac{2B^2}{A} = \dfrac{2 \times 7}{3} = \dfrac{14}{3}$.

SECTION – C

57. 4

Sol. $L : 3^4 - [\,^3C_1(2^4 - 2) + \,^3C_2] = 36$

M: If $x > 0, \text{sgn}(x) = 1$

$f(x) = 0 + \dfrac{\pi}{2} = \dfrac{\pi}{2}$

For $x = 0$ $f(x)$ is not defined

$\therefore$ For $x < 0$, $f(x) = \pi - \dfrac{\pi}{2} = \dfrac{\pi}{2}$

$\therefore$ M = 1

N : Coefficient of $t^5 =$ coefficient of t^2 in $(1+t^2)^5 \times$ coefficient of t^3 in $(1+t^3)^8$

$= 5 \times 8 = 40$

$\Rightarrow LM + N = 36 + 40 = 76$

58. 8

Sol. $L = \prod_{n=3}^{\infty}\left(1-\frac{4}{n^2}\right) = \prod_{n=3}^{\infty}\left(\frac{n^2-4}{n^2}\right)$

$= \prod_{n=3}^{\infty}\left(\frac{n-2}{n}\right) \times \prod_{n=3}^{\infty}\left(\frac{n+2}{n}\right)$

$= \frac{n\left(1+\frac{1}{n}\right)n\left(1+\frac{2}{n}\right)}{n^2\left(1-\frac{1}{n}\right)} \times \frac{2}{3.4} = \frac{1}{6}$

$\Rightarrow L = \frac{1}{6}$

$M = \prod_{n=2}^{\infty}\left(\frac{n^3-1}{n^3+1}\right) = M = \prod_{n=2}^{\infty}\frac{n-1}{n+1}.\frac{(n^2+n+1)}{(n^2-n+1)}$

$= \lim_{x\to\infty}\frac{2}{n(n+1)}.\frac{n^2+n+1}{3} = \frac{2}{3}$

$\Rightarrow M = \frac{2}{3}$

$N = \prod_{n=1}^{\infty}\frac{(1+n^{-1})^2}{1+2n^{-1}} = \prod_{n=1}^{\infty}\left(\frac{n+1}{n}\right)^2\left(\frac{n}{n+2}\right)$

$= \frac{2(n+1)}{n+2} = 2$

$\Rightarrow N = 2$

$L^{-1} + M^{-1} + N^{-1} = 6 + \frac{3}{2} + \frac{1}{2} = 8$

59. 2

Sol. Let $S = \sum_{n=1}^{99}\sqrt{10+\sqrt{n}}$ $\qquad T = \sum_{n=2}^{99}\sqrt{10-\sqrt{n}}$

$\sqrt{2}\,S = \sum_{n=1}^{99}\sqrt{20+2\sqrt{n}} = \sum_{n=1}^{99}\left(\sqrt{10+\sqrt{100-n}} + \sqrt{10-\sqrt{100-n}}\right)$

$\sqrt{2}\,S = \sum_{n=1}^{99}\left(\sqrt{10+\sqrt{n}} + \sqrt{10-\sqrt{n}}\right) = S + T$

$\sqrt{2}\,S - S = T$

$\frac{S}{T} = \sqrt{2}+1$

60. 5

Sol. For each 3-element subsets x = {a, b, c} of the set M = {1, 2, ...23} with a + b + c < 36, map f(x) = {24 – a, 24 – b, 24 – c} then f is a bijection the set C_1 of all three element subsets of M with a + b + c < 36 and set C_2 of all three element subsets M with a + b + c > 36, Hence $|C_1| = |C_2|$.

Total $= {}^{23}C_3 = 1771$ different 3 element subset of M, $|C_1| = \frac{1}{2}(1771-61) = 855$

61. 6

Sol. Given, $f(x^2).f''(x) = f'(x).f'(x^2)$

Put $x = 1$ in the given relation

$f(1).f''(1) = (f'(1))^2$

Let $f'(1) = a$ and $f''(1) = b$

$\therefore \quad b = a^2 \quad ....(1)$

Differentiating the given relation

$f(x^2).f'''(x) + f''(x).2x f'(x^2)$

$= f''(x)f'(x^2) + f'(x).(2x)f''(x^2)$

Put $x = 1$

$8 + 2ba = 2ab + ab$

$\Rightarrow \quad ab = 8 \quad ....(2)$

62. 3

Sol. Since roots of $x^2 - x - 1 = 0$, are $P = \frac{1}{2}(1+\sqrt{5})$ and $q = \frac{1}{2}(1-\sqrt{5})$

$ax^{17} + bx^{16} + 1 = 0$

$ap^{17} + bp^{16} = -1 \quad ...(1)$

$aq^{17} + bq^{16} = -1 \quad ...(2)$

Multiply (1) by q^{16} and (2) by p^{16}

$ap + b = -q^{16}$

$aq + b = -p^{16}$

$a = \frac{p^{16} - q^{16}}{p - q} = (p^8 + q^8)(p^4 + q^4)(p^2 + q^2)(p + q)$

$p + q = 1 \qquad p^4 + q^4 = (p^2 + q^2)^2 - 2(pq)^2 = 9 - 2 = 7$

$p^2 + q^2 = 3 \qquad p^8 + q^8 = (p^4 + q^4)^2 - 2(pq)^4 = 49 - 2 = 47$

$a = 47 \times 7 \times 3 \times 1 = 987$

63. 5

Sol. $J = \int_0^1 (1 - x^{50})^{100} x^{100}\, dx$

$= \left((1 - x^{50})^{100} \frac{x^{101}}{101} \right)_0^1 - \int_0^1 100(1 - x^{50})^{99} (-50x^{49}) \frac{x^{101}}{101} dx$

$= 0 + \frac{5000}{101} \int_0^1 (1 - x^{50})^{99} (1 - (1 - x^{50})) x^{100}\, dx$

$= \frac{5000}{101} \left(\int_0^1 (1 - x^{50})^{99} x^{100} dx - \int_0^1 (1 - x^{50})^{100} x^{100}\, dx \right)$

$\frac{5101}{101} J = \frac{5000}{101} I$

$\Rightarrow \frac{I}{J} = \frac{5101}{5000} = \frac{m}{n}$

$\therefore \quad \frac{m - 1 - n}{20} = \frac{5101 - 1 - 5000}{20} = 5$

64. 1

Sol. $D_1 = |10| \qquad D_2 = \begin{vmatrix} 10 & 3 \\ 3 & 10 \end{vmatrix} = 10 \times 10 - 3.3 = 91$

$$D_3 = \begin{vmatrix} 10 & 3 & 0 \\ 3 & 10 & 3 \\ 0 & 3 & 10 \end{vmatrix} = 10\begin{vmatrix} 10 & 3 \\ 3 & 10 \end{vmatrix} - 3\begin{vmatrix} 3 & 3 \\ 0 & 10 \end{vmatrix} + 0\begin{vmatrix} 3 & 10 \\ 0 & 3 \end{vmatrix}$$

$D_n = 10D_{n-1} - 9D_{n-2} = 10(D_{n-1} - D_{n-2}) + D_{n-2}$

$D_2 = 10D_1 - 9D_0 \Rightarrow D_0 = 1$ by recursion formula $D_4 = 7381$

$D_1 - D_0 = 10 - 1 = 9$

$D_2 - D_1 = 81 = 9^2$

$D_3 - D_2 = 820 - 91 = 729 = 9^3$

$D_4 - D_3 = 7381 - 820 = 6561 = 9^4$

$D_n = D_0 + 9^1 + 9^2 + ...9^n = \sum_{i=0}^{n} 9^i$

Desired sum

$$\sum_{n=1}^{\infty} \frac{1}{\frac{8.9^{n+1}-1}{8}+1} = \sum_{n=1}^{\infty} \frac{1}{9^{n+1}-1+1} = \sum_{n=1}^{\infty} \frac{1}{9^{n+1}} = \frac{1}{72}$$

p + q = 1 + 72 = 073

65. 2

Sol. For n = 0, 1, 2..... Let a_n be the prob. That bug is at vertex A after crawling exactly n meter's, then

$a_{n+1} = \frac{1}{3}(1 - a_n)$

Become the bug can be at vertex A after crawling n + 1 meter if and only if
(i) It was not at A following crawling of n meter (this has prob $1 - a_n$)
(ii) from one of other vertices it heads towards A (thes probability 1/3)

Since $a_0 = 1$ $\quad a_1 = 0$ $\quad a_2 = \frac{1}{3}$ $\quad a_3 = \frac{2}{9}$

$a_4 = \frac{7}{27}$ $\quad a_5 = \frac{20}{81}$ $\quad a_6 = \frac{61}{243}$ $\quad a_7 = \frac{182}{729}$

66. 4

Multiple the given equation by $z^3 - 1 = 0$

Yield $z^9 - 1 = 0$

$z_n = \cos n, 40^o + i \sin n\ 40^o n = 0, 1, 2......, 8$ of these only z_3 and z_4 are in the second quadrant. However, Since the solution of $z^9 - 1 = 0$ are distinct and since z_3 is a solution of $z^3 = 1$ It cannot be solution of the original equation. It follows that desired root in z_4 with of agree measure 160º.

SECTION – D

67. 18564.00

Sol. The sum as $\left(\binom{6}{0} + \binom{6}{1}x + \binom{6}{2}x^2 + \binom{6}{3}x^3 + ... + \binom{6}{6}x^6\right)^3$.

We can see the sum we wish to compute is just the coefficient of the x^6 term. However $P(x) = ((1+x)^6)^3 = (1+x)^{18}$. Therefore, the coefficient of the x^6 term is just $\binom{18}{6} = 18564$

68. 00038.00

Sol. The probability that the chord doesn't intersect the triangle is $\frac{11}{25}$.

The only way this can happen is if the two points are chosen on the same arc between two of the triangle vertices. The probability that a point is chosen on one of the arcs opposite one of the base angles is $\frac{x}{180}$, and the probability that a point is chosen on the arc between the two-page angles is $\frac{180-2x}{180}$. Therefore, we can write

$$2\left(\frac{x}{180}\right)^2+\left(\frac{180-2x}{180}\right)^2=\frac{11}{25}$$

This simplifies to

$$x^2-120x+3024=0$$

Which factors as

$$(x-84)((x-36)=0$$

So $x=84,36.$ The difference between.

69. 00501.00

The equation $\log(kx)=2\log(x+2)$ is valid for $kx>0$ and x> -2.

It is easy to seen that the all negative values of k make the equation $\log(kx)=2\log(x+2)$ have 500 integer values and for positive reason of x, k has only one value.